



GOLD FIELDS

BEATRIX NORTH SECTION

Horizontal Transport System Integration

**Presented by:
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Engineer, Beatrix 3#**

The complete Gold company

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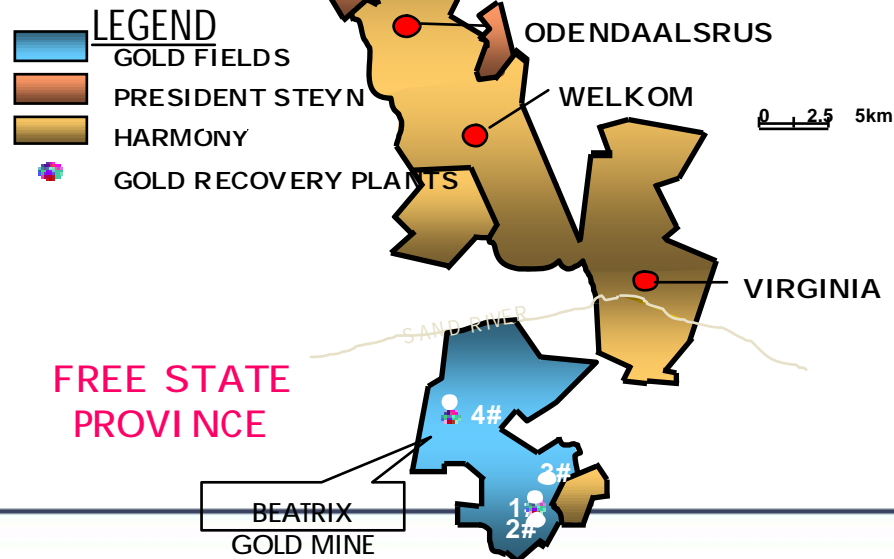
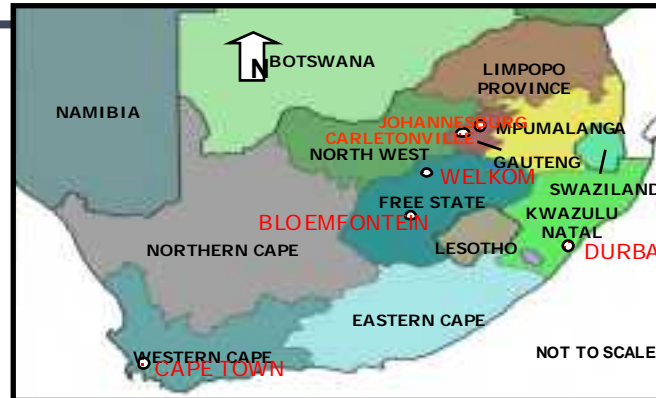
- Beatrix locality plan
- Introduction
- System Integration
 - Locomotive
 - Slowdown Unit
 - Data Loggers
 - Rails
 - Financial Benefit
- Conclusion



Beatrice 3#



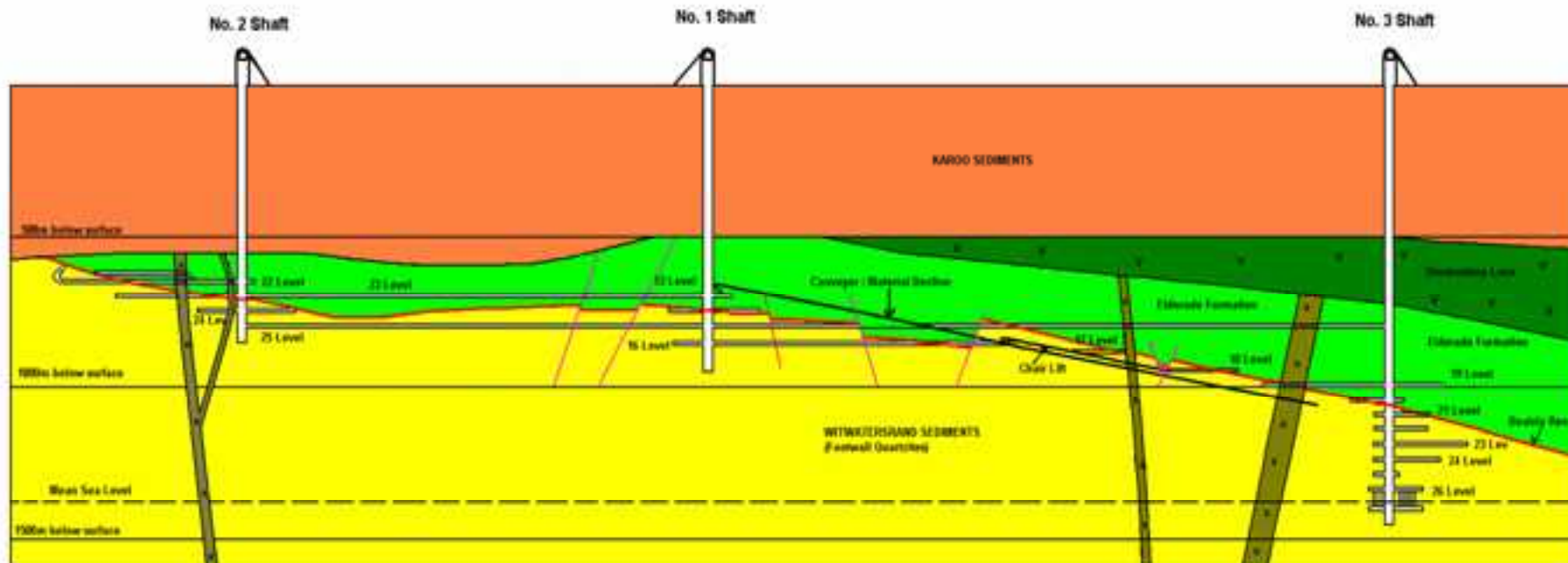
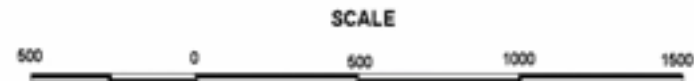
BEATRIX: Locality



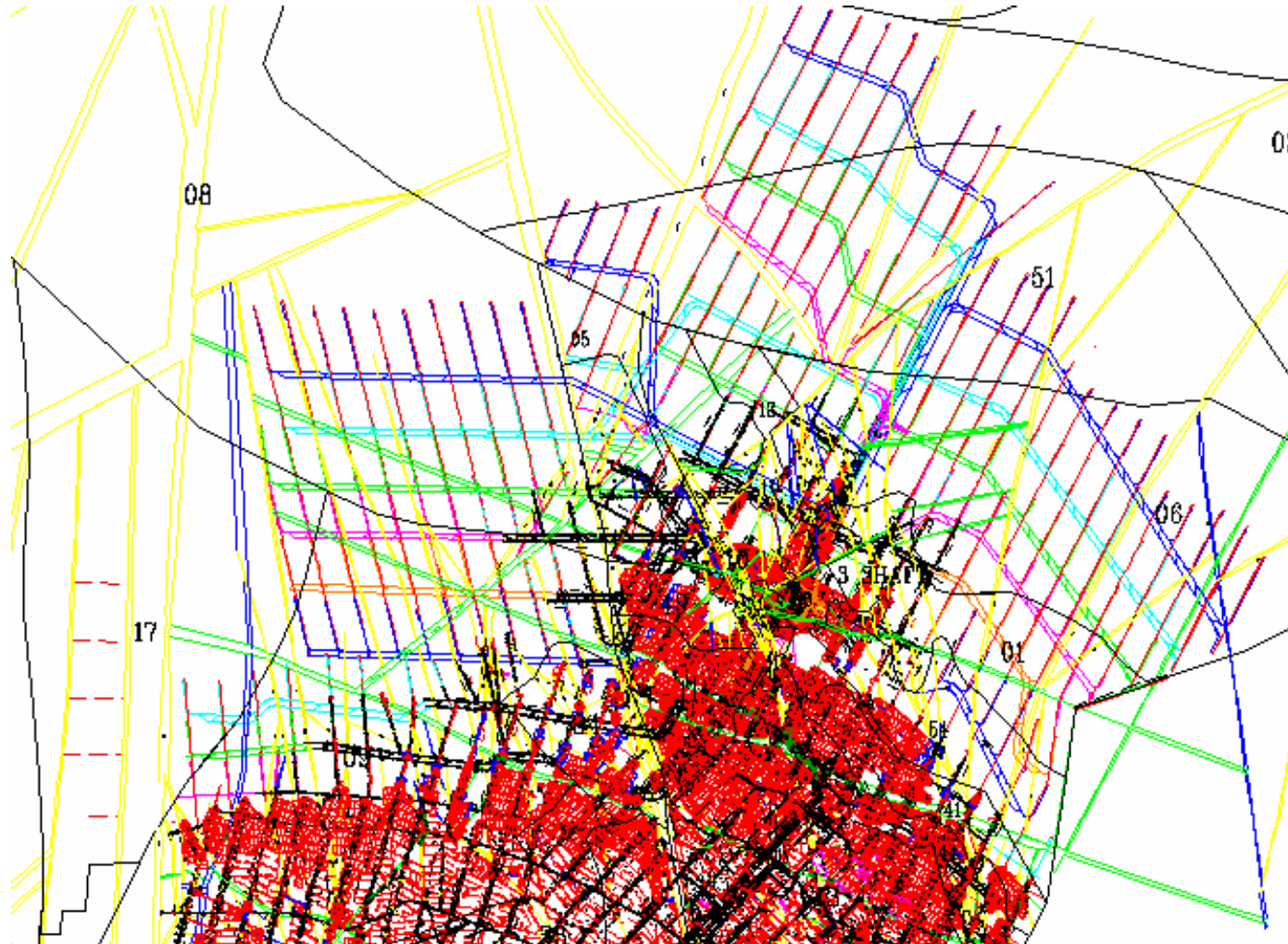
SOUTH-NORTH SECTION ON BEATRIX MINE



GOLD FIELDS



Mine Design North Section



North Section



Key Statistics

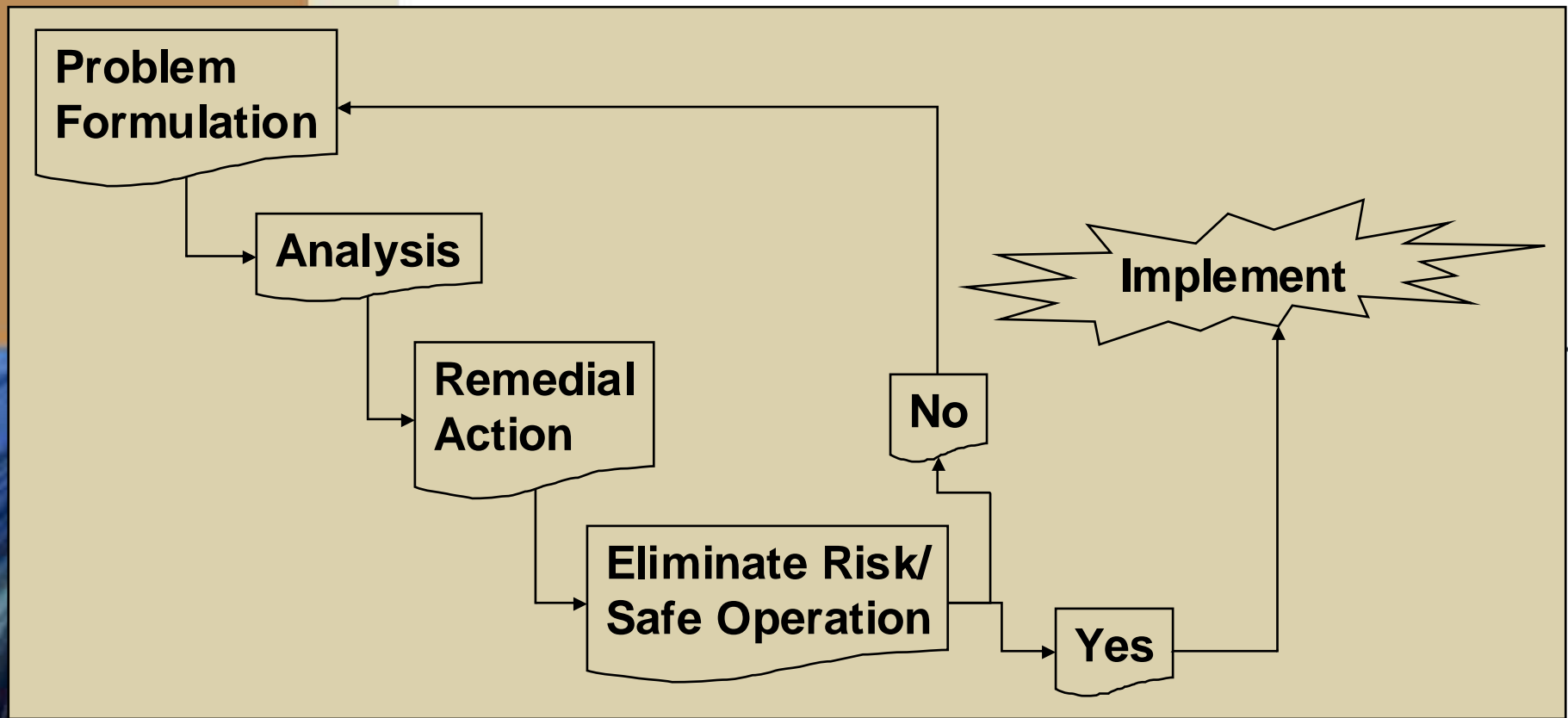
- **Monthly Gold Produced** \pm 750 kgs
- **Monthly Volume Mined** 29000 sq / m
- **Monthly Development** 2 500 m / mth
- **Employees** 4163

Introduction



- **Underground Transportation**
 - 20% of total operating costs
 - 25% of all mine accidents
 - Increase as Mines Matures
- **Underground railway system**
- **System integration**

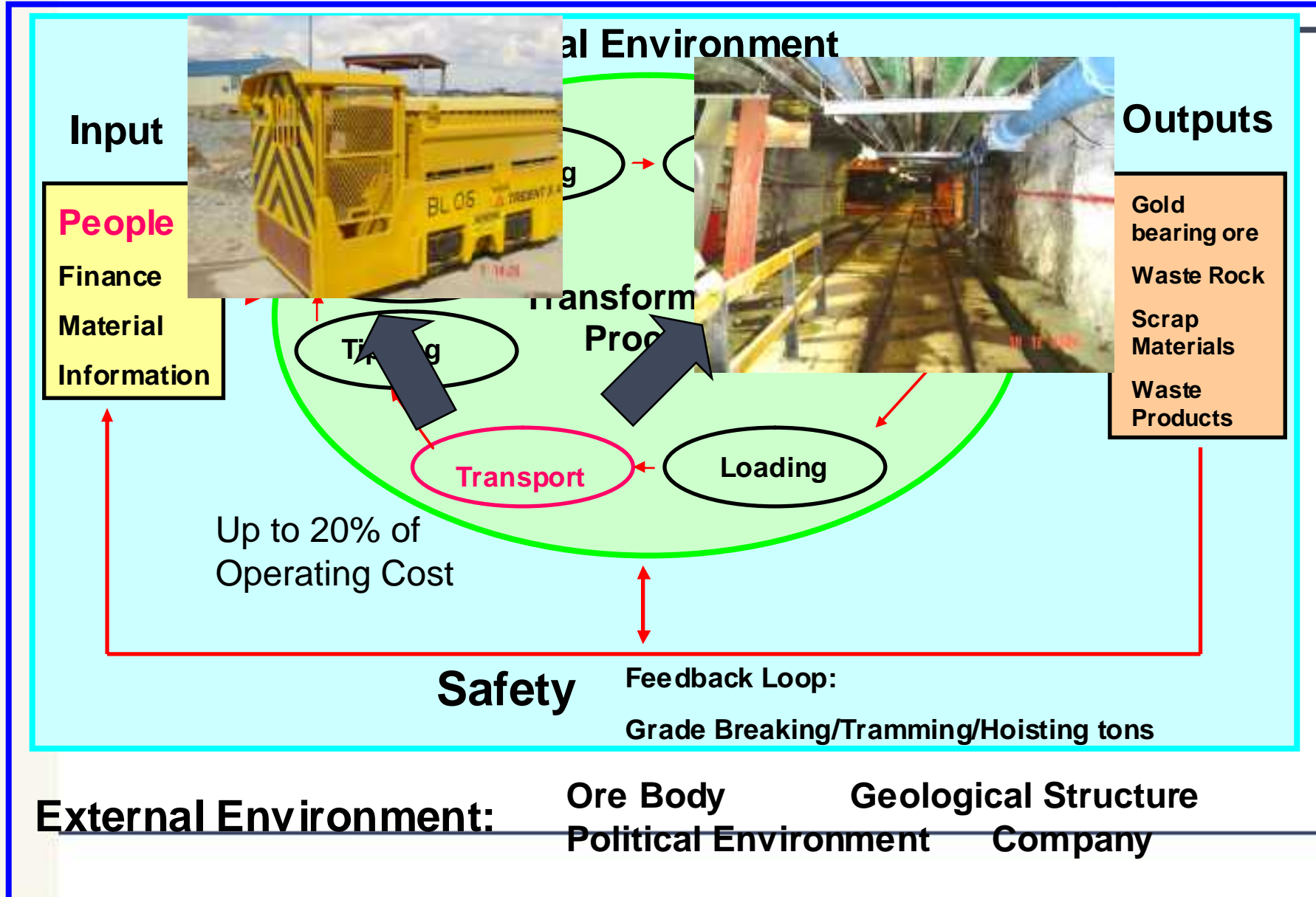
Systems Route Map



Operational Diagram



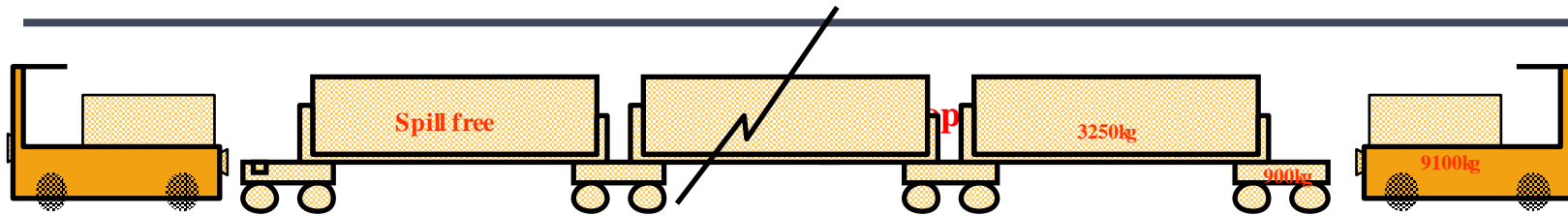
GOLD FIELDS



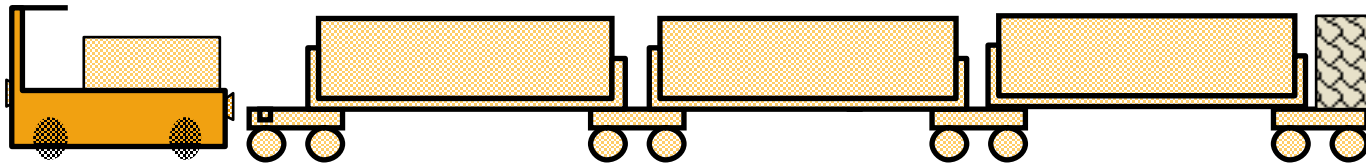
Locomotives



The Locos



- Front Driven & Double header



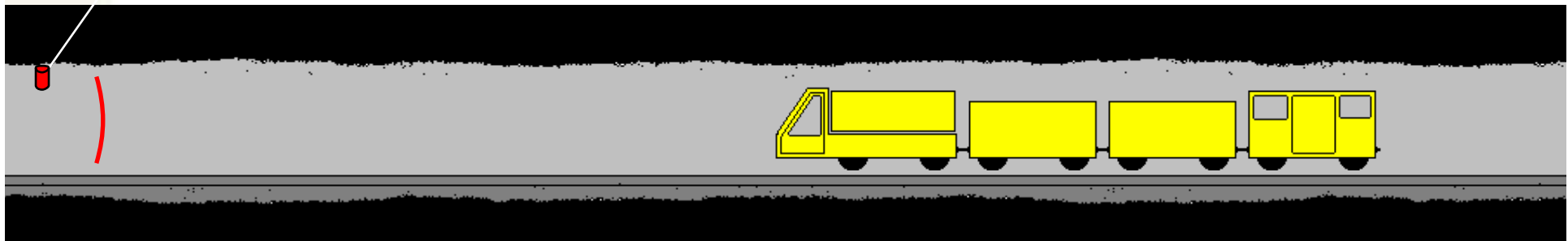
The Controller



Haulage unit to Loco operation of Slow Down Unit.



Haulage
Unit



When a loco fitted with a proximity transponder approaches a haulage transponder, the haulage transponder can activate an indicator (siren, lamp) and the transponder in the loco will activate an indicator (siren, lamp)(preferred) and/or initiate a slow down response action.



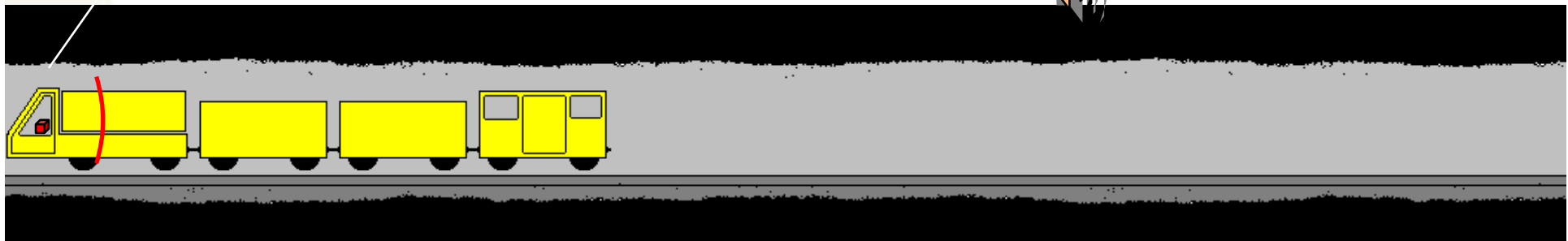
The Controller



GOLD FIELDS

Loco to Loco operation of Slow Down Unit.

Loco
Unit



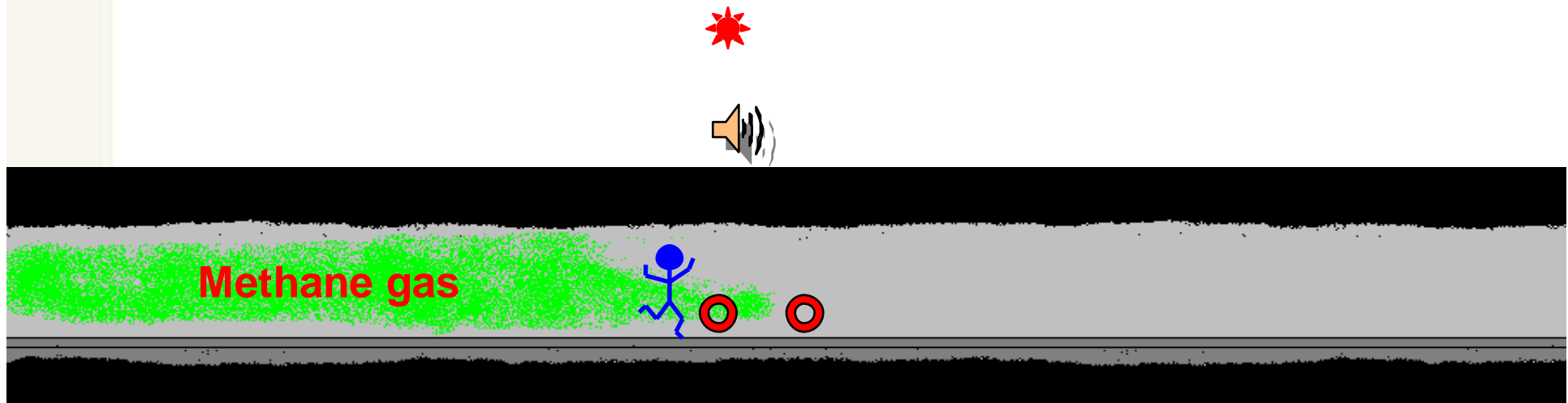
When two loco's fitted with a proximity transponder approach each other, the transponders on both units will activate an indicator (siren, lamp)(preferred) and/or initiate a slow down response action.



The Controller



Brake System coupled to Methanometer.



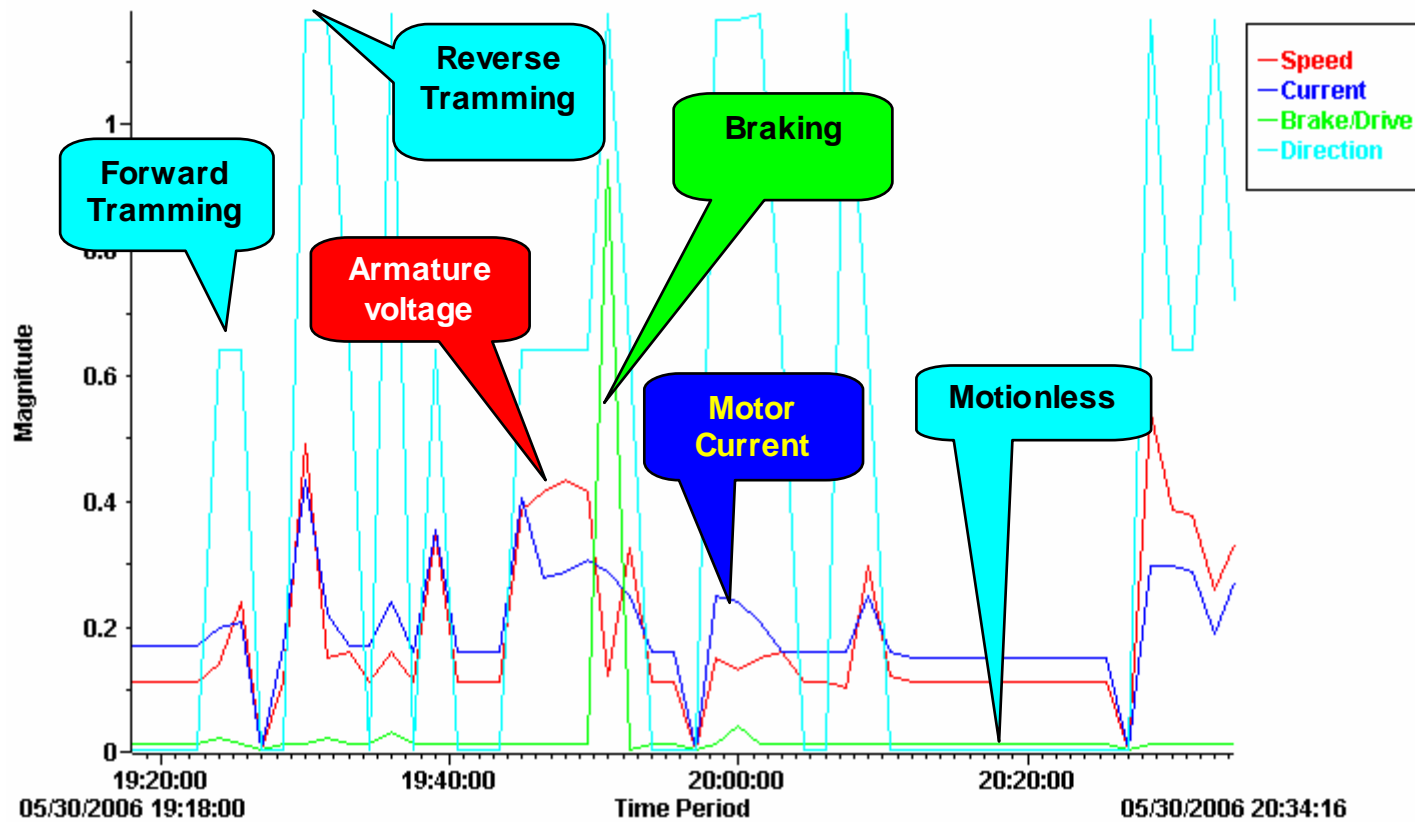
When a loco fitted with a controller coupled methanometer, upon methane gas detection, the loco controller can be shut down.



The Controller



Data Logging.

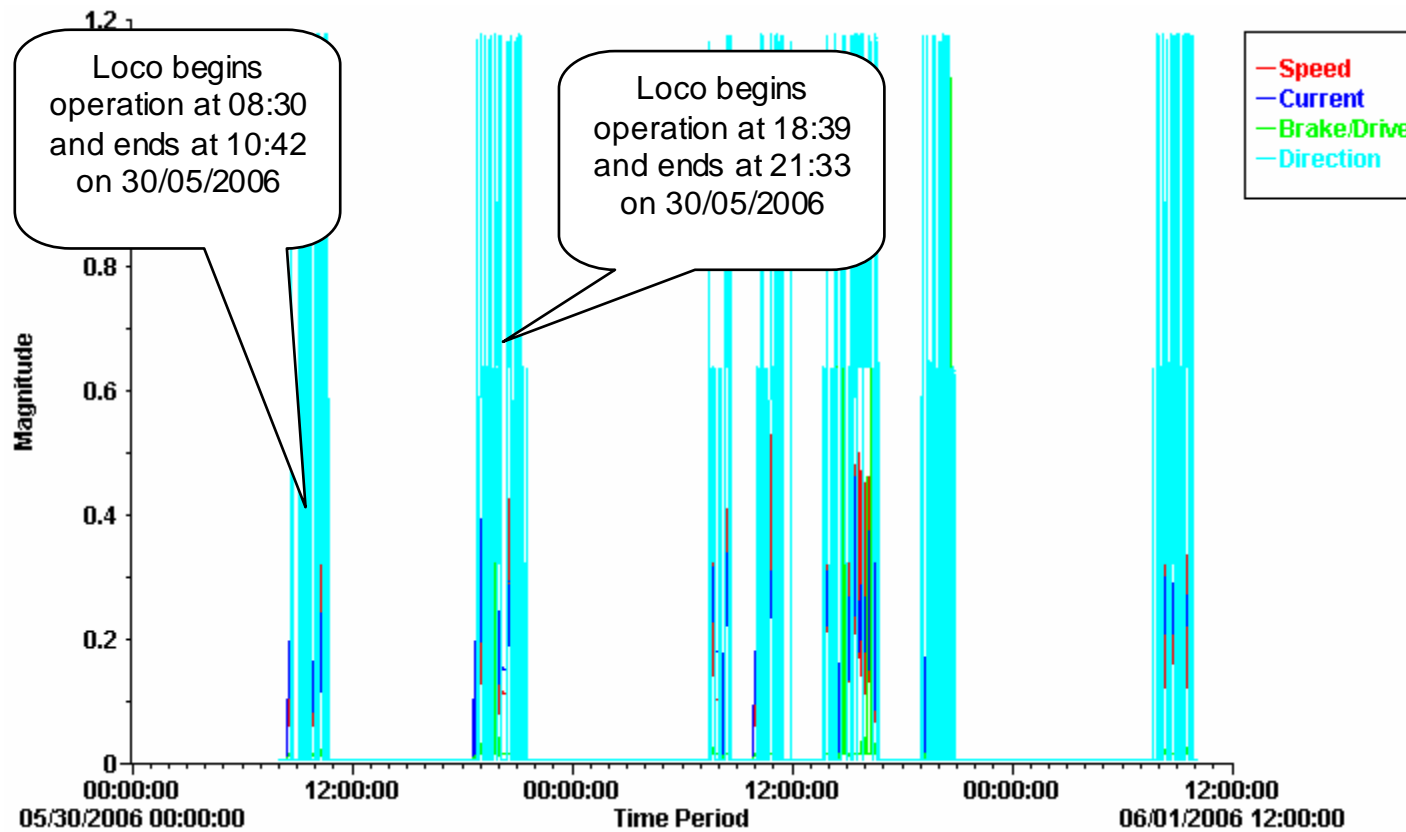


Specific events and magnitude can be monitored as illustrated.

The Controller



Data Logging.



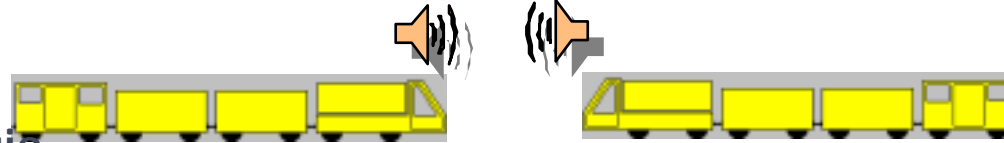
Operating times of the loco can be determined by observing controller activity.

The Future?



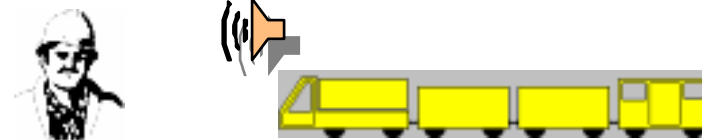
- Loco Sensor

- Travel direction logic
- Effected distance (Loco leading vs. hopper leading)



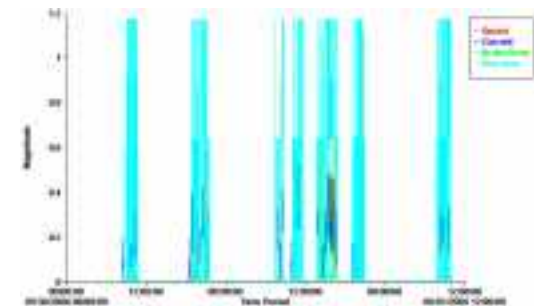
- Haulage Beacon

- Battery Operated Unit
- No Go / One direction

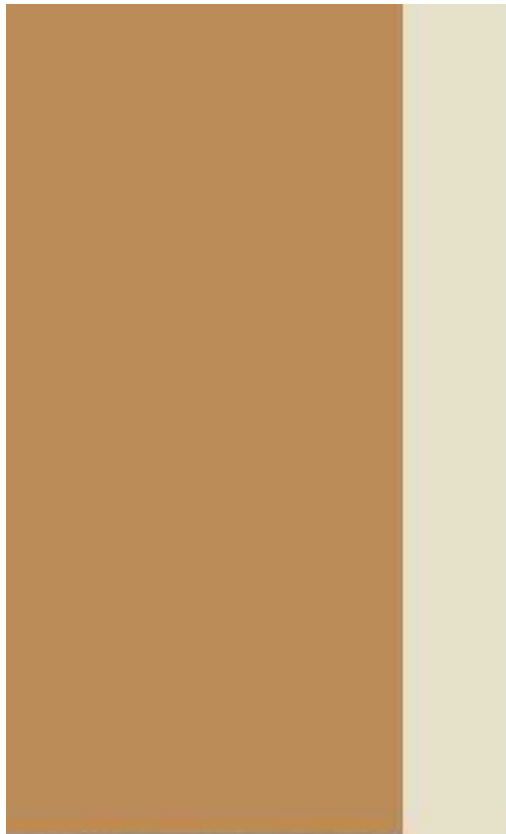


- Data Logger

- Intelligent software – data analysis
 - Hour Meters / Utilization
 - Service intervals
 - Non Routine data - Manually Analyzed
- Auto downloading
 - Controller ➡ battery charger ➡ surface



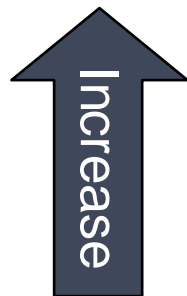
Rails



Horizontal Transport: A Vital Link in the Total Mining Activity



- The consequences of poor tracks are:



- Derailments
- Track Maintenance
- Mechanical (loco) Maintenance & Repairs
- Rolling stock Maintenance & Repairs
- Labour (haulage maintenance) Costs

And a decrease in....



- Tramming speed
- Safety
- Utilisation of rolling stock
- Production



By designing and constructing a **proper support** and **drainage system**, the existing rails and sleepers can provide a more **reliable track** than is presently being experienced.

In addition, the system must be **regularly maintained**.



Track Classification

Item	Class of Track					Additional Information
	1	2	3	4	5	
Tonnage per month	> 125	125 - 50	50 - 20	20 - 7.2	<7.2	x 1000
Personnel	Yes	Yes	Yes	N/r	N/r	
Rock	Yes	Yes	Yes	Yes	Yes	
Explosives	Yes	Yes	Yes	Yes	N/r	
Material standard vehicle	Yes	Yes	Yes	Yes	Yes	
Material abnormal length	Yes	Yes	Yes	Yes	N/r	
Material abnormal mass	Yes	Yes	Yes	Yes	N/r	
Maximum axle load	15	10	7.5	5	5	Tons
Maximum speed on straight	45	24	16	10	5	km/h (Note 1)
Planned operation life	25	20	10	5	3	Years (Note 2)
Rails	40/30	30	30/20	22	22/15	kg/m
Sleepers	10+	10	7	5	5	Axle load tons
Sleeper type (graded ballast)	C/S/W	C/S/W	C/S/W	C/S/W	C/S/W	Grade 38.5mm (+15mm, -60mm)
Sleeper type (ungraded ballast)	S/W	S/W	S/W	C*/S/W	C*/S/W	Run of mine (max 0, -75mm)
Minimum curve radii (restricted speed)	75	50	30	20	15	meters
Minimum curve radii (unrestricted speed)	250	150	90	60	30	meters
Joints welded	Yes	Yes	Yes	N/r	N/r	
Joints fishplated	N/a	Yes	Yes	Yes	Yes	
Pedestrian traffic	N/a	N/a	Yes	Yes	Yes	Note 3
Signalling	Yes	Yes	N/r	N/r	N/r	Traffic control

Notes:

1. By special arrangement where speeds exceed 16 km/h, see mines health and safety act (Act 29 of 1996 as amended)
 2. Life expectancy based on ongoing maintenance with 20% of original permissible deviation
 3. Consult mines health and safety act regarding restrictions
- * Subject to concrete sleeper manufacturers risk analysis



Track Classification Tolerances

MAXIMUM PERMISSIBLE DEVIATION

Item	Class Of Track					Additional Information
	1	2	3	4	5	
From Design Level	±5	±7	±10	±20	±30	(Over 5m length)
From True Level	±5	±7	±10	±20	±30	
Cross-Slack	3	3	5	8	15	(Over <2m length)
Straightness	5	7	10	20	30	(Over 5m length)
Design Alignment	±10	±10	±10	±15	±15	
Gauge (nominal;)	5	5	10	15	25	
	-2	-2	-3	-3	-5	
Gauge Widening	3	3	5	5	N/r	See note 2.
	-2	-2	-2	-2		
Sleeper Spacing (nominal)	±20	±20	±50	±50	±75	
Sleeper Spacing (Joint)	±10	±10	±20	±20	±50	
Circular Curves	±5	±5	±10	±15	±25	(Over 5m length)
Superelevation	5	5	8	10	20	(Over <2m length)
Height Differential at Joint	0	<1	<2	<5	<10	
Lateral Differential at Joint	0	<2	<3	<3	<5	
Joint Gap	0	<2	<6	<6	<10	

Notes:

1. Should track condition fall outside the parameters of the class, remedial measures shall be instituted.
2. Gauge widening deviation limits are based on design values.

Maintenance Schedules



Area	Category	Description of Work Item	Daily	Weekly	Monthly
Track Geometry	Rail Gauge	Check and adjust gauge on straights and curves			X
	Grade & Line	Check and adjust			X
Formation	Balast	Tamp sleepers showing excessive movement		X	
	Drain System	Clear slurry and remove from haulage		X	
Tracks	Sleepers	Visual check	X		
		Replace non-functional sleepers		X	
	Sleepers Fastenings	Visual check	X		
		Replace missing fastenings	X		
		Tighten fastenings		X	
	Rails	Visual check	X		
		Replace broken rails	Immediately		
		Replace worn rails	According to classification criteria		
	Fishplate Joints	Visual check	X		
		Tighten bolts		X	
		Replace worn fishplates			X
	Spillage and Falls of Ground	Clear obstructions from tracks and drains	X		
		Remove spoil material from haulage		X	
	Turnouts	Blades and Frog	Clear obstructions from turnout	X	
Remove spoil material from haulage				X	
Check function of connecting rod and switchblades			X		
Tighten all fastenings and replace blocks as required				X	
Check rail wear on blades or frog			X		
Replace worn blades or frog					X
Other	Overhead Conductor	Check and report dead spots / damage	X N/A	N/A	N/A
	Signal Operation	Test and repair	X		
	Electrical Traction Bond	Check and repair	X N/A	N/A	N/A
	Warning Notice and Restriction Board	Clean and repair		X	
	Shaft station Safety Stopping Devices	Test and report defects	X		



Wheelbase

Wheel	(mm)	229	254	305	356	381	406	457	533	610	686
Diameter	(inches)	9	10	12	14	15	16	18	21	24	27
c		11.3	11.5	11.8	12.1	12.3	12.4	12.7	13.2	13.7	14.1

Gauge Widening

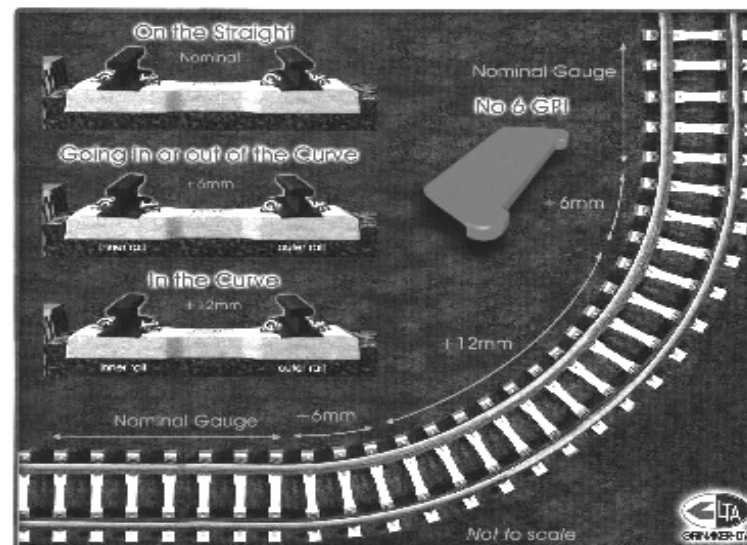


Figure 2



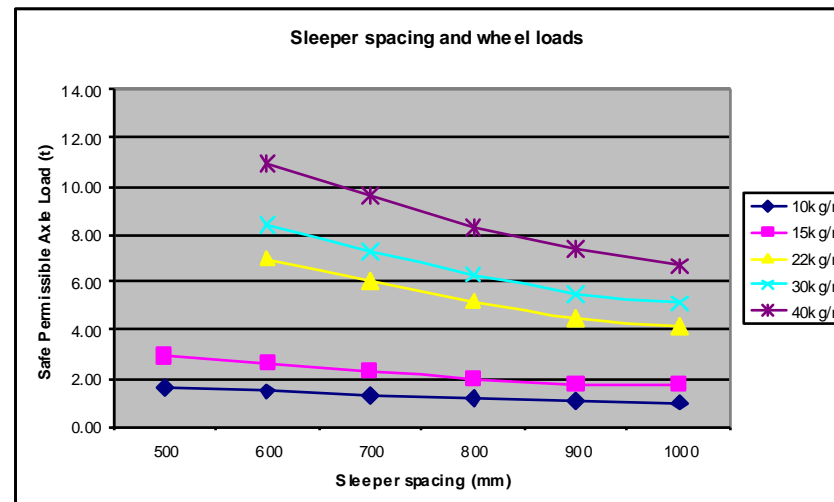
Super elevation

• Super elevation (mm) = $\frac{\text{Gauge (mm)} \times (\text{Velocity})^2}{9.81 \times \text{Radius (m)}}$

If no super elevation: Speed = 20km/h => Side force = 1.311t

Super elevation = 25mm: Speed = 20km/h => Side force = 0.626t

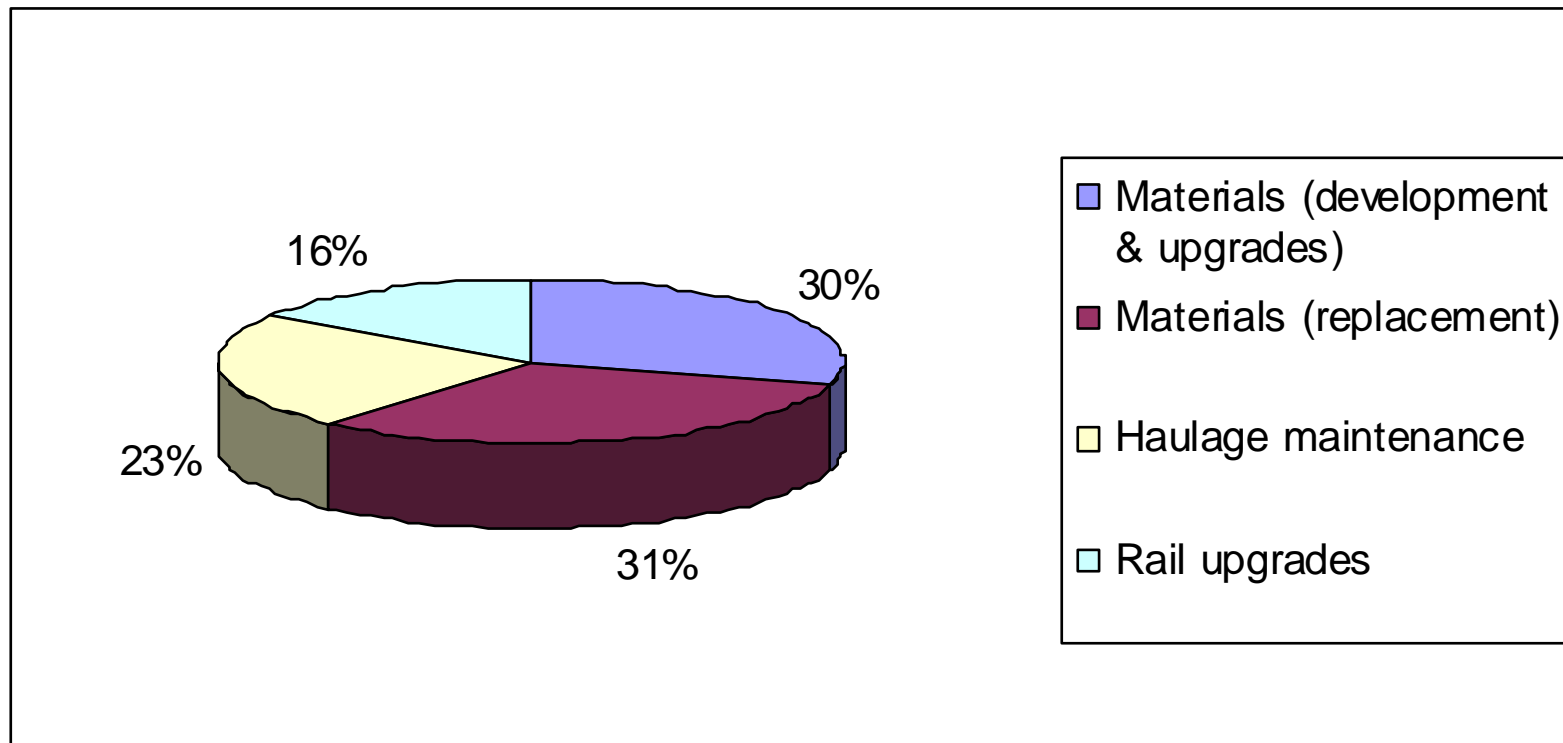
Sleeper Spacing



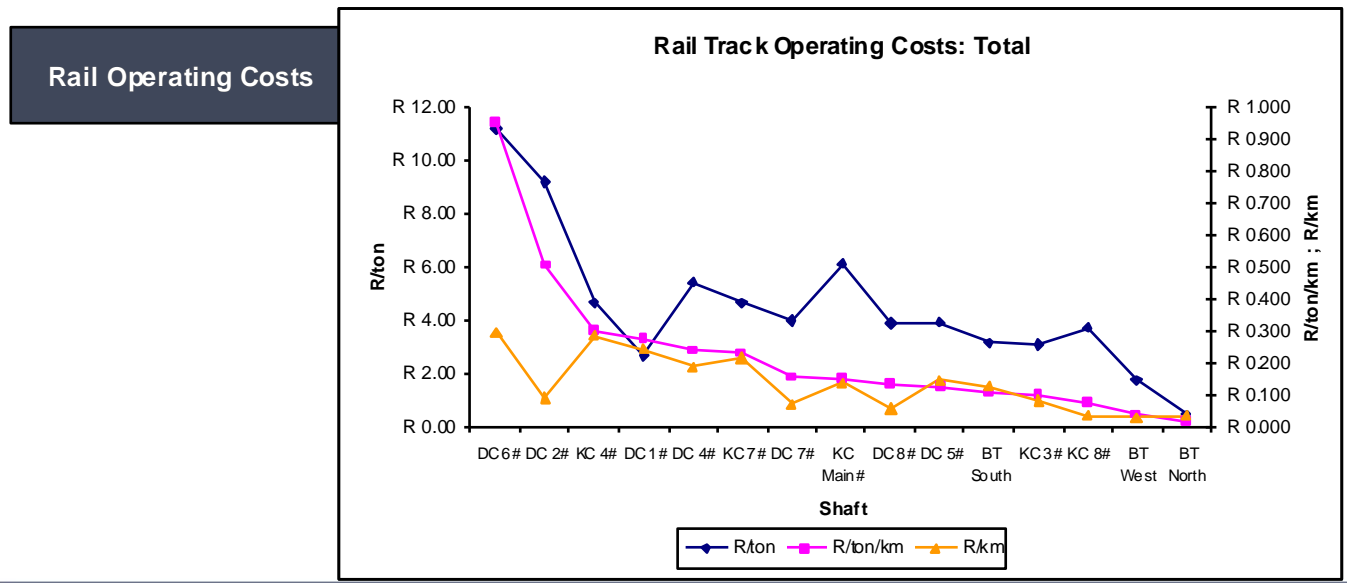
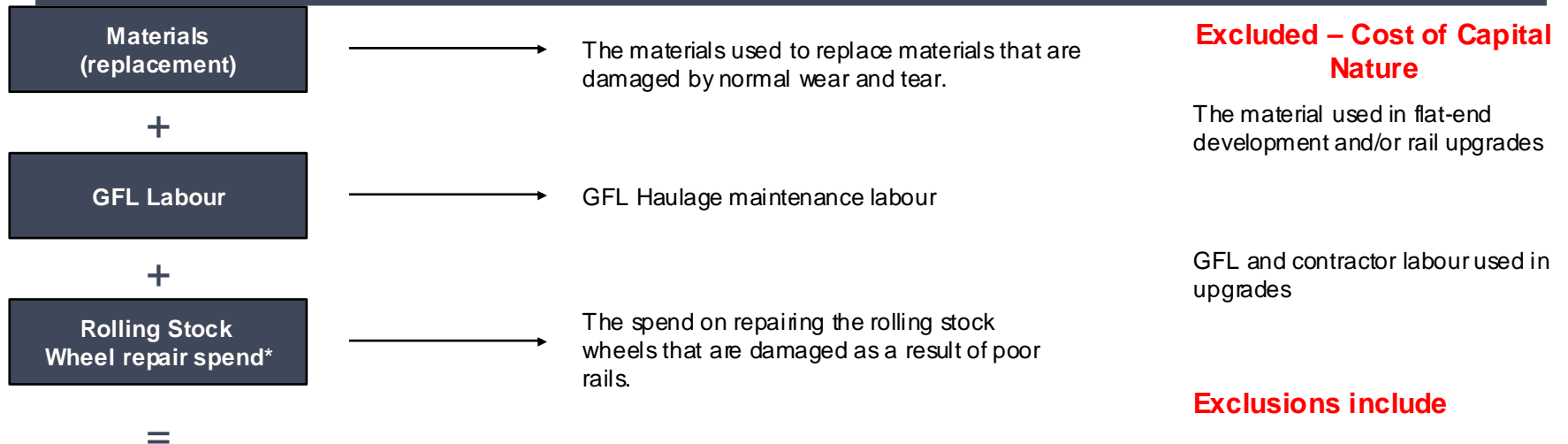
Cost Benefit of Rail Upgrading



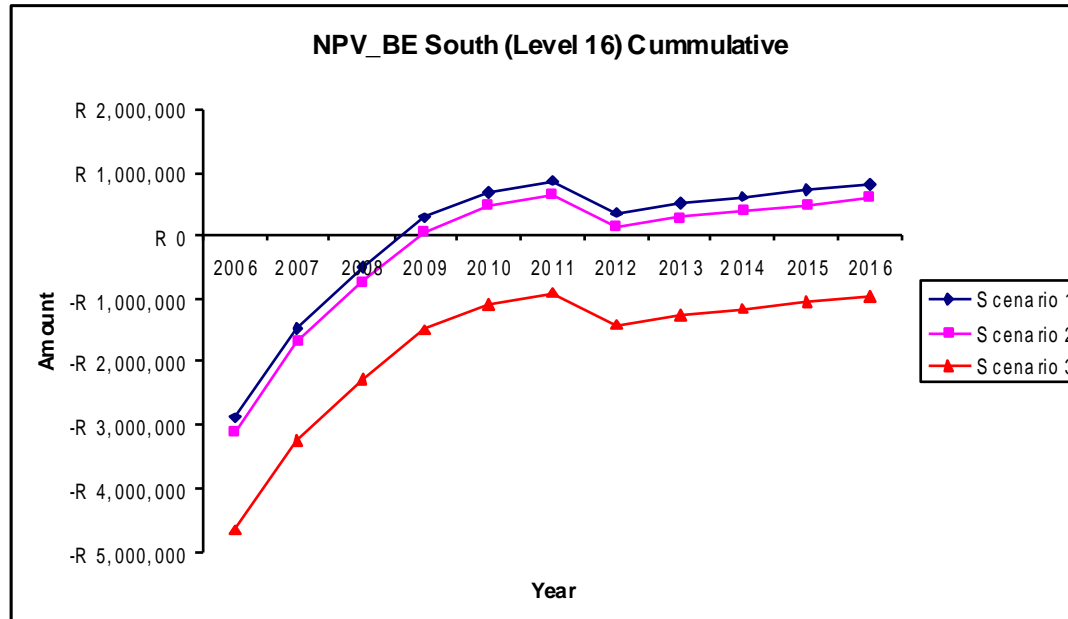
- Expenditure from Jan – Dec 2005



Rail Operating Costs



How viable is upgrading



	SCENARIO 1	SCENARIO 2	SCENARIO 3
RAIL	0	5 %	100 %
SLEEPERS	5 %	20 %	100 %
DRAIN SECTOR	5 %	10 %	100 %
RETAINING WALLS	√	√	√
BALLAST	√	√	√
CONCRETE	√	√	√

Conclusion



Link between:

- Equipment quality
- Track Design
- Production Output
- SAFETY

Follow Development:

- Maximum life
- High Return on investment

Catch up track

- Negative NPV
-

END

