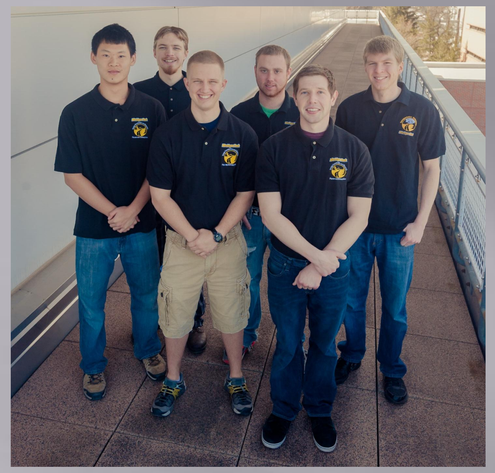


Rail Lubrication Assessment for Lake Superior & Ishpeming Railroad

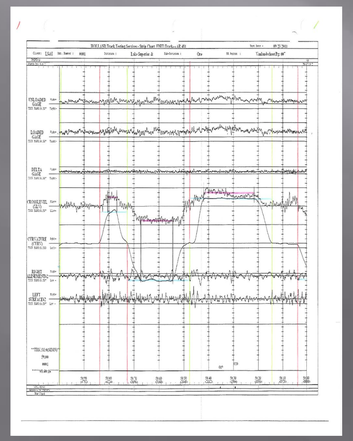
Transportation Enterprise

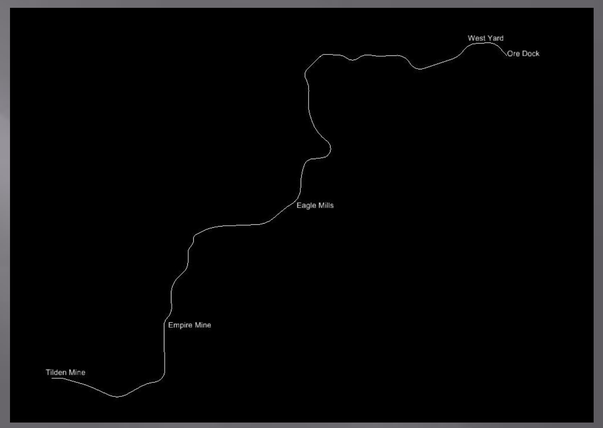
Why is Rail Lubrication Important?

The friction between the wheel and rail cause significant energy losses and accelerate rail and wheel profile deterioration. Proper lubrication of the rail-wheel interface reduces the overall rolling resistance of the train which directly reduces Fuel Consumption. Additionally lubrication extends the life expectancy of both the rail and wheels which helps reduce the maintenance required to keep the system running.

Project Scope

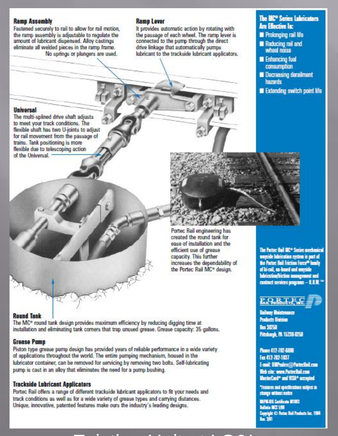
Lake Superior and Ishpeming Railroad (LS&I) is owned and operated by Cliffs Natural Resources, one of the largest mining companies in North America. The Michigan mines ship their product by rail to either Escanaba, MI or Marquette, MI. LS&I focuses on shipping several million tons of iron ore pellets to the Marquette Ore Dock 20 miles away. The operations run 24/7 for most of they year along a curvy single mainline track with limited capacity for maintenance activities. Upon initial inspection of the track, it became evident that the super-elevation of the track must be modified in order to achieve optimum performance of the new recommended system.



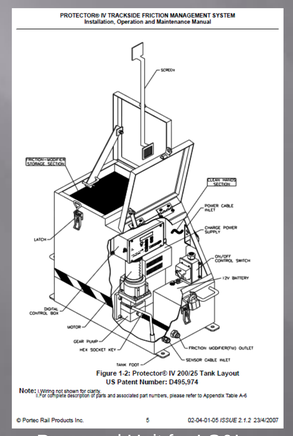


Left: A map of the track at LS&I. The quantity and severity of curves along the track, coupled with the fact that excessive wear on the gage (inside) face of the rail occurs throughout curves led the team to suggest gage face lubrication to protect the rails in the curves.

Below: A picture of the team visit to LS&I to better understand their operations and existing lubricator conditions



Existing Unit at LS&I



Proposed Unit for LS&I

Above: Sample Geometry car script sheet

Left: Super-elevation spreadsheet compiled based off of Geometry car data

Location			Curvature		Superelevation			
MP Start	MP End	Curve Length	Chart	Geo. Car	Chart	Geo. Car	Equilibrium	Difference
55.68	55.78	475.2		1.5		0.5	0.42	0.08
56.66	56.92	1372.8		4		1.5	1.12	0.38
56.04	56.38	1795.2		4		1.5	1.12	0.38
57.16	57.34	1161.6		1.5		1	0.42	0.58
57.40	57.54	739.2		4		1	1.12	0.12
57.78	58.04	0.26		4.00		1.25	1.12	0.13
58.15	58.48	0.33		5.00		1.50	1.40	0.1
58.48	58.72	0.24		4.00		1.50	1.12	0.38
58.72	58.84	0.12		3.50		1.00	0.98	0.02
59.00	59.36	0.36		2.50		1.00	0.70	0.3
		0.00		5.00		0.75	1.40	0.65
59.88	60.26	0.38		4.75		1.00	1.33	0.33
60.26	60.46	0.20		3.75		1.00	1.05	0.05
60.76	60.91	0.15		3.00		1.50	0.84	0.66
60.92	61.01	0.09		5.00		1.25	1.40	0.15
61.09	61.26	0.17		2.00		0.75	0.56	0.19
61.64	62.07	0.43		2.00		1.00	0.56	0.44

Project Outcomes

- Recommendation for new lubrication system equipment and placement
- Cost benefit analysis of proposed lubrication system
- Recommendation of new track super-elevation

CLIFFS