

Havant Thicket Reservoir Project

Environmental Statement Volume 2 – Main Report Chapter 20 Vulnerability to Major Accidents and Disasters

Portsmouth Water Ltd.

02/09/20

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Document history

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20. Vulnerability to major accidents and disasters

Introduction

- 20.1. The Town and Country Planning (Environmental Impact Assessment) Regulations 2017¹ introduced a requirement to identify, describe, and assess expected significant effects arising from the vulnerability of a Scheme to major accidents or disasters that are relevant to the Scheme.
- 20.2. In order to meet this requirement, this assessment has evaluated the exposure and vulnerability of the Scheme to a variety of potential major accidents and/or disasters (herewith referred to collectively as “major events”).
- 20.3. The assessment identifies:
- Any significant adverse environmental effects arising as a consequence of the identified major events; and
 - Measures to prevent or mitigate the significant adverse environmental effects of those major events, and details the preparedness for and response to such major events.
- 20.4. The assessment of the vulnerability of the Scheme to major events has:
- Applied professional judgement to develop definitions of major events specific to the Scheme;
 - Identified any major events that are relevant to and can affect the Scheme;
 - Identified if the major event affects the construction and/or operation of the Scheme;
 - Where major events are identified, described the expected consequences arising from the vulnerability of the Scheme to the events;
 - Reported the conclusions of the assessment within this chapter; and
 - Clearly described any assumed mitigation measures and details of the preparedness for and proposed response to such emergencies. This provides an evidence base to support the conclusions and demonstrate that likely effects have been mitigated/managed to an acceptable level.

Definitions

- 20.5. The definition of a major accident used in this assessment is contained in the Control of Major Accident Hazards Regulations 2015 (COMAH)², which define a “major accident” as an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances.
- 20.6. A disaster is defined for the purposes of this assessment as a naturally occurring event such as extreme weather (storm, flooding) or a ground-related hazard event (subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a major accident.
- 20.7. The COMAH Regulations 2015 Schedule 5² define a major accident (and therefore also relate to the definition of disaster) are as follows:
- Injury to persons and damage to property:
 - A death;
 - Six persons injured within the establishment and hospitalised for at least 24 hours;

¹ <http://www.legislation.gov.uk/ukxi/2017/571/contents/made>

² <https://www.hse.gov.uk/comah/> Schedule 5

- One person outside the establishment hospitalised for at least 24 hours;
- A dwelling outside the establishment damaged and unusable as a result of the accident;
- The evacuation or confinement of persons for more than 2 hours where the value (persons × hours) is at least 500; or
- The interruption of drinking water, electricity, gas or telephone services for more than 2 hours where the value (persons × hours) is at least 1,000.
- Immediate damage to the environment:
 - Permanent or long-term damage to terrestrial habitats:
 - 0.5 ha or more of a habitat of environmental or conservation importance protected by legislation; or
 - 10 or more ha of more widespread habitat, including agricultural land.
 - Significant or long-term damage to freshwater and marine habitats:
 - 10 km or more of river or canal;
 - 1 ha or more of a lake or pond;
 - 2 ha or more of delta; or
 - 2 ha or more of a coastline or open sea; or
 - Significant damage to an aquifer or underground water: 1 ha or more.
- Damage to property:
 - Damage to property in the establishment, to the value of at least EUR 2,000,000; or
 - Damage to property outside the establishment, to the value of at least EUR 500,000).

20.8. Key terms used in this assessment are listed below in Table 20-1.

Table 20-1 - Key terms used in the assessment of vulnerability of major events

Term	Definition
Major accident	The COMAH 2015 regulations define a 'major accident' as an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances.
Natural disaster	A naturally occurring event such as extreme weather (storm, flooding) or a ground-related hazard event (subsidence, landslide, earthquake) with the potential to cause an event or situation that meets the definition of a major accident.
Risk	The likelihood of an impact occurring combined with the effect or consequence(s) of the impact on a receptor(s) if it does occur.
Risk event	An identified unplanned event which is considered relevant to the Scheme and has the potential to be a major accident or natural disaster subject to the identification of its potential to result in a significant adverse effect on an environmental receptor.
Serious damage	Serious damage includes the loss of life, permanent injury and temporary or permanent damage/destruction of an environmental receptor.
Vulnerability	In the context of environmental risk assessment, the term refers to the 'exposure and resilience' of the Scheme to the risk of a major accident or natural disaster.

20.9. By the above definitions, a significant adverse effect is considered to mean the loss of life or permanent injury, and/or permanent or long-lasting damage to an environmental receptor. The

significance of this effect takes into account the extent, severity and duration of harm and the importance and sensitivity of the receptor.

20.10. Relevant major events and any consequences for receptors are reported in this chapter.

Methodology

20.11. The methodology adopted includes three main stages.

Stage 1

20.12. A long list of all possible major events has been developed and is provided in Table 20-2. This list drew upon a variety of sources, including the UK Government's Risk Register of Civil Emergencies³. Major events with little relevance in the UK were not included. A screening exercise was undertaken to review this long list of major events and their relevance to the Scheme. The results of this screening are included in Table 20-2 below.

20.13. In general, it was identified that major events as they relate to the Scheme, fall into three categories, to which relevance to the Scheme has been attributed:

- Not relevant - Events that could not realistically occur, due to the type of Scheme or its location;
- Not relevant - Events that could realistically occur, but for which the Scheme and associated receptors, are no more vulnerable than any other development; and
- Relevant - Events that could occur, and to which the Scheme is particularly vulnerable, or which the Scheme has a particular capacity to exacerbate.

Stage 2

20.14. A Scheme specific short list of major events is provided in Table 20-3 below. This assessment takes into account site location and land uses, embedded mitigation and additional mitigation required to manage risk. The study area for relevant major events was identified to be within 2 km of the Scheme. The extent of the study area is based on the study areas identified for each environmental topic assessed in the ES.

Stage 3

20.15. Where additional mitigation is identified in Table 20-3 below to reduce risk for major events relevant to the Scheme, these will be included in the Record of Environmental Actions and Commitments (REAC) as part of the Outline Environmental Management Plan (OEMP) in Appendix A2.1 in ES Volume 4.

20.16. During detailed design, where additional mitigation is unable to remove the potential interaction between a major event and a particular topic, the potential consequence for receptors during construction and operation, will be identified and included in the design risk register for consideration by Portsmouth Water, principal designer and the appointed contractor.

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/644968/UK_National_Risk_Register_2017.pdf

Table 20-2 - Stage 1 – Screening of long list of major events and relevance

Major event type	Relevant to the Scheme	Source of major event
Geological		
Avalanches and landslides	No	Event could not realistically occur, due to scheme location.
Earthquakes	No	The site is not in a geologically active area and as such event could not realistically occur.
Volcanic eruptions	No	The site is not in a geologically active area and as such volcanic eruptions events could not realistically occur.
Sinkholes	Yes	There is the potential for natural cavities such as swallow holes and sinkholes to be present beneath the Scheme associated with karst dissolution features within the underlying White Chalk Sub-Group. However, the presence of sinkholes was not identified within any of the aerial photography or geomorphological field mapping undertaken for the reservoir site. No sinkholes are recorded within the reservoir site and pipeline corridor.
Ground instability	Yes	Risk of instability of existing ground due to existing shear planes in clay under proposed embankment.
Hydrological		
Floods	Yes	Fluvial flooding from streams flowing into reservoir, rainwater directly falling on the reservoir and surface water runoff.
Tsunami/Storm surge	No	The site is not in an area considered to be at risk of tsunami, therefore it is considered that this event could not realistically occur, due to scheme location. The reservoir itself is at an elevation well beyond the reach of tsunami or storm surge. Storm surge can, however, restrict the Hermitage Stream from discharging to Langstone Harbour. This would only be relevant in an Emergency Drawdown scenario, i.e. where embankment breach is suspected and the reservoir has to be rapidly lowered. This is an extremely remote risk.
Limnic eruptions	No	Features of limnic eruptions include CO ₂ saturated incoming water, distinct stratification with different CO ₂ levels at upper and lower layers and proximity to areas with volcanic activity (which could be the trigger). The site does not meet any of these criteria. Stratification of the water column will be avoided by the use of compressed air aerators. Therefore, this event could not realistically occur.
Major change to groundwater levels	Yes	Extreme rainfall could result in a rise in groundwater levels leading to increased spring flows. These may arise from the Palaeogene deposits or could potentially also receive Chalk baseflow at higher groundwater levels at locations along the Chalk-Palaeogene contact. This could result in localised groundwater flooding and could place some additional pressure on the embankments surrounding the reservoir and/or the drainage schemes in place (to re-route existing drainage channels). However, this event is not likely to result in a disaster, and as such is not considered further.
Pollution at source/abstraction location	Yes	The Chalk aquifer and/or the Havant and Bedhampton Springs become polluted and drinking water quality is compromised. Aquifer protected by clay around the reservoir site, but not up- and down-gradient which means this is a potential local risk around Bedhampton itself or up gradient from the same spring due to local pollution incidents e.g. oil tanker or incident on railway line during construction and operation.
Pollution of the reservoir	Yes	Major release of contamination into the reservoir, which can include intentional or unintentional releases of a range of substances including organic and inorganic pollutants.
Meteorological		
Blizzards	Yes	Freezing temperatures could cause pipeline burst
Periods of extreme cold	Yes	Freezing temperatures could cause pipeline burst

Major event type	Relevant to the Scheme	Source of major event
Cyclonic storms	Yes	Cyclonic storms could cause high winds and heavy rain causing damage to infrastructure and property.
Droughts	Yes	Extreme drought in south-east region.
Thunderstorms	Yes	Thunderstorms could cause flooding from streams flowing into reservoir and rainwater directly falling on the reservoir.
Hailstorms	No	Hailstorms are not considered a risk to the safe operation of the Scheme.
Heat waves	No	Extreme heat for a prolonged period can cause a higher risk of fires to the surrounding vegetation. Therefore, although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Tornadoes and high winds	Yes	High winds causing waves to erode the embankment.
Wildfires	No	There is the potential for wildfires to the surrounding woodland, hedgerows and grassland. Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Poor air quality episode	No	A poor air quality episode for a prolonged period can cause a higher risk of health and/or ecological impacts temporarily over the short term. Given that the main air quality metric of concern in England is the annual average objective for nitrogen dioxide, and that any effect would be temporary, this is not considered likely to significantly affect the findings of the air quality assessment. Although, this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Space		
Geomagnetic storm	No	Solar wind shock waves can interact with the earth's magnetic field causing disruption to electrical systems, communications and GPS. Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Solar flare	No	Solar flares can interrupt radio and other electronic communications. Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development
Astronomical object collision	No	An impact from an astronomical object can cause effects such as shock waves, heat radiation and craters. Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development
Transport		
Road accidents	Yes	The A3(M) is the nearest A road to the reservoir site, located approximately 500m west. The A27 is the nearest A road to the pipeline at the Bedhampton Pumping Station, located approximately 1 km south. Temporary construction traffic causing increased risk.
Rail accidents	Yes	Rowlands Castle Railway Station is located approximately 2 km east of the reservoir site. The pipeline will cross the Southern Railway line west of Bedhampton station. Ground loss/settlement causing derailment of trains.
Aircraft disasters	Yes	Aircraft crashing into reservoir. The nearest commercial airport, Southampton Airport, is not located within 2 km of the Scheme. There are other smaller airports located within the Portsmouth area, but they are also not located within 2 km of the Scheme.
Maritime disasters	No	Portsmouth Harbour is the closest navigable area, located more than 2 km south-west of the Scheme.

Major event type	Relevant to the Scheme	Source of major event
		This event could not realistically occur, due to Scheme location.
Engineering accidents/failures		
Bridge failure	No	Pipeline will be buried and no new bridges to be designed. This event could not realistically occur, due to the design of the Scheme.
Flood defence/reservoir failure	Yes	Structural failure leading to breach of the embankment and the release of the reservoir volume over the residential area to the south.
Mast and tower collapse	No	There are no masts and/or tower located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Building fire or failure	Yes	The control house and visitor/education centre/café could catch fire or collapse.
Utilities failure (gas, electricity, water, sewage, oil, communications)	Yes	Pipe burst in pipeline from reservoir to Bedhampton Instrumental failure
Industrial accidents		
Defence industry	No	No defence industries are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Energy industry (fossil fuel)	No	No energy industries are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Nuclear power	No	No nuclear power plants are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Oil and gas refinery/storage	No	No oil and gas refinery/storage facilities are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Food industry	No	No food industries are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Chemical industry	No	No chemical industries are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Manufacturing industry	No	No manufacturing industries are located within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.
Mining industry	No	No historical mining activities are located on the site or within 2 km of the Scheme. This event could not realistically occur, due to Scheme location.

Major event type	Relevant to the Scheme	Source of major event
Terrorism/crime/civil unrest		
Terrorism Bomb/vehicle attack on people	No	The Scheme is unlikely to be any more of a target for this attack therefore, although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Terrorism Bomb/vehicle attack on infrastructure	Yes	An attack causing failure of the embankment could lead to breach, and a quick release of huge volumes of water over Havant.
<u>Terrorism</u> Marauding attack / Mass shooting	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Terrorism Chemical / Biological / Gas attack	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Civil unrest Protest / Rioting	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Terrorism Cyber attack	Yes	The use of remote technology to operate the control house could put the Scheme at risk of a cyber-attack.
Conventional crime Vandalism – setting fires to the surrounding environment, buildings, etc	Yes	The surrounding vegetation of woodland, hedgerows and grassland and buildings on the site - control house and visitor / education centre / café could be vandalised. In the case of the control house, damage could prevent use, and therefore management of the reservoir systems.
Terrorism/ Conventional Crime Vandalism – drinking water pollution from hazardous pollutants	Yes	The reservoir could be polluted by the introduction of hazardous pollutants.
Terrorism / Conventional crime Criminal damage	Yes	Individuals or groups socialising around and creating a less sustainable environment around the public areas and the reservoir.
Conventional Crime Antisocial behaviour and & Theft	Yes	Anti-social behaviour Individuals or groups socialising around and creating a less sustainable environment around the public areas and the reservoir. Theft Individuals or groups aiming to remove control equipment.
War		
Conventional	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Chemical	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Nuclear	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.



Major event type	Relevant to the Scheme	Source of major event
Disease		
Human disease	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Animal disease	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Plant disease	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.
Animal infestation	No	Although this event could realistically occur, the Scheme and associated receptors, are no more vulnerable than any other development.

Table 20-3 - Stage 2 – Short list of major events and mitigation to manage risk

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
Geological								
Ground instability	Yes	Risk of instability of existing ground due to existing shear planes in clay under proposed embankment.	Infrastructure and property, surrounding environment.	Casualties, damage to infrastructure and property, disruption to services.	Yes – Chapter 10 – Geology and Soils in ES Volume 2	Yes, Design and Engineering Report	The risk is being mitigated in the design by digging out and recompacting the top 3m of ground below the footprint of the embankment.	Further ground investigation to confirm depth of shear planes.
Sinkholes	Yes	There is the potential for natural cavities such as swallow holes and sinkholes to be present beneath the Scheme associated with karst dissolution features within the underlying White Chalk Sub-Group.	Infrastructure and property, surrounding environment.	Casualties, damage to infrastructure and property, disruption to services.	Yes – Chapter 10 – Geology and Soils in ES Volume 2	Yes, Design and Engineering Report	Risk mitigated by review of the presence of sinkholes within aerial photography and geomorphological field mapping. No sinkholes are recorded within the reservoir site and pipeline corridor.	The risk will be further mitigated by undertaking a geophysical survey of the site.
Hydrological								
Floods	Yes	Fluvial flooding from streams flowing into reservoir and rainwater directly falling on the reservoir.	Residential areas south / downhill of reservoir.	Flooding of properties.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	No	Flood storage capacity in the reservoir has been assessed to contain flood inflows during operation below the embankment crest in an extreme event ie probable maximum flood, with an overflow spillway designed to pass excess floodwater The construction of the new reservoir will actually reduce the existing risk of flooding as the new reservoir will act to store floodwater from upstream.	Maintenance and regular inspection of overflow spillway will be included in operating procedures.
Major change to groundwater levels	Yes	Extreme rainfall could result in a rise in groundwater levels leading to increased spring flows. These	Operatives during construction and local	Flooding	Yes (Chapter 15 – Water in ES Volume 2 and	N/A	Reservoir design includes lining and cut-offs to virtually eliminate seepage loss from	Water invasion during borrow pit excavation to be

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
		may arise from the Palaeogene deposits or could potentially also receive Chalk baseflow at higher groundwater levels at locations along the Chalk-Palaeogene contact. This could result in localised groundwater flooding and could place some additional pressure on the embankments surrounding the reservoir and/or the drainage schemes in place (to re-route existing drainage channels). However, this event is not likely to result in a disaster, and as such is not considered further.	residents		Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)		reservoir when full.	managed by contractor Water from incoming streams diverted and pumped elsewhere, up to a 1 in 30 storm event – contractor to include in design and construction methodology
Pollution at source/abstraction location	Yes	The Chalk aquifer and/or the Havant and Bedhampton Springs become polluted and drinking water quality is compromised. Aquifer partly protected by clay which means this is a potential local effect around Bedhampton or up gradient from the same spring due to local pollution incidents eg oil tanker or incident on railway line during construction and operation.	Portsmouth Water customers	The reservoir cannot be filled or topped up and customers receive contaminated water.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4) – considers pollution incidents during construction	This risk will be mitigated by the contractor during construction. Precautions to be included within contractor's method of working to minimise risk of pollution following EA guidance on pollution prevention.	None included currently – though ES assumes mitigation during construction implemented	Contractors method statement in accordance with EA pollution prevention guidance
Pollution of the reservoir	Yes	Major release of contamination into the reservoir.	Portsmouth Water customers	Customers receive contaminated water.	No	No	Volatile Organic Compound (VOC) monitoring will be provided at the abstraction intake to monitor organic pollutants. Automatic monitoring of other water quality parameters will also be included at the WTW including pH, ammonia and turbidity to ensure no pollution reaches the WTW. Granular Activated Carbon (GAC) will also be included within the WTW	Portsmouth Water Havant Thicket Reservoir Water Safety Plan and potential catchment management measures

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
							filters. Physical barriers will also be include eg reinforced concrete kerbing to control access.	
Meteorological								
Blizzards	Yes	Freezing temperatures could cause pipeline burst	Customers and properties along pipeline	Flooding or loss of supply	No	No	Pipework is buried in culvert under embankment and under control house then pipeline is buried thereafter	N/A – embedded mitigation deemed sufficient
Periods of extreme cold	Yes	Freezing temperatures could cause pipeline burst	Customers and properties along pipeline	Flooding or loss of supply	No	No	Pipework is buried in culvert under embankment and under control house then pipeline is buried thereafter	N/A – embedded mitigation deemed sufficient
Cyclonic storms	Yes	Cyclonic storms could cause high winds and heavy rain causing damage to infrastructure and property.	Properties downhill from reservoir.	Erosion causing instability of embankment.	Yes – (Chapter 2 - Scheme Description in ES Volume 2)	Yes - Design and Access Statement (DAS) in planning application	Rock armour designed to protect inside face slope.	Regular inspections of embankment in operation.
Droughts	Yes	Extreme drought in south-east region.	Reservoir will be used to supply water during droughts.	None as the reservoir is designed to provide supply in droughts. Drawdown in supply mode will be relatively slow and the effect of drawdown will not cause instability in the embankment.	Yes – (Chapter 2 - Scheme Description in ES Volume 2)	Yes – Planning Statement in planning application	Reservoir is sized to mitigate droughts with a minimum storage capacity to provide the yield required in extreme droughts. 21M/d in a 1:200year drought.	Risk of drought itself cannot be reduced, therefore drought to be included in detailed design risk register (see paragraph 20.21).
Thunderstorms	Yes	Thunderstorms could cause flooding from streams flowing into reservoir and rainwater directly falling on the reservoir.	Residential areas south / downhill of reservoir.	Flooding of properties.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	Yes (Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	Flood storage capacity in the reservoir has been assessed to contain flood inflows below the embankment crest, with an overflow spillway designed to pass excess floodwater. Flood risk will be reduced due to	Maintenance and regular inspection of overflow spillway will be included in operating procedures.

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
							storage capacity of reservoir.	
Tornadoes and high winds	Yes	High winds causing waves to erode the embankment.	Properties downhill from reservoir.	Erosion causing instability of embankment.	Yes	Yes - Design and Access Statement (DAS) in planning application	Rock armour designed to protect inside face slope to accommodate 1:200 chance event.	Regular inspections of embankment in operation.
Transport								
Road accidents	Yes	Road traffic accidents due to construction traffic. Pipe leaks causing erosion of sediment or backfill, resulting in settlement.	Public	Casualties, road flooding	Yes – Chapter 13 Traffic and Transport; Appendix A13.1 Transport Assessment Report	N/A	Construction traffic to only use specific access routes at specific times. Appropriate pipe lining and coating (internal and external) to prevent premature erosion of pipe.	Traffic Management Plan to be implemented by the appointed contractor. Quality control of pipe connections by appointed contractor. Suitable pipe material selection for ground conditions and construction methods.
Rail accidents	Yes	Rowlands Castle Railway Station is located approximately 2 km east of the reservoir site. The pipeline will cross the Southern Railway line west of Bedhampton station.	Public, Network Rail staff and assets	Ground loss/settlement causing derailment of trains	N/A	Yes, As included within the Engineering and Design Report in planning application	Full compliance with Network Rail's asset protection standards and guidance. Network Rail approved Principle Contractor to be appointed.	Pipe jacking selected as a proven system used for under track crossings. A detailed GI will be undertaken to inform design and construction of Under Track Crossing (UTX).
Aircraft disaster	Yes	Aircraft crashing into reservoir/embankment.	Public, properties	Casualties, damage to infrastructure and property, flooding	N/A	N/A	Risk to the reservoir integrity is mitigated with erosion protection on the embankment slopes for a wave from a	Risk to people in the aircraft could be mitigated by ensuring that OS

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
							crashing aircraft. Risk to water quality is mitigated by the water quality telemetry systems providing alarms if contaminants from the aircraft are picked up	and other publicly available maps are updated to include the reservoir surface area, so that it does not appear as an open field on pilot's navigational systems.
Engineering accidents/failures								
Flood defence/reservoir failure	Yes	Structural failure leading to breach of the embankment and the release of the reservoir volume over the residential area to the south.	Properties and people downstream of the reservoir.	Significant flooding due to a breach of the embankment, including potential loss of life and property damage.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment in ES Volume 4)	Yes (Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	The reservoir embankment will be inspected regularly for any indication of structural weakening or of potential to breach. Pipeline has been checked to provide capacity for emergency drawdown discharge in the event of instability in the embankment or other dam safety incident. Drainage blanket added to inside face of dam to reduce instability in rapid drawdown condition. Instrumentation linked to telemetry will be installed to monitor embankment movement, seepage, pore water pressures to give alarm of rapid changes.	If imminent breach is suspected, the Emergency Drawdown strategy will be enacted, lowering the reservoir level quickly, without causing flooding, and thus reducing the risk and consequence of breach. Drawdown will be able to start in a few hours and the capacity of the drawdown pipes is designed to achieve reduction in reservoir water level by a third in 6 days (to meet EA guideline requirements).
Building fire or failure	Yes	The control house and visitor/education centre/café could	Local residents and people living downhill of	Damage to pipeline control valves causes	N/A	N/A	Control house to be built non-flammable materials, reducing risk of fire damage to pipeline	Daily surveillance of reservoir, and alarms connected

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
		catch fire or collapse.	reservoir.	uncontrolled release of water downstream			and control valves inside building. The balustrades of the visitor centre are to be metal fins and the proposed bridge deck is currently being proposed as timber. The timber would be treated with a flame retardant.	to PW system
Utilities failure (gas, electricity, water, sewage, oil, communications)	Yes	Pipe burst in pipeline from reservoir to Bedhampton Instrumental failure	Reservoir culvert pipework Public and river receptor	Loss of control of flows into the pipeline from a pipe burst creating pressure waves upstream. Catastrophic flooding	No	Yes, within Engineering and Design Report in planning application	Valves in pipeline at reservoir outlet culvert to be automatically self-closing to prevent loss of control of flows Double isolation at Hermitage stream discharge point Reservoir valve actuators will have Uninterrupted Power Supply (UPS) power, provided from a battery in the control house, and will be manually operable.	Monitoring system and telemetry connection to allow remote actuation of valves at reservoir
Terrorism/crime/civil unrest								
Terrorism Bomb/vehicle attack on infrastructure	Yes	An attack causing failure of the embankment could lead to breach, and a quick release of huge volumes of water over Havant.	People and structures in areas downstream of the reservoir.	Flooding due to a breach of the embankment, including potential loss of life and property damage.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	No	The consequence of reservoir breach is assessed and understood through the use of a hydraulic model in the Flood Risk Assessment. The flood outlines will be used before commissioning in an Emergency Response Plan to prioritise areas and routes for evacuation, although it is acknowledged that there is unlikely to be significant warning in such an event.	Daily surveillance of reservoir, and alarms connected to Portsmouth Water system. Use of CCTV to be determined at detailed design.
Terrorism Cyber attack	Yes	The use of remote technology to operate the control house could put the Scheme at risk of a cyber-	Beneficiaries of the reservoir's supply resulting from denial or	Service degradation.	No	No	Design includes the selection of cyber secure systems, which will be integrated with	Appointed contractor is required to

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
		attack.	reduction of service. People and structures in areas downstream of the reservoir in case of flooding.	Flooding due to a cyber-attack on the computer systems used to control the reservoir and pipeline.			existing Portsmouth Water communications systems and will monitor the lines for cyber issues.	undertake detailed design of all new and modified systems in line with cyber security standards.
Conventional crime Vandalism – setting fires to the surrounding environment, buildings, etc	Yes	The surrounding vegetation of woodland, hedgerows and grassland and buildings on the site - control house and visitor / education centre / café could be vandalised. In the case of the control house, damage could prevent use, and therefore management of the reservoir systems.	Local residents, natural ecosystems.	Potential harm to people, infrastructure and the local ecological ecosystem.	Not Known	Not Known	Control house to be built from concrete with cladding to be not flammable, reducing risk of fire damage to pipes and control valves inside building. Signed and designated routes for the public to escape from the incident area.	Daily surveillance of reservoir, and alarms connected to PW system. There will be staff training and awareness of these incidents and security systems, such as public address, to aid to the incident.
Terrorism/ Conventional Crime Vandalism – drinking water pollution from hazardous pollutants	Yes	The reservoir could be polluted by the introduction of hazardous pollutants.	Drinking water customers	Potential harm to individuals (illness) / potential harm to ecosystems.	Yes (Chapter 15 – Water in ES Volume 2 and Appendix A15.2 Flood Risk Assessment (FRA) in ES Volume 4)	N/A	Intakes from reservoir will be remote from the embankment crest so any pollutants could not be dropped directly into the intake system to the supply pipeline.	Daily surveillance of reservoir, and alarms to be set within water quality monitoring system.
Terrorism / Conventional crime Criminal damage	Yes	Individuals or groups socialising around and creating a less sustainable environment around the public areas and the reservoir.	People and structures / downstream of the reservoir.	Flooding of properties downhill from reservoir	No	Yes, in Engineering and Design Report in planning application	Reinforcement in two lines of concrete kerbs / bedding to make it difficult to dig across the crest.	Daily inspection and alarms to be set for sudden changes in water level.
Conventional Crime Antisocial behaviour and & Theft	Yes	Anti-social behaviour Individuals or groups socialising around and creating a less sustainable environment around the public areas and the reservoir.	Anti-social behaviour Public areas and the reservoir could be affected.	Anti-social behaviour Potential harm to the sense of sustained and secure	No	No	Anti-social behaviour Access routes to be well defined and promote a sense of ownership, respect and territorial responsibility and community.	Appropriate physical protection that include well designed security features. Special consideration will

Major event type	Relevant to the scheme	Source of major event	Potential receptors	Consequence	Addressed in ES (yes/no and where)	Covered outside of ES (yes/no and where)	Embedded mitigation	Stage 3 – Identification of additional mitigation to reduce risk
		Theft Individuals or groups aiming to remove control equipment.	Theft Beneficiaries of the reservoir's supply resulting from denial or reduction of service. People and structures in areas downstream of the reservoir in case of flooding.	environment around reservoir and public areas where people socialise. Theft Service degradation. Flooding due to an attack on the computer systems used to control the reservoir and pipeline.			Theft All critical control equipment will be designed to be secured.	be given to areas where the human activity is concentrated in order to reduce risk of crime and built a sense of sustainable environment and provide safety and security at all times.

Conclusion

- 20.18. The methodology for assessment involved three stages. A long list of possible events was initially developed, drawing upon UK Government Risk Registers. The long list was screened (stage 1) and their relevance to the scheme assessed in Table 20-2. It was identified that major events, fall into three categories:
- Not relevant - Events that could not realistically occur, due to the type of Scheme or its location;
 - Not relevant - Events that could realistically occur, but for which the Scheme and associated receptors, are no more vulnerable than any other development; and
 - Relevant - Events that could occur, and to which the Scheme is particularly vulnerable, or which the Scheme has a particular capacity to exacerbate.
- 20.19. A Scheme specific short list of major events that were deemed to be relevant to the scheme was then provided in Table 20-3 (stage 2). The assessment of the short list took into account site location and land uses, embedded mitigation and additional mitigation required to manage any risk identified.
- 20.20. The majority of major events identified as relevant to the scheme have been sufficiently mitigated through embedded mitigation and additional mitigation as stated in Table 20-3. The additional mitigation identified will be included in the Record of Environmental Actions and Commitments (REAC) as part of the Outline Environmental Management Plan (OEMP) in Appendix A2.1 in ES Volume 4 (stage 3).
- 20.21. Where major events have not been fully mitigated by the use of embedded mitigation and/or additional mitigation, during detailed design the potential consequence for receptors during construction and operation will be identified and included in the design risk register for consideration by Portsmouth Water, principal designer and the appointed contractor (stage 3).
- 20.22. The only major event identified which has not been fully mitigated through embedded and/or additional mitigation is droughts, due to the risk of a drought itself cannot be reduced by design.



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