18. Surface water and groundwater

The airport site contains about 64 kilometres of mapped watercourses and drainage lines (notably Badgerys Creek, Cosgroves Creek and Duncans Creek) and overlies the Bringelly Shale aquifer as well as unconfined areas of alluvial groundwater. Water quality sampling indicates that existing water quality is relatively degraded, with high levels of phosphorous and nitrogen in surface water attributable to land uses at the airport site and within the broader catchment.

Site preparation and construction of the Stage 1 development would transform the airport site from a rolling grassy and vegetated landscape to an essentially built environment with some landscaping. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which would in turn alter the duration, volume and velocity of surface water flow.

An estimated 1.36 ML of water would be required per day for site preparation works for the proposed airport. For the purposes of this draft EIS it has been assumed that to meet this requirement 8,600 litres (0.0086ML) of potable water would be sourced from existing assets operated by Sydney Water per day and the remaining water supplied through stormwater runoff captured in sediment dams or existing farm dams. To meet water demand during construction it may be necessary to source water from other sources such as groundwater or other sources of surface water. However, consideration of the impacts associated with using these alternative sources would be subject to a separate assessment.

Water would be utilised during construction for soil conditioning and dust suppression. Water supply options include water reticulated to the site from existing major utilities and extraction from existing surface water resources.

The design of the Stage 1 development includes a drainage system to control the flow of surface water and improve the quality of water prior to its release back into the environment. This drainage system comprises a series of channels and basins to collect and treat flows prior to release to receiving waters. The assessment indicates that this system would be generally effective at mitigating flooding and water quality impacts.

The transformation of the airport site would alter groundwater levels and recharge conditions through an increase in impervious surfaces. Bulk earthworks and excavations at the airport site would also receive some groundwater inflows, which would require management during construction and operation. Impacts on groundwater levels, including impacts on dependent vegetation or watercourses, would be unlikely to be significant given the existing low hydraulic conductivity and water quality of the Bringelly Shale aquifer. Registered bores surrounding the airport site are understood to target the Hawkesbury Sandstone aquifer, which is significantly deeper than the Bringelly Shale aquifer and not considered to be connected. As such, impacts on groundwater users are not expected.

The identified impacts would likely be further reduced during detailed design of the surface water drainage system. Baseline and ongoing monitoring of surface water and groundwater would be undertaken to characterise any residual impacts and prompt corrective action where necessary.

18.1. Introduction

This chapter provides an analysis of the surface water and groundwater systems potentially affected by the development of the proposed airport. It draws on technical assessments of hydrology and geomorphology (see Appendix K1), surface water quality (see Appendix K2) and groundwater (see Appendix K3). The assessment describes the existing surface and groundwater resources at the airport site, considers potential impacts during construction and operation of the proposed airport and proposes measures to mitigate and manage these impacts.

18.2. Methodology

A range of qualitative and quantitative assessment approaches were adopted to consider the impact of the proposed airport on surface and groundwater resources at the airport site.

Field surveys were undertaken to provide an overview of the existing surface water features at the site, determine the physical stability of watercourses, identify hydraulic structures (such as bridges and culverts) and supplement existing water quality data.

Predictive models were used to consider the impact of the change in landform characteristics at the airport site on runoff volumes and the subsequent impacts upon stream flow, flooding, groundwater recharge and water quality. Identification of the potential impacts on the environmental values and beneficial uses of surface and groundwater resources were identified, and mitigation and management measures were proposed to minimise the extent of potential impacts. The assessment included an analysis of the potential for climate change to exacerbate the environmental impacts arising from the proposed airport, including the susceptibility of the airport site to flooding.

18.2.1. Baseline data

Existing surface water and groundwater resources were described with reference to:

- aerial imagery (AusImage 2014);
- topography data (NSW LPMA 2014);
- climatology data (BoM 2015a);
- 1997-99 EIS (PPK 1997);
- geotechnical and contamination investigations (Coffey & Partners 1991; GHD 2015);
- *South Creek Flood Study* (Worley Parsons 2015); and
- surface water quality data in the *Environmental Field Survey of Commonwealth Land at Badgerys Creek* (SMEC 2014).

18.2.2. Predictive modelling and analysis

Existing hydrologic and hydraulic models were developed to simulate runoff and streamflow associated with storms of varying severity. These storms are categorised in terms of the average recurrence interval (ARI), or average length of time between successive storms, and include the one year ARI, two year ARI, five year ARI, 20 year ARI and 100 year ARI events. The largest expected flood over any duration was also modelled based on estimates of maximum rainfall. The results of the hydrologic and hydraulic models were analysed to identify changes in the volume and velocity of surface water. Water quality models were developed to assess the quality of surface water leaving the airport site. Models used as part of the assessment included:

- hydrology models (RAFTS);
- hydraulics models (MIKE 21); and
- water quality models (MUSIC).

All models included representations of the drainage system incorporated into the indicative design of the proposed airport, which includes a configuration of channels and detention basins to collect and treat flows prior to release to receiving water (see Figure 18–1).

The basins would be situated at key locations where surface water flows off the airport site and would be designed to release water at controlled flow rates. The basins would also have the effect of improving the quality of the surface water they contain prior to release.

The drainage system has been designed to contain flows up to the 100 year ARI event without uncontrolled discharges occurring. The capacities of the basins to store surface water flows are presented in Table 18–1, excluding Basin 5 which would be integrated into the drainage system for the long term development (see Chapter 36).

The results of models were analysed to identify impacts on waterways, people and property and thereby assess the effectiveness of the drainage system.

Table 18–1 – Detention basin attenuation volumes

Basin	Volume (kilolitres)	Discharge
Basin 1	64,000	Badgerys Creek
Basin 2	8,100	Badgerys Creek
Basin 3	15,900	Badgerys Creek
Basin 4	10,400	Badgerys Creek
Basin 6	75,000	Oaky Creek
Basin 7	82,000	Oaky Creek (via tributary)
Basin 8	41,000	Duncans Creek (via tributary)

Note: Basin 5 would be integrated into the drainage system for the longer term development (see Chapter 36) and so has not been included in the assessment of the Stage 1 development.

Historical water quality monitoring data available for the airport site and downstream areas, includes data from the 1997-1999 EIS and the SMEC *Environmental Field Survey of Commonwealth Land at Badgerys Creek*. A limited scope of water quality sampling was also undertaken by GHD during the aquatic ecology surveys in March 2015 at water quality sampling sites shown on Figure 18–1. The historical monitoring data and recent survey provides a snapshot of baseline water quality in the catchment at the time of each investigation.

It is recognised that water quality monitoring data is influenced by the surrounding land-use and the rainfall and run-off conditions at the time of sampling. Predictive modelling using MUSIC modelling software was therefore undertaken to estimate pollutant loads in the catchment under existing baseline conditions and calibrated with the available water quality monitoring results. The MUSIC model was chosen as it has the ability to estimate the quantity and quality of surface water generated at a site under a range of rainfall and catchment configurations and therefore a direct comparison between the baseline catchment conditions and the proposed development scenarios.

LEGEND

- Airport site
- Stage 1 development
- Hydrology assessment reporting locations
- Drainage swales
- Watercourses
- Detention ponds
- Water quality sampling sites

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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Figure 18-1 - Surface water drainage system and sample sites

The MUSIC model was initially set up to represent the existing airport catchment comprising a total of 39 individual sub catchments which were delineated using 1 m contours generated for the site. Two additional external catchments were modelled to represent the area downstream of Elizabeth Drive down to the confluence of South Creek with Blaxland Creek in order to assess the impacts on downstream water quality at a more regional scale.

Each individual sub-catchment was broken down into five land use types to represent the existing land uses at the airport site and pollution parameters assigned based upon modelling guidelines and statistical analysis from extensive research undertaken at locations throughout Australia. The existing baseline model was then stimulated for the full range of rainfall data and calibrated using the recent monitoring data using an iterative approach to achieve modelled results similar to the monitoring data. Full details of the MUSIC modelling approach is provided in Appendix L2 of Volume 4.

18.3. Regulatory and policy setting

Stage 1 would be developed in accordance with the draft Airport Plan under the provisions of the *Airports Act 1996* (Airports Act), following finalisation of the EIS.

The Commonwealth and NSW legislative and policy settings and guidelines in regards to water resources – even where not directly applicable to the proposed airport – have been considered as part of the assessment process.

18.3.1. Legislation

18.3.1.1. Airports Act 1996

Environmental management at the airport site would be undertaken in accordance with Part 6 of the Airports Act and the Airports (Environment Protection) Regulations 1997, following the grant of an airport lease to an airport-lessee company. The Airports Act specifies offences relating to environmental harm, environmental management standards, and monitoring and incident response requirements, including in relation to water pollution. Standards in relation to water pollution deal with matters such as oxygen content, pH, salinity and turbidity.

Part 4 of the Airports (Environment Protection) Regulations 1997 require an airport-lessee company to take all reasonable and practicable measures to avoid polluting water. Part 6 of the regulations requires an airport-lessee company to monitor pollution levels, including laboratory analysis accredited by the National Associated of Testing Authorities. In the period prior to granting an airport lease, any construction activities on the airport site would be conducted in accordance with the Airport Plan and have regard to the requirements of the Airports (Environment Protection) Regulations 1997.

18.3.1.2. Water Management Act 2000

The *Water Management Act 2000* (NSW) is administered by the NSW Department of Primary Industries and is intended to ensure that water resources are conserved and properly managed for sustainable use benefitting both present and future generations. The Water Management Act is also intended to provide a formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses, and to provide for protection of catchment conditions. The intent and objectives of the Act have been considered as part of this assessment.

Water sharing plans have been developed under the Water Management Act for all water sources within NSW. The water sharing plans are developed with the aims of:

- clarifying the rights of the environment, landholders, town water suppliers and other licensed users;
- defining the long-term average annual extraction limit for water sources;
- setting rules to manage impacts of extraction; and
- facilitating the trading of water between users.

Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources

The *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources* commenced in 2011 and covers 87 management zones that are grouped into six water sources. The airport site is situated in the Hawkesbury and Lower Nepean Rivers source, or catchment.

The Hawkesbury and Lower Nepean Rivers catchment is separated into numerous management areas, which include the Upper and Lower South Creek Management Zones and the Mid Nepean River Catchment Management Zone. Badgerys, Oaky and Cosgroves Creeks are interpreted to be within the Upper South Creek Management Zone, and Duncans Creek is interpreted to be within the Wallacia Weir Management Zone (one of the Mid Nepean River Catchment Management Zones). The water sharing plan background document (NOW 2011) suggests that the South Creek region has high economic significance and depends on extraction for irrigation, town and industrial water supply.

Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources

The *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* covers 13 groundwater sources on the east coast of NSW. The airport is located within the Sydney Basin Central Porous Rock groundwater source area. The porous rock aquifer is referenced in the plan as sedimentary sandstone and siltstone formations with intervening coal seams.

The background document for the water sharing plan (NOW 2011) lists the Sydney Basin Central porous rock aquifer as having low to moderate contact with surface water with generally long travel times (years to decades). The allocated volumes of 2,592 ML/yr versus a long-term average annual extraction limit of 45,915 ML/yr suggests that there is a significant amount of groundwater in the aquifer that has not been released for use.

18.3.1.3. Protection of the Environment Operations Act 1997

The objectives of the Protection of the *Environment and Operations Act 1997* (NSW) include the protection, restoration and enhancement of the quality of the environment, in recognition of the need to maintain ecological sustainable development including specific references the protection of water quality. This assessment has taken into account the intent and objectives of that Act.

18.3.2. Policies and guidelines

18.3.2.1. National Water Quality Management Strategy

The *National Water Quality Management Strategy* aims to protect Australian water resources, by improving water quality while supporting the businesses, industry, environment and communities that depend on water for their continued development. The strategy consists of three major elements: policy, process and guidelines.

The main policy objective of the Strategy is to achieve sustainable use of water resources, by protecting and enhancing their quality, while maintaining economic and social development. The process strives to form a nationally consistent approach to water quality management through the development of high-status national guidelines. The guidelines provide the point of reference when issues are being determined on a case-by-case basis. These include guidance on regulatory and market-based approaches to managing water quality as well as regional water quality criteria.

The policy and principles document states:

The generally accepted mechanism for establishing in-stream or aquifer water quality requirements is a two-step process which involves establishing a set of environmental values and establishing scientifically based water quality criteria corresponding to each value.

Environmental values are often interchanged with the term ‘beneficial use’ and are identified in the guidelines to include:

- ecosystem protection;
- recreation and aesthetics;
- drinking water;
- agricultural water (irrigation and stock water); and
- industrial water.

Criteria have been developed to characterise water quality relative to these environmental criteria and are outlined in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) and the *Australian Drinking Water Guidelines* (NHMRC 2011) and are discussed further below.

The criteria specified in these documents have been used as the basis for the current environmental values in this assessment for the treatment requirements for discharge to receiving water environments.

18.3.2.2. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

The national guidelines on water quality benchmarks within the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) are applicable to the Stage 1 development and provide default trigger values of various analytes for comparison with sampled values.

The core concept of the guidelines relates to managing water quality for environmental values. For each environmental value, the guidelines identify particular water quality characteristics or 'indicators' that are used to assess whether the condition of the water supports that value.

The environmental values, expressed as water quality objectives, provide goals to assist in the selection of the most appropriate management options within a catchment. The guiding principles include the identification and protection of the environment values of a waterway. Where targets are not achieved for environmental values, activities in the catchment should be geared toward improving these values.

The guidelines also advocate an 'issues-based' approach to assessing ambient water quality, rather than the application of rigid numerical criteria without an appreciation of the context. This means that the guidelines focus on:

- the environmental values we are seeking to achieve or maintain;
- the outcomes being sought; and
- the ecological and environmental processes that drive any water quality problem.

It should be also be noted that the environmental values and respective numerical indicator values apply to ambient background water quality and are not intended to be applied directly to stormwater discharges.

18.3.2.3. Australian Drinking Water Guidelines

The *Australian Drinking Water Guidelines* (NHMRC 2011) provide a framework for the management of drinking water supplies to achieve a safe and appropriate point of supply. The guidelines provide a base standard for aesthetic and health water quality levels. These values apply in this assessment to the suitability of the groundwater for potable use.

18.3.2.4. State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011

The *State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011* includes provisions requiring development within Sydney drinking water catchments to demonstrate a neutral or beneficial effect on water quality. As the airport site is not within a Sydney drinking water catchment, the policy does not directly apply to the Stage 1 development. Neutral or beneficial effect has nonetheless been considered in the process of describing the potential impacts of the Stage 1 development with reference to existing water quality.

18.3.2.5. New South Wales Floodplain Development Manual

The *New South Wales Floodplain Development Manual* (Department of Infrastructure, Planning and Natural Resources 2005) concerns the management of flood-prone land within NSW. It provides guidelines in relation to flood management, including any development that has the potential to influence flooding, particularly in relation to increasing the flood risk to people and infrastructure.

Greater Sydney Local Land Service Transition Catchment Action Plan

Catchment actions plans are 10-year plans to guide the management of water, land and vegetation by state government and local communities. The main waterways at the airport site (Badgerys Creek, Oaky Creek, Cosgroves Creek and Duncans Creek) fall within the Hawkesbury-Nepean catchment, which is managed under the *Greater Sydney Local Land Service Transition Catchment Action Plan* (NSW Catchment Management Authority 2014).

The action plan is relevant to any influence the proposed airport may have on the downstream catchments in relation to surface water and aquatic ecology. Relevant strategies within the action plan include development of a more water sensitive catchment, promoting resilience through climate change adaptation and a number of strategies relating to protecting aquatic ecosystems.

18.3.2.6. Lower Hawkesbury-Nepean River Nutrient Management Strategy

The *Lower Hawkesbury-Nepean River Nutrient Management Strategy* (OEH 2010a) has been developed with the aim of reducing nutrient loads from existing sources and limiting the growth in nutrient loads from changing land uses. The strategy includes development of a catchment-wide framework to coordinate and guide action on managing nutrients in the lower Hawkesbury-Nepean. The sources of nutrients identified as a priority are: urban stormwater, agricultural practices, on-site sewage management systems, sewage treatment systems and overflows, and degraded land and riparian vegetation.

18.3.2.7. Managing Urban Stormwater: Soils and Construction

Managing Urban Stormwater: Soils and Construction (Landcom 2004), also known as 'the Blue Book', provides guidance on stormwater management with a focus on control of erosion and sedimentation during construction. The guidance contained in the Blue Book has been considered in the commitments to mitigation and management measures.

Water Sensitive Urban Design: Technical Guidelines for Western Sydney

Water Sensitive Urban Design: Technical Guidelines for Western Sydney (Upper Parramatta River Catchment Trust 2004) provides guidance on stormwater management with a focus on urban land uses. The technical guidelines include recommendations for on-site treatment measures to mitigate and limit the potential adverse effects on the downstream receiving waterways. The guidelines also specify percentage reduction targets for phosphorus, nitrogen and suspended solids. The technical guidelines have been considered in the assessment of potential impacts and commitment to mitigation and management measures.

18.3.2.8. Aquifer Interference Policy

The purpose of the *Aquifer Interference Policy* is to explain the role and requirements of the responsible NSW Minister in administering the water licensing and assessment processes for aquifer interference activities under the *Water Management Act 2000*. The aquifer interference assessment framework is a supporting tool to assess proposed activities against the *Aquifer Interference Policy*.

The proposed Stage 1 development includes the excavation of an underground cavity to provide for basement levels for the major terminal buildings. These works may constitute aquifer interference activities and as such the *Aquifer Interference Policy* has been considered as part of the assessment of these works.

18.3.2.9. NSW State Groundwater Policy Framework Document

The objective of the NSW *State Groundwater Policy Framework Document* (Department of Land and Water Conservation 1997) is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW. The NSW groundwater policy contains provisions regarding the protection of groundwater dependent ecosystems in addition to groundwater quantity and quality.

18.4. Existing environment

18.4.1. Climate and rainfall

The airport site hosts an automatic weather station operated by the Bureau of Meteorology. The weather station has recorded rainfall data at the airport site since 1998. Average annual rainfall at the airport site is 676.4 mm. Average monthly rainfall and evaporation data is shown in Table 18–2.

Table 18–2 – Average monthly rainfall at the airport site

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly rainfall (mm)[a]	77.4	108.0	77.3	43.2	40.1	52.1	23.0	35.9	33.9	52.7	74.5	63.6
Highest monthly[a] rainfall (mm)	192.2	342.4	198.0	129.4	155.6	220.0	71.6	231.0	82.2	182.2	173.2	131.2
Lowest monthly rainfall (mm)[a]	13.6	13.4	21.4	1.8	1.8	2.0	2.8	1.0	6.4	0.4	8.4	14.2
Highest daily rainfall (mm)[a]	138.0	106.8	67.8	82.4	54.0	63.8	28.4	70.0	50.8	63.0	63.0	65.0
Evaporation (mm)[b]	172.7	128.4	115.9	75.6	50.2	38.4	38.4	55.5	75	120	145.5	154.1

[a] Data from the Bureau of Meteorology automatic weather station.

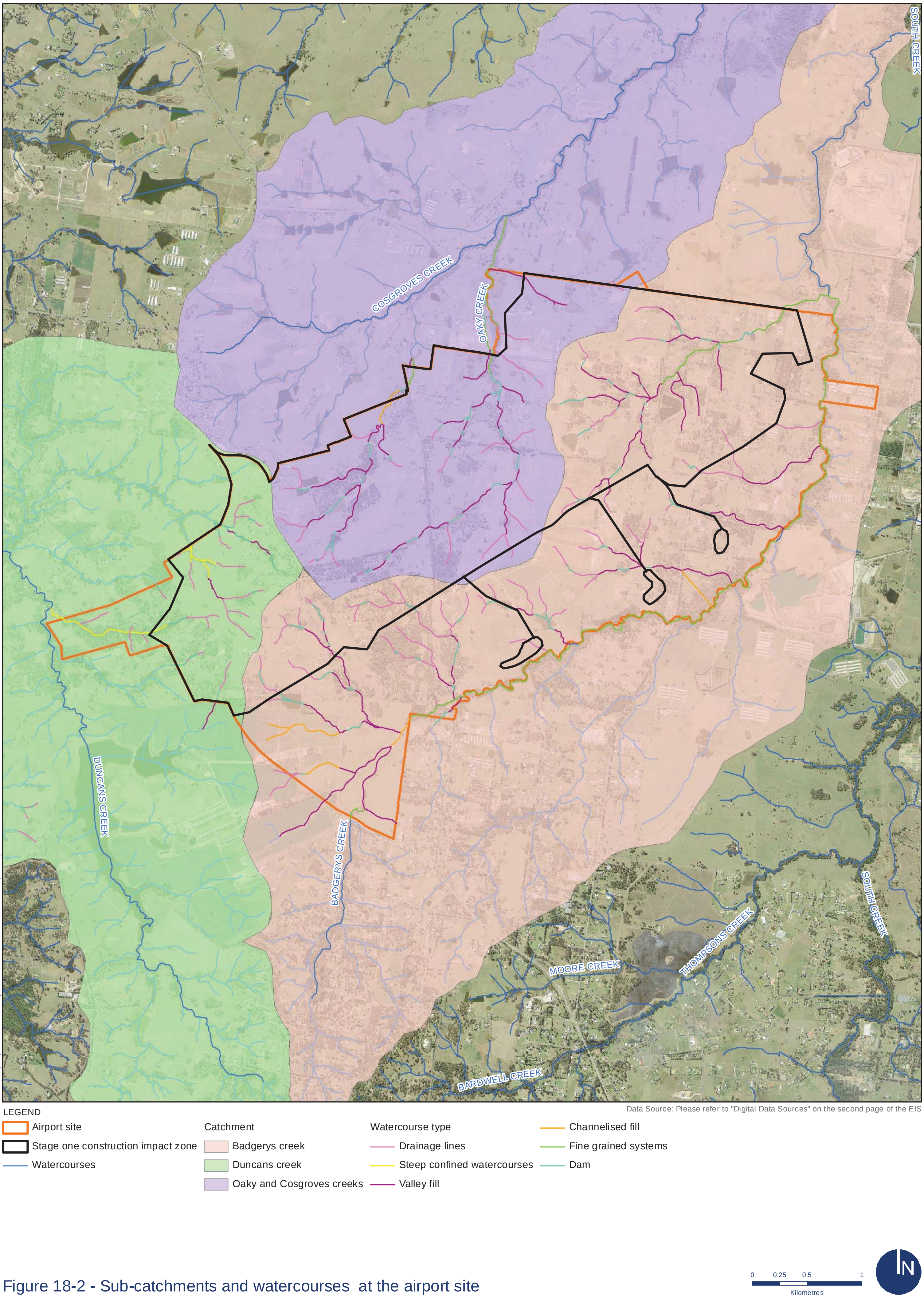
[b] Data from the Bureau of Meteorology Parramatta weather station, as the nearest representative location with available evaporation data.

18.4.2. Catchments

The airport site lies in the north-east of the Hawkesbury-Nepean catchment, which covers an area of 21,400 square kilometres. The Hawkesbury-Nepean catchment is characterised by meandering watercourses and is highly disturbed by clearing and urbanisation. Within the broader catchment, the airport site lies in the Badgerys Creek, Cosgroves Creek and Duncans Creek sub-catchments. Badgerys Creek and Cosgroves Creek are tributaries of South Creek which flows to the Hawkesbury River and Duncans Creek is a tributary of the Nepean River. Sub-catchments at the airport site are shown in Figure 18–2. Land uses within these sub-catchments at airport site are predominantly pastoral (85 per cent) with smaller areas of rural residential (10 per cent), forest (four per cent) and horticulture (one per cent).

Endorsed environmental values for the Hawkesbury-Nepean catchment include aquatic ecosystem protection, recreational water use, raw drinking water, irrigation and general use. Sub-catchments at the airport site are located downstream of Sydney’s drinking water catchment area and would primary used for agricultural use with recreational activities primarily undertaken considerably downstream in the Hawkesbury estuary.

The receiving waters are considered to be “slightly modified fresh water systems”. Based upon this classification a protection level of 95 per cent for freshwater ecosystems, as recommended in the ANZECC Guidelines, is considered to be suitable for toxicants. The airport site also has a ‘lowland rivers’ classification (NSW rivers, less than 150m in altitude).



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

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Figure 18-2 - Sub-catchments and watercourses at the airport site

Default ANZECC trigger values for physical and chemical stressors applicable to the airport site and adopted in this assessment are shown in Table 18–3. It is noted that these default trigger values are guideline values or water quality objectives only, and are not compliance standards or discharge criteria.

Table 18–3 – ANZECC Guidelines Default Trigger Values for NSW Lowland Rivers

Parameter	Default Trigger Value for Lowland Rivers
Chlorophyll a Chl a (mg/L)	0.005
Total phosphorus TP (mg/L)	0.05
Filterable reactive phosphate FRP (mg/L)	0.02
Total nitrogen TN (mg/L)	0.5
Oxides of nitrogen NOx (mg/L)	0.04
Ammonium NH4+ (mg/L)	0.02
Dissolved oxygen DO	85-110 %
pH	6.5 – 8
Salinity (µS/cm)	125-2200
Turbidity (NTU)	6 – 50

Source: ANZECC Guidelines (2000)

18.4.3. Watercourses

The airport site contains 64 kilometres of watercourses and drainage lines, including the adjacent Badgerys Creek. The watercourses at the airport site are classified in Table 18–4 and mapped in Figure 18–2. The main watercourses are Badgerys Creek, Cosgroves Creek and Duncans Creek, with the remaining watercourses being tributaries of these.

Badgerys Creek starts about two kilometres south-west of the airport site and flows north-easterly along its southern boundary before joining South Creek about four kilometres downstream. South Creek ultimately drains to the Hawkesbury River.

Cosgroves Creek starts about one kilometre north of the airport site and flows north-easterly before joining South Creek about six kilometres north-west. Oaky Creek starts at the airport site and flows north to Cosgroves Creek, before its confluence with South Creek about seven kilometres downstream.

Duncans Creek starts about three kilometres south-west of the airport site and flows north-westerly before joining the Nepean River about nine kilometres downstream from the airport site. Duncans Creek receives flows from a number of unnamed tributaries at the airport site.

Clearing, agriculture and the construction of in-stream dams have affected the physical stability of watercourses at the airport site. Bank erosion and head cut are evident at Badgerys Creek and Cosgroves Creek, despite these watercourses also having well vegetated riparian zones.

Table 18–4 – Watercourses at the airport site

Watercourse type	Definition
Drainage lines	Drainage lines are typically narrow flow paths set within gently concave valleys. Flows within drainage lines are sheet like due to the absence of defined channels. Typically, drainage lines are physically stable with no visible signs of erosion.
Valley fill	Valley fills are watercourses where sheet flows move along a flat valley floor, while valley slopes act as banks. The energy of flows in valley fills is dissipated across the flat valley floor, which leads to sediment deposition.
Channelized fill	Channelised fills are watercourses with defined channels that form within valley fills, with the remainder of the valley fill acting as the flood plain. Channelised fills can have moderate flow energy resulting in head cut erosion and channel erosion.
Fine grained systems	Fine grained systems are single channel set within deposited silt and sand floodplains. Channels have low gradient and capacity, meaning flows have low energy and readily spill onto the floodplain.
Steep confined watercourses	Steep confined watercourses have steep channels, which are typically stable but may slowly erode over time. Floodplains are absent and sedimentation is typically limited to bars within the channel.

18.4.4. Flooding

Existing surface water flows at the airport site during one year ARI and 100 year ARI storms were simulated in hydrologic and hydraulic models. In the one year ARI event flooding is mostly confined to main watercourse channels and dams, while considerable out-of-bank flooding is expected in a 100 year ARI event, as shown on Figure 18–3 and Figure 18–4.

The floodplain is more extensive on the airport side (western bank) of Badgerys Creek than on the eastern bank due to the wider and flatter floodplain in this location.

A number of the flood-affected rural residential lots outside the airport site are located in Bringelly in the area bounded by the airport site, The Northern Road and Badgerys Creek Road. Based on the available imagery, while a number of lots experience some inundation in a 100 year ARI event, most existing dwellings in this area remain outside the flood extent. A number of dwellings are also located within or close to the flood extent on Badgerys Creek upstream of the airport site. Two dwellings close to the flood extent were also identified downstream of the airport site on Cosgroves Creek.

LEGEND

Airport site

Flood depth (m)

0.1 - 0.2	0.6 - 0.8	2 - 2.5
0.2 - 0.4	0.8 - 1	2.5 - 3
0.4 - 0.6	1 - 1.5	3 - 4
	1.5 - 2	>4

Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

0 0.25 0.5 1
Kilometres

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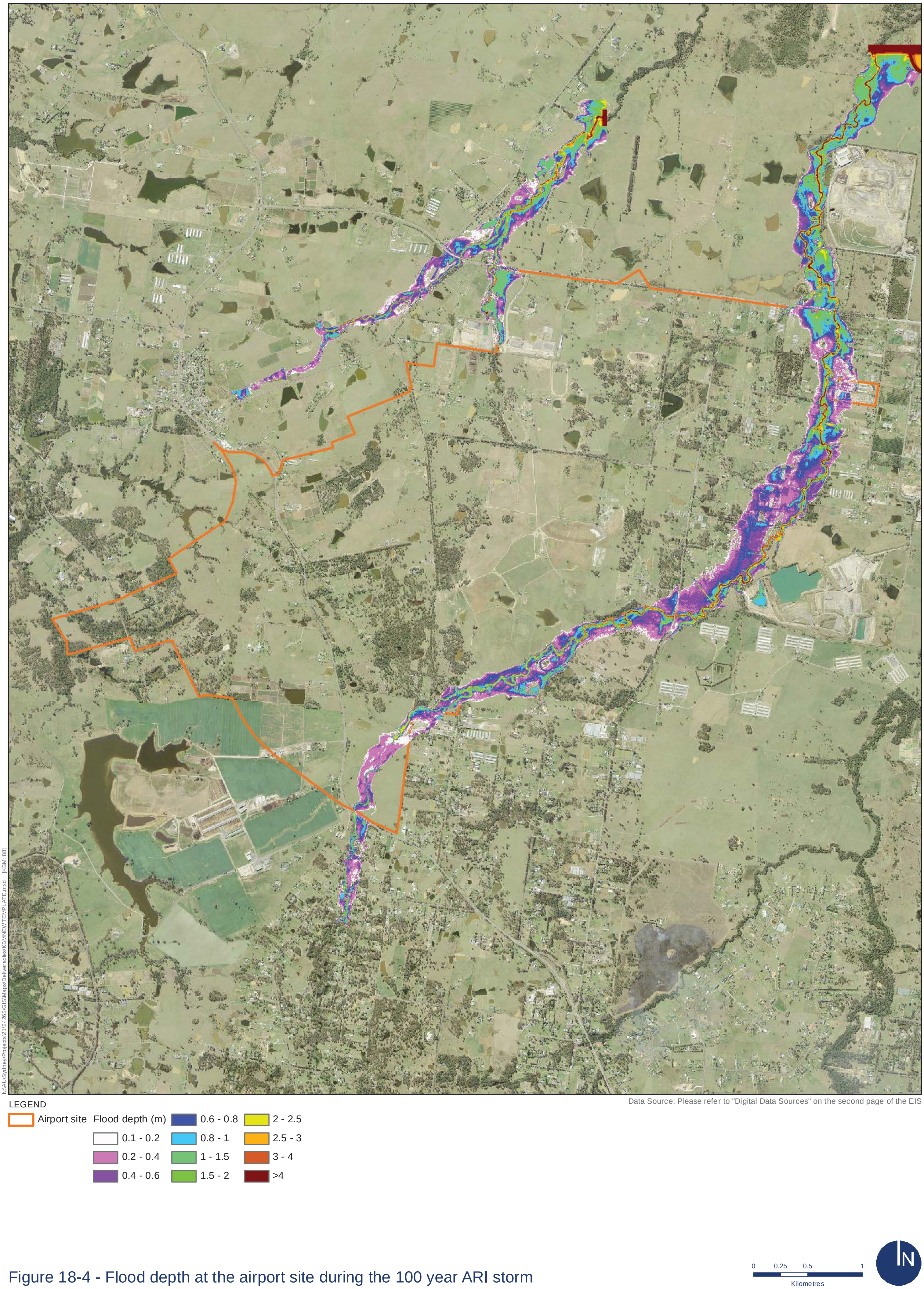
Figure 18-3 - Flood depth at the airport site during the 1 year ARI storm



Data Source: Please refer to "Digital Data Sources" on the second page of the EIS

Figure 18-4 - Flood depth at the airport site during the 100 year ARI storm

18.4.5. Surface water quality

Preliminary water quality sampling was undertaken during preparation of the draft EIS and is presented in Table 18–5. The results indicate that the nutrient loads are generally well above the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000). Turbidity and total suspended solids were found to be generally within acceptable levels, while dissolved oxygen levels were found to be relatively low. The data also indicate that conductivity levels were high, and above those for typical lowland rivers. These results are generally consistent with prior sampling (PPK 1997; SMEC 2014), which can be attributed to the minimal change to existing land-use between the periods of sampling.

Table 18–5 – Background surface water quality

Location	Dissolved oxygen (%)	Conductivity (µS/cm)	Turbidity (Nephelometric Turbidity Units)	Total suspended solids (mg/L)	Nitrogen (mg/L)	Phosphorous (mg/L)
Guidelines	85-100	125-2,200	6-50	<40	0.5	0.05
Badgerys Creek 2	36	3,100	7.71	5	18.5	0.31
Badgerys Creek 3	8.6	3,050	13	5	2.3	1
Badgerys Creek 4	21.3	2,710	12	23	6.2	0.42
Cosgroves Creek 1	55.4 (73.6)	4,320 (5,020)	38.1 (4.25)	19 (5)	1.2 (0.8)	0.05 (0.03)
Duncans Creek	52.5	847	89.2	14	0.9	0.06

Existing surface water quality was modelled at upstream, downstream and major outflow locations in and around the airport site and calibrated using the existing water sampling results. The surface water quality model indicated relatively high levels of nutrients (phosphorous and nitrogen), exceeding the ANZECC guidelines. Total suspended solids and dissolved oxygen were found to be at acceptable levels. The surface water quality predicts that surface water runoff from the airport site contributes 231,140 kilograms of suspended solids, 366 kilograms of phosphorous and 3,303 kilograms of nitrogen to downstream waterways on average each year. The model results are consistent with surface water quality sampling at the airport site and prior data (PPK 1997; SMEC 2014). The results of the water quality model for the existing environment and Stage 1 development are presented and discussed in Section 18.6.3.

A surface water quality monitoring program will be implemented to collect additional background data prior to the commencement of constructions. An initial monthly sampling program is commencing in October 2015 to provide additional baseline data to allow further calibration of the modelled results.

18.4.6. Groundwater

Groundwater at the airport site is generally poor quality with limited beneficial use or environmental value. The aquifers at the airport site include:

- unconfined aquifer in the shallow alluvium of the main watercourses at the airport site;
- intermittent aquifer in weathered clays overlying the Bringelly Shale;
- confined aquifer within the Bringelly Shale; and
- confined aquifer within the Hawkesbury Sandstone.

Groundwater within the alluvium has been measured at depths between 0.7 and 4.7 metres. Within the Bringelly Shale, groundwater has been measured at depths between 3.0 and 11.7 metres, and at depths between 2.4 and 4 metres in the overlying weathered material (PPK 1997; Coffey & Partners 1991). Groundwater within the Hawkesbury Sandstone is significantly deeper because the aquifer is 100 metres below ground level. The variation in depths to groundwater indicates low potential for connectivity between groundwater aquifers.

The Bringelly Shale aquifers at the airport site are considered to have limited hydraulic conductivity. Vertical hydraulic conductivities are expected to be two to three orders of magnitude lower than horizontal hydraulic conductivities, indicating a strong downward head gradient, further limiting potential for connectivity with the underlying Hawkesbury Sandstone aquifer.

The weathered soils of the Bringelly Shale that occur over most of the airport site are anticipated to result in relatively low groundwater recharge with an average of 0.5 per cent of annual rainfall entering the groundwater system. Soil infiltration testing estimates maximum recharge rates of approximately 0.012 millimetres per day for the clayey shale soils, and 0.0057 millimetres per day for the alluvium, indicating very limited groundwater recharge conditions.

An idealised hydrogeological conceptual model for the airport site is shown on Figure 18–5, highlighting the interactions between groundwater, and potential systems reliant on groundwater.

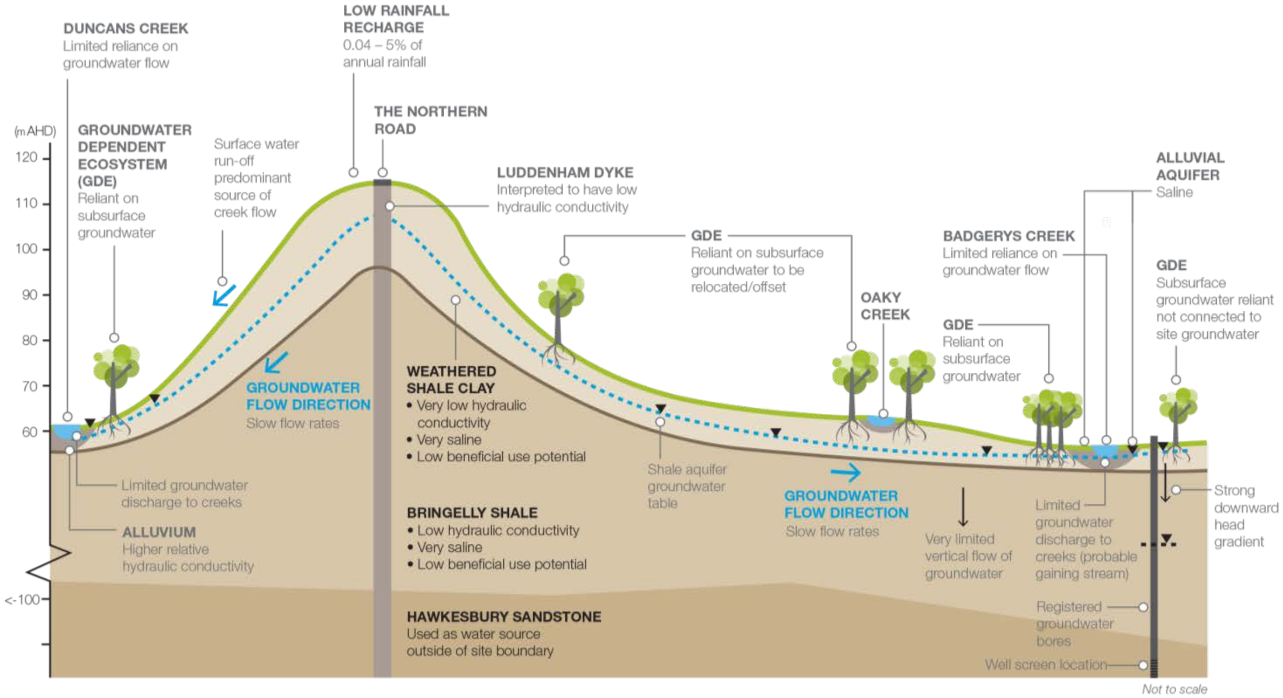


Figure 18–5 – Conceptual hydrogeological model

Groundwater quality data indicates elevated concentrations of lead, zinc, copper, nitrogen and phosphorous above ANZECC freshwater guidelines. Nitrate and sulphate exceeded guideline values at some locations. Groundwater was found to be saline with an average electrical conductivity equalling 21,474 µS/cm and exceeding the 2,200 µS/cm guideline (PPK 1997), indicating a low beneficial reuse potential.

The airport site has been cleared extensively with the exception of stands of remnant and regrowth vegetation located predominantly along Badgerys Creek and the south-western portion of the airport site. This remaining vegetation generally comprises Cumberland Plain Woodland and River-flat Forest. These stands of vegetation broadly correlate with the areas identified as potentially groundwater dependent ecosystems; however, no watercourses in or adjoining the airport site are recorded as being groundwater dependent (BoM 2015a).

The shallower alluvial aquifer at the airport site is understood to discharge at Badgerys Creek, Cosgroves Creek and Duncans Creek. However, surface discharges from the Bringelly Shale aquifer and overlying weathered material are likely to be limited by low connectivity and hydraulic conductivity. Groundwater salinity is an order of magnitude higher on average than surface water salinity at the airport site, further evidencing limited groundwater discharge to surface water.

A number of surface water dams are present across the site. These have been interpreted by site biodiversity investigations to be ‘artificial freshwater wetlands’ in good condition. These features are expected to have been developed initially to capture surface water runoff and are therefore primarily reliant on surface water inputs rather than groundwater. The low permeability clays in which these dams have been developed would limit the connection with surrounding groundwater.

A total of 42 groundwater bores are registered in the vicinity of the airport site. The groundwater bores are recorded as being constructed to significant depths and are understood to generally target the Hawkesbury Sandstone aquifer, which is known to be of higher beneficial use value. It is likely that the Hawkesbury Sandstone is preferentially targeted because of the relatively poor quality of Bringelly Shale groundwater.

18.5. Assessment of impacts during construction

Construction of Stage 1 would transform the airport site from a rolling grassy and vegetated landscape to an essentially built environment with some landscaping. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which in turn would alter the duration, volume and velocity of surface water flows.

An estimated 1.36 ML of water would be required per day for site preparation works for the proposed airport. For the purposes of this draft EIS it has been assumed that to meet this requirement 8,600 litres (0.0086ML) of potable water would be sourced from existing assets operated by Sydney Water per day and the remaining water supplied through stormwater runoff captured in sediment dams or existing farm dams. To meet water demand during construction it may be necessary to source water from other sources such as groundwater or other sources of surface water. However, consideration of the impacts associated with using these alternative sources would be subject to a separate assessment.

Stage 1 would include a drainage system to control the flow of surface water and improve the quality of water before it flows downstream (see Section 18.2.2). The assessment accounts for the effectiveness of this system in mitigating potential impacts to waterways, people and property.

18.5.1. Watercourses

The bulk earthworks program proposed to be carried out for construction of the Stage 1 development would involve the removal of minor watercourses within the construction impact zone. The total length of watercourse that would be removed is 36.5 kilometres. The majority of these watercourses are minor drainage lines and valley fills with less defined channels.

Construction would also change the topography and permeability of sub-catchment areas at the airport site. These changes would affect flows in receiving watercourses upstream and downstream of the airport site. The changes would occur progressively over construction and would be greatest at completion.

Water would be utilised during construction for soil conditioning and dust suppression. Water supply options include water reticulated to the site from existing major utilities and extraction from existing surface water resources, including capture of overland flows and water recycling.

18.5.2. Flooding

Stage 1 would include substantial and large-scale earthworks which would modify drainage direction and overland flow paths, changing the nature of flooding on the airport site. As construction progress and impervious area expands, runoff from the airport site would increase.

Without progressive introduction of formal drainage designed to cater to the new site conditions, there is potential for disruption to construction activities due to flooding and waterlogged soils, as well as the potential for downstream flooding. Detention basins have been incorporated into the indicative site design which would mitigate the increase in runoff, reducing offsite impacts of surface water flows. The detention basins would be established at the start of construction.

There is a high likelihood of large rainfall events occurring during the construction of the Stage 1 development and throughout operation of the proposed airport. The operation of the drainage system during such events is discussed in Section 18.6.2.

18.5.3. Surface water quality

Clearing and bulk earthworks would increase the surface area, and in some places the slope, of exposed soil surfaces at the airport site. These conditions would present a risk of erosion and associated surface water quality impacts. With regard to the main watercourses at the airport site bulk earthworks would not occur within 90 metres of Badgerys Creek, 300 metres of Cosgroves Creek or 880 metres of Duncans Creek.

The design capacity and placement of detention basins would ensure that all drainage water from disturbed areas would be captured prior to discharge. The drainage system would include the main detention basins (see Figure 18–1) and a series of upstream interim detention basins. The drainage system would have the effect of improving the quality of the surface water prior to release by allowing sediment to settle within the basins. The drainage system, in combination with other standard construction erosion control measures would readily mitigate the potential impacts of sedimentation. These and related measures are detailed in Section 18.7.

Construction of the proposed Stage 1 development would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. In the unlikely event of a significant leak or spill of contaminants, remediation would be implemented as soon as practicable.

Aqueous film-forming foams (AFFF) have historically been used for firefighting purposes at airports, at fuel depots, hangars and for aviation rescue and fire-fighting (for both operational and training purposes). AFFF products historically used on airport sites contain perfluorinated or polyfluorinated compounds, or fluorosurfactants (PFCs). Depending on the type of AFFF used, the principal PFC constituents could have included perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) and fluorotelomers such as 6:2 fluorotelomer sulfonate (6:2FtS) and 8:2 fluorotelomer sulfonate (8:2FtS).

AFFF has not been used for aviation rescue and fire-fighting by Airservices Australia since 2010, but continues to be used around fuel depots and hangars at many airports (GHD 2015 b).

18.5.4. Groundwater

Noting the poor quality of existing groundwater, the proposed airport has the potential to affect groundwater conditions through changes to groundwater recharge, groundwater drawdown and impacts on groundwater quality.

18.5.4.1. Groundwater recharge

Groundwater recharge, the process by which surface water infiltrates downward toward the water table would be affected by compaction and the establishment of impermeable surfaces across the airport site during construction. Re-profiling of the land surface may lead to a temporary increase in rainfall recharge during bulk earthworks, as the fill is expected to have a higher overall permeability than the existing site conditions. However, as construction progresses, the proportion of paved surfaces would increase, which would reduce recharge to below existing conditions.

Overall, minimal change to local groundwater recharge would be expected as the existing shale derived clay soils have low permeability resulting in the majority of rainfall at the site being released as stormwater runoff rather than infiltrating to groundwater. It is not expected that a reduction in recharge would affect any sensitive ecological receptors or beneficial uses of the groundwater system.

18.5.4.2. Groundwater drawdown

Groundwater drawdown is anticipated as a result of airport site re-profiling and dewatering of excavation beneath the water table. Extensive re-profiling of the airport site would be undertaken to create a flatter surface for the development of the proposed runway and associated facilities. The re-profiling would result in a lowering of groundwater elevations in areas that currently have higher topographical elevation, and is expected to result in reduced groundwater flow rates and hence reduced discharge to surrounding surface features. The peripheries of the re-profiled area would result in exposed cuttings that would seep and reduce groundwater elevations in the elevated areas around the cuttings. The re-profiling would not result in dewatering of the groundwater system below the level of the surrounding creeks and there would be no potential for drying up of the creeks from this activity.

Establishment of basements in the terminal complex would likely intercept the underlying shale aquifers and require dewatering and management throughout construction. Due to low inherent hydraulic conductivities of the geology in these areas, it can be expected that seepage volumes would be relatively small.

As drawdown impacts are expected to be minor, a groundwater monitoring programme at potential sensitive receptors (riparian vegetation and creeks) is considered to be sufficient to assess the emergence of any impacts.

18.5.4.3. Groundwater quality

Potential groundwater quality risks include isolated spills and incidents occurring during construction, and diffuse impacts associated with general construction activities such as use of machinery. Contaminants of primary concern are usually hydrocarbons; however, other chemicals such as herbicides, pesticides and fertiliser may also be used during construction. Impacts would have the potential to occur through the infiltration of pollutants through the ground surface or through dirty water retention facilities (such as temporary sediment basins) to the underlying groundwater systems.

Groundwater seepage into excavations for building basements would need to be managed by pumping to stormwater management facilities or other suitable treatment systems. Chemicals of concern in groundwater seepage include total dissolved solids, metals, total nitrogen, phosphorus and sulphate. There would be small seeps from cuttings that would also require appropriate management prior to discharge offsite.

Groundwater present in the shallow geology has been identified to have high salinity values. The excavation and use of this material for infilling could permit the release of additional salts into groundwater. This would only occur where increased recharge occurs to fill areas, and where a shallow groundwater table develops in the fill material.

As the underlying aquifer system is of low beneficial use, adverse impacts may potentially emerge when affected groundwater migrates beneath areas of groundwater-reliant vegetation (located in creek riparian areas) or discharges into creeks. Groundwater flow velocities are expected to be slow, and as such the emergence of any impacts would also be slow. A groundwater monitoring approach is considered suitable to manage the identification of groundwater quality impacts.

18.6. Assessment of impacts during operation

The Stage 1 development during operation would comprise a built environment with some landscaping. The catchment areas within the airport site and the permeability of the ground surface would therefore be significantly altered, which in turn alters the duration, volume and velocity of surface water flow.

The design of the Stage 1 development includes a drainage system to control the flow of surface water (see Section 18.2.2). The assessment accounts for the effectiveness of this system in mitigating potential impacts on waterways, people and property.

18.6.1. Watercourses

The alterations to the topography and permeability of the airport site made during construction would persist through operation of the Stage 1 development. The operating Stage 1 development could therefore affect flows in receiving watercourses upstream and downstream of the airport site, relative to existing conditions. Changes to flows in receiving watercourses have the potential to affect their physical conditions.

Hydrologic and hydraulic modelling incorporated the Stage 1 development landform and drainage system indicates that duration, volume and velocity of surface water flows in watercourses are similar or reduced when compared to existing flow conditions in all but a few cases.

Increases in flood depth at Cosgroves Creek and Oaky Creek (see Section 18.6.2) have the potential to affect the physical stability of watercourses through bed or bank erosion. Localised increases are also expected to occur at basin outflows.

Changes to surface water flows elsewhere upstream and downstream of the airport site are not expected to affect the physical stability of watercourses.

Potential impacts would be mitigated through further refinement of the surface water drainage system, including the provision of erosion controls at basin outlets.

18.6.2. Flooding

The establishment of the Stage 1 development would comprise a major modification to existing on site flow paths and sub-catchment boundaries, with resultant potential impacts on surface water flows and the receiving watercourses.

Stage 1 would result in a portion of the airport site that currently drains towards the Oaky Creek and Cosgroves Creek catchments to the north being diverted south towards Badgerys Creek, while a portion of the airport site that currently drains to Badgerys Creek would be diverted to Duncans and Oaky Creeks. The proposed airport would change surface run-off conditions in the catchments it intersects, which may also create minor incidental losses associated with evaporative changes.

A summary of changes to sub-catchment areas comprising the airport site is provided in Table 18–6. A reduction in catchment area would generally result in reduced flows downstream; conversely, an increase in catchment area would increase flows downstream. An increase in impervious surfaces would also increase runoff and downstream flows.

Table 18–6 – Changes in catchment area and impervious area at the airport site

Location	Catchment area (ha)		Impervious area (%)	
	Existing	Stage 1	Existing	Stage 1
Badgerys Creek at Elizabeth Drive	2,052	↑2,362	12%	↑14%
Oaky Creek at Elizabeth Drive	361	↓292	10%	↑49%
Cosgroves Creek at Elizabeth Drive	536	↑603	14%	↑20%
Badgerys Creek at South Creek	2,799	↑2,800	12%	↑14%
Cosgroves Creek at South Creek	2,163	↓2,148	14%	↑21%
Duncans Creek at Nepean River	2,379	↑2,385	14%	↑15%

↓/↑ denotes decrease/increase

Hydrologic and hydraulic modelling indicates that duration, volume and velocity of surface water flows in watercourses would be generally similar or reduced when compared to existing flow conditions. Comparison of peak flows under existing and Stage 1 conditions for a one year ARI and 100 year ARI events are provided in Table 18–7. The reporting locations were defined in the hydrological and hydraulic models as shown in Figure 18–1.

The general reductions in peak flows demonstrate the function of the detention basins proposed at most site discharge points for the dual purpose of treating water quality and mitigating potential increases in peak flows (refer to Figure 18–1).

Despite the general reductions, increases of up to 100 mm in stream depths may occur at Cosgroves Creek and up to 250 mm in limited reaches of its tributary Oaky Creek for the smaller one year ARI and five year ARI events, plus associated increases in flow volume and velocity. Localised increases would also be expected to occur at basin outflows during discharge events. These potential impacts would need to be mitigated through further refinement of the surface water drainage system (see Section 18.7). No changes to flood levels are expected to occur at dwellings or other infrastructure surrounding the airport site.

Table 18–7 – Modelled peak flows at the airport site with Stage 1 development

Location	Basin	1 year ARI peak flows (m^3/s)			100 year ARI peak flows (m^3/s)		
		Existing	Basin inflow	Outflow	Existing	Basin inflow	Outflow
Location A	Basin 1	8.4	4.4	3.5	33.5	25.9	12.7
Location B	Basin 2	1.9	0.9	0.8	8.2	5.0	3.1
Location C	Basin 3	3.2	2.1	1.8	12.9	12.4	6.1
Location D	Basin 4	2.3	1.5	1.5	9.1	7.2	5.5
Location E/F	–	6.5[a]	–	2.9[b]	26.3[a]	–	12.6[b]
Location G/H	Basin 6	8.9[d]	8.2[c]	6.6[c] 7.9[d]	37.6[d]	54.3[c]	23.8[c] 29.3[d]
Location I	Basin 7	4.1	4.4	2.7	16.5	27.9	8.7
Location J	Basin 8	3.3	2.4	1.7	10.9	14.5	5.3
Location K	–	2.1	–	1.7	9.6	–	7.4
Location L	–	4.6	–	4.2	19.8	–	18.0

[a] Location E
[b] Location F
[c] Location G
[d] Location H

18.6.3. Surface water quality

Existing surface water quality was modelled at upstream, downstream and major outflow locations in and around the airport site. The model results are summarised in Table 18–8, and show that actual pollutant concentrations would decrease at most downstream locations. Despite the Stage 1 development leading to general improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet ANZECC guideline objectives, noting the catchment has not met ANZECC guidelines for several years.

Despite the general decrease in pollutant concentrations, Stage 1 would result in increased loads of phosphorous and nitrogen, largely as a function of the increase in runoff volumes associated with the modified catchment areas and changes to land-use.

Relative increases in phosphorous and nitrogen loads attributed to the proposed airport would be most pronounced at basin outlets, where surface water flows leave the airport site, but would progressively decrease downstream of the airport site as receiving waterways receive flows from the wider catchment. In any case, though loads would be volumetrically higher, actual pollutant concentrations would be generally improved in comparison to existing water quality conditions. The proposed drainage system would be generally effective at reducing loads of suspended solids in surface water, compared to existing conditions. Further resolution of mitigation measures would be provided in the final EIS having regard to identified downstream assets and potential for impacts.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling.

Releases would be avoided with the implementation of Australian standards for the storage and handling of hazardous materials. Remediation would be implemented as soon as practicable in the unlikely event of a significant leak or spill of contaminants.

Table 18–8 – Surface water quality at the airport site

	Existing (mg/L)			Stage 1 development (mg/L)		
Location	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
ANZECC	40	0.05	0.5	40	0.05	0.5
Basin 1	22.1	0.14	1.54	↓12.9	↓0.11	↓0.91
Basin 2	22.1	0.09	1.25	↓16.5	↑0.11	↓0.99
Basin 3	21.9	0.09	1.26	↓12.2	↑0.12	↓0.88
Basin 4	20.7	0.38	2.91	↓15.9	↓0.11	↓1.00
Basin 6	22.5	0.15	1.60	↓6.99	↓0.12	↓0.76
Basin 7	22.3	0.14	1.46	↓10.6	↓0.12	↓0.81
Basin 8	23.2	0.13	1.51	↓11.9	↓0.11	↓0.90
Badgerys Creek 1	21.5	0.14	1.47	↑22.5	↓0.11	↓1.21
Badgerys Creek 2	21.8	0.15	1.54	↓18.1	↓0.11	↓1.10

	Existing (mg/L)			Stage 1 development (mg/L)		
Location	Suspended solids	Phosphorous	Nitrogen	Suspended solids	Phosphorous	Nitrogen
Badgerys Creek 3	21.9	0.14	1.53	↓14.8	↓0.12	↓1.00
Cosgroves Creek 1	22.7	0.14	1.54	↓10.2	↓0.12	↓0.88
Cosgroves Creek 2	22.5	0.14	1.50	↓10.9	↓0.12	↓0.88
Duncans Creek	10.3	0.06	0.70	↑13.2	↑0.11	↑0.96
Kemps Creek	20.9	0.13	1.34	↓15.4	↓0.11	↓1.03
Blaxland Creek	20.8	0.12	1.31	↓15.5	↓0.11	↓1.02

↓/↑ denotes decrease/increase

18.6.4. Reclaimed water irrigation

An estimated 2.5 ML of wastewater per day would be generated during operation of the Stage 1 development. The wastewater would be reticulated, treated and recycled (as grey water) or irrigated on site. Treatment and irrigation methods would be determined in detailed design, but it is expected that wastewater would be treated to a high quality with membrane biological reactor technology to produce high quality reclaimed water suitable for beneficial reuse or irrigation.

The key risks to surface water and groundwater associated with the irrigation of reclaimed water are runoff to surface water or infiltration to groundwater. These risks would be limited in the first instance as reclaimed water would be relatively high quality and appropriate management practices such as balancing storages and proper irrigation scheduling to avoid excessive irrigation are proposed.

18.6.5. Groundwater

Potential impacts associated with the operation of the proposed airport would continue to be associated with potential changes to groundwater recharge, groundwater drawdown and potential impacts on groundwater quality as discussed in Section 18.5.4. Impacts on groundwater recharge are not expected to be significant given the very limited groundwater recharge condition at the airport site (see Section 18.4.6). Groundwater drawdown effects due to inflows would be limited following the initial effects of bulk earthworks and excavation. Significant groundwater inflows to underground infrastructure are not expected and would be controlled, if necessary, through the use of lining or other engineering controls.

The operation of the proposed airport would involve the use of a range of fuels and chemicals. These substances may be released to the environment in the event of a mishap during refuelling, maintenance or general storage and handling. Releases would be avoided with the implementation of Australian Standards for the storage and handling of hazardous materials. Remediation would be implemented as soon as practicable in the unlikely event of a significant leak or spill of contaminants.

18.7. Mitigation and management measures

Measures to manage potential impacts on surface water and groundwater during construction and operation are listed in Table 18–9. Some of the main proposed measures include:

- refinement of the surface water drainage system to improve flood and water quality performance as far as practicable;
- regular inspection and maintenance of the surface water drainage system to ensure all components are functioning as designed;
- implementation of standards for storage and handling of fuels or chemicals with the potential to contaminate surface water or groundwater; and
- baseline and ongoing monitoring of surface water and groundwater, fulfilling the requirements of the *Airports (Environment Protection) Regulations 1997*.

The establishment of erosion controls in line with *Managing urban stormwater: soils and construction* (Landcom 2004) would be central to the management and mitigation of erosion and associated surface water quality impacts. These measures are discussed in Chapter 17.

The reclaimed water reuse scheme would be designed and operated in accordance with the risk framework and management principles contained in the *National Guidelines on Water Recycling* (Environment Protection and Heritage Council 2006) and the *Environmental guidelines: Use of effluent by irrigation* (DEC 2004d). This approach would avoid environmental harm to surface water and groundwater. These measures are discussed in Chapter 17.

Table 18–9 – Mitigation and management measures

ID	Issue	Measure	Timing
18.1	Surface water drainage system	Preparation of a plan to refine the surface water drainage system during detailed design to address the following: • detailed design of basins and channels to capture the majority of runoff, including during construction; • refinement of drainage system design performance standards to optimise capacity and release timing, mimicking natural flows as far as practicable; • provision of intermediate sediment retention basins upstream of larger basins to provide additional treatment; • provision of separate bio-retention swales and basins to provide additional treatment and separation of these features from the drainage system to protect contained water during floods; • provision of pollutant traps to prevent debris and other coarse material entering the drainage system; • stabilisation structures at outlets to include rock check dams at regular intervals along channels and energy dissipaters at basin outlets; and • capacity for containment of accidental leaks or spills in the drainage system at maintenance areas, fuel farms or other areas where fuels or chemicals are stored or handled in accordance with Australian standards.	Pre-construction
18.2	Erosion and sedimentation	The surface area disturbed at any one time would be minimised as far as possible by construction staging and stabilised with vegetation or appropriate cover.	Construction

ID	Issue	Measure	Timing
18.3	Leaks or spills of fuel or other chemicals	Fuel and other chemicals would be stored and handled in accordance with relevant Australian standards such as: • *AS 1940-2004 The storage and handling of flammable and combustible liquids;* • *AS/NZS 4452:1997 The storage and handling of toxic substances;* • *AS/NZS 5026:2012 The storage and handling of Class 4 dangerous goods; and* • *AS/NZS 1547:2012 On-site domestic wastewater management.*	Construction
18.4	Surface water quality	Surface water quality criteria for releases from the drainage system would be developed with due consideration to the *Airports (Environment Protection) Regulations 1997* and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) and the results of baseline water quality monitoring.	Pre-construction
18.5		Surface water quality monitoring would be conducted at basin outflows and selected upstream and downstream conditions. Once an airport lease is granted, the proposed airport would be subject to water quality monitoring requirements as set out in the *Airports (Environmental Protection) Regulations 1997* and the results of baseline water quality monitoring.	Construction Operation
18.6	Leaks or spills of fuel or other chemicals	Maintenance areas, fuel farms and other areas where fuels or chemicals are stored or handled would be bunded to contain any accidental spills or leaks.	Construction Operation
18.7	Leaks or spills of fuel or other chemicals	Develop and implement response procedures to remedy leaks or spills.	Construction Operation
18.8	Groundwater inflows	Groundwater elevation monitoring would be conducted to detect potential impacts to base flow in the vicinity of potentially sensitive creeks or groundwater dependent vegetation. Monitoring would be undertaken quarterly through construction up to a minimum period of three years after the completion of the Stage 1 development and until any identified impacts stabilise.	Construction Operation
18.9		Measures to supplement groundwater supplies would be made in the unlikely event of impacts to dependent vegetation or watercourses.	Construction Operation
18.10	Groundwater quality	Groundwater quality monitoring of alluvial and Bringelly Shale aquifers would be conducted at major infrastructure locations, down gradient from those locations and in the vicinity of groundwater dependent vegetation or watercourses. Monitoring would initially be undertaken quarterly and adjusted as appropriate. Once and airport lease is granted, the proposed airport would be subject to water quality monitoring requirements as set out in the *Airports (Environmental Protection) Regulations 1997.*	Construction Operation
18.11		Groundwater inflows would be reused or released with appropriate treatment. Where groundwater is released to surface waters, treatment would be to the appropriate level under the ANZECC guidelines.	Construction Operation

18.8. Conclusion

Construction of Stage 1 would transform the airport site from a rolling grassy and vegetated landscape to an essentially built environment with some landscaping. These changes would alter the catchment areas within the airport site and the permeability of the ground surface, which would in turn alter the duration, volume and velocity of surface water flow. The proposed bulk earthworks and excavations at the airport site are likely to receive some groundwater inflows.

Hydrologic and hydraulic modelling of the airport site during construction and operation indicates that there is a degree of variation in how the drainage system responds to different storm events. The drainage system as currently planned would be generally effective at mitigating watercourse and flooding impacts; however refinement of the drainage system would occur during detailed design of the proposed airport.

The refinement of the drainage system would address some of the more substantial increases to flows at Oaky Creek, as well as the enhanced use of bio-retention basins and swales and other intermediate structures to further improve water quality outcomes.

Overall it is considered that the residual impacts to surface water and groundwater would be reasonable considering the scale and nature of the proposed airport development. Baseline and ongoing monitoring of surface water and groundwater would be undertaken to characterise any residual impacts and prompt corrective action where necessary.