Environmental Statement

Chapter 12: Road Drainage and the Water Environment

Appendix 12.3: Water Framework Directive Assessment

Sub Appendix F: WFD Mitigation

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1 WFD Mitigation

1.1 Mitigation

1.1.1 Proposed mitigation for both the construction and operation phases of the Proposed Scheme are detailed below. A mitigation reference has been assigned for each mitigation measure, which is used within the main body of the report.

1.2 Construction

1.2.1 Table F-1 describes potential construction impacts that may arise due to the Proposed Scheme and mitigation measures proposed within the **OCEMP** (Document Reference: 3.03.01). This table should be read in conjunction with the impact assessment tables in Section 5.2 of the main report.

Table F-1 Potential construction impacts and mitigation

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Fine sediment and pollution risk	Constructions and installation of culverts, Bailey bridge, embankment, attenuation ponds, cuttings, and piers for the River Wensum Viaduct could release fine sediment into the watercourses. Noise and vibrations produced during the construction phase may result in an increased quantity of sediment being delivered to the watercourses.	Best practice measures would be in place to manage, and control run off during the construction process to prevent silt- and pollutant-laden runoff from entering watercourses. Preliminary earthwork drain (PED) network, the infrastructure for the management of surface water runoff, should be installed at the start of the construction phase. These should include suitable measures to deal with sediment settlement generated as part of the construction phase. Vehicles and construction plant will be refuelled away from any drains or watercourses and in a controlled manner. Spill kits and drip trays will be available for use when refuelling. Bunds and interceptors will be used to prevent run-off carrying sedimentation or construction material into the PED network, ditches or local watercourses. Cut-off ditches will be used for entrance and exit from site to avoid sediment dispersion. Wheel washing facilities will be incorporated. These will require suitable containment of wash water, and sediment settlement provided if the wash water is to be discharged to a grass swale or similar. A Piling Risk Assessment (PRA) will be required due to groundwater and surface water sensitivity within the River Wensum floodplain. This shall be produced by the Principal Contractor based on the detailed piling design. This will need to consider and ensure that no contamination becomes entrained into the shallow or deeper chalk aquifer, because of pile installation. This will need to be submitted as part of the Environmental Permits associated with the works. Pollution control measures in place on-site, including silt barriers, allocated re-fuelling areas, and spill response measures in place (e.g., spill kits, emergency contractor). This would also need to consider runoff from any temporary bridges required for construction. Any wheel washing facilities would need suitable containment of wash water, and sediment settlement will need to be provided if the wash water is to be discharged, via a grassed swale if feasible. There should be no uncontrolled run-off of water or mud from the Site. Monitoring of water quality during and following the works.	Fine sediment management - CM-RDWE-01

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Fine sediment and pollution risk	During construction, plant oil/fuel/hydraulic fluid leaks and cement can alter the baseline physico-chemical characteristics of the channel. In addition, fine sediment ingress to the channel may also result in a pollution incident within the receiving watercourses with the potential for far-reaching downstream impacts. There is the potential for pollutants and contaminated soil to be disturbed and transported to the watercourses.	Standard pollution prevention measures would be implemented as part of the OCEMP minimising pollution risks. The preliminary earthwork drain (PED) network, the infrastructure for the management of surface water runoff, should be installed at the start of the construction phase. These should include suitable measures to deal with sediment settlement generated as part of the construction phase. Vehicles and construction plant will be refuelled away from any drains or watercourses and in a controlled manner. Spill kits and drip trays will be available for use when refuelling. Spill kits will be made available in the refuelling area. Bunds and interceptors will be used to prevent run-off carrying sedimentation or construction material into the PED network, ditches or local watercourses. Bunded trays for standing pumps and chemical storage containers will be used as anti-pollution measures for site compounds located at/near potential sources of contamination. Construction vehicles will be maintained, and construction materials managed to minimise the risk posed to the aquatic environment. The Environment Agency and other appropriate bodies must be consulted prior to the commencement of site activity. No foul drainage or contaminated surface water run-off will be discharged into any borehole, well, spring, soak away, lake or watercourse (including dry ditches having a connection with a watercourse). Any contaminated water must be treated and disposed of in accordance with environmental legislation. No bentonite or any other piling support fluid must be allowed to reach the ground or surface waters of the River Wensum. In stakeholder discussions it has been agreed that a pipe can be used to transport bentonite piling support fluid across the River Wensum with appropriate mitigation. The mitigation measures shall be included within the Risk Assessment Method Statement (RAMS) produced by the Principal Contractor which will form part of the Flood Risk Activity Permit (FRAP). A Piling Risk Assessment (PRA) will be required due to groundwater and surface water sensitivity within the River Wensum floodplain. This shall be produced by the Principal Contractor based on the detailed piling design. This will need to consider and ensure that no contamination becomes entrained into the shallow or deeper chalk aquifer, because of pile installation. This will need to be submitted as part of the Environmental Permits associated with the works.	

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Fine sediment and pollution risk	During construction, plant oil/fuel/hydraulic fluid leaks and cement can alter the baseline physico-chemical characteristics of the channel. In addition, fine sediment ingress to the channel may also result in a pollution incident within the receiving watercourses with the potential for far-reaching downstream impacts. There is the potential for pollutants and contaminated soil to be disturbed and transported to the watercourses.	Flood risk activity permits will be required for the construction of elements of the Scheme within 8m of the River Wensum or those elements within the floodplain which are not covered by the planning application. Appropriate methods statements will be required as part of the permit applications. These will need to set out site access requirements including the temporary works proposals within the River Wensum floodplain. The temporary works platform is situated above the River Wensum floodplain and will be used to store materials and plant during the construction phase. Restrictions on working areas and types of activities to be undertaken on this working platform should be put in place to minimise the risk of pollution events. For example, areas for washing down vehicles and storage of fuels should be avoided where possible). If required within the floodplain, any bentonite processing plants and associated pumping stations must be bunded, to contain any leaks or spills, with an impermeable membrane or surface to avoid any impacts to ground or water. Any wheel washing facilities would need suitable containment of wash water, and sediment settlement will need to be provided if the wash water is to be discharged, via a grassed swale if feasible. When construction activities, including stock piling and plant and vehicle washing, occur near a watercourse they should be separated from the watercourse with barriers (e.g. sediment fences) to prevent surface runoff from these sites entering the watercourse. Construction activities should be as far from the bank top of a watercourse and/or connected hydrological pathways where practicable. Fuel tanks or COSHH storage areas to be bunded to 110% of contents volume. All project plants are to be maintained according to the manufacturer’s standards. Spill kits to be stored at selected locations. There should be no uncontrolled run-off of water or mud from the Site. All machinery will be regularly checked for oil leaks or similar, which, if found, must be prevented from entering the drainage ditches or watercourses either through immediate repair of the machinery or by a drip tray/spill kit or similar. Pollution control measures in place on-site, including silt barriers, allocated re-fuelling areas, and spill response measures in place (e.g., spill kits, emergency contractor). This would also need to consider runoff from any temporary bridges required for construction.	Pollution prevention management - CM-RDWE-02

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Fine sediment and pollution risk	During construction, plant oil/fuel/hydraulic fluid leaks and cement can alter the baseline physico-chemical characteristics of the channel. In addition, fine sediment ingress to the channel may also result in a pollution incident within the receiving watercourses with the potential for far-reaching downstream impacts. There is the potential for pollutants and contaminated soil to be disturbed and transported to the watercourses.	In the event of a spillage on site, the material should be contained (using an absorbent material such as sand or soil or commercially available booms). Sorbents will be used to soak up a spill and stop it from spreading on hard surfaces. Using sorbents generates waste and this method will only be used on small spills, or where a spill has been contained to stop further spread. All used sorbents will be disposed of at an accredited site for disposal. If it is not possible to stop the spill at the source, significant attempts will be made to stop it as close to the source as possible. If possible, the spilling material will be safely moved into another container to limit the size of the spill. The use of a suitable container and pump may be required. Sediment management and water quality monitoring should be implemented during any construction works with the potential to affect any watercourse, and a plan for appropriate remediation measures to ameliorate any adverse effects should they occur should be prepared. Fuel, oil, and chemicals will be stored in secondary containment and located a minimum of 10m from any watercourse. The secondary containment system must provide storage of at least 110% of the tank's maximum capacity and ensure that any valves, filters, sight gauges, vent pipes or other ancillary equipment are also situated within the secondary containment system and arranged so that any discharges are contained. De-watering and contaminated land control measures should be in place: particularly with reference to the management of excavated material from excavations which may be contaminated. Attenuation features that control additional surface water runoff resulting from the PED network and associated changes to the natural topographic catchment should be put in place at the start of the construction phase. Monitoring of water quality during and following the works. Scheduled ecological survey work during and following the works, related to WFD / SAC features of the River Wensum. Maintain records of any incidents (including spills or non-compliance with controls) and report to regulators (if required by conditions of consents or other agreement).	

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Fine sediment and pollution risk	Potential for silt-laden runoff and fine sediment input to watercourses due to vegetation removal.	Supervision by an ecological clerk of works for high-risk works within proximity of the River Wensum, including vegetation clearance and installation of temporary structures. The extent of vegetation clearance should be limited as far as practicable near to watercourses. Where possible, any vegetation removed should be managed carefully to limit the extent of bare soil on site at any given time, to limit the potential for sediment run-off during wet weather. Impacts to vegetation within the riparian zone during the enabling works and construction phase should be monitored for recovery and suitably reinstated. Works should avoid being carried out on soft riverbanks where feasible to avoid compaction, erosion, and sediment release. Where temporary crossings or permanent structures are being constructed on watercourses, these works should remain localised within close proximity to the structure. The temporary bailey bridge over the River Wensum will be removed upon completion of the construction phase. Following removal, it is expected that vegetation will recover naturally, however this recovery will be monitored and any deterioration or loss of vegetation as a result of shading from the temporary crossing within the riparian zone will be returned to its previous state Monitoring of planted vegetation to ensure it establishes successfully. Impacts to vegetation within the riparian zone should be monitored for recovery and suitably reinstated. Regular water quality monitoring. Clearly mark trees and vegetation that are to be retained and included within the CEMP(s) which can be shown and communicated to staff during construction. Trees and vegetation to be retained are to be protected using protective fencing in accordance with BS5387:2012 where necessary. No storage of equipment or materials in areas of retained vegetation or in the Root Protection Area of retained trees Following removal of temporary culverts on WC5, banks will be reprofiled and allowed to return to their previous condition and recovery monitored.	Vegetation clearance - CM-RDWE-03

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Spread of INNS	Risk of the spread of INNS from construction activity.	To address the risk of spreading invasive non-native plant and animal species an invasive species strategy would be produced by the Contractor implementing the Proposed Scheme. This strategy should include the following measures: • A pre-construction ecological survey would be completed in the active growing season (approximately April to August inclusive) prior to vegetation and site clearance commencing in any part of the Site. • Measures to present the spread of any invasive species across and beyond the Site. Exclusions zones around identified areas of invasive species where no works are to take place will be implemented to ensure these species are not disturbed by works. The invasive species removal will be carried out by a specialist contractor. • Briefing and training of workers on good biosecurity practices appropriate to their role. • Equipping workers with the necessary equipment, Personal Protective Equipment (PPE) and substances to implement biosecurity control measures, including effective hygiene and sanitation practices. This will most frequently comprise disinfectant tablets, sprayers and brushes to clean and disinfect equipment and PPE prior to leaving site. • Ensure that Defra's "Check, Clean, Dry" principles are followed and ensure that all PPE and survey equipment is clean and dry (and if necessary, disinfected) prior to going to and from site.	INNS management - CM-RDWE-04

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and / or habitats	Changes to overland flow paths due to the construction activities. Cuttings could generate silt laden runoff and interfere with groundwater connectivity. Dewatering and drainage of cuttings can lower groundwater levels which may influence the groundwater regime.	The preliminary earthwork drain (PED) network, the infrastructure for the management of surface water runoff, should be installed at the start of the construction phase. These should include suitable measures to deal with sediment settlement generated as part of the construction phase. Bunds and interceptors will be used to prevent run-off carrying sedimentation or construction material into the PED network, ditches or local watercourses. Cut-off ditches will be used for entrance and exit from site to avoid sediment dispersion. Wheel washing facilities will be incorporated. These will require suitable containment of wash water, and sediment settlement provided if the wash water is to be discharged to a grass swale or similar. A Piling Risk Assessment (PRA) will be required due to groundwater and surface water sensitivity within the River Wensum floodplain. This shall be produced by the Principal Contractor based on the detailed piling design. This will need to consider and ensure that no contamination becomes entrained into the shallow or deeper chalk aquifer, because of pile installation. This will need to be submitted as part of the Environmental Permits associated with the works. There should be no uncontrolled run-off of water or mud from the Site. Temporary works de-watering (groundwater abstraction) is likely to be required locally. A dewatering management plan (dewatering strategy) will need to be developed and agreed with the Environment Agency to obtain suitable abstraction licenses and discharge permits. In particular in proximity to the River Wensum significant groundwater inflows into excavations should be avoided as much as practical to reduce the need for comprehensive water management. De-watering and contaminated land control measures should be in place: particularly with reference to the management of excavated material from excavations which may be contaminated. Attenuation features that control additional surface water runoff resulting from the PED network and associated changes to the natural topographic catchment should be put in place at the start of the construction phase	Drainage management – CM-RDWE-05

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and / or habitats	Loss of floodplain storage during the construction of the River Wensum Viaduct due to the temporary works platform and Bailey bridge, which would constrict out-of-bank flows.	Flood risk activity permits will be required for the construction of elements of the Scheme within 8m of the River Wensum or those elements within the floodplain which are not covered by the planning application. Appropriate methods statements will be required as part of the permit applications. These will need to set out site access requirements including the temporary works proposals within the River Wensum floodplain The temporary works platform is situated above the River Wensum floodplain and will be used to store materials and plant during the construction phase. Sign up for flood warnings and check online warnings regularly. Appropriate thresholds and flood warning systems should be identified beyond which working on the temporary works platform should be avoided because there is unacceptable risk associated with high flow events. Site compounds should not be placed within an area at high risk of surface water flooding as identified on Environment Agency mapping, most notably the surface water flow paths that run between: • Weston Road and Ringland Lane, in close proximity to the Ringland Road site compound; • Along the alignment of the Foxburrow Stream between Honingham and Weston Green, where the Broadway Green Bridge is proposed. If a flood warning is issued, move all machinery and equipment out of the floodplain. If this cannot be completed in a safe time, secure equipment to prevent it from being washed away.	Floodplain storage - CM-RDWE-06
Alteration to flows and/or habitats	Risk to the water environment and flows due to the construction activities.	Flood risk activity permits will be required for the construction of elements of the Scheme within 8m of the River Wensum or those elements within the floodplain which are not covered by the planning application. Appropriate methods statements will be required as part of the permit applications. These will need to set out site access requirements including the temporary works proposals within the River Wensum floodplain. Culverting of WC5 will require temporary dewatering and diversion of a section of the existing watercourse. As an IDB managed drain and its proximity to the Wensum SSSI / SAC, it will require IDB and NE consultation and consent.	Consents – CM-RDWE-07

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and / or habitats	Alteration to habitats arising due to vegetation clearance, earthworks, channel realignments and the installation of temporary structures to enable construction activities.	Impacts to vegetation within the riparian zone during the enabling works and construction phase should be monitored for recovery and suitably reinstated. Following removal of temporary culverts on WC5, banks will be reprofiled and allowed to return to their previous condition and recovery monitored. The temporary bailey bridge over the River Wensum will be removed upon completion of the construction phase. Following removal, it is expected that vegetation will recover naturally, however this recovery will be monitored and any deterioration or loss of vegetation as a result of shading from the temporary crossing within the riparian zone will be returned to its previous state.	Landscape plan - CM-RDWE-08
Alteration to flows and / or habitats	Loss, alteration to or disturbance to habitats due to proposed watercourse realignment, installation of structures, and over-pumping of water and/or diversion of flows.	Watercourse realignments will be kept to a minimum and any resulting increases or decreases in channel length would be limited as far as practicable. Realignments will be constructed off-line and seeded prior to connecting the watercourse to the new channel. Following removal of temporary culverts on WC5, banks will be reprofiled and allowed to return to their previous condition and recovery monitored	Channel modifications - CM-RDWE-09

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and / or habitats	Loss, alteration to or disturbance to habitats due to proposed watercourse realignment, installation of structures, and over-pumping of water and/or diversion of flows.	In line with consultation regarding fish from Natural England and the Environment Agency, the culvert design will meet the criteria specified in the Environment Agency's Fish Pass Manual. The mitigation for the degradation of aquatic habitat will comprise ditch enhancement elsewhere on the Wensum floodplain. The location and design of the watercourse crossings (to be culverted or bridged) have been considered to minimise impacts upon aquatic and semi-aquatic species. Should any part of a watercourse need to be impounded during the works, then a fish translocation should be carried out to remove fish from the impoundment. Fish translocation operations will require a permit from the EA in order to use electric fishing and ancillary equipment (such as hand nets). It can take as long as 20 days to obtain a permit, so this will need to be planned in advance. Any such operation will need careful co-ordination with the Principal Contractor to set-up and drain any coffer dam or impounded area. Culverting of WC5 will require temporary dewatering and diversion of a section of the existing watercourse. This will require a license from the Environment Agency, and authorisation to allow fish removal by a trained ecologist to avoid fish entrapment as described above. As an IDB managed drain and its proximity to the Wensum SSSI/SAC, it will also require IDB and NE consultation and consent. Culverts should be placed so that the invert level is below the existing bed level, to prevent impedance of fish movement. Any floodplain areas modified or created should be designed to allow fish passage back into watercourses following flood events, avoiding fish entrapment. Following removal of temporary culverts on WC5, banks will be reprofiled and allowed to return to their previous condition and recovery monitored. Timing of construction works around the River Wensum should consider key fish migration periods in consultation with Environment Agency Fisheries Officer to agree appropriate measures to avoid the obstruction of passage or disturbance to fish moving to upstream reaches for spawning.	Fish translocation - CM-RDWE-10

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Noise and vibration	Noise and vibration can have an adverse impact to aquatic fauna.	Sensitivity (to noise and vibration) of those fish species present should be considered to ensure that appropriate construction methods can be implemented to minimise and avoid disturbance. Soft-start piling method will be implemented for sheet piling in close proximity to watercourses. Timing of piling works near watercourses should allow for fish dispersion and be of a short duration to allow migratory fish a window to move upstream A 3m construction exclusion zone from the water's edge of the River Wensum will be enforced to reduce potential impacts to the SAC and SSSI watercourse. The exception is the temporary bailey bridge that spans the River Wensum, though the bridge abutments will be at least 3m away from the river.	Noise management - CM-RDWE-11
Shading	The temporary works platform crossing would create a shading effect on the River Wensum and riparian zone beneath the footprint of the structure for the period of the construction phase within the floodplain of the River Wensum. The shading could result in a contraction of macrophyte growth within the shaded zone, which could result in a reduction of bed roughness and alter hydraulic processes locally.	A Bailey bridge will be used for the temporary crossing to minimise potential impacts to the river channel and banks during the construction phase. By implementing a temporary bridge as the primary river crossing, it minimises the need of further temporary and ancillary works, that could increase levels of shading. The Constructor has considered as the optimum solution the "Steel Ladder Deck with 10 spans". The proposed solution improves the overall interface with the environment, ecology, and community; lowers the economic resources required for its delivery; and preserves the maintenance approach, compared to the reference design. The temporary bailey bridge over the River Wensum will be removed upon completion of the construction phase. Following removal, it is expected that vegetation will recover naturally, however this recovery will be monitored and any deterioration or loss of vegetation as a result of shading from the temporary crossing within the riparian zone will be returned to its previous state	Shading - CM-RDWE-12

Operation

Table F-1 Potential operation impacts and mitigation

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Road runoff and pollution risk	Fine sediment and pollution risk could arise due to road drainage including rain runoff, pollution spills and salt spreading.	Road runoff will be attenuated with six treatment trains (NWL Basins 1, 2, 3, 4, 5 and 6). Road drainage will infiltrate to ground, except for one attenuation which will discharge to a new outfall into the Foxburrow Stream.	Fine sediment management - OM-RDWE-01
Road runoff and pollution risk	The outfalls and new discharge could cause localised scour to the bed and banks around the structure and release fine sediment into the watercourse.	The outfalls will be angled in the direction of flow to reduce the risk of scour. Flows will be attenuated, and the proposed discharge is 8.7l/s for a 1-year return flow, 24.6l/s for a 30-year return flow, and 35.7l/s for a 100-year return flow. The design flows are equivalent to greenfield runoff rates. Where practicable, the outfalls will be set back from the bank face and connected to the watercourse via an open channel. This will reduce the risk of scour and prevent the need for new hard bank reinforcement on the bank face.	Outfall mitigation - OM-RDWE-02
Road runoff and pollution risk	Pollution incidents and spillages during the road operation.	Pollution incidents and spillage will be attenuated through six treatment trains (NWL Basins 1, 2, 3, 4, 5 and 6). Surface water will infiltrate to ground, except for one attenuation which will discharge to a new outfall into the Foxburrow Stream.	Pollution and spillages incidents - OM-RDWE-03
Road runoff and pollution risk	Increase in overland flow with the road operation.	Chemical compounds and fine sediments can reach the watercourses due to an increased overland flow. To mitigate, the drainage strategy will attenuate flow through six treatment trains (NWL Basins 1, 2, 3, 4, 5 and 6). Surface water will infiltrate to ground, except for one attenuation which will discharge to a new outfall into the Foxburrow Stream.	Increase in overland flow - OM-RDWE-04
Shading	The River Wensum Viaduct would create a shading effect on the River Wensum and riparian zone beneath the footprint of the structure for the period of the operational phase within the floodplain of the River Wensum. The shading could result in a contraction of macrophyte growth within the shaded zone, which could result in a reduction of bed roughness and alter hydraulic processes locally.	A 500m long River Wensum Viaduct with a single deck arrangement. At the crossing point of the River Wensum, the proposed deck height is 20.4mAOD where the proposed design height has mitigated the potential impacts of shading as far as practicable. The River Wensum Viaduct design comprises nine piers at approximately 54m intervals, which would neither be located within the active channel nor in adjacent watercourses within the floodplain, therefore eliminating any effects of shading upon the channel caused by the piers.	River Wensum Viaduct shading mitigation - OM-RDWE-05

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Shading	The approximately 50m Tud tributary culvert / Bat underpass (excluding wingwalls) on the Foxburrow Stream and the approximate 18m long culvert on WC5 within the floodplain of the River Wensum would create a shading effect on the culverted section of the watercourse.	The proposed culverts will be over-sized to enable maximum light penetration through the structures and therefore reduce the shading effect as far as practicable. The design dimensions of the culverts are: Tud tributary culvert / Bat underpass: 4m wide x 4.5m high. WC5 culvert: 7.6m wide x 1.5m high.	Culvert shading mitigation - OM-RDWE-06
Alteration to flows and / or habitats	The piers of the River Wensum Viaduct could result in alteration of flows during out-of-bank events, which could impact in-channel habitats.	No in-channel piers and piers are setback from the bank top to minimise impacts on flows, as much as practicable. The piers will be at least 9m from the top of the riverbank.	River Wensum Viaduct habitat mitigation - OM-RDWE-07
Alteration to flows and/or habitats	Permanent access tracks across the River Wensum floodplain for River Wensum Viaduct maintenance. This could alter floodplain roughness and the characteristics of out-of-bank flows, with an increase on overland flows. Hence, it could increase sediment input to the channel with alteration to in-channel habitats	Permanent access tracks are located on both banks of the River Wensum to avoid the need for permanent maintenance access crossing of the river. Maintenance access tracks are proposed to be drained to the nearest watercourse or infiltration feature. Hydraulic modelling results indicate that the impact of the permanent access tracks is negligible on the existing baseline characteristics. Hence, given the embedded mitigation, the alteration of flow/habitats is expected to be negligible on the WFD water body.	Maintenance access mitigation - OM-RDWE-08
Alteration to flows and / or habitats	The Tud tributary culvert / Bat underpass will cause alteration to flow and habitats, which could impact upon bed substrate, flow types and velocity, fish and mammal passage.	The culverts will be over-sized with a depressed invert to allow the formation of a natural bed through the structure. The depressed invert will also reduce the risk of bed and bank scour at the culvert inlet and outlet. The over-sizing of the culverts will allow for maximum light penetration to encourage fish and mammal passage. A mammal ledge is also included within the design. The culverts sizing will allow for the formation of a low-flow channel, therefore reducing impacts to flow types. Tud tributary culvert / Bat underpass: 4m wide x 4.5m high. WC5 culvert: 7.6m wide x 1.5m high.	Culvert design mitigation - OM-RDWE-09
Alteration to flows and / or habitats	The realigned Foxburrow Stream could affect the overall channel length and therefore, channel gradient. Hence, it could impact the existing flows and in-channel habitats.	The realignment design will minimise, as far as practicable, the loss/gain of channel length and the length of channel requiring realignment. Hence, retaining the overall reach channel gradient. By doing this, it will minimise changes in river hydraulics and in-channel habitats. Hydraulic modelling results indicate that the proposed Tud tributary culvert / Bat underpass does not cause significant changes to the existing baseline processes.	Realignment mitigation - OM-RDWE-10

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and/or habitats	The Tud tributary culvert / Bat underpass will result in the loss of approximately 50m (excluding wingwalls) of open water habitat.	In addition to embedded design features of the Tud tributary culvert / Bat underpass to mitigate impacts on aquatic habitats, the Proposed Scheme aims to mitigate any adverse impacts to the Foxburrow Stream through delivering a minimum 10% uplift in river units through enhancement measures. Proposed enhancement measures that may be pursued to enhance habitat in the vicinity of Foxburrow Stream include: • Introduction of woody debris to enhance river flow characteristics. • Livestock exclusion, to prevent or reduce access to watercourse and associated negative effects of poaching and soil compaction. • Planting of native trees and local macrophyte species. • Reprofiling of bank face and bank tops to reconnect floodplains and promote the formation of wetlands and wet woodlands. • Removal of existing redundant structures (such as culverts and dilapidated bridges). • Installation of wood dam analogues to diversify flows and create aquatic habitat.	Foxburrow Enhancements - OM-RDWE-11
Alteration to flows and/or habitats	The presence of a River Wensum Viaduct over the River Wensum has the potential to degrade the habitat beneath it.	In addition to embedded design features of the River Wensum Viaduct across the River Wensum to mitigate impacts on aquatic habitats, The Proposed Scheme aims to mitigate any adverse impacts and achieve a 10% gain in BNG units through enhancement measures to the River Wensum. Examples of enhancement measures that may be pursued to enhance habitat on the River Wensum include: • Reconnection of historic meander on the river Wensum, creating river length. • Introduction of gravel features to replenish river bed substrate. • Introduction of large wood to enhance river flow characteristics. • Livestock exclusion, to prevent or reduce access to watercourse and associated negative effects of poaching and soil compaction. • Planting of native trees and local macrophyte species.	River Wensum Enhancements - OM-RDWE-12

Potential impact	Description of potential impact	Description of mitigation measure	Mitigation reference
Alteration to flows and / or habitats	The culvert on the WC5 of the Wensum floodplain will result in the loss of approximate 18m of open water habitat.	In addition to embedded design features of the culvert on WC5 to mitigate impacts on aquatic habitats, the Proposed Scheme aims to mitigate any adverse impacts and achieve a 10% gain in BNG units through enhancement measures to the Wensum floodplain ditch network. Examples of enhancement measures that may be pursued to enhance ditches include: • Livestock exclusion, to prevent or reduce access to watercourse and associated negative effects of poaching and soil compaction. • Planting of native trees and local macrophyte species. • Reduced maintenance of ditch network. • Reprofiling of bank face and bank tops to reconnect floodplains. • Installation of large wood dams to slow flows.	Ditch Network Enhancements - OM-RDWE-13