

Crossrail 2 | Asset Portal

A 3D analysis of assets below the surface of London

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About ARUP

Arup is the creative force at the heart of many of the world's most prominent projects in the **built environment** and across industry.



+14k

Staff

35

Countries

89

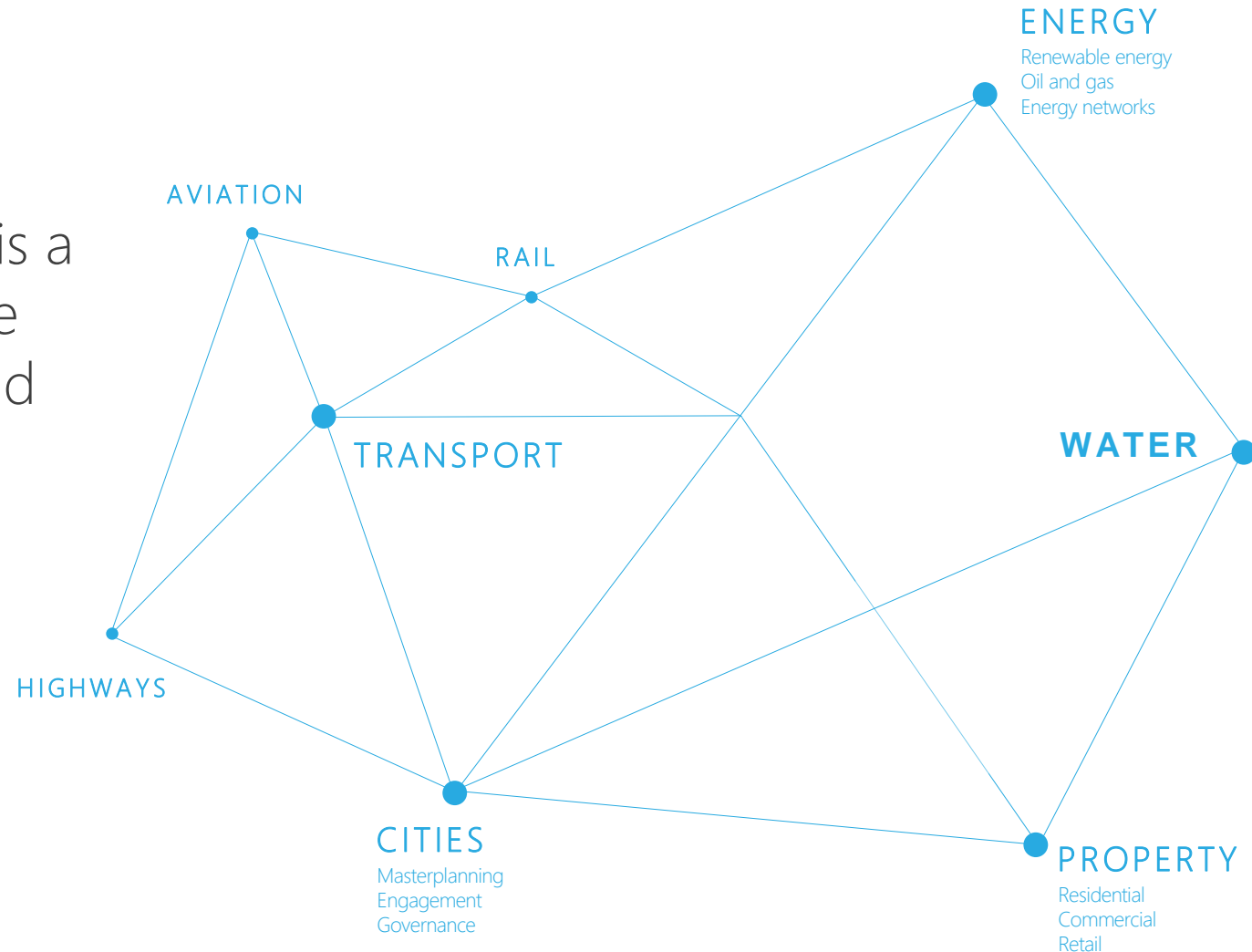
Offices
Worldwide

+14k

Projects
across 146
countries

About ARUP - ADE

The Advanced Digital Engineering group is a centre of excellence for digital in Arup. We combine Arup's traditional engineering and design strengths with advanced digital expertise in data, models, analytics, and user-centred design.



Crossrail 2 – Project Overview

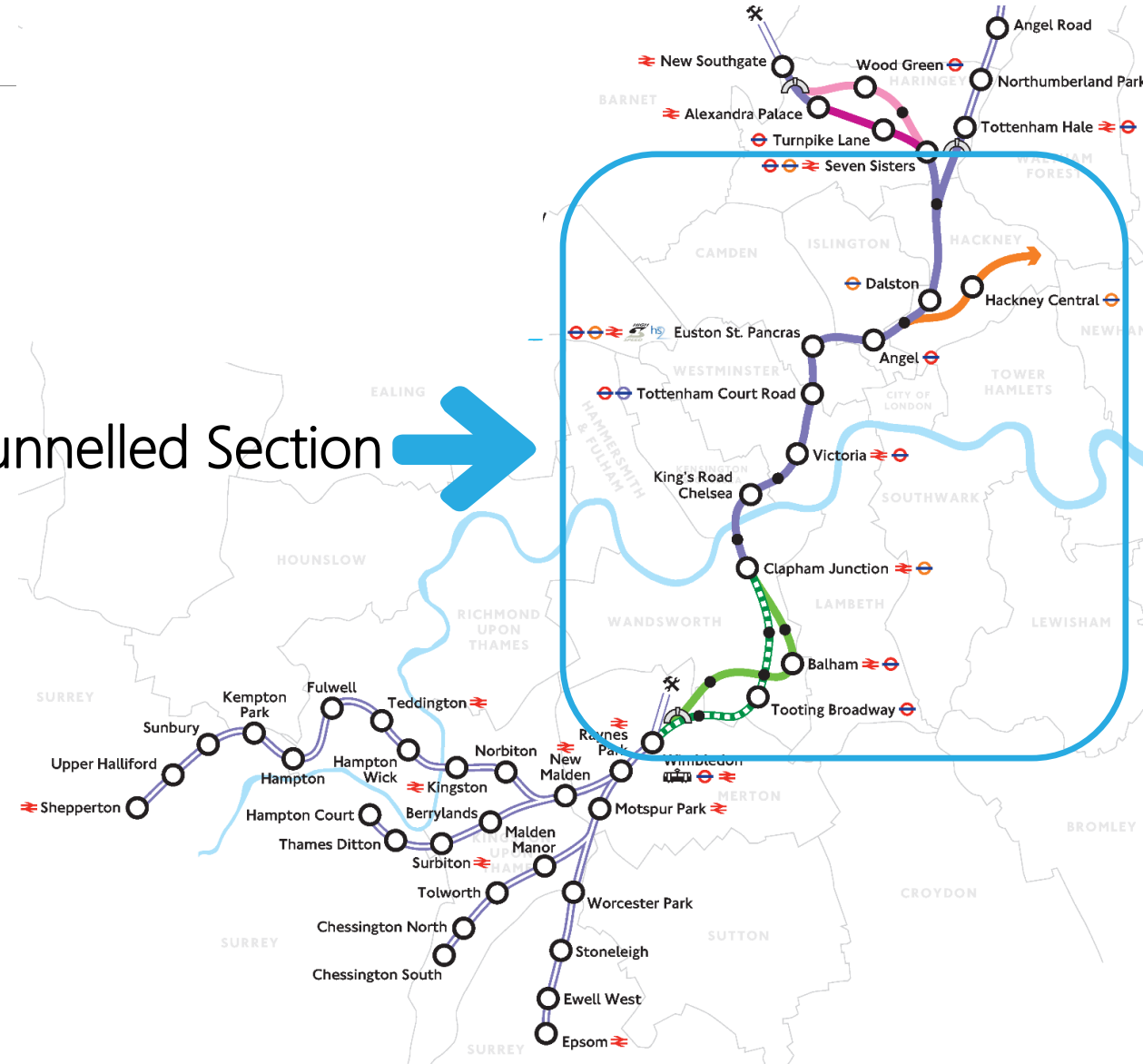
By 2030 London's population is set to grow from 8.6 million to 10 million;

Crossrail 2 (running North-South) will reduce the pressure on London's transport infrastructure;

The 30km route runs across London will provide opportunity for:

- 200,000 new homes
- Increase London's rail capacity by 10%
- Additional daily capacity for 270,000 more passengers

Tunnelled Section ➔



Crossrail 2 - Asset Portal Introduction

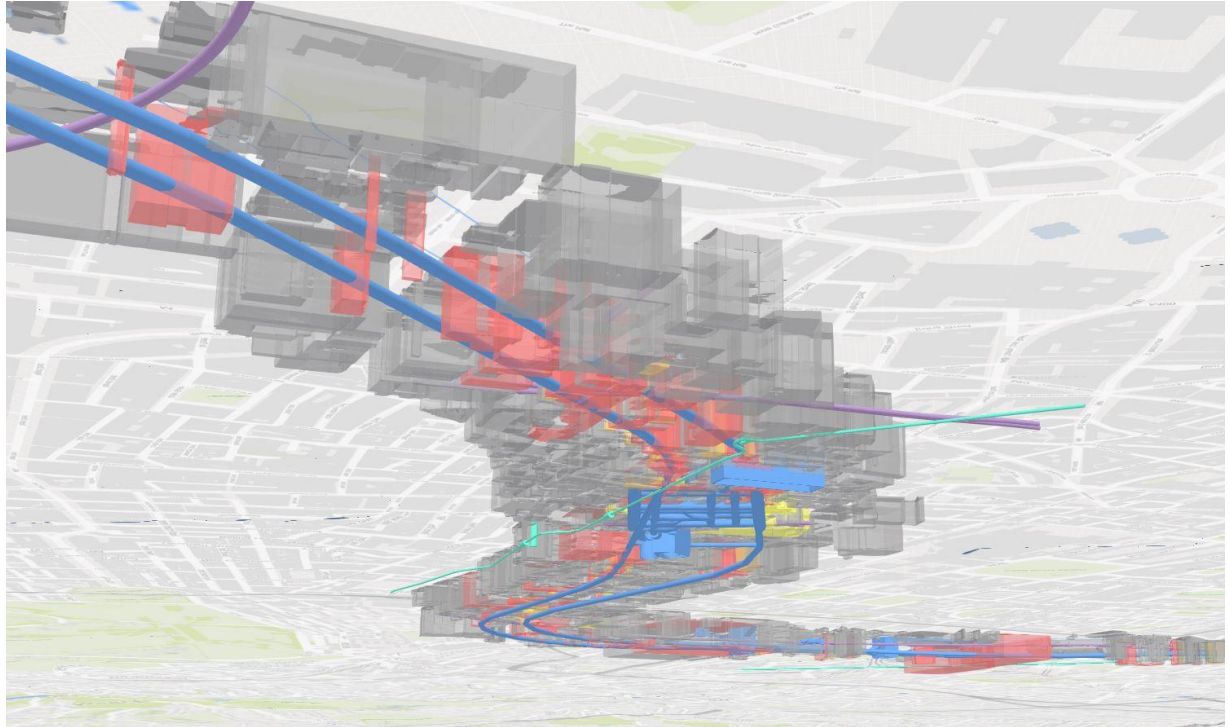
Route covers thousands of assets across London

- Buildings
- Utilities
- Rail assets

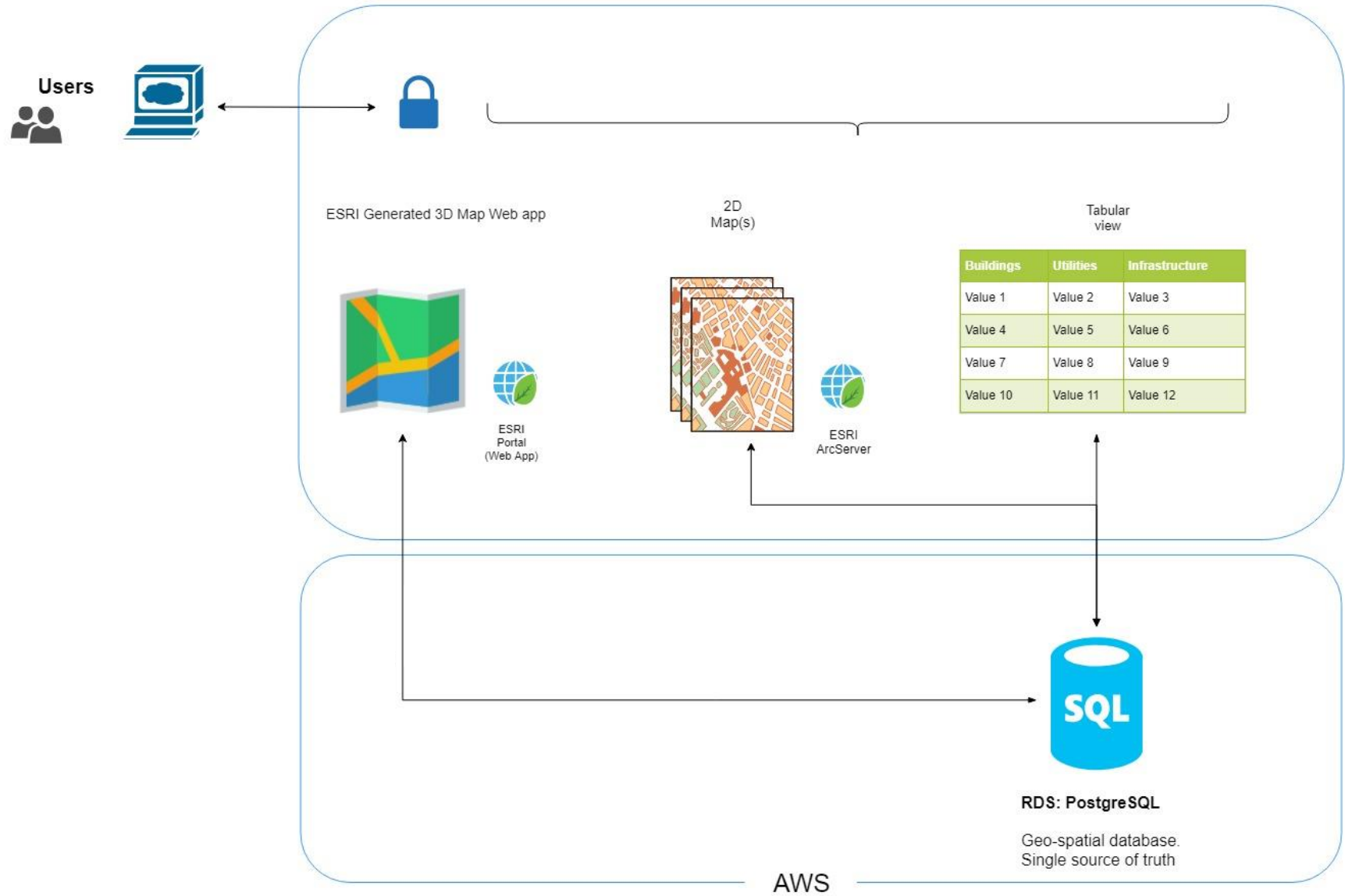
The Asset Portal (AP) is a *web-based* tool for gathering and identifying potential obstructions to the proposed tunnel route

AP serves the central source of truth for all asset information

Users can view, add, edit and manage data in one application

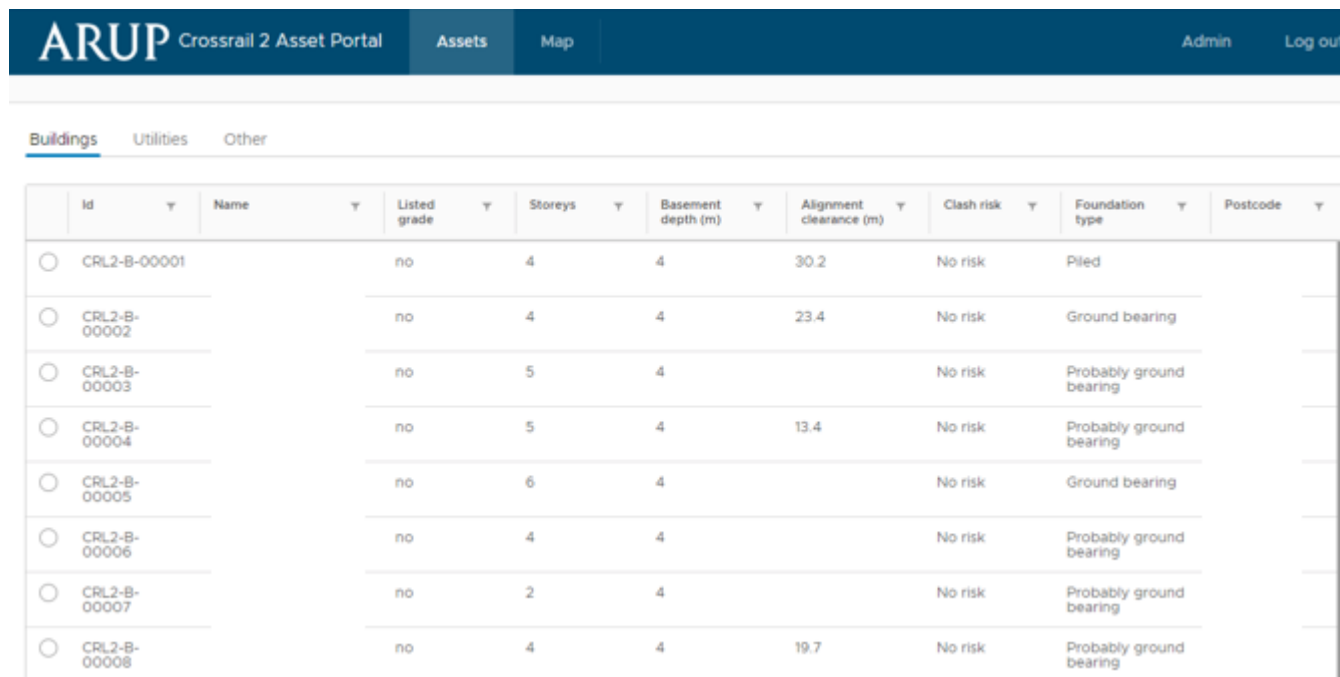


Architecture



Tabular Data

- Information about each assets
- Updated by engineers
- Website data entry form
- Controlled data format
- Links to supporting information in ProjectWise
- User history / audit trail



The screenshot displays the ARUP Crossrail 2 Asset Portal interface. The top navigation bar includes the ARUP logo, the page title 'Crossrail 2 Asset Portal', and links for 'Assets', 'Map', 'Admin', and 'Log out'. Below the navigation bar, there are tabs for 'Buildings', 'Utilities', and 'Other', with 'Buildings' currently selected. The main content area features a table with the following columns: Id, Name, Listed grade, Storeys, Basement depth (m), Alignment clearance (m), Clash risk, Foundation type, and Postcode. The table contains eight rows of data, each representing a building asset. The first row is highlighted, and a vertical scrollbar is visible on the right side of the table.

	Id	Name	Listed grade	Storeys	Basement depth (m)	Alignment clearance (m)	Clash risk	Foundation type	Postcode
<input type="radio"/>	CRL2-B-00001		no	4	4	30.2	No risk	Piled	
<input type="radio"/>	CRL2-B-00002		no	4	4	23.4	No risk	Ground bearing	
<input type="radio"/>	CRL2-B-00003		no	5	4		No risk	Probably ground bearing	
<input type="radio"/>	CRL2-B-00004		no	5	4	13.4	No risk	Probably ground bearing	
<input type="radio"/>	CRL2-B-00005		no	6	4		No risk	Ground bearing	
<input type="radio"/>	CRL2-B-00006		no	4	4		No risk	Probably ground bearing	
<input type="radio"/>	CRL2-B-00007		no	2	4		No risk	Probably ground bearing	
<input type="radio"/>	CRL2-B-00008		no	4	4	19.7	No risk	Probably ground bearing	

Tabular Data & 2D Map

ARUP Crossrail 2 Asset Portal

AssetsMap

AdminLog out

General

Location

Description

Asset files

History

Local geology

Notional design pile calculation

Asset Id: CRL2-B-03684

Alignment Version: MK 19.1

Exact building age2004

Min building age2004

Max building age2004

Listed gradeno

Height (m)16.10

Ground level (mATD)139

Storeys (no)5

Basement levels (no)1 ⓘ

Basement depth below ground (m)4

Superstructure formUnknown

Superstructure form comments

Foundation information sourceNotional design

Notional Pile TypeLondon Clay Piles

ArcServer

Buildings

Clash risk

Clash

High risk

Risk

Low risk

Alignment

Contains OS data © Crown Copyright and database right 2018

Powered by Esri

- Clash risk and clearance values
- Address of buildings 1-to-many
- Building structure and foundation info
- Geology information

3D Map

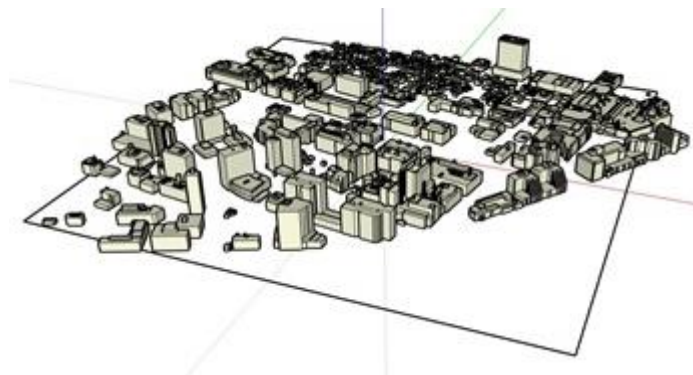


3D Map - ArcGIS Pro

ArcGIS Pro
(Extrusions)



ESRI Multipatch format



ESRI Portal

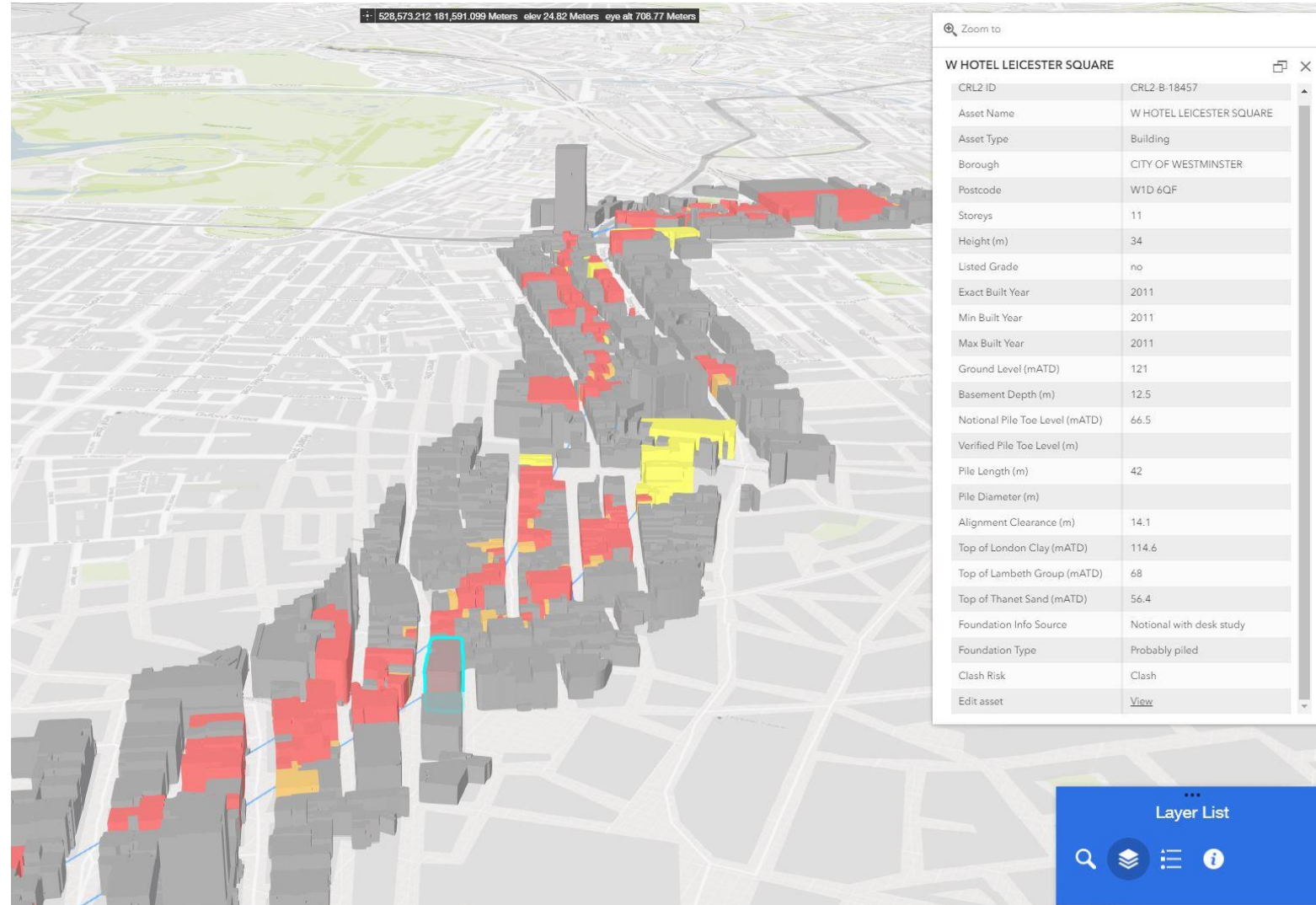


ESRI Web App Builder

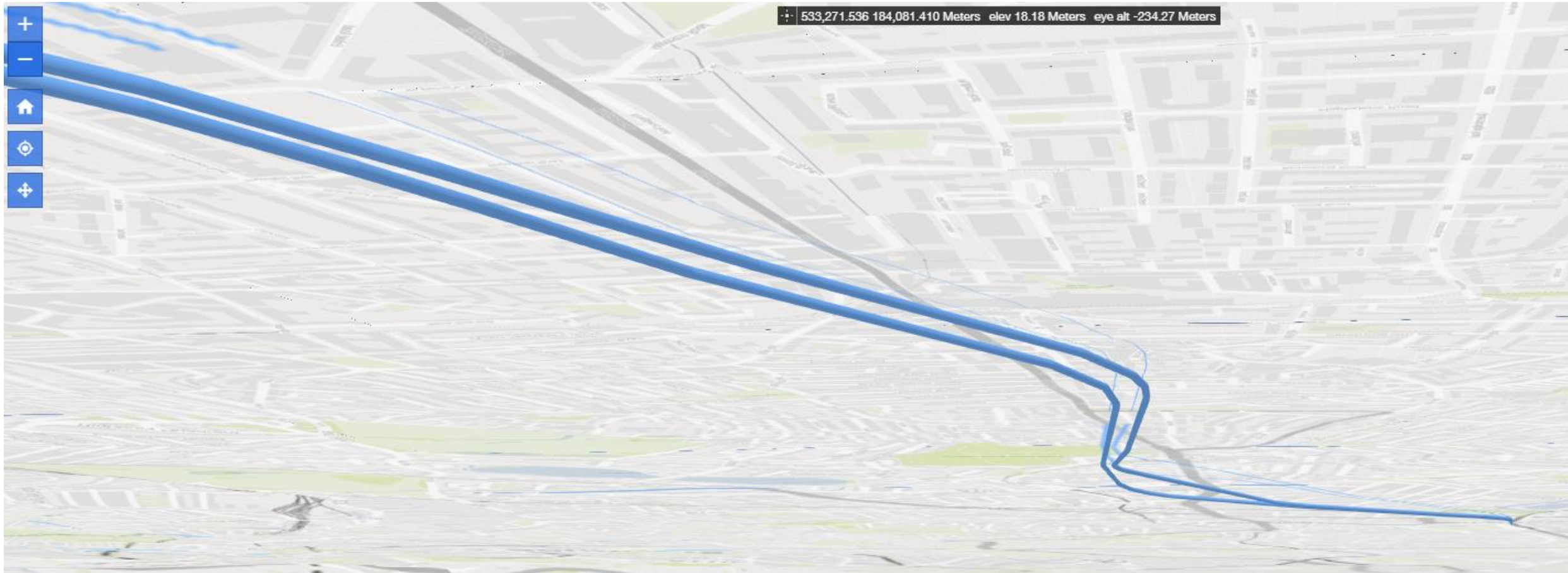


3D Map

- Interact with assets in 3D viewer
- External user access
- Above and below ground exploration
- Helps engineers plan new routes away from known clashes

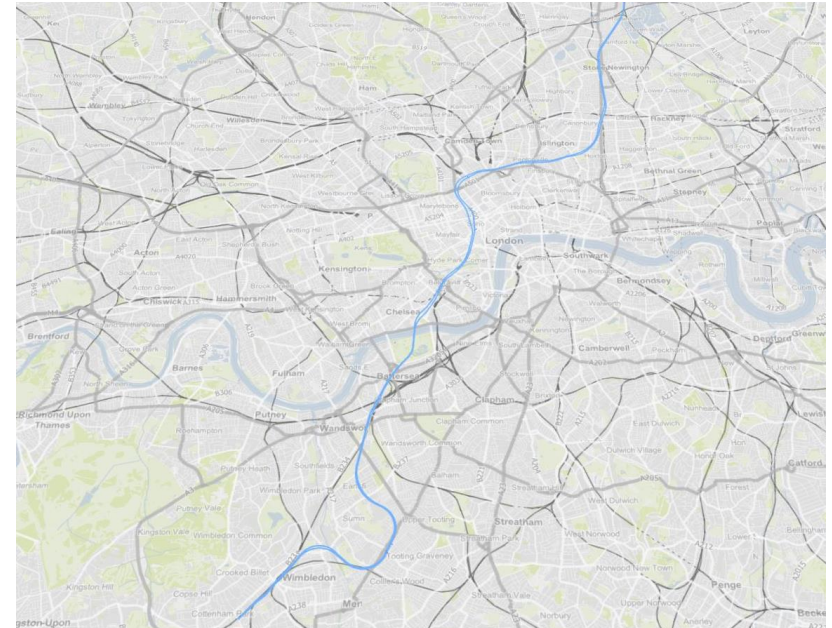


Tunnel Alignment

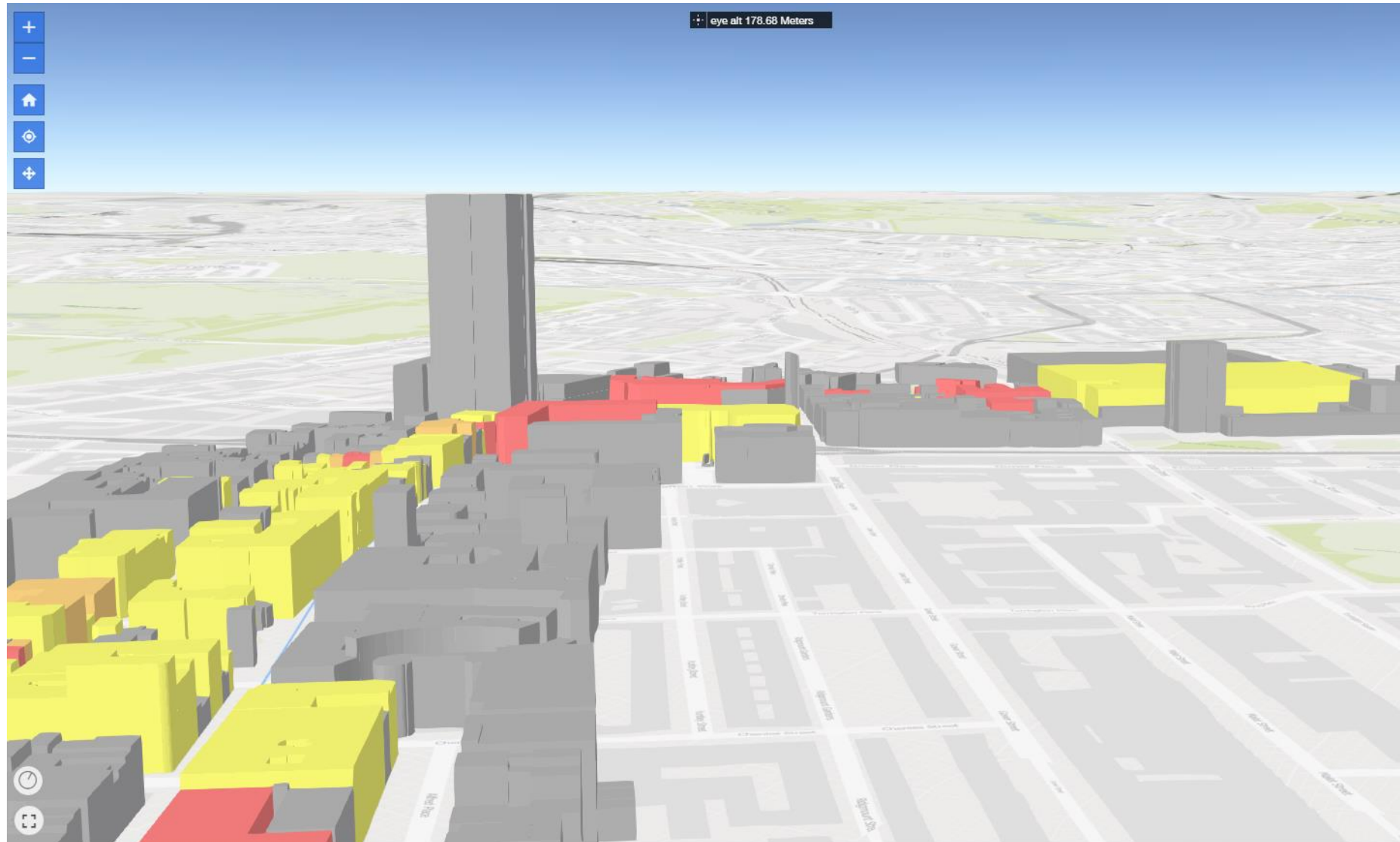


Tunnel Alignment

- Alignment is designed in CAD by Arup alignment team and converted to GIS
- Alignment is stored in the AP as a 3D Linestring
- All past alignment strings are stored in the database for comparison
- Alignment string is used for clash detection



Buildings



Buildings

- Buildings are stored as 2D footprints (using Ordnance Survey data)
- Buildings are extruded upwards based on height (Lidar)
- Building piles are extruded down based on pile depth (calculated)
- Ground level is used as a starting point for extrusion (DEM)
- Building footprints linked to multiple addresses and key information (age, type etc)



Buildings & Tunnel | Clash Detection

- Finds closest point in 3D space
- Applies buffer to buildings
- Uses PostGIS for clash detection

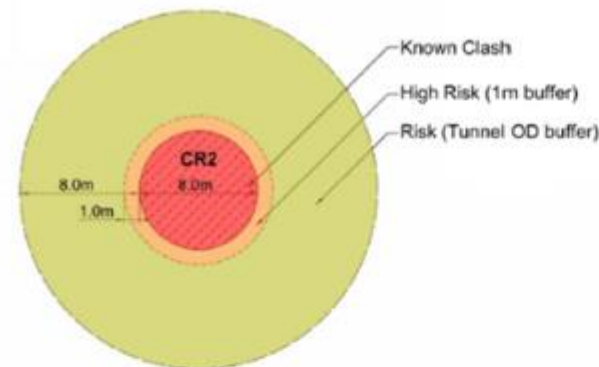
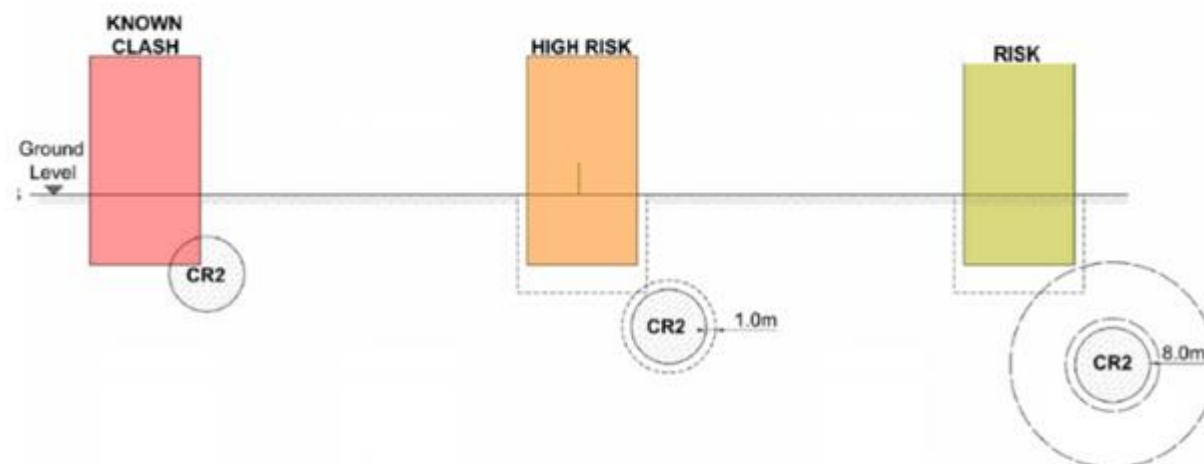


Figure 4: Example – risk classification of buildings

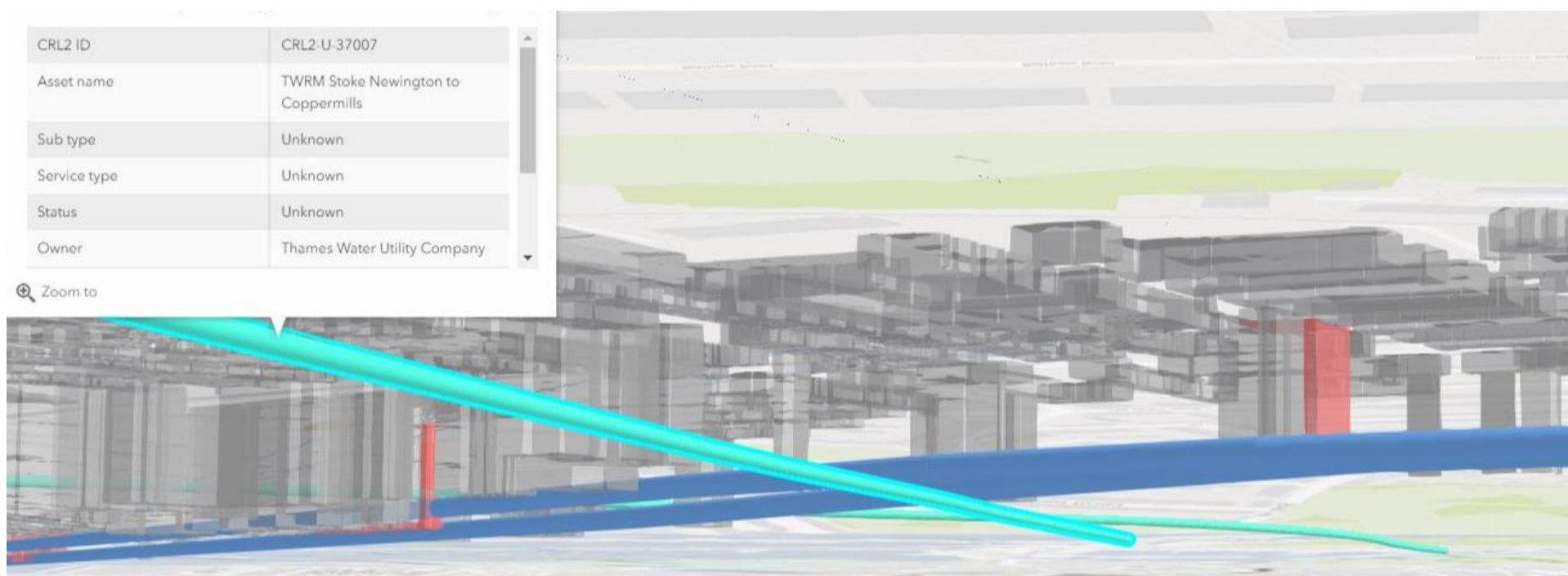


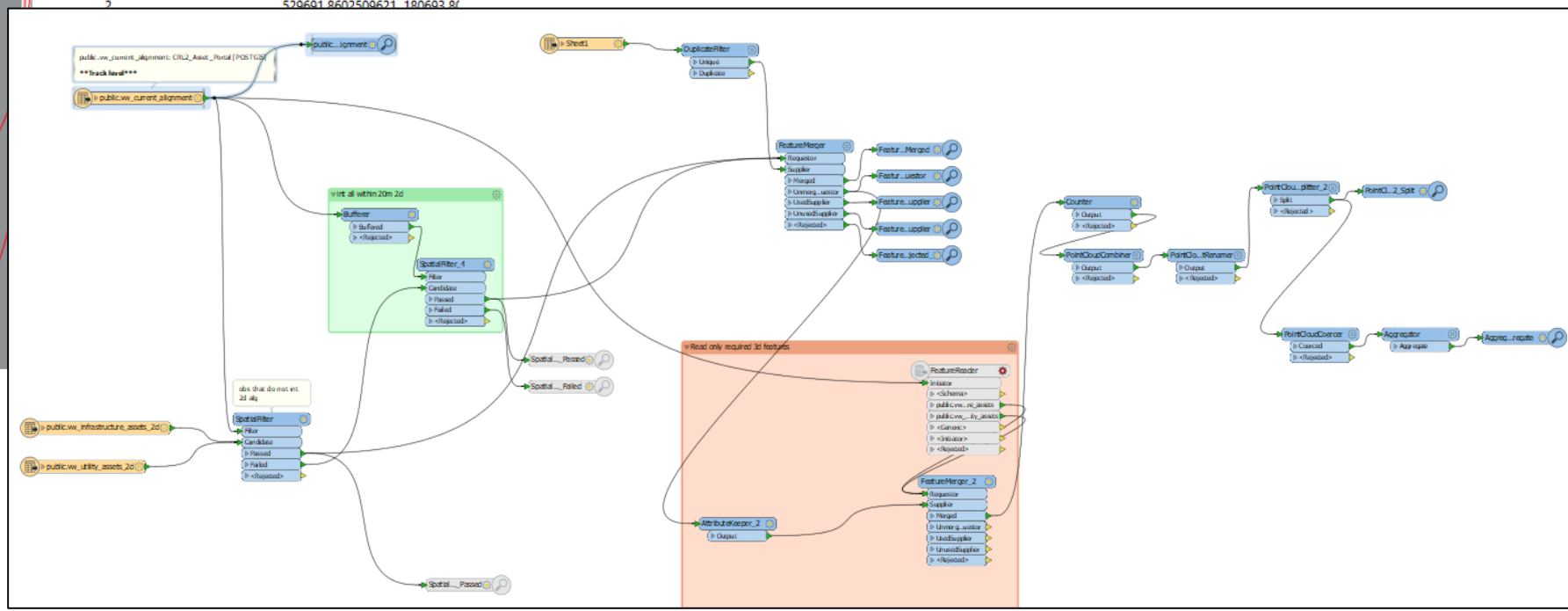
Utilities & Infrastructure



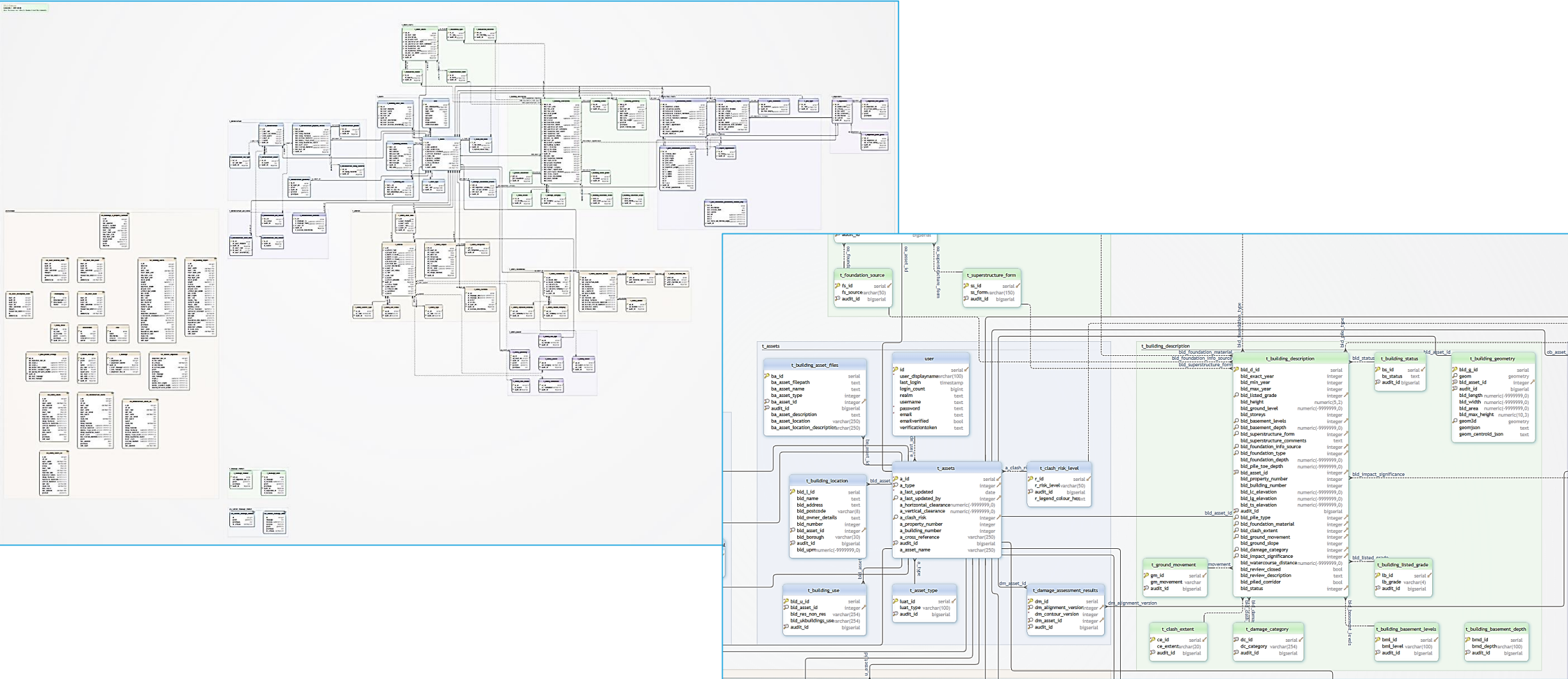
Utilities & Infrastructure

- Information includes large sewer, water, telecoms, electricity, gas & other transit tunnels
- Utilities and Infrastructure are created in CAD or delivered by Asset Owners
- Converted to multipatch





Database – Schema / Tables



Database – Schema / Tables

Asset / Clash Risk

t_assets	
a_id	serial
a_type	integer
a_last_updated	date
a_last_updated_by	integer
a_horizontal_clearance	numeric(-9999999,0)
a_vertical_clearance	numeric(-9999999,0)
a_clash_risk	integer
a_property_number	integer
a_building_number	integer
a_cross_reference	varchar(250)
audit_id	bigserial
a_asset_name	varchar(250)

Building Attributes

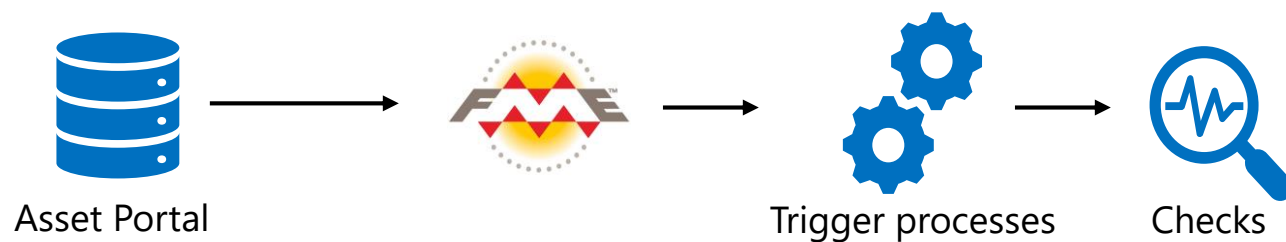
t_building_description	
bld_d_id	serial
bld_exact_year	integer
bld_min_year	integer
bld_max_year	integer
bld_listed_grade	integer
bld_height	numeric(5,2)
bld_ground_level	numeric(-9999999,0)
bld_storeys	integer
bld_basement_levels	integer
bld_basement_depth	numeric(-9999999,0)
bld_superstructure_form	integer
bld_superstructure_comments	text
bld_foundation_info_source	integer
bld_foundation_type	integer
bld_foundation_depth	numeric(-9999999,0)
bld_pile_toe_depth	numeric(-9999999,0)
bld_asset_id	integer
bld_property_number	integer
bld_building_number	integer
bld_lc_elevation	numeric(-9999999,0)
bld_lg_elevation	numeric(-9999999,0)
bld_ts_elevation	numeric(-9999999,0)
audit_id	bigserial
bld_pile_type	integer
bld_foundation_material	integer
bld_clash_extent	integer
bld_ground_movement	integer
bld_ground_slope	integer
bld_damage_category	integer
bld_impact_significance	integer
bld_watercourse_distance	numeric(-9999999,0)
bld_review_closed	bool
bld_review_description	text
bld_piled_corridor	bool
bld_status	integer

Geometry

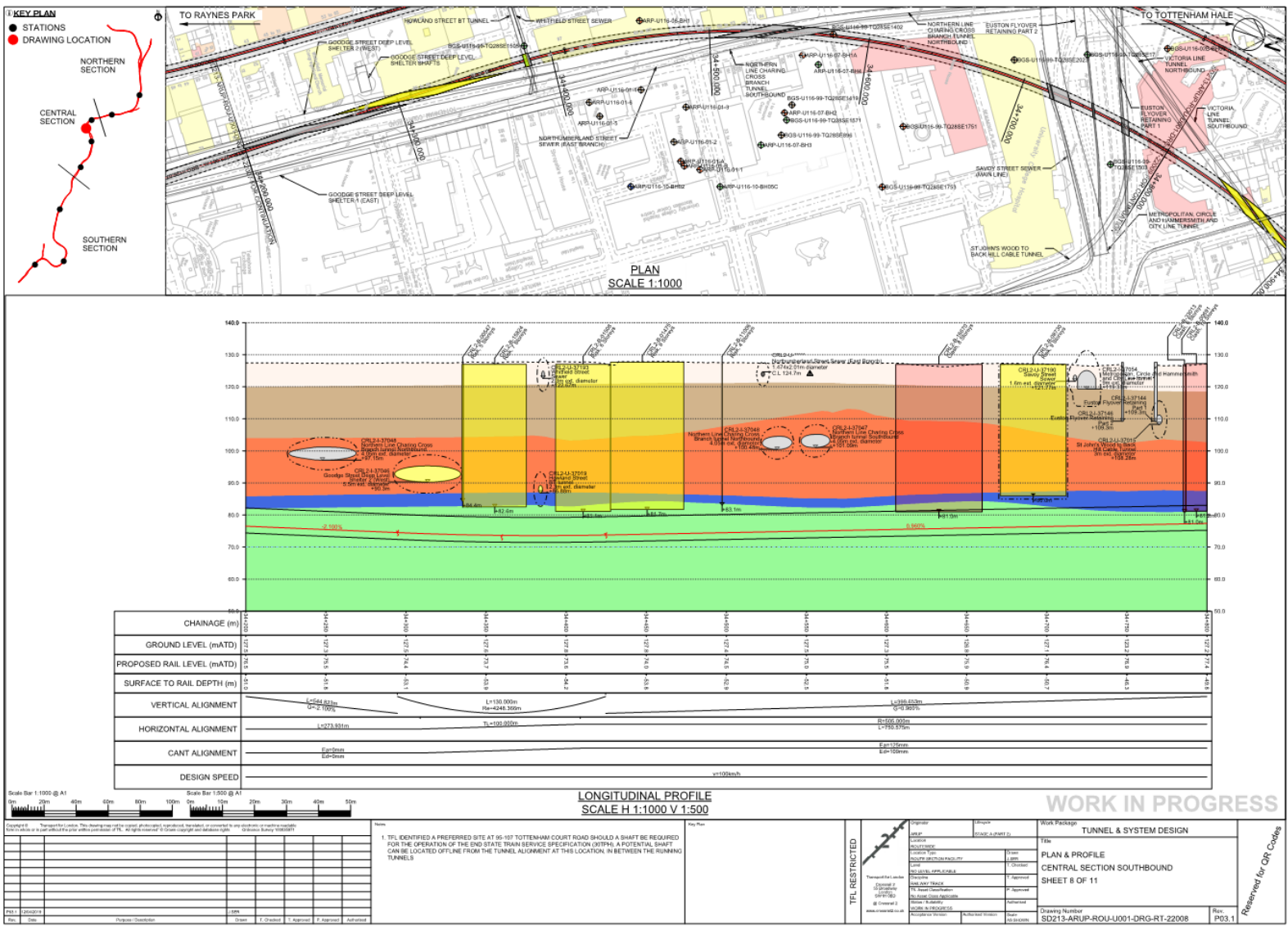
t_building_geometry	
bld_g_id	serial
geom	geometry
bld_asset_id	integer
audit_id	bigserial
bld_length	numeric(-9999999,0)
bld_width	numeric(-9999999,0)
bld_area	numeric(-9999999,0)
bld_max_height	numeric(10,3)
geom3d	geometry
geomjson	text
geom_centroid_json	text

Automation

- A big part of our engineering work is delivering a new alignment and understanding obstructions, geology and all associated risks
- A fundamental document is a set of *plan and profiles*



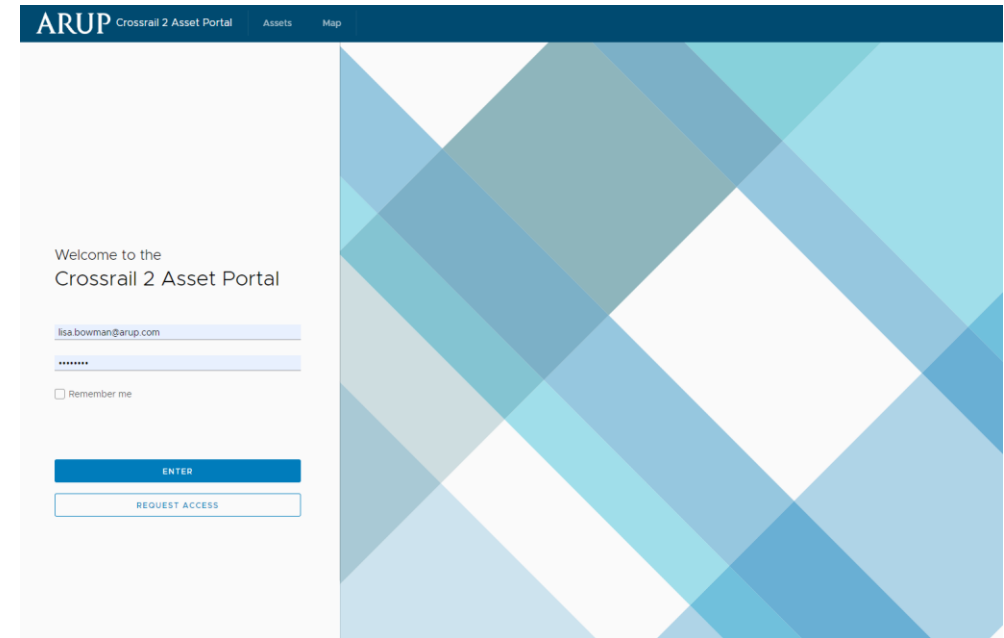
Automation - Output



- Obstructions model
- Clash Risk analysis
- Tunnel alignment
- Annotations
- Slice / section through structural models

Summary

- ArcGIS aids engineers understanding of assets in a 2D & 3D environment
- GIS and CAD Tools are complimentary technologies
- Single Source of truth for project – efficient and accurate
- Data editing by wider team in browser – saving time
- Data driven processes creating Production Drawings
- Potential for further expansion of features



QUESTIONS

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