



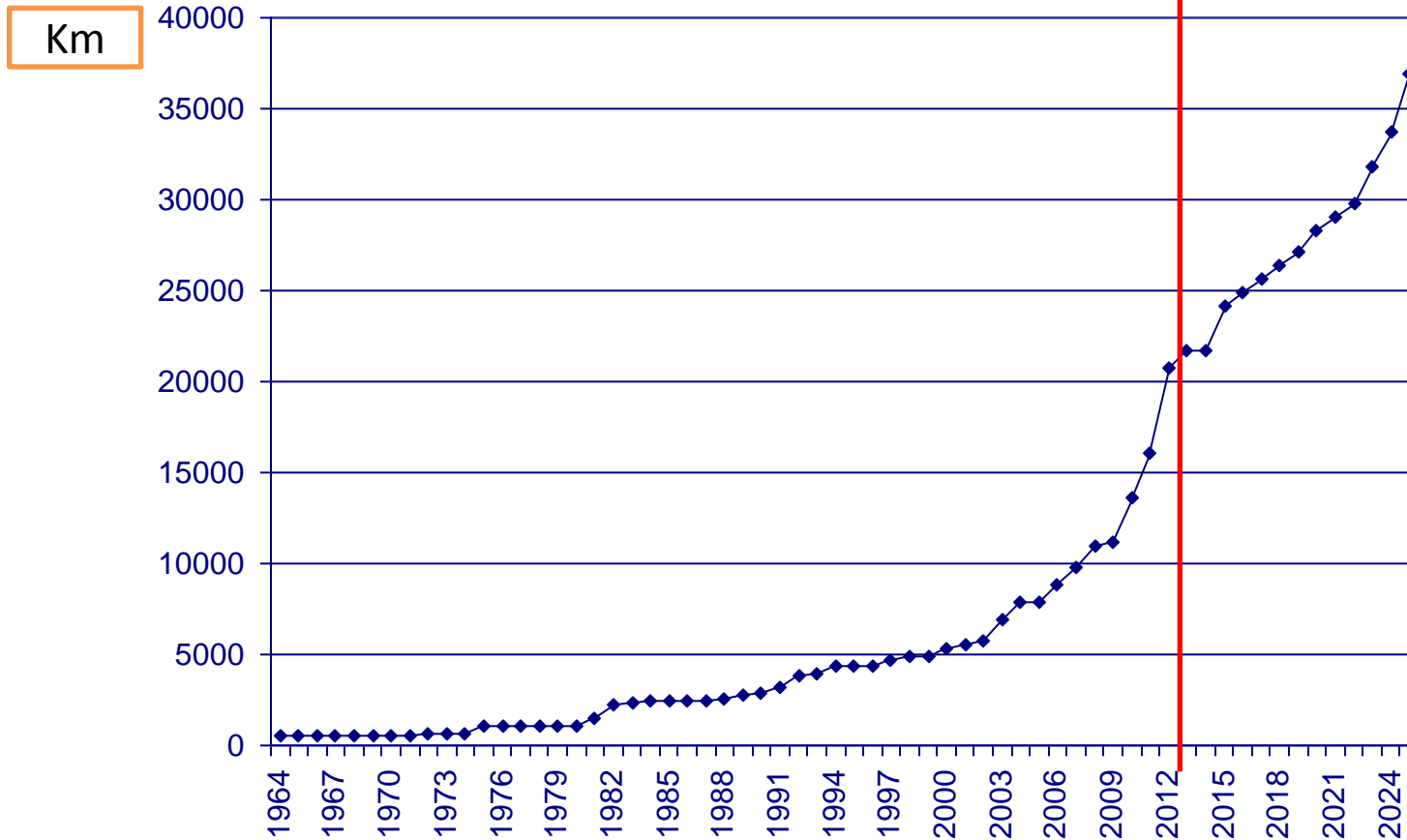
The HS2 Design

Prof Andrew McNaughton
Technical Director

High Speed Rail is 49 Years Old



World High Speed Rail Expansion



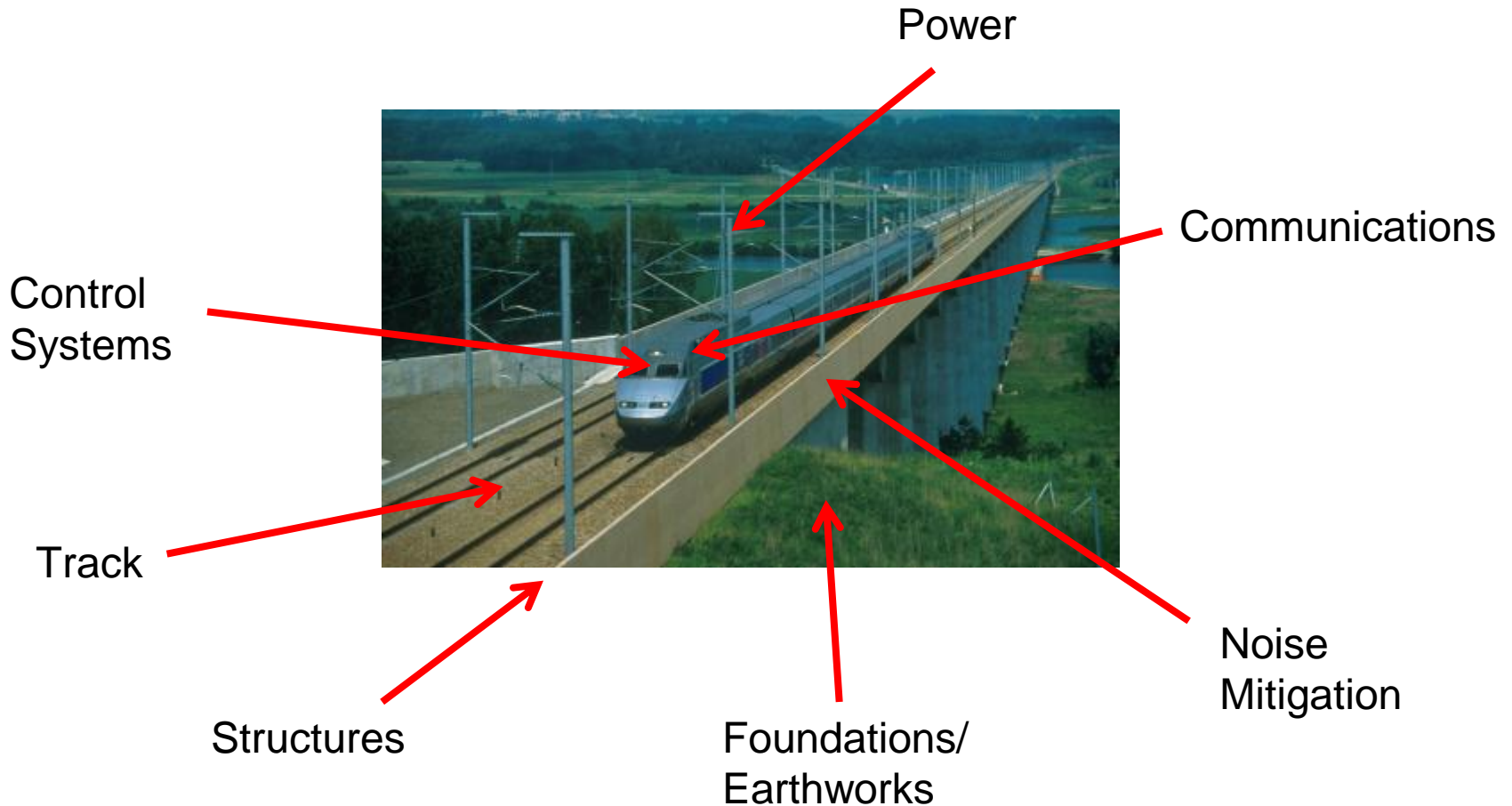
International Technical Standards



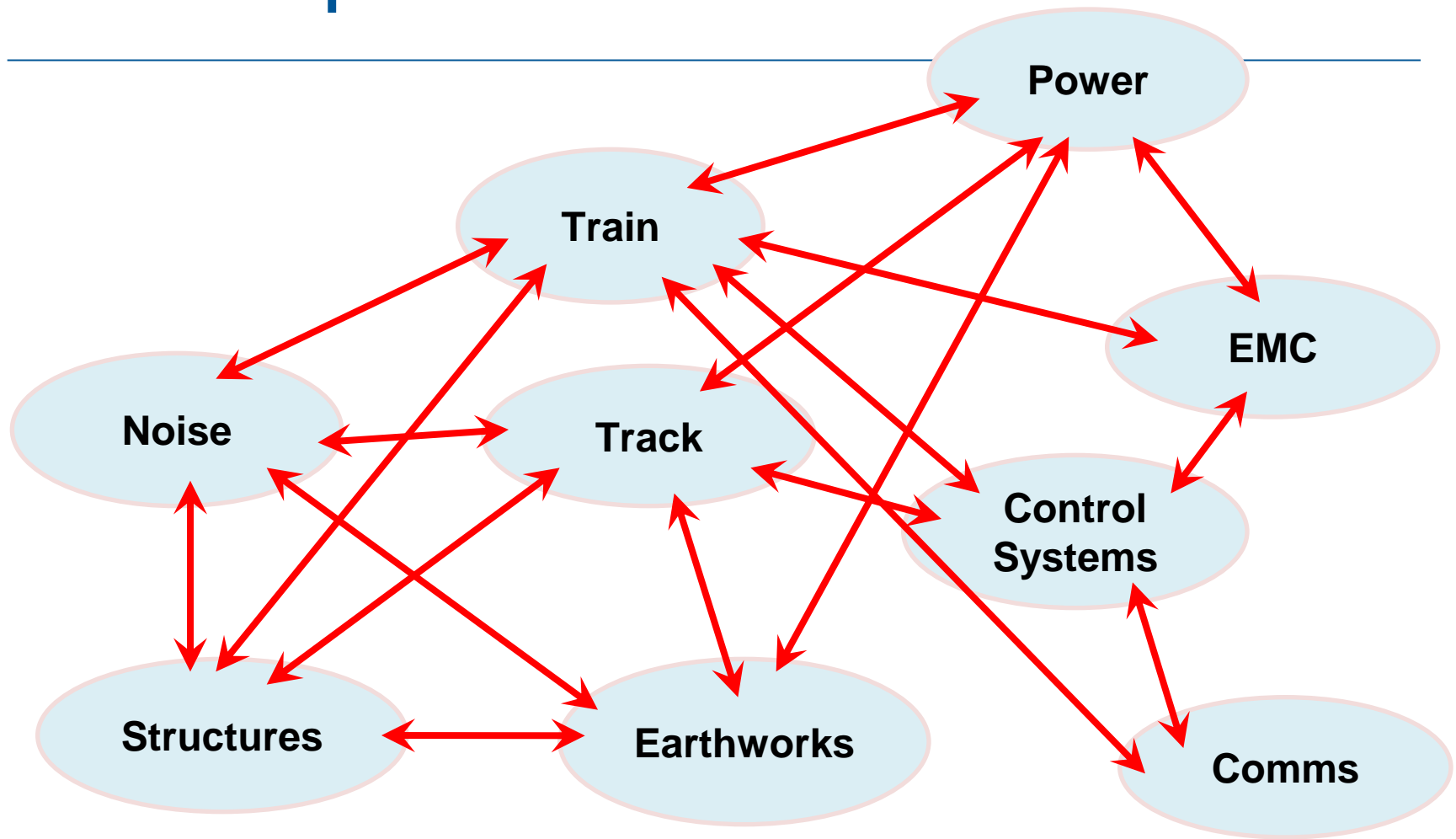
Technical Principles

- International standards
- Compliant with EU Interoperability Directive
- Latest proven technology

A Complex Technical System



With Multiple Interactions



With the Human at its Heart

- Designer
- Constructor
- Operator
- Maintainer



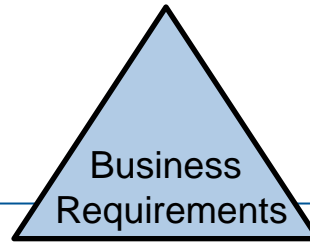
Designed for Individual Passengers

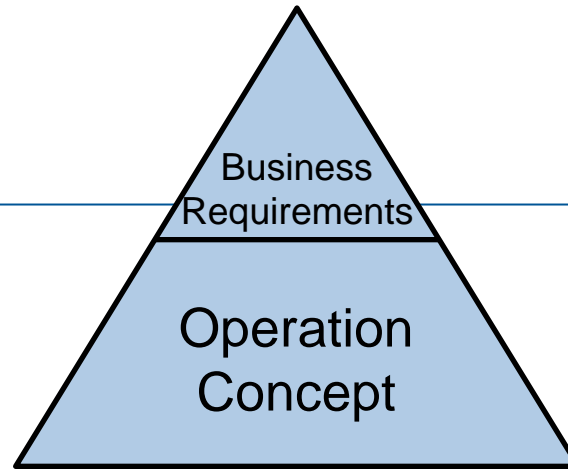


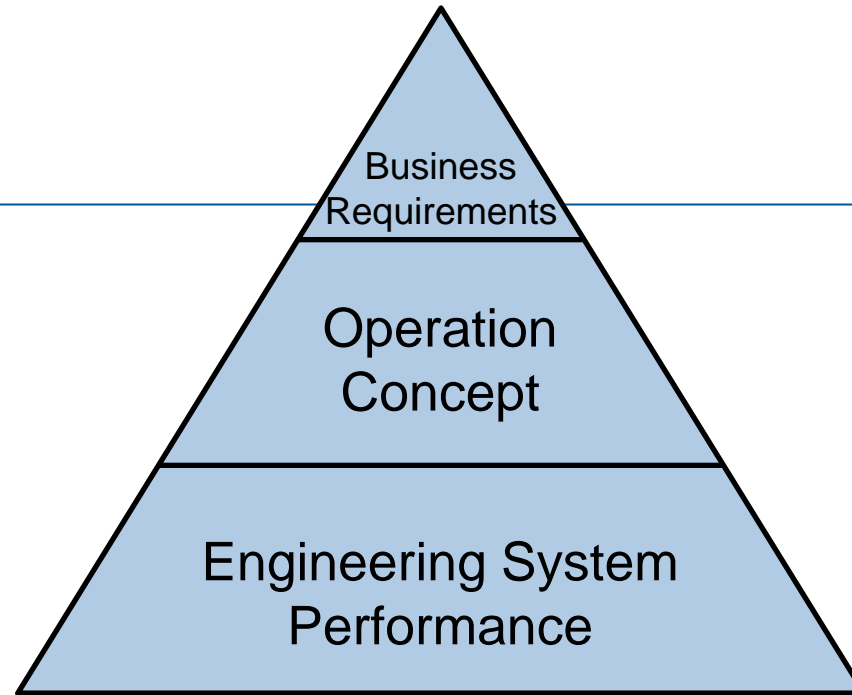
And Whole Life

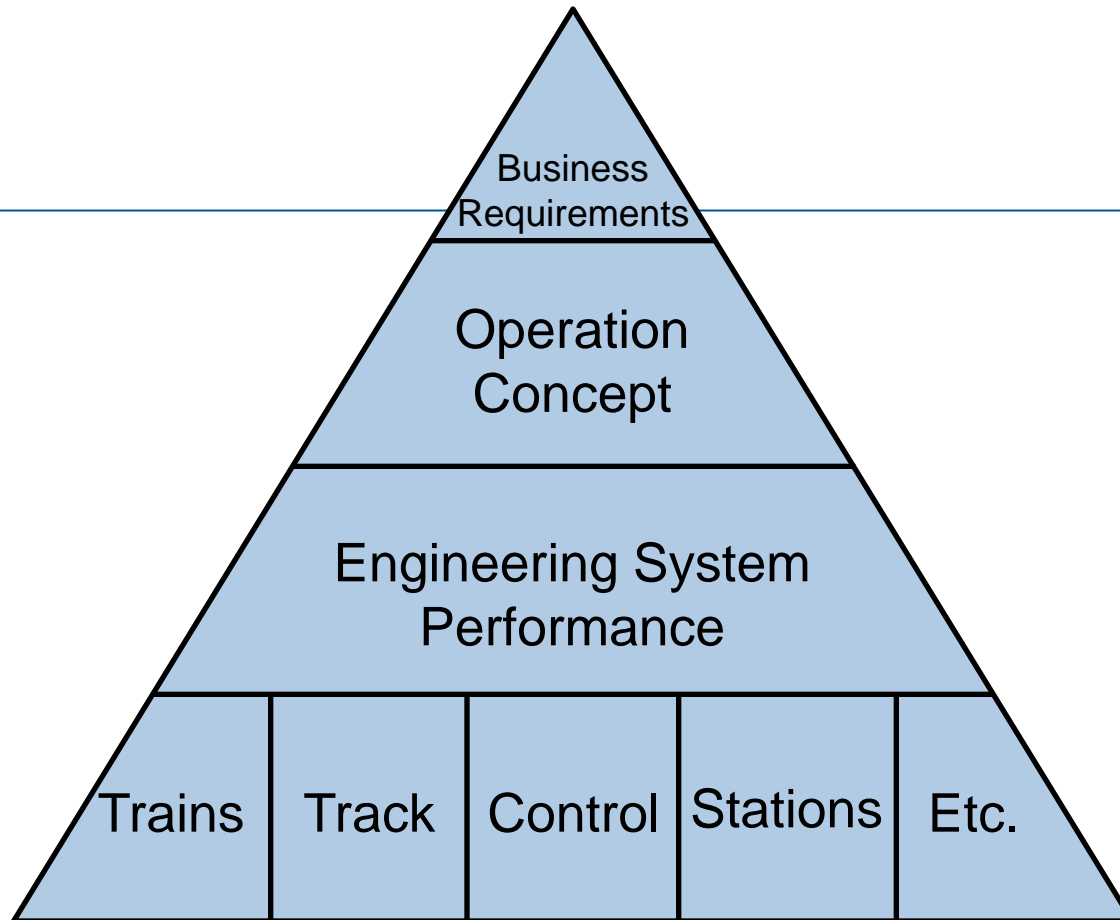
- Construct
- Commission
- Operate
- Maintain
- Renew

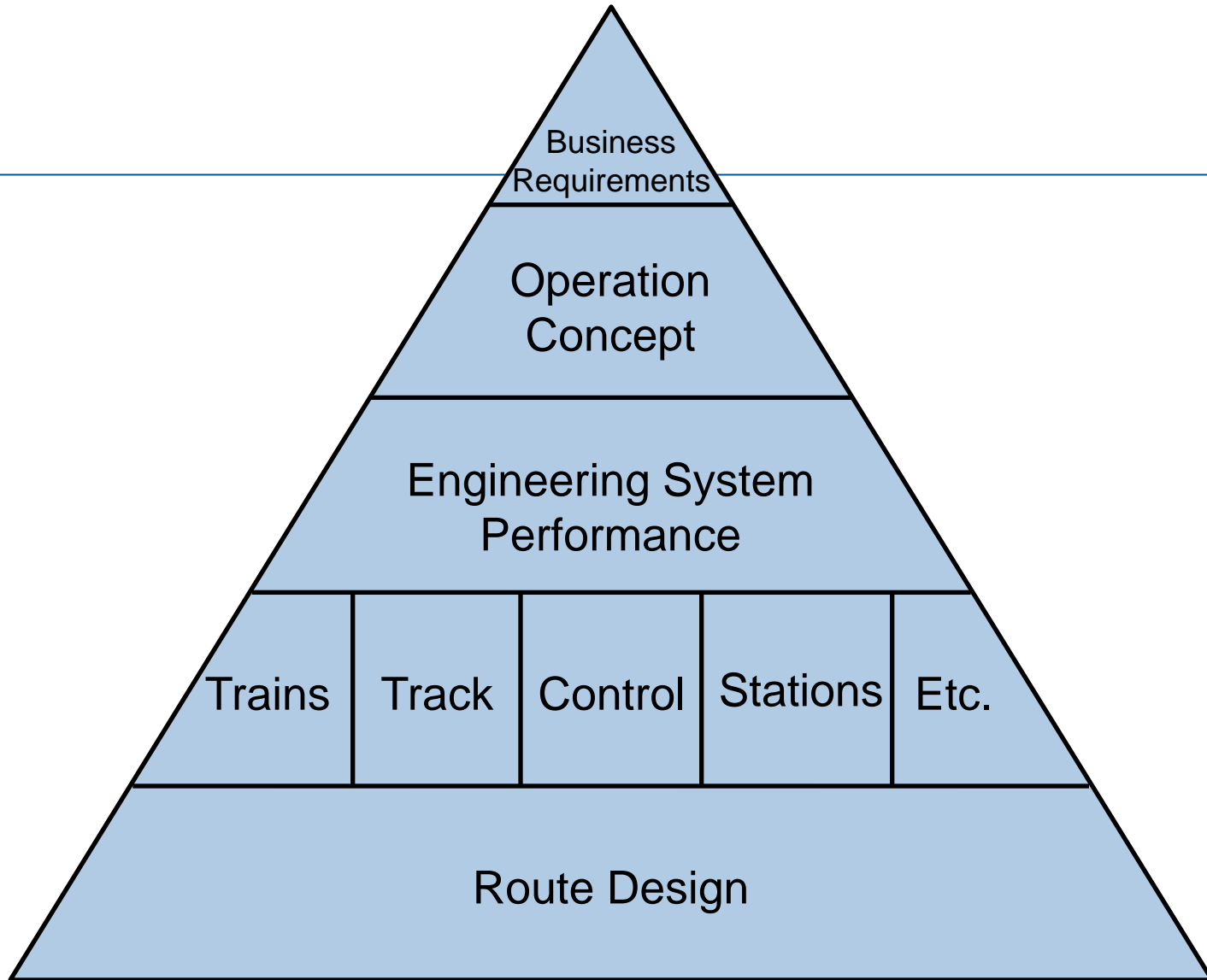




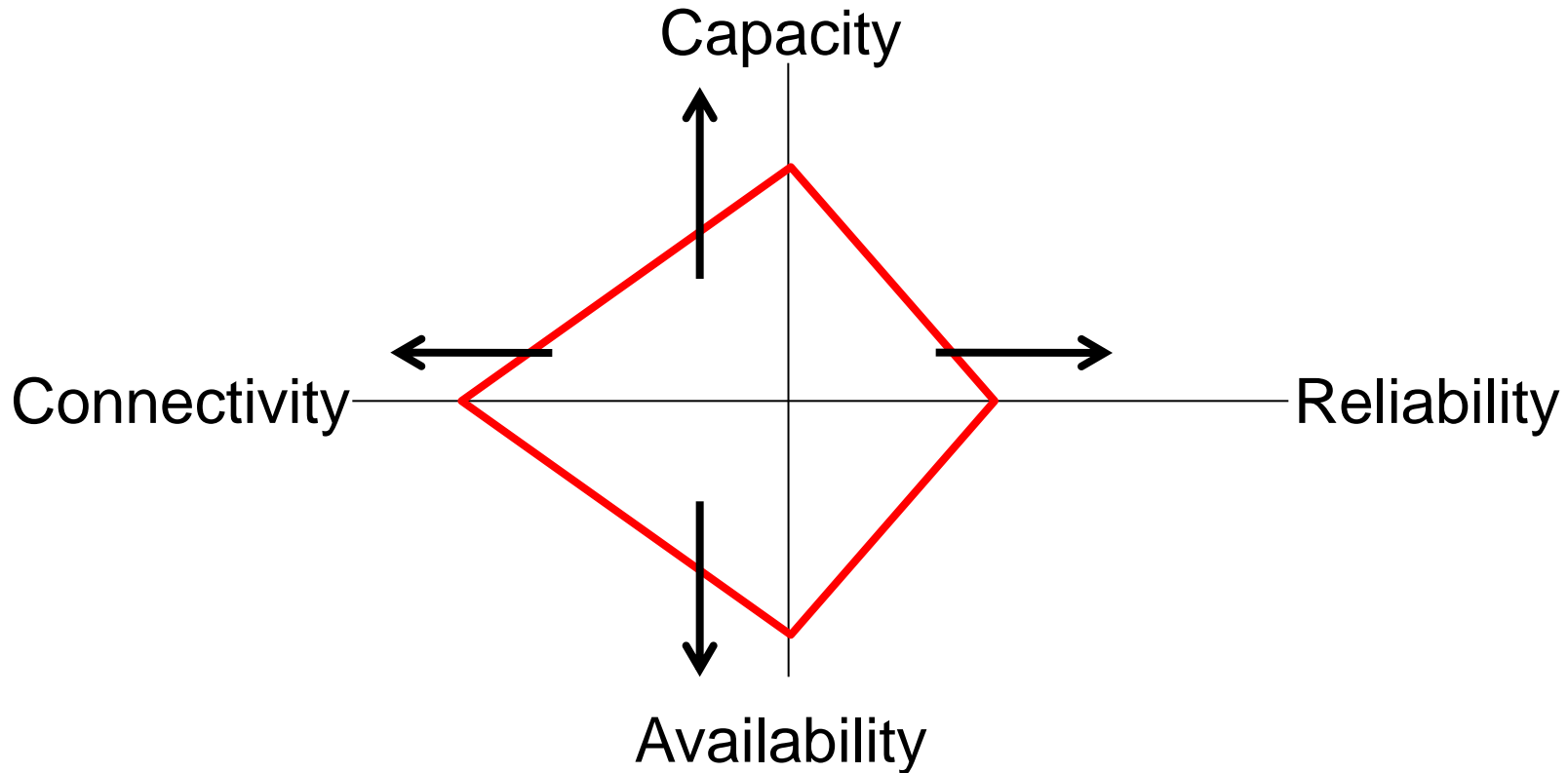








Maximising Capacity, Connectivity, Availability *and* Reliability



Operational Specification

- **Safety**
 - EU Common Safety Method (CSM)
- **Capacity**
 - Up to 18 services per hour each way on the core
 - Up to 1100 passengers per service
- **Availability**
 - Operational hours 0500 – 2400 (0800 - 2400 Sunday)
- **Reliability**
 - Average delay less than 30 seconds per service
- **Connectivity**
 - Journey times based on up to 360km/h maximum speed – balanced with environment impact
 - Whole-journey time reduction – station design / service frequency

Northbound Timetable

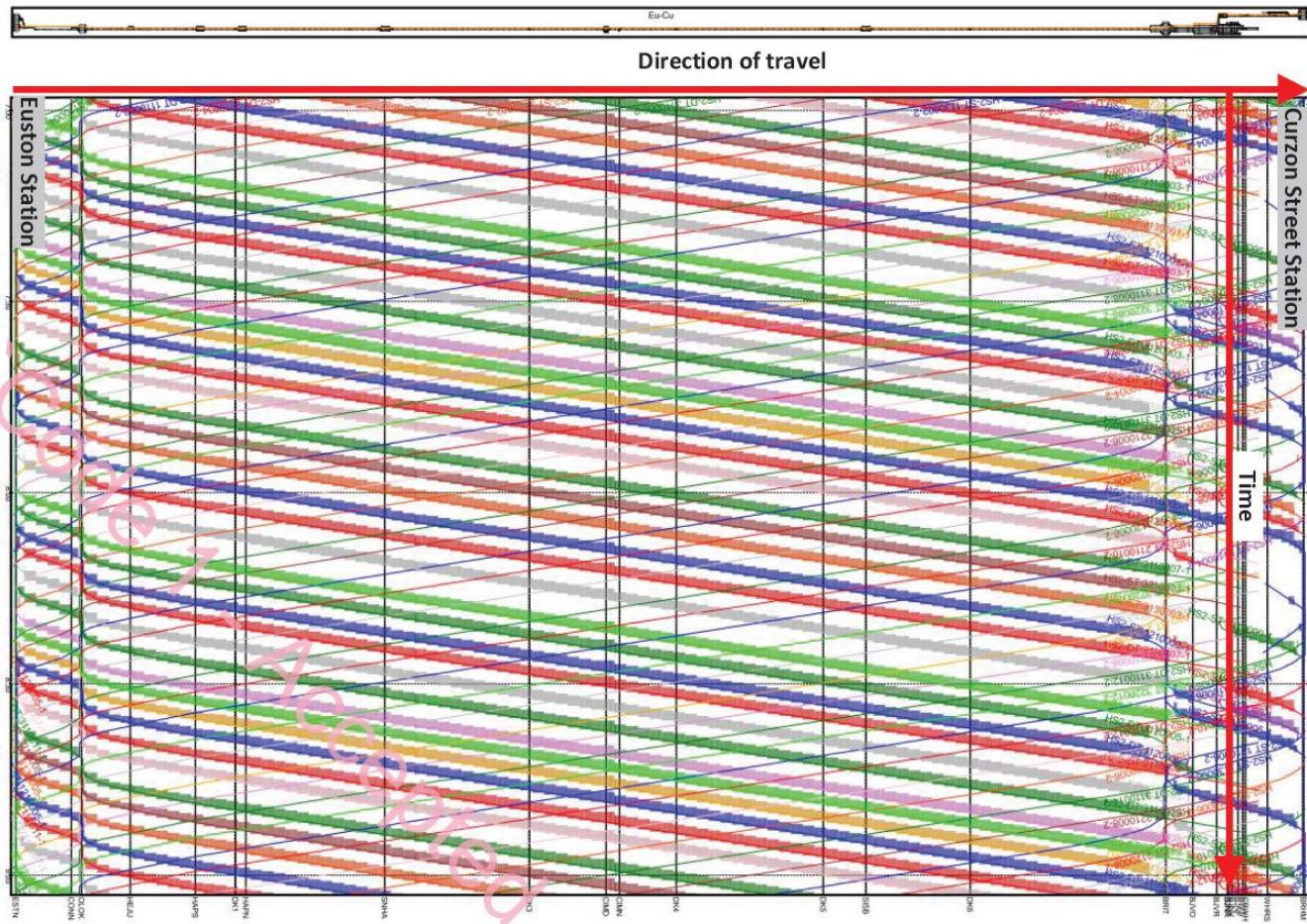
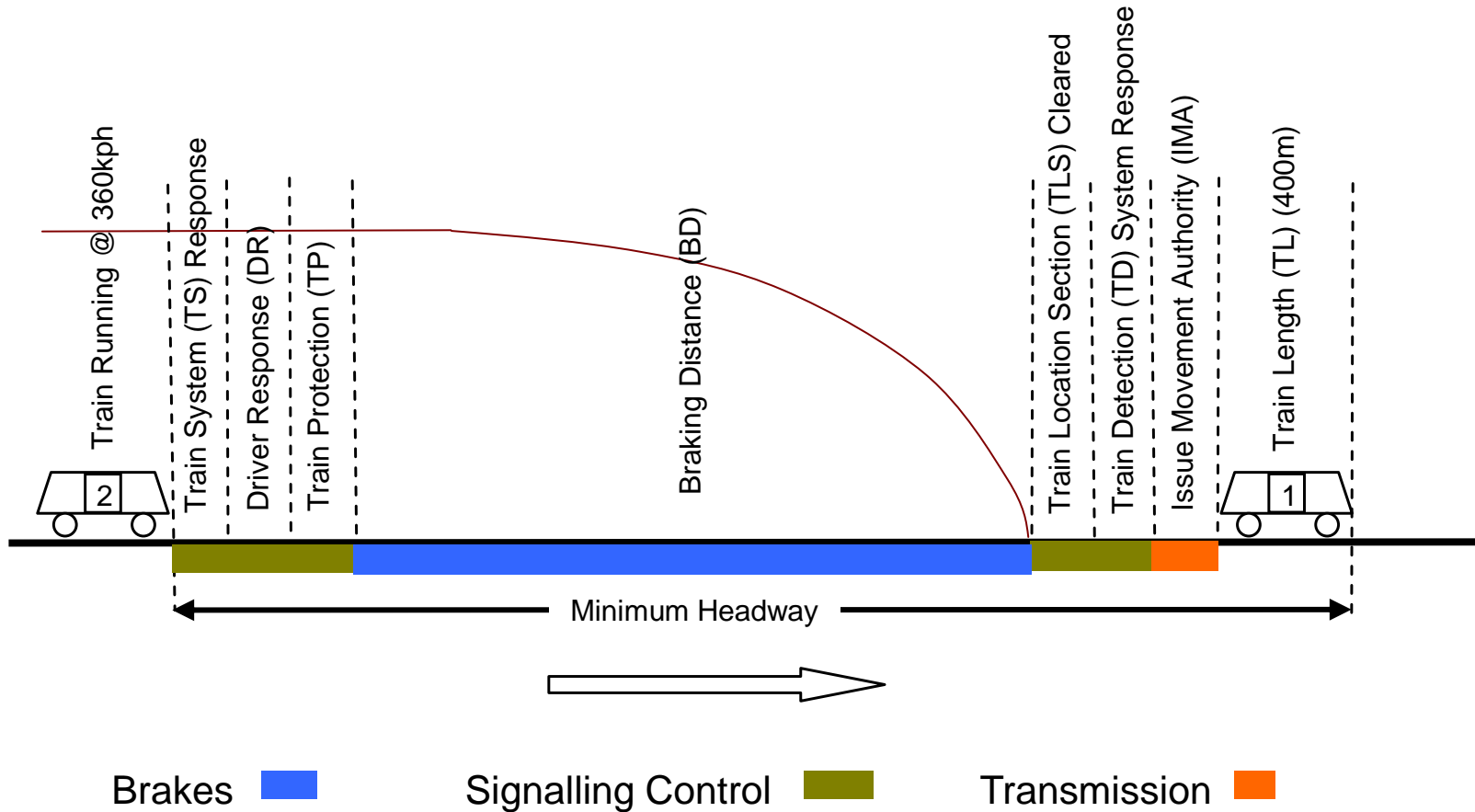


Figure 8: Timetable at peak hour from Euston to Curzon Street – Down Line

Open Line Headway



Reference Train – AGV In Service with NTV



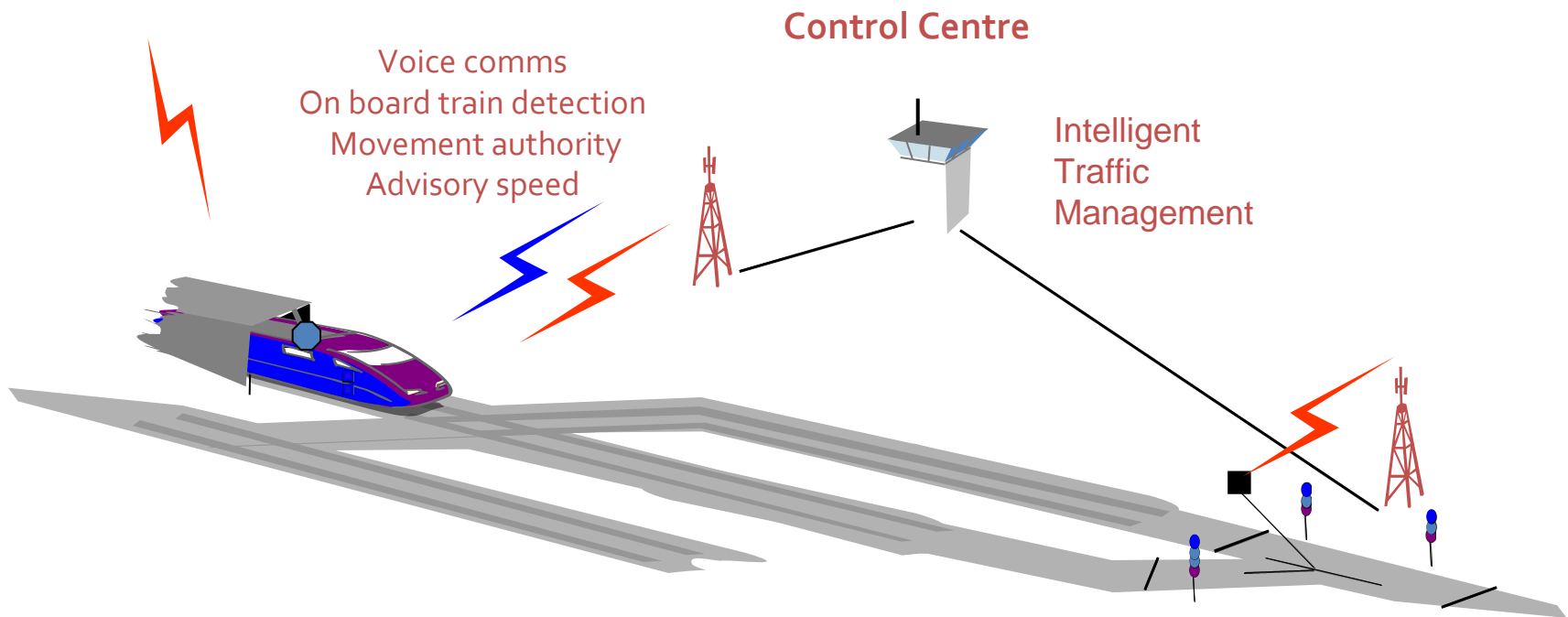
200m Trains Capable of Running in Pairs

Classic Compatible

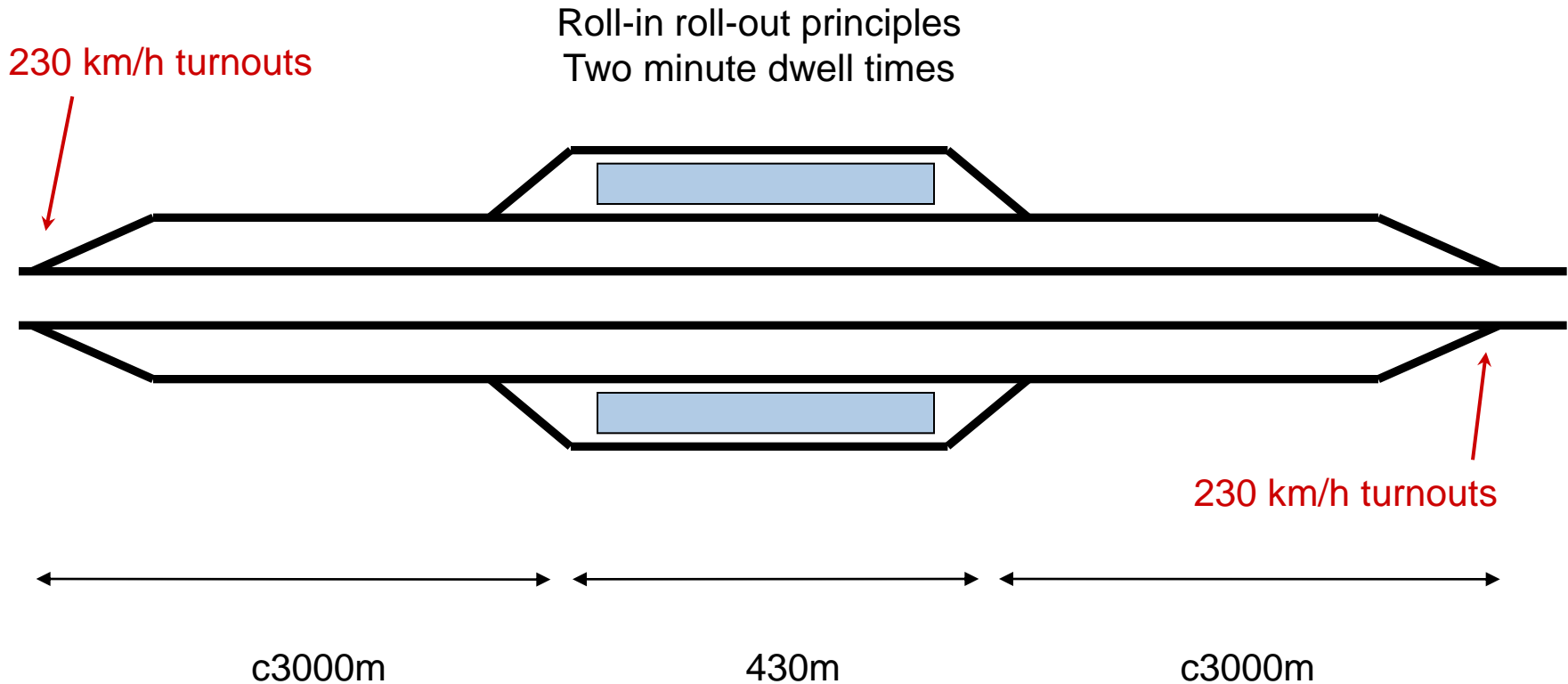


Captive

Transmission Based Control (ETCS Level 2)



Station Design for Capacity



Automatic Train Operation



“Japanese” Operational Precision



Maintenance Specification

- Preventive servicing
- Automation of examination / conditions monitoring
- Mechanisation of maintenance (replace not repair)
- Largely rail based
- Standardised elements
- “Factory” approach throughout

Route and Station Development For The Bill



Britain is Densely Populated



Current Train Sound (360km/h)

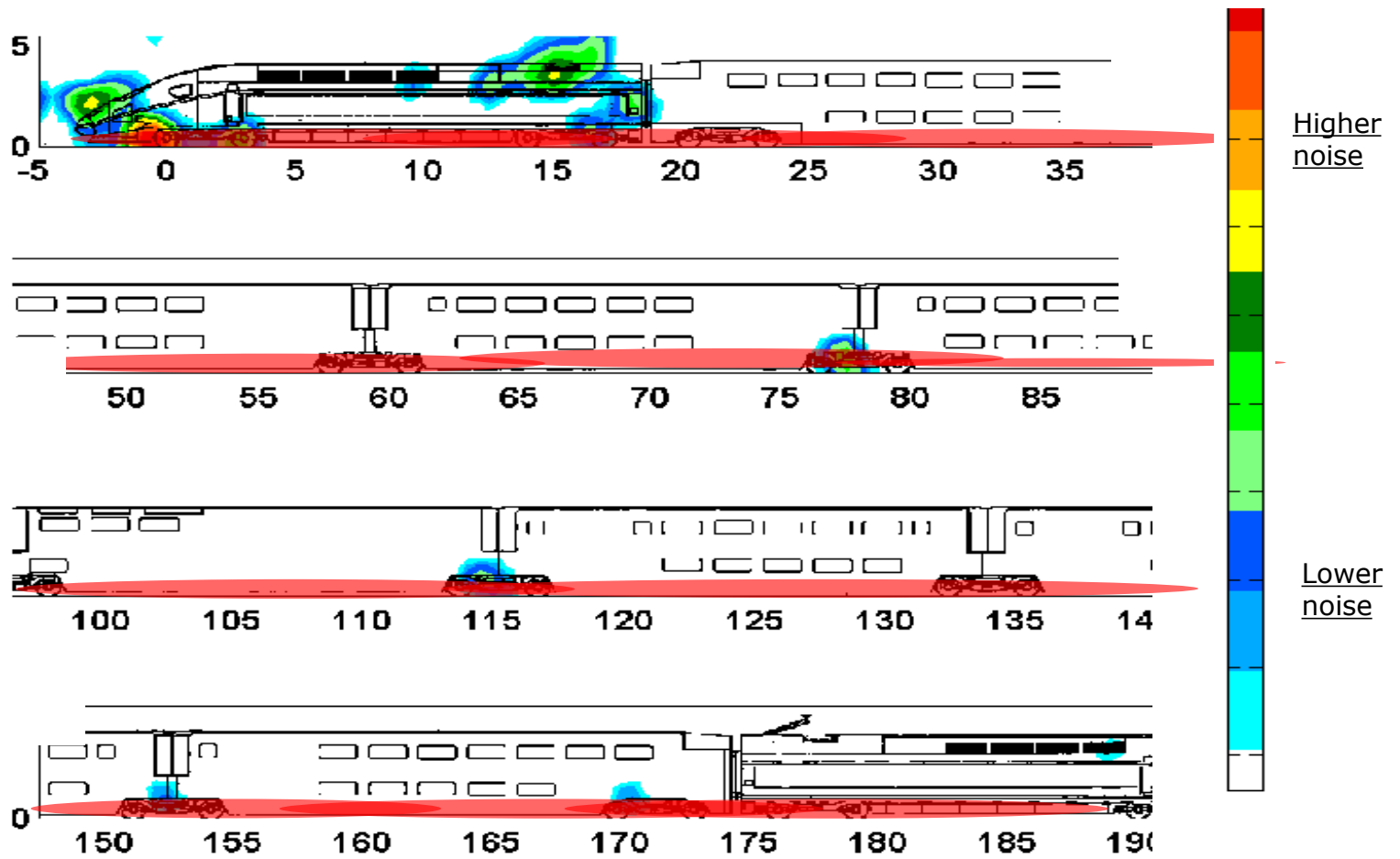


Image based on SNCF 1/3 Octave Noise Map of TGV at 360km/hr modified to represent L_{pAeq} using output from TWINS modelling

Sound Reduction at Source



Low noise pantograph

Pantograph Screens

Inter-car seals

Aerodynamic nose

Bogie shrouds

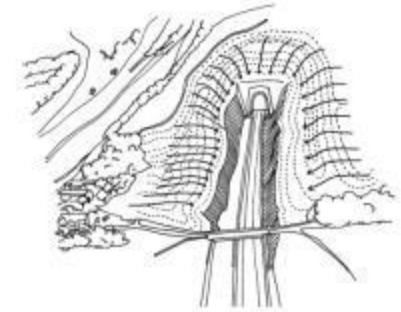
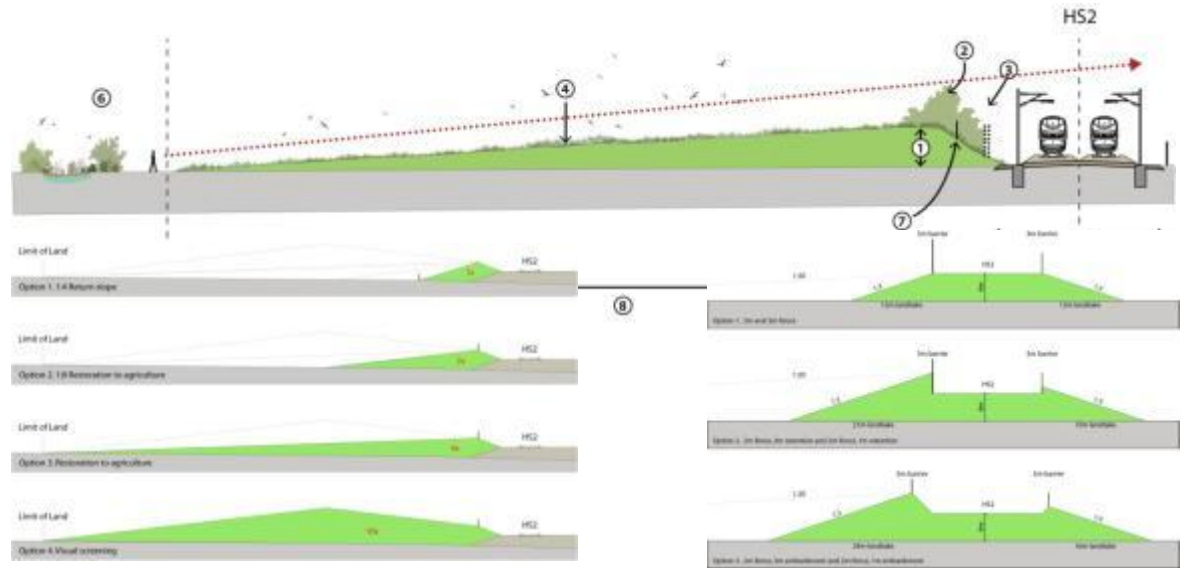
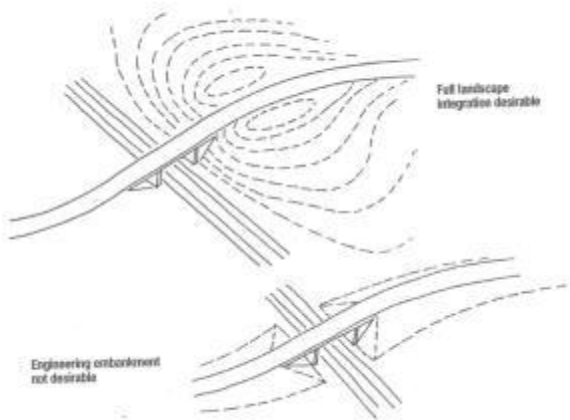
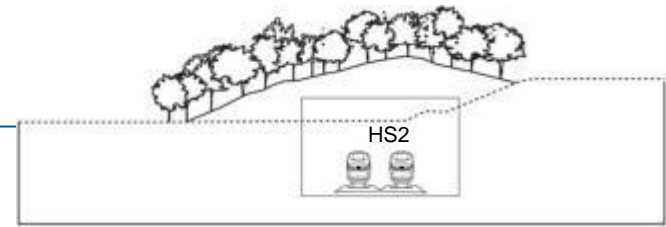
Spoiler

Image courtesy of Toshinori Baba

Position in Landscape is Key



HS2 Design Principles

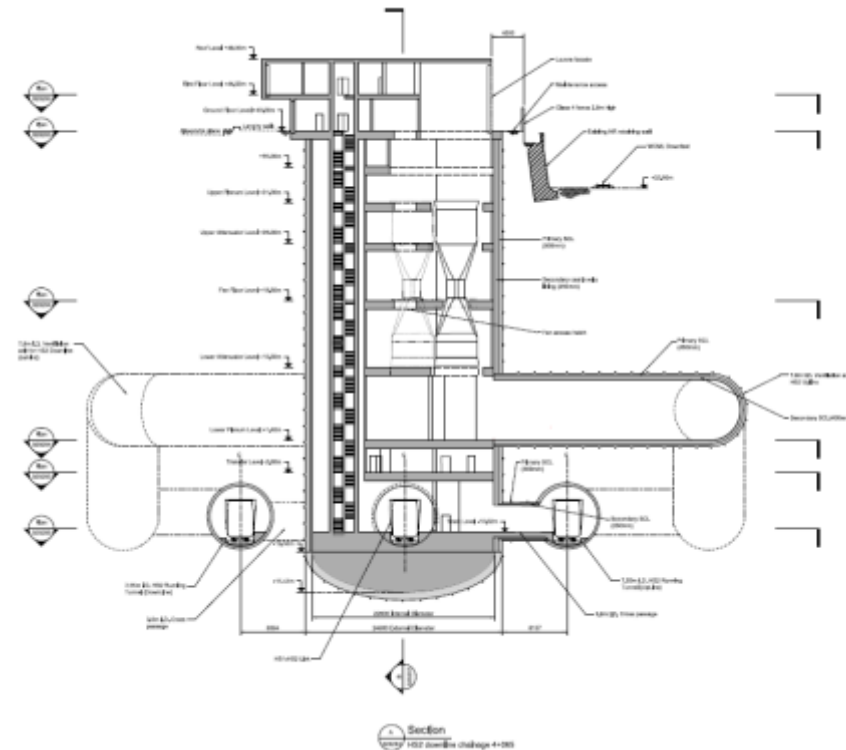


Outline Design of Major Elements



Design Components Include

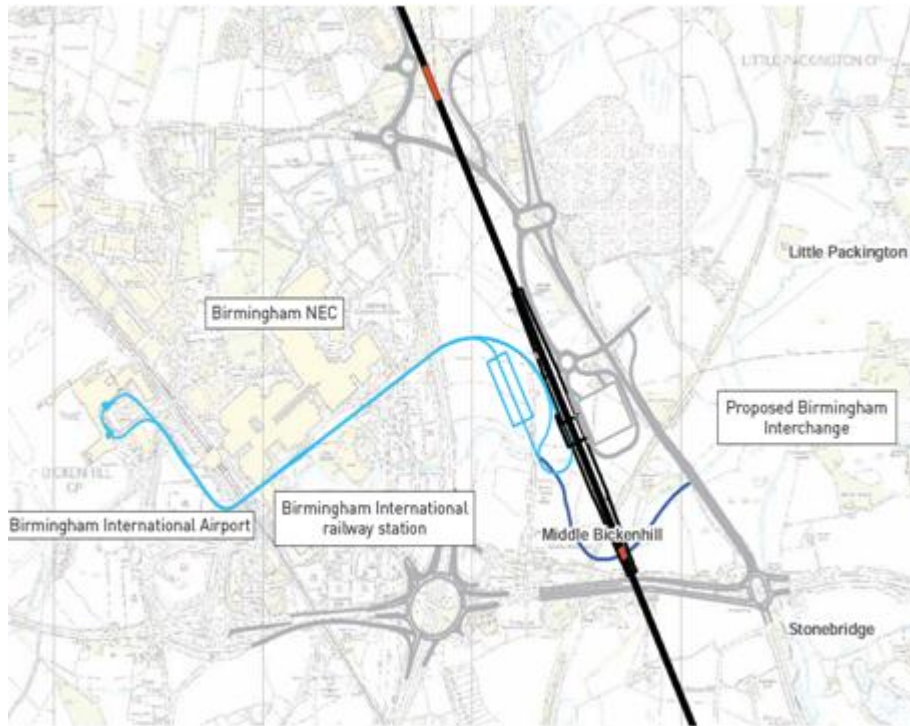
- Stations, buildings & associated public realm
- Earthworks including for visual/ noise screening
- Structures, bridges, viaducts and tunnel portals
- Retaining structures
- Boundary & security fencing
- Noise barriers
- Lighting (urban and rural)
- Planting for visual screening
- Tunnel ventilation & fire safety
- Diverted watercourses/ balancing ponds
- Footpaths and highway infrastructure
- Operational compounds, substations etc.



EIA / Environmental Statement

- Comprehensive mapping
- Key Policies
 - Sustainability Policy – sets HS2 Ltd’s approach towards environment – balanced, proportionate and practicable
 - Environmental Design Aims
 - Code of Construction Practice – set out the measures to protect people and natural environment during construction
- Technical Annexes – assessment of the scheme under 14 topic areas
 - From Air Quality to Waste Materials

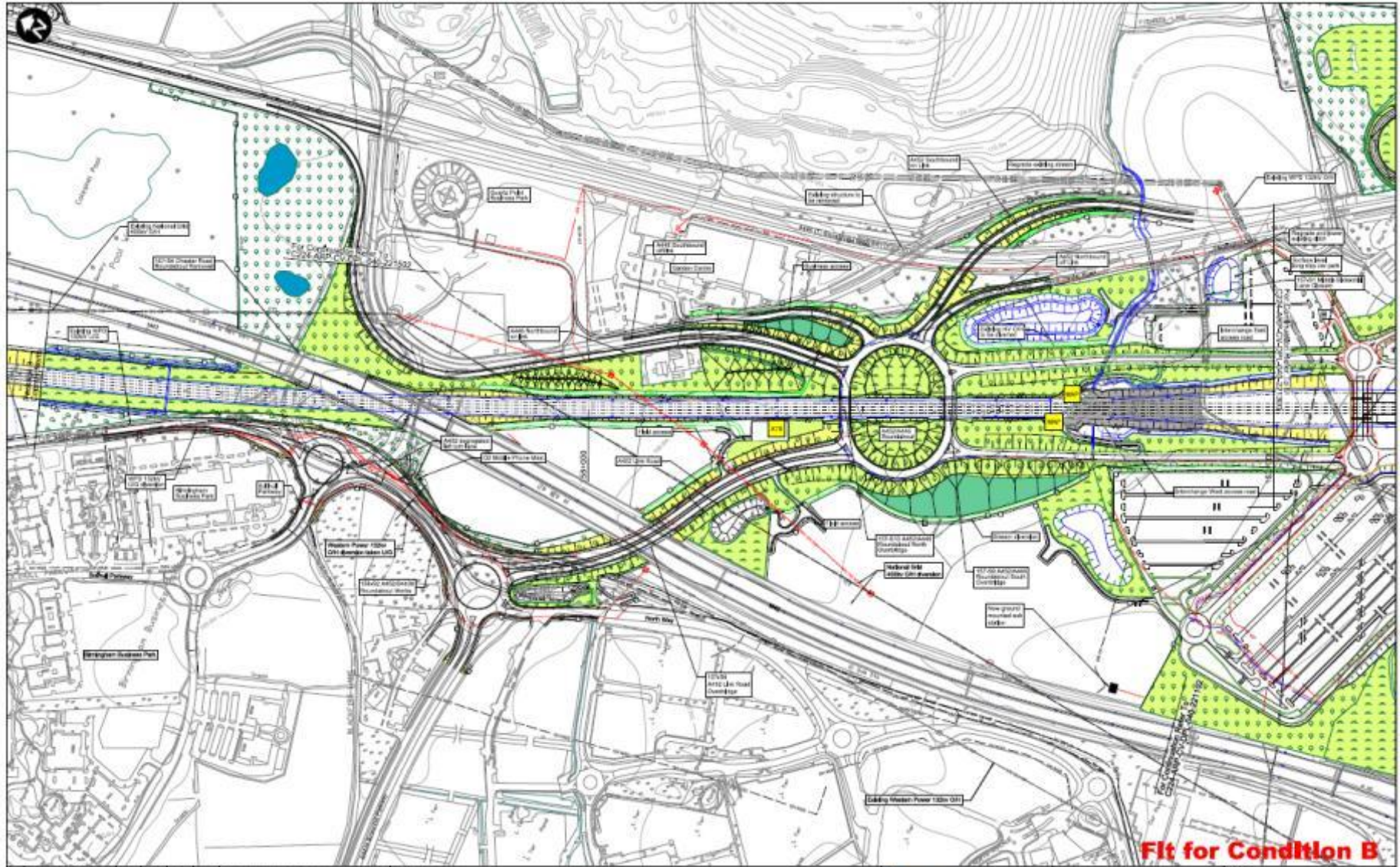
Example: Birmingham Interchange



People mover to National Exhibition Centre and the Airport

'Parkway' feeder for the metropolitan area

Highway connections to trunk network



Fit for Condition B

Rev	Description	Issued	By	Checked	Scale
001	Issue for approval	15/03/2012	JPH	JPH	1:1000
002	Issue for approval	15/03/2012	JPH	JPH	1:1000
003	Issue for approval	15/03/2012	JPH	JPH	1:1000
004	Issue for approval	15/03/2012	JPH	JPH	1:1000
005	Issue for approval	15/03/2012	JPH	JPH	1:1000
006	Issue for approval	15/03/2012	JPH	JPH	1:1000

For more information, please refer to the project website: www.hs-engine.com

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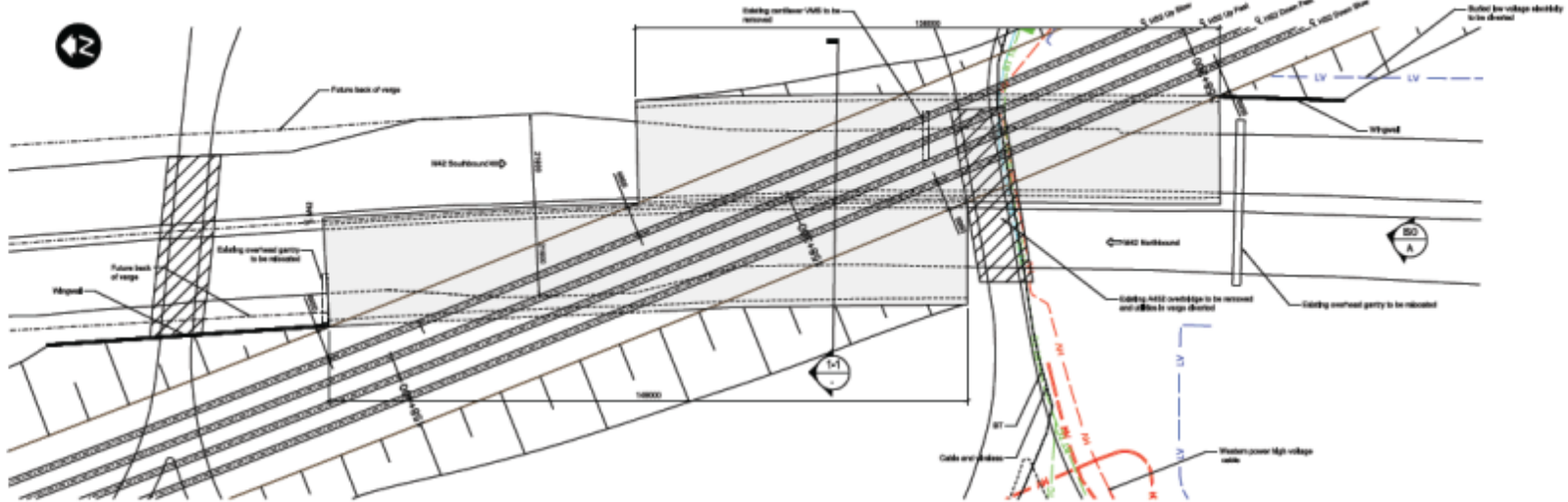
For more information, please refer to the project website: www.hs-engine.com



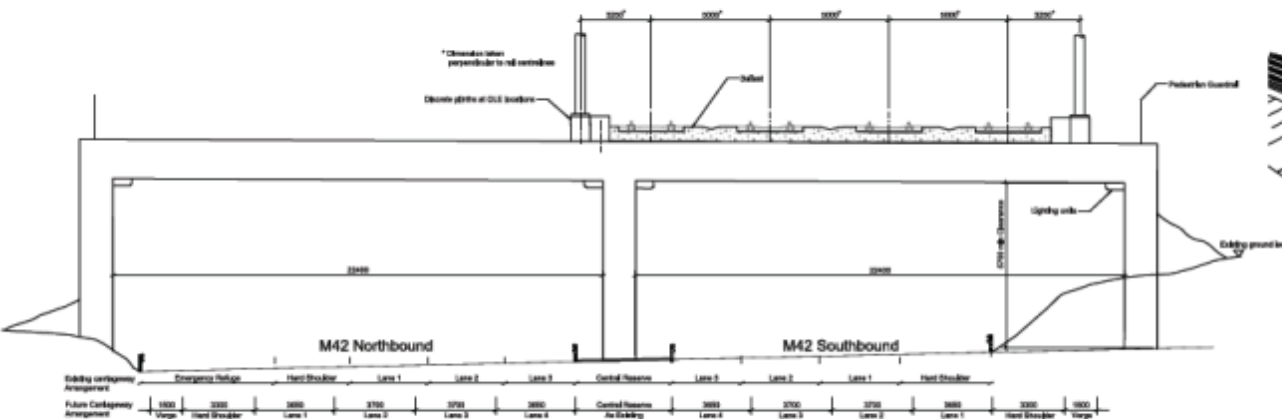
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 E: info@hs2.com
 www.hs2.com

Headline & Partners International Ltd

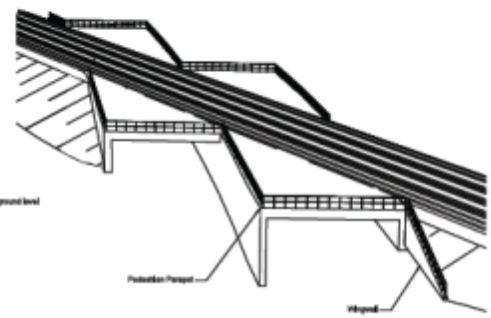
West Midlands Metropolitan Area Design		Midlands Metropolitan Area Design	
Project Name	West Midlands Metropolitan Area Design	Client	HS2
Project No.	HS2/01/001	Drawn	AJT
Project No.	HS2/01/001	Checked	PW
Project No.	HS2/01/001	Approved	JPH
Project No.	HS2/01/001	Date	20/11/2012
Project No.	HS2/01/001	Scale	1:2500
Project No.	HS2/01/001	Rev	A1
Project No.	HS2/01/001	Project No.	HS2/01/001
Project No.	HS2/01/001	Project No.	HS2/01/001



Plan
1:500



Section 1-1
1:500



Isometric View A
N.T.S.

Fit for Information



Issue	1	2	3	4
Date	2023/07/18	2023/07/18	2023/07/18	2023/07/18
By	JM	JM	JM	JM
Checked				
Drawn				
Checked				
Issue No.				

- Legend:**
- All ground not to be shown unless otherwise stated.
 - Foundations not shown.
 - Design based on M42 M&T Preliminary Design Agreement, refer to drawing CD24-APP-007-00A-040-1/001/1 P06.
 - For details not shown refer to drawings CD24-APP-007-00A-040-000000, CD24-APP-007-00A-040-000001 and CD24-APP-007-00A-040-000002.
 - Design based on Requirements for Special Arrangements (Overhead Approach Statement Northbound P&L (MSO-MSD-CV-GAD-030-000001) and Overhead Approach Statement - Structure and Underbridge Roadway P&L (MSO-MSD-CV-GAD-030-000002)).

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The Parkway, Birmingham
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Tel: 0121 717 8000
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Email: info@hs2.com

Project Manager
Gus Arns & Partners International Ltd

HS2 Local Stakeholder
PROTECT

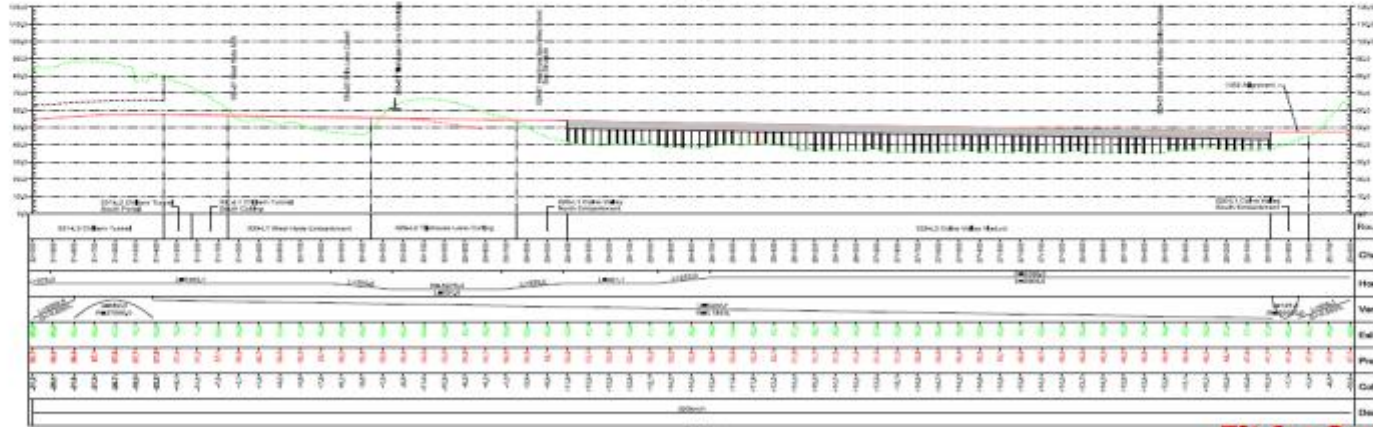
Site	West Midlands Metro/HS2	Birmingham Metro/HS2 Area Design	
Design Stage	Preliminary - Initial Condition 04	Structure/Function	Bridge
Drawing No.	STRUCTURE 1980 M42 UNDERBRIDGE GENERAL ARRANGEMENT	Drawn	DT
		Checked	CMH
		Approved	SMC
		Date	26/07/2023
		Scale	AS SHOWN
		Rev	A1
		Drawing No.	CD24-APP-007-00A-040-1980/0
		Rev.	P00.3



Example of Landscaping



Plan



Profile

Fit for Condition B

Code	Description	Quantity	Unit	Value
100	Excavation	100	m ³	100
200	Gravel	200	m ³	200
300	Concrete	300	m ³	300
400	Asphalt	400	m ²	400
500	Paint	500	liters	500
600	Signage	600	units	600
700	Lighting	700	units	700
800	Drainage	800	m	800
900	Other	900	units	900

For Approval or marking this is a preliminary drawing. It is not to be used for construction purposes.



Client	Country South
Project	Public Works - Roads
Phase	Plan & Profile
Sheet	Sheet 1

Scale	1:1000
Author	AS
Check	AS
Drawn	AS
Project No.	18/00012
Client No.	AS 04000
Revision	A0
File No.	0200170101_000400001
Scale	1:100

Land Acquisition for Habitat Replacement – HS1 Example



Example of Construction Options



Figure 2. (above) shows Park Village East during construction.



Figure 3. (above) shows Park Village East after construction.

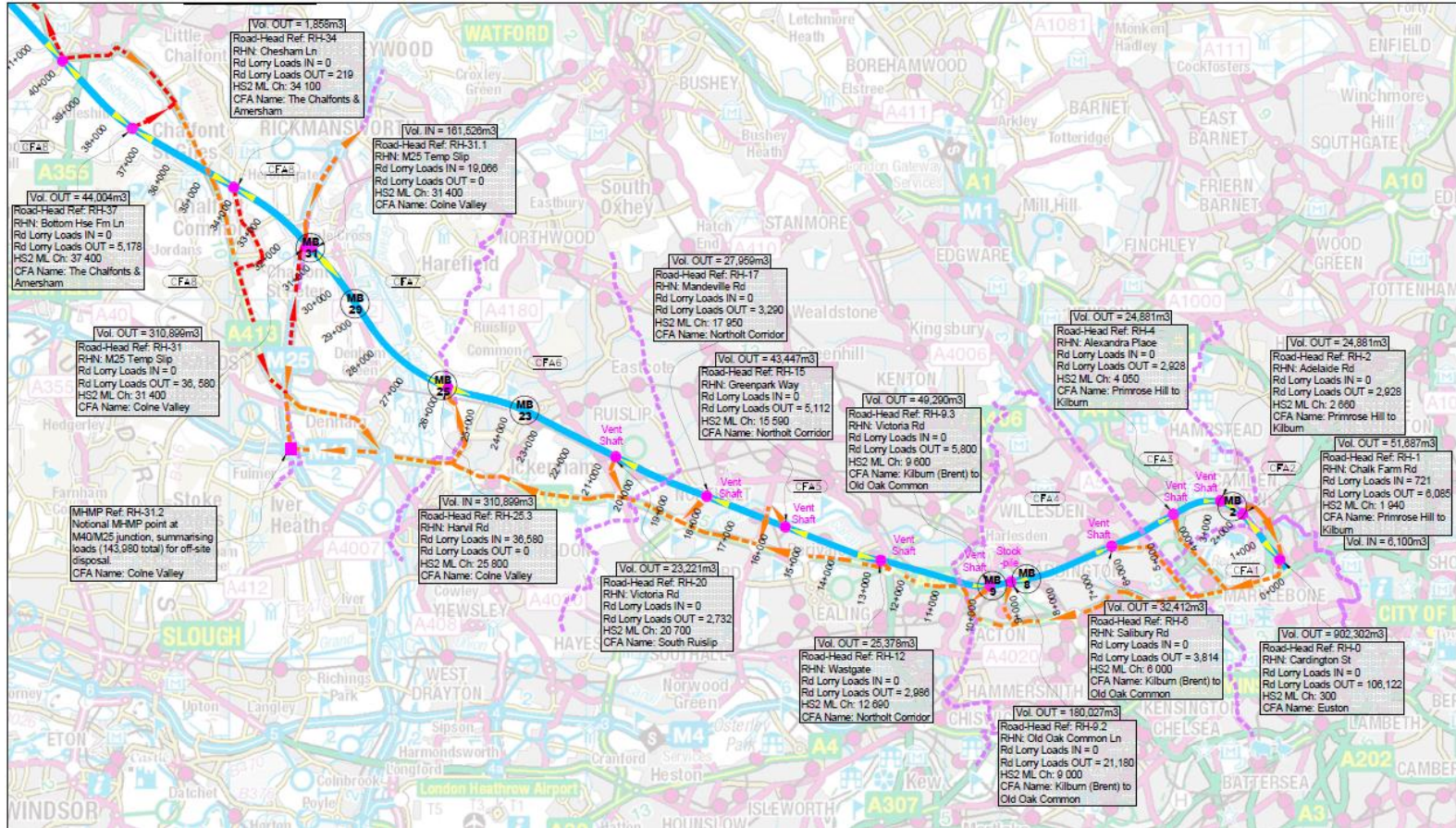
Earthworks and Mass Haul



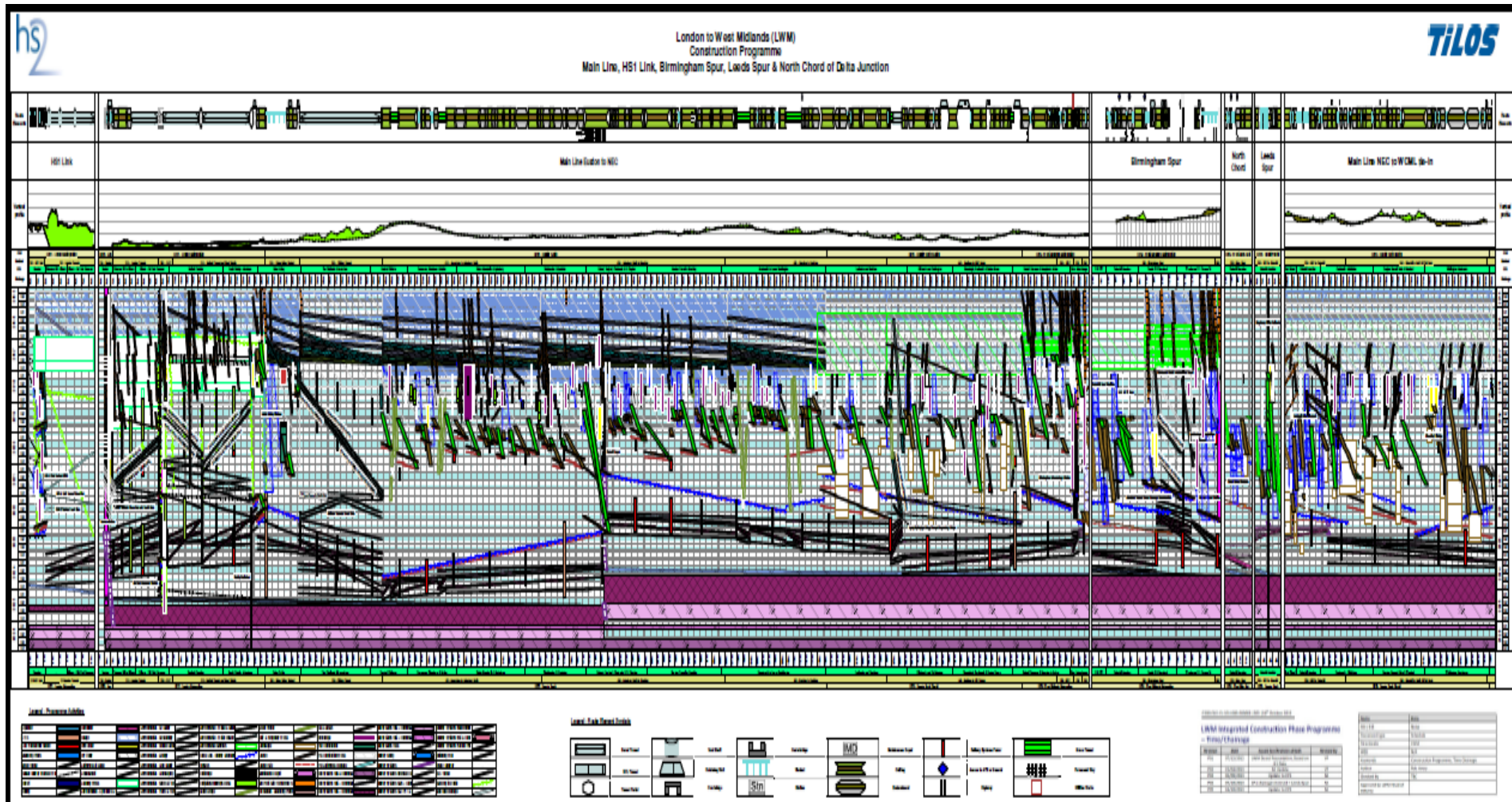
Quality of Structural Earthworks



Construction Programme & Mass Haul Sites



Integrated Programme





Cut to BIM, Ops & Mtce and Passenger Experience Big Pictures

Placeholder



Judged By Future Generations