How the West Was One

N17N18 Gort to Tuam PPP Scheme
Project Background And Pavement Aspects
N17/N18 Gort To Tuam PPP Scheme

- N17 Tuam Bypass CPO 2005
- M17 Galway Tuam CPO 2007
- M18 Oranmore Gort CPO 2006

Combined as one PPP Scheme

- N17 Tuam Bypass 4km
- M17 Galway-Tuam 26km
- M18 Oranmore-Gort 27km

57km
N17/N18 – History of Project - 1

- 3 Separate Projects
- 3 Separate Statutory Process Approvals
- N18 D&B Tender Process 2008
- D&B Tender Process not completed due to economic downturn
N17/N18 – History of Project - 2

• 3 Projects combined into single PPP Project
• Procurement commenced Spring 2009
• 4 PPP Consortia Prequalified
• Stage 1 Submissions November 2009
• Stage 2 BAFO Submission August 2010 - Preferred Bidder No 1
• Second BAFO Submission August 2011 - Preferred Bidder No 2
• Procurement Suspended and Reopened
• Financial Close - April 2014
N17/N18 Delivery Programme

- Financial Close: April 2014
- Construction Start: January 2015
- N17/N18 Motorway Opening: Q4 2017
- Operation & Maintenance: 2017 - 2042
N17/N18 – PPP Model

• 25 year concession period (2017-2042)
• Private sector designs, builds, finances and operates (incl. maintenance) the Project Road
• Private sector funds construction
• PPP Co. receives availability payments over 25 years
• Road returns to public sector with prescribed residual life
Design Joint Venture

- Design Joint Venture consists of joint venture between CH2M Barry and Arup
- Tender Design was completed in 2010 and forms the Conceptual Design
- CH2M Barry are designers for the northern half of the scheme, Arup designers for the southern half of the scheme
- Design commenced in May 2014 with the preparation of a Design Manual to standardise design approach across the Scheme
- Max Design Team at Peak: Design Office: 93 Site: 25
- Design is now complete. As-builts being produced
Scheme Information – Key Elements

- 53km of Standard Dual Carriageway Motorway
- 4km of Type 2 Dual Carriageway
- 4 grade Separated junctions including a major junction with the M6 Motorway
- Link Roads, Side Road Diversions and Access Roads
- 71 Principal Structures including road bridges, river bridges, rail bridges, footbridges, accommodation bridges and culverts,
- 33 other structures including retaining walls, gantry signs and VMS signs
- Fencing, Safety Barriers, drainage, communications, earthworks, signage, lining, landscaping, lighting, utilities, environmental and ancillary road works
## Scheme Information – Key Quantities

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Earthworks</td>
<td>4,340,071m³</td>
</tr>
<tr>
<td>Rock</td>
<td>1,827,053m³</td>
</tr>
<tr>
<td>Suitable &amp; Unsuitable Material</td>
<td>2,513,017m³</td>
</tr>
<tr>
<td>Fencing</td>
<td>150,000m</td>
</tr>
<tr>
<td>Structures</td>
<td>71 number</td>
</tr>
<tr>
<td>Structural Concrete</td>
<td>30,000m³</td>
</tr>
<tr>
<td>CBM</td>
<td>198,324m³</td>
</tr>
<tr>
<td>804</td>
<td>236,098m³</td>
</tr>
<tr>
<td>Blacktop</td>
<td>210,720m³</td>
</tr>
</tbody>
</table>
Key Design Challenges

• Three Contractors – Two Designers – Different Requirements
• The design of significant Peat areas within the Tuam Bypass and on the M17 south of Tuam
• Design of earthworks through karst areas
• Flooding
• Environmental
• Structures
• Pavement
Key Construction Challenges

- Three Separate Design Supervision Teams with a DSR overseeing all three
- Three Separate Contractors
- Three Separate Authority’s Representative supervision teams
- The management of areas of significant Peat
- Construction through areas of Karst Features within limestone bedrock
- Construction of the Rathmorrissy Interchange over the live M6 Galway – Ballinasloe Motorway
- Construction over watercourses – prevention of an impact on the watercourse and maintaining the integrity of river banks for wildlife
Environmental Challenges

- Scheme encroaches into the catchment area of the Lough Corrib SAC and crosses the Abbert and Grange tributary rivers

- Scheme is adjacent to the Coole – Garryland Complex (SAC, pNHA, SPA, SNR) and Kiltiernan Turlough (SAC, pNHA)

- Nationally rare plants present – Mudwort, Dropwort, Alder, Buckthorn, Lady’s Tresses, Orchid and Wood Bitter Vetch
Environmental Challenges

The habitats of protected species that are located within the scheme –

- Whooper Swan
- Pine Martin
- Bewicks Swan
- Otter
- Lesser Horsehoe Bat
Environmental Mitigation
Coole Green Accommodation Overbridge
Flooding – Nov 2015
Flooding – Nov 2015
Mitigation against Flooding

• Drainage Blanket
• Road Design Levels
• Flood Relief Culverts
Earthworks - Karst Protocol

1. Designer to characterise the potential for karst features in the GIR risk register.
2. Designer to review risk of features affecting works and outline any change to risk and locations in the GIR/EW package.
3. DSR to investigate karst features identified during the GIR and marked on the plan profiles.
4. Talk to landowners.
5. Features identified on drawings from desk study?
6. Topsoil strip noted on drawings.
7. Strip topsoil where embankment is <3.0m or within 15m of structure proceed with earthworks.
8. DSR to inspect subgrade for visible karst features.
9. Is additional GI required?
10. Carry out Trial pit.
11. Documentation reason why it is not a karst feature.
12. Carry out trial pit to investigate.
14. Complete earthworks including blanket geotextiles where shown in design.
16. Apply appropriate SED.
17. Correct development solution.
18. Cat III approval.
19. Apply design solution.
20. Carry out GI.
Karst Features at Structures

M17 Ballinphuill Overbridge

• 8 conduit karst features converging at the Central Pier

• Clay filled void

• 12m in length

• 8m in width

• 8m to solid rock

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Ballinphuill: How did we fix this on Site?
Karst Features at Structures

M17 Ballygaddy Overbridge

- Large Linear Karst Feature
- Saturated sand filled void
- 3.5m width
- Minimum 20m in length
- 13m to solid rock
Ballygaddy: How did we fix this on Site?
Soft Ground Treatment

Soft Ground

- Approx. 3km of soft ground
- Vertical band drains at 1.0m spacing
- 5 Loading stages
- Up to 7m of embankment
- 1.5 years duration
- Constant monitoring of instrumentation. PWP, inclinometers, settlement plates, etc.
Structures - OB23 – Long span variable depth concrete beam

Plan on highway alignment

Elevation on reference design
Rathmorrissy Junction
Pavement
Pavement Design for the N17/N18 Gort to Tuam Project Road is an analytically designed Flexible Composite Pavement, designed in accordance with TRL Report 615

Non-Project Road – designed to standard method (Chpt 4-5 of HD25-26) for a 40 year design life

Why analytical Design?
• Common on many PPP Projects
• Based on customising design to locally available materials and construction methods
• Maximise whole life value
• However, additional testing required to prove design assumptions are achieved in situ.
Why Flexible Composite Pavement?
• Site won Aggregate – very significant limestone rock ideal for aggregate
  • Sustainable use of Material
  • Cost Efficiency

Flexible Composite design in soft ground?

• Assumed foundation CBR of 15% proved through testing
• Primary settlement fully achieved and significant secondary settlement achieved through maintaining surcharge beyond required design period
• Use of geosynthetics as reinforcement to pavement layers eg Kilmore Roundabout
• Reduced crack induced spacings to 2m.

All reducing the potential for settlement or reflective cracking
Typical Pavement Make-up for Design Traffic of 36-56msa based on Analytical design

<table>
<thead>
<tr>
<th>Layer</th>
<th>Clause</th>
<th>Mat.</th>
<th>Grade of Binder</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Course</td>
<td>942</td>
<td>SMA 10 surf PMB 65/105-60 des</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Binder Course</td>
<td>929</td>
<td>AC 20 dense bin des</td>
<td>40/60</td>
<td>55</td>
</tr>
<tr>
<td>Upper-Base</td>
<td>929</td>
<td>AC 32 dense base des</td>
<td>40/60</td>
<td>75</td>
</tr>
<tr>
<td>Thickness of Asphalt</td>
<td></td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Lower-Base</td>
<td>822</td>
<td>CBGM B C12/15</td>
<td></td>
<td>180</td>
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<tr>
<td>Sub-base</td>
<td>808</td>
<td>Type B</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Capping</td>
<td>613</td>
<td>6F1 r 6F2</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

**TOTAL THICKNESS (mm)** 440 mm
Pavement Construction

CGBM Placement M17 Corofin

Tuam Bypass Ch150 NB - Wearing Course

Wearing course M17 Corofin

Tuam Bypass Ch 400 – Sand patch testing
Pavement Handback Requirements (Schedule 25) – 10 year residual life handback requirement in common with other PPP Schemes

Pavement Maintenance & Survey Requirements (Schedule 7 Annex 4 to Part 1)
Maintenance work will be identified by:
• Surface characteristics – Skidding Resistance – SCRIM  
  Ride Quality – AAN Testing for rutting and texture
• Structural Performance – Visual defects  
  Residual Life assessed by FWD  
  Pavement layer Thickness – ground radar and or coring/pitting

Pavement Intervention Strategy developed based on design to maximise design life of pavement.
<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>Measuring Equipment</th>
<th>Internationa Standard/ Guidelines</th>
<th>Survey Frequency (years)</th>
<th>Investigatory Levels</th>
<th>Minimum Performance Levels During the Operations</th>
<th>Minimum Performance Levels at Handback</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCRIM Reading (SR)</td>
<td>SCRIM (Skidding Resistance)</td>
<td>HD 28</td>
<td>See paragraph 3.1 of this Annex 4 to Part 1</td>
<td>Refer to Notes 3 - 6</td>
<td>1 2 1 Average SCRM Coefficient (as defined in Annex 3 of HD 28/04) less than 0.40 (Site category A) and less than 0.50 (Site category Q) as per Table 4.1 of HD 28/04</td>
<td>Average SCRM Coefficient (as defined in Annex 3 of HD 28/04) greater than 0.35 (Site category A) and greater than 0.15 (Site category Q) as per Table 4.1 of HD 28/04</td>
</tr>
<tr>
<td>International Roughness Index (IRI)</td>
<td>RSP</td>
<td>See paragraph 3.1 of this Annex 4 to Part 1</td>
<td>Refer to Notes 7 - 9</td>
<td>1 2 1 IRI of 80% of the 20m sections greater than 2.3 m/km in each 200m</td>
<td>IRI of 80% of the 20m sections not greater than 2.5 m/km and 100% of the 20 metre sections not greater than 2.7 m/km in each 200m</td>
<td>IRI of 80% of the 20m sections not greater than 2.3 m/km and 100% of the 20 metre sections not greater than 2.5 m/km in each 200m</td>
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<tr>
<td>Surface Texture (MPD)</td>
<td>RSP</td>
<td>See paragraph 3.1 of this Annex 4 to Part 1</td>
<td>Refer to Note 9</td>
<td>1 2 1 Average MPD greater than 1.0</td>
<td>Average MPD greater than 0.8</td>
<td>Average MPD greater than 1.2</td>
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<tr>
<td>Rut Depth</td>
<td>RSP</td>
<td>See paragraph 3.1 of this Annex 4 to Part 1</td>
<td>Refer to Note 10</td>
<td>1 2 1 More than one 20m section with Rut Depth exceeding 9mm in each 200m</td>
<td>(i) Not more than two 20m sections greater than 9mm in each 200m, and (ii) Average Rut Depth not exceeding 6mm</td>
<td>(i) Average Rut Depth not exceeding 5mm, and (ii) Not more than one 20m section exceeding 9mm in each 200m</td>
</tr>
<tr>
<td>Performance Indicator</td>
<td>Measuring Method</td>
<td>Reference</td>
<td>Survey Category</td>
<td>Survey Frequency (years)</td>
<td>Investigatory Levels</td>
<td>Minimum Performance Levels During the Operations</td>
</tr>
<tr>
<td>-----------------------</td>
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<td>-------------------------------------------------</td>
</tr>
<tr>
<td>Surface Condition (Cracking/Spalling)</td>
<td>Visual Condition Survey</td>
<td>Refer to Notes 1 &amp; 5 below</td>
<td>Bituminous Surfacing</td>
<td>4 4 4 Slip Roads</td>
<td>H/S L1 L2/L3 Slip Roads</td>
<td>WC &gt; 5%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H/S L1 L2/L3 Slip Roads</td>
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<td></td>
<td></td>
<td>H/S L1 L2/L3 Slip Roads</td>
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<td></td>
<td></td>
<td>H/S L1 L2/L3 Slip Roads</td>
<td></td>
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</tr>
<tr>
<td>Structural capacity</td>
<td>Falling Weight Deflectometer</td>
<td>HD 29 (DMRB Section 7.3.2.5) and paragraph 3.2 (b) of this Annex 4 to Part 1 and Note 3 below</td>
<td>Refer to Note 2</td>
<td>4 4 4 RESIDUAL LIFE (Years)</td>
<td>RESIDUAL LIFE (Years)</td>
<td>i) Average residual life overall &gt; 10 years, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H/S L1 L2/L3 Slip Roads</td>
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<td></td>
<td></td>
<td>H/S L1 L2/L3 Slip Roads</td>
<td></td>
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</tr>
</tbody>
</table>

1. Key to Visual Condition terms
   - WC: Single longitudinal wheelpath cracking and multiple wheelpath cracking and crazing as defined in DMRB 7.3.2.3 Table 3.1
   - 10%: WC in ten percent of wheelpath length
   - STEP: Measured step at joint or crack
   - SPALL: Shallow or deep spalling as percentage of joint length
   - FAIL: Failure criteria defined in RR87 as percentage of bays For CRCP apply the RR87 criteria to 25m Lane Length
2. Assessment to be carried out as required, as detailed in this Part.
3. Key to FWD terms
   - RESIDUAL LIFE – Residual life to critical conditions in years, see section 4 of this Annex 4 to Part 1 for details of procedure
   - AVERAGE RESIDUAL LIFE – Calculated for each 200 metre section of lane and then averaged
   - MINIMUM RESIDUAL LIFE – Calculated for each 500 metre section of lane
4. Key to general terms: H/S – Hard Shoulder; L1, L2 and L3 – Lane 1, Lane 2, and Lane 3.
5. Visual Condition Survey Guidelines: For CRCP (100mm or more surfacing) apply bituminous surfacing criteria; for rigid pavements with 25mm or less bituminous surfacing apply concrete criteria; for rigid pavements with 25-100mm depth of surfacing apply both criteria.
6. Each lane, hard shoulder, and auxiliary lane each to be tested, reported and assessed against Minimum Performance Levels as separate entities, unless otherwise set out in the Specification.
# Maintenance Strategy

<table>
<thead>
<tr>
<th>Year of Operation</th>
<th>Planned Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-12 years</td>
<td>Milling, then Inlay of 30-40mm TSCS</td>
</tr>
<tr>
<td>23-25 years</td>
<td>Milling, then inlay of 30-40mm TSCS</td>
</tr>
</tbody>
</table>

These treatments will achieve a minimum 40 year design life of the pavement exceeding handback requirements of Concession period + 10 Years.