



Using OpenTrack to evaluate Rollingstock and Infrastructure Projects in Queensland Rail

PREPARED BY
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David Lassen – Queensland Rail

Network Capability Manager

David Lassen

- Queensland Rail Since 1985
- Started as a Nipper for a Bridge Gang
- Moved to Train Control
- Introduced to timetable planning system
- Capture Proving and Mtrain, written in Fortans running on DOS
- Timetable design for 11 years
- Moved to below rail assets in Network
- Created Network Capability 10 years ago
- Introduced OpenTrack and OpenPowerNet user for 8 years



Rolingstock Upgrade

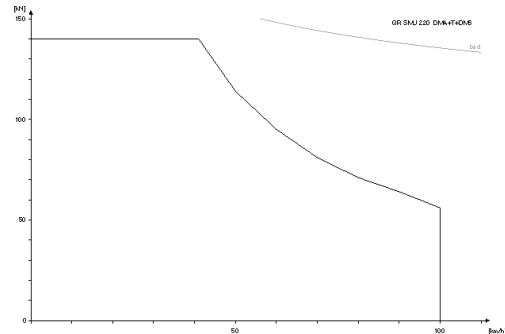
How can we help you?

New Traction Package Proposal

SMU200

- Vehicle Details

Constructed -1994-1995
 Maximum speed - 100 km/h
 Braking system - Blended Regenerative electric and electro-pneumatic
 Fleet 201 – 212, Twelve 3 car vehicles
 Current OpenTrack Configuration



Trains - Edit

Train Name: QR SMU 200 (6 Car) Default

Description:

Type: Commuter / Regio Train

Category: 6 Car SMUM/UMU

Engines

Pos.	Name	Load [t]	Len. [m]	E [m]		Delete
1	QR SMU 200 DM+M+DT	123.000	71		55.00	
2	QR SMU 200 DM+M+DT	123.000	71		55.00	Add

Σ Load [t]: 246.000 Σ Len. [m]: 142

Trailers

Pos.	Name	Load [t]	Len. [m]	P Loss [kW]	No. of	Delete
1						Add

Σ Load [t]: 0.000 Σ Len. [m]: 0

Resistance Equation

Rolling: Strahl / Southoff Formula

A: B: C: Unit: N below Speed [km/h]

Starting Res. [N/t]

Gradient: Distributed Mass per Train

Curve: RocoK Formula 1000 mm (Trains) [%]: 50.0

Acceleration (Train related Settings)

Max. Acceleration [m/s²]: 0.80 Max. Drawbar Force [kN]:

Acc. Delay [s]: 0 Min. Time to hold Speed [s]: 30.0

Acc. Delay at Stop [s]: 0

Deceleration

Deceleration Function: Default

From [km/h]	To [km/h]	Dec. [m/s²]	Delete
0	v max.	-0.90	Add

Braked Weight Percentage (BWP) [%]: 100

$a = -(C1 + C2 \cdot BWP)$ C1: C2: Result [m/s²]:

Use Dynamic Braking above [km/h]: 0.010

Correct Deceleration on Gradients [m/s² 2‰]

Min. Dec. [m/s²]: -0.10 Max. [m/s²]: -1.50

Default Dec. Delay [s]:

Cancel OK

Engines

Engine: QR SMU 220 DMA+T+DMB 7 / 26

Engine Name: QR SMU 220 DMA+T+DMB

Engine Description:

Load [t]: 122.000 Resistance Factor: 3.30

Adh. Load [t]: 81.000 Rot. mass Factor: 1.06

Length [m]: 71 Balise Telegram

Speed max [km/h]: 100 Loop Telegram

Tractive Effort max [kN]: 140 Radio Telegram

Rack Traction

ZNV-Diagrams No

Diagram 1 1

System

- Universal Electric
- Thermic
- Thermoelectric
- AC 15 kV 16 2/3 Hz

Export Import Dupl. Del. Add Diagram Color:

Adhesion [%] bad: 80 normal: 125 good: 150

Loss Function: Edit

Selected Point:

v [km/h] Z [kN] P [MW] linear

Visual Rectangle:

Speed max [km/h]: 110 Scale

Tractive Effort max [kN]: 150 Min. [kN]: 0 Autoscale

Del. Engine New Engine

Set Data Save Depot New Depot Open Depot

New Traction Package Proposal

IMU100

- Vehicle Details



Constructed -1993-1997
 Maximum speed - 140 km/h
 Braking system - Blended Regenerative electric and electro-pneumatic
 Fleet 101 – 110, Ten 3 car vehicles
 Current OpenTrack Configuration

Trains - Edit

Train Name: QR IMU 100 (6 car) Default
 Description:
 Type: Commuter / Regio Train
 Category: 6 Car SMU/IMU

Engines

Pos.	Name	Load [t]	Len. [m]	Delete
1	QR IMU 100 DM+M+DT	129.000	71	
2	QR IMU 100 DM+M+DT	129.000	71	

Σ Load [t]: 258.000 Σ Len. [m]: 142

Trailers

Pos.	Name	Load [t]	Len. [m]	P Loss [kW]	No. of	Delete

Σ Load [t]: 0.000 Σ Len. [m]: 0

Resistance Equation

Rolling: Strahl / Sauthoff Formula

A: B: C: Unit: N
 Starting Res. [N/t] below Speed [km/h]

Gradient: Distributed Mass per Train
 Curve: Roeckl Formula 1000 mm (Trains) [%]: 50.0

Acceleration (Train related Settings)

Max. Acceleration [m/s²]: 1.00 Max. Drawbar Force [kN]:
 Acc. Delay [s]: 0 Min. Time to hold Speed [s]: 30.0
 Acc. Delay at Stop [s]: 0

Deceleration

Deceleration Function: Default

From [km/h]	To [km/h]	Dec. [m/s ²]	Delete
0	v max.	-0.90	

Braked Weight Percentage (BWP) [%]: 100
 $a = -(C1 + C2 \cdot BWP)$ C1: C2: Result [m/s²]:
 Use Dynamic Braking above [km/h]:
 Correct Deceleration on Gradients [m/s²/‰]: 0.0 10
 Min. Dec. [m/s²]: -0.10 Max. [m/s²]: -1.50
 Default Dec. Delay [s]: above [km/h]:

Cancel OK

Engines

Engine: QR IMU 100 DM+M+DT 13 / 26

Engine Name: QR IMU 100 DM+M+DT
 Engine Description:

Load [t]: 129.000 Resistance Factor: 3.30
 Adh. Load [t]: 90.000 Rot. mass Factor: 1.06
 Length [m]: 71
 Speed max. [km/h]: 140
 Tractive Effort max. [kN]: 128

Balise Telegram
 Loop Telegram
 Radio Telegram
 Rack Traction

Z/V-Diagrams No

Diagram	No	System
Diagram 1	1	<input checked="" type="checkbox"/> Universal Electric <input type="checkbox"/> Thermoic <input type="checkbox"/> Thermoelectric <input type="checkbox"/> AC 15 kV 16 2/3 Hz

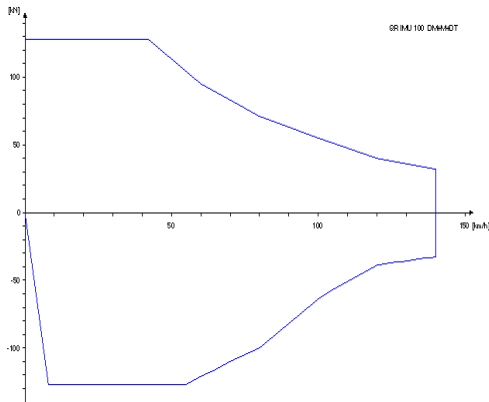
Export Import Dupl. Del. Add Diagram Color:

Adhesion [%] bad: 80 normal: 111 good: 150
 Loss Function: Edit

Selected Point:
 v [km/h]: Z [kN]: P [MW]: linear

Visual Rectangle:
 Speed max. [km/h]: 150 Scale
 Tractive Effort max. [kN]: 140 Min. [kN]: -140 Autoscale

Del. Engine New Engine
 Set Data Save Depot New Depot Open Depot





Initial Proposal

Data Request

Initial proposal

Data requests

Rollingstock approached us for track data for the vendor

We asked why?

A tentative answer, The vendor wants to run some simulations

We asked what is the vendor looking for?

The vendor just wants some Speed, Times and Energy data.

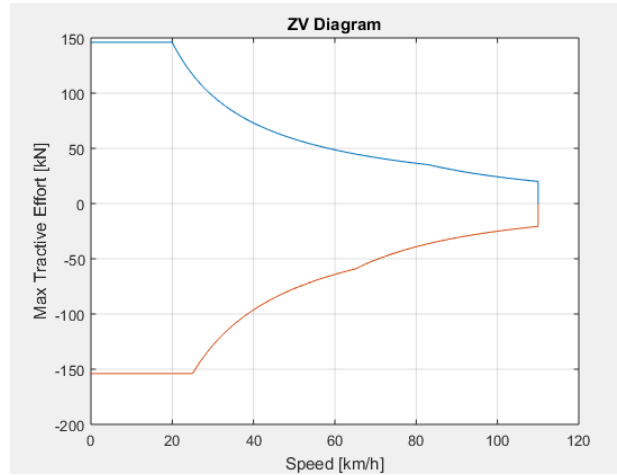
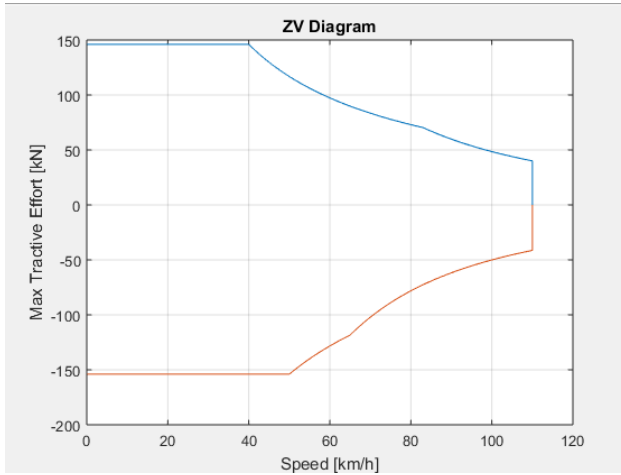
We said we can supply the Vs, Ms, TT and TSVP files if the vendor supplies the rollingstock data.



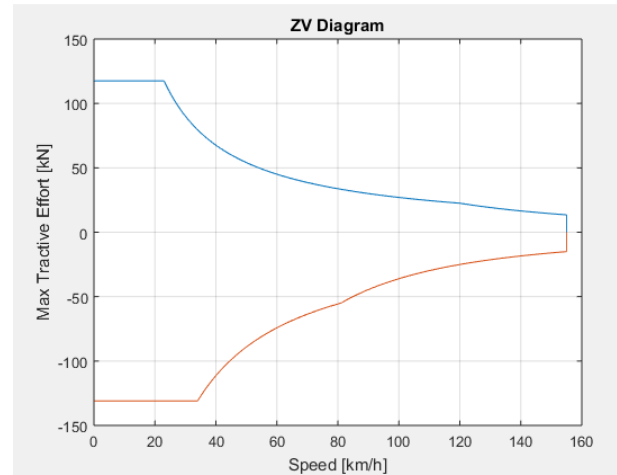
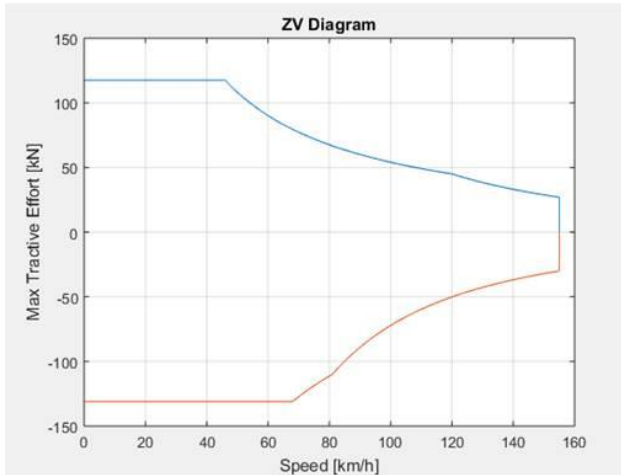
Initial proposal

Data Supplied

New Tractive and Braking effort curves for SMU200



New Tractive and Braking effort curves for IMU100



Initial proposal

Simulation Request

Can you please let me know if 14 working days after receipt of the TE and BE data in format you can work with, is sufficient to run the SMU200/IMU100 class service time tables to confirm whether there are any OTR issues with full performance and 75% of full performance (6-cars only)? Please let me know.

The Process

1. Convert the Fig files to OpenTrack Z/V import files(MatLab)
2. Talk to Timetable Planners to get Master Template Services.
 - a. 26 template services delivered in RailMI file
 - b. Prepare 26 Itineraries for OpenTrack Master Network
3. Build 4 New Engines
 1. IMU100 – Full Performance.
 2. IMU100 – 75% Performance 1 line converter in operation.
 3. SMU200 – Full Performance
 4. SMU200 – 75% Performance 1 line converter in operation.
4. Build 8 New Trains
 1. QR IMU 100 (3 car) Traction package upgrade
 2. QR IMU 100 (3 car) Traction package upgrade 1LC
 3. QR IMU 100 (6 car) Traction Package Upgrade
 4. QR IMU 100 (6 car) Traction Package Upgrade 3LC
 5. QR SMU 200 (3 Car)traction package upgrade
 6. QR SMU 200 (3 Car)traction package upgrade 1LC
 7. QR SMU 200 (6 Car) traction package upgrade
 8. QR SMU 200 (6 Car) traction package upgrade 3LC

Initial proposal

Simulation Request

The Process

5. Assign fleet to Master Template services, IMU fleet to regional lines
6. Simulate
7. Outputs





Simulation

Outputs

Simulation

Outputs

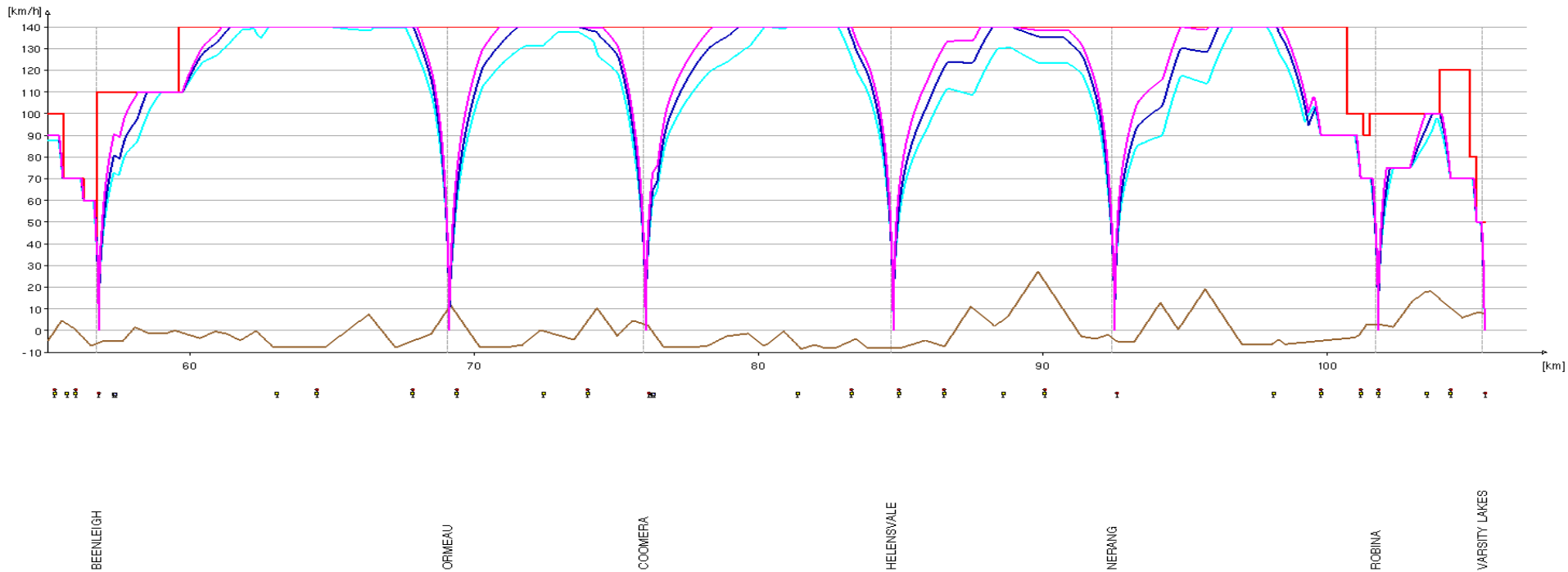
Speed Distance Performance

IMU 100 Regional Line

Magenta – Current Configuration

Blue – New Configuration Full Performance

Cyan – New Configuration Reduced Performance



Simulation

Outputs

Result findings

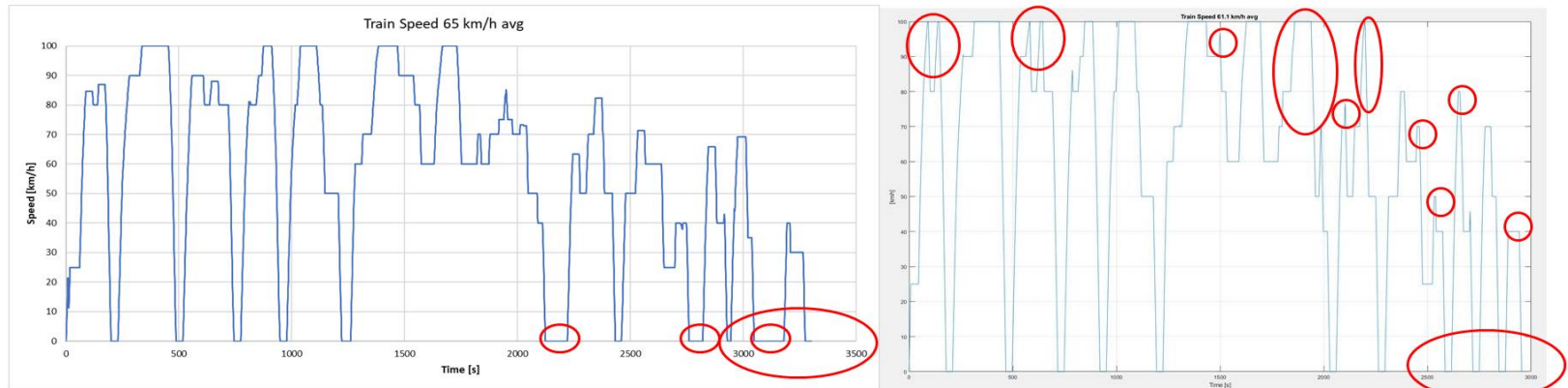
Current IMU Trains are too light, 30 tonne difference.

Similar problem with the SMU200.

New Configuration compliant with Master Train Plans

Sharing of outputs with vendors to enable validation

Vendor Outputs from data shared from OpenTrack



Vendor utilised the Vs, Ms, TSVP and IVT outputs to evaluate and model their requirements.

Both teams working on the same page, for different contractual requirements. This enabling is achieved by sharing uncomplicated data.



Infrastructure Proposal

Wacol Yard redevelopment

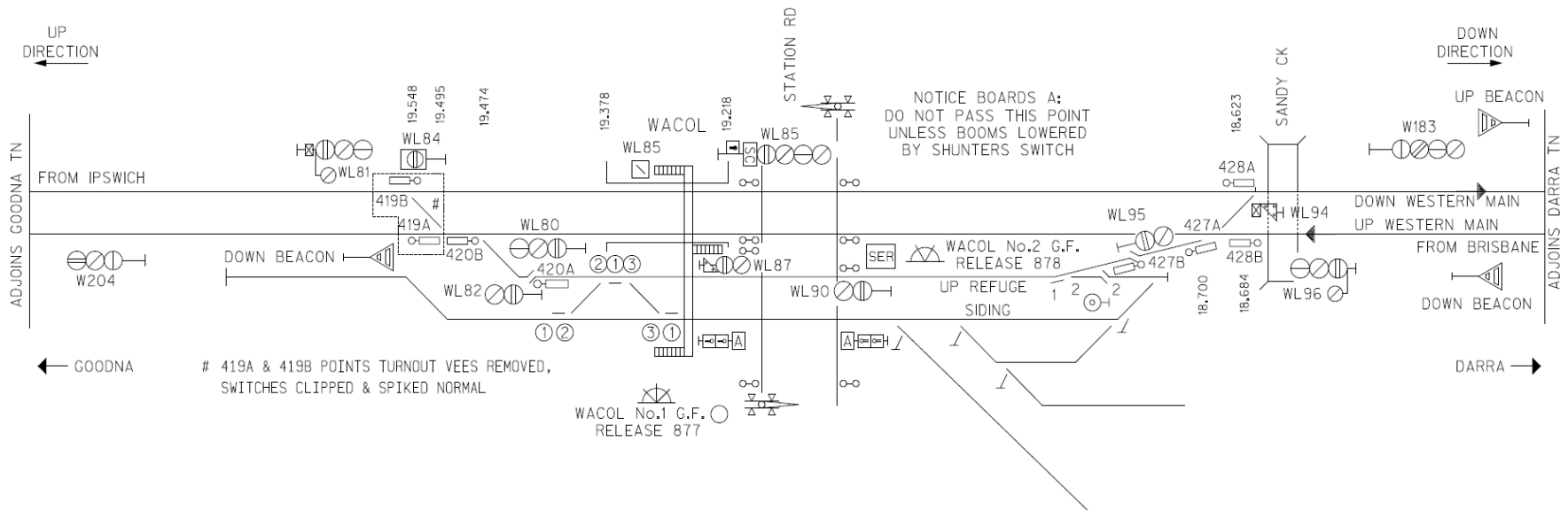
Wacol Re-signalling Project

Simulation Request

Redesign the old yard for use by rail infrastructure work trains

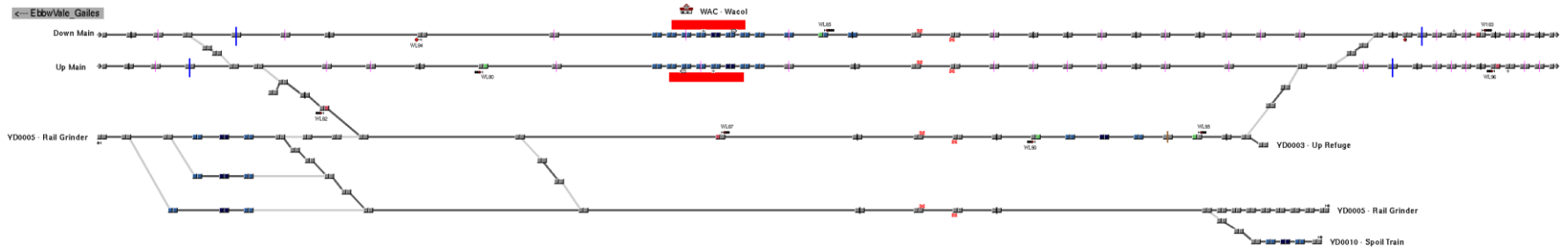
Ballast, Sleeper, Spoil trains and empty consist storage

Braking deficiency in current signal design

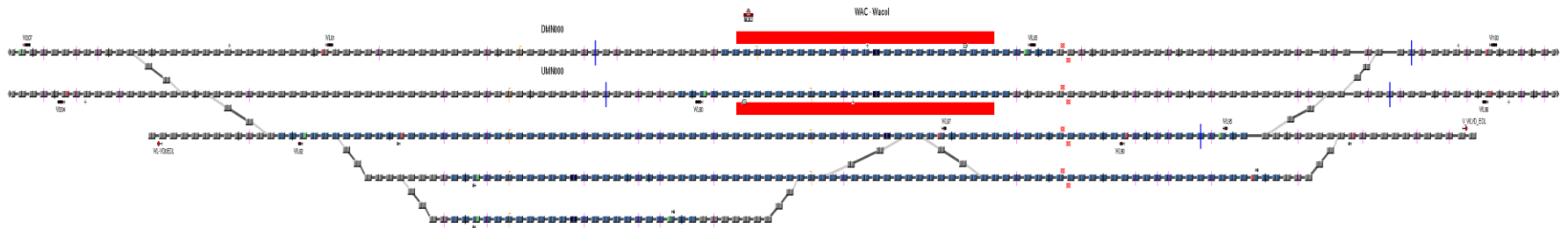


Wacol Re-signalling Project

Current OpenTrack document

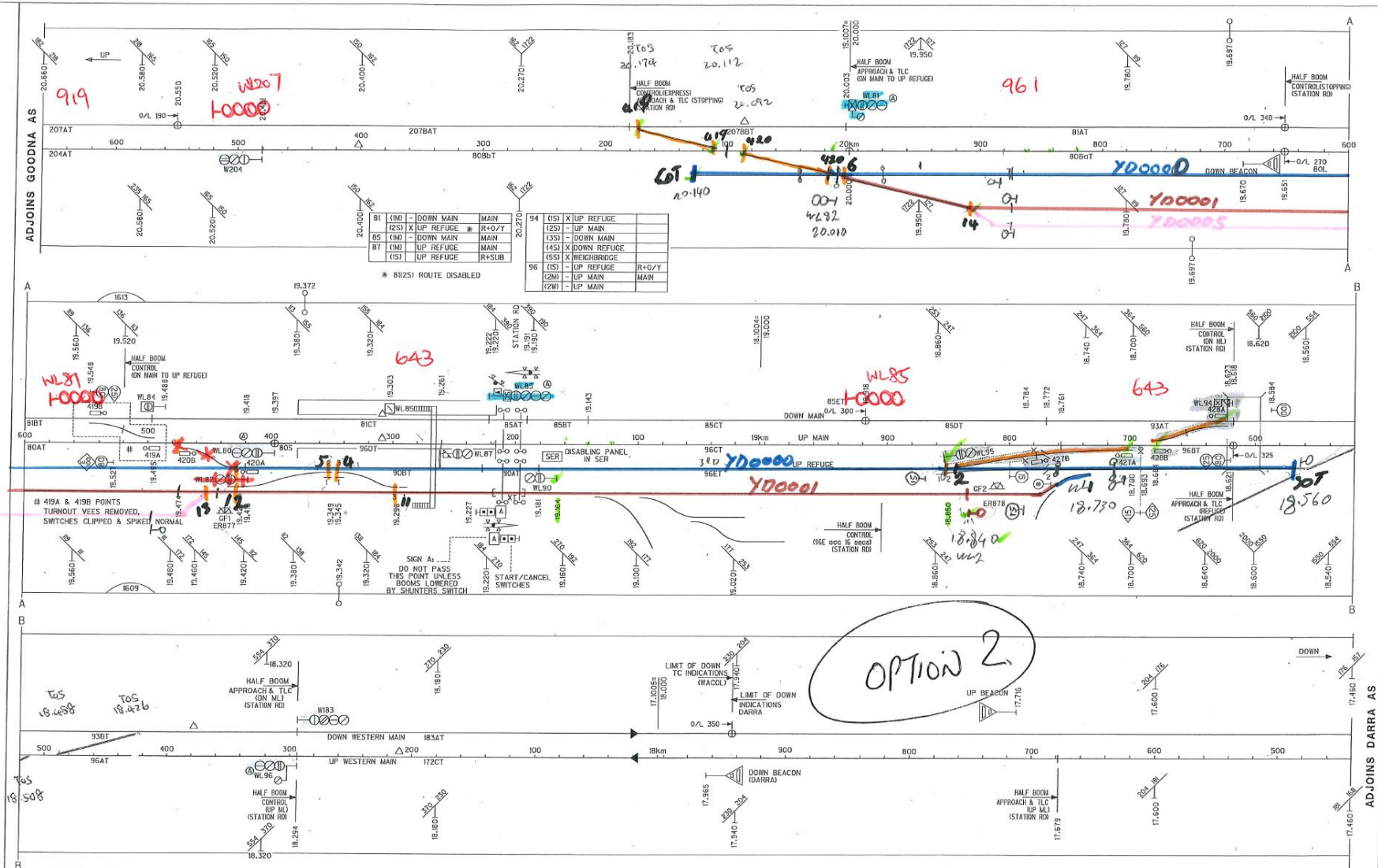


Proposed OpenTrack document



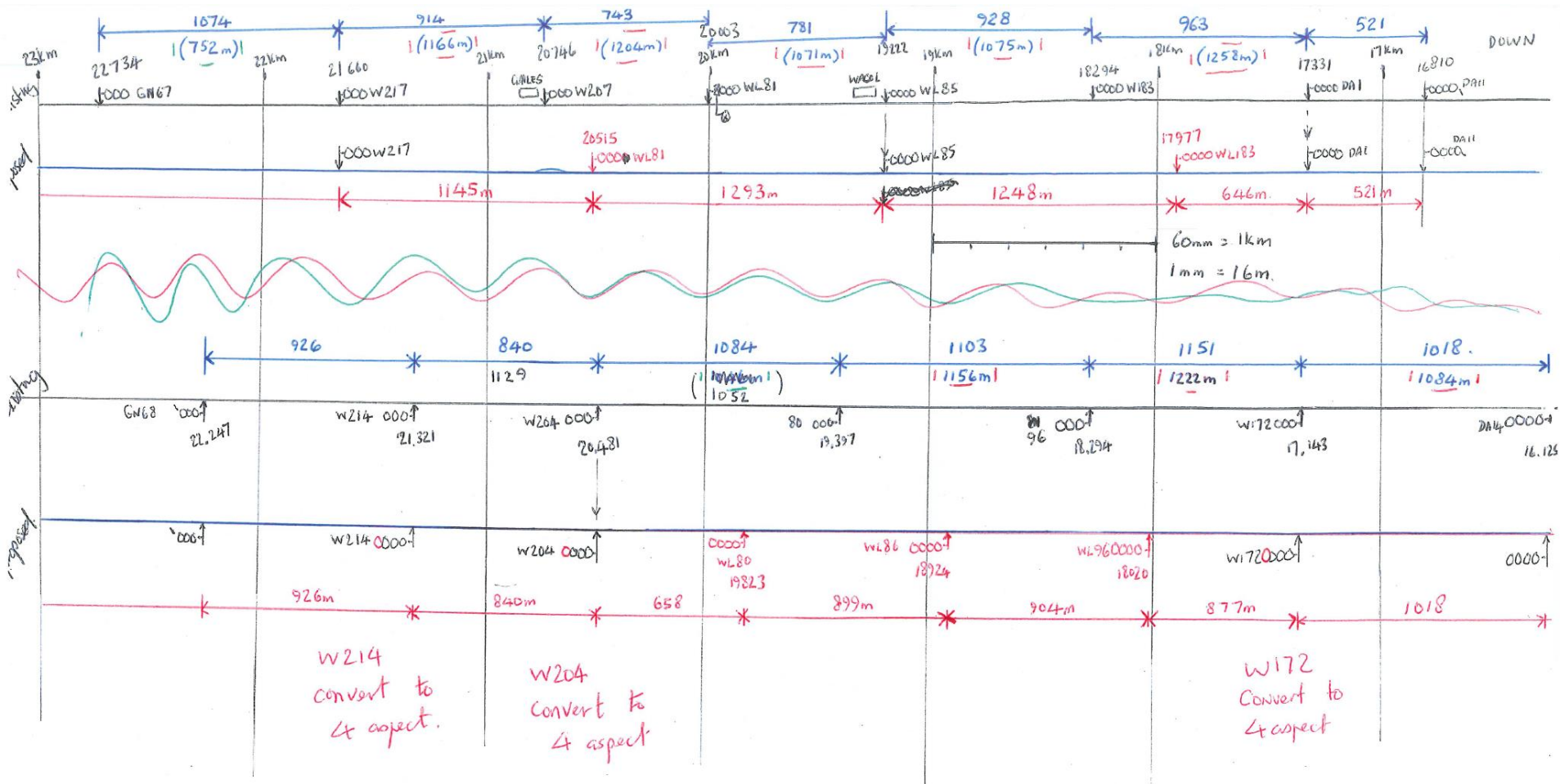
Wacol Re-signalling Project

Documents Supplied



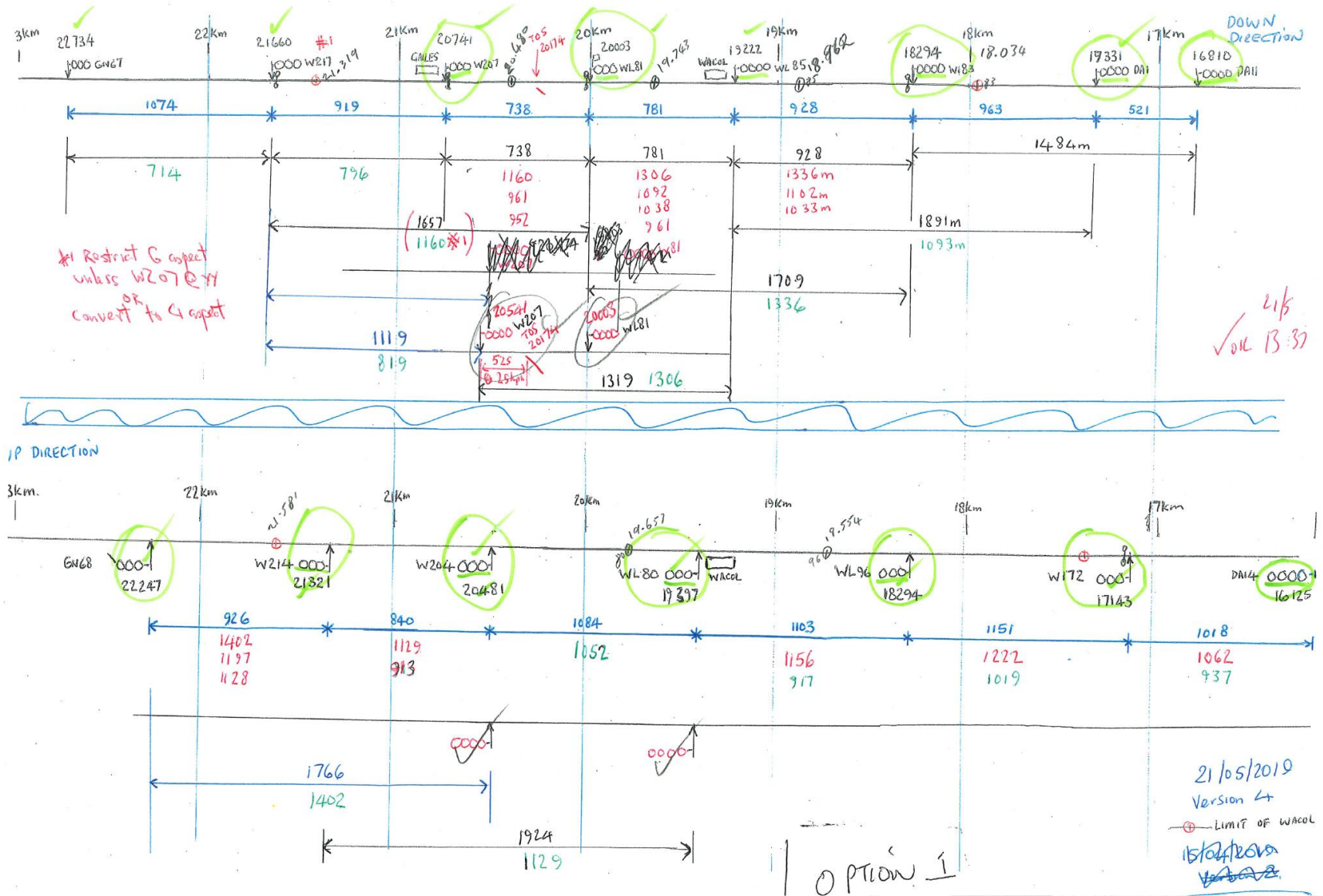
Wacol Re-signalling Project

Documents Supplied



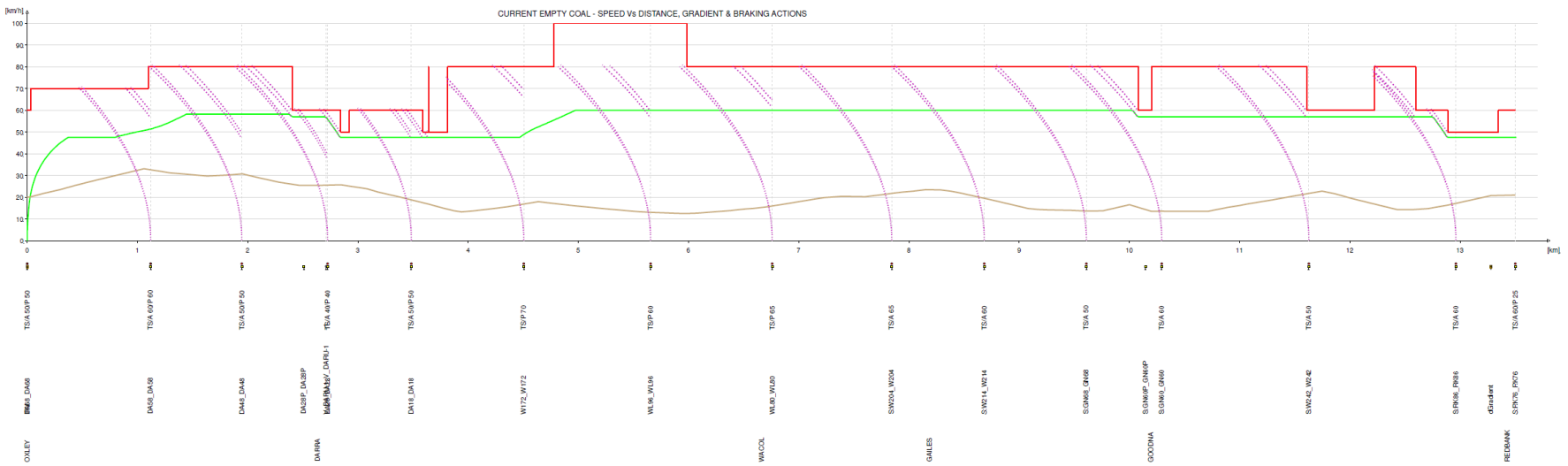
Wacol Re-signalling Project

Documents Supplied



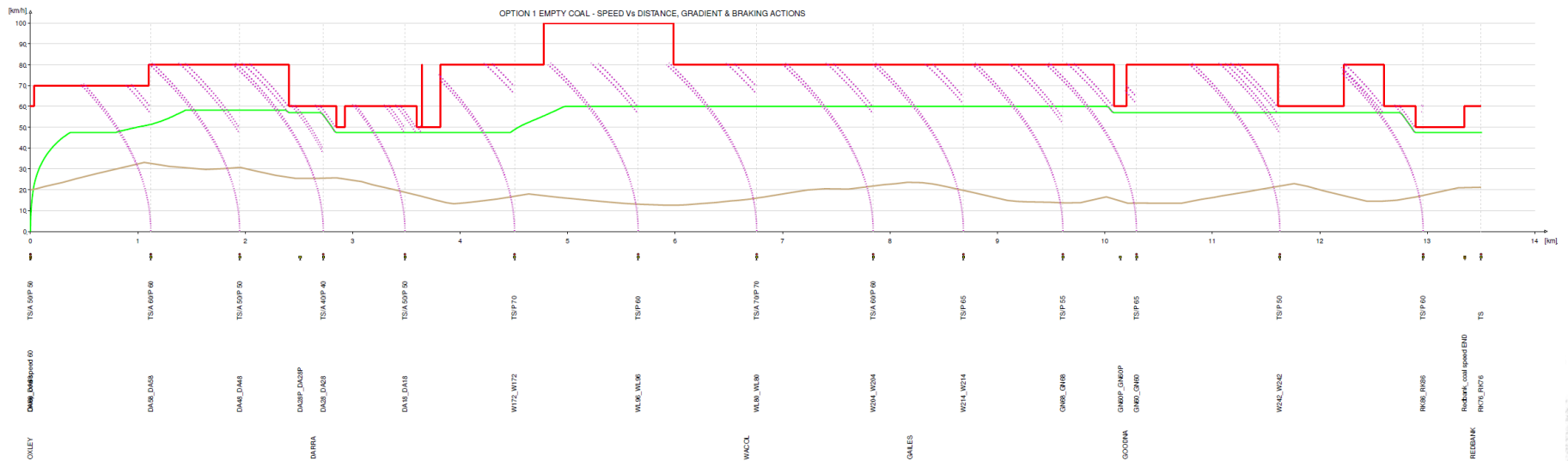
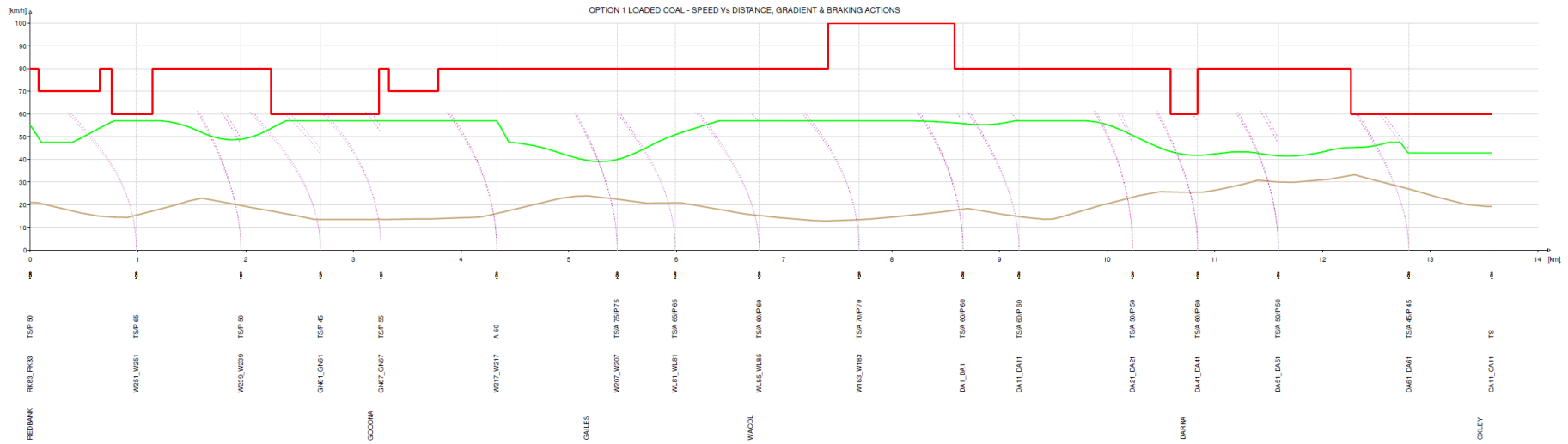
Wacol Re-signalling Project

Outputs from Simulation – Current State



Wacol Re-signalling Project

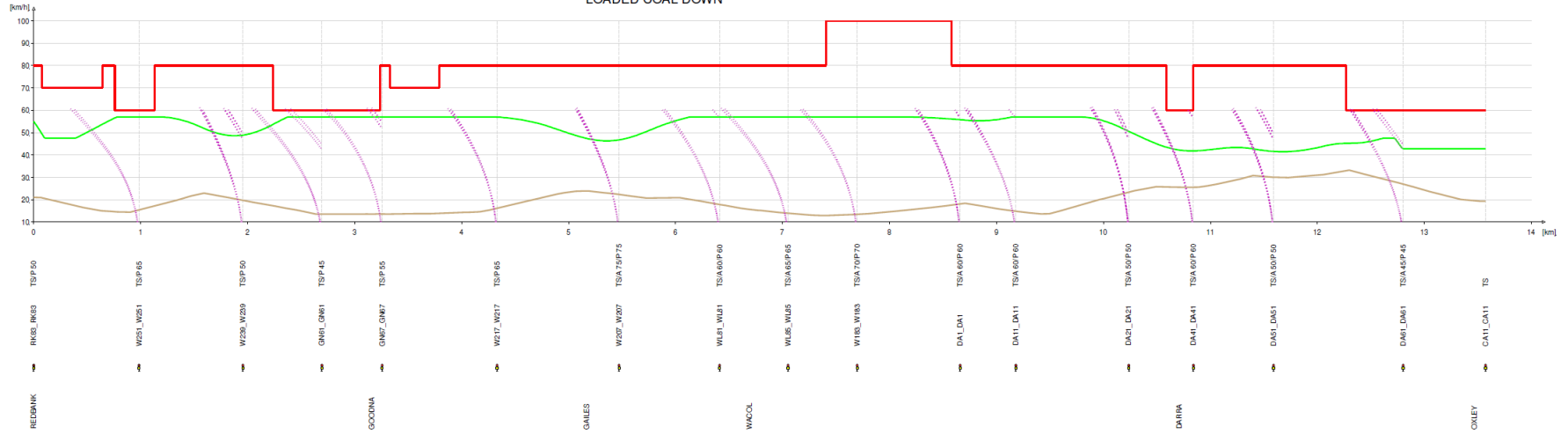
Outputs from Simulation – Option 1



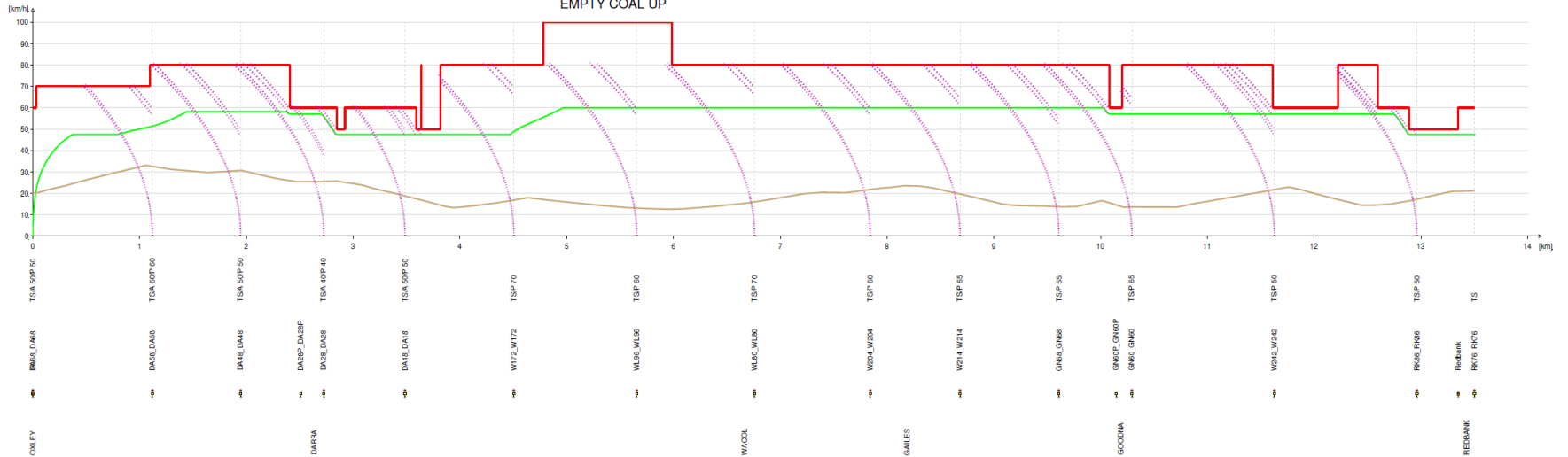
Wacol Re-signalling Project

Outputs from Simulation – Option 2

LOADED COAL DOWN



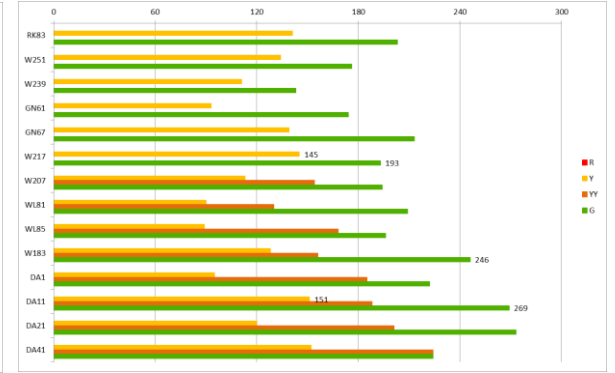
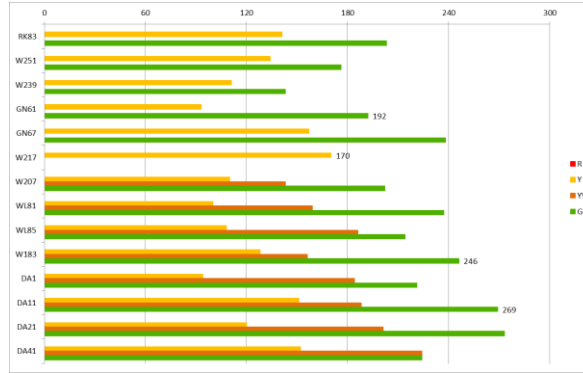
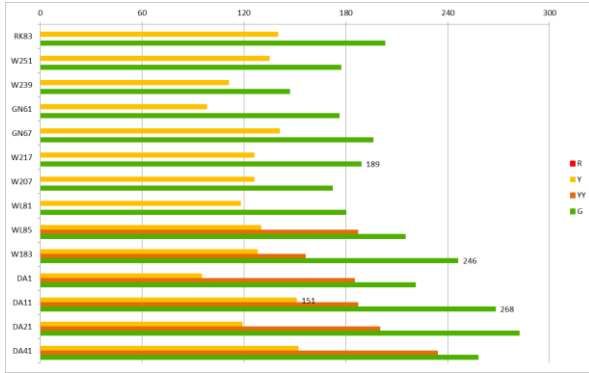
EMPTY COAL UP



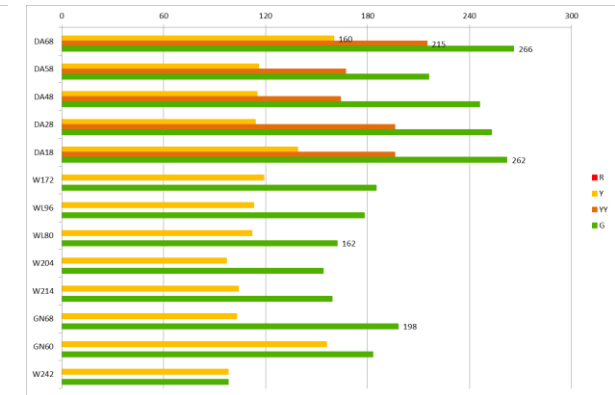
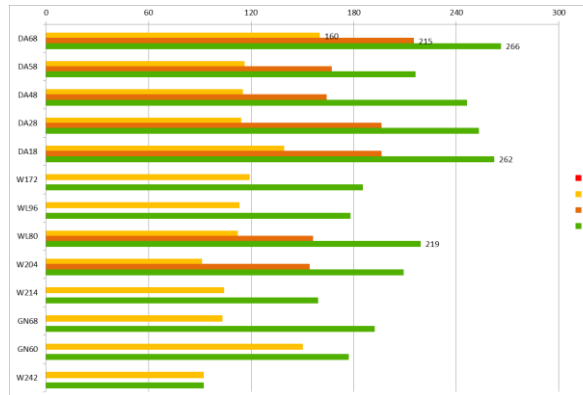
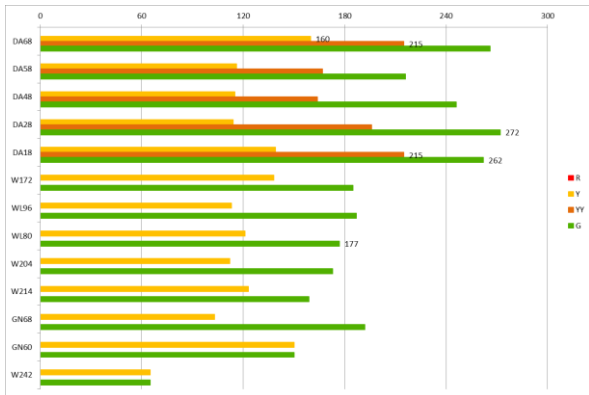
Wacol Re-signalling Project

Outputs from Simulation – Headway

Loaded Coal Down Main – Current, Option 1 & 2



Empty Coal Up Main – Current, Option 1 & 2



Wacol Re-signalling Project

Outcomes from Simulation

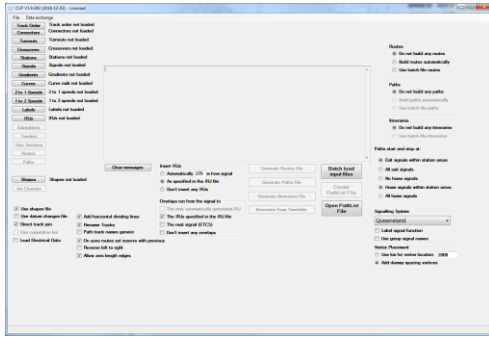
Project did not proceed

Re-signalling exceeded budget allowed for whole project.

Operators did not know how they wanted to use the yard.

The 2019 Queensland Rail Suite

CLIP



OpenTrack



TRENO





Thankyou for your attention

Questions?