ENVIRONMENTAL STATEMENT
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A15.1 SURFACE WATER – DETAILED ASSESSMENT

15.1 INTRODUCTION

This Appendix describes the detailed assessment of the predicted impacts on the quality and hydrology of surface waters, most notably the streams in Rupert's Valley, Dry Gut and Sharks Valley which could potentially be directly affected by the proposed scheme. Potential impacts on groundwater and the ecology associated with aquatic features are covered in the Geology, Contaminated Land and Hydrogeology, and Terrestrial and Ecology Appendices 13 and 9, respectively.

15.2 METHODS

15.2.1 General Approach

Broadly the method for assessment of effects on the surface water environment involves the following stages:

1) Description of the existing surface water features which might be affected. This includes a discussion regarding the value and importance of each of the features – see Section 15.2.2 which describes the assessment of importance and significance
2) Assessment of the potential effects which could occur temporarily during construction and permanently during operation.
3) Identification of the mitigation measures which will be, and have been, incorporated into the scheme to reduce the effects
4) Description of the residual effects, i.e. prediction of the effects which would occur taking into account mitigation measures.

This Chapter covers several aspects of the proposed scheme which could potentially affect the surface water environment, including:

- **Diversion of the stream** around the proposed new Bulk Fuel Installation in Rupert's Valley
- The **temporary quarry** in Rupert's Valley
- **Drainage** from the new **access road**
- **Crossings of watercourses** by the new access road
- Proposed **new culvert of Dry Gut** under the runway embankment
- **Permanent water supply to the airport -** abstraction of water from point A1/A2 in **Sharks Valley** close to Hencock Hole

There are three options for the possible source of water to supply the construction works. A number of assumptions have been made in this regard and these have been made clear in the text. It may be that these supply options are used in combination with each other. The options are as follows:

- **Temporary** water supply to the construction works - **abstraction of water from Sharks Valley close to the waterfall at the beach;** or
- **Temporary Storage Reservoir in Dry Gut** for water supply during construction; or
- **Abstraction and use of sea water** for compaction of the Dry Gut embankment during construction.

All the potential effects have been investigated following the same broad approach which is detailed in Section 15.2.2. The potential effects have been identified and possible mitigation measures to reduce the impacts are discussed.

15.2.2 Method for the Assessment of Importance of Existing Features and Significance of Potential Effects

Potential impacts that may result from the construction and operation of the scheme have been assessed for significance following a methodology based broadly on Department for Transport Appraisal Guidance (TAG) /Design Manual for Roads and Bridges (DMRB) methodology. This methodology was originally produced for the assessment of the impact of highway development on the water environment, but lends itself to this scheme as it enables systematic ranking of the water environment features and impacts.

Potential impacts have been classed as adverse/beneficial, direct/indirect, permanent/temporary, and short/long term. The magnitude of a potential impact is independent of the importance of the feature and is initially estimated on the basis of no mitigation measures being included. The significance of a specific potential impact is derived from both the importance of the feature and the magnitude of the impact taking into account proposed mitigation. The result of this assessment is presented as “residual impacts”. The assessment is largely based on a qualitative approach which has involved an element of professional judgement in determining likely effects.

The assessment process described above has three stages:

1) Each water feature (or specific attribute of a water feature) is assessed for **importance** using the criteria presented in **Table 15.1**;
2) The **magnitude** of potential impacts is then determined using the criteria in **Table 15.2**; and
3) Finally, the importance of a water feature is compared against the magnitude of potential impacts in the assessment of **significance matrix** presented in **Table 15.3.**

Table 15.1 Criteria to determine the importance of features

Importance of feature/attribute	Criteria
Very High	Attribute has a high quality and high rarity on the regional or national scale
High	Attribute has a high quality and high rarity on the local scale
Medium	Attribute has medium quality and medium rarity on the local scale
Low	Attribute has low quality and low rarity on the local scale

Note: quality includes factors such as conveyance of flows and flood flows, biodiversity, water supply, aesthetics and recreation

Table 15.2 Criteria to determine the Magnitude of Impact

Magnitude of Impact	Criteria
Major adverse	Results in loss of attribute and/or quality and integrity of the attribute
Moderate adverse	Results in effect on integrity of attribute, or loss of part of attribute
Minor adverse	Results in some measurable change in attributes quality or vulnerability
Negligible	Results in effect on attribute, but of insufficient magnitude to effect the use or integrity

Note: It is assumed that beneficial impacts better than minor are unlikely to occur as a result of the scheme and are therefore not presented.

Table 15.3 Assessment of Significance Matrix

Importance of Attribute	Magnitude of Impact				
		Major	**Moderate**	**Minor**	**Negligible**
	Very High	Very large	Large/very large	Moderate/large	Neutral
	High	Large/very large	Moderate/large	Slight/moderate	Neutral
	Medium	Large	Moderate	Slight	Neutral
	Low	Slight/moderate	Slight	Neutral	Neutral

15.3 EXISTING SURFACE WATER FEATURES

An environmental baseline sufficiently detailed for the assessment of potential impacts was determined following a desk study and site walk-over. Monitoring data was also reviewed where available. The desk study included consultation with the Public Works and Services Department and the Environmental Co-ordinator. The sources of information included the following:

- St Helena Water Plan 1990 to 2010.
- Atkins studies and technical specifications relating to raw water provision for the proposed St Helena Airport and Supporting Infrastructure including the ITT for the DBO contract: DFID and SHG, May 2007.
- Information from Atkins regarding demand during construction and operation and possible sources of water including St Helena Access: Procurement of a DBO Contractor – Review of Demand for and supply of Water for airport construction purposes, Draft Report, April 2007.
- Sharks Valley flow data collected by PWSD – presented in Appendix 15.2.

Table 15.4 identifies the main features within the vicinity of the site of the proposed airport, haul roads and permanent access roads. Figure 15.1, Volume 3 also identifies the watercourses. Photographs 15.1 to 15.15 are presented on Figure 15.3, Volume 3 of the ES.

Table 15.4 Watercourses

Name	Location	Flow	Importance	Photo No. in Figure 15.3, Vol. 3 of this ES
Rupert's Valley	Drains a large catchment including Rupert's Hill and Bunker's Hill	Ephemeral	High	15.7, 15.8 and 15.9
Streams which outfall to Rupert's Bay and Bank's Valley Bay	In addition to the main stream in Rupert's Valley two streams outfall to the Bay one via Bloody Bridge the other close to the Bulk Fuel Farm	Ephemeral	Medium	
Tributaries of Rupert's Valley	Drain the slopes of Rupert's Hill and Bunker's Hill and join the watercourse at the bottom of the valley	Ephemeral	Low	
Streams which outfall to Bank's Valley Bay	These streams drain Rupert's Hill and Bank's Ridge	Ephemeral	Medium	
Netley Gut	Drain Deadwood Plain and flows to Turk's Cap Bay via Turk's Cap Valley	Ephemeral	Medium	
Mulberry Gut	Rises in Longwood and flows to Turk's Cap Bay via Turk's Cap Valley	Ephemeral	Medium	
Bilberry Field Gut	Rises in Longwood and flows to Turk's Cap Bay via Turk's Cap Valley	Ephemeral	Medium	
Watercourse close to Bottom Woods met station and the landfill site at Horse Point	Rises close to the met station at Bottom Woods and meets the coast to the south of Turk's Cap	Ephemeral	Medium	
Fisher's Valley and Prosperous Bay Valley	Rises in the higher ground close to the peaks and flows in an easterly direction, meeting the coast at Prosperous Bay. Fisher's Valley has been identified as a candidate site for a Ramsar due to its importance for wetland birds.	Ephemeral During October/ November 05 site visit low flow over base rock waterfalls and dry in sections of deep soft sediment bottom substrate.	High	15.4, 15.5 & 15.6
Tributaries of Fisher's Valley	Drain the northern extent of Prosperous Bay Plain	Ephemeral	Medium	15.7

Name	Location	Flow	Importance	Photo No. in Figure 15.3, Vol. 3 of this ES
Guts draining Prosperous Bay Plain	Drain Prosperous Bay Plain directly to Dry Gut Bay to the east of the proposed airport	Ephemeral	Medium	
Dry Gut	Rises in Woody Ridge and flows east between Bencoolen and Prosperous Bay Plain to reach the coast close to Gill Point	Ephemeral	High	15.8 & 15.9
Tributaries of Dry Gut	Carry drainage from the southern extent of Prosperous Bay Plain	Ephemeral	Medium	
Sharks Valley	Drains a large catchment which includes Levelwood. Flows from west to east to reach the coast at Stone Top Bay	Normally flows all year round.	Very High – being one of only two steams on St Helena which flow throughout the year	15.10 to 15.15

The majority of the guts and valleys are heavily eroded steep sided valleys with dry and easily eroded gravel and boulder substrates although some watercourses have stretches of bedrock, including sections of Dry Gut. With the exception of Sharks Valley, the majority of the watercourses were dry during the October/November 2005 site visit. During April 2006 water was flowing in Dry Gut.

The proposed site for the airfield is located on Prosperous Bay Plain within the eastern arid area of the island. Rainfall is low (approx 460mm/year at Bottoms Wood, Met Office, 2006, and could be less than 300mm/year on Prosperous Bay Plain, Atkins 2007) but can be intense at times. Conditions along the route of the access road and within Rupert's Valley are slightly wetter than on Prosperous Bay Plain.

15.3.1 Flow Data for Sharks Valley

A limited amount of flow data is available for Sharks Valley (see Appendix 15.2). Since July 2006 PWSD estimate the daily flow in Sharks Valley on a weekly basis at four locations along the watercourse. The four locations are referred to as; A1, A1/A2, C and D as illustrated in Figure 15.1, Volume 3. Measurements at the waterfall close to the point at which the stream joins the ocean in Stone Top Bay were also carried every two weeks between 23 December 2006 and 16th June 2007. PWSD report that the daily flows are estimated using a stop watch and 30 litre ($0.03m^3$) container, where the length of time to fill the container is used as a means of calculating the daily flow.

In addition to the PWSD data, the Royal Engineers estimated daily flows on a weekly basis between January and December 1979. This data-set comprises 46 readings at five locations along Sharks Valley; G, A1, A2, B, and C as illustrated in Figure 15.1, Volume 3.

The locations where flows are estimated are slightly different between the two data-sets; whereas the Royal Engineers added the flow recorded at A1 to A2, PWSD take a single measurement downstream of the confluence. It should also be noted that the Royal Engineers point B is slightly downstream of the PWSD point C and the Royal Engineers point C is much further downstream than the current point D.

The proposed abstraction point on Sharks Valley is referred to as "A1/A2" for which data from PWSD and the Royal Engineers is comparable.

Data concerning daily river flows in Sharks Valley has been collected by PWSD on a weekly basis between July 2006 and August 2007. There are 16 measurements at the waterfall in Sharks valley between the period November 2006 and June 2007. Six of these measurements record the flow at the waterfall as 648m^3 per day, nine are 518m^3 per day and the final reading is 162m^3 per day. With the exception of the final reading, the data suggests a very limited variability in the flow observed at the waterfall. The quality of the data is unknown. Collection of flow data is continuing.

The PWSD flow data at point A1/A2 comprises 68 readings taken between July 2006 and August 2007 on a weekly basis, plus several additional readings prior to July 2006. There is also a lack of variability in the A1/A2 dataset similarly to that from the waterfall. 23 of the readings are recorded as 324m^3 per day, 22 readings are 370m^3 per day and a further 18 readings are 288m^3 per day. Due to the lack of variability in the dataset it does not lend itself to deriving flow statistics such as Q95 which is the flow which is exceeded for 95% of the time. The Q95 to the Q70 are all 288m^3 per day, the Q65 up to the Q40 are all 324m^3 per day, and the Q35 to the Q5 are all 370m^3 per day.

On the basis that the flows in Sharks Valley exhibit very little variation, and assuming that the data is accurate, it is hypothesised that the baseflow measured is sourced from groundwater / spring flow. An analysis of flow and rainfall data indicated that the flows do not appear respond to periods of rainfall. Diagram 15.1 presents the daily rainfall record from three gauges which are all in close proximity to Sharks Valley, along with the observed flow at point A1/A2. The data covers the period 15th November to 12th December 2006 when there was no variability in the observed flow in Sharks Valley even though there is some variation in the rainfall recorded.

Diagram 15.1 Rainfall Data close to Sharks Valley November – December 2006

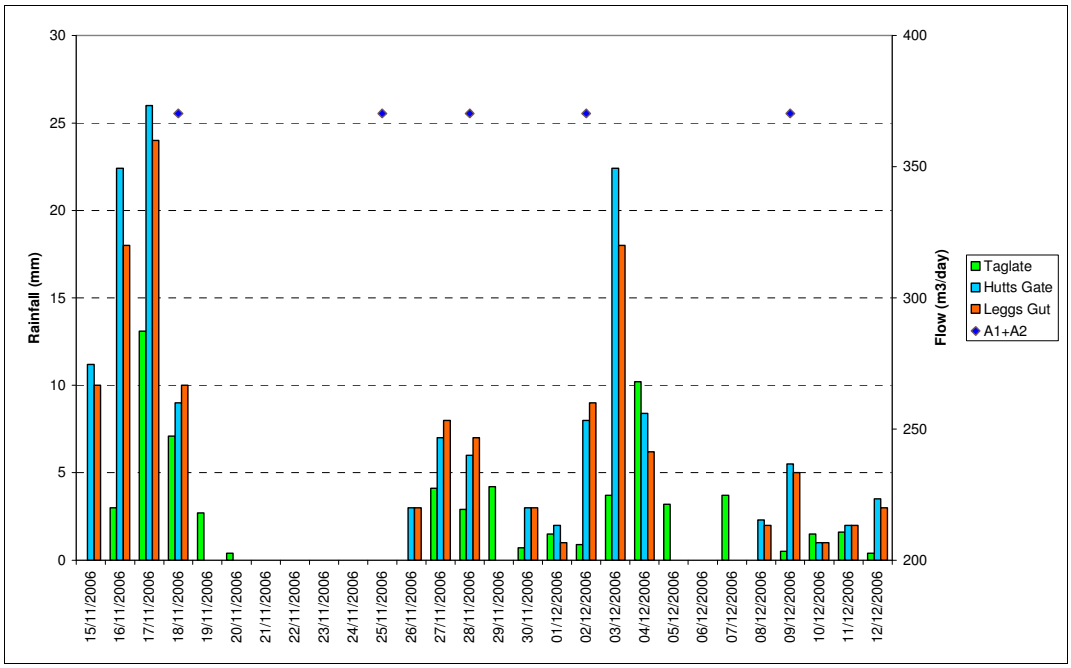
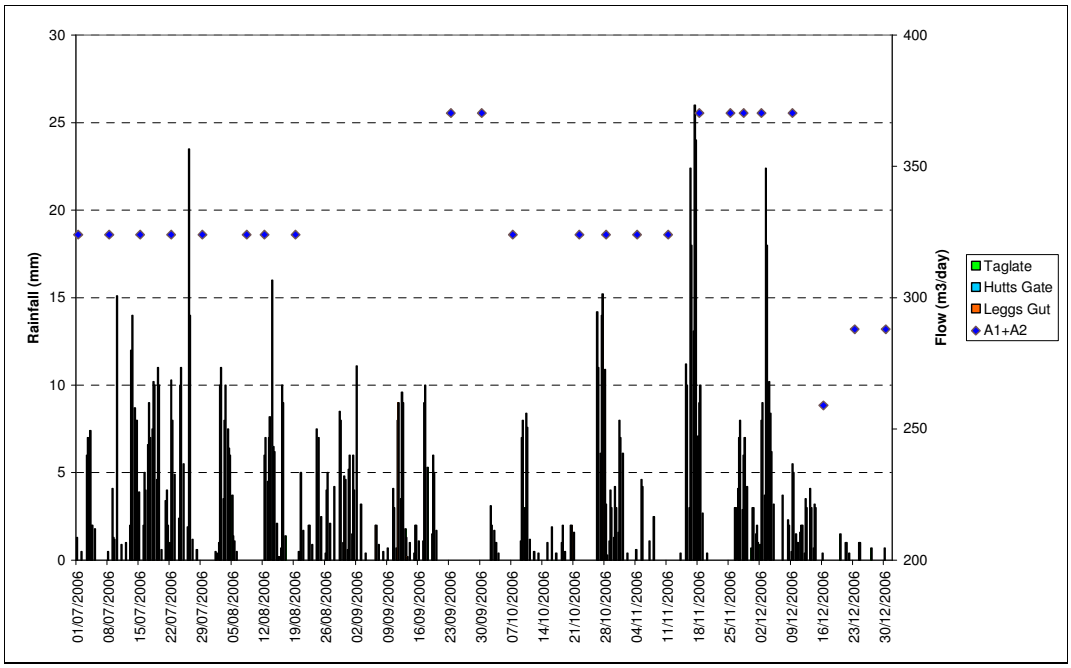


Diagram 15.2 illustrates rainfall and flows covering the period from July to December 2006 where the only occasion when river flows appear to respond to a rainfall input is on the 18th November. Otherwise there appears to be no pattern between rainfall inputs impacting on the observed flow.

Diagram 15.2: Rainfall Data close to Sharks Valley July – December 2006



Consequently it is assumed that during a rainfall event, runoff is fairly instantaneous due to the bare gravel sides of the valley. As a result the river has responded to the rainfall

event and flows returned to normal by the time PWSD next measure the flows. During a site walkover water was seen to be seeping out of the cliff face. Therefore any rain that does infiltrate the surface may be channelled along discontinuities in the rock strata and is seen seeping out of the cliff face, rather than percolating down to the watercourse. These characteristics, should they exist, may explain why there is little variation in the flows in Sharks Valley.

15.4 CONSTRUCTION EFFECTS – TEMPORARY

15.4.1 Potential Effects

This Section describes the potential impacts might occur during construction if no mitigation is put in place. This covers general construction impacts applicable to all construction sites followed by a description of more specific concerns applicable to particular sites.

15.4.1.1 General Construction Effects

If site activities are not adequately controlled pollution of watercourses could occur as a result of the following:

a) Storage of **oils, fuels or chemicals** have the potential cause pollution of watercourses.
b) Deposition of **silt or detritus** in watercourses.
c) Washing of **tools or materials** in watercourses.
d) Silt from **pumped water from excavations** entering watercourses.
e) **Interference with banks and channels** of watercourses.
f) **Vehicles driving** in watercourses.
g) **Batching plant** discharges to watercourses.
h) Lack of environmental awareness of construction workers.
i) Lack of effective clean-up after an incident.

15.4.1.2 Rupert's Valley and the Route of the Haul Road

The construction of the diversion channel for the stream in Rupert's Valley at the proposed BFI site could cause effects as described in b) and e) in Section 15.4.1.1 above.

The proposed temporary quarry could also cause disruption to hydrology and could cause large scale contamination of local watercourse.

Construction materials and silt could fall or be washed into watercourses within Rupert's Valley and into other guts and valleys along the route of the proposed haul road, including Mulberry Gut and Bilberry Field Gut. This could lead to pollution of watercourses and possible blockages in flows.

15.4.1.3 Prosperous Bay Plain

In addition to the general construction effects described above the earthworks and construction associated with the airfield, including the Dry Gut embankment, the possible temporary runway could result in the following effects:

a) Additional run-off from increased permeable area

b) Silt being washed off road surface into watercourses
c) Foul sewage from contractor's compound

15.4.1.4 Sharks Valley - Temporary Water Supply for Construction

Abstraction of water from Sharks Valley will have the effect of reducing the volume of water in the watercourse downstream of the abstraction point. Locations close to the waterfall and at point A1/A2 have been cited as potential abstraction points. Point A1/A2 at which the intake works would be constructed, the route of the pipeline, break tank and storage tanks are all shown in Figure 15.2. Flows in Sharks Valley may also be affected by groundwater abstraction elsewhere within the catchment, if this were to occur.

The reduction in water volume, depth and flow rates downstream of the abstraction point during construction is unlikely to cause the permanent loss of any plant species or habitats. Less water in Sharks Valley could have the effects of;

- Drying out surrounding soils.
- Expose aquatic habitats.
- Reduce erosion and increase sediment deposition.
- Additional sedimentation may smother vegetation and any aquatic habitats that may support invertebrates or other species.
- Damage to habitat viability through formation of sediment 'concretions'.
- Potential for damage to or dieback of marginal vegetation through reduction in support from water column and drying out of soil/sediments.
- Terrestrial vegetation dieback and reduction in biodiversity.
- Reduction in water quality due to reduced aeration and higher water temperatures.

The impacts of there being less water in Sharks Valley are predominately associated with vegetation that may depend on the watercourse. The drier soils could hasten the spread of the alien invasive wild mango, which as well as enjoying moist situations is also drought tolerant, over the water loving and more dependent species, like the Scirpus and wild celery. Controlling the spread of wild mango may be necessary as part of ecological reinstatement works.

15.4.1.5 Water Supply - Dry Gut – possible temporary storage reservoir

A 15m high weir has been proposed to create a storage reservoir in Dry Gut capable of storing 100,000m^3 of water. Dry Gut is an ephemeral stream only flowing for certain months of the year. There is currently no information available concerning the characteristics of flow in Dry Gut.

A weir would act as a dam trapping a significant quantity of the ephemeral flow limiting the flow experienced further downstream. This could have the effect of limiting seasonal plant growth that may only occur when the stream is flowing. However, given that the river corridor regularly experiences dry conditions it is assumed that any extension of the lack of flow will not have a detrimental impact upon the environment.

The weir would also create a zone of deposition limiting sediment transport further downstream. Depending on the nature of the watercourse, rare flood flows may play a role in geomorphic evolution of the landscape moving large quantities of sediment down

valley thereby re-shaping the river corridor and re-organising the biodiversity. If so the presence of a 15m weir would prevent this.

In addition to limiting flow further downstream, the weir will create a reservoir immediately upstream. This will flood marginal land either side of the watercourse that previously experienced drier conditions and could cause instability amongst the sediments and drown, albeit sparse, marginal vegetation. The weir will also block certain biological communication channels between the upstream and downstream aquatics in Dry Gut. It may also impair genetic exchanging between the species in the river bed. These negative impacts might be more obvious in the long term. It is difficult to fully evaluate the degree of such impacts, due mainly to lack of data and uncertainty in effects.

In contrast to the potential adverse effects stated above, creation of a water body on Dry Gut behind the weir could also have a beneficial effect on the local environment. The wetter conditions should encourage the growth and development of some of the more water loving vegetation communities. However this should be managed to ensure favourable species establish in preference to invasive species.

15.4.1.6 Water Supply - Gill Point – temporary sea water abstraction

The Contractor may abstract sea water from Gill Point for use during compaction of the embankment in Dry Gut. It is during this activity that the peak in demand for water would occur.

15.4.1.7 Summary of Potential Adverse Effects on the Surface Water Environment during Construction

Table 15.5 Summary of Potential Adverse Effects on the Surface Water Environment during Construction

	Potential Impacts
Construction - general	Potential contamination from surface water drainage from the construction site and dewatering of excavations if required. Contaminants could include silt washed from exposed ground
	Potential for temporary disturbance to river banks, bed, channel, flow regime, and water quality during construction of new crossings, culverts and outfalls including the culvert of Dry Gut, crossing of Fisher's Valley at Cook's Bridge and the other watercourses crossed by the proposed airfield and access roads.
	Increase in volume of run-off from compacted surfaces. Changes in the run-off regime in the catchment.
	Potential for uncontrolled run-off to encroach adjacent sensitive areas including the sensitive ecological habitats on Prosperous Bay Plain
	Contamination from accidents or spillages of, for example fuel, oil or materials used during construction.
	Potential effects on the flow regime and quality as a result of abstraction for supply of raw water to the construction site, particularly Sharks valley
	Construction material falling or washing into Rupert's Valley or other watercourses blocking flows
	Contamination of watercourses from site activities such as washing of tools or materials in watercourses or discharges from batching plant etc
	Silt from pumped water from excavations entering watercourses
	Increased run-off from increased permeable area causing erosion

	Potential Impacts
Sharks Valley abstraction	Additional sedimentation may smother vegetation and any aquatic habitats that may support invertebrates or other species.
	Damage to habitat viability through formation of sediment 'concretions'
	Potential for damage to, or dieback of, marginal vegetation through reduction in support from water column and drying out of soil/sediments.
	Terrestrial vegetation dieback and reduction in biodiversity.
	Reduction in water quality due to reduced aeration and higher water temperatures.
Dry Gut water storage reservoir	Limited transport of sediment / nutrients downstream.
	Drown marginal vegetation
	Create wetter conditions benefiting certain species

15.4.2 Mitigation

The development of mitigation measures has been informed by the following good practice guidance for the protection of the surface water environment:

- CIRIA Report 648 (2006) Control of water pollution from linear construction sites;
- CIRIA Report 532 (2001) Control of water pollution from construction sites;
- The following EA Pollution Prevention Guidance documents (PPG):
  - PPG 1 – General guide to the prevention of pollution;
  - PPG 2 – Above ground oil storage tanks;
  - PPG 3 - Use and design of oil separators in surface water drainage systems;
  - PPG 4 - Treatment and disposal of sewage where no foul sewer is available;
  - PPG 5 – Works in, near or liable to affect watercourses;
  - PPG 6 – Working at construction and demolition sites;
  - PPG 7 – Refuelling facilities;
  - PPG 8 – Safe storage and disposal of used oils;
  - PPG 13 – High pressure water and steam cleaners;
  - PPG 18 – Managing fire water and major spillages;
  - PPG 20 – Dewatering underground ducts and chambers;
  - PPG 21 – Pollution incidence response planning;
  - PPG 27 – Installation, decommissioning and removal of underground storage tanks; and
  - Pesticides – Code of Practice for using plant protection products (2006 DEFRA, WAG, HSE, and PDS).

Mitigation has been developed through the design and incorporated into the technical specification which the DBO Contractor must follow. Mitigation measures have also been developed for the construction and operation of the proposed scheme and these are set out in the EMP in Volume 5 of the ES.

The potential effects during the construction phase of the project have been described in Section 15.4.1 above. The measures described in Sections 15.4.2.1 to 15.4.2.6 are proposed to mitigate the effect of these potential adverse impacts. Further mitigation, particularly relating to the abstraction and use of water during construction is provided in Section 2.9.2 of the EMP in Volume 5.

15.4.2.1 Mitigation of General Construction Effects

Storage facilities for oils, fuels or chemicals shall be carried out in accordance with details submitted to and reviewed by the Engineer before the development is commenced. The storage facilities for fuel and oil shall comply with the UK Control of Pollution (Oil Storage) Regulations (England) Regulations 2001. Any tanks or drums of non oil based chemicals shall be stored in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations 2002. Storage facilities should be secure containers or compounds which shall be kept locked when not in use. In order to prevent pollution from oil, fuel and chemicals the following shall be implemented:

- **Filling and refuelling shall be strictly controlled** and together with any oil storage tanks, should be confined to a location remote from any watercourse, drain or the sea.
- **Leaking or empty drums shall be removed** from the site immediately and stored in a manner which shall prevent pollution prior to disposal.
- Before any tank is removed or perforated, particularly during demolition works, **all contents and residues shall be identified for safe disposal**. Pipes which may contain significant quantities of oil or chemicals, shall be capped, or valves closed to prevent spillage.
- All diesel/petrol powered pumps and generators and other static plant shall be placed on **impervious drip trays** and positioned away from any watercourse or drain. Drip trays shall be regularly maintained.
- **Demand for water shall be minimised** as far as possible.

The Contractor shall take all precautions to avoid the deposition of silt or detritus in watercourses and the coastal waters. This could be by the means of settling ponds, filters or any other suitable means reviewed by the Engineer. Flow attenuation may be necessary under some circumstances. Temporary silt traps and interceptors shall be regularly inspected, emptied and maintained as necessary by the Contractor. All drainage from the site shall be directed through treatment facilities and temporary outfalls at locations to be reviewed by the Engineer. The limits shall not exceed the following:

- pH 6 - 9
- Total suspended solids 100mg/l
- Ammoniacal Nitrogen 2mg/l
- Biochemical Oxygen Demand 10mg/l
- No visible oil

In order to limit pollution from silt and cement and other pollutants, the Contractor shall ensure the following measures are followed:

- The washwater from concrete mixing plant, or the cleaning of ready mixed concrete lorries shall not be allowed to flow into any drain, watercourse or coastal waters. Washings shall be contained in sealed units for disposal at a location to be agreed by the Engineer.
- Site roads shall be regularly swept or scraped and kept free from deposits in order to prevent silt, oil or other materials entering any drain or watercourse.
- Any wheel wash facilities shall be securely constructed with no overflow and effluent shall be contained for proper treatment and disposal.
- Before any discharge of water is made from the site, adequate provisions, such as settlement lagoons or silt traps fitted with oil absorbent booms, shall be made to ensure that pollution shall not occur.
- Prior to being discharged all surface water drainage from impermeable parking areas, roadways and hardstandings for vehicles shall be passed through an oil interceptor designed and constructed to have a capacity and details compatible with the site being drained.

No tools or equipment shall be washed in any watercourses or the sea but at designated washing areas. Wash water shall not be discharged into a watercourse, the sea or into road drains or disposed of in any other way that could result in pollution of a water body.

Surface or groundwater from excavations or other parts of the working area shall not be pumped or allowed to run directly into a watercourse, the sea or drain. Such water shall be passed through suitably sized settlement lagoons to remove silt solids before discharge to a watercourse.

Prior approval shall be obtained from the Engineer for all temporary works which may interfere with the bed or banks or flood plains of any watercourse or within 8 metres of the bank of any watercourse. Where banksides of watercourses are disturbed, the Contractor shall reinstate these areas to the Engineer's requirements in accordance with the Conditions of Contract.

No vehicle or any item of plant or equipment shall be used in watercourses or costal zone or the sea unless required for specific operations Where machinery is unavoidably required to work within a waterbody the individual item of plant concerned shall be clean and free from oil leaks, and shall be agreed with the Engineer. Where possible rubber tyred vehicles rather than those with tracks shall be used for works required within watercourses. The Contractor shall provide, install and remove temporary culverts and bridges to allow vehicles to cross watercourses and to prevent disturbance of the bed of the watercourse. Such temporary works shall prevent mud from vehicles contaminating the watercourse.

A direct discharge from Batching Plant to a watercourse or coastal water is not permissible and recirculation or other methods of management of discharge is required.

The Contractor shall implement a training programme to ensure that all site staff are aware of the risks of site activities to the water environment.

If any pollution occurs, then the Contractor shall advise the Engineer immediately and take prompt action to minimise the effect. A procedure shall be put in place to ensure an effective response to a pollution incident. This shall be agreed with the Engineer in advance of the commencement of any works. The Contractor shall have in place a procedure and sufficient supplied of materials at key locations around the site to contain and clean-up all spillages or leak of polluting material.

15.4.2.2 Mitigation for Areas within Rupert's Valley and the Route of the Haul Road

In relation to the proposed diversion of the stream in around the BFI in Rupert's Valley mitigation as described above for general construction effects will be implemented. The length of channel disturbed will be minimised as far as possible. The stream will only be diverted into a new permanent or temporary channel once the channel is clear of debris and construction materials.

Prior to the commencement of any quarrying activity adequate planning will be undertaken so as to ensure the effects of quarrying are mitigated as far as possible.

Adequate sheeting for vehicles carrying loose material will be provided to prevent material falling onto the haul road surfaces and adjacent areas.

15.4.2.3 Mitigation for Works on Prosperous Bay Plain

In order to reduce the potential effects of the proposed works on Prosperous Bay Plain, including during the earthworks the following measures would be implemented:

- **Attenuation of run-off** from increased permeable area would be provided.
- **Silt management** techniques to be employed as described in Section 15.4.2.1, Mitigation of General Effects.
- **Foul sewage** from the Contractor's compound to be **treated** using a sewage treatment works.

15.4.2.4 Mitigation for Sharks Valley Temporary Water Supply for Construction

The Contractor shall minimise the demand for water as far as possible so as to reduce the volume of water that is required during construction. The Contractor shall maintain a record of the volume of water abstracted from the water supply sources used for potable supply and for construction purposes. A sampling programme should be established to monitor the quality of any discharges of effluent to ground or surface waters.

If water was abstracted from Point A1/A2 and/or the waterfall it would be necessary to introduce a number of mitigation procedures so as to manage the risk posed to the environment as a result of there being less water in Sharks Valley. It is advised that measures shall apply such as:

- **Up to 40m^3 per day may be abstracted from Point A1/A2 in Sharks Valley**. Point A1/A2 is relatively high up the catchment (refer Figure ?, Volume 3) and water taken out of the channel at this point has the capacity to influence 2km of the lower valley environment, therefore a low figure has been identified for abstraction to limit any adverse impacts. The figure of 40m^3 per day is approximately half of the natural observed variability in flows and therefore should minimise any effects.
- **Should water be abstracted from the waterfall, as a guideline, the Contractor must leave in the stream, at least 138m^3 per day** (a figure equivalent to just over a quarter of the flow based on current data). A much larger amount of water could be abstracted from the waterfall in comparison to point A1/A2 since the waterfall discharges into the sea and any adverse impacts would be felt over a much smaller area.
- Continued **data collection of flows** along Shark's Valley, ideally with an increased frequency of once a week at the waterfall.
- **Use alternative sources of water to supplement Shark's Valley.**
- **Build storage ponds** to develop a store of water prior to construction starting. These could catch site runoff to be used in construction.
- The **design of the abstraction facility at the waterfall** and the route of the pipeline shall be **developed in conjunction with the Engineer** in order that the ecological, landscape and recreation sensitivities and requirements are accommodated in the design. All areas affected by these temporary structures shall be fully reinstated in compliance with the Section 4 below, Landscape and Ecological Requirements
- **More detailed ecological assessment** including mapping of the existing situation prior to construction starting to identify environmentally important areas to be preserved. Regular monitoring should be undertaken during construction to identify any variations in the baseline conditions.
- **Identify key areas where plant species should be protected** and investigate ways of preserving their status. This could include a series of small dams to create ponds/wet areas along the river that would sustain these communities.
- **Undertake selective vegetation clearance** to limit demand for water in these areas.
- **Manage the potential for invasion/spread of wild mango** and other drought resistant species.

Further mitigation is also described in the EMP in Volume 5 and the Landscape and Ecological Mitigation Plan enclosed in Appendix 10.2, Volume 4.

15.4.2.5 Mitigation for the possible temporary storage reservoir in Dry Gut

Much of the mitigation described above for Sharks Valley is equally applicable to the storage reservoir in Dry Gut. Demolition of the weir after construction would have to be done in a controlled manner to avoid a large body of water cascading down the valley which could pose a threat to both the environment and humans.

15.4.2.6 Mitigation for Water Supply - Gill Point – temporary sea water abstraction

Sea water may only be used in the Works subject to the Contractor demonstrating that he can meet the strict environmental constraints stated below and in the EMP in Volume 5 of the ES.

- Sea water shall only be used for the core of the Dry Gut embankment if it is proven that salt will not migrate to the surface of the land or groundwater. The surface includes the surface at the airfield, the outer layers of Dry Gut embankment, the benches and terraces of Dry Gut embankment, Prosperous Bay Plain and Dry Gut Valley.
- Use of sea water shall be restricted to the core of the embankment structure in Dry Gut and shall not be used in any other area of construction across the Site.
- Either dry compaction or use of fresh water shall be used for the outer layers at all levels across the embankment. An appropriate depth would be determined following further investigation by the Contractor and in consultation with the Employer's Environmental Consultants and agreed with the Engineer.
- During construction of the embankment, releases (fugitive or direct losses) of saline water shall be tightly controlled in order that any releases to the valley/gut down stream, the surrounding area core embankment, within or around the gut or to groundwater are prevented. A method statement shall be produced by the Contractor and agreed with the Engineer prior to construction commencing.
- Any infrastructure, plant and equipment in place and used for the abstraction and/or application of sea water shall be well maintained and must not cause leaks of sea water to the surrounding land or freshwater.
- Appropriate measures to protect the marine environment at the point of abstraction shall be put in place. These shall include noise attenuation to minimise disturbance to sea birds, pollution control measures and measures to prevent direct effect and minimise disturbance to marine biota.
- The Contractor shall use separate pumping equipment and pipelines for sea and fresh water supply unless agreed otherwise by Engineer.
- When decommissioning any infrastructure, plant and equipment used for the abstraction and/or application of sea water the item shall be drained in a controlled manner which prevents discharge of sea water to the land or freshwater. Before equipment that has been used to handle sea water is to be used for freshwater application or transfer it should be purged of all traces of sea water in a controlled manner.
- The design of any abstraction facility and the route of any pipeline shall be developed in conjunction with the Employer's Environmental Consultants in order that the ecological, landscape and recreation sensitivities and requirements are accommodated in the design. All areas affected by these temporary structures shall be fully reinstated in compliance with the EMP.

15.4.3 Residual Effects

Table 15.6 provides a description of the residual effects which would occur during construction.

Table 15.6 Residual Construction Effects Summary Table

Description of Potential Impact	Classification of Potential Impact	Assessment of Significance Without	Proposed and Recommended Mitigation Measures	Residual Impact
The mobilisation of sediment laden runoff which could enter local watercourses and drains	Temporary Short term	Moderate to large adverse	Appropriate mitigation measures to prevent sediment laden runoff being discharged to local watercourses untreated will be in place.	**Neutral**

Description of Potential Impact	Classification of Potential Impact	Assessment of Significance Without	Proposed and Recommended Mitigation Measures	Residual Impact
The potential risk of chemical and fuel (oil) spillages entering local watercourses	Direct Temporary Short term	Moderate to large adverse	Appropriate mitigation measures to protect local watercourses from the potential risk of chemical/fuel spillages will be in place, these shall include an emergency procedure to be followed in the event of a spillage or other pollution incident.	**Neutral**
The potential erosion of and damage to the banks of local watercourses and drains	Direct Temporary Short term	Minor adverse	Appropriate measures will be implemented to protect minor watercourses from erosion and bank damage, although by the nature of the improvement works, adverse impacts will occur.	**Minor adverse**
Temporary culverting and diversion of existing watercourses	Direct Temporary Short term	Minor adverse	Appropriate planning and execution of diversion to ensure potential for contamination and erosion is minimised.	**Minor adverse**
Disposal of construction site foul water	Direct Temporary Short term	Neutral	Foul drainage will be collected and treated on site or connected to a cesspool which will be regularly emptied for disposal off site.	**Neutral**
Quarry	Temporary Short term	Major adverse	Adequate planning prior to commencement of quarry construction to ensure effect of construction is mitigated as far as possible.	**Neutral**
Diversion of the stream in Rupert's Valley around the proposed Bulk Fuel Installation	Temporary Short term	Minor adverse	Appropriate planning and execution of diversion to ensure potential for contamination and erosion is minimised. Watercourse diversions shall follow natural and sinuous forms. The channel profiles of any diverted watercourse shall reflect a natural channel form with varied bank slopes and bed width.	**Minor adverse**
Dry Gut embankment and culvert	Temporary Short term	Moderate Adverse	Appropriate planning and execution of diversion to ensure potential for contamination and erosion is minimised.	**Neutral**

Description of Potential Impact	Classification of Potential Impact	Assessment of Significance Without	Proposed and Recommended Mitigation Measures	Residual Impact
Water for construction supply - Sharks Valley close to the beach waterfall and point A1/A2	Direct Temporary Short Term	Moderate to major adverse	Monitoring of flows and changes to environmental baseline conditions. Minimum abstraction quantities. Management to control loss of water dependant species.	**Minor adverse**
Abstraction, management, storage and use of water for construction supply - Dry Gut Storage	Direct Temporary Short term	Moderate adverse	Monitoring of flows and changes to environmental baseline conditions.	**Minor adverse**
Abstraction, management, storage and use of water for construction supply - Sea Water abstraction from Gill Point Direct	Temporary Short term	Moderate adverse	Sea water may only be used in the Works subject to the Contractor demonstrating that he can meet the strict environmental constraints stated in the EMP in Volume 5 of the ES. These measures include a requirement that sea water shall only be used for the core of the Dry Gut embankment if it is proven that salt will not migrate to the surface of the land or groundwater. The Contractor shall minimise the demand for water as far as possible so as to reduce the volume of water that is required during construction. Abstraction quantities will be kept to a minimum.	**Neutral**

15.5 PERMANENT AND OPERATIONAL EFFECTS

15.5.1 Potential Effects

This Section describes the potential impacts that might occur during operation of the airport and supporting infrastructure if no mitigation is put in place. Section 15.5.1.1 covers general operational impacts applicable to all sites and Sections 15.5.1.2 to 15.5.1.6 provide a description of more specific potential impacts that may arise at particular sites.

15.5.1.1 General Operations Effects

If adequate mitigation is not implemented during the operation phase of the development, pollution and deterioration of watercourses could occur as a result of the following:

a) Increased impermeable area causing **increased rate of surface water run-off** and risk of erosion.
b) Contamination of watercourses from **foul sewage**.
c) Contamination of watercourses from **oil or silt** from airfield.
d) **Erosion** of watercourses.
e) Spillage of **aviation fuel** causing contamination of local watercourses.
f) Erosion of the toe of Dry Gut **embankment** causing instability.
g) Contamination of watercourses from **fire fighting foam** from fire training ground.
h) Culverting and embankment in Dry Gut leading to loss of habitat

15.5.1.2 Rupert's Valley and the Route of the Haul Road

If site activities are not adequately controlled pollution of watercourses could occur as a result of the following:

- **Bulk fuel installation:**
  - Rupture of fuel tanks causing a slippage of fuel to watercourses or to ground.
  - Foul water from BFI contaminating ground or surface water.
  - Surface water drainage from BFI contaminated with hydrocarbons.
- **Access/haul road - Rupert's Bay to Prosperous Bay Plain:**
  - Increased impermeable area causing increased rate of surface water run-off and risk of erosion.
  - Silt being washed off road surface into watercourses.
  - Drainage from the access road affecting Deadwood.
  - Presence of the road affecting drainage catchments.
  - Erosion of land and watercourses alongside road from surface water run-off.
  - Inadequate sized culverts and bridges could cause erosion or flooding.

15.5.1.3 Permanent Water Supply for Operation of the Airport - Sharks Valley

As shown on Figure 15.2 the Sharks Valley intake at point A1/A2, the break tank, pipeline and storage tanks provide the infrastructure for the permanent supply for the operation of the airport.

Assuming the Sharks Valley intake is implemented as a permanent water supply for the airport then those effects associated with construction would continue to be relevant during operation.

A prolonged period of lower flows within Sharks Valley may require an increased level of environmental management within the valley to control the spread of drought resistant plants at the expense of species that favour wetter conditions.

15.5.1.4 Prosperous Bay Plain

There will be a substantial increase in impermeable areas as a result of the construction of the runway, taxiways and associated infrastructure such as car parking and terminal buildings. This will change the character of the catchment area of several watercourses. In some cases drainage will flow to an entirely different watercourse. Drainage flows will

also increase in both intensity and volume. This will be caused by rainfall reaching watercourses more quickly across impermeable surfaces, and as a result of a reduction in infiltration of rainwater into ground. If not adequately controlled this could exacerbate the erosion of guts and valleys changing the morphology of the channels and lead to larger volumes of sediment reaching the coast.

15.5.1.5 Summary of Potential Adverse Effects on the Surface Water Environment during Operation

The potential environmental effects during the operation on surface waters are summarised in Table 15.7.

Table 15.7 Potential Adverse Effects on the Surface Water Environment during Operation

	Potential Impacts
Operation – general	Effects on flow regime and quality of watercourses receiving drainage from the development.
	Minor potential for accumulated contaminants being washed into receiving watercourses.
	Effects on flow regime and quality from permanent modifications to the channel, bed and banks.
	Potential effects on the flow regime and quality as a result of abstraction for supply of raw water to the construction site, particularly Sharks valley.
	Increased impermeable area causing increased rate of surface water run-off and risk of erosion.
	Presence of the road affecting drainage catchments.
	Erosion of land and watercourses alongside road from surface water run-off.
	Inadequate sized culverts and bridges could cause erosion or flooding.
	Drainage from the access road affecting Deadwood.
	Silt being washed off road surface into watercourses.
	Increased impermeable area causing increased rate of surface water run-off and risk of erosion.
	Surface water drainage from BFI contaminated with hydrocarbons.
	Rupture of fuel tanks causing a slippage of fuel to watercourses or to ground.
	Foul water from BFI contaminating ground or surface water.
	Contamination of watercourses from fire fighting foam from fire training ground.
	Erosion of toe of embankment causing instability.
	Spillage of aviation fuel causing contamination of local watercourses.
	Erosion of watercourses.
	Contamination of watercourses from oil or silt from airfield.
	Contamination of watercourses from foul sewage.
Sharks Valley	Terrestrial vegetation dieback and reduction in biodiversity.
	Reduction in water quality due to reduced aeration and higher water temperatures.
Dry Gut	Limited transport of sediment / nutrients downstream.
	Loss of biodiversity downstream of the culvert and weir and within the footprint of the proposed embankment
	Create wetter conditions in association with the reservoir benefiting certain species.

15.5.2 Mitigation

15.5.2.1 Mitigation of General Operation Effects

The potential effects during the operational phase of the project have been described in Section 15.5.1.5 above. The following measures are proposed to reduce the effect of these adverse impacts, this includes the effects which may occur at the airport at Prosperous Bay Plain. Further mitigation, particularly relating to the abstraction and use of water during operation is provided in Section 2.9.2 of the EMP in Volume 5 of the ES.

a) Storage and **attenuation of drainage** to 'greenfield runoff' (see below) rates through the use of retention ponds, infiltration structures and similar sustainable drainage systems. Attenuate outflow to the 'greenfield runoff' rates for all return period storms up to a 1 in 100 year event plus climate change.
b) **Treatment of foul water** in a sewage treatment plant with appropriate limits for biochemical oxygen demand, ammonia and total suspended solids.
c) **Oil interception of drainage** with provision for silt storage. Bypass interceptors will be installed for drainage from the runway and car park. Full retention interceptors will be installed at the apron, terminal area, fuel storage and fire training rig. Either full or bypass interceptors will be installed on the drainage system from the taxiway.
d) **Energy dissipation and bank protection** will be provided on receiving watercourses susceptible to erosion.
e) The design of retention ponds at the airfield includes **penstocks** at the outlets from the ponds which can be closed in the event of a fire or spillage **to prevent contaminated drainage from reaching receiving watercourses**. There will be a bypass to ensure that the drainage system can continue to operate effectively whilst the ponds are storing contaminated drainage.
f) **Drainage** will be provided for the runway strip and RESA and **along the toe of the embankment.**
g) The **fire training ground** is positively drained to the southern stormwater attenuation pond via a full retention interceptor to separate oil spills from rainwater. However, when fire training incorporates the use of fire suppressing foam, the drainage valving is reconfigured so that the foam is drained to a **separate foam storage tank**.
h) Storage of fuel at the AFF in accordance with the same criteria as described for the BFI in Section 15.5.1.2, above.

15.5.2.2 Mitigation for Areas within Rupert's Valley and the Route of the Haul Road

The following provides the mitigation proposed for the BFI in Rupert's Valley:

BFI

a) Storage of **fuel in tanks within a watertight compound** with a bund wall in accordance with CIRIA and EA guidance, i.e. the bund shall have the capacity to contain 110% of the largest tank in the compound (or 25% of the total capacity of all the tanks located in the same bund, whichever is greater).
b) **Suitable treatment of foul effluent** from BFI.
c) Contaminated surface water from BFI to pass through suitable **oil interception** before being discharged.

Access/haul road

a) **Silt management** techniques described in Mitigation of general construction effects (see 15.4.2.1 above).
b) Where the road is built on an embankment consideration will be given to providing bridges or culverts to prevent trapping any potential catchments.
c) **Drainage** will comprise open channels between the road and the excavated face and gullys and drains or culverts under the road. These drains will discharge into local watercourses along the access road at locations resistant against erosion. Alternatively, **suitable measures** will be provided **to prevent erosion**.
d) In the area of **Deadwood**, specific drainage provisions are required as the run off from the road needs to be **collected and discharged downhill of residential properties**.
e) **Adequate sized culverts and bridges** to prevent erosion or flooding to a watercourse.

15.5.2.3 Mitigation for Sharks Valley Permanent Water Supply for Operation

If water continued to be abstracted from Point A1/A2 and/or the waterfall on Sharks Valley it would be necessary to introduce a number of mitigation procedures so as to manage the long term risk posed to the environment. The Contractor shall minimise the demand for water as far as possible so as to reduce the volume of water that is required during operation. A number of monitoring programmes will be implemented to ensure that the abstraction of water from Sharks Valley does not have a detrimental impact upon the wider environment and reduce the local biodiversity.

This would comprise continued monitoring of flows within the watercourse to enable a better understanding of the hydrological regime and environmental monitoring and mapping to ensure that the abstraction was not having a detrimental impact upon the vegetation communities and habitats found within Sharks Valley.

15.5.3 Residual Effects

Table 15.8 provides a description of the residual effects which would occur during operation.

Table 15.8 Residual Permanent Operational Effects Summary Table

Description of Potential Impact	Classification of Potential Impact	Assessment of Significance Without	Proposed and Recommended Mitigation Measures	Residual Impact
Road drainage potentially affecting several watercourses Including Rupert's Valley stream.	Permanent Long term	Moderate Adverse	Culverts and bridges to ensure flow paths are maintained and the risk of erosion and flooding are reduced.	**Neutral**
Diversion of the stream in Rupert's Valley around the proposed Bulk Fuel Installation	Permanent Long term	Minor adverse	Appropriate design and planning of diversion channel to ensure potential for contamination and erosion is minimised.	**Minor adverse**
Dry Gut embankment and culvert	Permanent Long term	Moderate Adverse	Appropriate planning and execution of diversions and culverts to ensure potential for contamination and erosion is minimised.	**Minor adverse**
Airfield drainage - contaminated surface water discharge (routine run-off of pollutants from runway, apron, and spillage risk).	Permanent Long term	Moderate Adverse	Silt and oil interception facilities will be provided.	**Neutral**
Erosion of watercourses from surface water run-off	Permanent Long Term	Moderate Adverse	Attenuation of surface water drainage to Greenfield run-off rate. Provision of energy dissipation structures.	**Neutral**
Erosion of embankments	Permanent Long Term	Major adverse	Adequate drainage and erosion control at the toe of embankments.	**Neutral**
Contamination of watercourses from oil, fire-fighting foam or sewage	Temporary Short term	Moderate adverse	Interception of contaminants at source using oil interception, dedicated drainage system and treatment.	**Neutral**
Water supply – abstraction of $40m^3$ per day from Sharks Valley at point A1/A2	Direct Permanent Long Term	Moderate to major adverse	Monitoring of flows and changes to environmental baseline conditions. Minimum abstraction quantities. Management to control loss of water dependant species.	**Minor adverse**