Limerick Tunnel PPP Project

Michael Tonnesen

Senior Project Manager, COWI A/S

Limerick Tunnel PPP Project

Main Issues

- General Introduction to the Project
- Route Selection Phase
- Preliminary Design/EIS/CPO Phase
- Tunnel Design Features

Limerick Tunnel PPP Project

Location

- Southwest of Limerick City, Ireland
- Crossing of Shannon River

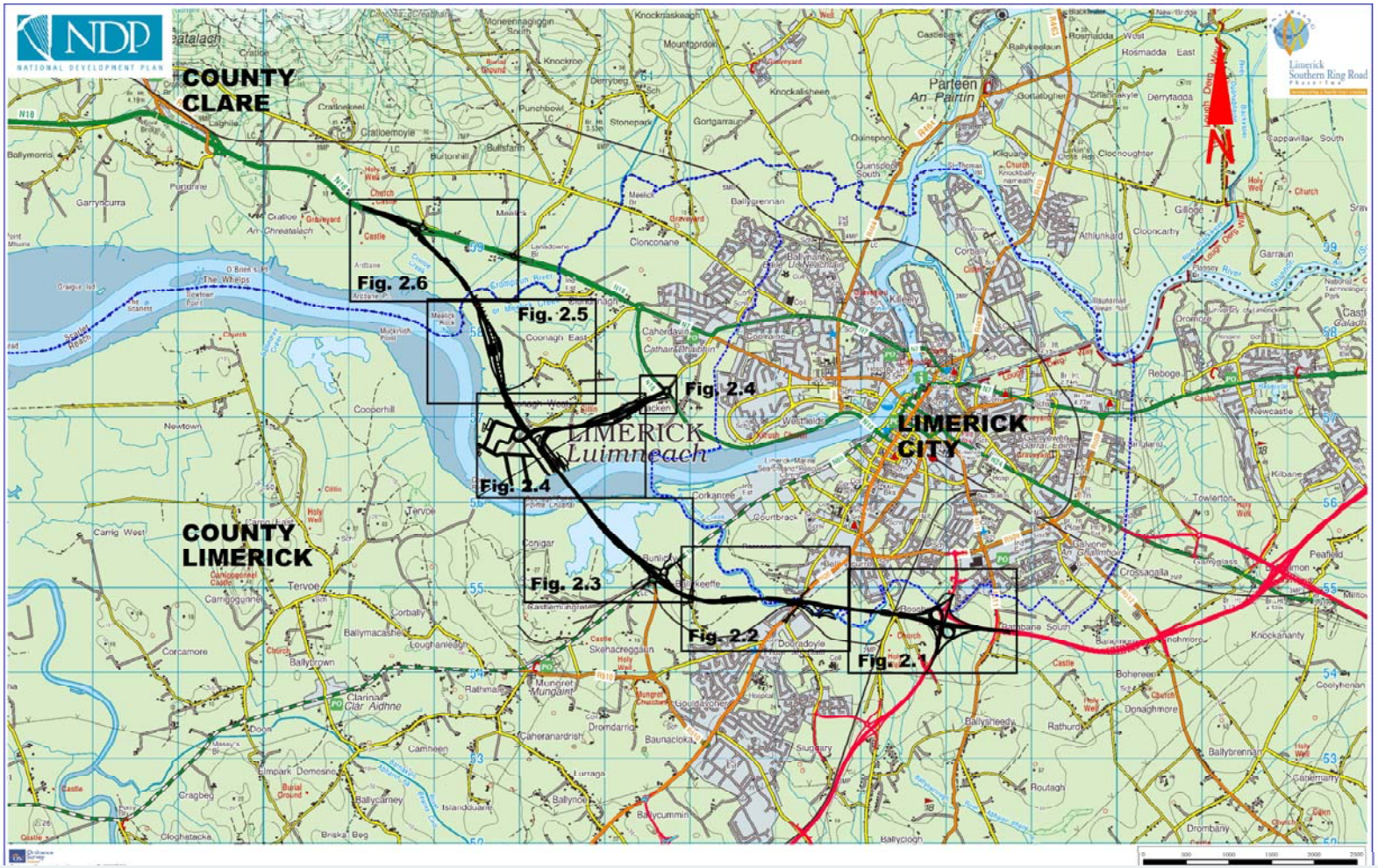
Objectives

- Reduce Limerick City traffic congestion
- Improve national, regional and local network
- Benefit local development

Scheme comprises

- 9.8 km Dual Carriageway Motorway
- 2.3 km link road
- 4 no grade separated interchanges
- Immersed tunnel under the River Shannon
- 11 no bridges
- Upgrading and realignment of existing roads
- Toll Station

Limerick Tunnel PPP Project



Limerick Tunnel PPP Project

Parties

Authority
Headed by National Roads Authority, NRA in cooperation with Limerick County Council, LCC

Consultant to LCC
RPS MC O'Sullivan COWI JV

Schedule

Constraints Study Completion		2000
Route Selection Report Completion		2001
Environmental Impact Statement		2003
Oral Hearing and Decision	Summer	2004
Invitation to tender	February	2005
Consultation meetings	March / May	2005
Receipt of Tenders	July	2005
Tender Evaluation	July / August	2005
Negotiations and BAFO	Autumn	2005
Selection of preferred Bidder	Winter	2006
Construction Start	Spring	2006
Construction Finish		2010

Route Selection Options

Constraints Study

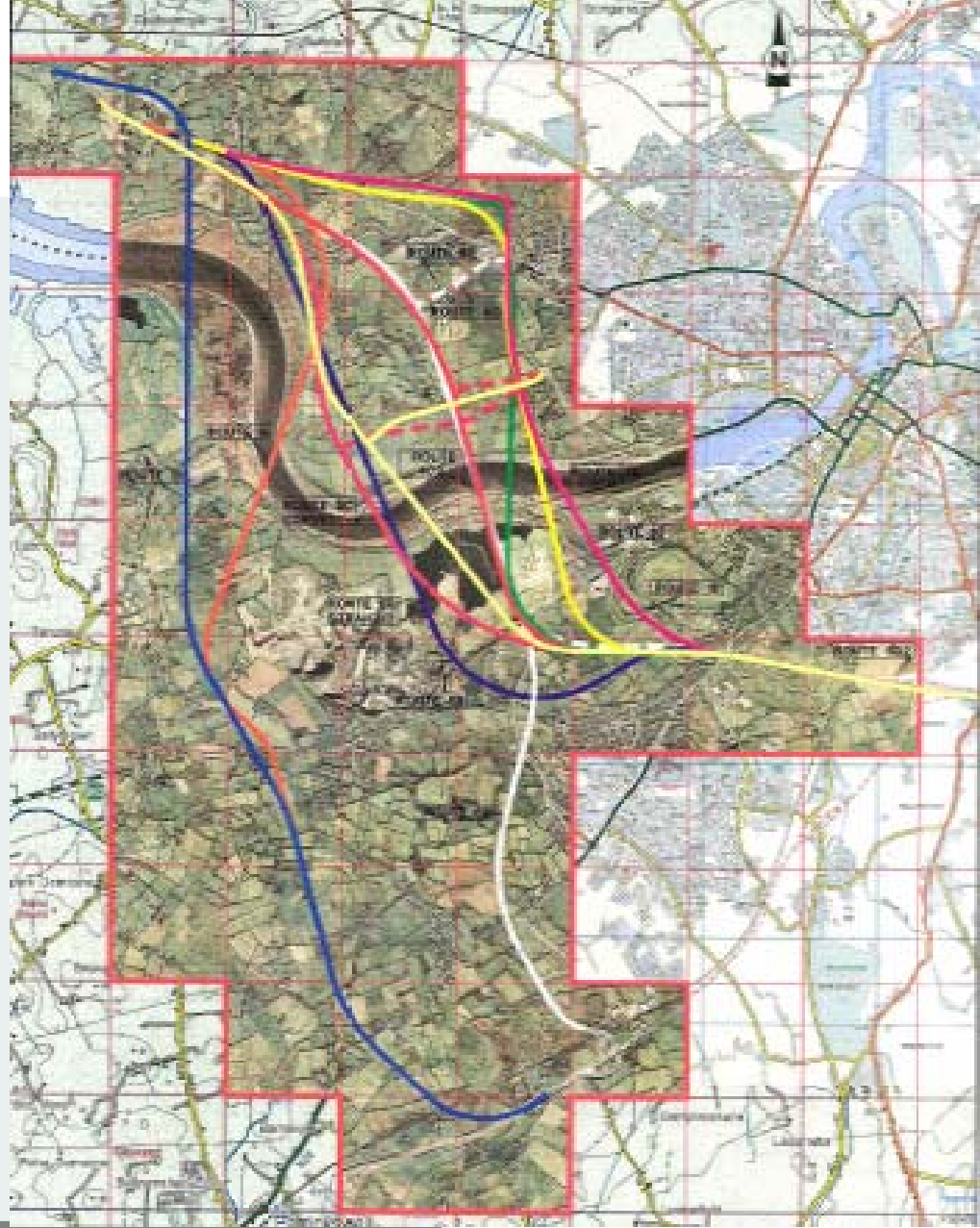
Alignments

Traffic Benefits

Traffic impacts – EIA

River Crossing Options

COST

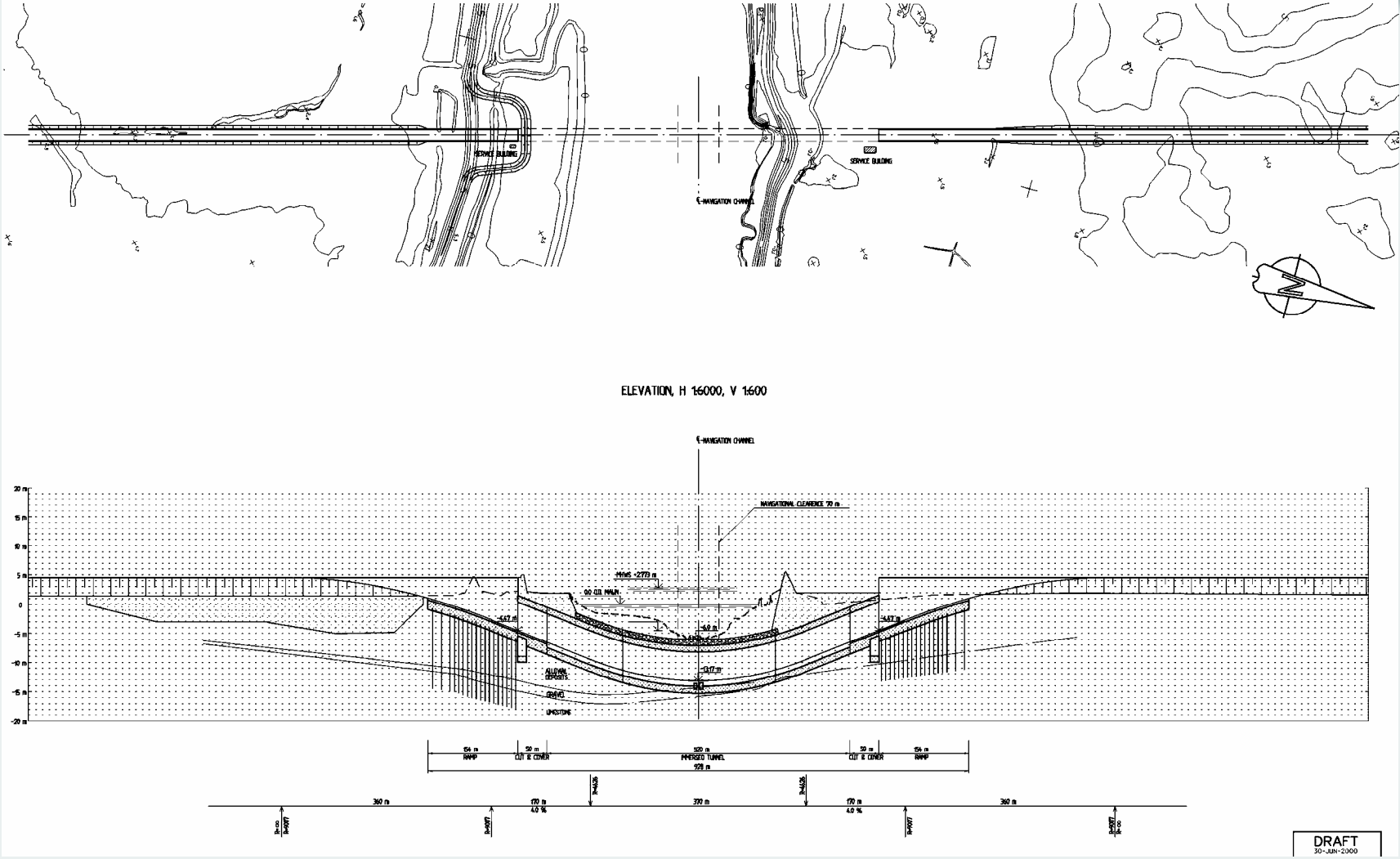


Ted Russel Dock - Limerick

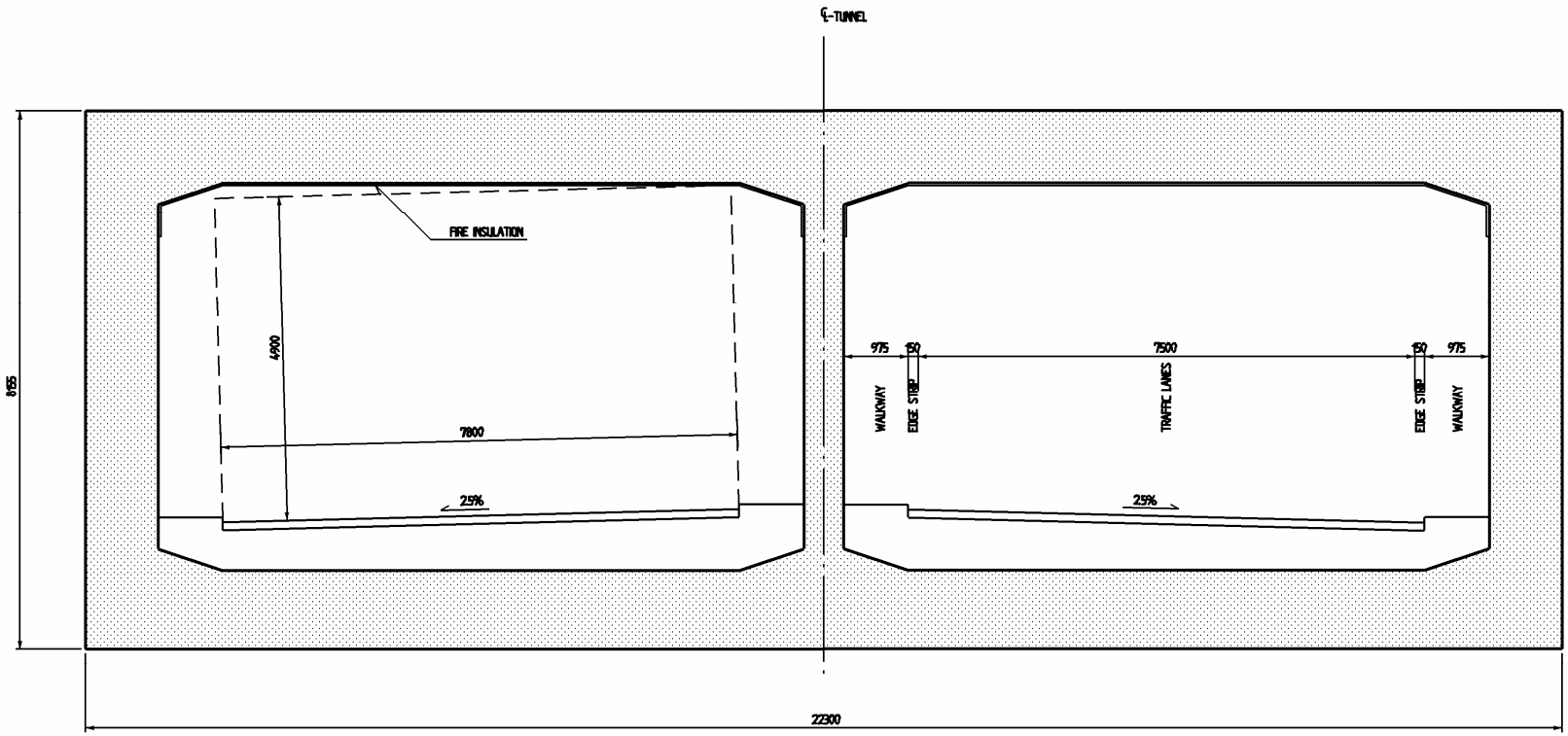
Main Constraint

- 200 ships annual into Ted Russel Dock
- Cannot turn around if approach to dock has started
- Only a window of ~2 hours at high tide is available

Base Case
Tunnel - Plan - Elevation

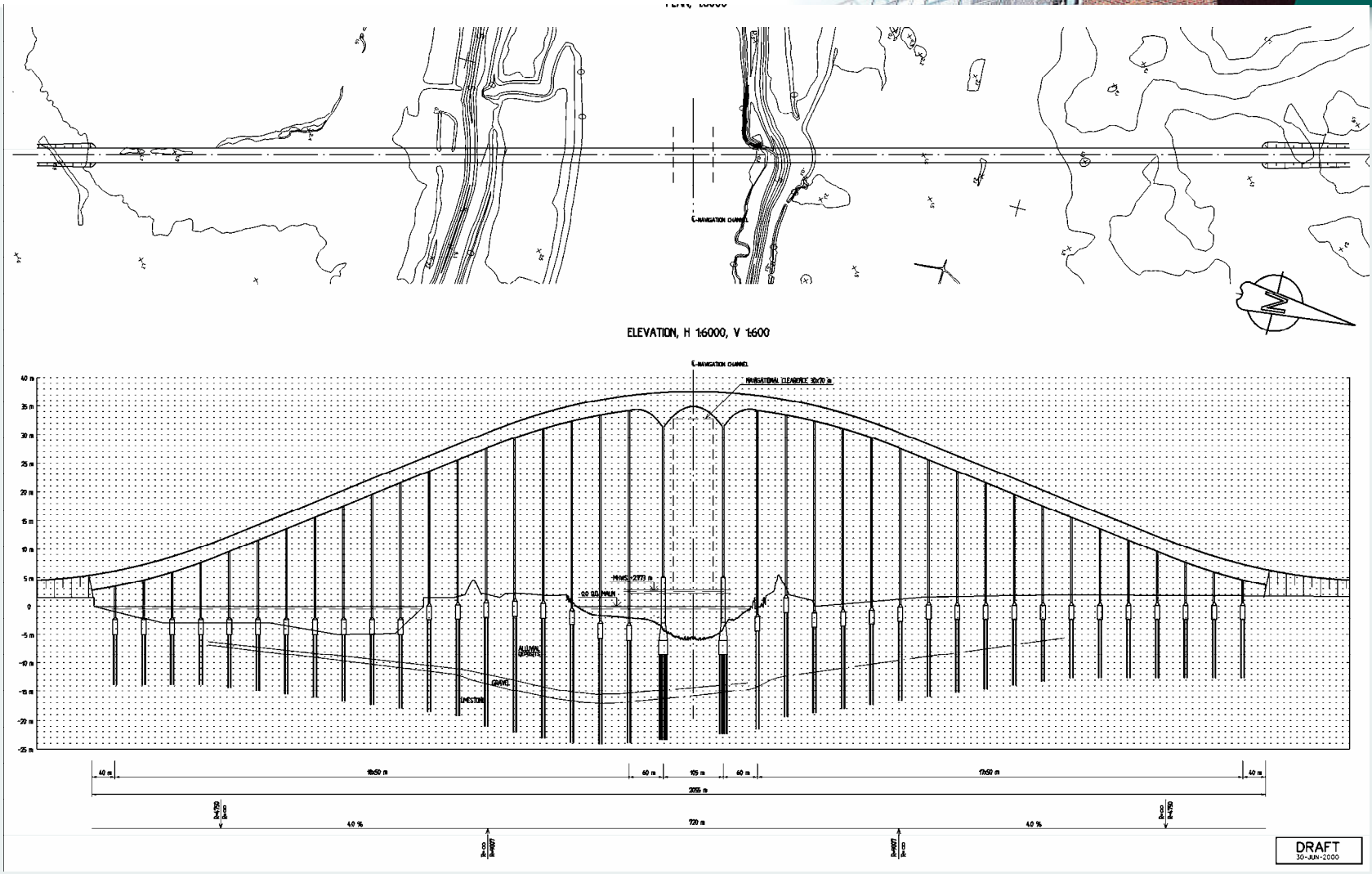


Base Case
Tunnel – Cross Section

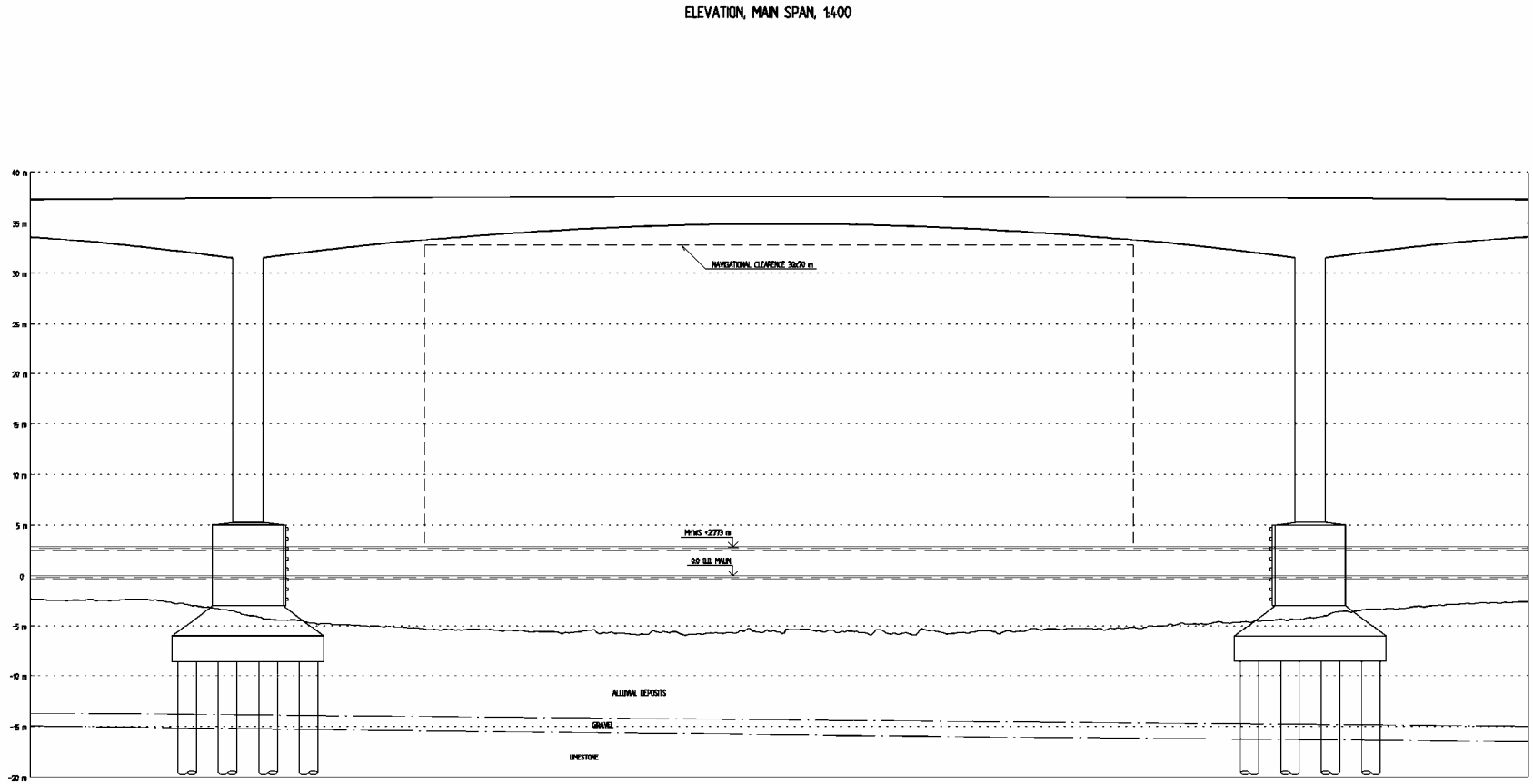


Visualization
Tunnel

Base Case
High-level Bridge – Plan - Elevation

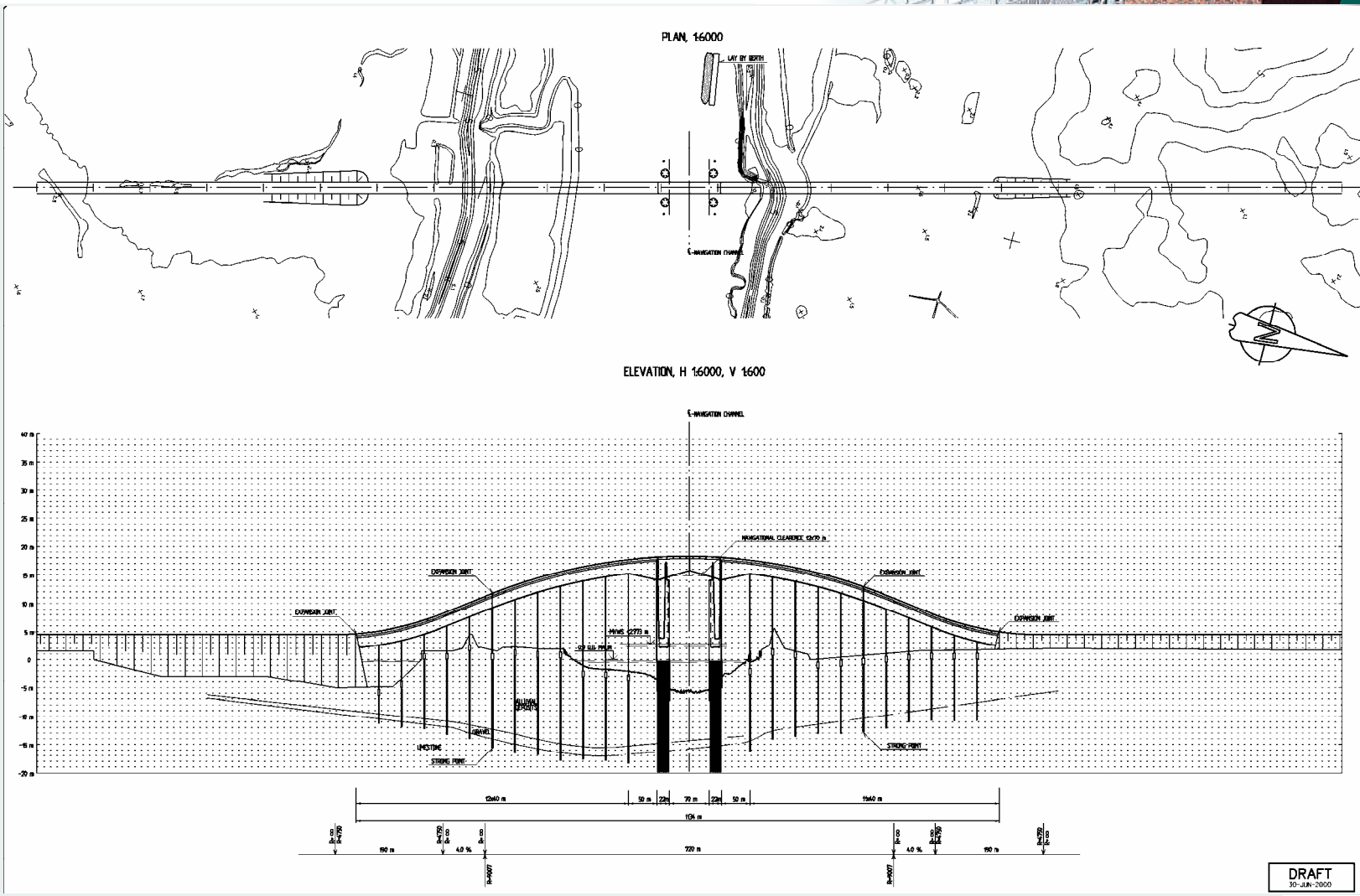


Base Case
High-level Bridge - Elevation

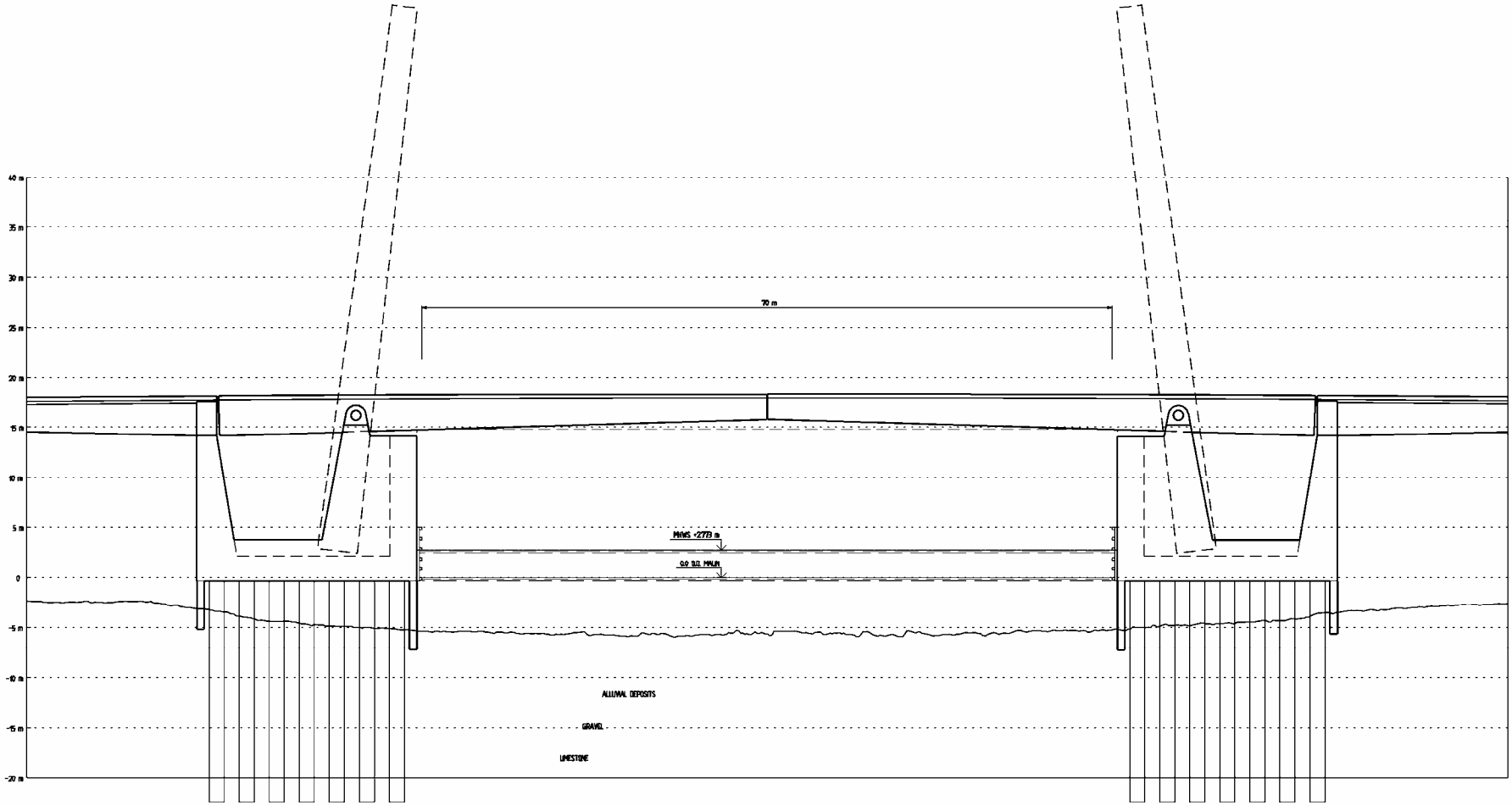


Visualizations
High-level Bridges

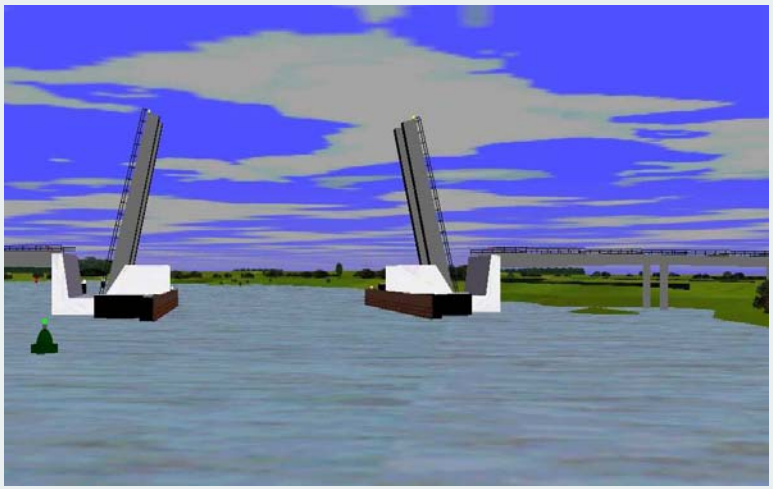
Base Case
Low-level Opening Bridge



Base Case
Low-level Opening Bridge - Elevation



Navigational Safety Maneuver Simulation



Simulation Model

- River model
- Tidal variation
- Typical Vessels
- Base Case bridges

Simulation Conditions

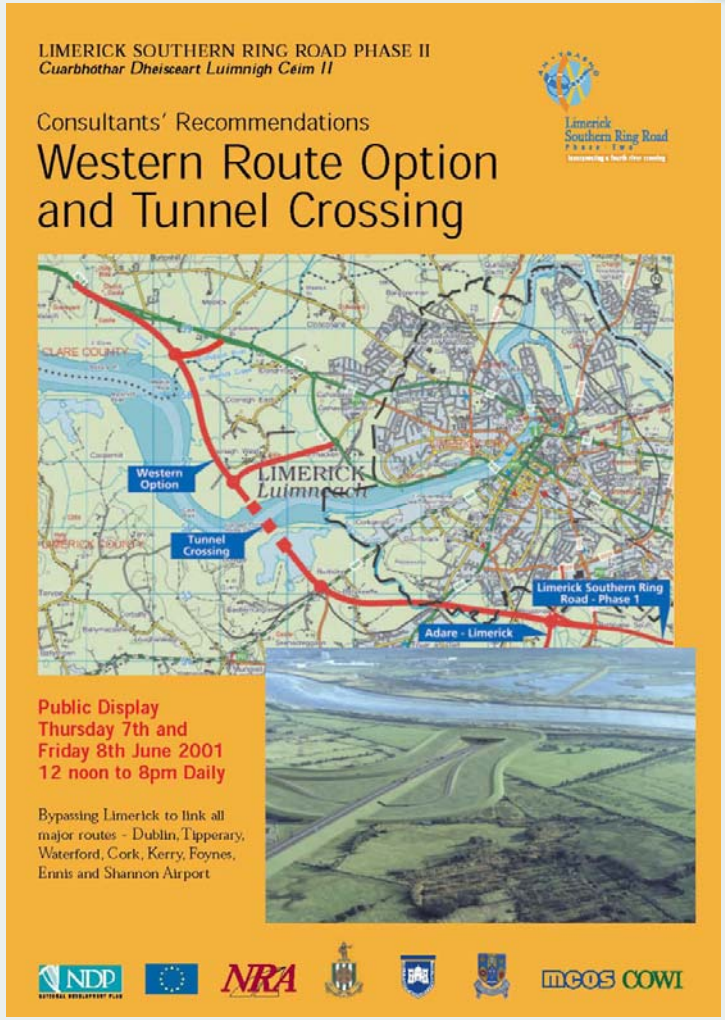
- Local Pilots
- Current & Wind
- Companion Traffic

Visualization
Low-level Opening Bridge

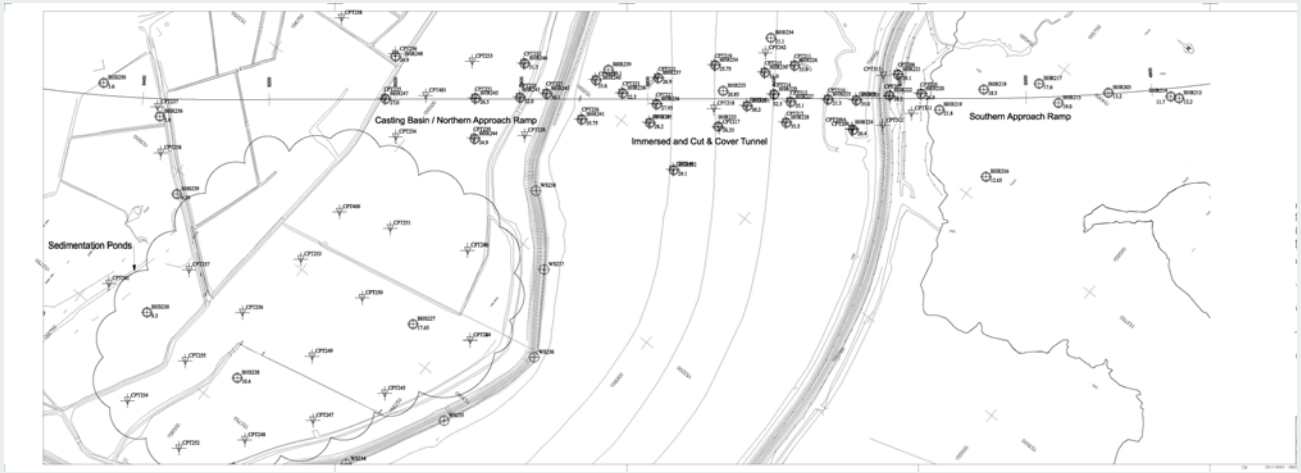
Route and Crossing Type Selection

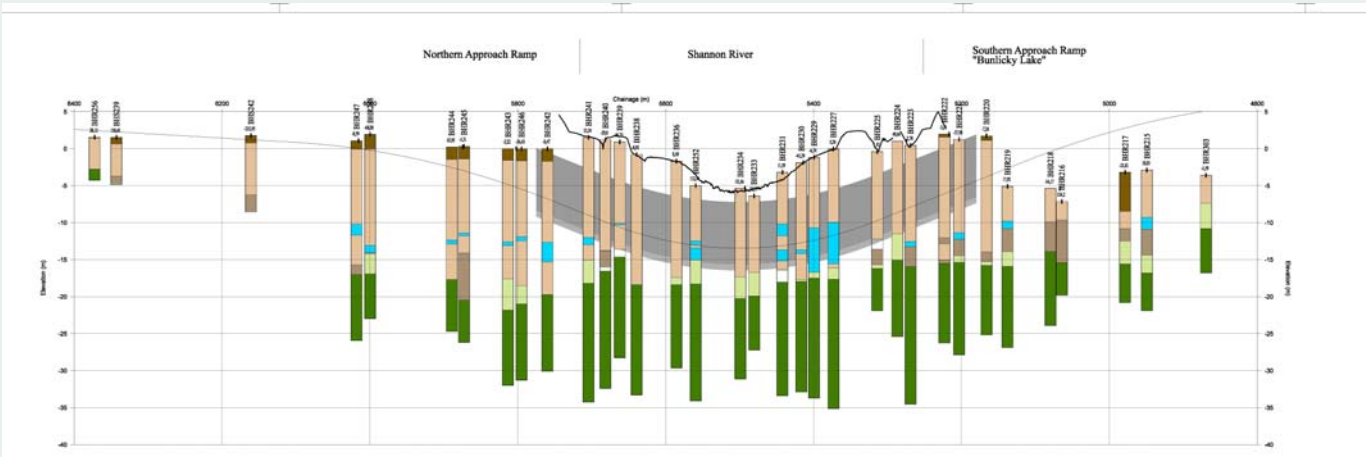
Crossing Type Comparison / Tunnel versus Low Level Opening Bridge

- Environmental Impact
- Construction Cost
  Tunnel ~25 mill EUR more expensive compared to Low level opening bridge
- Availability of Connection
  Bridge: ~80 disruptions with an opening time between 15min and 30min



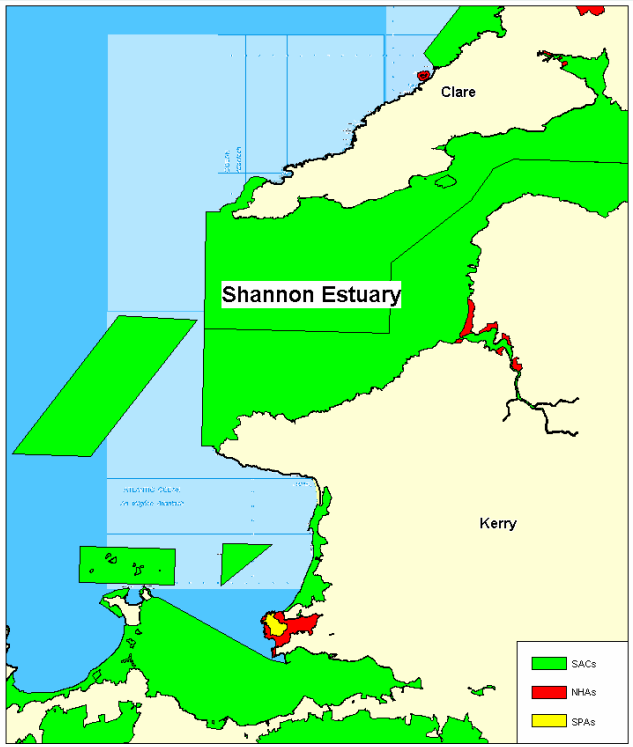
Geotechnical Profile



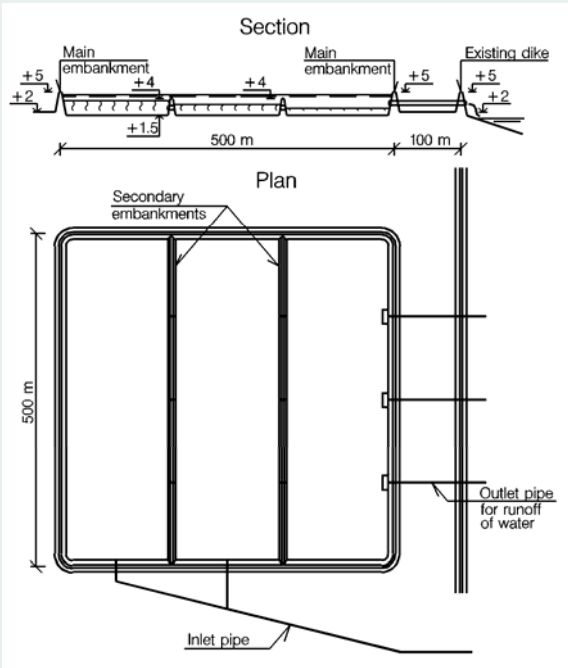


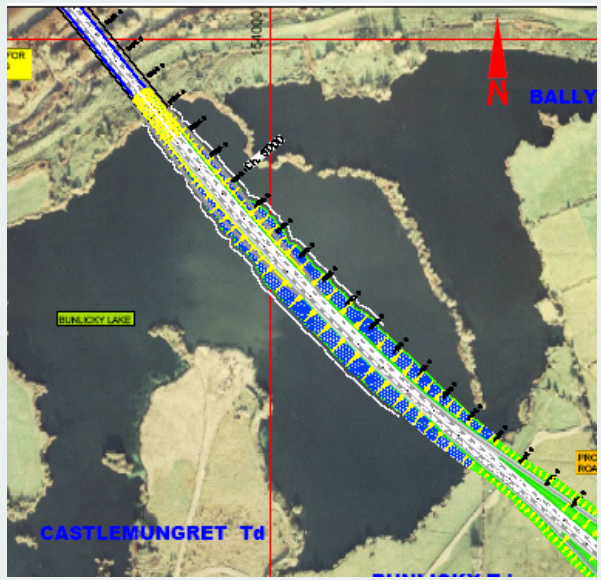
Soil Deposition (IMT)

1. Disposal in Shannon Estuary
2. Disposal at sea
3. Sedimentation Ponds
4. Pumped into Bunlicky Lake
5. Deposition on land at existing depot

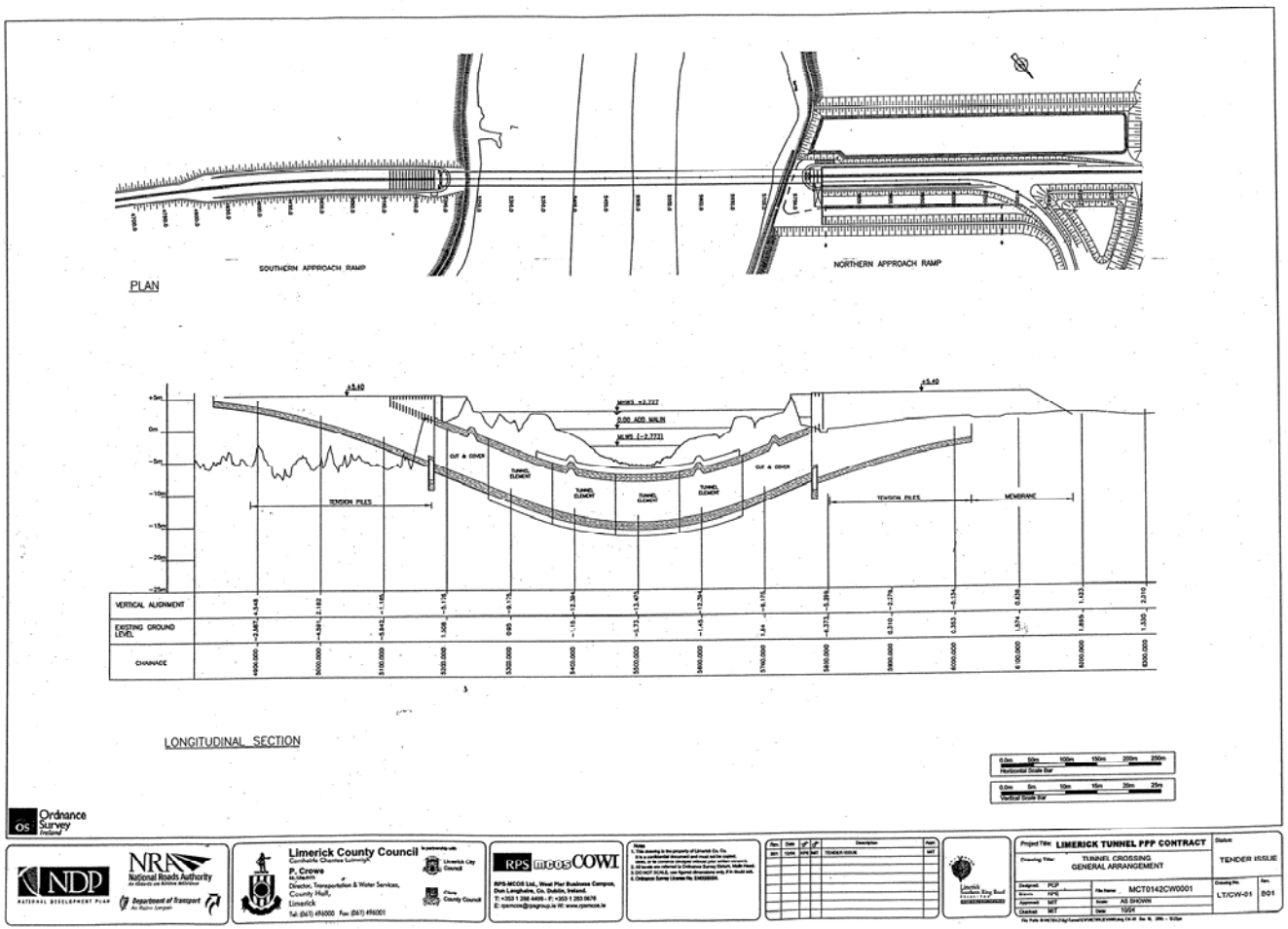


SPECIAL DESIGNATIONS





Preliminary Design Tunnel



Specimen Design

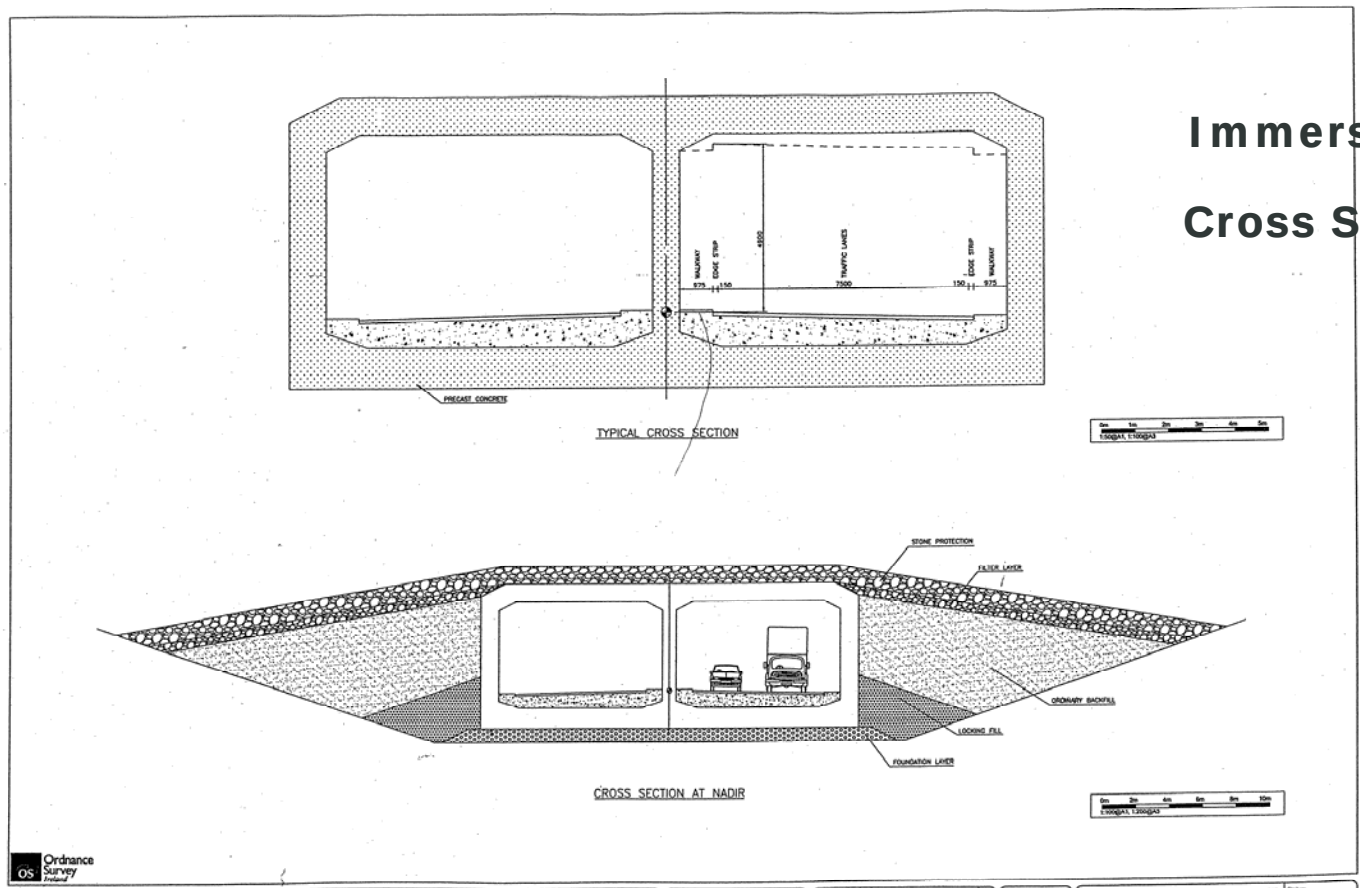
Main Components:

- 400m Immersed Tunnel
- Composed of 4 no 100m long elements
- 85m / 110m Cut & Cover Tunnel (South / North)
- 300-400m open approach ramps at each end

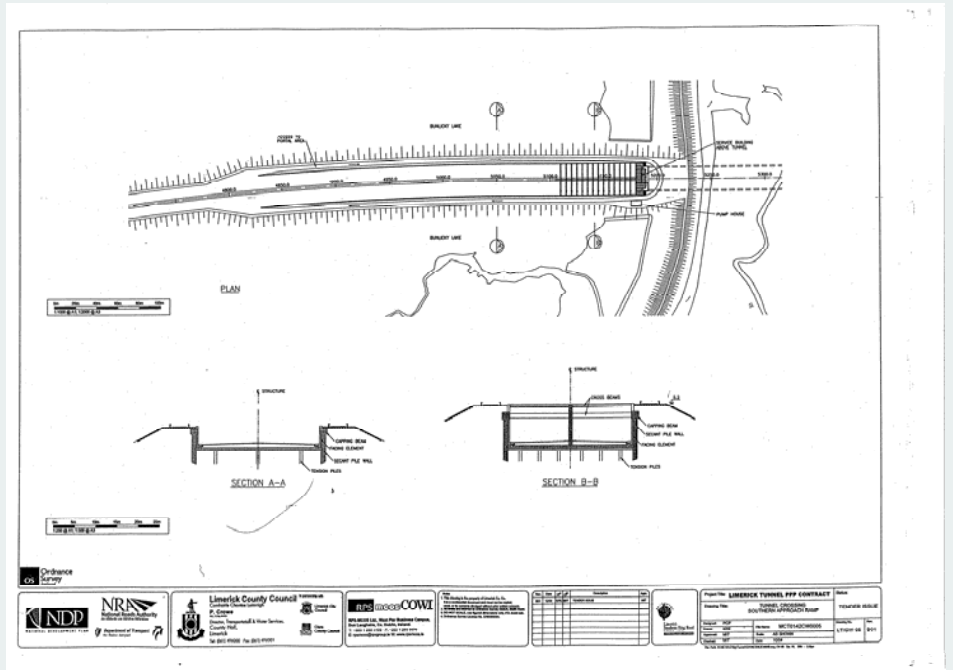
Limerick PPP Project

Immersed Tunnel

Cross Section



Preliminary Design



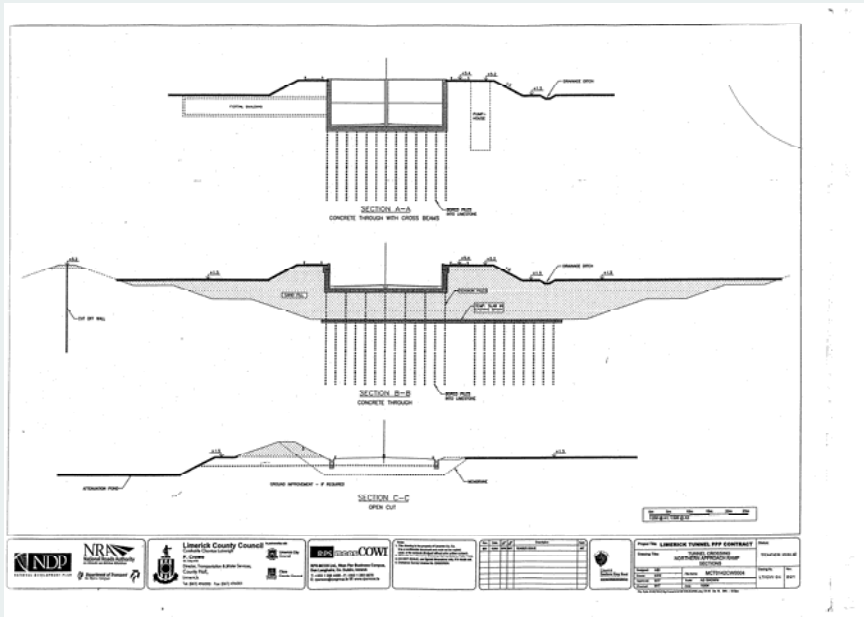
Southern Approach Ramp

Within Bunds towards Bunlicky Lake

Application of Diaphragm Walls and Tension Piles envisaged

Preliminary Design
Tunnel – Southern Approach Ramp and embankment

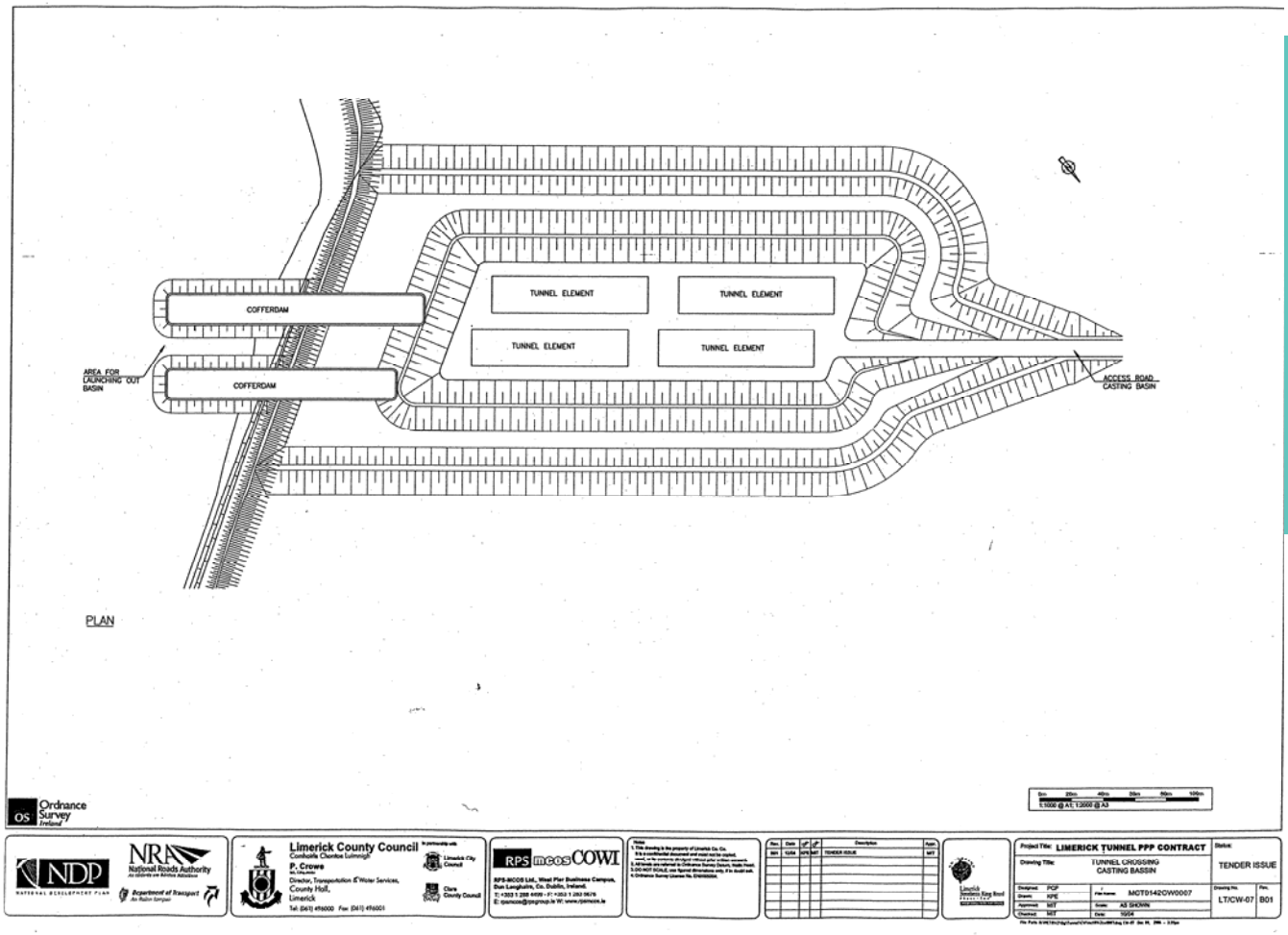
Preliminary Design



Northern Approach Ramp

- Bottom slab anchored against uplift with Tension Piles
- Ballasted Watertight Membrane applied for upper ramp

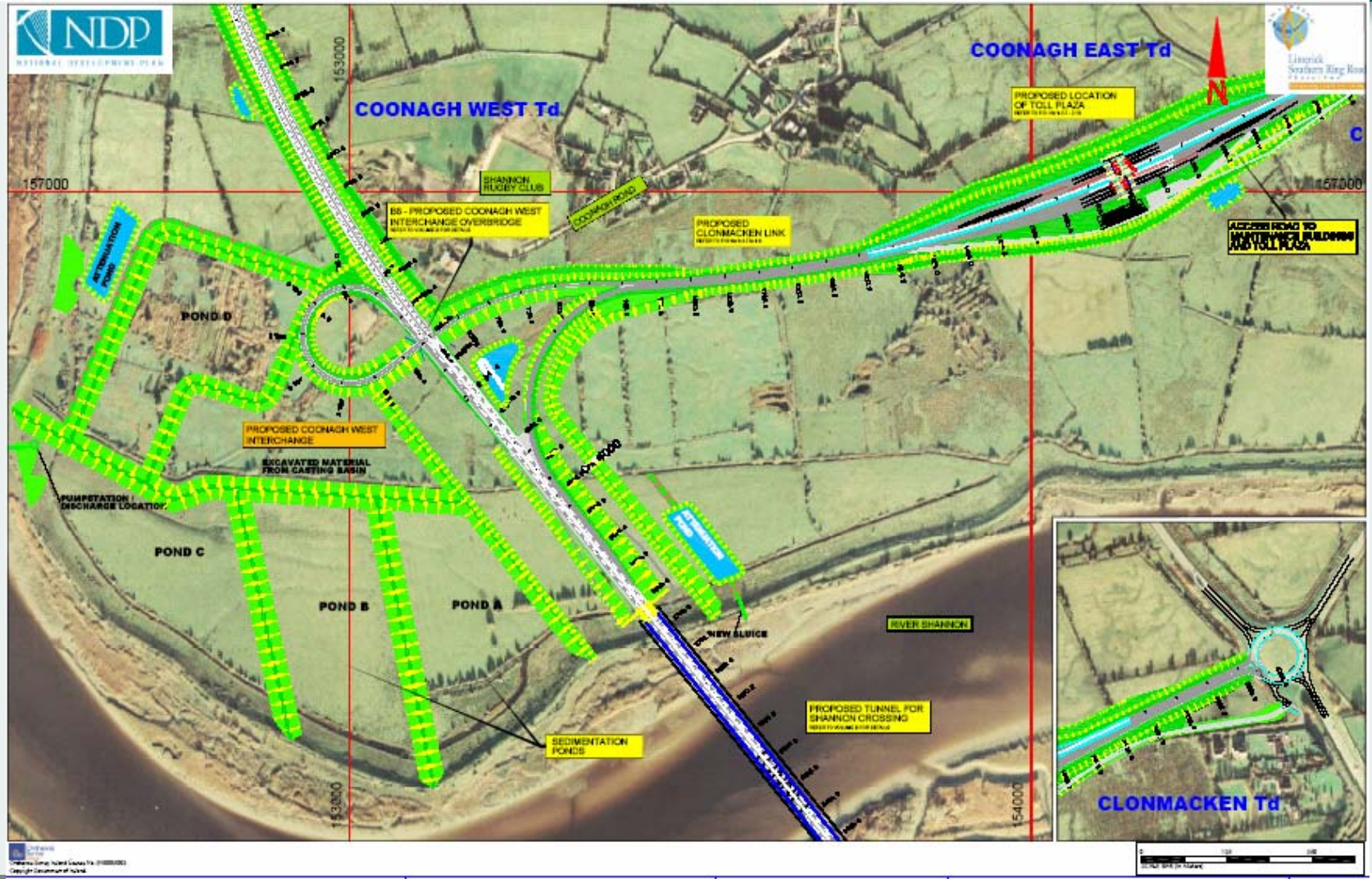
Preliminary Design



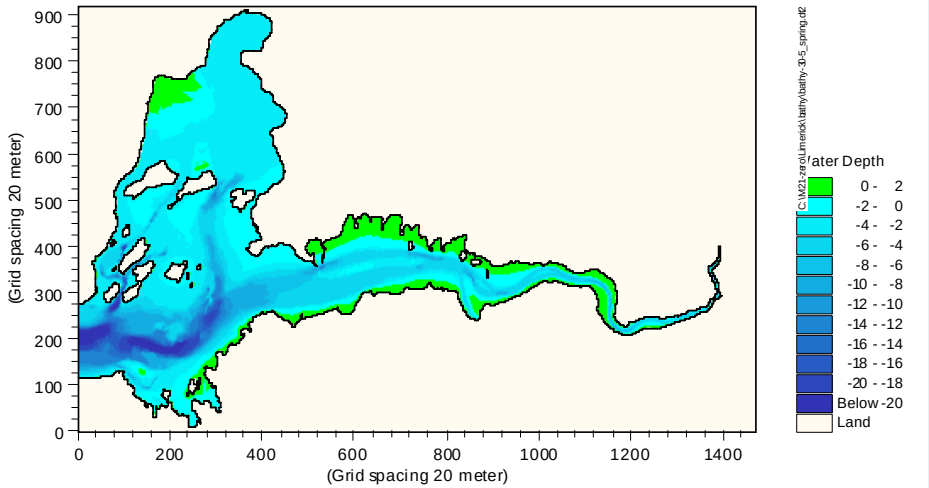
Casting Basin

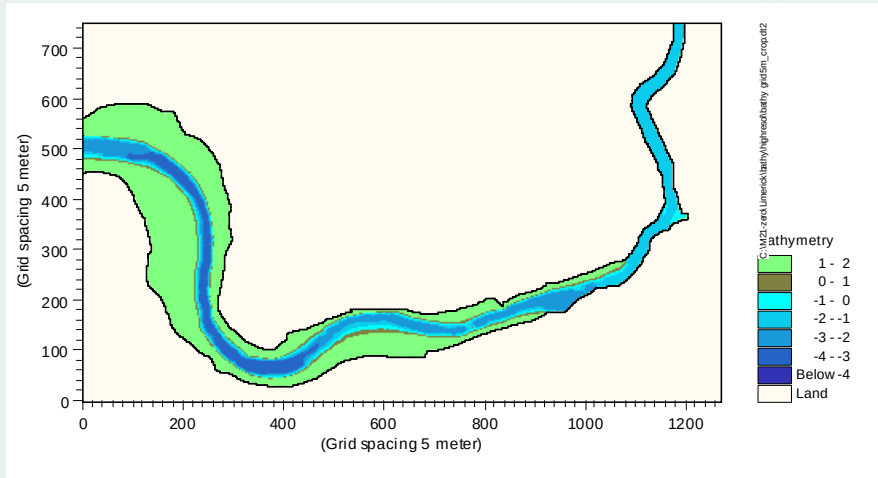
- Location within site boundaries at North Approach
- Soil improvement needed to avoid excess settlements
- Cofferdams to serve as fitting out quays

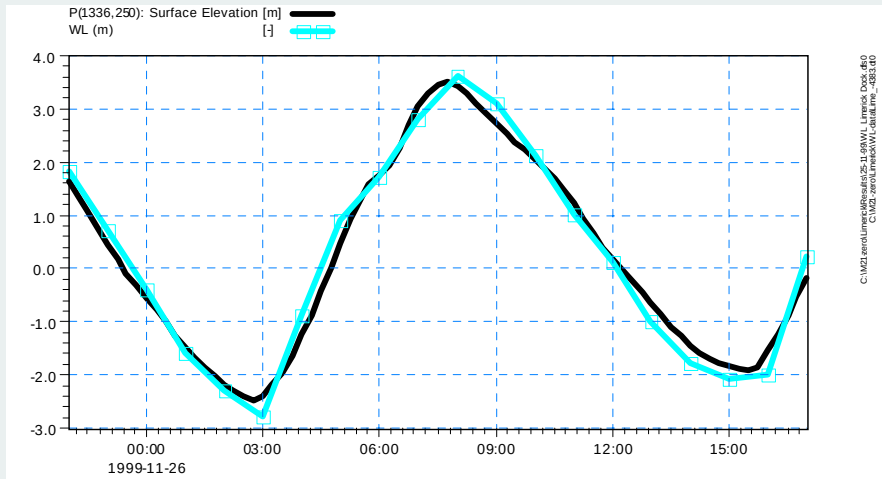
Preliminary Design
Northern Approach Ramp incl. Sedimentation Ponds



Hydraulic Model

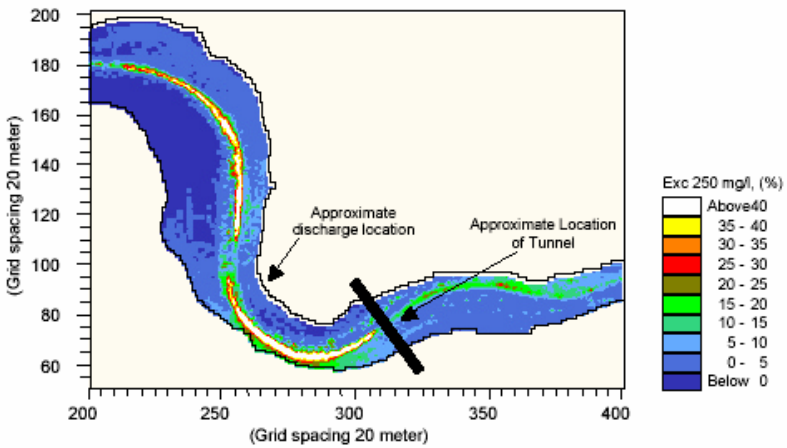






Hydraulic Model

Sediment Spillage



Concentration above 250 mg/l (time frequency during dredging)

EIS Recommendations

- **Avoid dredging Feb to Aug**
- **If not possible avoid period Feb to Apr**
- **Avoid dredging at night time**

Fish Migration

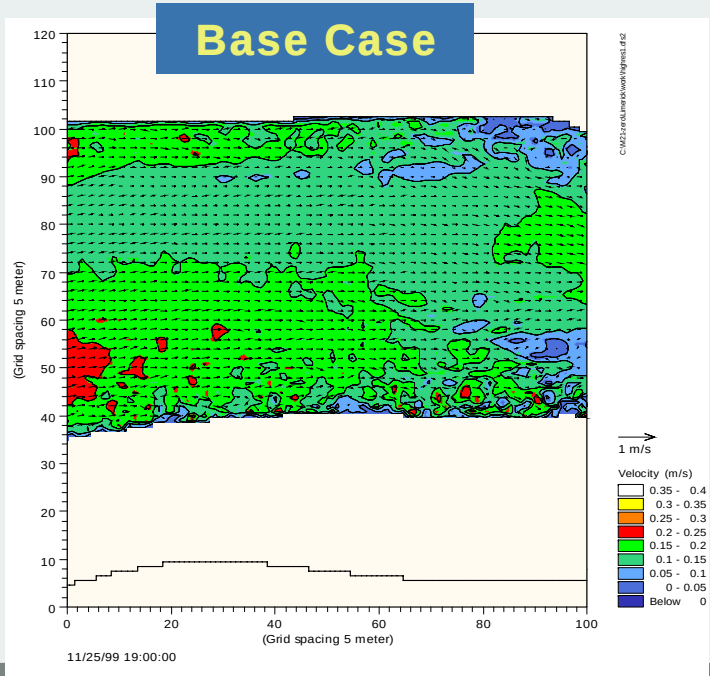
	Month											
Fish species	J	F	M	A	M	J	J	A	S	O	N	D
Salmon smolt (downstream)												
Salmon adults (upstream)												
Sea trout adults (u/s)												
Sea trout smolt (d/s)												
Trout (estuarine)												
Sea lamprey (upstream)												
River lamprey (upstream)												
Smelt (upstream)												
Smelt (downstream)												
Allis shad (upstream)												
Twaite shad (upstream)												

Hydraulic Model

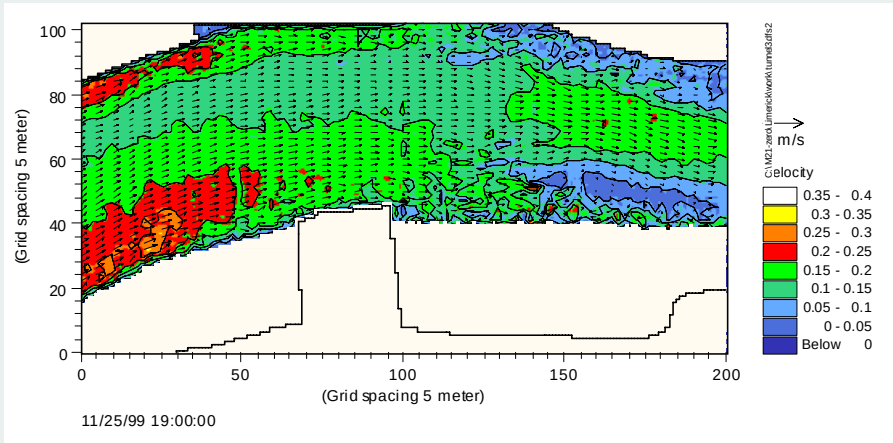
Construction implication on River Currents

- Cofferdam at Southern River Bank

Base Case

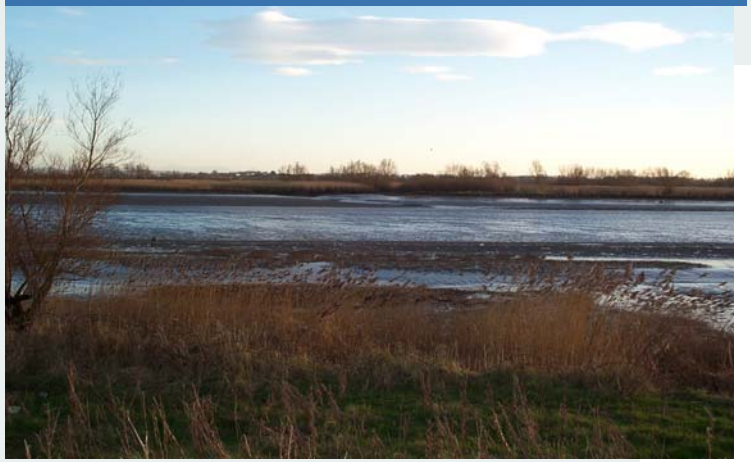


With Cofferdam



Scirpus Triqueter (Kogleaks)

Northern River embankment looking south



Holding Tanks ready to receive "Scirpus Triqueter"

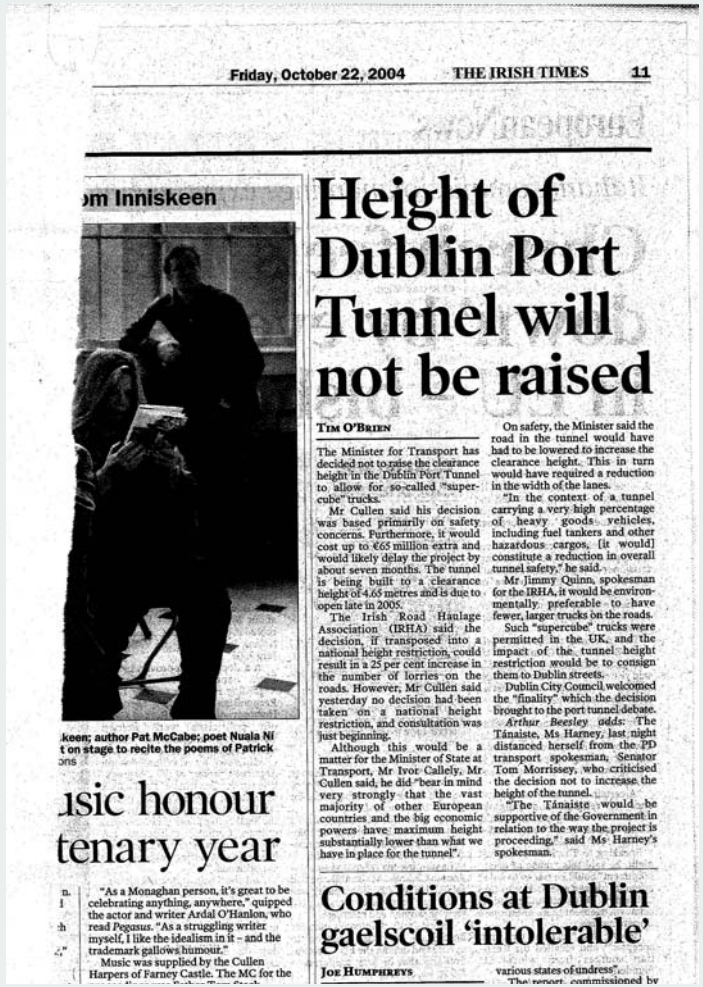
EIS Recommendations

- Affected sites with "Scirpus Triqueter" shall be transplanted prior to commencement of Construction

Limerick Tunnel PPP

Other Major Issues

- Head Room Clearance of 4.9m (similar to Jack Lynch Tunnel, Cork & Dublin Port Tunnel - 5.3m used in UK)
- 2 cell versus 3 cell solution (covered by Casper in Part 2)



Friday, October 22, 2004 THE IRISH TIMES 11

om Inniskeen

keen; author Pat McCabe; poet Nuala Ní
t on stage to recite the poems of Patrick
ons

usic honour
tenary year

"As a Monaghan person, it's great to be celebrating anything, anywhere," quipped the actor and writer Ardal O'Hanlon, who read *Pegasus*. "As a struggling writer myself, I like the idealism in it – and the trademark gallows humour."

Music was supplied by the Cullen Harpers of Farney Castle. The MC for the

Height of Dublin Port Tunnel will not be raised

TIM O'BRIEN

The Minister for Transport has decided not to raise the clearance height in the Dublin Port Tunnel to allow for so-called "supercube" trucks.

Mr Cullen said his decision was based primarily on safety concerns. Furthermore, it would cost up to €65 million extra and would likely delay the project by about seven months. The tunnel is being built to a clearance height of 4.65 metres and is due to open late in 2005.

The Irish Road Haulage Association (IRHA) said the decision, if transposed into a national height restriction, could result in a 25 per cent increase in the number of lorries on the roads. However, Mr Cullen said yesterday no decision had been taken on a national height restriction, and consultation was just beginning.

Although this would be a matter for the Minister of State at Transport, Mr Ivor Callely, Mr Cullen said, he did "bear in mind very strongly that the vast majority of other European countries and the big economic powers have maximum height substantially lower than what we have in place for the tunnel".

On safety, the Minister said the road in the tunnel would have had to be lowered to increase the clearance height. This in turn would have required a reduction in the width of the lanes.

"In the context of a tunnel carrying a very high percentage of heavy goods vehicles, including fuel tankers and other hazardous cargos, [it would] constitute a reduction in overall tunnel safety," he said.

Mr Jimmy Quinn, spokesman for the IRHA, it would be environmentally preferable to have fewer, larger trucks on the roads.

Such "supercube" trucks were permitted in the UK, and the impact of the tunnel height restriction would be to consign them to Dublin streets.

Dublin City Council welcomed the "finality" which the decision brought to the port tunnel debate.

Arthur Beesley adds: The Tánaiste, Ms Harney, last night distanced herself from the PD transport spokesman, Senator Tom Morrissey, who criticised the decision not to increase the height of the tunnel.

"The Tánaiste would be supportive of the Government in relation to the way the project is proceeding," said Ms Harney's spokesman.

Conditions at Dublin gaelscoil 'intolerable'

JOE HUMPHREYS

various states of undress".

The report, commissioned by

Limerick Tunnel PPP

END

PART 1

Limerick Projektet, Irland - Sænketunnel under Shannon floden

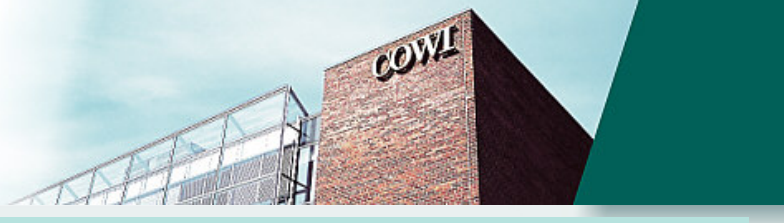
Casper Paludan-Müller

Senior projektleder

Oversigt

- Tunnel sikkerhed
- Public Private Partnership (PPP)
- Udbud og konsultationsproces
- Tilbud og kontrahering
- Entreprenørens projekt
- Udførelse

Limerick Projektet, Irland - Sænketunnel under Shannon floden



Sikkerhed i tunnel

Basis

•BD 78/99 (norm/guideline) i NRA's "Design Manual for Roads and Bridges"

•Europa-Parlamentets og Rådets direktiv 2004/54/EF af 29. april 2004 om minimums-sikkerhedskrav for tunneler i det trans-europæiske vejnet

•Drøftelser med brandvæsen i Limerick

EU direktiv

Minimumssikkerhedsstandarder på baggrund af brandene i Mont Blanc-tunnelen (1999) og Gotthard-tunnelen (2001)

Gælder alle tunneler af mere end 500 meters længde i det trans-europæiske vejnet af mere end 500 meters længde

Minimumskrav

•Modsat rettet trafik i to rør (hastighed nedsættes ved kontra flow)

•Gradient max 5% (øgede sikkerhedsfornastaltninger over 3%)

•Nødfortove

•Nødudgange for mindst hver 500m (ikke obligat, skal evalueres)

•Mulighed for at krydse midterrabat uden for hver portal

•Afløb for brandbare og giftige væsker, må ikke spredes til andet rør

•Brandmodstandsevne af konstruktioner og udstyr

•Belysning (normal, sikkerhed, evakuering)

•Mekanisk ventilation (ikke obligatorisk for korte tunneler)

•Nødpaneler per mindst 150m

•Vandforsyning til brandslukning

•Skiltning

•Video (hvis kontrol center)

•Automatisk branddetektering

•Nødmeldinger via radio

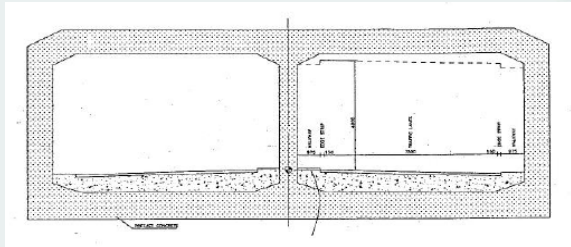
•Nødstrømsforsyning

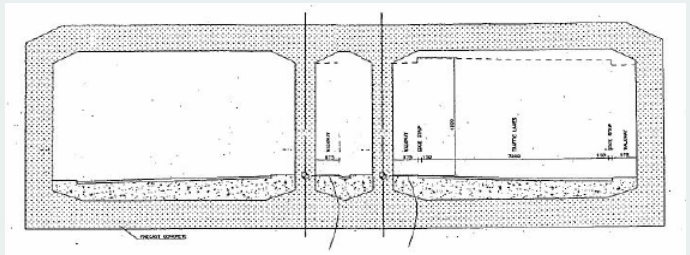
Limerick Projektet, Irland - Sænketunnel under Shannon floden

Centralt galleri

Anvendelse af ALARP princippet

- Sikkerhedsforanstaltninger udover minimumskrav indføres mhp at nedbringe risici til ”As Low As Reasonable Practicle"
- Foranstaltning indføres med mindre omkostning uforholdsmæssig stor
- Cost benefit undersøgelse af størrelsesforhold mellem fordele og ulemper
- Risiko for trafik i modsat rør under evakuering og risiko for spredning af røg til det andet rør
- Analyse af evakueringsscenarier viser af forventet nedsættelse af antal dødsulykker på grund af centralt galleri er meget beskeden
- Betydelig ekstra omkostning til galleri
- Galleri evt. berettiget for at lette adgang til vedligehold af installationer





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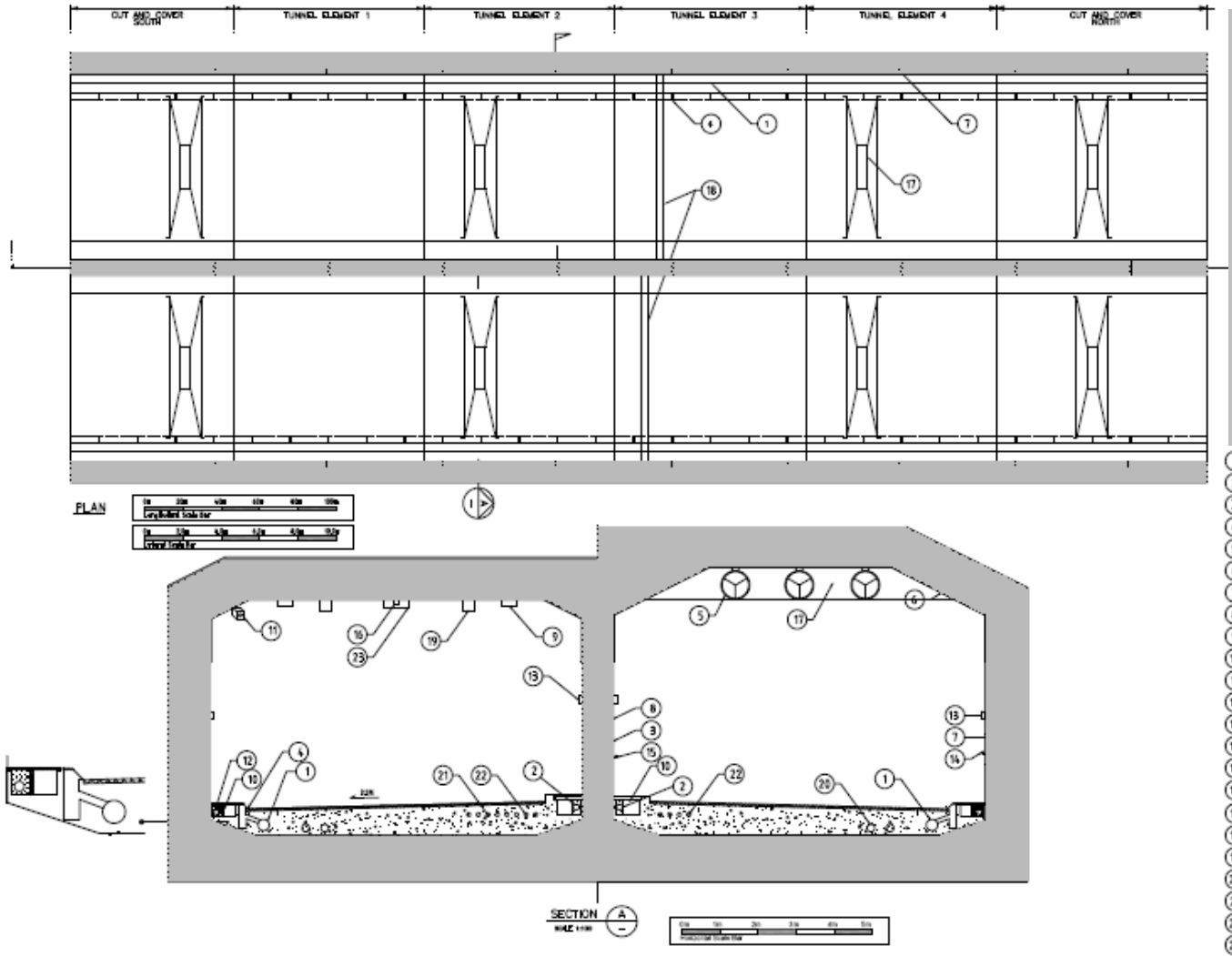


Tunnel sikkerhed

- Ingen restriktioner for farligt gods
- Mekanisk ventilation for sikring af luftkvalitet og røg ventilation
- Nødudgange per 60m
- Ingen krav om centralt galleri

1. DRAINAGE PIPE, ø300
2. FIRE MAIN, ø160
3. FIRE HYDRANT & FIRE HOSE REEL
4. ROAD GULLIES, C/C ~20m
5. JET FANS, ø700
6. FIRE PROTECTION
7. EMERGENCY PANELS, C/C ~60m
8. EMERGENCY DOORS, C/C ~60m
9. LIGHT
10. CONCRETE CHANNEL FOR CABLE DUCTS AND PIPES
11. VIDEO MONITORING SYSTEM
12. PUMP PRESSURE PIPE
13. SIGNS FOR EMERGENCY PANELS AND EXITS
14. CO MONITORING
15. NOx MONITORING
16. ANNTENA SYSTEM FOR PUBLIC RADIO AND MOBILE TELEPHONE COMMUNICATION
17. RECESS FOR JET FANS
18. CENTRAL PUMP SUMP
19. LANE CONTROL SIGNS
20. DUCTS FOR HIGH VOLTAGE CABLE, ø200
21. DUCTS FOR BROAD BAND AND OTHER SERVICES, ø100
22. SPARE DUCTS 4 x ø100
23. VARIABLE TEXT SIGNS

Limerick Projektet, Irland - Sænketunnel under Shannon floden

PPP projekter i Irland

NRA National Development Plan 2000-2006:

- 736 km Major Inter Urban Routes
- 822 km Other Priority Routes
- Ca. 20 % udføres som PPP (Public Private Partnership)

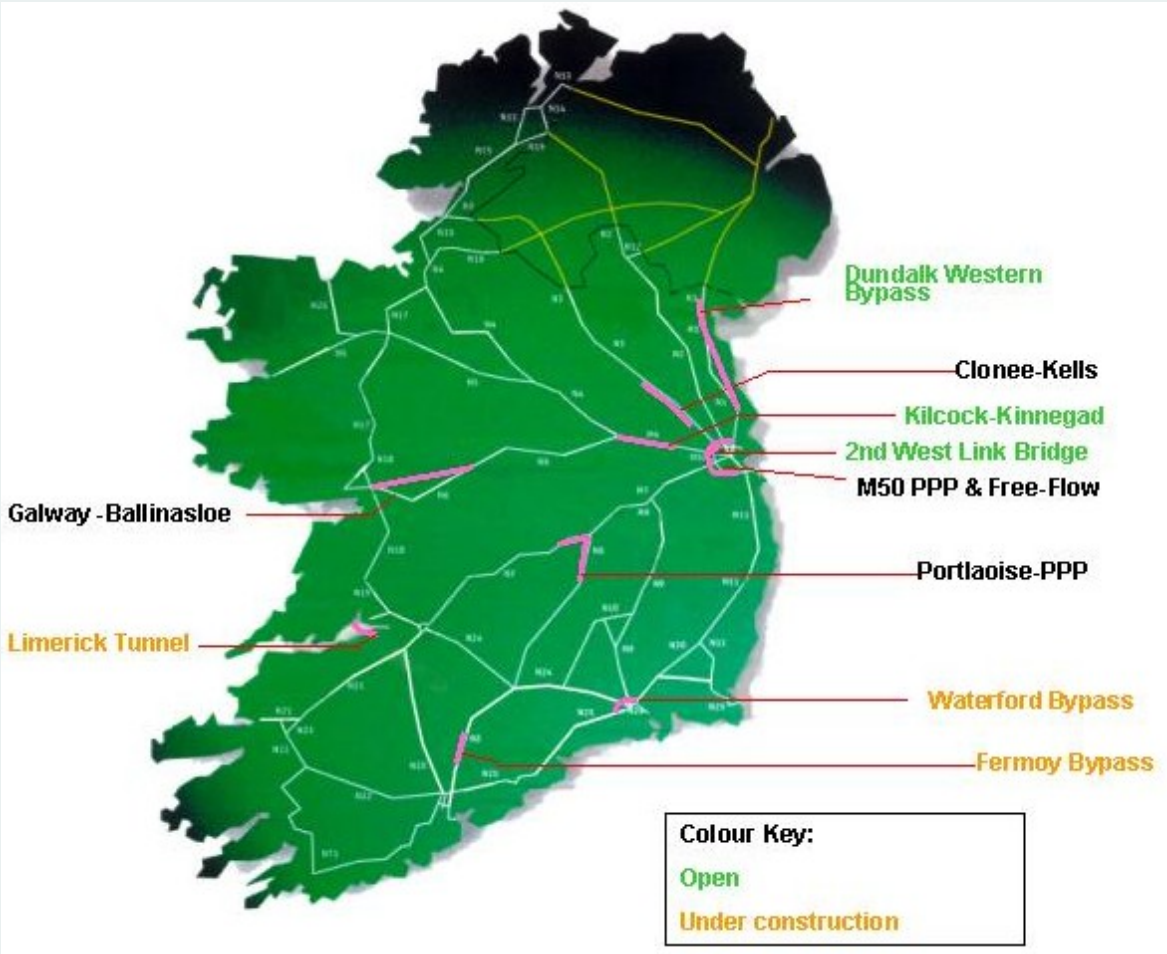
Anlægsomkostninger: ca.3 mia EUR

Privat investering: ca.1,5 mia. EUR

Koncessionshaver ansvarlig for:

- Projektering og anlæg
- Finansiering
- Drift og vedligehold

Koncessionsperiode typisk 30 år efter åbning af forbindelse



Limerick Projektet, Irland - Sænketunnel under Shannon floden

PPP Kontrakter

Parter

•"The Authority" (NRA), klient og "myndighed"

•"The PPP Consortium" (koncessionsindehaver)

Koncessionsform

•"Toll Concessions", dvs koncessions-indehaver får indtægter fra betalingsanlæg

•Reinvestering (fornyelse og reparation) inden tilbagelevering efter 30 år i flg. specificerede restlevetider ved "Hand Back"

Risici

•Koncessionsindehaver påtager sig normalt alle risici vedr. projektering udførelse, finansiering og trafik.

•For Limerick dog delt risiko vedr. arkæologi

Tilbudt kvalitet og pris

•Overholdelse af krav til projektering, udførelse og drift & vedligehold

•Fra Authority til PPP Company: Faste beløb betales ved milepæle under udførelse og i driftsperioden

•Fra PPP Company til Authority: Andel af indtægter fra betalings anlæg, afhængigt af trafikmængder

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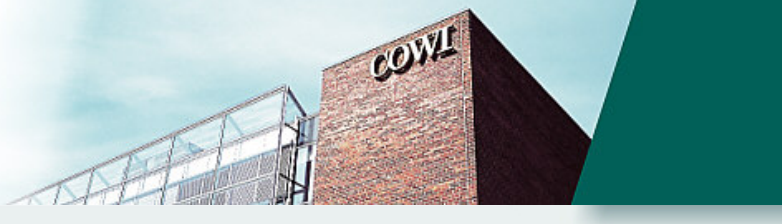

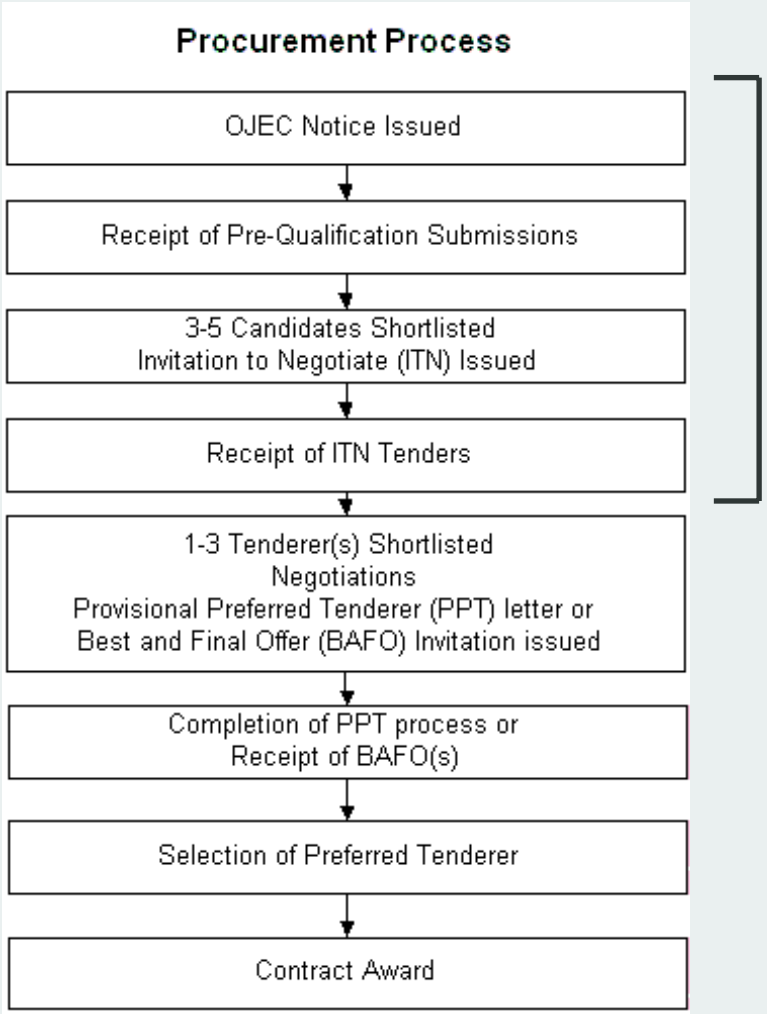

Tilbudsperiode

Prækvalifikation og tilbud

Modtagelse af prækvalifikations ansøgninger: Juni 2004

Prækvalifikation og Udbudsmateriale "Invitation to negotiate" udsendt: Februar 2005

Tre tekniske konsultationsmøder: marts/april/maj 2005

To finansielle/kommercielle konsultationsmøder april/juni 2005

"Outline Conceptual Design" kommenteret: Juni 2005

Tilbud afgives: Juli 2005

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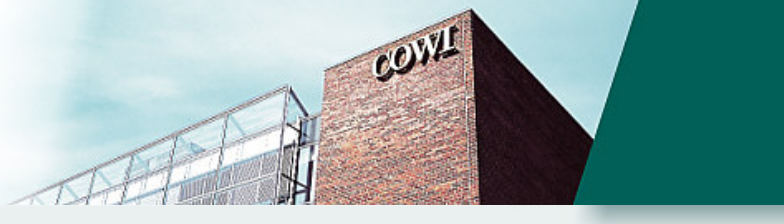

Udbudsdokumenter

Specifikation af tekniske krav

- Projekteringskrav og tekniske specifikationer for udførelse
- Krav til drift og vedligehold
- Krav til tilstanden ved tilbagelevering efter 30 år
- Normgrundlag

"Specifimen Design"

- Illustration af mulig overholdelse af krav
- Koncepter og detaljeringsgrad som for Preliminary Design

Detaljerede projekteringskrav udvikles af entreprenør

Overordnede funktionskrav til tunnel overlader videre udvikling af projekterings kriterier til den udførende mht.:

- Opsamling af grundlæggende data og udledning af design værdier
- Udledning af laste, lastkombinationer kalibrering af partialkoefficienter
- Detaljering af krav til sikkerhed i driftsfasen ud fra risiko analyse
- "Preliminary Design" og "Detailed Design" skal udarbejdes af entreprenør og godkendes af uafhængig Design Checker

Limerick Projektet, Irland - Sænketunnel under Shannon floden

Tilbud og kontrahering

Prækvalificerede konsortier

Sli Nua	CLCBL	Shannon Link	Direct Route
Laing O'Rourke	Bouygues	HBG Ascon (BAM)	Kellogg Brown & Root
Laing Roads Ltd.	Egis Projects	P.J. Hegarty & Sons	Strabag
Hochtief	DTP Terrassement	VINCI	John Sisk & Son
Intertoll (Pty)		NTR Plc	Lagan Holding Ltd
			Roadbridge Ltd
Tunnel Designer: Hyder	Tunnel Designer: TEC	Tunnel Design: Mott MacDonald & Arup	Tunnel Design: Capita Symonds

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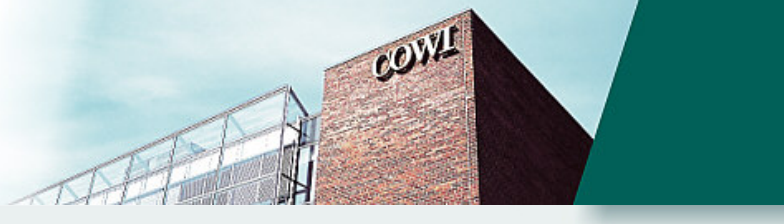

Dialog med tilbudsgiverne

Tekniske konsultations møder

•Formål: at opnå feed-back fra ”Authority” på fremsatte forslag

•Før sidste møde specielt forslag vedr. æstetiske løsninger og sikring af krav til holdbarhed

•Forslag fremsendt 1 uge før møde

•”Authority” forklarer evt’e indvendinger, typisk i tilfælde af manglende overholdelse af krav

”Outline Conceptual Design”

•Udkast til tilbudsprojekt for hovedelementer kommenteres 1-1½ måned før tilbudsdato mht. overholdelse af krav

•Forslag til sikkerhedskoncept

Projektforslag og udvikling

Første konsultationsmøde:

•To tilbudsgivere fik afslag på at bygge en bro (højbro, svingbro) i stedet

•Alle ønskede støbe bassin flyttet til Bunlicky Lake

•To tilbudsgivere ønskede centralt galleri, - men kun én bibeholdt det i tilbud

•Alternativt ventilationssystem

•Længde af tunnel

•Lodret linieføring

Efterfølgende mere detaljerede emner

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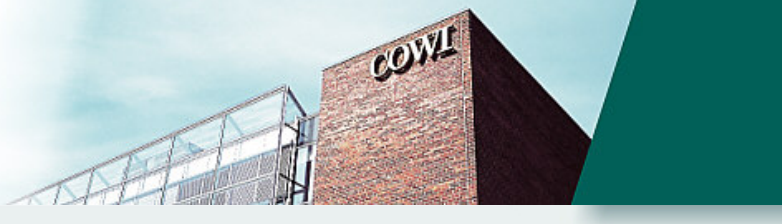

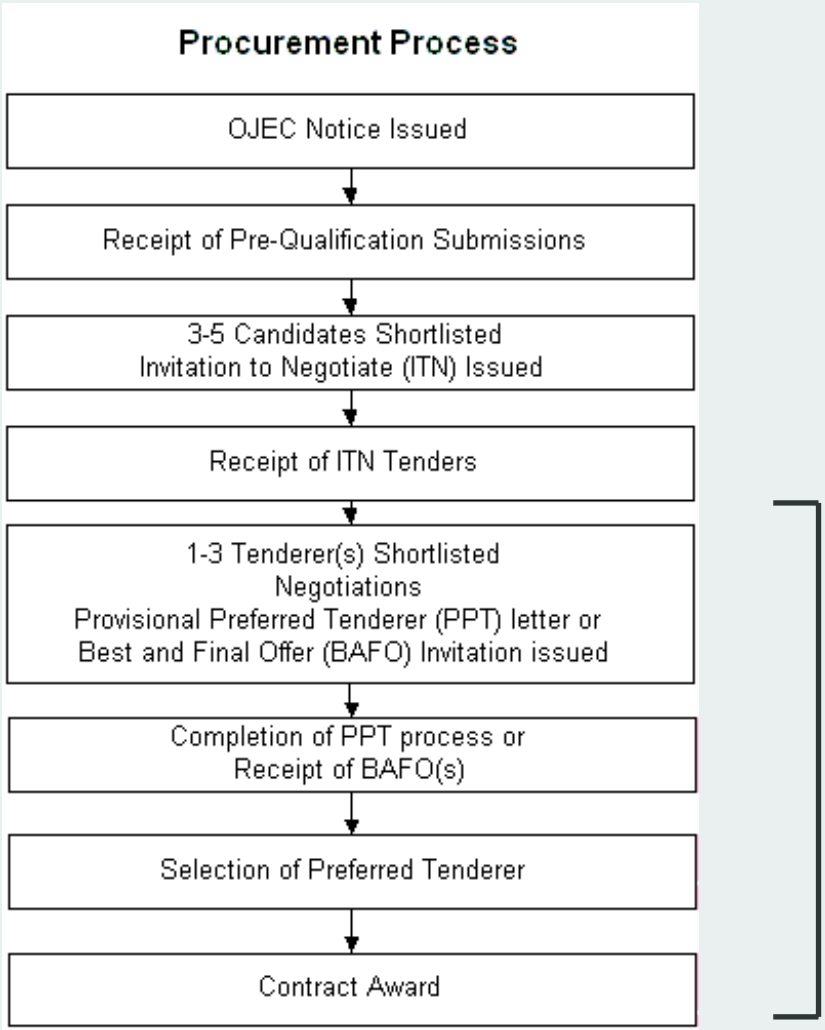

Kontraheringsperiode

Tilbudsevaluering og kontrakt

- Tilbudsevaluering august 2005
- Direct Route "Provisional Preferred Tenderer" september 2005
- Ingen "Best and Final Offer" fase

Direct Route nomineret "Preferred Tenderer" november 2005

Kontrakt underskrevet august 2006

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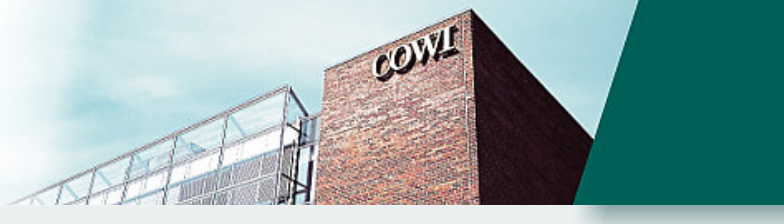

Tilbud - forskelle og lighedspunkter

Projekt

- Tunnel element længde: 100-132m
- Antal af tunnel elementer: 3-5
- Længde af sænketunnel: 375m-530m
- Længde af Cut & Cover tunnel: 67m til 250m
- Kun én tilbudsgiver valgte centralt galleri i tværsnit

Udførelse

- Segment-opdelte elementer og vandtæt beton frem for monolitiske elementer med membran valgt af alle
- "Gravel Bed" og "Sand Flow" fundering var lige populære
- Konventionel transport og nedsænknings metode valgt af alle
- Et enkelt alternativ med tunnel element støbt "off-site"

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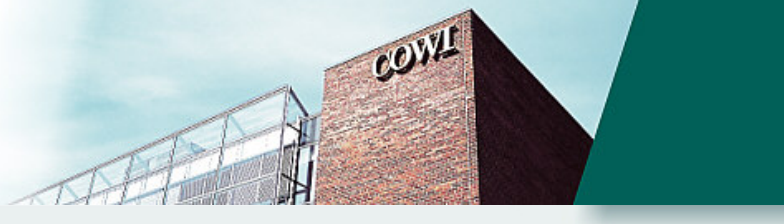

Projektøkonomi

Samlede projekt omkostninger

•Omkostninger til arealerhvervelse, geoteknik, arkæologi, miljø, rådgivning, tilsyn mv.: ca. **150 mio. EUR**

•Estimerede omkostninger til projektering, udførelse, drift, vedligehold, re-investering: ca. **660 mio. EUR** (heraf tunnel ca. 200 mio. EUR)

•Finansieringsomkostninger: ukendte

NRA's samlede projekt finansiering

•Omkostninger til arealerhvervelse, geoteknik, arkæologi, miljø, rådgivning, tilsyn mv. afholdt af NRA

•Betaling fra NRA til Direct Route under udførelse: **180 mio. EUR**

•Betaling fra NRA til Direct Route under drift: **60 mio. EUR**

•Betaling fra Direct Route til NRA, afhængig af trafikmængder, forventes at give en **betydelig tilbagebetaling**

Direct Route finansieringkilder

•Bond facilitet fra HBoS (UK bank)

•European Investment Bank

•Funds fra konsortium medlemmer

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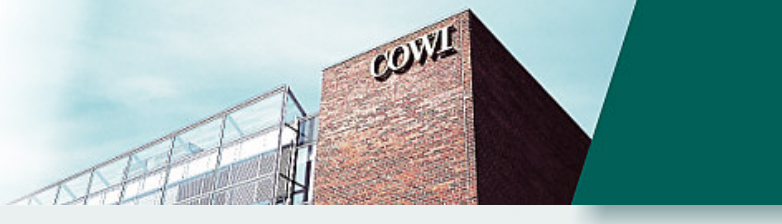
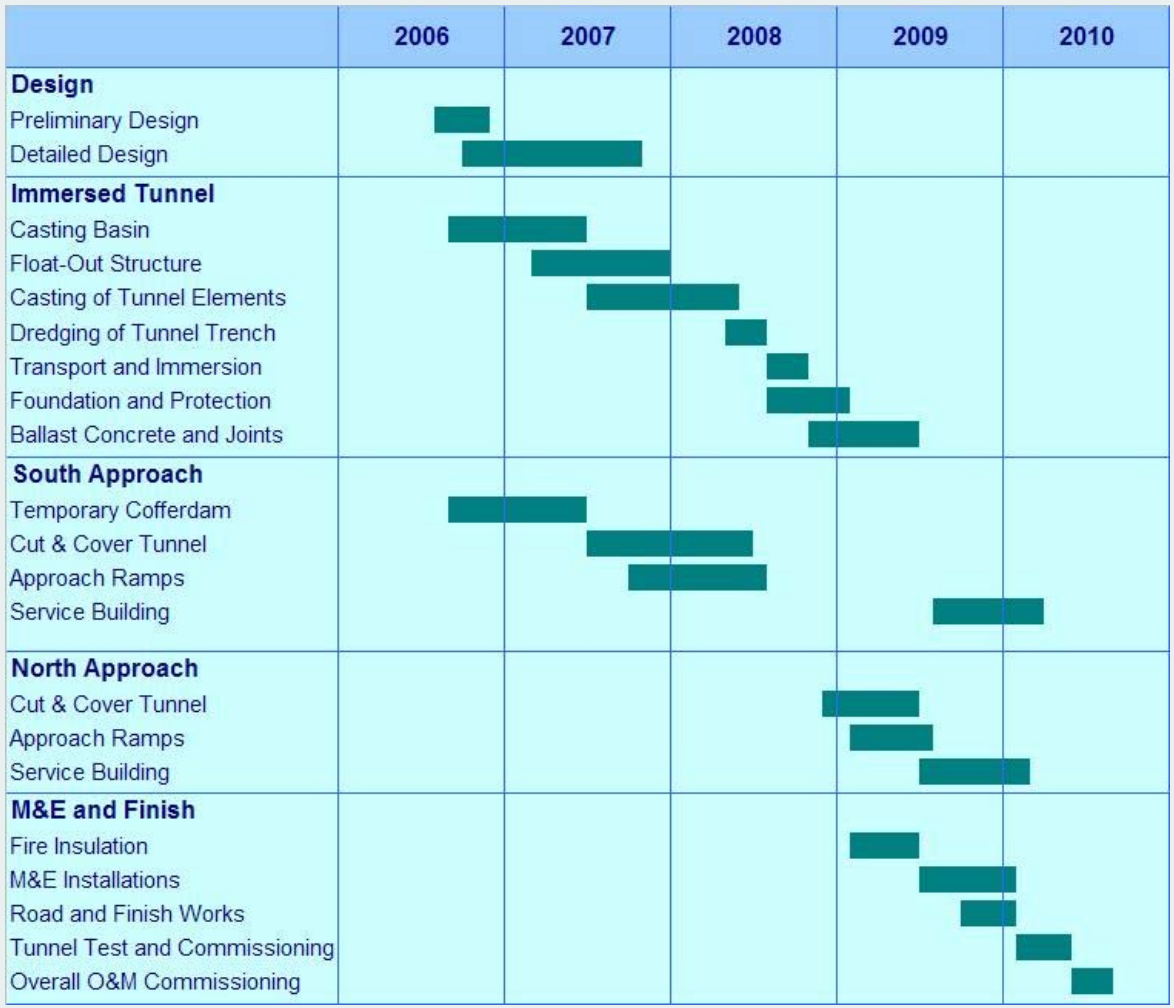




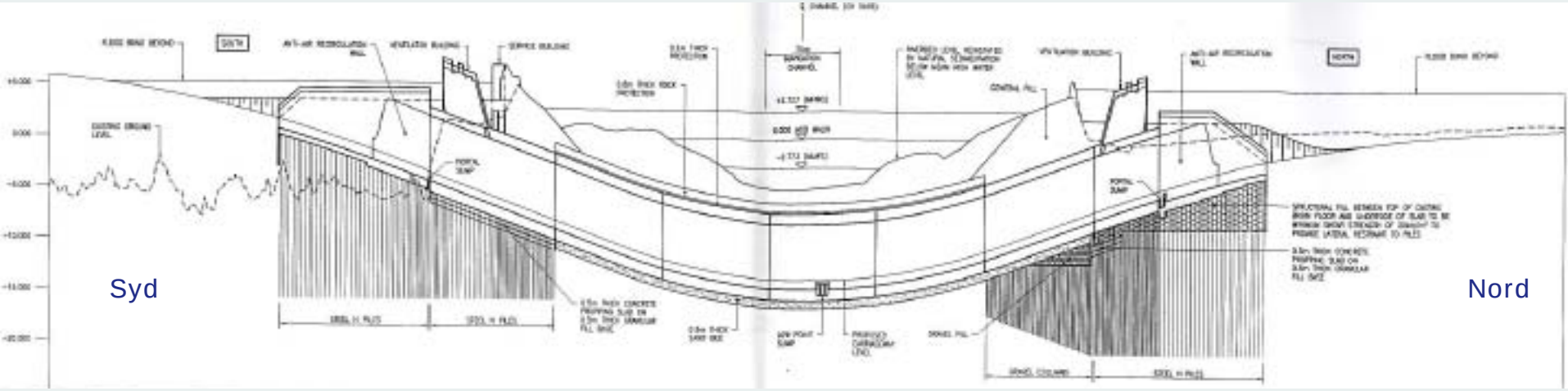
Program for udførelse

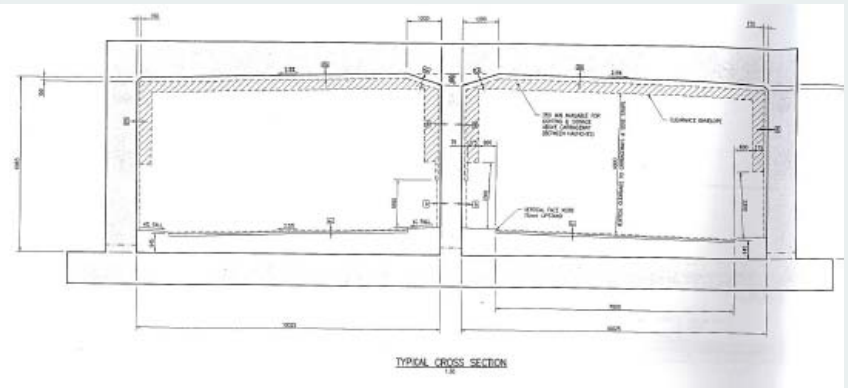
Milepæle

Kontrakt start	18.08.06
Start element støbning	22.06.07
Placering første element	01.08.08
Start M&E og Finish	02.02.09
Start Test/Commissioning	20.01.10
Åbning af vejforbindelse	17.09.10

Limerick Projektet, Irland - Sænketunnel under Shannon floden

Direct Route Preliminary Design





Tværsnit

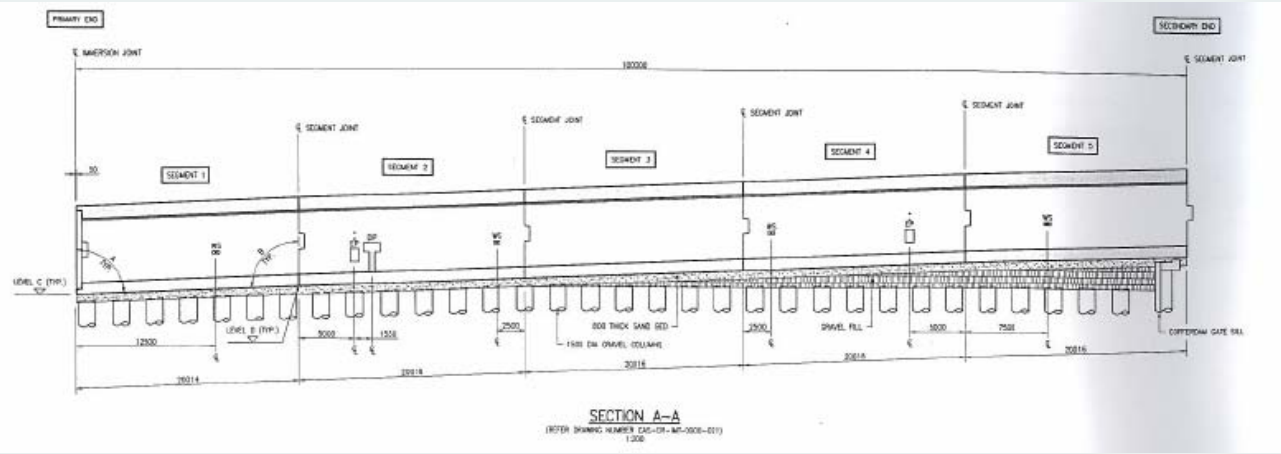
- ”Tæer” aktiverer sidefyld
- Optimeret efter fritrumsprofil

Længdeprofil

- Sænketunnel: 5 stk. 100 m lange elementer
- Pæle under Cut & Cover tunnel og ramper
- ”Gravel Columns” under tunnel element nr. 5

Limerick Projektet, Irland - Sænketunnel under Shannon floden

Direct Route Preliminary Design

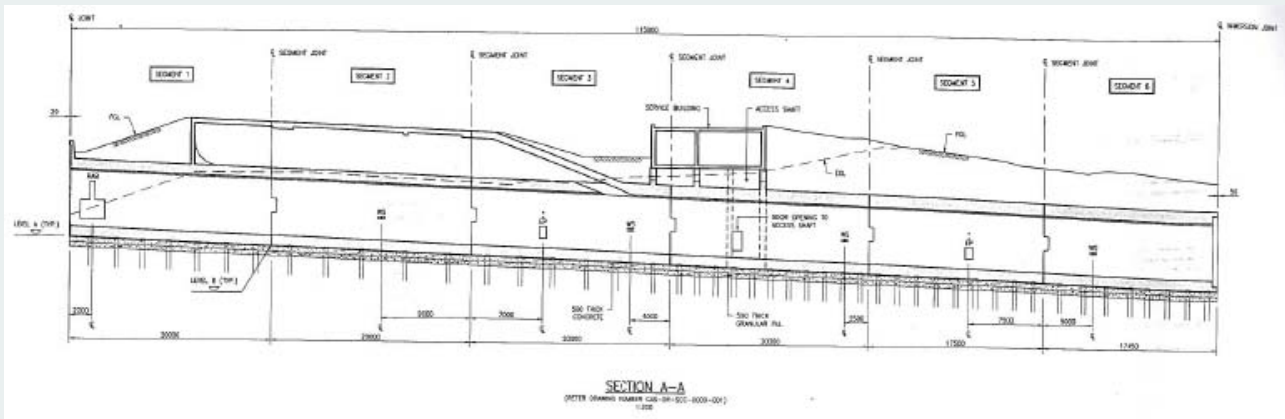


Tunnel element (nr.5)

- Opdelt i 5 segmenter på 20m
- Forskydningslåse mellem segmenter og elementer
- Waterstops (dobbelt tætning) mellem segmenter
- Traditionelle Gina og Omega tætningslister mellem elementer

Cut & Cover tunnel (syd)

- Opdelt i segmenter
- Ventilation med "Saccardo Nozzles" princip i stedet for "jet fans"



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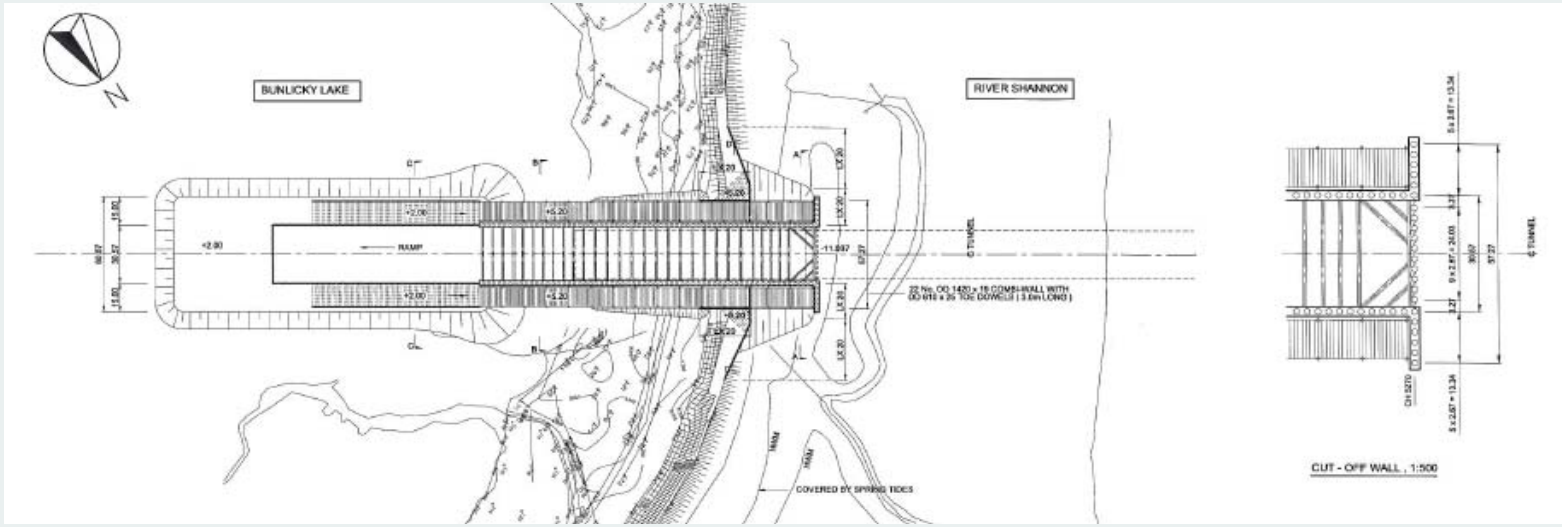
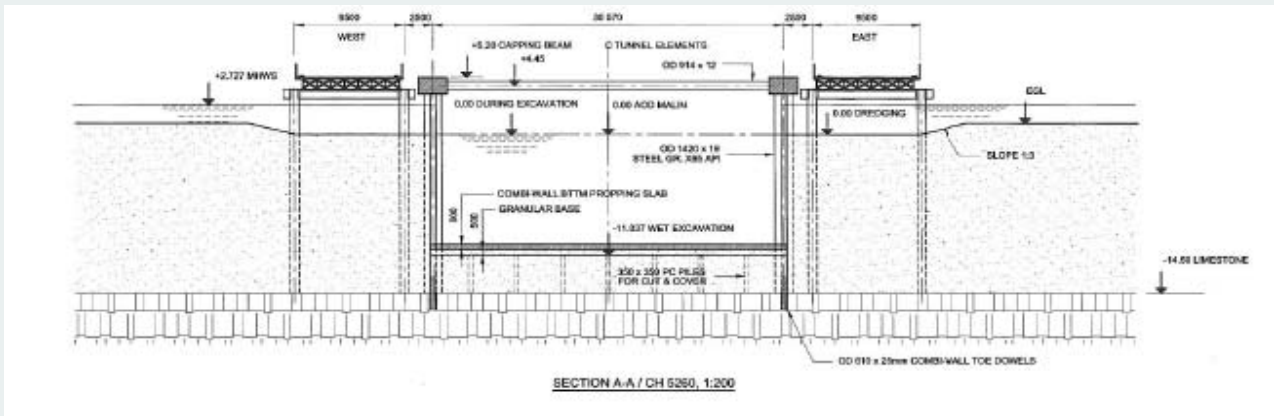
Direct Route Temporary Works Design





Fangedæmning for Cut & Cover tunnel syd

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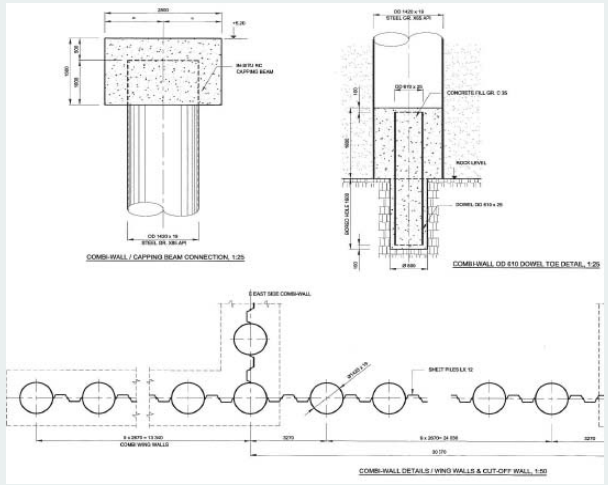
Direct Route Temporary Works Design



Fangedæmning for Cut & Cover tunnel syd

”Combi Walls” Rørpæle (Ø1420x19) og spunsvægge

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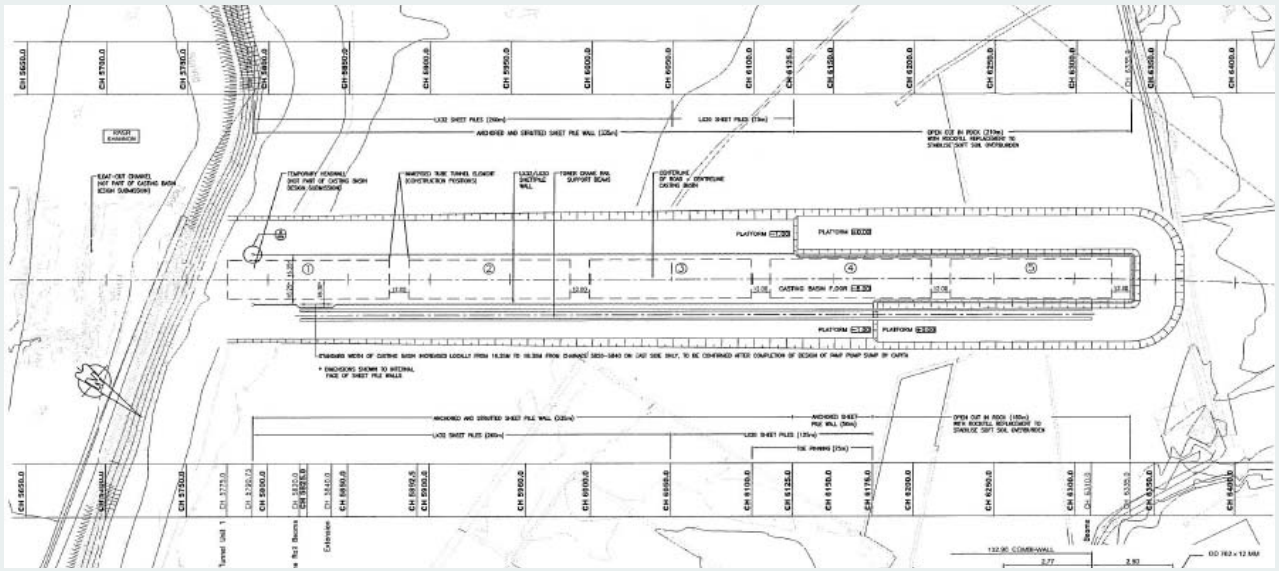
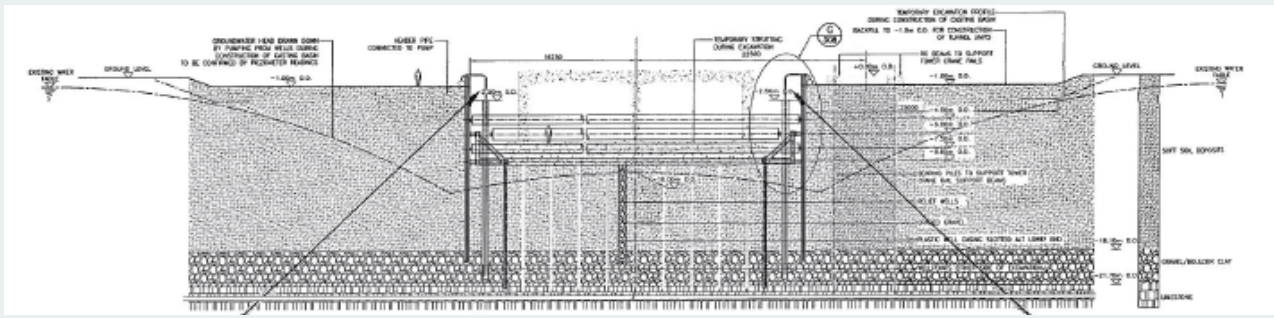
Direct Route Temporary Works Design





Tørdok på nordlig side som spunsvæg indfattet byggegrube

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Direct Route Temporary Works Design

Udgravning til tørdok og nordlig Cut & Cover tunnel og rampe

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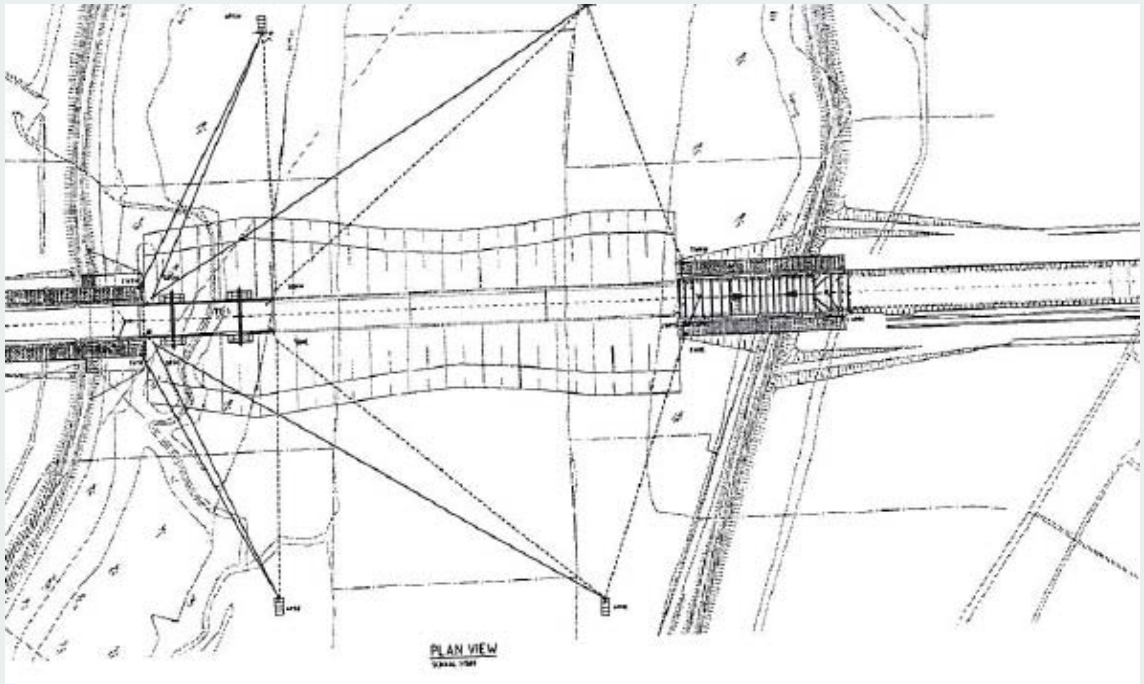
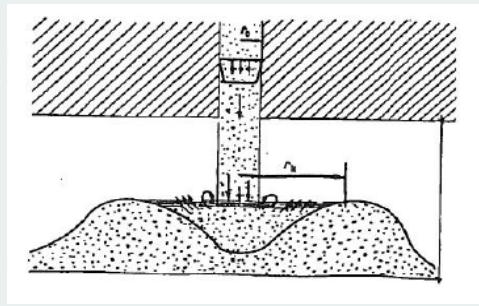
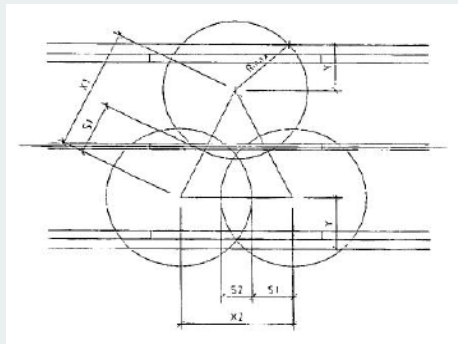
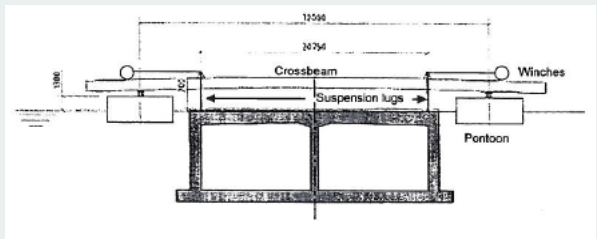
Direct Route Temporary Works Design









Transport (warping) af tunnel element nr. 1

Permanent fundament ved ”Sand Flowing”