How we determined which assets were worth collecting and including in asset management efforts

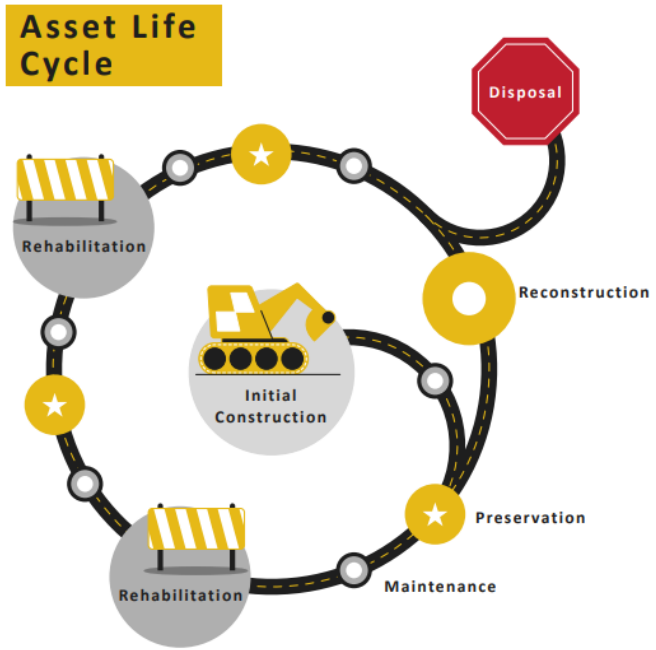
Michael Cremin | Transportation Asset Management Engineer

How MnDOT determined life-cycle approaches for ancillary assets and used those determinations to identify needed and desired data elements

- Asset Management Strategic Implementation Plan developed to further TAMP implementation
- 5 workgroups, Workgroup 1 focus on an Asset Matrix
- Workgroup members include district transportation engineers, district traffic engineers, district maintenance engineers, and central office counterparts

What is Life Cycle Planning?

LCP is the process of developing and ***comparing strategies*** to *"estimate the cost of managing an* ***asset network*** *over its* ***whole life****, with consideration for* ***minimizing cost*** *while* ***preserving or improving conditions****."*



MnDOT Life Cycle Planning Objectives

- Establish a long-term focus for improving and preserving the system.
- Improve infrastructure asset resilience to climate change & extreme weather events.
- Determine the conditions that can be achieved for different levels of funding.
- Reduce the annual *cost of system preservation* without impacting asset conditions.
- Provide objective data to support investment decisions.
- Demonstrate good stewardship to internal and external stakeholders.
- **Determine investment funding needed to achieve the desired state of good repair.**
- **Develop maintenance strategies that consider long-term investment needs.**

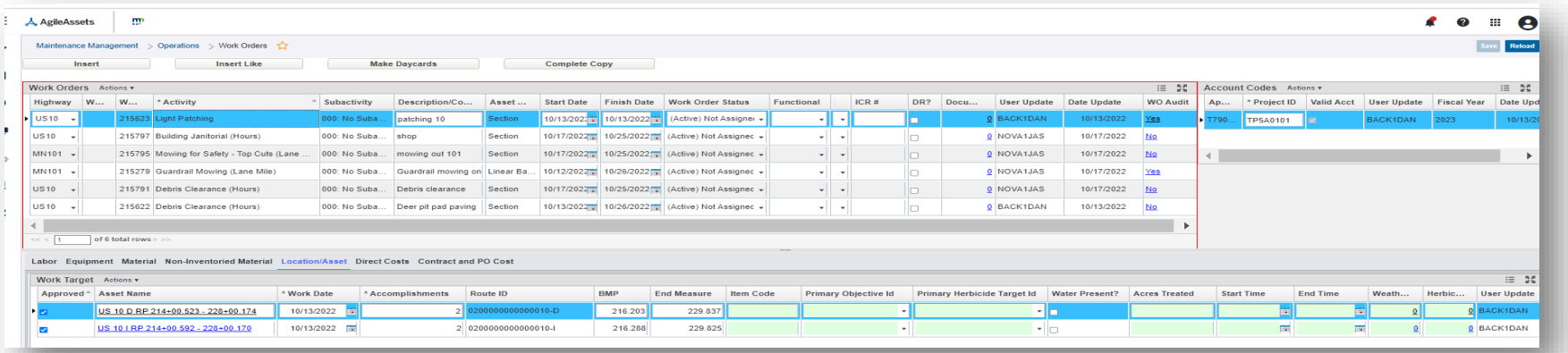
MnDOT Life Cycle Planning Process Improvements

<u>2018 TAMP</u> LCP was project-level perspective.

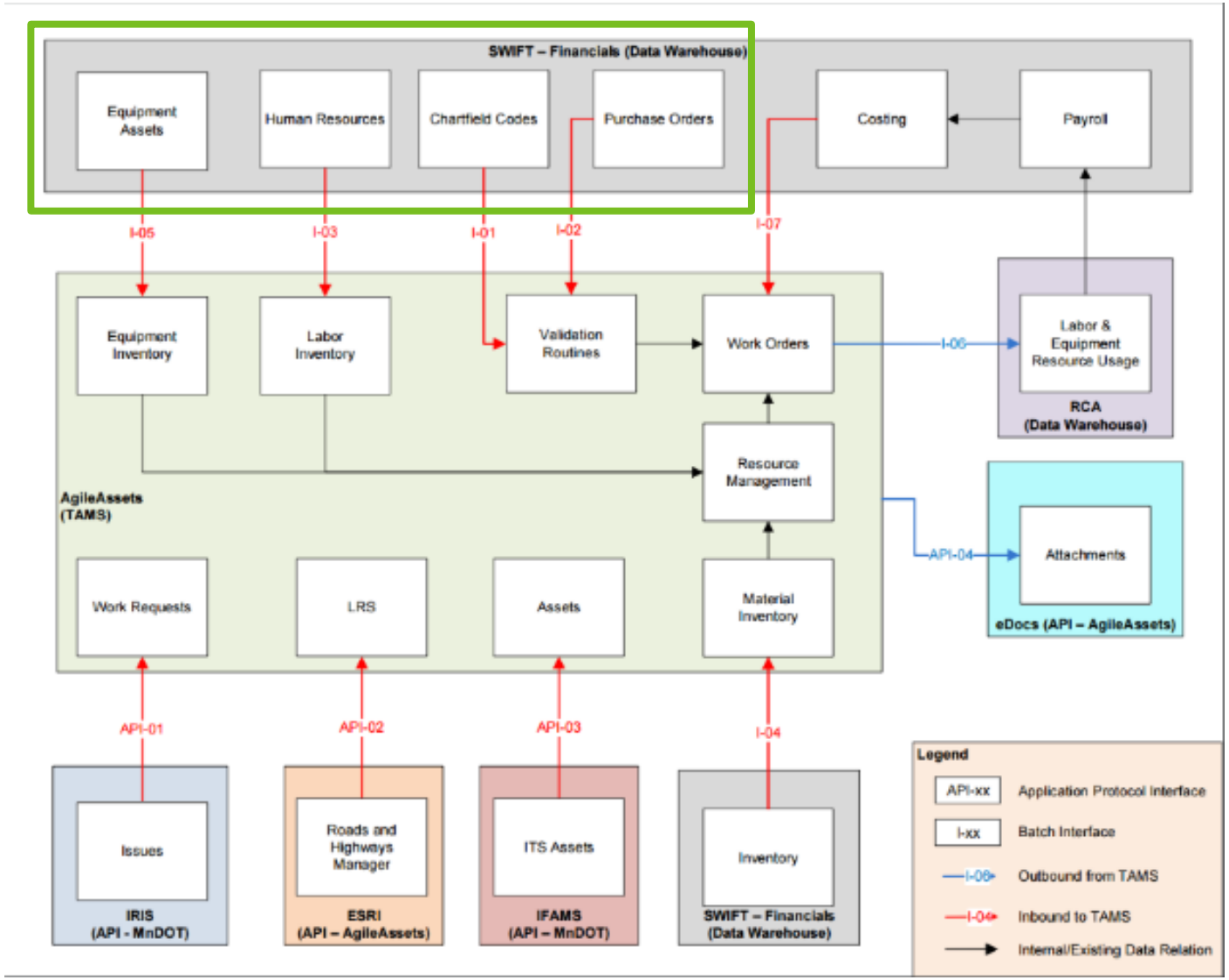
- Two Treatment Strategies.
- Ancillary Asset Did Not Include Network Condition.
- Maintenance Costs Were Estimated For Most Ancillary Assets.

<u>2022 TAMP</u> LCP network-level analysis of system performance

- Additional LCP Strategies.
- Considers Current and Predicted Asset Network Condition.
- Utilize Historical Cost Data
  - Maintenance Management System (TAMS)
    - ➢ Labor$, Equipment$, Materials$



Ancillary Maintenance Management System Integration Diagram



Life Cycle Planning Details By Asset Class

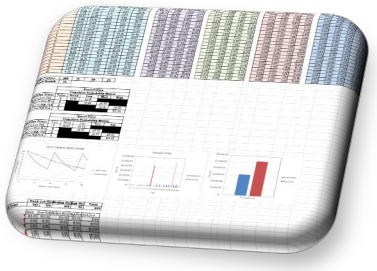
Asset Class	Tool	Strategies	Maintenance Costs Included?
Pavements	Highway Pavement Management Application	Baseline, Low-Volume Roads, Concrete Pavement, No Preservation	Yes
Bridges	Bridge Replacement and Improvement Management Application	Preservation, Worst-First	Yes
Buildings	Archibus System and Analysis	Facilities 20-year Strategic Plan	Yes
Highway Culverts	Markov Deterioration Model in Advanced LCP Spreadsheet	Desired and Current	Yes
Deep Stormwater Tunnels			
ITS Assets			
Noise Walls*			
Signs			
Signals			
Lighting			
Pedestrian Facilities			

Thank you! Applied Pavement Technology

*The analysis utilized actual deterioration curve data from inspections

Ancillary Assets
Advanced LCP Spreadsheet Inputs

- Percent of Current Asset Network In Good/Fair/Poor Condition
- The Number of Assets Added Each Year
- Length of Time To Transition From One Condition State To Another
- Maintenance or Inspection Activity, Frequency, Cost, & Impact To Asset Condition
- Capital% Versus Maintenance% Funding



TREATMENT	% ANNUALLY TREATED IN GOOD CONDITION	% ANNUALLY TREATED IN FAIR CONDITION	% ANNUALLY TREATED IN POOR CONDITION	UNIT COST ($/ ASSET
Reactive Maintenance	1%	2%	3%	$90,000
Inspection	20%	20%	20%	$200
Major rehab	0%	0%	5%	$19,000
Replacement	0%	0%	3%	$125,000

CURRENT CONDITION	REACTIVE MAINTENANCE	INSPECTION	MAJOR REHAB	REPLACEMENT
Good	Good	Good	N/A	N/A
Fair	Fair	Fair	N/A	N/A
Poor	Poor	Poor	75% to Good and 25% to Fair	Good

MnDOT Life Cycle Planning Results

- 10 Year Projected Condition - Each Strategy
- 10 Year Investment Need - Each strategy
  - Maintenance Bucket
  - Capital Bucket
- Key Takeaways

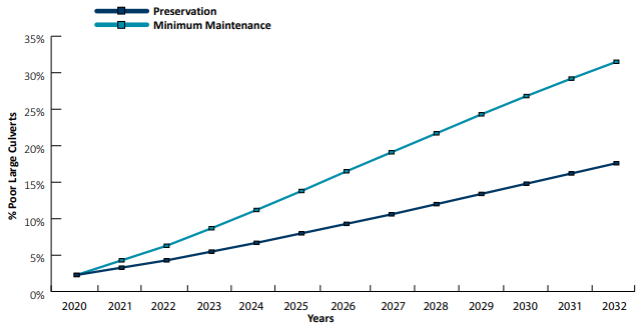
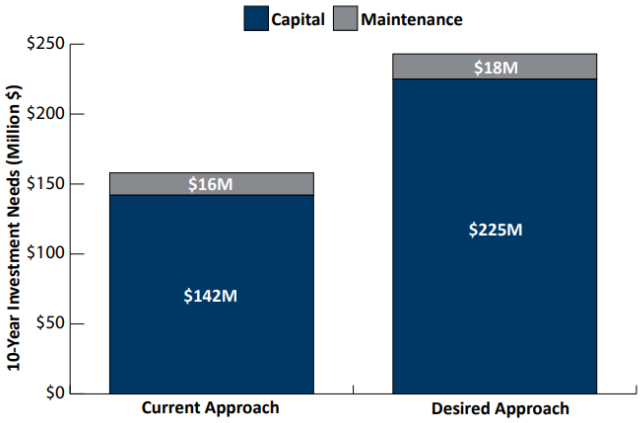


Figure 6-46: 10-Year Investment Needs for Curb Ramps



Pavement Treatments and Costs

- ✓ Treatment Decision Tree's programmed into PMS
- ✓ Cost Information Coming from Pay Items and TAMS MMS

Figure 6-3: Typical Treatments and Associated Costs for Asphalt-Surfaced Pavements

TREATMENTS	FHWA TREATMENT CATEGORY	COST PER LANE-MILE
Reclaim and Overlay, Urban Regrade, Rural Regrade, Concrete Replacement, Unbonded Concrete Overlay	Reconstruction	$268,000 - $2,615,000
Medium Mill and Overlay, Major CPR and Grinding, Cold In-Place Recycling, Thin Mill and Overlay, Crack/Seal and Thick Overlay, Major CPR, Medium Overlay, Micro-mill and UTBWC, Minor CPR and Grinding, Reclaim and Whitetopping, Thick Mill and Overlay, Thin Overlay, UTBWC, Whitetopping, Hot In-Place Recycling	Rehabilitation	$101,000 - $640,000
Chip Seal, Crack Seal, Crack Fill, Joint Seal	Preservation	$3,000 - $31,000

CPR: Concrete Pavement Restoration; UTBWC: Ultra-thin bituminous wearing course

<u>Future Improvements Pavements</u>

- New Pavement Management System Project Underway
- TAMS MMS integration with AASHTOware Capital Project Costs (Pay Items)

Bridge Treatments and Costs

- Internal Staff Perform Preventive Maintenance Activities
  - Flushing – Annually or As Often As Constraints Allow
  - Crack sealing – 5 Year Cycle
  - Other Repairs (deck sealing, poured joint sealing, cleaning and lubricating bearings, rail sealing, painting) – In Response to Inspection/Element Condition
- Activity Recorded in Bentley AssetWise
- Internal Maintenance Cost By Activity - MnDOT Timesheet System.

Figure 6-9: Cost of Bridge Treatments and Actions

TREATMENTS AND ACTIONS	FHWA TREATMENT CATEGORY	COST
Culvert	Reconstruction	$144 Sq. Ft.
Early Materials	Reconstruction	N/A
New Bridge	Reconstruction	$174 – $302 Sq. Ft.
Pedestrian Bridge	Reconstruction	$1M - $4M per bridge
Temporary Bridge	Reconstruction	N/A
Deck Replacement	Rehabiliation	$74.40 Sq. Ft.
Major Widening	Rehabiliation	$229 Sq. Ft.
Superstructure Replacement	Rehabiliation	$131.60 Sq. Ft.
Bridge Painting	Preservation	$18.60 - $21.70 Sq. Ft.
Deck Overlay	Preservation	$9.70 Sq. Ft.
End Posts	Preservation	$9000 Corner of Bridge
Joint Replacements	Preservation	$1144 - $3432 Linear Foot
Railing or Median Barrier Replacement	Preservation	$225 - $350 Linear Foot
Substructure Repairs or Pier Struts	Preservation	$160 - $200 Linear Foot Substructure. Pier Struts $1100 Linear Foot
Preventive Maintenance (Set aside in STIP and CHIP)	Maintenance	$5.70 - $13.70 Sq Ft
Bridge Portion of BARC (Set aside in STIP and CHIP)	Maintenance	N/A
Crack Sealing	Maintenance	$3.00 Linear Foot

Life Cycle Planning Process
Highway Culverts

TREATMENT	MAINTENANCE FUNDING	CAPITAL FUNDING	UNIT COST ($ PER ASSET)
Inspection	100%	0%	$100
Cleaning	70%	30%	$1,000
Reset ends	20%	80%	$3,900
Joint repair	15%	85%	$3,440
Pave invert	75%	25%	$1,840
Replace ends	33%	67%	$5,630
Slipliner	45%	55%	$14,000
Cured in-place pipe	0%	100%	$19,500
Replace-Trench	10%	90%	$31,500
Replace-Jack	0%	100%	$91,000

Figure C-6: Deterioration Models for Highway Culverts

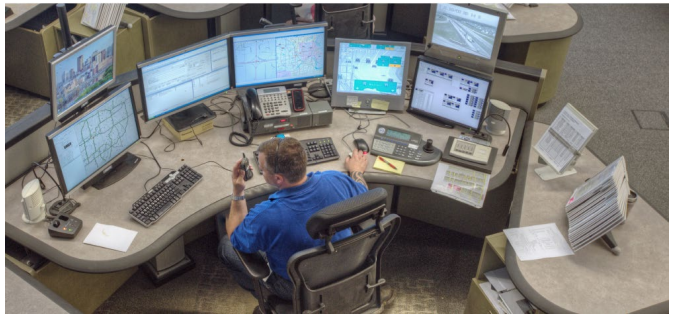
APPROACH	TRANSITION STATES	YEARS	GOOD	FAIR	POOR	VERY POOR
Current	Good to Fair	10	93.3%	6.7%	N/A	N/A
Current	Fair to Poor	14	N/A	95.2%	4.8%	N/A
Current	oor to Very Poor	6	N/A	N/A	89.1%	10.9%
Desired	Good to Fair	10	93.3%	6.7%	N/A	N/A
Desired	Fair to Poor	16	N/A	95.8%	4.2%	N/A
Desired	oor to Very Poor	8	N/A	N/A	91.7%	8.3%

% Treatment Distribution (How many culverts treated in each condition state) By Condition State

Life Cycle Planning Process
Intelligent Transportation System

Figure 6-26: ITS Infrastructure Assets and Typical Treatment Actions

ITS ASSET	TYPICAL TREATMENT ACTIONS
Fiber Network Shelters	Routine, Preventive Maintenance, and Minor Rehabilitation Actions: Filter change, fan checks and replacement, power supply check and replacements, infestation and leak checks, debris removal. Major Rehabilitation: Power supply replacement, fan replacement, HVAC system maintenance. Replacement: Shelter and foundation replacement
Traffic Management System Cabinets	Routine and Preventive Maintenance: Filter replacement, general cleaning, inspection. Minor Rehabilitation: Fan replacement. Major Rehabilitation: Door and lock replacement. Replacement: Cabinet replacement
Dynamic Message Signs	Routine and Preventive Maintenance: Filter change, fan check, pixel board and power supply check, infestation and leak checks, debris removal. Minor Rehabilitation: Fan replacement, power supply replacement. Major Rehabilitation: Pixel board replacement. Replacement: Walk-in DMS and post-mounted DMS installation
Traffic Monitoring Cameras	Routine and Preventive Maintenance: Tilt camera up (to let rain wash the lens of camera). Minor Rehabilitation: Wiper blade replacement. Major Rehabilitation: Repair of internal and external camera components. Replacement: Replacement or upgrade of camera
E-ZPass Readers	Routine and Preventive Maintenance: Annual inspection (five years after installation) to ensure mounting brackets on antennae are in good condition. Minor Rehabilitation: N/A. Major Rehabilitation: N/A. Replacement: Complete replacement of device
Reversible Road Gates	Routine and Preventive Maintenance: Lubrication, hydraulic oil draining and replacement. Minor Rehabilitation: Flasher unit, orange flag replacement. Major Rehabilitation: Hydraulic pump and arm replacement. Replacement: Complete replacement
Ramp Meters	Routine and Preventive Maintenance: None. Minor Rehabilitation: LED bulb replacement. Major Rehabilitation: New indicators (signal body). Replacement: Complete replacement
Fiber Communication Network	Routine and Preventive Maintenance: None. Minor Rehabilitation: Splice in connectors. Major Rehabilitation: Fixing severed cable. Replacement: Complete replacement
Traffic Detection	Routine and Preventive Maintenance: None. Minor Rehabilitation: Splice (loops); recalibration (radar). Major Rehabilitation: Wire pulls (loops); new eletrical wires (radars). Replacement: Complete replacement



Helped to Document and Communicate Consistent Routine & Preventive Maintenance Activities and Costs!!

Life Cycle Planning Results
Highway Culverts

Figure 6-19: 10-Year Performance Trends for Highway Culverts

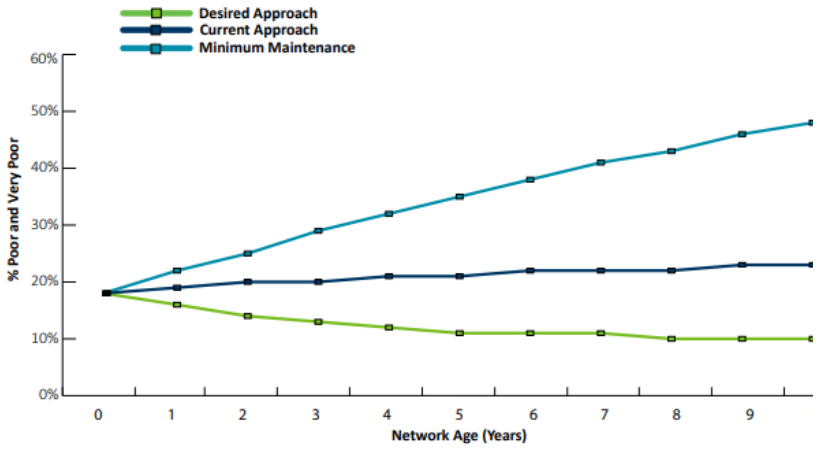
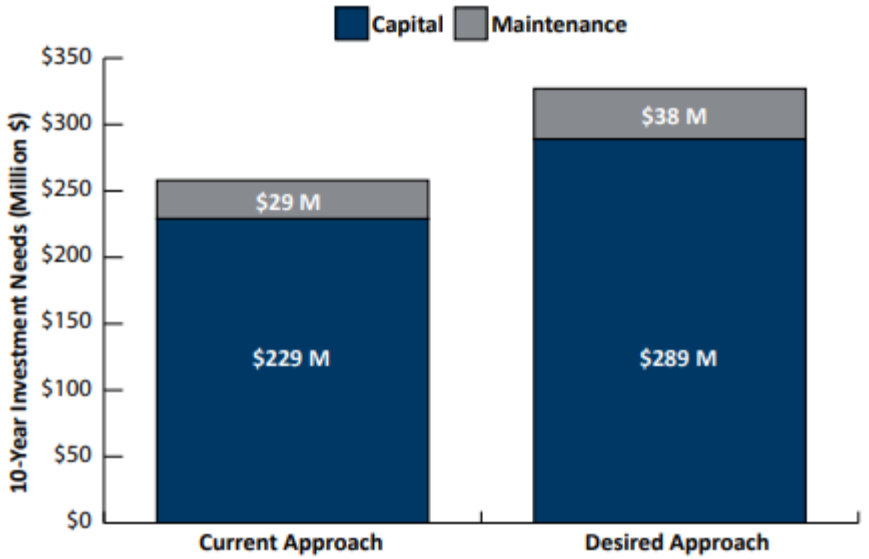


Figure 6-21: 10-Year Investment Needs for Highway Culverts



- As The Network Age Increase; Desired Approach Obtains 10% Network Level Condition.
- Funding Investment Needs to Increase By 31% Under Desired Approach.

Life Cycle Planning Results
Maintenance + LCP

ITS Assets

- Routine and preventive maintenance actions have no impact on asset condition.

Overhead Sign Structures

- An increase in out-of-cycle inspections, helps identify and monitor issues before causing structures to deteriorate. In addition, increase the frequency of nut tightening, rehabilitation, and replacement.

Signals and Lighting

- Utilizing age-based condition and performance targets, thus limiting preventive maintenance's impact to extend asset service life.
- MnDOT staff believe that electrical and structural inspections could extend service life.
- Investing in strategic preventive maintenance for High-Mast Lighting will maintain the assets in a good state of repair over their design life.

Summary

- Incorporating maintenance and capital activities = complete picture of life cycle planning for each asset.
- Data speaks louder than words, generating culture and funding shifts. This data may be used for future maintenance distribution across MnDOT Districts.
- Utilization of Maintenance Cost data for better decision-making reinforcing dedication and accuracy in enterprise asset management systems.

MnDOT's 2022 TAMP is…

More Informative, Compelling, and Useful.

http://www.dot.state.mn.us/assetmanagement/tamp.html

Workshop Exercise

Maintenance Approaches

Approach	Definition
Condition-Driven PLUS (Optimal)	The condition of the asset is routinely monitored and modeled. Actions are taken proactively and reactively to **optimize the asset lifecycle** through minimum lifecycle cost, maximum benefit, maximum life-cycle length, or some similar approach
Condition-Driven	The condition of the asset is routinely monitored, and **actions are taken to manage the long-term performance** of the asset or the assets impact on system performance.
Cyclical-Driven PLUS	The asset is inspected and **maintained on a cyclical** basis, where the inspection and maintenance activities are performed in **simultaneously** or in concert and condition data is collected and maintained for analysis that could lead to additional condition-based decisions. **Condition data required**.
Cycle-Driven	The asset is **maintained on a cyclical** basis. Condition data may be collected on these assets to meet other business needs, but the inspection cycle is **managed separately** from the maintenance cycle. **Condition data not required.**
Reactive	An **inventory is maintained**, but there is **no regular condition data** collection, and **no maintenance performed to slow or address damage** or deterioration until an asset is reported as having an unacceptable defect. Annual work is planned at the aggregate level, without concern for the specific locations of potential future defects.
Minimal Maintenance	**No inventory or condition data** is collected or maintained. Maintenance is performed when assets are identified as having an unacceptable defect.

Thank you

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