2016 MARC Lifecycle Management Plan

MTA Maryland

Providing safe, efficient and reliable transit across Maryland with world-class customer service.

Table of Contents

1 Document Control

1.1 Table of Revisions

Rev. #	Date	Page #	Section	Description

1.2 Guidance Office & Distribution List

1.2.1. Guidance Office

Office of Planning & Programming

1.2.2. Distribution List

Name	Position
Paul Comfort	Administrator & CEO, MTA
Suhair Al Khatib	Chief Planning, Programming, and Engineering Officer
Pat Keller	Deputy Chief, Statewide Network
Kevin Quinn	Director, Office of Planning & Programming
Vernon Hartsock	Chief Engineer, Office of Engineering
Phil Thomas	Chief Safety Officer, Office of Safety Quality Assurance & Risk Management
Heidi Tarleton	Deputy Director, Office of Finance
Georgia Peake	Director, Office of Procurement
Erich Kolig	Director of MARC & Commuter Bus
Glenn Saffran	Deputy Director of MARC & Commuter Bus
James Gillece	Manager, Contract Services, Compliance, & Review
MTA ProjectWise	Global Electronic Distribution: pw:\\mtapwint2:MTA_PW_Data\Documents\07 - Core Operations & Modes\MARC & Commuter Bus\MARC\MARC Life Cycle Management Plan (LMP)\

1.3 Signature for Authorization

Approved By:

X _____ 10/10/17

Erich Kolig Date

Deputy Chief Operating Officer of Rail

X _____ 10-17-17

Holly T. Arnold Date

Deputy Director of Planning and Capital Programming

2 Introduction

2.1 MTA Transit Asset Management Background

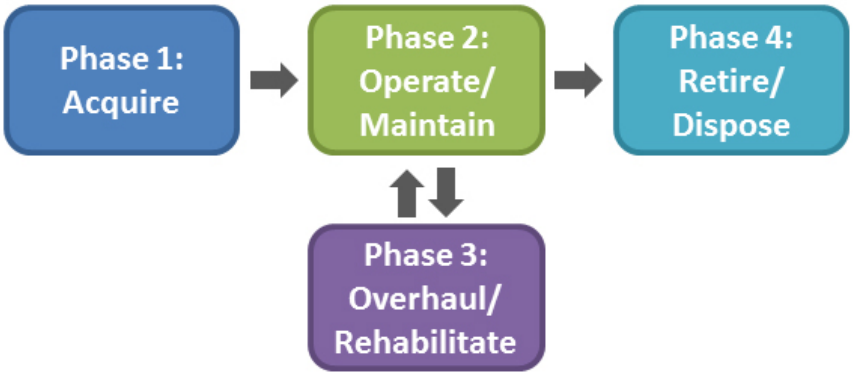
This Lifecycle Management Plan (LMP) has been created for Maryland Area Regional Commuter (MARC) mode to document existing business processes, and to strategically plan for enhancements to those processes. This LMP outlines how Transit Assets are managed by MARC across all lifecycle phases. This document has also been created to help attain broader asset management objectives set by the Maryland Transit Administration in its Transit Asset Management Plan (TAMP), and fulfill a variety of grant management, performance management, and reporting requirements established under 49 U.S.C. 5326 (Transit Asset Management) and 49 U.S.C. 5329 (Public Transportation Safety Program).

Lifecycle Management Plans provide a number of key benefits, among them:

- Preserving institutional knowledge by documenting current practices;
- Providing mode-specific asset management best practices;
- Helping to better-inform investment decisions; and
- Improving cross-department coordination.

Not only does this LMP document MTA management practices surrounding Transit Assets in the MARC system, but it also captures third party processes and procedures through operations and maintenance (O&M) contract agreements. These practices are centered on the four lifecycle phases of a Transit Asset:

Figure 2.1 - An asset's lifecycle, or the four phases over an asset's life.



This LMP does not describe administrative and human resource-related processes unless they directly impact cost, risk, or performance of MARC's Transit Assets.

2.2 Document Structure

The structure of this document follows the LMP standard outline found in *Appendix D* of MTA's Transit Asset Management Plan (TAMP), and is based on the structure proposed in FTA's Asset Management Guide (Report No. 0027, dated October 2012). In general, information is presented for the MARC mode as a whole, but where appropriate, information is broken down by asset categories and classes, as described in Section 3.5.

Hyperlinks are embedded throughout this document for related policies, plans, and procedures that are stored on MTA's ProjectWise document management system. The ability to access these documents will be limited by individual user rights, but supervisors may request authorization for anyone with limited access.

2.3 Relationship of this Document to Other Plans

Transit Asset Management and Safety Management Systems (SMS) are inextricably linked. Condition assessment of an asset should inform MTA's SMS. Conversely, hazards, risk, and safety performance data from the SMS should inform MTA's TAMP and capital investment prioritization.

The *Office of Planning and Programming* and the *Office of Safety Quality and Risk Management* (OSQARM) facilitates the development of MTA's TAMP and the System Safety Program Plan (SSPP), respectively. This LMP was drafted to help meet the broad objectives outlined in MTA's TAMP and SSPP, and does not supersede those documents.

2.4 Key Definitions

Asset (Definition used by MTA Office of Finance: 2015)
Land, land improvements, buildings, building improvements, and capital equipment typically greater than $250 in value. Any high theft item or easily concealable item having a value under $250 may also be capitalized for their sensitive nature or issues. The term does not include materials, supplies, and non-capital equipment. *See definitions of Land Asset, Transit Asset, and Critical Asset below for disambiguation.*

Land Asset
A subset of the term "Asset." A developed or undeveloped plat owned or leased by the MTA. *See definitions of Asset, Transit Asset, and Critical Asset for disambiguation.*

Transit Asset
A subset of the term "Asset." A depreciable physical Asset required to support transit service either directly or indirectly, including vehicles, stations, facilities, guideway and systems Assets, whether mobile or fixed. Transit Assets may be tracked down to the sub-system level except for guideway assets, which should be tracked at the component level. Transit Assets do not include land, spare parts, or office furniture. *See definitions of Asset, Land Asset, and Critical Asset for disambiguation.*

Critical Asset

A subset of the term "Transit Asset." A Transit Asset having the potential to substantially impact safety or reliability of the transit system upon failure. Criticality will be calculated using the capital investment prioritization scores used by TERM Lite by Transit Asset type. TERM Lite prioritization scores are calculated on a 1-5 scale across four categories: asset condition, reliability, safety and O&M cost impact. To calculate asset criticality, the reliability and safety scores will be multiplied; if the product of this calculation is greater than or equal to 12, the asset will be considered critical. Critical Assets will be identified by asset type within each LMP and the MTA Transit Asset inventory alike. *See definitions of Asset, Land Asset, and Transit Asset for disambiguation.*

Asset Owner

Generally refers to the agency staff or department responsible for the inspection and/or maintenance phase of a Transit Asset's or Land Asset's lifecycle. For non-revenue vehicles allocated to a mode, the Asset Owner will be the agency staff or department dependent upon these Transit Assets.

Environmental Sustainability

Minimizing the impacts of MTA operations on air, land, water, and human health such that needs of the present are met without compromising the ability of future generations to meet their own needs.

Lifecycle

The time interval that begins with identifying the need for a Transit Asset or Land Asset, and ends with the disposal of the Transit Asset or Land Asset. Lifecycle phases may include planning, design, procurement, construction, operations, maintenance, rehabilitation, and asset replacement/disposal.

Lifecycle Management Plan (LMP)

A department/mode-specific TAM plan. An LMP describes performance measures and targets aligned with the commitments established in the TAMP, strategies for delivering these performance targets, and other mode/department-specific approaches to continually improve management of its Transit Assets and Land Assets over their lifecycle.

Maintenance (disambiguation):

Scheduled Maintenance – A form of preventive maintenance, regularly Scheduled Maintenance improve an asset's condition, avoid future failures/breakdowns, and assure that it reaches its design life.

Corrective Maintenance – Unscheduled Corrective Maintenance conducted in response to asset failure or detected fault so that the asset can be restored to an operable condition.

Maximo
Maintenance and inventory management software developed by IBM and purchased by MDOT for use among all modal administrations. While the use of Maximo varies mode-by-mode, MTA generally uses this software for scheduling inspection and maintenance activities, and spare parts inventory ordering.

Safety Management System (SMS)
The formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of a transit agency's safety risk mitigation. SMS includes systematic procedures, practices, and policies for managing risks and hazards.

State of Good Repair (SGR)
When the physical condition of a Transit Asset is at or above 2.5 according to the Federal Transit Administration's (FTA) numerically based system for evaluating Transit Asset conditions: 5 (excellent), 4 (good), 3 (adequate), 2 (marginal), 1 (poor). Obsolescence of a Transit Asset may constitute a "poor" condition rating. *Subject to change based on forthcoming FTA definition.*

State of Good Repair (SGR) Backlog
The cumulative dollar value of deferred Transit Asset maintenance and replacement needs.

TERM Lite
An MS Access-based decision tool provided by the FTA for estimating SGR Backlog, annual capital investment needs, current and future asset conditions, and capital investment priorities over a 20 to 30 year time horizon. TERM Lite produces these analyses for the MTA based on complete and comprehensive Transit Asset inventory data.

Transit Asset Management (TAM)
A total business approach through which an organization acquires, operates/maintains, rehabilitates, and disposes of Transit Assets and Land Assets to manage their performance, risks, and costs over their lifecycle to achieve the commitments made in the Transit Asset Management Plan (TAMP).

Transit Asset Management Plan (TAMP)
This document describes agency-wide TAM objectives, performance measures, and targets; strategies for delivering these performance targets, and other agency-wide approaches to continually improve TAM practices. While this TAMP exists as a standalone document, LMPs may be considered an extension of the TAMP by reference.

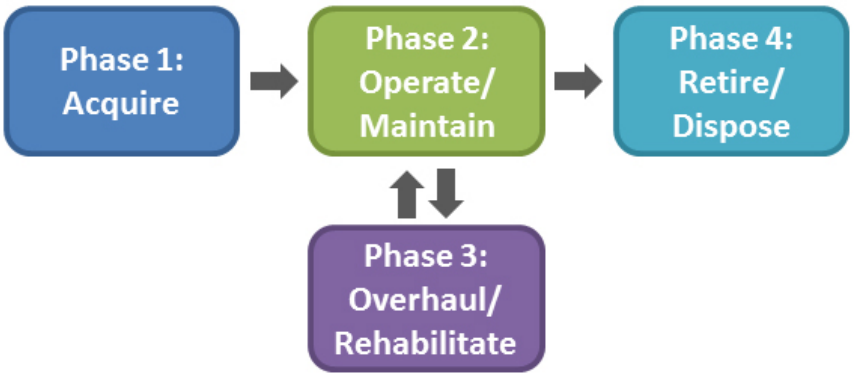
2.5 Overview of Lifecycle Management Phases

FTA's Asset Management Guide[1] describes a number of basic lifecycle activities (Figure 2.2). Poor decisions in any of these lifecycle phases can result in higher costs, lower performance, or even safety

[1] Federal Transit Administration. *Asset Management Guide*. Prepared by Parsons Brinckerhoff, Inc. Washington, DC., 2012. < http://www.fta.dot.gov/13248.html>

impacts throughout the MARC system. Of particular note, the decisions made in the Plan/Design/Procure phase have the greatest potential to impact system-wide cost, risk, and performance at MARC. For this reason, this LMP seeks to eliminate barriers between decision makers in any one phase and to consider assets comprehensively across their whole life.

Figure 2.2 - An asset's lifecycle or the four phases over an asset's life.



For a given asset, different MTA departments or offices will serve as major stakeholders in each phase of the asset's lifecycle. A summary of these phases with corresponding major stakeholders are as follows:

Table 2.1 - Major stakeholders involved with each phase of an asset's lifecycle.

Phase	Phase Name	Primary Stakeholders
1	Acquire	MARC, Offices of: *Planning and Programming*, *Engineering*, *Procurement,* and *Information Technology*
2	Operate & Maintain	MARC, Outside contractors
3	Overhaul & Rehabilitate	MARC, Outside contractors
4	Retire & Dispose	Department of General Services

3 Mode Overview

3.1 Mode Background

MTA's Commuter Rail fleet consists of 50 locomotives and 177 cars running on three (3) lines that service eight (8) Maryland Counties, Baltimore City, Washington D.C., and West Virginia (Table 3.1).

Table 3.1 – A summary of MARC's commuter rail lines, including: length, number of stations, Right of Way (ROW) ownership, and allocated number of locomotives and passenger cars.

	Northern Terminus	Southern Terminus	Total Length	# of Stations*	ROW Ownership	Loco-Motives	Passenger Cars***
Penn Line	Perryville Station, Harford County	Union Station, Washington D.C.	76.6 miles	13	Amtrak	8	53
Brunswick Line	Martinsburg Station, WV	Union Station, Washington D.C.	74 miles	19**	CSX**	9	42
Camden Line	Camden Station, Baltimore City	Union Station, Washington D.C.	36.4 miles	12	CSX	5	19

** Union station is served by all three lines*

*** The 3.4 mile Frederick spur is owned by MTA and contains two stations*

**** The number of passenger cars may vary depending on schedule*

While MARC provides service on all three lines, it must contend with traffic from many other rail users. The Penn line also supports regular Amtrak passenger service (including high-speed Acela service) and freight service from CSX Transportation and Norfolk Southern Railway. The Brunswick and Camden lines also support freight service from CSX Transportation. All three MARC lines terminate at Washington Union Station, which is also served by Amtrak and Virginia Railway Express (VRE) commuter service, making Union Station the 2nd busiest train station in the country.

The Penn Line itself is a segment of the Northeast Corridor (NEC), one of the busiest and most productive railroad corridors in the world. Stretching from Boston, Massachusetts to Washington, DC, *passenger* service on the NEC accommodates 710,000 commuters and 40,000 intercity travelers on 2,000 trains *each day*. In fact, the NEC provides access to one of every three jobs in the larger NEC region – a region that, if it were its own country, would have the fifth largest economy in the world. [2]

In 2008, the Passenger Rail Investment and Improvement Act (PRIIA) recognized the unique constraints of the NEC. Some of these challenges include: existence of numerous Asset Owners, competing

[2] Northeast Corridor Commission. *Northeast Corridor Commuter and Intercity Rail Cost Allocation Policy.* June 15, 2016.

stakeholder objectives, and substantial State of Good Repair needs. To overcome these challenges, PRIIA required the development of an NEC Commission to manage the NEC as a single system. As such, Asset Management on the Penn line must conform to the policies and priorities set by the NEC Commission; this includes MARC customizing its own asset management approach to meet these requirements set by the NEC Commission.

By contrast, no single organization exists to coordinate competing needs and objectives on the Brunswick and Camden lines. Furthermore, FTA's Asset Management rulemaking does not apply to freight railroads, such as CSX Transportation. This presents additional layers of complexity for MARC's Asset Management program. The MTA will be dependent on guideway and system asset data to comply with the new FTA rulemaking, however CSX Transportation is not compelled by legislation nor contract obligation to provide this information to the MTA. As a result, the MTA will need to rely on the nature of its good working relationship with CSX Transportation to obtain asset information related to Brunswick and Camden guideway and system asset and fulfill FTA requirements.

Table 3.1- Major events of Maryland passenger rail service. 1827-Present.

Date	Existing Line	Event
1827	Brunswick Camden	• Maryland and Virginia grants charter to the B&O
1828-1835	Camden	• B&O completes construction of mainline between Baltimore and Washington, D.C.
1828-1837	Brunswick	• B&O completes construction between Washington, D.C. and Harpers Ferry, WV
1867	Penn	• PRR and NCRY purchases and co-owns B&P
1873	Penn	• B&P completes construction of mainline between Baltimore and Washington, D.C. • Union Railway completes construction between Baltimore and Philadelphia
	Brunswick	• B&O's Metropolitan Branch opens from Washington, D.C. to the Old Main Line at Point of Rocks
1882	Penn	• PRR purchases Union Railway
1901	All	• B&O Railroad files for bankruptcy • PRR acquires majority interest in B&O
1902	Penn	• B&P undergoes consolidation to become PB&W
1907	All	• WATC opens Union Station, servicing B&O and PB&W
1928-1935	Penn	• PRR completes electrification of mainline between Washington, D.C. and NYC
1962	Brunswick Camden	• C&O acquires controlling interest in B&O
1963	Brunswick Camden	• Chessie is incorporated, becomes holding company for C&O and B&O.
1968	All	• PRR and New York Central Railroad merge and become Penn Central
1970	All	• Penn Central files for bankruptcy • The Rail Passenger Service Act becomes law, creating Amtrak
1971	Penn	• Amtrak begins intercity passenger rail service

Date	Existing Line	Event
1973	All	• The "3R" Act becomes law: Conrail created, railroad industry stabilized, and USRA created
1974	Brunswick Camden	• Conrail incorporated • MDOT provides partial subsidy to B&O for passenger service
1975	Brunswick Camden	• B&O signs operating agreement with MDOT to provide passenger service
1976	Penn	• Amtrak signs operating agreement with MDOT to provide passenger service
	Brunswick	• Amtrak begins *Blue Ridge* service between Washington and Martinsburg, WV.
	All	• The "4R" Act becomes law, authorizing: Conrail's operating budget, Amtrak's authority and capital funding to acquire the NEC from Conrail • Conrail begins service
1978	Penn	• Amtrak begins *Chesapeake* service between Philadelphia and Washington.
	All	• Governor creates the State Railroad Administration through Executive Order.
1980	Brunswick Camden	• Seaboard Coast Line Railroad and Chessie merge • The holding company, CSX Corporation, was created
	Penn	• BWI station opens
	All	• Staggers Act passed, easing economic regulation of the railroad industry
1981	All	• Amtrak assumes control of WATC operations at Union Station • NERSA becomes law: Passenger service mandate transferred from Conrail to local transit authorities
1983	Penn	• Amtrak ends *Chesapeake* service
	All	• Conrail's obligation to provide passenger service expires • Maryland creates MARC service
1986	Brunswick Camden	• Seaboard Coast Line renamed to CSX Transportation
	Brunswick	• Amtrak's *Blue Ridge* service transferred to MARC
1987	Brunswick Camden	• Corporate mergers take place: 1) B&O into C&O; 2) C&O into CSX Transportation
1991	Penn	• MARC service begins at Baltimore Penn Station
1992	All	• SRA restructured under Mass Transit Administration • Mass Transit Administration becomes the Maryland Transit Administration (MTA) • MTA assumes oversight for commuter rail service
1994	Penn	• Amtrak signs operating agreement with MTA to provide passenger service
1997	Brunswick Camden	• CSX signs operating agreement with MTA to provide passenger service
1997-1999	All	• CSX Transportation and Norfolk Southern jointly acquire Conrail
2000	Penn	• Amtrak begins high-speed Acela service
2001	Brunswick	• MTA completes construction of the Frederick spur, service begins
2008	Penn	• PRIIA passed, creating framework for establishing national and regional policy for the NEC through the creation of the NEC Commission, charged with establishing cost-sharing requirements for the Corridor

Date	Existing Line	Event
2012	Brunswick Camden	• BTS signs third-party operating and maintenance agreement with MTA
2013	Brunswick Camden	• BTS assumes full operational control of MARC service on the Brunswick and Camden Lines
	Penn	• MARC starts weekend service

Table 3.2 – Acronyms used in the timeline above.

Acronym	Definition
3R ACT	Regional Rail Reorganization Act
4R ACT	Railroad Revitalization & Regulatory Reform Act
AMTRAK	National Railroad Passenger Corporation
B&O	Baltimore & Ohio Railroad, segments eventually becomes the Brunswick and Camden Lines
B&P	Baltimore & Potomac Railroad one segment eventually becomes the Penn Line and segment of the NEC.
BTS	Bombardier Transportation Service
BWI	Thurgood Marshall Baltimore-Washington International Airport
CHESSIE	Chessie Systems, Inc.
MDOT	Maryland Department of Transportation
NCRY	Northern Central Railway
NEC	Northeast Corridor
NERSA	Northeast Rail Service Act
NS	Norfolk Southern
PB&W	Philadelphia, Baltimore, & Washington Railroad, controlled by PRR
PRIIA	Passenger Rail Investment and Improvement Act
PRR	Pennsylvania Railroad
SCL	Seaboard Coast Line Railroad
SRA	State Railroad Administration of Maryland
USRA	United States Railroad Association
WATC	Washington Terminal Company, established by B&O and PRR in 1901

In FY 2014 MARC had capital budget of $74.3 million, of which $7 million is set aside for joint benefit projects with Amtrak, and $6 million is set aside for joint benefit projects with CSX. In FY 2014 MARC had an operating budget of $117.4 million, which supports 33 MTA employees.

With the establishment of the NEC Commission under PRIAA, the MTA will be required to set aside additional funds for its cost share of the capital improvements needed on the NEC, as deemed by the NEC Commission. MTA's cost share is subject to the Northeast Corridor Commuter and Intercity Rail Cost Allocation Policy. It is anticipated that NEC cost share payments will be in lieu of current Amtrak joint benefit agreements. Furthermore, it is anticipated that these NEC cost share payments will be larger in value than the annual $7 million Amtrak joint benefit budget described above.

3.2 System Map

The MARC system (Figure 3.2) operates a number of route variations on each of the three (3) main lines: Penn, Brunswick, and Camden. The Table 3.3 summarizes these service variations.

Figure 3.2 - MARC system map.

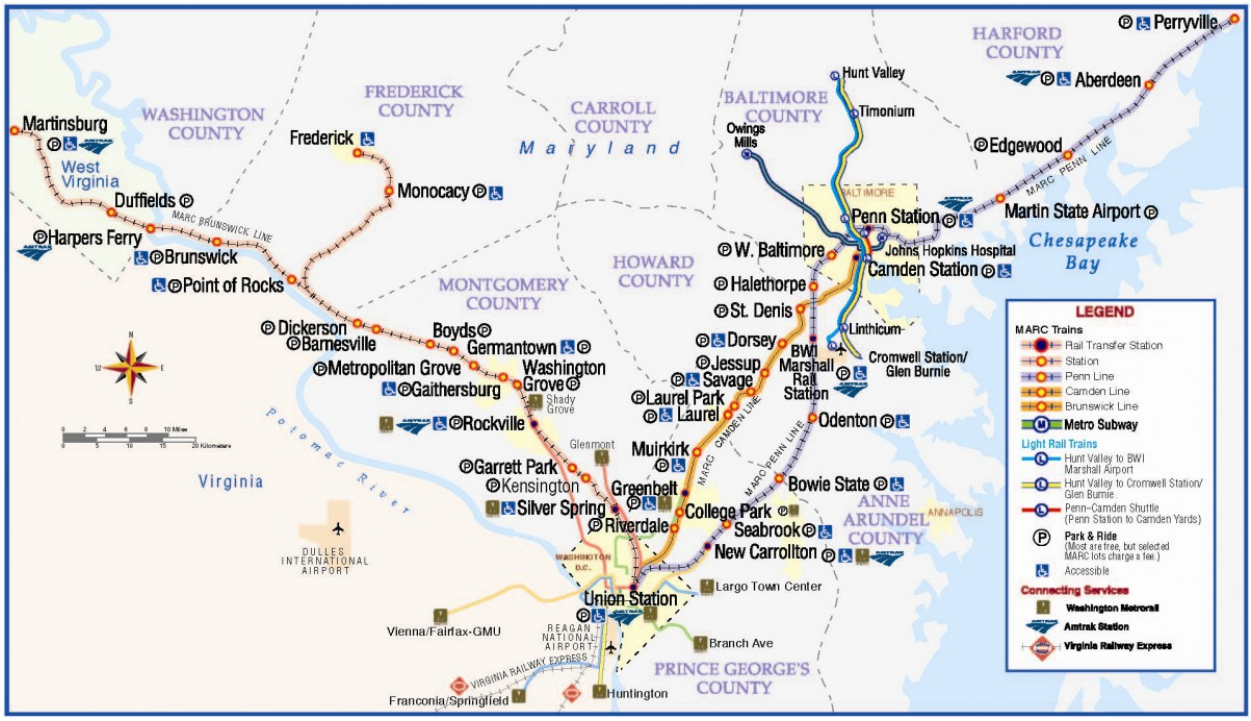


Table 3.3 – The main route variations on MARC service for the Penn, Brunswick, and Camden Lines.

Line	Route	Trip Length[2]	Trip Type	Notes
Penn	Perryville – Penn[1]	45 min	Weekday, Regular	
	Penn – Union	60 min 50 min 37 min 60 min	Weekday, Regular Weekday, Peak Weekday, Express Weekend	• *May include:* Martin Airport • *Peak hours:* Skip-stop service, skipping stations either closest to Union or Penn • *Express:* Only includes Union and Penn, may include BWI or other select stations
	Perryville – Union	110 min 100 min	Weekday, Regular Weekday, Express	• Limited service to stations between Penn and Union, *except* BWI.
Brunswick	Brunswick – Union[1]	90 min	Weekday, Peak	
	Martinsburg – Union[1]	130 min	Weekday, Peak	• Certain schedules connect the mainline and the Frederick spur via a bus bridge.
	Frederick – Union[1]	100 min	Weekday, Peak	
Camden	Camden – Union[1]	70 min	Weekday, Peak	

[1] Select stations are excluded or have limited service depending upon the route posted in public timetable

[2] Approximately, depending upon the route posted in public timetable

While a passenger can transfer between any of these lines at Washington's Union Station, crossover capability does not exist between the Camden and Penn lines in Baltimore City.

MARC also provides connectivity between MTA's other transit services (Table 3.4)**.** Note that BWI Airport contains separate MARC and Light Rail stations over two miles apart and lacks sufficient wayfinding to inform riders of connectivity (e.g. shuttle service, signage, and/or detailed system maps).

Table 3.4 – Connectivity between MARC and MTA Bus (B), Commuter Bus (CB), and Light Rail (LR) services as of June, 2016.

Penn Line				Camden Line				Brunswick Line			
MARC Station	**B**	**CB**	**LR**	**MARC Station**	**B**	**CB**	**LR**	**MARC Station**	**B**	**CB**	**LR**
Perryville				*Camden*	✓	✓	✓	*Martinsburg*			
Aberdeen		✓		*St. Denis*		✓		*Duffields*			
Edgewood				*Dorsey*		✓		*Harpers Ferry*			
Martin Airport	✓			*Jessup*		✓		*Brunswick*			
Penn	✓		✓	*Savage*				*Point of Rocks*			
West Baltimore	✓			*Laurel Park*				*Frederick*		✓	
Halethorpe	✓			*Laurel*				*Monocacy*		✓	
BWI Airport	✓	✓	✓	*Muirkirk*				*Dickerson*			
Odenton		✓		*Greenbelt*				*Barnsville*			
Bowie State		✓		*College Park*		✓		*Boyds*			
Seabrook				*Riverdale*		✓		*Germantown*			
New Carrollton				*Union*		✓		*Met. Grove*		✓	
Union		✓						*Gaithersburg*			
								Wash. Grove			
								Rockville			
								Garrett Park			
								Kensington			
								Silver Spring		✓	
								Union		✓	

The MARC system also provides connectivity between many non-MTA provided transportation options throughout the region:

- **Amtrak**: via the Penn Line (Perryville, Aberdeen, Edgewood, Penn, BWI, and New Carrollton), and the Brunswick Line (Martinsburg, Harpers Ferry, and Rockville). All MARC lines connect with Amtrak via Union Station.
- **Virginia Railway Express (VRE)**: All MARC lines connect with VRE via Union Station.
- **Washington Metropolitan Area Transit Authority (WMATA) Metro**: via the Penn Line (New Carrollton), Camden Line (Greenbelt), and Brunswick Line (Silver Spring). All MARC lines connect with WMATA at Union Station.

- **Other Baltimore-Based, Non-Rail, Non-MTA Services**: Charm City Circulator (Penn Station) and many free college shuttles including those run by Johns Hopkins University, Collegetown, University of Baltimore, and the University of Maryland.
- **Other DC-Based, Non-Rail, Non-MTA Services**: WMATA Bus (Montgomery and Prince George's County MARC stations), and DC Circulator (Union Station).

3.3 Ridership & Schedules

In 2014[3], MARC provided 9,167,940 unlinked passenger trips annually, accounting for 8.0 percent of MTA's total ridership. As of FY 2017, MARC system operates:

Table 3.5 – Frequency and hours of operation for MARC service. Bidirectional service is provided unless otherwise noted.

Line	Calendar Day	Hours of Operation	Frequency of Service
Penn	Weekday	4:17 a.m. – 11:30 p.m.	Peak: ~25 min[1,2] Off-peak: ~60 min[1,2]
	Saturday	7:10 a.m. – 12:03 a.m.	~60 min[1,2]
	Sunday	8:50 a.m. – 8:28 p.m.	~120 min[1,2]
Camden	Weekday	5:00 a.m. – 8:55 p.m.	~30 min[1,2,3,4]
Brunswick	Weekday	4:50 a.m. – 9:25 p.m.	~30 min[1,2,3,4]

[1] Select stations are excluded or have limited service depending upon the route posted in public timetable

[2] Approximately, depending upon the route posted in public timetable

[3] Brunswick and Camden lines only operate at peak hours

[4] Eastbound service operates in the morning; Westbound in the evening

Current schedules and approximate travel times are available at: https://mta.maryland.gov/marc-train

3.4 Fares

MARC utilizes a prorated fare structure that depends upon multiple factors, including:

- Line traveled;
- Trip length;
- Whether the rider is traveling in Maryland or West Virginia; and
- Rider status (e.g. student, senior/disability)

MARC fare structure summaries can be located at the MTA's internet site: https://mta.maryland.gov/marc-fares.

[3] Federal Transit Administration. National Transit Database, 2014 Profile. Accessed 6/22/2016.

MARC FARES													
One-way Full Fare	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
Senior/Disability One-way	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50
Weekly Ticket (7 Day Sat-Fri)	50.00	60.00	70.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00	150.00	160.00	170.00
Weekly Ticket (5 Day Mon-Fri)	37.50	45.00	52.50	60.00	67.50	75.00	82.50	90.00	97.50	105.00	112.50	120.00	127.50
Monthly Ticket	135.00	162.00	189.00	216.00	243.00	270.00	297.00	324.00	351.00	378.00	405.00	432.00	459.00
Senior/Disability Monthly	67.50	81.00	94.50	108.00	121.50	135.00	148.50	162.00	175.50	189.00	202.50	216.00	229.50
Student Advantage One-way	4.25	5.00	5.75	6.75	7.50	8.50	9.25	10.00	11.00	11.75	12.75	13.50	14.50
Student Advantage Weekly (7 Day Sat-Fri)	42.50	51.00	59.50	68.00	76.50	85.00	93.50	102.00	110.50	119.00	127.50	136.00	144.50
Student Advantage Weekly (5 Day Mon-Fri)	32.00	38.50	45.00	51.00	57.50	64.00	70.00	76.50	83.00	89.50	96.00	102.00	108.50
Student Advantage Monthly	114.75	137.50	160.50	183.50	206.50	229.50	252.25	275.25	298.25	321.25	344.25	367.25	390.25
Transit Link Card (WMATA Product)	Visit MTA.CommuterDirect.com for pricing												

Maryland's Transportation Infrastructure Investment Act of 2013 requires MTA on a biennial basis to increase its base fare prices and the cost of multiuse passes to the nearest 10 cents for local service (local bus, metro-subway, light rail, and mobility) based on the percentage increase in the Consumer Price Index for All Urban Consumers as determined from January 1, 2012 to December 31, 2013 and each subsequent 2-year period. The bill also requires MTA to increase the base fare and the cost of multiuse passes to the nearest dollar **for premium service (MARC & Commute Bus) every five years** based on the percentage increase in the CPI from January 1, 2009 to December 31, 2013 and each subsequent 5-year period. MTA may take other commuter costs into consideration such as monthly parking fees, gas prices, the amount of any Federal Commuting Subsidy, and other factors when setting fares for premium service.

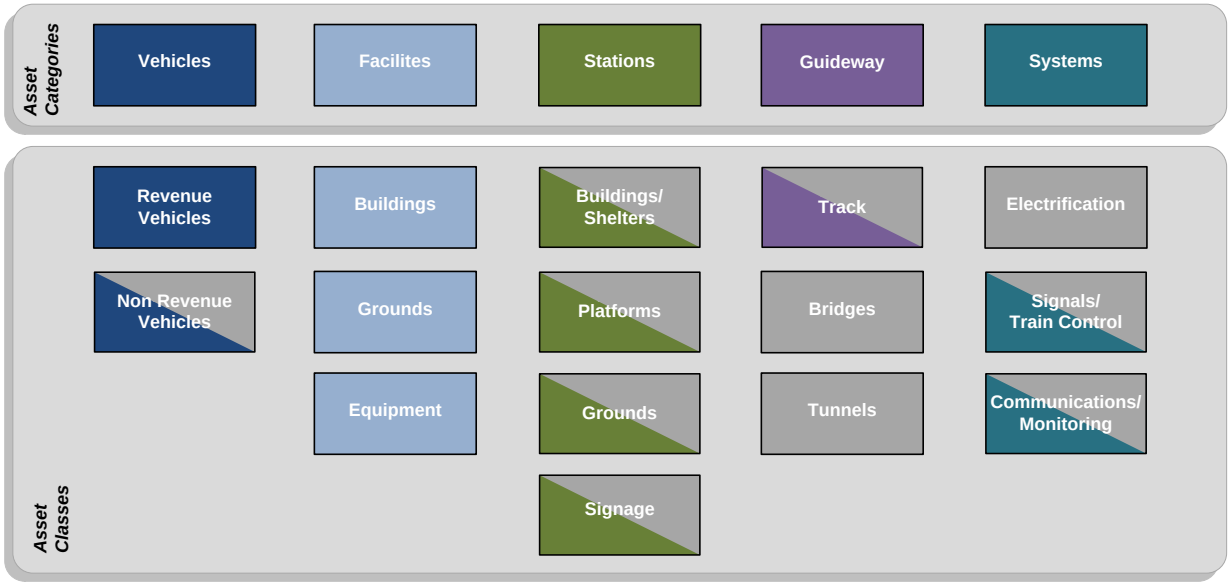
Fare increases are scheduled for the following fiscal years:

- *Local service* – 2017, 2019, 2021
- *Premium service* – 2020, 2025

3.5 Snapshot of MARC Transit Assets

Every MTA mode provides transit service through the use of vehicles, facilities, and other infrastructure Transit Assets (assets). In an effort to better manage these assets, a common hierarchy must be established in order to standardize the way these Transit Assets are discussed and reported on – both internally and externally. The MTA Transit Asset hierarchy (Figure 3.3) is based on FTA guidance and shows MARC assets organized into five broad asset **categories** that are divided into sub-groups known as asset **classes**.

Figure 3.3 - MTA's Transit Asset breakdown hierarchy organizes Transit Assets into broad **categories** followed by separation into more descriptive sub-groups, or **classes**. MARC asset classes owned by a third- party are depicted in gray.



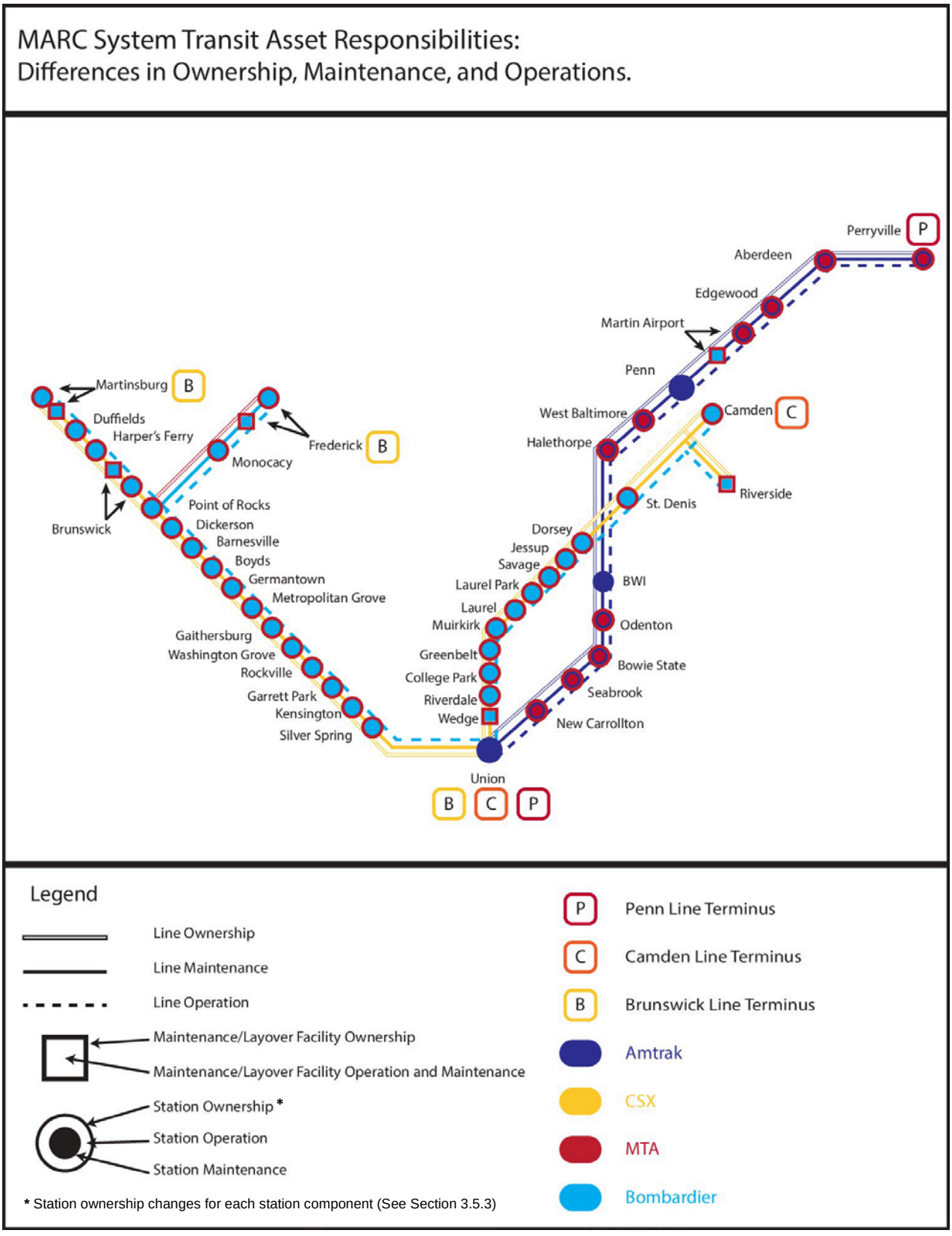
MARC depends on a number of third-party contracts to acquire, operate, and maintain these assets. Currently, the National Passenger Railroad Corporation (Amtrak) provides ROW access and is responsible for operations and maintenance of the Penn Line. CSX Transportation (CSX) provides ROW access for the Brunswick and Camden lines, and Bombardier Transportation Services (BTS) is generally responsible for operations on those lines (Table 3.6).

Table 3.6 – A summary of major MARC third-party contractors, the type and duration of each contract held.

VENDOR	CONTRACT TYPE	CONTRACT EFFECTIVE DATE	CONTRACT DURATION	CONTRACT EXPIRATION DATE	OPTION YEARS
National Railroad Passenger Corporation (Amtrak)	Third-party O&M	7/1/2013	5.0	7/1/2018	5.0
	Access	7/1/2013	5.0	7/1/2018	5.0
CSX Transportation (CSX)	Access	6/30/2010	10.0	6/30/2020	5.0
	License	6/21/2013	2.0	6/30/2015	5.0
Bombardier Transportation Services (BTS)	Third-party O&M	10/18/2012	5.8	7/18/2018	5.0

A closer look, however, at asset ownership, operations, and maintenance of these lines reveals a much more complex arrangement (Figure 3.4). A more detailed description of MARC assets and the arrangements surrounding ownership and asset management responsibilities can be found in the following subsections of this document.

Figure 3.4 – Identifying differences in ownership, maintenance, and operations of MARC Transit Assets.



3.5.1. Vehicles

The MARC revenue fleet is currently composed of 42 locomotives, and 177 passenger cars.[4] The MTA plans to purchase an additional 8 diesel locomotives from Siemens in 2017 (*See Major Procurements for more details)*. Locomotives can be broken down by sub-class into diesel and electric powered, whereas railcars can be broken down by sub-class into MARC II, III, and IV, representing sequential generations of railcar procurements (Table 3.7).

All revenue vehicles are owned by the MTA. However, MTA chooses to delegate maintenance responsibilities to third-party contractors, Amtrak and BTS, which manages daily operations and maintenance vehicles through third- party operations and maintenance (O&M) contract/agreements**.**

Table 3.7 – Summary of MARC revenue vehicles. BTS: Bombardier Transportation Services. E/H denotes elderly and handicapped accessibility.

Asset Sub-Class	Asset Type	Quantity	Operations/ Maintenance	Manufacturer
Diesel- Locomotive	MP36PH	26	Bombardier	MotivePower, Inc. (MPI)
Diesel- Locomotive	GP-39	6	Bombardier	ElectroMotive Diesel, Inc. (EMD)
Electric- Locomotive	AEM-7	4	Amtrak	EMD & ASEA
Electric- Locomotive	HHP-8	6	Amtrak	BTS & Alstom
Car – MARC II	Trailer Cab E/H	9 5	Bombardier	Sumitomo
Car – MARC IIa	Trailer Cab E/H	6 6	Bombardier	Sumitomo
Car – MARC IIb	Trailer Cab E/H E/H	19 6 9	Bombardier	Sumitomo
Car – MARC III	Trailer Cab E/H Snack	35 14 7 7	Amtrak	Kawasaki
Car – MARC IV	Trailer Cab Toilets	34 15 5	Bombardier	Bombardier

MARC also owns several non-revenue vehicles including sedans, SUVs and trucks which are used for supervisory support and maintenance needs. In addition, MARC owns 6 small tractors used for light maintenance activities. All MARC owned non-revenue vehicles are maintained by BTS. However, BTS may also choose to provide, and maintain, its own non-revenue vehicles to satisfy the terms of the contract.

[4] MARC leases one GP40WH-2 diesel locomotive, not included in the MARC asset inventory or counted above.

3.5.2. Facilities

The MARC mode is headquartered at the Riverside Layover Facility, located at 1600 Ludlow Street, Baltimore, Maryland. While MARC uses the entire facility, a small amount of space is dedicated to administrative and contract management functions. The remaining space is allocated to inspection and maintenance needs as outlined below.

MARC owns or leases six (6) maintenance and layover facilities:

PENN LINE

- *Martin's Airport Facility* (**Martins**): 2700 Eastern Boulevard, Baltimore, MD. Owned by MTA. Capable of inspection, scheduled/corrective maintenance, and vehicle commissioning activities.

CAMDEN LINE

- *Riverside Layover Facility* (**Riverside**): 1600 Ludlow Street, Baltimore, MD. Leased from CSX, however, MTA is in the process of procuring Riverside from CSX. Capable of inspection and scheduled maintenance activities on locomotives and passenger cars. Daily inspection of 5 train sets occur here and houses the inventory for all vehicles.
- *Wedge Yard Layover Facility* (**Wedge**): 1801 9th St NE, Washington, DC. Owned by MTA. Capable of locomotive fueling, inspections, and light maintenance for 3 train sets.

BRUNSWICK LINE

- *Martinsburg Layover Facility* (**Martinsburg**): 1 Exchange Place, Martinsburg, WV. Leased from CSX. Capable of only daily inspection, fueling, and light maintenance.
- *Brunswick Layover Facility* (**Brunswick**): 400 South Street, Brunswick, MD. Owned by MTA. Capable of daily inspection, light maintenance, and fueling of locomotives, as well as scheduled maintenance activities for passenger cars.
- *Frederick Layover Facility* (**Frederick**): 7900 Reichs Ford Road, Frederick, MD. Owned by MTA. Capable of locomotive fueling, as well as daily inspections and light maintenance for 3 train sets.

Due to the nature of the access and lease agreements with CSX, the MTA has ultimate responsibility for maintenance at all of these layover facilities. However, MTA has chosen to subcontract facility maintenance to BTS.

Revenue vehicle maintenance also occurs at facilities not owned or leased by the MTA. Amtrak owns both the **Ivy City** facility (near Union Station) and the **Penn Station** facility, to inspect and maintain MTA's electric locomotives and MARC III passenger cars by way of their third-party O&M agreement. The Ivy City facility can accommodate intensive maintenance activities and layover capability, whereas the Penn Station layover facility only handles light maintenance and layover activities.

3.5.3. Stations

42 stations compose the MARC system along the Penn (12 stations), Camden (11 stations), and Brunswick (18 stations) lines before terminating at Union Station (1 station) in Washington, DC. Station designs vary depending upon each location, but major components include: signage, platform, elevator, shelter, building, and parking (e.g. lot, garage).

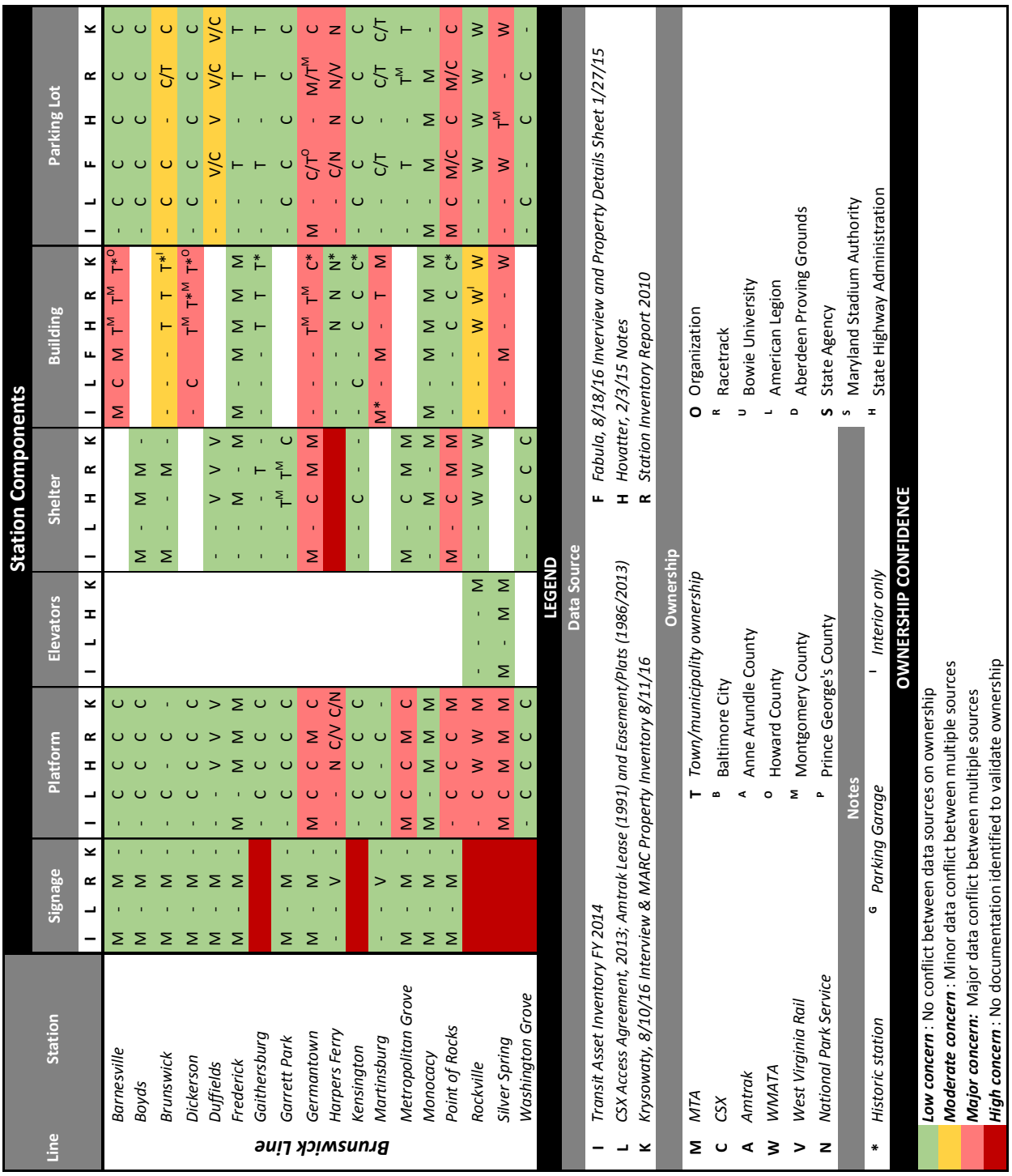
Stations management responsibility is complex. Each station component may be owned, or co-owned, by different stakeholders, and in some cases MTA does not fully understand which stakeholders owns which station components (Table 3.8). Regardless of ownership, a number of access and lease agreements grant MTA the ability to use these stations for MARC service. These agreements collectively state that the MTA has ultimate responsibility for all routine station maintenance with some exceptions:

- Penn station and Union station are owned and maintained Amtrak
- All other Penn line island platforms are maintained by Amtrak

On the Penn Line, MARC conducts their own inspections and coordinates corrective maintenance needs with a standing ancillary contractor. On the Camden and Brunswick lines, MTA contracts with BTS for station maintenance.

Table 3.8 – Ownership of MARC station components.

Line	Station	Station Components																																	
		Signage				Platform				Elevators				Shelter				Building				Parking Lot			
		I	L	R	K	I	L	H	R	K	I	L	H	K	I	L	H	R	K	I	L	F	H	R	K	I	L	F	H	R	K
Penn Line	*Aberdeen*	M	-	M	-	-	A	A	A	A										-	-	-	A	A	A	-	-	A	A	A	A
	Bowie State	M	-	M	-	-	A	A	A	A					M	-	-	M								M	M	M/O^{U}	M/O^{U}	M/O^{U}	M/O^{U}
	BWI	-	-	A	-	-	-	A	A	A										-	-	-	M	A	A	M^{G}	-	M^{G}	M^{G}	M^{G}	M^{G}
	Edgewood	M	-	M	-	-	A	A	A	M	-	M	A	-	M	-	M	M	M	-	-	-	A	A	A/O^{D}	A	-	-	A	A	A/O^{D}	A
	Halethorpe	M	-	M	-	M	-	A	A	M	M	-	-	M	M	-	-	M	M	M	-	-	M	M	M	M	-	-	M	M	M	M
	Martin Airport	-	-	M	-	-	A	M	M	M	-	M	-	M	-	-	-	M	M	M	-	-	M	S^{H}	S^{H}	M/S^{H}	M	-	M	S^{H}	S^{H}	M/S^{H}
	New Carrollton	-	-	-	W	-	-	A	-	W	-	-	-	W	-	-	-	W	-	-	-	-	-	-	-	W	-	-	-	-	-	W
	Odenton	M	-	M	-	M	A	A	M	A	M	-	A	M	-	-	A	A	A*	M	-	-	M/T^{A}	M/T^{A}	M/T^{A}	M/T^{A}	M	-	M/T^{A}	M/T^{A}	M/T^{A}	M/T^{A}
	Penn					-	-	A	-	A	-	-	-	A	-	-	-	A	-	-	-	-	A/T^{B}	A	-	A/T^{B}	-	-	A/T^{B}	A	-	A/T^{B}
	Perryville					-	A	A	A	-	-	-	-	-	-	-	-	A	A*	-	-	-	A	A	A/M	A	M	-	M	M	M	M
	Seabrook	M	-	M	-	-	A	A	A	A	M	-	A	M	-	-	A	-	-	M	-	-	M	M	M	M	-	-	A	A	-	A
	Union	-	-	-	A	-	-	A	-	A	-	-	-	A	-	-	-	A	-	-	-	-	A	A	-	A	-	-	T^{B}	T^{B}	T^{B}	T^{B}
	West Baltimore	M	-	M	-	-	M	A	A	M	M	-	A	M	M	-	A	M	M	-	-	-	S^{S}	-	S^{S}	S^{S}	-	-	S^{S}	-	S^{S}	S^{S}
Camden Line	*Camden*	M	-	M	-	M	-	M	M	M					-	-	M	M	-	M	-	M	M	M	M	-	-	M	-	-	-	-	-	-
	College Park	M	-	M	-	-	C	C	C	C					M	-	M	M								-	-	W	C	C	W
	Dorsey	M	-	M	-	-	C	C	C	C										M	-	M	M	M	M	M	-	M	M	M	M
	Greenbelt	M	-	M	-	M	C	C	M	-	-	-	-	W	M	-	W	M	-	-	-	-	W	W	W	-	-	W	-	W	W
	Jessup	M	-	M	-	-	C	C	C	C					M	-	C	M	M	-	-	-	T$^{A/O}$	C	T$^{A/O}$	T$^{A/O}$	-	-	T$^{A/O}$	C	T$^{A/O}$	T$^{A/O}$
	Laurel	M	-	M	-	M	C	C	M	-					M	-	-	M	C	M	-	M	C	M	M	M	-	-	M	C/M	M/O^{L}	M
	Laurel Racetrack	M	-	M	-	-	C	C	C	C										M^{H}	-	M	C	M	M	M	-	-	O^{R}	O^{R}	O^{R}	O^{R}
	Muirkirk	M	-	M	-	-	C	C	C	C																									
	Riverdale	M	-	M	-	-	C	C	C	C					M	-	-	M		M	-	M	?	?	M	M	-	-	M	M	M	M
	Savage	M	-	M	-	-	C	C	C	C					-	-	-	M	-	-	-	-	T	T	C	-	C	C/T^{P}	C	C/T^{P}	C/T^{P}
	St. Denis	M	-	M	-	-	C	C	C	C					M	-	C	M	M	-	-	M	M		M	M^{G}	-	M	M	M	M/S^{H}
															M	-	C	M	M							-	C	C	-	-	C



3.5.4. Guideway (Right of Way)

While the Penn, Camden, and Brunswick lines are 187 miles in combined length, each line contains multiple tracks, totaling over 400 track miles. The distances of each station from Washington Union Station terminus are demonstrated below (Table 3.9). Amtrak owns, operates, and maintains the Penn line, a segment of the larger Northeast Corridor (NEC). CSX Transportation owns and maintains the

Camden and Brunswick mainlines. Note however, that MTA owns the 3.4 mile Frederick spur that extends from the Point of Rocks station to the Frederick station.

Table 3.9 – The distances of each station from the Washington D.C. Union Station terminus. Directional Route Miles (DRM) can be calculated by multiplying each figure by two.

Penn Line	Miles from Union Station	Brunswick Line	Miles from Union Station	Camden Line	Miles from Union Station
Union Station	0.0	Union Station	0.0	Union Station	0.0
New Carrollton	9.0	Silver Spring	7.5	Riverdale	5.9
Seabrook	11.3	Kensington	11.0	College Park	7.0
Bowie state	16.6	Garrett Park	12.4	Greenbelt	9.2
Odenton	22.4	Rockville	163.7	Muirkirk	13.3
BWI	29.7	Wash. Grove	20.6	Laurel	17.1
Halethorpe	33.0	Gaithersburg	21.6	Laurel Racetrack	17.6
West Baltimore	37.5	Met. Grove	24.1	Savage	20.3
Baltimore	40.3	Germantown	26.4	Jessup	22.6
Martins Airport	52.0	Boyds	28.9	St. Denis	29.6
Edgewood	60.9	Barnesville	33.4	Camden	36.4
Aberdeen	70.5	Dickerson	35.5		
Perryville	76.6	Point of Rocks	42.8		
		Monocacy*	54.1		
		Frederick*	56.7		
		Brunswick	49.8		
		Harpers Ferry	55.7		
		Duffields	62.0		
		Martinsburg	74.0		

* Denotes Frederick Spur located on the Brunswick line

While the Amtrak and CSX *Access and lease agreements* allow MTA to use these Rights of Way, these contracts do not authorize MTA to conduct or oversee maintenance activities for the associated track, bridge and tunnel assets. MTA contracts with BTS for maintenance of the Frederick spur Guideway assets.

3.5.5. Systems

MARC utilizes three major classes of Systems assets:

- **Electrification** – overhead catenary located along the Penn line only, this system provides DC power to MTA's electric locomotives.
- **Signals and Train Control** – Rail signals, instrument houses, Positive Train Control (PTC) equipment, and traffic signals.
- **Security/Monitoring** – Communications, Closed Circuit Television (CCTV), and other security equipment.

PTC is a safety system that automatically stops trains in the event of human error. To comply with Federal Railroad Administration (FRA) regulation, MTA is in the process of installing on-board PTC equipment for its vehicles, and is also co-funding the installation of PTC wayside equipment. While certain railroads may obtain a 2 year extension, FRA's deadline for implementing PTC is December 31, 2018.

System assets are **owned** by Amtrak (Electrification, Signals, and Train Control), CSX (Electrification, Signals, and Train Control), or MTA (vehicle PTC equipment, traffic signals at Frederick spur grade crossings, and system-wide CCTV). In the near future, Norfolk Southern will install and own other PTC wayside equipment along the Penn line.

While the Amtrak and CSX ***Access and lease agreements*** allow MTA to use these Systems assets, these contracts do not authorize MTA to conduct or oversee maintenance activities for the associated electrification, signals, train control, and security/monitoring assets. MTA contracts with BTS for **maintenance** of the Frederick spur Systems assets.

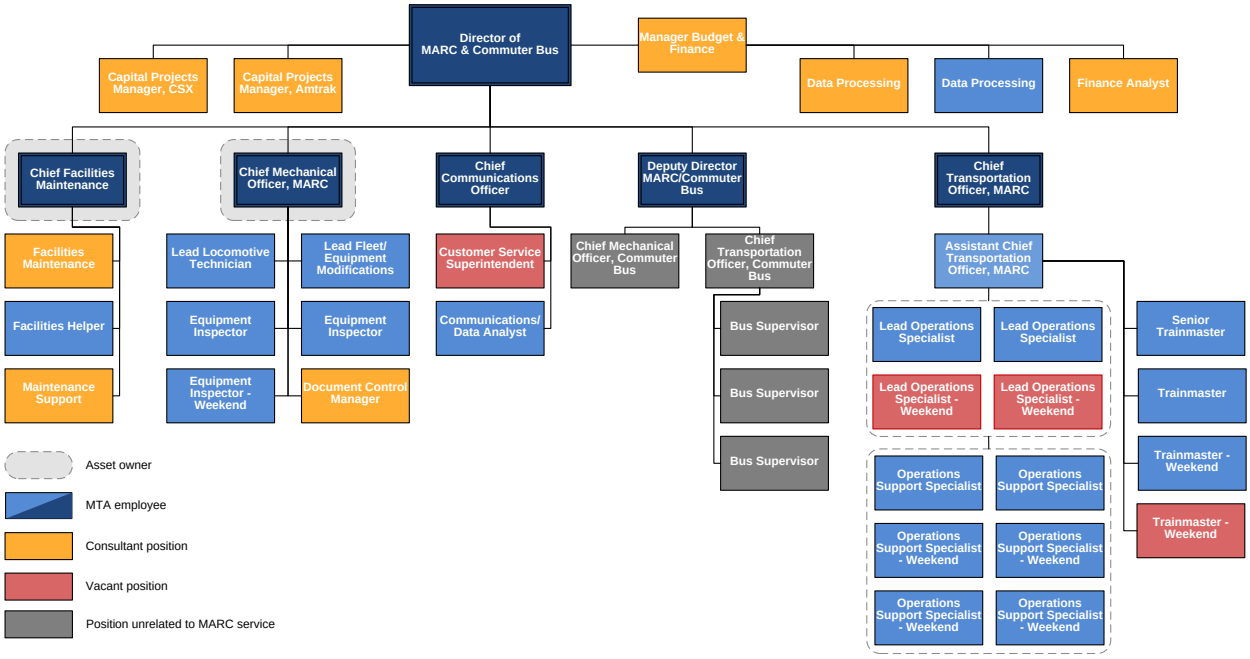
4 Roles & Responsibilities

While MARC is considered a standalone service, it is managed by the same MTA leadership responsible for Commuter Bus service. Despite these being two separate services/modes, they are sometimes referred to as the "MARC/Commuter Bus mode" by agency employees due to the shared organizational structure. Nine (9) of the 35 total Personnel Identification Numbers (PINs) in the MARC/Commuter Bus mode are allocated for managing MARC State of Good Repair (SGR) needs. This section of the LMP focuses on the human resources allocated to manage those SGR needs.

4.1 MARC and Commuter Bus Organizational Structure and Staffing Levels

Figure 4.1 presents the current organizational structure and relationships between management and workforce between the MARC and Commuter Bus modes. Commuter Bus-only roles are greyed-out and MARC roles are shown in full color for convenience. This organizational structure makes distinctions between positions and departments geared toward either administration or operations management.

Figure 4.1 – MARC and Commuter Bus' organizational chart. Last updated April 2016.



While the Director of MARC/Commuter Bus manages the MARC mode as a whole, the Chief Facilities Maintenance and the Chief Mechanical Officer are the only positions with *direct* state of good repair responsibilities for MARC Transit Assets. The Chief Transportation Officer has responsibilities unrelated to asset SGR, such as managing dispatch and operations.

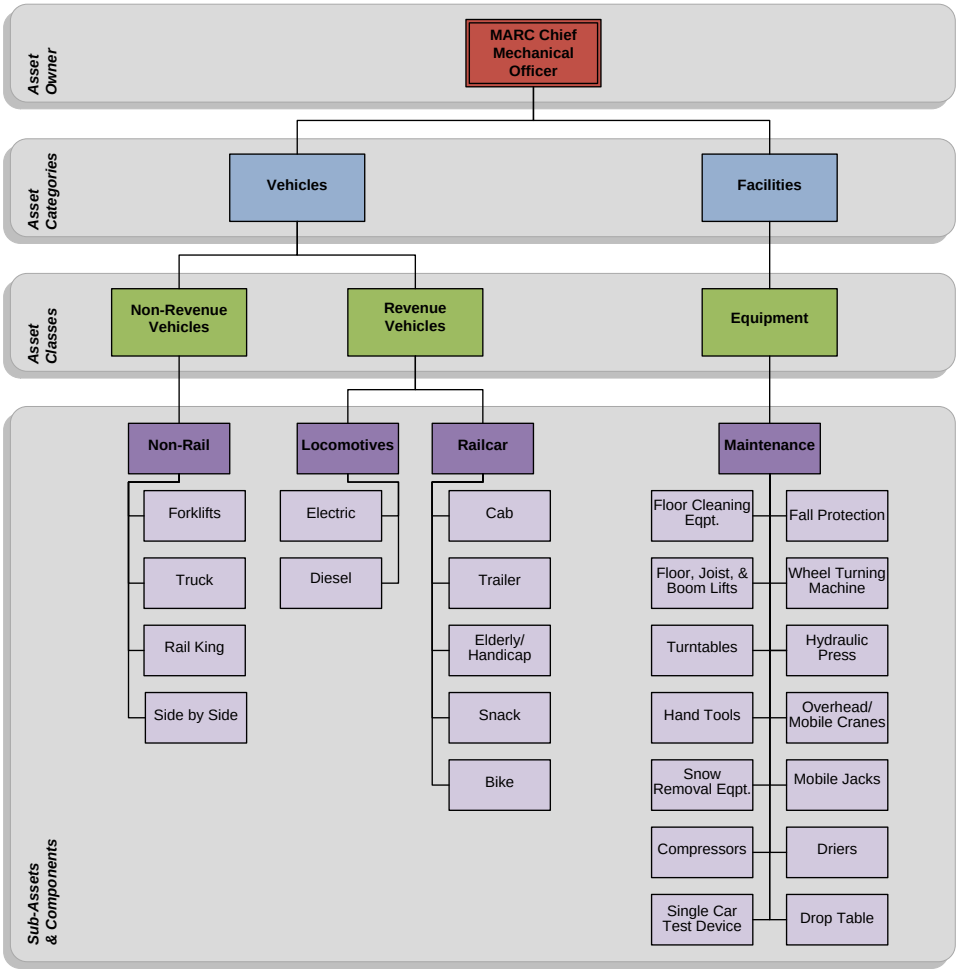
4.2 Transit Asset Owners

MARC has less control over its assets than most MTA modes. The "Asset Owners" for MARC assets, as defined in Section 2.4, are either MTA employees or third-party contractors. The Asset Owner hierarchies below illustrate only those Transit Assets under the Asset Owner's direct purview.

4.2.1. Vehicle Asset Responsibilities

The Asset Owner for the Vehicle asset category is the MARC Chief Mechanical Officer. The officer is responsible for maintenance oversight to ensure all revenue vehicles and certain facilities equipment are maintained in a state of good repair. Actual maintenance of revenue vehicles is conducted by either Amtrak or BTS, as discussed in Chapter 9.

Figure 4.2 – Asset Owner hierarchy for the MARC Chief Mechanical Officer



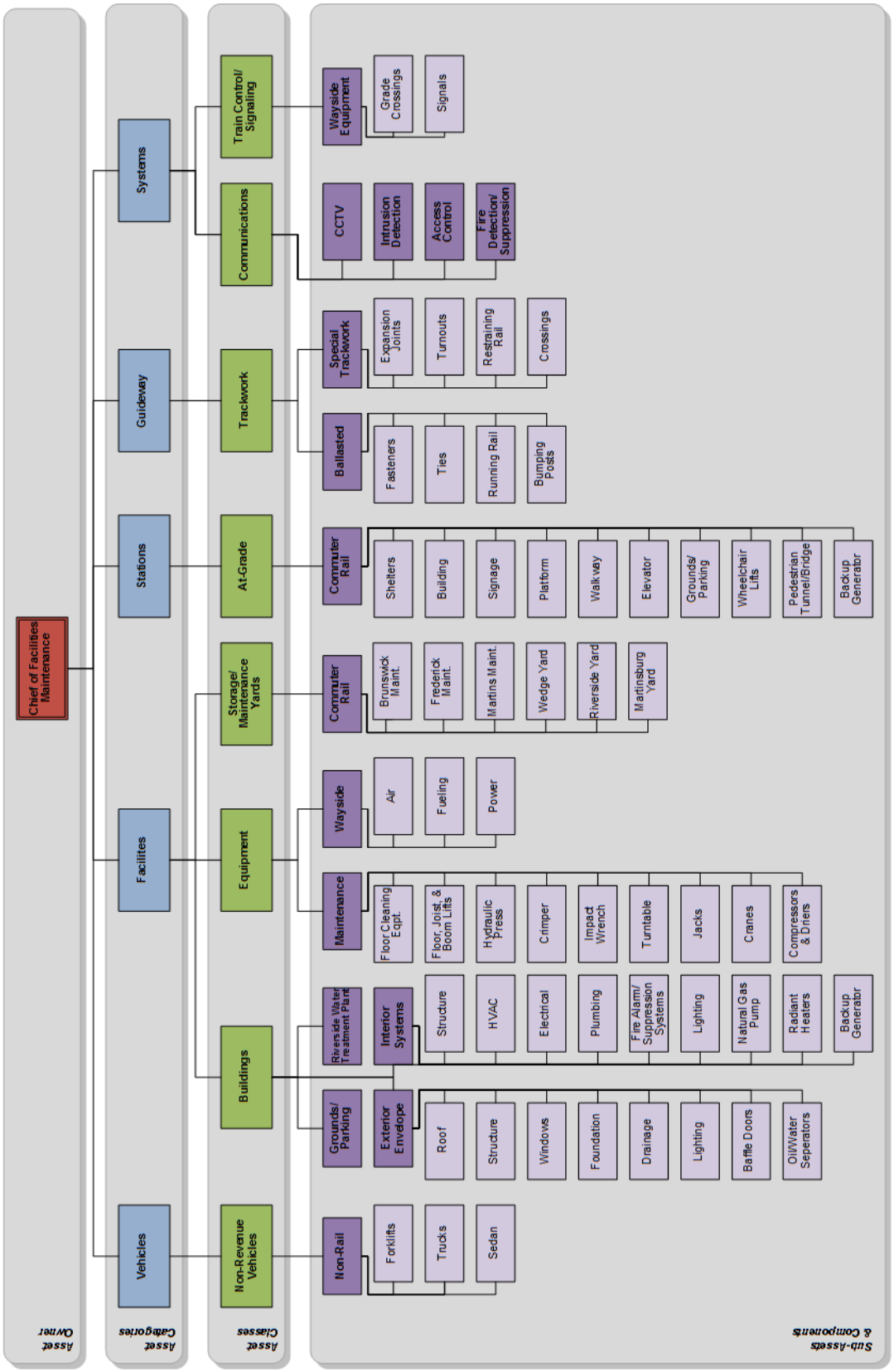
4.2.2. Facilities, Stations, Guideway, and Systems Asset Responsibilities

The Chief of Facilities Maintenance provides oversight to ensure completion of all scheduled inspection, maintenance, and corrective repair to:

- All layover/maintenance facilities;
- All stations, except for Penn and Union Stations;
- All guideway and systems Transit Assets along the 3.4 mile Right of Way of the Frederick spur;
- All MTA-owned non-revenue vehicles; and
- MTA-owned shop equipment not overseen by the Chief Mechanical Officer.

Actual maintenance conducted by BTS will be discussed in Chapter 9.

Figure 4.3 – Asset Owner hierarchy for the Chief of Facilities Maintenance.

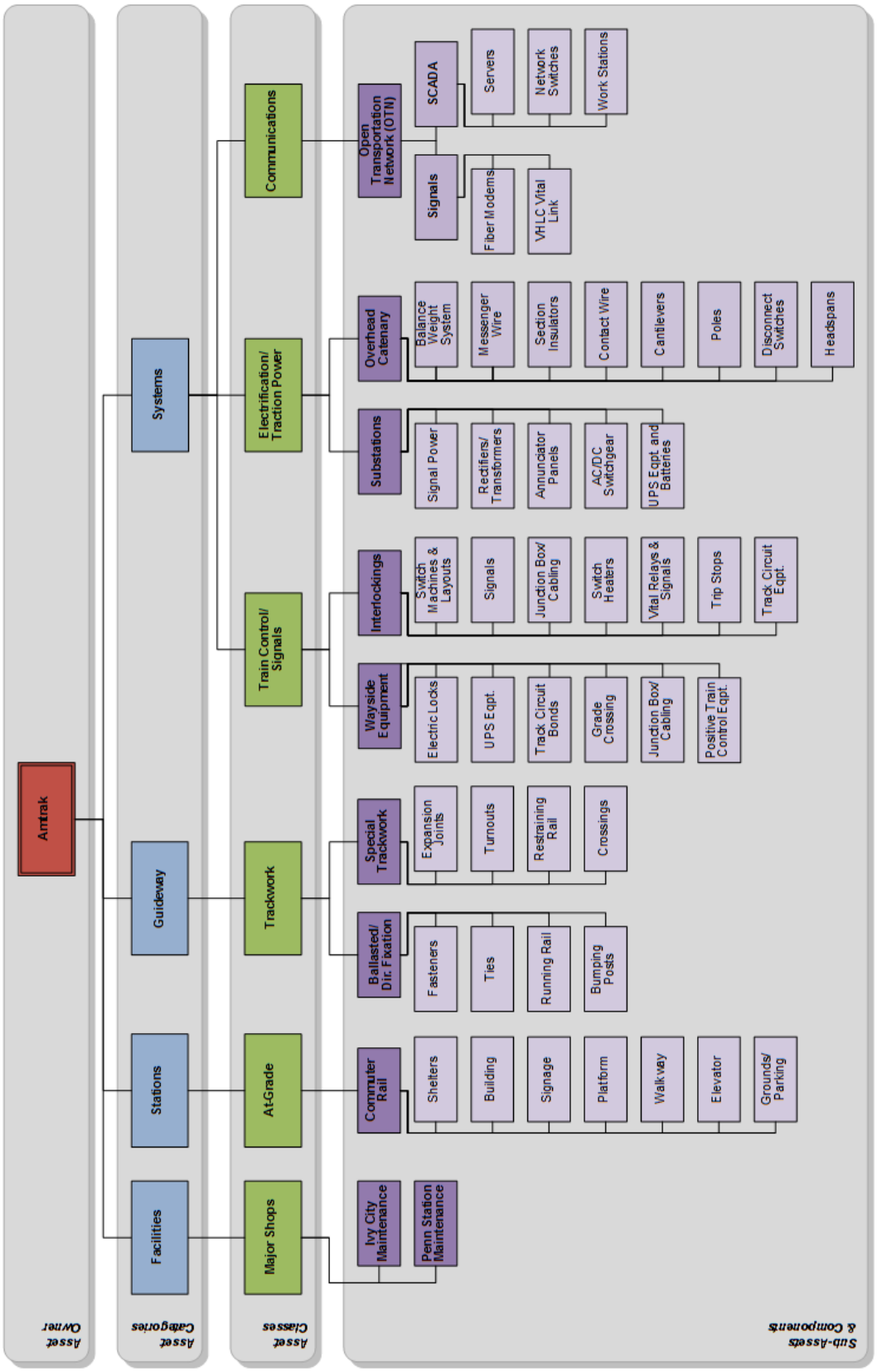


4.2.3. Amtrak – Facilities, Stations, Guideway, and Systems Responsibilities

While Amtrak is not represented in the MARC and Commuter Bus organizational chart, it is considered the asset owner of many non-MTA-owned assets which MARC depends upon to provide service:

- Facility assets, such as the Penn Station layover facility and the Ivy City layover/maintenance facility;
- Station assets, such as Penn Station, Union Station, and intertrack platforms located at stations along the Penn line;
- Guideway assets, such as trackwork, located along the Penn line; and
- System assets located along the Penn line ROW include overhead catenary, signaling, communications, and positive train control.

Figure 4.4 – Asset Owner hierarchy for Amtrak.

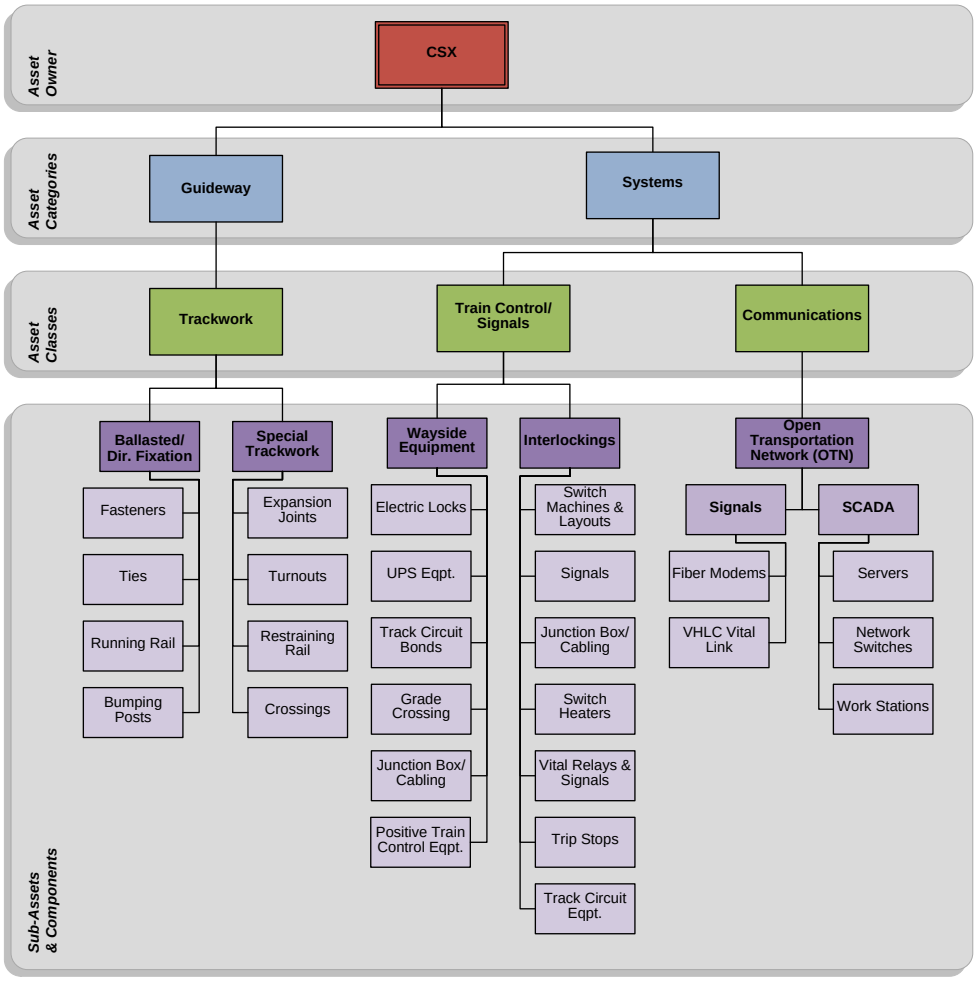


4.2.4. CSX Transportation (CSX) – Guideway and Systems Responsibilities

While CSX is not represented in the MARC and Commuter Bus organizational chart, it is considered the Asset Owner of many non-MTA-owned assets which MARC depends upon to provide service:

- Guideway assets, such as trackwork, located along the Camden and Brunswick lines, excluding the Frederick spur; and
- System assets located along the Camden and Brunswick lines, excluding the Frederick spur.

Figure 4.5 – Asset Owner hierarchy for CSX Transportation.



4.3 Overarching MARC Responsibilities

While MARC currently provides oversight of MTA-owned assets, the MARC mode expresses the need to extend safety oversight and quality control over non-MTA-owned assets. With limited PINs dedicated to SGR responsibilities, it is difficult for MARC to fulfill this need and police the terms of their contracts. It is recommended that MARC conduct a thorough organizational assessment to inform how these challenges can be overcome.

5 Transit Asset Inventory

The MTA asset inventory details those assets owned by each mode/department, and associated data for each unique asset record. The inventory minimally includes an in-service (or construction) date, procurement cost, and estimated useful life for each record. Useful life values in MTA's initial asset inventory are based either on industry guidelines or values that reflect MTA's actual experience, if available. Additional details, such as serial number or asset location, are included where available.

*MTA's asset inventory includes **in-service date**, **cost**, and **useful life** (at a minimum) for each record.*

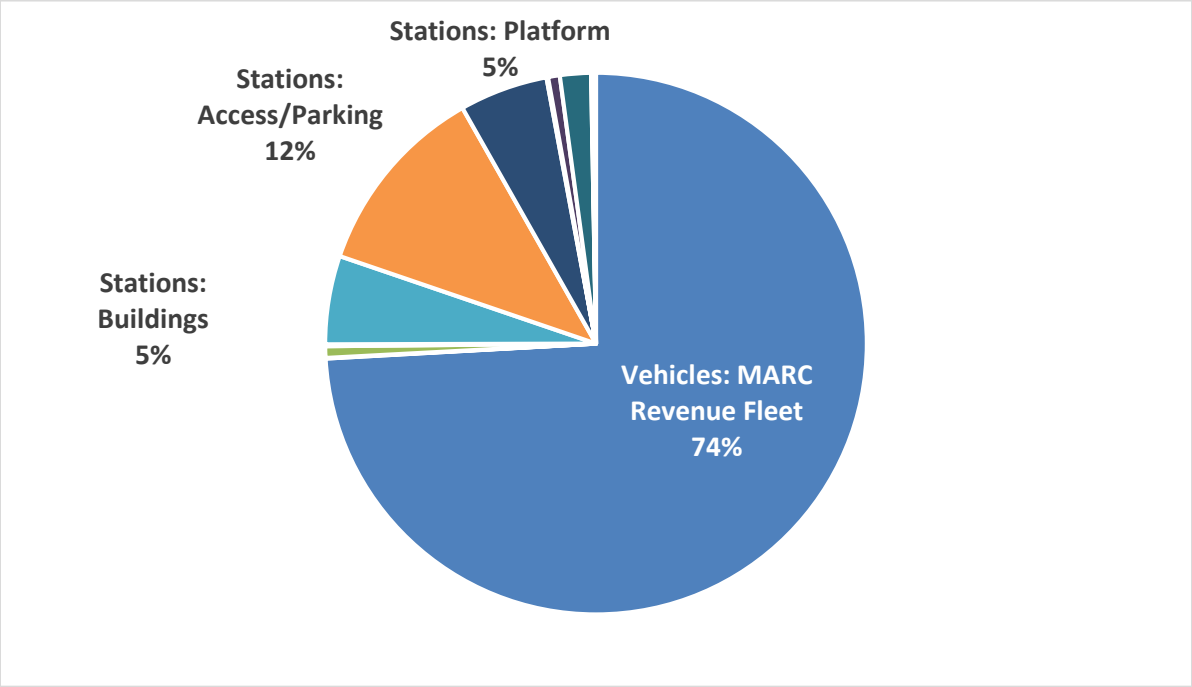
The MTA asset inventory also provides the ability to disaggregate high level asset groupings into a logical grouping of child assets. This is what is commonly referred to as the parent-child relationship. This is achieved by identifying each record's asset category, class, and type according to an accepted hierarchical structure, which has been summarized in Figure 3.3. Having this basic data enables MTA and MARC to perform deeper analyses and ultimately to make better asset management decisions.

The MARC asset inventory is a subset of MTA's asset inventory and **currently reflects only assets owned by MTA**. Table 5.1 and Figure 5.1 below summarizes the MARC asset inventory and also includes expansion assets (eight Siemens locomotives and the purchase of Riverside Yard). Based on a TERM-Lite analysis conducted on November 4, 2015, MARC's asset portfolio is valued at approximately $1.3 billion ($2014), which includes $48 million for the new Siemens locomotives and $33.5 million for Riverside Yard.

Table 5.1 - Summary of MARC Transit Asset inventory by value.

MARC Asset Types	Replacement Cost (2014$)	% of Asset Base
Vehicles: MARC Revenue Fleet	$ 953,040,000	74.1%
Vehicles: Non-Revenue	$ 469,411	0.0%
Facilities: Buildings	$ 8,894,579	0.7%
Facilities: Equipment	$ 1,425,646	0.1%
Stations: Buildings	$ 67,871,444	5.3%
Stations: Access/Parking	$ 148,592,824	11.6%
Stations: Platform	$ 67,861,601	5.3%
Stations: Signage	$ 1,038,899	0.1%
Guideway	$ 150,444	0.0%
Guideway: Trackwork	$ 8,989,403	0.7%
Guideway: Yard & Special Structures	$ 23,762,090	1.8%
Systems: Comms	$ 492,327	0.0%
Systems: Revenue Collection	$ 1,737,000	0.1%
Systems: Train Control	$ 1,501,454	0.1%
Total	**$ 1,285,827,123**	**100.0%**

Figure 5.1 - Summary of MARC Transit Asset inventory by value.



Revenue vehicles make-up the biggest share of the MARC asset base (at 74% of asset base), followed by Station Access & Parking (at 12% of asset base).

Consistent with the discussion in Section 4.2 above, the MTA asset inventory currently does not include assets owned by third-parties, such as maintenance facilities, stations, guideway, or systems assets. Many of these third-party-owned assets will need to be included in future versions of the MTA asset inventory to be consistent with the TAM Final Rule, effective October 1, 2016.

While the MTA has developed a consolidated inventory of its Transit Assets, MARC "owns" a number of linear assets, such as trackwork, which are difficult to track and visualize in the absence of a more sophisticated inventory software system. Strategy #1 (*Maintain Transit Asset and Land Asset Inventories*) of the TAMP suggests that MTA and develop an improved strategy for visualizing and managing linear assets. The ability to visualize linear assets will allow MARC to better understand the condition and performance of these assets, consolidate inspection and maintenance activities within the same geographic area, and make better management decisions.

5.1 Inventory Maintenance Process

MTA believes the initial MARC inventory accurately reflects **MTA-owned assets**. However, some of the records are based upon assumptions and it is unknown if some assets might be still missing from the inventory. Over time, MTA will continue to replace its assets and acquire new ones.

Therefore, in accordance with Strategy #1 in the TAMP (*Maintain Transit Asset and Land Asset Inventories*), MARC will:

- Develop a process, in collaboration with other MTA Asset Owners, to keep the MARC inventory current and continually improve the quality of the data it contains;
- House the MARC inventory in the official inventory system(s) of record as designated through the MTA asset management program;
- Contribute to the development of an improved strategy to visualize/manage linear assets; and
- Assist with reporting of asset information through the National Transit Database (NTD) as required by 49 U.S.C. 5326.

5.2 Asset Criticality Assessment

Asset criticality plays a role in multiple decision making processes and strongly influences risk evaluation and capital investment considerations. In extreme circumstances, failure of Critical Assets may result in property damage, human injury, and possibly loss of life. But in most circumstances, failure of Critical Assets leads to service disruptions and loss of revenue. Having a formal process in place for identifying Critical Assets can help the MTA and MARC determine what level of intervention is appropriate for its Transit Assets and can help reduce costs.

Asset criticality scores were calculated using the TERM Lite capital investment prioritization weighting criteria by Transit Asset type. TERM Lite prioritization weighting criteria are set on a 1-5 scale across four categories: asset condition, reliability, safety and O&M cost impact. To calculate asset criticality, the reliability and safety values are multiplied; for those assets where the product of this calculation is greater than or equal to 12, the asset is considered critical.

MARC's critical assets include all trackwork, all revenue vehicles, and certain communications, train control, and station assets (Table 5.2).

Table 5.2 - MARC Critical Assets.

Asset Category	Asset Class	Asset Type	Department Responsible
Vehicles	Revenue Vehicles	Revenue Locomotive	MARC Mechanical Department
		Passenger Car	
Stations	Access	Elevators	MARC Facilities Department
Guideway Elements	Trackwork	*All trackwork assets*	
Systems	Train Control	Grade Crossing System	
	Communications	*All communications assets*	

MTA will need to identify additional Critical assets associated with MARC when it expands its inventory to include third-party assets.

5.3 Major Procurements

MARC manages projects involving new asset acquisition, asset rehabilitation, and asset replacement. All large-scale projects are considered procurements, even if they are focused on existing system assets, such as is the case with overhauls or upgrades. This is because they rely on the procurement of *services*, such as engineering, design, testing, repair, installation, and construction, among others. A brief description of MARC's recent and current projects are provided in the sections below.

For those interested in additional information, including cost and schedule details, the four digit project number has been provided to locate the project in MTA's Capital Programming Management System (CPMS). If you have no or only limited access to CPMS, you may contact the Capital Programming division of MTA's Office of Planning directly for assistance at 410-767-3770.

MARC has either completed within the past five years or is undertaking key projects focused on system preservation and enhancement. System preservation, or SGR, projects are typically aimed at making necessary repairs, upgrades, and overhauls that are needed to realize the intended design life of a given Transit Asset; system enhancement projects add additional functionalities to the existing MARC system. Recent and current major projects are summarized in Table 5.3 and Table 5.4 below.

__Major__ procurements detailed below include the acquisition of new assets, overhauls, and replacements that involve __Critical Assets__ and are over __$2 million__ in fully loaded costs.

Table 5.3 - Recently completed preservation and enhancement projects on the MARC system.

Project Name	Details	
CSX Joint Benefit- Second Track (*Enhancement*)	*Project Code:*	0687
	Cost:	$21.00 million
	Description:	• Planning, design, and construction of a 4 mile second track between JD and Jones Hill. • Located on the CSX owned Alexandria Extension to alleviate congestion on the Camden line.
	Completion:	March, 2015
Amtrak Joint Benefit- B&P Tunnel Block Ties (*Preservation*)	*Project Code:*	0183
	Cost:	$5.50 million
	Description:	• Replacing the block ties within the B&P Tunnel.
	Completion:	April, 2016
Washington Mid-Day Storage (*Enhancement*)	*Project Code:*	0208
	Cost:	$46.90 million
	Description:	• Construction of Wedge Yard to help eliminate passenger overcrowding and train congestion. • Provides layover, light maintenance, and inspection capabilities.
	Completion:	December, 2014

PA/LED Sign Replacement (*Preservation*)	*Project Code:*	0430
	Cost:	$11.20 million
	Description:	• Design, procure, and install ADA compliant signage and PA system across all stations.
	Completion:	December, 2013
Halethorpe Station Platforms (*Enhancement*)	*Project Code:*	0435
	Cost:	$38.28 million
	Description:	• Design and construct 700 foot, ADA compliant, high-level platforms. • Includes new pedestrian bridge, elevator, and stairs.
	Completion:	December, 2014
West Baltimore Parking Expansion (*Enhancement*)	*Project Code:*	1089
	Cost:	$10.58 million
	Description:	• Double parking capacity to 638 spaces. • Reestablish community connections through streetscape features, gardens, street art, and future TOD capacity.
	Completion:	October, 2014
Edgewood Station (*Enhancement*)	*Project Code:*	1296
	Cost:	$5.09 million
	Description:	• New construction includes: station building, northbound shelters, and parking lot modifications.
	Completion:	April, 2013
BWI Station Renovation (*Preservation*)	*Project Code:*	8008
	Cost:	$2.44 million
	Description:	• Replacement of two elevators and adding an additional elevator.
	Completion:	November, 2011
Public Address System (*Enhancement*)	*Project Code:*	8011
	Cost:	$8.00 million
	Description:	• Procurement and installation of ADA compliant public address system on all stations.
	Completion:	August, 2013
IIB Passenger Car Overhaul (*Preservation*)	*Project Code:*	0181
	Cost:	$23.95 million
	Description:	• Overhaul of 34 MARC IIB passenger cars. • Includes replacement/refurbishment of doors, trucks, couplers, running gear, HVAC, emergency lighting, and ADA features.
	Completion:	June, 2012
Frederick Spur Extension (*Enhancement*)	*Project Code:*	0200
	Cost:	$60.25 million
	Description:	• Expansion of service from Point of Rocks to downtown Frederick. • Includes ROW acquisition, Frederick station design/construction, and signal improvements.
	Completion:	December, 2011

Diesel Locomotive Procurement (*Preservation*)	*Project Code:*	1245
	Cost:	$95.82 million
	Description:	• Procurement of 26 new diesel locomotives. • 3600 HP engine meets EPA Tier II requirements; 720 KW HEP meets EPA Tier III requirements. • Operations: 100 MPH Penn line; 79 MPH Camden/Brunswick lines. • GP-40 diesel locomotives traded in for credit.
	Completion:	June, 2013
Multi-level Vehicle Procurement (*Preservation & Enhancement*)	*Project Code:*	1263
	Projected Cost:	$ 160.30 million
	Description:	• Procurement of 54 MARC IV passenger cars. • Total of 15 cab, 5 restroom, and 34 trailers. • 9 vehicles are for replacement, 45 are for expansion.
	Estimated Completion:	September 2016

Table 5.4 - Current preservation and enhancement projects on the MARC systems.

Project Name	**Details**	
CSX Joint Benefit-Brunswick Platform (*Enhancement*)	*Project Code:*	0687
	Projected Cost:	$ 2.90 million
	Description:	• Expansion of the Brunswick Platform.
	Estimated Completion:	June 2020
CSX Joint Benefit-Carroll Interlocking (*Preservation*)	*Project Code:*	0687
	Projected Cost:	$ 6.90 million
	Description:	• Replacement of the Carroll interlocking.
	Estimated Completion:	June 2018
CSX Joint Benefit-Jessup Yard (*Preservation*)	*Project Code:*	0687
	Projected Cost:	$ 12.0 million
	Description:	• Enhancement at Jessup Yard.
	Estimated Completion:	June 2017
CSX Joint Benefit-Switch Heater Replacement (*Preservation*)	*Project Code:*	0687
	Projected Cost:	$ 7.00 million
	Description:	• Replacement of switch heaters.
	Estimated Completion:	November 2016

CSX Joint Benefit- West Baltimore Interlocking (*Preservation*)	*Project Code:*	0687
	Projected Cost:	$ 4.00 million
	Description:	• Replacement of the West Baltimore Interlocking
	Estimated Completion:	June 2018
Positive Train Control (*Enhancement*)	*Project Code:*	1380
	Projected Cost:	$16.56 million
	Description:	• Procurement of Positive Train Control system to prevent collisions. • Includes on-board locomotive and cab car equipment.
	Estimated Completion:	November 2016
Diesel Locomotive Procurement (*Preservation*)	*Project Code:*	1440
	Projected Cost:	$ 61.74 million
	Description:	• Procurement of (8) 125 MPH diesel locomotives. • Piggyback from Illinois DOT with Siemens.
	Estimated Completion:	November 2019
GP-39 Repower (*Preservation*)	*Project Code:*	1444
	Projected Cost:	$11.78 million
	Description:	• Repower of 6 GP-39 diesel locomotives (extend life by 25-30 years). • Includes rebuild of main and engines, rewiring generators, overhauling draft and cooling systems, trucks, and traction motors.
	Estimated Completion:	March 2017
IIA Passenger Car Overhaul (*Preservation*)	*Project Code:*	1450
	Projected Cost:	$ 30 million – *Partially funded by Capital Programming*
	Description:	• Overhaul of 26 MARC IIA, single-level, passenger cars. • Includes overhaul of safety features, interior, communications, and onboard, and running systems.
	Estimated Completion:	July 2023
Amtrak Joint Benefit- Hanson Interlocking (*Preservation*)	*Project Code:*	0183
	Projected Cost:	$ 36 million – *Partially funded by Capital Programming*
	Description:	• Replacement of the Hanson interlocking. • New interlocking would enable a future 4th track on the Penn line.
	Estimated Completion:	September 2018
Riverside Maintenance Facility Procurement (*Enhancement*)	*Project Code:*	1177
	Projected Cost:	$ 27.44 million
	Description:	• Procurement of the Riverside Maintenance Facility from CSX. • National Environmental Protection Act approved, with HazMat testing & results expected 2017.
	Estimated Completion:	July 2017

Northeast Maintenance Facility (*Enhancement*)	*Project Code:*	1208
	Projected Cost:	$ 363 million – *Partially funded by Capital Programming*
	Description:	• Current capital funding includes land acquisition. Site of future layover/maintenance facility for Penn line operations.
	Estimated Completion:	October 2016
BWI Station Improvements (*Preservation*)	*Project Code:*	1209
	Projected Cost:	$ 9.50 million
	Description:	• Includes canopy replacement and new pedestrian connector bridge.
	Estimated Completion:	April 2018
Martin State Airport Yard Improvements (*Preservation*)	*Project Code:*	1217
	Projected Cost:	$ 15.14 million – *Partially funded by Capital Programming*
	Description:	• Includes purchase of ROW, construction of 2 electrified storage tracks, and utilities. • Utilities include: stormwater management, yard standby power cabinets, water & compressed air distribution system. • Required for long range electric locomotive needs.
	Estimated Completion:	June 2019
West Baltimore Station (*Preservation*)	*Project Code:*	1290
	Projected Cost:	$ 83.00 million – *Partially funded by Capital Programming*
	Description:	• Construct a new station with full ADA compliance. • Includes improved bus connections and pedestrian access. • New station may be in current location, or correspond with the alignment of the new B&P tunnel.
	Estimated Completion:	July 2025
MARC III Coach Overhaul (*Enhancement*)	*Project Code:*	1304
	Projected Cost:	$ 45.30 million
	Description:	• Overhaul of 63 multi-level coaches. • Includes major components: HVAC, trucks, brakes doors, and communications.
	Estimated Completion:	February 2019

6 Condition Assessment & Performance Monitoring

6.1 Condition Assessment Philosophies

On Feb. 14, 2013, the FTA's State of Good Repair White Paper was published. This document explores the following four approaches to assessing Transit Asset conditions:

- Age-based
- Inspection-based
- Performance-based
- Comprehensive (combined)

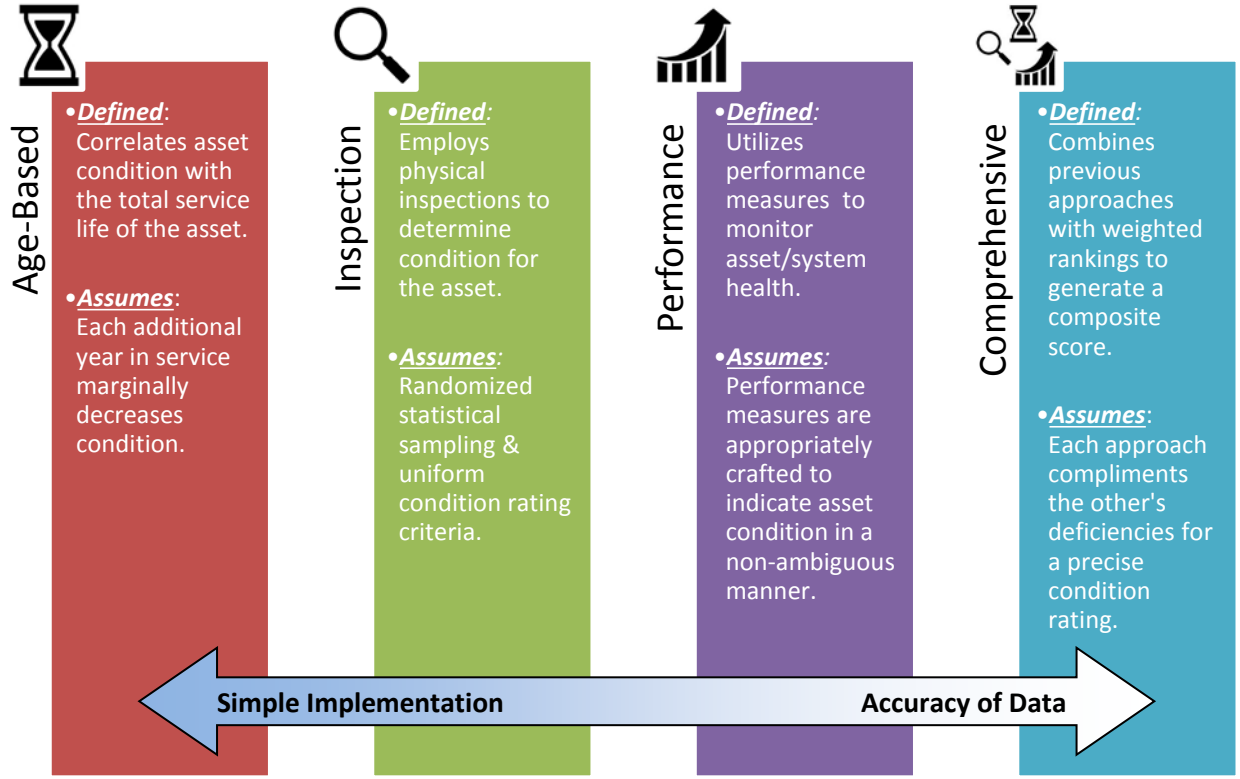
The **age-based approach** to assessing condition assumes that most assets have a useful life, measured in years. Once that useful life is met, it is assumed the asset will exhibit decreased performance, higher risk of failure, and higher maintenance costs. Using this method, the condition of assets can be estimated based on the asset's age in relation to its expected useful life. This approach usually relies on the use of empirically derived asset decay curves unique to each asset type, and each curve provides a point estimate of asset condition given the asset's age. A benefit of this approach is that it is cost effective, as it does not require on-site inspection of the asset. However, it only provides an approximation of condition and therefore is not appropriate if a more detailed understanding of actual condition is required. Finally, as asset age in only one of several determinants of asset performance, age-based condition measures can only provide a rough proxy measure of performance.

The **inspection-based approach** to assessing condition employs standardized inspection procedures and criteria. The frequency for these inspections will vary depending on type, criticality and the expected useful life of each asset. Because inspection of each and every asset can be unrealistic from a manpower standpoint, many assets may be assessed via a statistical representative sampling, and an average condition value can be calculated and assumed for all assets of the same type.

The **performance-based approach** to assessing condition employs diagnostic information and performance metrics to monitor the overall health of a transit system. This method assumes that performance metrics are sufficiently crafted in a way that allows management to quickly diagnose which assets are associated with a drop in performance. Using this method, the condition of assets can be estimated based on the overall performance of the transit system.

The **comprehensive approach** combines age-based, inspection-based, and performance-based metrics with weighted rankings into a composite condition score for each asset.

Figure 6.1 - A description of the age, inspection, performance, and comprehensive-based approaches to quantifying asset condition.



Of all four approaches outlined above, the age-based approach to condition assessment is the easiest to employ; by comparison inspection-based and comprehensive approaches require substantial manpower commitments, and performance-based approaches require substantial data systems to be in place. Furthermore, an age-based approach to estimating asset condition can be easily automated with a tool like **TERM Lite**.

TERM Lite is a Microsoft Access-based decision tool provided by the FTA, which allows transit agencies to estimate the current and potential future condition of their Transit Assets using agency inventory data and a series of asset-specific, age-based decay curves embedded in the tool. TERM Lite's decay curves were commissioned by the FTA using statistical analysis of condition assessment data from thousands of on-site inspections across a broad range of asset types and US transit operators. Each curve predicts how condition is expected to decline (on average) based on asset type and age. While TERM Lite's decay curves may not always attain the accuracy of actual on-site inspections, they are significantly more cost effective and provide the advantage of being able to look forward in time. That is, TERM Lite can estimate asset conditions today and what they may be tomorrow given differing levels of capital investment.

While the TERM Lite model is built on industry average data, it can also be customized to reflect asset decay scenarios specific to MTA. These condition estimates produced by TERM Lite serve as a supplement to existing inspection-based condition assessments employed by MARC, and serve as a proxy where MARC does not currently have any inspection-based condition assessment regimes.

6.2 Condition Estimates & "State of Good Repair" (SGR) Backlog

TERM Lite calculates condition estimates on a 5-point numerical scale (Table 6.1). By standardizing the use of this 1-5 scale for a condition rating, the MTA can begin to understand the condition of its assets across all modes and asset types, providing a common language for prioritizing SGR needs.

*MARC's current backlog is **$5.6 million**, accounting for **0.4%** of the total asset base.*

Table 6.1 - FTA's TERM Lite condition rating scale.

Condition	Ratings	Description
Excellent	**4.51 to 5.00**	New asset; No visible defects
Good	**3.51 to 4.50**	Asset showing minimal signs of wear; Some (slightly) defective or deteriorated component(s)
Adequate	**2.76 to 3.50**	Asset has reached its mid-life (condition 3.5); Some moderately defective or deteriorated component(s)
Marginal	**2.00 to 2.75**	Asset reaching or just past the end of its useful life (reached between condition 2.75 and 2.5); Increasing number of defective or deteriorated component(s) and increasing maintenance needs
Poor	**1.00 to 1.99**	Asset is past its useful life and is in need of immediate repair or replacement; May have critically damaged component(s)

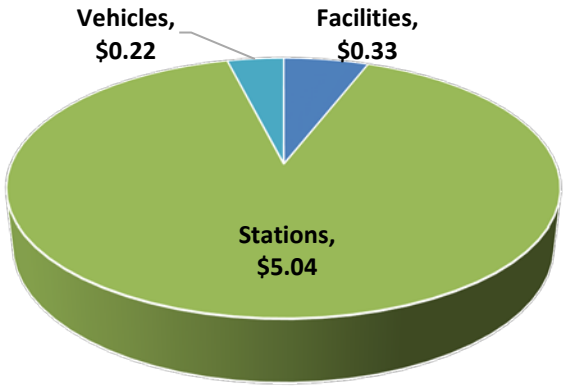
On November 4, 2015, a TERM Lite analysis of MARC assets, yielded the following summary of condition estimates (Table 6.2); a more detailed summary may be found in **Appendix D**. TERM Lite considers assets with a condition estimate of 2.50 and above to be in a **State of Good Repair** (SGR), while those assets with less than a 2.50 are considered to *not* be in a SGR and therefore considered to be in the **backlog** of assets that need replacement (SGR Backlog). All ratings are weighted by asset replacement value, while omitting expansion assets and those replaced in late CY 2014 and CY 2015. Subsequent changes to the MARC asset inventory will be reflected in future TERM Lite analyses which will be conducted on an annual basis, in accordance with Strategy #3 in the TAMP (*Monitor Transit Asset Condition*).

Table 6.2 - Outline of condition ratings generated by TERM Lite output conducted on November 4, 2015.

Category & Sub-Category	Avg. Condition
Facilities	**3.88**
Equipment	**3.63**
Buildings	**3.92**
Storage Yard	**3.77**
Systems	**3.71**
Communications	**4.81**
Train Control	**3.35**
Vehicles	**4.21**
Revenue Vehicles	**4.21**
Non-Revenue Vehicles	**3.27**
Stations	**3.83**
Access	**3.69**
Building	**4.10**
Signage & Graphics	**3.50**
Platform	**3.86**
Guideway Elements	**4.55**
Guideway	**5.00**
Trackwork	**4.46**
Special Structures	**5.00**
Grand Total	**4.12**

MARC's current SGR Backlog stands at $5.6 million (in 2014 dollars) and accounts for 0.03 percent of the mode's asset base. $5.04 million of the SGR Backlog, or 90.2 percent, belongs to station assets. Given the current capital program, the MARC SGR Backlog would be eliminated in 2015 and only reappear in 2020 and 2021 as station and vehicle assets reach the end of their useful lives. Note that this backlog is small largely because of a TERM Lite was programmed to assume that revenue vehicles would never be replaced. If revenue vehicles are assigned an expected useful life in a future run of the TERM model, and/or TERM Lite is run against an expanded inventory that reflects third-party owned assets, this backlog would grow substantially.

Figure 6.2 - MARC's current SGR backlog estimate ($m).



6.3 Current Condition Rating Methodologies

While MARC's third-party O&M contract with BTS requires the submission of several asset-related reports (Table 6.3), neither MARC nor any of its third-party contractors rate the actual condition of MARC's Transit Assets. Maintenance data are captured from completed maintenance checklists, stored in hard copy with corresponding updates to electronic records. Electronic records are stored through the vendor's prescribed Maintenance Management System (MMS).

Table 6.3 – Contractually required reporting for all MARC Transit Assets.

Required Reporting	Frequency	Asset Types
Mainline Track Switch Crossing Inspection	Biweekly	Guideway
MTA Owned Guideway Inspection	Biweekly	Guideway
Track Surfacing Report	Annual	Guideway
Corrective Maintenance Report	Monthly	All
FRA/CSX/BTS Test Compliance Report	Monthly	All
Incident / Unusual Occurrence Report	Daily	Vehicles
FRA Report	Annual	All
Goal Report	Monthly	All
BTS Scheduled Maintenance Plan	Annual	All

6.4 Recommended Condition Rating Methodologies

It is difficult to measure the efficacy of MARC's current TAM practices in the absence of inspection-based condition ratings. Accordingly, it is recommended that MARC implement Strategy #3 in the TAMP (*Monitor Transit Asset Condition*), which requires that:

- ✓ Specifications be developed for Critical Assets;
- ✓ Methodologies be mapped to FTA's universal 1-5 rating scale; and
- ✓ Be performed by MARC or its third-party contractors accordingly.

7 Performance Monitoring

Performance monitoring enables MARC management to continually assess the efficacy of their management decisions. TAMP Strategy #11 (*Enhance Enterprise Performance Management*) requires that performance measures and targets be established at both the agency-wide and modal/department level. While MARC currently employs some asset-specific performance measures, better performance measures need to be developed in alignment with the agency wide performance measures in the TAMP, and TAMP Strategy #11, alike. Some initial recommendations for future performance measures are made below.

7.1 Current Performance Measures

MTA collects MARC performance data directly from its third-party contractors and reports some of this data through an agencywide dashboard. Other Key Performance Indicators (KPIs) are used for internal purposes only.

- **Dashboard** – MTA's newest initiative provides the public with quarterly KPI data based upon MTA's core mission: https://mta.maryland.gov/mta-performance-improvement
- **Internal** – Pertains to MTA's asset management initiative, including this LMP, with KPIs that directly characterize a Transit Asset and are not reported outside of the MTA.

Key Terms

Input KPI- *Measures the amount of resources invested in an asset (time, money, etc.)*

Output KPI- *Measures the service capacity/delivery by an asset (efficacy of resources invested)*

MARC's BTS contract documentation requires collection and reporting for a number of asset-related KPIs (Table 7.1). Of these measures, MARC currently collects only the On-Time Performance (OTP) and related root-cause data. The mode is still developing processes to collect the remaining contractually required performance data. Contracts with CSX and Amtrak do not require the collection or reporting of performance data.

Table 7.1 – KPIs under development by MARC, as well as corresponding types of measure and type of assets involved.

KPI	Type of Measure	Asset Types
PM on-time completion	Output	All
Passenger safety incidents	Output	All
On-Time Performance (OTP)	Output	Vehicles
No. mechanical failures	Output	Vehicles
No. Guideway incidents	Output	Guideway
Mean distance between failures (MDBF)	Output	Vehicles
Open/Closed work order ratio	Output	All
Planned/total work order ratio	Output	All
Employee safety incidents	Output	All
Long-term hold violations	Output	Vehicles
Facility maintenance violations	Output	Facilities
Distance traveled per unit	Output	Vehicles
No. units washed	Input	Vehicles

Future versions of this LMP may not only provide baseline KPI data, but also outline methodologies for establishing and reporting these KPIs.

7.2 Recommended Performance Measures

Several additional KPIs have been proposed for the MARC mode (Table 7.2), in accordance with TAMP Strategy #11. These proposed KPIs are focused on asset-level performance management, designed to support the agency-wide KPIs identified in the TAMP where possible, and support continued reporting for other internal MTA needs.

Table 7.2 - Proposed KPIs for MARC and corresponding types of measure, type of assets involved, and rationale for inclusion.

MTA Mission Element	TAM Vision Element	KPI	Type of Measure	Asset Types
Safety	Safety	Asset-related preventable accidents per 100,000 miles	Output	Vehicles
		% of rail slow zone mileage	Output	Guideway
Efficiency	Fiscal Responsibility	Farebox Recovery Ratio	Output	Treasury
		Cost of service outages	Output	All
		Value of SGR Backlog	Output	All
Reliability	Operational Performance	Mean Time b/t Failure (MTBF)	Output	Vehicles
		% of assets (by value) at or above a 2.5 FTA Condition Rating	Output	All
Customer Service	Customer Service	Count of asset related customer complaints	Output	All
		Count of asset related customer satisfaction results	Output	All

As business processes evolve, MTA and MARC should evaluate and leverage the best possible data sources. For example, MTBF can be reported entirely out of Maximo if business processes change to enter data and run reports out of that system. MARC will also need to modify some of its daily activities to support the calculation of these recommended KPIs.

While previous chapters discuss MARC responsibilities and asset inventory management, the next four chapters describe each phase of an asset's lifecycle, organized by asset category.

8 Lifecycle Phase 1 – Acquisition

While core MTA modes mostly acquire their Transit Assets directly, MARC also relies upon third party organizations to supply Transit Assets. Depending on the asset type and location, MARC will use one of three mechanisms may handle asset acquisition:

- Access and lease agreements;
- Procurement of third-party O&M services; or
- Direct MTA acquisition process

In the first two cases, third-party contractors determine the degree to which traditional planning, design and construction processes apply to their asset acquisitions. Note that while these third-party contractors have discretion over their procurement process, they are still required to be consistent with FRA and FTA procurement regulations.

Since many of MARC's assets are procured, operated, and maintained by third-party contractors, corresponding access, lease, and O&M contracts must be carefully structured to ensure that the contractors employ effective asset management practices. While these third-party services are themselves not considered "assets", they are discussed in this section because the establishment of these services is a prerequisite to many of the TAM activities that follow.

Contract documentation shapes the management processes discussed within this chapter. Additionally, these processes also influence procedures within the other lifecycle phases. Appendix A depicts the nature of these relationships between contract documentation, acquisition processes, and other lifecycle phases.

8.1 Access/Licensing Agreements

In order to provide passenger service, MARC must obtain permission to utilize certain non-MTA owned assets. MTA obtains this permission by entering into negotiations with Amtrak and CSX to develop access and/or license agreements between MTA and the Asset Owner. In general, these access/licensing agreements grant MARC the permission to:

- Serve customers at Penn and Union stations;
- Operate, maintain, and improve other stations or station components;
- Operate, maintain, and improve certain maintenance/layover facilities;
- Operate on host railroad trackwork assets (excluding the MTA-owned Frederick spur); and
- Operate using host railroad systems assets (excluding the MTA-owned Frederick spur).

While MARC may only have permission to utilize certain assets (Penn and Union station, trackwork, and systems assets), both CSX and Amtrak may request the MTA to fund improvements to those same assets. Current access/license agreements require MTA to set-aside a dedicated funding source, to jointly fund these capital projects that benefit both the third-party and MTA (also known as a **Joint Benefit Project**). This funding can be accessed through a negotiated process as described in Section 12.1.2 and Figure 12.4.

Note, these agreements may also allow MTA temporary permission to use an undeveloped land tract along non-MTA owned ROW. MTA would employ this strategy in order to directly acquire a Transit Asset, such as an entire station or parking lot.

A comparison of MARC's three access and license agreements can be found in Table 8.1 below.

Table 8.1 – Comparison of MARC access and license agreements.

Contract Number	MTA-1395	MTA-1331	MTA-1329
ROW Owner	Amtrak	CSX	CSX
Document Name	Access Agreement	License Agreement	Access Agreement
Contract Duration (Years)	5	2	10
Contract Option Year(s)	5	5	5
Contract Mobilization *(Specific requirements that a contractor must meet when initiating a new contract)*	✗	✗	✗
Asset Specifications *(General asset design, procurement, and/or maintenance requirements)*	Descriptions for electrified territory & rental equipment	✗	Identifies track permitted for MARC use
Activity Schedules *(Asset maintenance interval requirements)*	✗	✗	✗
Condition Ratings *(Asset condition assessment or condition rating requirements)*	✗	✗	✗
System Requirements *(Hardware and software requirements)*	✗	✗	✗
Performance Measures *(Any type of required measure, whether related to TAM or not)*	On Time Performance (OTP), arrival within 5' 59" of posted timetable	✗	✗
Performance Incentives *(Financial rewards for meeting performance targets)*	Monthly prorated incentive based upon OTP average	✗	✗
Performance Penalties *(Financial penalties for failing to meet contract requirements)*	Reduction of joint benefit budget if spending targets are missed	✗	✗
Joint Benefit Projects *(Requirements for MTA to set-aside funds for Joint Benefit projects)*	Outlines process and reimbursement	✗	Outlines process and reimbursement
Other Financial Charges & Fees	Dispatching, overhead, NEC access, & terminal access fees	License fees	Access, supervision, special train, and equipment rental fees
Contract Number	**MTA-1395**	**MTA-1331**	**MTA-1329**
Reporting Requirements	11 required reports, unknown frequency. Same as MTA-1394.	✗	✗

(Operations, maintenance, and/or financial reporting requirements)			
Reporting Templates *(Required or optional reporting templates)*	✗	✗	✗
Contract Close Out *(Transition requirements upon expiration of contract)*	✗	✗	✗

8.2 Procurement of Third-Party Operations and Maintenance Services

MARC's two (2) third-party O&M contracts with Amtrak and BTS are a base five year duration with a single five year extension option. These contracts specify vehicle maintenance parameters, activity schedules, performance measures/incentives, and reporting requirements/templates, but are very different in their level of detail.

Table 8.2 – Comparison of MARC O&M contracts. CDRL: Control Document Requirement List (technical contract addendum)

Contract Number	MTA-1360	MTA-1394
Service Provider	Bombardier (BTS)	Amtrak
Document Name	Third-party O&M Contract	Third-party O&M Agreement
Service Lines	Brunswick, Camden	Penn
Contract Duration (Years)	5.8	5
Contract Option Year(s)	5	5
Contract Mobilization *(Specific requirements that a contractor must meet when initiating a new contract)*	0.8 year mobilization, to conduct asset condition audits, and develop procedures and policies (i.e. CDRLs). CDRLs approved by MTA.	✗
Asset Specifications *(General asset design, procurement, and/or maintenance requirements)*	Descriptions of operating procedures, station maintenance procedures, existing rolling stock and maintenance facility characteristics.	Describes revenue vehicles.
Activity Schedules *(Asset maintenance interval requirements)*	References CDRLs for maintenance and inspection activity schedules for all Transit Assets allocated to the Brunswick and Camden lines.	Turnaround and DC terminal departure services, public timetables, and heavy maintenance checklists.
Condition Ratings *(Asset condition assessment or condition rating requirements)*	✗	✗
System Requirements *(Hardware and software requirements)*	CDRL referenced for Maintenance Information System Utilization Plan	✗
Performance Measures *(Any type of required measure, whether related to TAM or not)*	See Section 7.1 for full list of measures	On Time Performance (OTP)
Contract Number	**MTA-1360**	**MTA-1394**

Performance Incentives *(Financial rewards for meeting performance targets)*	Incentive Plan CDRL referenced, See Section 7.1.	$140 awarded for each instance of OTP arrival.
Performance Penalties *(Financial penalties for failing to meet contract requirements)*	✗	✗
Joint Benefit Project *(Requirements for MTA to set-aside funds for Joint Benefit projects)*	✗	✗
Other Financial Charges & Fees	Cost triggered MTA approval procedures related to maintenance	Maintenance, car washing, materials/fuel, ticket commissions, and other costs.
Reporting Requirements *(Operations, maintenance, and/or financial reporting requirements)*	(8) CDRLs reference reporting requirements. Include maintenance, inspection, disposal, inventory, and incident reports	11 required reports, unknown frequency. Same as MTA-1395.
Reporting Templates *(Required or optional reporting templates)*	✗	✗
Contract Close Out *(Transition requirements upon expiration of contract)*	✗	✗

Including all appendices and CDRLs, the Amtrak and BTS O&M contracts vary drastically in length, 228 pages versus 1625 pages, respectively. Some of this variation in length is due to the number of asset types each third-party must manage, Amtrak only manages revenue vehicles whereas BTS manages every asset class as depicted in the Asset Owner Hierarchies of the Mechanical Officer and Facilities Maintenance Officer. However, 105 pages of Amtrak's contract is dedicated prescriptive maintenance activities (i.e. check-off lists), whereas the BTS contract allocates 1,220 pages to CDRLs that discuss policy, process, and procedures. As such, MTA should investigate the merits of having a longer and more detailed contract versus one that is more concise.

8.2.1. Establishing Contracts for Third-Party Providers

While both of MARC's third-party O&M contracts contain similar types of specifications, these specifications are enforced in very different ways. These differences originate from how each O&M contract was established, either through: a standard request for proposal (RFP) process, or a negotiated agreement process.

As discussed in Section 8.3.6 below, an RFP is a typical, 11-step, competitive process facilitated by the *Office of Procurement.* RFPs enable the MTA to issue specific service requirements, such as mandating a specific process or reporting of performance data. MTA was able to issue a RFP for O&M of the Camden and Brunswick lines and procure BTS' services on terms favorable to MARC.

Negotiated agreements are utilized where MTA does not have the bargaining power to dictate all terms of the agreement to the third-party. This is the type of agreement utilized between MTA and Amtrak.

While MTA would prefer to utilize a RFP for O&M services on the Penn line, their current relationship with Amtrak requires a negotiated process.

8.2.2. Recommended Improvements to Third-Party O&M Contracting

MARC can deliver the strategies and objectives in the TAMP by strengthening its third-party contract agreements and forging greater partnerships with its vendors. Accordingly, it is recommended that MARC incorporate the following requirements in its next service contract solicitations:

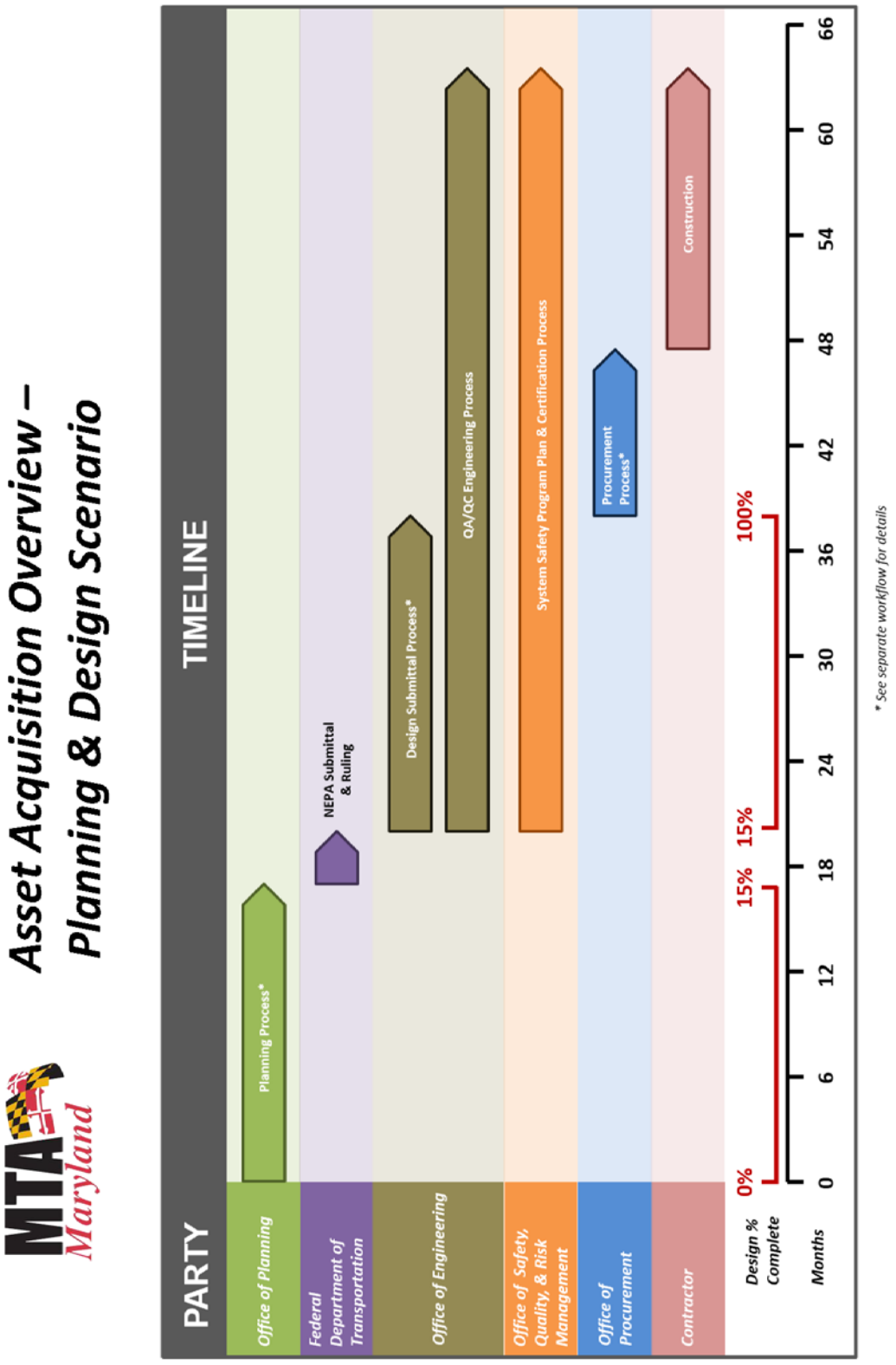
- ✓ Asset specifications for all assets procured by third-party vendors for use in revenue service;
- ✓ Asset inventory requirements aligned with MTA policies and procedures;
- ✓ More robust Reliability, Availability, maintainability, and Safety (RAMS) specifications;
- ✓ A standardized/documented process for monitoring asset condition based on the TERM scale;
- ✓ Performance measures and targets aligned with the TAMP; and
- ✓ Reporting requirements that facilitate the completion of internal performance reports as described in Section 7 above, and TAM reporting through the National Transit Database (NTD).

8.3 Direct MTA Acquisition Process

The MTA uses a traditional procurement process to acquire all assets where MARC will be the Asset Owner. The direct MTA acquisition process requires coordination of numerous MTA offices, and often includes planning, design, and/or construction processes. Smaller procurements may sometimes be accomplished through a purchase order or a credit card. Figure 8.1 illustrates the interrelationship between these asset acquisition processes, durations, and designation of responsibility to associated MTA offices or departments. The following subsections discuss these processes in greater depth.

Note, Figure 8.1 is only applicable to the acquisition of larger assets, such as facilities, signaling systems, revenue vehicles, or guideway. Smaller scale procurements, such as equipment, commodities, small storage facilities, or non-specialty non-revenue vehicles, will *not* undergo planning or National Environmental Protection Act (NEPA) documentation submittal.

Figure 8.1 – Overview of an asset's acquisition. Only applies to larger assets, such as facilities, signaling systems, revenue vehicles, or guideway. Demonstrates key player for each major process and related duration.



In addition, Figure 8.1 also assumes ideal conditions when correlating timeframes to each asset acquisition process. In other words, this timeline represents the best case scenario for all stakeholder involvement and capital funding availability to ensure an acquisition process without interruption. However, circumstances often arise that would increase the amount of time required to complete an acquisition (Table 8.3). Examples of these circumstances may include:

Table 8.3 – Possible delays in the asset acquisition process. The concepts and vocabulary contained in this table are discussed in greater detail throughout the remainder of this document. Please refer to the corresponding Section for each acquisition process.

ACQUISITION PROCESS	PROCESS TOPIC	CIRCUMSTANCE
PLANNING	NEPA documentation	When projects receive federal funding and require level of environmental documentation beyond a Categorical Exclusion.
	Site alternative analysis	Late stage discovery of a fatal flaw at the preferred site.
	Leadership priority	Executive or Legislative leaders change the priority of the organization.
	Hazardous Materials (HazMat) discovery	Discovery of HazMat at project site prompts participation into MDE's Voluntary Clean Up program.
	Negative public perception	Community stakeholders strongly oppose the project.
DESIGN SUBMITTAL	Right of Way (ROW) acquisition	Property seller does not agree with terms and legal action is required.
	Re-design	High bid projects must undergo value engineering to arrive at expected cost.
PROCUREMENT	Delegated authority surpassed	The value of the procurement surpasses agency's delegated authority. Would require control agency or Board of Public Works approval.
	Unexpectedly high bid	Bids come in higher than the Engineer's Estimate.
	Dispute, protest, & other conflict resolution	Bidders disagree with procurement process, either pre or post award.
CONSTRUCTION	Underperforming contractor	Contractor does not adhere to project schedule.
	Change order request	Construction findings requires modification to design.

The following subsections describe the interrelated acquisition processes in further detail, except for four because they are outside the scope of this LMP:

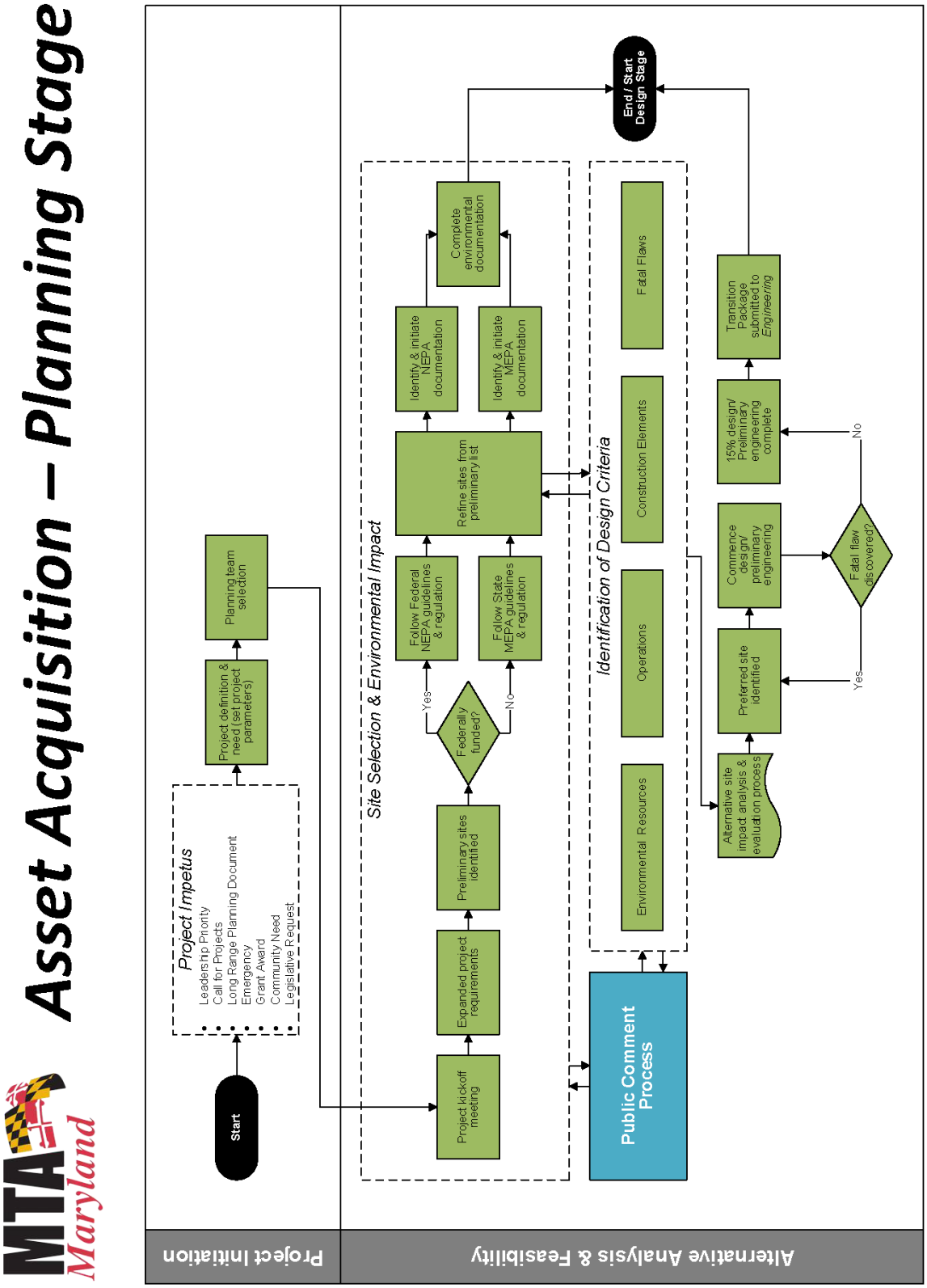
- NEPA Submittal & Ruling
- QA/QC Engineering Process
- System Safety Program Plan & Certification
- Construction

A detailed explanation of these four other processes can be found in other existing MTA documents; these have been hyperlinked above to the extent they have been available at the time of publishing.

8.3.1. Planning Process

Planning is not always part of the asset acquisition phase. System expansion activities, including the construction of new fixed guideway/systems, facilities, stations, and other infrastructure, all undergo an intensive planning process at the outset of the asset acquisition phase. Acquisition of new vehicles, and replacement of existing assets typically do *not* involve planning activities. The MTA *Office of Planning* coordinates and conducts the Planning stage of an asset's acquisition, based upon the process below (Figure 8.2).

Figure 8.2 - Overview of the Planning Process. NEPA: National Environmental Protection Act; MEPA: Maryland Environmental Protection Act.



The *Planning Process* includes the development of NEPA/MEPA documentation and are only portrayed as one step in the diagram above for simplicity purposes. NEPA is required when a project utilizes Federal funding, whereas MEPA documentation occurs when a project receives *only* State funding. According to both NEPA and MEPA regulations, the project size (or impact) triggers more intensive levels of environmental documentation. Examples of this documentation include:

Figure 8.3 - Increasing intensity of NEPA/MEPA documentation.

NEPA	MEPA
Categorical Exclusion	Environmental Assessment Form
Environmental Assessment	Environmental Effects Report
Environmental Impact Statement	

Several other important distinctions are worth mentioning within Figure 8.2:

- This diagram focuses upon process and not assigning a chronological duration to each step.
- Environmental considerations provide a basis for the simultaneous execution of site alternative analysis *and* NEPA/MEPA documentation.
- Each of the four *Design Criteria* become main elements of the alternative site impact analysis.
- The *Public Comment Process* box denotes that public comment is employed throughout the Planning stage at key junctures.

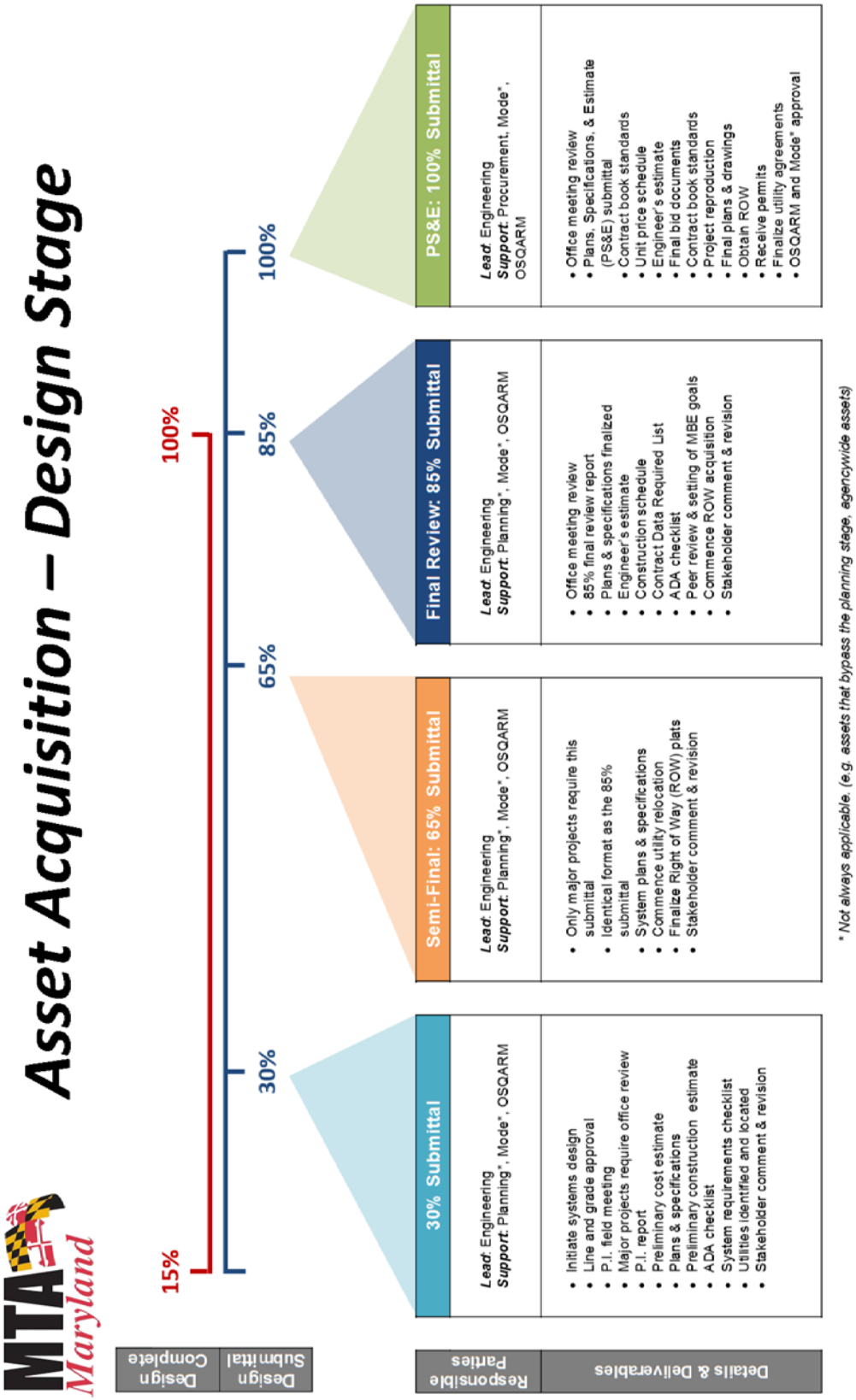
8.3.2. NEPA Submittal & Ruling Process

The *NEPA Submittal & Ruling Process* refers to the submittal of all NEPA documentation, prepared in the *Planning Process* above, to the Federal Department of Transportation (DOT). This three month duration allots time for DOT to obtain, review, and make final judgment on the NEPA package. This process may be fully detailed within a later version of this LMP.

8.3.3. Design Stage Process

MTA Office of Engineering coordinates the design stage of asset acquisition. Two diagrams are associated with this section, one embedded within this subsection describing the Design process (Figure 8.4) and another within the appendix describing applicable drawings and plans, categorized by engineering discipline (**Appendix C**).

Figure 8.4 - Overview of the Design Process.



The Design Stage process above identifies which deliverables are required from each major submittal step of a project's design. Additionally, each submittal step maps to the total completion of the project design, as well as corresponding responsible parties. In the scenario where a project requires planning, the *Office of Planning* will carry project design through up to 15 percent design. Upon reaching 15 percent design completion, *Planning* prepares a transition package to transfer project design leadership to the *Office of Engineering*. If a project does not require planning, then the *Office of Engineering* assumes responsibility for the entirety of a project's design.

Furthermore, Figure 8.4 denotes that all right of way (ROW), or Land Assets, are procured within this stage *not* the procurement stage. While *Office of Procurement* purchases the service or Transit Asset (Section 8.3.6), the *Office of Engineering, Real Estate Division* manages all ROW acquisition. The details of the ROW acquisition process will be captured within a future version of the LMP.

8.3.4. QA/QC Engineering Process

Once a project enters the *Office of Engineering* for design, the *Office* employs a self-audit procedure via a formal QA/QC process. While QA/QC is documented within this LMP as part of the design process, it also provides *Engineering* oversight once the project enters the procurement and construction stages, as well. This process may be fully detailed within a later version of this LMP.

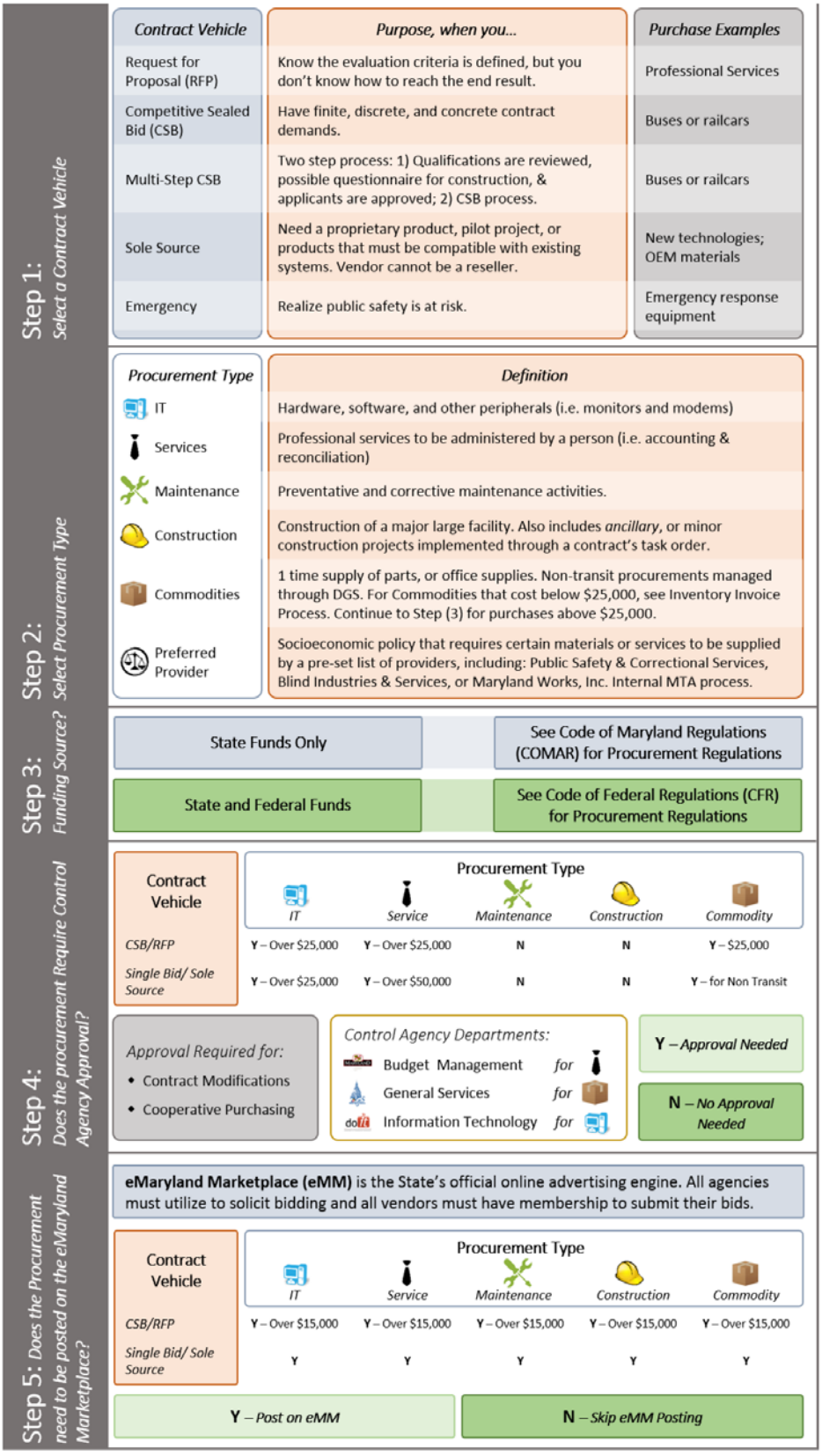
8.3.5. System Safety Program Plan (SSPP) and Certification Process

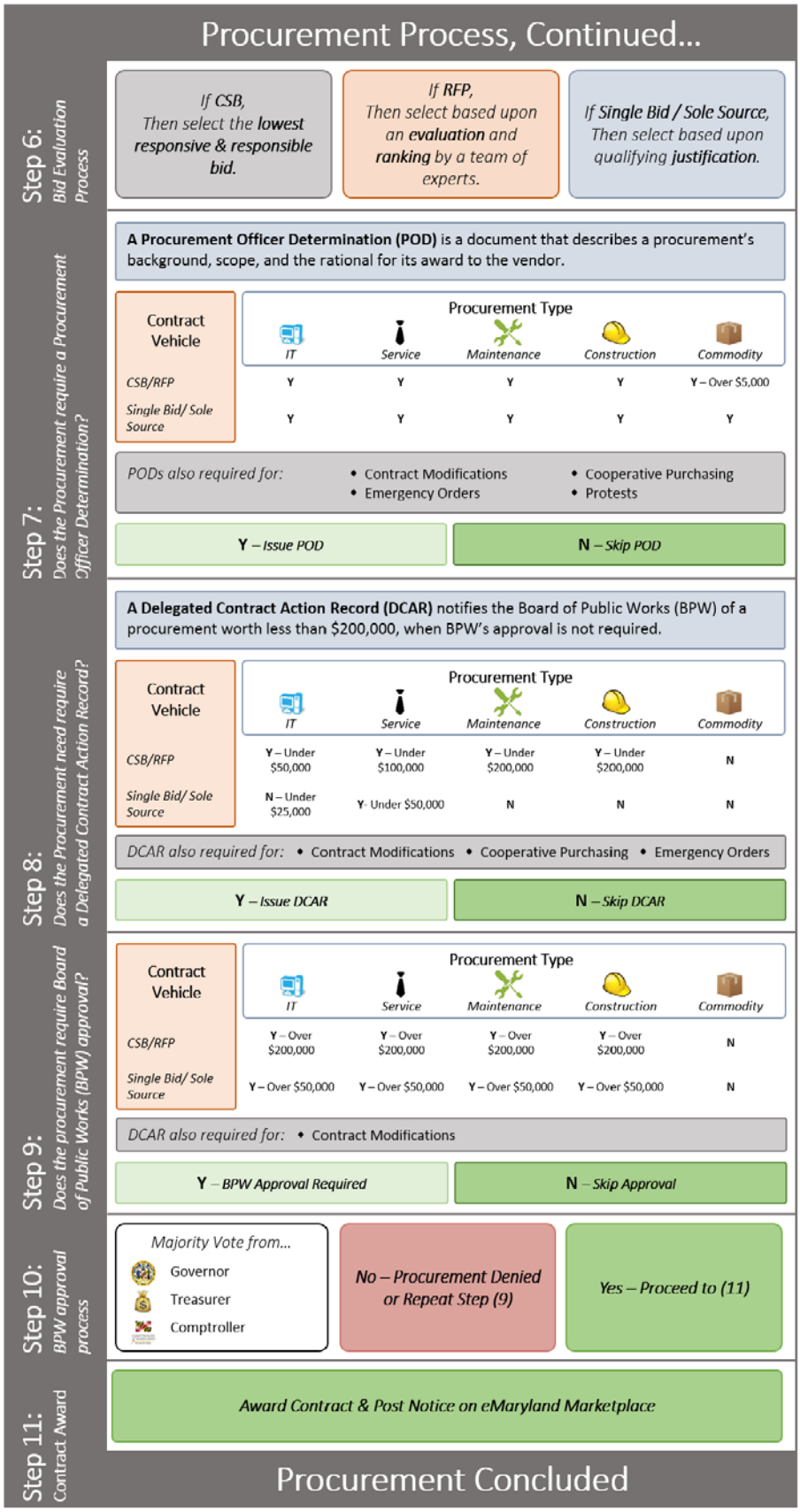
The MTA System Safety Program Plan (SSPP) requires that all major procurements undergo a regimented "certification process" to ensure the safety/security of MTA employees, customers, and the surrounding community throughout the lifecycle of the Transit Asset. The *Office of Safety, Quality, and Risk Management* (OSQARM) coordinates system safety/security certification parallel to Engineering's QA/QC. The SSPP and the safety/security certification process also ensure compliance with all federal and state regulation. For further details, a copy of the SSPP can be found on ProjectWise (Signed MTA 2016 SSPP.pdf).

8.3.6. Procurement Stage

After the completion of the Design stage, *Office of Procurement* coordinates the procurement of the Transit Asset (Figure 8.5). Figure 8.5 indicates the procurement process will generally require nine months for completion.

Figure 8.5 - Overview of MTA's 11 step procurement process.




Procurement Process, Continued...
Step 6: Bid Evaluation Process
If CSB, Then select the lowest responsive & responsible bid.
If RFP, Then select based upon an evaluation and ranking by a team of experts.
If Single Bid / Sole Source, Then select based upon qualifying justification.
Step 7: Does the Procurement require a Procurement Officer Determination?
A Procurement Officer Determination (POD) is a document that describes a procurement's background, scope, and the rational for its award to the vendor.
Contract Vehicle
Procurement Type
IT
Service
Maintenance
Construction
Commodity
CSB/RFP
Y
Y
Y
Y
Y – Over $5,000
Single Bid/ Sole Source
Y
Y
Y
Y
Y
PODs also required for:
• Contract Modifications
• Cooperative Purchasing
• Emergency Orders
• Protests
Y – Issue POD
N – Skip POD
Step 8: Does the Procurement need require a Delegated Contract Action Record?
A Delegated Contract Action Record (DCAR) notifies the Board of Public Works (BPW) of a procurement worth less than $200,000, when BPW's approval is not required.
Contract Vehicle
Procurement Type
IT
Service
Maintenance
Construction
Commodity
CSB/RFP
Y – Under $50,000
Y – Under $100,000
Y – Under $200,000
Y – Under $200,000
N
Single Bid/ Sole Source
N – Under $25,000
Y- Under $50,000
N
N
N
DCAR also required for:
• Contract Modifications
• Cooperative Purchasing
• Emergency Orders
Y – Issue DCAR
N – Skip DCAR
Step 9: Does the procurement require Board of Public Works (BPW) approval?
Contract Vehicle
Procurement Type
IT
Service
Maintenance
Construction
Commodity
CSB/RFP
Y – Over $200,000
Y – Over $200,000
Y – Over $200,000
Y – Over $200,000
N
Single Bid/ Sole Source
Y – Over $50,000
Y – Over $50,000
Y – Over $50,000
Y – Over $50,000
N
DCAR also required for:
• Contract Modifications
Y – BPW Approval Required
N – Skip Approval
Step 10: BPW approval process
Majority Vote from...
Governor
Treasurer
Comptroller
No – Procurement Denied or Repeat Step (9)
Yes – Proceed to (11)
Step 11: Contract Award
Award Contract & Post Notice on eMaryland Marketplace
Procurement Concluded

Depending upon the type of contract vehicle used, and special circumstances that may exist, procurement durations may vary. Some examples of ideal procurement durations include:

Table 8.4- Duration of specific contract vehicles and applicable special circumstances.

CONTRACT VEHICLE	STANDARD DURATION (MONTHS)	SPECIAL CIRCUMSTANCE	SPECIAL DURATION (MONTHS)
COMPETITIVE SEALED BID (CSB)	7	IT procurement	9
REQUEST FOR PROPOSAL (RFP)	7	Best and Final Offer (BAFO)	9
		IT procurement	9
PURCHASE ORDER (PO)	1.5	IT procurement	9
ANCILLARY TASK	1.5	IT procurement	9

8.3.7. Construction Phase

For asset acquisitions that involve a discrete design phase, construction represents the final step in acquisition. For all major procurements, construction is generally performed by vendors/contractors on MTA property, and is coordinated by the *Office of Engineering, Construction Division.* However, offsite construction (e.g. revenue vehicles) and installation of on-vehicle systems is coordinated by the *Office of Engineering, Systems Division.* The main sequence of construction projects include:

1. **Notice to Proceed (NTP)** – Written authorization to initiate work, sent from the MTA to the vendor/contractor. A base contract NTP is authored by the *Office of Procurement*, whereas an ancillary task order NTP is authored by the appropriate division within the *Office of Engineering.*
2. **Mobilization** – A period in which the vendor/contractor coordinates construction materials, equipment, labor, site logistics, and any other permits not already obtained within the Design Phase.
3. **Work** – Physical construction activity.
4. **Substantial completion** – A period where the majority of physical construction activity is complete, and only punch-out items remain.
5. **Closeout** – Submittal and payout of final vendor/contractor invoice.

This process may be fully detailed within a later version of this LMP.

8.4 Typical Asset Procurement Scenarios

While Sections 8.1 through 8.3 detail asset acquisition mechanisms and process, the subsections below describe typical procurement scenarios by asset category.

8.4.1. Vehicles

The MARC mode acquires all revenue vehicles with the direct MTA acquisition process. Once acquired, the mode utilizes third-party O&M agreements to operate and maintain these vehicles. Non-revenue vehicles can either be directly acquired by the MTA or through the third-party contractor to meet the terms of their respective O&M contract.

8.4.2. Stations

Stations assets are acquired in two different ways:

- ***Access/Lease a pre-existing station*** – Agreements vary depending upon location, but usually include a platform at minimum. Lease agreements usually allow the MTA to make improvements to the station, including the addition or expansion of shelters, signage, buildings, parking lots/garages, or the platform itself. Such **site improvements** are conducted through a Joint Benefit process (Penn and Union stations) or direct MTA acquisition process (all other stations).
- ***Direct MTA acquisition of a new station –*** This may occur on non-MTA owned ROW or MTA owned ROW. In both cases MTA office of Real Estate obtains an access/lease or deed of the required land before the MTA could initiate its acquisition process. An example of an MTA-owned station on non-MTA owned ROW is Halethorpe; examples of an MTA-owned station on MTA owned ROW are Monocacy and Frederick.

8.4.3. Facilities

Maintenance/layover facility assets are acquired in three different ways:

- ***Lease a pre-existing facility*** – MTA leases pre-existing maintenance facilities from CSX, with the ability to directly acquire the facility in the future (e.g. Riverside). MTA may choose to expand or upgrade the facility through a direct MTA acquisition process.
- ***Third-Party O&M supplied facility*** – In order for Amtrak to satisfy the terms of its O&M agreements, Amtrak allocates a portion of its Ivy City and Penn Station storage/maintenance capabilities for MARC needs. In these circumstances Amtrak will invoice MARC for the use of these spaces as per their Access Agreement.
- ***Direct MTA acquisition of a new facility*** – MTA may directly acquire a maintenance/layover facility through planning, design, and construction activities (e.g. Wedge Yard).

8.4.4. Guideway and Systems

Guideway and Systems assets are acquired vary in two different ways:

- ***Access agreements, non-MTA owned ROW*** – To provide MARC service, MTA may be granted permission to operate on CSX and Amtrak owned ROW. To acquire/improve trackwork and systems assets, these third-parties may leverage the Joint Benefit process.

- ***Direct acquisition, MTA owned ROW*** – MARC uses traditional planning, design, and construction processes (as applicable) to acquire guideway and systems assets along the Frederick spur.

8.5 Recommended Improvements to Asset Procurement Scenarios

MARC can better deliver the strategies and objectives in the TAMP by enhancing the Transit Asset procurement process. Accordingly, it is recommended that MARC:

- ✓ Collaborate with Office of Engineering and OSQARM to develop/review/ specifications for third-party asset acquisitions; and
- ✓ Consider how to improve the Joint Benefit process, including influencing asset prioritization and obtaining asset management data as a result of the acquisition.

9 Lifecycle Phase 2 – Operations/Maintenance

Maintenance is often the first topic that comes to mind when one considers the broader discipline of asset management. This is because Lifecycle Phase 2 – Operations/Maintenance is the phase with the longest duration, and often reflects the majority of an asset's Total Cost of Ownership (TCO). Generally, MARC employs corrective and/or Scheduled Maintenance regimes for its Transit Assets.

Contract documentation shapes the management processes discussed within this chapter. Additionally, these processes also influence procedures within the other lifecycle phases. Appendix A depicts the nature of these relationships between contract documentation, operations/maintenance processes, and other lifecycle phases.

9.1 Current Maintenance Practices

O&M practices at the MARC mode vary between asset type and ownership. MARC owned revenue vehicles undergo preventive maintenance, whereas other asset types generally undergo corrective maintenance ("find-and-fix" approach) or simply run to failure (Table 9.1). While third-party asset owners must comply FTA and FRA regulations, MTA does not know the extent of their maintenance approaches.

Table 9.1 – Current maintenance practices for MARC assets.

Asset Category	Sub-Category	Owner-ship	Operations Responsibility	Maintenance Responsibility	Maintenance Approach	Location	MARC Oversight	Critical Asset
Vehicles	Revenue	MARC	BTS/Amtrak	BTS/Amtrak	Preventive	N/A	Informal	Yes
Vehicles	Non-Revenue	MARC	BTS	BTS	Corrective	N/A	Informal	No
Vehicles	Non-Revenue	BTS/ Amtrak	BTS/ Amtrak	BTS/ Amtrak	Unknown	N/A	None	No
Stations	All[1]	MARC[1]	BTS	BTS	Corrective	Brunswick, Camden	Informal	No
Stations	All[1]	MARC[1]	Amtrak	MARC	Corrective	Penn line	Informal	No
Stations	All	Amtrak	Amtrak	Amtrak	Unknown	Penn/Union stations	None	No
Facilities	Building	Leased	BTS	BTS	Corrective	Riverside, Martinsburg	Informal	No
Facilities	Building	MARC	BTS	BTS	Corrective	All except Riverside, Martinsburg	Informal	No
Facilities	Building	Amtrak	Amtrak	Amtrak	Unknown	Ivy City, Penn Station	None	No
Facilities	Equipment	MARC	BTS	BTS	Preventive	N/A	Informal	No
Facilities	Equipment	BTS/ Amtrak	BTS/ Amtrak	BTS/ Amtrak	Unknown	N/A	None	No
Guideway	Track	MARC	BTS	BTS	Corrective	Frederick spur	Informal	Yes
Guideway	Track	Amtrak	Amtrak	Amtrak	Unknown	Penn	None	Yes
Guideway	Track	CSX	CSX	CSX	Unknown	Brunswick, Camden	None	Yes

Asset Category	Sub-Category	Owner-ship	Operations Responsibility	Maintenance Responsibility	Maintenance Approach	Location	MARC Oversight	Critical Asset
Systems	All	MARC	BTS	BTS	Corrective	Frederick spur	Informal	Yes
Systems	All	Amtrak	Amtrak	Amtrak	Unknown	Penn	None	Yes
Systems	All	CSX	CSX	CSX	Unknown	Brunswick, Camden	None	Yes

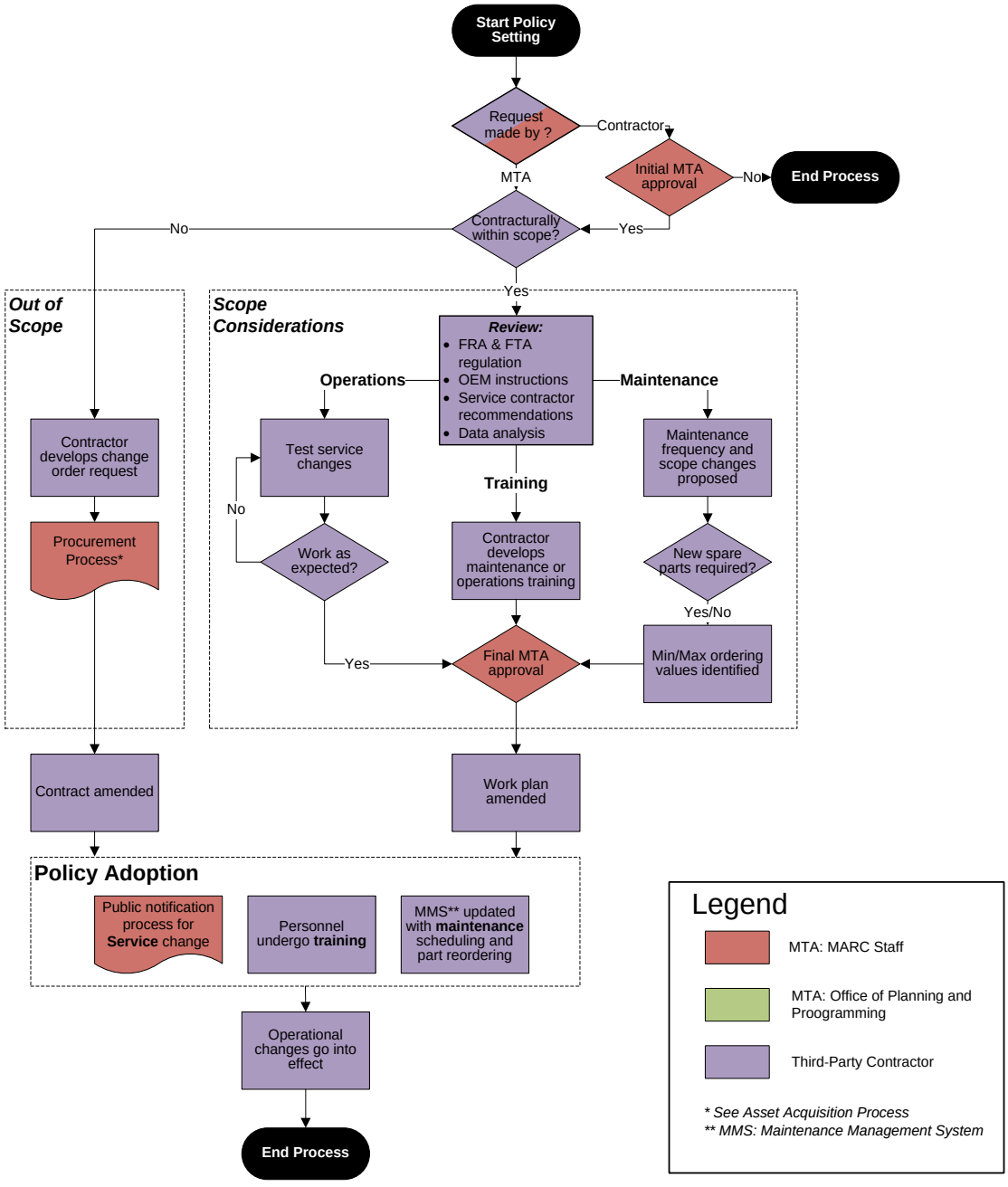
[1] Ownership differs depending upon each station component

While this outsourced approach to O&M significantly reduces the level of MARC's involvement in the day-to-day maintenance activities, its effectiveness is limited by the requirements in the access, license, lease and O&M contract agreements, and the degree to which MARC exercises its oversight function.

9.1.1. Operation and Maintenance Policy-Setting

MARC O&M policies are generally set in third-party agreements to ensure maintenance practices minimally comply with Title 49, Subtitle B, Chapter II of the Code of Federal Regulations (FRA). However, MARC uses the following process to adopt more proactive maintenance policies (Figure 9.1).

Figure 9.1 – MARC maintenance policy process.



PENN LINE

Maintenance policies for revenue vehicle assets, specifically electric locomotives (AEM-7 and HHP-8) and passenger cars (MARC III), are based upon the Amtrak O&M agreement (See Section 8.1). Amtrak's contract contains a prescriptive maintenance policy, consisting of a series of checklists to be completed at the specified maintenance interval (e.g. quarterly, annually).

As identified from the access agreement, Amtrak determines its own maintenance policy for Facilities (Ivy City and Penn Station), Stations (Union Station and Penn Station), Guideway, and Systems assets. Due to

the lack of Amtrak performance data available to MARC, the mode is unable to assess the adequacy of these maintenance practices.

Maintenance policies for Martins Airport maintenance facility are established through the BTS contract and contractually CDRLs (See Camden and Brunswick line section below).

No O&M policies were found for Penn line stations.

CAMDEN AND BRUNSWICK LINES

The BTS contract (Section 8.1) and contractually required CDRLs submitted and approved by MTA from BTS (Table 9.2), contain maintenance policies for the following assets:

- Revenue vehicles[5]
    - Diesel locomotives (GP-39 and MP36PH-3C)
    - Passenger cars (MARC II, IIa, IIb, and IV);
- All Stations;
- Brunswick, Frederick, Martinsburg, Riverside, and Wedge maintenance Facilities; and
- Guideway and systems located on the Frederick spur.

As a part of the 2013 BTS contract, CDRLs were drafted by BTS and submitted to MTA for approval. The contract also requires that these documents be updated and approved by the MTA on an annual basis, however the first significant update to these CDRL documents were not available at the time of publishing. Interviews with both MARC staff and third-party contractors supplement and augment policies outlined within the CDRLs to generate accurate depictions of daily activities.

[5] Electric locomotives are powered through overhead catenary and therefore can only operate on the Penn line. However, diesel locomotives can operate on any line and are also maintained at facilities located on all three lines.

Table 9.2 - Summary of CDRLs that are applicable to Operations/Maintenance of Transit Assets.

ASSET CATEGORY	ASSET CLASS	CDRL NO.	CDRL NAME
All	--	410	Inventory Maintenance Plan
All	--	412	Information Management Systems (IMS) Plan
Vehicles	Revenue	601	Rolling Stock Utilization Plan
Facilities	Buildings		
Vehicles	Revenue	701	Equipment Maintenance and Support Plan
Vehicles	Revenue	702	Maintenance of Equipment Plan
Vehicles	Revenue	703	HVAC Maintenance Plan
Vehicles	Revenue	704	Rolling Stock Cleaning Services Program Plan
Facilities	Maintenance Equipment	706	Support Equipment Maintenance Plan
Facilities	Buildings	801	Facilities Maintenance Management Plan
Stations	All	802	Maintenance of Stations and other Buildings Plan
Guideway	All	901	Maintenance of Way Plan
Systems	All	903	Signals and Communications Equipment and Inspection and Test Manual

As identified from the access and license agreements, CSX determines its own maintenance policy for guideway and systems. Due to the lack of CSX performance data available to MARC, the mode is unable to assess the adequacy of these maintenance practices.

9.1.2. Maintenance Policy Implementation

MARC grants Amtrak, BTS, and CSX the right to enact their own preventive maintenance program as long as it adheres to the policies described above. Table 9.1 identifies the Amtrak and BTS maintenance practices that MARC has the contractual right to monitor on a scheduled and unscheduled basis. A summary of those include:

PENN LINE

- Amtrak maintained revenue vehicles
    - Electric locomotives (AEM-7 and HHP-8) and
    - Passenger cars (MARC III);
- BTS maintained facilities: Martins Airport; and
- Ancillary contractor maintained stations, excluding Penn and Union stations.

CAMDEN AND BRUNSWICK LINES (*BTS maintained*)

- Revenue vehicles
    - Diesel locomotives (GP-39 and MP36PH-3C)
    - Passenger cars (MARC II, IIa, IIb, and IV);
- All stations;

- Brunswick, Frederick, Martinsburg, Riverside, and Wedge maintenance facilities; and
- Guideway and systems located on the Frederick spur.

MARC does not have the contractual right to monitor maintenance practices for the following assets:

PENN LINE (*Amtrak maintained*)

- Facilities: Ivy City and Penn Station
- Stations: Union and Penn Station
- Guideway and systems

CAMDEN AND BRUNSWICK LINES (*CSX maintained*)

- Guideway and systems, excluding the Frederick spur

Since MARC does not require all contractors to utilize Maximo, these parties track and report their maintenance activities using their own preferred method (Table 9.3). While both MARC and BTS utilize Maximo, direct server communication between these systems, such as scheduled data transfer, has not been established.

Table 9.3 – Maintenance databases used by MARC vendors.

Vendor	Maintenance Database
Amtrak	Work Management System
Bombardier Transportation Services	Maximo
CSX Transportation	Unknown

The following subsections describe maintenance implementation for each asset category.

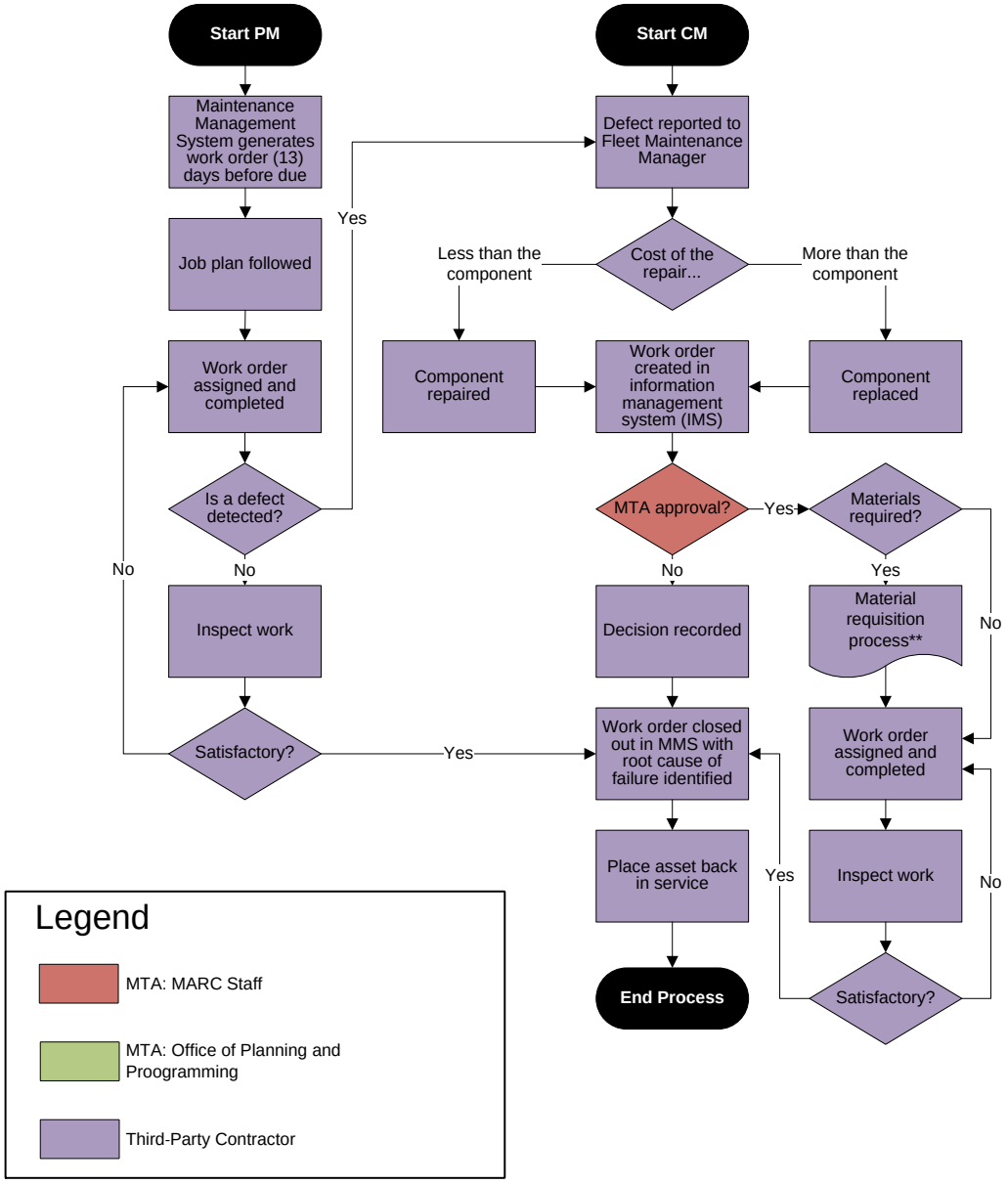
9.1.2.1. Vehicles

MARC Mechanical oversees revenue vehicle maintenance. Revenue maintenance commences with either a Scheduled Maintenance or a Corrective Maintenance approach conducted by either:

- Amtrak: Electric locomotives (AEM-7 and HHP-8) and passenger cars (MARC III)
- BTS: Diesel locomotives (GP-39 and MP36PH-3C) and passenger cars (MARC II, IIa, IIb, and IV)

While MARC owns and third-party operators utilize non-revenue vehicles, no formal process exists to how they are maintained.

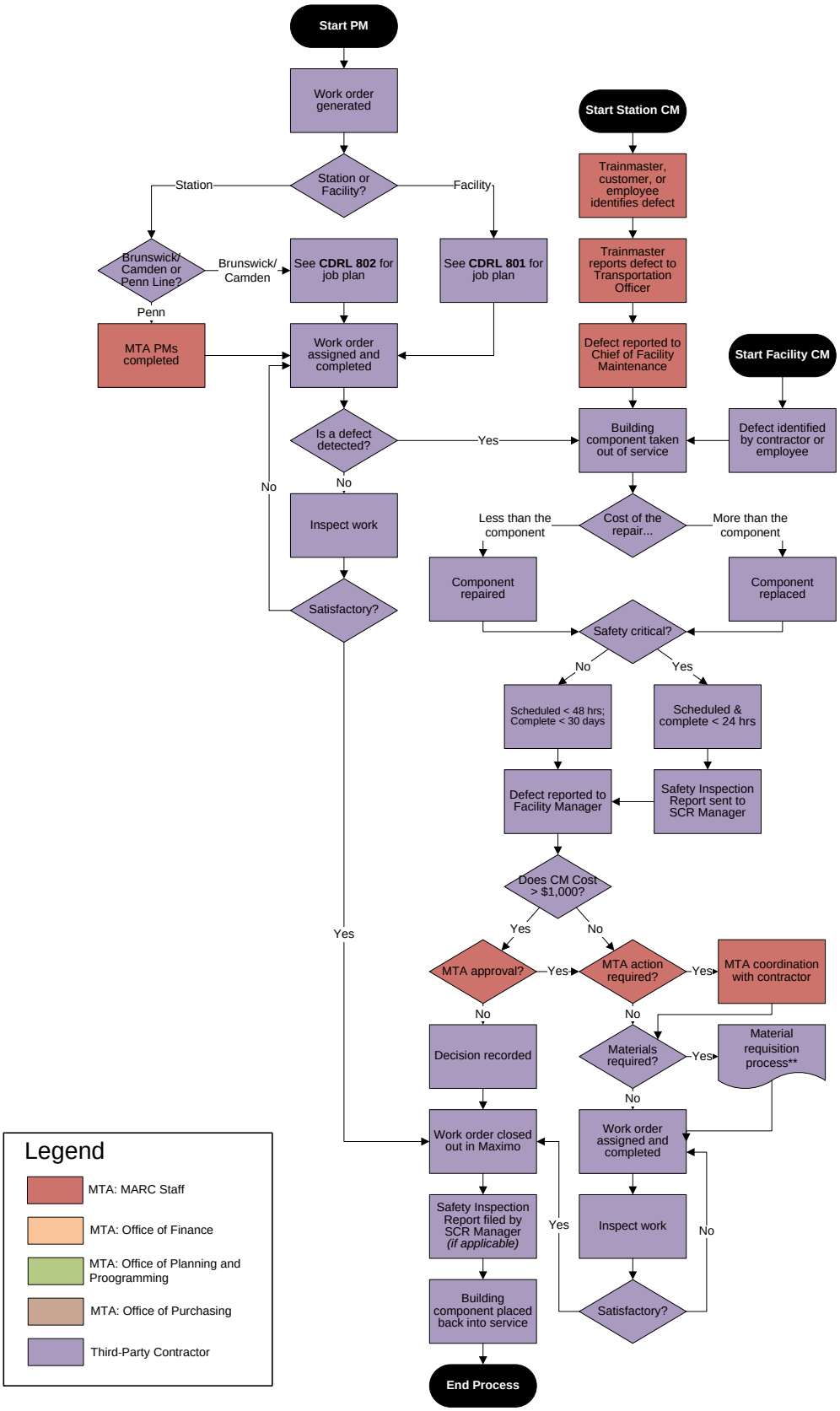
Figure 9.2 – Policy implementation for both Amtrak- and BTS-maintained Revenue Vehicle assets.



9.1.2.2. Facilities and Stations

Brunswick and Camden line Facility and Station assets may undergo either a Scheduled Maintenance or a Corrective Maintenance approach conducted by BTS (Figure 9.3). Penn line stations, except for Penn and Union station, undergo MTA-conducted scheduled inspection and ancillary contractor-conducted corrective maintenance. This workflow process does not apply to Amtrak-owned and operated Facility or Station assets (e.g. Ivy City and Penn Station maintenance/layover facilities, Penn and Union stations).

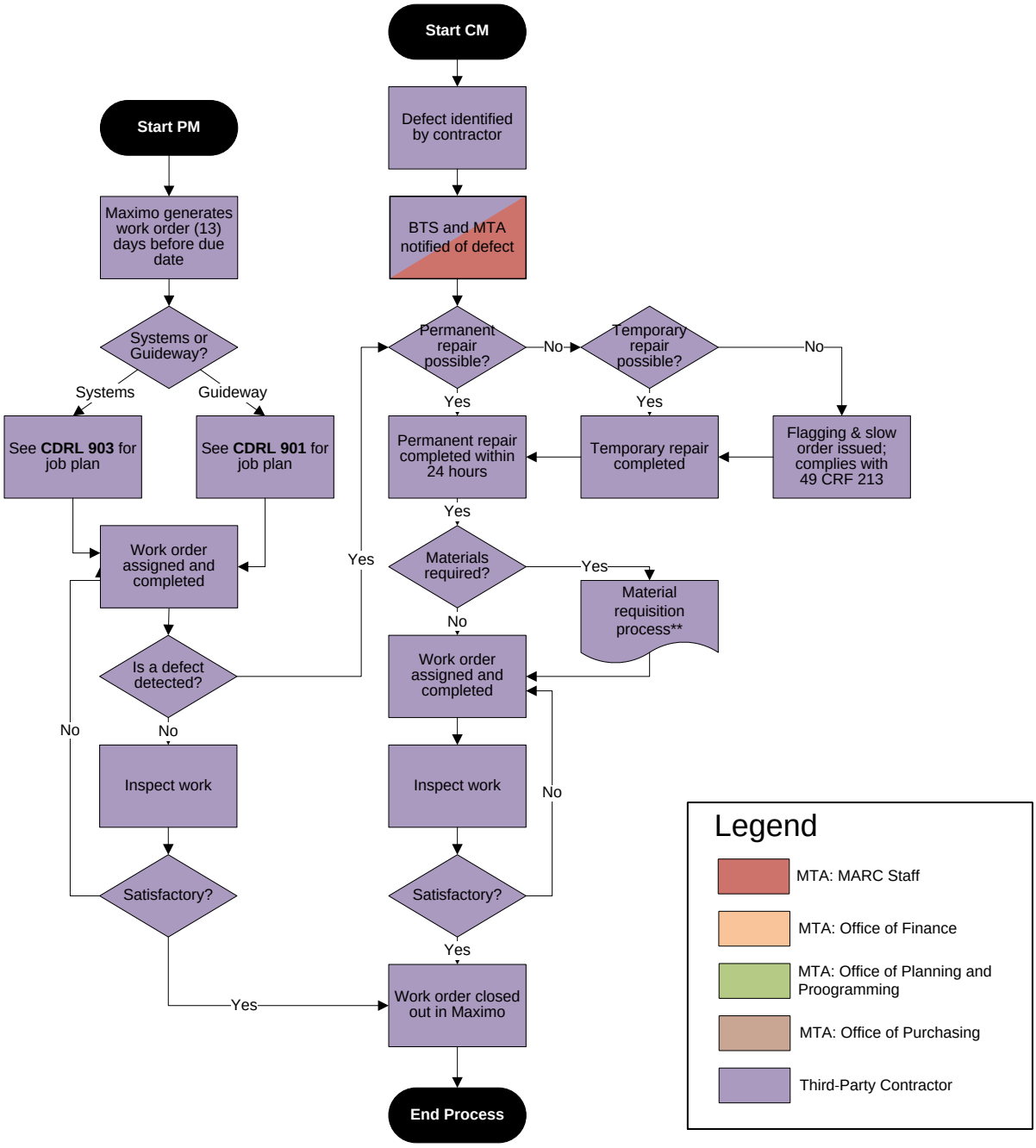
Figure 9.3 - Policy implementation for both Station and Facility assets, service lines are delineated where appropriate.



9.1.2.3. Guideway (Right of Way) and Systems

Guideway and Systems assets may undergo either a Scheduled Maintenance or a Corrective Maintenance approach conducted by BTS (Figure 9.4). This process only applies to assets located on the Frederick spur of the Brunswick line. **Maintenance procedures for Amtrak and CSX owned Guideway and System assets along the Penn, Brunswick, and Camden lines are not available to the MTA.**

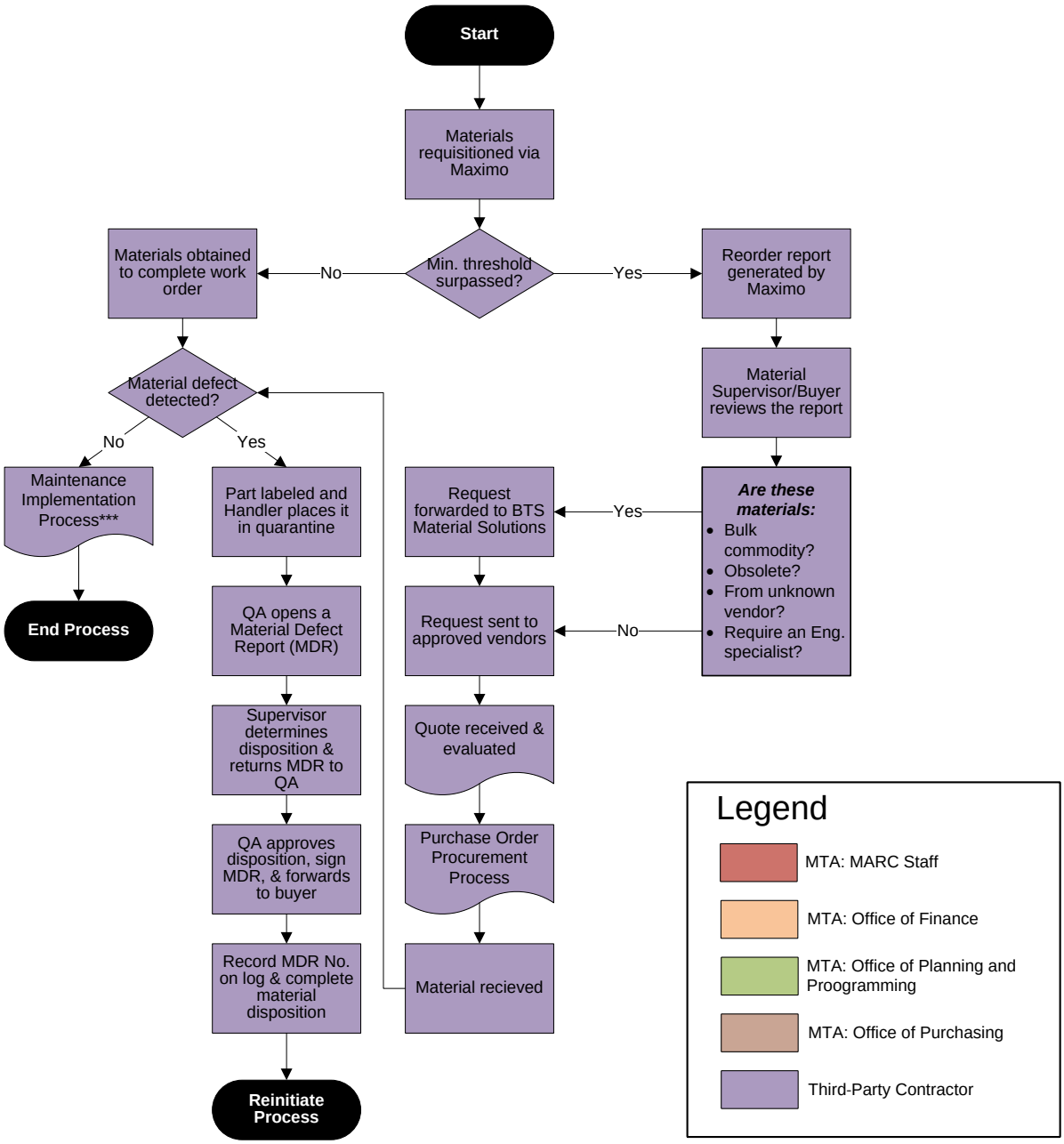
Figure 9.4 - Policy implementation for both Guideway and System assets on the Frederick spur of the Brunswick line.



9.1.2.4. Materials and Spare Parts

Materials maintenance requisitioning is conducted through BTS and supplies spare parts for all assets managed by BTS. This process also applies to Amtrak maintenance of revenue vehicles, since Amtrak now obtains spare parts from BTS. This workflow addresses requisitioning, reordering, quality control, and fulfillment of maintenance needs (Figure 9.5).

Figure 9.5 – Policy implementation for materials and spare parts for all revenue vehicles.



9.2 Current Maintenance Schedules

The following sections summarize *current* inspection and maintenance schedules; they do not match the maintenance schedules in MARC contracts (Section 8.1) and the contractually required CDRLs submitted to MTA by BTS (Table 9.2). Interviews with both MARC staff and third-party contractors were used to develop the schedules detailed in this section to more accurately reflect actual maintenance practices. These inspection and maintenance schedules are summarized by asset category and further detailed by asset class in the subsections below.

9.2.1. Vehicles

The MARC Mechanical Department is oversees the daily operations and maintenance of its **revenue vehicles**, which are considered Critical Assets, and approves all Amtrak and BTS scheduled vehicle inspection and maintenance regimes (Table 9.4). MARC IV passenger vehicles were procured from BTS and are still under warranty, as such BTS is currently developing maintenance procedures for these vehicles.

Maintenance decisions for MTA-owned **non-revenue vehicles** are handled via BTS; the associated maintenance regimes employed by this contractor are not well documented at the MTA.

Table 9.4 - Summary of current inspection and maintenance schedules for Vehicle assets, outlined from MARC BTS and Amtrak contract documents and augmented by MARC and respective contractor staff. The table does not include maintenance regimes for non-revenue vehicles because this documentation was not available at the time of publishing.

Asset Category	Asset Class	Asset Sub-Class	Asset Type	Model	PM Frequency for each System Component (where work plans vary)									
					Air Brake	Air System*	Operating Cab & Signals **	Prime Mover*	HEP / Aux. Power*	Electrical Distribution ***	Propulsion & Electric Braking*	Carbody	Waste/Water Retention ***
Vehicles	Revenue Vehicles	Loco-motive	Diesel	GP-39	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A
Vehicles	Revenue Vehicles	Loco-motive	Diesel	MP36PH-3C	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A
Vehicles	Revenue Vehicles	Car	Trailer/ Cab	MARC II, MARC IIB	Daily, Month, Quarter** Biannual, Annual, 4 year	N/A	Daily, 46 day, Quarter, Biannual, 4 year,	N/A	N/A	Daily, Quarter, Biannual, 4 year	N/A	Daily, Quarter, Biannual, 4 year	Daily, Quarter, Month, Biannual, Annual
Vehicles	Revenue	Car	Trailer/ Cab	MARC IV									
Vehicles	Revenue	Loco-motive	Electric	HHP-8	Daily, Quarter, Biannual, 270 day, Annual, 4 year	Daily, Quarter, Biannual, 270 day, Annual, 4 year	Daily, 45 day Quarter, Biannual, 270 day, Annual	N/A	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual
Vehicles	Revenue	Loco-motive	Electric	AEM-7	Daily, Quarter, Biannual, 270 day, Annual, 4 year	Daily, Quarter, Biannual, 270 day, Annual, 4 year	Daily, 45 day Quarter, Biannual, 270 day, Annual	N/A	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual
Vehicles	Revenue	Car	Trailer/ Cab	MARC III	Daily, Biannual, Annual	Daily, Biannual	Daily, 45 day Biannual	N/A	N/A	Daily, Biannual	N/A	Daily, Biannual	Daily, Biannual

KEY

* System only pertains to locomotives
** System only pertains to locomotives and cab cars
*** System only pertains to cars

Asset Category	Asset Class	Asset Sub-Class	Asset Type	Model	Trucks & Suspension	Coupler / Draft Gear	Lighting & Indicators	Comm.	Safety Appliances	Doors & Traps	HVAC	Interior ***
Vehicles	Revenue Vehicles	Loco-motive	Diesel	GP-39	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A	Daily, 46 day, Quarter, Annual, 4 year	N/A
Vehicles	Revenue Vehicles	Loco-motive	Diesel	MP36PH-3C	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	Daily, 46 day, Quarter, Annual, 4 year	N/A	Daily, 46 day, Quarter, Annual, 4 year	N/A
Vehicles	Revenue Vehicles	Car	Trailer/ Cab	MARC II, MARC IIB	Daily, Biannual, Annual, 4 year	Daily, Quarter, Biannual, 4 year	Daily, Biannual, Annual, 4 year	Daily, 4 year	Daily, Month, Biannual, Annual, 4 year	Daily, Quarter, Biannual, Annual, 4 year	Daily, Month, Quarter, Biannual, Annual, 4 year	Quarter, Biannual, 4 year
Vehicles	Revenue	Car	Trailer/ Cab	MARC IV								
Vehicles	Revenue	Loco-motive	Electric	HHP-8	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	N/A
Vehicles	Revenue	Loco-motive	Electric	AEM-7	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	Daily, Quarter, Biannual, 270 day, Annual	N/A
Vehicles	Revenue	Car	Trailer/ Cab	MARC III	Daily, Biannual, annual	Daily, Biannual	Daily	Daily, Biannual	Daily, 45 day Biannual	Daily, Biannual	Daily, Biannual	Daily, Biannual

9.2.1.1. Revenue Vehicles

Below is a more detailed discussion of the revenue vehicle maintenance schedules found in Table 9.4. The MARC Mechanical department and third-party contractors (Amtrak and BTS) inspect and maintain MARC vehicles at a component level (Table 9.5). While some system components are similar between locomotives and passenger cars, other components are unique to each vehicle type:

Table 9.5 – Description of revenue vehicle major system components for locomotives and passenger cars.

	System Components
All Revenue Vehicles	Air brake, operating cab & signals*, carbody, trucks & suspension, coupler & draft gear, lighting & indicators, communications, safety appliances, doors & traps, and HVAC.
Locomotives Only	Air system, prime mover, Head-End Power (HEP) & auxiliary power, and propulsion & electric breaking.
Passenger Cars Only	Electrical distribution, waste & water retention, and interior.

* Operating cab & signal systems only appear in a portion of passenger cars, these cars are referred to as “cab cars”

While maintenance schedules are outlined in contract documentation, MARC Mechanical staff and third-party contractors adhere to an extensive check-off list specialized for each major maintenance frequency. However, these check-off lists are not easily interpreted to individuals unfamiliar with maintenance practices, nor do they correlate with major system components. Furthermore, both MARC and BTS staff have indicated that schedule and scope between the CDRLs and check-off lists do not completely correlate with one another.

Amtrak check-off lists are attachments within the Amtrak third-party O&M Agreement, which indicate revenue vehicle maintenance frequencies (Table 9.6). BTS check-off lists are not included in their contract documentation and were not made available at the time of publishing this LMP), but CDRLS and staff interviews indicate revenue vehicle maintenance frequencies (Table 9.6).

Table 9.6 – Summary of Amtrak’s revenue vehicle maintenance check-off lists.

Revenue Vehicle Type	Models	Maintenance Frequency
Electric Locomotives	HHP-8 and AEM-7	Daily, Quarter 1, Quarter 2 (biannual), Quarter 3 (270 day), and Quarter 4 (annual)
Passenger Cars	MARC III	Daily, biannual

Table 9.7 – Summary of BTS’ revenue vehicle maintenance as outlined in CDRLs and amended by staff interviews.

Revenue Vehicle Type	Models	Maintenance Frequency
Diesel Locomotives	GP-39 and MP36PH-3C	Daily, 45 day, quarterly, annually, and 4 year
Passenger Cars	MARC (II, IIa, IIb)	Daily, monthly, 45 day, quarterly, biannually, annually, and 4 year
Passenger Cars	MARC IV	Currently under warrantee, BTS is currently developing maintenance documentation for this asset type

9.2.1.2. Non-Revenue Vehicles

MARC owned non-revenue vehicles include light trucks, specialized track maintenance vehicles, and other maintenance vehicles that are able to be driven both on and off the rails. Maintenance schedules for non-revenue vehicles are unknown and not provided through BTS CDRLs. MARC has not documented the maintenance schedules for BTS or Amtrak owned non-revenue vehicles.

9.2.2. Facilities

MARC is responsible for overseeing the daily operations and maintenance of its **Facilities** assets, including buildings and maintenance equipment, and approves all BTS scheduled inspection and maintenance regimes for these assets accordingly. The MARC Facilities Maintenance department and BTS inspect and maintain all MTA-owned and leased Facility assets (Table 9.8).

Facilities assets not included within these inspection and maintenance schedules include Amtrak-owned Ivy City maintenance/layover and Penn Station layover facilities. MARC has not documented the maintenance schedules for these facility assets.

Table 9.8 – Summary of current inspection and maintenance schedules for Facility assets, outlined from MARC contract documents and augmented by MARC and contractor staff interviews.

Asset Class	Asset Type	Department Responsible	Activity Name	Activity Frequency
Building	Building	Facilities Maintenance	Inspection & Cleaning	90 day
Building	Climate Control Systems	Facilities Maintenance	Inspection & Maintenance	30, 90 day, 1 year
Building	Electrical Systems	Facilities Maintenance	Inspection	90 day
Building	Fire Protection System	Facilities Maintenance	Inspection	30 day, 1 year
Building	Grounds	Facilities Maintenance	Landscaping; snow/ice removal	30 day; special
Building	Lighting Systems	Facilities Maintenance	Inspection	90 day
Building	Plumbing System	Facilities Maintenance	Inspection	30 day
Equipment	Air Compressors	Facilities Maintenance	Inspection & Maintenance	7, 30, 90 day, 1 year
Equipment	Drop Tables	Facilities Maintenance	Inspection & Maintenance	7, 30, 180 day
Equipment	Fork Trucks	Facilities Maintenance	Inspection & Maintenance	90 day, 1 year
Equipment	Generator	Facilities Maintenance	Inspection & Maintenance	30 day
Equipment	Hydraulic Jacking Systems	Facilities Maintenance	Inspection & Maintenance	7, 30, 180 day
Equipment	Jib Cranes/Hoists	Facilities Maintenance	Inspection & Maintenance	7, 30 day, 1 year
Equipment	Lube Oil System	Facilities Maintenance	Inspection & Maintenance	30 day
Equipment	Oil Water Separator	Facilities Maintenance	Inspection & Maintenance	7, 90 day, 1 year
Equipment	Overhead Crane	Facilities Maintenance	Inspection & Maintenance	7, 30, 180 day, 1 year
Equipment	Potable Water System	Facilities Maintenance	Inspection & Maintenance	30 day
Equipment	Pressure Washer	Facilities Maintenance	Inspection & Maintenance	30 day
Equipment	Sander Equipment	Facilities Maintenance	Inspection & Maintenance	7, 30, 180 day, 1 year

Equipment	Track Drip Pans	Facilities Maintenance	Inspection & Maintenance	30 day, 1 year
Equipment	Turntables/ Transfer Tables	Facilities Maintenance	Inspection & Maintenance	7, 30, 180 day
Equipment	Wayside Power System	Facilities Maintenance	Inspection & Maintenance	30 day
Equipment	Welding Machines	Facilities Maintenance	Inspection & Maintenance	30, 90 day
Equipment	Yard Mover	Facilities Maintenance	Inspection & Maintenance	30 day; 1 year

9.2.3. Stations

MARC is responsible for overseeing for the daily operations and maintenance of its **Stations** and approves BTS scheduled inspection and maintenance regimes for these assets accordingly. The MARC Facilities Maintenance department and BTS inspect and maintain all MTA-owned Station assets along the Brunswick and Camden lines (Table 9.9). Furthermore, the MARC Facilities Maintenance department also conducts 180 day inspections for Penn line stations (excluding wholly owned Amtrak stations such as Penn and Union stations) with commensurate corrective maintenance completed by their ancillary contractor.

Table 9.9 – Summary of current inspection and maintenance schedules for Station assets located along the Brunswick and Camden lines, outlined from MARC contract documents and augmented by MARC and contractor staff interviews.

Asset Category	Asset Class	Asset Type	Department Responsible	Activity Name	Activity Frequency
Stations	Building	Roof	Facilities Maintenance	Inspection	30 day
Stations	Building	Gutters, drainage	Facilities Maintenance	Inspection	30 day
Stations	Building	Exterior	Facilities Maintenance	Inspection	30 day
Stations	Building	Siding	Facilities Maintenance	Inspection	30 day
Stations	Building	Windows	Facilities Maintenance	Inspection	30 day
Stations	Building	Doors	Facilities Maintenance	Inspection	30 day
Stations	Building	Foundation	Facilities Maintenance	Inspection	30 day
Stations	Building	Steps & Ramps	Facilities Maintenance	Inspection	30 day
Stations	Building	Interior	Facilities Maintenance	Inspection	30 day
Stations	Building	Lighting	Facilities Maintenance	Inspection, testing; Cleaning; Proactive Replacement	30 day; 180 day; 2 years
Stations	Building	Plumbing System	Facilities Maintenance	Inspection	30 day, 1 year
Stations	Building	Climate Control Systems	Facilities Maintenance	Inspection, Maintenance	30 day, 1 year
Stations	Building	Fire Protection System	Facilities Maintenance	Inspection	30 day, 1 year
Stations	Building	Grounds	Facilities Maintenance	Landscaping; snow/ice removal	15, 30 days; as needed
Stations	Building	Shelters & Platforms	Facilities Maintenance	Inspection	30 days

9.2.4. Guideway

MARC is directly responsible for overseeing the daily operations and maintenance of the Guideway assets it owns and approves BTS scheduled inspection and maintenance regimes for these assets accordingly. The MARC Facilities Maintenance department and BTS inspect and maintain all these assets along the Frederick spur (Table 9.10). These maintenance practices are designed to meet FRA Class IV regulations, applicable to each mainline, as well as FRA Class II regulations for track allocated to maintenance/layover facilities.

For the remainder of MARC's permitted guideway, both Amtrak (Penn line) and CSX (Brunswick and Camden lines) are directly responsible for daily operations and maintenance activities. Amtrak and CSX maintenance schedules are not documented by the MTA.

Table 9.10 – Summary of current inspection and maintenance schedules for guideway assets located along the Frederick spur of the Brunswick line outlined from MARC contract documents and augmented by MARC and contractor staff interviews.

Asset Category	Asset Class	Asset Type	Department Responsible	Activity Name	Activity Frequency
Guideway	Trackwork	Derail	Facilities Maintenance	Inspection	14 day
Guideway	Trackwork	Switch	Facilities Maintenance	Inspection	14 day
Guideway	Trackwork	Signal	Facilities Maintenance	Inspection	14 day
Guideway	Trackwork	Crossing	Facilities Maintenance	Inspection	14 day
Guideway	Trackwork	Mainline Track	Facilities Maintenance	Inspection	14 day
Guideway	Trackwork	Yard Track	Facilities Maintenance	Inspection	30 day

9.2.5. Systems

MARC is responsible for provide overseeing for the daily operations and maintenance of the **Systems** assets it owns and approves BTS scheduled inspection and maintenance regimes for these assets accordingly. The MARC Facilities Maintenance department and BTS inspect and maintain all MTA-owned Systems assets, specifically train control/signaling assets, along the Frederick spur (Table 9.11).

BTS also maintains other MTA-owned assets, such as grade crossing signals, CCTV, and intrusion detection systems. However, maintenance procedures for these assets are not described within the most current CDRLs.

For other train control/signaling assets along MARC's permitted ROW, both Amtrak (Penn line) and CSX (Brunswick and Camden lines) are directly responsible for daily operations and maintenance activities, which are not known to MARC. Traction power/electrification assets only exist along the Penn line, and consequently Amtrak has sole responsibility for maintaining those assets.

Table 9.11 – Summary of current inspection and maintenance schedules for Systems assets located along the Frederick spur of the Brunswick line, outlined from MARC contract documents and augmented by MARC and contractor staff interviews.

Asset Category	Asset Class	Asset Type	Department Responsible	Activity Name	Activity Frequency
Systems	Train Control/Signals	Signal	Facilities Maintenance	Signal Mechanism - Inspection and Testing	6 month, 2 year
Systems	Train Control/Signals	Shunt Fouling Circuit	Facilities Maintenance	--	30 day
Systems	Train Control/Signals	Electric Lock	Facilities Maintenance	Test	2 years
Systems	Train Control/Signals	Relays (2)	Facilities Maintenance	--	2, 4 years
Systems	Train Control/Signals	Cabling (2)	Facilities Maintenance	Insulation Resistance Tests	1, 10 years
Systems	Train Control/Signals	Timing Relays (2)	Facilities Maintenance	Time Devices Test	1 year
Systems	Train Control/Signals	Interlocking (5)	Facilities Maintenance	Approach/ Time/ Route/ Indication/ Traffic locking tests	2 years
Systems	Train Control/Signals	Switch Machine	Facilities Maintenance	Switch Obstruction Test	1 month
Systems	Train Control/Signals	Valve locks	Facilities Maintenance	Valve locks of non-cutoff types; Valves & valve magnets	90 days, 1 year
Systems	Train Control/Signals	Grade Crossing	Facilities Maintenance	Inspection (3); Cross protection test	30, 90, 360; 180 days
Systems	Train Control/Signals	Power Switches	Facilities Maintenance	Restoring feature on power switches test	90 days
Systems	Train Control/Signals	UPS Batteries	Facilities Maintenance	Primary and storage	30 days
Systems	Train Control/Signals	--	Facilities Maintenance	Power off test	1 year
Systems	Train Control/Signals	Lighting arrestors	Facilities Maintenance	Lighting arrestors & ground rod connections	30 day
Systems	Train Control/Signals	Hazard detector	Facilities Maintenance	High water, dragging equipment, etc.	90 day
Systems	Train Control/Signals	Shunts	Facilities Maintenance	Shunting sensitivity	1 year
Systems	Train Control/Signals	Insulated joints	Facilities Maintenance	Inspect insulated joints	30 day
Systems	Train Control/Signals	Highway grade crossings	Facilities Maintenance	--	30 day, 1 year
Systems	Train Control/Signals	Signal lenses	Facilities Maintenance	Clean lenses	30, 90 day, 1 year
Systems	Train Control/Signals	Switch machine clutches	Facilities Maintenance	--	1 year
Systems	Train Control/Signals	Energy bus	Facilities Maintenance	Energy bus ground test	1 month

Systems	Train Control/Signals	Standby power	Facilities Maintenance	--	1 month
Systems	Train Control/Signals	Light units and lamps	Facilities Maintenance	Flashing light units and lamp voltage	1 year
Systems	Train Control/Signals	Gate arm / mechanism	Facilities Maintenance	--	30 day
Systems	Train Control/Signals	Warning system (3)	Facilities Maintenance	Warning system operation; ground test; time test	30 day; 30 day; 1 year
Systems	Train Control/Signals	Highway traffic signal	Facilities Maintenance	Highway traffic signal preemption interconnections	30 day
Systems	Train Control/Signals	Cut-out circuits	Facilities Maintenance	--	90 day

9.3 Other Maintenance-Related Activities

MARC relies on BTS to manage material requisition, spare part tracking, and asset warranties for all assets maintained by BTS. Furthermore, Amtrak also utilizes this system to maintain MARC revenue vehicles. However, it is unknown to what capacity that CSX or Amtrak utilizes warrantee program for facilities, stations, guideway, or systems on the MARC system. MARC should consider the merits for adopting a uniform spare part tracking and warranty process for the entire mode.

9.4 Recommended Maintenance Approaches

MARC has many opportunities to improve its asset maintenance regimes and standardize some of the maintenance practices between its vendors, which can improve service performance and oversight efficiency. Logically, improvements to maintenance regimes should focus on Critical Assets as identified in Section 5.2.

Any assessment of maintenance regimes should begin with the selection of a desired maintenance philosophy. MARC can then adopt the maintenance implementation strategies that ultimately incorporate RAMS specifications for inclusion in the next round of service contracts.

9.4.1. Maintenance Philosophies

As MARC seeks to improve their Transit Asset maintenance regimes, it should consider the myriad maintenance philosophies that can be reasonably implemented with available resources. These maintenance philosophies exist along a continuum, running from the lowest intensity strategies (no maintenance, run-to-failure, then replace), and the highest intensity strategies on the other end (focused on predicting and preventing failures before they occur). Table 9.12 lists and describes these maintenance strategies in greater detail.

Table 9.12 - A summary of common maintenance strategies, from the simplest to most complex. MARC's current maintenance interventions are, for the most part, either corrective or scheduled.

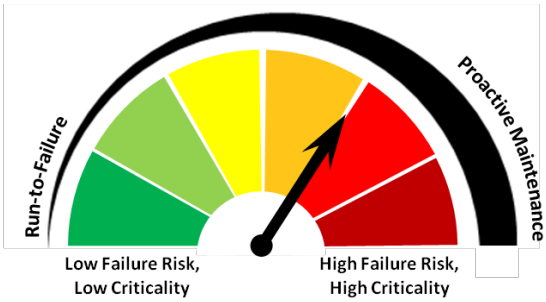
Maintenance Strategy	Description
No Maintenance/ Run-to Failure	No prescribed maintenance for the asset in question. Simply replace it when it fails. This approach should only be used when no cost-effective maintenance treatments exist for the asset, and the risks associated with failure are low compared to the cost of preventive maintenance.
Reactive/Corrective Maintenance	Corrects failures in response to a fault or functional failure, or when an issue has been identified through an inspection. This approach should be used when an asset is relatively reliable or when failures are infrequent and appear to occur randomly; when the time and effort to repair are minimal; or when the asset's failure would not likely impact service delivery. Also known as "Fix it When it Fails."
Scheduled Maintenance	A form of preventive maintenance in which the asset has a prescribed set of activities performed at standard intervals. These intervals can be either mileage or time-based and are usually prescribed by the Original Equipment Manufacturer (OEM) specifications manual(s). This type of approach is usually undertaken in addition to reactive maintenance and may be derived from regulatory requirements.
Predictive Maintenance	A form of preventive maintenance which is prescriptively adjusted based upon an asset's level of use, condition, and/or performance. This approach uses historical condition and performance data for prognostics and better timing of preventive maintenance activity. It tends to be more costly from the standpoint of additional inspection, testing, and ongoing data analysis. Yet these costs may be fully offset by reduction in unnecessary maintenance and in-service failures.
Proactive Maintenance	A form of preventive maintenance that builds on predictive maintenance and emphasizes ongoing improvement with a particular focus on Quality Assurance and Quality Control (QA/QC) measures, as well as on modifications to maintenance procedures to mitigate conditions that lead to wear and tear. This type of approach is usually reserved for the most Critical Assets that consume maintenance resources disproportionately.
Self-Maintenance	Self-maintenance, also known as "e-maintenance", is an engineering approach to give an asset the capability to actively manage its own performance via: monitoring capability (in real-time via electronic sensors); fault judging capability (to assess whether the asset is operating within normal parameters); diagnostic capability (to identify likely causes of abnormal performance); repair planning capability (to identify appropriate repair actions and to schedule them); adaptive control (adjusting operations to avoid failure); and self-learning and improvement (using past data to update control logic). This represents an aspirational, optimized approach to maintenance, where asset reliability is paramount.

9.4.2. Maintenance Implementation

Best practice suggests the most intensive maintenance strategies should be assigned to Critical Assets (Figure 9.6). Therefore, MARC will implement TAMP Strategy #4 (*Optimize the preventive maintenance of Critical Assets*) to prioritize the optimizations of preventative maintenance regimes by asset class.

Additionally, MARC will develop Reliability, Availability, Maintainability, and Safety (RAMS) contract language for third-party maintenance services.

Figure 9.6 - Intensive maintenance philosophies are often attributed to assets with a higher risk.



MARC will consider requiring more intensive maintenance philosophies for those Transit Assets owned by the MTA (per TAMP Strategy #9 – *Consider Total Cost of Ownership in Investment Decisions*). These advanced maintenance regimes can be incorporated into O&M contracts as they are amended or renewed. While recognizing maintenance costs go up as the level of intervention increases, this may not necessarily result in a higher total cost to the third party contractor or agency. Preventive maintenance activity has the ability to offset risks that can be substantially greater, such as those incurred with accidents or system shutdowns.

For those MARC assets *not* owned by the MTA, more intensive maintenance philosophies may still provide mutual benefit for MTA and its O&M contractors. Accordingly, MARC will advocate for its O&M contractors to employ more advanced maintenance regimes. This can be a collaborative process where MTA guides dialogue with its contractors and solicits advice on how to best manage assets, better capture data (especially pertaining to asset inventory, condition, and performance), and advice on new asset procurements.

MARC can better deliver the strategies and objectives in the TAMP by enhancing its approach to O&M. Accordingly, it is recommended that MARC:

- ✓ Extend MARC oversight and audits to include third-party owned/managed Facilities, Stations, Guideway, and Systems assets;
- ✓ Adopt Maximo as MARC's inventory system of record and enforce reporting and analysis of maintenance activities in Maximo by third-party vendors;
- ✓ Develop RAMS specifications to include in contract documents;
- ✓ Collaborate with OSQARM to develop appropriate safety and hazard assessment requirements to include in contract documents; and
- ✓ Collaborate with OSQARM to oversee and audit third-party vendors from a safety perspective.

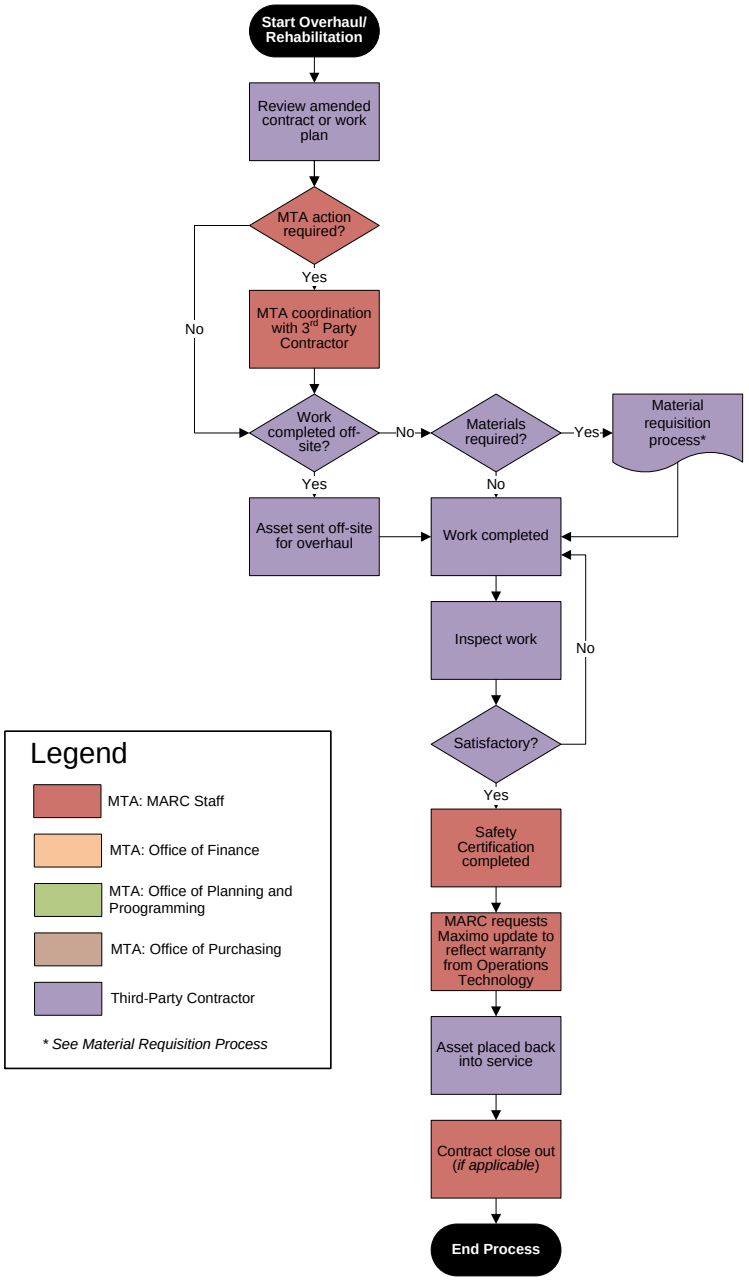
10 Lifecycle Phase 3 – Overhaul/Rehabilitation

10.1 Overhaul/Rehabilitation Policy Setting and Implementation

MARC generally does not schedule overhaul/rehabilitation of entire assets, but will replace an asset's components as needed. However, both the MARC staff and Siemens acknowledge that the new locomotives will require at least one overhaul to perform throughout their expected useful life.

Categorically, Amtrak does not perform scheduled component overhauls/rehabilitations, but the BTS contract identifies some overhaul/rehabilitation policies for revenue vehicles using the following process.

Figure 10.1 – General BTS component overhaul/rehabilitation process for revenue vehicles.



Contract documentation shapes the management processes discussed within this chapter. Additionally, these processes also influence procedures within the other lifecycle phases. Appendix A depicts the nature of these relationships between contract documentation, overhaul/rehabilitation processes, and other lifecycle phases.

10.2 Current Overhaul/Rehabilitation Schedules

MARC **revenue vehicles** operated and maintained by BTS undergo component replacement, rebuild, or overhaul as identified through MTA approved CDRLs (Table 10.1).

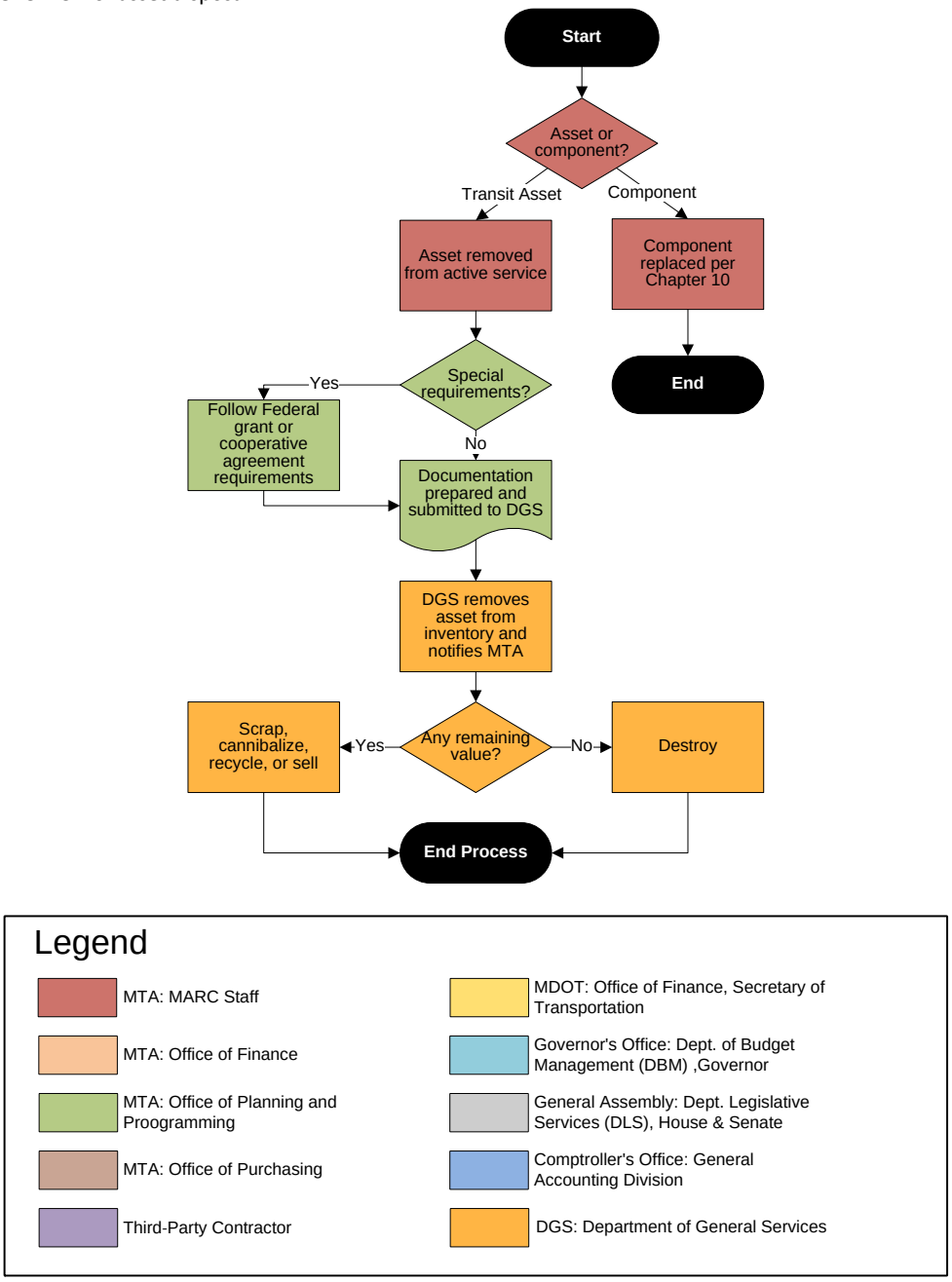
Table 10.1 – Schedule of component replacements for revenue vehicles, as outlined within BTS CDRLs.

Asset Category	Asset Class	Sub-Class	Asset Type	System	Component	Department Responsible	Activity Type	Activity Frequency (years)
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air Brake	Valves	Mechanical	Replace/rebuild	1
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air Brake	Cock & strainer	Mechanical	Replace/rebuild	2
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air Brake	Valves	Mechanical	Replace/rebuild	3
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air System	Twin tower dryer	Mechanical	Replace/rebuild	1
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air System	Trainline hoses	Mechanical	Replace	1
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Engine protector	Mechanical	Replace/rebuild	2
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air System	Ball Cut-out cocks	Mechanical	Replace/rebuild	3
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Seals & bearings	Mechanical	Replace	3
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Trucks & Suspension	Traction motors	Mechanical	Replace	3
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air System	Air Dryer	Mechanical	Overhaul	3
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Carbody	Cooling fans	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Carbody	Blower	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Carbody	Inertial air filter motor	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	HEP & Aux. Power	Aux. generator & drive couplings	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Fuel pump & motor	Mechanical	Rebuild	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Governor	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Turbocharger	Mechanical	Replace	4
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	HEP & Aux. Power	HEP	Mechanical	Replace/overhaul	5
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Air System	Air compressor & drive coupling	Mechanical	Rebuild	6
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Lower liner inserts	Mechanical	Replace	6
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Oil pump	Mechanical	Replace/rebuild	6
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Crankshaft viscous damper	Mechanical	Replace	9
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Coupler	Draft gear	Mechanical	Replace	12
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Prime Mover	Engine	Mechanical	Replace	12
Vehicles	Revenue	Diesel Locomotive	GP-39 & GP-40	Propulsion & Electric Braking	Main generator	Mechanical	Replace	12
Vehicles	Revenue	Diesel Locomotive	MP36PH-3C	HEP & Aux. Power	Jacket water pump	Mechanical	Replace	2
Vehicles	Revenue	Diesel Locomotive	MP36PH-3C	Cooling System	Pressure cap	Mechanical	Replace	2
Vehicles	Revenue	Diesel Locomotive	MP36PH-3C	Cooling System	Coupling	Mechanical	Replace	3
Vehicles	Revenue	Diesel Locomotive	MP36PH-3C	Air System	Valves	Mechanical	Replace	3
Vehicles	Revenue	Diesel Locomotive	MP36PH-3C	Air System	Air Dryer	Mechanical	Replace	4
Vehicles	Revenue	Cars	MARC II, MARC IIB	Air Brake	Valves, tread/disc, slide subsystem	Mechanical	Overhaul	Biannual, 4 year
Vehicles	Revenue	Cars	Gallery Car	Air Brake	Valves, tread/disc, slide subsystem	Mechanical	Overhaul	Biannual, 4 year

11 Lifecycle Phase 4 – Disposal

This section describes the disposal process for assets *owned* by MARC. Assets furnished by third-party contractors are retired/disposed according to the policies set by those contractors. Figure 11.1 provides a summary overview of MARC practices around asset retirement and disposal. Note that asset disposal is heavily dependent on people and policies outside of these modes, namely the Maryland Department of General Services (DGS). DGS has an Inventory Standards and Support Services Division responsible for the creation of its **Inventory Control Manual**, which governs this process and is available here: http://www.dgs.maryland.gov/ISSSD/InventoryControlManual.pdf

Figure 11.1 – Overview of asset disposal.



Contract documentation shapes the management processes discussed within this chapter. Additionally, these processes also influence procedures within the other lifecycle phases. Appendix A depicts the nature of these relationships between contract documentation, disposal process, and other lifecycle phases.

As a basic premise of system preservation, MARC replaces Transit Assets that are past their useful life. Meaning, these modes often initiate the acquisition of a new Transit Asset concurrent with the retirement/disposition of an in-kind Transit Asset. Rarely does MARC retire/dispose of a Transit Asset causing the inventory to shrink on a net basis.

Figure 11.2 - An asset's lifecycle, or the four phases over an asset's life. Return arrow between Phase 4 and Phase 1 indicates asset replacement.

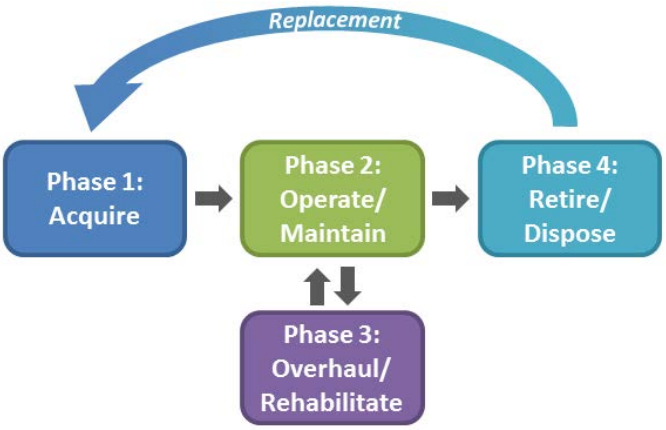


Figure 11.2 illustrates the cyclical nature of lifecycle management. Given MARC's current approach, many opportunities exist to increase the performance of the MARC system, decrease safety risks and risks of Transit Asset failure, and gain capture time/cost savings. These opportunities are discussed in further detail within the Chapter 14, *Continuous Improvement*.

Funding will be required to capitalize on many of these opportunities to improve lifecycle management of the MARC systems. The following chapter details the process of capital and operations budgeting. By making this process more transparent, MARC management can begin to contemplate how it may take a modified approach to prioritizing its budget requests, and strengthen its business justifications for those requests.

12 Financial Management

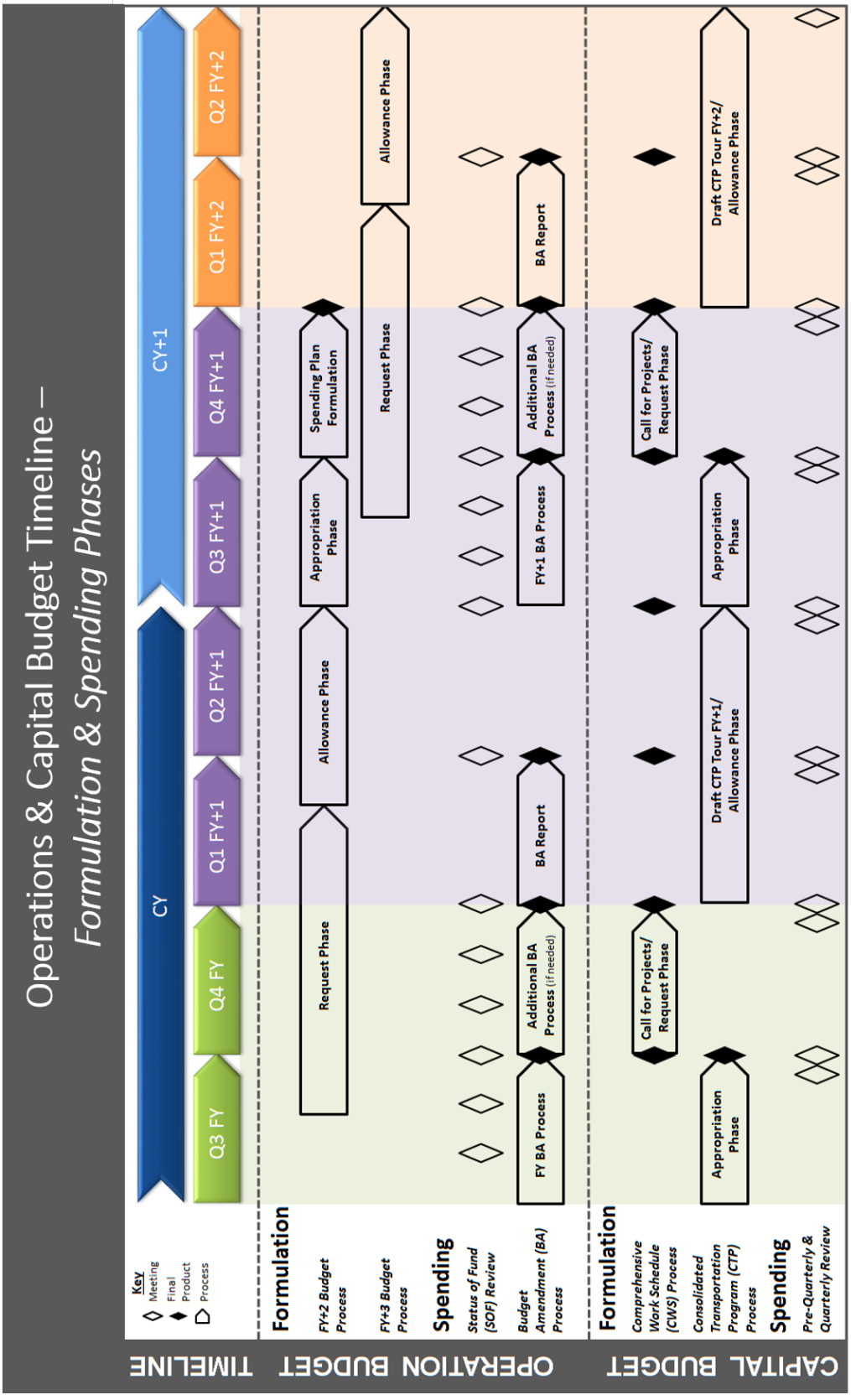
The MTA maintains separate Operating and Capital budgets, coordinated by the *Office of Finance* and the *Office of Planning and Programming*, respectively. Each of these budgets are maintained on an accrual basis, and have their own formulation and spending processes based upon the Maryland Fiscal Year (FY), which runs from July of a given calendar through June of the following calendar year. For the purposes of this LMP, **budget formulation** refers to the overarching process by which a budget is approved. Once a budget has been approved, all activities surrounding the ongoing management of that budget are collectively referred to the **spending process**.

Figure 12.1 below provides a high level, chronological overview of MTA's budget formulation and spending processes. Budget formulation is the same for both Operations and Capital, and includes three discrete phases: Request, Allowance, and Appropriation. The Operating and Capital budgets are each subject to their own unique spending process. The Operating spending process is managed via "Status of Fund" (SOF) meetings. The Capital spending process is managed via a series of meetings known as "Pre-Quarterlies" and "Quarterlies."

If a funding shortfall is discovered at any given point in the year, and all cost containment measures fail, discrete processes may be employed to request mid-year increases to the Operating and Capital budgets. Requests to increase the MTA Operating budget are facilitated by a stand-alone Budget Amendment process that may occur up to twice a year. Requests to increase the MTA Capital budget may be submitted as part of the Consolidated Work Schedule (CWS) process, which programmatically reviewed four times per year. If MARC experiences an accident, incident, or other emergency, and immediately requires additional funds as a result, they may work directly with the *Office of Finance* and/or *Office of Planning and Programming* on a case-by-case basis.

The details of these processes are discussed later in this chapter.

Figure 12.1 – Overview of the capital and operating budget processes and related durations.



12.1 Budget Formulation

Budget formulation is the same for both Operations and Capital, and includes three discrete phases: Request, Allowance, and Appropriation. MARC influences these budgets through the Request Phase. Like all modes and departments throughout the MTA, MARC makes its Budget Request based upon a prioritized list of needs; not all of these needs will be funded, due to State-wide budget constraints.

12.1.1 Operations Budget Formulation

The *Office of Finance* manages the formulation of MTA's Operations budget (Figure 12.2). The operations budget funds all scheduled preventative maintenance, minor corrective maintenance, regularly ordered inventory items under $25,000.00, wages, and other personnel benefits; and is managed year-to-year.

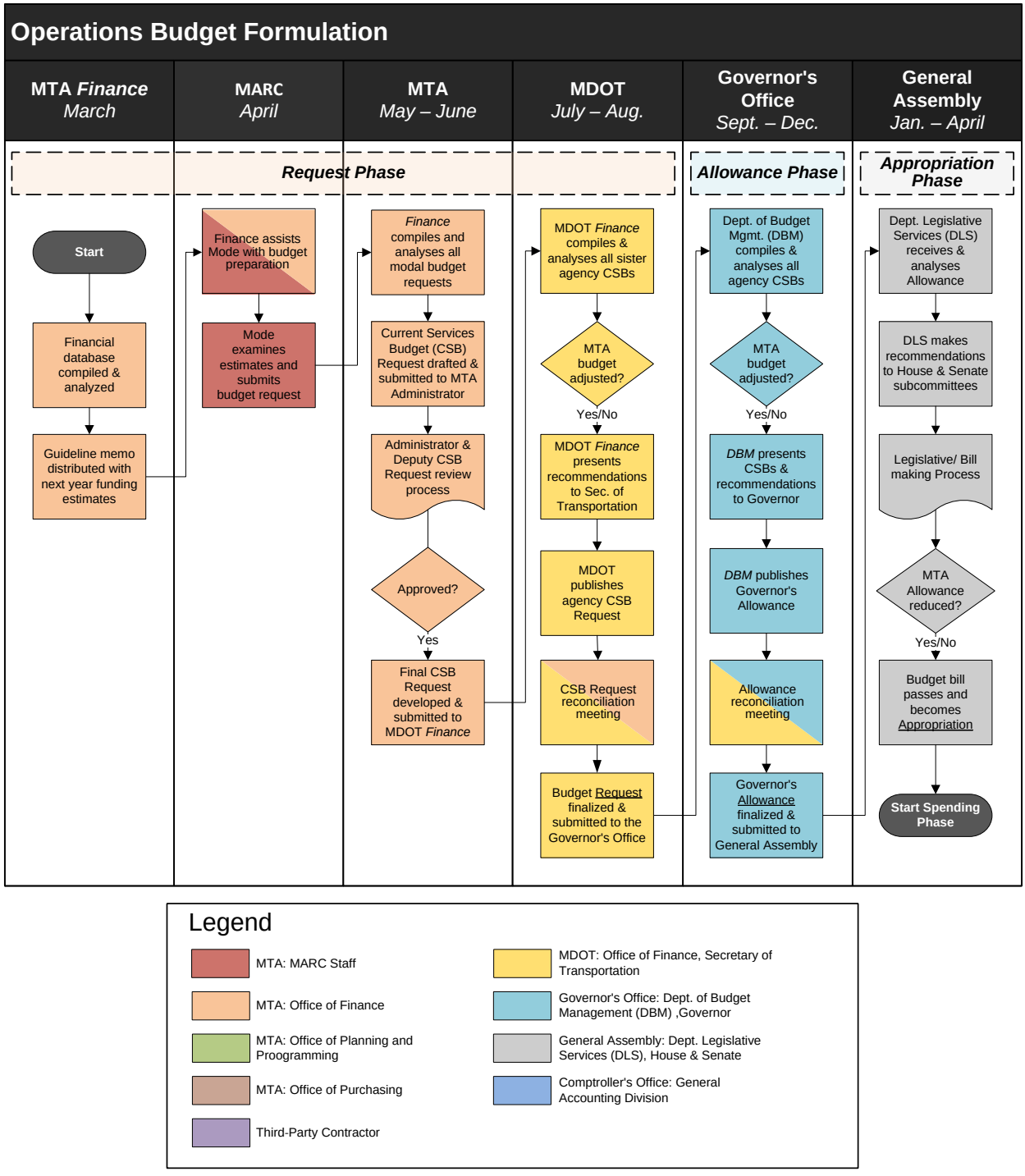
The Operations Budget is generally based on an annual analysis of historic expenditures – this analysis yields a trend line that can be used to forecast the approximate level of funds needed for this upcoming year. This budget forecast, called the Current Services Budget (CSB), is provided to these modes for review in the third Fiscal Quarter of every year (March). MARC first conducts an independent review of its portion of the CSB based upon a set of guidelines provided by the *Office of Finance.* This is followed by subsequent joint meetings between MARC and the *Office of Finance* to produce justifications for any additional operational needs and ultimately formulate MARC's annual CSB request.

The *Office of Finance* concurrently works with all other modes/departments to complete their annual Operating Budget requests respectively, and compile a complete draft CSB for the whole agency. MTA executive leadership then reviews, approves, and submits the agency-wide CSB to MDOT. In turn, MDOT compiles and analyzes all sister agency CSBs in advance of a final review by the Secretary of Transportation.

Should MDOT have any questions, comments, or concerns with MTA's CSB, a series of reconciliation meetings would then occur, allowing the MTA to advocate for additional needs. Upon a final revision, MDOT's CSB becomes the formal **Budget Request** and submitted to the Department of Budget Management (DBM) in the Governor's Office.

DBM then initiates a similar process, with compilation, DBM review, Governor review, and reconciliation between MDOT and DBM before publishing the final draft, or **Governor's Allowance**. The MTA Operating Budget now requires final review by the Maryland State Legislature. Once approved by both the House of Delegates and the Senate, and signature by the Governor, then the **Appropriation** is formally adopted as the operations budget for the upcoming Fiscal Year.

Figure 12.2 - Formulation of the Operations Budget.



Throughout this LMP, MARC has identified a number of gaps in its documented procedures, and opportunities to improve its lifecycle management approach. Efforts to improve TAM may require an increase in MARC's Operating Budget. MARC intends to use analysis of its Transit Assets and their lifecycle needs to better guide the development of their future Operating Budget requests accordingly.

12.1.2 Capital Budget Formulation

Capital Programming, a division of the *Office of Planning and Programming*, manages the formulation and of MTA's Capital Budget (Figure 12.3). The Capital Budget, also known as the Capital Program, funds all activities associated with the acquisition of Transit and Land Assets. It may also fund other Capital costs not directly attributable to system preservation, such as software procurement, management studies, etc.

MTA's Capital Budget covers a six year period, and is approved once per year by the Maryland State Legislature, as part of a master Capital Budget for MDOT and its modal administrations. This master Capital Budget is referred to as the Consolidated Transportation Program (CTP). While the CTP is only approved once per year at the State level, MDOT revises the Capital Budgets of MTA and its sister agencies each fiscal quarter, within the budget limits set by the General Assembly.

While MTA can revise its Capital Budget four times per year, the first Fiscal Quarter of the year represents the formal opportunity for MARC to submit new projects into the Capital Program. The process for submitting new projects into the Capital Program occurs in January of each year and can either follow a *Joint Benefit* track or a *Call for Projects* track (Figure 12.4). As previously mentioned, *Joint Benefit* projects are funded out of a special budget built for that purpose (See Chapter 8), whereas *Call for Projects* employs the Capital Budgeting processes described within this section. The remaining quarterly revisions to the Capital Budget are reserved for balancing project over/under expenditures, and funding unforeseen emergency needs.

Each quarterly revision of MTA's Capital Budget is captured in a database known as the Comprehensive Work Schedule (CWS). The FY 1st quarter CWS represents the **Request Phase** in the formulation of MTA's Capital Budget, and captures the *Call for Projects* accordingly. The submittal of FY 3rd quarter CWS to the Maryland State Legislature constitutes the **Allowance Phase** in the formulation of MTA's Capital Budget. The **Appropriations Phase** entails the review and approval of the 3rd Quarter CWS, or the Allowance, by the Maryland State Legislature, which is ultimately published in the CTP.

Figure 12.3 - MTA's capital budget formulation. The capital spending processes is grayed out. Budget formation involves the creation and editing of the CWS and CTP documents, whereas spending remains a standalone process that informs the CWS.

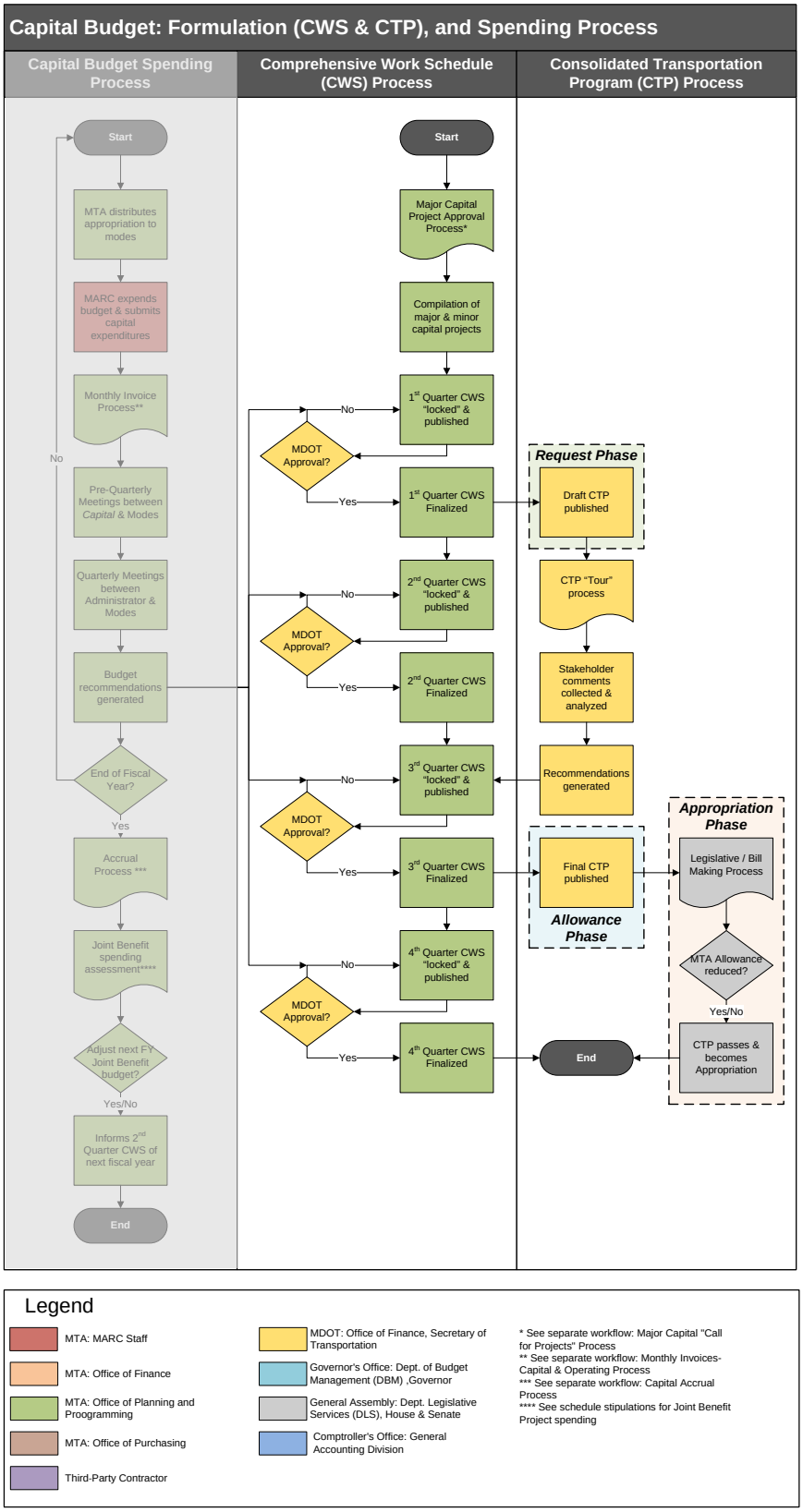
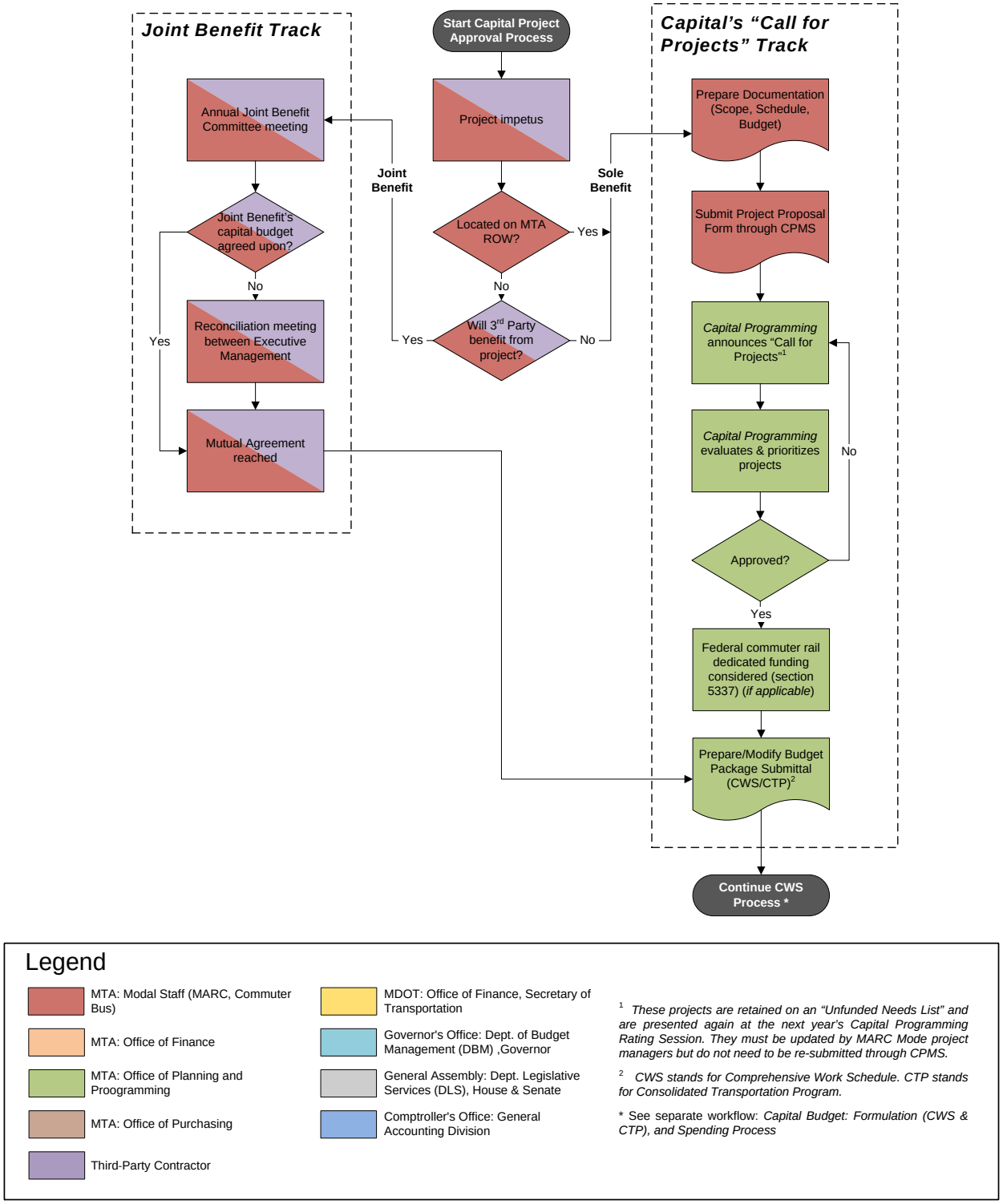


Figure 12.4 - Capital Programming's project approval process.



Traditionally, MARC has defined its Capital projects with a focus on minimizing acquisition costs. However, the MTA may save money in the long-term by considering Total Cost of Ownership in its Capital investment decisions. Therefore, MARC will apply the principles defined in TAMP Strategy #9 (*Consider the Total Cost of Ownership in Investment Decisions*), to the extent practicable.

Throughout this LMP, MARC has identified a number of Transit Assets in its SGR Backlog, and other capital needs to improve its lifecycle management approach. Efforts to improve TAM may require an increase in the MARC Capital Budget. MARC intends to use analysis of its Transit Assets and their lifecycle needs to better guide the development of its future Capital Budget requests accordingly.

12.2 Spending Process

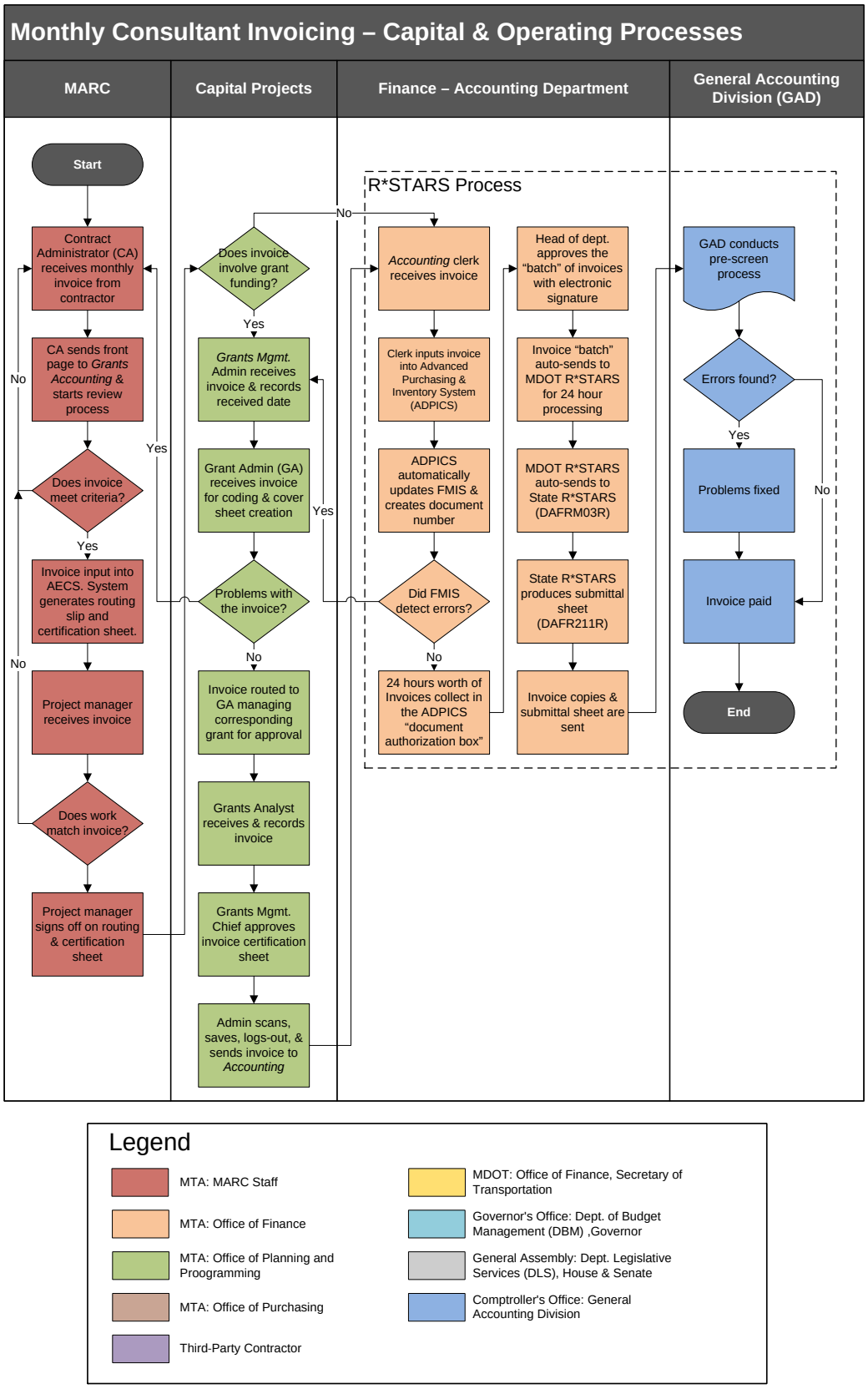
Once the Operating and Capital Budgets have been set, the Spending Process begins with the expenditure of funds, but extends to all processes associated with the ongoing management of those budgets. Expenditure of funds occurs after work has been performed by MTA staff and reported on their timecards accordingly. For vendors/contractors expenditure of funds occurs following their submittal of an invoice, which is paid by MTA.

The processes for ongoing management of the Operating and Capital Budgets are respectively different. Each budget is managed via different meetings, and usage of different software, cost containment, and accrual processes. These different processes are detailed in the subsections below.

12.2.1 Operations and Capital Shared Spending Processes

While spending process for both the Operating and Capital Budgets are respectively different, they generally share the same invoicing process for vendors/contractors (Figure 12.5). Note, both Amtrak and CSX will submit invoices through this process to fund *Joint Benefit* projects.

Figure 12.5 - Overview of the invoicing process, applicable to both capital and operating budgets.



12.2.2 Operations Spending Process

The *Office of Finance* coordinates the Spending Process of the Operations Budget, and uses a series of Status of Funds (SOF) meetings to contain costs, and identify the potential need for a budget amendment request (Figure 12.6). While vendor/contractor invoicing was detailed in the subsection above, a separate invoicing process exists for inventory invoicing (Figure 12.7). The *Office of Finance* also uses a distinct process for accruals, which is detailed in Figure 12.8. Note, MARC shares responsibility for the Operations Spending Process with various other MTA offices/departments, as illustrated in the aforementioned figures.

Figure 12.6 - Operations budget spending process.

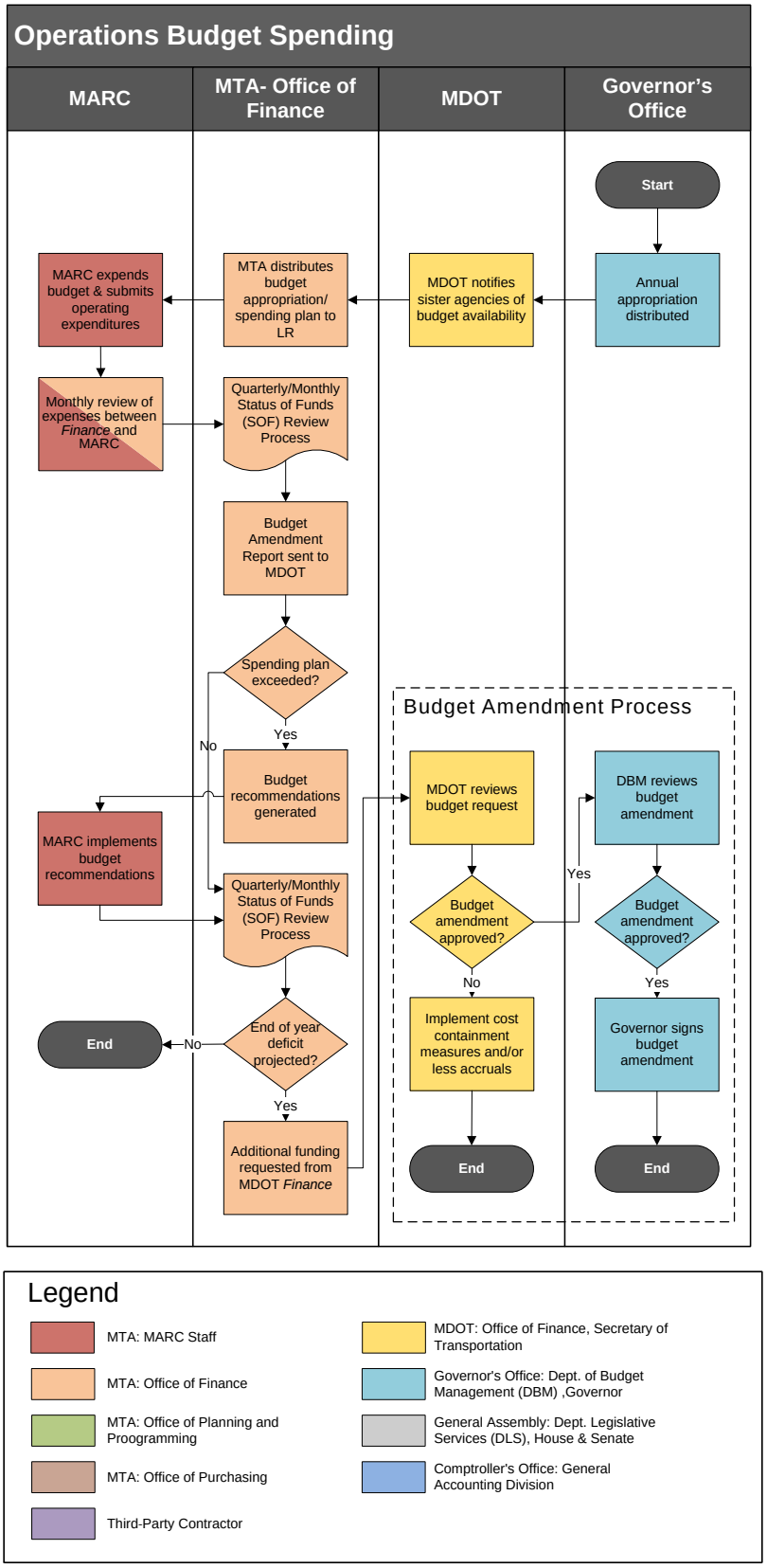
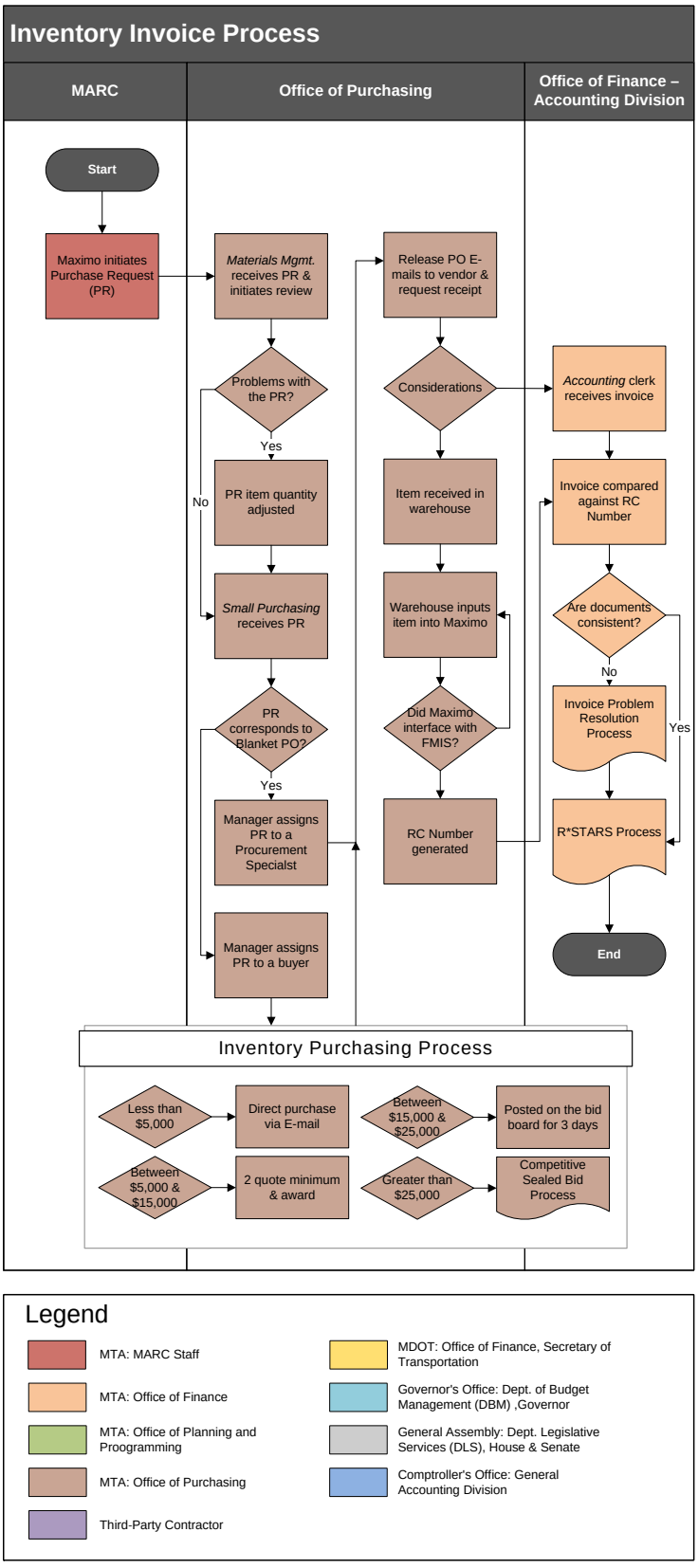


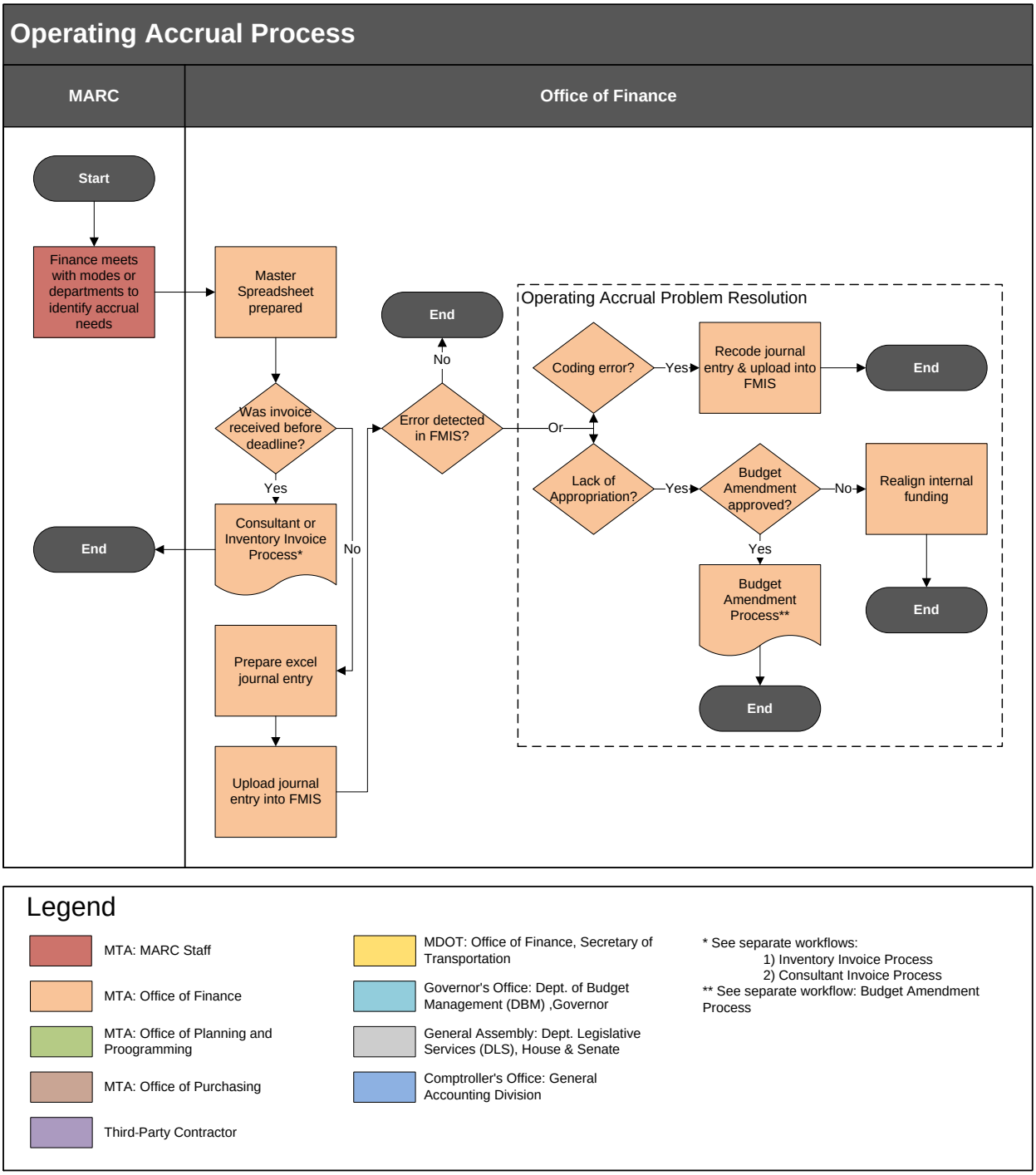
Figure 12.7 – Inventory invoice process.



The MTA Operating Budget is managed on an *accrual* basis per FTA regulations, meaning that MTA is required to account for the cost of work *performed* in a given month, not when that work was paid for. For example, if a vendor performed a service for $1,000.00 in August, and MTA received an invoice in late September, and paid the invoice in early October, MTA is required to show the $1,000.00 expense in August.

Throughout most of the year the *Office of Finance* records these expenses on an accrual basis based on of the information contained in an invoice. However, in the last few months of the Fiscal Year work is still being performed by MTA's vendors/contractors, but the *Office of Finance* may not receive an invoice in time to guide how the accrued expenses should be recorded. Therefore, in the last Fiscal Quarter of each year, the *Office of Finance* will reach out to MARC for assistance in estimating year-end accruals. This process is detailed in Figure 12.8. This year-end accrual process is time sensitive as all accrual based activities must be completed by a deadline set by the Maryland Legislature for subsequent review.

Figure 12.8 - Accrual process for the operating budget.



12.2.3 Capital Spending Process

The Division of Capital Programming coordinates the Spending Process of the Capital Budget, and uses a series of Pre-Quarterly and Quarterly meetings to help ensure projects stay on-budget and on-schedule. Should a funding discrepancy arise through any of these meetings, they may inform the next quarterly revision of the Capital Budget. The process for all invoicing in the Capital Spending Process, including invoices related to Joint Benefit projects, was detailed in Section 8. A detailed illustration of the ongoing management processes for the Capital Spending Process can be found in Figure 12.9 below. Furthermore, a specific MARC Capital Spending track indicates opportunities to adjust Joint Benefit budget availability on an annual basis, based upon current rate of spending (See Figure 12.9 and Table 12.1). Capital Programming also uses a distinct process for accruals, which is detailed in Figure 12.10.

Figure 12.9 - MTA's capital spending process. The capital budget formulation is grayed out. Budget formation involves the creation and editing of the CWS and CTP documents, whereas spending remains a standalone process that informs the CWS.

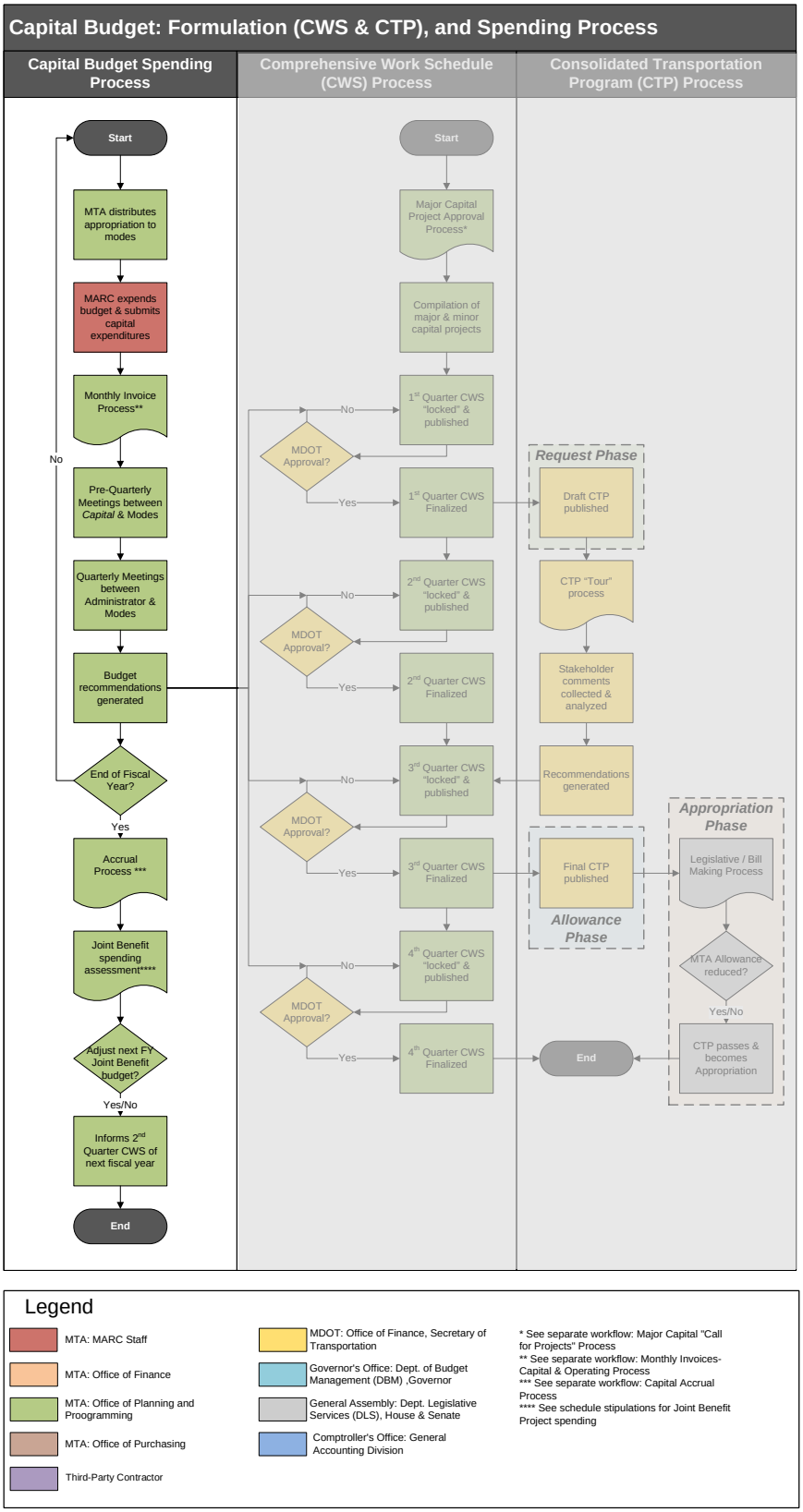


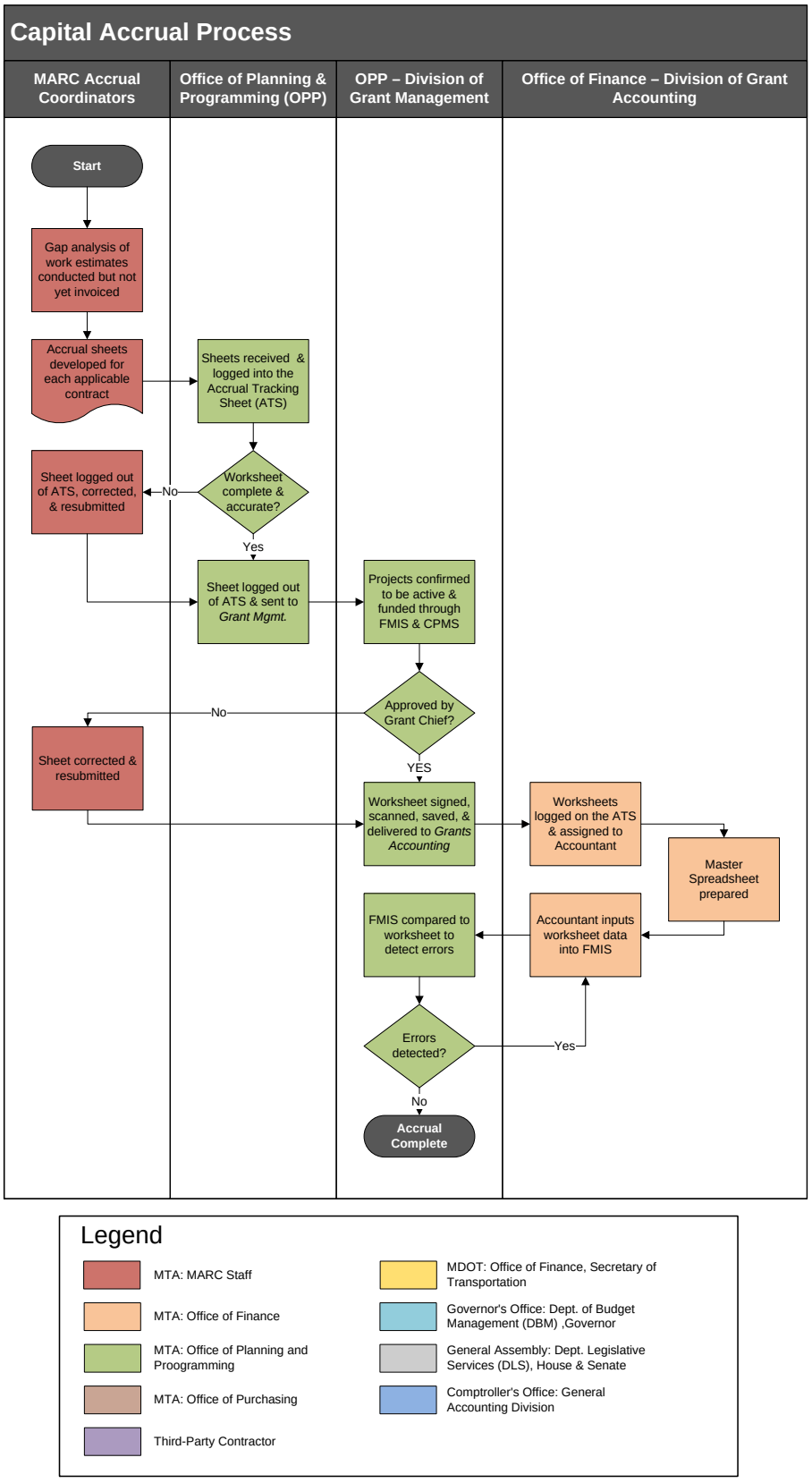
Table 12.1 – Adjustments to Amtrak's Joint Benefit budget availability based upon spending capability, as identified within the Amtrak Access Agreement. CSX Transportation does not have these budget adjustment mechanisms built into their Access Agreement. *Left,* Joint Benefit budget may be adjusted downward on an annual basis if budget was underspent. *Right*, Joint Benefit budget may be adjusted upward at the end of the 4th year if the budget is close to being spent.

At the end of each year		At the end of 4 years	
Budget Spent	**Adjust Next Year's Budget By:**	**Budget Spent**	**Adjust Next Year's Budget By:**
> 61 %	(-) 15%	> 75%	(+) 22.2%
51 - 60%	(-) 20%	60.71 - 67.9%	(+) 17.6%
41 - 50%	(-) 25%	53.61 - 60.7%	(+) 12.5%
31 - 40%	(-) 30%	< 53.6%	(+) 6.7%
< 30%	(-) 35%		

The MTA Capital Budget is managed on an *accrual* basis per FTA regulations, meaning that MTA is required to account for the cost of work *performed* in a given month, not when that work was paid for. For example, if a vendor performed a service for $1,000.00 in August, and MTA received an invoice in late September, and paid the invoice in early October, MTA is required to show the $1,000.00 expense in August.

Throughout most of the year Capital Programming records these expenses on an accrual basis based on of the information contained in an invoice. However, in the last few months of the Fiscal Year work is still being performed by MTA's vendors/contractors, but Capital Programming may not receive an invoice in time to guide how the accrued expenses should be recorded. Therefore, in the last Fiscal Quarter of each year, Capital Programming will reach out to MARC for assistance in estimating year-end accruals. This process is detailed in Figure 12.10. This year-end accrual process is time sensitive as all accrual based activities must be completed by a deadline set by the Maryland Legislature for subsequent review.

Figure 12.10 - Capital Programming's accrual process.



13 Summary of Performance and Funding Impacts

13.1 Anticipated Transit Asset Replacement Needs

With rare exception, Transit Assets will need to be replaced as they reach the end of their useful lives. These replacement needs and necessary funding can be forecasted. For the analysis below, replacement policies are driven by the useful lives of assets, determined by MARC staff during interviews. In lieu of specific useful life data, default values contained within TERM Lite were utilized. The sum of all replacement and rehabilitation activities yield the total *capital* expenditures identified by TERM Lite over a 20 year analysis (Figure 13.1), based on the MARC inventory at the time of publication.

Over the 20 year analysis, MARC requires $986 Million to replace all Transit Assets when they reach the end of their useful life. This averages to $49.3 million in needs per year.

Table 13.1 itemizes all assumptions built into the analysis.

Figure 13.1 - TERM Lite analysis, MARC capital expenditures through 2034.

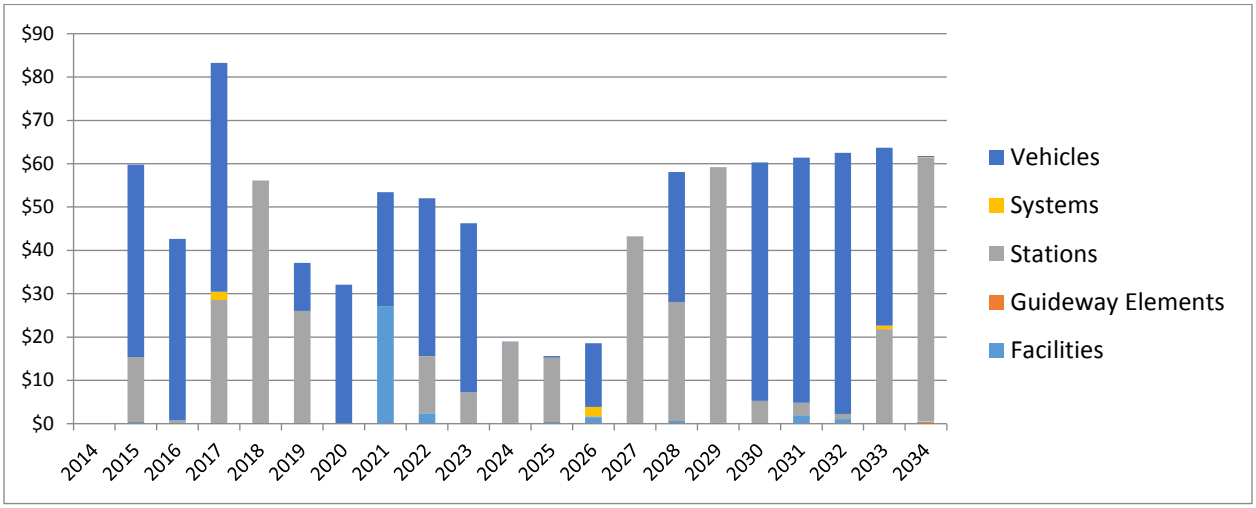


Table 13.1 - Assumptions for the TERM Lite analysis.

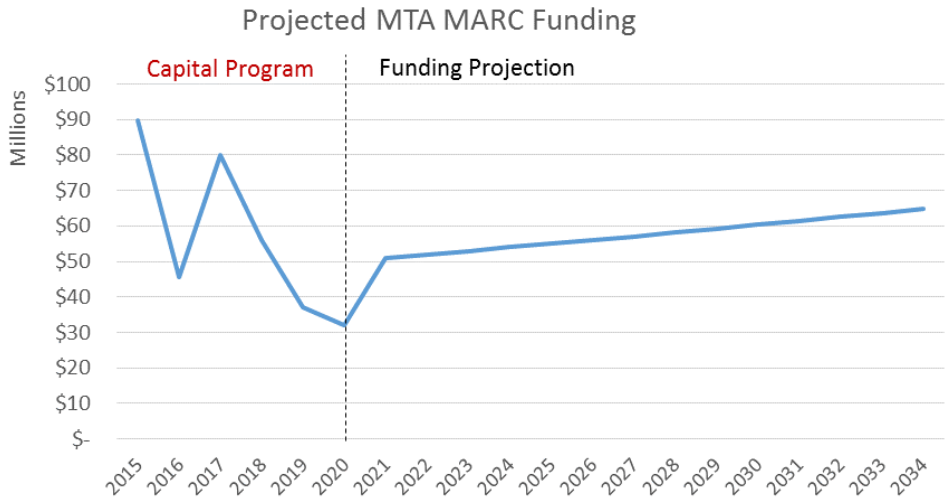
Assumptions
• All costs in Fixed Asset Ledger (FA) are in "In Service" year dollars
• Unless otherwise given, all Priority Status is "Normal"
• Unless otherwise noted, TERM default useful lives are applied
• Revenue collection assets taken from FMIS and confirmed with MTA's *Office of Treasury*
• Where linear assets with differing useful lives were identified, cost was subtracted from the total FMIS record based upon segment length.
• Needs are inflated at 2.82% (based on direction from *MDOT Office of Finance)*

13.2 Anticipated MARC SGR Funding

Not all of MARC capital budget is used for SGR needs; other portions of the budget are used for system enhancements and management studies. The analysis below projects MARC SGR funding based on historic trends. Funding projections are based on historic expenditures from 1996 through the current capital program, which goes to 2020. Upon the capital program's conclusion in 2021, MARC's average funding level increases to adjust for inflation at an annual growth rate of 1.86%. Accordingly, the analysis below forecasts an annual average of $57.4 million in funding over 20 years.

Projected MARC funding also includes dedicated funding for Amtrak and CSX Joint Benefit projects, as required through their respective Access Agreements. MTA allocates: $7 million per year without budget adjustments to Amtrak; $6 million per year to CSX.

Figure 13.2 – Projected capital funding through 2034 for MARC.



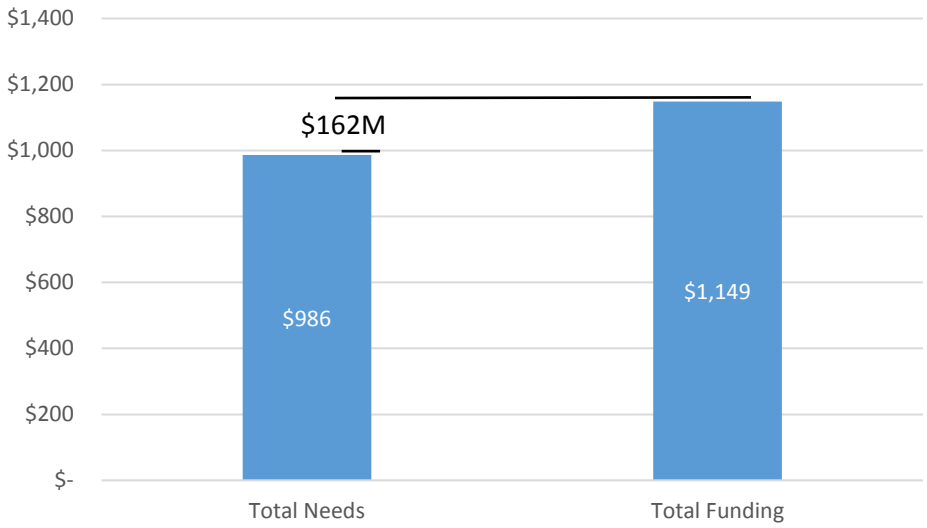
13.3 Funding Impact Analysis

As discussed above, MARC's total 20 Year asset replacement needs are $986 million in year of expenditure dollars; however, MARC is anticipated to have $1,149 million (year of expenditure dollars) in SGR funding available over the same period. The result is a total funding surplus of approximately $162 million over the 20-year period (Figure 13.3).

On annual basis, MARC's average annual reinvestment needs over the same 20-year period are $49.3 million. Average annual funding, over 20 years, is constrained to $57.4 million. The result is an average annual funding surplus of $8.1 million.

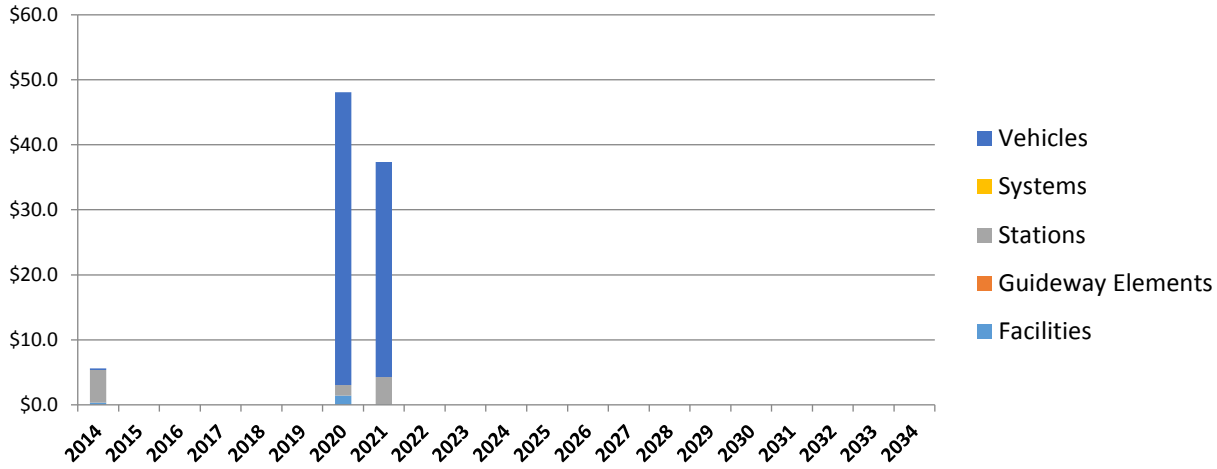
Note, this funding surplus will change if TERM lite runs against an expanded inventory that captures third-party owned assets.

Figure 13.3 – MARC's SGR Backlog needs over 20 years.



Due to this funding surplus, MARC is expected to eliminate the SGR Backlog through 2034. This assumes consistent funding levels and the ability for MARC to carry over their unused respective budgets from year to year. A SGR backlog does appear at the conclusion of the current capital program, due to some revenue fleet *Vehicles* reaching their useful lives. However, this SGR backlog in 2020 and 2021 is quickly eliminated due to the aforementioned reasons.

Figure 13.4 - Anticipated elimination of the MARC SGR Backlog due to annual funding surplus.



14 Continuous Improvement

In relation to this LMP, continuous improvement refers to not only improving asset management activities within MARC, but also ensuring continual update of this LMP to document these improvements. This section captures recommendations to improve asset management activities and mitigate risk, and instituting an annual LMP update and approval process.

14.1 Risk & Review

An Enterprise Risk Management system currently doesn't exist at the MTA. However, risk management is a critical component of any asset management system. The MTA has committed in its TAMP to employ an Enterprise Risk Management (ERM) approach to identify and quantify all risks, then select the highest risks for mitigation. TAMP Strategy #2 (*Employ an Enterprise Risk Management Approach)* aimed to formulate the mechanics of the ERM, including responsibilities, process, and milestones. MARC intends to incorporate the ERM approach into its future TAM activities and this LMP alike.

14.2 Performance Modeling

TAMP Strategy #11 (*Enhance Enterprise Performance Management*) specifies the need to develop performance models. Performance modeling is an advanced technique used to inform managerial decision making, and ultimately guide the improvement of TAM practices. Essentially, performance modeling is an exercise of data analysis enabling the structured comparison of various operational scenarios. Performance modeling can be as simple as a spreadsheet-based analysis, and as complex as a full software tool.

In many cases, performance modeling is used to forecast asset condition, asset failure, or asset replacement costs; many of these functions are currently provided through the TERM Lite model used for the various analyses in this LMP. Ultimately, performance modeling at MARC should evolve to forecast lifecycle costs of an asset or system, and optimize the value of MARC's entire asset portfolio. In the future, available performance models will be listed and hyperlinked in this LMP to provide MARC management with easy access to these tools.

14.2.1. Performance Modeling Uses

Initially, MARC may benefit from smaller discrete studies to determine the optimal time to rehab/replace an asset, the optimal maintenance interval for a given asset, the optimal number of spares to hold in inventory, etc. The intent is to focus performance modeling on activities that will result in cost savings, system performance increases, and risk reductions.

While TERM Lite is currently used for estimating SGR Backlog, annual capital investment needs, current and future asset conditions, and long-term capital investment priorities, its application is limited. TERM forecasts major capital needs, but it cannot predict operating and maintenance costs associated with Transit Assets.

The ideal approach to lifecycle costing (TAMP Strategy #9) considers all costs and ownership implications for an asset or system of assets over its entire lifecycle. Through a lifecycle cost analysis, MARC can

consider the "Total Cost of Ownership" (TCO) associated with various investment scenarios, ensuring that asset performance requirements are met at the lowest TCO.

Value optimization is a further evolution of the lifecycle cost model; it goes beyond performance and cost implications, and considers the other elements of the MTA's TAM Vision to deliver the best value-for-money of the entire modal asset portfolio. Value optimization represents the pinnacle of performance modeling, and is currently beyond industry capabilities.

14.2.2. Current Data Deficiencies

MARC is currently limited in its ability to employ performance modeling techniques due to a lack of quality data inputs. Each type of performance analysis referenced in Section 11.1 is listed with required data inputs and a generalized reference to MARC data deficiencies (Table 14.1).

Table 14.1 – MARC's current data deficiencies.

Performance Model	Level of Analysis	Required Data Currently Available within MARC	Required Data Currently ***Not*** Available within MARC
Rehab/Replacement Schedule Optimization	**Intermediate**	✓ Asset replacement cost ✓ Asset overhaul cost estimate ✓ Asset-level corrective maintenance action history	× Asset-level maintenance cost history × Asset condition history (performance and/or physical condition)
Maintenance Interval Optimization	**Intermediate**	✓ Asset useful life policy/ history ✓ Asset-level corrective maintenance action history	× Asset-level maintenance cost history
Spares Analysis	**Intermediate**	✓ Spare part cost history	× Inventory depletion history × Time history for fulfillment of spares needs
Lifecycle Cost Model	**Advanced**	✓ Asset replacement cost ✓ Asset useful life policy/ history ✓ Asset-level corrective maintenance action history ✓ Anticipated decommissioning/ disposal costs/revenues	× Asset-level maintenance cost history × History of direct consequences due to asset failure × Performance valuation standards (for calculating lost opportunity asset failure costs) × Asset-level socio-economic costs × Identification of post-disposal residual liabilities
Value Optimization	**Aspirational**	*TBD*	*TBD*

The list of performance models above is illustrative, and will be modified in future revisions of this LMP to guide desired investments in data capture and performance modeling improvements.

14.2.3. Data Capture Improvement Plan

The ability to capture quality input data is prerequisite to any valuable performance modeling. Once MARC has identified the performance models it wishes to invest in, these modes will initiate development of corresponding data capture improvement plans which will detail:

- Identifying which Transit Assets to be used in the desired performance model
- Applicability to other modes/departments
- Process map for performance model
- Data input requirements
- Inventory and gap analysis of existing input data
    - Relevant MTA technology policies
    - Data system(s) of record (and associated data owners)
    - Schedules for data updates
- Strategies to fill data gaps
- Projects to implement data capture improvement plan

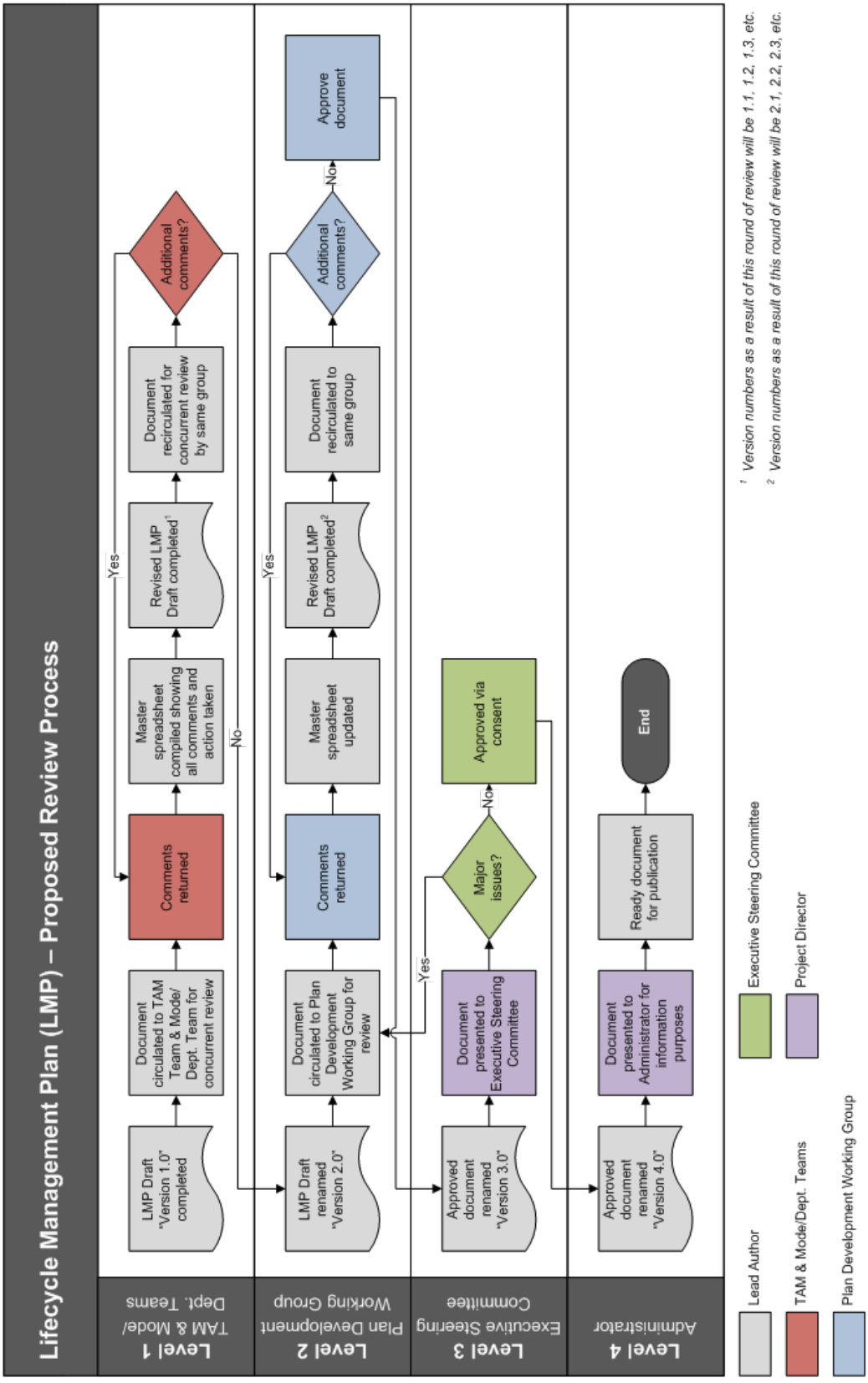
14.3 Other Recommendations

Several key recommendations are detailed in the preceding chapters. However, additional recommendations were identified through staff interviews and the development of this LMP at large. A complete summary of *all* recommendations can be found in **Appendix E**. MARC recognizes that it cannot take action on all recommendations with existing resources, and therefore will take a strategic approach to the prioritization of these improvements, forming a basis for the next version of this LMP.

14.4 LMP Maintenance Process & Timeline

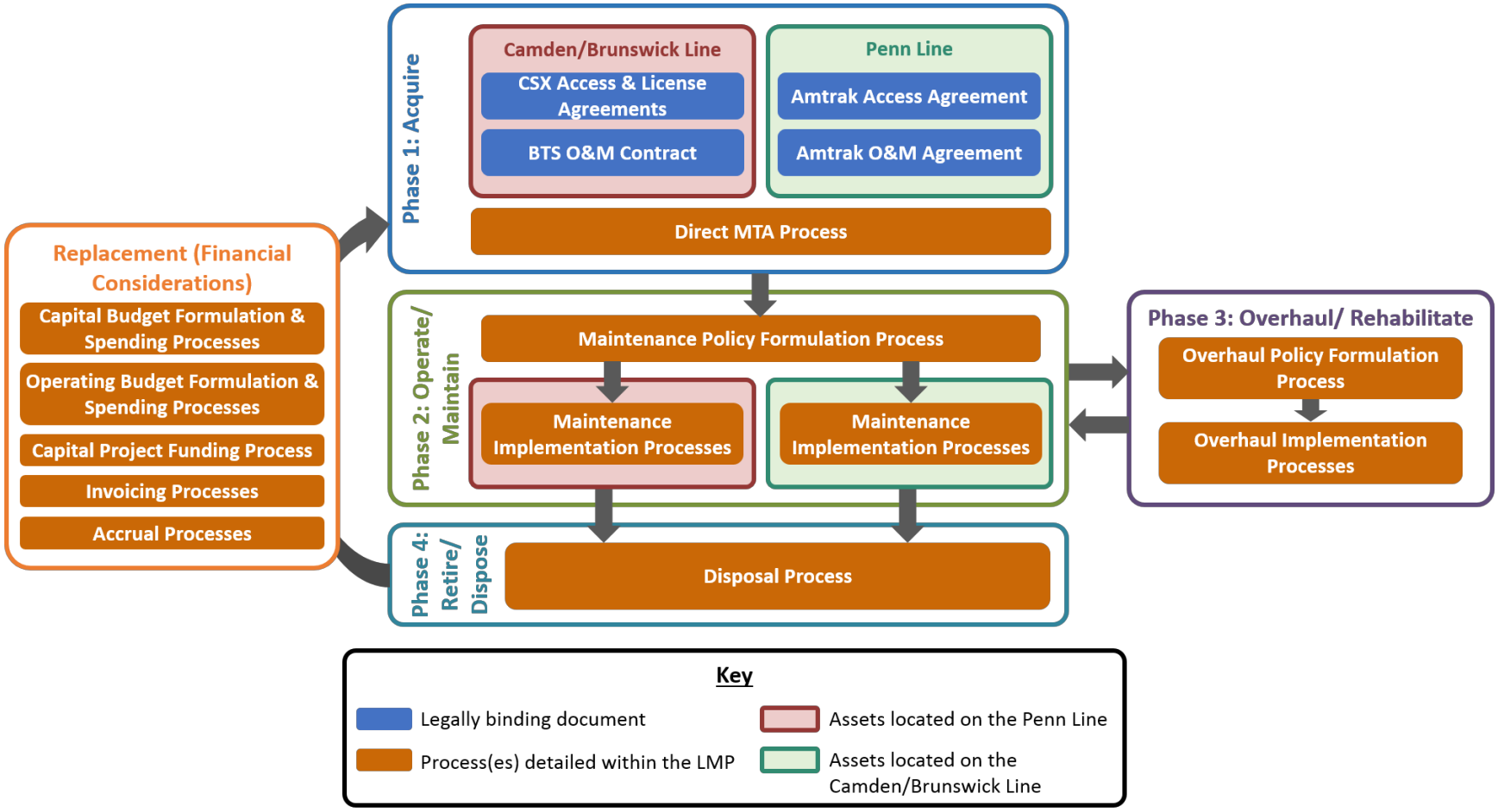
This LMP will be updated **annually** since Transit Asset Management is founded on a continuous business process. The LMP update will also coincide with an annual update of the TAMP and SSPP, since changes in either document may warrant corresponding changes in this LMP. The annual maintenance process (Figure 14.1) outlines steps for LMP approval and comment.

Figure 14.1 – LMP maintenance process and timeline.



15 Appendices

15.1 Appendix A: Relationship between Contract Documentation, Management Processes, and Lifecycle Phases

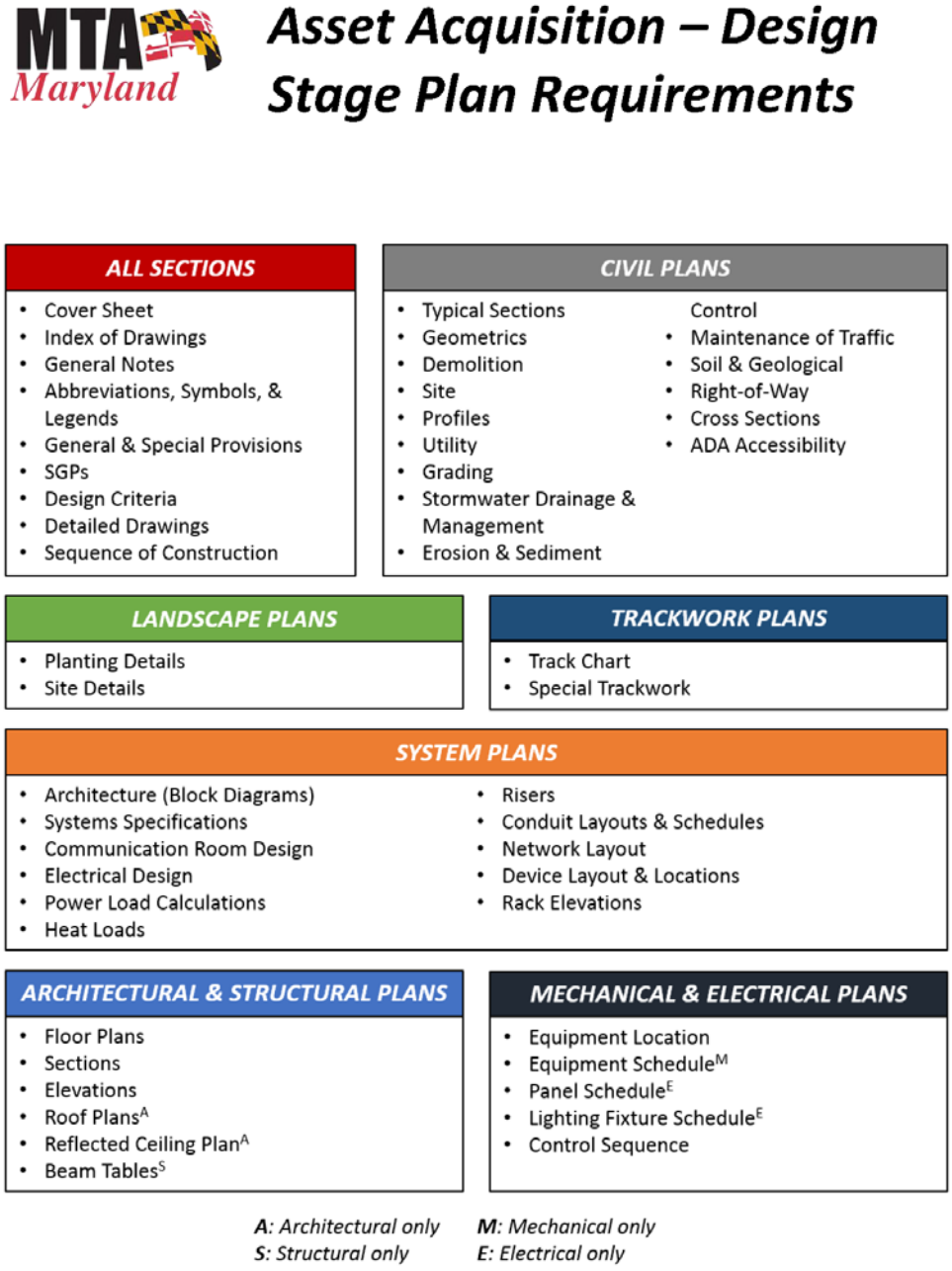


15.2 Appendix B: MARC Transit Asset Replacement Schedules

Category	Sub-Category	Element	Sub-Element	Average Agency Useful Life	# of Rehabs
Facilities	**Buildings**	Administration	-	50	1
		Building Components	Generators	15	
			Major HVAC	40	
			Minor HVAC	40	
			Other	15	
		Maintenance	Rail Commuter Rail	50	1
	Equipment	-	-	15	
		Furniture	-	12	
		Maintenance	-	10	
			Air Compressor	25	
			Fuel Tank	25	
			Lifts - Fixed: In Floor	25	
			Lifts - Portable	7	
			Misc Equip	25	
			Rail Commuter Rail	10	
		MIS/IT/Network Systems	Computers/Hardware	6	
	Storage Yard	Rail	Commuter Rail	50	1
Guideway Elements	**Guideway**	At Grade-In-Street	Grade Crossing Commuter Rail	20	
	Special Structures	-	-	30	
	Trackwork	Ballasted	-	35	
		Yard	-	70	
Stations	**Access**	Elevators	-	25	
		Parking	Garage	45	1
			Lot	20	1
			MARC Garage	20	1

Category	Sub-Category	Element	Sub-Element	Average Agency Useful Life	# of Rehabs
			Park & Ride	20	1
		Pedestrian Walkway	-	80	
	Building	Building Components	HVAC	40	1
			Shelter	20	
		Commuter Rail	-	40	1
			At-Grade Historic	60	5
	Platform	Canopy	Commuter Rail	50	
		Platform	-	35	1
	Signage & Graphics	-	-	20	
		Electronic	-	20	
Systems	**Communications**	Safety and Security	CCTV	20	
			Intrusion Detection System (IDS)	20	
	Electrification	Catenary	Commuter Rail	40	
	Revenue Collection	Central Revenue Collection	Commuter Rail	20	
		In-Station	Commuter Rail	20	
	Train Control	Roadway Crossings	Grade Crossing System	25	
	UPS	-	-	15	
Vehicles	**Non-Revenue Vehicles**	-	-	10	
		Car	-	6	
		Truck	-	10	
		Commuter Rail	Passenger Car	35	1 to 2
			Revenue Locomotive	32.6	1 to 2

15.3 Appendix C: Design Stage Plan Requirements



15.4 Appendix D: Detailed Summary of Transit Asset Conditions

Category, Sub-Category & Element	Avg. Condition
Vehicles	**4.21**
Revenue Vehicles	**4.21**
Commuter Rail	**4.21**
Non-Revenue Vehicles	**3.27**
Misc.	**5.00**
Car	**3.82**
Truck	**2.87**
Facilities	**3.88**
Equipment	**3.63**
Misc.	**4.52**
Furniture	**2.97**
Maintenance	**3.65**
MIS/IT/Network Systems	**3.49**
Buildings	**3.92**
Administration	**3.40**
Building Components	**3.97**
Maintenance	**4.06**
Storage Yard	**3.77**
Rail	**3.77**
Systems	**3.71**
Communications	**4.81**
Safety and Security	**4.81**
Train Control	**3.35**
Roadway Crossings	**3.35**
Stations	**3.83**
Access	**3.69**
Elevators	**4.20**
Parking	**3.64**
Pedestrian Walkway	**4.71**
Building	**4.10**
Building Components	**2.76**
Commuter Rail	**4.16**
Signage & Graphics	**3.50**
-	**2.59**
Electronic	**4.80**
Platform	**3.86**
Canopy	**4.92**
Platform	**3.85**
Guideway Elements	**4.55**
Guideway	**5.00**
At Grade-In-Street	**5.00**
Trackwork	**4.46**
Ballasted	**3.74**
Yard	**4.70**
Special Structures	**5.00**
Misc.	**5.00**
Grand Total	**4.12**

15.5 Appendix E: Prioritized Summary of Recommendations

NO.	TOPIC	CORRESPONDING TAMP STRATEGY	RECOMMENDATION
1	Maintain Transit Inventories	1	MARC will maintain its Transit Asset inventories in Maximo and in alignment with 49 U.S.C. 5326. This includes implementing policies and procedures that adds or removes records with the asset's acquisition or disposal, respectively. Additionally, MARC needs to maintain a high level of data quality that ensures Transit Asset records have accurate: names, quantities, acquisition costs, and in-service dates.
2	Maintain Transit Inventories: Add Third-Party Assets	1	To comply with FTA's Asset Management final rule, effective October 1, 2016, MARC must capture third-party vehicle and facility assets within mode's asset inventory. MARC must ensure that these Transit Asset records have accurate: names, quantities, acquisition costs, and in-service dates. *MTA to provide assistance*.
3	Asset Condition: Implement FTA Rating Scale	3	Each MARC department, coordinated by management, should implement FTA's standardized 1-5 point rating scale for evaluating Transit Asset physical conditions. *MTA will provide standards for replicating unique Transit Asset class scales across all modes and departments.*
4	Critical Assets: Maintenance Oversight	4	MARC will extend oversight and audits to include third-party owned/managed vehicles, facilities, and systems assets.
5	Critical Assets: Improve Third-Party Contract Language	4	MARC will consider including one or more of the following requirements in future iterations of its contract documents: • Asset specifications for all assets procured by third-party vendors for use in revenue service • Asset inventory requirements aligned with MTA policies and procedures • More robust Reliability, Availability, Maintainability, and Safety (RAMS) specification • The ability for MTA to revise maintenance requirements as assets are procured/replaced

			• A standardized/documented process for monitoring asset condition based on the TERM scale • Performance measures and targets aligned with the TAMP and MARC LMP; and • Reporting requirements that facilitate the completion of internal performance reports as described in Section 7 above, and TAM reporting through the National Transit Database (NTD)
6	Performance Monitoring: Adopt Recommended Key Performance Indicators (KPIs)	11	MARC and MTA should adopt recommended asset related KPIs as outlined in Section 7.2
7	Organizational Assessment for Enhanced Oversight	N/A	MARC should conduct an organizational assessment to determine the appropriate number of PINs and/or consultant support positions to extend audit responsibilities to third-party-owned Facilities, Stations, Guideway, and Systems assets.
8	Asset Condition: Make Data Sheets Compatible with FTA Condition Rating Scale	3	MARC, its stakeholders and vendors, should update all post work order sheets, data sheets, or check-off sheets with fields to accommodate FTA's 1-5 point condition rating scale. *See Recommendation #2.*
9	Asset Condition: Train Staff	3	MARC should train all stakeholders and vendors how to utilize FTA's 1-5 point scale for their respective Transit Asset classes. *See Recommendation #2.*
10	Asset Condition: Enhance Physical Inspection	3	MARC should compare all TERM Lite condition estimate data against perceived physical condition. For those Transit Assets where MARC is producing an inaccurate estimate of condition, the mode will perform a structured and comprehensive physical condition assessment of those assets. MTA will provide standards on physical inspection methodology.
11	Asset Condition: Store Data Sheets Electronically	3	MARC should eliminate the practice of only archiving hard copy Data Sheets (paperwork associated with asset inspections). Until MTA

			provides additional guidance, MARC should store electronic copies of Data Sheets on ProjectWise.
12	Establish Universal Transit Asset Specifications	NA	MARC will set standard asset specifications for all assets procured by third-party vendors for use in revenue service. This includes (but is not limited to) specifications for coach buses, radios, etc.
13	Risk Management: Operational Safety Assurance	2	MARC will work with OSQARM to oversee and audit third-party vendors from a safety perspective
14	Risk Management: Revenue Vehicle Safety	2	MARC will collaborate with OSQARM to develop/review/certify revenue vehicle specifications in advance of all new procurements
15	Data Management: Enhance Analysis of Work Order History	10	MARC will use Maximo or otherwise create a database to analyze asset condition and work order history. The mode will also strive to enforce reporting and analysis of maintenance activities in Maximo by third-party vendors.
16	Data Management: Document Existing Data Systems and Needs	10	MARC depends on numerous disparate spreadsheets and databases to track TAM-related information. The mode and its partners should document the existence of each respective data system, its purpose, the employee who manages the data system, and any obvious needs to improve these data systems. This will support the agency-wide initiative to develop a data catalogue and ultimately enhance enterprise data management. *MTA to provide guidance.*
17	Improve Joint Benefit Process		MARC should consider how to improve the Joint Benefit process, including how that process should: • Influence the prioritization of an asset's acquisition; and • Collect data, especially related to asset management
18	Improve Succession Planning	3	While this LMP captures institutional knowledge and improves training for the position's successor, the MTA should explore how it can more proactively identify candidates for succeeding a position and increase the duration of shared time between the outgoing employee and the successor.

19	Risk Management: Employ an Enterprise Risk Management Approach	2	MARC should employ an ERM approach to identify and quantify all risks, then select the highest risks for mitigation. *MTA will provide a standardized methodology and milestones*.
20	Data Management: Develop Performance Modeling Data Capture Plans	11	MARC will identify the performance models it wishes to invest in, and initiate development of corresponding data capture improvement plans.
21	Perform Third-Party Contractor Cost-Benefit Analyses	NA	MARC and MTA should implement a comprehensive cost-benefit evaluation of conducting maintenance either in-houses versus through a contractor.
22	Data Management: Automate Data Capture for Revenue Vehicles	10	MARC will require vehicles to include an on-board computer interface for Maximo to capture performance data (odometer readings, life deployments, door openings, etc.)
23	Evaluate Contract Detail		MARC's third party O&M contracts vary in length and detail. MTA and MARC should evaluate these strengths and weaknesses to improve their next round of performance contracts.
24	Spare Part Tracking & Warranty		BTS utilizes a system to manage spare parts and warrantees for all assets maintained by BTS. While Amtrak also uses this process for Revenue Vehicles, it is unknown whether Amtrak or CSX uses this type of process for other asset classes (e.g. trackwork, facilities, stations, and systems). MARC should consider the merits of adopting a uniform spare part tracking and warrantee process for the entire mode.