A417 Missing Link
TR010056

6.4 Environmental Statement
Appendix 13.9 Non-Significant Effects

Planning Act 2008

APFP Regulation 5(2)(a)
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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6.4 Environmental Statement
Appendix 13.9 Non -Significant Effects

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1 Non-Significant Effects Summary

1.1 Summary of non-significant effects – Surface water – Construction

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Alteration to baseflows as a result of embankments during construction impacting surface water quantity	Tributary of Norman's Brook	High	Mitigation listed in Annex G of ES Appendix 2.1 EMP (Document Reference 6.4) will maintain existing flow regime	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
Alteration to baseflows as a result of cuttings and structures during construction impacting surface water quantity	Tributary of Norman's Brook	High	Cutting or structure drainage maintains flow directions and existing catchment areas wherever possible. Detailed assessment of groundwater-surface water interaction during detailed design. Adherence to Annex G of ES Appendix 2.1 EMP (Document Reference 6.4).	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Pollution incident as a result of construction impacting surface water quality	Tributary of Norman's Brook	High	Annex G of ES Appendix 2.1 EMP (Document Reference 6.4) includes best practice measures for the storage of hazardous substances, the siting of higher risk activities (e.g. vehicle washdown areas) and the maintenance of plant	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Flood risk to the site during construction	Existing A417 road	Very High	Annex G of ES Appendix 2.1 EMP (Document Reference 6.4)	No change	Neutral
Flood risk from the site during construction	Residential properties surrounding the scheme extent	High	Surface water generated across the site would be managed by construction drainage	No change	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
	Colleges, High Schools and Primary Schools surrounding scheme extent	High	(including suitably sized temporary settlement and attenuation basins, drainage ditches and culverts). This will be installed early in the construction period as per Annex G of ES Appendix 2.1 EMP (Document Reference 6.4), which would manage surface and groundwater flooding to ensure that flood risk does not increase as a result of the scheme.		
	Land used for agriculture surrounding the scheme extent	Medium			

1.2 Summary of non-significant effects – Groundwater – Construction

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Accidental spillage during construction	Superficial deposits - Secondary A aquifer	High	Annex G of the EMP (Appendix 2.1) includes best practice measures for the storage of hazardous substances, the siting of higher risk activities (e.g. vehicle washdown areas) and the maintenance of plant	Negligible	Slight adverse
	Lias Group - Secondary (undifferentiated) aquifer	Medium			Slight adverse
	Inferior Oolite - Principal aquifer	High			Slight adverse
	Great Oolite - Principal aquifer	High			Slight adverse
Pollution incident as a result of construction	Superficial deposits - Secondary A aquifer	High	Mitigation listed in Annex G of ES Appendix 2.1 EMP (Document Reference 6.4)	Negligible	Slight adverse
	Lias Group - Secondary (undifferentiated) aquifer	Medium			Slight adverse
	Inferior Oolite - Principal aquifer	High			Slight adverse
	Great Oolite - Principal aquifer	High			Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Temporary works associated with construction of cuttings, embankments and drainage basins have the potential to affect groundwater quality, although this is likely to be very localised and temporary.	Alluvium - Secondary A aquifer	Medium	Mitigation listed in Annex G of ES Appendix 2.1 EMP (Document Reference 6.4)	Negligible	Slight adverse
	Cheltenham Sand and Gravel - Secondary A aquifer	Medium			Slight adverse
	Great Oolite limestone - Principal aquifer	High			Slight adverse
	Inferior Oolite - Principal aquifer	High			Slight adverse
	Lias Group - Secondary (undifferentiated) aquifer	Medium			Slight adverse
	Well No. G199, historic disused well	Low			Neutral
	Dry valley (G3) (new fault)	High			Slight adverse
	Shab Hill dry valley (G146, G183)	Medium			Slight adverse
	Springs and seepages in tributary of River Churn headwaters (G4, G97-G99, G145, G146, G174, G148, G179, G180, G181)	Medium			Slight adverse
	Springs and seepages in tributary of River Frome headwaters (east) (G143, G150, G147, G173, G100, G219, G223, G222)	High			Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Temporary construction works for the Cotswolds Way crossing piled foundations have the potential to affect groundwater quality, particularly if fissures, gulls or karst are encountered during construction and pile grout has the potential to escape through these flow paths. Gloucester Way crossing, Cowley and Stockwell overbridges pile foundations have also the potential to affect groundwater quality within the Inferior Oolite during construction, however this will be localised and temporary.	Inferior Oolite - Principal aquifer	High	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4), voids treatment protocol and FWRA	Negligible	Slight adverse
	Baunton public water supply, SPZ3	High		Negligible	Slight adverse
Construction of widening the existing A417 has the potential to cause minor drawdown within the aquifer, however the widening is at grade with the existing A417 so the drawdown impacts are anticipated to be negligible	Cheltenham Sand and Gravel - Secondary A aquifer	Medium	None	Negligible	Slight adverse
Construction works will only extend into the superficial deposits overlying the low water bearing Lias Group, which will protect the Lias Group in terms of both groundwater flow	Lias Group - Secondary (undifferentiated) aquifer	Medium	None	No change	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Springs in the upper escarpment are likely fed from shallow groundwater flows originating from the upper Inferior Oolite aquifer. Drainage introduced as part of stabilisation measures at Crickley Hill is designed to drawdown the water level in cohesive superficial deposits. If these drains intersect permeable deposits they have the potential to intercept groundwater flow that contributes to springs.	Springs in tributary of Norman's Brook - upper Crickley Hill escarpment springs and seepages (G206 and 83)	High	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
Construction of cutting between Ch. 1+700 and 3+000 is likely to have an impact on groundwater flow paths, particularly near the Crickley Hill escarpment where it may intercept fissures and gulls that transport groundwater to groundwater dependent features at Crickley Hill.	Inferior Oolite - Principal aquifer	High	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4), and voids treatment protocol	Negligible	Slight adverse
Springs are likely to be fed by groundwater flowing through the fault, which is receiving groundwater from the Inferior Oolite aquifer, upgradient of cutting Ch. 1+700 to 3+000. The springs are outside radius of influence boundary of this cutting, however there may be reduction in peak winter flow if cutting intersects karst in drainage invert	Springs in tributary to Norman's Brook - fault springs (16, 17, 18, 19)	High	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4) Temporary drainage design to maintain water balance within specific sub-catchment and voids treatment protocol	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Well located in an area not anticipated to be impacted by cutting Ch. 1+700 to 3+000 (outside scheme footprint of calculated drawdown).	Well No. 83, potentially fed by perched groundwater/spring flow from Inferior Oolite limestone. The purpose of the well is unknown.	Low	None	No change	Neutral
Construction of cutting Ch. 1+700 to 3+000 is unlikely to have an impact on groundwater flow and levels at Well G199 location.	Well No. G199, historic disused well	Low	None	No change	Neutral
Construction of the cutting Ch. 1+700 to 3+000 likely to intercept groundwater that is within the Severn Vale groundwater catchment and does not contribute to groundwater spring flow.	Springs and seepages in tributary of River Churn headwaters (G99, G97)	Medium	None	No change	Neutral
Construction of cutting Ch. 1+700 to 3+000 is unlikely to have an impact on groundwater flow and levels at the dry valley. The dry valley is anticipated to be up-gradient of the cutting with respect to local groundwater flow paths. The dry valley is beyond the maximum drawdown radius of influence, induced by the cutting.	Dry valley (G3) (new fault)	High	None	No change	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Excavation and dewatering impacts due to the Shab Hill junction on/off ramp cuttings on groundwater levels are unlikely to have an impact as the cutting level is above the maximum anticipated groundwater level.	Inferior Oolite - Principal aquifer	High	None	No change	Neutral
The cuttings assessment shows that this feature is outside of the potential dewatering zone of influence, however there may be potential reduction in peak winter spring flow	Shab Hill dry valley (G146)	Medium	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
The public water supply is abstracting water from the Inferior Oolite aquifer, which is overlain by the Fuller's Earth Formation aquitard and Great Oolite limestone in the Stockwell-Nettleton area. The cuttings Ch. 3+200 and 5+000 will be founded within the Great Oolite Group and hydraulically disconnected from the Inferior Oolite so potential impacts to flow are negligible.	Baunton public water supply, SPZ3	High	None	No change	Neutral
Ch. 3+200 to 5+000 cuttings will result in removal of Great Oolite aquifer within the Severn Vale catchment which will cause a reduction in the resource extent.	Great Oolite limestone - Principal aquifer	High	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Excavation and dewatering of cuttings between Ch. 3+200 and 5+000 will result in removal of Great Oolite aquifer within the Severn Vale catchment which will cause a reduction in the resource extent and recharge area that feeds into the alluvium aquifer. Potential drawdown impacts from Ch. 3+200 to 5+000 cuttings are assessed as negligible as the alluvium is beyond the maximum calculated radius of influence	Alluvium - Secondary A aquifer	Medium	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
Construction of cuttings Ch. 3+200 to 5+000 will be within the Great Oolite limestone. Groundwater that would run-off from the Great Oolite, over the Fuller's Earth Formation and into the headwaters will be intercepted by the drainage design.	Springs and seepages in tributary of River Churn headwaters (G174, G4, G5, G6, G77)	Medium	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
	Springs and seepages in tributary of River Frome headwaters (east) (G143, G150, G147, G173, G100, G219, G223, G222)	High	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Construction of cuttings Ch. 3+200 to 5+000 will be within the Great Oolite limestone. The cuttings assessment (HIA) shows that these springs are outside of the potential dewatering zone of influence, however there may be potential reduction in peak winter spring flow.	Springs and seepages in tributary of River Frome headwaters (east) (G150, G147, G173, G100, G219, G220, G221)	High	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
Drawdown in groundwater levels associated with scheme's cuttings Ch. 3+200 to 5+000 impacting Groundwater Dependent Terrestrial Ecosystem	Bushley Muzzard SSSI and other springs and seepages in tributary of River Frome headwaters (west)	High	Not required	No change	Neutral
These springs in the direct path of the scheme alignment. They will be lost during construction in addition to the tributary of Norman's Brook that they feed into.	Springs in tributary of Norman's Brook springs and seepages (61, 69, 72, 78, 80, G2, G17, G20, G151)	High	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
The construction of widening the existing A417 will result in the loss of this feature, which is a localised feature not supporting any groundwater dependent habitats.	Seepage G138	Low	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
These springs in the direct path of the scheme alignment. Construction of the Shab Hill junction embankment will include a drainage blanket foundation that will allow for groundwater flow across the dry valley. Impacts on flow across the valley are likely to be negligible.	Shab Hill dry valley (G146, G183)	Medium	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
This spring is in the footprint of an embankment and will be buried during construction.	Springs in tributary of River Churn headwaters (G174)	Medium	Temporary drainage design to maintain water balance within specific sub-catchment	Negligible	Slight adverse
Construction of Cotswolds Way crossing piled foundation is likely to have an impact on groundwater flow paths, particularly near the Crickley Hill escarpment where it may intercept fissures and gulls that transport groundwater to groundwater dependent features at Crickley Hill.	Inferior Oolite - Principal aquifer	High	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4), FWRA and voids treatment protocol	Negligible	Slight adverse
Construction of the Cowley and Stockwell overbridges pile foundation is likely to intercept the Inferior Oolite limestone underlying the Great Oolite limestone and Fuller's Earth Formation. Construction is likely to be above the maximum groundwater level so impacts on groundwater flow and level are likely to be negligible.	Inferior Oolite - Principal aquifer	High	FWRA	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Construction of the Cowley and Stockwell overbridge pile foundation may impact groundwater flow and level in the Great Oolite limestones. However, the impact is likely to be very local. As the foundations piles are likely to be constructed in groups with gaps in between individual piles, impact on groundwater flow is likely to be negligible.	Springs and seepages in tributary of River Churn headwaters (G174, G4, G5, G6, G77)	Medium	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4) and FWRA.	Negligible	Slight adverse
	Springs and seepages in tributary of River Frome headwaters (east) (G143, G150, G147, G173, G100, G219, G223, G222)	High	Adherence to ES Appendix 2.1 EMP (Document Reference 6.4) and FWRA	Negligible	Slight adverse
The Bushley Muzzard SSSI is fed by groundwater springs at the Great Oolite limestone and Fuller's Earth formation, which feed into the headwaters of the River Frome tributary (west). Underlying Head Deposits may allow for some perching of shallow groundwater. The SSSI is unlikely to be directly hydraulically connected to the proposed works on the opposite side of the River Frome headwater valley (east).	Bushley Muzzard SSSI and associated springs (G102, G25) also feeding to tributary of River Frome headwaters (west)	High	None	No impact	Neutral

1.3 Summary of non-significant effects – Surface Water – Operation

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Alteration to baseflow of springs as a result of embankments during operation impacting surface water quantity	Tributary of Norman's Brook	High	Mitigation listed in Annex G of ES Appendix 2.1 EMP (Document Reference 6.4) will maintain existing flow regime	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
Alteration to baseflows as a result of cuttings and structures during operation impacting surface water quantity	Tributary of Norman's Brook	High	Cutting or structure drainage maintains flow directions and existing catchment areas wherever possible. Detailed assessment of groundwater-surface water interaction during detailed design. Adherence to Annex G of ES Appendix 2.1 EMP (Document Reference 6.4)	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Sediment and dissolved metals discharging into surface watercourses via outfalls impacting surface water quality	Tributary of Norman's Brook	High	Mitigation will be required at detailed design stage for outfalls to ensure appropriate treatment levels are met.	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Introduction of new culverts and outfalls on hydrology impacting hydromorphology	Tributary of Norman's Brook	High	CD 529 Design of outfall and culvert details standard and CIRIA C786 Culvert, Screen and Operation Manual guidance adhered to	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Accidental spillage during operation impacting water quality	Tributary of Norman's Brook	High	Not required	Negligible	Slight adverse
	Unnamed tributaries of River Churn	Medium			Slight adverse
	Unnamed tributary of River Frome	High			Slight adverse
	Unnamed tributary of Horsbere Brook	Medium			Slight adverse
Flood risk to the site during operation	Scheme	Very High	Draining and crossing will be designed to the standard level of protection as the design progresses and residual risk is understood	No change	Neutral
Flood risk from the site during operation	Residential properties surrounding the scheme extent	High	It is assumed that the scheme will be designed to not cause any detriment to fluvial, surface or groundwater flood risk.	No change	Neutral
	Colleges, High Schools and Primary Schools surrounding scheme extent	High			
	Land used for agriculture surrounding the scheme extent	Medium			

1.4 Summary of non-significant effects – Groundwater – Operation

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Accidental spillage during operation	Superficial deposits - Secondary A aquifer	High	Not required	Negligible	Slight adverse
	Lias Group - Secondary (undifferentiated) aquifer	Medium			Slight adverse
	Inferior Oolite - Principal aquifer	High			Slight adverse
	Great Oolite - Principal aquifer	High			Slight adverse
The permanent construction and operation of drainage basins	Cheltenham Sand and Gravel - Secondary A aquifer	Medium	Drainage basin design with in-built treatment measures to mitigate potential impacts to groundwater quality.	No change	Neutral
	Great Oolite limestone - Principal aquifer	High			
	Inferior Oolite - Principal aquifer	High			
	Shab Hill dry valley (G146)	Medium			
	Springs in tributary of River Churn headwaters	Medium			
Highway drainage has the potential to cause minor drawdown within the aquifer, however the widening is at grade with the existing A417 so the drawdown impacts are anticipated to be negligible	Cheltenham Sand and Gravel - Secondary A aquifer	Medium	None	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Highway drainage within the superficial deposits overlying the low water bearing Lias Group, which will protect the Lias Group in terms of both groundwater flow	Lias Group - Secondary (undifferentiated) aquifer	Medium	None	No change	Neutral
Springs in the upper escarpment are likely fed from shallow groundwater flows originating from the upper Inferior Oolite aquifer. Drainage introduced as part of stabilisation measures at Crickley Hill is designed to permanently drawdown the water level in cohesive superficial deposits. If these drains intersect permeable deposits they have the potential to intercept groundwater flow that contributes to springs.	Springs in tributary of Norman's Brook - upper Crickley Hill escarpment springs and seepages (G206 and 83)	High	Drainage strategy intent is to convey groundwater captured in the drainage back to surface water catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse
Cutting between Ch. 1+700 and 3+000 is likely to have an impact on groundwater flow paths, particularly near the Crickley Hill escarpment where it may intercept fissures and gulls that transport groundwater to groundwater dependent features at Crickley Hill.	Inferior Oolite - Principal aquifer	High	Voids treatment protocol	Negligible	Slight adverse
Springs are likely to be fed by groundwater flowing through the fault, which is receiving groundwater from the Inferior Oolite aquifer, upgradient of cutting Ch. 1+700 to 3+000. The springs are outside radius of influence boundary of highway drainage, however there may be reduction in peak winter flow if highway drainage intersects karst.	Springs in tributary to Norman's Brook - fault springs (16, 17, 18, 19)	High	None	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Well located in an area not anticipated to be impacted by cutting Ch. 1+700 to 3+000 (outside scheme footprint of calculated drawdown).	Well No. 83, potentially fed by perched groundwater/spring flow from Inferior Oolite limestone. The purpose of the well is unknown.	Low	None	No change	Neutral
Highway drainage within cutting Ch. 1+700 to 3+000 is unlikely to have an impact on groundwater flow and levels at Well G199 location.	Well No. G199, historic disused well	Low	None	No change	Neutral
Highway drainage of cutting Ch. 1+700 to 3+000 likely to intercept groundwater that is within the Severn Vale groundwater catchment and does not contribute to groundwater spring flow.	Springs and seepages in tributary of River Churn headwaters (G99, G97)	Medium	None	No change	Neutral
Highway drainage of cutting Ch. 1+700 to 3+000 is unlikely to have an impact on groundwater flow and levels at the dry valley. The dry valley is anticipated to be up-gradient of the cutting with respect to local groundwater flow paths. The dry valley is beyond the maximum drawdown radius of drainage influence.	Dry valley (G3) (new fault)	High	None	No change	Neutral
Highway drainage at the Shab Hill junction on/off ramp cuttings on groundwater levels are unlikely to have an impact as the cutting level is above the maximum anticipated groundwater level.	Inferior Oolite - Principal aquifer	High	None	No change	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
The assessment shows that this feature is outside of the potential zone of influence of highway drainage, however there may be potential reduction in peak winter spring flow	Shab Hill dry valley (G146)	Medium	Drainage strategy intent is to return groundwater captured in the cutting drainage back to the same aquifer and groundwater catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse
The public water supply is abstracting water from the Inferior Oolite aquifer, which is overlain by the Fuller's Earth Formation aquitard and Great Oolite limestone in the Stockwell-Nettleton area. The cuttings Ch. 3+200 and 5+000 will be founded within the Great Oolite Group and hydraulically disconnected from the Inferior Oolite so potential impacts to flow are negligible.	Baunton public water supply, SPZ3	High	None	No change	Neutral
Ch. 3+200 to 5+000 cuttings will result in removal of Great Oolite aquifer within the Severn Vale catchment which will cause a reduction in the resource extent.	Great Oolite limestone - Principal aquifer	High	Drainage strategy intent is to return groundwater captured in the cutting drainage back to the same aquifer and groundwater catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse
Permanent highway drainage of cuttings between Ch. 3+200 and 5+000 will result potential drawdown in Great and will cause a reduction in the resource extent and recharge area that feeds into the alluvium aquifer. The alluvium is beyond the maximum calculated radius of influence.	Alluvium - Secondary A aquifer	Medium	Drainage strategy intent is to return groundwater captured in the cutting drainage back to the same aquifer and groundwater catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Highway drainage of cuttings Ch. 3+200 to 5+000 will be within the Great Oolite limestone. Groundwater that would run-off from the Great Oolite, over the Fuller's Earth Formation and into the headwaters will be intercepted by that drainage.	Springs and seepages in tributary of River Churn headwaters (G174, G4, G5, G6, G77)	Medium	Drainage strategy intent is to return groundwater captured in the cutting drainage back to the same aquifer and groundwater catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse
	Springs and seepages in tributary of River Frome headwaters (east) (G143, G150, G147, G173, G100, G219, G223, G222)	High		Negligible	Slight adverse
Highway drainage of cuttings Ch. 3+200 to 5+000 will be within the Great Oolite limestone. The assessment shows that these springs are outside of the potential zone of influence, however there may be potential reduction in peak winter spring flow.	Springs and seepages in tributary of River Frome headwaters (east) (G150, G147, G173, G100, G219, G220, G221)	High	Drainage strategy intent is to return groundwater captured in the cutting drainage back to the same aquifer and groundwater catchment resulting in minimal net loss to the water balance.	Negligible	Slight adverse
Drawdown in groundwater levels associated with highway drainage at Ch. 3+200 to 5+000 impacting Groundwater Dependent Terrestrial Ecosystem	Bushley Muzzard SSSI and other springs and seepages in tributary of River Frome headwaters (west)	High	Not required	No change	Neutral
These springs will be buried beneath the embankment.	Springs in tributary of Norman's Brook springs and seepages (61, 69, 72, 78, 80, G2, G17, G20, G151)	High	Design of embankment and tributary realignment will include a drainage blanket and redirection of the springs to the realigned tributary	Negligible	Slight adverse
This seepage is in the footprint of the scheme and will be buried. It is a localised feature not supporting any groundwater dependent habitats.	Seepage G138	Low		Negligible	Neutral

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
These springs in the scheme footprint and will be buried.	Shab Hill dry valley (G146, G183)	Medium	Design of embankment will include a drainage blanket and redirection of the springs to the dry valley	Negligible	Slight adverse
This spring is in the footprint of an embankment and will be buried.	Springs in tributary of River Churn headwaters (G174)	Medium	Drainage design will return intercepted groundwater to the same groundwater catchment resulting in no net loss from the groundwater body and spring flow.	Negligible	Slight adverse
Potential alteration of shallow groundwater flow pathways may occur around new overbridge foundations. Due to the location and minor extent of the foundations within the much larger area of aquifer and close proximity to the anticipated groundwater divide location, the impact on groundwater flow pathways will be minor.	Great Oolite limestone - Principal aquifer	High	None	Negligible	Slight adverse
Piled foundation for Cotswolds Way crossing is likely to have an impact on groundwater flow paths, particularly near the Crickley Hill escarpment where it may intercept fissures and gulls that transport groundwater to groundwater dependent features at Crickley Hill.	Inferior Oolite - Principal aquifer	High	FWRA and voids treatment protocol	Negligible	Slight adverse
Pile foundation for Cowley and Stockwell overbridges is likely to intercept the Inferior Oolite limestone underlying the Great Oolite limestone and Fuller's Earth Formation. Piles are likely to be above the maximum groundwater level so impacts on groundwater flow and level are likely to be negligible.	Inferior Oolite - Principal aquifer	High	FWRA	Negligible	Slight adverse

Potential impact	Receptor	Value	Design and mitigation measures	Magnitude of impact	Significance of effect
Construction of the Cowley and Stockwell overbridge pile foundation may impact groundwater flow and level in the Great Oolite limestones. However, the impact is likely to be very local. As the foundations piles are likely to be constructed in groups with gaps in between individual piles, impact on groundwater flow is likely to be negligible.	Springs and seepages in tributary of River Churn headwaters (G174, G4, G5, G6, G77)	Medium	The design intention is to have gaps between the piles to minimise the impact of groundwater mounding. FWRA	Negligible	Slight adverse
	Springs and seepages in tributary of River Frome headwaters (east) (G143, G150, G147, G173, G100, G219, G223, G222)	High		Negligible	Slight adverse
The Bushley Muzzard SSSI is fed by groundwater springs at the Great Oolite limestone and Fuller's Earth formation, which feed into the headwaters of the River Frome tributary (west). Underlying Head Deposits may allow for some perching of shallow groundwater. The SSSI is unlikely to be directly hydraulically connected to the scheme on the opposite side of the River Frome headwater valley (east).	Bushley Muzzard SSSI and associated springs (G102, G25) also feeding to tributary of River Frome headwaters (west)	High	None	No impact	Neutral