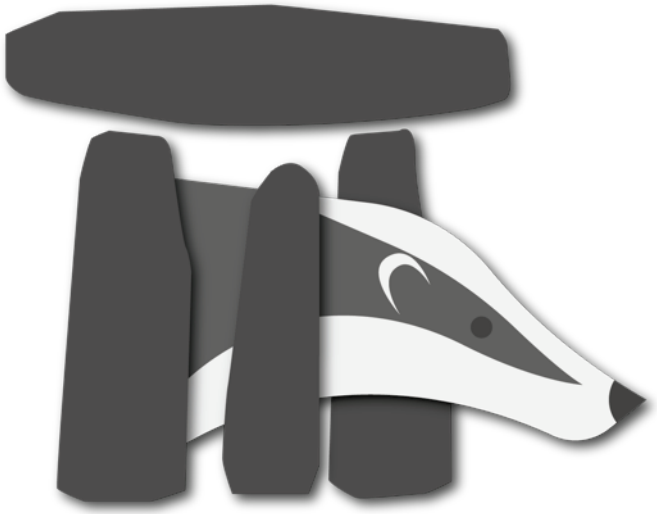


highways england

QS-10A
Drainage Strategy for the whole scheme

1. 1. Your drainage strategy for the Scheme shall provide the following information as a minimum:
1.1. a summary of the constraints which have dictated the drainage strategy, including catchments, hydrology, geology and environmental constraints;
1.2. a description of the drainage strategy which covers the whole Scheme, including:
1.2.1 the drainage strategy for the section of Scheme west of the tunnel;
1.2.2 the drainage strategy for the tunnel;
1.2.3 the drainage strategy for the section of Scheme east of the tunnel;
1.3. an explanation of how the different parts of the drainage design will be integrated;
1.4. how the drainage strategy will maintain or improve the quality of water entering the ground, including a risk assessment of the proposals and an assessment of whether mitigation measures in excess of the minimum stated in the DMRB may be required;
1.5. how sustainable drainage features will be used to treat and attenuate all runoff from the highway prior to discharge or infiltration;
1.6. typical details of the drainage treatment areas, including planting locations and types;
1.7. measures for the management of surface water and foul drainage;
1.8. pollution control measures, including containment of contaminant spillages;
1.9. the management of flows from catchments external to the highway;
1.10. how sub-surface groundwater flows will be managed;
1.11. an explanation of how the drainage strategy does not result in an increased risk of flooding, including how the drainage design will mitigate the risks of flooding from groundwater during extreme groundwater events, with specific reference to the eastern and western cuts and at Parsonage Down;
1.12. an explanation of how the drainage strategy will provide a reduction in the existing discharge rates;
1.13. the integration of existing drainage systems into the Scheme-wide drainage design;
1.14. the strategy for drainage around known or suspected contaminated land

1. Drainage Strategy for the whole scheme

1.1 A summary of the constraints which have dictated the drainage strategy, including catchments, hydrology, geology and environmental constraints;

Key constraints dictating the drainage strategy are outlined below. Engineering constraints influencing the drainage network design are outlined in section **1.2**:

Water Environment:

The following surface water body features/catchments have been identified within the study Area (1km beyond the redline boundary):

- River Till
- River Avon, Hampshire Avon (Upper) upstream of the Nine Mile River confluence WFD waterbody catchment (WFD waterbody catchment).
- River Avon, Hampshire Avon (Upper) downstream of the Nine Mile River confluence WFD waterbody catchment (WFD waterbody catchment).
- There are also a number of small channels, ponds and ditches located within the River Avon WFD catchment
    - Including Amesbury Abbey Pond and Blick Mead drain located in the Amesbury Abbey estate, as well as a seasonal pond within the Blick Mead archaeological site that can occur in winter.
- There are also small number of non-classified WFD channels, ditches and ponds within the River Till catchment (not named).

A number of surface water features entirely fed by groundwater are present within the Study Area. These include a seasonal spring at Springbottom Farm (present at peak groundwater levels only), a seasonal groundwater-fed lake near the village of Lake, just to the west of the River Avon; a spring system in West Amesbury and Gallows Hill; and Amesbury Abbey Springs (previously referred to as Blick Mead spring), in the grounds of Amesbury Abbey and adjacent to the Blick Mead archaeological site.

The Environmental constraints map identifies the following further Designated Areas:

- The River Avon (SAC), which includes the River Till (Site of Special Scientific Interest – SSSI)
- Parsonage Down (SSSI),
- National Nature Reserve - NNR and County Wildlife Site - CWS).
- Normanton Down RSPB Reserve
- Salisbury Plain (Special Protection Area - SPA, SAC and SSSI)
- A Great Crested Newt buffer zone is also included within the Study Area.

Geology and Hydrogeology:

The majority of the scheme and surrounding area is underlain by White Chalk Group including the Newhaven and Seaford Chalk Formations, with deposits of Phosphatic Chalk. Superficial deposits comprise Alluvium, River Terrace Deposits and Head Deposits consisting of mainly reworked/remobilised Chalk material. The superficial deposits are located within the vicinity of river valleys (Till and Avon) and within dry river valleys (Stonehenge Bottom). Groundwater levels within the Chalk are controlled by recharge from rainfall and by discharges to the Avon/Till and abstractions.

- Groundwater levels within the vicinity of the scheme have been observed to vary up to 25m between wet (winter) and dry (summer) periods with smaller fluctuations observed within river valleys and dry valleys compared to interfluvial areas (between valleys).
- Groundwater levels are understood to have risen to ground level within Stonehenge Bottom dry valley and at Parsonage Down.
- The likely effects of climate change on groundwater are considered to be more extreme highs and lows; this is taken into account within the drainage design for the Scheme.

Archaeology:
The majority of archaeological mitigation fieldwork will be undertaken during the Preliminary Works (PW) stage of the construction programme as advanced archaeological works. It is therefore assumed that areas of archaeological remains identified in the Detailed Archaeological Mitigation Strategy (DAMS) as requiring mitigation through archaeological recording will have been dealt with at the PW stage (and Main Works stage where archaeological monitoring is required) and will therefore not be a constraint to the Drainage Strategy.

The key constraints relating to the drainage strategy and archaeological remains comprise those areas identified in the DAMS as Preservation of Archaeological Remains (PAR), No Construction Impact Areas (X Areas) and Trial Trench Evaluation Areas.

The Drainage Strategy will not disturb the following PAR and X Areas in accordance with the requirements of the DAMS:

- PAR Sites: 17.4, 21, 29, 60 and 61
- X Areas: X11, 12, 14, 16 and 17

It is acknowledged that dependent on the results of the Trial Trench Evaluations at DAMS Sites 19 and 40-43, that these areas may be identified as requiring preservation, and will therefore be assumed to be key constraints until identified otherwise.

Landscape:
There are large areas within the scheme where the landscape is characterised by open, rolling fields and/or grassland. In these areas the design objective is to sustain that characteristic by limiting the presence of linear elements that emphasise the road geometry. Refer to sections **1.3** and **1.9** for mitigation.

1.2 A description of the drainage strategy which covers the whole Scheme

Refer to sections **1.2.1** to **1.2.3** below:

1.2.1 The drainage strategy for the section of Scheme west of the tunnel

The proposed route to the west of the tunnel has been divided into 11 different catchments (seven mainline and four connections to side roads) with five treatment areas, based on highway alignment levels:

Collection and conveyance:

- Runoff from the carriageway will be collected in road edge concrete surface water channels or gullies which outfall to carrier pipe systems. Over structures, combined kerb drainage on the bridge-deck will be used to ensure drainage and pipework is not required to go through the deck.
- Subsurface drainage will be provided by narrow filter drains throughout all sections of the scheme where necessary to drain the pavement. A separate filter drain shall be used where engineered cuttings or embankments are 3m high or greater, or groundwater requires lowering. This filter drain prevents water from flowing onto the carriageway from the cutting and the below carrier drain is used for conveyance.
- Cut off drains and ditches shall be located at the top of cuttings or at the toe of embankments to capture surface water flows from natural catchments adjacent to the highway. These will outfall to the River Till with a free discharge, or a soakaway where levels prevent discharge to the river. These cut off drains will primarily be filter drains to reduce space impact, and to minimise impact on the landscaping. Ditches are proposed where space allows, and where they can be aligned with the landscape proposals, for example running along a linear feature such as a proposed hedge line (refer to section **1.3**).
- New sections of the A360, B3083 and Rollestone Cross will be drained over the edge soakaways within the verge.

Attenuation and Pollution control:

- Five Drainage Treatment Areas (DTAs) are proposed in the form of infiltration basins. The infiltration basins will be grassed and designed to naturalise with the adjacent landscape and topography; the basins will be at 1:3 side slopes, and generally round / oval to form a simple "inverted barrow impression" with the surrounding earthworks connecting to existing ground at 1:5 gradient. A section of these are shown in section **1.6**. These DTAs will be accessed via maintenance tracks from side roads, and include an access track around the perimeter to allow inspection and maintenance of all areas of the DTAs.
- The DTAs will include a small impermeable forebay to capture silt, the slopes of the DTAs will be planted (see section **1.6**) and the base will have planting overlying activated filter material to further capture suspended solids and heavy metals prior to discharge to the ground. The DTAs have been sized using known infiltration rates (from tests) and applied a factor of safety of 10 (CIRIA C753 Table 25.2) to minimise the risk of flooding. The total drain time associated with a critical storm is sufficiently short (within 48hrs) so that there is no permanent water will stand.
- All road drainage networks will have pollution shut of valves in the last chamber in the carriageway. These will be remotely operated, so can be active without an operative attending site. In the event of an acute spillage or incident, this will prevent pollution reaching the DTAs and containing it within the carrier pipe network.

West of Tunnel Approach:

- The road drainage system on the west of tunnel approach is distinct from the rest of the western road drainage, due to the presence of the retained cut, and the fluctuation of the groundwater.
- Along this section, the drainage has been split into two networks; Network 8A (Longbarrow to Green Bridge 4) and Network 8B (Green Bridge 4 to Tunnel Portal). This has been split based on maximum extreme groundwater levels, so that Network 8A is not impacted by the variable groundwater, refer to section **1.10** for Groundwater levels determination.
- Network 8A has a carrier pipe running under the concrete surface water channels, in common with the drainage for the rest of the scheme. This is designed to no flooding to 1:100 years (+30% CC) to protect the tunnel from flooding. These carrier pipe networks discharge to infiltration tanks in the central reserve. Due to the volumes required, the network has been split in two, and outfall into two infiltration tanks.
- The infiltration tanks will be concrete box culvert structures, with holes in to allow infiltration. A granular layer will be laid between the discharge holes and the chalk surface to reduce the risk of chalk dissolution. Concrete structural tanks were chosen in preference to geocellular, as due to the size and depth, they will be subject to traffic and earth pressure loading. These tanks will be minimum 2.5m high, to allow internal access for maintenance and inspection. This will be accessed by chambers located in the central reserve.
- To minimise access and maintenance requirements of the infiltration tanks, proprietary pollution mitigation measures will be located in the carrier pipe network in the verge, rather than in the tank itself. Vortex separators and filtration units will be installed online of the pipe network before crossing to the central reserve. These can be accessed from surface level in the verge when maintenance is required.
- As with the other networks, a remotely operated shut off valve will be installed in the downstream chambers in the verge, to allow the network to be isolated upstream of the infiltration tanks.

- Network 8B will operate in a similar way to Network 8A, however this is coincident with the “bathtub” base and side slabs, which protect the road from flooding at extreme groundwater events.
- As outlined in design schematic **Figure 1.2.1.1**, the road drainage discharges into an infiltration tank in the central reserve outside the tunnel extents, the arrangement of which is the same as described for Network 8A. There are separate attenuation and infiltration tanks, so during periods of extreme high groundwater levels, the road drainage can be isolated from the groundwater and diverted into the attenuation tank and pumped away. The attenuation tank will be an integral part of the tunnel structure and will be designed in accordance with CD352, including all ventilation and fire suppression/detection requirements.
- This will be done by means of a shut-off valve in the tank isolation chamber in the central reserve. This will be operated by a float switch in a borehole in the verge, when the groundwater reaches 1.0m below the infiltration tank invert, the valve is shut and the infiltration tanks sealed off, which can backfill with groundwater. The valve will be alarmed, so should it fail, it can be manually closed before the groundwater rises to tank level.
- The infiltration tank will fill with groundwater to its natural level. There will be minimal re-entrainment of pollutants, as the run-off has passed through the proprietary pollution control measures in the verge prior to discharge to the tanks.
- When the shut-off valve is closed, the attenuation tank will fill with road run-off and be pumped, via a pump in the tunnel services building, to the Network 8A tank, near Green Bridge 4, which is high enough to avoid influence from the extreme groundwater levels . Once the groundwater receded to below 1.0m below the infiltration tank, the shut off valve is opened, and the attenuation tank will drain to the infiltration tank and not to the pumped system.

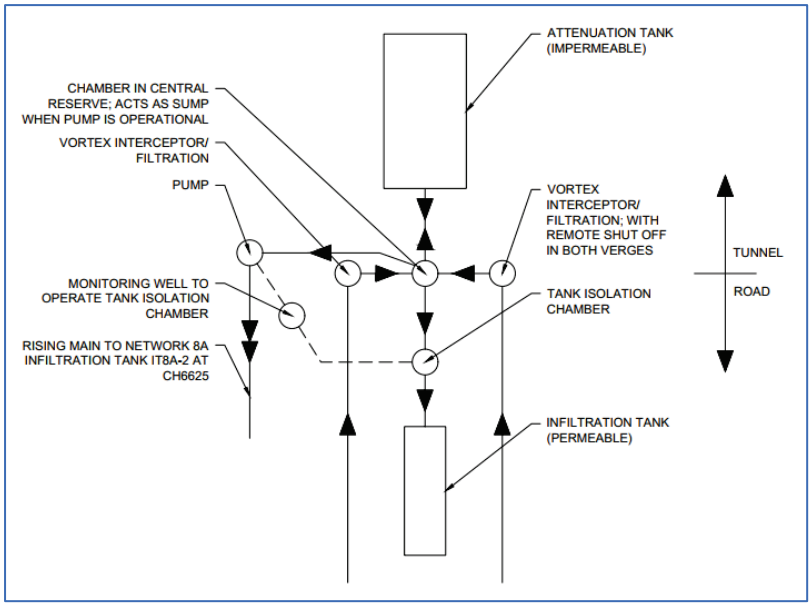


Figure 1.2.1.1: Network 8B Drainage Schematic

Green Bridge & Structures Drainage;

- Along the River Till, the road drainage will drain through bridge deck drainage units, discharging the road drainage pipe network downstream of the structures.
- Highways over the green bridges, such as Green Bridge Three will be drained using bridge deck units connecting to the road drainage network. The vegetated sections of the green bridges will be drained via a granular drainage blanket surrounding the underlying structure, connecting to the cutting earthworks drainage.

1.2.2 The drainage strategy for the tunnel

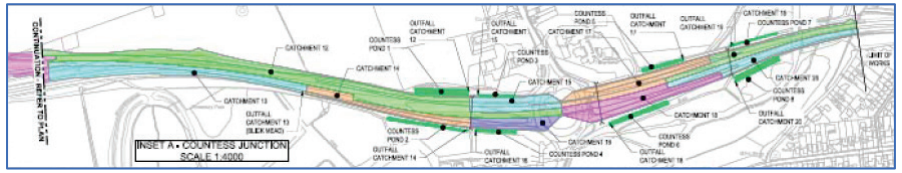
- Highway drainage System will not discharge into Tunnel Drainage System (self-contained system).

- A drain will be provided at the nearside carriageway in both tunnel bores to collect spillages, run-off from vehicles and any groundwater seepage
- A combined kerb drainage unit is foreseen for this carriageway drain system
- Flame traps (siphon manholes) will be installed at not greater than 25-m intervals along the kerb drains, to prevent the spread of flame within the system.
- At each tunnel low point, a pumping sump will be provided. The sump will be located beneath the road deck and accessed from maintenance from central under-deck maintenance gallery.
- The tunnel sumps will be sized to contain simultaneously:
    - Tunnel wall washing after a fire (1 bore only).
    - Tunnel wall washing (2 bores).
    - FFFS discharge (2 hours) (NB, this increase in supply duration beyond the ITPD minimum requirement has been allowed for within the design of the drainage system).
    - 1 hour of fire hydrant discharge at a maximum of 1500 litres/minute (CD 352).
    - Allowance for lining infiltration.
    - Allowance for water carried in by vehicles.

  **note that these may require special disposal from the impounding sump*
- All in-tunnels sumps, including the impounding sump and attenuation tank, to have gas/fire detection and automatic fire suppression, as well as capacity for remote maintenance and monitoring from the TCMS over SCADA/similar.
- No separate contaminated inflow sump to be provided, diversion and segregation to be done at surface at main impounding sump. There will be no impounding sump at the bored tunnel low point.
- All tunnel drainage will be pumped to the alignment high point east of the tunnel where a gravity system will then convey the flow to either the impounding sump or the proposed highway network depending on water quality.
- A remotely operated control valve will be placed in the high point chamber to allow an operator to open/close the valve to divert the flows.
- The impounding sump will be located below the eastern TSB, within the cut-and-cover portal section. The maintenance hardstanding area in front of the TSB will be adjacent to the tanker extraction point, so transferring water from the sump to a tanker will not require traffic management or bore/lane closure.
- A septic tank of at least 10m3 will be provided in the basement of each TSB to deal with welfare discharges. This will contain gas/fire detection, fire suppression and level monitoring via the TCMS (refer to section **1.7**).

1.2.3 The drainage strategy for the section of Scheme east of the tunnel

Eastern section has been divided into 10 different catchments.



Collection and conveyance:

- On the mainline, runoff from the carriageway will be collected in road edge concrete channels or gullies which outfall to carrier pipe systems. Combined kerb-drainage units to be used along the structures and fly-over.

- Kerb and gully system is proposed along the slip roads. Combined kerb drainage in locations other than the new A303 is acceptable, where required gullies spaces is less than 5m.
- Existing drainage system around the circulatory carriageway at Countess Roundabout will be retained
- Subsurface drainage will be provided by narrow filter drains throughout all sections of the scheme where necessary to drain the pavement. A separate filter drain shall be used where engineered cuttings or embankments are 3m high or greater.
- Cut off drains and ditches shall be located at the top of cuttings or at the toe of embankments to capture surface water flows from natural catchments adjacent to the highway. These will outfall to the River Avon with a free discharge. These will primarily be filter drains to reduce space impact, and to minimise impact on the landscaping. Ditches are proposed where space allows, and where they can be aligned with the landscape proposals and with consideration of the DAMS Areas.

Attenuation and Pollution control:

Overall discharge rate to the River Avon should achieve a minimum 20% betterment of the existing discharge rates. Therefore, Eight DTAs in the form of linear ponds or swales, adjacent to the slip roads are proposed at Countess Roundabout. The ponds will be lined, planted with reeds and contain permanent water to provide treatment. The ponds will be designed to ensure no ingress from flood waters in the 1 in 100 year plus climate change event from the adjacent River Avon catchment.

- Attenuation ponds are sized for up to and including 100-year return events plus 30% climate change allowance.
- Remotely operated pollution shut of valves in the last chamber in the carriageway will be provided, refer to **1.2.1** for details.
- All ponds would outfall to the existing highway ditches which ultimately discharge the runoff to the River Avon.
- An infiltration system similar to that on the western portal will be used to drain the carriageway in Network 11. The maximum anticipated groundwater level in this location, (using 20% allowance for Climate Change) is 73.1m. The invert level of the proposed infiltration system will be minimum 1m above the ground water level and therefore pumped mitigation measures, like that at the western portal will not be required.
- For infiltration tank principles, maintenance access and pollution mitigation measures, refer to **1.2.1** (Network 8A).

Catchment adjacent to Blick Mead

- Potential adverse effects on the hydrology present in the catchment adjacent to Blick Mead shall be avoided.
- Blick Mead catchment will discharge to the existing highways ditch adjacent to the mainline, with a contributing area of similar size when compared to existing, thus maintaining the same flows in the proposed and current situations.
- Vortex separators and filtration units will be installed online on the pipe network before discharge to the ditch.
- Proposed cut off drain ditches would be within DAMS area, to avoid this, the solution is to steepen the embankment and provide filter drains outside the DAMS areas.

Maintenance:

- Linear ponds maintenance access from proposed hard-shoulder.
- Access from proposed laybys.
- Access from petrol station access road.
- Access from existing properties, subject to the access rights.

1.3 An explanation of how the different parts of the drainage design will be integrated

The drainage has been developed along with the highways and tunnels disciplines, to ensure integration with the functionality of the drainage for the road. It has also been developed with water environment (hydrology, hydrogeology, water quality), archaeology, ecology and landscape to ensure the drainage is integrated with all relevant disciplines on the project to ensure the constraints outlined in section **1.1** are accounted for.

Ecology and Landscape integration:

Green Bridges: The OEMP states: "It is assumed that all embankments, cuttings, green bridges and tunnel portals will be covered with a layer of chalk", with these mostly being recognised as opportunities for species-rich chalk grassland habitat creation. Therefore, drainage of these features will be designed to ensure that the substrate is free-draining to maximise the potential for successful habitat creation (outlined in section **1.2.1**). This will be most challenging on green bridges where the design of the structure and its drainage could influence habitat development most significantly.

Mammal tunnels: The Environmental Masterplan includes five locations for mammal tunnels (four of which are in the vicinity of Longbarrow Junction). The mammal tunnels are important structures providing ecological connectivity across the scheme for species such as badgers and the location and drainage design solution for these will ensure that they are not at risk of becoming waterlogged.

Drainage ponds and an integrated design: To accord with the statements in the Landscape QS – "Ensure a fully integrated design and delivery approach by working collaboratively within the wider project e.g. engineering, heritage, ecology, drainage, noise, highways, recreation and agriculture to develop and deliver integrated design solutions" and "Investigate new opportunities to re-connect locally fragmented habitats and green corridors, including small-scale habitat creation or enhancements to provide further-reaching benefits"; A design consideration of these ponds includes opportunities for habitat creation and enhancing habitat connectivity wherever possible, using appropriate geometry and planting.

For cut off drains, filter drains will be used in areas where the landscape is open, and the intention of the design is to minimise the presence of the road corridor. This is of particular importance through the World Heritage Site and west of Green Bridge One. Ditches are only proposed in locations where they can tie into visual screening and other linear elements. As such, the alignment of ditches shall be synchronous to proposed hedgerows, PROWS and embankments. Ditches shall have a rounded profile to reduce their engineered appearance and shall be seeded with the same seed mix as neighbouring grasslands to reduce their visual presence (see **Figure 1.9.1**).

Linear ponds shall be naturalised through varied bank slopes and geometry, and locally appropriate marginal planting, where physical constraints allow. This is of particular relevance where the linear ponds will be seen alongside the channels of the River Avon at Countess Junction. Where a more engineered pond is required, these shall be softened with adjacent planting. Linear ponds shall be designed so as to retain nearby existing mature trees where possible, using data from the tree survey. DTAs shall be designed with simple rounded shapes, avoiding complicated sinuous forms and patterns that would be conspicuous in the upland landscape. The exception to this is DTA1, the shape of which reflects the contours of Parsonage Down. DTA banks will be seeded to match adjacent grassland landscapes, integrating the DTAs into a seamless and consistent landscape of rolling, open chalk grassland.

1.4. How the drainage strategy will maintain or improve the quality of water entering the ground, including a risk assessment of the proposals and an assessment of whether mitigation measures in excess of the minimum stated in the DMRB may be required

Drainage on the existing highway comprises direct discharge to either roadside ditches or watercourses without water quality treatment.
As the existing road drainage is currently untreated, the proposed drainage strategy will result in improved water quality to receiving water receptors, this includes both surface and groundwaters.

The method used to assess impacts to water quality from the Scheme is based on the DRMB LA113 and incorporates methodologies for assessing the effects on groundwater flows, groundwater dependent terrestrial ecosystems and the local hydromorphology.
Based on preliminary work, the assessment is anticipated to result in no Significant impact to receiving watercourses or groundwaters are expected. The HEWRAT assessment indicates improvements to the River Avon would be based on the provision of drainage treatment identified within the drainage strategy (i.e. attenuation and pollution control that is included before discharge to ground through infiltration structures.
Connectivity between the River Avon and groundwaters, are also likely to maintain/ improve groundwater as treated drainage is discharged to the River Avon catchment.

Given this expected improvement, no recommendations are made to improve treatment over and above DRMB are proposed. Both the EIA and WFD assessment conclude no impact to surface or ground water quality through the use of the drainage system.

West of Tunnel:

- The drainage strategy to the West of the tunnel incorporates five DTAs, with outfalls to infiltration basins (including one within the Parsonage Down area) Infiltration basins will be grassed with shallow slopes and will include impermeable areas to capture a proportion of runoff and aid biodiversity (see sections **1.3** and **1.6**). Under the planted base, a proprietary treatment system of activated filter material will absorb heavy metals and silt before the runoff is discharged via infiltration to ground. Remotely operated penstocks would be provided in the chambers immediately upstream of the basins to provide spillage control.
- An infiltration system positioned underneath the central reserved is proposed for Network 8, with discharge to infiltration tanks. Pollution will be mitigated with proprietary vortex separators and filtration in chambers in the verges before entering the tanks.

Tunnel Drainage

- The tunnel drainage would either be conveyed to the proposed impounding sump or highway network east of the tunnel, dependant on water quality, outlined in section **1.2.2.**

East of Tunnel:

- An infiltration system like those at the western portal approach will be used to drain the carriageway in Network 11.
- Combination of swales and linear ponds, lined, planted with reeds and contain permanent water to provide treatment prior to discharge and enhance biodiversity opportunities.

Spillage containment measures are outlined in section **1.8**.

Parsonage Down

A qualitative assessment to determine impacts from drainage from the proposed tunnel spoil placed on land east of Parsonage Down NNR has been undertaken. Key points from this assessment are summarised here. Site obtained chalk will be processed with lime to facilitate pressing at the Slurry Treatment Plant, with acid added as required to correct pH. Trials, testing and further risk assessment will be implemented to determine the effect of altering pH and potentially changing the geochemistry of the Chalk, including the Phosphatic Chalk, on the mobility of contaminants such as phosphorous through the addition of lime and/or acid. Appropriate mitigation will be implemented to ensure that there are no adverse risks to receptors if

risks are identified. As noted in section **1.4**, only materials that are assessed as suitable for use will be placed on land to the east of Parsonage Down, as required under the Materials Management Plan. As such no significant risk, associated with the potential mobilisation of contamination, is anticipated, including to the River Till as the receiving watercourse.

Source Protection Zones (SPZs):
No Environment Agency (EA) designated SPZs are located within the footprint of the scheme, the closest being at Durrington and Shrewton. Local private water supply SPZs will be accounted for to avoid direct discharge into them.

1.5 How sustainable drainage features will be used to treat and attenuate all runoff from the highway prior to discharge or infiltration

West of Tunnel

- Infiltration basins (DTAs) to attenuate and treat runoff prior to discharge which will include planting and filtration material in the base as outlined in sections **1.2.1**, **1.3** and 1.**6**.
- Central reserve infiltration tanks attenuate the runoff, and will have proprietary vortex separators and filtration treatment in the drainage network upstream of the tanks, in the verge, for tunnel portal highway catchment Network 8, outlined in section **1.2.1**.

East of Tunnel (including tunnel highway runoff)

- Overall discharge rate to the River Avon will achieve a minimum 20% betterment of the existing discharge rates.
- Use of online attenuation systems such as oversized pipes along the carriageway including flow controls to maximize its capacity.
- Drainage to the east of the tunnel includes eight new DTAs in the form of linear ponds. These ponds will replace unlined ditches to which the runoff from the carriageway currently outfalls. The ponds shall be planted with reeds to provide treatment prior to discharge. All ponds will discharge to existing highway ditches which ultimately discharge the runoff to the River Avon. Alternatives to the pond, such as swales are outlined in section **1.2.3**.

The SuDS treatment systems will require appropriate levels of maintenance to ensure full functionality, in line with CIRIA C753 guidance. All SuDS are designed up to and around the features to ensure required maintenance can occur.

Side road drainage will utilise filter drains acting as on-line soakaways in the verge which provide treatment and attenuation to the runoff. Where kerbing is required on side roads, gullies shall convey the runoff to the linear soakaways

1.6. typical details of the drainage treatment areas, including planting locations and types;

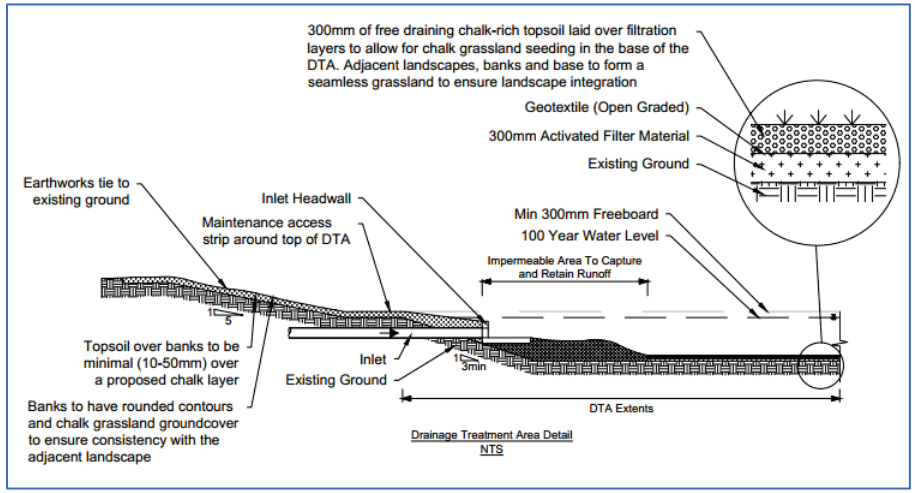


Figure 1.6.1: DTA Typical Cross Section (Infiltration)

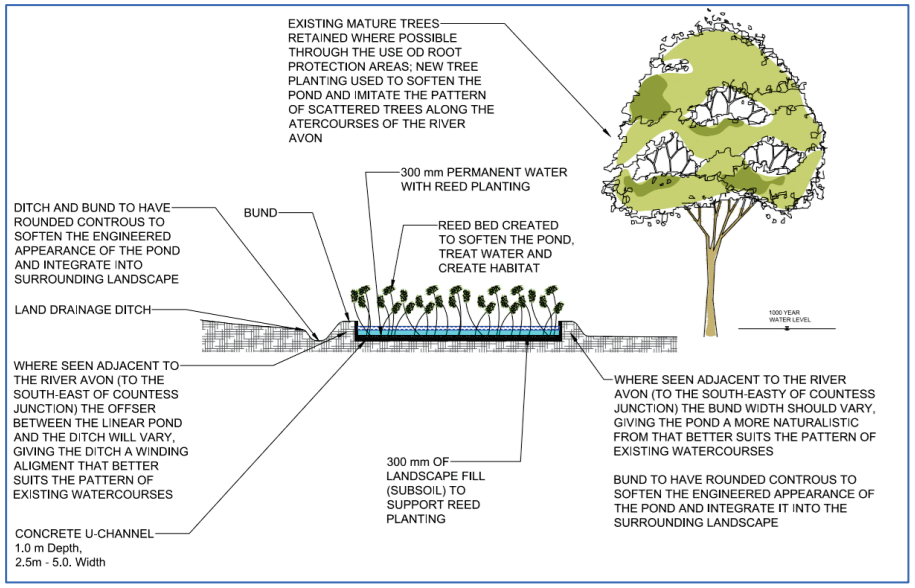


Figure 1.6.2: Linear Pond Typical Cross Section

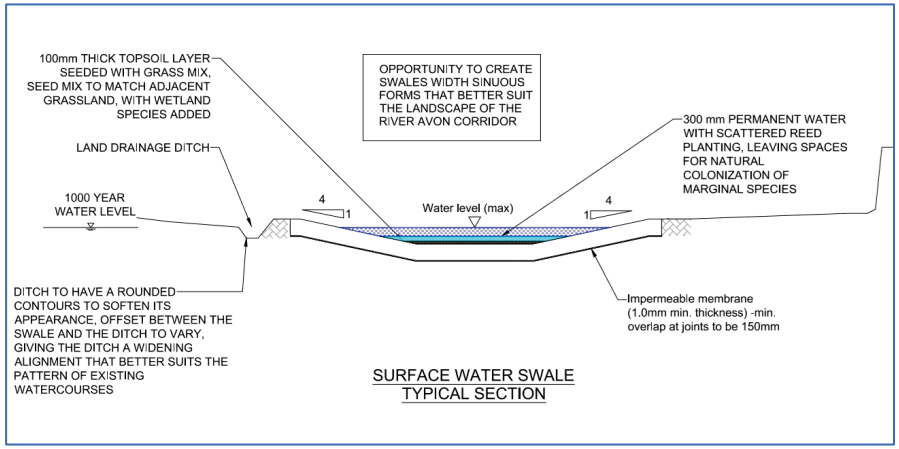


Figure 1.6.3: Swale Typical Cross Section

1.7 measures for the management of surface water and foul drainage

Management of surface water from the highways is outlined in section **1.2**.

Foul drainage (from tunnel drainage) will discharge to an impounding sump to the east of the tunnel – outlined in section **1.2.2.**

The welfare facilities in the tunnel service buildings (TSB) will discharge to a septic tank located within the TSB basement, which can be tankered away periodically. In line with CD352, the tank will contain ventilation and fire detection/suppression. Level monitoring will be remote, via the TCMS.

1.8 pollution control measures, including containment of contaminant spillages

- For surface water and groundwater protection, the OEMP has used industry best practice and pollution prevention guidelines, which have been accounted for in the design.
- It is acknowledged that discharges to controlled waters and sewers will require appropriate permitting; fully quantitative water quality models are recommended to ensure no detrimental impacts to ecologically sensitive surface waters.
- New ponds created as part of the drainage design should be appropriately monitored.

Accidental spill control:

- Remotely controlled penstock to isolate pipe networks from DTAs and central reserve infiltration tanks, being remotely operated they can be activated without the operative having to physically attend the site location and operate a manual penstock.

- Contamination will be retained within the drainage pipe network, upstream of the DTAs
- Refer to section **1.2** for pollution control within the tunnel.

1.9 the management of flows from catchments external to the highway;

Any surface runoff flowing toward the highway will need to be intercepted and conveyed in the appropriate direction so that it ends up back where it would in the baseline scenario.

- In areas where overland runoff will drain toward the highway, this flow will be intercepted using cut off ditches or filter drains. Where there is sufficient space open ditches will be used. In more constrained locations filter drains will be used (refer to section **1.3**).
- Filter drains have been selected for use in these areas as a preferable alternative to ditches. Ditches are proposed where they can be visually integrated with screen planting and other linear elements such as hedgerows (see **Figure 1.9.1**).
- Filter drains have also been selected for use in areas where ditches would require the steepening of cutting slopes, potentially leading to less successful establishment of calcareous grassland, reduced scope for the rounding of earthworks and the requirement for additional retaining structures.
- The drains and ditches will need to intercept runoff from all sources that drains toward the highway, either naturally through overland flow; through drainage ditches or subsurface land drainage. They will be sized appropriately to convey the runoff associated with design storm (1:100 years) including appropriate allowances for climate change (40%). There will be no transfer of flow across different natural catchments, ensuring that the intercepted runoff discharges into the same watercourse, or watercourse catchment as it does presently.
- Where it can be proven to be appropriate, in some locations cut off drains may be excluded. In areas where the contributing catchment is small and ground infiltration rates are very high, there may be no requirement for cut off drainage, this will be investigated and confirmed during the detailed design.
- The intercepted external flow will be discharged into either soakaways or into the Rivers Till or Avon. Where discharge is into watercourses, the design will ensure that there is no adverse impact on the receiving watercourse which may occur due to reduced travel times, measures such as flow limiting check dams may be considered if appropriate.
- At the western extent of the scheme, the road is flanked by bunds and grips will be installed so that overland flow can pass through them and be intercepted by the earthworks drainage.

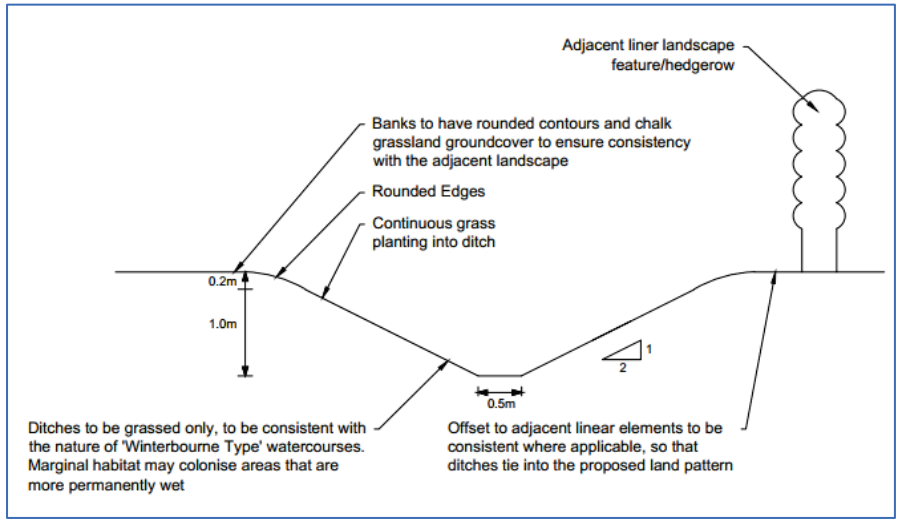


Fig 1.9.1: ditch cross section

Parsonage Down

The design proposals include diversion of the surface overland flow and groundwater flooding through a piped flow route under the A303 and B3803 towards the River Till.

The composition and drainage potential of the material being deposited at Parsonage Down and the finished ground levels and topography will depend on many factors that are yet to be determined. The runoff rates from Parsonage Down will be influenced by these factors and therefore the design of the piped crossings of the A303 and the B3803 and the land drainage design will need to adapt as and when there is greater certainty of these unknowns during detailed design. Sub surface land drainage will be required (**Figure 1.9.2**) to a greater or lesser extent where appropriate to create the necessary conditions for the target calcareous grassland habitat. Further details of the strategy for achieving these conditions is outlined within **QS-11A**.

The existing culvert under the B3803 is a significant restriction to overland flow. The design proposals include culvert crossings of the A303 and B3803 that are appropriately sized to ensure free flow up the design standard flood event. This will remove the current flood risk to the B3803 but is expected to marginally increase the peak runoff rate into the River Till.

The deposited tunnel arisings will lower the permeability of the area. Unmitigated, this results in an increase in the volume of runoff flowing into the River Till floodplain. The proposed engineering solutions to improve the drainage and infiltration rates, to create the appropriate conditions for the calcareous grassland, will be optimised to minimise the increase in runoff volume to the River Till.

The proposals will be tested to check the underlying hydrological and hydraulic assumptions including blockage of the new pipes.

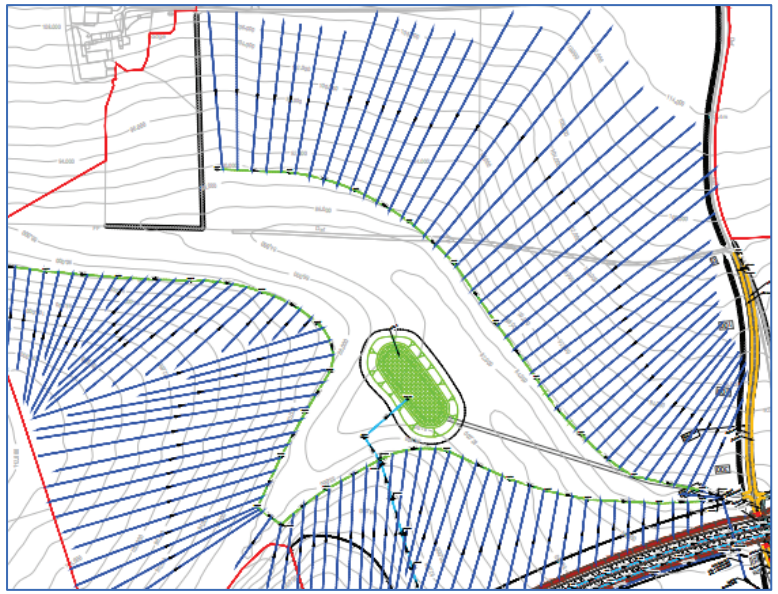


Figure 1.9.2: Sub-surface land drainage

1.10 how sub-surface groundwater flows will be managed;

The hydrogeology within the scheme is highly heterogeneous. Groundwater levels, flow, storativity and transmissivity vary both spatially and temporally. The interaction of drainage and groundwater flows has been assessed and will be managed through the design. Specifically, the following aspects have been noted as having been considered in the design:

- Groundwater flooding at Parsonage Down to River Till areas.
- High groundwater levels at the western tunnel portal, groundwater monitored and pumped when 1.0m below infiltration base (to avoid direct discharge).
- Impact of climate change on predicted groundwater levels.

- The proposed drainage design differs from the existing (point discharge rather than linear) the impact of this change on groundwater levels and groundwater flow will be assessed.

To understand extreme groundwater levels further assessment was carried out analysing historical trends and predicted future maximum values. The analysis used long term groundwater level responses within the study area and used these to simulate responses at all available monitoring points as per the P1 hydrograph presented below.

Time series graphs have been developed covering a period from 2002 to 2019 including predicted groundwater levels in response to 20% increase in recharge. The work predicted that groundwater levels with 20% increase in recharge reached heights above the road at the tunnel end of the western tunnel portal. Groundwater levels with a 20% increase in recharge at the eastern portal did not reach heights which would intersect the drainage network (estimated to be 4 m below road base).

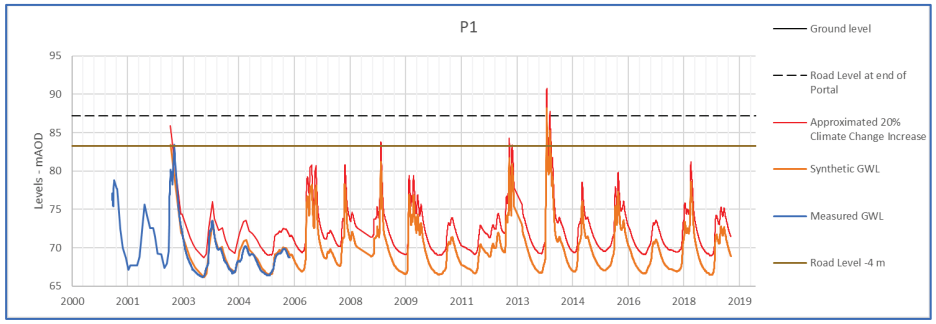


Figure 1.10.1: Modelled groundwater levels

The graph provided using water levels for a borehole in close vicinity to the western portal indicates that groundwater levels are expected to interact with the drainage system on roughly 4 occurrences over the 17 year period.

The data indicates that based on the maximum observed level in 2014 groundwater levels will be above the drainage system for 9 days, 36 days based on 20% increase in recharge. The design has been developed such that the extreme groundwater levels are managed at the western portal as detailed in section **1.2.1**.

Any groundwater flooding at Parsonage Down will be mitigated within the sub-surface drainage outlined in section **1.9.**

1.11 an explanation of how the drainage strategy does not result in an increased risk of flooding, including how the drainage design will mitigate the risks of flooding from groundwater during extreme groundwater events, with specific reference to the eastern and western cuts and at Parsonage Down;

Mitigation for groundwater and surface water from external catchments is outlined in sections **1.9** and **1.10**:

- Parsonage Down land and groundwater drainage in overland flow system towards the River Till
- Groundwater at extreme high levels at the western portal shall be managed via a pumped system outlined in section **1.2.1**.
- The eastern portal cut has been assessed as having a road level above the extreme event for climate change water level, so the road is not deemed at risk from flooding from groundwater.
- Overland flow to follow existing catchments and flow mitigation where required to ensure flood risk not increased due to reduced travel times.
- The impact of the scheme as a whole will be assessed/ managed and mitigated to ensure that the impact of the scheme on groundwater is minimal and that groundwater flooding is mitigated, the solution to this will include the drainage design.

Road drainage – attenuated in advance of discharge:

- Using a greater than 1:5 year return period for no flooding of carriageway for networks 8 and 11 especially; to reduce risk flooding into the tunnel (1:100 year return period +30% climate change)
- Infiltration basins designed to store the 1:100 year event, including a 30% allowance for climate change and 300mm freeboard
- Linear ponds/ swales design designed the 1:100 year event, including a 30% allowance for climate change and 300mm freeboard
- Exceedance routes investigated to ensure no negative impact on downstream receptors.

1.12. an explanation of how the drainage strategy will provide a reduction in the existing discharge rates;

- Refer to **1.11** – attenuating proposed flows within system/SuDS compared to existing free discharge outfalls for surface water discharges into River Avon and associated watercourses.
- As outlined in section **1.2.3**, discharges to the River Avon will achieve a 20% reduction in discharge rates.

1.13. the integration of existing drainage systems into the Scheme-wide drainage design;

Locations to existing drainage to remain will be investigated and integrated if completely separate systems are not appropriate
Where appropriate to integrate them, existing drainage shall be surveyed, hydraulically modelled and repaired where appropriate to ensure the capacity and condition are no less than the new drainage.

West of tunnel:

- A360 and Longbarrow junction side road tie ins.
- B3083 drainage; dependant on highways proposals.
- Western route tie in.

East of tunnel:

- Countess Roundabout / A345.

Detrunked A303:

- Existing drainage to remain in places; based on highway/surface treatment and usage.

1.14 The strategy for drainage around known or suspected contaminated land

Where risks associated with land contamination are identified in the location of drainage features, these will be mitigated either through remediation to prevent contamination from entering the drainage system or controlled waters, or through design.

Based on available geo-environmental data for phases of ground investigation completed up to and including Phase 7A, areas of known contamination within the scheme are limited to a single exceedance of human health Generic Assessment Criteria (GAC) for benzo(a)pyrene, a polycyclic aromatic hydrocarbon (PAH) and limited leachate analysis has identified marginal exceedances of controlled waters GAC for some PAH and metal species in soil-derived leachate. Naturally high concentrations of phosphorus have been identified in the White Chalk but are not considered leachable. As such, the risk to the water environment associated with mobile contamination is considered low.

Further mitigation is currently being implemented during the preliminary works comprising:

- A further Phase 7B ground investigation to address key data gaps, including areas of suspected contamination, and obtain further baseline information for the Scheme, including for Parsonage Down; and,
- Remediation (as per commitments PW-GEO1 and PW-GEO2 of the OEMP and in accordance with Requirement 7 of the DCO).

Remediation measures

- Given remediation is being implemented during the preliminary works, it is considered that most risks associated with contamination will have been assessed and remediated as necessary in advance of the main works.
- Further confirmatory sampling from the locations of proposed drainage features would be undertaken as necessary during either the detailed design or construction phases to inform the drainage design or any further remediation requirements.
- Remediation, where required, would comprise localised source removal, with the intention that the materials could be re-used elsewhere within the scheme subject to meeting the relevant re-use criteria (as per the Series 600 Earthworks Specification for the Scheme), and/or treatment on site.
- The Series 600 Earthworks Specification will also include a reactive strategy as per commitment MW-GEO2 to address any contamination identified during the main works that was not previously identified in the environmental statement or during the preliminary works.
- As detailed in the Environmental Statement and as per commitment MW-MAT2, excavated and processed material from the tunnelling operation will also be reused on land to the east of Parsonage Down NNR under a Materials Management Plan, produced under the CL:AIRE Definition of Waste Code of Practice. Its suitability for use within that location will be assessed. As such, no risks associated with the potential mobilisation of contamination are anticipated as only materials that are assessed as suitable for use will be placed.

Design measures

- Where mitigation through design is necessary, suitable barrier systems such as impermeable liners will be implemented.
- Drainage will also be designed to the relevant design standard, LA113.
- Further, sections **1.2.1** to **1.2.3** and **1.8** detail the attenuation and pollution control measures that will be implemented to capture contamination arising from the operation of the scheme and prevent its release to controlled waters. These include the implementation of planting over activated filter material or liners and planting in DTAs/ponds, remote pollution shut-off valves, infiltration systems and attenuation tanks.