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Date: 22 May 2018

Ref: 1912 RTC 220518sd

Re: Wastewater Assessment for North Byron Parklands

1. Introduction

At the request of Byron Venue Management Pty Ltd (the Client), Whitehead & Associates (W&A) prepared a Wastewater Assessment (WWA) for the proposed continuation and expansion of the North Byron Parklands (NBP) cultural events site. The WWA (Ref: 1912 WWA 081217 Rev, dated 8 December 2017), was included as Appendix R in the Environmental Impact Statement for the proposed development.

A number of comments have been received on the WWA by the Department of Planning & Environment (DP&E), Tweed and Byron Shire Councils (TSC and BSC), and the DP&E's appointed third party reviewer, GHD. The comments and responses by W&A are provided in the following sections.

2. Comments and Responses by W&A

2.1. DP&E Comments

The DP&E comments as received by W&A are provided and responded to in Table 1 below.

Table 1: DP&E Comments

Item	DP&E Comments	Response
1D	Please provide further justification why the alternative water and wastewater infrastructure proposed in the EIS (composting and grey water handling	W&A built on the foundation work performed by Gilbert & Sutherland for the original NBP wastewater treatment system. The On-Site Sewage Management System (OSMS) proposed under the Stage 2 works of the original approval consisted of a technological, resource (electricity) and capital intensive (infrastructure and media) treatment system including: • Initial grit screening then addition of flocculent and

Item	DP&E Comments	Response
	system) is considered to be more appropriate than what was proposed under the Stage 2 works in the original approval.	clarification prior to: • Primary and secondary treatment via aeration with air pumped through bottom mounted diffusers; • Secondary to tertiary polishing by pumping through Zeolite and sand media filters; • Disinfection through chlorine dosing; • Storage in a large open dam in the middle of the festival precinct; • Gravity flow through a series of surface wetland ponds; and • Surface irrigation of an average 50.9kL/day onto 28,000m^2 forest plantation and 30,000m^2 grass, with proposed minimum 20m buffers to boundaries. The above treatment system is similar to that installed and operated at the Woodford Folk Festival Site in Queensland. As part of the OSMS design for the Parklands project W&A discussed the operation of this plant with a member of the management team who confirmed that the treatment system is problematic in the install and operational cost, as well as requiring specialist input during operation. A client of the Woodford Folk Festival Site that we discussed the OSMS with, whom hired the site for a small festival, also separately commented on the high water usage of the flushing toilet type inputs into the OSMS and the resultant cost of utilising the venue. NBP requested W&A to develop an OSMS that allowed the venue to maintain its triple bottom line of financial responsibility, as well as social and environmental credentials and aspirations. That is, a low energy and water use OSMS. The OSMS design by W&A achieves a balance of utilising existing proven technologies (reed beds and surface irrigation), that operate mainly in a passive and biological manner, and that are suitably robust and easy to maintain/operate. The design by W&A is partially a reconfiguration of the original design to: • Maximize distance of the treatment system to site users and reduce the risk of odour and complaints and health risks. The original design based the treatment system around the large dam adjacent to the main amphitheatre and secondary amphitheatre entertainment areas. The revised design places the treatment area over the forested ridgeline, well away from the public zone and off-site receivers; • Maximize upfront storage during the peak short term rather than post treatment storage in the original design that requires a very large treatment system that is oversized for the majority of the year; • Utilises reed beds rather than wetland polishing, providing similar treatment mechanisms; • Is more robust and reliable in having parallel treatment trains rather than a single treatment train; • Does not require use of oxidising chemicals (hydrogen peroxide) and the associated human health and environmental risks of spillage, plus environmental impact of production;

Item	DP&E Comments	Response
		• Is more robust in that it utilises surface spray irrigation rather than a mix of drip/surface spray, given that drip irrigation can have maintenance and longevity issues; and • Provides for a similar application rate of 35kL/day over 36,000m^2 disposal area (1mm/m^2), than 50.9kL/day over 58,000m^2 area (0.9mm/m^2).

2.2. GHD Comments

The comments and requirements for further information in the third party review undertaken by GHD (Ref: 2316318-43067, dated 12 April 2018) are addressed in Table 2 through Table 4 below.

Table 2: GHD Comments

Item	GHD Comment	Response
1G	The irrigation of treated wastewater on a flood plain area is considered a contamination risk on and off-site.	The NSW EPA's *Use of Effluent by Irrigation* (2004) guidelines state that employing floodplain areas can be acceptable for effluent irrigation (S2.8) subject to appropriate engineering controls. W&A concur that irrigation onto a floodplain has management issues, but that floodplains across NSW and locally provide productive spaces used by various agricultural activities such as sugar cane farming and dairying. These activities operate throughout the year, and manage wastewater application (particularly dairies) through flood events. The OSMS design by W&A allows for a three day withholding wet weather storage and an above floodplain emergency land application area, plus a pre-event withholding period of up to 4 weeks per event, which can be utilised in cases of direct flood situations or to catch up on the irrigation cycle following these events. The land application area is based on a water balance that accounts for higher rainfall periods (i.e. a lower land application rate to account for increased soil moisture), and use of vegetation uptake zones adjacent to drains. The irrigation area required for hydraulic loading based on rainfall and evaporation effects is only ~17,000m^2, much less than the proposed ~36,000m^2 footprint. This results in the actual irrigation rate being much lower than the allowable required to limit deep percolation to groundwater and surface runoff. The larger footprint was based on nutrient balancing requirements to ensure net export of nitrogen and phosphorus are within allowable cumulative impacts. The original WWMP prepared by Gilbert & Sutherland in 2010 that was approved for the property, also allowed for land application onto the floodplain, and modelled the land application using alternative irrigation models to those by W&A. That assessment also confirmed no significant cumulative impact to surface or groundwaters.
2G	Water demand for the proposal does not account	The water demands associated with the proposal are outlined in the potable water supply assessment undertaken by JED

Item	GHD Comment	Response
	for staff on-site.	Civil (see Appendix Q of the EIS). W&A has discussed the water demand assumptions used in the potable water assessment with JED Civil, and reviewed the water demand calculations in Table 1 of that document. Based on these discussions and review, W&A and JED Civil agree that the total water demand calculated by JED civil is relatively simplistic and conservative compared to the more detailed calculations by W&A for wastewater production. In this regard, the wastewater assessment required a greater degree of accuracy compared to the potable water assessment, which was primarily concerned with providing a conservative storage estimate for potable water. Whilst the potable water assessment did not separately account for staff on site, its patronage assumptions are overly conservative, in that it assumed: • Full patronage for up to 5 event days for large events (as outlined in the EIS, events would run for 3 to 4 days, with 1 to 2 shoulder days); • Overnight camping for all patrons for all medium and minor events (which is extremely unlikely given the type of events likely to be held under these categories); and • Full capacity for the conference centre year round (the wastewater assessment adopts a more realistic usage of 189 days a year at full occupancy, which provides allowance for withholding periods between events). As such, the water demand modelling undertaken by JED Civil, though not specifically allowing for staff, is conservative in duration and occupancy and would provide sufficient volume for staff consumption. In addition, given the non-standard nature of the water consumption and wastewater production by festival patrons and the use of compost toilets, W&A believes there is a disconnect between water demand and wastewater production. We would expect water demand to be much higher than wastewater production (see table in in response to 1B below), and previous production values show a wastewater production to water consumption ratio of 0.5-0.7. With reductions in water demand due to over estimation, and reduced wastewater production due to the nature of water demand in a festival and the use of compost toilets, the volume of wastewater of 9.2ML/annum modelled by W&A is considered to be reasonable and appropriate.
3G	Water demand for the proposal does not account for any staff and patrons arriving on the day before and leaving on the day following each major event.	
4G	Proposed discharge volumes are stated to be based on historical data yet are only 49.6% of the stated demand for the Proposal. The discharge volumes adopted in the proposal are not substantiated. Only 49.6% of the proposed Stage 3 annual water demand is accounted for in the proposed wastewater discharge volume and on-site management systems.	

Item	GHD Comment	Response
5G	Areas designated for treated wastewater sub-surface discharge, irrigation and compost burial are not proposed to be equipped with infrastructure to control stormwater run-off in case of contamination.	The wastewater assessment notes that further detailed engineering design for the sewer reticulation and treatment system would be undertaken as part of the treatment system plans and s68 application. The EIS includes commitments to preparing a detailed Wastewater Management Plan, along with Stormwater Management Plans for applicable infrastructure. Bunding and stormwater control would be detailed in these detailed plans. It is reasonable given the scale of the treatment area to provide spill and run-on and runoff control measures at the main treatment plant site. Compost is required to be buried at 100mm below the surface, and given the ability to choose the day of burial, non-raining conditions can be chosen. As such stormwater diversion is not considered applicable for small compost (tree planting and maintenance) locations. Compost management and any stormwater management measures would be detailed in the Wastewater Management Plan. Stormwater run-on berms are typically required upslope of effluent land application areas. At the proposed irrigation areas of NBP these are not considered to be practical or warranted given the low almost flat ground surface. More important is run-off control. Given the almost flat ground surface, run-off is very low naturally but has been accelerated by the historical excavation of a drain network through the site during previous sugarcane farming. These drains form an important part of the modified landscape which W&A considered in the WWA. Installation of downslope run-off berms were considered but are not practical as they would limit draining of the ground surface and cause pooling of water. The WWA recommended planting of vetiver grass vegetation strips along all drains. These would form both a hydraulic and nutrient barrier, as a $1m^2$ planting of vetiver can utilise up to 6L of water/wastewater per day. The presence of vetiver grass strips for water and nutrient uptakes were not considered in the wastewater modelling and would provide additional sinks beyond that required.
6G	The wastewater composition for on-site treatment is not substantiated with historic site data or other data.	The NBP has been used as a cultural events site for approximately 5 years, and due to the nature of its trial approval has been relying on trucking in and out of water and wastewater. As such, data available is relatively short term and in-house. W&A were provided with and utilised water consumption and wastewater volumes that are utilised for planning purposes for the Falls and Splendour in the Grass festivals for the years 2014 and 2016 for Falls and 2015, 2016 and 2017 for Splendour in the Grass (see table below). As such the 1.4ML wastewater generation assumed by W&A, and JED Civil's estimate of 2.34ML potable water demand for the current SITG festival are accurate. Wastewater production has been reducing as new water consumption reduction methods have been introduced, in particular the progressive introduction of compost toilets.

Item	GHD Comment	Response

Source	Water Supply (kL)*	Wastewater Production (kL)					WW:W**	
		Grey	Black	Catering	Total	Total Less	Total	No Catering
Falls 2016	2,541	1,106	146	133	1,386	1,253	0.55	0.49
Falls 2017	1,579	899	165	66	1,130	1,064	0.72	0.67
Falls 2018	2,426	1,008	159	60	1,227	1,167	0.51	0.48
SITG 2014	2,460	1,139	272	177	1,588	1,411	0.65	0.57
SITG 2015	2,091	1,218	269	161	1,648	1,487	0.79	0.71
SITG 2016	2,347	1,135	354	210	1,699	1,489	0.72	0.63
SITG 2017	2,341	793	269	168	1,230	1,062	0.53	0.45
* Includes dust suppression, fire tanks, medics, urinals, showers, catering, laundry								
** Ratio of wastewater production to water supply								

Tables 7 and 8 of the WWA provide a breakdown of wastewater production for the events from 2015-2017 into the various sources and type of wastewater.

7G Proposed wastewater storage capacity of 2.2 ML will fill on day 4/5 of a large event.

The Falls and Splendour in the Grass events currently operate for three to four days only. W&A modelled the events over a seven day ramp up and leaving cycle plus a lead up build period. A detailed storage balance for 393 day cycle was modelled to confirm the maximum storage required. See the appendices of the WWA for the storage calculations.

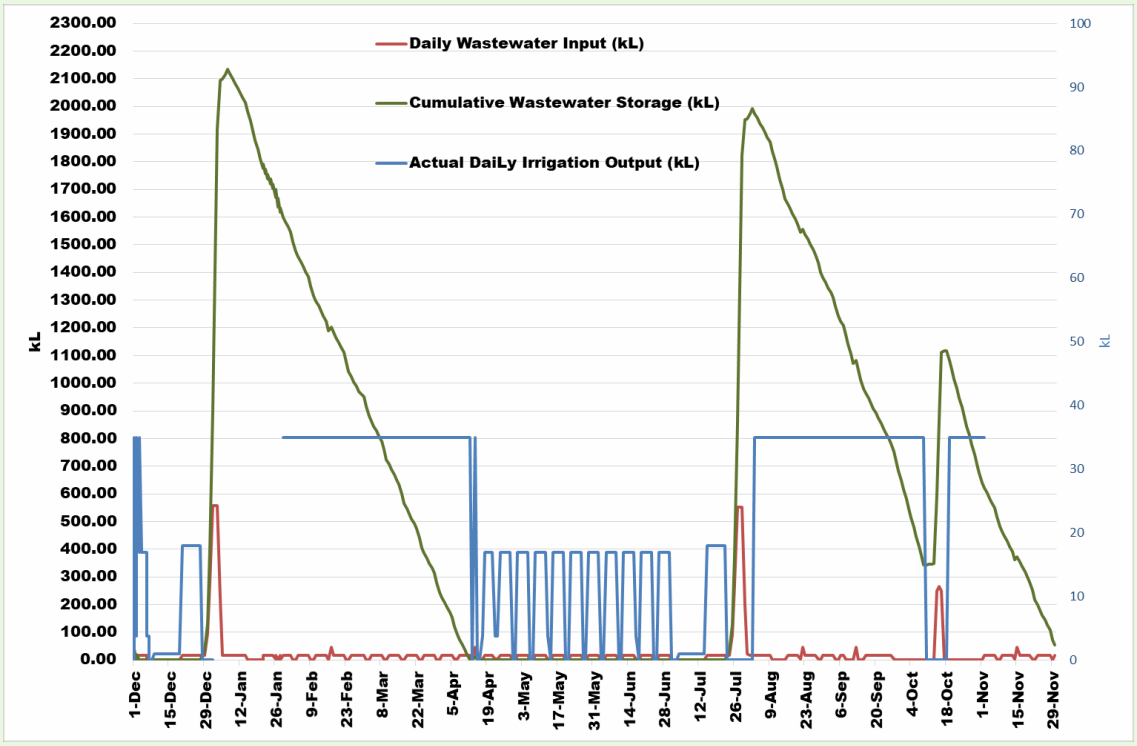
The storage capacity is considered to be satisfactory.

8G Significant reed bed overloading will occur on days 5 – 7 of a large event with the consequence that chlorine (or UV) treatment will be ineffective.

W&A's modelling indicates that there would be no reed bed overloading.

The treatment train has been designed to hold all wastewater for a total of 9 days prior to and following the two large events, with subsequent controlled 35kL/day release through the primary tanks and reed beds. This was modelled in the storage calculations.

See the appendices of the WWA for the storage calculations and graph below that was included in the WWA.

Item	GHD Comment	Response
	 **Storage balance chart as presented in WWA.**	
9G	The stated treated water quality for irrigation is considered not to be achievable especially on days 5- 7 of a large event.	See response to Comment 8G above, Given the design of the treatment train, a maximum of 35kL/day would be treated through the primary system and reed bed polishing. Quality would be maintained, as demonstrated through limiting maximum flow rates through the reed beds and thereby maintaining the design hydraulic residence time of the wastewater within the beds.
10G	The proposed arrangement allows only for expected year- round average daily flow of 35 kL/day treated wastewater which would theoretically enable two days storage (outside events) in the septic tank and loading of	The reed bed sizing in the WWA was based on the calculation sheets prepared by W&A utilising largest area requirements based on BOD, nitrogen, suspended solids and faecal coliforms inputs. The BOD calculations were derived from published work by Headley & Davison in 2003[1].

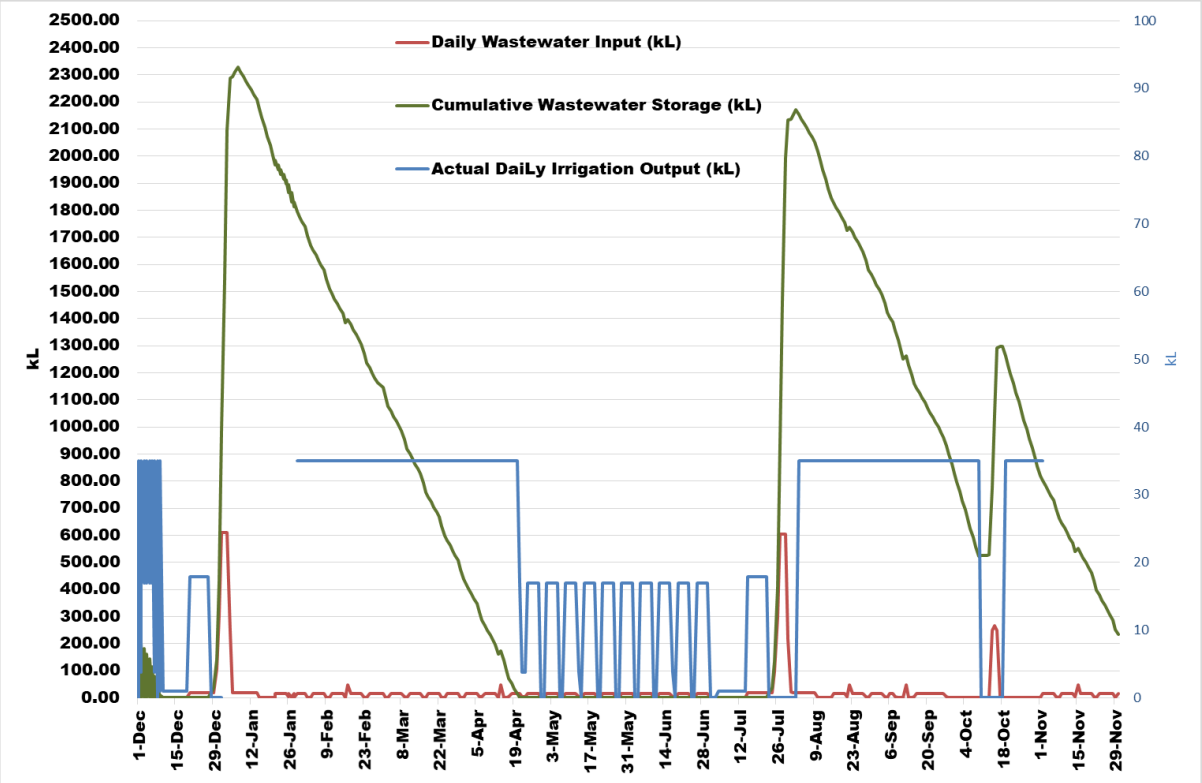
[1] Headley, TR & Davison, L 2003, 'Design models for the removal of BOD and total nitrogen in reed beds'[1], in RA Patterson & MJ Jones (eds), On-site '03 : proceedings of On-Site '03 Conference : future directions for on-site systems, best management practice, University of New England, Armidale, NSW, 30 September-2 October, Lanfax Laboratories, Armidale, NSW, pp. 169-176. ISBN: 0957943814

Item	GHD Comment	Response
	some 1-200 kg BOD/ha/d, on the reed beds which may be suitable. However, BOD monitoring results would need to be confirmed from the proponent and further justification of demand and discharge volumes, before we would be able to regard the acceptability of the system.	The hydraulic and nutrient balance model utilised for the irrigation area also provides a reed bed sizing calculation separate to that utilised by W&A. W&A calculated a reed bed required area of 400m^2, whilst the alternative model approved by Byron Shire Council calculated an area required of 244m^2. W&A conservatively adopted the larger footprint, and there is potentially capacity within the reed beds to treat larger than design hydraulic flows. Given the capped flows, disinfection ability would not be affected.
11G	The proposed disposal of treated wastewater via irrigation on a flood prone area is considered a high risk.	See responses to comments 1G and 5G above. The risks are able to be effectively managed in accordance with the EPA's effluent irrigation guidelines and applicable standards through engineering controls, conservative modelling of areas required, timing, withholding ability, disinfection and vegetative uptake zones.
12G	The long-term sustainability of composted solids waste practices proposed, is not addressed.	Compost volume calculations can vary as they depend on the amount of bulking utilised, the holding period, and the addition of additives such worms. W&A were advised that previous experience at SITG/Falls festivals a full bin from one day can be half full after 24 hours due to natural compaction, and bins utilised for 1-2 festivals per annum have been known to not require emptying for between 12-18 months. W&A have independent confirmation from alternative festival sites using batch composting that bins may not require emptying for up to 5 years at one festival/annum. That is, the natural biological processes within the bin result in consumption of the product and conversion to worm cast, liquid and gas fractions between festivals. The assumed annual emptying cycle is considered conservative in this context. At a nominal ¼ residual in a bin per annum requiring emptying, it is calculated that for the maximum 1000 bins, up to 62.5m^3 of compost would be generated. Spreading 0.3m deep, the compost would cover only a footprint of 20x10.5m annually. In addition, with three months of secondary aeration, the compost could be utilised on the surface. Given the very large footprint of the NBP, there is ample surface and subsurface areas available for compost or surface mulch addition for the foreseeable future.

Table 3: GHD Recommendations

Item	GHD Recommendation	Response
13G	Water demand and waste water discharge values proposed are not possible to be reconciled based on the data presented. Clarification and substantiation are required for the discrepancies in the Appendices Q and R in terms of proposed water demand and waste water discharge volumes.	See response to comments 2-4G above. The water demand calculation in the potable water assessment was overly conservative and cannot be directly related to wastewater production given the disconnect between water use and wastewater production at the site. The conservative water demand calculations is not problematic to the proposal, and would only result in larger storage tanks that are underutilised.

Item	GHD Recommendation	Response
		W&A undertook a more nuanced and detailed calculation of wastewater production requirements, given the more significant effect that wastewater volumes have on infrastructure requirements. No modifications are considered to be required. Higher than estimated wastewater production would result in requirement for increased storage capacity only. There is generally sufficient factor of safety built into the irrigation cycling to allow the 35kL/day treatment and irrigation to continue for slightly longer than allowed to cope with any total annual extra wastewater production. Given the volumes in the short time frame generated, the two large festivals would provide the biggest risk to wastewater storage requirements. As a contingency in the unlikely occurrence, during a large event offsite emergency disposal would be possible. W&A have undertaken a sensitivity analysis of the risks associated with increased wastewater from the two large festivals. An increase in wastewater production by say 10% would increase maximum storage requirements by approximately 10% (to 2.33ML up from 2.1ML), resulting in an extension of the timing of the storage resetting to 0ML (at 35kL/day treatment) by 6-8 days into April and December. See below for the revised storage balance chart with an increase in wastewater generation by 10%. Alternatively, with a 10% increase on wastewater production, increasing the treatment train capacity to 37kL/day would maintain the existing modelled timing of storage at 0ML at the beginning of April/December, increasing the irrigation area by about 6% to 38,000m^2. There is ample irrigation area available on the NBP site such that there is the opportunity to increase wastewater application further. Installation of the OSMS early in the staging process will enable flow meters to be installed and reliable data collected of the storage and irrigation volumes, thereby allowing tweaking of the storage, treatment train and irrigation design as required.



Revised storage balance chart with an increase in wastewater generation by 10%.

14G	On-site wastewater treatment, storage and disposal requirements to be reconsidered in conjunction with potential hazards and consequences as detailed in the Risk Analysis attached hereto.	See responses to comments 1G-12G above. The risk assessment conducted by GHD concluded that the risks following control measures were reduced to negligible, low or moderate. Risks assessments are qualitative and up to the user to define the likelihood, consequence and control measures required. W&A have undertaken a comparable risk assessment using the hazard assessment process of the Australian Guidelines for Water Recycling (2006) (attached). In the light of the reinterpretation of identified hazards, all risks are reduced to “low”, with only one ongoing “moderate” risk of handling of compost bins by staff. Given this and the using of Log Reduction Values assessment presented in the WWA, the recommended concept OSMS is considered to be appropriate for the NBP.

15G	The Applicant should seek permanent agreement with Byron Shire Council for trucked wastewater disposal and confirm quantities per day or event as well as wastewater strength limits acceptable to Council. The possible contributions requirement should also be clarified.	NBP management met with Byron Shire Councils' Director of Infrastructure Services and the General Manager on the 12th of April 2018 to discuss wastewater quality issues. It was determined that a blending rate of 50% "black water" to 50% "greywater" would guarantee an acceptable receiving strength of wastewater directed to Council's STPs. This requirement was not clearly articulated in past trade waste agreements with only the term "acceptable blending" being documented. NBP management and the events organisers have adopted the following policy measures to ensure these blending rates are complied with in the short term prior to construction of the permanent OSMS: • All wastewater loads to be delivered to Council's STP to be diluted at a ratio of 50:50; • Including the above blending requirements into a one-year contract with our wastewater management contractor (including penalties for non-compliance with Council' wastewater quality limits); • Including the above blending requirements into the engagement letter of our potable water and liquid waste compliance consultant; • Offering the Council Trade Waste Officer the mobile and email contacts of SITG's Event Manager (where the buck stops) to communicate any concerns during the event period; and • Parklands to develop a concise procedure covering the above blending requirements and audit the implementation (or otherwise) of this procedure. Once the OSMS is constructed, disposal to BSCs STP will not be required as greywater and blackwater will be treated onsite. W&A understand that events held at NBP have ongoing agreements in place with Summerland Environmental located in Ballina Shire for treatment and disposal of trade waste. No trade waste is disposed of to Ballina or Byron Shire Council STP's. Following construction of the upgraded OSMS, trade waste will continue to be disposed offsite for treatment by Summerland Environmental.

Table 4: GHD Further Information Required

Item	GHD Information Required	Response
16G	Quantification of solid waste generation, burial area, tree planting area requirements and long term sustainability analysis.	As per the response to item 12G, a maximum of 62.5m^3 of compost waste per annum could be expected by Stage 3 expansion. This represents a very small volume and footprint, and is readily able to be land applied over the cleared portions of the 270ha property. A compost management plan would be prepared as part of the detailed Wastewater Management Plan, to address the day to day management of the solid waste.
17G	Substantiation of wastewater generation volumes proposed. (The values presented are considered very low).	See the response to comments 2-4G. The NBP is an events based property utilising imported water and cutting edge composting waste treatment technologies. Globally, batch compost systems have been shown to be environmentally friendly and robust systems for festivals, partly due to the low water consumption. Water consumption data was provided in the WWA for 2015-2017 and extrapolated through to Stage 3 expansion.
18G	Reconciliation of water demand and wastewater discharge volumes is required.	
19G	Substantiation of wastewater composition (contaminants loading).	Wastewater generated at the NBP has been greywater. As such, the composition is standard and readily known from multiple published NSW Guidelines[2] and international documents. One sample was collected in 2016 of the liquid in the greywater storage tank (attached), which confirmed the concentrations are domestic and "low strength" in nature, with a pH of 6.5, TSS of 4mg/L (80-120mg/L expected range) BOD of 6mg/L (80-120mg/L expected range), oils and grease of 4mg/L, total phosphorus of 25mg/L (7-17.5mg/L expected range), total nitrogen of 60.4mg/L (8-40mg/L expected range) and faecal coliforms 10cuf/100ml (10^3-10^2cfu/100ml expected range). Trade waste (kitchen) is collected and direct disposed off-site to a licensed facility (Summerland Environmental) in Ballina Shire. In the future the greywater mix will contain more compost seep and will have a modified chemistry with higher TSS, BOD and faecal coliforms. The WWA allowed for the modified chemistry in the treatment train design.
20G	Waste water handling and treatment revised to address risks identified.	See the response to comment 14G.
21G	Substantiation of treatment efficiency to achieve targeted reduced wastewater contaminants loading.	See the response to comment 10G above. The reed bed design was modelled based on published calculations, and verified utilising a second model. The larger area requirement was conservatively adopted by W&A in the WWA.

[2] Crites & Tchobanoglous (1998). Small and Decentralized Wastewater management Systems.

2.3. Tweed Shire Council Comments

The comments and requirements for further information in the review undertaken by Tweed Shire Council (TSC) (Ref: SSD 8169 & MP09_0028 Mod 5, dated 19 February 2018) are addressed in Table 5 below.

Table 5: TSC Comments

Item	TSC Comments	Response
1T	Item 6 of the TSC letter. Tweed Shire Council raises no concerns with the proposed wastewater treatment, noting that the appropriate regulatory authority for the assessment of wastewater will be the Byron Shire Council and NSW Health. Tweed Shire Council's interest relates to ensuring waste water disposal does not result in off-site impacts to the land or adjacent water courses. With the appropriate assessment and approvals undertaken by both the Byron Shire Council and NSW Health against appropriate performance standards specified under the Local Government (General) Regulation 2005 and AS/NZSI 547:2012 the potential for off-site impacts is considered minimal.	Noted. Treatment of effluent and application by irrigation has been modelled by two independent companies, Gilbert & Sutherland and W&A utilising independent and detailed hydraulic and nutrient cumulative impact models. These have shown that with appropriate management, effluent application is sustainable and poses minimal risks for off-site discharge and groundwater contamination.

2.4. Byron Shire Council Comments

The comments and requirements for further information in the review undertaken by Byron Shire Council (BSC) (Ref: #E2018/17345, dated 9 March 2018) are addressed in Table 6 below.

Table 6: BSC Comments

Item	BSC Comments	Response
1B	Further information is required to provide verifiable evidence as to the method of water and wastewater metered that has been used to determine the litres/per person per day in Tables 7 and 8 of Whitehead (2017). There remains a concern that these figures for wastewater are understated.	The water and wastewater estimates utilised by W&A have been sourced directly from data obtained from recent Falls Festival and Splendour in the Grass events held during the trial period. The estimates had been successively refined after each year's events and following introduction of compost toilets, with the 2017 estimates providing the most realistic rates. Given that NBP's wastewater management system is largely 'off-grid', limited metered data is available on wastewater production. Elite Waste are the provider of water supplies and wastewater movement at the SITG/Falls festivals and have provided summaries of the carted in and out of liquids at these events. Subsequent to the WWA, Elite Waste provided additional production tallies for the majority of festivals conducted to date. The summary of these tallies is presented in the following table.

Source	Water Supply (kL)*	Wastewater Production (kL)					WW:W**	
		Grey	Black	Catering	Total	Total Less	Total	No Catering
Falls 2016	2,541	1,106	146	133	1,386	1,253	0.55	0.49
Falls 2017	1,579	899	165	66	1,130	1,064	0.72	0.67
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SITG 2016	2,347	1,135	354	210	1,699	1,489	0.72	0.63
SITG 2017	2,341	793	269	168	1,230	1,062	0.53	0.45
* Includes dust suppression, fire tanks, medics, urinals, showers, catering, laundry								
** Ratio of wastewater production to water supply								

As outlined above, these values correspond well with that modelled by W&A for the current SITG festival of 1.4ML generation and JED Civil's current estimate of 2.34ML water demand, and provide W&A with confidence in the design for future expanded capacity (Appendix C).

The data shows that as compost toilets have been installed and water reduction practices implemented, wastewater production has decreased.

In any case new flow meters were recommended in the WWA for the treatment train of the OSMS. If during the initial establishment of the OSMS, unusual inflows are recorded, the OSMS design can be modified.

Item	BSC Comments	Response
2B	A review of the Tweed Byron Flood model has identified that the site of EMA 2 is located below the 1:5; 1:20 and 1:100 flood level. The use of flood prone area for effluent dispersal/ disposal is not acceptable, having regards to the potential impacts of receiving waters within both the northern end of the Brunswick River Catchment and the southern end of the Crabbes Creek/ Mooball Creek Catchment which flows northwards into Tweed Shire.	This issue was also raised by GHD and responded to by W&A in item 1G. The NSW EPA's *Use of Effluent by Irrigation* (2004) guidelines state that use of floodplain areas can be acceptable for effluent irrigation (S2.8) subject to appropriate engineering controls. W&A acknowledges that treated effluent application on land below the 1in5 flood level poses a higher risk than on land below the 1in20 flood level, and on land below the 1in100 flood level. These risks are usually assessed for domestic situations where wastewater in = effluent out 365 days of the year. The risks for NBP are much lower given the controlled release of treated effluent. The residual risks have been mitigated by engineering the treatment system and land application area, and irrigation methodology, including conservative modelling of area requirements (i.e. low application rate), storage and withholding capacity, alternative EMA that is flood free, buffer zones and vegetative uptake strips along drains. As such, irrigation during flooding will not be required, and if excessive rainfall occurs on a day of irrigation prior to cessation, the risks of runoff have been reduced.

Item	BSC Comments	Response
3B	Above-ground spray irrigation requires prior tertiary disinfection of sewage (NSW Health). Within the Byron Shire, spray irrigation of effluent is not favoured due to public health risks from aerosol-transmitted pathogens and the particular need to add toxic substances (such as chlorine) to disinfect the effluent before above-ground release. There may be some circumstances (e.g. on larger agricultural holdings in which the proposed land application area is a considerable distance from any houses, where spray irrigation may be accepted. The proposal comprises partially treated secondary effluent with disinfection. Table 21: Adopted Environmental Buffers (Whitehead 2017) indicates a 20m buffer from spray irrigation to property boundary to pubic areas. Depending on the nature of spray application and local topography and local wind regime this setback may be insufficient.	The OSMS design is for fully secondary treated and disinfected effluent, not partially treated. NSW Health only requires effluent to be secondary treated and disinfected to allow spray irrigation in NSW (para 6 of Advisory Note 4 – December 2012), and historically councils in NSW have struggled with spray irrigation at domestic properties due to poor design, installation, maintenance and operation. The EMA for spray irrigation is located in the northeast corner of the NBP, with no adjacent dwellings or public areas. The surrounding property to the north is agricultural in nature and owned by NBP. The nearest dwelling is located about 660m to the northeast of NBP at 214 Wooyung Road, Wooyung. The NSW EPA's Use of Effluent by Irrigation (2004) guidelines provide 50m buffers for spray irrigation to public areas such as schools and houses, but given these are not present near the proposed EMA a site specific buffer is applicable. AS/NZS1547:2012 provides risk based buffers for effluent application in relation to property boundaries of 1.5-50m. Because of the use of spray irrigation of disinfected effluent onto a gently sloping EMA, a moderate risk is assessed and a buffer of around 20m is applicable. Given the agricultural nature and management measure of modified or no irrigation during excessive wind conditions, the 20m buffer is considered adequate.
4B	Discussion with Council's Water & Sewer Staff indicate that Council has had problems with the quality of effluent received by the development in the past and may not be keen to receive further effluent from the subject site. The strength of the wastewater (concentration of ammonia) has at times exceeded the Environmental Protection License Limit for the Byron Bay Sewage Treatment plant. The proposed Wastewater Management System is based partly on the acceptance of wastewater by Council. No	See response to 15G above. That is, NBP management met with Byron Shire Councils' Director of Infrastructure Services and the General Manager on the 12th of April 2018 to discuss wastewater quality issues. It was determined that a blending rate of 50% "black water" to 50% "greywater" would guarantee an acceptable receiving strength of wastewater directed to Council's STPs. This requirement was not clearly articulated in past trade waste agreements with only the term "acceptable blending" being documented. NBP management and the events organisers have adopted the following policy measures to ensure these blending rates are complied with in the short term prior to construction of the permanent OSMS: • All wastewater loads to be delivered to Council's STP to be diluted at a ratio of 50:50; • Including the above blending requirements into a one-year contract with our wastewater management contractor (including penalties for non-compliance with

Item	BSC Comments	Response
	arrangements have been made by the applicant with Council to accept effluent into the future. There is no evidence that the applicant has consulted with Ballina Shire Council with respect to their ongoing acceptance of effluent for a permanent facility. The view of Ballina Shire Council to continue to accept effluent at their STP is unknown. This should be sought from the applicants. In this regard this is a critical matter for consideration having regards to the matters for consideration under Clause 45 of Byron LEP 1988 – Provision of Services and Clause 6.6 of Byron LEP 2014 - Essential Services. To date Council is unable to confirm or guarantee it has capacity within existing treatment plants to accept sewage from the development in the future. Council's Water & Sewerage staff advised that they will be making a separate submission on this matter. It is recommended that the Department liaise with staff in relation to capacity issues at the Byron STP.	Council' wastewater quality limits); • Including the above blending requirements into the engagement letter of our potable water and liquid waste compliance consultant; • Offering the Council Trade Waste Officer the mobile and email contacts of SITG's Event Manager (where the buck stops) to communicate any concerns during the event period; and • Parklands to develop a concise procedure covering the above blending requirements and audit the implementation (or otherwise) of this procedure. Once the OSMS is constructed, disposal to BSCs STP will not be required as greywater and blackwater will be treated onsite. W&A understand that events held at NBP have ongoing agreements in place with Summerland Environmental located in Ballina Shire for treatment and disposal of trade waste. No trade waste is disposed of to Ballina or Byron Shire Council STP's. Following construction of the upgraded OSMS, trade waste will continue to be disposed offsite for treatment by Summerland Environmental.
5B	The progressive installation of OSMS infrastructure with an unknown duration following Development Approval is not acceptable. As part of any future section 68 BSC would require installation of the completed upgrade prior to a clearly nominated time frame agreed to by Council.	Noted. Any s68 application and approval must be for a volume treatment capacity suitable for the NBP at that time. If NBP wishes to expand progressively it accepts that it will be required to submit successive s68 applications confirming the treatment capacity meets requirements. Notwithstanding, the WWA demonstrates that the final Stage 3 OSMS layout and operation is sustainable.
6B	The application of treated effluent on EMA 2 (the proposed new Land Application Area on flood prone land) requires treatment in the form of lime and gypsum to improve ability to accept effluent.	Agreed. It is considered that this is a minor issue that can be addressed with any s68 application and preparation of an irrigation management plan.

Item	BSC Comments	Response
	Details will need to be submitted by the applicant should this be supported in a limited way to enable its use for treatment dispersal/ disposal.	
7B	There appears to be inconsistencies with Table 5 and Table 19 in relation to DIR, with 4mm/day considered appropriate. Further detail is also required on how the existing 24 bed IDSFB field as a back-up area be sufficient to adequately disperse effluent from the entire load of 50,000 person event?	Table 5 of the WWA discusses the DIR based on AS/NZS1547:2012, whilst Table 19 relates to the actual inputs adopted by the BSC model. The BSC model was selected for "loams, clay loams and silts", with a hydraulic conductivity of 0.5-1.5m/day. This is considered conservative. In any case, the EMA sizing was nutrient based to 36,000m^2, with the hydraulic requirement for irrigation only around 17,000m^2. The actual application rate is 1mm/m^2, well below 4mm/day. Calculations were undertaken and presented in the WWA for the beds in EMA 1, and these were shown to be able to handle 4.8kL/day based on conservative DLR rates. A higher flow rate could be achieved with short term usage. The IDSFB beds were not stated nor intended to accommodate the wastewater generated for a 50,000 person event, nor the 35kL/day irrigation rate. The beds would only provide short term backup land application.

For and on behalf of

Whitehead & Associates

Strider Duerinckx

Office Manager

Encl Greywater Analytical Results Sheet

Risk Assessment

RESULTS OF WATER ANALYSIS (Page 1 of 1)

1 sample supplied by Luke Houghton on the 12th May, 2016 - Lab. Job No. F0239

Analysis requested by Luke Houghton - **Your Project: NBP-Greywater**

(11 Pagottos Ridge Road LISMORE NSW 2480)

PARAMETER	METHODS REFERENCE	Sample 1 Greywater G.TANK1 11/05/16
	Job No.	*F0239/1*
pH	APHA 4500-H^+-B	6.50
TOTAL SUSPENDED SOLIDS (mg/L)	GFC equiv. filter - APHA 2540-D	4
BIOCHEMICAL OXYGEN DEMAND$_5$ (mg/L O_2)	APHA 5210-B	6
TOTAL OILS AND GREASE (mg/L)	APHA 5520-D (hexane extractable)	4
TOTAL PHOSPHORUS (mg/L P)	APHA 4500 P-H	25.0
ORTHOPHOSPHATE (mg/L P)	APHA 4500 P-G	24.9
TOTAL NITROGEN (mg/L N)	APHA 4500 N-C	60.4
TOTAL KJELDAHL NITROGEN (mg/L N)	CALCULATION: TN - NOx	27.5
NITRATE (mg/L N)	APHA 4500 NO_3^--F	28.8
NITRITE (mg/L N)	APHA 4500 $NO3^-$-I	4.14
AMMONIA (mg/L N)	APHA 4500 NH_3-H	26.7
FAECAL COLIFORMS (cfu/100 ml)	**APHA 9222-D	10

Notes:

1. 1 mg/L (milligram per litre) = 1 ppm (part per million) = 1000 µg/L (micrograms per litre)= 1000 ppb (part per billion)
2. For Bacteria - cfu= colony forming unit
3. Analysis performed according to APHA, 2012, "Standard Methods for the Examination of Water & Wastewater", 22nd Edition, except where stated otherwise.
4. Analysis conducted between sample arrival date and Report provision date
5. ** denotes these test procedures are as yet not NATA accredited but quality control data is available

NATA
WORLD RECOGNISED ACCREDITATION
Accreditation No. 14960.
Accredited for compliance with ISO/IEC 17025.

Environmental Analysis Laboratory, Southern Cross University,
Tel. 02 6620 3678, website: scu.edu.au/eal

checked: .....
Graham Lancaster
Laboratory Manager

Table 2.5 Qualitative measures of likelihood

Level	Descriptor	Example description
A	Rare	May occur only in exceptional circumstances. May occur once in 100 years
B	Unlikely	Could occur within 20 years or in unusual circumstances
C	Possible	Might occur or should be expected to occur within a 5- to 10-year period
D	Likely	Will probably occur within a 1- to 5-year period
E	Almost certain	Is expected to occur with a probability of multiple occurrences within a year

Table 2.6 Qualitative measures of consequence or impact

Level	Descriptor	Example description
1	Insignificant	Insignificant impact or not detectable
2	Minor	Health — Minor impact for small population
		Environment — Potentially harmful to local ecosystem with local impacts contained to site
3	Moderate	Health — Minor impact for large population
		Environment — Potentially harmful to regional ecosystem with local impacts primarily contained to on-site
4	Major	Health — Major impact for small population
		Environment — Potentially lethal to local ecosystem; predominantly local, but potential for off-site impacts
5	Catastrophic	Health — Major impact for large population
		Environment — Potentially lethal to regional ecosystem or threatened species; widespread on-site and off-site impacts

Table 2.7 Qualitative risk estimation

	Consequences				
Likelihood	**1-Insignificant**	**2-Minor**	**3-Moderate**	**4-Major**	**5-Catastrophic**
A Rare	Low	Low	Low	High	High
B Unlikely	Low	Low	Moderate	High	Very high
C Possible	Low	Moderate	High	Very high	Very high
D Likely	Low	Moderate	High	Very high	Very high
E Almost certain	Low	Moderate	High	Very high	Very high

Note: Level of environmental risk is specific to definitions of likelihood and consequence defined in Tables 2.5 and 2.6

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk			Risk Control Measures	Hierarchy of Controls	Residual Risk			Person responsible for implementing on site
			Severity	Likelihood	Risk Rating			Severity	Likelihood	Risk Rating	
1	Patron Access to Waste bin or wastewater storage areas	GHD concern: Human contact with compost or wastewater.	4	C	VH	Existing "pass" system controls access of public to service areas of the NBP, and a staff member is present at all times for each amenities building. It is unlikely that public would have access to wastewater storage or treatment areas.	Engineering and administration	2	A	L	Management
2	Size and slope location of OSMS	GHD concern: Destruction of high conservation vegetation	3	D	H	The OSMS design by W&A did not propose the destruction of any conservation vegetation. The treatment area is located on cleared ground with only limited weed vegetation clearing, and irrigation onto grassed paddocks. The proposal is for compost to be placed in cleared areas and used for revegetation, thereby increasing the conservation value of the NBP.	Administration	1	A	L	Management
3	Pump failure at pump wells	GHD concern: Overflow and contamination, health and odour impacts	3	C	H	As per the WMA all pumpwells to have duty and standby pumps and audio/visual alarms, as well as inbuilt emergency storage. Therefore if there is a failure of a component the impact would be limited to that immediate area. Given onsite staff are present at each amenity, this would be quickly observed (by hearing and sight of alarms prior to overflows, and once overflowed responsed to.	Administration and engineering	B	2	L	Management
4	Floodplain irrigation onto camping area with contaminated drain water flowing offsite	GHD concern: Nutrient buildup, discharged into drainage channels	3	E	H	The WMA considered this is as a significant risk. The risk was reduced by providing for throttled treatment allowing for irrigation of smaller daily volumes, wet wetaher storage capability, emergency IDSFB EMA area, resetting the storage tanks by 4 weeks prior to the next large festival, use of vetiver grass buffer strips adjacent to drains, buffers of 15m to the drains, and modelling for hydraulic and nutrient requirements. Modelling indicated that the hydraulic required irrigation footprint is substantially smaller than the nutrient required, such that nutrient impacted water is unlikely to runoff to drains.	Design and administration	2	B	L	Management

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk			Risk Control Measures	Hierarchy of Controls	Residual Risk			Person responsible for implementing on site
			Severity	Likelihood	Risk Rating			Severity	Likelihood	Risk Rating	
5	Floodplain camping irrigation causing health issues	GHD concern: Pathogens in treated effluent / human contact	4	E	VH	The WMA considered this. The irrigation will occur following vacatation fo the NBP by all campers and following cleanup of the irrigation zone of rubbish by staff. There are multiple irrigation zones nominated in the WMA for progressive irrigation, allowing for flexibility in staging. The irrigated wastewater is disinfected with effluent, such that the risk of pathogen contamination is reduced.	Design and administration	2	A	L	Management
6	Wet weather storage overflow	GHD concern: Environmental contamination and human health impact	2	B	L	The wet weather storage tank would be located up in the main treatment area in the northwest portion of the NBP. This area has no drains or creeks in the immediate vicinity, downslope to the north is farmland. The drains present in that area drain to the east and southeast back towards the northeast corner of the NBP, before tracking north for a total 3km distance to Crabbes Creek. Wet weather storage can be controlled by halting treatment in the reedbeds (ie storage in the storage tanks), pumping back through into the storage tanks, or discharge to the	Design and administration	2	A	L	Management
7	Weat weather charging of in-ground sand filter system under low evaporation conditions	GHD concern: Floodplain contamination	2	E	M	The OSMS design by W&A utilised the IDSFB as backup emergency disposal areas only for reduced loading of 4.8kL/day. The IDSFB are located up in the main treatment area in the northwest portion of the NBP. This area has no drains or creeks in the immediate vicinity, downslope to the north is farmland. The drains present in that area drain to the east and southeast back towards the northeast corner of the NBP, before tracking north for a total 3km distance to Crabbes Creek. Wet weather storage can be controlled by halting treatment in the reedbeds (ie storage in the storage tanks), pumping back through into the storage tanks, or discharge to the IDSFB	Design and administration	1	B	L	Management
8	Odours from storage / treatment vessels and tanks	GHD concern: Nuisance value to patrons	2	D	M	The OSMS design is for wastewater to be drained to pumpwells and pumped in a short time frame up to the storage tanks away from the public area. Given wastewater will be stored for <24hours (and likely 1-6 hours), odours will be negligable.	Design	1	B	L	Designer

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk			Risk Control Measures	Hierarchy of Controls	Residual Risk			Person responsible for implementing on site
			Severity	Likelihood	Risk Rating			Severity	Likelihood	Risk Rating	
9	Nutrient build up in reed bed and stormwater overflow	GHD concern: Environmental contamination and human health risk	2	C	M	Reedbeds can buildup with sludges and fines that are trapped in the gravel voids. Typically nutrient buildup is not a concern, but it is expected that after some years the gravel would be excavated and washed, with sludges trucked offsite for disposal. Stormwater overflow is unusual in reed beds given the dpeth of wastewater is maintained at 100mm beneath the gravel surface and a lip is present above the gravel layer, both of which act as wet weather storage. Reed beds are left proud to llimit stormwater ingress. As per above, if there was an overflow event, the treatment system is in a low environmental and human health	Design	2	B	L	Designer
10	Surface irrigation of camping grounds	GHD concern: Human health risk	4	E	VH	Addressed in Item 5.	Design and administration	2	A	L	Management
11	Patron access to treatment areas	GHD concern: Human health risk, spillage risk	3	C	H	Addressed in Item 1	Engineering and administration	2	A	L	Management
12	Manual handlling of sewage bins	GHD concern: Human health risk	4	D	VH	The compost bins are wheelie bin style units that are fully sealed except for the drain pipe, and have handle, rear wheels, and lids that fold back over and close up the raw waste/bulking agent mix. There is a risk of spillage if the bins tip over during replacement with empty bins. Management practices and training to limit volumes in the bins, plus PPE are important practices to ensure reduced risks to workers. In addition, concrete of the ground beneath the amenities to ensure that the bins sit on a stable surface and are easily wheeled will be an improvement on the current grass surface, which can be implemented with a permanent OSMS	Engineering and administration	2	C	M	Management
13	Raw sewage to irrigation, subsurface discharge	GHD concern: Human and environmental health risk	4	E	VH	The OSMS treatment train has been designed to treat wastewater to a secondary (Class B) standard. That includes a minimum of 24hours HRT in a septic tank for anerobic digestion and 6 days HRT in a reedbed. In addition to these minimum detention times, there woudl be additional detention and anaerobic treatment in the storage tanks during a large festival (up to 8 days if counting wastewater inputted on day 1), and in the 4-5 months in storage prior to septic tank and reedbed processing. Finally effluent would be chlorinated prior to	Design and operation	2	B	L	Management

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk			Risk Control Measures	Hierarchy of Controls	Residual Risk			Person responsible for implementing on site
			Severity	Likelihood	Risk Rating			Severity	Likelihood	Risk Rating	
14	Wastewater system flow and overload	GHD concern: Human and environmental health risk	3	C	H	The wastewater production is based on five years of inhouse data collection by both the SITG and Falls festivals. The data is used to order in water supplies as well as budget for offsite trucking of wastes. Once permanent approval is obtained, in the short term trucking will continue which will enable ongoing data collection and independant verificationn of volumes. As part of the management of the preparation for a large event, the wastewater level in the septic tanks and the reed bed swould be lowered to enable emergency storage capacity. In the event that the permanent OSMS is hydraulically overloaded during a large event, high level alarms will be present, and contingency planning to ensure that emergency offsite disposal is possible for the excess volume. This would then allow for a review prior to the next large event. The treatment system is located in an elevated area away from the nearest drains, and with a flow path of at least 3km to Crabbes Creek, reducing the potential	Design and operation	2	B	L	Management
15	Septic tank system maintenance	GHD concern: Human and environmental risk, sludge drying not allowed for in concept design	3	C	M	It is verry routine to maintain septic tanks and numerous contractors are present in the Yelgun area. Onsite sludge drying and processing is problematic from a physical and regulatory perspective, and it is most common to have a truck pump accumulated sludges for offsite processing. An annual inspection and desludging cycle was allowed for in the WMA, common for larger commercial operations	Design and operation	2	B	L	Management
16	Insect and airborne disease spreading from amenities to drinking water bucket collection systems	GHD concern: Human health risk, large patronage in concentrated area	4	E	VH	Insect and airborne diseases can spread with concentration of human populations and waste systems. Compost toilets are not really more problematic than flushing toilets or portaloos in that respect. Appropriate cleaning regimes and public education is expected. The two large festivals have operated fo rthe past five years without disease outbreaks. It is our understanding that drinking water will not be supplied from tank water collection as this requires signficant treatment and management as part of a private water supply system.	Education and operation	2	B	L	Management

RISK ASSESSMENT

No.	Individual Activity	Risk/ Unwanted Events	Latent Risk			Risk Control Measures	Hierarchy of Controls	Residual Risk			Person responsible for implementing on site
			Severity	Likelihood	Risk Rating			Severity	Likelihood	Risk Rating	
17	Erosion	Topsoil, treated wastewater to floodplain	2	C	**M**	Erosion requires a number of factors to be present, including loss of cover (vegetation), slope (velocity), water application (rainfall and effluent) and erosive soils. The irrigation system designed by W&A reduces the risk of erosion by applciation onto nearly level land and at a very low rate (about 1mm/m2/day). In the short term, the natural grass vegetated cover will be disturbed by campers, but the disturbance is patchy and grass regrowth is epxected especially with nutrients in the effluent. In addition a buffer of 15m has been nominated to drains and a vegetative vetiver grass strip allowed for.	Operation	1	B	**L**	Management