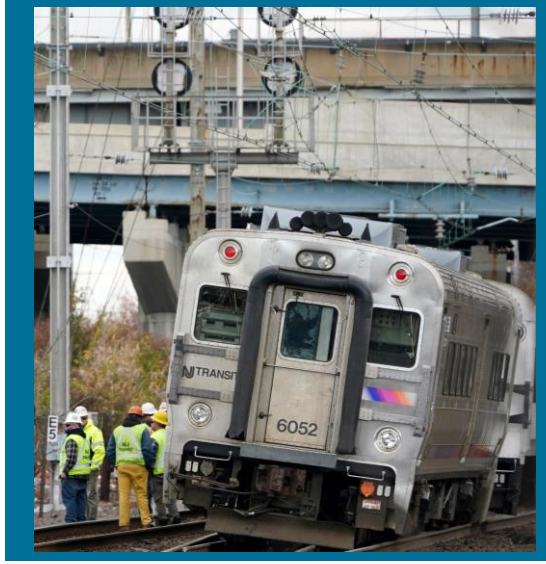
NYSERDA Public Transit Technology and Innovation Program Update

Integrating Decision Making into Enterprise Asset Management (EAM)

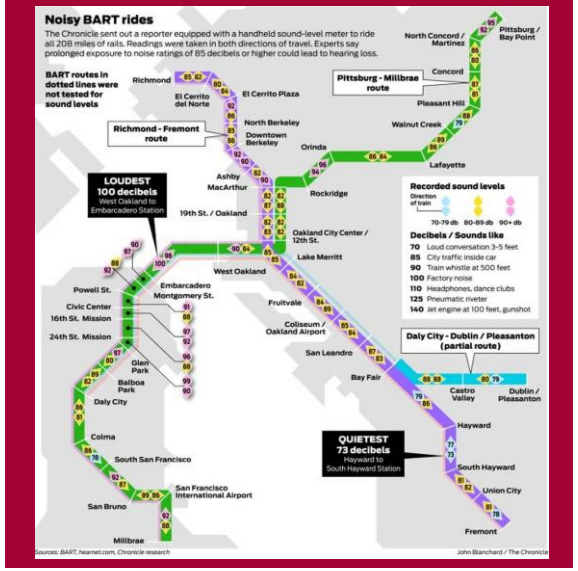
June 21st, 2022

Rail within track infrastructure are hardest assets to budget for State of Good Repair

Ridership



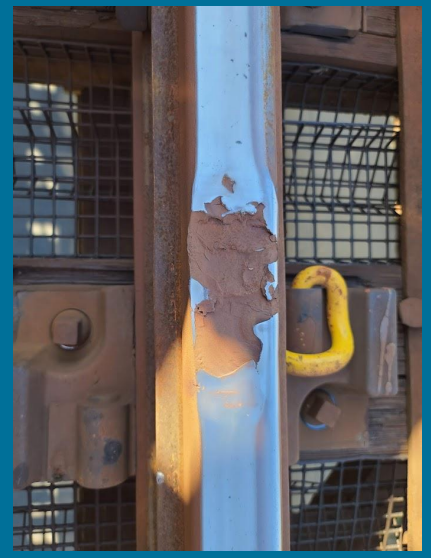
Community



Costs

Rail within track infrastructure are hardest assets to budget for State of Good Repair

Tangent



Curves

Turnouts

Rail within track infrastructure are hardest assets to budget for State of Good Repair

The most consistent pain point was that agencies could not provide evidence to quantify the benefits of preventive maintenance for procurement decision making.

Without this data, agencies could not:

- Request additional preventive maintenance funding
- Protect existing preventive maintenance budgets
- Differentiate quality and performance of maintenance contractors

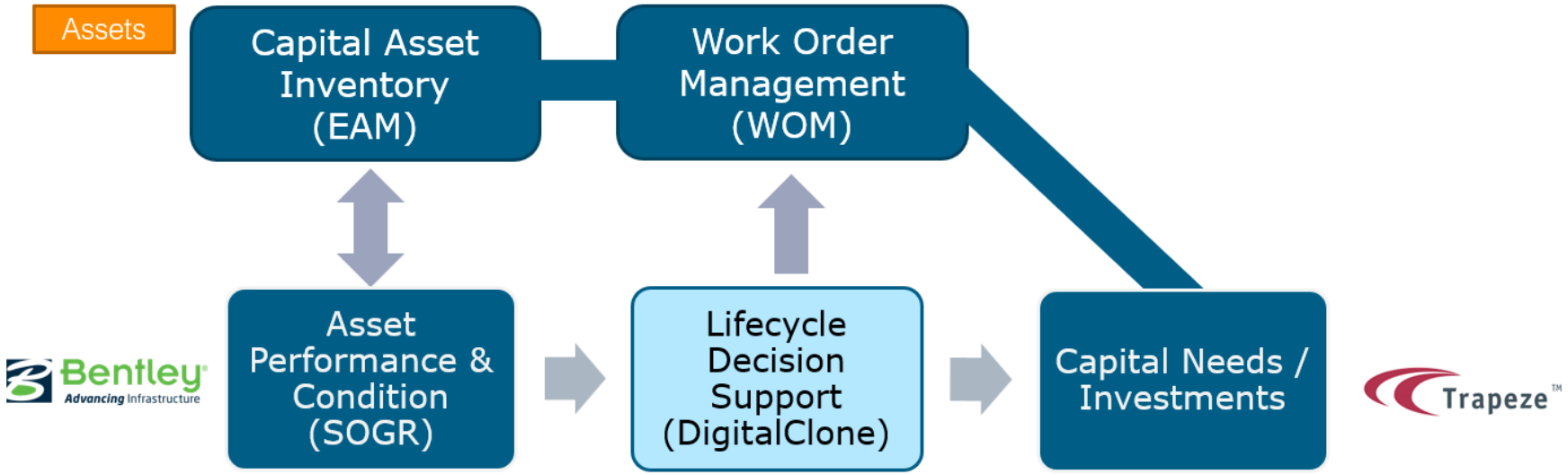
New York State Energy Research and Development Authority (NYSERDA) set-up demonstration at New York City Transit.

for Rail

ECONOMIC MODELS | TRACK MODELS | WHEEL-RAIL MODELS | WEAR MODELS | RCF & GRINDING MODELS | **ASSET MANAGEMENT**

Sentient Science helps railroads **optimize lifecycle strategies** for Rail assets

Trapeze helps railroad **budget & execute** the rail lifecycle strategy in State of Good Repair / Capital Projects EAM modules



Press Release: [TRAPEZE GROUP AND SENTIENT SCIENCE ANNOUNCE NEW COLLABORATION TO HELP TRANSIT AGENCIES BUDGET AND OPTIMIZE RAIL MAINTENANCE INVESTMENTS]

Blog Post: [Get the Rail Maintenance Evidence You Need to Show the Business Case You Want]

for Rail

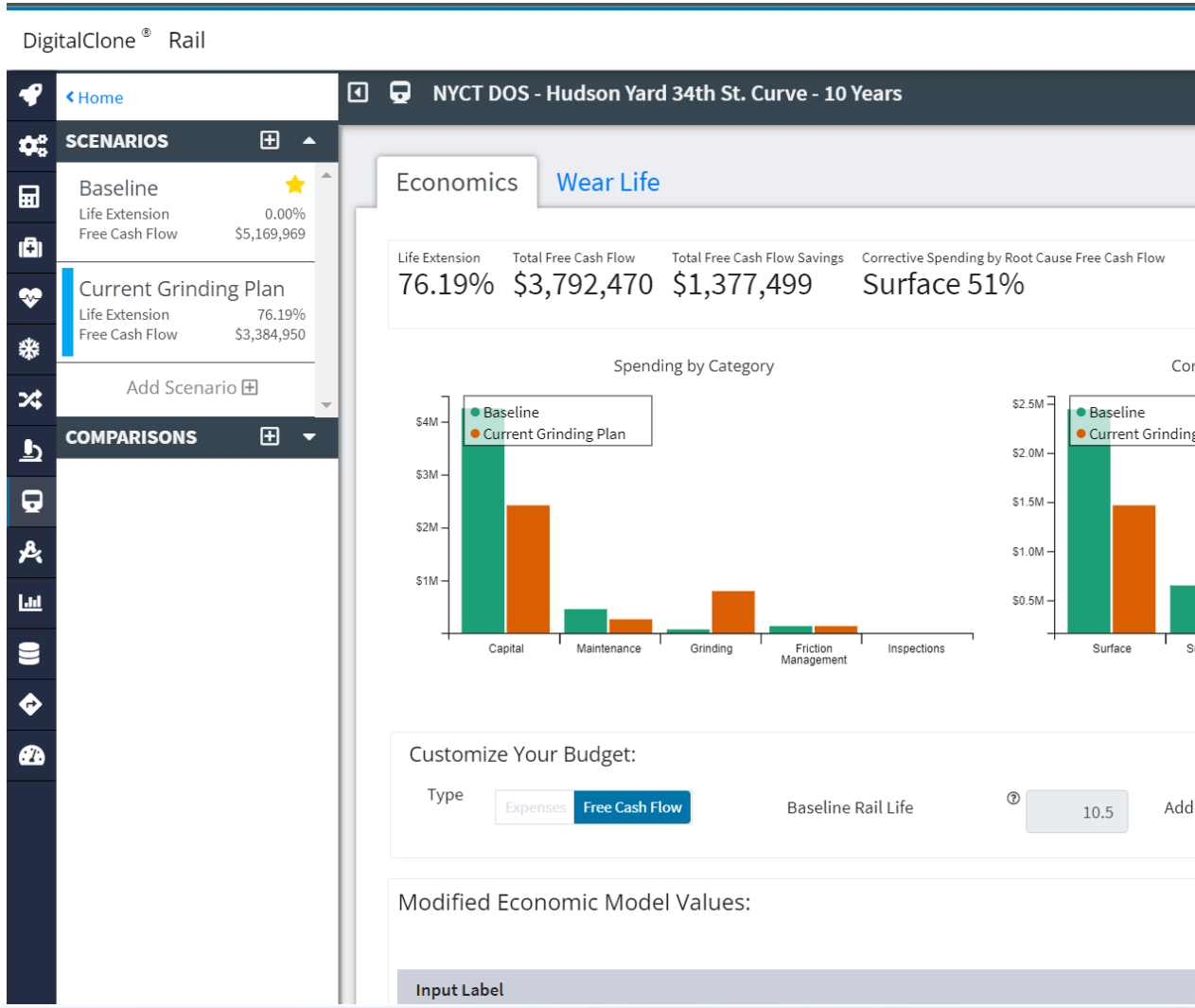
ECONOMIC MODELS | TRACK MODELS | WHEEL-RAIL MODELS | WEAR MODELS | RCF & GRINDING MODELS | ASSET MANAGEMENT

DigitalClone®
for Rail

Precision Maintenance (PMx) Software

Decision Support and Investment Prioritization to:

- Prevent Surface Related & Wear Defects
- Protect Maintenance Budgets with Evidence
- Maximize Rail Life Extension

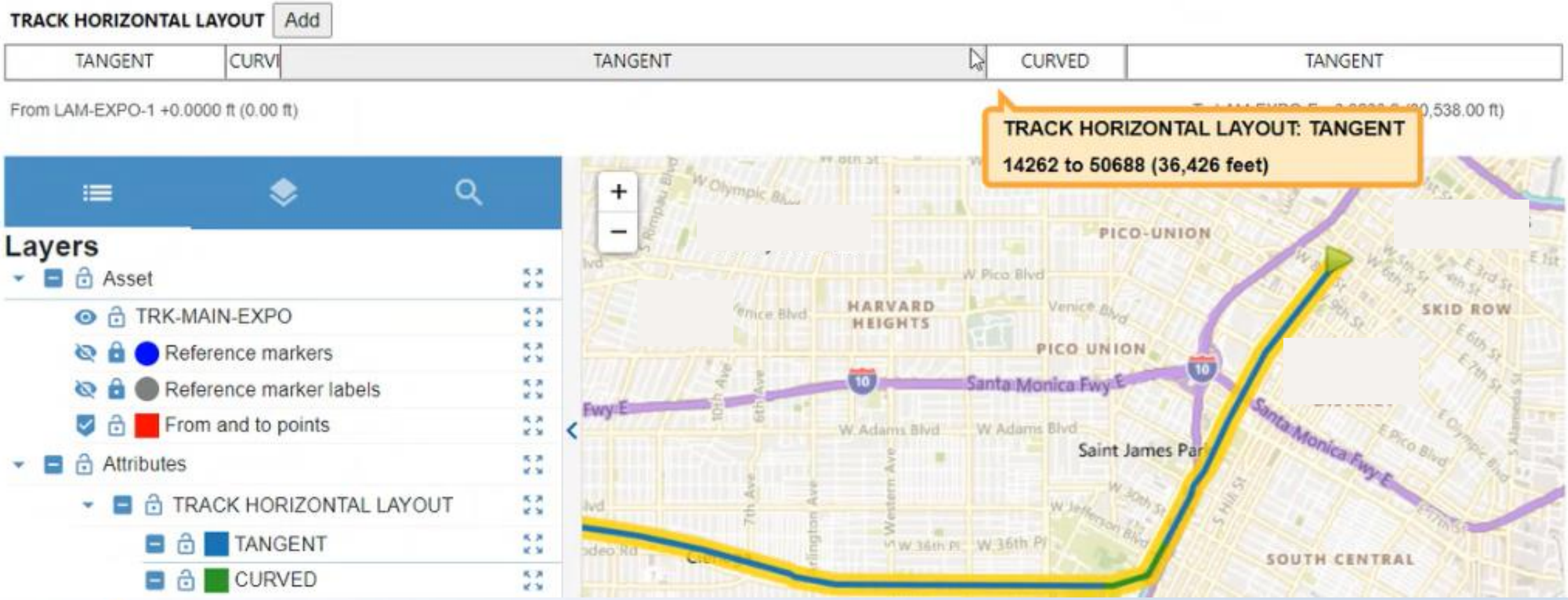


RAIL TRANSIT SEMINAR · JUNE 21

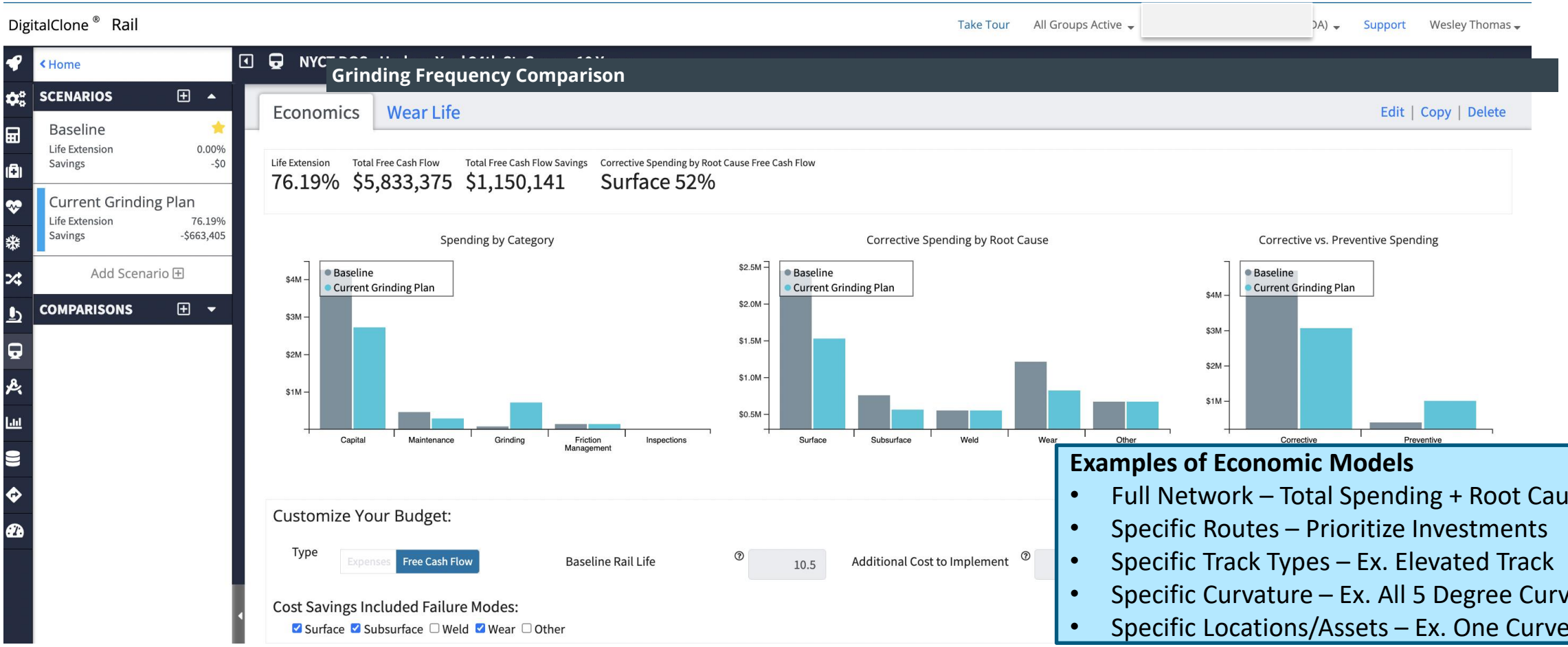
Materials Science. Digitalization. Life Extension.

WRI 2022

Enterprise Asset Management – Linear Asset Registry and Attributes (EAM)



Select Where to Focus – Identify **Total Spending** and **Root Causes** for improvement



Examples of Economic Models

- Full Network – Total Spending + Root Causes
- Specific Routes – Prioritize Investments
- Specific Track Types – Ex. Elevated Track
- Specific Curvature – Ex. All 5 Degree Curves
- Specific Locations/Assets – Ex. One Curve

Enterprise Asset Management – Work Order Management (WOM) Economic Inputs

Parent Work Order ID: SCRRAMOW-2021-92

Job Type:	REPAIR	Date Opened:	03/20/2020 16:18
Status:	OPEN	Date Finished:	__/__/____ __:__
Warranty:	NO	Date Closed	__/__/____ __:__
Account:	E0142-000.170 ... EAST LINE MOW FACILITY	Repair Reason:	C ... WEAR AND TEAR
Priority:	1 ... IMMEDIATE/URGENT	Repair Site:	01 ... FACILITY
Work Class:	2 ... NON-SCHEDULED		
PM Service:	TS4-DU-NS-FR ... TRK INSP; FRI; DUNWOODY TO NORTH SPRINGS ON	PM Scheduled:	03/20/2022 16:21
Standard Job:	...		
Title:	SPOT REPLACEMENT OF UT DEFECT		

Notes

SPERRY ULTRASONIC INSPECTION IDENTIFIED A TRANSVERSE DETAIL DEFECT REQUIRING 39' SPOT REPLACEMENT PER AGENCY MOW STANDARDS. ROLLING CONTACT FATIGUE (RCF) ROOT CAUSE.

Choose an Asset

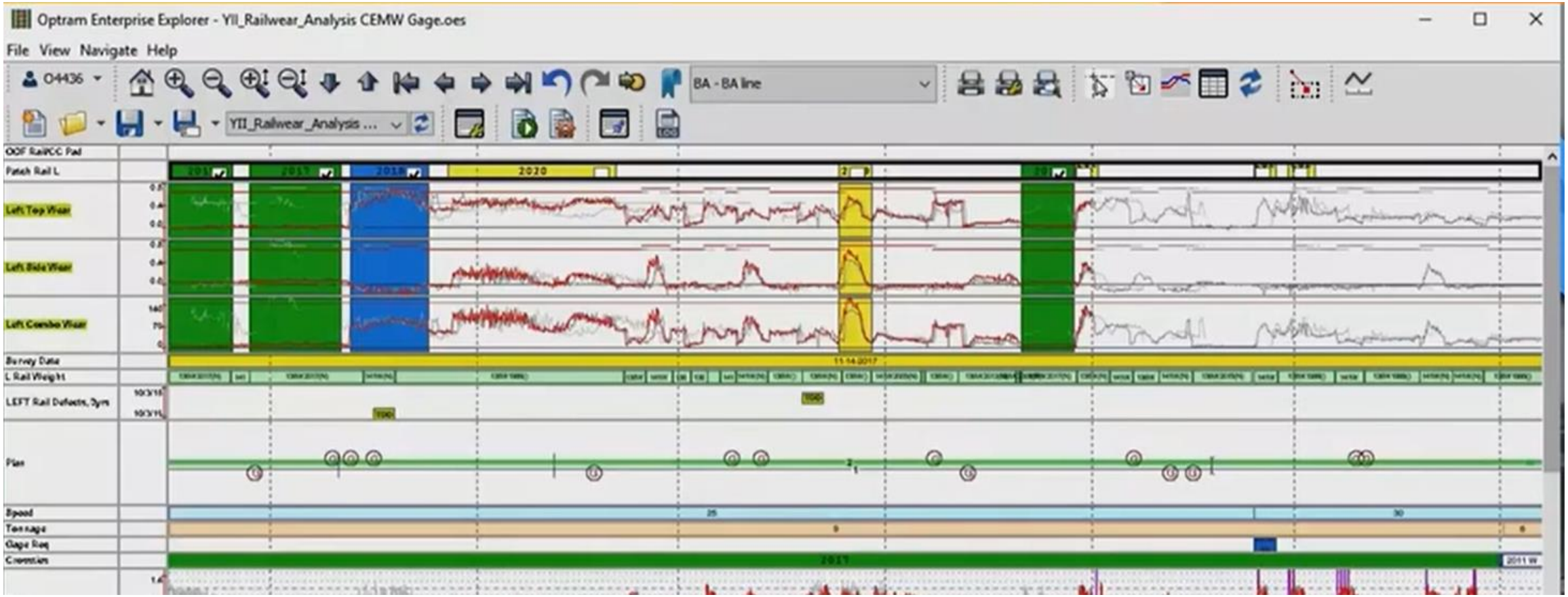
Select Attributes profile

Asset Type TRACK

Work Order Summary Add/Edit Filter

Filter	Edit	Saved Filter	Planning	Pending	Open	Finished
		ALL	133	40	56	134

Select High Risk Rail – Identify **High Wear** and **RCF** locations for improvement

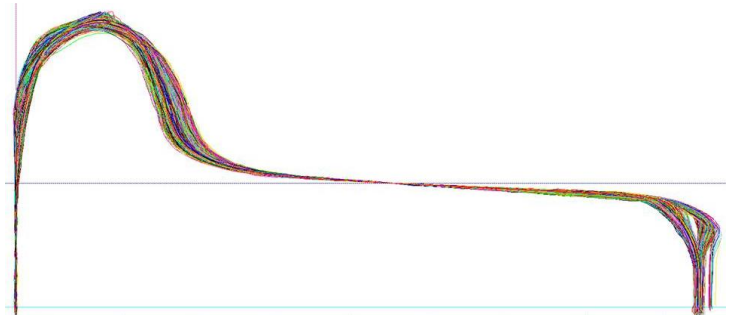


Case Study – Protect **Budget** for **Grinding** Preventive Maintenance on Sharp Curve

2800 foot unguarded curve

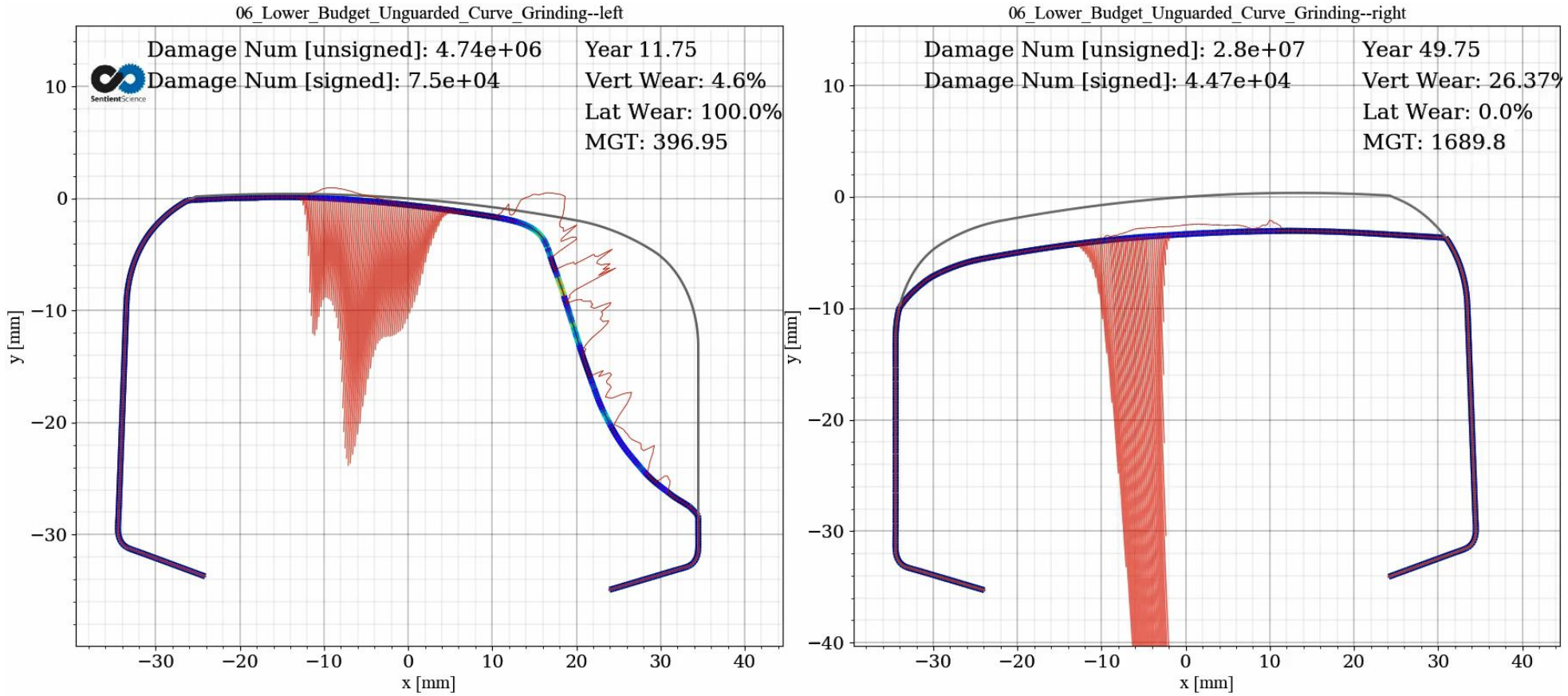
- Ground 2x per year to remove corrugation vs.
- Ground once every 6 years (average of unguarded curves)

Required Data – Set-Up DigitalClone Models

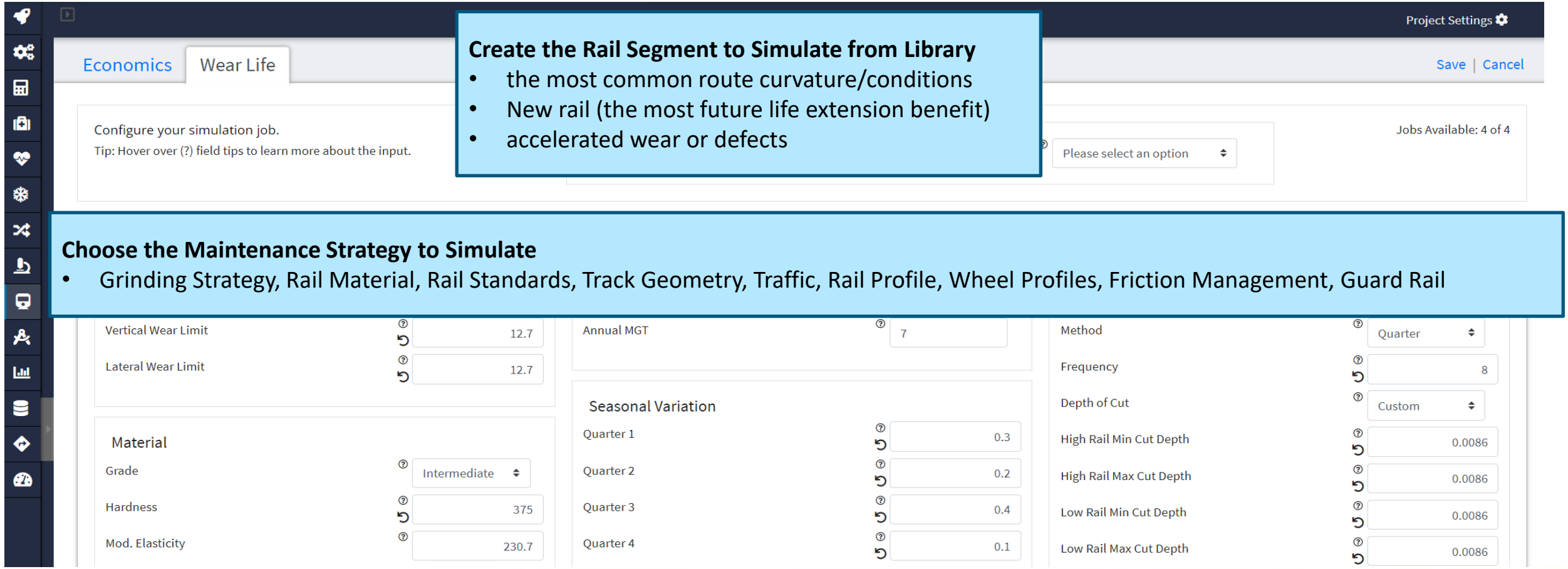


1. **Track Geometry** – curvature, gauge, and super-elevation design
2. **Rail Profile** – rail profile and rail cant
3. **Rail Material** – rail material hardness and modulus of elasticity
4. **Rail Standards** – vertical wear limit, horizontal wear limit, combined wear limit
5. **Traffic** – MGT, speed, traffic direction, and traffic type (i.e. hopper, flat, tanker etc.)
6. **Wheel Population** – wheel profile shapes
7. **Grinding Strategy** – grinding target profile, grinding frequency, grinding depth of cut
8. **Friction Management** – gauge face friction coefficient, top of rail friction coefficient
9. **Guard Rail** – rail profile and guard rail spacing

Model Baseline – Calculate **Life** of rail based on data and maintenance strategy



Select Maintenance – Compare **Life Extension** of different rail maintenance investments



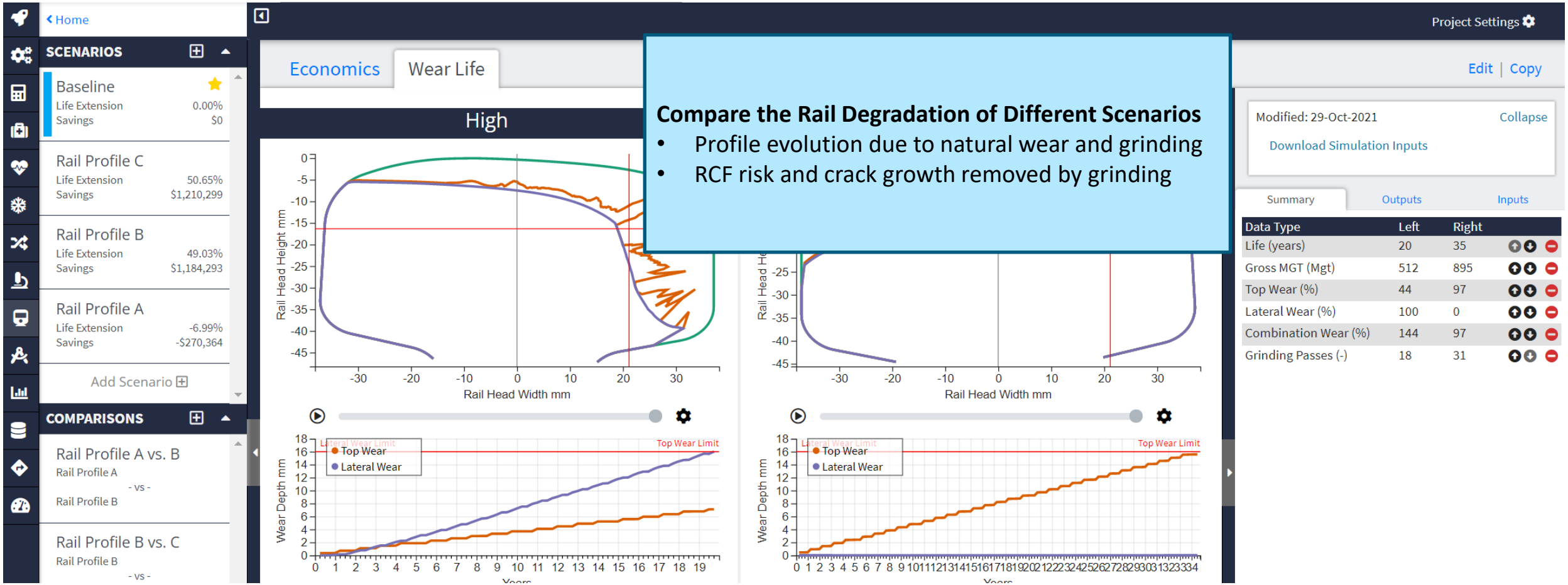
Create the Rail Segment to Simulate from Library

- the most common route curvature/conditions
- New rail (the most future life extension benefit)
- accelerated wear or defects

Choose the Maintenance Strategy to Simulate

- Grinding Strategy, Rail Material, Rail Standards, Track Geometry, Traffic, Rail Profile, Wheel Profiles, Friction Management, Guard Rail

Compare Rail Life – Quantify **Life Extension** of different rail maintenance investments



Compare the Rail Degradation of Different Scenarios

- Profile evolution due to natural wear and grinding
- RCF risk and crack growth removed by grinding

Case Study – Calculated **75% Life Extension** of grinding 2x per year

DigitalClone® Rail

Take Tour | All Groups Active | Sentient Science | Support | Ankur Ashtekar

SCENARIOS

8.84	Curve (deg)	8.84
5.2	Super-Elevation (in)	5.2
34	Annual Traffic (MGT)	34
13.9	Timetable Speed (mph)	13.9
Hudson Yards Curve	Route (Wheels & Traffic Type)	Hudson Yards Curve
115	Rail Weight (lb)	115
Head Hardened	Rail Material	Head Hardened
NRC 2020 Profiles	Grind Profile	NRC 2020 Profiles
204 (Each 6 Years)	Grind Frequency (MGT)	17 (2x Each Year)
.028 / .024 from 10 Passes	Grind Depth (inches)	.028 / .024 from 10 Passes
Lubricated	Friction Level	Lubricated
0.5 / 0.5	Wear Limit (inch)	0.5 / 0.5

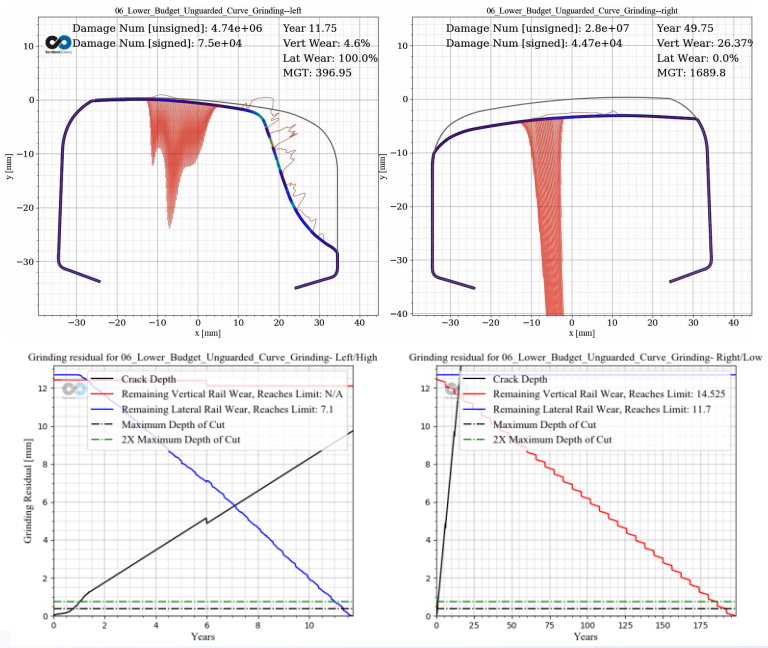
Grinding Frequency Comparison

Settings

Economics | Wear

Edit | Copy | Delete

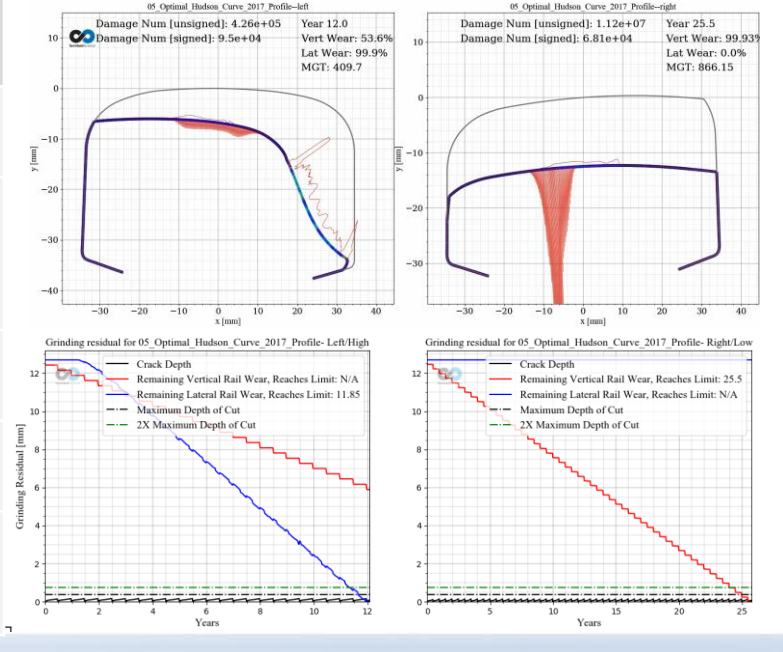
Average Unguarded Curve Grinding Frequency



Life Data

7 / 14 (10.5)	Life (Years) High / Low	11 / 25 (18)
241 / 493 (367)	Life (MGT) High / Low	445 / 865 (665)
4.7 / 28	RCF Damage Number (10^6)	0.4 / 11 -92% / -60%
11 / 49 (30)	Wear Limit High / Low	12 / 25 (18.5)
Lateral / Vertical	Wear Limit Reached	Lateral / Vertical
7 / 14 (10.5)	RCF Crack Limit High / Low	11 / 25 (18)

Current 2x Grinding Frequency



Case Study – Calculated **$1.1M net savings** of grinding 2x per year

DigitalClone® Rail — Take Tour — All Groups Active — Support — Wesley Thomas

Home

SCENARIOS

Baseline
Life Extension 0.00%
Savings -$0

Current Grinding Plan
Life Extension 76.19%
Savings -$663,405

Add Scenario

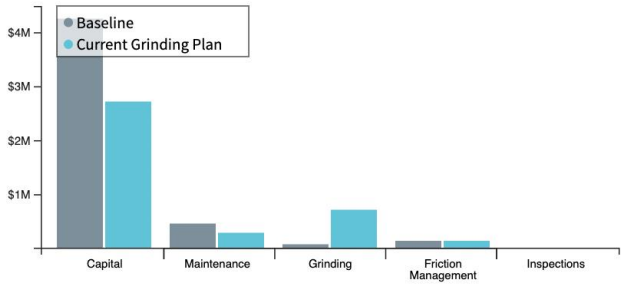
COMPARISONS

Grinding Frequency Comparison

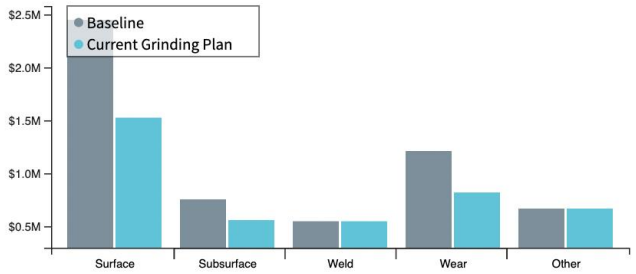
Economics | Wear Life — Edit | Copy | Delete

Life Extension	Total Free Cash Flow	Total Free Cash Flow Savings	Corrective Spending by Root Cause Free Cash Flow
76.19%	$5,833,375	$1,150,141	Surface 52%

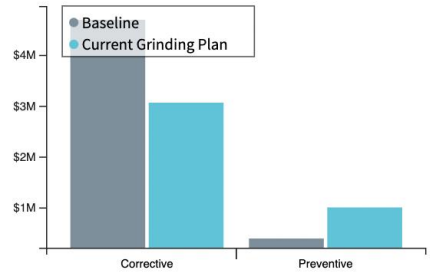
Spending by Category



Corrective Spending by Root Cause



Corrective vs. Preventive Spending



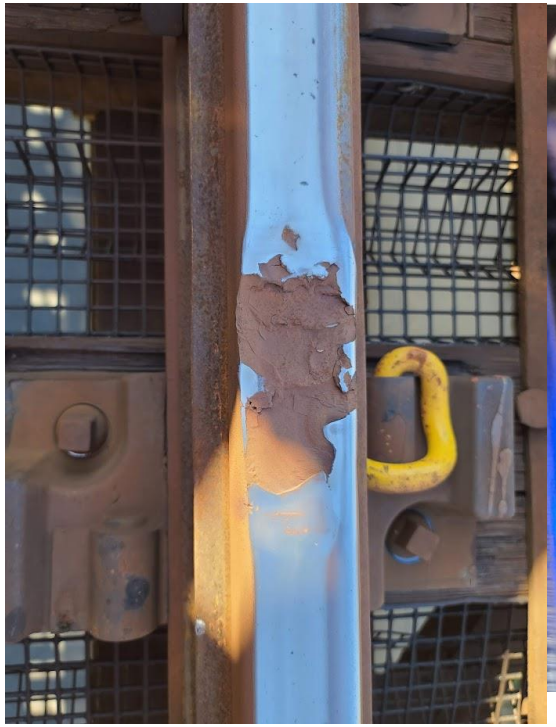
Customize Your Budget:

Type: Expenses | Free Cash Flow — Baseline Rail Life: 10.5 — Additional Cost to Implement: 0

Cost Savings Included Failure Modes:

☑ Surface ☑ Subsurface ☐ Weld ☑ Wear ☐ Other

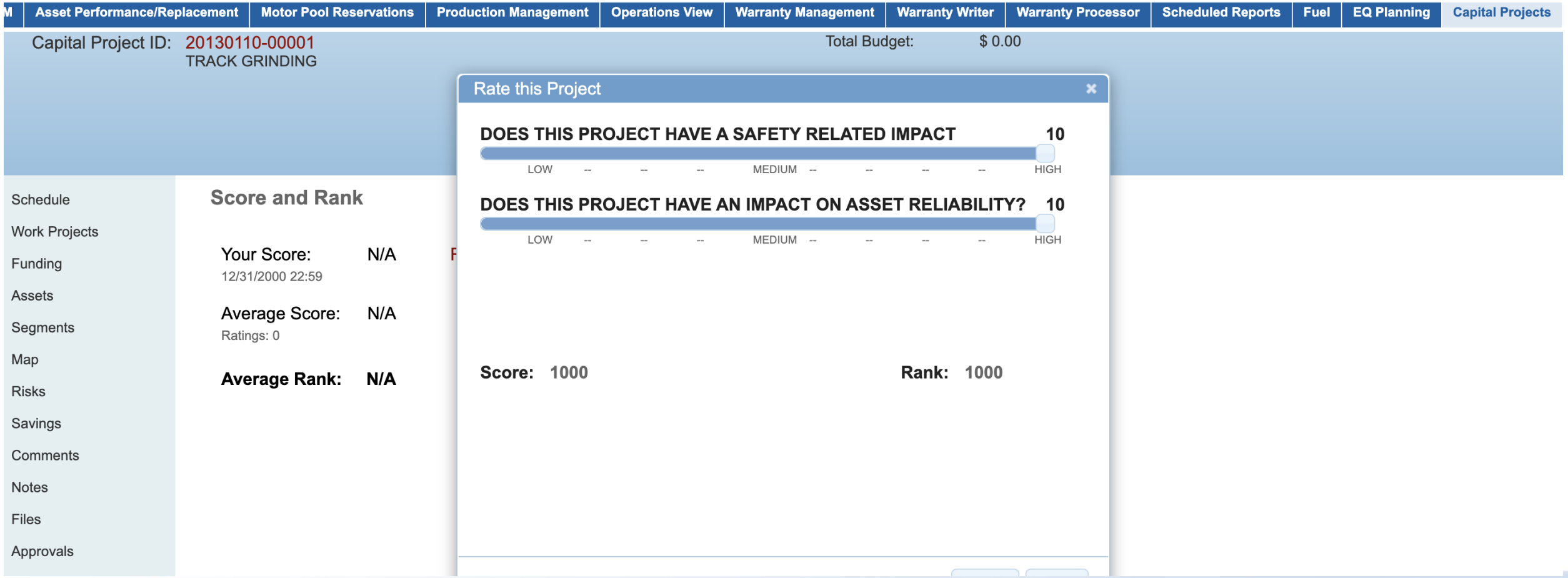
Case Study – Identified defect clusters where milling was more economic than replace



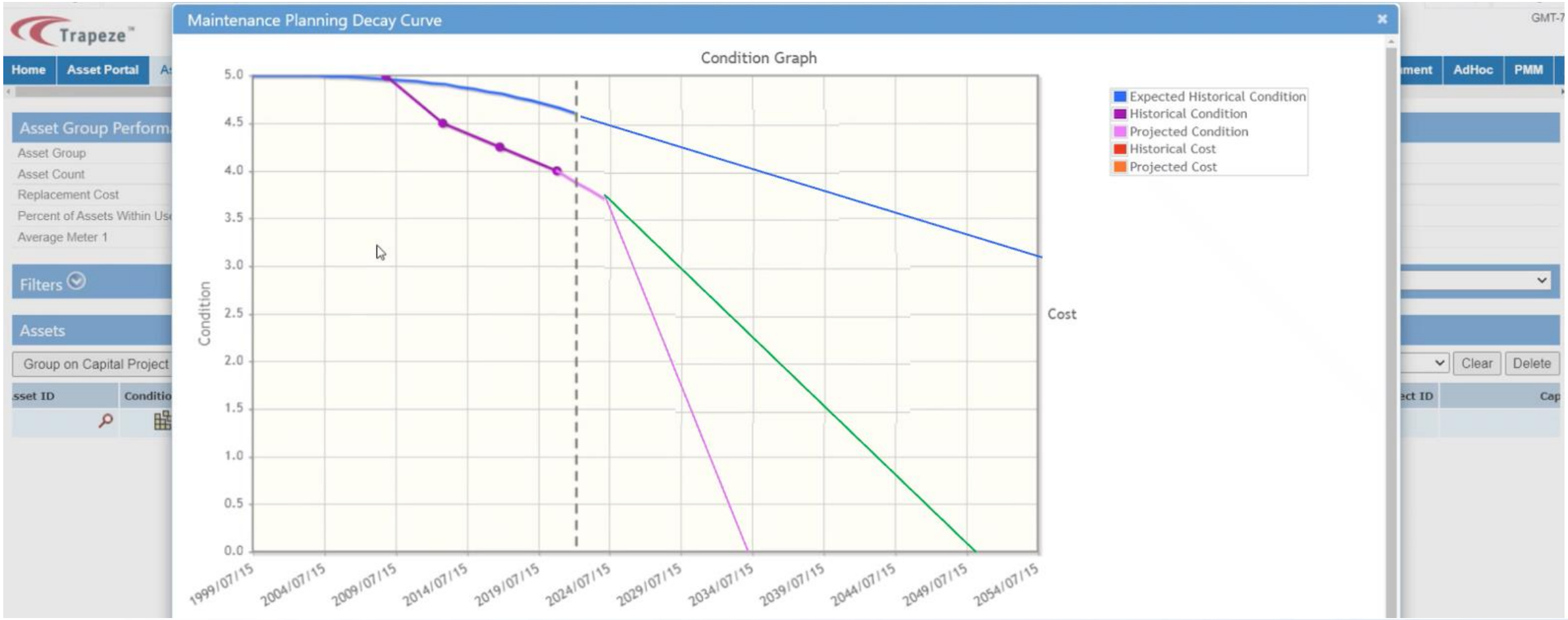
Select Best Maintenance Strategy – Cost/Benefits of different maintenance scenarios

1. **Grind Planning –** Determine the ideal grinding frequency and depth for each rail segment based on its condition & future life
2. **Grinding Profile Optimization** - Design new rail profiles optimized for the whole railroad to extend rail life and reduce costs, and determine if condition-specific profile design would provide rail life extension and financial savings
3. **Grind Quality Index (GQI) Optimization** - Determine the life extension benefit of increasing grind quality index (GQI) vs. the additional cost of grinding
4. **Depreciation Studies** - Quantify the average service life of the Rail assets and quantify the overall improvement of average service life achieved due to life extension recommendations performed from 2020 to 2025 to help reduce depreciation operating expense.
5. **Prioritize Life Extension Factors -** Rank rail maintenance changes (including grinding profile, grinding frequency, grinding depth, material hardness, and coefficient of friction) based on their overall impact to different degrees of curvature
6. **Select Rail Material -** Compare the life extension between different rail material grades and vendors to recommend optimal track curvature to install each type of rail
7. **Set New Track Geometry Economic Standards -** Determine the impact of track geometry irregularities on life extension & costs
8. **Optimize Life Extension of "Problem Curves" -** Identify curves with historical rates of higher wear rate, and perform simulations of these specific curves to identify the optimal life extension actions
9. **Optimize Friction Management Strategy and Maintenance -** Compare different levels of coefficient of friction on their network (i.e. based on the uptime on the wayside lubrication system) and compare different vendors of friction modifiers
10. **Capital Planning –** Provide a degradation model of how each rail segment life is changing over time to help with planning for future capital requirements and reducing this spend

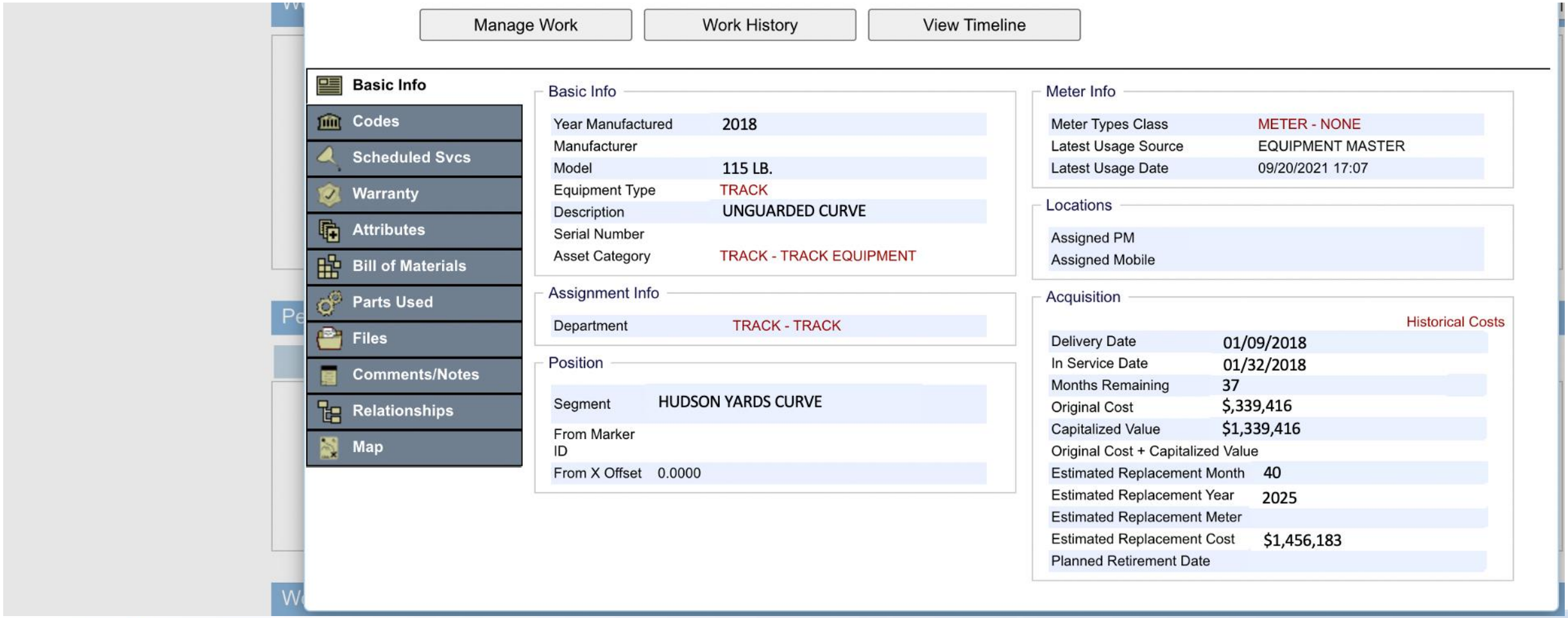
Enterprise Asset Management – Create Capital Projects to Request Funding for Maintenance



Enterprise Asset Management – Update State of Good Repair (SOGR) Decay Curves



Enterprise Asset Management – Update Asset Expected Service Life due to Maintenance



Enterprise Asset Management – Update 5-Year and 20-Year Capital Plan

ID	Description	Program Category	Status	Project Rank	Percent of Funding	Start Date	End Date	Goals
GREENLAKE FACILITY MAINT.	GREENLAKE - LIGHTING UPGRADE	FACILITIES	CANDIDATE	N/A	$ 0.00 / $ 2,800,000.00	03/01/2026	06/01/2027	
20161114-00002	2022 HVAC SYSTEM SGR - REPLACEMENTS	FACILITIES	CANDIDATE	550	$ 600,000.00 / $ 568,750.00	01/01/2022	08/29/2022	MODERNIZATION
20150908-00001	SOUTH OPS MAINTENANCE ROOF REPLACEMENT	FACILITIES	CANDIDATE	575	$ 0.00 / $ 675,000.00	11/16/2022	04/29/2024	
20150421-00001	BRIDGE RENOVATION FOR LEWIS STREET BRIDGE	MAINTENANCE OF WAY	CANDIDATE	325	$ 3,300,000.00 / $ 3,750,000.00	04/20/2020	09/20/2021	
20140605-00006	WEST LINE SIGNAL REPLACEMENT	MAINTENANCE OF WAY	CANDIDATE	50	$ 13,270,000.00 / $ 7,380,000.00	11/24/2015	12/31/2028	URBAN GROWTH, MODERNIZATI
20130919-00002	PROJECT TO REFURBISH PEDESTRIAN BRIDGES	FACILITIES	SUBMITTED	800	$ 614,150.00 / $ 695,750.00	10/01/2021	12/12/2022	
20130802-00002	REFURBISHMENT OF NORTH HIGHLAND RAIL PLATFORM	FACILITIES	CANDIDATE	375	$ 6,685,000.00 / $ 7,900,000.00	06/01/2024	11/01/2026	

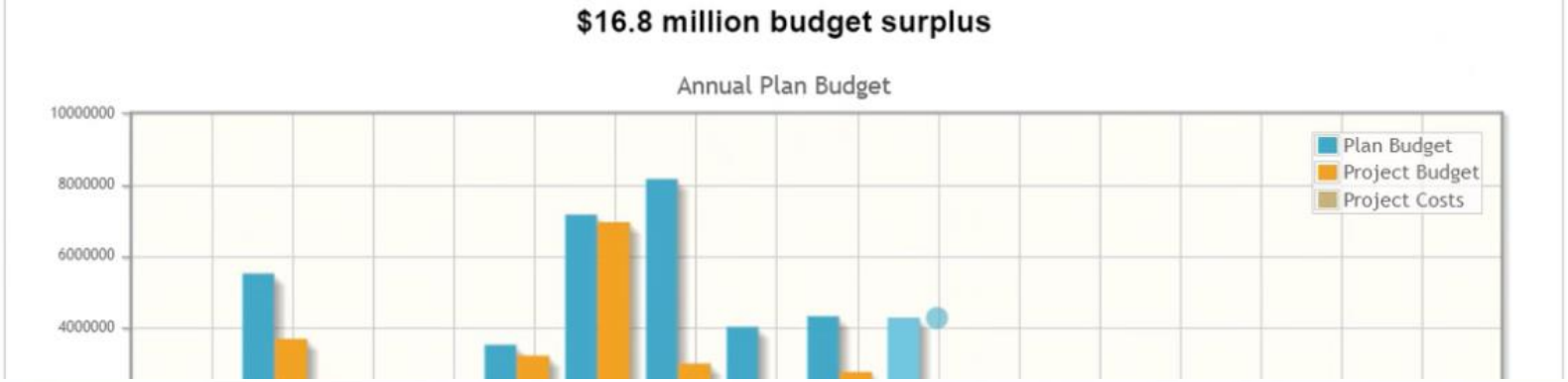
Showing 8 records

Goals Add

39%
GREENHOUSE GAS REDUCTION
30% CO REDUCTION
30% OZONE REDUCTION
30% PM REDUCTION

100%
GOLD LINE EXPANSION
STATION ACCEPTANCE
VEHICLE ACCEPTANCE
WAYSIDE ACCEPTANCE

Plan Metrics



Thank You

Reach Out:

- **Free** Economic Tools
- **Data** Quality Guidance
- Program **Updates**

Acknowledgements: Alexandre Woelfle (NRC-C), Eric Magel (NRC-C), Wei Huang (NRC-C), Wesley Thomas, Ashkan Darbani (Sentient), Mark Reimer (ARM), Tom Lamb (NYCT), Tony Cabrera (NYCT), Rob Sarno (NYCT) +