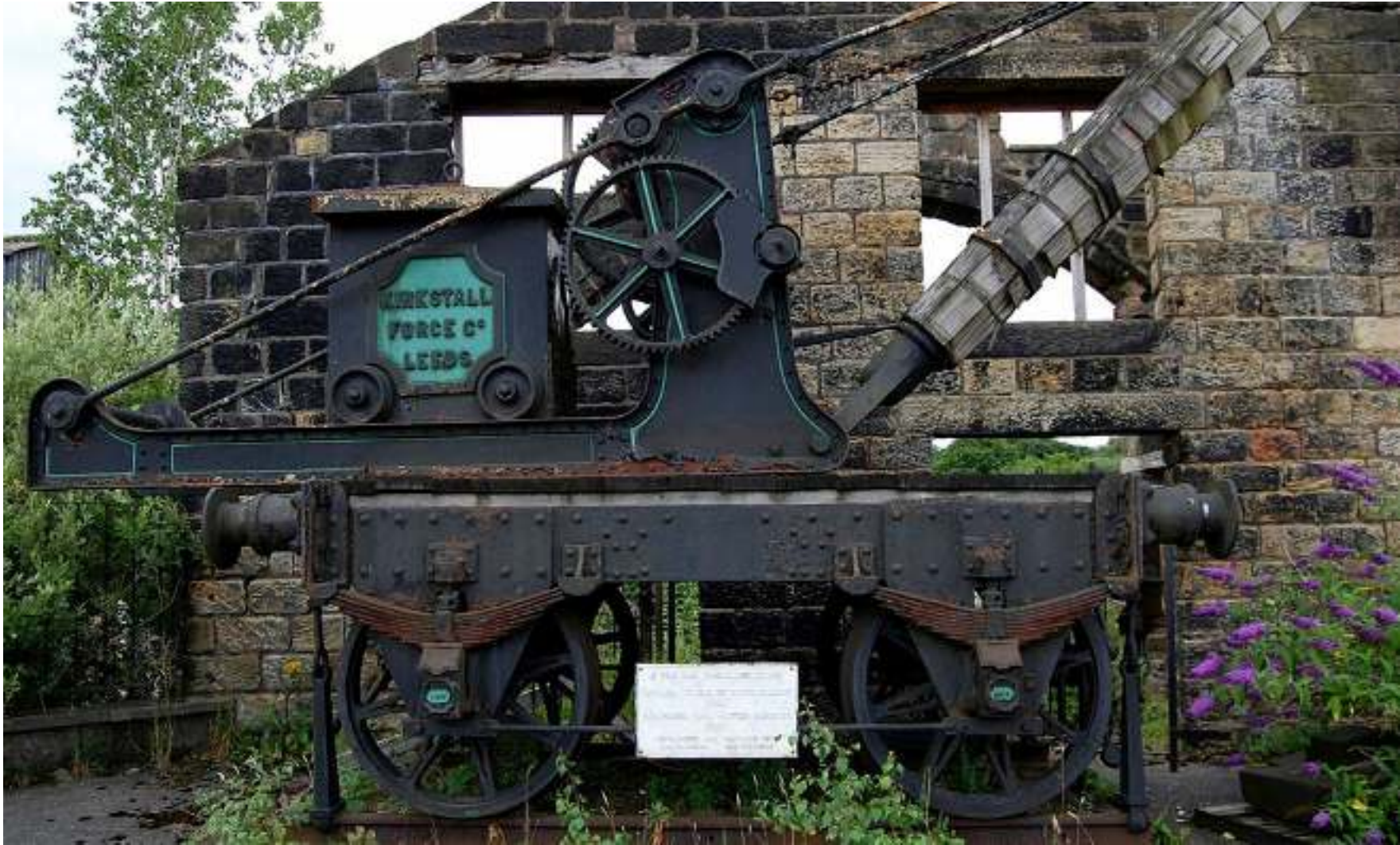


# Kirkstall Forge - Paving the Way for a new urban regeneration project in Leeds



# Project Team



Commercial Estates Group Ltd (CEG) - Client

WYG - Environmental and Engineering Consultant

Rebecca Reynolds – Geotechnical Lead

Patricia Gill – Contaminated Land Director

# Presentation Summary



- Site Setting and History
- Geology and Ground Investigations
- Redevelopment Plans
- Geotechnical Challenges
- Ground Contamination Challenges



# Location and Setting

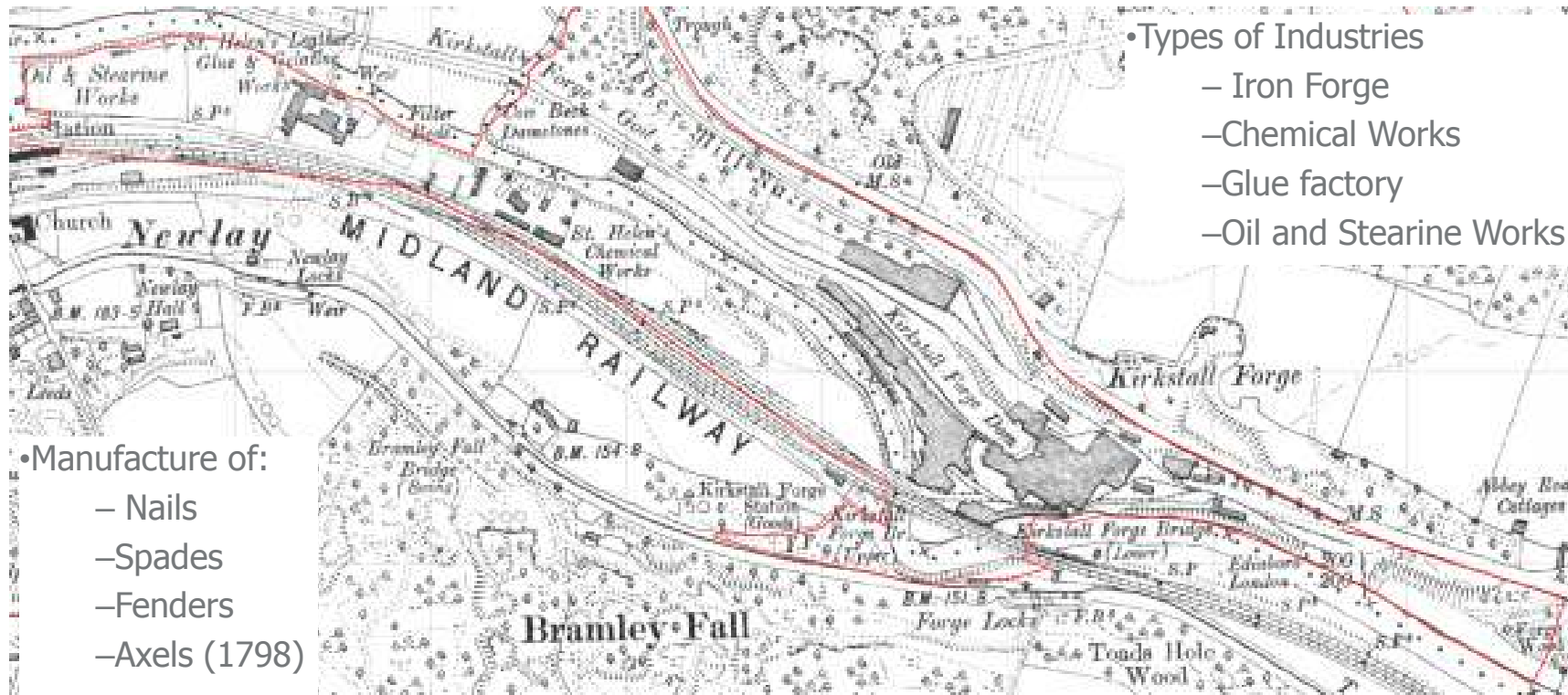
- 2.5km north west of Leeds city centre
- South of the A65 Abbey Road, Kirkstall
- River Aire
- Railway
- Canal



# Site History



- 1200– the Monks from Kirkstall Abbey started Kirkstall Forge making horse shoes and iron work for the Abbey
- 1589 – dissolution of the Monasteries – Earl of Cardigan
- 1600 to 2002/7 – Continuous use as an iron forge



- Types of Industries
  - Iron Forge
  - Chemical Works
  - Glue factory
  - Oil and Stearine Works

- Manufacture of:
  - Nails
  - Spades
  - Fenders
  - Axels (1798)

# Site History



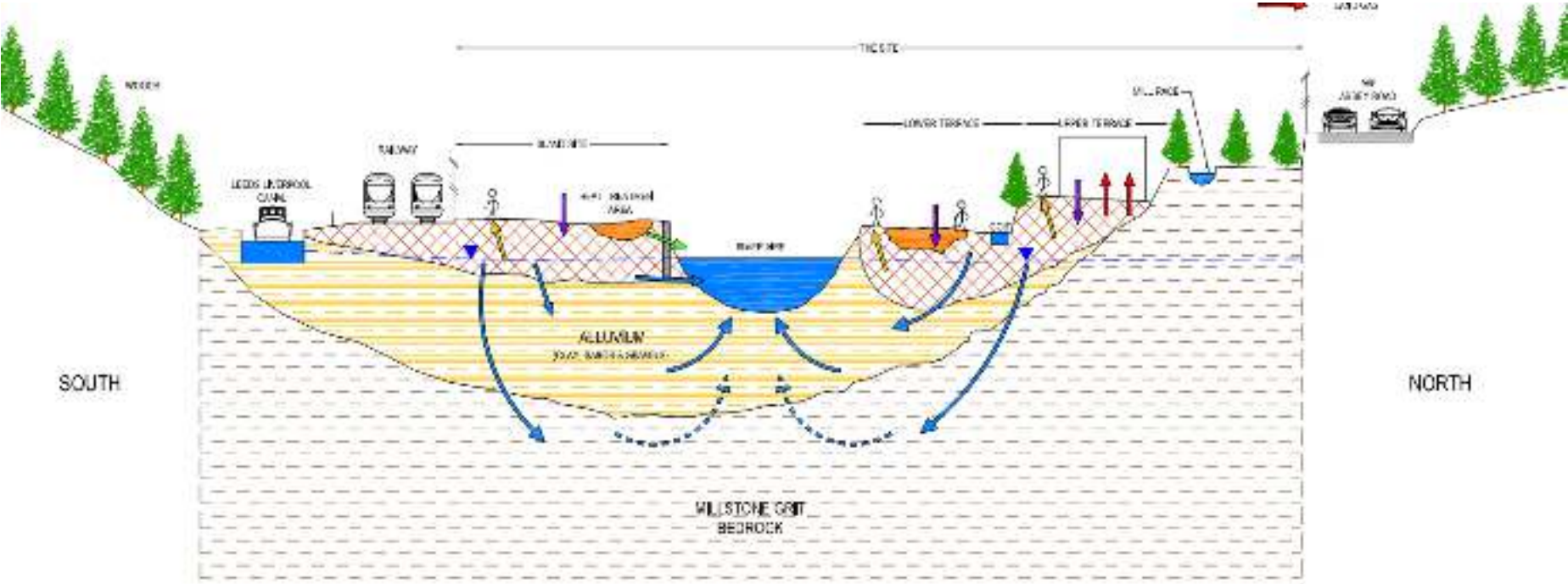
# Site History - UXO



# Geology, hydrology & hydrogeology



- Made Ground
- Alluvium
- Millstone Grit bedrock
- Groundwater / flooding

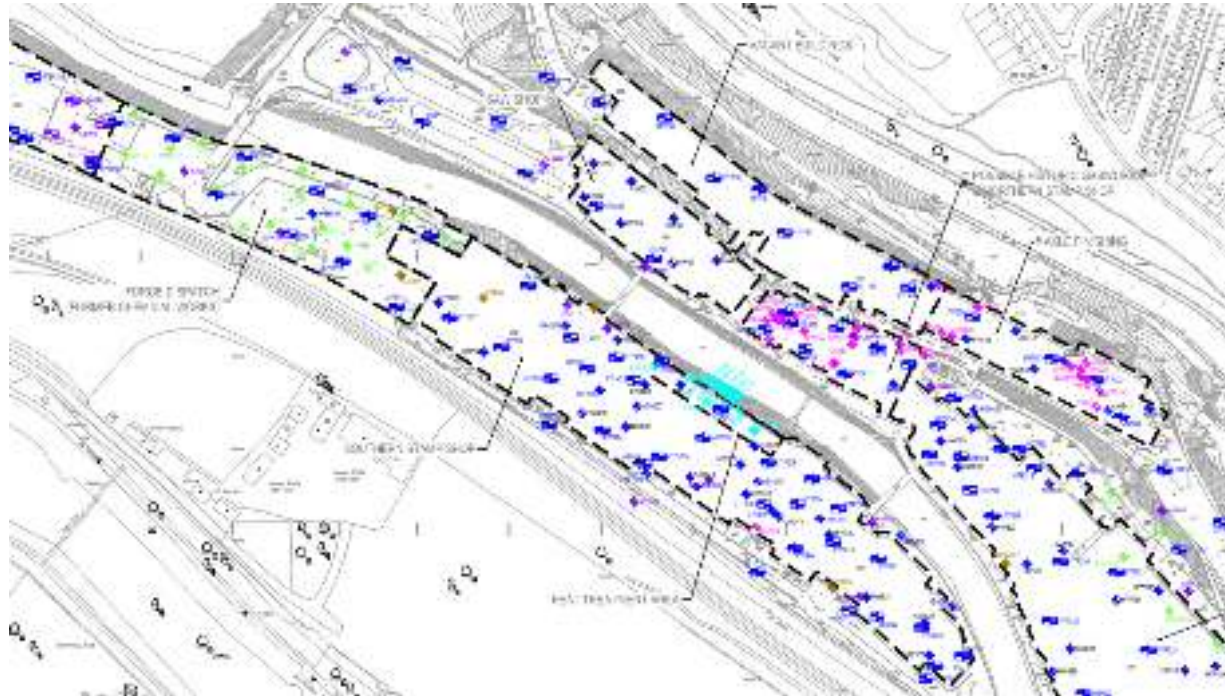




# Ground Investigations



- Prior to 2008 – Several phases of Environmental Ground Investigation
- 2008 to present – WYG Geotechnical and Environmental Investigation
  - Deeper boreholes
  - Groundwater installations
  - Geotechnical testing and sampling



# Redevelopment – CEG’s Masterplan



# Redevelopment



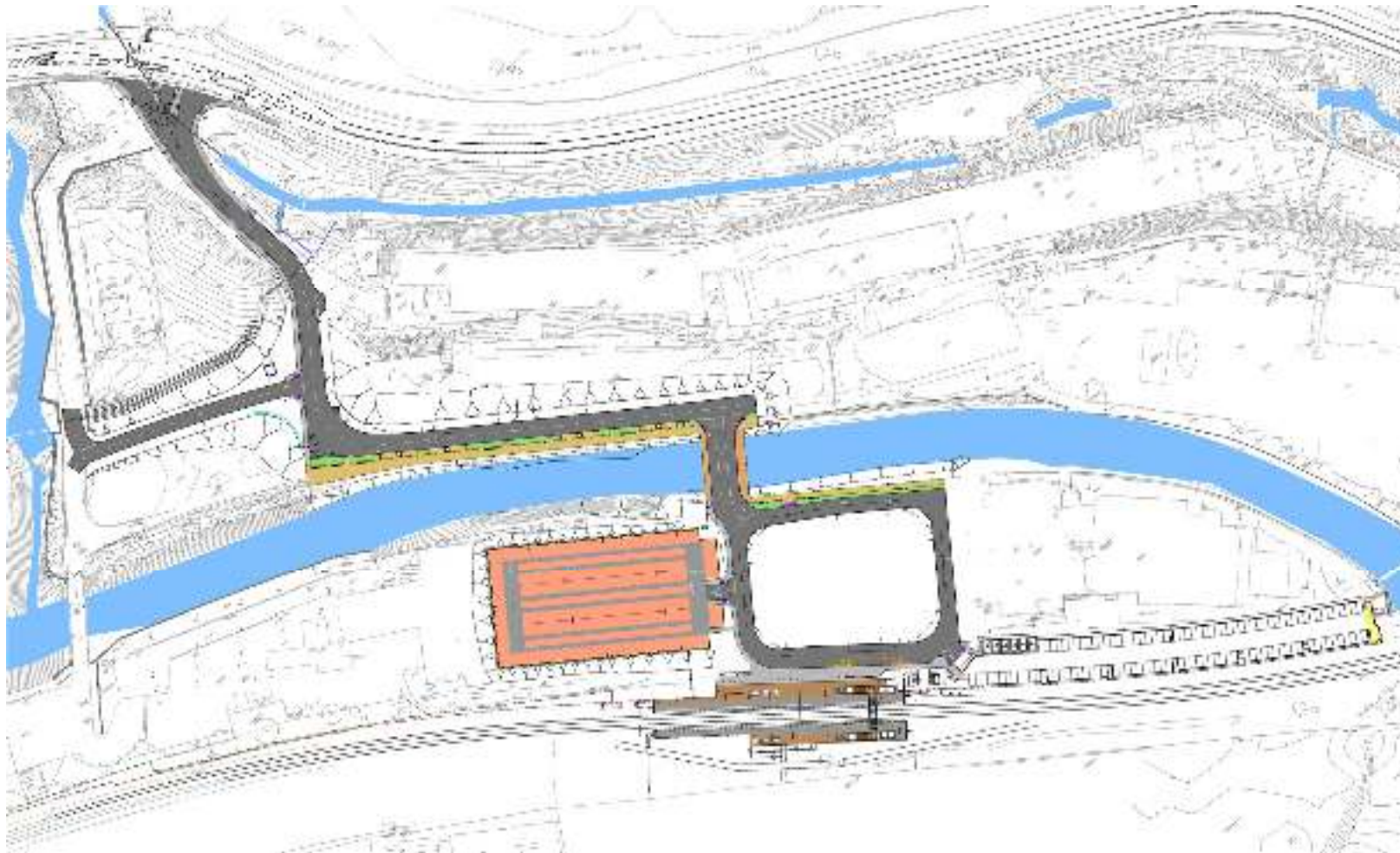
- 2008- Demolition / archaeology / early remediation
- 2014 – Phase 1 Infrastructure



# Phase 1 infrastructure



- 2014 - 2016- Construction





# Geotechnical Challenges

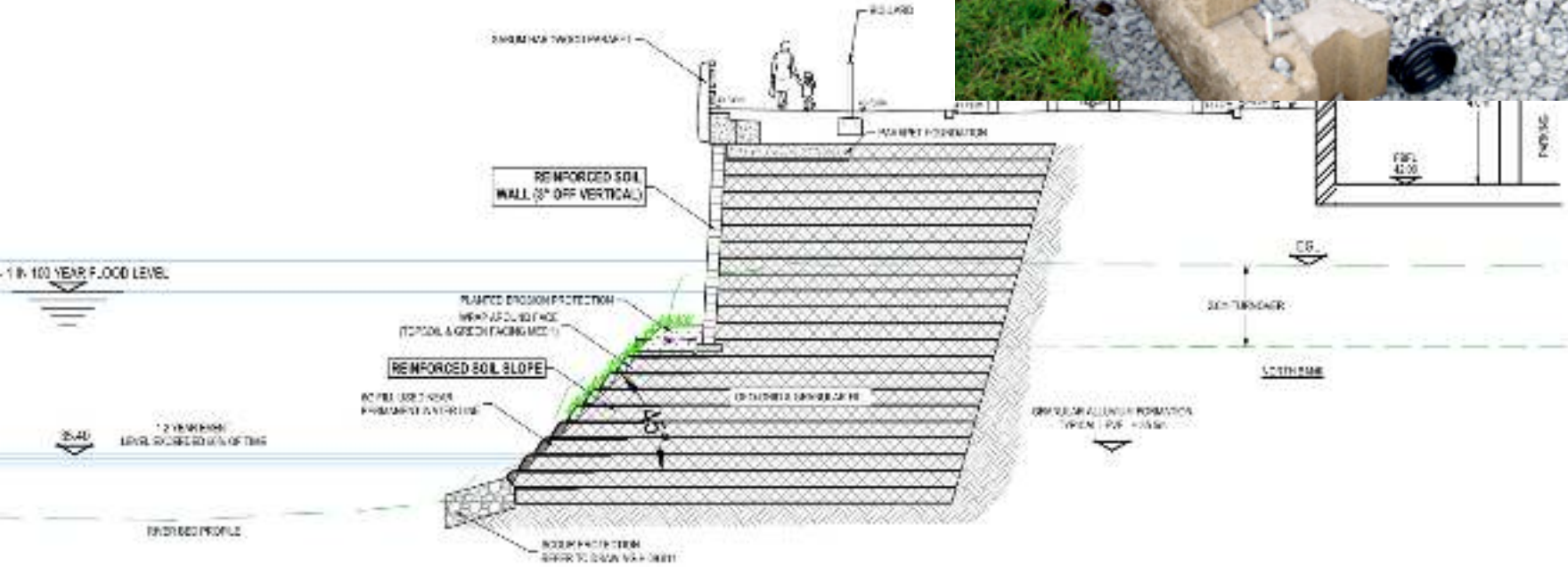
- Raising site levels up to 5m
- Retained heights up to 10m
- Foundations for an 18m wide 30m span bridge
- Foundations for two cantilever pedestrian platforms
- River environment
- Obstructions
- Variable Made Ground



# Geotechnical Challenges



- Reinforced soil and wall solution
  - Re-use of site won materials
  - Allowed founding of bridge bank seats and platforms
  - Provided natural finish



# Geotechnical Challenges



# Geotechnical Challenges



Raising levels





# Geotechnical Challenges



- Winter 2015 – worst flood on record
- Flood levels in line with those predicted



# Contamination



## Key Contaminants

- Diesel range hydrocarbons C10-28 – general former forge uses
- Coal tar – PAH – naphthalene and oil range hydrocarbons C20-35 – former chemical works
- Lubricating oils C20-C35– Heat Treatment Area

# Heat Treatment Area – Early Phase Remediation



- Worst area of contamination
- Former use – crane dipped heated metal into oil and then water prior to cooling on racks
- Included 3 oil quench tanks 52m<sup>3</sup> each
- Significant oil spillages – some near surface contamination
- Greatest contamination at groundwater level / smear zone
- Up to 0.8m free product LNAPL
- Remediated two phases 2002 and 2008 as early phase betterment

# Heat Treatment Area – Early Phase Remediation



- First Phase Remediation
  - Free product recovery from boreholes – 1,400m<sup>3</sup> LNAPL removed
  - Residual LNAPL remained 0.1 to 0.4m thickness
  
- Second Phase Remediation
  - Excavation of clean overburden soils for re-use
  - Excavation of contaminated smear zone soils
  - Skimming of free product from water in excavation
  - Validation by visual inspection of groundwater – no visible free product
  - Limited off site disposal of most contaminated soils
  - Bioremediation of less contaminated soils for re-use

# Heat Treatment Area – LNAPL



# Heat Treatment Area - Obstructions



# Remediation Strategy



- Detailed remediation strategy for rest of site – 2008
- Receptors - Human health (much residential) and River Aire
- dQRA controlled waters – dilution but no degradation (river through site)
- Enabling works – source treatment - controlled waters driven
- Development Works – cover layer and gas membrane – human health driven
- Cut and fill balance – sustainable re-use of materials wherever possible



# Phase 1 Infrastructure Works

- No significant areas of hydrocarbon contamination
- Asbestos identified frequently in soils – improved lab testing
- Initially any asbestos contaminated soils – place 2m beneath new road
- Volume too great – agreed re-use where  $<0.001\%$  asbestos
  - beneath roads – any depth
  - under cover layer for landscaping + to prevent dust generation by machine tracking
- Enabled maximisation of site soils for re-use





# Future Works

- Former chemical works area
  - approximately 10,000m<sup>3</sup> of soils - coal tar
  - likely stabilisation / solidification
  - re-use on site at locations not to be re-excavated
  
- Other areas of hydrocarbon contamination
  - mostly diesel range
  - likely treatable by bioremediation



# Drone video



# Kirkstall Forge



creative minds safe hands



If you would like any more  
information, please visit  
[www.wyg.com](http://www.wyg.com)

