Water Management Plan Visy Pulp & Paper Tumut Mill

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VISY
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1.0 Introduction

1.1 Background

The Visy Water Management Plan describes the water quality and conservation management at the Tumut Pulp and Paper mill. This plan consolidates the following existing plans

- Surface Water;
- Groundwater; and
- Wastewater Management Plan.

These plans, initially prepared to address conditions under the Stage 1 Development Consent Conditions 1998 (DCC 1998) have been updated to include requirements under the Project and Concept Approval Conditions 2007 (PA 2007, CA 2007) and the Environment Protection Licence No. 10232.

The Water Management Plan (WMP) aims to covers the area of land currently occupied by the Visy Mill (approximately 60 ha) and its infrastructure, located North of Sandy Creek and area of land utilised for wastewater irrigation (approximately 110 ha) located on the south side of Sandy Creek. The plan includes all activities associated with these areas and the water quality aspects of the adjacent tributaries and aquifers.

The plan is based on best environmental practice and addresses the requirements of the NSW Department of Planning and Environment (DPE), Environment Protection Authority (EPA) and Snowy Valleys Council (SVC).

1.2 Overview of Assessments

A detailed environmental assessment and calculations on water use within the mill, wastewater production and options for irrigation were undertaken for the Environmental Impact Statement dated February 1998. Approval was granted by the Minister of Urban Affairs and Planning in October 1998. A review of water management resulting in changes to the water balance and irrigation system, described in the Statement of Environmental Effects (SEE) dated March 2000 was submitted and approved in June 2000.

The Environmental Assessment on the Visy Expansion was undertaken in the Visy Tumut Expansion EA dated January 2007. The assessment included the independent evaluation of the existing irrigation operations and winter storage dam by Charles Sturt University. Approval was granted by the Minister in May 2007. A further Water Management Assessment was undertaken the during design phase of the expanded mill and the report (WMA 2009) outlining these modifications was submitted to the NSW Department of Planning in March 2009.

The following Water Management Plan incorporates the relevant aspects of these various assessments and their subsequent modifications.

1.3 Environmental Management System

The Water Management Plan is a component of the site’s Environmental Management System (EMS), certified to ISO 14,001:2015. The Environmental Management System consisting of the Operation Environmental Management Plans, operational and environment procedures, and detailed monitoring and auditing program aims to maintain compliance with Environmental regulations and achieve best-practice standards through a system of continual improvement, as represented below in Figure 1.0.

The EMS is integrated with the site's Safety and Quality management systems which are both certified to the relevant standards (i.e. ISO 9,001:2015, ISO 45001:2018).

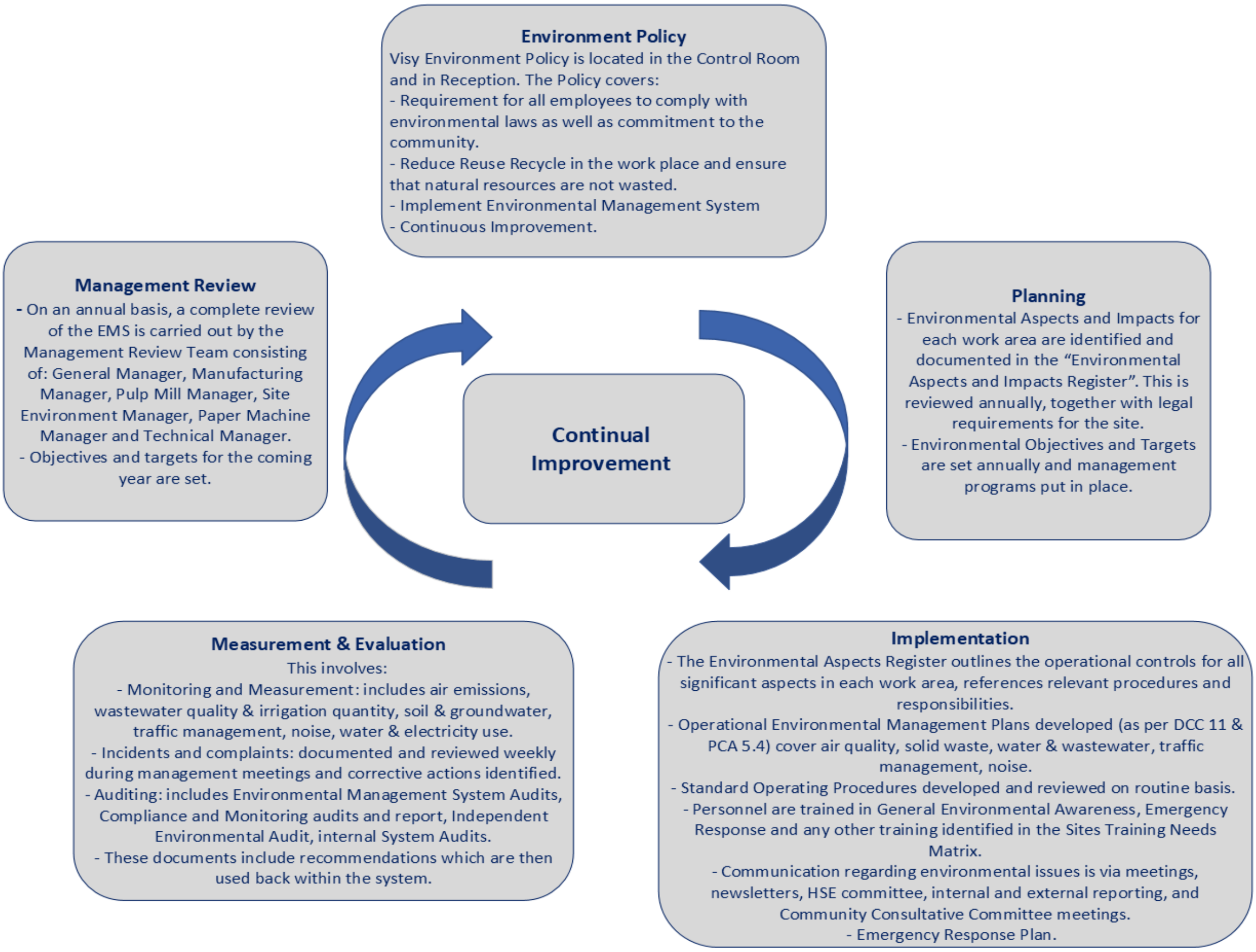

Figure 1.0 Overview of Site Environmental Management System (EMS) Continual Improvement.

2.0 Legal Requirements

The NSW legislation for granting of development approval for the Visy Mill Development is the Environment Planning and Assessment Act 1979. Approval of the initial Development (Stage 1) was granted under section 91AB (2) of the Act. Approval was granted subject to meeting the Development Consent Conditions under approval S96/00598. The subsequent Visy Tumut Mill Expansion Development was granted under Part 3A. This approval was granted subject to meeting the Concept and Project Approval Conditions under approval 06_0159.

The Protection of the Environment Operations Act 1997, is the key piece of environmental protection legislation administered by the EPA to authorise the carrying out of scheduled activities at Visy Tumut. Under this legislation Visy are issued with a Licence (Licence No. 10232) to operate subject to satisfying the various conditions of this Licence that includes air and water emission limits, waste receival and disposal and requirements for monitoring and reporting.

The Protection of the Environment Operations Act, governs releases to surface water, groundwater or land as well as the granting of the site Environment Protection (EP) licence. The EP licence contains the requirements for monitoring, reporting and notification in the case of any incidents on site that may impact on surface water, groundwater or land.

The statutory requirements in regard to surface, ground and wastewater management which apply to the Tumut site are:

- Documents as listed under Condition 1 of Development Consent Conditions for the initial development(S96/00598 DCC);
- Additional documents as listed under Condition 2 of Development Consent Conditions for the modified development(S96/00598 DCC_ MOD -45-5-2003-1);
- Environment Protection Licence (Licence No. 10232);
- Documents as listed under Condition 1.1 of Project Approval Conditions for the Expansion (06_0159 PA);
- Documents as listed under Condition 1.1 Concept Approval Conditions for the Expansion (06_0159 CA);
- Statement of Commitments Stage 2 (April 2007);
- Documents as listed under Condition 1.1 Modification Approval for the Expansion (06_0159 Mod 1); and
- Water Access Licence 40AL405643 & 40AL405644 (Part of 40CA403012 Combined Approval, formally 40AL40336), under the Murrumbidgee Water Sharing Plan.
- Water Licence 40AL412076 (Part of 40WA412077 Work Approval, formally 40BL191801 – 40BL191802).

Regulations concerning use and releases to surface water, groundwater or land, relevant to this site are contained within the following legislation and standards:

- *Environmental Planning and Assessment Amendment Act* 2012;
- *Protection of the Environment Operations (General) Regulation* 2009;
- *Protection of the Environment Operations Act (Clean Air) Regulation* 2010;

- *Water Management Act*, 2000;
- Murrumbidgee River, Water Sharing Plan, 2004;
- *Water Act*, 2007; and
- Environmental Guidelines for the Use of Effluent by Irrigation (DEC, 2004).

3.0 Objectives and performance Outcomes

The objectives and performance outcomes for the Water Management Plan are described below in Table 1.0.

Table 1.0: Objectives and Performance Outcomes

Objectives	Performance outcomes
• Comply with all statutory requirements. • Separation of clean storm-water runoff from dirty or potentially contaminated runoff. • Ensure there are no downstream surface water impacts on Sandy Creek. • Ensure there are no impacts on groundwater levels and quality from irrigation. • Minimise Freshwater consumption. • Ensure there are no negative environmental impacts on soil profile from irrigation. • Minimise odour impacts from Wastewater Treatment Plant and irrigation areas. • Ensure all spills from Process are contained within bunded areas. • Ensure all spills external to bunded areas are contained to the mill site. • Periodically review and assess the Water Management Plan.	• Appropriate actions are undertaken to quickly and effectively respond to spills, or mill upset events. • Fresh water consumption is routinely monitored and reported to Divisional and Corporate Management. • Plant and equipment is operated and maintained in accordance with the Operational and Maintenance procedures. • The results and analysis of all monitoring is periodically reviewed and compared to EP Licence limits and other relevant guidelines. • A summary of all environmental Monitoring is included in the annual Environmental Compliance Report and Annual Return. • All Wastewater plant checks are undertaken and appropriate actions immediately undertaken to address any issues. • All complaints are recorded and appropriate actions taken to quickly and effectively respond to the complainant. • Surface and wastewater quality monitoring is undertaken in accordance with requirements of the EP Licence and Consent Conditions. • Groundwater levels and quality are monitored in accordance with EP Licence and Consent Conditions. • Undertake periodic auditing to ensure requirements of Water Management Plan are adhered to. • Undertake periodic training on Spill Response Procedures. • Undertake biennial review of Water Management Plan.

4.0 Water Issues, Management Safeguards and Controls

4.1 Surface Water Quality

4.1.1 Surface Water Diversion

The mill site is located in the valley of Sandy Creek which is a south-east draining tributary of the lower Gilmore Creek. The mill is located north of Sandy Creek and on gently undulating land at the base of the Table Top Mountain Range that runs from north-west to south-east. The catchment area from the top of the ridge slopes from the north to the south draining towards Sandy Creek, Figure 2.0. The vegetation within the catchment area consists of existing woodland remnant areas along the peaks and higher reaches and grazed pastures with scattered paddock trees along the lower slopes.

Runoff from up-slope of the mill site is collected in the 'Clean-runoff Diversion Drain' and diverted into existing drainage lines to the west and east of the mill site, Figure 2.0. The existing drainage lines flow some 700 to 800 metres through existing pasture areas on Visy property prior to discharging into Sandy Creek. The drainage lines were originally fenced off to exclude stock. A re-vegetation program was established to reduce soil erosion and resulting water quality impacts on Sandy Creek while also providing habitat for local wildlife. The native vegetation planted is now well established.

4.1.2 Surface Water Runoff from Mill-Site

The mill site covers approximately 60ha. Clean stormwater is segregated from process areas to prevent contamination. All rainwater falling inside of externally bunded process areas is collected and re-used within the process.

Rainfall falling on building roofs is collected and directed through downpipes into the Mill's underground stormwater drainage network, Figure 3.0. The drainage network has been designed to accommodate up to a 1 in 10 year storm event. Similarly runoff from roads and surrounding landscaped and hardstand areas is collected and diverted via open drains into the drainage network from where it discharges into the Stormwater retaining basin.

The Stormwater retaining basin separated into two sections dissected by the main road into the Administration car-park. Three culverts located under the road are equipped with isolation valves to allow the sections to be isolated. The main outlet of the pond discharges into a contour drain that directs all flows in an easterly direction until it reaches an existing drainage line running north/south directly east of the mill site. The drainage line flows some 700 metres along the Visy Property, through a sediment control structure and farm dam structures before discharging into Sandy Creek, Figure 2.0.

The Stormwater retaining basin function is to act as secondary containment to capture all major spills or up to 90 minutes of fire water. It incorporates a spill containment boom which prevents floating debris and oil spills and a gate structure which can be manually shut to prevent contaminated runoff from discharging.

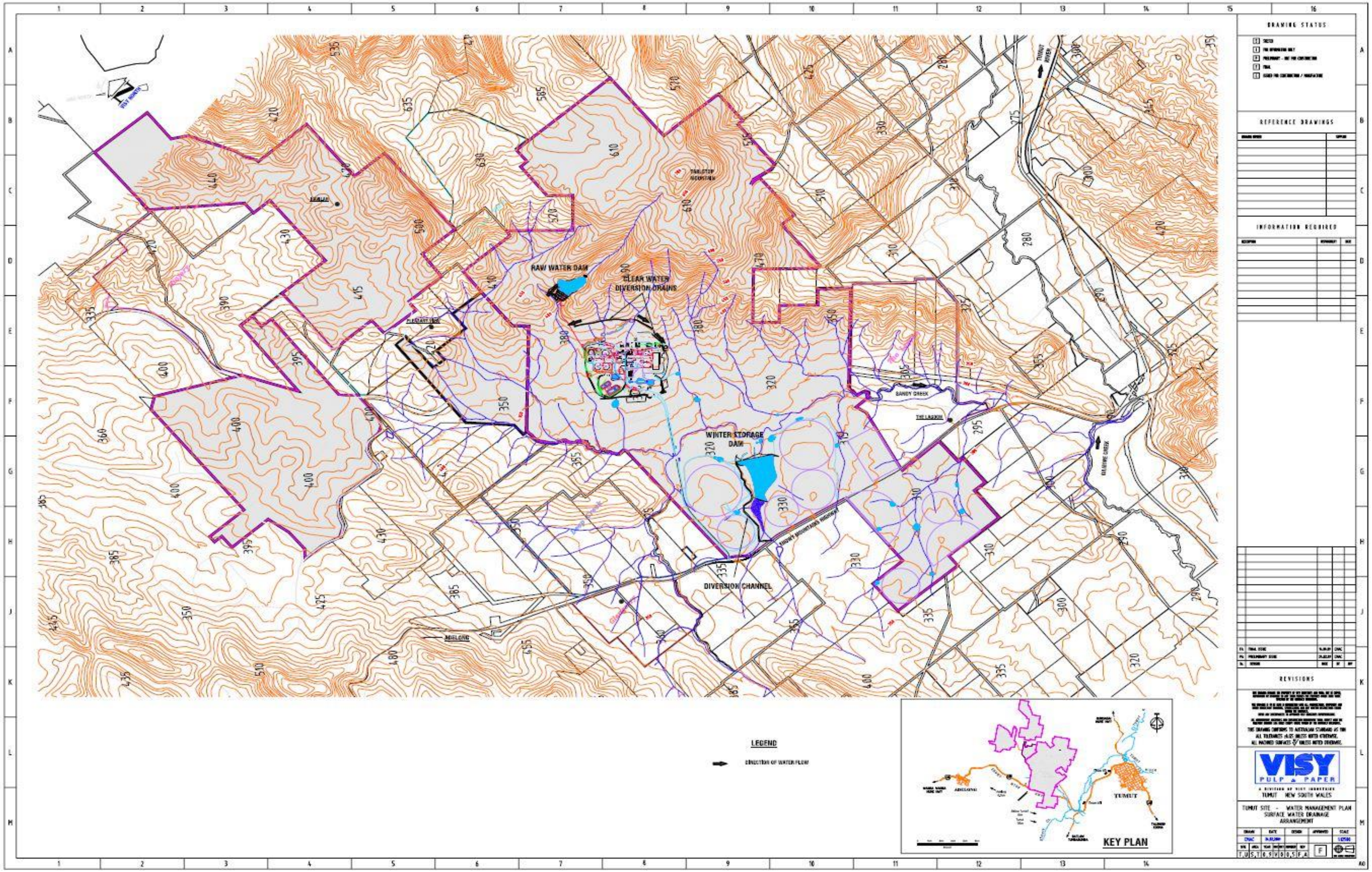

Figure 2.0 Sandy Creek Area and Mill Site

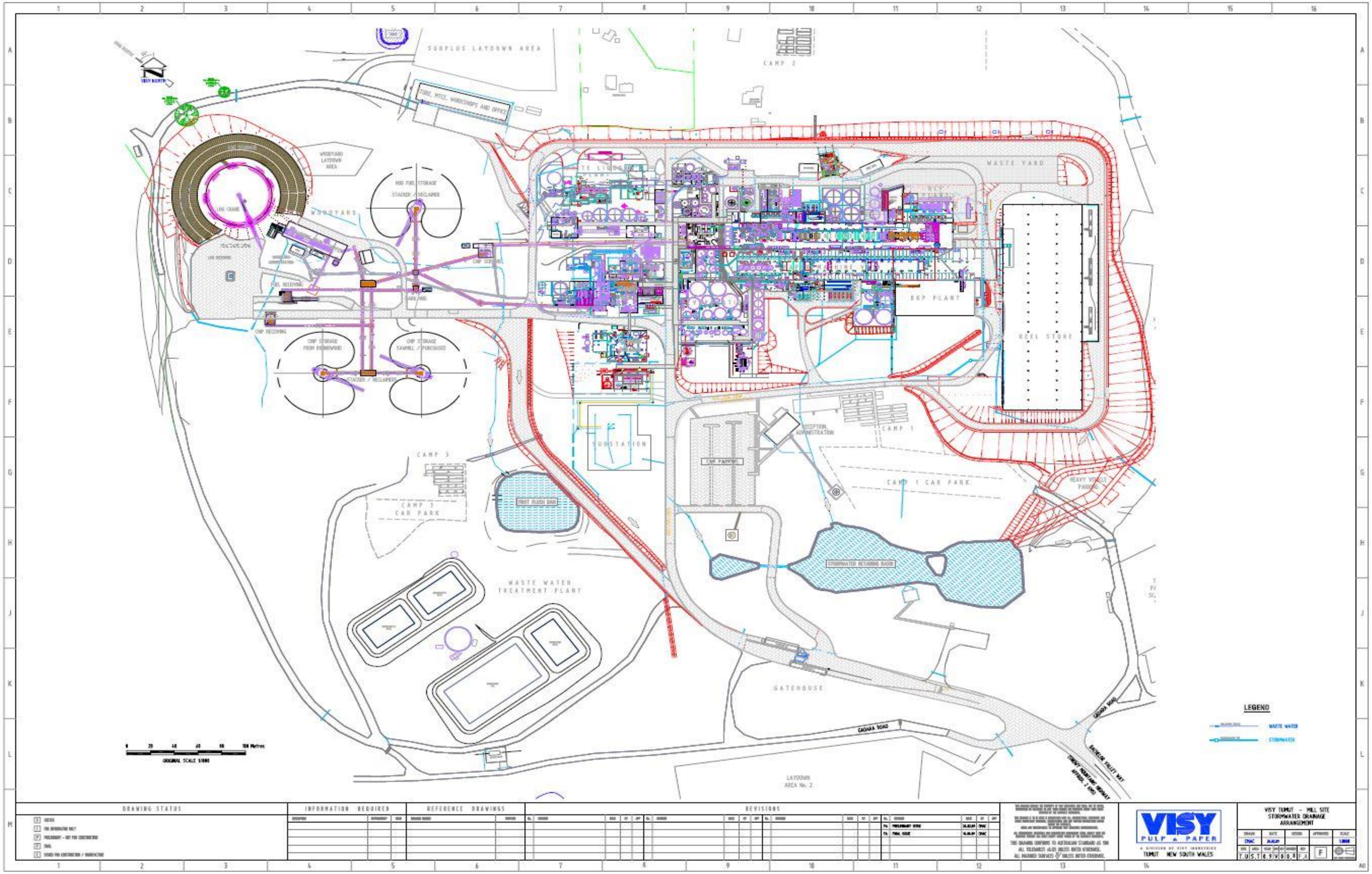

Figure 3.0 Stormwater System on Site

4.1.3 Surface Water Runoff from Woodyard

Surface runoff from the Woodyard Area is not suitable for discharge to Sandy Creek due to the potential for it to contain floating wood debris and tannins extracted from wood storage piles. Therefore all runoff from the Woodyard is collected separately in open drains and channels and directed to the clay lined Woodyard Runoff Dam (known as the First Flush Dam) located at the South-East corner of the Woodyard, Figure 4.0. A coarse screen is located on the inlet to the dam to trap any debris prior to flowing into the dam. This screen is cleaned out on a regular basis and any organic matter disposed of on the Boiler Fuel pile. Runoff from the RST 360 Stacker Reclaimer is collected via a drainage ring main around the perimeter which collects in a sump and is pumped across to the first flush dam. The outlet from the dam is fed via gravity to the Cooling Ponds at the Wastewater Treatment Plant (WWTP). Flow from the Woodyard Runoff Dam is regulated to control temperature in the Cooling Ponds.

Figure 4.0: Woodyard Runoff Dam

4.1.4 Stormwater Runoff from Waste Paper Storage Area

Stormwater runoff from the storage of baled waste paper can contain litter in the form of waste paper and plastics. Due to the pavement design, most of the fire water would be directed back into the adjacent RCF plant floor drainage system, with the remainder captured via storm water drains and directed to the Stormwater Pond. The drains are fitted with mesh covers to trap potential contaminants, so they do not reach the main Stormwater Pond. Perimeter fencing around the waste paper area and regular housekeeping reduces the amount of litter that could enter the stormwater system outside of this area.

4.1.5 Process Containment Areas

All main process areas at the mill site are separately bunded to contain process spills. The main bunded areas are shown in Figure 5.0. (Note that this drawing refers to more detailed operational drawings which show the dimensions of the bunds). Each area has tanks and pressure vessels of various sizes and a floor drainage system that transfers spills to a common sump. Each bunded area has been sized to contain 110% of the largest tank. A separate drawing is also provided which shows the individual external tank areas,

Figure 6.0. (Note that this drawing also refers to more detailed operational drawings showing the size and contents of the main vessels).

A more detailed description of each process containment system is provided below.

4.1.5.1 Recausticising and Lime Kiln Area

The Recausticising and Lime Kiln area consists of a number of large process vessels. These are namely:

- Green Liquor Dregs Tank
- Causticiser Tanks
- Green Liquor Equalising Tanks
- Green Liquor Tank
- Weak Wash Tank
- White Liquor Tank
- Wash Water Tank
- Dilution Tank
- Lime Mud Tanks
- Lime Mud Mixing Tanks
- Sulphamic Acid Mixing Tank
- Formic Acid Tank

Green and white liquor are chemical mixtures and although not classified according to Australian Dangerous Goods Code, are similar to a Class 8, Packaging (ii) Dangerous Good. All the above tanks excluding Sulphamic and Formic acid are located within a common bunded area. In the event of a concurrent spill the chemical mixtures are compatible non-reactive substances. Sulphamic acid mixing and Formic acid tanks are separately bunded to prevent any spills from mixing and reacting with the other chemical mixtures. Sulphamic acid and Formic acid are considered a Class 8 PG III chemical according to the Dangerous Goods Code. The volume of the Sulphamic acid mixing tank is $28m^3$ and Formic acid tank is $6\ m^3$.

The height of the bund wall surrounding the main bunded area is 450mm. Should a rupture occur near the top of any of the tanks, splash shields on each tank (a fibreglass insulation layer between the tank and the outer Zincalume cladding) directs any spills downwards to the base and into the bunded area.

The levels in these tanks are constantly monitored by operators via the mill's Distributed Control System (DCS). Alarms are programmed to signal, in the event of high or low tank levels and will alert operators to tank overflow or a sudden loss in storage. In the event of a rupture/spill from one of these process vessels, the spilt liquid is directed by the slope of the floor to the process mill drains. The liquid then enters the spill sump and is pumped to the $1000\ m^3$ capacity Weak wash storage tank. In the event that the Weak wash tank becomes full during a spill, the remaining liquid can be transferred to the main Spill Tank in the Evaporation area.

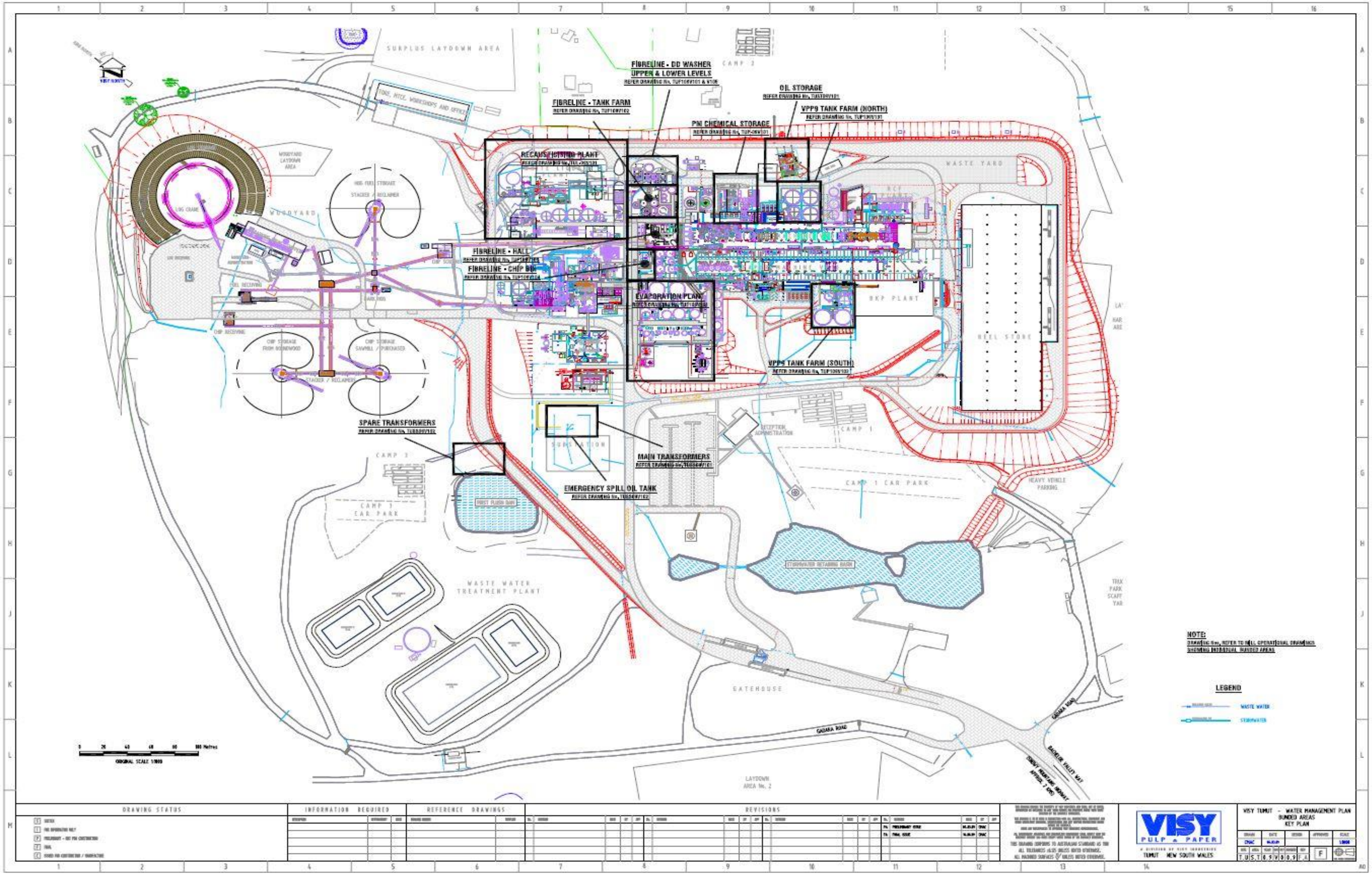

Figure 5.0 Main Bunded Areas on Site

During rain events, runoff enters the mill drains in the bunded area. The runoff may contain residual chemicals from minor spills, flushing water and liquor from sampling and so is directed to the dirty water sump. The contents of the dirty water sump are pumped across to the Weak Wash Tank, which is then fed back into the process. Should the weak wash tank be full, provisions allow the contents of the sump to be pumped across to the Spill Tank in the Evaporation Area or to the 6ML dam at the WWTP.

4.1.5.2 Evaporation area

All tanks in this area are process vessels and are listed below:

- Feed Liquor Tanks
- Vapour compressor Feed tank
- Soap Decanter
- Soap Storage Tank
- Spill Liquor Tank
- Foul Condensate Tank
- Clean Condensate Tank
- Medium strong liquor tank
- Heavy Black Liquor Tanks (Pressure Vessels)
- White Water Condensate Tank
- Intermediate Condensate Tank
- Evaporator Effects 1 to 6 (Pressure Vessels)
- Stripper Column
- Vapour Compression Evaporator (Pressure Vessel)

The Evaporator Effects, Heavy Black Liquor tank and Vapour Compression Evaporator are registered pressure equipment/vessels designed to AS1200.

The largest tanks are the Feed Liquor Tanks with a volume of 2000m3 for each tank. The height of the bund wall surrounding the Evaporation area is 950mm. The volume of the bunded area is 2422m3.

Tanks are clad with a splash shield (i.e. have fibreglass insulation and outer Zincalume cladding) which prevents leaks near the top of the tank from spraying out over the top of the bund. Spills are directed downwards to the base of the tank and into the bunded area.

A high level alarm on the probe in the main Evaporation Sump alerts the Operator through the DCS that there may be a spill. In the event of a spill, the spilt liquid is directed to the mill drains within the Evaporation bunded area. The liquid enters the spill sump and is pumped to the spill liquor tank in the Evaporation Area. All rainfall collected inside the bunded area, due to the potential for contamination, is also transferred across to the Spill Tank. The Spill Tank is utilised for the processing of all major process spills on site through the Evaporators.   The volume of this tank is 2000m3 (this volume is in addition to the bund area calculation above of 2422 m3 which forms part of the spill containment system, therefore the total spill catchment volume is 4422m3). The contents of the spill tank are combined with weak black liquor and processed through the Evaporators.

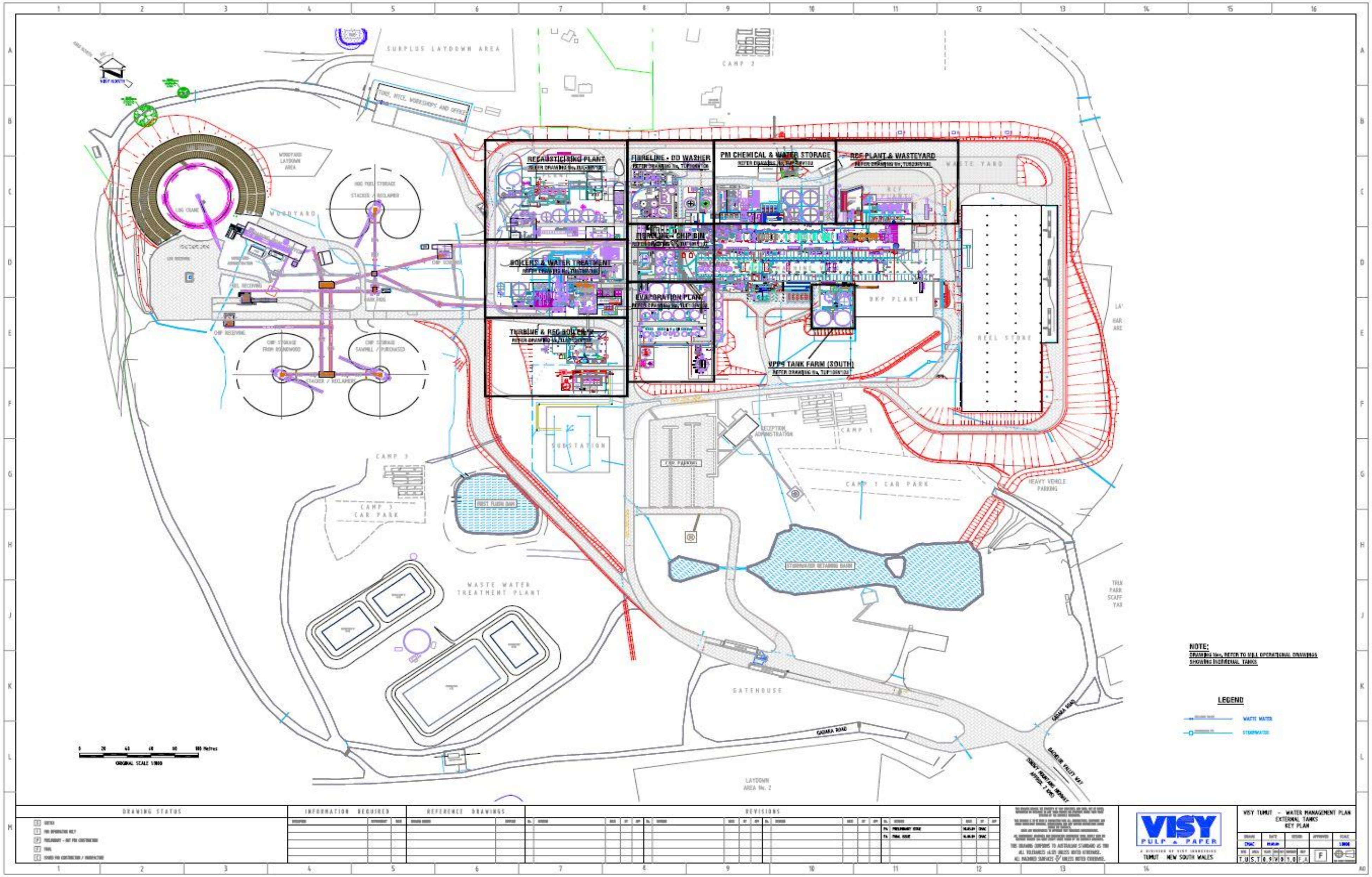

Figure 6.0 External Tank Areas on Site

In the event that the spill tank is full, additional volume is provided by the Cooling and Emergency Spill Ponds located at the WWTP which can be later returned back to the spill tank in the Evaporation Area once capacity becomes available.

Procedures and training ensure that appropriate personnel correctly determine the destination of spills and or water from the sump.

4.1.5.3 Liquid Methanol System

Liquid methanol is produced continuously from condensing of the Stripper off Gases from the Stripper Column in the Evaporation area. The Methanol is stored in the Methanol Tank prior to transferring via pump across to the Recovery Boiler Methanol Burner. Methanol although not considered a Dangerous Good has an equivalent Dangerous Good classification of Class 3 packaging group (ii) liquid. Due to the inherent flammability of this substance, the Methanol Column and Tank are contained within an isolated bund, with adequate separation distance from other process equipment. These vessels have been assessed and classified in accordance with AS2430 with specific hazardous zoning and included on the site's hazardous zoning plan.

The methanol storage level is typically operated at 30% of its capacity. Level control on the tank ensures that it cannot overflow as at high level indication, the Methanol Column is automatically shut down and the Stripper off Gas supply isolated. Any methanol that does spill inside the bund is initially diluted at a rate of 10:1 to ensure that it is no longer combustible before transfer via gravity to the Evaporator Sump. Rainwater collected in the bund is also transferred to the Evaporator sump. In the evaporator sump it is then pumped into the Spill Tank to be processed through the Evaporators.

4.1.5.4 Fibreline

All tanks in this area are process vessels and are listed below:

- Spill Collection Tank
- Wash Filtrate Tank
- Brownstock DD Washer Filtrate Tank
- Blow Tank
- Digester (Pressure vessel)
- Impregnation vessel (Pressure Vessel)
- HD Storage Towers
- Diffuser filtrate tanks
- Presate tank
- Liquor surge tank
- Washwater tanks
- Seal water tank
- Seal water return tank

The Digester and Impregnation vessels are registered pressure equipment/vessels designed to AS1200. The largest tank (excluding the digester) is the Filtrate Tank with a volume of 700m3. The total volume of the bunded area is 794m3.

All tanks are clad with a splash shield from the base to half way up the tank. This cladding is primarily for safety reasons for operators in the area, as the tank contents may be at high temperatures. The tank closest to the bund wall, Spill Collection Tank is entirely clad from top to bottom for spill containment reasons.

All tanks are equipped with level transmitters that signal an alarm at high levels to alert operators of any potential overflow situation. Any spills in this bunded area are directed by the fall of the floor into mill drains and from there into the main sump. All spills entering the sump will be automatically pumped to the 180 m3 capacity Spill Collection Tank in the Fibreline Area. From the spill collection tank, the spill is pumped back into the process. Should the spill volume exceed the capacity of the spill tank and spill containment area, the excess can be pumped across to the Spill tank in the Evaporation Area and further transferred if required, to the Emergency Spill Pond in the Wastewater Treatment Plant.

All rainwater captured inside the bunded area is transferred from the main sump to the Spill Collection Tank from where it is combined with other process related liquids/liquors and utilised in the process.

Statutory pressure vessel inspections and testing are undertaken on the Digester and Impregnation vessel. Operators are trained in spill response procedures and manual operation of the stormwater pond.

4.1.5.5 Paper Machine

The following permanent tanks are located external to the Paper Machine Buildings within appropriately bunded areas:

- Process Tanks
- Top, Middle and Bottom Silos
- Broke Tanks
- White Water Storage Tank
- Clear Water Storage Tank
- Pulp Storage Towers
- Dump Chest
- Recycled Fibre Tanks
- Pulping Water Tower
- Cloudy Filtrate Tanks
- Chemical Tanks
- Alum Tanks
- Drainage Aid Tank
- Retention Aid Tank
- Sizing Agent Tank
- Paper Machine De-foamer
- Pulp De-foamer
- Biocide
- Dye Tanks
- Liquid Hydrosulphite Tank

The tanks in the Paper Machine area are a combination of, process tanks which contain primarily process water and pulp during various stages of the process, and chemical storage tanks for chemicals used in paper manufacturing.

All process tanks are located within a common bund within an area that incorporates the ground floor of the Paper Machine Buildings. Any overflow within this area is directed to a common sump via a system of open drains. From the sump, any spills are transferred across to the White-Water Storage Tank in the Paper Machine area to be re-used in the process primarily for wash down stations, pulp washing, showers and dilution of pulp. The capacity of the clear water tanks for VPP9 is 1.7 ML and for VPP10 is 4.1ML. In the event of a large process water spill beyond the capacity of the paper machine's mill drain system, the excess spill will overflow into the Evaporator area or be pumped across to the Emergency Spill Pond at the Wastewater Treatment Plant. From the Emergency Spill pond, the excess spill can be transferred back into the process as capacity becomes available.

All chemicals are stored within the Paper Machine chemical area. Except for Hydrosulphite, they are located in a common bund. Small spills or overflows in this area can be directed into the Paper Machine drainage system. Any major spills will be recovered and pumped back into the storage tank or 1 m3 capacity IBC's. The Liquid Hydrosulphite tank is separately bunded as it contains a Class 8 PG ii chemical. The bund is designed to contain 110% of the tank volume. Any small spills are neutralised prior to being pumped into the paper machine mill drainage system.

The chemical area has a common chemical tanker unloading area that is designed to capture and contain spills. Floor drains in the unloading area are connected to the Chemical Area floor drainage system. Any major spills can be contained within this area and either transferred back into the Tank or released into the Paper Machine mill drain system. All the hose connection points are well labelled to ensure that hoses during unloading activities are connected to the appropriate tank. Chemical unloading is carried out in accordance with the written procedures.

The Biocide is classified as Class 8 PG 3 chemical. All other chemicals are considered non-dangerous.

4.1.6 Chemical Storage Tanks

4.1.6.1 Caustic Soda Tank

The caustic soda (Sodium Hydroxide) tank is currently located adjacent to the redundant Sulphuric Acid Tank bund. Caustic Soda is at 47% concentration and designated as Class 8 PG III chemical according to the Dangerous Goods Code. The volume of the tank is 43.3m3 and the bund has been designed with 50m3 capacity.

The caustic is transferred to the Caustic Soda Tank via a road tanker from the adjacent common Tanker unloading area. Unloading is carried out in accordance with *Procedure U2: Caustic Unloading Procedure.* This procedure requires the stormwater bypass valve and Sulphuric Acid Bund to be closed and the valve on the Caustic bund to be opened to allow any spills that could occur during delivery to overflow from the truck into the Caustic bund. Labels on the valves clearly indicate which valves need to be opened and closed. Bulk tankers are required to have their brakes inter-locked to prevent the risk of the truck moving while unloading chemicals and to avoid hoses becoming detached. Upon completion of unloading activities the transfer area is hosed down to ensure there are no remaining residues of caustic. The stormwater bypass valve is re-opened once clean-up has been completed.

There are future plans to relocate the Caustic Tank to the Recausticising Area B. A new tank will be installed in a separate fully contained bund within the Recausticising and Lime kiln bunded area with capacity well within the requirements of AS3680.

A proposed new unloading area is to be located directly north of the Recausticising and Lime Kiln area and will also be fully bunded. Any spills within the unloading area will be discharged via gravity to the main sump. From the sump the spilt caustic is pumped to the Weak Liquor Tank in the Recausticising Area or the Spill Tank in the Evaporation Area depending on levels in each tank.

4.1.6.2 Turpentine Tanks

Turpentine is a by-product from wood extracted during the chemical pulping process. It is produced on a continuous basis from condensation of vapours extracted from steaming chips in the Chip Bin. Turpentine has a high re-sale value and is used in the manufacture of perfumes.

Turpentine, classified as Class 3 PG III in accordance with Dangerous Goods code, is a flammable liquid with flash point of 35^{0}C and is stored in two 55 m^3 capacity storage tanks. These tanks are contained within a bunded area adjacent to the redundant Sulphuric Acid Bund, which is now used as a contingency bund for the Turpentine, via a relief valve through the two-hour fire rated wall which separates the bunds.

Turpentine from the process is transferred from the Turpentine Decanter across to the storage tanks. The turpentine tanks have a water seal system. During filling operations, water which has a higher specific gravity and total immiscibility, is displaced with turpentine. This ensures that the tank is always full, and no volatile explosive gases are formed. During transfer from storage to road tanker, the turpentine removed is displaced with water. Transfer to tanker is carried out in accordance with *Procedure: VP9-10-10.4-OP-026:Turpentine_Red Oil Deliveries*. Any spills of turpentine during transfer from the tanks to road tanker vehicles are captured by the drain alongside the transfer point and the bunded unloading area. Spills are transferred back into the storage tank.

4.1.6.3 Diesel Storage Tank

The Diesel storage tank is located in a self-contained bunded area. The tank volume is 30,000L and the bund capacity is 50,000L. The Diesel storage bund has roof and walls to prevent rain entering and includes a Tanker transfer area. The transfer area drains via gravity into the diesel tank bund to provide sufficient capacity for a road tanker. Any spills that occur in this area are transferred across to the Spill Tank via the Fibreline sump.

4.1.7 Spill Response and Secondary Containment

Procedures are in place in the event of a spill outlining contingencies and emergency response actions for operators to undertake.

- Operators have been trained in these procedures:
- Spill Response External to Bunded Areas HowTo, HOWTO-VPP-TUM-HSE-048;
- Fire Water Control HowTo, HOWTO-VPP-TUM-HSE-046; and
- Spill or Fire Water to WWTP from Stormwater VP9-10-10.4-OP-013.

In addition to the bunding and spill containment systems described in earlier sections and the spill procedures developed for the site, spill kits are located around the site in key areas such as the chemical delivery and storage areas. An Emergency plan is in place for the site and all operators have been trained in emergency preparedness response.

During a spill, the spillway from the Stormwater retaining basin would be manually shut, giving approximately 6.47ML of storage capacity between the overflow pipe and spillway for surface water retaining once the valve to the overflow has been isolated.

4.1.8 Fire Water Management

4.1.8.1 Containment

The fire suppression systems on site incorporate both automatic and manual firefighting systems. These systems are mainly located in process areas where all fire water is collected within the process area bunds thus minimising the risk of fire water entering the storm-water system. Should fire water enter the storm-water system, it can be retained in the main storm-water pond. The highest risk areas from a fire and fire water overflow are the Reel Store and the Waste Paper Area.

The Reel Store is protected with an automatic fire sprinkler system designed for maximum discharge of 10,900 litres per minute. All of the fire water from this area would overflow the building into the storm-water system, discharging into the site's retaining pond. To contain 90 minutes of fire water from the operation of the fire sprinkler system, the maximum on site storage capacity is required to be 981,000 litres or 981 kL. To allow for maximum of four manual firefighting hoses each delivering 950 litres/minute, an additional fire water storage capacity of 342,000 litres or 342 kL would be required. Therefore a total fire water storage capacity of 1,323 kL is required to contain 90 minutes of fire water from this area.

The external Waste paper area is protected with high performance fire monitors that can deliver up to 12,000 litres per minute of water to the area. Due to the pavement design, most of the fire water would be directed back into the adjacent RCF plant floor drainage system. A proportion, depending on the location of the fire, could overflow into the storm-water system. In a worst case scenario assuming 75% would overflow into the storm-water system and enter the storm-water retaining pond, the amount of fire water to be retained over 90 minutes would be 810,000 litres or 810 kL. Allowing for four manual firefighting hoses, the total fire water retaining capacity based on a waste paper fire is 1,152 kL.

Therefore the estimated maximum fire water retaining capacity required is 1,323 kL based on the Reel-Store fire scenario above.

The surface area of the existing Storm-water retaining pond is approximately 9,530 square metres with average depth of 0.8 metres at the low discharge level. As the Storm-water retaining pond always holds water, the low discharge level on the outlet weir to the Storm-water retaining pond is at RL 352.85 (AHD). The isolation gate closed during emergencies on the outlet weir in accordance with HowTo: Fire Water Control HowTo HOWTO-VPP-TUM-HSE-046, can increase the overflow level to RL 353.52 (AHD) providing a maximum buffer storage capacity of 6,387 kL.

Therefore this storage is more than adequate to contain the 90 minutes of fire water at a maximum of 1,323 kL as calculated above for the Reel store.

4.1.8.2 Treatment and disposal of firefighting water

Contaminated firefighting water would require analysis prior to being discharged from the Mill. Analysis would involve sampling the firewater with the subsequent analysis conducted by a NATA accredited laboratory. The water would be analysed for specific analytes for comparisons to the Australian Water Quality Guidelines for Fresh and Marine Waters (2000). Should quality of fire water meet the guideline level it can be discharged with-out further treatment. Otherwise it will need to be treated on site in either the Wastewater treatment plant or transferred to the Spill Tank in the evaporation area.

If fire water quality excludes it from being treated on site it would be pumped into a series of road tankers and disposed offsite at an appropriate facility. To prevent a risk of overflowing during a storm event while fire water is being held in the storm-water pond, fire water will be transferred across to the 6ML Dam at the WWTP in accordance with Procedure: Spill or Fire Water to WWTP from Stormwater VP9-10-10.4-OP-013 until treatment or disposal can be completed.

4.1.9 Storm-water from Wastewater Irrigation Area

The Wastewater Irrigation area is situated on slightly undulating farmland between Sandy Creek to the North and Snowy Mountains Hwy to the south. All runoff within the irrigation area, is diverted through a series of contour drains into small collection dams. During the irrigation season the contents of the collection dams are pumped across to the Winter Storage Dam. During the non-irrigation season when there would be no runoff from irrigation application, the dams are pumped into the nearby water courses for discharge into Sandy Creek.

All 'clean' runoff from the southern side of the Snowy Mountain Highway, upstream of the irrigation area, drains into an existing natural drainage line that is diverted around the western perimeter of the Winter Storage Dam and irrigation area via a diversion channel and into Sandy Creek, Figure 2.0. Contour drains built along the top of the diversion channels directs runoff from irrigation areas away from the channel. The diversion drain has been designed for flows of up to 5.5m3/second (i.e. all flows less than 1 in 10 year event) as described in the Statement of Environmental Effects March 2000.

A wetland area has been created in the low lying area between the diversion channel and the upstream embankment of the Winter Storage Dam. This area has a small catchment that tends to fill and overflow into the Winter Storage Dam during the wetter months and dry out during the dryer periods. Re-vegetation using native trees and shrubs has been established around the wetland area providing habitat for various native birds and reptiles. Fencing has been erected around this area to exclude stock to reduce the amount of disturbance. The wetland also provides a more natural visual aspect to the irrigation area from the Snowy Mountains Highway.

4.2 Fresh Water Management System

4.2.1 Overview

Freshwater is primarily used as boiler-water for steam generation, mechanical seals on pumps, and make-up to the Paper Machine and the Cooling Water System. A large proportion of the water used in the process is derived from the water entering with the woodchips which is extracted during the digestion process then evaporated to produce secondary condensates. The secondary condensate streams are of variable quality and are reused in parts of the mill including the lime kiln and paper machines to substitute for freshwater. Treated effluent after undergoing disinfection is also returned or re-used as cooling water.

4.2.2 Raw Water Supply System

The raw water supplied to the mill is pumped from the Tumut River via a 375mm diameter DICL, 14km pipeline. The river pumping station located on the banks of Tumut River consists of a below ground inlet structure, pumping well and coarse screening and two submersible pumps. The river pumps and pipeline infrastructure from the river to the booster pumps located adjacent the Visy Wastewater Treatment Plant, is operated and maintained by the Snowy Valleys Council under agreement with Visy. Water metering for the purposes of water accounting is from the pump station and is linked in real-time through telemetry back to the Mill's electronic Distributed Control System (DCS).

Water from the pump station is transferred to the 190ML capacity Raw Water dam (also known as the Fresh Water Dam) located on the Visy property to the north east of the mill, Figure 2.0. The dam acts as buffer storage to allow for scheduled or unscheduled disruptions to water supply from the river or from the prospect of zero allocations.

As the dam is located approximately 60 metres in elevation above the Mill site, water for process requirements is supplied to the mill by gravity through a common 375mm diameter pipeline. The dam also supplies all fire water requirements for the Mill through a separate 375mm diameter pipeline.

Bore water can be extracted from DB6 and DB10 is pumped directly into the 375mm diameter Process Water outlet of the Fresh Water Dam. Submersible pumps and rising mains, complete with drawdown measurement and flow meters have not been installed at either of the bores. If these are ever connected in the future, flow from each bore will be regulated and monitored to ensure water extraction is maintained within the Bore Licence annual allocation. Drawdown limits will be set to automatically cut-off pumps to ensure water levels do not fall below pump suction. The long term performance of bores will be monitored.

The combined raw water transferred from the dam is further separated into the general Mill water and Boiler water systems. The general Mill water undergoes fine filtration prior to distribution through-out the mill. It is used for make-up water to the WETSAC, Cooling Water and Seal Water systems and to the Paper Machine. The boiler water undergoes a further three stages of treatment using micro-filtration, reverse-osmosis and electo de-ionisation to achieve a high quality feed water. The treated boiler water is used to generate steam for the process. Primary condensate from the steam system is collected and returned back to the Boiler Feed Water Treatment system. Flow meters installed on each of the above water flow systems are used to measure fresh water usage in the mill.

The fire water supply main transfers water to the mill from where it is distributed via a network of underground ring mains to supply the fire hydrant, fire hose reel, fire monitor and fire sprinkler systems installed in various areas of the mill.

4.2.3 Secondary Condensate

The mill produces various qualities of condensates within the mill processes. The higher quality condensates known as primary condensates are clean enough to be returned back to the boiler feed-water system. The secondary condensates are contaminated condensates that are flashed from black liquor. These secondary condensates are further separated into two condensate streams, intermediate and clean condensate. The intermediate condensate which has a higher concentration of organic sulphides, is used in the Recausticising area for lime mud washing, dilution and lime mud filter showers. The clean condensates, which have the lowest concentration of organic sulphides, are used in open areas of the mill such as the Paper Machine showers, dilution streams, and the Cooling Towers. Mostly all of the condensates produced can be utilised within the process areas with only a small amount discharged to the WWTP.

4.2.4 Recycled Water Use

Treated effluent from Visy's Wastewater Treatment Plant (WWTP) is returned to the process as cooling water in accordance with Water Recycling Risk Management Plan (VP9-10-10.3-PN-013). After treatment, the effluent is of very high quality with Biochemical Oxygen Demand (BOD) less than 30 mg/L and Total Suspended Solids (TSS) less than 50mg/L. In order to return the effluent to the process, it is disinfected by chemical dosing to destroy pathogenic micro-organisms. Chemical dosing is undertaken continuously on the discharge point of the pump that delivers the treated wastewater to the mill. To monitor the effectiveness of chemical control, on-line analysers and routine sampling and testing which includes testing for Legionella bacteria is undertaken on a weekly basis.

The disinfected treated effluent displaces clean condensate from the evaporators and fresh-water as cooling tower make up, and will allow these clean condensates to be utilised in other areas of the process in place of fresh water. As the treated effluent has a lower BOD/Chemical Oxygen Demand (COD) concentration than clean condensate, it improves the cooling water quality resulting in a reduction in biocide consumption and fouling in heat exchangers throughout the mill. Other benefits result from energy savings due to less energy required in lowering the temperature of cooling water (i.e. condensate temperature is typically over 55 degrees Celsius) and higher heat transfer efficiency due to reduced fouling across the various heat exchangers.

4.2.5 Water Balance

The overall water balance for the mill process is provided below in tables 2.0 and 3.0. The balance takes into account all of the water saving measures including the re-use of secondary condensates and rainfall runoff captured within process bunded areas and the Woodyard. The annual volumes are provided to reflect the difference in the water usage between discharging all of the wastewater to irrigation, to the 100% re-use of wastewater as cooling water make-up, and are shown as Annual volume (1) and (2). The actual water usage will be in between these two operating scenarios, as there will be occasions when the wastewater will need to be discharged to irrigation, to manage the liquor chemistry within the mill.

Table 2.0: Water input balance calculations.

Water Inputs	Specific rate (m^3/ADT)	Annual Volume$^{(1)}$ (ML)	Annual Volume$^{(2)}$ (ML)
Freshwater	2.6 – 2.8	1768 - 1904	1522 - 1632
Incoming wood	1.20 – 1.30	816 - 884	816 - 884
Woodyard runoff	0	62 - 75	62 - 75
Rainfall bunded areas	0	0.6 - 1	0.6 - 1
Groundwater bores(to process)	0	85	85

Total		2,732 - 2949	2,494 - 2677

(1) Water balance based on 100% discharge of wastewater to irrigation

(2) Water balance based on 100% re-use of wastewater as cooling water make-up

Table 3.0: Water output balance calculations.

Water Outputs	Specific rate (m^3/ADT)	Annual Volume[(1)] (ML)	Annual Volume[(2)] (ML)
Kraft paper	0.07 – 0.09	47 - 61	47 - 61
Paper machine exhaust	1.1 – 1.3	748 - 884	748 - 884
Cooling towers	0.9 – 0.95	612 - 646	612 - 646
Stacks	1.0 – 1.2	680 - 816	680 - 816
Wastewater	0.35 – 0.40	238 – 272	-
Other losses	0.4 – 0.5	272 - 340	272 - 340
Total		2595 - 3019	2357 - 2747

(1) Water balance based on 100% discharge of wastewater to irrigation

(2) Water balance based on 100% re-use of wastewater as cooling water make-up

4.3 Wastewater System

4.3.1 Sources and volumes of wastewater

There are six main sources of wastewater inflows to the Wastewater Treatment Plant (WWTP). A brief description and characteristic of each of the inflow sources is provided below.

Cooling water bleed: As cooling water absorbs heat from the process, some water is lost through evaporation thus increasing the conductivity. This can lead to increased scaling and fouling issues in heat exchangers across the mill. To maintain conductivity within specified limits, cooling water is bled continuously from the system and discharged to the WWTP. The cooling water bleed has the highest volume and organic load on the WWTP. The discharge volumes are higher in summer, due to higher evaporation rates. The temperature of cooling water discharged to the WWTP varies between 40 – 45°C.

Clean Condensate: Clean condensate is a secondary condensate produced from the evaporation of black liquor. Due to the quality, this is mainly re-used directly back into the process with no further treatment. Excess clean condensate which is only a small flow, is discharged to the WWTP. The volume discharged will vary seasonally as water usage in the mill is higher during summer. The organic load of the clean condensate is similar to the cooling water.

Reverse Osmosis bleed: Reverse Osmosis is a filtration technique where under pressure, water is passed through a very fine membrane which filters both ions and dissolved matter from the water. The permeate, which is the water that penetrates through the filter membrane, is of very high quality with low residual concentrations. The fluid on the feed side of the filter membrane is called the concentrate, and this must be bled on a continuous basis to the WWTP otherwise its concentration will continue to increase affecting the quality of the permeate. This source is of relative high quality with minimal organic load. The flows are fairly constant through-out the year.

WETSAC bleed: The WETSAC condenses steam under vacuum from the steam turbine. Water is sprayed over the outside of the tube bank, counter-current to the flow of air and steam. The steam injected through the tubes, condenses and is returned back to the boiler feed water system. The water sprayed over the tubes is collected in the basin and re-circulated. Losses to the water spray system through evaporation result in increases in conductivity. Similar to the cooling water system, spray water is continuously bled from the system to control the conductivity. This bleed is discharged to the WWTP. The WETSAC bleed is a relatively small volume with some organic loading. The load varies seasonally from summer to winter due to increased evaporative losses.

Woodyard Runoff: Woodyard runoff is primarily stormwater collected in open drains located within the Woodyard area. This stormwater has potential for leachate contamination due to the storage of woodchips and boiler fuel. The stormwater is segregated from clean stormwater, upstream of Woodyard area and diverted into the Woodyard Runoff Dam. The quantity of runoff collected in the dam varies seasonally. The dam provides a buffer to regulate the temperature and organic load on the WWTP.

Domestic sewerage: Domestic sewage is collected from the site amenity areas located at the mill. The sewerage is separately piped to the WWTP where it initially passes through a screening plant to remove solids. The solids are bagged and disposed of too landfill. The liquid is discharged into the cooling pond. The volume of domestic effluent is small in comparison to other wastewater sources and will vary based on number of personnel on site. The sewerage provides a good source of nitrogen for the SBR as the other influents are low on nutrients. The typical inflow qualities are shown below in Table 4.0.

Table 4.0: Average wastewater inflow quality.

Major Wastewater Sources	Paper Production – 680,000 (ADt/Annum)		
	Flow (m^3/d)	COD (mg/L)	TDS (uS/m^3)
Cooling Tower Bleed	354	500 – 600	370 - 430
Clean Condensate	28	n/a	n/a
RO Rejects	208	0	300 - 400
Domestic Sewerage	5 – 8	0	350 - 450
WETSAC Bleed	61	210	250 - 380
Woodyard Runoff	34	200 – 800	120 - 180
Combined Influent	*690 - 693*	*250 – 400*	*340 - 380*

4.3.2 Wastewater Treatment

The Wastewater Treatment Plant comprises of two Cooling Ponds, a Sequencing Batch Reactor (SBR) a 6 ML dam, 3 ML dam and 2.5 ML dam downstream of the SBR. The design parameters of the SBR are provided below in Table 5.0.

Table 5.0: Sequencing Batch Reactor (SBR) Design operating parameters.

Parameter	Range
Flow	1500m^3/day
BOD_5	100 – 250 mg/L
TSS	50 – 300 mg/L
SO_4 peak	100mg/L
pH	7.0 – 8.0
Temp.	25 - 30 ^{0}C

The various influents are combined and discharged into the Cooling Ponds via an underground pipe network. As the influent sources vary in temperature between 55 to 65 °C, aerators are used in the Cooling ponds to cool the wastewater to 30-35 °C. The Cooling ponds also provide buffering capacity for additional hydraulic load. The effective capacity of the cooling ponds is 2.4 ML.

The SBR is a fill and draw, non-steady state activated sludge process in which the reactor completes all unit process steps in the same reactor in sequence. A single cycle for the reactor is as follows:

- Anoxic fill phase
- React phase
- Settle phase
- Decant phase
- Idle/waste sludge phase

An automatic inflow valve controls the flow into the basin, which contains a mixer/aerator which provides energy and oxygen for the treatment, control instrumentation and a floating solids excluding decanter. Biological action provides additional energy and removes nutrients and organic load, concentrating minerals into the settled sludge and releasing carbon dioxide and nitrogen to the atmosphere. Settling and clarification are carried out in the same reactor after treatment and the decanter removes the cleaned effluent from the reactor. The decant process is controlled by an automatic decant valve. The cycle times can be varied between small batches and large batches based on quality and quantity of influent. After the settle phase, the treated effluent is transferred across to the Holding ponds. The Holding pond is split into two sections. The first has an effective volume of 2.5ML. It is primarily used as a buffer pond for treated effluent prior to either transfer to the Winter Storage Dam for irrigation, or to the Cooling Tower as the cooling water make-up system.

The second section has an effective volume of 9ML and is primarily used as buffer storage for untreated process streams such as the process water from the Paper machine/s during shut downs, upset mill conditions or emergency situations. Process waters stored within the 6 ML and 3 ML dams can either be treated through the WWTP or transferred back to the Spill Tank in the Evaporation area or the process from where it came.

During the idle/waste sludge phase, excess sludge is removed from the base of the SBR and transferred across to the Sludge tank. The sludge is in a liquid form (<1.5% solids) and is removed from the sludge tank for application on the Visy farm as a soil conditioner. The sludge is applied using a purpose built applicator by the Visy Farm Manager in accordance with Procedure: By-product reuse/disposal VP9-10-10.4-OP-002.

Samples of the sludge and soil from the area where it is applied are taken for analysis as part of the Environmental monitoring program, document VP9-10-10.5-001-A01 IMS Monitoring and Measurement Table.

The chemical dosing for disinfection of the treated wastewater occurs only when it is being returned to the process. The dosing point is located at the outlet of the treated effluent return pump. As the return line is approximately 400 metres long it provides sufficient time for disinfection to take place in the pipeline.

4.3.3 Treated Wastewater Quality

The treated wastewater quality is assessed against the concentration limits as specified in Clause L3 of the Environment Protection Licence 10232 and as listed in Table 5.4 in the following section. These wastewater quality limits apply to discharges to the utilisation area, and monitoring is undertaken at Point 10 (SBR Decant at the 2.5ML Dam)

Composite samples from Point 10 are taken on a monthly basis by an Environmental Consultant. More routine sampling is taken on a daily basis by the Wastewater Treatment Plant Operators during the decant phase of the SBR.

The wastewater volume discharge limit to the wastewater irrigation area is specified in Clause L4.1 of the Environment Protection Licence 10232 and provided in Table 5.5 in the following section. The volume limits correspond to discharges from the discharge pipe downstream from the sand filters. The total irrigation flow is calculated by summing the flows from each of the irrigators.

4.3.4 Management measures

4.3.4.1 Routine Operations

Operational monitoring of the Wastewater treatment system is undertaken by shift operators periodically through-out each shift. Up to four batches of wastewater are treated per day. One sample is taken each day from each of the fill, react and decant phases, and analysed for turbidity, total suspended solids, sulphate and phosphate. Further analysis is undertaken on every second fill and decant phase sample, for pH, conductivity and chemical oxygen demand. The samples are analysed in the laboratory on site and reported to Operators and Supervisors.

Dissolved oxygen sensors and pH probes are located in the reactor, which relay continuous readings to the operators in the control room. Electronic flow meters are located on the boiler blowdown, cooling tower and clean condensate inflow streams and daily flows are logged with a daily report printed. The electronic information is fed directly to an electronic Wastewater spreadsheet and then onto a monthly report which is provided to senior management on site. Information on decant volumes and batches is recorded daily and recorded on the same spreadsheet Other influent streams are subject to monthly flow tests, and updated on to the electronic spreadsheet.

Influent samples are taken from the Cooling towers and Wetsac water each shift and analysed on site for pH, conductivity, chlorine and chemical oxygen demand.

Additional testing is undertaken of each of the sources of water that enters the Wastewater treatment plant to track variability in wastewater quality from these sources over time. The result of monitoring including the amount of nutrient addition, and pH adjustment, is used for monitoring wastewater quality and potential impacts on the irrigation area from the various wastewater sources.

If any items of concern occur, operators can either trend these electronically or double check monitoring, following this the Operator is notified. Items of concern in relation to the plant are reported at daily production meetings. If more specialised knowledge or resources are required, contact has been maintained with the original designer of the system.

Adjustment of pH is undertaken based on decant monitoring if required, and if the level is at 6.7 or below, potassium hydroxide dosing is undertaken if the wastewater is going to the Winter Storage Dam, and sodium hydroxide if the wastewater is being recycled.

Wastewater treatment operators undertake weekly cleaning and maintenance on the dissolved oxygen probes and pH sensors, and the screw press on the incoming sewage system. Regular maintenance and vibration monitoring is undertaken on pumps and valves.

The Cooling Ponds are periodically emptied to remove all sediment and sludge that builds on the bottom of the ponds over time. The sludge which is high in organic carbon is utilised as a soil amendment product on the Visy farm. Sludge is applied in accordance with Clause E8 in the EP Licence and Procedure: WWTP Sludge Disposal by Land Application on Site Procedure PROC-TUM-ENV-005.

4.3.4.2 Abnormal Operating Conditions

Abnormal operating conditions such as high BOD loading or high hydraulic loading can have an adverse effect on quality of effluent from the SBR. Should these abnormal conditions occur, the following contingency measures can be taken:

- Transfer influents to 3ML or 6ML ponds for storage;
- Transfer excess influent progressively to SBR or Spill Tank in Evaporation Area; and
- Emergency discharge to irrigation area, after written approval is granted by the EPA.

Procedures that apply to these situations are listed as follows:

- VPP9-10-10.4-OP-010: High Effluent BOD to the WWTP; and
- VPP9-10-10.4-OP-011: High Hydraulic Load on the WWTP

4.3.4.3 Emergency Discharge to Irrigation Areas

Prior to any untreated or partially treated effluent being discharged to the irrigation area, as a result of partial or major process failure of the Wastewater treatment plant written approval to discharge must be sought from the EPA. The application to irrigate must include;

- Details and reasons regarding the failure of the wastewater treatment plant system;

- Expected duration of irrigation of untreated effluent;
- Volume and quantity of effluent;
- Portion of land to receive untreated effluent;
- Action being taken to resolve the immediate problem; and
- Measures to prevent a similar re-occurrence in the future.

Proposed modified concentration limits for the BOD and TSS of the un-treated and partially treated effluent as provided below in Table 6.0 and Table 7.0 take precedence over EP Licence condition L3. All other concentration limits must still comply with condition L3 of the EP Licence. Written approval must be sought from the EPA in regard to the proposed limits in tables 6.0 and 7.0.

Table 6.0: Concentration limits for un-treated effluent to irrigation area.

Pollutant	Units of measure	100 % concentration limit
Biological oxygen demand	mg/L	4000
Total suspended solids	mg/L	100

Duration of the application of untreated effluent must not exceed 10 days and for partially treated effluent 30 days unless further written approval is obtained.

Table 7.0: Concentration limits for partially treated effluent to irrigation area.

Pollutant	Units of measure	100 % concentration limit
Biological oxygen demand	mg/L	800
Total suspended solids	mg/L	100

The land proposed to receive untreated and partially treated effluent is provided below, Table 8.0.

Table 8.0: Irrigation land proposed to receive un-treated effluent.

Portion of land	Area (ha)
Centre Pivot 3	25.7
Centre Pivot 4	16.6
Rectangular paddock for hard hose travelling irrigator	17.5
Other areas approved in writing by the NSWEPA	

The application of high BOD wastewater must be undertaken in accordance with the environmental guidelines Use of Effluent by Irrigation, DEC NSW, 2004.

4.4 Wastewater Irrigation System

4.4.1. Irrigation System Design

The treated wastewater is re-used for irrigation, applied to selected crops over 110 Ha of land on the Visy farm property. The irrigation system consists of the 480 ML capacity Winter Storage Dam, irrigation pumps, sand filters, five centre pivot irrigators and one soft hose traveller and discharge pipe-work and outlet to Sandy Creek, Figure 7.0. The design of the irrigation system is as described in Statement of Environmental Effects (March 2000) approved in July 2000. The irrigation area capacity was determined based on no discharges to Sandy Creek except in a 1 in 10 wet year. An extensive assessment of the irrigation system design and management was undertaken by Charles Sturt University in 2006, and report included in Appendix G of the Visy Mill Expansion EA 2007. Recommendations on changes to some of the management practices from this assessment have been included in this management plan.

Treated wastewater from the Wastewater treatment plant is gravity fed via a 250mm diameter pipeline to the Winter Storage Dam. The delivery pipe to the dam also acts as the suction to the irrigation pumps, allowing the wastewater to be discharged from the WWTP directly to the irrigation area. Other minor flows into this dam come from direct rainfall and runoff pumped from the irrigation area runoff dams.

Soil analysis undertaken during the initial soil investigation as per the Environmental Impact Statement (EIS)indicated that soils in the irrigation area were typically, Red Podzolic and Yellow Podzolics, homogenous, with an average infiltration rate of 5.18 mm/hr, poor in nutrients, having a shallow top soil, with low pH and no salinity. The basic design factor used in the irrigation system was soil infiltration rate. As soil infiltration rates vary based on soil type, topography and amount of compaction soil undergoes from farming operations they can be quite variable under each area of application. The design infiltration rates were initially based on report by Van Der Graaff (1997) during the investigation into the suitability of the soils of the Gadara Plains area for irrigation with wastewater and later updated by Charles Colson, agronomist in (2000). The soil monitoring system takes into account the moisture at specific levels and in specific root-zones. Soils are also discussed in depth in the Soil Management Plan prepared to meet the requirements of Project Approval Condition 5.4 e.

Crop selection was undertaken with consideration of the following factors; sowing, leaf humidity, water salinity, soil conditions, water requirement and availability, irrigation frequency, nutrients requirements, pest, weed management, disease, cropping, nutritional properties, productivity, summer or winter crops, labour and market. Typical crops grown on the irrigation areas on a rotational basis are lucerne, maize, wheat, rye grass, oats, forage sorghum and triticale.

Irrigation is by the sprinkler irrigation method, the selection of this was based on water supply, topography, climate, soil, crop type, economics and the human factor. The irrigation areas and the irrigation method employed in each area are provided in Figure 7.0.

The irrigation system design has also included items as detailed in the site EP Licence conditions O4.1 to O4.7 which include denying public access to the irrigation area during direct application and until the area has dried, not allowing connection of the wastewater main and sub-mains into any other water pipelines, clearly labelling fittings and pipelines and correlating irrigation with climate data so that drift is minimised during irrigating.

Irrigation management practises generally preclude access by livestock during irrigation and until the area has dried to minimise soil compaction. Livestock will occasionally be allowed onto the irrigation area for crash grazing.

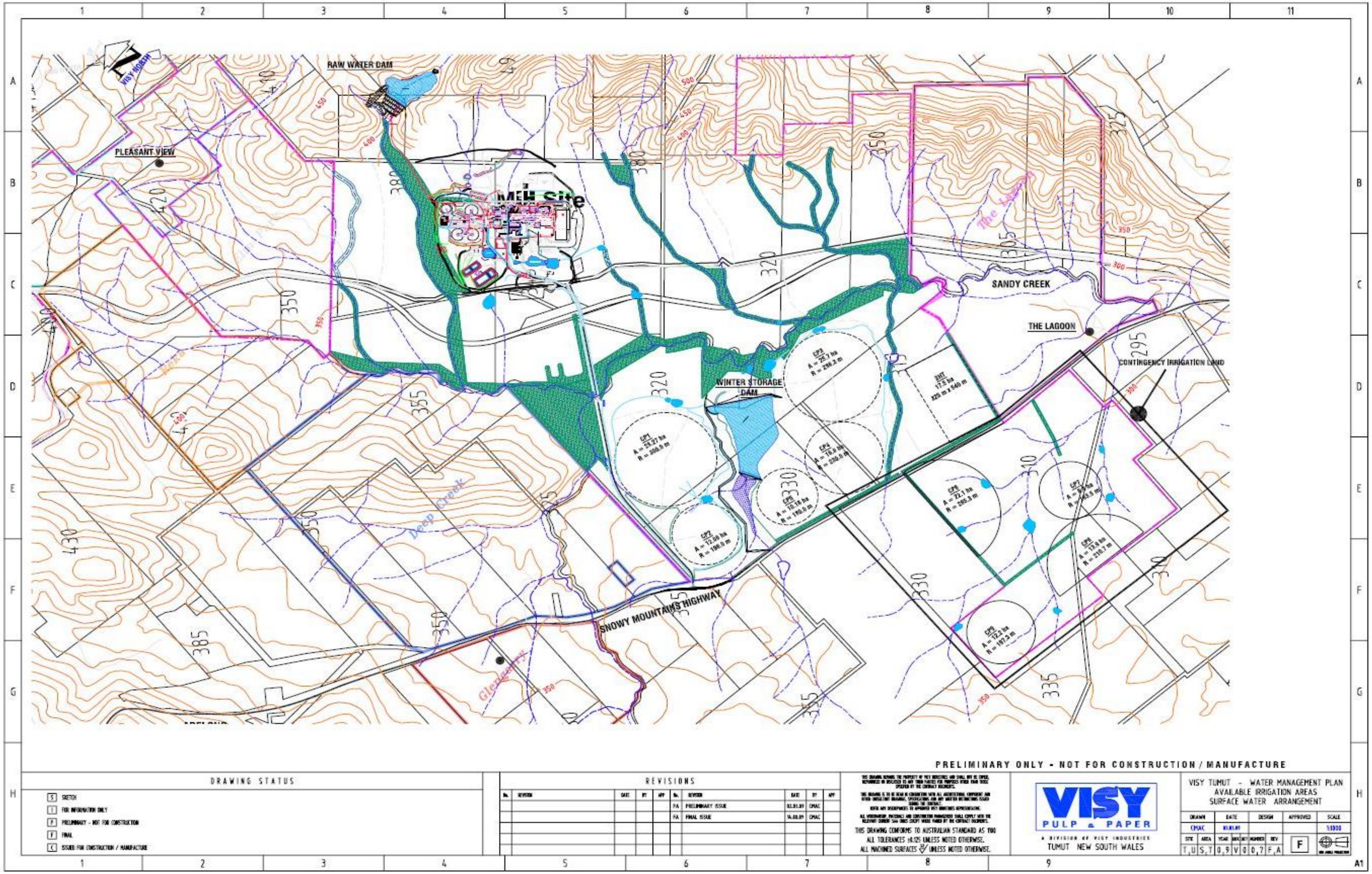

Figure 7.0 Available Irrigation Areas

4.4.2 Winter Storage Dam

The Winter Storage Dam has a capacity of 480ML. The dam has been constructed with a 600mm thick clay liner to the base and geo-textile composite liner to the walls. The dam has a combined inlet/outlet pipe that runs underneath the main embankment. The base of the dam has been benched at two elevations. The higher level has had bunding constructed to its perimeter to ensure that minimum level of wastewater is retained during low storage levels to prevent the clay from drying out. During extreme dry conditions, if the clay liner to the higher level becomes exposed, water from the lower level will need to be manually pumped up to the higher level.

The inlet of the pipe is approximately 1 metre above the clay liner on the lower level. This ensures that there is a minimum level of wastewater over the clay liner to prevent the clay liner from drying out. A water level sensor is located on the upstream surface of the Winter Storage Dam. The water level sensor monitors the dam level on a continuous basis and feeds the information via telemetry to Agua, which is a Web based Automated System for Soil, Irrigation & Weather Monitoring. This data is then used to monitor dam levels and available water for irrigation.

4.4.3 Irrigation Methods

There are two main irrigation methods used in the application of the treated wastewater, Centre pivot which is the main method and a Soft hose traveller.

The Centre pivot is the most efficient method and the least labour intensive. Water is applied by a number of sprayers along the length of a boom which rotates around a central point. There are five Centre pivot irrigators installed irrigating a total area of 93 Ha. Each Centre pivot covers an area from 10ha up to 28ha. The Centre pivot irrigation system is well suited in the application area as it can be utilised for a wide range of crop types (pasture, maize, legumes), can easily apply small amounts of water frequently which reduces soil erosion potential, applies water uniformly, even in windy conditions, handle rough terrain and large areas, and can be used for fertigation.

The other method of application is a Soft hose traveller. This type of irrigation is a lateral moving irrigation method making it very flexible for irrigation in tight areas. It also suits a wide range of crop types (pasture, maize, legumes), has excellent water application uniformity (no wind conditions), and is reliable with low maintenance costs. The application efficiency is 80 - 90% and is adaptable for any crop height. The Soft hose traveller covers an area of 3.24ha per single setting. Up to 6 settings are available in the designated Soft hose traveller area. As there is only one Soft hose traveller it has to be manually relocated for each setting making it more labour intensive.

The design features for each of the irrigators is listed in Table 9.0. All irrigators except for Centre Pivot (CP) 3 and CP4, have a constant flow rate. CP3 and CP4 can be operated in two modes, high flow and low flow. The application rate over a given area is determined by the number of rotations per application, i.e. if the application rate is determined to be 4.00 mm over CP1, then the number of rotations will be set as 1.5. When watering is complete the machine is ideally situated for a second irrigation. The CP can also be set to irrigate over any arc of the circle. This makes it ideal where there is variability in soil infiltration rates and moisture levels as there is typically between higher ground and lower gully areas. The Soft hose traveller application quantity is based on each pass.

Table 9.0: Design features of Centre Pivots and Soft Hose Travelling (SHT) Irrigators.

Centre Pivots & Soft Hose Traveller	Area (Ha)	Radius (m)	Flow Rate (L/sec)	Rotation Time (hrs)	Application Quantity per Rotation (mm)	Application Quantity per Rotation (ML)
CP1	28.3	300	39.4	5.6	2.81	0.79
CP2	12.1	196	16.8	3.5	1.73	0.21
CP3 (high flow)	25.7	286	35.8	5.6	2.81	0.72
CP3 (low flow)	25.7	286	17.3	5.6	1.36	0.35
CP4 (high flow)	16.6	230	23.24	4.48	2.21	0.37
CP4 (low flow)	16.6	230	17.3	4.48	1.65	0.27
CP5	10.2	180	16.9	3.36	1.92	0.2
SHT (single setting)	3.24		15.5	12.00	20.67	0.67
SHT (all areas)	17.5		15.5	64.81	20.67	3.62

4.4.4 Irrigation Scheduling

Irrigation is typically undertaken from October through to May each year. The Irrigation scheduling aims to maximise wastewater re-use to provide sufficient buffer in the Winter Storage Dam during non-irrigation periods. In planning for the irrigation season, crop selection and management practices are important considerations. Each year a Farm Plan is prepared by the Farm Manager taking into consideration how much water will be available for irrigation, crop types, farm and weed management, nutrient balance and climatic conditions. The Farm Plan provides the Farm Manager with a basis for planning crop rotations and irrigation scheduling over the irrigation season.

Water balances for the irrigated areas are calculated to ensure irrigation supply is matched to crop demands. The actual amount of water irrigated is aimed to match the daily crop water requirements. The daily crop water requirements take into account available water for irrigation, crop type, stage in plant development, growth rates, climatic conditions and soil moisture. Irrigation efficiency is commonly 85 to 90%; therefore the amount irrigated will sometimes be slightly more than the plants water requirement to allow for losses from drift, evaporation, runoff, leaching fraction and deep drainage. Demand based irrigation using both climate and soil based irrigation schedules are used. The two methods are described below.

Climate based method: requires weather station daily evaporation readings, daily rainfall and crop factors for each crop. The crop factor is an estimate of the ratio of plant water use to pan evaporation. For example, a crop factor of 0.7 estimates plant water use as 70% of pan evaporation. From this is it is easy to calculate the Crop water requirement, which however will vary from crop to crop, site to site and property to property. This method must be used alongside the soil based method.

Soil based method: aims to keep the soil moisture within an acceptable range (between the Field capacity and the Refilling point or Available soil water capacity) and to determine before each irrigation event, the actual soil moisture. Soil moisture is measured "in situ" using soil moisture monitoring equipment. One soil moisture probe has been installed in each Centre Pivot and Soft Hose Traveller, irrigation area. Centre Pivot 1 has two soil moisture probes installed.

The actual amount of water irrigated is aimed to match the daily crop water requirements.

4.4.5 Management measures

4.4.5.1 Overview

Irrigation scheduling is carried out through demand based irrigation method as described in above in Section 4.4.4. Soil moisture probes locations were selected from an electro-magnetic survey of the soil types, and are situated under each of the Centre Pivot and Soft Hose Traveller irrigation areas. The locations have been selected to best represent the soil type and topography. Each probe is calibrated to ensure spatial coverage of hydro-geological conditions under each application area. Each probe has three moisture sensors that continuously monitor moisture levels in the soil at 100mm, 300mm and 500mm depths. The soil moisture probes are linked via telemetry that allows automatic transfer of data onto the Agua website. This provides up to date information on soil moisture levels.

Potential evaporation and rainfall data is obtained for the irrigation area by using the SILO Data Drill site, which interpolates weather data for a specified location from the nearest Bureau of Meteorology weather station. The co-ordinates entered to represent the Visy site are Latitude 35.18'S; and Longitude 149.09'E. This information is correlated with weather data collected from the onsite weather stations. Crop water requirements are computed by multiplying the daily evapo-transpiration with the monthly crop factors sourced from FAO Irrigation and Drainage Paper 56 (Allen, et al. 1998).

Wastewater application rates are aimed to match crop water demand to ensure sustainable and efficient plant water use. The volume of wastewater applied to each irrigation area and the irrigation rate in mega litres per hectare (ML/ha) are calculated and recorded daily. The volume applied over a given CP area is varied to allow for observed variations in hydraulic conductivity in the soils, to minimise surface runoff and water-logging. In some of the more poorly drained soil areas, sub-surface drainage systems have been installed to minimise water-logging.

The selected crops must be able to adequately use the water that is available in the form of treated wastewater each year. The aim of the irrigation management on Gadara Park is to have a set but flexible rotation in place for each farming block or centre pivot. Having set rotations allows the farm manager to plan future crops and subsequent paddock preparation and management. The establishment of a high protein and water usage crop such as Lucerne is the goal of the rotation.

An annual review is undertaken of the farm management in terms of nutrient levels, crop production and water usage. This review is used in preparation of the Farm Plan for the coming year. In addition regular water balances are calculated to ensure that irrigation supply (dependent on water availability) is matched to crop demands. The irrigation schedule for December 2020 is provided as an example of the monthly irrigation schedule undertaken, Appendix 1.

4.4.5.2 Nutrient Management

The 15 year nutrient budget required under the EP load Base Licensing Protocol has been prepared by DM McMahon, Visy's Land Management Consultant. The mill's wastewater is typically low in the essential crop nutrients such as Nitrogen and Phosphorous. The annual loading is on average 17.6 and 12.8 kg/ha respectively. Annual uptake of nitrogen and phosphorous by a perennial pasture is around 200-280 kg/ha and 20 – 50 kg/ha. Thus there is no risk of nutrients building up in the soil profile. To meet plant nutrient requirements, fertilisers are generally applied each year. Fertilisers are applied either at seeding by a mechanical ground spreader, or via the Centre pivots (fertigation) during the crop growth cycle. The quantity of nutrients applied is recorded and the 15 year nutrient budget is updated each year, the nutrient budget prepared for 2021 is provided in Appendix 2.

4.4.5.3 Salinity Management

The salt concentration in the wastewater generated from the Visy mill operations when compared to Environmental guidelines, Use of Effluent by Irrigation, (DEC 2004), is considered low strength effluent and suitable for even the most salt intolerant crops. Nevertheless, salt concentrations can build-up in root zone of the soil profile having detrimental effect on crops, especially in poorly drained soils such as in the case of low lying water-logged areas. To alleviate this, sub-surface drainage has been installed in the poorly drained areas to improve the soil permeability and promote root penetration. Should salinity levels build-up in the soil profile that could be detrimental to plant growth, an irrigation leaching fraction of up to 30% will be applied. Other salinity impacts can result from higher groundwater table or increased groundwater flows to Sandy Creek. The ground and surface water monitoring program ensures any salinity impacts can be identified early and addressed to prevent any adverse effects.

4.4.5.4 Crop establishment methods

A "Conservation tillage" programme has been adopted on Gadara Park farmland. Conservation tillage is an umbrella term that looks beyond "soil preparation" in the narrow sense. Its focus is on the broader concept of conservation agriculture, since this embraces not only the seedbed preparation but also nutrient content of soils, their structure and biological status. Such factors are important determinants of agricultural productivity as a result of farm management and land husbandry practices.

By definition, Conservation tillage consists of any reduced tillage system that leaves 30% or more of crop residue on the soil surface after planting, the method used on Gadara Park is direct seeding. This is a process of planting directly into crop residue, leaving the soil undisturbed from harvest to harvest. Only the seed zone is prepared by a coulter or disk, which cuts through the crop residue, to place the seed in a narrow furrow. Weed control is by plant competition and herbicides, the type and timing of herbicide application depends on weed pressure and climate conditions. Uniformly distributed residue shields the soil surface from rainfall impact, important in considering the Gadara soils, thus reducing the tearing and washing away of soil particles.

At the end of each rotation crops are either grazed by stock, harvested for seed or cut for hay or silage leaving a crop stubble to a height of 20-30mm for easy application of soil amendments/fertiliser, a quick re-growth between cuts, and to allow for the promotion of a thick swath for ground cover to encourage micro bacterial activity. Weeds are controlled by crop rotation and the application of appropriate herbicides where warranted.

Pasture stands have been selected on the basis that, legume clovers will provide organic nitrogen to the grasses, and therefore, only prescription quantities of inorganic super-phosphate fertiliser in the form of sulphate needs to be applied to the clovers. Plant tissue analysis is undertaken regularly to ascertain plant health, nutrient status and feed quality. Soil samples are taken yearly to determine plant nutrient requirements.

4.4.5.5 Surface water Runoff Detention and diversion

To avoid any overflow of surface water during irrigation into the natural watercourses running through the site (Sandy Creek and Deep Creek), the irrigation area is constructed with a combination of contour banks and open channels to divert all runoff into runoff collection dams. There are four runoff dams in the irrigated area. Two of the dams are connected via overflow to an adjoining dam further downstream. The contents of the downstream dams are pumped back to the Winter Storage Dam with a portable diesel pump during the irrigation season and into Sandy Creek during the non-irrigation season.

During a rainfall event should soil moisture levels be close to their field moisture capacity the irrigation pumps will be shut down to minimise runoff from the irrigation areas.

4.4.5.6 Discharge to Sandy Creek

The assessment undertaken by Nolan ITU in the SOEE dated March 2000 of the wastewater re-use system, determined the minimum Winter Storage Dam capacity of 400ML. This was based on wastewater generation of 391 ML/year and overflow frequency of 1 in 10 years on average. The Winter Storage Dam has been built with effective capacity of 480 ML and the predicted wastewater discharge for the Visy Expansion is 245 ML/annum. Thus, the expected overflows into Sandy Creek when the Winter Storage Dam is full should occur less often.

Should discharges to Sandy Creek be required, these must be approved by the NSW Environment Protection Authority in accordance with condition O4 of the EP Licence.

During the non-irrigation season Winter Storage Dam levels are to be monitored on a regular basis. When storage levels reach 90% of full capacity, an application to discharge to Sandy Creek is to be prepared and submitted to the NSW EPA for approval. The application for discharge must be accompanied by supporting documentation which includes.

Volume of effluent generated, the volume of effluent re-used and the percentage capacity of the holding dam for both the system as designed and the actual volume for the previous 12 months. This information is to be presented in both text and graphical form.

Details of reasons for the discharge in the event that it is proposed to discharge in a year when the rainfall has been less than the wettest year in ten.

Upon approval, public notice is to be given of the impending wastewater discharge in accordance with DCC 94. Notification must also be provided to all persons downstream of the site to Tumut River who use water from Sandy or Gilmore Creeks for domestic purposes.

The discharge to Sandy Creek is to be fully recorded as required under DCC 33(c) in terms of:

- Discharge volumes
- Duration
- Wastewater quality
- Flow conditions in Sandy Creek
- Water quality in Sandy Creek, upstream and downstream of discharge point in accordance with frequency as specified in the EP Licence and included in Section 5.0 of this plan.

The effluent discharge must meet flow and quality criteria as specified in the EP Licence and included in Section 5 of this plan.

4.4.5.7 Flood Mitigation from Discharges to Sandy Creek

Hydrological assessment on the potential flooding impacts to Sandy Creek due to wastewater discharge events was undertaken by Nolan ITU during the Tumut Visy Pulp and Paper Mill EIS dated February 1998 and included in the Supplementary Report Volume 2. The assessment was based on wastewater discharge to re-use system of 1050 ML/annum (i.e. 3ML/day) and predicted overflows to be less than 4% of total stream flows under peak10 year Average Recurrence Interval. This marginal increase in peak stream flows was considered to be acceptable by the Deputy Chairman in the Commission of Inquiry Report dated June 1998. As the predicted wastewater discharges are less than 25% than that modelled the overflow impacts into Sandy/Gilmore Creeks will be substantially reduced from that described in the EIS.

4.4.5.8 Annual Review

An annual review of the application of wastewater on the irrigation area is undertaken each year by the Land management consultant. During the assessment, results of monitoring are reviewed and comparisons made with background data as well as guideline levels to assess any impacts on soil, groundwater or surface waters. From the review a Farm Plan is developed for the upcoming year. The plan includes water availability and scheduling, weed management, crops to be grown, nutrient budgeting and grazing management.

4.4.5.9 Expert review of Irrigation Management Practices

The review of the existing irrigation management area was undertaken by Charles Sturt University during the preparation of the Environmental Assessment (EA) in 2007. The review found that there was no soil salinity threat under any of the paddocks studied and that the Electrical conductivity (ECe) values represent soil salinity conditions that are even suitable for salinity sensitive crops. During the review, spatial modelling on surface/groundwater interactions was undertaken to assess the cumulative short and long term impacts of the existing and then proposed expanded wastewater irrigation scheme on soils, groundwater and surface water flows. Under various scenarios, the assessment established that the current irrigation area management was acceptable in managing issues and had further recommended some additional management techniques to ensure the long term sustainability of the design and operation of the irrigation system.

The recommendations for continual improvement of the irrigation management included:

- Continue current monitoring program for soil, surface water;
- Calibration of soil moisture probes to soil conditions under each pivot;
- Installation of additional groundwater monitoring bores;
- Planting of legumes as an integral part of any cropping pattern, which may include lucerne, oats, rye grass, forage wheat, triticale, barley, maize, forage sorghum, cowpeas, millet, and sugar beet;
- A cropping pattern based on 1, 2, 3 and 4 years of lucerne rotation should be adopted under different paddocks;
- Subsurface drainage to be installed under low-lying areas (in particular under CP3 and CP4);

- Should salinity levels in the root zone exceed the plant threshold levels of 2.5dS/m, application of an additional 30% of irrigation to effectively leach the salts to below the root zone area to maintain healthy crops; and
- Installation of pan evaporation monitor at the mill site weather station with the data to be used for irrigation scheduling.

4.4.5.10 Contingency Irrigation Area

During the Environmental Assessment for the Visy Tumut Expansion, an assessment was undertaken on the suitability of the existing property located on the southern side of the Snowy Mountains Highway for irrigation. The assessment identified an additional 60ha to be available for irrigation. Although this area is not required for the current development it will be continued to be set aside as contingency irrigation area in the event of it being required, Figure 7.0. In addition approximately 35ha is available north of Gadara Road for contingency measures.

The area of land currently dedicated for irrigation is approximately 110 hectares, located on either side of the Winter Storage Dam, Figure 7.0.

The Environmental Assessment recommended that should the monitoring program associated with the irrigation re-use system identify that it is not operating in accordance with objectives, appropriate amelioration measures will be carried out depending on the nature and extent of the problem.

Possible ameliorative measures could include any, or a combination of the following:

- Installation of further subsurface drainage;
- Further soil amelioration;
- Planting of more trees;
- Using high water demanding crops to maximise the water uptake, based on the soil pH conditions; and
- Reducing irrigation application rate by expanding irrigation area on Visy owned land or purchasing additional land.

4.5 Groundwater Quality

A requirement of the Stage 1 development was the preparation and submission of a Groundwater monitoring strategy to assess whether the irrigation system was having an impact on the quality and level of groundwater beneath the site. The following Development Consent Conditions directly relate to groundwater and were used in the development of the original strategy, DCC, 35, 36, 62, 63, 64, and 65. The program within the strategy was approved by the then Department of Land and Water Conservation (DLWC).

4.5.1 Groundwater Monitoring Program

In June 1997, during the Environmental Impact Study for Stage 1, six groundwater bores Bore hole (BH) 1 to 6, were established within the proposed development site. BH 1, 2 and 3 were located on the southern side of the Snowy Mountains Highway, BH4 was located on the northern side of the actual proposed mill site, and BH5 to 6 were located on Gadara Road, east of the proposed mill site. The groundwater bores were sited to provide data representative of the range of hydro-geological settings in the study area. A shallow and deep bore were installed at two of the four drill sites and all bores encountered water although yields were consistently low. Weathered granodiorite was encountered in the southern bores (1, 2 and 3) while weathered sedimentary rock was encountered in the northern bores (4, 5 and 6).

If shallow groundwater was encountered at less than 5 metres depth while drilling any of the piezometers then nested piezometers were installed as per the requirements of DLWC. Nested piezometers give information on the vertical movement of groundwater at a monitoring point. The deeper piezometers were constructed first and the depth of any shallow aquifers noted during drilling. The shallow piezometer at each nested site was then constructed to tap any shallow aquifers encountered during drilling of the deeper aquifer. A qualified hydrogeologist was present during drilling to make the final decision regarding the depth of the piezometer. The vertical separation between the piezometer screens was no less than 5 metres. The proposed monitoring bores were installed, and the bore logs were provided showing depth and strata encountered during installation to DLWC as per DCC 64.

Groundwater samples were collected from each bore in June 1997 and analysed. Groundwater levels were monitored on a monthly to 3 monthly basis until December 1998 when measurement of groundwater levels increased to monthly.

In March 2001, an additional fourteen monitoring bores were located and installed in consultation with the NSW EPA around the irrigation area. These bores (BH 5 to 17) were located to monitor groundwater quality upstream and downstream of the irrigation area and downstream of the Winter Storage Dam. Bore holes 7, 8, 11 and 15 are nested groundwater bores, each consisting of a shallow and deep piezometer. The location of all monitoring bores is provided in Figure 8.0.

The groundwater bores are classified within the following three main groups used for comparing quality and depths.

Background bores: Bores BH1, BH2, BH3, BH7S, BH7D, BH11S and BH11D are classified as background monitoring bores, being located upstream of irrigation and mill activities and provide information on existing groundwater quality and depth. They provide an indication of how groundwater levels fluctuate without the influence of irrigation or water storage. They are useful for comparison with the other piezometers when determining if irrigation and water storage are affecting groundwater levels.

Bores BH1, BH2, and BH3 are large diameter bores (75mm to 100mm casing), ranging in depth from 10m to 30m. Bores BH1, BH2 and BH3 are located on the southern boundary of the farm and are at a higher elevation within the Sandy Creek catchment than all irrigation and mill activities. Bores BH7S and BH7D are located on the western margin of the Gadara Park property, before the junction of Sandy Creek and Deep Creek. These bores are upstream of all mill and irrigation activities. Bores BH7S and BH7D have respective depths of approximately 7m and 14m.

Irrigation bores: Bores BH8S, BH8D, BH9, BH10, BH15S and BH15D are located within, or near, the irrigated paddocks, and potentially impacting activities, and have been installed to determine if irrigation is affecting groundwater quality or levels. BH8S and BH8D are located to the north-east (down-slope) of the western irrigation area slightly above the creek flats. They are 6m and 10m deep respectively. BH9 is located to the north-east (down-slope) of the eastern irrigation area and Centre Pivot number 3. BH9 is 16m deep. BH10 is located on the eastern edge of the farm, and of all the bores is the furthest downstream of all irrigation activities. BH10 is 14m deep. BH15S and BH15D are located to the north of Centre Pivot 1 on the creek flats. They are 6m and 17.5m deep respectively.

Winter storage bores: Bores BH13, BH14, BH16, and BH17 are located immediately below the northern edge of the Winter Storage Dam to determine if water-tables or groundwater quality are influenced by the storage. They are all shallow in depth compared to the background and irrigation monitoring bores, ranging in depth from 3m to 7.5m, and measure shallow aquifers or moisture in colluvial layers only.

Thirty new groundwater monitoring bores, (15 pairs of shallow and deep piezometers) were installed as per the recommendations from CSU during the review of the irrigation system in the Environment Assessment. They were installed adjacent to the existing irrigation paddocks, and on the proposed new irrigation area located on the south side of Snowy Mountains Highway, Figure 8.0. These were installed to monitor groundwater and water-tables directly underneath the irrigated paddocks to gain a better understanding of the groundwater characteristics upstream of, and within the irrigation area and to include in the surface/groundwater interaction model for assessment on the impacts from the proposed expanded irrigation.

The thirty new groundwater monitoring bores (15 deep and 15 shallow) were installed in the following general location and for specific purpose as described below:

Future Irrigation Bores: BH29S, BH29D, BH30S, BH30D, BH30S, BH31D, BH32S, BH32D, BH33S, and BH33D are located under the proposed future irrigation paddocks. Monitoring of these bores has provided background groundwater data prior to irrigation commencing. Should irrigation be established in this area in future, regular monitoring of these bores will re-commence.

Background Bores: BH34S, BH34D, BH35S and BH35D are located adjacent to the drainage line directly upstream of the Winter Storage Dam. These bores are 4 to 8 metres deep and used as background bores.

Irrigation Bores: BH21S, BH21D, BH22S, BH22D, BH23S, BH23D, BH24S, BH24D, BH25S, BH25D, BH26S and BH26D are located within the irrigation area.

Winter Storage Bores: BH27S, BH27D, BH28S and BH28D are located on either side of the Winter Storage Dam to assess any impacts of the dam on shallow groundwater.

Groundwater bores BH5 and BH6 are not included in the monitoring program and BH4 located north of the mill was destroyed in January 2008, due to its location within the proposed development.

All monitoring for the groundwater system is documented in Section 5.4.

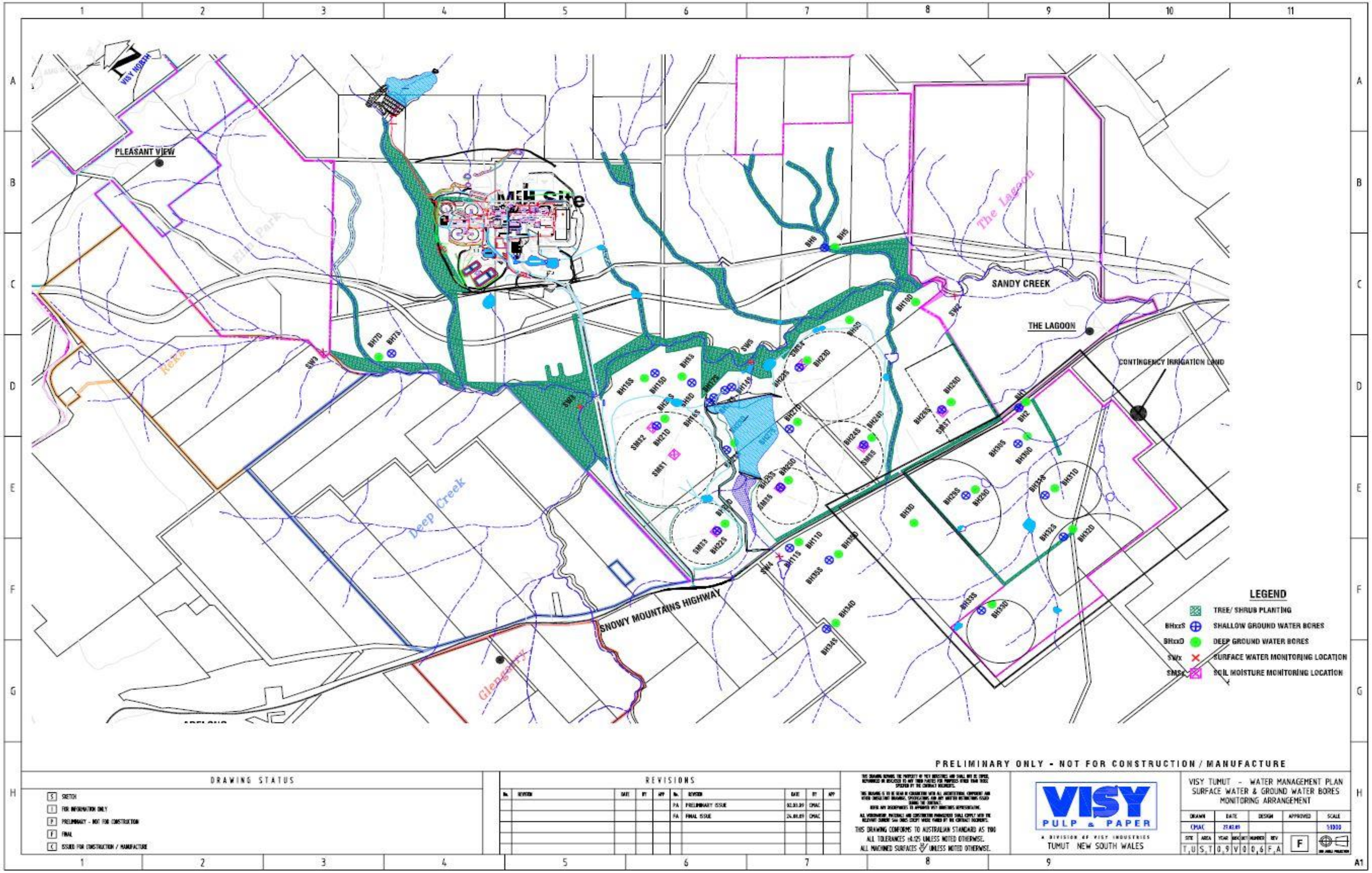

Figure 8.0 Surface Water and Ground Water Bore Monitoring Locations

4.5.2 Surface groundwater interaction modelling

The potential spatial impact of wastewater irrigation on groundwater levels and salinity were examined by the Charles Sturt University team using Surface/groundwater interaction modelling. The conceptual model is presented below, Figure 9.0. The modelling was based on the proposed wastewater production rate of 826ML/annum in the Environment Assessment under various climatic scenarios. As the revised wastewater production rate is 259 ML/annum, which is also less than current rate, the modelling depicts worst case scenarios.

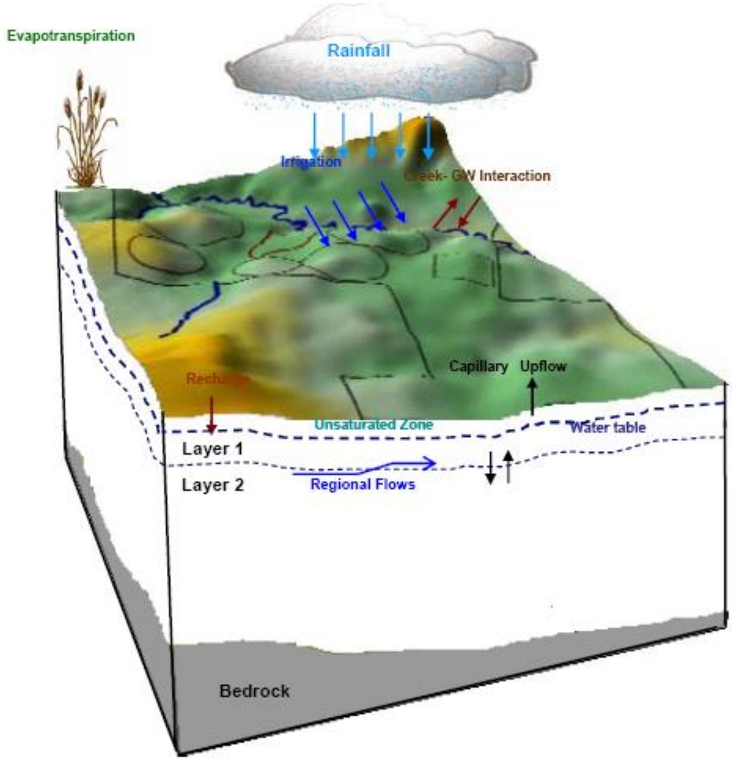

Figure 9.0: Surface/Groundwater interaction conceptual model.

The modelling showed that the aquifers at Gadara Park would undergo water depletion under all climatic conditions, including dry, average and wet. It was noted that the greatest change in aquifer storage occurs in average conditions when the model shows a combined effect of irrigation and rainfall. Under these conditions the model shows that there would be higher regional water storage underneath the irrigation paddocks, and a greater hydraulic gradient between the irrigated paddocks and Sandy Creek. The modelling showed that the existing area of irrigation was sufficient to match the production of wastewater from the pulp and paper mill.

4.5.3 Management measures

Groundwater levels are recorded in each bore and samples are collected every three months and analysed for analytes specified in the EP Licence and included in Table 5.9. Data collated from the monitoring program is used to undertake groundwater impact assessments to determine whether as a result of irrigation there is a water-table rise in excess of 10 cm per year over a five year period or significant increases in salinity in accordance with Development Consent Approval Conditions 35 and 36.

The assessment is carried through the following observations:

- Variations in level and quality during irrigation, non-irrigation and rainfall periods;
- Variations in level and quality between shallow and deep bores;
- Comparisons in level and quality between back-ground, and irrigation bores;
- Comparisons in level and quality against historical data;
- Calculation of mean annual groundwater level; and
- Comparisons of groundwater levels to monthly rainfall and irrigation volumes.

Results of assessments are reported monthly and a yearly interpreted report is prepared and included in the Annual Environmental Management Report as required under Concept Approval condition 6.3 and Development Consent Condition 12, as detailed in Section 7. A copy of this report is distributed to the DPE and the EPA for review and comment. In the event of significant increases in water table or salinity, Visy will develop and implement measures to avoid adverse impacts in consultation with EPA as required under Development Consent Condition no. 36.

5.0 Criteria and Guidelines

5.1 Surface Water

The surface water quality goals and performance criteria that apply to Visy Tumut in accordance with the consent conditions and Environment Protection Licence (EPL) conditions are detailed below in Table 10.0. The sample locations are upstream and downstream of the Visy site, see Appendix 6.

Table 10.0: Surface water quality goals.

Parameter	Units	Frequency	Sampling	ANZECC Goals	ADWG[e]
BOD	mg/L	Special Frequency 1[d]	Grab sample		
Nitrogen (total)	mg/L	Special Frequency 1[d]	Grab sample	250[a]	
Phosphorus (total)	mg/L	Special Frequency 1[d]	Grab sample	20[a]	
Total dissolved solids	mg/L	Special Frequency 1[d]	Grab sample	350[b]	500
pH	pH	Special Frequency 1[d]	Grab sample	6.5 – 8.0[a]	6.5 - 8.5

a) ANZECC Table 3.3.2 Upland rivers Trigger values
b) Units are in uScm-1 for NSW rivers
c) ANZECC Table 3.4.1 Level of protection 99% species Trigger values
d) On the day of discharge of effluent into Sandy Creek commences and monthly thereafter.
e) ADWG – Australian Drinking Water Guideline

Sample results are compared to Volume 1 of the ANZECC Guidelines (2000) that specifies trigger values for the protection of aquatic ecosystems. These trigger values are used for the assessment of surface water quality from upstream and downstream of the mill and have been included above in Table 5.1. Comparisons are also made against the *Australian Drinking Water Guidelines*. These levels provide guidance on water quality issues in regards to public health and aesthetics.

The assessment focuses on any change in water quality between the upstream and downstream samples that could be attributable to the Wastewater irrigation scheme and that may be detrimental to downstream water users and the aquatic ecosystem.

5.2 Fresh Water

5.2.1 Water Allocation Licences

Approval to extract water from the Tumut River is permitted by water access licences and allocations under the NSW Water Management Act 2000. These are managed under the Water Sharing Plan for Murrumbidgee Regulated River Water Source (WSP) which sets the rules for management of water access licences, water allocation accounts, trading and dealings in licences and water allocations the extraction of water, and the operation of dams and the management of water flows.

Available water determinations are made by the NSW Office of Water for each access licence category at the start of the water year and if required during the course of the year.

The maximum volume that can be extracted under the Water Sharing Plan by each access licence is set by the available water determination. Carry-over of unused entitlements into the next water year is subject to public announcements by the Director of NSW Office of Water. The current Water Allocation Licences held by Visy under the Water Sharing Plan are listed in Table 11.0 below.

Table 11.0: Water allocation licences.

WAL No.	Water Source	Allocation Category	Share Component (ML)
40AL405643 & 40AL405644	Murrumbidgee Regulated River Water Source	High & General Security	2382

These allocations will vary as Visy acquire further entitlements as the need arises. Water allocation accounts are administered by the State Water Corporation. Water order application forms are to be filled in by the licence holders nominating the total volume of water to be extracted over the selected time period. These bulk water order forms are submitted to the Customer Services Officer (CSO) for the Upper Murrumbidgee and Tumut State Water South region prior to the commencement of each water year. State Water can also confirm status of water accounting for each Water Allocation Licence upon request to the CSO.

5.2.2 Groundwater Bore Licences

Visy have a licence to extract water from two groundwater bores located on the Visy property. The bore water Licences will allow Visy to extract a total of 85 ML/annum from two deep bores (DB 6 and DB 10).

The bore water licence certificate held by Visy specifies the details of land to be supplied with water. The licence is approved under Section 115 of the Water Act 1912. The groundwater licence number including the maximum allowable extraction amount are listed below in Table 12.0.

Table 12.0: Groundwater bore water licences.

Bore Lic. No.	Water Source	Purpose	Annual Allocation (ML)
40AL412076 (Formally 40BL191801 & 40BL191802)	Murrumbidgee region	Industrial	85

When in use, monthly flow meter readings are entered on to the Water Order Form which is submitted to State Water, Leeton monthly.

5.3 Wastewater

5.3.1 Concentration Limits

The concentrations limits that apply to the treated wastewater are detailed below in Table 13.0. These limits apply to treated wastewater at sampling Point 10 located at the decant line from the SBR. Samples are collected from this location for analysis on a two monthly basis in accordance with condition M2 of the EP Licence. Similar limits apply at Point 9 which is located at the outlet pipe from the Winter Storage Dam. Samples are to be taken from this location only during discharge from the Winter Storage Dam to Sandy Creek on the first day of discharge and monthly thereafter in accordance with condition M2 of the EP Licence. Discharge to Sandy Creek can only occur upon seeking written approval from the EPA in accordance with condition O4 of the EP Licence.

Table 13.0: EP Licence concentration Limits - Point 9 and 10.

Parameter	Units	EP Licence Limits		
		50%ile	90%ile	100%ile
Biochemical Oxygen Demand	mg/L	-	-	40
Total Suspended Solids	mg/L	-	-	45
Total Phosphorus	mg/L	-	-	5
Total Nitrogen	mg/L	-	-	20
Oil and Grease	mg/L	-	-	5
pH		-	-	5.5-9.5

5.3.2 Volumetric Flow Limits

The volumetric flow limits as per condition L4.1 in the EP Licence, which apply to treated wastewater, are shown below in Table 14.0

The flow limit to irrigation is measured at the discharge of the irrigation pumps after the Sand Filters and is the maximum amount of effluent that can be applied to the irrigation areas on each day of application. The flow is measured by totalising flows at each of the irrigators (refer to Section 4.4.5). The total application amount may be further limited by soil moisture levels.

The flow limit applying to Point 9, located on the outlet pipe of the Winter Storage Dam, is the maximum amount of effluent that can be discharged to Sandy Creek on each day of discharge. Flow measurements are to be recorded daily from the flow meter located on the discharge pipe.

Table 14.0: EP Licence volumetric flow limits.

Point	Unit of measure	Volume Limit
9	kilo-litres/day	3000
10	kilo-litres/day	16000

5.4 Groundwater

5.4.1 Groundwater Quality Goals

Groundwater samples are collected from all EP Licence stipulated bores for analysis, and monitored as per EP Licence condition M2.1 at the following frequency, Table 15.0.

Table 15.0: Groundwater quality goals and frequency

Parameter	Frequency	ANZECC Goals
pH	Quarterly	6.5 – 7.5[a]
Electrical conductivity (EC)	Six monthly	350[a]
Nitrate	Six monthly	0.7[b]
Depth	Quarterly	

a) ANZECC, 2000. Table 3.3.2 and 3.3.3 Upland rivers Trigger value
b) ANZECC, 2000. Table 3.4.1 Freshwater trigger values

Sample results are compared to Volume 1 of the ANZECC Guidelines (2000) that specifies trigger values for the protection of aquatic ecosystems. These trigger values are used for the assessment of groundwater quality and have been included above in Table 15.0.

6.0 Training and Responsibilities

6.1 Surface Water Management

6.1.1 Training

All personnel and contractors are to undertake an online Site Specific Induction prior to undertaking any work onsite. The induction covers the key health, safety and environment aspects and provides general awareness of sites HSE requirements.

Fire, Spill and Chemical response refresher training is to be undertaken by all personnel and permanent contractors at least every two years.

Environmental training is integrated into the competency based operational training of mill personnel. Training modules are to include the relevant environmental management plans and environmental aspects.

A training needs matrix has been developed for the site and is periodically reviewed by the sites HSE representatives.

6.1.2 Responsibility of personnel

The following personnel will be responsible for actions, monitoring and reporting in relation to the premises:

- The Shift Supervisor is responsible for:
    - Allocating suitably trained and competent personnel to isolate the Stormwater retaining basin during a fire event or spill and monitoring the water level as fire water enters the pond.
    - Providing spill kits and erecting instruction signs for personnel to follow in the event of a spill i.e. especially near the chemical delivery areas.
    - Notifying relevant personnel that may include the Pulp Mill/Paper Machine Manger and/or the Site HSE Manager of the incident as soon as possible.
- Area Manager – Chemical Recovery & Utilities is responsible for:
    - During a fire or spill event, should the Stormwater Retaining Basin start to reach high levels and need to be diverted to the 6ML Dam, the Area Manager – Chemical Recovery & Utilities will be responsible for:
    - Directing the Wastewater operator to undertake:
    - Visual inspection of the water;
    - Collecting a sample for analysis;
    - Interpretation of the results; and
    - In consultation with the Pulp Mill Manager and HSE Manager, determine whether the water can be treated at the Wastewater treatment plant, the Spill Tank in the evaporation area or needs to be removed by a licensed contractor.
- The HSE Manager will be responsible for:
    - Ensuring that all monitoring of surface water is carried out in accordance with the EP Licence;
    - Coordinating and overseeing major spill clean-up and fire water containment activities and ensure that monitoring of surface waters is carried out;
    - Notifying authorities in the event of a major spill or fire as per incident notification protocols and procedure.

6.2 Wastewater

6.2.1 Training

Wastewater operator training is done on site, following a specific 12 module training program based on the wastewater operation manuals, work experience under supervision, and a formal assessment upon completion. The training covers operations under normal and upset conditions. There is a wastewater operator on each shift who is also responsible for operations of the Water Treatment Plant and Recrystallisation plant.

The Gadara Park Farm Manager and farm staff are trained in the operations and monitoring of the centre pivot and soft hose traveller irrigators and soil moisture probes. Soil, groundwater and wastewater sampling is undertaken by Visy's Land Management Consultant specialised in the agricultural and environmental sciences.

6.2.2 Responsibility of personnel

The Wastewater Treatment plant operators are responsible for:

- Overseeing the operations of the Wastewater treatment plant;
- Daily sampling and analysis of wastewater;
- Plant monitoring and reporting to site management and the HSE Manager; and
- Informing the Shift Supervisor and HSE Manager of any malfunctions or emergencies.

The Pulp Mill Manager is responsible for:

- Any decision to shut down the Wastewater treatment plant;
- Informing the General Manager and/or HSE Manager of any decision to shut down the Wastewater treatment plant; and
- Ensuring Wastewater treatment plant operators are aware and appropriately trained in Emergency procedures.

Gadara Park Farm Manager is responsible for:

- Co-ordination with the HSE Manager and Pulp Mill Manager for discharging of Treated Effluent to Sandy Creek or of application of untreated or partially treated effluent to irrigation areas.

HSE Manager is responsible for:

- Ensuring that all relevant monitoring and reporting requirements to site management and authorities occurs efficiently and on time;
- Reviewing monitoring data for wastewater to ensure they are in compliance with EP Licence conditions;
- Reporting non-conformances to the relevant parties (i.e. site Management, Corporate and Authorities) and organising corrective and preventative actions;
- Preparing an application to the EPA for release of treated effluent from the Winter Storage Dam to Sandy Creek should the event arise;
- Notifying the community and downstream users of Sandy Creek and associated waterways, prior to release of waters from the Winter Storage Dam; and
- Applying to the EPA for emergency discharge to irrigation areas of untreated or partially treated effluent in the event of a partial process or major process failure of the Wastewater treatment plant.

Electrical and Instrumentation Manager is responsible for:

- Implementing schedules for maintenance and calibration for wastewater treatment plant and irrigation monitoring instruments;
- Ensuring maintenance and calibration of the monitoring instruments occurs as per preventative maintenance schedule; and
- Maintaining calibration records for this equipment.

6.3 Irrigation system

6.3.1 Training

The Gadara Park Farm manager and farm staff are trained in the operations and monitoring of the centre pivot and soft hose traveller irrigators and soil moisture probes. They are also trained in general environmental awareness as with all site staff.

Specific training has also been provided in relation, chemical management, irrigation scheduling and checking of irrigation areas including, soil moisture probes, surface runoff, soil water logging etc.

6.3.2 Responsibility of personnel

The Land Management consultant is responsible for:

- Undertaking monitoring and reporting of the irrigated area including soil, groundwater monitoring;
- Annual review of all data associated with irrigation and any effects it may be having on soils or groundwater quality;
- Development of the annual report Monitoring of Gadara Park;
- Preparing the 15 year and 5 year rolling nutrient budget and cropping regime for the irrigation area and reporting on these annually in the above report;
- Preparation of the annual Farm Management Plan in consultation with the Gadara Park Farm manager.

Gadara Park Farm Manager is responsible for:

- Overseeing wastewater application to the irrigation areas;
- Implementing Farm Management Plan;
- Establishment and monitoring of irrigated crops;
- Recording of irrigation application rates;
- Fertigation, harvesting and cropping on irrigation areas;
- Daily monitoring of soil moisture levels; and
- Retaining calibration records for soil moisture monitoring probes.

HSE Manager will be responsible for:

- Ensuring that there is an annual review of the irrigation and farm performance;
- Monitoring Winter Storage Dam Levels; and
- Notifying Farm Manager, General Manager and Operation Managers of critically high levels in Winter Storage Dam.

7.0 Monitoring

7.1 Surface water

7.1.1 Location and Parameters

Surface waters, mill site surface flows and Sandy Creek are monitored in order to determine the quality of stormwater and the impact of any of the irrigation activities on local waterways.

The site EP Licence requires surface water monitoring occur on the day discharge of effluent discharge to Sandy Creek and then monthly thereafter at Points 11 upstream of the overflow and Point 12 which is downstream of the overflow. The surface water monitoring sites are shown in Figure 8.0 and 10.0 over page. Point 11, upstream of the overflow is represented by three sites Surface Water (SW) 1, SW3 and SW4. These are upstream of the irrigation area providing an indication of background surface water quality. Point 12 downstream of the overflow is represented by two sites, SW2 and SW5. These are downstream of the irrigation area providing an indication of any change in surface water quality due to irrigation practices. Details on all sites are provided below in Table 16.0.

In addition, the sites land management consultant undertakes monitoring of surface water quality monthly during the irrigation season at all locations.

The monitoring results from sites upstream of the mill are compared with those downstream to determine if the mill and irrigation activities are having an effect on water quality.

Table 16.0: Summary of Surface Water sampling locations and purpose.

Sample point	Location	Purpose
SW1	Surface water monitoring North (the northwest most sample site)	To monitor quality upstream of the site and irrigation area.
SW2	Surface Water Monitoring South (at the southeast boundary)	To monitor water quality as it exits the property.
SW3	Surface Water Monitoring Deep Creek (in Deep Creek before confluence with Sandy Creek)	To monitor water quality upstream in Deep Creek before it joins Sandy Creek
SW4	Surface Water Monitoring Snowy Highway (at the diverted gully upstream of property boundary)	To monitor water quality from upstream of the diverted gully outside of irrigated areas.
SW5	Surface Water Monitoring Sandy Creek (at diverted gully just before Sandy Creek confluence)	To monitor water quality of the diverted gully adjacent to the irrigation areas

Surface water samples from these locations are analysed for the parameters listed in Table 17.0 as required under clause M2.1 for Point 11 and 12 of the EP licence and the consent conditions.

From the review of the irrigation system undertaken by CSU for the Environment Assessment (January 2006), it was recommended that flow should be monitored at two of the surface water monitoring sites in

Sandy Creek, located upstream and downstream of the irrigation area to adequately estimate the salt and water balance for the site. During monthly sampling, flow is estimated at the Surface water monitoring points. In addition observation of Particulate matter and Water quality is undertaken.

Table 17.0: Surface water sample analysis and frequency.

Parameter	Units of Measurement	Frequency	
		Routine	EP Licence Requirements
Total dissolved solids (TDS)	milligrams/litre	Monthly during irrigation	On discharge to Sandy Creek and Monthly thereafter
pH	pH	Monthly during irrigation	On discharge to Sandy Creek and Monthly thereafter
Nitrogen	milligrams/litre	Monthly during irrigation	On discharge to Sandy Creek and Monthly thereafter
Phosphorous	milligrams/litre	Monthly during irrigation	On discharge to Sandy Creek and Monthly thereafter
Biochemical oxygen demand (BOD)	milligrams/litre	Monthly during irrigation	On discharge to Sandy Creek and Monthly thereafter
Electrical conductivity (EC)	micro Siemens (µS)	Monthly during irrigation	NA
Total suspended solids	milligrams/litre	Monthly during irrigation	NA
Zinc	milligrams/litre	Monthly during irrigation	NA
Manganese	milligrams/litre	Monthly during irrigation	NA
Faecal Coliforms	cfu/100mL	Monthly during irrigation	NA
Oil & Grease	mg/L	Monthly during irrigation	NA
Flow	Estimation	Monthly during irrigation	NA

The results of all monitoring are reported annually in the annual Environmental Compliance and Monitoring Report.

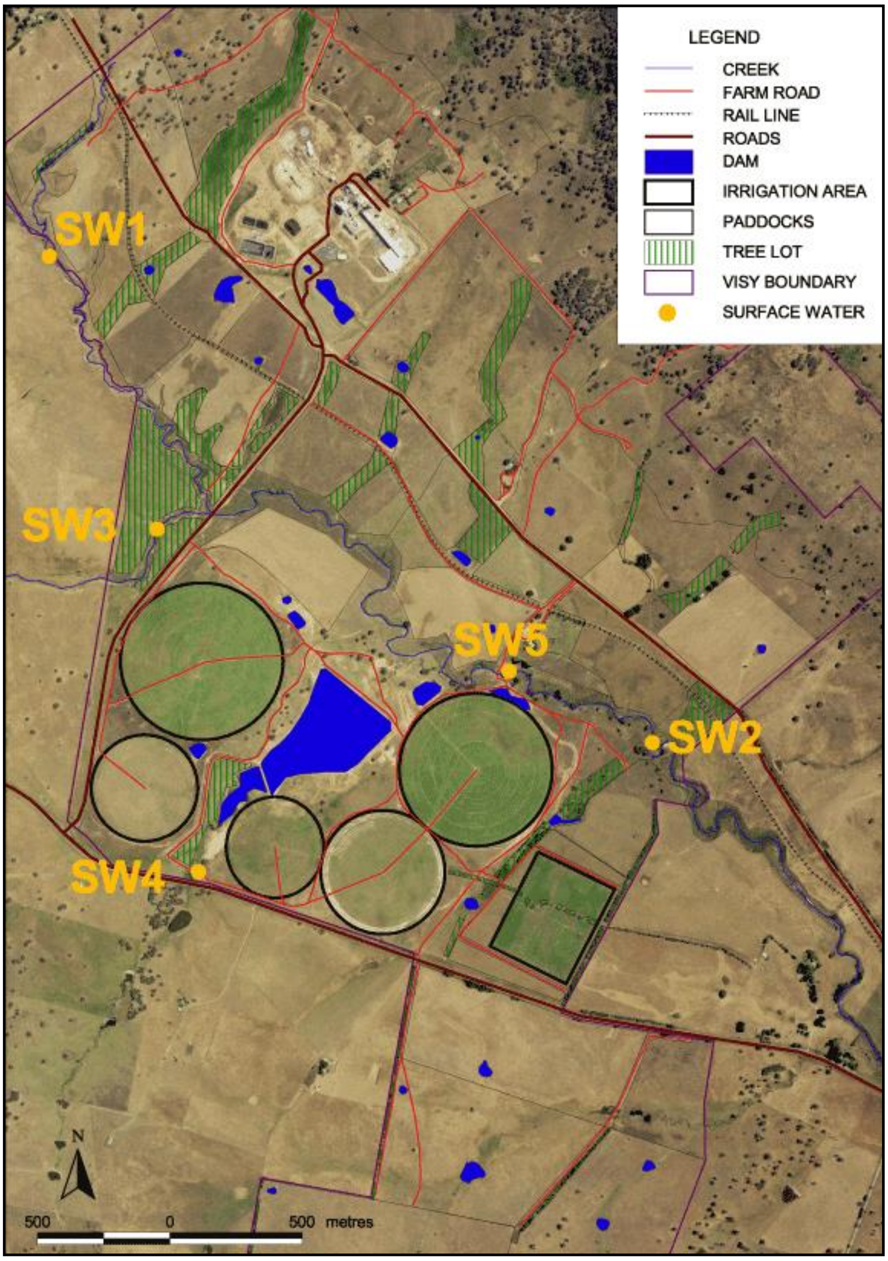

Figure 10.0 Surface Water Sampling Locations

7.1.2 Sampling procedure

7.1.2.1 Sample collection

Surface water samples are collected either by environmental personnel or by a qualified contractor. Field observations are recorded initially with the following observations noted:

- Flow conditions in the Creek
- Colour and odour; and
- Presence of suspended material/debris

Surface water samples are collected from the specified location by immersing the appropriate containers into the water manually. To ensure the analytical results are representative of the site conditions, the samples are collected in the correctly preserved sample containers, appropriate for the selected analysis, in compliance with United States Environment Protection Agency (US EPA) and American Public Health Association (APHA) guidelines.

Sample labels are filled in with details of date, time and sample location. Once filled, all sample containers are tightly capped, packed using bubble wrap to minimise breakage from the time of collection, and stored in a chilled Esky until delivery to the laboratory. Field data is recorded in field notebooks or record sheets and filed with sample information to provide an accurate means for reference and analysis.

All sampling equipment contacting surface water used at different sample locations is decontaminated at the beginning of the sampling event and after sampling at each surface water location.

7.1.2.2 Chain of custody

A Chain of custody document is filled out for each sampling round and is a record of sample possession. It is used to transfer specific analytical instructions to the laboratory. Information includes:

- Date and time;
- Name and signature of sampling personnel;
- Sample type, identification number and location;
- Date and time of sample collection;
- Number and type of sample containers; and
- Required chemical analysis.

The original copy is sent with the samples to the laboratory and a copy signed by laboratory personnel returned to the requesting personnel.

7.1.3 Data capture and retention

All monitoring records and Chain of custody forms are stored in hard copy and electronically on site. All hardcopy records are kept for a minimum of four years as per EP Licence condition M1.2. Records are stored as per the Records procedure: VP9-10-10.5-OP-004 and the Records register VP9-10-10.5-RG-0041.

7.1.4 Corrective and Preventative actions

Surface water sampling results are compared against background results (upstream sites), to historical data and the surface water quality goals summarised in Table 5.1. In the event that sample results are higher than normal or guideline levels, field information from the day of testing including irrigation flows and rainfall are reviewed. In the event that elevated results have occurred on more than two consecutive sampling events, further investigation and sampling will be undertaken to determine the possible cause. Details of the results and subsequent investigation are entered into the Vault incident reporting system as per Environmental Incident Reporting HowTo, HOWTO-VPP-TUM-HSE-041.

7.2 Fresh water use

7.2.1 Equipment and parameters

Freshwater is pumped via a pipeline from the Tumut River to the Raw Water Dam (also known as the Fresh Water Dam) and then flows by gravity to the mill. A flow meter located at the pumping station on the Tumut River pipeline is used for water accounting purposes against allocations under each Water Allocation Licence (refer Section 5.2).

Water for the process is gravity fed from the Raw Water Dam to the mill from where it splits off into two main supplies. Magnetic flow meters are installed on both supplies; one measuring flow to the Reverse osmosis plant and the other measuring flows to all other areas. These two flow meters are used for reporting total water usage within the mill. Major processes have individual flow meters installed, e.g. Paper machines, Cooling towers, Wetsac. These are used as a check on discrepancies against upstream flow meters.

A Potable Water treatment plant has been installed at the mill to allow the raw water to be treated to meet drinking water standards. This high quality water is also used for the mill's eyewash and safety shower stations. The treatment plant consists of multimedia filtration and chlorination. Routine testing is undertaken to ensure the water quality complies with health standards.

7.2.2 Calibration and maintenance

The flow meter located on the pipeline from the Tumut River is maintained and calibrated by Snowy Valleys Council.

The flow meters located on the site downstream from the Raw Water Dam are calibrated and maintained by site personnel. Flow meters are checked and if necessary cleaned during the annual maintenance shutdowns and serviced otherwise as required.

7.2.3 Data capture and retention

Instantaneous high resolution flow recordings from the flow meters, located at the Tumut River, downstream of the Raw Water Dam, and on the major process users within the plant are relayed directly to the electronic Distributed control system (DCS). This information is trended graphically on the screens for the operators in the Main control room. Alarms are set for high and low flows to alert operators of potential problems. Flow volumes from each meter can be totalled and used for early detection of any leakages, or calibration checks of individual flow meters.

The DCS system is backed up daily and all information on water use from the commissioning of Stage 1 to present is retained on site electronically.

7.2.4 Corrective and Preventative actions

Water flows into and throughout the mill are monitored constantly and totalled on a daily basis. Any imbalances are investigated immediately with checks done on valve positions and other flow meter readings. Total water consumption is reported in the daily production meetings and a monthly report is prepared providing water used, wastewater treated and irrigated. Freshwater usage is reported annually in the Environmental Compliance and Monitoring Report.

7.3 Wastewater

7.3.1 Location and Parameters

7.3.1.1 Quality

Wastewater samples are taken 6 times a year as required by clause M2.1 of the EP Licence. Samples are taken from Point 10 SBR Decant at 2.5ML Dam.

The sample is a composite sample, typically from three grab samples taken during a Decant cycle on the SBR (refer Section 4.3.2).

Wastewater samples are analysed for the parameters listed in Table 18.0 in accordance with the EP licence.

Table 18.0: Wastewater quality sampling from Point 10 (as per EP Licence) and frequency.

Parameter	Units	Frequency
Biochemical oxygen demand (BOD)	milligrams per litre	6 times a year
Nitrogen (total)	milligrams per litre	6 times a year
Oil & Grease	milligrams per litre	6 times a year
pH	pH	6 times a year
Phosphorous (total)	milligrams per litre	6 times a year
Sodium adsorption ratio	sodium adsorption ratio	6 times a year
Total dissolved solids	milligrams per litre	6 times a year
Total suspended solids	milligrams per litre	6 times a year
Zinc	milligrams per litre	6 times a year

7.3.1.2 Wastewater Flow Monitoring

Wastewater flows from each major sources (refer Table 4.2) are monitored on a continuous basis to ensure hydraulic loads on SBR are within the design. These flows are recorded onto the DCS and included in Wastewater report. Total flows are determined by summation of each of the individual flow meters and providing an estimate for the other minor flows. The total flow is checked for accuracy against the number of SBR batches processed.

A flow meter is also installed on the wastewater return pipeline to the Cooling Towers which records the quantity of wastewater recycled through the cooling water system.

The net flow discharged to the Wastewater Re-use area is calculated by subtracting the quantity of wastewater returned to the cooling water circuit from the total inflow to the SBR.

Refer to Section 7.4.1.4 below for flow monitoring to the wastewater irrigation area.

Should wastewater be discharged to Sandy Creek under clause O4 of the EP Licence, a flow meter is located on the discharge pipe adjacent to the Irrigation Pump Station to record flow. The readings on the flow meter are to be manually recorded at the same time on each day of discharge.

7.3.2 Sampling procedure

7.3.2.1 Sample collection

Wastewater samples are collected from the sampling point SBR Decant at the 2.5ML Dam. To ensure the analytical results are representative of the site conditions, the samples are collected in the correctly preserved sample containers, appropriate for the selected analysis, in compliance with United States Environment Protection Agency (US EPA) and American Public Health Association (APHA) guidelines.

Field observations are recorded initially with the following observations noted:

- Flow conditions ; and
- Colour and odour.

Sample labels are filled in with details of date, time and sample location. Once filled, all sample containers are tightly capped packed using bubble wrap to minimise breakage from the time of collection, and stored in a chilled Esky, until delivery to the laboratory. Field data is recorded in field notebooks or record sheets and filed with sample information to provide an accurate means for reference and analysis.

7.3.2.2 Chain of custody

A Chain of custody document is filled out for each sampling round and is a record of sample possession as detailed in Section 7.1.2.2.

7.3.3 Data capture and retention

All monitoring records and Chain of custody forms are stored in hard copy and electronically on site. These records are kept for a minimum of four years as per EP Licence condition M1.2. Hard copy files are retained in the HSE Manager's office for one year prior to being stored in a dedicated location for three years. Electronic copies are kept on the common site drive which is backed up daily by a dedicated electronic server. Records are stored as per the Records procedure: VP9-10-10.5-OP-004 and the Records register VP9-10-10.5-RG-0041.

7.3.4 Corrective and Preventative actions

Wastewater sampling results are compared to licence limits and existing site data. In the event that sample results are above normal or higher than licence requirements, it is investigated and recorded in the Noggin reporting system as per Environmental Incident Reporting HowTo, HOWTO-VPP-TUM-HSE-041.

7.4 Irrigation

7.4.1 Equipment and Parameters

7.4.1.1 Soil moisture monitoring

Soil moisture probes are located under each of the Centre Pivots and Soft Hose Traveller irrigation areas. Each probe has three moisture sensors that continuously monitor moisture levels in the soil at 10cm, 30cm and 50 cm depths. The soil moisture probes are linked via telemetry that allows automatic transfer of data onto the Agua website. This provides up to date information on soil moisture levels under the irrigation areas.

7.4.1.2 Soil Quality Monitoring

In addition soil sampling is undertaken at designated sites selected to be representative of soil conditions under irrigation as per site EP licence condition P1.3. Soil samples are taken as per EP Licence condition M2.1, and in accordance with the Visy Soil Management Plan.

7.4.1.3 Crop tissue analysis

Plant tissues are collected and analysed for a range of feed quality, macro nutrients, and currently heavy metals as detailed below, Table 19.0. This enables the Land management consultant and Farm manager to determine if the plants are lacking in nutrients or other essential elements and to remedy with fertiliser or agricultural products. This is undertaken as part of the farm management of Gadara Park area that is under irrigation.

7.4.1.4 Flow Monitoring

Monitoring of volumetric flows to the irrigation area in accordance with Clause M8.1 is by summation of the daily flows at each of the Centre Pivots and Soft hose traveller. Gadara Park personnel record the number of hours each day during the irrigation season that each Centre pivots or the Soft hose traveller operates. The volume applied to the area is then calculated by multiplying the flow rate listed in Table 4.7 by the total operating time. A record of daily irrigation flows is kept for each reporting period. This daily volume is not to exceed volume limit specified for Point 10 by Clause L4 in the EP Licence.

Table 19.0: Plant tissue analysis.

Test	Unit of measure	Method Reference	Desirable Range
Crop	NA	NA	NA
Moisture	%	wet	NA
Dry Matter	%	wet	25-30[4]
Crude Protein (N x 6.25)	% of dry matter	NIR	16 - 25[5]
Neutral Detergent Fibre	% of dry matter	NIR	>60[3]
Water Soluble Carbohydrate	% of dry matter	NIR	
DM Digestibility (DMD)	% of dry matter	NIR	>60[3]
DM Digestibility (DOMD)	% of dry matter	Calculated	
Metabolisable Energy	MJ/kg DM	Calculated	8 - 10[5]
Total Nitrogen (Kjedldahl)	%	NA	4.5-5.0
Nitrate Nitrogen (NO3)	mg/kg	NA	NA
Phosphorus (P)	%	NA	0.35-0.40

Potassium (K)	%	NA	2.0-2.5
Sulphur (S)	%	NA	0.27-0.32
Calcium (Ca)	%	NA	0.25-0.30
Magnesium (Mg)	%	NA	0.16-0.20
Sodium (Na)	%	NA	TBA
Chloride (Cl)	%	NA	TBA
Manganese (Mn)	mg/kg	NA	50-300
Arsenic	ppm		<8[2]
Lead	ppm		<15[2]
Nickel	ppm		<10[2]

(1) Reuter & Robinson (1997) Plant Analysis: An Interpretation Manual. 2nd Ed. CSIRO Publishing, Collingwood.

(2) US EPA (2000) Estimated Risk from Contaminants Contained in Agricultural Fertilizers. Washington.

(3) Dept. of Nat. Resources & Enviro. (2002) Understanding your Feed test Report. Agriculture Vic, Hamilton.

(4) NSW Agriculture (2002) Suitability of Feedstuffs.

(5) Feed test DPI (Vic) The Protein and Energy Content of some Commonly Used Feeds (Lucerne).

7.4.2 Data capture and retention

All monitoring records are stored in hard copy and electronically on site. These records are kept for a minimum of four years as per EP Licence condition M1.2. Electronic copies are kept on the common site drive which is backed up daily. Records are stored as per the Records procedure: VP9-10-10.5-OP-004 and the Records register VP9-10-10.5-RG-0041.

7.4.3 Corrective and Preventative actions

Sampling results are compared to historical site data, EP Licence conditions or relevant guideline levels. In the event that sample results are above normal or higher than licence requirements, it is investigated and recorded in the Noggin reporting system as per the Environmental Incident Reporting HowTo, HOWTO-VPP-TUM-HSE-041.

7.5 Groundwater

7.5.1 Location and Parameters

Groundwater monitoring is required to be undertaken in accordance with Clause M2.1 in the EP Licence at the Licence monitoring Point 32-46. The groundwater monitoring network, Point 34-46 includes groundwater bores 1 to 4 and 7 to 15 as shown in Figure 11.0 and represents Point 14. Also additional bores constructed have been included on Figure 11.0. A description of each location is provided in Table 21.0 over page.

The groundwater bores are monitored for parameters listed in Table 20.0 below at the specified frequency in accordance with the requirements of Clause M2.1 of the EP Licence for Point 32-46.

Table 20.0: Groundwater monitoring parameters.

Parameter	Frequency
Electrical conductivity (EC)	Every 6 months
Depth	Quarterly
Nitrate	Every 6 months
pH	Quarterly

7.5.2 Sampling procedure

7.5.2.1 Depth monitoring

Depth to groundwater level is assessed every 3 months manually with a level indicator and tape measure. Continuous groundwater level monitoring is installed at two bores, BH7 and BH9. The levels are accessed via the Agua website similar to the soil moisture probes.

Manual depth monitoring is undertaken prior to purging or sampling of groundwater bores. The static water level is recorded in metres from the top of the casing. The top of the casing has a measured elevation to AHD (Australian Height Datum).

Table 21.0: Groundwater bore locations.

Borehole	Purpose
BH1	Onsite upstream of irrigated areas
BH2	Onsite upstream of irrigated areas
BH3	Deep bore off site to monitor upstream groundwater quality
BH4	Destroyed due to Visy expansion.
BH7S	Shallow bore on north side of Sandy Creek upstream of irrigation area
BH7D	Deep bore on north side of Sandy Creek upstream of irrigation area
BH8S	Shallow bore to monitor groundwater quality downstream of irrigated areas
BH8D	Deep bore to monitor groundwater quality downstream of irrigated areas
BH9	Deep bore to monitor groundwater quality downstream of the irrigated areas
BH10	Deep bore to monitor groundwater quality off site and downstream of irrigated areas
BH11S	Shallow bore to monitor groundwater quality upstream of WSD and irrigation areas
BH11D	Deep bore to monitor groundwater quality upstream of WSD and irrigation areas
BH13	Shallow bore to monitor seepage from the Winter Storage Dam
BH14	Shallow bore to monitor seepage from the Winter Storage

BH15S	Shallow bore to monitor groundwater quality downstream of irrigated areas
BH15D	Deep bore to monitor groundwater quality downstream of irrigated areas
BH21S	Shallow bore to monitor groundwater quality directly under CP1
BH21D	Deep bore to monitor groundwater quality directly under CP1
BH22S	Shallow bore to monitor groundwater quality directly under CP2
BH22D	Deep bore to monitor groundwater quality directly under CP2
BH23S	Shallow bore to monitor groundwater quality directly under CP3
BH23D	Deep bore to monitor groundwater quality directly under CP3
BH24S	Shallow bore to monitor groundwater quality directly under CP4
BH24D	Deep bore to monitor groundwater quality directly under CP4
BH25S	Shallow bore to monitor groundwater quality directly under CP5
BH25D	Deep bore to monitor groundwater quality directly under CP5
BH26S	Shallow bore to monitor groundwater quality directly under HHT
BH26D	Deep bore to monitor groundwater quality directly under HHT
BH27S	Shallow bore to monitor groundwater quality directly East of WSD
BH27D	Deep bore to monitor groundwater quality directly East of WSD
BH28S	Shallow bore to monitor groundwater quality directly West of WSD
BH28D	Deep bore to monitor groundwater quality directly West of WSD
BH34S	Shallow bore to monitor groundwater quality upstream of WSD
BH34D	Deep bore to monitor groundwater quality upstream of WSD
BH35S	Shallow bore to monitor groundwater quality upstream of WSD
BH35D	Deep bore to monitor groundwater quality upstream of WSD

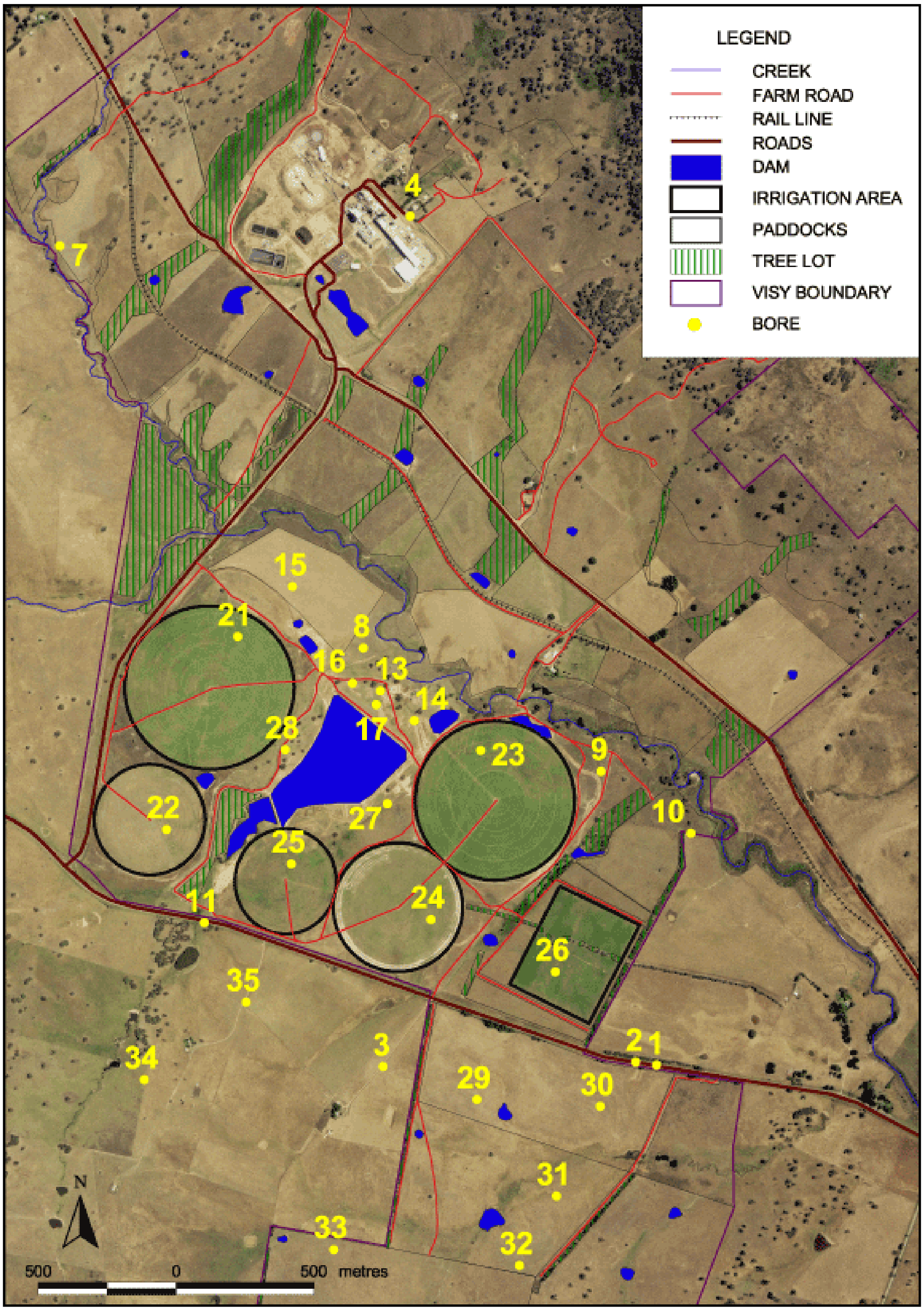

Figure 11.0 Groundwater Monitoring Network

7.5.2.2 Sample collection

Groundwater bores are purged to obtain stabilised groundwater from the aquifer formation and remove any stale water that may be in the bore casing. Purging involves removing the groundwater that is not representative of aquifer/formation water. The pH, electrical conductivity and temperature of the purged groundwater is monitored to determine when the groundwater quality has stabilised, indicating that it is the natural formation water. Groundwater monitoring instruments are calibrated against standard solutions at the start of each days sampling. In the event that the bore becomes dry prior to stabilisation occurring, samples are collected within 24 hours.   The static water level is recorded prior to and after purging.

Once the formation parameters have stabilised, samples are collected in correctly preserved containers as supplied by the laboratory. To ensure the analytical results are representative of the site conditions, all groundwater samples are collected in correctly preserved sample containers, appropriate for the selected analysis, in compliance with United States Environment Protection Agency (US EPA) and American Public Health Association (APHA) guidelines. All samples are analysed by a NATA accredited laboratory.

Monitoring wells are sampled using a bore specific Waterra foot-valve, within 24 hours of purging, which ensures sampling from the aquifer. This is a low flow apparatus that reduces turbidity and disturbance to the bore and because it is dedicated, reduces the risk of cross contamination. Groundwater is transferred from the sampling equipment directly into the sample container. Once filled, all sample containers are tightly capped and stored in a chilled Esky until delivery to the laboratory. Sample labels are filled in with details of date, time and sample location. Field data is recorded in field notebooks or record sheets and filed with sample information to provide an accurate means for reference and analysis.

All field sampling equipment is decontaminated during the sampling program to prevent cross contamination. Decontamination procedures are presented below:

- Remove any material from equipment;
- Wash/scrub equipment in 'Decon 90' (or other phosphate free detergent) and potable water solution;
- Rinse equipment with potable water; and
- Air dry equipment.

7.5.2.3 Chain of custody

A Chain of custody document is filled out for each sampling round and is a record of sample possession as detailed in Section 7.1.2.2.

7.5.2.4 Field quality control samples

Procedures for checking the accuracy and precision of analytical data in order to ensure the data quality objectives are satisfied, involve the analysis of field Quality control samples. Both field duplicate samples and field blank samples are collected and analysed when groundwater samples are collected.

Field duplicate samples: are a set of two samples collected from the one sampling point. The duplicate samples are prepared in the field by splitting a sample and then submitting both to the same laboratory for analysis as two independent samples.

Approximately 10% of the primary samples collected during any monitoring event should be replicates i.e. if 20 primary samples have been collected then two of these should be duplicate samples.

Field Blank samples: are prepared in the field by sampling personnel in the same manner as regular samples. The blank samples consist of analyte free media supplied or recommended for use by the laboratory, collected directly into the same type of containers used for regular sample analysis. At least one field blank sample is taken during each monitoring event and submitted to the laboratory and labelled so that it cannot be recognised as a clean water sample.

7.5.3 Data capture and retention

All monitoring records and Chain of custody forms are stored in hard copy and electronically on site. These records are kept for a minimum of four years as per EP Licence condition M1.2. Hard copy files are retained in the HSE Manager's office for one year prior to being stored in a dedicated location for three years. Electronic copies are kept on the common site drive which is backed up daily by a dedicated electronic server.

Records are stored as per the *Records procedure: VP9-10-10.5-OP-004* and the Records register VP9-10-10.5-RG-0041.

7.5.4 Corrective and Preventative actions

All data is compared with historical and other monitoring results by the Land management consultant on a 3 monthly basis and any anomalies reported to the HSE Manager.

In the event that sample results are above normal expected levels, the result is investigated and recorded in the Noggin reporting system as per Environmental Incident Reporting HowTo, HOWTO-VPP-TUM-HSE-041.

Should the investigation show that irrigation is having an adverse impact on groundwater level or quality, irrigation will be immediately halted, and consultation will be undertaken with the EPA as to the agreed corrective measures.

8.0 Reporting

8.1 Legal reporting requirements

8.1.1 Complaint and Incident Reports

The Shift Supervisor or HSE Manager is informed immediately of any incidents to ensure that appropriate and immediate actions are undertaken to mitigate the issue.

All Incidents are ranked from Level 1 to 5 in accordance with Visy Incident Classification (refer to table in Environmental Incident Reporting Procedure, HOWTO-VPP-TUM-HSE-041) and reported to relevant personnel and agencies in accordance with Visy Reporting Requirements and with DCC15, Concept Approval 6.1 and EP licence clause R2.

In accordance with the Visy Environmental Incident Reporting Procedure, all incidents are reported in an electronic reporting database system that automatically notifies relevant personnel and senior management and are used for incident review and tracking results of investigations and corrective actions.

Any incident that results in off-site impact will be notified to NSW EPA in accordance with EP Licence condition R2, and to NSW DPE in accordance with Condition 6.1 of the Concept Approval.

8.1.2 Annual Return

An Annual Return in the approved format in accordance with Condition R1 Annual Return Documents in the EP Licence 10232 must be completed and supplied to the NSW EPA. The Annual Return comprises a monitoring and complaints summary along with all non-compliances that have occurred through-out the reporting period.

This Annual Return must include a Statement of Compliance signed by a delegated company authority and submitted to the NSW EPA by registered post within 60 days of the end of the Reporting Period.

8.1.3 Annual Environmental Compliance and Monitoring Report

An Environmental Compliance and Monitoring report to satisfy Condition 12 of the Development Consent Conditions (Oct 1998) and Condition 6.3 of the Concept Approval Conditions (May 2007) must be submitted to the NSW Department of Planning and Environment (NSW DPE). This report is to provide a summary of all environmental monitoring, the Environmental Complaints register for the preceding 12-month period and an annual review of operational environment management plans, the conditions of consent and other licenses and approvals relating to the operation of the plant as well as comparisons with the EIS (1996) and EA (2007) predictions.

This report is submitted annually to the Department of Planning and Environment, and copies provided to the EPA (in accordance with Condition R1.10 of the EP Licence), Snowy Valleys Council and Visy Community Consultative Committee (VCCC).

Development consent condition 35 requires the review of groundwater depth to determine if the irrigation system is having any deleterious effects on the groundwater tables or salinity levels within the groundwater. A five-yearly trend of groundwater depths is included as an appendix in the annual Environmental Compliance and Monitoring Report.

8.1.4 Process water review

Development Consent Condition 96 requires a review of process water usage two years after commencement of operations and then report every three years or at such longer period as determined by the Director General. The review is to include consideration of improved recycling rates and reduced generation of wastewater. The initial Process Water Review report was submitted in 2005 and subsequently in 2008 and 2015, which documented reductions in freshwater use, wastewater production and increases in recycling.

8.2 Internal reporting

Monthly environmental accounts are reported to Visy Corporate in accordance with Visy Corporate *Procedure 205-0*. The monthly environmental accounts include key performance indicators for the raw materials, water and energy consumption as listed Attachment 1 in Visy Corporate *Procedure 205-0*. This data is collected, verified and reviewed by the Visy Environmental representative prior to submission.

9.0 Auditing

A program of internal and external audits exists for the site to determine whether the site meets environmental objectives and statutory requirements.

9.1 Legal requirements and external audits

9.1.1 Annual audit

An Independent Environmental Audit is to be undertaken in accordance with Condition 71 of Development Consent Condition (1998) and Condition 3.16 of Project Approval Condition (2007). This audit covers all aspects of monitoring and environmental performance and compliance with Development Consent Condition (1998), Project Approval Condition (2007) and predictions in the Environment Impact Statement (1998) and the Environmental Assessment (2007).

The audit report is to be submitted to the Department of Planning and Environment, with copies supplied to Snowy Valleys Council, and Visy Community Consultative Committee. In addition a copy is supplied to the NSW EPA in accordance with Condition R1.10 of the EP Licence.

9.1.2 Complaints system

A quarterly complaints audit is undertaken to monitor compliance with Conditions 73-76 of the Development Consent Conditions. These conditions require that a complaints system be instigated, a complaints register be maintained and an audit be undertaken as to the effectiveness and the degree of public satisfaction with the service. The audit is to be undertaken quarterly, and submitted within seven days of the end of the quarter, to the Department of Planning and Environment, NSW Environment Protection Authority and Snowy Valleys Council.

The audit comprises a review of the:

- Complaints forms (electronic and paper copy);
- Development Consent Conditions relevant to complaints management;
- Operational Environmental Management Plan procedures;
- Community Consultative Committee meeting minutes;
- Information provided to the public regarding how to make a complaint; and
- Whether actions identified in the previous audit of the system have been followed up with the procedures in the Operational Environmental Management Plan.

9.2 Internal Environmental Management System and Compliance Audit

An internal EMS and Compliance Audit of the site is undertaken in accordance with Visy Corporate *Procedure 1102*. The Visy Group Manager - Safety and Environment, co-ordinates and implements the audit program, which is conducted in accordance with Corporate EMS Audit Protocol.

9.3 Environmental Management System Certification

The site operates and is certified under the ISO 14,001:2015 Environmental Management System, ISO 9,001:2015 Quality Management System and ISO 45,001: 2018 Safety Management System. A surveillance audit is undertaken by BSI each year and a re-certification audit on a triennial basis.

Any Opportunity for improvements, Areas of concern or Non compliances from these audits are reviewed by Management and HSE personnel and agreed actions entered into the Noggin system.

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Appendix 1 – Irrigation Scheduling and ETo Data, December 2020, CP3

Date	Temp. Min °C	Temp. Max °C	Rain mm	ETo mm	Crop factor	Water requirement mm	Actual irrigation mm
01/12/20	14.5	34.6	0	6.7	1.2	8.0	8.52
02/12/20	11.7	25.6	0	5.5	1.2	6.6	12.06
03/12/20	10.8	27.6	0	6	1.2	7.2	9.53
04/12/20	9.9	28.3	0	6.6	1.2	7.9	0
05/12/20	9	29	0	4.7	1.2	5.6	0
06/12/20	11.6	18.8	19.9	4.4	1.2	0	0
07/12/20	9.3	19.8	0	4.5	1.2	5.4	0
08/12/20	7.1	20.7	1.7	5.1	1.2	6.1	0
09/12/20	5.8	26.2	0	5.7	1.2	6.8	0
10/12/20	8.1	25	0	5	1.2	6.0	0
11/12/20	10.5	23.8	4.3	5.8	1.2	7.0	0
12/12/20	9.5	24.8	0	5.7	1.2	6.8	0
13/12/20	11	27	0	5.7	1.2	6.8	0
14/12/20	12.6	29.1	0	6.2	1.2	7.4	0
15/12/20	15.8	29.4	0	4.8	1.2	5.8	8.52
16/12/20	16.8	30.4	0	5.2	1.2	6.2	12.06
17/12/20	17.8	31.4	37.7	5.6	1.2	0	12.06
18/12/20	18.3	27.3	0	4.9	1.2	5.9	12.06
19/12/20	14.9	27.1	0	4	1.2	4.8	12.06
20/12/20	11.7	26.8	0	4.7	1.2	5.6	9.53
21/12/20	11.6	25	0	4.4	1.2	5.3	0
22/12/20	11.4	25.5	25.1	4.1	1.2	0	0
23/12/20	11.1	25.9	1.7	4.9	1.2	5.9	0
24/12/20	9.8	28.1	0	4.8	1.2	5.8	0
25/12/20	11.2	29	0	5.3	1.2	6.4	0
26/12/20	13.5	29.9	0	5.9	1.2	7.1	0
27/12/20	12.7	33.3	0	5.9	1.2	7.1	0
28/12/20	11.9	31.1	0	6	1.2	7.2	0
29/12/20	11.1	28.8	0	4.4	1.2	5.3	0
30/12/20	13.6	30.1	0	5.1	1.2	6.1	12.06
31/12/20	15.5	27.5	0.1	5.8	1.2	7.0	9.53
TOTALS			**90.5**	**163.4**	**-**	**179.2**	**118.0**

Appendix 2 – Fifteen Year Nutrient Budget

WINTER 2021	CROP (VARIETY)	DATE SOWN	SOIL P STATUS (kg/ha)	SOIL N STATUS (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	n/a	102.6	21.2	26.4	63.6	1	45	42	93	88.0	36.8
CP2	RYEGRASS	n/a	27.6	21.6	26.4	63.6	1	45	42	93	13.0	37.2
CP3	RYEGRASS	n/a	90.0	7.6	26.4	63.6	1	45	42	93	75.4	23.2
CP4	RYEGRASS & CANOLA	n/a	86.4	28.8	26.4	63.6	1	45	42	93	71.8	44.4
CP5	RYEGRASS	n/a	33.6	11.8	26.4	63.6	1	45	42	93	19.0	27.4
SHT	RYEGRASS	n/a	25.2	9.0	26.4	63.6	1	45	42	93	10.6	24.6

SUMMER 2021/22	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE & RYEGRASS	n/a	88.0	36.8	22	135	3	45	35	200	78.0	16.8
CP2	LUCERNE & RYEGRASS	n/a	13.0	37.2	22	135	3	45	35	200	3	17.2
CP3	LUCERNE & RYEGRASS	n/a	75.4	23.2	22	135	3	45	35	200	65.4	3.16
CP4	LUCERNE & RYEGRASS	n/a	71.8	44.4	22	135	3	45	35	200	61.8	24.4
CP5	LUCERNE & RYEGRASS	n/a	19.0	27.4	22	135	3	45	35	200	9	7.36
SHT	RYEGRASS	n/a	10.6	24.6	26.4	23	1	45	42	93	0	0.0

WINTER 2022	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	78	16.78	26.4	63.6	1	45	42	93	63.4	32.38
CP2	RYEGRASS	tba	3	17.2	26.4	63.6	1	45	42	93	0	32.8
CP3	RYEGRASS	tba	65.4	3.16	26.4	63.6	1	45	42	93	50.8	18.76
CP4	RYEGRASS	tba	61.8	24.4	26.4	63.6	1	45	42	93	47.2	40
CP5	RYEGRASS	tba	9	7.36	26.4	63.6	1	45	42	93	0	22.96
SHT	RYEGRASS	tba	0	0	26.4	63.6	1	45	42	93	0	15.6

SUMMER 2022/23	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE & RYEGRASS	tba	63.4	32.38	22	135	3	45	35	200	53.4	12.38
CP2	LUCERNE & RYEGRASS	tba	0	32.8	22	135	3	45	35	200	0	12.8
CP3	LUCERNE & RYEGRASS	tba	50.8	18.76	22	135	3	45	35	200	40.8	0
CP4	LUCERNE & RYEGRASS	tba	47.2	40	22	135	3	45	35	200	37.2	20
CP5	LUCERNE & RYEGRASS	tba	0	22.96	22	135	3	45	35	200	0	2.96
SHT	RYEGRASS	tba	0	15.6	44	45	1	45	45	93	0	12.6

WINTER 2023	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	53.4	12.38	22	23	3	193	25	200	53.4	28.38
CP2	LUCERNE	tba	0	12.8	22	23	3	193	25	200	0	28.8
CP3	LUCERNE	tba	40.8	0	22	23	3	193	25	200	40.8	16
CP4	LUCERNE	tba	37.2	20	22	23	3	193	25	200	37.2	36
CP5	LUCERNE	tba	0	2.96	22	23	3	193	25	200	0	18.96
SHT	RYEGRASS	tba	0	12.6	48.4	45	1	45	45	100	4.4	2.6

SUMMER 2023/24	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	53.4	28.38	22	0	3	193	25	200	53.4	21.38
CP2	LUCERNE	tba	0	28.8	22	0	3	193	25	200	0	21.8
CP3	LUCERNE	tba	40.8	16	22	0	3	193	25	200	40.8	9
CP4	LUCERNE	tba	37.2	36	22	0	3	193	25	200	37.2	29
CP5	FALLOW	tba	0	18.96	0	0	0	0	0	0	0	18.96
SHT	FALLOW	tba	4.4	2.6	0	0	0	0	0	0	4.4	2.6

WINTER 2024	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	53.4	21.38	22	0	3	193	25	200	53.4	14.38
CP2	LUCERNE	tba	0	21.8	22	0	3	193	25	200	0	14.8
CP3	RYEGRASS	tba	40.8	9	26.4	44	1	45	21	93	47.2	5
CP4	RYEGRASS	tba	37.2	29	26.4	44	1	45	21	93	43.6	25
CP5	RYEGRASS	tba	0	18.96	26.4	18.6	1	90	21	93	6.4	34.56
SHT	RYEGRASS	tba	4.4	2.6	26.4	44	1	45	21	93	10.8	0

SUMMER 2024/25	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	53.4	14.38	26.4	0	3	193	25	200	57.8	7.38
CP2	LUCERNE	tba	0	14.8	26.4	0	3	193	25	200	4.4	7.8
CP3	RYEGRASS	tba	47.2	5	22	11	3	53	21	47	51.2	22
CP4	RYEGRASS	tba	43.6	25	22	11	3	53	21	47	47.6	42
CP5	RYEGRASS	tba	6.4	34.56	22	11	3	53	21	47	10.4	51.56
SHT	RYEGRASS	tba	10.8	0	22	23	3	53	21	47	14.8	29

WINTER 2025	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	57.8	7.38	22	23	3	193	25	200	57.8	23.38
CP2	LUCERNE	tba	4.4	7.8	22	23	3	193	25	200	4.4	23.8
CP3	RYEGRASS	tba	51.2	22	26.4	23	1	45	21	93	57.6	0
CP4	RYEGRASS	tba	47.6	42	26.4	23	1	45	21	93	54	17
CP5	RYEGRASS	tba	10.4	51.56	26.4	23	1	45	21	93	16.8	26.56
SHT	RYEGRASS	tba	14.8	29	26.4	18.6	1	45	21	93	21.2	0

SUMMER 2024/2025	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	57.8	23.38	26.4	0	3	193	25	200	62.2	16.38
CP2	LUCERNE	tba	4.4	23.8	26.4	0	3	193	25	200	8.8	16.8
CP3	RYEGRASS	tba	57.6	0	0	23	3	53	21	47	39.6	29
CP4	RYEGRASS	tba	54	17	0	23	3	53	21	47	36	46
CP5	RYEGRASS	tba	16.8	26.56	0	23	3	53	21	47	0	55.56
SHT	RYEGRASS	tba	21.2	0	22	23	3	53	21	47	25.2	29

WINTER 2026	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	62.2	16.38	22	0	3	193	25	200	62.2	9.38
CP2	LUCERNE	tba	8.8	16.8	22	0	3	193	25	200	8.8	9.8
CP3	WHEAT	tba	39.6	29	48.4	18	1	45	45	100	44	0
CP4	WHEAT	tba	36	46	26.4	39	1	45	45	100	18.4	30
CP5	RYEGRASS	tba	0	55.56	26.4	18	1	45	21	93	6.4	25.56
SHT	RYEGRASS	tba	25.2	29	26.4	39	1	45	21	93	31.6	20

SUMMER 2026/27	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	62.2	9.38	26.4	0	3	193	25	200	66.6	2.38
CP2	LUCERNE	tba	8.8	9.8	26.4	0	3	193	25	200	13.2	2.8
CP3	FALLOW	tba	44	0	0	0	0	0	0	0	44	0
CP4	FALLOW	tba	18.4	30	0	0	0	0	0	0	18.4	30
CP5	RYEGRASS	tba	6.4	25.56	22	23	3	53	21	47	10.4	54.56
SHT	RYEGRASS	tba	31.6	20	22	23	3	53	21	47	35.6	49

WINTER 2027	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	66.6	2.38	22	0	3	193	25	200	66.6	0
CP2	LUCERNE	tba	13.2	2.8	22	23	3	193	25	200	13.2	18.8
CP3	WHEAT	tba	44	0	26.4	63.6	1	45	45	100	26.4	8.6
CP4	WHEAT	tba	18.4	30	35.4	63.6	1	45	45	100	9.8	38.6
CP5	RYEGRASS	tba	10.4	54.56	22	18.6	1	45	21	93	12.4	25.16
SHT	RYEGRASS	tba	35.6	49	22	18.6	1	45	21	93	37.6	19.6

SUMMER 2027/28	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	66.6	0	0	23	3	53	21	47	48.6	29
CP2	RYEGRASS	tba	13.2	18.8	0	23	3	53	21	47	0	47.8
CP3	LUCERNE	tba	26.4	8.6	37.4	0	3	193	25	200	41.8	1.6
CP4	LUCERNE	tba	9.8	38.6	37.4	0	3	193	25	200	25.2	31.6
CP5	RYEGRASS	tba	12.4	25.16	0	23	1	53	21	47	0	54.16
SHT	RYEGRASS	tba	37.6	19.6	0	23	3	53	21	47	19.6	48.6

WINTER 2028	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	48.6	29	26.4	23	1	45	21	93	55	4
CP2	RYEGRASS	tba	0	47.8	26.4	23	1	45	21	93	6.4	22.8
CP3	LUCERNE	tba	41.8	1.6	22	0	3	193	25	200	41.8	0
CP4	LUCERNE	tba	25.2	31.6	22	0	3	193	25	200	25.2	24.6
CP5	RYEGRASS	tba	0	54.16	26.4	23	1	45	21	93	6.4	29.16
SHT	RYEGRASS	tba	19.6	48.6	26.4	23	1	45	21	93	26	23.6

SUMMER 2028/29	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	55	4	22	0	3	53	21	47	59	10
CP2	RYEGRASS	tba	6.4	22.8	22	0	3	53	21	47	10.4	28.8
CP3	LUCERNE	tba	41.8	0	22	0	3	193	25	200	41.8	0
CP4	LUCERNE	tba	25.2	24.6	22	23	3	193	25	200	25.2	40.6
CP5	RYEGRASS	tba	6.4	29.16	22	0	3	53	21	47	10.4	35.16
SHT	RYEGRASS	tba	26	23.6	22	0	3	53	21	47	30	29.6

WINTER 2029	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	WHEAT	tba	59	10	39.6	46	1	45	45	100	54.6	1
CP2	WHEAT	tba	10.4	28.8	39.6	46	1	45	45	100	6	19.8
CP3	LUCERNE	tba	41.8	0	22	0	3	193	25	200	41.8	0
CP4	LUCERNE	tba	25.2	40.6	22	0	3	193	25	200	25.2	33.6
CP5	WHEAT	tba	10.4	35.16	26.4	55	1	45	45	100	0	35.16
SHT	RYEGRASS	tba	30	29.6	26.4	23	1	45	21	93	36.4	4.6

SUMMER 2029/2030	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	FALLOW	tba	54.6	1	0	0	0	0	0	0	54.6	1
CP2	FALLOW	tba	6	19.8	0	0	0	0	0	0	6	19.8
CP3	LUCERNE	tba	41.8	0	22	0	3	193	25	200	41.8	0
CP4	LUCERNE	tba	25.2	33.6	22	0	3	193	25	200	25.2	26.6
CP5	MAIZE	tba	0	35.16	44	162	3	53	50	250	0	0.16
SHT	RYEGRASS	tba	36.4	4.6	0	0	3	53	21	47	18.4	10.6

WINTER 2030	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	WHEAT	tba	54.6	1	39.6	46	1	45	45	100	50.2	0
CP2	WHEAT	tba	6	19.8	39.6	46	1	45	45	100	1.6	10.8
CP3	LUCERNE	tba	41.8	0	22	0	3	193	25	200	41.8	0
CP4	LUCERNE	tba	25.2	26.6	22	0	3	193	25	200	25.2	19.6
CP5	WHEAT	tba	0	0.16	39.6	55	1	45	45	100	0	0.16
SHT	RYEGRASS	tba	18.4	10.6	26.4	46	1	45	21	93	24.8	8.6

SUMMER 2030/31	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	50.2	0	26.4	21	3	193	25	200	54.6	14
CP2	LUCERNE	tba	1.6	10.8	26.4	21	3	193	25	200	6	24.8
CP3	LUCERNE	tba	41.8	0	22	21	3	193	25	200	41.8	14
CP4	LUCERNE	tba	25.2	19.6	22	21	3	193	25	200	25.2	33.6
CP5	FALLOW	tba	0	0.16	0	0	0	0	0	0	0	0.16
SHT	FALLOW	tba	24.8	8.6	0	0	0	0	0	0	24.8	8.6

WINTER 2031	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	54.6	14	22	0	3	193	25	200	54.6	7
CP2	LUCERNE	tba	6	24.8	22	0	3	193	25	200	6	17.8
CP3	RYEGRASS	tba	41.8	14	26.4	44	1	45	21	93	48.2	10
CP4	RYEGRASS	tba	25.2	33.6	26.4	44	1	45	21	93	31.6	29.6
CP5	RYEGRASS	tba	0	0.16	26.4	63.6	1	45	21	93	6.4	15.76
SHT	RYEGRASS	tba	24.8	8.6	26.4	63.6	1	45	21	93	31.2	24.2

SUMMER 2031/32	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	54.6	7	26.4	0	3	193	25	200	59	0
CP2	LUCERNE	tba	6	17.8	26.4	0	3	193	25	200	10.4	10.8
CP3	RYEGRASS	tba	48.2	10	11	23	3	53	21	47	41.2	39
CP4	RYEGRASS	tba	31.6	29.6	11	23	3	53	21	47	24.6	58.6
CP5	RYEGRASS	tba	6.4	15.76	22	23	3	53	21	47	10.4	44.76
SHT	RYEGRASS	tba	31.2	24.2	11	23	3	53	21	47	24.2	53.2

WINTER 2032	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	59	0	22	0	3	193	25	200	59	0
CP2	LUCERNE	tba	10.4	10.8	22	18.6	3	193	25	200	10.4	22.4
CP3	RYEGRASS	tba	41.2	39	26.4	18.6	1	45	21	93	47.6	9.6
CP4	RYEGRASS	tba	24.6	58.6	26.4	18.6	1	45	21	93	31	29.2
CP5	RYEGRASS	tba	10.4	44.76	26.4	42.6	1	45	21	93	16.8	39.36
SHT	RYEGRASS	tba	24.2	53.2	26.4	18.6	1	45	21	93	30.6	23.8

SUMMER 2032/33	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	59	0	22	22	3	193	25	200	59	15
CP2	LUCERNE	tba	10.4	22.4	22	0	3	193	25	200	10.4	15.4
CP3	RYEGRASS	tba	47.6	9.6	0	0	3	53	21	47	29.6	15.6
CP4	RYEGRASS	tba	31	29.2	22	0	3	53	21	47	35	35.2
CP5	RYEGRASS	tba	16.8	39.36	22	0	3	53	21	47	20.8	45.36
SHT	RYEGRASS	tba	30.6	23.8	22	0	3	53	21	47	34.6	29.8

WINTER 2033	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	59	15	22	0	3	193	25	200	59	8
CP2	LUCERNE	tba	10.4	15.4	22	0	3	193	25	200	10.4	8.4
CP3	WHEAT	tba	29.6	15.6	26.4	44	1	45	45	100	12	4.6
CP4	WHEAT	tba	35	35.2	26.4	44	1	45	45	100	17.4	24.2
CP5	RYEGRASS	tba	20.8	45.36	26.4	23	1	45	21	93	27.2	20.36
SHT	RYEGRASS	tba	34.6	29.8	26.4	23	1	45	21	93	41	4.8

SUMMER 2033/34	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	59	8	22	22	3	193	25	200	59	23
CP2	LUCERNE	tba	10.4	8.4	22	22	3	193	25	200	10.4	23.4
CP3	FALLOW	tba	12	4.6	22	22	3	53	21	47	16	32.6
CP4	FALLOW	tba	17.4	24.2	22	23	0	0	0	0	39.4	47.2
CP5	RYEGRASS	tba	27.2	20.36	22	23	3	53	21	47	31.2	49.36
SHT	RYEGRASS	tba	41	4.8	22	23	3	53	21	47	45	33.8

WINTER 2034	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	LUCERNE	tba	59	23	22	0	3	193	25	200	59	16
CP2	LUCERNE	tba	10.4	23.4	22	0	3	193	25	200	10.4	16.4
CP3	WHEAT	tba	16	32.6	52.8	46	1	45	45	100	24.8	23.6
CP4	WHEAT	tba	39.4	47.2	26.4	46	1	45	45	100	21.8	38.2
CP5	RYEGRASS	tba	31.2	49.36	26.4	18.6	1	45	21	93	37.6	19.96
SHT	RYEGRASS	tba	45	33.8	26.4	18.6	1	45	21	93	51.4	4.4

SUMMER 2034/35	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	59	16	22	23	3	53	21	47	63	45
CP2	RYEGRASS	tba	10.4	16.4	22	23	3	53	21	47	14.4	45.4
CP3	LUCERNE	tba	24.8	23.6	37.4	0	3	193	25	200	40.2	16.6
CP4	LUCERNE	tba	21.8	38.2	37.4	23	3	193	25	200	37.2	54.2
CP5	RYEGRASS	tba	37.6	19.96	0	23	1	53	21	47	17.6	48.96
SHT	RYEGRASS	tba	51.4	4.4	0	23	3	53	21	47	33.4	33.4

WINTER 2035	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	63	45	22	0	3	193	25	200	63	38
CP2	RYEGRASS	tba	14.4	45.4	22	0	3	193	25	200	14.4	38.4
CP3	LUCERNE	tba	40.2	16.6	44	63.6	1	45	45	100	40.2	25.2
CP4	LUCERNE	tba	37.2	54.2	44	63.6	1	45	45	100	37.2	62.8
CP5	RYEGRASS	tba	17.6	48.96	26.4	18.6	1	45	21	93	24	19.56
SHT	RYEGRASS	tba	33.4	33.4	26.4	18.6	1	45	21	93	39.8	4

SUMMER 2035/36	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	63	38	0	12.5	22	53	21	47	64	56.5
CP2	RYEGRASS	tba	14.4	38.4	0	12.5	22	53	21	47	15.4	56.9
CP3	LUCERNE	tba	40.2	25.2	37.4	0	3	193	25	200	55.6	18.2
CP4	LUCERNE	tba	37.2	62.8	37.4	0	3	193	25	200	52.6	55.8
CP5	RYEGRASS	tba	24	19.56	0	23	22	53	21	47	25	48.56
SHT	RYEGRASS	tba	39.8	4	0	23	3	53	21	47	21.8	33

WINTER 2036	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	15.4	56.9	22	0	3	193	25	200	15.4	49.9
CP2	RYEGRASS	tba	55.6	18.2	22	0	3	193	25	200	55.6	11.2
CP3	LUCERNE	tba	52.6	55.8	44	63.6	1	45	45	100	52.6	64.4
CP4	LUCERNE	tba	25	48.56	44	63.6	1	45	45	100	25	57.16
CP5	RYEGRASS	tba	21.8	33	26.4	44	1	45	21	93	28.2	29
SHT	RYEGRASS	tba	21.8	33	26.4	55	1	45	21	93	28.2	40

SUMMER 2036/37	CROP (VARIETY)	DATE SOWN	SOIL P AT SOWING (kg/ha)	SOIL N AT SOWING (kg/ha)	P FERTLISER (kg/ha)	N FERTILISER (kg/ha)	P ADDITIONAL (kg/ha)	N ADDITIONAL (kg/ha)	P REMOVAL (kg/ha)	N REMOVAL (kg/ha)	P AFTER CROP (kg/ha)	N AFTER CROP (kg/ha)
CP1	RYEGRASS	tba	15.4	49.9	0	23	22	53	21	47	16.4	78.9
CP2	RYEGRASS	tba	55.6	11.2	0	23	22	53	21	47	56.6	40.2
CP3	LUCERNE	tba	52.6	64.4	37.4	0	3	193	25	200	68	57.4
CP4	LUCERNE	tba	25	57.16	37.4	0	3	193	25	200	40.4	50.16
CP5	RYEGRASS	tba	28.2	29	0	23	22	53	21	47	29.2	58
SHT	RYEGRASS	tba	28.2	40	26.4	23	3	53	21	47	36.6	69