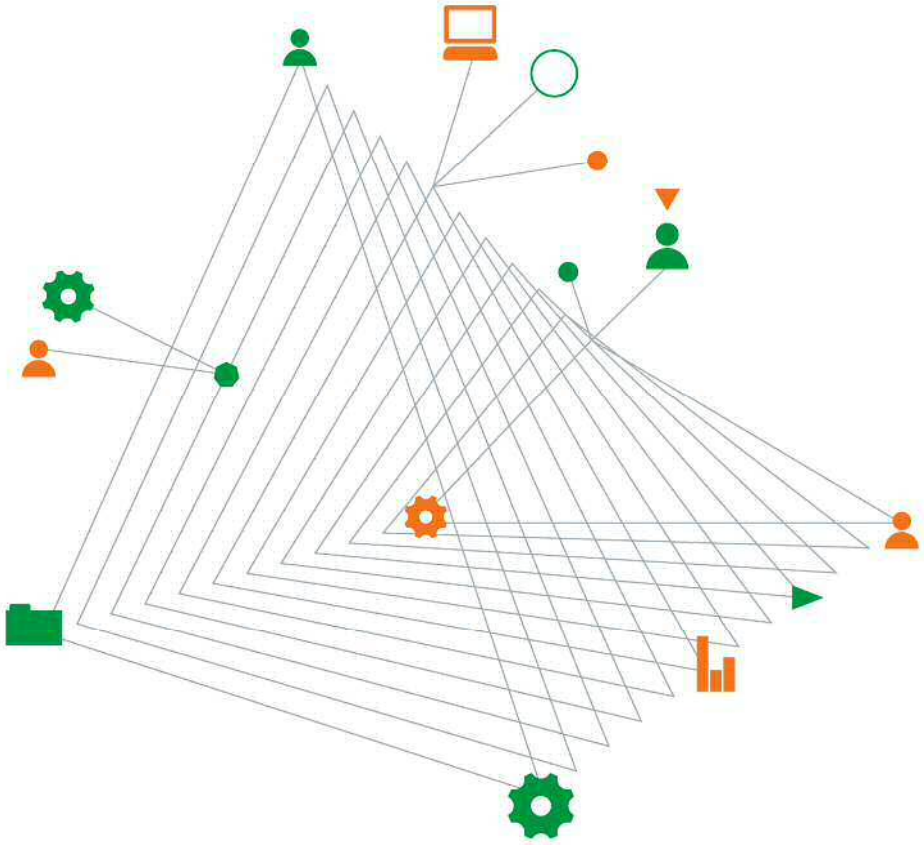
Griffiths Investment Properties

Preliminary groundwater assessment – potential impact from proposed sand quarry

Bobs Farm, NSW

26 February 2015



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Preliminary groundwater assessment – potential impact from proposed sand quarry

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1. Introduction

Coffey Environments Australia Pty Ltd (Coffey) was commissioned by Griffiths Investment Properties Pty Limited (GIPPL) to assess potential groundwater impacts of proposed sand mining on a proposed recreational water park. This report presents that assessment.

A sand quarry is proposed to be developed off Nelson Bay Road at Bobs Farm (Bobs Farm Sand Quarry). The estimated resource is about 10 million tonnes on a 44 hectare extraction site with mining to be carried out over 15 years and extend to about -15 m AHD. At this stage it is understood that the Director General's Requirements (DGRs) have been set by the NSW Department of Planning but the Environmental Impact Statement (EIS) has not been put on public exhibition for comment.

GIPPL intend to operate a Ride Water Park (the Park) in close proximity to the proposed Bobs Farm Sand Quarry and are concerned about the potential groundwater impact from the quarry on the operations of the Park. As part of the Park, a dam covering 5 acres (about 2 hectares) is proposed to be excavated to a maximum depth of 2.5 m. The Park is located approximately 500 m north east of the proposed Bobs Farm Sand Quarry and would be hydraulically down gradient.

This preliminary groundwater assessment conducted does not address the effects of the Park itself on the groundwater system.

We draw your attention to the enclosed sheet entitled "Important Information about your Coffey Report" which should be read in conjunction with this report.

1.1. Objective

The objective of the preliminary groundwater assessment was to provide a desk study and high level review of the potential groundwater impacts from the proposed Bobs Farm Sand Quarry on the operations of the Park.

The review considered potential groundwater level changes and groundwater quality changes associated with the proposed sand mining operation. The timing of these changes and the period of recovery post-mining was also considered.

1.2. Scope of work

The scope of work conducted was in general accordance with our proposal reference ENAUWARA04587AA-P01, dated 23 December 2014.

The assessment included data review, assessment and reporting as follows.

1.2.1. Data review

The groundwater assessment reviewed the following information:

- Local geology, soils and topography maps;
- NSW Office of Water (NOW) groundwater bore database records for a 3 km radius from the Park;
- Rainfall and evaporation data from the nearest weather station;
- Relevant legislation and water quality guidelines;
- Selected Coffey reports and other reports previously conducted in the surrounding area and within sand mined areas.

1.2.2. Data assessment and reporting

This report provides an overview of information on the regional and local groundwater setting, regulatory framework and the potential impacts from sand mining on down gradient properties. This report does not provide comment on the EIS for the quarry at this stage. This would be covered under a separate commission.

2. Relevant legislation, plans and policies

The Tomago, Tomaree and Stockton groundwater sources are dune sand aquifers within the Lower North Coast and Hunter Water Management Areas as shown in attached Drawing 1. Collectively they are known as the Tomago Tomaree Stockton aquifers and cover an area of 275 km^2. The three sand groundwater sources occur along a coastal strip some 10 to 15 km wide. Sediment thickness increases towards the coast, reaching depths of up to 40 m.

The proposed Bobs Farm Sand Quarry is underlain by the Stockton Sand Member which contains an aquifer that forms a component of the water supply for the region.

Legislation and policies are in place which aims to minimise potential impacts to groundwater. Management measures to take account of these will need to be presented in the EIS for the quarry. The following sections discuss relevant legislation and policies.

2.1. Water sharing plan

The *Water Management Act 2000* aims to ensure the sustainable management of water resources in NSW for present and future generations, primarily through the issue of licenses and approvals for the extraction and use of water from rivers and groundwater aquifers. The *Water Management Act 2000* applies to parts of NSW that are subject to Water Sharing Plans (WSPs).

Groundwater within the study area is managed as part of the WSP for the Tomago Tomaree Stockton Groundwater Sources gazetted on 7 February 2003 and amended on 1 July 2004. This is a legal document made under the *Water Management Act 2000* and applies to 30 June 2015. The WSP is administered by the NSW Office of Water (NOW).

The Tomago Tomaree Stockton WSP quantifies the available water and contains rules for how water is shared between the environment and licensees, and between the different categories of licences. Climate and the level of recharge to groundwater sources vary from year to year. The WSP therefore uses the average annual recharge as the basis for sharing water in these groundwater sources. The estimated average annual recharge for each of the three groundwater sources is shown in Table 1.

Table 1 - Recharge water requirements and extraction limits at start of water sharing plan (ML/year)

Groundwater Source	Average Annual Recharge [2]	Environmental Water from Recharge [2]	Basic Landholder Rights	Hunter Water Corporation Share Components	Other Licensed Share Components	Extraction Limit [2]
Tomago	35,700	10,700	1,000	25,300[1]	1,300	25,000
Tomaree	8,600	2,600	3,000	3,700[1]	800	6,000
Stockton	20,000	6,000	2,000	0	3,100	14,000

Source: DIPNR, 2005

1 These figures represent the average per year over a three year period.

2 These figures are subject to further review during the term of the Water Sharing Plan.

The *Water Management Act 2000* requires that water be allocated for the fundamental health of a water source and its dependent ecosystems as a first priority. This means that extractions from a groundwater source must not have significant impact on ecosystems that rely on that groundwater.

The proportion of recharge water that can be extracted without compromising the integrity of the water source and the ecosystems that depend on it is known as the extraction limit or sustainable yield. The Tomago Tomaree Stockton WSP allows the estimated average annual recharge and the proportion of the recharge reserved as planned environmental water to be varied during the life of the WSP. In most cases, any variation is based on further assessments of recharge, and/or groundwater dependent ecosystems (DWE, 2008).

Other than basic landholder rights, water extraction must be authorised under a water access licence. There are different categories of water access licences under the *Water Management Act 2000* relevant to the Tomago Tomaree Stockton Groundwater Sources. These are:

Major utility access licence – for the Hunter Water Corporation (HWC);

Domestic and stock access licences – for those not covered by the basic landholder rights provisions;

Aboriginal cultural – for personal, domestic and communal purposes (up to 10 ML/year per licence) by Aboriginal persons or communities;

Aquifer access licence – this is a general purpose category that covers purposes such as mining, industry, irrigation and general farming.

Previous domestic and stock licences under the *Water Act 1912* will mostly be covered by the basic landholder right provisions and do not require a water access licence (DIPNR, 2005).

Both the proposed Bobs Farm Sand Quarry and the Park will need to ensure that the developments do not affect the water quantities, water qualities or associated ecosystems that are recognised under this WSP.

2.2. Groundwater protection

The Guidelines for Groundwater Protection in Australia (ARMCANZ and ANZECC, 1995) are part of the National Water Quality Management Strategy and provide a framework for protecting groundwater from contamination in Australia and involve the identification of specific beneficial uses and values for every major aquifer.

The guidelines outline a number of protection strategies to protect each aquifer and all involve groundwater monitoring. Recommendations for baseline groundwater level and quality monitoring for the Park are provided in Section 8.

2.3. NSW groundwater policies

Groundwater management in NSW is guided by the State Groundwater Policy Framework Document developed by the NSW Department of Land and Water Conservation (DLWC) in 1997. A set of three component policies have been developed in association with stakeholder-based working groups, identifying management needs and providing management principles and guidelines. The policies commit agencies to the review and modification of related regulatory and operational activities, and to the support of cooperative management programs. The three policies are listed below:

Groundwater Quality Protection Policy (DLWC, 1998);

Groundwater Quantity Management Policy (DLWC, 1998); and

Groundwater Dependent Ecosystems Policy (DLWC, 2002).

The framework document (DLWC, 1997) outlines the following policy principles with respect to groundwater management in NSW:

An ethos for the sustainable management of groundwater resources should be encouraged in all agencies, communities and individuals who own, manage or use these resources, and its practical application facilitated;

Non sustainable resource uses should be phased out;

Significant environmental and/or social values dependent on groundwater should be accorded special protection;

Environmentally degrading processes and practices should be replaced with more efficient and ecologically sustainable alternatives;

Where possible, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored;

Where appropriate, the management of surface and groundwater resources should be integrated;

Groundwater management should be adaptive, to account for both increasing understanding of resource dynamics and changing community attitudes and needs; and

Groundwater management should be integrated with the wider environmental and resource management framework, and also with other policies dealing with human activities and land use, such as urban development, agriculture, industry, mining, energy, transport and tourism.

Both the proposed developments at Bobs Farm Sand Quarry and the Park will need to take into account the above principles.

2.4. Aquifer interference policy

The Department of Primary Industries Office of Water NSW Aquifer Interference Policy (March 2012 Draft) considers the scale of a development, as measured by rate and volume of dewatering, for the purposes of dewatering licencing requirements. The draft policy noted (Section 2.5.1) that aquifer interference activities exempt from requiring volumetric access licences include those where the dewatering rate is less than 5 L/s (432 m^3 /day) and where the total volume extracted is less than 3 ML per annum. The expected rate of inflow to both the proposed Bobs Farm Sand Quarry and the Park is expected to be greater than this and therefore the exemption is not likely to apply for either of the projects.

The final issue of the NSW Aquifer Interference Policy (September 2012) does not discuss dewatering licencing exemptions conditions, but instead considers assessment of impacts of aquifer interference activities on water resources and the concept of ensuring “no more than minimal harm” referred to in the *Water Management Act 2000*.

Additional assessment of the likely rates and volumes of dewatering will be required as part of the groundwater licence application for both the sand mining and recreational water park projects.

3. Reviewed reports

The following reports were reviewed as part of the groundwater assessment:

Binning P, Potter M, Naidu R (2000) Investigation of the Geochemical Impact of Sandmining in the Tomago Sandbeds Aquifer. The University of Newcastle and CSIRO Land and Water. July 2000.

Coffey Partners International Pty Ltd (1998) Development of post-mining groundwater monitoring recommendations Tomago Sandbeds, NSW. Report No. G442/1-BC for RZM Pty Ltd. June 1998.

Coffey Environments Pty Ltd (2014) Acid sulfate soil and groundwater assessment 775 Marsh Rd, Bobs Farm NSW. Report ref. ENAUWARA04470AA-L01. March 2014.

GHD Pty Ltd (1995) Hydrogeological study of the Tomago and North Stockton aquifers. Draft working paper 1 for Hunter Water Corporation. February 1995.

Northrop Pty Ltd (2014) Proposed Wakeboard Park - Bobs Farm Concept Stormwater Management Plan. July 2014.

Steering Committee (1996) Report No. 1 Data Review and Assessment of Hydrogeological and Hydrochemical Impacts of Heavy Mineral Mining on the Tomago Sandbeds, Newcastle, NSW.

Woolley D, Mount T and Gill J (1995) Tomago Tomaree Stockton Groundwater Technical Review. NSW Department of Water Resources, February 1995.

4. Site characterisation

4.1. Rainfall and evaporation

The Tanilba Bay WWTP automatic weather station (AWS) 61395 is approximately 3.5 km to the north west of the Park at an elevation of 5 m AHD. Climate data at this station is limited with rainfall data since 2001 and no pan evaporation data recorded.

The Williamtown RAAF Base AWS 61078 is approximately 17 km to the south west of the Park at an elevation of 9 m AHD. Climate data has been recorded at this location since 1942. Recorded data at Williamtown has been sourced from the Bureau of Meteorology website www.bom.gov.au and covers the following periods:

Pan evaporation: 1974 to the present.

Rainfall: 1942 to the present.

Table 2 lists the mean rainfall and pan evaporation recorded at Williamtown over the time of record. Mean rainfall is approximately 1124 mm with a median (decile 5) annual rainfall of 1090 mm. Mean monthly rainfall is highest from February to June and lowest in winter and spring. Evaporation also varies with the seasons and is highest in the spring and summer months (from October to February). Mean annual evaporation is 1716 mm, which exceeds mean annual rainfall.

Table 2 – Mean rainfall and evaporation at Williamtown

	Rainfall (mm)	Pan Evaporation (mm)
Monthly		
January	98	214
February	122	174
March	121	152
April	105	114
May	115	84
June	121	72
July	72	81
August	76	112
September	61	141
October	75	174
November	81	189
December	80	223
Annual		
Mean	1124	1716
Decile 1	788	
Decile 5	1090	
Decile 9	1497	

4.2. Topography

Covering approximately 11 hectares, the proposed Park is relatively flat with elevations ranging between 0.8 and 1.2 m AHD. The site is situated in a low-lying alluvial plain on the Tilligerry peninsula and is currently being used as grazing land for cattle. To the south west of the Park at Bobs Farm Sand Quarry, ground level rises with elevations up to approximately 30 m AHD at the Stockton sand dunes.

4.3. Surface water and drainage

Drainage at the Park is likely to occur slowly via land infiltration with runoff generated from heavy rainfall events sheeting towards the western and eastern boundaries.

South west of the Park at Bobs Farm Sand Quarry, complex dune forms contribute to the characteristically hilly dune terrain and some runoff does occur during intense rainfall events and is guided by the landform to converge on the low point of each depression. Permanent swamps and ephemeral wetlands are a common feature of the landscape, marking the floors of the largest and lowest depressions.

Apart from the Hunter River, Tilligerry Creek (located approximately 500 m north west of the Park, Drawing 2) is the most prominent surface drainage in the area. Near Salt Ash village, the creek narrows and merges with an extensive network of agricultural drains that continue along the floor of the Tilligerry lowlands to join with Fullerton Cove. The system forms an axial drain for the Tilligerry

interdunal depression, the water flowing to outlets at either Fullerton Cove in the south west or Tilligerry Estuary in the north east.

Unlike the dune areas, soils along the Tilligerry lowlands are predominately clays and infiltration is very low. Combined with a shallow water table and the flat nature of the lowlands almost at sea level, surface water movement is slow and extensive waterlogging and floods follow intense rainfall events. Waterlogging is only slowly relieved by the agricultural drainage network.

4.4. Geology

The geology of the area consists of Quaternary age sands, silts and clays as illustrated in Figure 1 (Nelson Bay 1:100 000 and 1:25 000, Coastal Quaternary Geology Map Series, Geological Survey of New South Wales, 2008). The Park is located in a Holocene saline swamp (Tilligerry Mud Member). The Bobs Farm Sand Quarry is located in a Holocene dune (Stockton Sand Member).

The Stockton Sand Member is associated with the outer barrier dune system of the Stockton Dune Ridge, running parallel to the coast between the villages of Stockton and Anna Bay consisting of a series of parallel smaller dune ridges, with intervening lowland swales tending to swamps, located between the Pacific Coast and Tilligerry Creek and extending from the Hunter River at Stockton in the south to the drainage complex of Bobs Farm Creek, Fenninghams Island Creek and Murrumburrimbah Swamp near Anna Bay in the north. The Stockton Sand Member includes the full thickness of sand deposits in the Stockton area and is 32 km in length, 2 to 3 km in width, 78 km^2 in area and has a thickness of 10 to 40 m.

The Tomago Sandbeds consists of extensive inner barrier sand ridges extending from Tomago to Port Stephens in the northeast and about 5 km to 15 km inland from the present coastline. The Tomago Sandbeds comprise fine to medium grained, well sorted, quartzose beach sand with discontinuous indurated sand layers. The sand was deposited by alluvial and aeolian processes 10,000 to 120,000 years ago. The inner barrier sand slopes towards the sea and is overlain by younger sand of the outer barrier (Stockton Sands) and estuarine marine muds.

According to Woolley et al. (1995) the unconsolidated sediments can be divided into the following units (from oldest to youngest):

Medowie Clay Member;

Tomago Sand Member;

Stockton Sand Member; and

Tilligerry Mud Member.

Basement rocks form the platform on which the unconsolidated sediments were deposited. The sedimentary rocks west of the Grahamstown Storage Reservoir towards Hexham are assigned Permian age while the volcanics near Port Stephens are Carboniferous age. These rocks are massive and are assumed to be hydrogeologically impermeable for the purposes of this assessment.

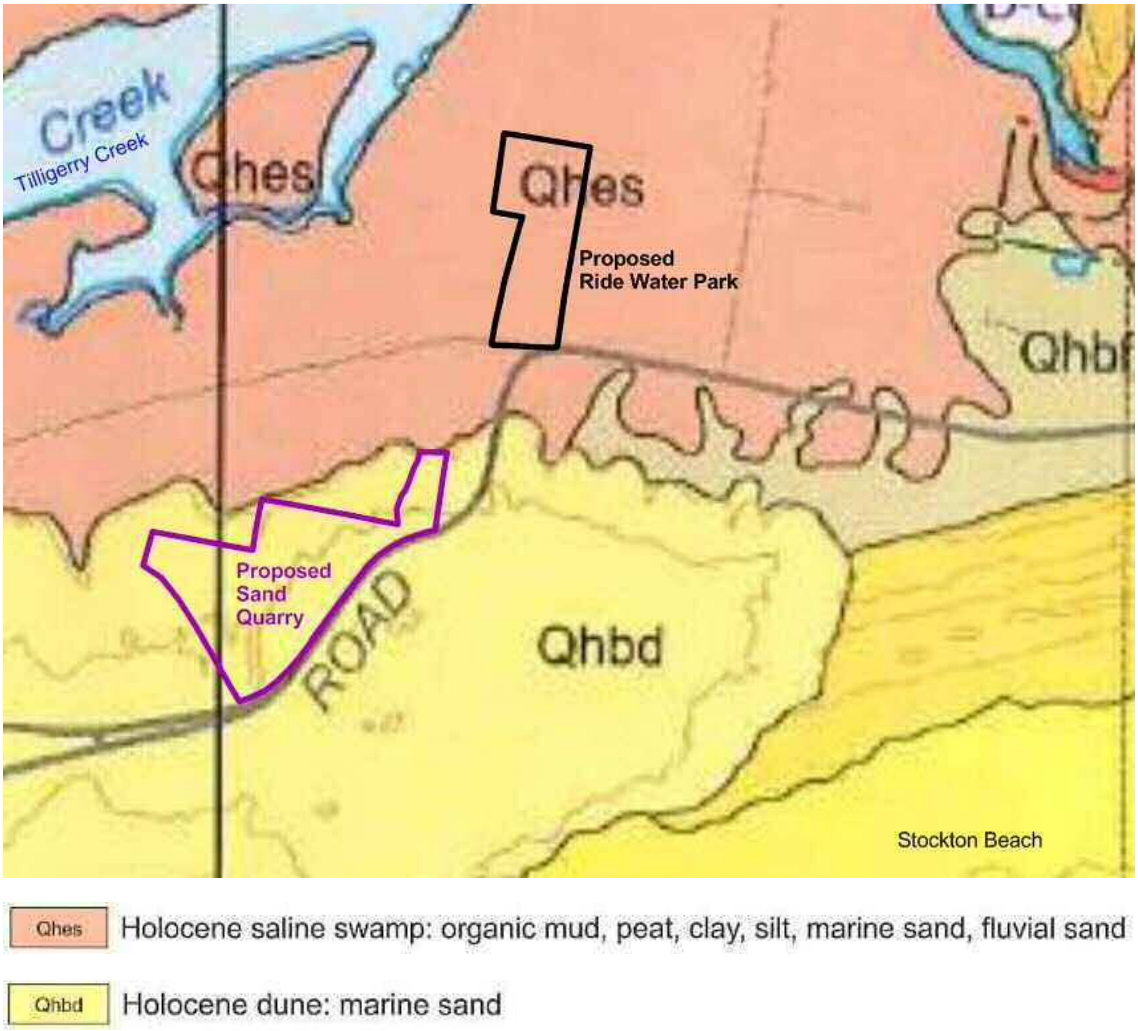


Figure 1 – Geology of the study area

4.5. Hydrogeology

The Stockton Sands form the major aquifer in the study area. The aquifer is generally unconfined (an aquifer whose upper surface is a water table free to fluctuate under atmospheric pressure).

Groundwater beneath the Park is anticipated to flow towards Tilligerry Creek, located approximately 500 m north west of the site.

During previous field investigations conducted by Coffey, groundwater was encountered in estuarine/alluvial clays and sands between 1 and 2 m below ground level (bgl) (Coffey, 2014). Clay was encountered to a depth of around 1 m, overlying grey sand.

Groundwater in the area is used for domestic, stock, irrigation and monitoring purposes. There are 15 registered groundwater bores within 3 km of the Park, as illustrated in Figure 2. One registered bore (GW080269) is located in the southern section of the Park. Registered bore details are provided in Table 3.

Table 3 – Registered groundwater bore details

Registered	Easting	Northing	Completion	Total	SWL	Yield	Purpose
GW080269	407461	6374255	2002	6	-	-	Stock
GW067296	407380	6374138	1991	8	0.5	2.5	Domestic
GW080296	405850	6373541	1992	6	6	2	Domestic, farming, irrigation
GW056098	407409	6373738	1982	13.3	-	-	Domestic, stock, irrigation
GW079396	407561	6373092	1999	-	-	-	HWC bore SK6346
GW079677	407562	6373092	1999	-	-	-	HWC bore SK6346
GW079401	408286	6373115	1999	-	-	-	HWC bore SK9590a
GW079402	408283	6373115	1999	-	-	-	HWC bore SK9590b
GW079354	408259	6372517	1999	-	-	-	HWC bore BL128
GW079425	408258	6372517	1999	-	-	-	HWC bore BL128
GW078618	408605	6373903	-	10	-	-	Domestic
GW078621	409125	6373939	-	3.03	-	-	Domestic
GW078620	409437	6373942	-	12.12	-	-	Domestic
GW079403	409591	6373233	1999	-	-	-	HWC bore SK9591a
GW079404	409589	6373233	1999	-	-	-	HWC bore SK9591b

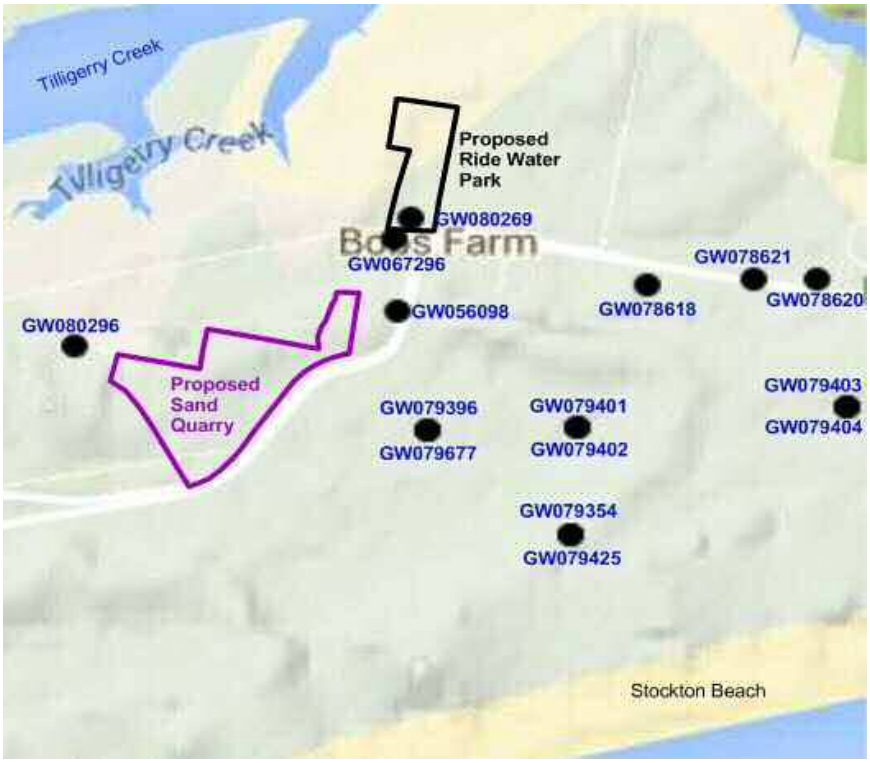


Figure 2 – Registered groundwater bores within a 3 km radius

An additional groundwater bore (test bore 1) has been constructed at the Park (Figure 3) to a depth of 9 m for monitoring and assessing future water supply.

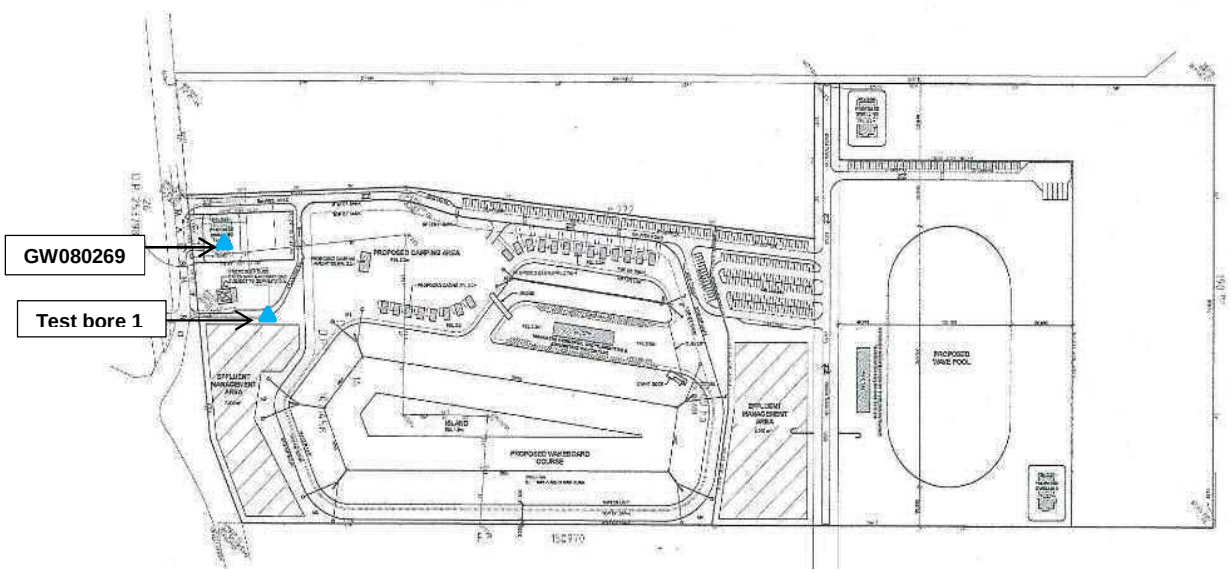
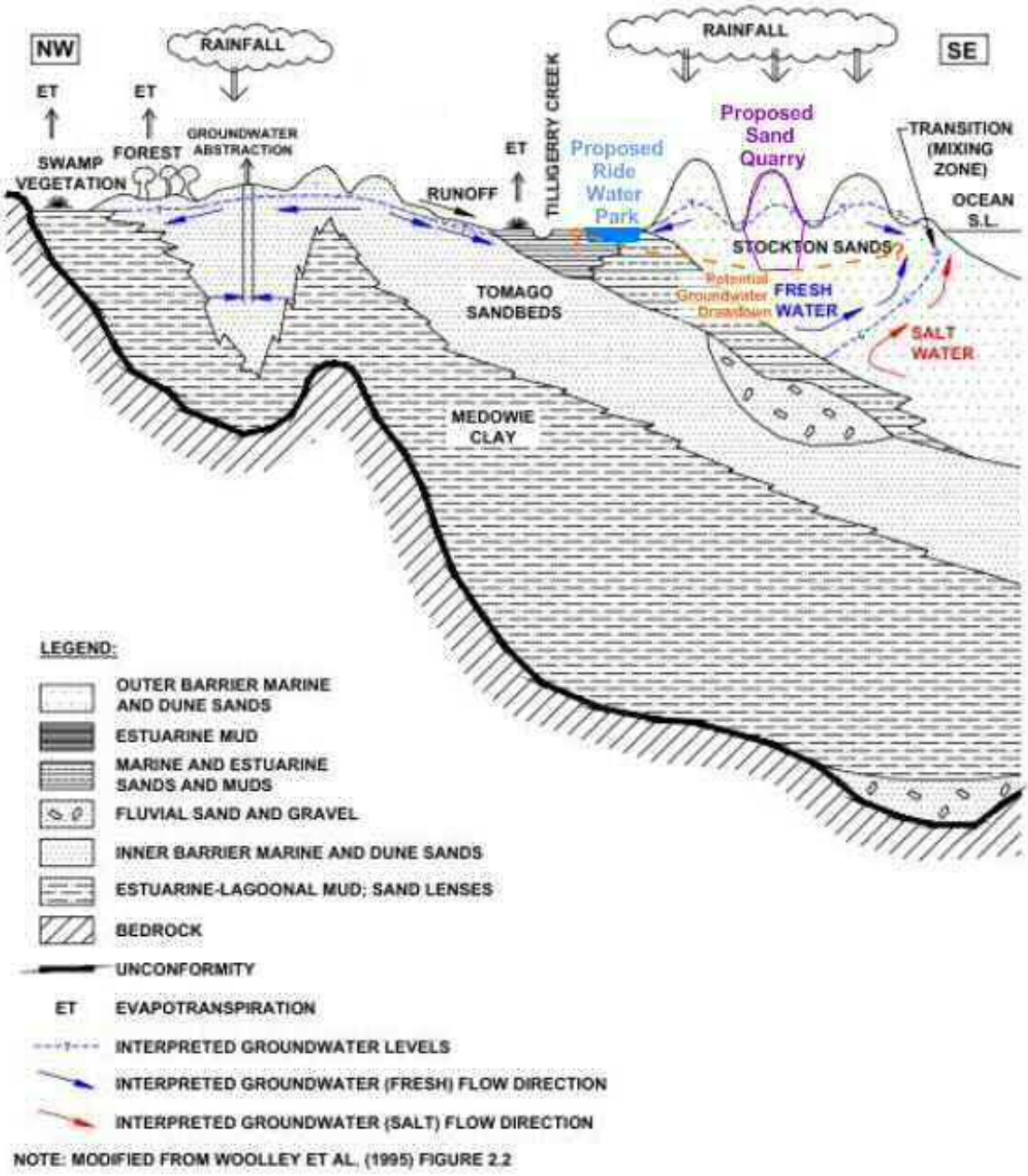


Figure 3 – Proposed Water Park site layout and bore locations

4.6. Conceptual site model

The elements of the hydrogeological system discussed in the previous sections are summarised in Figure 4 which shows a schematic hydrogeological conceptual model for the study area and surrounding areas.



Note: The conceptual site model provided is based on limited site specific hydrogeological testing and may be reviewed as more information becomes available.

Figure 4 – Conceptual site model

5. Proposed water park construction

The proposed water park site layout is illustrated in Figure 3 and will consist of the following development:

- 4 ha Wakeboard Lake;
- 1 ha Wave Pool;
- 16 cabin units;
- Managers facility and administration buildings;
- Three residential dwellings;
- Two 100 lot car parking areas; and
- 0.6 ha dedicated camping ground.

We have assumed the following details in our preliminary groundwater assessment:

- A target water level for the wakeboard course and wave pool of 0.5 m AHD, with the aim of having unlined pools integrated with the groundwater table.
- A target base excavation level of -1.5 m AHD to allow a minimum water depth of 1.8 m.

6. Potential impacts from sand quarry

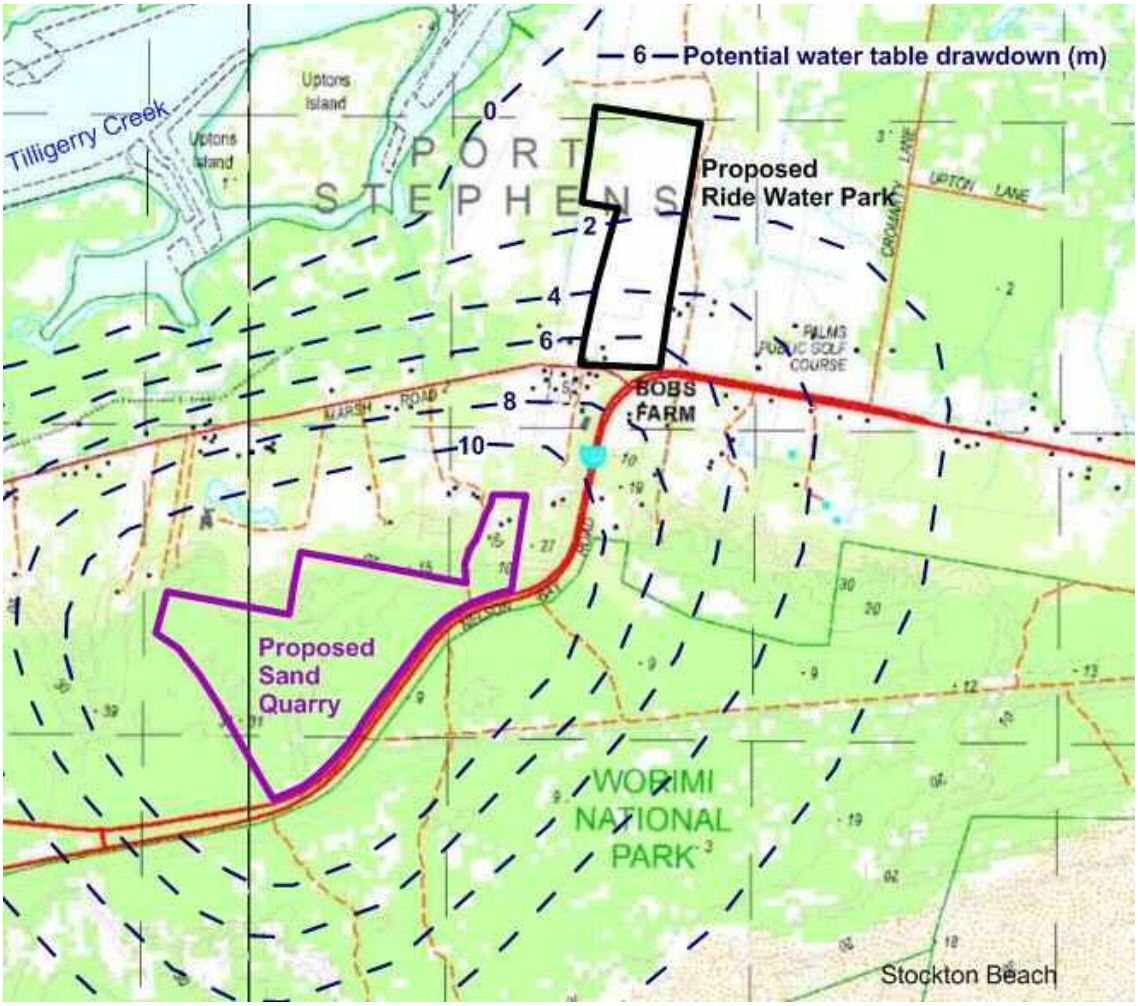
The assessment has considered potential groundwater level and quality changes at the Park associated with the proposed sand mining operation, as detailed in the following sections.

6.1. Groundwater levels

A simplified analytical assessment of potential groundwater drawdown was conducted with the following assumptions:

- The main quarry area is a 400 m diameter circle with a maximum excavation level of -15 m AHD;
- The centre of the quarry is 1.4 km from Tilligerry Creek;
- The distance of 2.4 km from the ocean was not taken into account;
- The groundwater level at the proposed sand quarry is 2 m AHD, resulting in a maximum drawdown of 17 m;
- A uniform medium that does not take into account permeability contrasts and the geological contact between the Stockton Sands and the Tilligerry Muds;
- Rainfall infiltration was not taken into account.

Based on this preliminary assessment, groundwater levels at the southern end of the Park may be drawn down up to 6 m at the maximum excavation level of -15 m AHD as illustrated in Figure 5, if no mitigation measures are adopted by the quarry. The timing of the groundwater level impacts will depend on quarry staging and tend to occur and recover relatively quickly.



Note: The drawdown assessment provided is based on limited site specific hydrogeological testing and may be reviewed as more information becomes available.

Figure 5 – Potential groundwater drawdown from sand quarry assuming no mitigation measures

6.2. Groundwater quality

Changes to groundwater quality take considerably longer to develop, migrate and recover, compared to groundwater level changes. Potential groundwater quality impacts at the Park are primarily related to oxidation of potential acid sulfate soil (PASS) identified at the Park (Coffey, 2014) due to potential groundwater drawdown that may result in acid generation and subsequent changes in water chemistry. Possible changes in water chemistry include:

Decrease in pH levels;

Increase in iron concentrations; and

Mobilisation of trace metals such as arsenic.

Coffey experience in the Tomago Sandbeds area has shown that the concentrations of iron and arsenic increase as a result of introduction of air into the groundwater profile. These changes develop quickly but do take a long time to recover to pre-development chemistry (more than ten years). Experience has also shown that these effects do not tend to migrate and the water quality down gradient from the affected area tends to be unaffected beyond a distance of about 100 m from the mine area.

Coffey consider that potential groundwater quality impacts generated at Bobs Farm Sand Quarry are unlikely to migrate 500 m from the mine area. Rather the potential impacts to groundwater quality at the Park may be due to drawdown of the water table in PASS materials identified between 1 m and 2.6 m bgl, and likely to extend to a depth of 3 m (Coffey, 2014).

An initial round of water sampling was conducted at the Park in February 2015 and included collection of two groundwater samples from the site bores and one rain water tank sample. Samples were sent to a NATA accredited laboratory for analysis of:

- General parameters – pH, electrical conductivity (EC), total organic carbon (TOC) and biochemical oxygen demand (BOD);
- Major cations – calcium, magnesium, potassium and sodium;
- Major anions – alkalinity as CaCO3, chloride and sulfate;
- Metals – aluminium, arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc and iron;
- Nutrients – ammonia, total nitrogen and nitrate.

The following guidelines are relevant for the initial water sampling event (results to be provided as a separate report) and future baseline groundwater quality monitoring proposed at the Park:

- Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC / ARMCANZ 2000) recreational water guidelines for primary and secondary contact;
- ANZECC 2000 marine water ecosystem trigger values for 95% species protection; and
- National Health and Medical Research Council (NHMRC) Australian drinking water guidelines (2011), updated December 2014.

7. Conclusions

Based on the preliminary groundwater assessment the following conclusions are made:

- A simplified analytical assessment of the potential maximum groundwater drawdown at the Park due to the proposed Bobs Farm Sand Quarry was conducted with a number of assumptions. The drawdown assessment provided is based on limited site specific hydrogeological testing and may be reviewed as more information becomes available.
- Based on this preliminary assessment, groundwater levels at the southern end of the Park may be drawn down up to 6 m at the maximum excavation level of -15 m AHD, if no mitigation measures are adopted by the quarry.
- The timing of the groundwater level impacts will depend on quarry staging and tend to occur and recover relatively quickly.
- Changes to groundwater quality take considerably longer to develop, migrate and recover, compared to groundwater level changes.
- The potential impacts to groundwater quality at the Park may be due to drawdown of the water table in potential acid sulfate soils resulting in a possible decrease in pH levels, an increase in iron concentrations and mobilisation of trace metals such as arsenic.

8. Recommendations

Based on the outcomes of this preliminary groundwater assessment the recommendations for the Park are provided below:

- Collection of site-specific data including aquifer permeability tests;
- Additional geological information to depths up to -15 m AHD;
- Installation of an additional groundwater monitoring bore towards the northern end of the Park;
- Introduction of a baseline monitoring program including groundwater level loggers and at least two water quality sampling events to provide a basis for a claim in the event that mining does impact on the water levels or water quality at the Park;
- Review of the sand quarry EIS when available.

9. Limitations

We draw your attention to the enclosed sheet entitled “Important Information about your Coffey Report” which should be read in conjunction with this report.

The preliminary groundwater assessment conducted does not address the effects of the Park itself on the groundwater system.

Details of sand quarry operations including proposed mitigation measures such as sheet piling or aquifer recharge are not known and are therefore not including in this preliminary groundwater assessment.

The simplified analytical assessment of potential groundwater drawdown was conducted with a number of assumptions as follows:

- The main quarry area is a 400 m diameter circle with a maximum excavation level of -15 m AHD;
- The centre of the quarry is 1.4 km from Tilligerry Creek;
- The distance of 2.4 km from the ocean was not taken into account;
- The groundwater level at the proposed sand quarry is 2 m AHD, resulting in a maximum drawdown of 17 m;
- A uniform medium that does not take into account permeability contrasts and the geological contact between the Stockton Sands and the Tilligerry Muds;
- Rainfall infiltration was not taken into account.

The drawdown assessment provided is based on limited site specific hydrogeological testing and may be reviewed as more information becomes available.

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Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice,

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but

steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

Report for benefit of client

Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

Coffey assumes no responsibility and will not be liable to any other person or organisation for, or in relation to, any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report.

To avoid misuse of the information presented in your report, we recommend that Coffey be consulted before the report is provided to another party who may not be familiar with the background and the purpose of the report. In particular, an environmental disclosure report for a property vendor may not be suitable for satisfying the needs of that property's purchaser. This report should not be applied for any purpose other than that stated in the report.

Interpretation by other professionals

Costly problems can occur when other professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, a suitably qualified and experienced environmental consultant should be retained to explain the implications of the report to other professionals referring to the report and then review plans and specifications produced to see how other professionals have incorporated the report findings.

Given Coffey prepared the report and has familiarity with the site, Coffey is well placed to provide such assistance. If another party is engaged to interpret the recommendations of the report, there is a risk that the contents of the report may be misinterpreted and Coffey disowns any responsibility for such misinterpretation.

Data should not be separated from the report

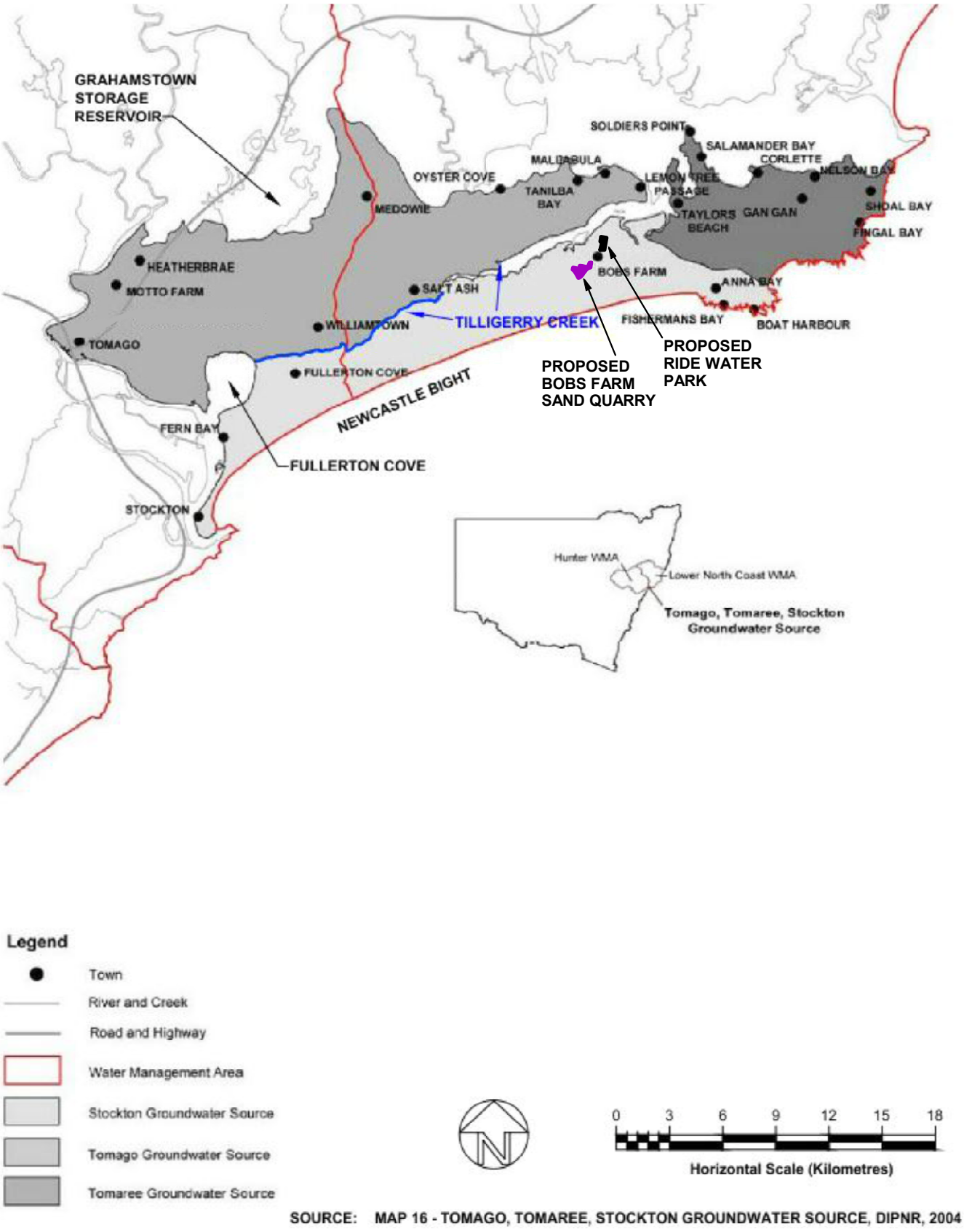
The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, laboratory data, drawings, etc. are customarily included in our reports and are developed by scientists or engineers based on their interpretation of field logs, field testing and laboratory evaluation of samples. This information should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

This report should be reproduced in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties.

Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Drawings



SOURCE: MAP 16 - TOMAGO, TOMAREE, STOCKTON GROUNDWATER SOURCE, DIPNR, 2004

drawn	CDC	coffey	client:	Griffiths Investment Properties
approved	RJB		project:	Preliminary Groundwater Assessment Potential Impact From Proposed Sand Quarry Bobs Farm, NSW
date	12 Feb 2015			
scale	As shown		title:	Regional Locality Map
original size	A4		project no: ENAUWARA04587AA-R01	drawing no: 1

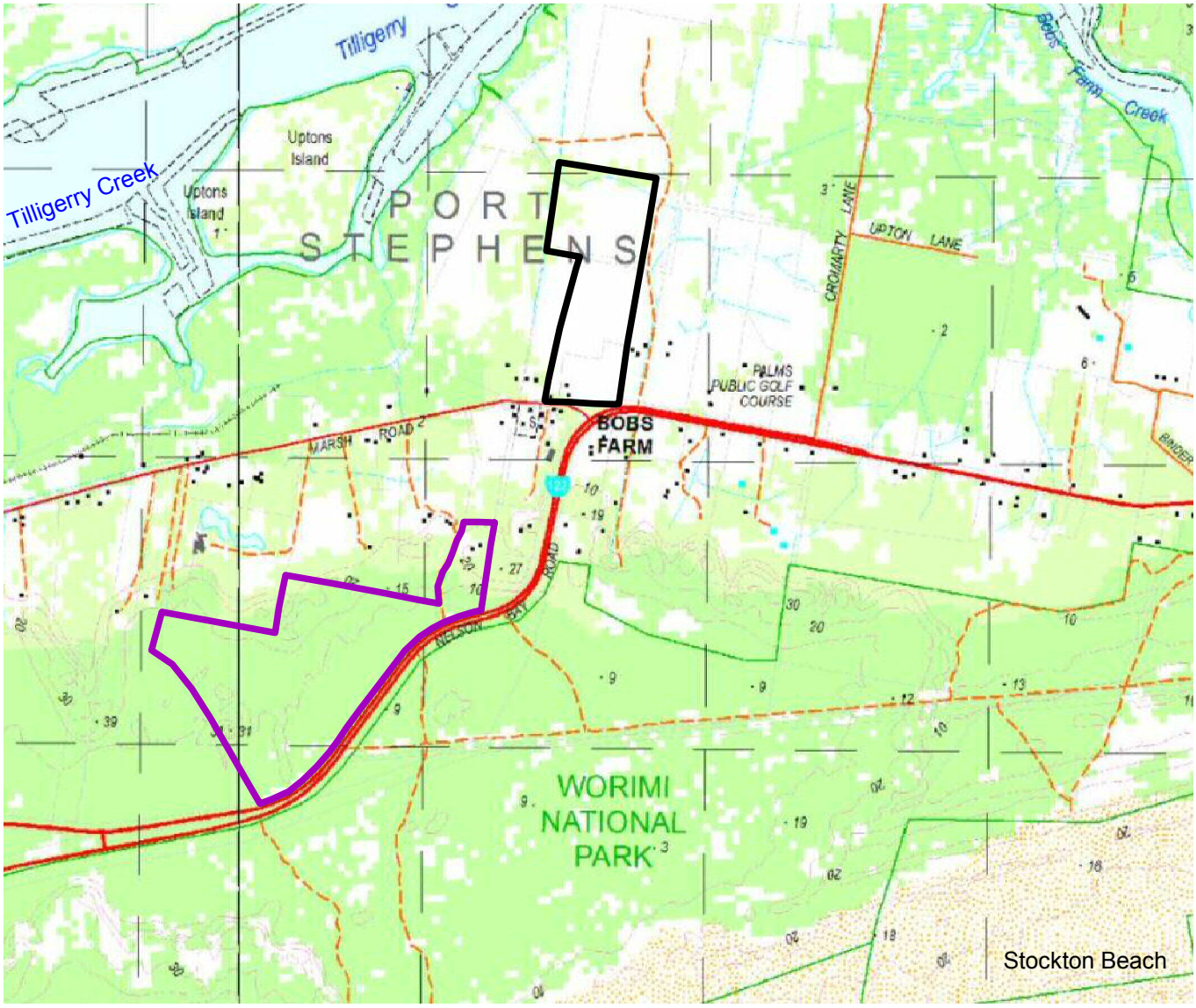
LEGEND

Proposed Ride Water Park

Proposed Bobs Farm Sand Quarry

20 Topography Contours (m AHD)

• 39 Spot Heights (m AHD)



Scale (metres): 0 500 1000 1500 2000

drawn	CDC	coffey	client:	Griffiths Investment Properties
approved	RJB		project:	Preliminary Groundwater Assessment Potential Impact From Proposed Sand Quarry Bobs Farm, NSW
date	12 Feb 2015		title:	Site Locality Map
scale	As shown		project no: ENAUWARA04587AA-R01	drawing no: 2
original size	A4			

Appendix A - Registered Bore Work Summaries

NSW Office of Water
Work Summary

GW080269

Licence: 20BL168417 **Licence Status:** CONVERTED

Authorised Purpose (s): STOCK
Intended Purpose(s): STOCK

Work Type: Spear
Work Status:
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 16/08/2002
Final Depth:
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A RMB 3349 MARSH ROAD BOBS FARM 2316
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	LT223 DP598773
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 223//598773

Region: 20 - Hunter
River Basin: 209 - KARUAH RIVER
Area/District:
CMA Map: 9332-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6374255.0
Easting: 407461.0
Latitude: 32°45'56.5"S
Longitude: 152°00'43.2"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

01/12/2009: Reviewed data - nothing to update.

***** End of GW080269 *****

NSW Office of Water
Work Summary

GW067296

Licence: 20BL142965
Licence Status: CONVERTED
Authorised Purpose (s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status: Supply Obtained
Construct.Method:
Owner Type: Other Govt

Commenced Date:
Completion Date: 05/04/1991
Final Depth: 8.00 m
Drilled Depth: 8.00 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A 3346 MARSH ROAD BOBS FARM 2301 NSW
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m): 0.500
Salinity Description:
Yield (L/s): 2.500

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	21
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 1//181858

Region: 20 - Hunter
River Basin: 209 - KARUAH RIVER
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 20.00 m (A.H.D.)
Elevation Source: Est. Contour 8-15M.
Northing: 6374138.0
Easting: 407380.0
Latitude: 32°46'00.3"S
Longitude: 152°00'40.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1	1	Casing	Stainless Steel	0.00	0.00	32			
1	1	Opening	Slots,Screen	6.90	7.90	32		1	Mechanically Slotted, A: 25.00mm
1	1	Opening	Slots,Screen	6.90	7.90	32		2	Stainless Steel

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
0.50	8.00	7.50	Unconsolidated	0.50		2.50			

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

25/11/2009: Updated details as per existing data.

***** End of GW067296 *****

NSW Office of Water
Work Summary

GW080296

Licence: 20BL168401 **Licence Status:** CONVERTED

Authorised Purpose (s): DOMESTIC,FARMING,IRRIGATION
Intended Purpose(s): DOMESTIC, FARMING, IRRIGATION

Work Type: Spear
Work Status:
Construct.Method:
Owner Type: Private

Commenced Date:
Completion Date: 06/09/2002
Final Depth:
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A RMB 3274 MARSH ROAD BOBS FARM 2316
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	LT201 DP736202
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 201//736202

Region: 20 - Hunter
River Basin: 209 - KARUAH RIVER
Area/District:
CMA Map: 9232-2N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6373541.0
Easting: 405850.0
Latitude: 32°46'19.2"S
Longitude: 151°59'41.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

06/09/2002: Form A Remarks:
Depth of spearpoint 6 mtrs
Year of construction 1992
Rate at which the spearpoint is normally pumped 2 ltrs per second
Depth of water level in spearpoint when not pumping 6 mtres
Depth of water level in spearpoint when pumping 6 mtrs
Diameter of spearpoint 50 mm
Nature of lining PVC
01/12/2009: Reviewd data - nothing to update.

***** End of GW080296 *****

NSW Office of Water
Work Summary

GW056098

Licence: 20BL122113 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC,STOCK
Intended Purpose(s): IRRIGATION

Work Type: Bore
Work Status:
Construct.Method: Cable Tool
Owner Type: Private

Commenced Date:
Completion Date: 01/01/1982
Final Depth: 13.30 m
Drilled Depth: 13.30 m

Contractor Name:
Driller:
Assistant Driller:

Property: N/A LOT 701 NELSON BAY ROAD BOBS FARM 2316
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	70
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 701//599716

Region: 20 - Hunter
River Basin: 209 - KARUAH RIVER
Area/District:
CMA Map: 9332-3N
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: (Unknown)
Northing: 6373738.0
Easting: 407409.0
Latitude: 32°46'13.3"S
Longitude: 152°00'41.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GD.,ACC.MAP

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Annulus	Waterworn/Rounded	11.30	13.30				
1	1	Casing		0.00	12.10				
1	1	Opening	Screen	12.10	13.30	65		1	Stainless Steel, A: 0.13mm

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

7.00	13.00	6.00	Unconsolidated	3.00		6.31			

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	3.00	3.00	Sand	Sand	
3.00	7.00	4.00	Sand Clayey	Sand	
7.00	13.00	6.00	Sand White Water Supply	Sand	

Remarks

***** End of GW056098 *****

NSW Office of Water
Work Summary

GW079396

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373092.0
Easting: 407561.0
Latitude: 32°46'34.3"S
Longitude: 152°00'46.6"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

19/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: SK6346
27/11/2009: Reviewed data - nothing to update.

***** End of GW079396 *****

NSW Office of Water
Work Summary

GW079677

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373092.0
Easting: 407562.0
Latitude: 32°46'34.3"S
Longitude: 152°00'46.7"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

28/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
TOMAGO
BORE: SK6346
30/11/2009: Reviewed data - nothing to update.

***** End of GW079677 *****

NSW Office of Water
Work Summary

GW079401

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373115.0
Easting: 408286.0
Latitude: 32°46'33.8"S
Longitude: 152°01'14.5"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

19/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: SK9590a
27/11/2009: Reviewed data - nothing to update.

***** End of GW079401 *****

NSW Office of Water
Work Summary

GW079402

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373115.0
Easting: 408283.0
Latitude: 32°46'33.8"S
Longitude: 152°01'14.4"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

19/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: SK9590b
27/11/2009: Reviewed data - nothing to update.

***** End of GW079402 *****

NSW Office of Water
Work Summary

GW079354

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6372517.0
Easting: 408259.0
Latitude: 32°46'53.2"S
Longitude: 152°01'13.3"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

18/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: BL128
27/11/2009: Reviewed data - nothing to update.

***** End of GW079354 *****

NSW Office of Water
Work Summary

GW079425

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6372517.0
Easting: 408258.0
Latitude: 32°46'53.2"S
Longitude: 152°01'13.2"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

20/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
TOMAGO
BORE: BL128
27/11/2009: Reviewed data - nothing to update.

***** End of GW079425 *****

NSW Office of Water
Work Summary

GW078618

Licence: 20BL167268 **Licence Status:** CONVERTED

Authorised Purpose (s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A 154 NELSON BAY ROAD BOBS FARM 2316
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	PORTION 78)
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 212//1113487

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373903.0
Easting: 408605.0
Latitude: 32°46'08.3"S
Longitude: 152°01'27.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

***** End of GW078618 *****

NSW Office of Water
Work Summary

GW078621

Licence: 20BL167379 **Licence Status:** CONVERTED

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A BOS FARM ROAD BOBS FARM 2316
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	PORTION 67)
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 671//588972

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373939.0
Easting: 409125.0
Latitude: 32°46'07.3"S
Longitude: 152°01'47.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

***** End of GW078621 *****

NSW Office of Water
Work Summary

GW078620

Licence: 20BL167378
Licence Status: CONVERTED

Authorised Purpose(s): DOMESTIC
Intended Purpose(s): DOMESTIC

Work Type: Bore
Work Status:
Construct.Method:
Owner Type:

Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:

Contractor Name:
Driller:
Assistant Driller:

Property: N/A RMB 3789 BOBS FARM ROAD BOBS FARM 2301
GWMA: 025 - TOMAGO TOMAREE STOCKTON
GW Zone: 003 - STOCKTON
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	GLOUC	GLOUC.049	(FORMERLY POR 109)
Licensed:	GLOUCESTER	TOMAREE	Whole Lot 1//350117

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373942.0
Easting: 409437.0
Latitude: 32°46'07.3"S
Longitude: 152°01'59.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

***** End of GW078620 *****

NSW Office of Water
Work Summary

GW079403

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373233.0
Easting: 409591.0
Latitude: 32°46'30.3"S
Longitude: 152°02'04.7"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

19/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: SK9591a
27/11/2009: Reviewed data - nothing to update.

***** End of GW079403 *****

NSW Office of Water
Work Summary

GW079404

Licence:
Licence Status:
Authorised Purpose(s):
Intended Purpose(s):
Work Type: Bore
Work Status:
Construct.Method:
Owner Type:
Commenced Date:
Completion Date:
Final Depth:
Drilled Depth:
Contractor Name:
Driller:
Assistant Driller:
Property:
GWMA:
GW Zone:
Standing Water Level (m):
Salinity Description:
Yield (L/s):

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:		.	
Licensed:			

Region: 20 - Hunter
River Basin: - Unknown
Area/District:
CMA Map:
Grid Zone:
Scale:
Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6373233.0
Easting: 409589.0
Latitude: 32°46'30.3"S
Longitude: 152°02'04.6"E
GS Map: -
MGA Zone: 0
Coordinate Source: Unknown

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

Remarks

19/10/1999: Form A Remarks:
HUNTER WATER CORPORATION
NORTH STOCKTON
BORE: SK9591b
27/11/2009: Reviewed data - nothing to update.

***** End of GW079404 *****