SECTION 7
ENVIRONMENTAL ASSESSMENT

This section describes the existing environment of the proposed development site in terms of the physical, biological and socio-economic environment and assesses the impact of the proposed development.

7.1 TOPOGRAPHY, GEOLOGY AND SOILS

7.1.1 Existing Site Conditions

Topography

The proposed development site lies in the centre of the Cumberland Plain, a low-lying undulating shale landscape composed of the Triassic Wianamatta Group. The Cumberland Plain is a topographic unit within the Cumberland Basin. It is typified by low undulating topography with a medium drainage line density.

The development site comprises an irregular shaped area bounded by Humes and Woodstock Avenue to the north, the Nurragingy Reserve to the east, the Main Western Railway line to the south and OneSteel to the west.

The proposed development site is shown in Figure 7.1. It naturally has a gentle undulating slope from the north west corner of the site (40 m AHD), to the southern section of the site (32.5 m AHD). This indicates a natural grade of approximately 1.5 % from Kellogg Road to the Main Western Railway Line. Due to the deposition of stockpile material associated with the development of the OneSteel site the topographical structure of the northern portion of the site has been modified from the natural terrain (refer Figure 7.1). The Humes section of the site where the office building and laboratory are to be located has been levelled, filled and sealed for its current use as a car park.

Angus Creek, a tributary of Eastern Creek, flows from the south west to the north east across the site and lies at approximately 30 m AHD. Angus Creek meets with Eastern Creek in Nurragingy Reserve to the north of the eastern end of the proposed rail siding.

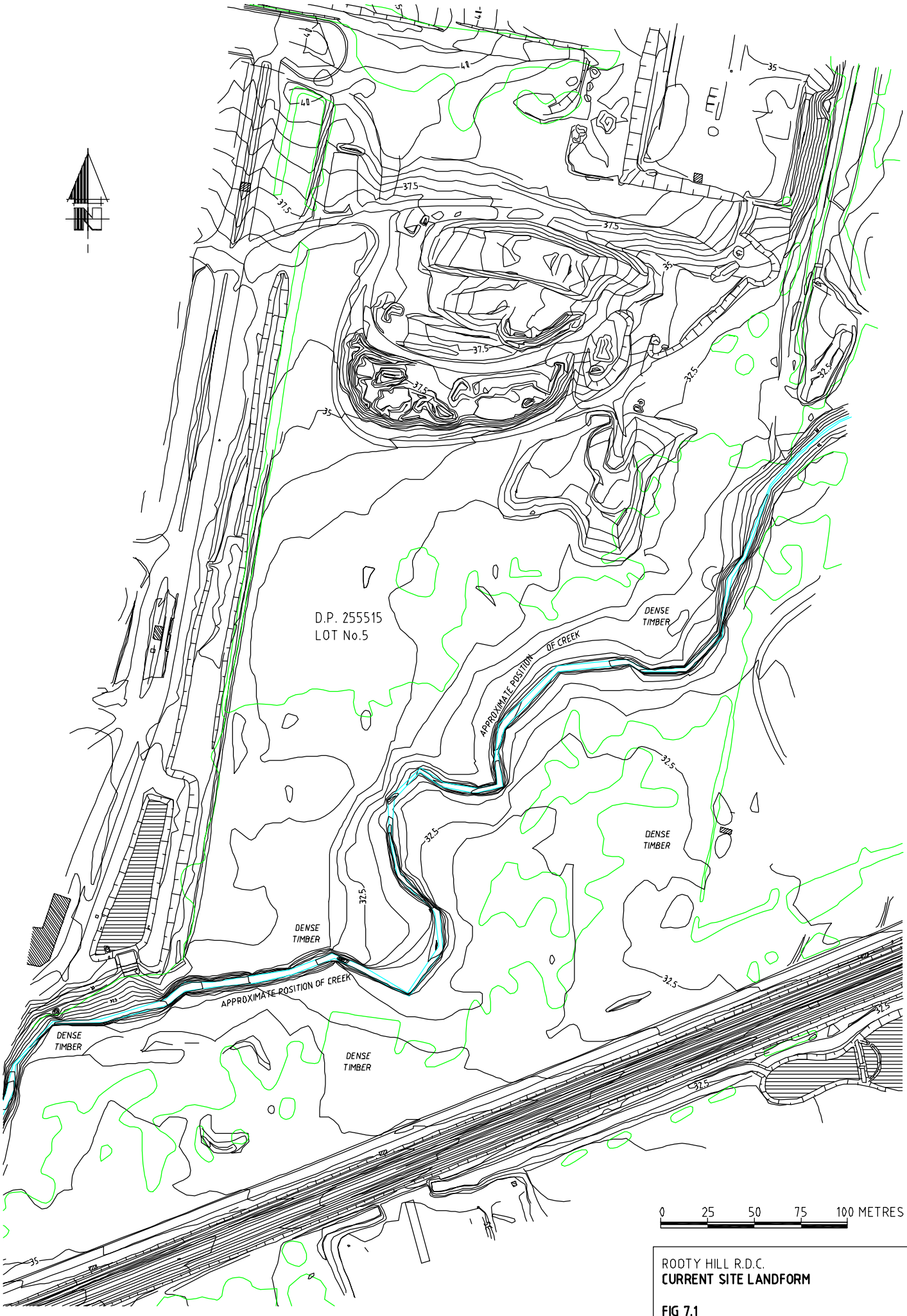
Geology

The proposed development site and much of the Cumberland Plain are located on the Bringelly Shale Formation, a member of the Wianamatta Group of Triassic Age. The Wianamatta Group consists of three formations of which the Bringelly Shale is stratigraphically the highest. In areas west of Sydney, sedimentary rocks have been gently folded to form a basin-like structure with the Bringelly Shale generally occupying the centre.

The Bringelly Shale typically comprises claystone, siltstone, laminate and sandstone units with minor occurrences of coal, carbonaceous claystone and tuff. The various units are typically dark grey or black but also include light grey claystone units possibly caused by leaching.

The sandstone units tend to occur in channel-like bodies of limited lateral extent and it is usually very difficult to correlate the sandstone beds even over relatively short distances. The results of a geological and groundwater study undertaken by Douglas Partners are presented in Technical Report No 1.

The Bringelly Shale, with a maximum thickness of 257 m at Razorback, near Campbelltown, grades upwards from a lagoonal-coastal marsh sequence at the base to increasingly terrestrial, alluvial plain sediments towards the top of the formation. The formation was deposited in a broad,



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CURRENT SITE LANDFORM

FIG 7.1

low-lying coastal plain consisting of swamplands cut by meandering estuarine and alluvial channels. The Bringelly Shale is underlain by the Triassic Hawkesbury Sandstone Formation.

Soils

The development site predominantly consists of two soil landscapes. According to Bannerman & Hazelton (1990), the dominant geological formation occurring at the site is the South Creek soil landscape. This soil landscape occurs along many of the drainage depressions of the Cumberland Plain. The geological formation of the South Creek landscape is Quaternary alluvium derived from Wianamatta Group shales and Hawkesbury Sandstone.

The least dominant geological formation of the site is the Blacktown Soil Landscape, a member of the Wianamatta Group, which occurs extensively on the Cumberland Plain Woodlands (Bannerman & Hazelton, 1990).

South Creek Soil Landscape

The South Creek Soil Landscape consists of floodplains, rivers and streams of the Cumberland Lowlands. The landscape is flat to gently sloping alluvial plain with occasional terraces or levees providing low relief up to 10 m. The soils are often deep, layered sediments overlying bedrock or relict soils. The main limitations of this soil landscape are the risk of erosion and frequent flooding.

This soil landscape dominates the development site and occurs extensively on the southern section of the site associated with Angus Creek that flows from the western boundary to the eastern boundary across the site.

Blacktown Soil Landscape

The Blacktown Soil Landscape (Bringelly Shale) occurs in the north west corner of the site. This group usually occurs on gently undulating rises over Wianamatta Group shales. The soils range from shallow to moderately deep and are hard setting, mottled textured clay soils. The Blacktown soil materials have moderate erodibility, low fertility and poor soil drainage.

Salinity

Salinity has been recognised as a regional problem in Western Sydney and the Western Sydney Regional Organisation of Councils has published a Draft Salinity Code of Practice which would be taken into account in the final design of the proposed RDC (refer Technical Report No 1). Areas requiring consideration as part of this Code include:

- Identification of hazard areas and processes on site;
- Site water balance;
- Site drainage;
- Vegetation retention; and
- Implementation of building controls or engineering responses where appropriate.

Laboratory testing of soil samples from the development site gave variable results ranging from slightly to moderately saline. The level of salinity in the soil is consistent with the concentration of total dissolved solids recorded in groundwater samples taken from the site and other sites in the region.

On the basis that the requirements of the Draft Code would be incorporated in the final design of the RDC, there would be no impact on soil salinity.

Acid Sulphate Soils

Douglas Partners undertook a geological and groundwater assessment of the site (refer Technical Report No. 1). Based on observations of the soils encountered in the bores and the elevation of the site it was considered that there is a very low risk of acid sulphate soils being found on the site.

Stockpile Materials

In 1993, BHP Engineering was granted approval under the *EP&A Act* 1979 (Section 92) to use the northern section of the proposed development site, now owned by Readymix, as a repository for excess spoil generated from excavations associated with construction and development of the steel mill. This area was completed by the end of February 1994. Readymix purchased the Rooty Hill site from BHP in 2000.

The stockpile area has an average height of approximately 37.5 m AHD, lower than the north west corner of the site (40 m AHD). A gravel road separates the two stockpiles on the northern section of the site. The smallest mound is situated to the south of the large stockpile, north of Angus Creek. Figure 7.1 shows the location of the stockpiles on the site.

In February 2000, CH2M Hill was commissioned to undertake a Phase 1 environmental site assessment. The purpose of the assessment was to:

- Identify past and present potentially contaminating activities;
- Identify potential contamination types;
- Discuss the site condition;
- Provide a preliminary assessment of site contamination; and
- Assess the need for further investigations.

The results of the assessment based on aerial photographic records, historical certificates of title, and discussions with BHP Steel and Blacktown City Council personnel indicate the land had been undeveloped with only the deposition of excavated spoil on the site in the 1990s.

Section 149 Certificates were obtained from Blacktown City Council and the certificates confirm that no NSW EPA notices have been issued for the proposed development site.

The Phase 1 Environmental Assessment Report states the excavated material on the site did not contain any visually contaminating sources and no building materials were included in the fill. The fill was covered with between 30 to 50 cm of topsoil and reseeded.

Following the CH2M Hill (2000) study, Johnstone Environmental Technology Pty Limited conducted a preliminary assessment of the fill material in April 2000. The fill materials sampled were tested for total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP) and the metals arsenic, cadmium, copper, chromium, lead, nickel and zinc.

The findings of the report can be summarised as:

- TPH was not present in any sample analysed at concentrations above the analysis detection limit. The TPH concentrations were therefore below the Threshold Concentrations;

- No significant metal concentrations were present in the samples analysed. All metal concentrations present were below the Threshold Concentrations;

- PAH was not present in any sample analysed at concentrations above the analysis detection limits. All benzo (a) pyrene (B (a) P) and total PAH concentrations were therefore below the Threshold Concentrations; and

- No significant concentrations of OCP were present in the samples analysed. All OCP concentrations were therefore below the Threshold Concentrations.

The report also stated the samples typically consisted of clay, shaley clay and gravel which is consistent with the Bannerman and Hazelton (1990), description of the Blacktown Soil profile.

Investigations by Douglas Partners described in Technical Report No 1 indicate that there is no other soil contamination within the development site.

7.1.2 Impact Assessment

Topography

Construction of the proposed RDC would take place over a two year period. During the initial stages of construction activities would include earthworks on the northern section of the site to create the landform/levels required for the storage and distribution area and construction of the road/conveyor bridge across Angus Creek. Once these works are completed construction of the associated structures could commence. Construction of the rail siding would take place over a period of at least 22 months. This would involve importation of materials including ballast to create the required embankment.

There is a significant amount of spoil stockpiled on the northern section of the site. The stockpile area to be levelled during the earthworks occupies approximately 3.5 ha. During the construction phase this material would be predominantly utilised to form a pad under the proposed Concrete Batching Plant. The remainder (approximately 11,000 m^3) would be either graded across the site north of the Angus Creek Corridor to provide uniform gradients for drainage and access or removed from the site. All excess material won through the construction of foundations on the site would be used in the same manner. The construction of the final landform north of Angus Creek would not require importation of any fill material to the site.

Other earthworks would involve site preparation and excavation for other components of the RDC and the construction of roadways and paved areas.

The movement of material and levelling of the northern section of the site would typically involve the use of excavators, trucks, dozer, compaction equipment and grader. All existing vegetation and topsoil within the development footprint would be removed as part of the earthworks. It is estimated approximately 10,000 m^3 of topsoil would need to be removed from the site.

The construction activities on the northern portion of the development site would result in some changes in the topography as a result of removal of stockpiles and the provision for uniform gradients for drainage, access and the location of structures. The landform resulting from the changes would not be inconsistent with the topography of the adjoining areas.

To the south east of the creek, the only material that would be imported would be for the construction of the rail siding embankment and the realignment of North Parade. This is required because materials with suitable engineering properties for these applications do not exist on the site.

The proposed development would involve the reorganisation of product storage areas within the Humes site including the site of the proposed office and laboratory buildings. Once the product currently stored on the south east corner of the Humes site was relocated, this area would be filled to the levels required. This activity would also require the construction of a retaining wall to maintain the stability of the ground adjacent to the Humes product storage area.

The construction of the conveyor system, rail unloading facilities, the road providing access to the southern section of the site and the associated road bridge over Angus Creek would not alter the overall topography of the site.

Geology

There would be some excavation during construction of the RDC. There would be excavation under the site of the proposed office and laboratory buildings to enable the car park and laboratory buildings to be constructed. There would also be excavations under the reclaim hopper, transfer house, the aggregate storage bins and the rail unloading station. Otherwise only minor excavations would be required for building and structure foundations. The maximum depth of excavation would be approximately 8 m.

The extent of the sub-surface activity would have a localised impact which is unavoidable given the topography of the development site and the nature of the components of the RDC.

Soils

The construction of the proposed RDC and its ongoing operations have the potential to result in sediment movement from the site due to surface soil erosion, changes in surface and groundwater salinity and impacts due to the disturbance and exposure of contaminated soils.

Investigations described in Technical Report No 1 and summarised in this section indicate that provided the final design of the RDC is in accordance with the Draft Salinity Code of Practice there would be no impact on soil salinity. The investigations also indicated there was a very low risk of acid sulfate soils being found on site so that the impact on soil and water acidity would be minimal. In addition no site contamination was found on the site.

Initial earthworks would involve levelling of excavated material on the northern portion of the site. The earthworks involve moving materials from the stockpiles to create the platform for the Concrete Batching Plant. The remaining stockpile materials would be levelled, and reshaped to provide uniform gradients for drainage and access or removed from the site.

Other earthworks would involve site preparation and excavation for other components of the RDC and the construction of roadways and paved areas.

As a result of the earthwork activities there would be the potential for sediment movement, via surface waters, following the removal of ground cover, as the soil would be exposed to erosive elements before being stabilised either by revegetation or structures and pavement.

The Site EMP would include measures that would be implemented in order to minimise sediment movement during levelling activities. These measures are summarised in Section 6.5.3. Silt fences would be installed along the northern section of the Angus Creek Corridor to ensure no sediment movement into this area. Daily site inspections would be undertaken to monitor the integrity of the fencing and any maintenance required to be undertaken prior to commencement of activities.

The Angus Creek Corridor would be protected from damage during construction activities as the measures outlined in Section 6 would be implemented and managed through the Site EMP. A riparian buffer of 40m from the Creek would be maintained wherever possible except for the two creek crossings and portions of the rail unloading and conveyor system south of the creek. Revegetation of cleared and disturbed areas on the site outside the development footprint and areas disturbed by construction would be undertaken using endemic native species.

Elsewhere on the site, including at the location of the proposed office and laboratory buildings and the area south of Angus Creek, silt fences would be installed to control sediment movement. These measures would remain in place until the proposed development is completed,

Access for earthmoving equipment would be via the existing entrance on Kellogg Road (refer Figure 5.1). During the initial period of site construction access for construction equipment to the southern section of the site would be via North Parade. This would cease once the bridge over Angus Creek was constructed.

Once site rehabilitation has been completed there would be no exposed unvegetated areas on the site.

7.2 SURFACE WATER

7.2.1 Regional Description

The proposed development site falls within the Hawkesbury-Nepean catchment, which covers an area of 22,000 square kilometres. The Hawkesbury-Nepean River System drains a large catchment to the west and north of Sydney, from Goulburn in the south west to Lithgow in the west and the Broken Bay Plateau in the north. The river system is utilised for a wide range of activities including:

- Water supply for industrial, agricultural and domestic purposes;
- Recreational activities including swimming, fishing, water skiing, boating etc; and
- Discharge point for sewerage treatment plants and other industrial activities.

The Hawkesbury-Nepean River is the main recreational water resource for Sydney's western suburbs. The catchment sustains a rich and diverse fauna - a consequence of the extensive sandstone environments largely unsuited for development (NSW EPA, 1995).

The many dams and weirs along the river have reduced freshwater flows, changed flood patterns and interfered with the migration of fish and other aquatic animals (Recher *et al*., 1993). In the freshwater creeks and rivers of the Hawkesbury-Nepean system the native fauna has declined, while introduced species have increased. The NSW EPA has been monitoring water quality of the river system and its tributaries continuously since 1990.

7.2.2 Surface Hydrology

Existing Conditions

The proposed development site is located within the catchment of Eastern Creek. The site is drained by Angus Creek which enters Eastern Creek to the east of the site. Eastern Creek flows into South Creek at Vineyard, which then flows into the Hawkesbury River at Windsor.

The main portion of the proposed development site is undeveloped. The exceptions are the site of the proposed office and laboratory, North Parade and the Main Western Railway line. The entire

site drains to Eastern Creek. The main portion of the site and part of North Parade and the Railway land drain directly to Angus Creek a tributary of Eastern Creek. The area of the proposed office and laboratory drains via the Humes site water management system to Eastern Creek or towards Kellogg Road and into Council's stormwater collection system.

Impact Assessment

The proposed RDC would not materially change the drainage patterns on the site. At present there is no runoff entering the site from the west because OneSteel has a stormwater swale along the entire length of its eastern boundary. Runoff from other areas external to the site would be diverted by cut-off drains around the site into either Angus Creek or Eastern Creek. Water storage tanks would collect water from a number of buildings and enclosures on site for reuse.

The proposed site drainage system for the storage and distribution area on the northern section of the site reflects the existing conditions on site and would flow towards Angus Creek. This section of the site has been divided into four catchments. Each of the four catchments would discharge into detention basins as described in Section 5.9. After filling these basins stormwater would overflow to Angus Creek as sheet flow. Runoff velocities from the banks of the swales are estimated to be less than 0.4 m/sec. Grass cover would be established where necessary and maintained below the banks. At the predicted velocity the potential for erosion is low.

Stormwater resulting from frequent events, up to 1 in 3 month ARI, would be held in the basins and would evaporate.

The office and laboratory building would use the existing water management system on the Humes site.

The lower section of the site has been designed to replicate existing conditions with site drainage having been designed accordingly.

Estimates have been made of existing peak flow rates and volumes of stormwater from the site in its existing condition and after construction of the proposed RDC. The existing conditions assume that the site is 50% impervious while after construction the site is 85% impervious. The estimates also assume that all on-site water storage structures are full. Table 7.1 shows the peak flows and volumes for the 5 year, 20 year and 100 year ARI events.

Table 7.1
Site Runoff Flow and Volume

	Existing Condition		**RDC Condition**	
	Peak Flow L/Sec	**Volume m^3**	**Peak Flow L/Sec**	**Volume m^3**
ARI 5YR	870	940	1470	1060
ARI 20 YR	1270	1370	2170	1560
ARI 100 YR	1900	2060	2980	2140

Given the small proportion (approximately 2%) of the Angus Creek catchment that the development site represents and the changes which have occurred and are planned upstream of the Main Western Railway line, the impact of the changed stormwater run-off flow regime off the site is assessed as being minimal.

7.2.3 Flooding

The major portion of the proposed development site is elevated and slopes in a general southeasterly direction towards Angus Creek (which flows in an easterly direction through the southern portion of the site).

While much of the project infrastructure is proposed to be located on the elevated northern portion of the proposed development site, some elements principally the rail siding, rail unloading station, rail unloading transfer conveyor system (and related access road), the two bridges over Angus Creek and the realigned North Parade would be within the Angus Creek 100 year ARI floodplain. Bewsher Consulting was commissioned to undertake a flood study to assess the project's potential impact on the local Angus Creek flood regime (refer Technical Report No 2).

In a report dated August 2003 and entitled *Readymix Concrete Batching Plant Development Flood and Drainage Assessment,* Bewsher Consulting had previously used Blacktown City Council flood study information which was prepared by Bewsher Consulting to document the 100 year average recurrence interval (ARI) flood regime through the proposed development site. However the scope of the proposed RDC works within the floodplain were such that a new and more detailed flood modelling approach needed to be adopted, as is described in Technical Report No 2. This report principally focuses on the 100 year ARI flood event, but also includes a broad picture of an extreme or Probable Maximum Flood (PMF) event.

The flood modelling made use of the following data:

- A RAFTS hydrologic model of the Angus Creek catchment which was used by Bewsher Consulting for the *Blacktown Floodplain Management Study;*
- Results from an Eastern Creek flood model also used by Bewsher Consulting for the *Blacktown Floodplain Management Study (1996);*
- Detailed aerial mapping undertaken by Geospectrum Pty Ltd for the RDC project but specifically extended to better suit the requirements of the flood study;
- Field survey data of local area Angus Creek and Eastern Creek culverts and bridges by Hammond Smeallie (registered surveyors);
- Railway siding embankment details prepared by Watson Technology Pty Ltd; and
- Project design ground levels along the northern fringe of the Angus Creek floodplain.

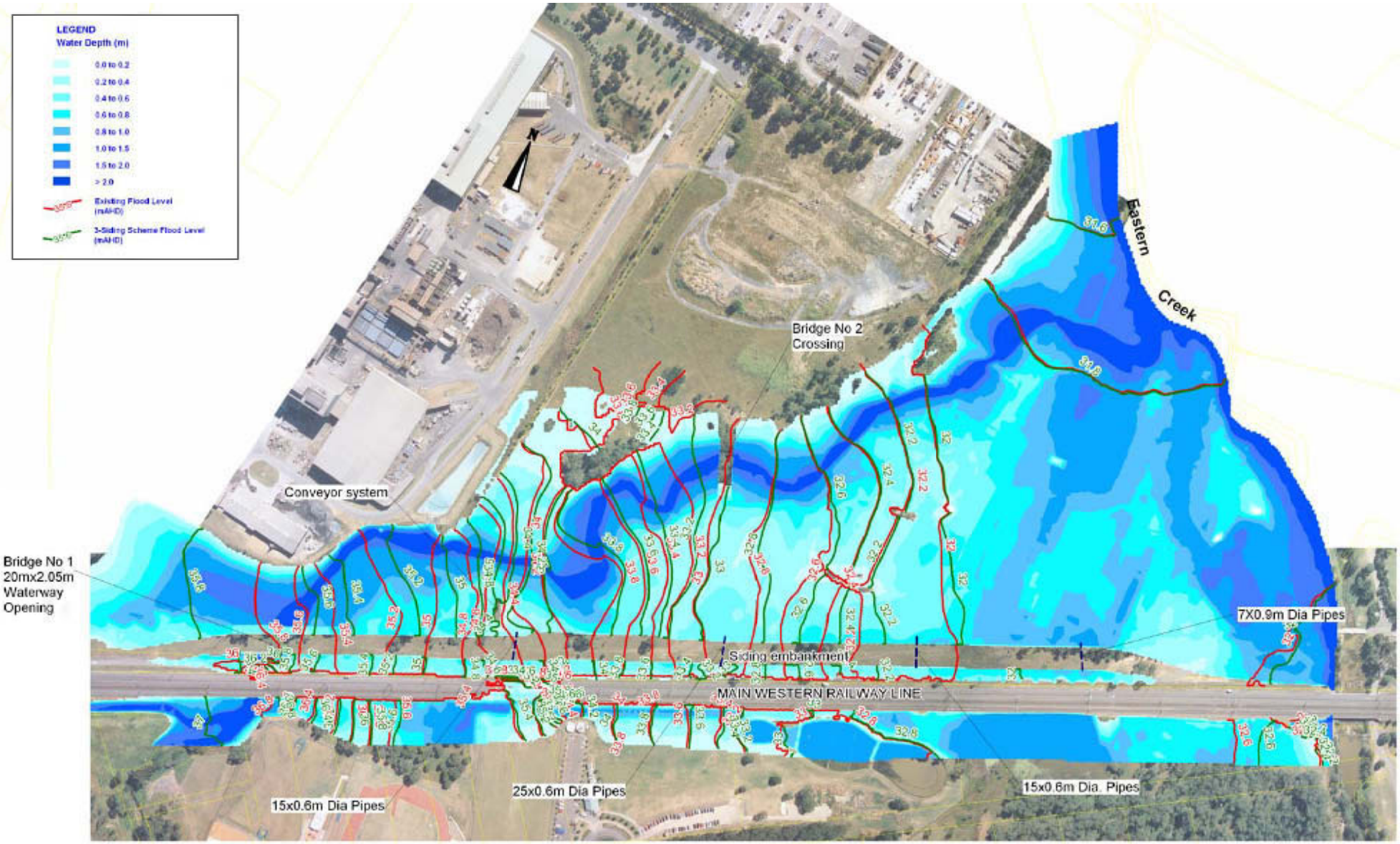
Impact Assessment

100 Year Event

The results of the modelling are presented in Figures 7.2 and 7.3**.** Figure 7.3 presents the contours and other information where the siding crosses Angus Creek. The red contours represent the *'existing condition'* flood levels and the green contours represent the flood levels after inclusion of the various RDC project elements. The inundation regime shown in both figures relates to the 'post RDC' scenario.

Figure 7.4 represents an 'afflux' map where various colour bands define the relative changes in flood levels between the *'existing conditions'* and 'RDC conditions' flood levels and the general trends are as follows:

- There is a localised increase in flood levels near the siding just east of the proposed development site eastern boundary. This is principally a function of an area of higher



Following structures are included in the model:-

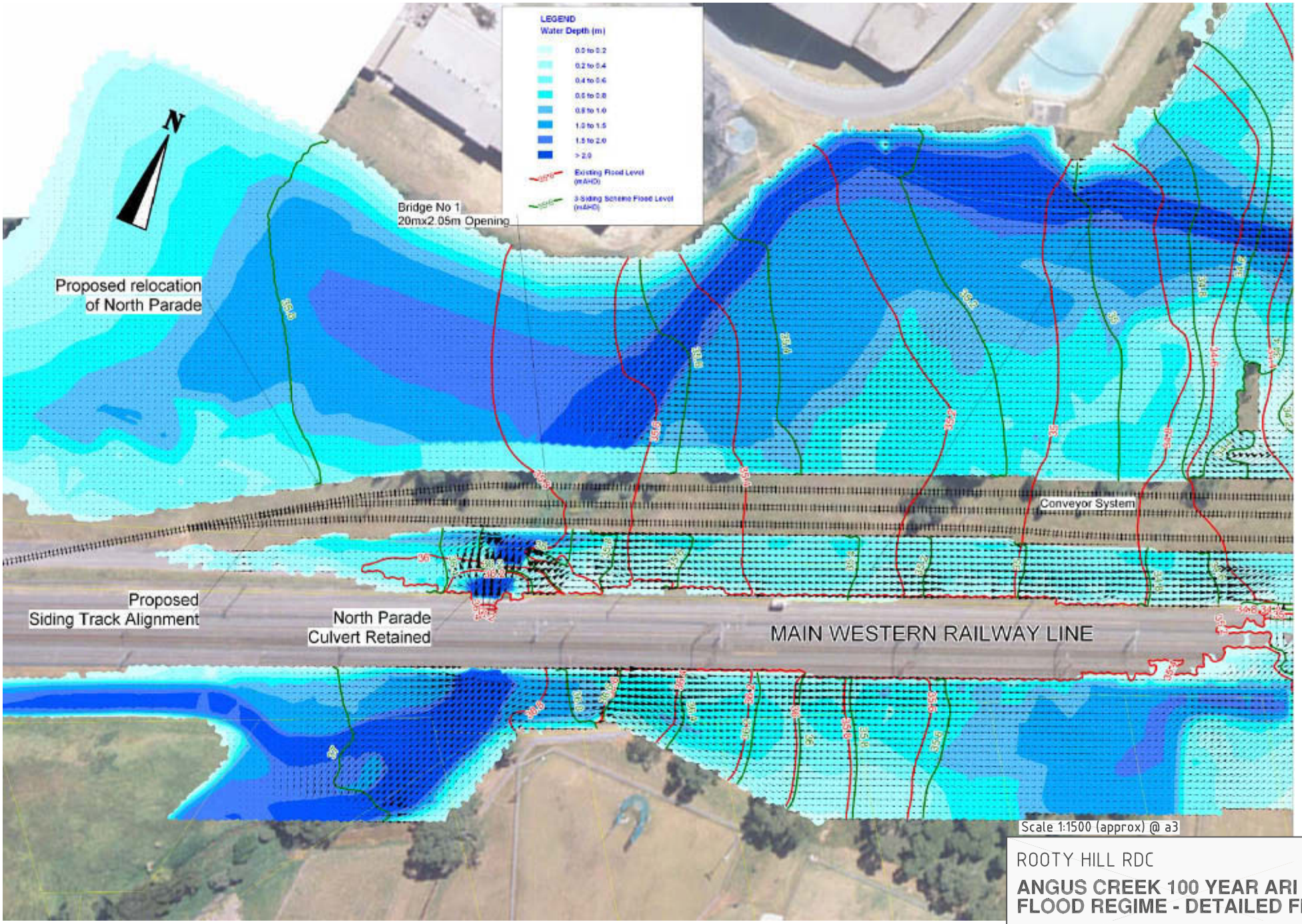
a) Relocated North Parade and three siding track embankment over 20mx2.05m rectangular waterway opening at Augus Creek;
b) Bridge structure approx. 600 metres d/s of main railway;
c) 7x0.9m dia pipes at eastern end of the siding track;
d) 2 sets of 15x0.6m dia. pipes and 1 set of 25x0.6m dia. pipes spaced along siding track;
e) Flow 'block out' for transfer conveyor system;
f) Project design contours north of Angus Creek.

Scale 1:5000 (approx) @ a3

ROOTY HILL RDC

ANGUS CREEK 100 YEAR ARI FLOOD REGIME

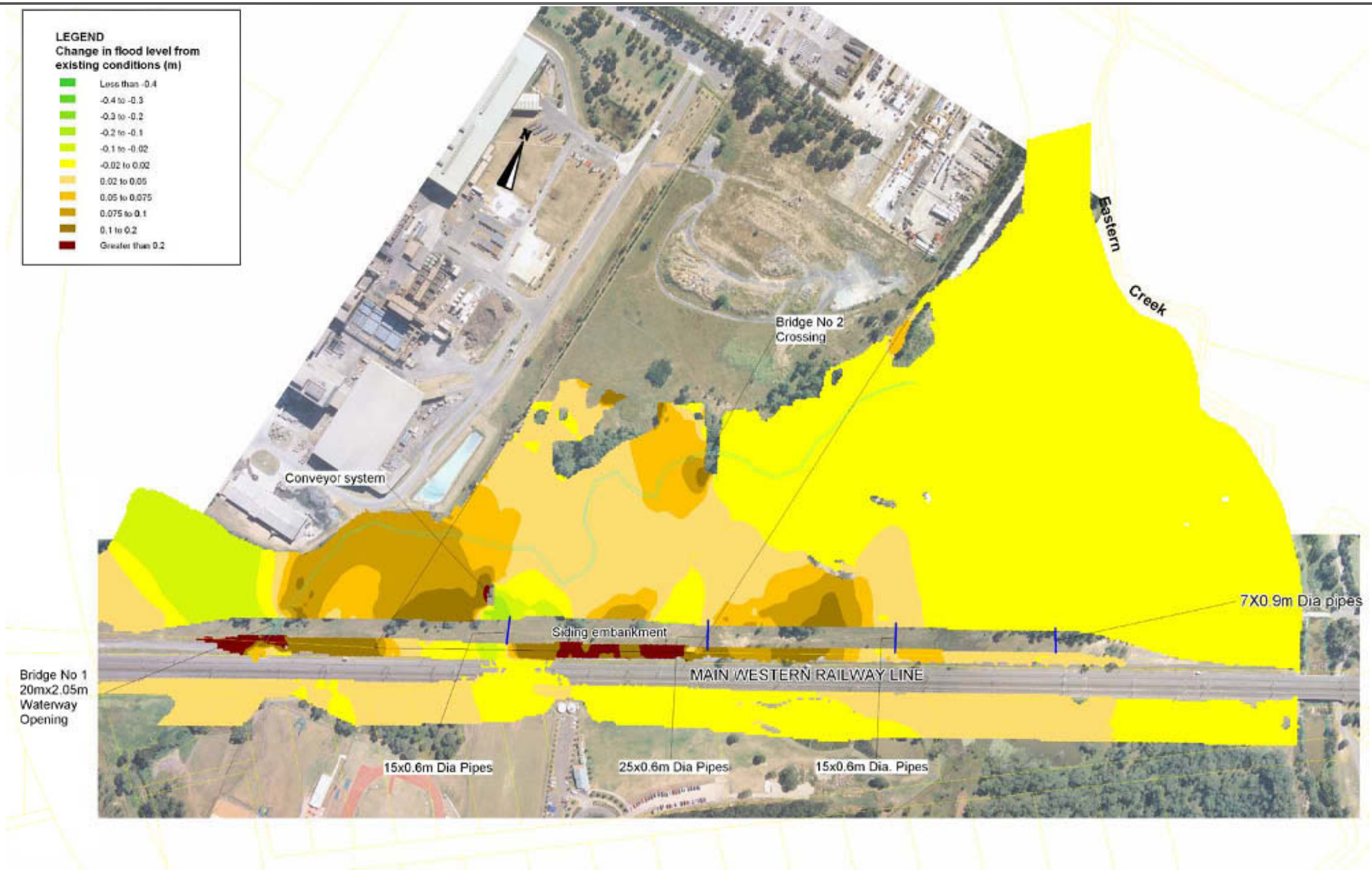
FIGURE 7.2



ROOTY HILL RDC

ANGUS CREEK 100 YEAR ARI FLOOD REGIME - DETAILED FIGURE

FIGURE 7.3



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ROOTY HILL RDC

IMPACT OF PROJECT ON ANGUS CREEK 100 YEAR ARI FLOOD LEVELS

FIGURE 7.4

ground levels which includes a small area which is actually not inundated in the 100 year event. This area of higher ground levels naturally causes a localised redistribution of floodwaters and this affect is more noticeable following the inclusion of the nearby siding embankment into the flood model. The impact of the re-distribution is considered to be minor;

- There are several locations of increased flood levels within the proposed development site, principally associated with the road/conveyor bridge crossing in the middle of the site and re-distribution of flood flows adjacent to the siding in the south-western corner of the site. The increase at the former location is typically less than 75 mm. While the latter impact zone extends west of the site, the increase in flood levels in that area is typically less than 100 mm. With the inundation line corresponding to the embankment below the OneSteel plant area, there are no existing or incremental flood damages in that minor impact zone;

- Immediately upstream of the Main Western Railway line, the Angus Creek flood levels increase by less than 50 mm. This is considered to be a nominal increase and again there are no incremental flood damages issues; and

- The potential impact of extra flows heading eastwards between the siding and main railway embankments has been addressed by the combined capacities of a series of stormwater pipes under the siding embankment. Where there are increases in flood levels along this 'corridor' they are typically limited to 100 mm to 200 mm (with a maximum increase of 250 mm). These correspond to only localised impacts and that there is no adverse impact on how upper catchment floodwaters would potentially overtop the Main Western Railway line. Hence the project has no adverse impact on the Main Western Railway line.

Construction of new bridges across floodplains can lead to significant changes in flood-time flow velocities. Interpretation of the TUFLOW model's flow calculations for the peak of the 100 year ARI flood at the proposed bridge locations revealed that the average velocities at the rail/road bridge location would likely increase from about 1.0 m/s to 1.8 m/s with its construction while the corresponding values at the central span of the conveyor/road bridge would be 0.7 m/s and 0.9 m/s. While the conveyor/road bridge velocity increase is not considered to be significant, the rail/road bridge concept design plan shows the placement of rock in the bed of the bridge waterway opening (and the adjacent bed of the transitional channel) would address potential scour issues. It is concluded that none of the project's flood impacts constitute a significant change to the existing 100 year flood regime, nor result in an increase in potential flood effects.

PMF

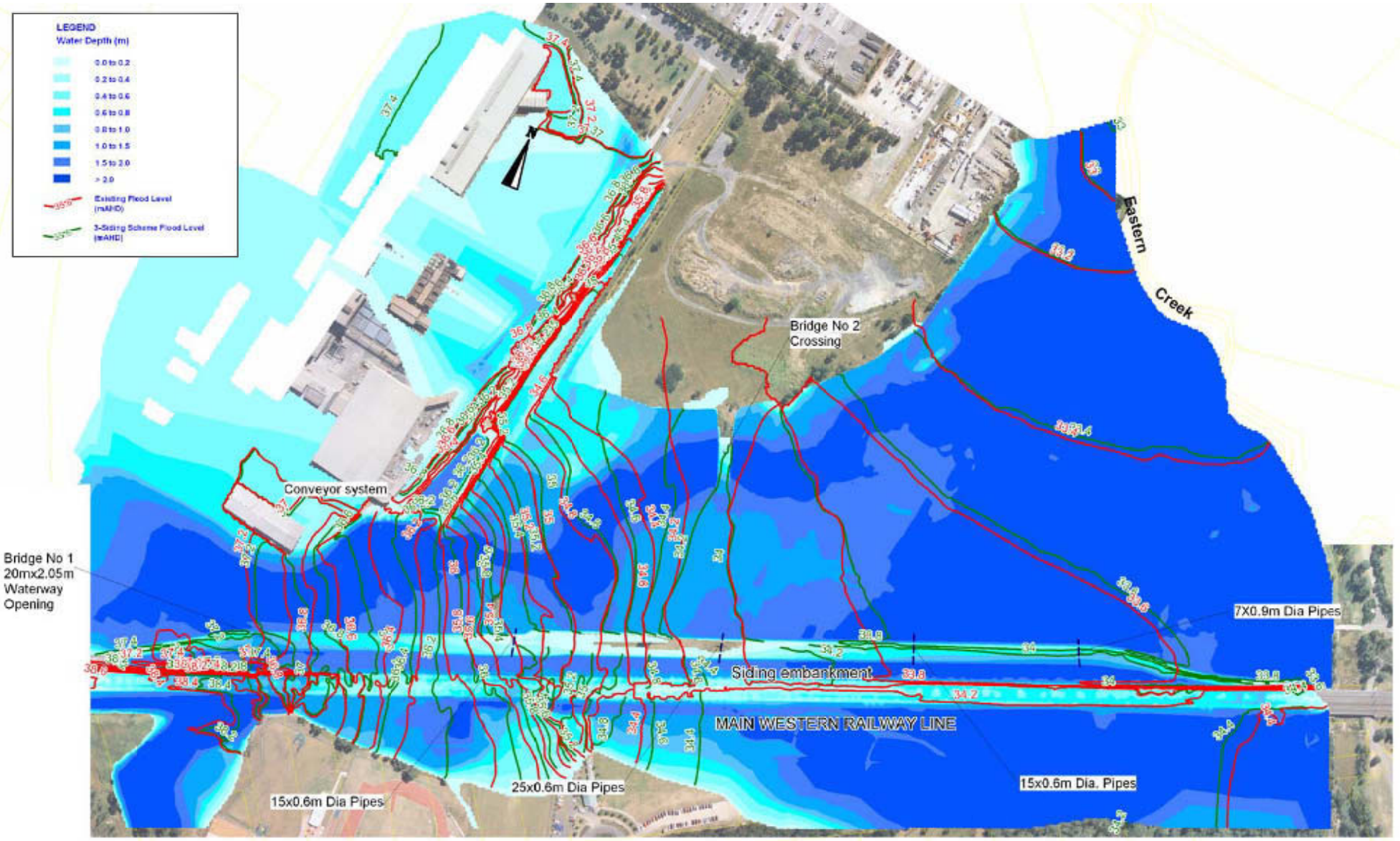
The following changes were made to the TUFLOW model to assess the Probable Maximum Flood (PMF) regime:

- The Angus Creek and Eastern Creek 100 year ARI flood flow hydrographs were increased to replicate the respective 1996 study's PMF flows;

- An approximate Eastern Creek stage-discharge relationship was developed to provide a model boundary level which was similar to 1996 study's peak flood level; and

- The TUFLOW model's floodplain boundaries were extended using as-available contour and spot level information to ensure that the resultant flood levels were not significantly constrained by the geographical limits of the digital elevation model north of the Main Western Railway.

Figure 7.5 shows the two sets of PMF flood levels where the red contours represent the 'existing condition' flood levels and the green contours represent the flood levels after inclusion of the various RDC project elements. The figure shows greater extents and depths of inundation than are



Following structures are included in the model:-

a) Relocated North Parade and three siding track embankment over 20mx2.05m rectangular waterway opening at Augus Creek;
b) Bridge structure approx. 600 metres d/s of main railway;
c) 7x0.9m dia pipes at eastern end of the siding track;
d) 2 sets of 15x0.6m dia. pipes and 1 set of 25x0.6m dia. pipes spaced along siding track;
e) Flow 'block out' for transfer conveyor system;
f) Project design contours north of Angus Creek.

Scale 1:5000 (approx) @ a3

ROOTY HILL RDC

ANGUS CREEK PMF REGIME

FIGURE 7.5

predicted to occur in the 100 year event. Hence all of the Main Western Railway and almost all of the siding are overtopped.

The red and green contours are similar in location and where there are increases in flood level they are typically less than 200 mm. There are flood level increases of the order of 400 mm to 500 mm in the area between the siding embankment and the Main Western Railway embankment but the increase is solely due to the siding itself being overtopped. It is therefore considered that the project does not have any major adverse impacts on the passage of an extreme flood event.

The inclusion of the proposed RDC project elements into the flood model has shown that there would be only minor changes to and no incremental increase in flood damages in the 100 year ARI flood event.

The modelling undertaken for this study indicates only minor changes to flood levels as a result of the proposed development. Impacts would be primarily restricted to within the site of the proposed development with minimal effect on adjacent or upstream land uses. The modelling also shows the proposed RDC would not have a major adverse impact on the passage of an extreme flood event.

7.2.4 Water Quality

Existing Site Conditions

As stated previously, Angus Creek traverses the site. The creek flows between the OneSteel site and the Nurragingy Reserve where it joins Eastern Creek. A water quality monitoring programme has been undertaken to provide baseline data for the site.

Sampling was undertaken at two locations. The first sample (S1) was taken from the point where Angus Creek enters the site. At this point the creek is approximately 1.5 – 2 m wide. The second sample (S2) was taken from the point where Angus Creek leaves the site and enters the Nurragingy Reserve. At this point the creek is approximately 0.5 – 1 m wide.

Due to the location of adjacent industry and the previously disturbed surroundings, Angus Creek has been assessed as being a slightly disturbed lowland freshwater waterway.

Samples were analysed in terms of pH, Dissolved Oxygen (DO), Alkalinity ($CaCO_3$), Turbidity, Biological Oxygen Demand (BOD), Total Phosphorus (P), Total nitrogen (N), Ammonia, Dissolved Metals (Iron, manganese, Aluminium, Calcium, Magnesium, Sodium and Potassium), Oil and Grease and Total Petroleum Hydrocarbons.

Three months of monitoring were undertaken initially and then quarterly monitoring was carried out. After the first quarterly monitoring in September 03, monitoring was confined to the Issue Performance Indicators as baseline conditions had been established for future monitoring once construction and operation have commenced.

Tables 7.2 and 7.3 provide the water quality results from Angus Creek. A comparison was undertaken of baseline water quality for Angus Creek in the vicinity of the proposed development with the Recommended Triggers for Assessed Ecosystem Type (ANZECC 2000):

A comparison of the performance indicators and chemical parameters against the default triggers for Angus Creek, which has been assessed as a slightly disturbed freshwater waterway, showed:

- The pH readings were within the desirable range for all the measured sites;
- Dissolved oxygen concentrations were within the accepted limits for most samples. Site S1 in March 2003 and both the upstream and downstream sites in September and December

2004 were lower than the desirable level. These sampling periods were during low flows in the creek;

- Turbidity levels were within the desirable range for all measured sites. In general turbidity levels fell at the low end of the range, which is expected for waterways flowing through well-vegetated catchments and with low flows (such as is the case with Angus Creek). Upstream catchment activity may have caused the slightly elevated levels shown in the Tables;

- Electrical conductivity levels were within the desirable range for all measured sites except in September 2003 at the upstream site with a relatively increased level downstream. There is no indication of a reason for this;

- Total Nitrogen levels were in general above the desirable level with a small variation between upstream and downstream sites. This would indicate some source of nitrogen upstream possibly fertiliser use;

- Total phosphorus levels were also slightly elevated above the desirable level probably for the same reason;

- Iron, manganese, aluminium and ammonia levels were below their corresponding default trigger values;

- As there are currently no guidelines for calcium, magnesium, potassium and sodium in these ecosystems, the results show the presence of these naturally occurring metals in this ecosystem. These metals were monitored because there is a potential for them to be introduced in to the ecosystem as a result of activities from the proposed development;

- There are currently no guidelines for alkalinity in these ecosystems. The total alkalinity of the system is pH dependant and is a measure of the carbonates, bicarbonates and hydroxides in a waterway. The results show that the total alkalinity is a result of naturally occurring bicarbonate, with no hydroxides and carbonates present; and

- There are currently no guidelines for oil and grease and total petroleum hydrocarbons in these ecosystems. As is desirable, there are no detectable quantities of oil and grease and total petroleum hydrocarbons in the waterway.

In the course of the aquatic biological investigations undertaken for the proposed RDC and described in Technical Report No 4 monitoring was undertaken in March 2005 at upstream and downstream locations in Angus Creek. The results were consistent with those presented in Tables 7.2 and 7.3.

Impact Assessment

As described previously a water quality monitoring programme has identified the existing conditions for the site and this programme would be continued during construction and operation of the RDC. Monitoring of Angus Creek upstream and downstream of the proposed development site would give an indication of impacts associated with the activities being undertaken on the RDC.

The potential sources of surface water contamination from the site are cementitous materials from the Concrete Batching Plant and Blending Plant / Pug Mill, sediment materials arising from the construction material brought to the site and distributed from it and spill and leakage of oils, fuels and other chemicals stored on site.

The water management system on site involves collection of rainfall, collection and management of process water and stormwater flows. The efficiency of the proposed water management system would influence the water quality downstream in Angus Creek.

External stormwater flows would be captured and diverted around the development area where applicable. Stormwater discharging from paved areas on the site would pass through silt traps and Humeceptors (hydrodynamic source control devices) for capture and retention of a range of contaminants from stormwater runoff including oils, greases and sediments. The stormwater drainage systems would discharge into dispersal basins. After filling the basins would overflow into the Angus Creek corridor as sheet flow. The basins would be regularly inspected and cleaned as required.

Water from areas classified as “dirty” in the RDC would be segregated from water from “clean” areas. The “dirty’ areas are where there is the potential for spills of cementitous materials, fuels and other chemicals. Where possible “dirty” water would be reused on site. As required it would be disposed of to a licenced contractor or to sewer. Where a first flush system is in place, as in the Concrete Batching Plant, water would flow through the site drainage system before being released. The first flush system would remove sediment and other temporarily suspended materials from the first flush water. Subsequent flows would be clean of these materials.

Implementation of the proposed water management system would ensure no negative impact on Angus Creek as a result of the construction or operation of the RDC.

Table 7.2
Baseline Water Quality Results for Sampling Site S1 Taken from Angus Creek Upstream of the Proposed Development.

Issue Performance Indicators	Sampling Event								Default Trigger for Ecosystem Type [a] (ANZECC 2000)
	1 6 Mar 03	2 9 Apr 03	3 6 May 03	4 Sept 03	5 3 Feb 04	6 12 May 04	7 29 Sept 04	8 1 Dec 04	
pH [b]	7.4	7.9	8.0	8.1	7.85	7.98	7.41	7.73	6.0 > pH > 9.0
Dissolved Oxygen (mg/L) [b]	4.3	10.3	6.3	7.3	6.4	7.7	4.8	4.7	> 6.0 mg/L
Temperature (°C) [c]	19.9	16.6	15.5	11.3	20.6	14.7	16.5	21.3	Seasonal
Conductivity (μS/cm) [c]	392	555	595	2680	1400	767	331	1360	125-2200 μS/cm
Turbidity (NTU) [c]	15	2	7	6.3	4.3	12.7	14	21.3	6-50 NTU
Total Nitrogen (mg/L) [b]	1.1	0.51	0.76	0.59	0.7	1.8	0.7	1.0	0.5 mg/L
Total Phosphorus (as P) (mg/L P) [b]	0.09	0.05	0.05	0.06	0.09	1.19	0.1	0.4	0.05 mg/L
Chemical Parameter	**Sampling Event**								**Default Trigger for Ecosystem Type [a] (ANZECC 2000**
	1 6 Mar 03	2 9 Apr 03	3 6 May 03	4 Sept 03	5 3 Feb 04	6 12 May 02	7 11 Oct 04	8 1 Dec 04	
Iron (mg/L) [b]	0.17	0.04	0.10	0.06					0.3 mg/L [e]
Manganese (mg/L) [b]	0.004	<0.003	<0.003	0.038					1.9 mg/L
Calcium (mg/L) [b]	21	27	32	51					NG [f]
Magnesium (mg/L) [b]	11	14	18	58					NG [f]
Potassium (mg/L) [b]	4	4	3	6					NG [f]

Sodium (mg/L) [b]	66	100	100	410					NG [f]
Aluminium (mg/L) [b]	0.05	0.08	0.03	0.07					0.05 mg/L for pH > 6.5
Ammonia (mg/L N) [b]	0.04	0.03	0.05	0.02					0.9 mg/L
Oils and Grease (mg/L) [b]	< 1	< 1	< 1	<1	<5	<5	<5	<5	NG [g]
Petroleum Hydrocarbons (mg/L) [b]	< 1	< 1	< 1	<1					NG [g]
Total Alkalinity (mg/L) [b]	77.0	121.2	116.9	229.0					NG [f]
Bicarbonate (mg/L) [b]	77.0	121.2	116.9	229.0					NG [f]
Carbonate (mg/L) [b]	0.0	0.0	0.0	0.0					NG [f]
Hydroxide (mg/L) [b]	0.0	0.0	0.0	0.0					NG [f]

[a] Trigger values for slightly disturbed lowland waterways in southeast Australia (ANZECC 2000).
[b] Result obtained from laboratory analysis.
[c] Average result, as obtained from field measurement.
[d] Trigger values for typical slightly to moderately disturbed freshwater systems (ANZECC 2000).
[e] There is insufficient data at this stage to derive a reliable trigger value for iron. The current Canadian guideline level of 0.3 mg/L is recommended for use as an interim indicative working level (ANZECC 2000).
[f] No guidelines available. Occurs in abundance naturally.
[g] No guidelines available.

Table 7.3
Baseline Water Quality Results for Sampling Site S2 Taken from Angus Creek Downstream of the Proposed Development

Issue Performance Indicators	Sampling Event								Default Trigger for Ecosystem Type [a] (ANZECC 2000)
	1 6 Mar 03	2 9 Apr 03	3 6 May 03	4 Sept 03	5 3 Feb 04	6 12 May 04	7 29 Sept 0	8 1 Dec 04	
pH [b]	7.3	7.8	7.9	8.0	7.83	7.77	7.31	7.87	6.0 > pH > 9.0
Dissolved oxygen (mg/L) [b]	7.4	9.8	6.5	7.5	7.3	8.3	5.4	5.6	> 6.0 mg/L
Temperature (°C) [c]	21.0	17.1	15.4	12	22.2	13.5	18.7	22.8	Seasonal
Conductivity (μS/cm) [c]	405	398	682	1630	615	194	296	1170	125-2200 μS/cm
Turbidity (NTU) [c]	26	2.6	3	6.7	22	3.0	4.3	5	6-50 NTU
Total Nitrogen (mg/L) [b]	1.1	0.44	0.52	0.59	0.8	0.7	1.0	0.7	0.5 mg/L
Total Phosphorus (as P) (mg/L P)	0.08	0.06	0.05	0.	0.12	0.07	0.13	0.1	0.05 mg/L
Chemical Parameter	**Sampling Event**								**Default Trigger for Ecosystem Type [a] (ANZECC 2000**
	1 6 Mar 03	2 9 Apr 03	3 6 May 03	4 Sept 03	5 3 Feb 04	6 12 May 02	7 11 Oct 04	8 1 Dec 04	
Iron (mg/L) [b]	0.18	0.24	0.13	0.10					0.3 mg/L [e]
Manganese (mg/L) [b]	0.090	0.12	0.017	0.11					1.9 mg/L
Calcium (mg/L) [b]	19	21	32	39					NG [f]
Magnesium (mg/L) [b]	11	12	21	36					NG [f]
Potassium (mg/L) [b]	4	3	3	4					NG [f]

Sodium (mg/L) [b]	65	68	120	240					NG [f]
Aluminium (mg/L) [b]	0.03	<0.02	0.02	0.08					0.05 mg/L for pH > 6.5
Ammonia (mg/L N) [b]	0.13	0.04	0.04	0.02					0.9 mg/L
Oils and Grease (mg/L) [b]	<1	<1	<1	<1	<5	<5	<5	<5	NG [g]
Petroleum Hydrocarbons (mg/L) [b]	<1	< 1	< 1	<1					NG [g]
Total Alkalinity (mg/L) [b]	73.6	105.6	133.8	173					NG [f]
Bicarbonate (mg/L) [b]	73.6	105.6	133.8	173					NG [f]
Carbonate (mg/L) [b]	0.0	0.0	0.0	0.0					NG [f]
Hydroxide (mg/L) [b]	0.0	0.0	0.0	0.0					NG [f]

[a] Trigger values for slightly disturbed lowland waterways in southeast Australia (ANZECC 2000).
[b] Result obtained from laboratory analysis.
[c] Average result, as obtained from field measurement.
[d] Trigger values for typical slightly to moderately disturbed freshwater systems (ANZECC 2000).
[e] There is insufficient data at this stage to derive a reliable trigger value for iron. The current Canadian guideline level of 0.3 mg/L is recommended for use as an interim indicative working level (ANZECC 2000).
[f] No guidelines available. Occurs in abundance naturally.
[g] No guidelines available.