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Huntlee Holdings Pty Ltd
PO Box 199
BRANXTON NSW 2335

Attention Ian Wilks - General Manager

Dear Sir

Huntlee New Town Stage 1A (MP 07_0116) and 1B (MP 08-0229) Project Applications

We refer to comments received from the *Department of Water and Energy (DWE)* concerning the above major project, in a letter dated the 23rd December, 2008. This letter responds to the comments provided in DWE's letter. As requested by DWE, further information is presented to detail the proposed treatment of riparian corridors in the Stage 1 Project Application Area.

It should be noted that an on-site meeting was attended by DWE and WorleyParsons on the 6th of March, 2009. During this meeting, the contents of this letter (*in draft form*) were discussed, and DWE agreed in principle to the revised development proposal subject to increased riparian corridor widths on some watercourses. Subsequently, the increased riparian corridor widths were adopted in the revised development proposal, which is documented in this letter.

This letter should be read in conjunction with the report titled "*Huntlee Project Trunk Stormwater and Flooding Assessment – Stage One Project Application*" (WorleyParsons, November, 2008). This report will be referred to as the *Stormwater Report* in the remainder of this document.

The following figures and attachments are referred to in this letter:

- **Figure 1** – Assessment of Existing Watercourse (*Tributaries 1 and 2*).
- **Figure 2** - Assessment of Existing Watercourse (*Large Lot Areas*).
- **Figure 3** – Proposed Watercourse Treatments (*Tributaries 1 and 2*).
- **Figure 4** – Proposed Watercourse Treatments (*Large Lot Areas*).
- **Figure 5** – Preliminary Design of Basin 2.
- **Attachment 1** – Water Balance Calculations.

1. ASSESSMENT OF EXISTING WATERCOURSES

A further assessment of the existing watercourses within the Stage One Project Application Area was undertaken to supplement previous assessments. The objective of the assessment was to



provide additional information and justify the proposed riparian corridor setback and rehabilitation measures documented in the Stormwater Report. The assessment of existing watercourses considered:

- The extent and state of the existing riparian vegetation.
- The condition of the existing channel in terms of channel erosion and vegetation coverage.
- The impact of any existing structures located in the riparian zone (*such as farm dams and road crossings*).

Each section of watercourse is described as either significantly disturbed, moderately disturbed, slightly disturbed or undisturbed.

The following discussion should be read in conjunction with **Figures 1 and 2**, which details the locations of the photographs and provides general notes to support the following discussion.

Tributary 1

The Tributary 1 watercourse is ephemeral with standing water only observed in deep scour holes and a large on-line farm dam, which is located approximately in the middle of the proposed development area. The tributary extends from the proposed Personia Park to the railway embankment, downstream of the Project Application area. The contributing catchment generally consists of partially cleared agricultural land, which has been historically used for cattle grazing.

The lower section of Tributary 1 below the existing farm dam generally consists of a small channel, approximately 2-3m wide and 0.5 to 1m deep. The channel is generally in good condition with evidence of minor erosion in some areas. Generally, existing riparian vegetation is established approximately 30m either side to the channel, forming a total 60m corridor of riparian vegetation (*refer to **Figure 1***). Generally, the riparian vegetation is limited to established trees with some lower-story vegetation. **Photo 1** shows a typical section of the watercourse.



Photos 1 and 2 – The lower section of Tributary 1. **Photo 1** on the left, shows a typical section of the watercourse below the farm dam. **Photo 2** on the right, shows accumulated sediment, which is likely the result of erosion from the upstream farm dam



There is evidence of significant accumulation of medium to coarse sediment in some sections of the channel downstream of the farm dam (*Refer to **Photo 2***). It is likely that this sediment accumulation is the result of significant channel erosion occurring immediately downstream of the farm dam. The erosion has caused a head cut which extends up to the dam wall (*refer to **Photo 3***) and around both sides of the dam (*refer to **Photo 4***), where it appears the dam spills. The head cut has resulted in significant bed lowering and widening in the section of channel approximately 30 metres downstream of the dam (*refer to **Photo 3***).



Photos 3 and 4 – Taken immediately downstream of the existing farm dam. **Photo 3** on the left, shows significant bed lowering and widening of the channel downstream of the farm dam. **Photo 4** on the right, shows a significant head cut to the right of the dam.

Upstream of the farm dam, the watercourse is similar to the section downstream of the dam. However, the riparian vegetation is limited to approximately 10-15m either side of the channel, resulting in a total vegetated corridor of 20 to 30m width (*refer to **Photo 5***). Similar to the downstream section, there is minor channel erosion in some areas (*refer to **Photo 6***).



Photos 5 and 6 – Taken upstream of the existing farm dam. **Photo 5** on the left shows a typical channel profile. **Photo 6** on the right shows some minor bank erosion.



In summary, the upper and lower sections of Tributary 1 would be described as a slightly disturbed watercourse. The middle section, which includes an online farm dam and the section of eroded channel immediately downstream of the dam, would be described as significantly disturbed.

Tributary 2

The Tributary 2 is an ephemeral watercourse with standing water only observed in on-line farm dams during a site inspection. The tributary extends from the proposed Personia Park to the railway embankment, downstream of the Stage 1 Project Application Area. The existing landuse is varied in the Tributary 2 catchment. The lower section of the catchment is predominantly cleared agricultural land, which incorporates numerous on-line farm dams and road crossings. The middle and upper sections of the catchment are progressively less disturbed, incorporating increased riparian vegetation. The Township of North Rothbury is located on the western portion of the catchment. There are numerous rural dwellings located adjacent to the watercourse in the lower and middle sections of the watercourse. A large on-line farm dam is located in the upper section of the watercourse, in the vicinity of the proposed Basin 3 location.

The lower section of the watercourse (*in the vicinity of the proposed Basin 5*) is highly disturbed by urban and agricultural activities. Generally stock has direct access to the channel (*refer to **Photo 8***). There are a number of small on-line farm dams and crossings in this section of the watercourse (*refer to **Photo 7***). Generally, there is no significant channel erosion. However, riparian vegetation appears to be predominately pastoral grasses and non-indigenous species.



Photos 7 and 8 – Taken in the lower section of Tributary 2 (*at the proposed Basin 5 location*). **Photo 7** on the left shows, one of the many small online dams in the lower section of the watercourse. Both photos show that there is a lack of any native riparian vegetation.

Additionally, it appears there has been illegal dumping of fill and rubbish in some areas of the lower section of the watercourse (*refer to **Photos 9 and 10***).



Photos 9 and 10 – Taken in the lower section of Tributary 2, between Basins 4 and 5. **Photo 9** on the left shows a highly disturbed section of the watercourse, where weed invasion and rubbish dumping is apparent. **Photo 10** shows areas of the watercourse where fill has been illegally dumped.

In summary, the lower section of Tributary 2 would be described as a significantly disturbed watercourse.

The middle section of Tributary 2 is generally in better condition than the lower section. There are no significant signs of channel erosion, and the riparian zone is generally lightly vegetated with a mix of native and non-native species. There are numerous fence and road crossings (*refer to Photos 11 and 12*) located along the watercourse. There is evidence of minor localised scour in the vicinity of these crossings. Stock has direct access to most sections of the watercourse. This section of the watercourse would be described as being moderately disturbed.



Photos 11 and 12 – Taken in the middle section of Tributary 2, near Basin 4. **Photo 11** shows one of the many fence crossings. Fence crossings can capture debris which can cause localised scour of the channel. This is apparent in **Photo 11**. **Photo 12** shows one of the many culverted road crossings.



There is a large online dam dividing the middle and upper sections of Tributary 2 (*Refer to **Photo 14***). Unlike the dam in Tributary 1, there is no evidence of scour downstream of the dam. The primary watercourse feeding the dam is a first order stream, which would be described as undisturbed (*Refer to **Photo 13***).



Photos 13 and 14 – Taken in the upper section of Tributary 2, above Basin 3. **Photo 13** shows a section of the watercourse upstream of the dam (*Photo 14*). The upper section of the watercourse is relatively undisturbed. **Photo 14** is looking upstream from the large online dam.

In summary, the lower section of Tributary 2 would be described as significantly disturbed, the middle section as moderately disturbed and the upper section is undisturbed.

Large Lot Area Watercourses

The proposed Large Lot land release area consists of two development areas, which have been referred to as Large Lot 1 and Large Lot 2 (*refer to Figure 6B from the Stormwater Report*). There are 6 identified watercourses traversing the two proposed large lot land release areas. Three of these watercourses are second order streams and three are first order streams.

The most significant watercourse is Dominicks Creek, which traverses the northern portion of Large Lot Area 1. Dominicks Creek is generally in good condition. In most places, there is a well defined channel (*refer to **Photo 15***). There is some moderate channel bank erosion in the section approximately 100m downstream of the Wine Country Drive Culverts (*refer to **Photo 16***). This erosion is generally localised with no evidence of bed lowering. The downstream section of the watercourse is in good condition (*refer to **Photo 15***). Riparian vegetation generally extends between 5 to 30m from the channel. There are some non-indigenous weeds growing amongst the native riparian vegetation (*refer to **Photos 15 and 16***). Dominicks Creek would be described as being slightly disturbed.



Photos 15 and 16 – are taken of Dominicks Creek. **Photo 15** on the left shows some moderate erosion of the channel bank, in a section approximately 100m downstream of the Wine Country Drive Culvert. The middle and lower sections of the creek are in good condition. However, there are some weed species present in the riparian vegetation (*refer to **Photo 16** on the right*).

The second watercourse in Lot Area 1 traverses through the middle of the site. Technically this watercourse is a second order stream. However, there is no established creek channel or riparian vegetation. Additionally, stock has access to the entire watercourse (*Refer to **Photo 17***). This watercourse would be described as being significantly degraded. There is a third watercourse traversing the south-western tip of the development area. This water course is located on flood prone land, and is outside of the proposed development area.

There are three first order watercourses located in Lot Area 2. The first crosses the north western tip of the development area. The second is adjacent to Old North Road, in the southern portion of the development area. **Photo 18** shows the crossing of the southern watercourse at Old North Road. The third crosses the eastern tip of the development area. All three watercourses in Large Lot Area 2 would be described as moderately disturbed.



Photos 17 and 18 – show other watercourses in the Large Lot Area. **Photo 17** on the left, shows the second order stream which traverses the middle of Large Lot Area 1. The photo, which was taken from Wine Country Drive, clearly shows that there is no established channel and little riparian vegetation. **Photo 18** on the right is taken from Old North Road, showing the 1st order stream crossing Old North Road.

Watercourse Summary

The following points summarises the assessment of the watercourses in the Stage One Project Application Area:

- **Tributary 1** is a second order stream which is in relatively good condition. The established riparian vegetation extends between 5 to 30m either side to the channel. There is a large online farm dam in the middle section of the watercourse. This dam has resulted in some channel erosion extending approximately 30m downstream of the dam. The upper and lower sections of Tributary 1 would be described as a slightly disturbed watercourse. The middle section, which includes an online farm dam and the section of eroded channel immediately downstream of the dam, would be described as significantly disturbed.
- **Tributary 2** consists of a first, second and third order stream. The lower section of Tributary 2 is degraded, with little riparian vegetation, significant weed infestation and numerous online dams. Stock has access to much of the lower section. The watercourse progressively improves upstream, with the middle section incorporating some established riparian vegetation. There are numerous rural dwellings in the middle section of the watercourse. A large online farm dam is located upstream of the middle section. The upper section is relatively undisturbed, with established riparian vegetation. In summary, the lower section would be described as significantly disturbed, the middle section as moderately disturbed and the upper section as undisturbed.
- **Dominicks Creek** traverses the northern portion of **Large Lot Area 1**. This watercourse would be described as slightly disturbed. An additional watercourse, traversing through the middle of Lot Area 1, has no established channel or riparian vegetation. This watercourse would be described as significantly disturbed. There is a third watercourse traversing the south-western tip of the development area. This water course is located on flood prone land, and is outside of the proposed development area.



- There are three first order watercourses in **Large Lot Area 2**. All of these watercourses have small on-line farm dams and stock access. These watercourses would be described as moderately disturbed.

2. RIPARIAN CORRIDORS

The following discussion should be read in conjunction with **Figures 3 and 4**, which details the proposed riparian corridors and rehabilitation measures.

Core Riparian Zone Setbacks

The proposed core riparian setbacks documented in the Stormwater Report for Tributaries 1 and 2 are in accordance with the DWE Guideline "*Guidelines for controlled Activities: Riparian Corridors*". The following methodology was applied in calculating the Core Riparian Zones (CRZs):

- A channel width of 5m was adopted in the riparian setback calculations. As discussed in **Section 1**, the actual channel widths are typically 2 to 3m. Hence, a 5m channel width is considered conservative.
- The CRZ setback was calculated based on the stream order in accordance with the DWE Guideline. 10 and 20m setbacks are proposed for 1st and 2nd order streams respectively. Collectively, this results in a minimum CRZ of 25m and 45m for first and second order streams respectively (*including the 5m channel width*).

Refer to **Figure 3** for proposed Core Riparian Zones.

Vegetated Buffer Setbacks

It is proposed to provide a 10m vegetated buffer in sections of the existing watercourse which are described as slightly disturbed or undisturbed (*refer to Section 1 and Figures 1 and 2*). As documented in the Stormwater Report, in some areas, it is proposed to include bio-retention basins as part of the vegetated buffer. The bio-retention basins would be fenced, with public access restricted. Bio-retention basins would be vegetated with select native plant species which would assist in the water quality treatment. This would effectively buffer the CRZ from the edge effects of the proposed urban areas. The images below display typical bio-retention basins.



Source: www.wsud.org



The Vegetated Buffer widths for sections of watercourses described as being moderately and significantly disturbed were determined during the on-site meeting attended by staff from both WorleyParsons and DWE on the 6th of March. The adopted buffer widths are presented in **Figures 3 and 4**.

Proposed Rehabilitation Measures

The following riparian corridor rehabilitation measures are proposed:

- Remove all non-indigenous vegetation from the riparian corridor.
- Retain all existing native riparian vegetation within the CRZ and where required, enhance riparian vegetation to consist of a fully structured vegetation corridor, including ground cover, shrubs and trees.
- Provide a 10m vegetated buffer for sections of watercourse which are described as either slightly disturbed or undisturbed. The vegetated buffer would consist of either riparian vegetation or vegetated bio-retention basins (*vegetated with native riparian species*).
- Remove all existing farm dams in the Stage One Project Application Area.
- Remove all existing fence and road crossings from the CRZ. All proposed road crossings will be reconstructed in accordance with DWE Guideline "*Guidelines for Controlled Activities: Watercourse Crossings*".
- Reconstruct sections of the watercourse which are significantly eroded. This will primarily be associated with the removal of farm dams and some crossings.

Figure 3 locates the above rehabilitation measures. It is proposed that detailed engineering and landscape plans will be provided for all of the above measures at the detailed design stage.

Large Lot Area

It is noted that the proposed setbacks documented in the Stormwater Report are not generally consistent with those proposed for Tributaries 1 and 2. Subsequently, the proposed plans have been amended to be generally consistent with the setbacks and rehabilitation measures proposed for Tributaries 1 and 2. The revised setbacks are detailed in **Figure 4**.

Riparian Vegetation Management Plan

It is anticipated that a riparian vegetation management plan would be provided at the detailed design stage. This will identify weed eradication programmes and detail planting plans for areas requiring rehabilitation of the riparian vegetation. On-going management requirements will also be detailed.

In Stream Works

All watercourse road, service and cable crossings as well as stormwater outfalls are to be consistent with the applicable DWE Guidelines for controlled activities. Detailed design drawings



of each crossing and outlet structure will be provided to DWE and other authorities at the detailed design stage.

It is noted, that most existing crossing would be removed as part of the creek rehabilitation measures.

3. JUSTIFICATION FOR ONLINE DETENTION BASINS

This section discusses the impacts and benefits of on-line detention basins.

3.1 Stormwater Management Strategy

As discussed in **Section 5** of the Stormwater Report, the proposed stormwater management measures would include separate water quality controls and flood mitigation controls.

The water quality controls are designed to provide the required water quality treatment as well as retention of the initial 20mm of runoff, which would mitigate the increased peak flow and flow duration during frequently occurring storm events, in accordance with best practice water sensitive urban design procedures. It is proposed to locate these stormwater controls outside of the Core Riparian Zone. Hence, all discharge would be treated to a reasonable level prior to discharge into the creeklines.

The flood mitigation component of the stormwater management plan refers to reducing the increase in peak flows as a result of the proposed urbanisation of the catchment. In accordance with best practise, flood mitigation has been designed to reduce post development peak flows to existing levels for all storm events up to and including a 1 in 100 year event. As the water quality controls would provide sufficient attenuation to mitigate the post development flows during the smaller rainfall events, the proposed detention basins would only attenuate flows exceeding the peak 2 year ARI flow.

Importantly, the provision of water quality treatment offline to the watercourses, will ensure stormwater discharge into the riparian corridors has received both water quality treatment (*litter, sediment, nutrients, hydrocarbons etc*) and water quantity treatment for frequently storms upto the 1-2 year ARI storm event. This would be achieved through the retention of the initial 20mm of runoff.

3.2 Dry Basin Concept Design

A preliminary design of Basin 2 was undertaken to demonstrate the dry basin concept. As discussed above, the dry basins are intended for flood mitigation only, meaning they would only provide detention treatment when flow exceeds the existing conditions 2yr peak flow. This will be achieved by providing an open channel control to moderate the low flows and a high flow weir to moderate the higher flows. The open channel control concept basically consists of a continuation for the creek channel through the basin embankment. The channel may be slightly constricted to achieve the required discharge. Importantly, there would be no significant alteration to the flow profile in the creekline for all flows upto the 2 year event.

Preliminary modelling of Basin 2 indicates that the open channel control will consist of 2.5m wide trapezoidal channel, which would be rock lined with appropriate sized rocks to prevent scour. A high flow bypass channel would be provided either side of the channel to provide the required



capacity during high flows, such as a 100 year flood. This concept is illustrated in **Figure 5**, which contains a cross section of the proposed open channel and high flow by-pass control. Additionally, **Figure 5** presents the water surface profiles, with and without the control, demonstrating that there is negligible alteration to the flow profile during the 2 year flood (*less than 300mm increase in water level*). **Figure 5** also provides a plan view of the basin areas indicating the estimated inundation extents during various flood events. Appropriate scour protection and vegetation planting would be required upstream and downstream of the controls to prevent localised erosion.

As indicated in **Figure 5**, the proposed road crossing would span across the basin outlet using a preset concrete bridge. This would maximise the amount of light penetration under the bridge.

The continuation of the creek channel through the embankment would ensure that there is a minimal impact on riparian function such as geomorphology, sediment movement and fauna passage. The only temporary alteration in flow profiles would occur during larger floods (*i.e. greater than 2yr Average Recurrence Interval*). Similar alterations would generally occur at most road crossings where typically bridges and culverts are undersized for the 100 year flood, resulting in flood water building up behind the road embankment.

3.3 Environmental Impact of Online Basins

The proposed dry basins would have a minimal impact on the riparian functions of the watercourses as:

- The basin embankments will utilise proposed road crossings, which would minimise the disturbance area.
- Apart from the embankments, the basins will not require any additional earthworks. This is because the natural topography would provide sufficient storage to meet detention requirements.
- The existing riparian vegetation behind the basins would be maintained or enhanced (*if required*). The infrequent increase in inundation depth is not expected to adversely impact this vegetation (*i.e. in events only greater than 2 year AR*).
- As discussed above, the proposed open channel controls will minimise any adverse impacts on sediment and flora movement through the riparian corridor.

As documented in the Stormwater Report, a large online basin, with a permanent waterbody is proposed in the Town Centre area. This basin (*referred to as Basin 5*) would potentially have a more significant impact on riparian functions than the dry basins. However, the proposed Basin would incorporate an open water body with fringing macrophytes, which would provide water quality treatment and aquatic habitat. Furthermore, it is noted that the proposed location of the basin is currently the most degraded section of watercourse in the Stage 1 Project Application Area. Hence, the relative impact of this basin is significantly less than if it was to be constructed in one of the less disturbed sections of the watercourse.

3.4 Benefits of Online Basins

Collectively, the five proposed online basins would yield an active detention volume of approximately 88,000 m³. If an offline strategy was to be adopted, then a significant redesign of



the proposed development layout would be required. The 5 on-line basins would be replaced by smaller offline basins, which would be located adjacent to the riparian corridor (*most likely integrated into the proposed bio-retention basins*). As offline basins would have a smaller contributing catchment area, it is likely that at least 25 to 30 smaller basins would be required. The smaller basins would offer less storage per area of footprint as there are typically no natural gullies to provide the required impoundment. Hence, the basins would require significant earthworks to achieve adequate storages. It is estimated that the land take requirements of offline basins would result in a loss of approximately 15 to 20ha of development area within the Tributary 1 and 2 catchments. This is equivalent to roughly 5% of the ultimate development area within these catchments (*including future stages*).

In conclusion, the proposal to construct online detention basins for flood mitigation purposes, offers an efficient solution to providing the required flood mitigation controls whilst maintaining functional riparian corridors. Provision of smaller basins, offline to the watercourses, would result in a reduction in developable land area with no significant environmental benefits.

4. WATER RIGHTS ASSESSMENT

It is proposed to construct two permanent water bodies in the Stage 1 Project Application Area. DWE have indicated that a water rights assessment should be undertaken to determine whether the proposed permanent water bodies would be required to be licensed under the WMA. Accordingly, an assessment was undertaken to determine the maximum dam volume permissible under *NSW Farm Dam Policy*.

It is noted that it is not proposed to extract any water from the permanent water bodies.

Assumptions

The following assumptions were adopted for the above assessments:

- **Village 1 Lake** – would be located offline to Tributary 1. The lake would have a contributing catchment of approximately 31ha. 10.5 ha of this would be retained as native forest (*catchment A12*) and 20.5ha would be urbanised catchment. The Village 1 Lake would have a permanent waterbody volume of approximately 6.15 ML.
- **Basin 5**: would be located online to Tributary 2. The basin would incorporate a permanent waterbody, with approximately 1 to 1.5m of overlying detention storage. Basin 5 has a contributing catchment of approximately 213ha. Over 90% of this area would be urbanised as part of the ultimate development proposal (*including future stages*). A preliminary design of Basin 5 indicates that the permanent water body volume would be in the range of 25 to 30 ML.
- **Project Application Area**: As harvestable rights allocations are based on the property area, the total Stage 1 Project Application Area minus the Large Lot Areas has been adopted for harvestable rights calculations. This results in a total area of 242ha.

Harvestable Rights Allocation Assessment

The *Maximum Harvestable Rights Dam Capacity (MHRDC)* was calculated using the *Maximum Harvestable Rights Dam Calculator* on the DWE website. The resulting capacity multiplier was determined to be 0.075ML/ha. The results of these calculations are outlined in **Table 1**.



Table 1 – Harvestable Rights Assessment

Proposed Waterbody	Project Application Area (ha)	Maximum Harvestable Rights Dam Capacity (ML)	Proposed Permanent Water Volume (ML)
Basin 5	242	18.15	30 (<i>estimated</i>)
Village 1 Lake			6.15

As indicated in **Table 1**, the proposed permanent water volume is approximately double that permitted using the maximum harvestable rights calculator. Hence, both permanent water bodies may require to be licensed under the WMA. The licensing requirements would be subject to the final permanent water volumes and exemptions for harvestable rights allocations; water quality treatment; as well as possible public ownership. Accordingly, it is proposed to determine the licensing requirements, in close liaison with DWE, during the Construction Certificate Stage of the development approvals process.

It is noted that the proposed urbanisation of the Tributary 1 and 2 Catchments would significantly increase the average annual volumetric runoff. Preliminary water balance calculations indicate that this increase in runoff volume would offset the water lost from the permanent water bodies through evaporation. However, it is WorleyParsons understanding that increases in volumetric runoff (*as a result of urbanisation*) are not considered by DWE when determining water rights entitlements. Notwithstanding, the water balance calculations are provided in **Attachment 1**.

5. SALINITY MANAGEMENT

It is proposed to undertake a salinity assessment within the project application area prior to the Construction Certificate stage. The salinity assessment would identify existing salinity hotspots and determine potential impacts as a result of the development. The outcomes of the assessment would be adopted as civil design constraints at the Construction Certificate stage.

6. GROUNDWATER MANAGEMENT

It is proposed to undertake groundwater monitoring in the lower section of Tributary 2, in the vicinity of the proposed Basin 5. The results from this monitoring would be implemented into the Basin 5 design. The monitoring would include:

- Installation of piezometers in the vicinity of proposed Basin 5 location. The piezometers would be located upstream, adjacent and downstream of the propose basin location. The exact number and location of the piezometers would be determined by a suitably qualified hydro-geologist.
- A bore log would be completed at each location to determine soil types, and estimate conductivity rates.
- Groundwater level monitoring would be undertaken on a monthly basis over a minimum 6 month period to determine the seasonal variation in groundwater levels. Monitoring frequency would be determined based on the conductivity rates.



- Monitoring would continue during and after the proposed construction of Basin 5 to assess any impact the basin may have on the local groundwater. Post development monitoring would continue for a minimum 2 year period. A decision on further monitoring requirements would be determined through consultation with DWE.
- Reports detailing the monitoring results would be provided to DWE and other authorities at the end of the minimum 6 month period, and on an annual basis during the 2 year post construction monitoring period.

Apart from Basin 5, it is unlikely that there would be any significant alterations to ground water levels as a result of the development. It is noted that the removal of the numerous on-line dams may lower the local groundwater table. However, any adjustments would return the groundwater behaviour in the riparian corridors to the natural levels (*i.e prior to the dam construction*), which would be considered a beneficial environmental outcome.

Ground Water Dependant Ecosystems

To date, there has not been any specific assessment of Ground Water Dependant Ecosystems in the Stage One Project Application Area. However, due to the clayey nature of the subsoil, and the underlying bedrock consisting of shales and sandstone, it is expected that groundwater would generally flow towards the creek lines, which are generally gullied ephemeral watercourses. Additionally, onsite observations suggest that it is unlikely that there is any significant alluvial floodplain outside of the Black Creek Floodplain (*which is flood prone land which is to be maintained in its existing condition*). Hence, it is expected that Groundwater Dependant Ecosystems would be principally located within and possibly 10-20 m either side of the creek channels. As noted above in **Section 2**, the riparian zones would to be retained and enhanced.

7. SUSTAINABLE AND EFFICIENT MAINS WATER SUPPLY

It is proposed to provide 5KL rainwater tanks for each residential dwelling in the Large Lot residential development area. Additionally, demand management measures such as efficient tap fittings would be adopted in accordance with BASIX requirements. It is noted that there is no proposal to extract either surface water or groundwater in any part of the Stage One Project Application Area.

8. CONCLUSION

This letter has provided additional information regarding the proposed treatment of the riparian corridors in the Stage One Project Application Area.

The additional information included:

- An assessment of the existing watercourses in the Stage One Project Application area was undertaken. The assessment considered:
 - The extent and state of the existing riparian vegetation.
 - The condition of the existing channel in terms of erosion and vegetation coverage.
 - The impact of any existing structures located in the riparian zone (*such as farm dams and road crossings*).



Each section of watercourse was described as either significantly disturbed, moderately disturbed, slightly disturbed or un-disturbed. The results of this assessment are summarised in **Figures 1 and 2**.

- A more detailed description of the proposed treatment of the watercourses in the Stage One Project Application was documented and included further information on:
 - Proposed riparian setbacks.
 - Proposed online detention basins, including a preliminary design of Basin 2 to demonstrate the 'dry basin concept'. **Figure 5** documents the preliminary basin design.
 - Further detail of the proposed rehabilitation measures, including commitments to undertake significant rehabilitation measures in degraded sections of the watercourses.
 - Commitments to construct all road and service crossings and outlet structures in accordance with the relevant DWE Guidelines.

Figures 3 and 4 detail the proposed riparian setbacks and rehabilitation commitments.

- A water rights assessment was undertaken for the proposed Basin 5 and Village 1 Lake permanent water bodies. The assessment concluded that both water bodies exceed the maximum harvestable rights for farm dams in NSW. Hence, both permanent water bodies may require to be licensed under the WMA. The licensing requirements would be subject to the final permanent water volumes and exemptions for harvestable rights allocations; stormwater treatment; as well as possible public ownership. Accordingly, is proposed to determine the licensing requirements, in close liaison with DWE, during the Construction Certificate Stage of the development approvals process.
- Commitments to undertaken salinity management and groundwater management assessments prior to the Construction Certificate stage were outlined in **Sections 6 and 7**.

As a result of this assessment and the following alterations to the development proposal (as documented in the *Stormwater Report*) include:

- Provision of a Vegetated Buffer for the middle and lower sections of Tributary 2.
- Increased riparian setbacks in the Large Lot Areas, including the rehabilitation of Dominicks Creek.
- Provision of 5KL rainwater tanks for all dwellings in the Large Lot development areas.

If you have any questions or would like to discuss this report further, please contact Chris Kuczera or Ben Patterson on 49287777.

Yours faithfully
WorleyParsons



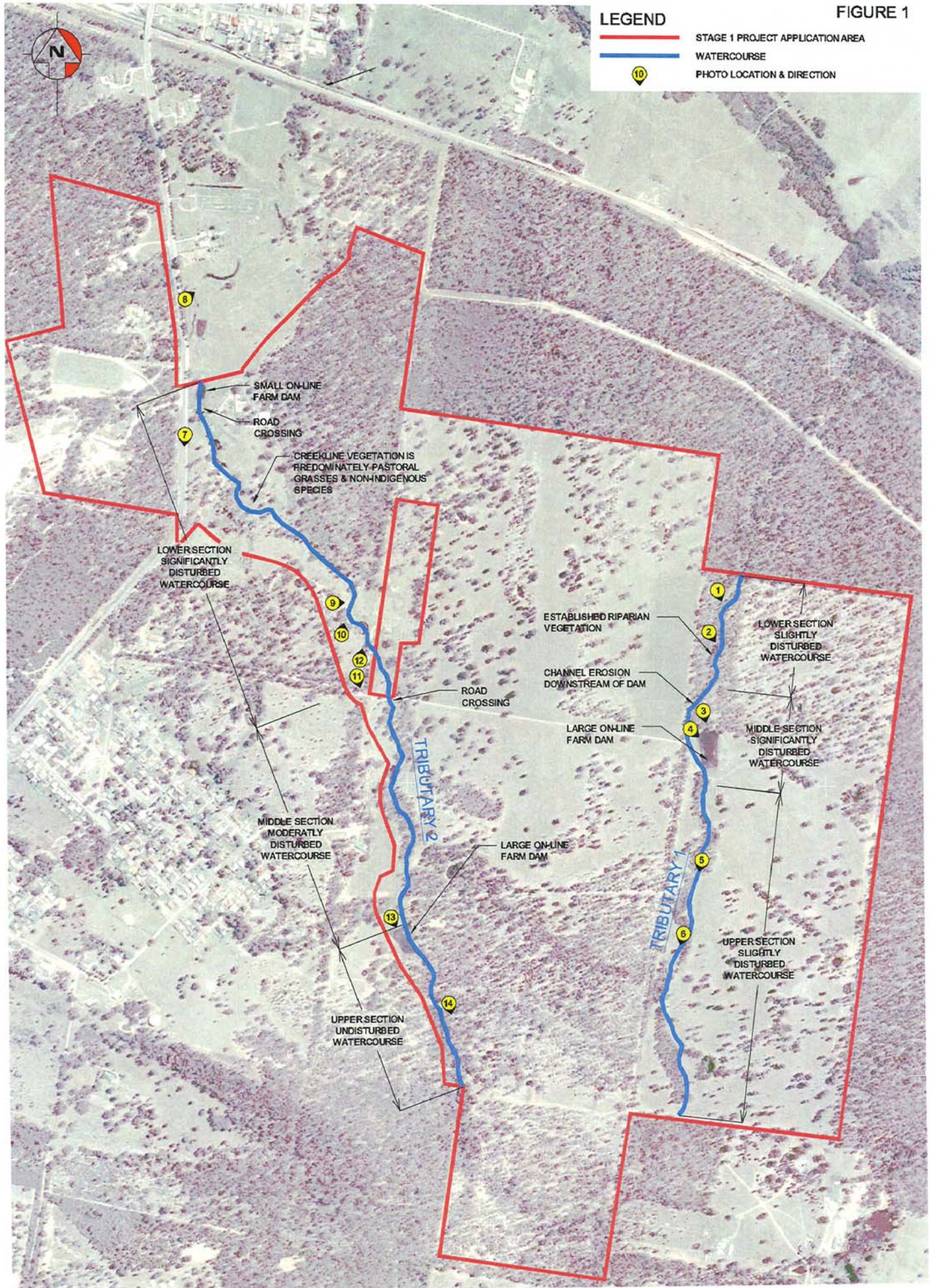
WorleyParsons

resources & energy

Ben Patterson,

Manager of Infrastructure & Environment, Newcastle

FIGURE 1



WorleyParsons
resources & energy

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**ASSESSMENT OF
EXISTING WATERCOURSES
STAGE 1 AREA**