Sustainability Workshop

Proposed Particle Board Facility

Water Cycle Impact Asessment

Report Prepared for: Borgs Group

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Project No. 015-087

Prepared by:
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EXECUTIVE SUMMARY

The Sustainability Workshop (TSW) was commissioned by Borg Construction (Borgs) to undertake a water cycle impact assessment of a proposed particle board facility at its long established manufacturing plant at Lowes Mount Road at Oberon in NSW.

The existing manufacturing plant manufactures Medium Density Fibreboard a, reconstituted timber board and ancillary (mainly wood and resin processing, painting and treated paper laminating) operation at its Oberon site. Borgs wish to further develop the site to enable production of particle board using a high tech, relatively clean and mostly covered and contained operation.

The proposed particle board facility will wrap around the undeveloped but disturbed south and western part of the existing facility at Lowes Mount Road, Oberon.

The proposed operation is to use closed silos for storage of chipped wood and would therefore generate less polluted runoff.

The proposed development involves an increase in impervious areas of approximately 10.5 hectares. Mostly this will be in the form of new roof and concrete hardstand areas associated with the new particle board facility and some covered conveyer belts and covered silos which are used to store wood chip. A log storage yard which will not be covered is also proposed and this is likely to be a source of additional surface water quality impacts. A detailed description of the proposed development is included in Section 3 of this report.

The existing operation is licenced and has an Environment Protection Licence (EPL) with tight limits on the discharge of stormwater from the site.

Kings Stockyard Creek receives runoff from the Borgs site and is a first order Strahler system creek without any other upstream reaches. It has a defined bed and bank and intermittent flow. The existing creek is denuded of riparian vegetation though it is well sealed and stable with a mildly incised bed typical of most rural creeks.

The proposed process is considered cleaner than the existing MDF process. Key sources of stormwater pollution will arise from:

- An increase in roof areas
- Storage of logs in a log yard
- Handling and transport of woodchip including woodchip created from recycled timber sources as well as new sources
- An increase in traffic volume

The key stormwater pollutants of concern will be:

- Tannins – tannic acid – these are thought to be strongly correlated with total suspended solids (TSS).
- TSS, total phosphorus (TP) and total nitrogen (TN).

A MUSIC water quality model for the site was constructed to assess the potential impacts of the proposed 10.5 hectare development and to help design appropriate mitigation measures.

Predicted maximum concentration values for TSS, TP and TN are shown below.

Parameter	Post-development with mitigation	EPL limit (mg/L)
Total Suspended Solids (mg/L)	44.1	50
Total Phosphorus (mg/L)	0.227	0.3
Total Nitrogen (mg/L)	9.515	10

The table shows that with mitigation in place the proposed development is predicted to meet the conditions of the EPL.

The proposed mitigation measures include:

- Construction of a new swale with a much longer flow path to convey CHH runoff around the site and ultimately into a new treatment pond described below.
- Creation of a new stormwater treatment pond with a storage volume with a minimum of 6 ML. No reliance on extended detention has been made though there may be a need to include detention to reduce peak flows. This would only improve water quality results further. An assumed weir width of 2m needs to be subject to appropriate design rigour during detailed design.
- The new pond is located downstream of the existing pond and accepts runoff from the whole Borgs site including overflows from the existing upper stormwater treatment pond.
- In accordance with the SEARs, a state of the art, stormwater harvesting and reuse scheme is proposed. Both the new pond and existing pond each have a daily demand for stormwater reuse of 200 m^3/day withdrawn from the pond. This water will be used in the production processes on-site and forms a low salt, preferable source of water. It also serves to reduce the volume of pollutants leaving the site and takes pressure of Council's town mains system.
- Stormwater from the existing upper pond will be pumped to the existing bank of sand filters and from there into the existing on site Microfiltration/Reverse Osmosis treatment process for use as steam and as an ultra-high quality alternative source of water.
- It is envisaged that stormwater from the lower pond would also be pumped back to the existing bank of sand filters and so on.
- Redirection of the southern catchment flows into the proposed treatment pond. Currently there is some treatment of the southern catchment flows in an existing dam which is to be removed. This also allows emergency spill retention from this whole southern catchment.
- The redirection of the southern catchment flows to the north to the new treatment pond making the existing small aerated dam redundant. Therefore it will be converted into a dry emergency spill dam. This dam would need to be manually

drained dry after wet weather events to ensure it has capacity to absorb a spill or fire-fighting water and a system of manual valves put in place to allow spills to be captured and temporarily stored in the dam. This approach would provide a superior level of spill protection, i.e. another critical control point in the risk management approach and prevent fire water or spills from migrating into the proposed stormwater treatment ponds. The small aerated dam which would be converted into a spill retention basin is located where it could capture a spill from the most hazardous aspects of this operation. This is in addition to existing bunds and existing compliant hazardous management practices.

- A second new accidental spill retention basin is also proposed to be located upstream of the proposed lower pond and provides yet another additional critical control point on the Borgs site and has been strategically located so that it can intercept an accidental spill from practically anywhere on the existing site. The new 6 ML stormwater pond will also provide yet another and final critical control point on the site, most often being drawn down due to the proposed stormwater use on the site and so will frequently have air space available with which to capture a spill that somehow exceeded the capacity of the upstream 4700m^2 emergency spill basin.

The site is located at an elevation of 1100m above sea level in the headwaters of the Macquarie catchment. The proposed development will not have any floodplain or flooding impacts either upstream or downstream. Local overland paths and site drainage will be designed to cater for 100 year peak flows during the detailed design process. The proposed development is located in a sparsely populated catchment, rural in nature, which has no buildings located close to the creek downstream of the development. The catchment also grows in size to become a very large catchment within a kilometre of the site. Any minor increase in peak flows associated with an increase in impervious area, estimated to be less than 500l/s, arising from the proposed development is unlikely to have any consequences. There are three buildings within several kilometres downstream of the development. These three buildings are unlikely to be located within the floodplain, i.e. are likely located above the probable maximum flood levels. None the less it is appreciated that the addition of 10.5 hectares of impervious area could result in an increase in peak flows leaving the site. During detailed design, a detailed site model will be prepared to assess the impacts on peak flows and if there is an increase then this will be mitigated through the use of on-site detention. The storage of stormwater for peak flow reduction purposes will in the air space above the proposed stormwater treatment pond and may, subject to modelling, require up to 0.5m of detention.

The proposal is likely to reduce any existing risk of groundwater contamination from an accidental spill due to the comprehensives spill management approach with numerous additional critical control points proposed. Wood chips used in the proposed particle board process will be stored in covered silos with no risk of leaching into groundwater. The proposal is therefore unlikely to have any chronic risk of groundwater pollution and it is not proposed to extract or alter any additional groundwater sources beyond the existing water access licence entitlements held by Borgs. Groundwater impacts are not considered further.

The proposed harvesting and reuse scheme will see the volume of runoff from the site, reduced from its unmitigated level of 406.5 ML/a down to 287.5 ML/a, this is despite an increase in impervious area associated with the proposed development resulting in an additional volume of runoff of about 39 ML/a compared to the current volumes of runoff.

This will see both the frequency and volume of runoff from the site reduced. Due to the highly impervious nature of this site with its approximately 12 hectares of roof area, the reuse of water will ensure that there are only positive geomorphic and creek health benefits arising from this project (Walsh et al, 2005 & Tippler et al 2012). This outcome, if approved, would see this development put in place best practice water quality and quantity management, resulting in conservation of town water and protection of the environment.

Runoff volumes for the site have been prepared for the site under three scenarios, rural, "future without harvesting" and "future with harvesting".

Rural runoff volume (ML/a)	Future Runoff Volume without harvesting (ML/a)	Future runoff volume with harvesting (ML/a)
140.35	406.5	287.5

It has been found that even after harvesting 120 ML/year of stormwater (proposed), the site still produces about double the volume of runoff it would if it was in a rural state. This is due to the extensive impervious areas on the site. Because this site generates so much more runoff than it would in its rural form the harvesting scheme will reduce environmental impacts and protect the receiving waters. Furthermore, creek health is still supported by the 'clean water' rural run off from the catchment west of Lowes Mount road which will continue to pass through to King's Stockyard Creek via the site's northern most swale.

In the absence of a clear policy on urban stormwater harvesting, dispensation from the need to acquire a water access licence to harvest this urban stormwater from the roofs and hardstands of the site is requested on this basis. Clearly it can be shown that the intent of the Water Management Act which is to protect the environment and to allocate water equitably would be achieved by allowing Borgs to harvest the excessive volumes of runoff it would otherwise dispose of down Kings Stockyard Creek.

It is recommended that the proposed pond be constructed prior to site stripping and used as a temporary sediment basin during construction and converted to a permanent water quality pond only once the site has been effectively sealed. During this high sediment loading phase of the project it is probable that a flocculent would need to be used before any water was allowed to discharge from the basins. This would also aid in the early reuse of water reducing the burden on the sand filters and filtration equipment.

Small scale sediment and erosion control measures would be needed to manage local erosion issues at the source and these can be designed and planned in more detail prior to construction. The site would need to comply with the Blue Book and its existing pollution control licence – both of which stipulate that TSS is to be less than 50 mg/L.

In conclusion the proposed stormwater harvesting and reuse scheme will see the impacts of the proposed development reduced below current levels through an improved treatment strategy that will manage water across the whole site not just the area subject to development. The proposal will see about 120ML/year of potable water harvested and treated on-site and therefore saved each year. The proposal, if approved, would improve water quality and geomorphology of Kings Stockyard Creek and is an exemplar of ecologically sustainable development in practice. The risk of an accidental spill leaving the site will also be dramatically reduced through the creation of three additional and significant critical points.

On this basis it is concluded the project can proceed as it would have a beneficial effect on the aquatic environment.

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1.0 INTRODUCTION

1.1. Background and Context

The Sustainability Workshop (TSW) was commissioned by Borg Construction (Borgs) to undertake a water cycle impact assessment of a proposed particle board facility at its long established manufacturing plant at Lowes Mount Road at Oberon in NSW.

The existing manufacturing plant makes Medium Density Fibreboard, reconstituted timber board and ancillary (mainly wood and resin processing, painting and treated paper laminating) operations at its Oberon site. Borgs wish to further develop the site to enable production of particle board using a world class, high tech, relatively clean and mostly covered and contained operation.

The proposed particle board facility will wrap around the undeveloped but disturbed south and western part of the existing facility at Lowes Mount Road, Oberon.

There is an existing environmental protection licence (EPL) which limits the discharge concentrations of stormwater leaving the site. Future runoff from the site would need to continue to comply with the conditions of the current EPL.

Oberon is situated at an elevation of 1100m above sea level where flash flooding, floodplain and riverine flooding is not an issue and the site is located within the headwaters of the Fish River in the Macquarie catchment. Kings Stockyard Creek is the initial receiving water for the site. Kings Stockyard Creek downstream of the existing development has in the past been subject to environmental remediation and creek rehabilitation and is in a stable and well vegetated condition following that rehabilitation process. Moreover surface waters now have undetectable levels of Dieldrin and it is concluded that previous work to seal contaminated areas and elsewhere to remove contaminated material has been successful.

The existing operation involves the transport, debarking, chipping and storage of timber for processing into MDF. The proposed operation is to use closed silos for storage of chipped wood and would therefore generate less polluted runoff.

The proposed development involves an increase in impervious areas of approximately 10.5 hectares. Mostly this will be in the form of new roof and concrete areas associated with the new particle board facility and some covered conveyer belts and covered silos which are used to store wood chip. A log storage yard which will not be covered is also proposed and this is likely to be a source of additional surface water quality impacts. A detailed description of the proposed development is included in Section 3.0 of this report.

1.2. Scope of Works

Sustainability Workshop has been commissioned to assess the water quality impacts of the proposed development. This document assesses the following water cycle impacts:

- Long term surface water quality impacts associated with the development
- Accidental spill control (acute impacts)

- Recommended mitigation measures to maintain compliance with the existing environmental pollution licence
- Assessing the impacts of the proposed development on the stability of Kings Stockyard Creek, i.e. assessing potential geomorphic impacts
- Flood risk – flood risk is qualitatively discussed in this report. During detailed design an open channel and piped drainage network would be designed to manage local drainage flows – this is typical of most development work and is not described in detail in this report. This report is instead focused at a strategic level whereby the general drainage system and flow directions and flow paths have been documented and modified where required to mitigate the impacts of the proposed development.
- Soils and water management during construction – largely this is a detailed design issue but is commented on in this report.

1.3. Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements (SEARS) detail what is required to be included in the Environmental Impact Assessment (EIS).

In the Table 1 below, the relevant requirements (pertaining to water issues) are summarised and adjacent is the location in this report where each requirement has been addressed.

Table 1: SEARS pertaining to water issues

SEARs	Relevant report section
Water usage, including location of intakes and discharges, volumes, water quality and frequency of discharge	Section 5 and 6.
Options considered to minimise discharge, and environmental impact due to discharge	Section 5 and 6
Relevant water balance including requirements, sources, disposal, treatment and re-use options	Section 5 and 6
Existing surface and groundwater quality considered and analysed where necessary	Section 2.4 deals with existing water quality, while Section 4.4.3 discusses groundwater implications.
Impact of discharges on receiving environment	Section 5.2.1 discusses discharge water quality results and the impact on the receiving creek, while 5.2.2 deals with the impact of increased quantity of discharge.

Management of stormwater during and after construction	Section 2.2 outlines current stormwater management facilities, and Section 6 outlines the proposed measures to manage stormwater during and after construction.
Monitoring and assessment of predicted impacts	Section 6.

2.0 EXISTING ENVIRONMENT

2.1. Description of Existing Environment

The existing manufacturing plant is shown in Figure 1 below:

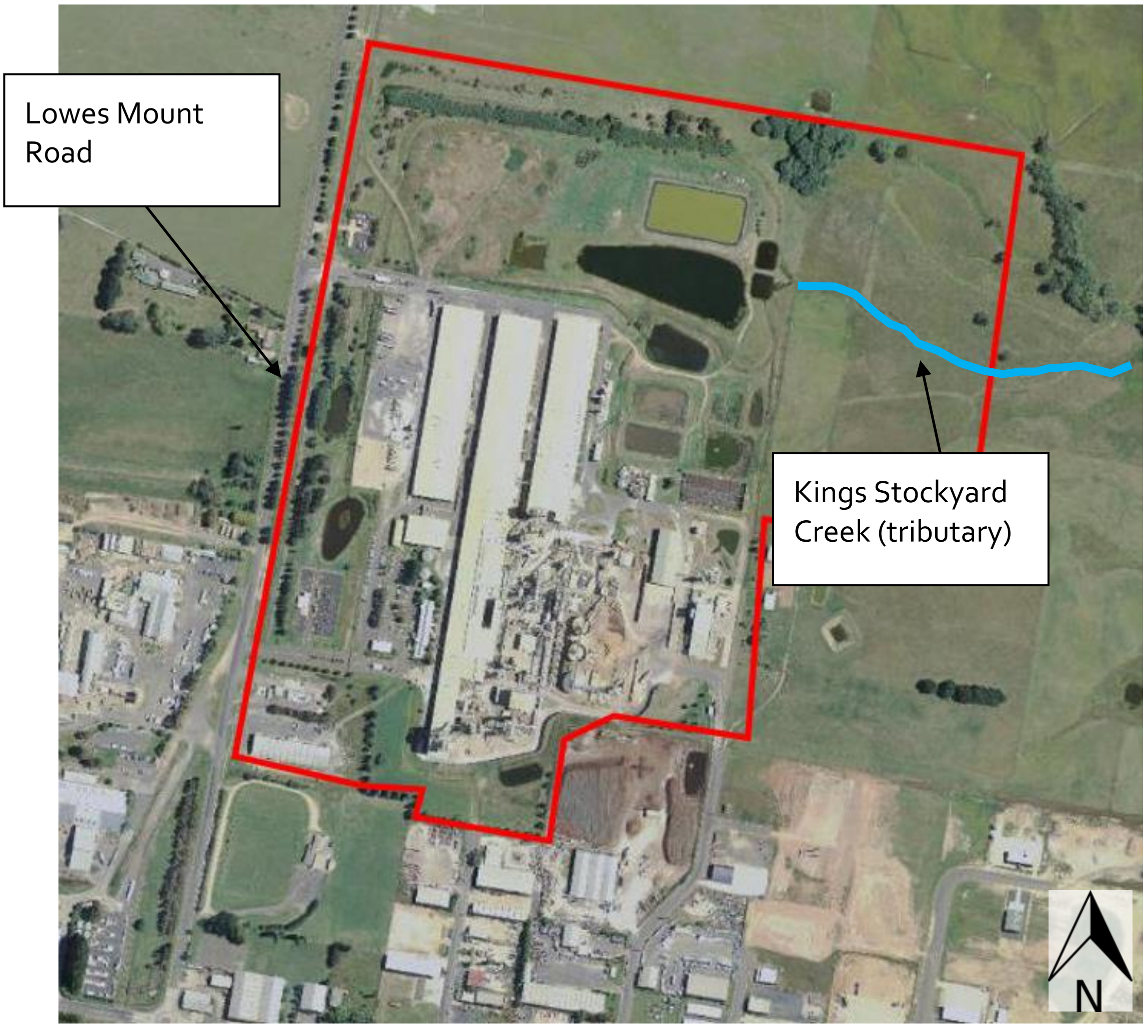


Figure 1: Existing Borgs operation at Oberon (courtesy Six Maps)

The existing plant includes substantial roof and hard stand areas and a complex water cycle management system involving numerous storage ponds with a multitude of functions.

There is a system of open vegetated swales and pipes/culverts which conveys water around the site. Existing stormwater management is described in more detail in Section 2.2.

Figure 1 shows a number of existing ponds on the site which are used for effluent treatment, stormwater treatment, fire water storage and as treated effluent storage for later reuse. Borgs has a trade waste agreement with Oberon Council and site effluent (that is not recycled internally) is discharged to the Council sewer with no on-site disposal. There is an existing microfiltration and reverse osmosis treatment plant on-site which recycles most of the process water back into the system as feedwater and the brine is directed to the Council wastewater treatment system for further treatment. On occasion the brine is too high in colour for discharge to the Council wastewater system and needs to be diluted with town water.

Note that another facility owned by Carter Holt Harvey (CHH) is located to the west of the Borgs site on the western side of Lowes Mount Road and is independent of the Borgs operation and not the subject of this assessment. However this facility does discharge its polluted stormwater into the same stormwater system which is measured for EPL purposes. There is an agreement between CHH and Borgs that CHH's stormwater discharge must comply with stipulated concentrations limits. Kings Stockyard Creek can be seen in the right of the image and is a typical rural creek, largely cleared of riparian vegetation.

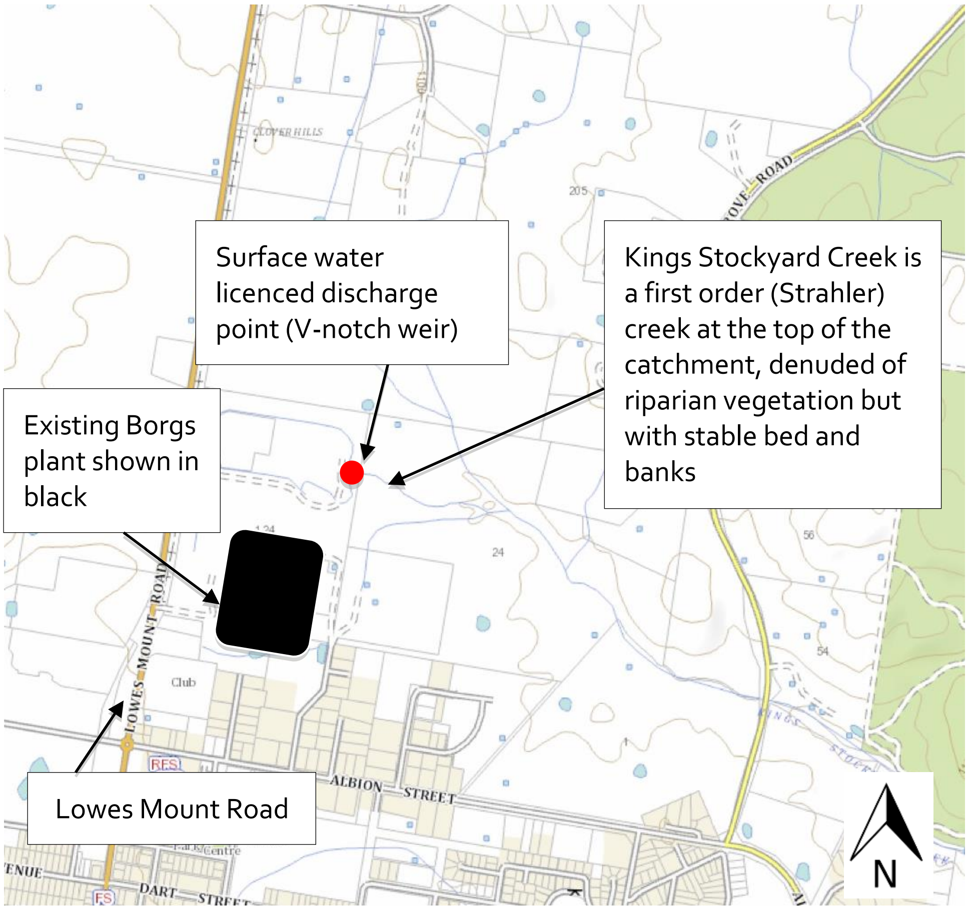


Figure 2: Kings Stockyard Creek at Oberon showing approved EPL monitoring point in red

Figure 2 shows the location of the Borgs plant in black and the licenced discharge point in red.

Kings Stockyard Creek is a first order Strahler system creek without any other upstream reaches. It has a defined bed and bank and intermittent flow. The existing creek is denuded of riparian vegetation though it is well sealed and stable with a mildly incised bed typical of most rural creeks. Leaky weirs have been placed across the creek downstream of the existing buildings and V notch weir where the EPL is measured.

2.2. Existing Water Management Approach

Referring to Figure 3 below, surface water is managed as follows:

- Runoff from the CHH facility across Lowes Mount Road is directed onto the site in a "dirty" water swale.
- Clean water from rural undeveloped parts west of Lowes Mount Road is also directed onto the site in a "clean" water swale which runs alongside the dirty water swale. This is shown below.

Plate 1: Clean water swale (left hand side) and dirty water swale from the CHH and Borgs site on the right hand side. Viewed looking north with Lowes Mount Road on the left hand side and the Borg factory on the right hand side.

- Borgs roof runoff and runoff from the western side of the Borgs development is directed into the dirty water swale and then conveyed into an existing stormwater treatment pond shown below.

Plate 2: Existing Stormwater Treatment Pond

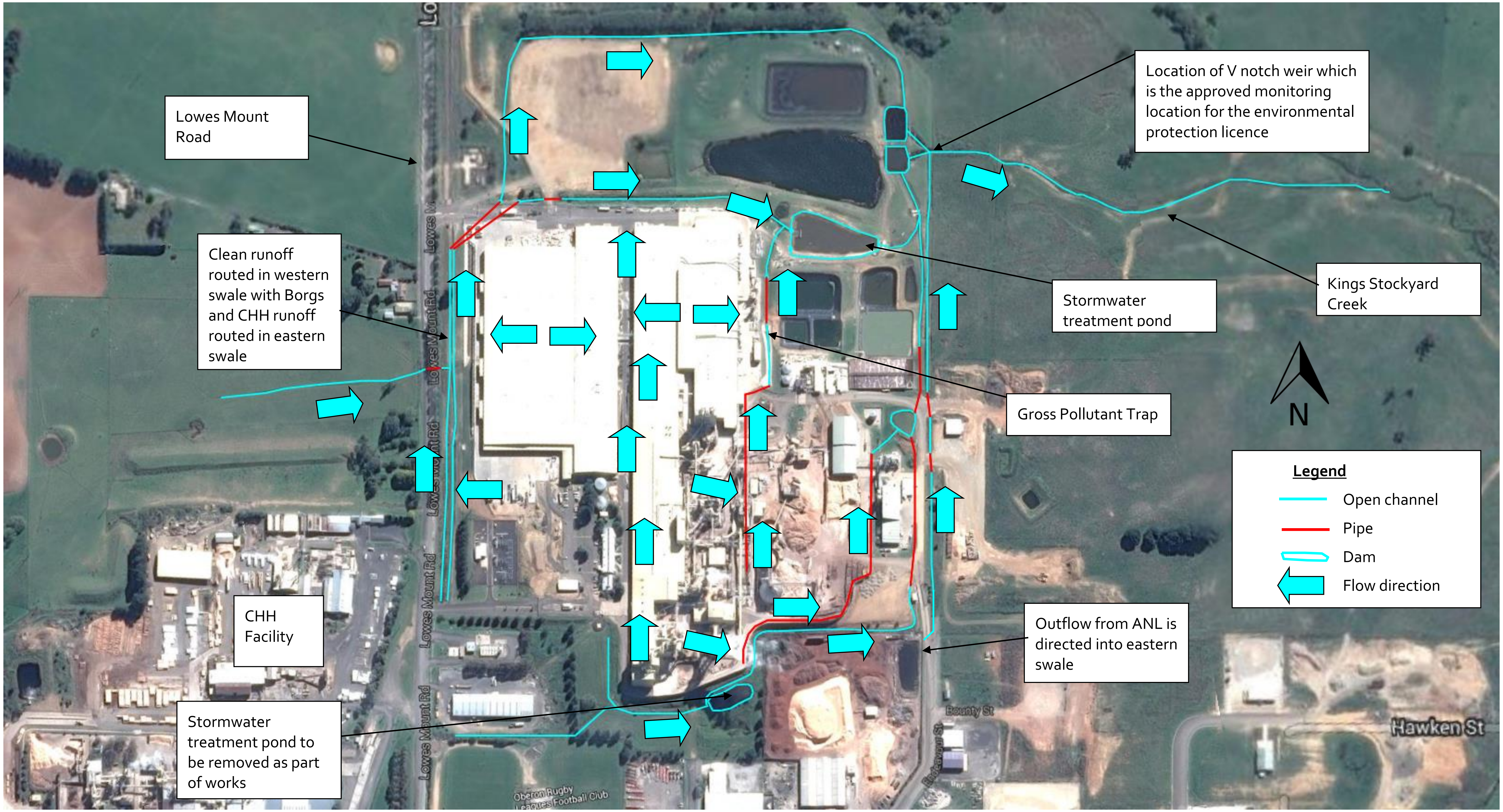


Figure 3: Current Stormwater Management at Borgs

Runoff from the eastern and open part of the site which contains fine fibrous wood material is directed first to a gross pollutant trap and then into the stormwater treatment pond shown above in Figure 3.

Plate 3: Gross Pollutant Trap with penstock control (not visible) upstream

2.3. Existing Pollution Licence

Borgs is currently permitted to discharge stormwater from the site, at the 100 % compliance level in accordance with following conditions:

Table 2: Permitted maximum discharge concentration limits

Pollutant	Permitted Maximum Discharge Concentration (mg/L)
Aldrin & Dieldrin	0.3
BOD	20
Colour (Hazen)	160
Methylene Blue Active substances	0.5
Total Nitrogen (TN)	10
Oil and Grease	10
pH	6.5-8.5
Total Phosphorus (TP)	0.3
Total Suspended Solids (TSS)	50

While all of these pollutants are sampled weekly during discharge or yearly in accordance with the licence conditions, the major pollutants of concern are total suspended solids (TSS), and nutrients (TN and TP). The Dieldrin and Aldrin have been chemicals of concern in the past associated with a previous spill on the CHH site. These are no longer a concern as affected parts of the site have been remediated. Kings Stockyard Creek was also rehabilitated with contaminated material removed and the creek stabilised. This work was undertaken when the site was under the ownership of CSR several years ago.

It is worth noting that the TSS concentrations stipulated in the licence are much more stringent than a typical rural land use which has an event mean concentration of 90 mg/L while agricultural land has a typical event mean concentration of 140 mg/L (Fletcher et al, 2004).

2.4. Existing Water Quality Performance

Tested water quality samples have been analysed over many years. Results for the major pollutants are summarised below from 2010 to 2014:

Table 3: Average concentrations of TSS, TP and TN from 2010 to 2014 from the Borgs site:

Pollutant	Average Concentration (mg/L)	Standard Deviation (mg/L)
TSS	25.08	27.32
TP	0.155	0.166
TN	5.127	8.577

Note these values include runoff from rural land characterised as clean runoff as well as runoff from the CHH site on the western side of Lowes Mount Road.

Average values for the same pollutants discharged from the CHH facility are tabulated below.

Table 4: CHH Average pollutant concentrations from 2012 to 2013.

Pollutant	Average Concentration (mg/L)
TSS	70.69
TP	0.215
TN	4.91

3.0 PROPOSED DEVELOPMENT

The proposed project is for the construction of new industrial buildings and the installation of plant at Oberon. See **Error! Reference source not found.** next page.

3.1. Key Project Components

The key Project components as numbered above are as follows (Position 1-9 represent existing plant):

Particle Board Facility

This is the principle focus of development. Particle board is constructed mainly from relatively coarse woodchip unlike the existing MDF which is constructed from fine wood particles resulting in the generation of a fibrous waste product.

Position 10

Log yard for storage of raw timber for particle board processing and recycling reclamation point

Position 11

Enclosed Chipper and Debarker Unit

Position 12

Conveyor to transfer woodchips to silo

Position 13

Silos for storage of woodchips

Position 14

Flaking building

Position 15

Flake silos to store the wet processed wood flakes

Position 16

Partial demolition of existing building and fines and sawdust storage

Position 17

Dryer area for the drying of processed particles

Position 18

Screening area to sort material in to appropriate grades.

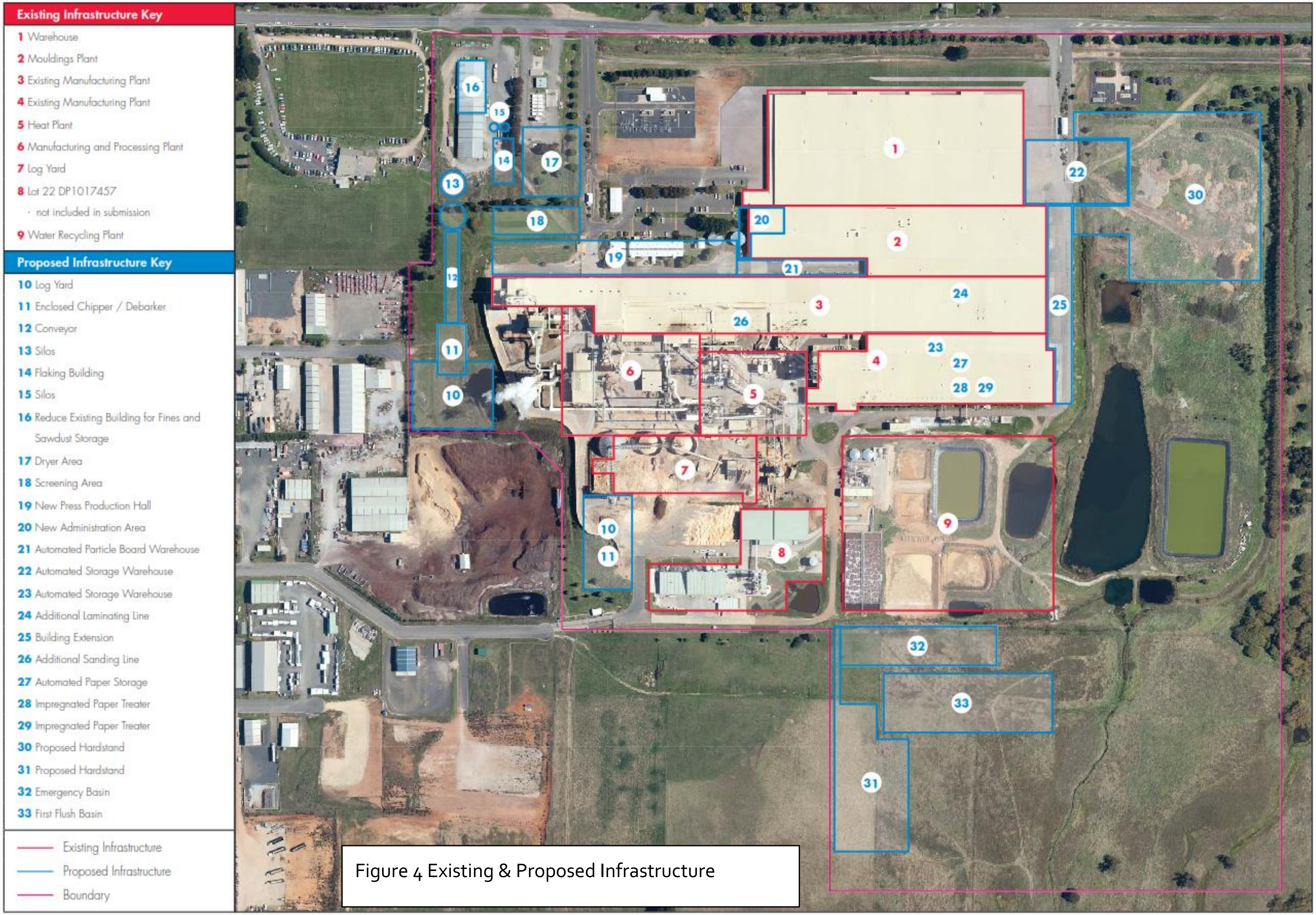


Figure 4 Existing & Proposed Infrastructure

Position 19

New production hall to allow for the manufacturing of particle boards once the wood has been processed (Positions 10-

18 above)

Other Site Works

Position 20

New administration area, located in existing building on site to replace administration area to be demolished to allow for the construction of 19.

Position 21

Automated warehousing system to store Medium Density Fibreboard, capable of storing approximately 6000m³.

Position 22

Automated board storage system, automated storage system to support site board production lines, capable of storing 3000m³.

Position 23

Automated laminated board warehouse system for laminating line, capable of storing 3000m3 of board.

Position 24

Additional laminating line- for production of laminated particleboard and MDF.

Position 25

Building extension- warehouse

Position 26

Additional sanding line for increased particle board capacity.

Position 27

Automated rolled paper storage system for paper produced on the paper treaters in preparation for use on the laminating lines. Capable of storing 1500 rolls.

Position 28

Impregnated paper treatment process.

Position 29

Impregnated paper treatment process.

Position 30

Proposed hardstand

Position 31

Proposed Hardstand

Position 32

Emergency spill catchment basin

Position 33

First Flush basin

3.2. Process Description

The Project is for the expansion of an existing timber manufacturing and processing facility. The major change to the existing approval for the site is to provide for a facility to manufacture particle board. Particle board manufacturing involves both the processing of virgin wood, residual wood waste from sawmills and the recycling and processing of appropriate used wood to create suitable sized particles. These are then processed to form particle board. In addition to this, expansion to existing Paper treatment and laminating operations are to be undertaken. These are largely to be located within existing structures on site.

3.2.1. Particle Board Facility

The process description for the particle board process is as follows, with the numbers relating to the key on **Error! Reference source not found.** and in Section **Error! Reference source not found.** above.

Plantation timber logs are brought to site from external locations and processed through a timber yard (10). This includes processing the timber through a debarker and chipper (11). The chipper is to reduce the timber to a consistent particle size. Once the chips have been produced the product is screened to ensure consistency in size and any foreign ferrous contaminants are removed using magnets.

These chips are then moved through (via belts and conveyors) (12) to a silo (13) prior to being further reduced in size using Knife Ring Flakers (14). These Knife Ring Flakers are designed to produce the optimum macro sized particles for the proposed processing methods. These particles are then stored in silos (15) prior to being fed into the drier. Saw dust is also introduced to the particles at this point in time.

The dry saw dust and wet wood particles are then dried in a rotating drum drier (17). Any small particles generated during the drying process which are smaller than required are removed using cyclone extractors. Any surplus air generated which is not required for the drying process is cleaned using a Wet Electrostatic Precipitator prior to being released to the atmosphere as clean air. Once dry and processed in this manner, the particles are removed and stored in a silo.

Once this process has been carried out, screening is undertaken (18). Any appropriate sized particles and dust are sent to storage, whilst any oversize particles are sent to a grinding mill to reduce them to an appropriate size.

These particles are then blended with glue and additives (usually a blend of urea formaldehyde with a paraffin wax emulsions and a catalyst to accelerate the reaction) in a specifically designed ribbon blender (19).

After blending, the now resinated particles are sent to the corresponding mat forming stations. The forming stations are designed to ensure that there is an even distribution of core and surface layer particles across both the width and through the thickness of the board. The mat is then weighed and adjusted electronically to ensure that the finished product has a consistent density.

The forming line then transports the layered mat in a continuous format to the press, while simultaneously measuring moisture and removing any remaining ferrous material. The forming line is able to reject and recycle the mat before pressing if the specified product parameters are not of a suitable standard. Any rejected material is reused on site. The press then applies the specified heat and pressure required to cure and consolidate the board in order to meet or exceed the relevant Australian Standards. This process is remotely controlled from the press control room.

Once processed, the pressed board is then cut square, cooled and stored in an automated storage system. Once cooled and cured, the boards are removed from storage and processed through the sander to ensure they meet final standards.

The boards are then stored on site before other downstream processing activities are undertaken and the boards are shipped out.

3.2.2. Other Site Processes

In addition to this, additional plant will be provided inside existing buildings on site. These will be extensions of existing operations on site and will be located internal to the existing approved structures.

These works are an expansion and continuation of the existing manufacturing facilities on site, and will follow the same process as the existing approved facilities, but with updated machinery that will create lower noise levels and operate more efficiently.

These works will run in parallel with the existing MDF processing lines, and MDF mouldings operation, laminating building (including press and paper treatment) ancillary cranes and storage systems which are to be retained. Full details of existing and proposed operations and processes on site are provided within the EIS.

3.3. Chemical Production and Storage

The resin transported to site will be stored in tanks near the particle board production process. The resin will be applied to the wood particles prior to drying. The resin is usually blended with additives to promote specific properties in the products quality. These include but are not limited to waxes, organic salts used as catalysts and dyes...

On the wider site, typical maintenance fluids such as hydraulic oil, diesel fuel, heating oil and the like will be stored. This will be carried out in accordance with the relevant guidelines and controls.

3.4. Utilities

The Project is located in close proximity to the existing Oberon township. As such, it is serviced by town water, sewerage, electricity and gas. As part of a wider approach taken by Borgs a number of options are being considered that will reduce the overall demand on these services, such as providing a co-generational power plant on site, reducing landfill waste as well optimizing the amount of natural gas the plant uses.

4.0 POTENTIAL IMPACTS

4.1. Water Quality

4.1.1. Long term water quality risks

By comparison with the existing MDF process, the proposed world class particle board facility is a cleaner process using covered silos, conveyors and fully enclosed buildings. The optimum particle size range for particle board production is between 2 mm and 5 mm which are fairly coarse particles easy to strain/screen and remove from solution.

The covered nature and larger particle size of this process means there will be lower risk of polluting stormwater. The proposed development will not see the generation of fine (particle sizes smaller than 1mm) fibrous wood waste that the existing MDF process generates.

The storage of logs in the log yard is likely to generate coarse timber particles and leach tannin from the logs. It should be noted that bark removed from logs is stored in a covered shed on both the existing and the proposed facilities. This will minimise the potential tannin leaching and gross pollutants.

Additional traffic loads will result in an increase in traffic related pollutants though these are not significant by comparison with any main road.

Additional roof and hardstand areas totalling 10.5 Ha associated with the proposed development will result in an increase in the export of TSS, TN and TP from the impervious roof areas though given the rural location, atmospheric deposition of dissolved nitrogen onto roof areas is not expected to be as high as atmospheric deposition in Sydney.

Electrostatic precipitator will scrub the air stream released from the particle board drying process and this will prevent airborne particle discharge which in turn will reduce stormwater pollution. There is an existing EPL which also limits discharge of pollutants to the air and indirectly this acts to limit water quality impacts on and away from the site.

In summary the proposed process is considered cleaner than the existing MDF process. Key sources of stormwater pollution will arise from:

- An increase in roof areas
- Storage of logs in a log yard
- Handling and transport of woodchip including woodchip created from recycled timber sources as well as new sources
- An increase in traffic volume

The key stormwater pollutants of concern will be:

- Tannins – tannic acid.
- TSS, TP and TN

The TSS generated from the wood handling parts of the process should be relatively easy to mitigate as expected particle sizes are in the gross size range, i.e. 2mm to 3mm or larger. Equally the forms of TP and TN associated with the wood handling will be the particulate forms and relatively easy to remove and unlikely to pose a significant water quality risk.

The TSS arising from roof runoff will be at a low loading rate given the relatively good air quality in Oberon compared to say the Cumberland Plain. The TP in the roof runoff is likely to be attached to the TSS and therefore removal of TSS will see good removal of TP. The TN in the roof runoff will be in the dissolved form (though at lower levels than typical urban environments) and more difficult to remove than the particulate form of nitrogen and sourced from the atmosphere. Again the good air quality in the region is likely to see lower levels of nitrogenous pollutants deposited on the building roofs.

The impact of the key pollutants on river health is as follows:

- TSS can smother benthic the benthos and result in siltation of creeks and an increase in turbidity of stormwater. By smothering benthos and benthic organisms TSS disrupts the natural exchange processes that occur in creeks. These processes see nutrients and sediment exchanged in different forms. Smothering of creeks with sediment reduces available habitat.
- TP and TN in the bioavailable forms (dissolved forms) contribute to the eutrophication of water bodies and waterways potentially leading to algal outbreaks and a change in the assemblage of the aquatic ecosystems from ones dominated by low nutrient levels to ones dominated by high nutrient levels.
- Tannic acids can discolour water and the impact is mainly aesthetic. There are many natural ecosystems (e.g. Melaleuca swamps) which have very high loads of tannic acids and which remain healthy and productive.

4.1.2. Short term Water Quality Risks

Short term water quality risks associated with the development would include:

- Soil and water management during construction.
- The risk of an accidental spill of a chemical during operation of the plant.

The management of soil and water during construction can have devastating impacts and is often overlooked. It is known that the impacts of poor soil and water management during construction can have the same effect as water quality discharged from an operation over its entire life. The transport of sediment from the site is the key risk during construction. It is likely that more than 1 hectare of land will be disturbed during construction and therefore the risks of sediment transport off the site are significant. The sediment could be deposited within the rehabilitated section of Kings Stockyard Creek downstream of the discharge point. This would impact on creek ecology at a time when it is probably reaching pre contamination levels of diversity. None the less adherence to the Blue Book would see soil and water impacts mitigated.

4.2. Geomorphology

The proposed development will not see any new structures within 40m of the top bank of a creek however there will be work associated with the construction of a modified drainage scheme for the site connecting into the existing ponds and Kings Stockyard Creek. Therefore direct geomorphic impacts will be negligible. No riparian vegetation or aquatic habitats will removed or affected by this proposal except that the existing southern water quality pond will be removed.

The addition of approximately 10.5 Hectares of impervious area would result in an increase in the volume of runoff leaving the site. This could potentially have some minor impact on the geomorphic condition of the creek resulting in erosion of either the bed and or banks to cater for the extra water being conveyed into the creek.

This could be mitigated through harvesting of the runoff which would reduce both the frequency of runoff and the volume of runoff and theoretically lead to an improvement in creek health (Walsh et al, 2004).

The creek has also been rehabilitated in the past by CSR and has already adjusted to the presence of large impervious areas draining into it and is now stable. Some further minor adjustment is possible though it is expected to be minor and potentially negligible if mitigated.

4.3. Flooding

The catchment downstream of the proposed development is a sparsely populated rural catchment where the creek flows through an incised valley eventually to form the Fish River a few kilometres downstream of the site. This is quite a common geomorphic feature of the weathered granite landform of this region which can sustain steep hills which are not prone to erosion.

Analysis of aerial photography down to the confluence of Fish River with Slippery Creek (15 km downstream of the site) reveals that there are three buildings which could potentially be affected by flooding. The first and second are located 75m from the creek and in fact not likely to be flood prone let alone affected by the 1 in 100 year flood event. Both of these buildings are elevated about 20m above the creek. The third building is located 40m from the creek and is elevated between 10m and 20m above the Fish River but where the sides of the river are relatively flat and the flood conveyance area is about 80m wide. Therefore the risk of any potential increase in peak flows impacting on downstream property is considered negligible.

None the less the 10.5 Ha increase in impervious area is not insignificant and could potentially increase peak flows without mitigation. Therefore, during detailed design, a peak flow model of the site shall be developed to determine if there is an increase in peak flows. If there is an increase in peak flows, these would need to be detained to ensure that peak post development flows do not exceed predevelopment peak flows for the full range of storm events from the 1 year ARI up to the 100 year ARI.

While this work has not been undertaken at this development application stage, the key land use decisions needed to assess the potential peak flow impacts of the proposed development have been made as follows. If on-site detention is required it will be provided as air space above a proposed stormwater treatment pond. Typical on site detention storage volumes vary from 300 to 450 m^3/Ha of development. Therefore the proposed development could need to store up to 4,500m^3 of stormwater, subject modelling. This volume of storage would, if required, be provided above the proposed stormwater treatment pond as approximately 0.5m of air space depending on final design levels and configurations.

Refer to **Error! Reference source not found.** and Figure 10 for more details. Both the proposed treatment pond and proposed emergency spill basin are described in more detail later in this report.

The proposal, located at an elevation of 1,100m above sea level is not located within a floodplain and therefore there would be no potential impacts from floodplain filling and this will not be considered further.

Local overland flow paths may be affected by the proposal. During the design stage, checks should be made to ensure that local overland flow paths will not be restricted by the proposal. This is considered beyond the scope of works of this report.

4.4. Water Resources

4.4.1. Water Supply

The new particle board process will see an increase in demand for water which could be sourced from either:

- Recycled water made available from the site's own treatment plant – this plant can treat up to 1000 m^3/day
- Town water - Council has indicated it has available capacity
- Harvested stormwater runoff. The impervious areas on the site and upstream are extensive and lend themselves to a reliable stormwater harvesting scheme.

4.4.2. Wastewater

Wastewater generated form the new plant will be recycled back into the process and permeate and excess wastewater will be directed to the town wastewater treatment plant as currently happens. As noted above the existing treatment plant has the capacity to treat up to 1000 m^3/day and currently treats about 350m^3/day. The extra 400m^3/day capacity could be used to treat and desalinate stormwater which would produce much lower volumes of brine due to the low salinity of the stormwater compared to the wastewater.

4.4.3. Groundwater

There are no expected impacts to ground water caused by the proposed development. While surface runoff across pervious surfaces can infiltrate into the groundwater storages, extensive mitigation measures have been proposed to treat the surface water such that it will pose no risk to either natural receiving stream or water bodies, or groundwater. Critical Control Points (CCPs) have been incorporated into the plan, in order to protect stormwater treatment and storage facilities from contamination threats such as spills. Covered silos will store woodchips and prevent potential leaching of tannins from the woodchip into the groundwater.

Furthermore, Borgs have a licence to extract water from an onsite spring fed dam and will not be extracting in excess of this licence, causing no additional demand on groundwater resources.

Any potential impacts to groundwater resources, groundwater (and the spring fed dam) are not considered further.

5.0 PREDICTED IMPACTS

5.1. Methodology

A MUSIC (Model for Urban Stormwater Improvement Conceptualisation) water quality model for the site was constructed. MUSIC was developed by the Cooperative Research Centre for Catchment Hydrology in 2001 and the program is now widely used across Australia to predict water quality impacts arising from a proposed development, and to then design appropriate stormwater mitigation strategies. The following sections of this report describe the MUSIC models that were created to simulate both the existing site (pre-development model), the proposed development for the site (post development model), and the site as it would be if in an un-developed state (rural model). All models of the site were developed based on previous catchment mapping by GHD, analysis of aerial mapping available through the NSW Government Six Maps site and available site contour data.

The method used to create the climate file which contains historical rainfall data and which was used to run the MUSIC models is described.

5.1.1. Pre-development model

The predevelopment model includes:

- "Clean" and "dirty" nodes: The Borgs site was broken up into areas termed clean and dirty. The clean part of the site is the large roofed areas where all activity is undercover and where effectively the site functions as would a distribution centre. Event mean concentration (EMC) values for the roof and road areas were taken from Fletcher et al, 2004. The dirty part of the site is that part of the site where wood fibre is handled or processed outdoors and some fibre can and does make its way into the stormwater system where either the existing GPTs or ponds remove the pollutants.
- Pervious and impervious areas: Each node has a mix of pervious surfaces (allowing rain to seep into the ground) and impervious surfaces (allowing no seepage).
- Flow paths: generally modelled as "links" (which merely convey the water in the model, providing no treatment), however the flow path along the southern boundary of the site was modelled as a swale, providing a certain level of treatment as well as conveyance.
- Treatment ponds and Gross Pollutant Traps (GPTs).
- Other catchments: The predevelopment model includes the CHH land to the west of the site and the Rugby oval to the south, as the runoff from these sites drain onto the Borgs land. There is also some agricultural land located to the west of Lowes Mount Road, controlled by Highland Pine Products (HPP) that drains through the "clean" swale to the northern V notch weir and

which is subject to its own (EPL). After the northern, HPP V-Notch this flow mixes with the runoff from the Borgs site. In the post development state this relatively clean swale will converge with the creek downstream of the proposed Borgs V-notch weir location and so it has been excluded from the water quality assessment in both the pre and post development models.

The configuration of the pre-development model can be seen below in Figure 5.

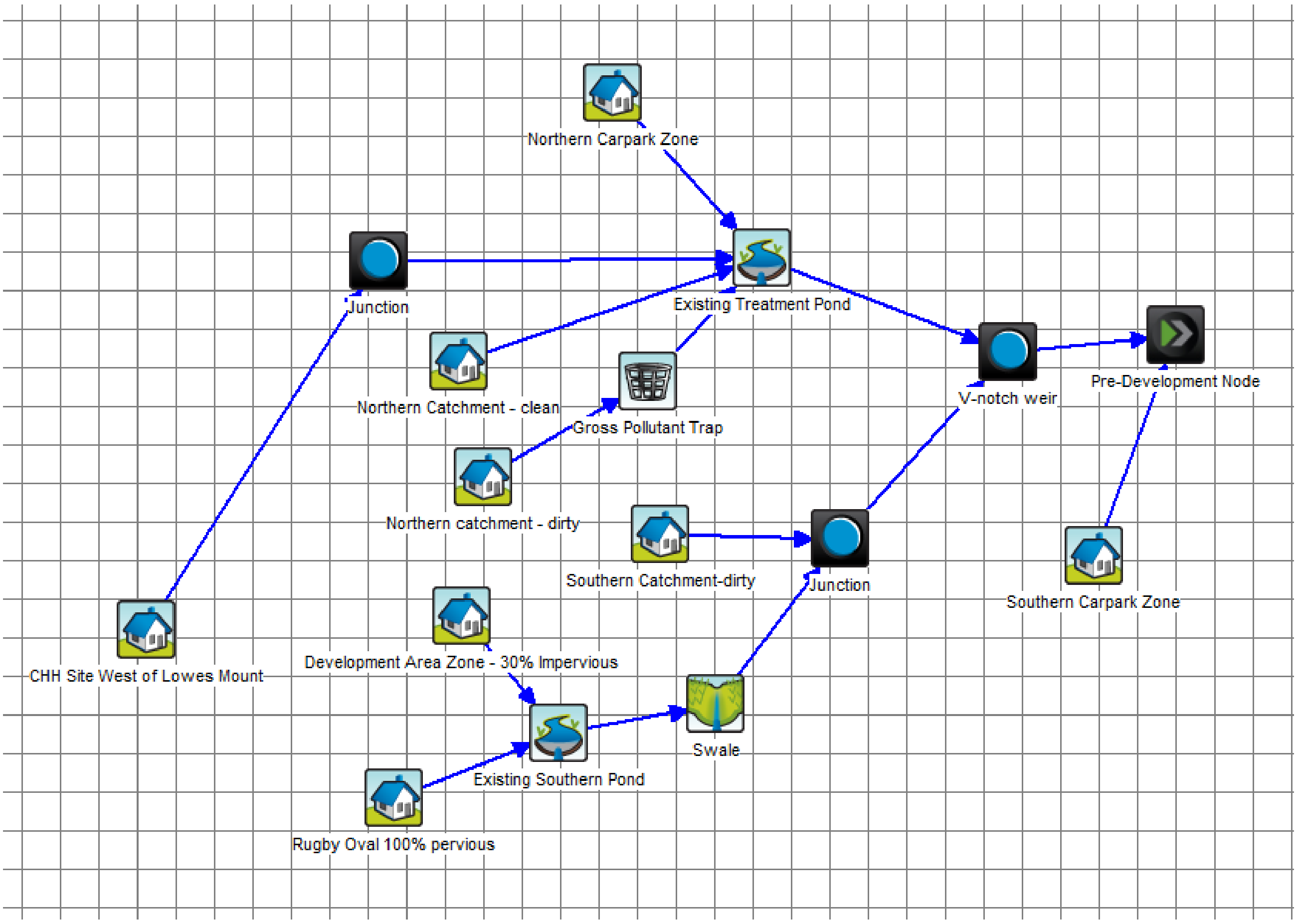


Figure 5: Predevelopment MUSIC model configuration

In order to calibrate the model the following actions were undertaken:

- The mean and standard deviation and maximum value of TSS, TN and TP for the CHH site was calculated from the existing water quality record – see Table 5 below, or Section 2.4for more details.
- The EMC data for the node representing the CHH land was adjusted so that the model indicated it was exporting pollutants with a concentration close to the mean and maximum pollutant values from the water quality record.
- "Clean" parts of the Borgs site had EMC values (for roof areas and road pavements) based on Fletcher et al (2004) which are widely recognised as being the most plausible estimates. The EMC values for dirty parts of the sites were manually adjusted until the receiving node (called the "Pre-Development" node in Figure 5) had mean and maximum concentration

values that were close to the field monitoring water quality data from 2010 to 2014.

- It is worth noting that some outlying maximum values could not be simulated by MUSIC, despite using the stochastic generator in the model. Outlier values are therefore considered unusual events outside of the log normal distribution range of pollutant events. In reality this is true and these unusual events correspond with unusual activity for example, construction on site where there has been major disturbance.
- The treatment pond was modelled in accordance with its characteristics – it has a surface area of 2,460 m^2 and a permanent pool volume of 6,000m^3.
- The southern swale was modelled based on its measured length and slope.
- The southern pond (which will be removed as a result of the proposed development) was modelled with a surface area of 1,000m^2 and a permanent pool volume of 1,000m^3.

The predevelopment model was trained to reproduce the actual measured data shown earlier in Section 2.4, and the model performance compared to these measured values can be seen below in Table 5. As mentioned, a conservative approach was adopted in the model in order to overestimate the predevelopment loads, to ensure there is some margin of error with the use of the model.

Table 5: Mean discharge concentrations

Location of water quality data	Measured Leaving the CHH site (mg/L)	Measured Leaving the Borgs site (mg/L)	MUSIC predictions Leaving the Borgs Site (mg/L) for flows > 0.001 m^3/s
TSS	70.69	25.08	24.05
TP	0.215	0.12	0.17
TN	4.91	5.127	3.96

Because the stochastic function in MUSIC was used to randomly generate a pollutant concentration value from a log normal distribution of pollutants (based around a specified mean and standard deviation), each model run has slightly different results.

Because the EPL specifies maximum upper limits at the 100th percentile, the maximum concentration values predicted by MUSIC become the key parameter for assessment.

There is therefore some degree of uncertainty with respect to the maximum values generated in MUSIC, i.e. the maximum values can vary considerably from run to run. We have reduced this uncertainty in two ways:

1) By having a climate file that covers 20 years of 6 minute data – this is discussed further later, i.e. a climate file that spans a very long time making it highly probable that a very high value would be generated within this very long time period, and
2) By running the model 10 times to obtain an envelope of solutions and by then adopting the largest maximum value from the set of 10 values. This provides us with sufficient certainly to predict the 1 in 20 year worst single pollutant event with confidence.

It is noted that should it occur, an occasional exceedance of the EPL limit of 50 mg/L for TSS is unlikely to cause environmental harm given the rural nature of Kings Stockyard Creek which is likely to receive significantly higher TSS loads from a variety of both upstream and downstream agricultural sources unrelated to Borgs or CHH.

To explain further, the cleanest (least polluting) land use (including pristine forested land uses) from a TSS perspective is a roof. Even the cleanest roofs discharge maximum TSS concentrations well in excess of 100 mg/L on occasion (Duncan, 1999 and Fletcher et al, 2004). Further, the average TSS concentration from a roof plus one standard deviation was found to be 90 mg/L (Duncan, 1999). This would equate to something like the 90th percentile event. In conclusion an occasional exceedence by Borgs of its stringent TSS target would still see levels of pollution emitted from its site, lower than an equivalent clean roof.

5.1.2. Post-development model

The predevelopment model was modified as follows to produce the post development model:

- Increase of impervious area: The node that represents that part of the site to be developed, was modified to reflect the addition of another 10.5 hectares of impervious area. This was achieved by increasing the imperviousness of the predevelopment catchments.
- Of the additional 10.5 hectares in impervious area this is split into roof and hardstand including 2 proposed car parks, in in the north and one in the south-east. Refer to Figure 6 and Figure 10 for more details.
- The southern pond was removed from the model as this pond is to be removed.
- All EMC values derived from the predevelopment model were kept constant. This means we assume the new development area will be as polluting as the existing development area. This is conservative as in reality, the increased use of covered processes and larger particle diameters associated with the core process will make it less polluting.
- Addition of new treatment pond: The new pond is to be located downstream of the existing pond and has similar dimensions to the existing pond – it is to be a minimum of 6 ML in volume with a surface area of about 2,500m^2.
- Addition of swales: two additional swales were added to convey runoff to the new proposed stormwater treatment pond, one to convey flows from the

Borgs southern site and the other along the northern boundary to convey the CHH site runoff.

- Stormwater harvesting from each pond was included in the model with demands of 200 m^3/day drawn from each pond when water was available.
- The HPP owned, undeveloped agricultural land to the west of Lowes Mount Road was included but was routed around the Borgs site to converge with the runoff from the Borgs site downstream of the proposed V-notch weir location. This point relates to water quantity calculations and not water quality calculations.

The proposed mitigation measures, namely additional pond and swale are shown in more detail in Figure 6 and Figure 10. It should be noted that the water *quality* analysis is conducted at the V-notch weir while the water *quantity* analysis is conducted just downstream, at the node called "Post Development Node". This is because the runoff from that undeveloped rural land is routed around the Borgs onsite stormwater treatment system, therefore not affecting the quality of the Borgs runoff, however it does affect the volume of runoff entering Kings Stockyard Creek and is therefore considered in the water quantity analysis included in this report.

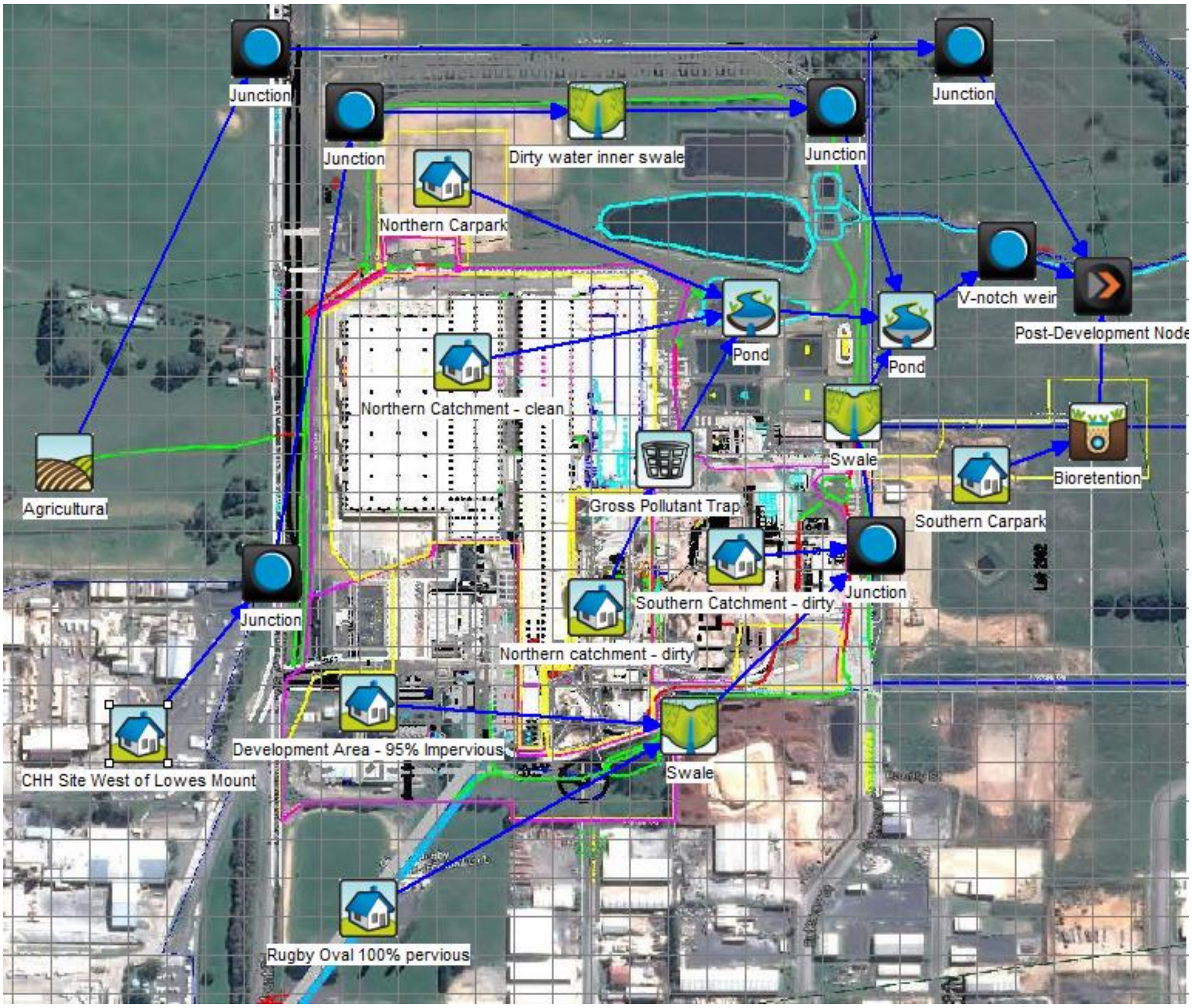


Figure 6: Post Development MUSIC model configuration

5.1.3. Rural state model

A model of the Borgs site, as it would be in an undeveloped rural state (i.e. 100% pervious) was developed. A comparison between the runoff quantity results from this model and the post development model provide an estimate of the increase in the quantity and frequency of runoff discharging into the Kings Stockyard creek, caused by the creation of impervious areas on the Borgs site. The results of the rural model are also used to analyse the potential impact of the increased runoff, both with and without harvesting the stormwater.

The configuration of the rural state model can be seen below in Figure 7, and consists of:

- One node of 54.5Ha representing the entire Borgs site plus the CHH site (with an area equal to the sum of all of the Borgs an CHH site nodes in the post development model, but set to be 100% pervious).
- The agricultural and rugby oval nodes (40 hectares) remained unchanged from the post developed case.
- Treatment and detention nodes (swales and ponds) were not included.

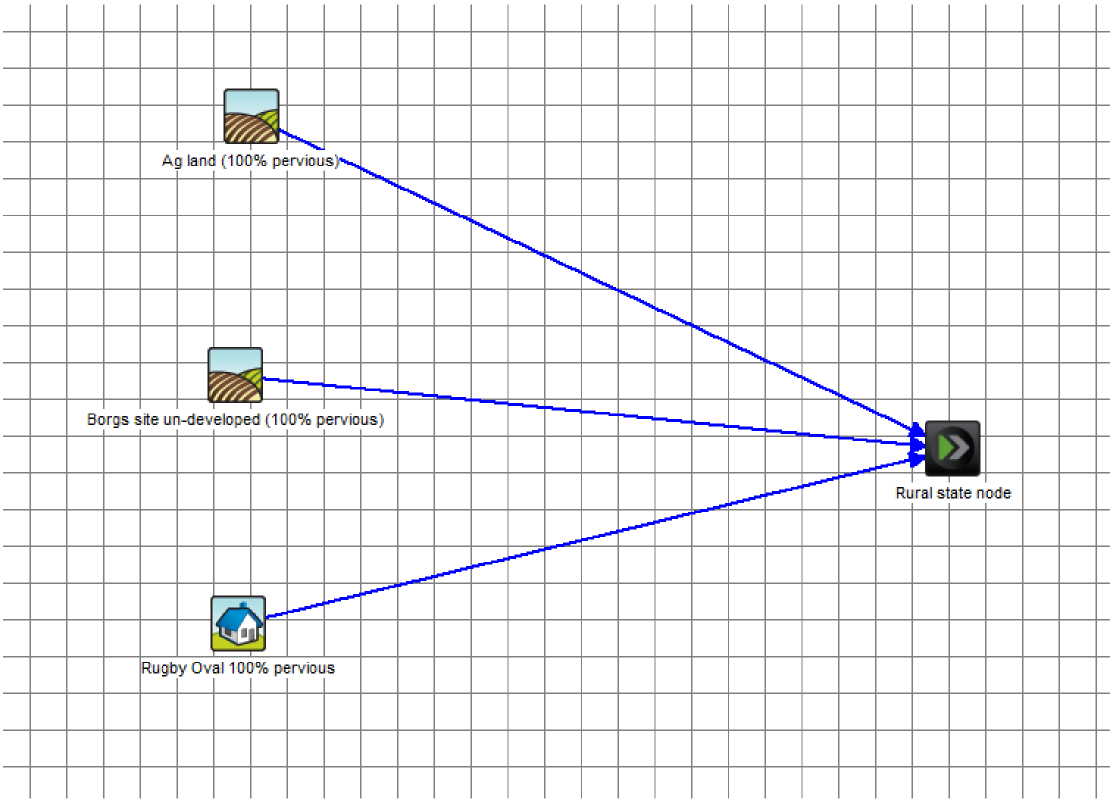


Figure 7: Rural state MUSIC model configuration

5.1.4. Rainfall data selection

There are several pluviograph stations in close proximity to the Borgs site, which are all in the same mean annual rainfall zone, as can be seen in Figure 8, and the long term daily records at each site were analysed extensively in order to select a data set of sufficient length and quality to run in the MUSIC models. In order to accurately model the impacts of the proposed development, 6 minute (or "real time") rainfall data is required from a pluviograph station. It is preferable to use a long period of data, which reflects the long-term average rainfall, so that the results are more reliable and not affected by short-term cyclical weather variability. Furthermore, the data chosen should have no large continuous gaps where the station has failed and stopped recording.

Unfortunately, none of the weather stations around Oberon provide long-term high quality data, making it difficult to select a period for use. To overcome this, two smaller high quality periods (of approximately 10 years each) were selected and run separately, but with the results analysed together, effectively creating a 20-year climate file used for simulation of the urban water cycle on the Borgs site.

The two periods selected were from 13/4/1966 to 15/6/1975 (with a mean annual rainfall of 1056mm), i.e. a wet period, and from 11/11/1977 until 20/05/1987 (with a mean annual rainfall of 592mm) i.e. a dry period, obtained from the Oberon Dam weather station (station number 063108). Since one period has a higher mean annual rainfall than the long term average, and the other has a lower one, the mean annual rainfall averaged across the two periods is 824mm/year while the long term average for the Dam gauge is 882.5mm/year.

Each model variation (outlined in sections 5.1.1 to 5.1.3) was then run for both the "66-75" and "77-87" sets of rainfall data, and the results collated and analysed.

Evapotranspiration data for the site was modelled as 1200mm per annum based also on BOM data monthly distribution.

Figure 8: Location of pluviograph stations around the Borgs site. The uniform background colour indicates all stations are within the same zone of average annual rainfall around 800mm/year.

5.2. Results

5.2.1. Surface water quality impacts

5.2.1.1. Load based results

The predevelopment and post development MUSIC models were run and the results obtained.

Pre and post development average annual loads and treatment performance is shown

Residual Pollutant Loads			
	Pre-development	Post-development	% Reduction from pre to post development
Total Suspended Solids (kg/yr)	8,325	4,980	40.2
Total Phosphorus (kg/yr)	42.2	30.45	27.8
Total Nitrogen (kg/yr)	1230	1130	8.1

below in **Error! Reference source not found.**. **Error! Reference source not found.** has sources columns, residual load columns and percentage reductions columns. The sources columns describe the unmitigated pollutant loads running off the land surface. The residual load is the pollutant load after mitigation. The percentage reduction columns report the percentage reduction from source to residual load, i.e. the effectiveness of the treatment systems. It needs to be appreciated that this is the predicted performance for the whole site in its entirety and not just for the additional impervious area proposed as part of this development, i.e. a wholistic approach to water management on the entire site is being undertaken as part of this assessment.

Table 6: Annual Pollutant Export Loads and Treatment Train Performance

Table 6 shows that despite the addition of another 10.5 hectares of impervious area, with the additional reuse of stormwater and the additional treatment measures, the proposed development is predicted to have a beneficial effect on its catchment. It is predicted there will be a substantial improvement in TSS and TP with a minor improvement in TN.

Best practice stormwater treatment is often described as follows:

Removal of:

- 85% of the average annual load of TSS
- 65% of the average annual load of TP
- 45% of the average annual load of TN

Table 7 Treatment Train Effectiveness of the Borgs Treatment System

Treatment-train Effectiveness (% Reduction of Pollutants)		
	Pre-development (with existing treatment system)	Post-development (with proposed treatment system and increased impervious areas)
Total Suspended Solids (kg/yr)	48.6	72.6
Total Phosphorus (kg/yr)	41.5	65.2
Total Nitrogen (kg/yr)	29.3	50.4

Table 8 shows how much the proposed treatment system improves as a result of this proposal. For example TSS retention increases from about 50% to 70% but remains below the best practice target of 85%. TP increases to 65% (best practice target) and TN exceeds the best practice target.

The performance of TSS removal is marginally less than best practice, however this is due to the already low concentration of TSS discharge from the site (25 mg/L measured event mean discharge concentration (EMC)), compared to the EMC of most urban land uses (150mg/L) upon which the Best Practice Standards are based. Reducing the already low concentration of TSS discharge by 85% becomes a very challenging task due to significant diminishing returns associated with incremental improvements to what is ostensibly very good existing water quality. For example an 85% reduction of 150 mg/L would see TSS reduced down to 22.5 mg/L, and could easily be achieved by measures such as those proposed at the Borgs site, where as an 85% reduction of 25 mg/L would require TSS to be reduced down to 3.75 mg/L which is a much more difficult, if not impossible level to achieve.

The resulting TSS discharge loads from the post development case are a 40% reduction when compared to the current TSS discharge load, meaning that the proposed development water treatment measures will achieve a substantial beneficial effect on water quality compared to the current state, despite not quite meeting Best Practice standards for TSS. A comparison between pre development levels and post development levels is common in drinking water catchments, and is one of the most stringent tests to apply to a new development. Viewed in this context, the proposal and mitigation measures would satisfy all current applicable legislation, namely the Water Management Act and Protection of the Environment Operations Act.

5.2.1.2. Concentration based results

The Environmental Protection Licence (EPL) specifies pollutant discharge limits in terms of concentrations rather than annual loads. Although there is less confidence in MUSIC's ability to predict concentration based results (versus load based results), it remains the best tool available for doing so, and thus enabling a comparison with the EPL limits.

One difficulty in modelling the predicted maximum discharge concentrations values in MUSIC, is that the pollutant concentration values applied at the source nodes in the model, are derived stochastically from a log normal distribution, meaning that a pollutant concentration value for each pollutant is randomly synthesized by MUSIC based around a log normal distribution defined by its event mean concentration and standard deviation at each time step and is therefore different for each simulation (or run) of the model. While the mean predicted pollutant concentrations don't vary much between each model run, the maximum values do vary significantly.

To overcome this uncertainty with the model, the model was run 10 times to ensure a broad envelope of results was predicted. This is equivalent to running 100 years of six minute climate data. From the 10 runs the maximum value was selected and reported below in Table 8.

Table 8: Predicted maximum discharge concentrations from the MUSIC model (from 10 runs)

Parameter	Predicted Maximum concentrations (mg/L)	EPL limit (mg/L)
Total Suspended Solids	44.1	50
Total Phosphorus	0.227	0.3
Total Nitrogen	9.515	10

The proposed treatment train and harvesting scheme are predicted to see compliance with the existing EPL limits.

5.2.2. Surface water quantity impacts

In order to examine the predicted impacts of the proposed development on Kings Stockyard Creek in terms of water quantity, the post development case is compared with the predevelopment and rural site case. The purpose of modelling the rural site, (that being the same area as the Borgs site and contributing catchments, but as it would be in its undeveloped condition i.e. 100% pervious), is to determine how much extra runoff is generated by the entire Borgs manufacturing site (including the proposed new development). We note the rural state is the same state of development adopted under all Water Sharing Plans formed under the Water Management Act (2000) regardless of the level of imperviousness of a site.

Table 9 below shows the results of the rural site simulation compared with the post development simulation, both with and without the reuse of the stormwater that is generated on the site. It can clearly be seen that the post development case (which includes the current infrastructure) causes a substantial increase in the volume of runoff produced on the site, more than doubling the volume of runoff that would be discharged to the creek. Such drastic increases compared with the "natural" flow regime in the creek, can have adverse effects such as erosion of the creek bed or banks.

However it can be seen in Table 9 that by harvesting and reusing some of the stormwater, rather than disposing it to the creek, the mean annual volume of runoff can be reduced closer to the rural runoff volumes, thereby lessening the chance of any adverse effects on the creek.

Table 9: Mean annual flow comparison

	Rural State (no dams)	Post development (No harvest)	Post development (with 400kL/day harvest)
Mean Annual Flow (ML/year)	140.35	406.5	287.5

It can be seen from the flow duration curves below in Figure 9 that the post development case with no reuse of the stormwater (red line), results in higher flow rates than would occur in the rural case (blue line).

If stormwater is harvested and reused (pink line), the magnitude of flow rates is reduced down much closer to the rural case but it can be seen that the magnitude of low flows is slightly lower than the rural case while the magnitude of high flows is higher than the rural case resulting in a net export of water into the catchment over and above the rural case which forms the basis for water allocations in the Macquarie catchment.

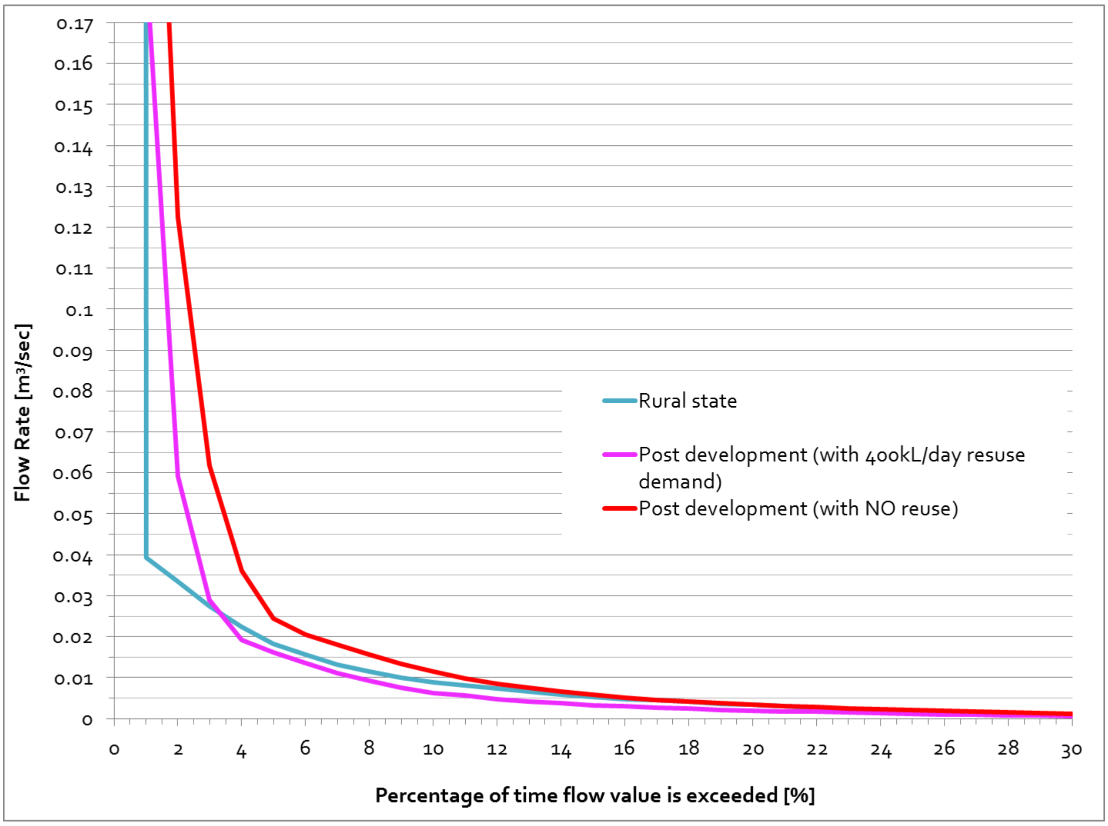


Figure 9: Flow Duration Curves, showing that the positive effect of harvesting the stormwater outweighs the negative.

Another benefit of harvesting the stormwater generated on the site is that less of Borgs demand will be required to be met through the supply of town mains water. Table 10 shows the yield from the proposed scheme would be about 120 ML/year and this will therefore reduce the demand for mains water of the same volume.

Table 10: Yield from stormwater harvesting and reuse

	Pond 1	Pond 2
Yield (ML/yr)	53.59	65.335
Total (ML/yr)	119	

It has been found that even after harvesting 120 ML/year of stormwater (proposed), the site still produces more runoff than it would if it was in a rural state. This is due to the extensive roof areas (approximately 13 hectares on the Borgs site alone) and hardstand areas. Because this industrial site generates so much more runoff than it would in its rural form the harvesting scheme will reduce environmental impacts and protect the receiving waters. It is understood that all water allocations under the Water Management Act (2000) are based on the assumption that all sites are undeveloped and that they are rural, i.e. have 100% perviousness. Clearly the water allocations would not be affected in this case if Borgs were permitted to harvest the water without a WAL. On the contrary, even after harvesting, the site would contribute almost twice as much water as water allocations would have allowed for.

In the absence of a clear policy on urban stormwater harvesting which the NSW Office of Water has reportedly been developing for years, dispensation from the Minister for the need to acquire a water access licence to harvest this excessive volume of urban stormwater from the roofs and hardstands of the site is requested on this basis.

Clearly it can be shown that the intent of the Water Management Act (2000) which is to protect the environment and to allocate water equitably would be achieved by allowing Borgs to harvest the excessive volumes of runoff it would otherwise dispose of down Kings Stockyard Creek.

6.0 PROPOSED MITIGATION MEASURES

The proposed mitigation measures and strategy is shown below in Figure 10.

The proposed long-term water quality treatment measures include:

- Construction of a new swale with a much longer flow path to convey CHH runoff around the site and ultimately into a new treatment pond described below. This new swale will provide additional reduction of TSS and improvement of colour through removal of tannins. The swale will be vegetated using appropriate grasses or macrophytes.
- Creation of a new stormwater treatment pond with a minimum storage volume of 6 ML. No reliance on extended detention has been made. An assumed weir width of 2m needs to be subject to appropriate design rigour.
- The new pond is located downstream of the existing pond and accepts runoff from the whole Borgs site including overflows from the existing upper stormwater treatment pond.
- Both the new pond and existing pond each have a daily demand for stormwater reuse of 200 m^3/day withdrawn from the pond.
- Stormwater from the existing upper pond will be pumped to the existing bank of sand filters and from there into the MF/RO process for use as steam make up water.
- It is envisaged that stormwater from the lower pond would also be pumped back to the existing bank of sand filters and so on.
- If the demand were to be increased above 200m^3/day this would improve the predicted water quality further though the predicted maximum discharge concentration values do not alter. Equally if the demand for stormwater drops below 200m^3/day it will not reduce the predicted performance of the system. This was checked by turning off the stormwater reuse option from both ponds, running the model and checking predicted maximum discharge concentrations. They did not differ with or without stormwater harvesting – probably because they are maximum values they occur when the ponds are full and overflowing and so remain unaffected by the harvesting. This means it is not essential that harvesting occurs to meet the EPL limits but it will none the less deliver load based water quality benefits and geomorphological benefits.
- It has also been confirmed that the existing plant has the capacity to treat the extra water.
- A Water Access Licence (WAL) to harvest the 120 ML/year is not warranted due to the excessive volumes of water produced from this site over and above the rural state.

The proposed accidental spill capture measures proposed include:

- Conversion of the small existing aerated pond into an emergency catch dam. This dam would need to be continually drained dry to ensure it has capacity to absorb a spill or fire-fighting water and a system of manual valves put in place to allow spills to be captured and temporarily stored in the dam. This approach would provide a superior level of spill protection and prevent fire water or spills from migrating into the proposed stormwater treatment ponds.
- There is also an additional emergency spill basin proposed of 4,700m^2. This basin will be operated as a dry basin, pumped out after inspection when there is water inside it. This proposed basin provides yet another critical control point on the Borgs site and is located strategically so that it could collect an accidental spill from practically the whole site.
- The proposed stormwater treatment pond would have a valve controlled outlet which would enable the pond to be drained for maintenance.
- Please note these measures are proposed in addition to the existing bunds and controls in place and are entirely voluntary.

During construction, compliance with the Blue Book would see sediment and erosion control measures put in place. It is likely that a sediment basin would be required given that it is likely that more than 1 hectare of land would be exposed. Thus if the proposed pond were constructed prior to stripping of any topsoil, it could be used as a temporary sediment basin and then converted into its final form following practical completion of works and site stabilisation. Operation as a sediment basin may require the use of a flocculent to expedite settlement prior to reuse of the water.

Continued water quality monitoring will take place in accordance with the EPL, and measurements will be taken at the V-notch weir, downstream of the two treatment ponds as shown in Figure 10 below.

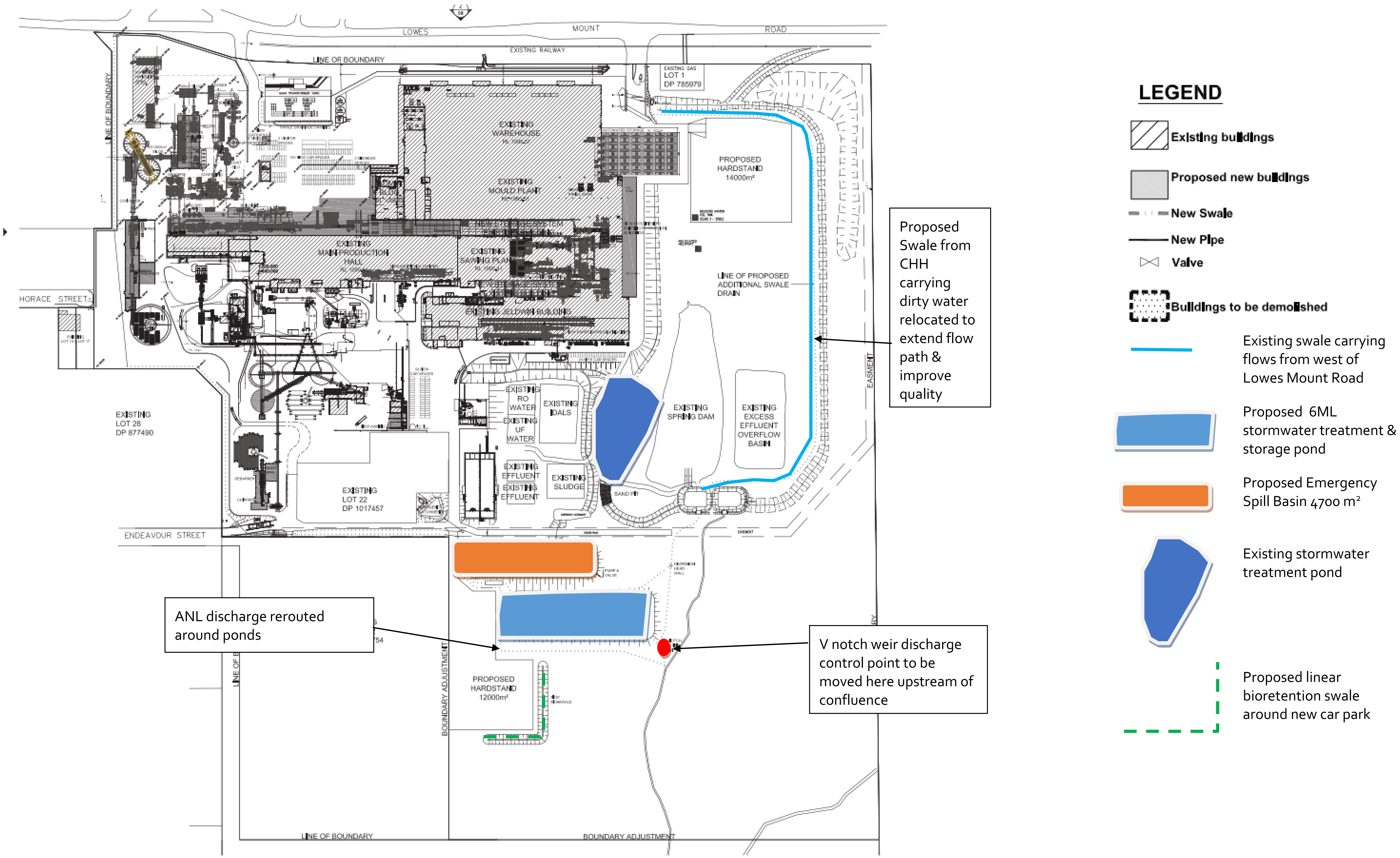


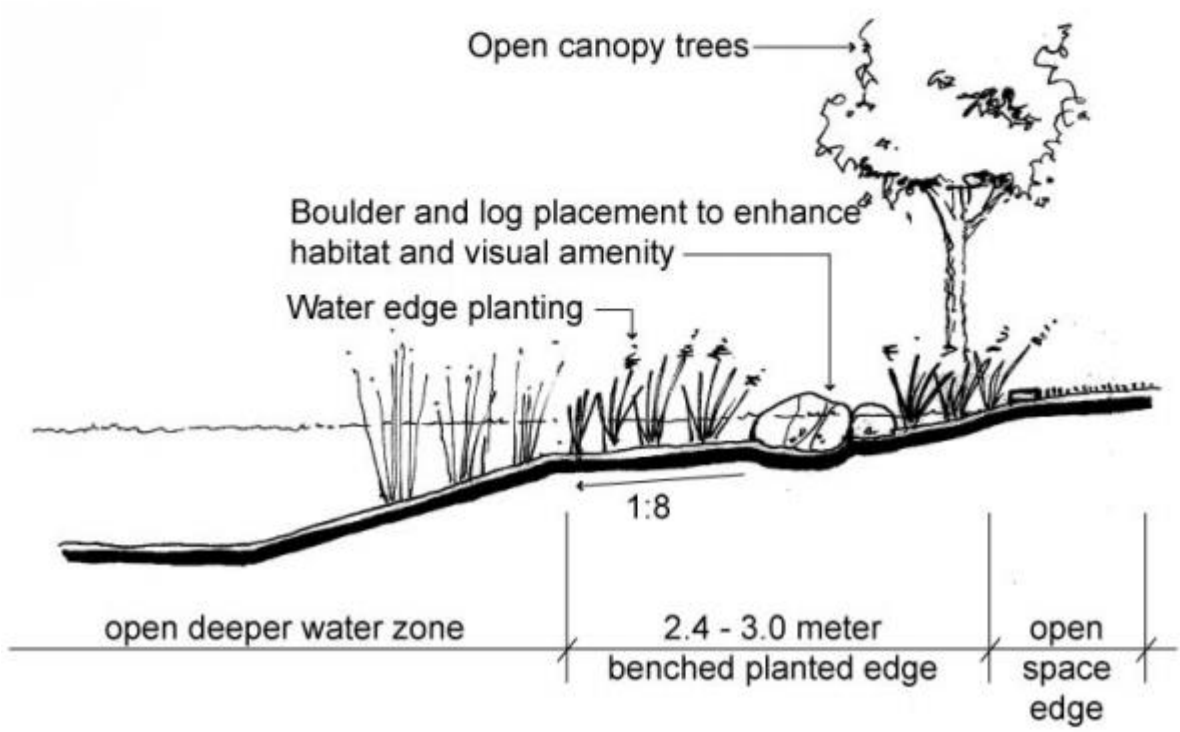
Figure 10 Proposed Mitigation Measures

The proposed stormwater treatment pond will need to be designed with care. Batters can typically be 1 in 4 and planted with appropriate reeds and sedges. The pond water levels will fluctuate significantly so vegetation must be designed to be suitable for its depth zone. Ephemeral wetland plants that can tolerate both extended wetting and drying would be most suitable.

If space permits, shallower batters would allow greater density and diversity of fringing vegetation and this would improve water quality and improve safety. The pond shall be designed to enable access by machinery to remove accumulated sediment from its bed on a routine basis. This will help to improve long term quality.

An example of a pond cross section is shown below in Figure 11Figure 11.

Figure 11 Typical water quality pond section

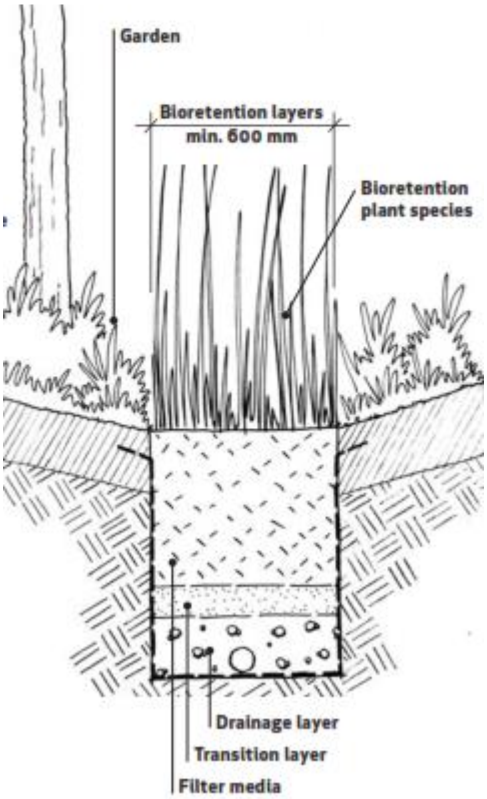


The proposed works also include a car park to be located in the south east of the site. Runoff from this car park will be treated in a linear bioretention swale and then allowed to flow across the open field toward Kings Stockyard Creek.

The proposed bioretention system is to be 60m² in area and with an assumed media width of 0.5 providing 30 m² of media in total. There should be a collection swale on top of the media that provides a minimum of 100mm extended detention depth. It was also assumed that the filter media would be 300mm deep and include a transition layer and drainage layer each 100mm deep. A subsoil drainage pipe would be located in the drainage layer and these would discharge into the field.

A typical bioswale is shown below in Figure 12

Figure 12 Typical Bioswale



7.0 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that the development can proceed without detrimental water quality impacts provided that the recommended mitigation measures are put in place.

7.1. Predicted Water Quality Results

Provided that the proposed mitigation measures are put in place then it is likely the future maximum discharge concentrations will be below current EPL limits. Should Borgs find that this is not the case then it will be necessary to retrofit additional water quality treatment measures. For example retrofitting of floating wetlands to the existing ponds would be feasible and not require any additional space and would certainly further improve water quality – notably reducing TSS if required.

The harvesting of stormwater would potentially reduce operating costs when compared to the cost of purchasing the water from Council. Therefore there is an economic incentive to pursue this action. It is however noted that it is not essential that harvesting is undertaken to meet the EPL limits. However there would be load based water quality and geomorphological benefits from harvesting and therefore it is to be considered a core component of the mitigation measures.

What this means in practice is that if the pumps or sand filters or MF/RO plants were to break down and there is no harvesting for say a month then Borgs should still be able to meet its EPL limits. Provided that harvesting resumes again once the RO plant is repaired then the load based and geomorphic benefits of the proposal would be restored. Should no harvesting occur at all then the proposal is likely to have some minor additional geomorphic and load based water quality impacts but it shouldn't breach its current licence conditions.

It is therefore recommended that the proposed mitigation measures are adopted and as much stormwater as possible is to be harvested from the ponds. The economic and environmental incentive to do so is certainly present.

7.1. Review of the EPL

It is recommended that the EPL is reviewed by the NSW EPA as follows:

1. The location of the approved monitoring point be moved downstream to the location shown in Figure 10. The reason for this is to enable discharge from the proposed new pond to be included while excluding discharge from the ANL site and Endeavour Road which are not part of the Borgs existing or proposed development.
2. It is recommended that it is not feasible to have an EPL with 100% limits and that it would be more appropriate to specify a 95th percentile level of discharge. Knowing that one day it is inevitable that this limit would be exceeded, not due to poor practice by Borgs but because this is what happens in nature. It is unreasonable to

impose an absolute maximum 50 mg/L discharge limit on Borgs while numerous other business, residential and industrial developments exceed this limit almost every time it rains. Moreover, it is unreasonable to impose this condition on Borgs on the basis of environmental protection – even fully undeveloped forested catchments have higher maximum levels of TSS concentrations in their runoff from time to time. Infrequent discharges of TSS that exceed 50 mg/L not more often than 5% of the time, i.e. 95th percentile, are not likely to result in degradation or harm to the receiving water. It is recommended that EPL be revised so that the same discharge limits are applied at the 95th percentile level rather than the 100th percentile level.

7.2. Emergency Spill Control

It is recommended that the spill control measures shown in Figure 10 are put in place. Noting that the existing aerated small dam (which is no longer required for water quality management) be converted into an emergency spill basin. It shall be operated to ensure there is sufficient spill storage capacity within it. This will require it to be drained by either pumping or gravity together with a system of manually operated diversion valves to isolate the basin if it is needed for spill control. It is recommended that spill control procedures be developed, staff trained and the procedures practiced annually.

7.3. Geomorphology Impacts

The proposed harvesting and reuse scheme will see the volume of runoff from the site reduced by about 133 ML/year compared to current levels of discharge. This will see both the frequency and volume of runoff from the site reduced. This in turn will ensure that there are only positive geomorphic and creek health benefits arising from this project (Walsh et al, 2005 & Tippler et al 2012).

7.4. Water Resources and Licencing

It is recommended that Borgs be granted dispensation from the Water Management Act (2000) for the need to acquire a water access licence to harvest the excessive volumes of runoff generated by this highly impervious site.

7.5. Soil and Water Management during Construction

It is recommended that the proposed pond be constructed prior to site stripping and used as a temporary sediment basin and converted to a permanent water quality pond once the site has been effectively sealed. Small scale sediment and erosion control measures would be needed to manage local erosion issues.

8.0 REFERENCES

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