Encountered Ground conditions:

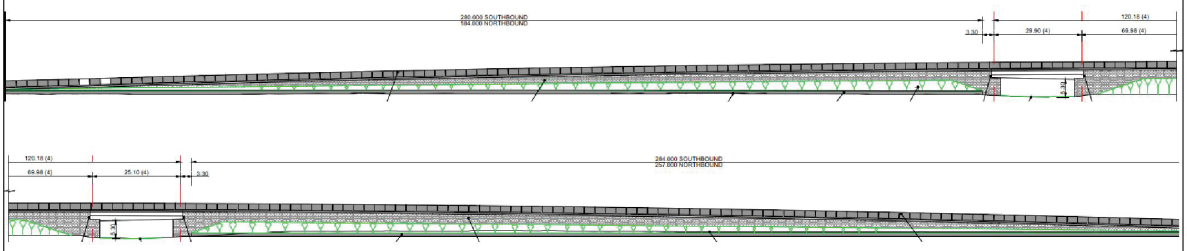
COUNTESS ROUNDABOUT-EAST AND WEST STRUCTURES

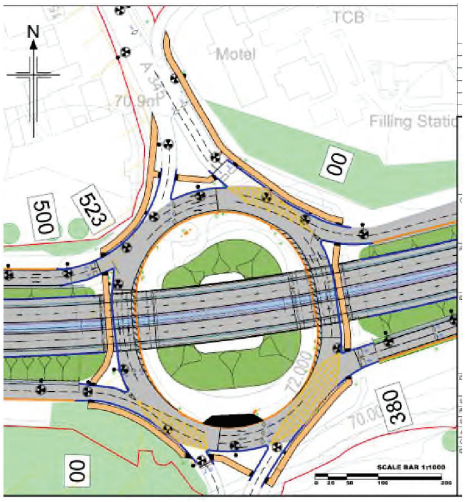
STRUCTURE		BOREHOLES			GROUND PROFILE (measured depth from surface)				
STRUCTURE	Chainage	Closest borehole	Ground elevation (m)	Borehole depth (m)	Made Ground MG	Alluvium ALV Cohesive (River Avon valley area)	Structureless chalk **Very soft**	Competent Chalk	Design GW level (m)
WEST	11+700	21762-R166	+71.25	20m	0.0-2.55 m	2.55-5.45 m	5.45-15.15 m CS9-10 (Dm) CS7-8 (Dc)	15.15-20m (end of borehole) CR2 (M, A3)	+68.7m elevation 2.55m depth
EAST	11+840	21762-R167	+71.07	20m	0.0-1.85 m	1.85-5.40 m	5.40-14.25 m CS9-10 (Dm)	14.25-20.05 m (end of borehole) CR2 (H, C3) CR3 (H, A2)	+69.22m elevation 1.85m depth

Note 1: Groundwater (GW) level for design is 20% Climate change GW level, as measured from the ground profile
Note 2: Chalk classification according to EGU codes in Table 2-1 of ref [2], and CIRIA field assessed (in brackets).

Proposed foundation:

These twin structures are bridge flyovers for the A303 over A345
The complete symmetrical structure consists of two 280m long approaching embankments, the two bridges (flyovers) over the A345 and one roundabout. The earthworks in the approaching embankments and the roundabout are being designed as MSE walls of maximum height 7.8m at the location of the bridges.





Bridge abutments are being designed to support the bridge superstructure on a spread foundation (bankseat) constructed directly on top of the reinforced soil zone. The selected solution will depend on the bearing capacity of the foundation soil and the probable need for ground improvement.

The analysis of the geotechnical information indicates the following:

1) Under some 5m of relatively compact soil (Man made ground and Alluvial soil) lies a very soft thick (some 10m) layer of structureless chalk of clayey nature (Dm)
2) This layer is too soft and too close to the surface so that the MSE wall constructed directly on top of the current ground would induce settlements in the order of 200-300 mm, unless these are mitigated. The magnitude of this settlement is not compatible with the bridge abutments should these have a piled foundation as this would act as “hard points”.
3) The MSE wall plus the bridge load cannot be directly founded on the natural ground, not just because of the excessive settlement, but because the combined loads exceed the bearing capacity of the soil

These initial findings suggest that the following aspects have to be included in the design:

1) The foundation of MSE walls and the bridges should be a whole combined design
2) A suitable solution would be to design a ground improvement solution along the whole length of the asset to improve the strength and stiffness of the soft soil and reduce the settlements to acceptable levels, both in maximum value and ensuring the compatibility of settlement between the bridge areas and the rest of the approaching and roundabout MSE earthworks

3) The ground improvement solution needs to be applied with an adequate scaled construction sequence, applying the earth loads allowing for consolidation hold periods

The initially proposed solution consists of:

1) 50 m long ground improvement zone from the bridge location into the approaching embankment. The ground treatment consists of ground inclusions (e.g. CMC Controlled Modulus Columns) of depths that may reach 16m beneath the bridge, and reducing in length to say 7m 50m away from the bridge. These CMCs act as settlement reducing piles, and in any case, the length, layout and dimensions of piles/CMCs at the abutment will be designed to provide acceptable levels of settlement at the structure location.
2) The remainder of the approaching embakment/MSE would be founded on a Geogrid/Geocell Mattress and the construction staged with hold periods to allow for enough consolidation

The design of the solutions requires additional ground investigation to allow for:

- Confirmation of ground profile and ground conditions with additional CPTs and boreholes
- Estimates of permeabilities- permeability testing within the structureless chalk to validate the assumed hold periods with the designed construction sequence

The validation of the design during construction requires:

- Piezometers, settlement plates & structure pins to monitor settlement

Ground model assessments

Relevant exploratory boreholes:

COUNTNESS EMBANKMNET STRUCTURES:

Chainage	Relevant boreholes	Ground elevation (m)	Borehole depth (m)
11+710.48 to 11+830.66	21762-R166	+71.25	20m
	21762-R167	+71.07	20m

Ground model for foundation design:

- Reference boreholes for ground model are two 20m long boreholes R166 and R167, which are very similar
- There are other ground investigation points in the area, but they are mostly trial pits and shallow,

Encountered Ground Conditions

Existing Ground Condition	Depth of base below egl (m)	Thickness (m)
Made Ground	1.8-2.6	1.8-2.6
Alluvium	4.2-6.0	2.5-3.6
Structureless Chalk (Dm Cohesive)	14.3-15.4	8.9-10.0
Structured Chalk	To depth	-

For the purpose of design of MSE walls a single ground model was considered for full length of embankments:

Existing Ground Condition	Depth of base below egl (m)	Thickness (m)
Made Ground	1.8	1.8
Alluvium	5.4	3.6
Structureless Chalk (Dm Cohesive)	15.4	10.0
Structured Chalk	To depth	-

The following set of parameters were considered in design.

Existing Ground Condition	Unit Weight (kn/m3)	Friction Angle (deg)	Eu (MPa)	mv (m2/MN)
Made Ground	19.5	28	40	0.042
Alluvium	18.5	26	40	0.09
Structureless Chalk (Dm Cohesive)	19.5	30	14-80	0.124-0.021

All soils were considered as cohesionless for the purpose of this design.

MSE fill was considered as a Class 6I/J material of following parameters:

Existing Ground Condition	Unit Weight (kN/m3)	Friction Angle (deg)
MSE fill	19.5	30