Australian Gas Infrastructure Group

ENSCOPE

A QUANTA SERVICES COMPANY

WEST ERREGULLA PROJECT

STORMWATER MANAGEMENT PLAN

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1	31/03/2021	Re-Issued for review	[redacted]		
0	17/03/2021	Issued for review	[redacted]		

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ABBREVIATIONS AND ACRONYMS

Term	Definition
AGIG	Australian Gas Infrastructure Group
ARI	Average Recurrence Interval
BoD	Basis of Design
BoM	Bureau of Meteorology
ELA	Ecological Australia
HDPE	High density polyethylene
RO	Reverse Osmosis
WQPN	Water Quality Protection Note

1 INTRODUCTION AND RECOMMENDATIONS

EP469JV is presently developing a gas field in the Perth Basin, Western Australia. The strategy includes an initial development which will collect gas from four wells and direct them to a common location from where a third party will receive the gas, treat it and transport it to the gas network for sale. The plant layout and location can be seen in the below figure 1.

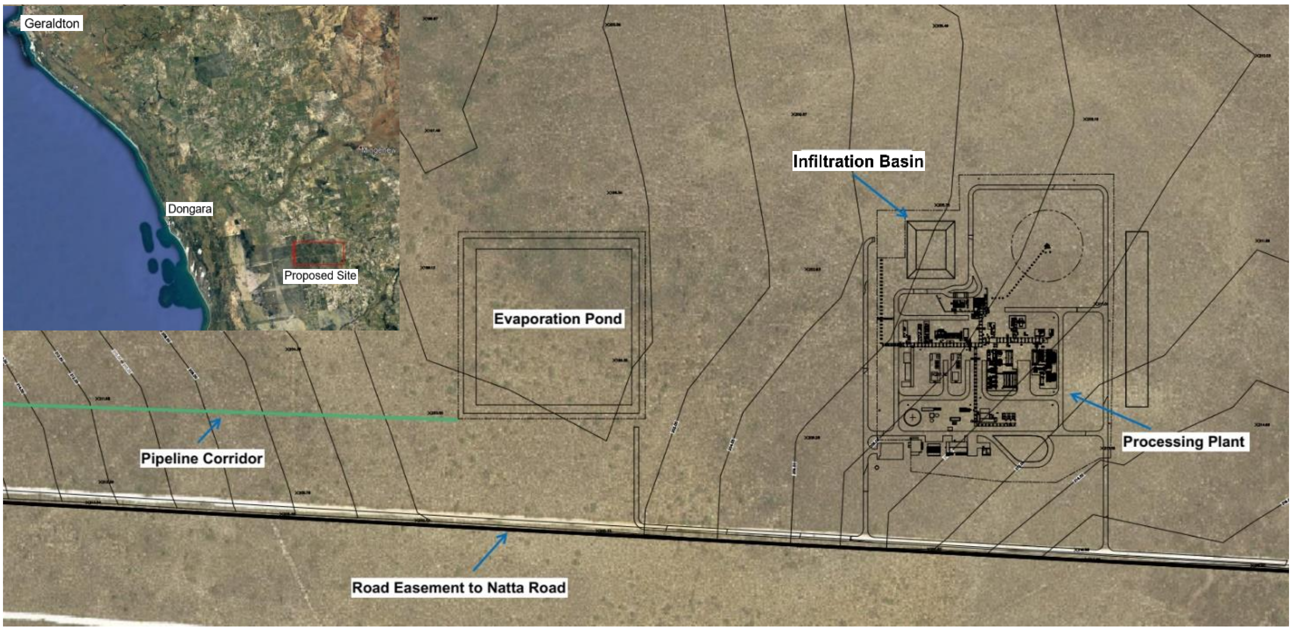


Figure 1: Location of the gas processing plant

A stormwater management assessment has been completed to provide drain sizing and to demonstrate the robustness of the proposed solution. The average rainfall is 425mm for this area, which although small still represents a flooding and water discharge risk, on rare occasions [4]. The soil is comprised of sand, clay and limestone, which typically prevents the pooling of water due to its high permeability and this can be seen from the lack of any surface water within or nearby to the development envelope [2,3].

This document is only applicable to the extent of the facility and does not consider the surrounding wellheads, interconnecting export pipeline (WER) or custody transfer metering facility at the DBNGP tie-in point.

An important recommendation within this report is to ensure that a soil sample is tested for permeability at the site and depth of the infiltration basin to ensure that the findings within this report are valid. This plant is expected to represent a minimal to low risk of groundwater contamination, with surface flow contamination also being minimalized through the implementation of management procedures.

2 WATER PROCESS DESCRIPTION

2.1 AQUIFER WATER SUPPLY AND CONSUMPTION

In 2018, two groundwater monitoring bores (eastern and western monitoring bore) were drilled and installed within the West Erregulla gas field, to develop a baseline water quality measurement and to monitor potential impacts upon groundwater arising from exploration drilling [3]. A production bore (PB1) was drilled in 2019, with the intention of supplying water for earthworks and drilling activities (the location of the water bores can be seen in attachment 11.4) [3]. There are no additional registered bores within the Development Envelope, although there are 38 within the area [3].

An additional production bore will be installed to supply water to the facility, this bore will draw from the "Yarragadee Formation" sub-surface aquifer, while also allowing intermittent water quality monitoring [3]. The raw water will be stored in the service water tank, where it will act as a feed source for the reverse osmosis water package. Once the water is purified it can be used throughout the plant. The water table/ quality will be monitored via the existing Eastern and Western Monitoring bores and the quantity of water removed is approximately 16 m^3 per day, .

2.2 REVERSE OSMOSIS PLANT

The reverse osmosis plant is sized to process an average of 16 m^3 per day of raw water, although in peak periods it can process ~200 m^3, which is possible due to the use of a service water tank. This plant is required to produce 1.5 m^3 per day of potable water, 9 m^3 per day of demineralized water and 2 m^3 per day of deionized water [11]. A by-product of the reverse osmosis plant is a brine rich discharge stream. This stream is sent to the evaporation pond to remove excess water and ensure that the contaminants are isolated from the environment.

2.3 EVAPORATION POND

The evaporation pond serves to remove any water processed in the oily water separator, the RO rejection brine line and the produced water generated from the process. This pond is sealed with a double barrier of 2mm high density polyethylene (HDPE) with an intermediate HDPE geonet, with intermembrane leak detection being employed [1]. This system ensures that all of the produced or captured water which possess the potential to be contaminated is isolated from the environment, while ensuring that a safe and cost effective disposal method is employed. The evaporation pond is sized with approximately 2.9 ha of surface area (28,900 m^2 from a 170 x 170 meter evaporation pond), which allows it to evaporate 33,390 m^3 of water per year [10]. This is sufficiently sized to ensure that the pond will not overflow during adverse weather events.

2.4 INFILTRATION BASIN

The infiltration basin is designed to allow storm water captured from within the plant to be drained to grade. An important note is that only stormwater is directed to the infiltration basin. All areas within the plant that contain liquids which could contaminate the environment are bunded and water collected in these areas are directed to the oily water separator and in turn to the pond. Therefore, there is minimal potential for any groundwater contamination in this system. This area is approximately 63 x 53 x 3 meters in size and features stone pitching on the drain inlets to prevent erosion, with a sandy base to ensure efficient and safe water removal. This pond has been sized to meet the peak rainwater flowrate possible for a 100-year design average recurrence interval (ARI).

2.5 STORM DRAINS

The plant has been built with stone pitched and geofabric netted storm drains to prevent stormwater from the plant discharging into the environment. These drains have been sized to meet the peak rainwater flowrate possible for a 20-year design average recurrence interval (ARI).

2.6 PLANT BUNDING

Surface water that is potentially contaminated due to leakage or maintenance processes at specific equipment locations will be contained via individual bunds [1]. Bunded areas around liquid hydrocarbon / amine / chemical inventories will be connected to the open drains system and routed to a buried oily water separator, providing facility to capture and treat any released liquids [1]. The wastewater will be pumped out of the open drains tank by pumps in a separate compartment and directed to the evaporation pond. Any hydrocarbon liquids retained by the oily water separator are sucked out using a vacuum truck and disposed of offsite [1].

2.7 PLANT PAD

The facility will be constructed upon a compacted gravel surface that will be graded at a minimum of 0.5% to facilitate overland discharge and reduce the risk of localised ponding [1]. The edges of the is pad will be lined with geofabric and stone pitching to prevent erosion and discharge into the environment.

3 MANAGEMENT OF THE PRODUCED WATER

There are multiple water treatment options which are capable of handling the quantity of water produced on site, however only the evaporation pond is seen as a cost-effective solution. Table 1 displays the requirement of water treatment and the risks associated with each treatment method.

Where an additional bore is required it will be constructed according to WQPN 30 "Groundwater Monitoring Bores" [6]. Where minimal/ minor groundwater monitoring is required, the existing Eastern and Western Monitoring Bores can be used to monitor groundwater quality, in addition to intermittent sampling from the new production bore when required. The extracted groundwater will be tested to AS 5667:1998, by sending the samples to a NATA accredited laboratory, to ensure compliance and ensure that the environment remains uncontaminated.

The evaporation pond will be constructed of high-density polyethylene (HDPE) to comply with the Department of Water's Water Quality Protection Note (WQPN 26), "Liners for Containing Pollutants, Using Synthetic Membranes" [1,7].

Table 1: Methods of managing produced water

Management Option	Water Treatment Required	Residual/ Approvability Risk
Evaporation Pond	No	Low risk of aquifer contamination; minor groundwater monitoring (a bore is required); minimal water testing required.
Wetland Construction	No	Low risk of aquifer contamination; requires approval to discharge water to the environment; discharged water must be tested with minor groundwater monitoring (a bore is required); a feasibility study for the environmental effects must also be completed; typically, uncommon within the mining and petroleum industry.
Reinjection of water into gas field.	No	Low risk of aquifer contamination; requires approval for pipeline construction; unknown bore and access restrictions; requires integrity testing; requires bores for water monitoring.
Reinjection of water into aquifer.	Yes	Low to moderate risk of aquifer contamination; may require expensive water treatment; may raise community concern; may raise environmental concerns; requires several water monitoring bores; moderate to stringent water monitoring is required.
Onsite water treatment	Yes	Cost prohibitive design; minimal risk of aquifer contamination.
Transport of water offsite	No	Cost prohibitive management plan; low risk of tanker spill.

4 EXISTING SURFACE WATER FLOWS ACCOMMODATION POST-DEVELOPMENT

The average recurrence interval (ARI) of rainfall intensity was taken from the Bureau of Meteorology (BoM), for the sites intended location [4,5]. The intention of this information was to assess whether surface flows were applicable for the existing surface to allow mitigation measures to be designed if they are required.

Table 2: Average Recurrence Interval of Rainfall Intensity (mm/hour)

	Average Recurrence Interval of Rainfall Intensity (mm/hour)			
Duration	**10 Years**	**20 Years**	**50 Years**	**100 Years**
1 Min	154	182	222	255
2 Mins	125	147	178	204
5 Mins	101	120	146	167
10 Mins	78.6	93.2	114	131
30 Mins	43.5	51.5	62.8	72.1
1 Hour	27.8	32.8	39.9	45.9
1 Day	3.17	3.81	4.73	5.51
1 Week	0.697	0.791	0.929	1.04

A hydraulic conductivity/ permeability of 3.84×10^{-5} m/ s (3.3 m/ day) was determined via a laboratory assessed soil sample (the laboratory report is seen in attachment 11.2) [2]. This sample was taken from the centre of the expected plant at a depth of 0 to 1.2m. Using this value, the surface can be expected to adsorb 140 mm/ hour of peak rainfall, if this rate is exceeded, then pooling and water flow is to be expected (see attachment 11.1.1).

In Table 2 above, rainfalls that are expected to result in surface flow have been shown in red above. In the highest periods of rainfall, the pooled water is less then 2L per square meter, with water expecting to last for no longer than 5 minutes. The lack of defined watercourses assessed in the “ELA Hydrology Baseline Report” supports how the area does have the potential to develop surface water, although the water quantity appears to be minimal [3]. From the site survey it is known that the development envelop intersects seven minor surface drainage features, although these are only expected to develop water during high intensity rain events [3]. Due to this low quantity of water in the worst cases, preventative measures have not been employed. However, the facility will employ geofabric and stone pitched edges to prevent external erosion resulting in environmental contamination.

5 STORMWATER WITHIN DEVELOPMENT SITE MANAGEMENT

The stormwater within the site will be managed via a minimum grade of 0.5% to facilitate the discharge of water runoff and reduce the risk of localised pooling [1]. Storm water is captured via stone pitched and lined spoon drains, which are constructed around the perimeter of the plant. This ensures that water is captured and passed into the infiltration basin where it can safely drain into the grade. These drains have been sized to meet the peak rainwater flowrate possible for a 20-year design average recurrence interval (ARI), while the infiltration basin has been sized to meet peak demand for a 100-year ARI (drain and infiltration basin sizing are shown in attachment 11.1). This ensures that there will be no rainwater spillage from the plant into the surrounding environment.

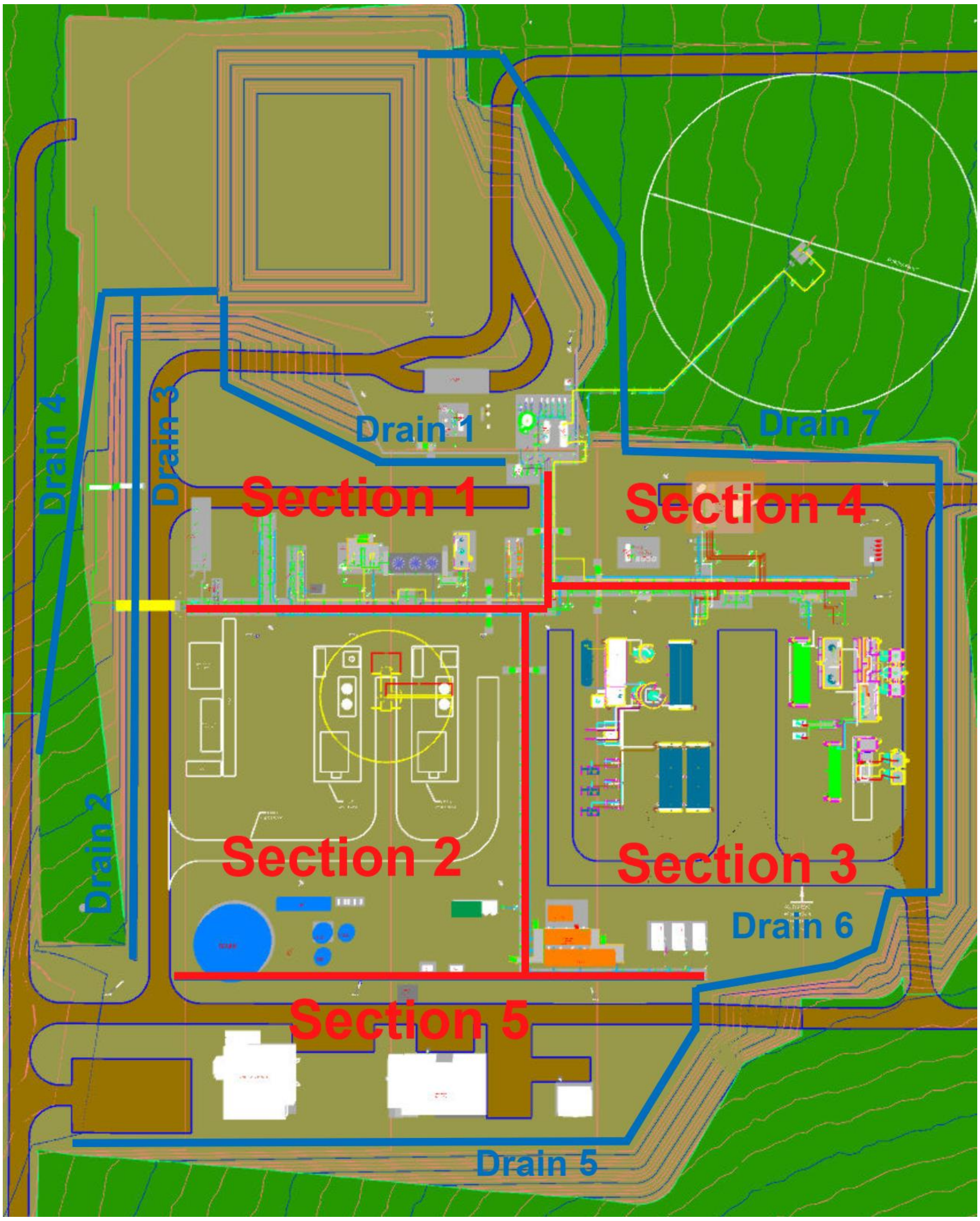
5.1 DRAIN SIZING RESULTS

The selected stormwater drain sizes are shown in table 3. Refer to Section 11.1.2 for stormwater drain sizing basis and Section 5.2 for drain locations.

Table 3: Storm Drain Sizing

Drain	Diameter (m)
1	0.72
2	1.2
3	1.32
4	0.96
5	0.96
6	1.26
7	1.38

5.2 DRAINAGE MAP



6 PRE-DEVELOPMENT VOLUMES AND WATER QUALITY MAINTENANCE

As discussed in section 4 pre-development water volumes are not present in the Development Envelope, this was confirmed via the ELA site survey and can likely be attributed to the soil composition, resulting in water being quickly absorbed [3]. This is supported by the ELA report which states *"DWER databases and the DWER WA Floodplain mapping showed no previously identified surface water features and/or government monitored surface water sites within, or immediately surrounding the Development Envelope" [3]*.

There are only "*two small ephemeral watercourses / drainage lines apparent in regional mapping*" *[3]*, although both are present to the south of the Development Envelope [3]. The closest major water body is the Arrowsmith river, which is approximately 15 km to the south [3]. Due to this the pre-development water volumes will be unaffected, although bore water sampling will still be completed on groundwater to ensure that the containment measures are functioning correctly, sampling is to be completed to AS 5667:1998 and management strategies are discussed in section 7.

7 IMPACTS ON GROUNDWATER AND SURFACE WATER QUALITY AND MANAGEMENT STRATEGIES

As per the "ELA Hydrology Baseline Report", the project has a minimal to low risk of groundwater contamination due to the existing controls of ground water monitoring and intermembrane leak detection, the risk is further reduced by the depth of the groundwater present under the plant (below 50m) [3].

Within this report is stated that the *"Development Envelope will intersect a minimum of seven (minor) surface water drainage features" [3]* and that *"indications of previous flow events were present suggesting that these areas may demonstrate flow and may potentially flood" [3]*. The potential activities resulting in surface water contamination are listed below [3].

- Spills or leakage at site;
- Runoff water from the plant;
- Construction activities undertaken in adverse weather conditions.

Spills are contained on site via the use of bunds in high risk/ probable areas of spillage or where leakage is possible. This ensures that the spilt material is isolated from the environment and processed (via the oily water separator), to ensure that the hydrocarbons are removed before the liquid is pumped to the evaporation pond. In un-bunded areas the quantity of contaminating materials will be minimised, with procedures and processes being in place to ensure that any minor spill does not possess the potential to enter the environment.

Runoff water from the plant in the event of adverse weather has been accounted for via the use of adequately sized storm drains surrounding the entire plant, these drains then flow into a infiltration basin where the water is adsorbed back into the ground.

It is known once the plant is constructed that the groundwater contamination risk is minimal to low, however it is essential to also limit the impact in the construction phase of the project. During construction best practice construction methods will be employed, such as erosion and sediment controls and the possible use of flow diversion and bunding structures in serve weather [3]. Through the completion of these actions, the potential of surface water contamination will be minimised throughout the plant's lifecycle.

8 STRATEGIES TO TREAT AND DISPOSE OF EFFLUENT

The plant is to be operated on the principle of “minimum manning”, meaning that process automation and remote systems will be employed [1]. During commissioning and early operation operators will be present on a 24 hour, 2 operators per shift basis, after this time operators will still be required, although only on a 10-hour day shift, this means that a septic system is required [1]. The proposed system will include two male and one female cubical, an ambulant toilet, a septic tank and tanker connection, all of these items will be installed to the Shire of Three Springs requirements, while also meeting AS1546 [1]. The waste will be removed via trucking provided by a licensed contractor, ensuring that no effluent is discharged into the environment. Additional information will be developed as this project progresses.

9 CONCLUSION

This report displays that the plant can be safely implemented regarding the stormwater risk, without causing environmental contamination. The surface water flows prior to developments are minimal and only rarely occur for short periods of time. The stormwater from within the facility will be correctly managed using stormwater drains and an infiltration basin. Pre-development water volumes are not present within or around the development envelop, likely due to the soil composition. The measures discussed in section 7 must be employed to ensure that the groundwater contamination risk remans at a minimal to low level and the risk of surface contamination is kept to a minimum. An onsite septic system will be required, and the proposed system is closed loop to prevent environmental contamination. It is important that the recommendation of testing an additional soil sample at the location and depth of the infiltration basin is completed to ensure the validity of the proposed solution.

10 REFERENCES

1. WEF-Z-BOD-0001_1_Basis of Design

2. Geotechnical Investigation & Site Classification (AS2870-2011) – Australian Gas Infrastructure Group West Erregulla Upstream Gather Compound.

3. West Erregulla Environmental Survey and Approvals Hydrology and Hydrogeology Baseline and Preliminary Impact Assessment Report.

4. http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_stn_num=008276

5. http://www.bom.gov.au/water/designRainfalls/revised-ifd/?coordinate_type=dd&latitude=29.409432324&longitude=115.303368539&user_label=&design=ifds&sdmin=true&sdhr=true&sdday=true&design=ifds&sdmin=true&sdhr=true&sdday=true

6. Department of Water, 2006, Water Quality Protection Note 30; Groundwater Monitoring Bores: Department of Water, Western Australia, 16p.

7. Department of Water, 2009, Water Quality Protection Note 26; Liners for Containing Pollutants, Using Synthetic Membranes: Department of Water, Western Australia, 11p.

8. http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

9. http://www.fao.org/3/t0099e/t0099e04.htm

10. WEF-M-DAS-0038_0_Evaporation Pond

11. WEF-C-CAL-0002_0_Water Usage Calculation

11 ATTACHMENTS AND CALCULATIONS

11.1 DRAINAGE SIZING

Overall Assumptions/ Basis:

- The permeability in the below lab test was assessed with the results being displayed in m/s, therefore this is the hydraulic conductivity, which was $3.84e^{-5}$ m/s (3.31776 m/day) [2]. This sample was taken from the centre of the plant which was deemed as being representative for the site due to the soil's similar compositions, however this should be validated by conducting a soil sample of the infiltration basin at the correct depth.

- The coefficient for stormwater runoff from the facility was assumed to be 0.7, as this is the highest possible factor for gravel, with a high factor being preferred as it results in more water being transferred to the drains requiring larger/ more conservative drain sizing to be calculated [9].

- Due to the calculation completed in 11.1.1 the runoff from the environment into the facility was considered minimal / insignificant, therefore in this calculation it was ignored.

11.1.1 PRE-EXISTING SURFACE DRAINAGE CALCULATION

Additional Assumptions/ Basis:

- The below peak rainfall was taken as 1 minute for an ARI of 100 years, the intention of taking this value was to provide the maximum quantity of water runoff. Other values that result in less run-off are displayed in red in table 2.

Calculation Inputs:

Parameter	Value	Unit	References
Peak Rainfall (for a 1-minute duration)	255	mm/hour	[5]
Hydraulic Conductivity	3.31776	m/day	[2]
Soil Surface Area	1	m^2	

Calculation:

Drainage flowrate is the quantity of water that can be drained to the environment. This value is calculated by the below equation:

$$Drainage\ Flowrate = 1m^2 \times hydraulic\ conductivity\ (\frac{m}{hour})$$

Quantity of run off is a measure of water accumulation and is the difference between the amount of water that is added and the amount of water that is drained (removed).

Parameter	Value	Unit
Rainfall flowrate	0.255	m^3/hour
Drainage flowrate	0.13824	m^3/hour
Quantity of run off	0.11676	m^3/hour
	1.946	L/min

11.1.2 SIZING OF THE STORMWATER DRAINS

Additional Assumptions/ Basis:

- The drain grades were assumed as 1:100.
- The drains have been sized for a 2-minute, 20-year ARI as this was able to fill the drains and represents the peak drain flowrate.
- The below drain calculations only account for the half cylinder within the drain that will be filled with water.
- The drains are assumed to be constructed using dry rubble or riprap on a gravel base, which has a normal channel roughness of 0.033 [8].
- The drains area is insignificant in relation to the overall facility that gathers stormwater; therefore, it has not been included in this investigation.
- A safety factor of 20% was assumed to account for the assumptions listed within this calculation.

- The drains have not been sized to process additional water from outside of the plant as it was assumed that water would be diverted around the stone pitching if surface water is to develop.

Calculation Inputs:

Inputs			
Parameter	**Value**	**Unit**	**Reference**
Rainfall	147	mm/hour	Table 2
Hydraulic Conductivity	3.31776	m/day	[2]
Surface Roughness	0.033	N/A	[8]
Grade	0.01	N/A	Stated in assumptions
Runoff Coefficient	0.7	N/A	[9]
Safety Factor	20	%	Stated in assumptions

Calculation:

Area of each facility section (refer Section 5.2)

Section	Area	Unit
1	4200	m^2
2	7950	m^2
3	9860	m^2
4	3280	m^2
5	8350	m^2

$$Q = A \times C \times rainfall\ (\frac{m}{hr})$$

Q = flowrate, A = section area, C = runoff coefficient

Water from each facility section (using the above formula)

Section	Water Flowrate	Unit
1	432.18	m^3/hour
2	818.055	m^3/hour
3	1014.594	m^3/hour
4	337.512	m^3/hour
5	859.215	m^3/hour

Water flowrate per drain

Drain	Maximum Water Flow	Unit	What sections this accounts for?
Drain 1	432.18	m^3/hour	Water from section 1.
Drain 2	1677.27	m^3/hour	Water from section 2, 5.
Drain 3	2109.45	m^3/hour	Water from section 1, 2, 5.
Drain 4	859.215	m^3/hour	Water from section 5.
Drain 5	859.215	m^3/hour	Water from section 5.
Drain 6	1873.809	m^3/hour	Water from section 3,5.
Drain 7	2211.321	m^3/hour	Water from section 3, 4, 5.

Manning Open Channel Flowrates

$$Q = (\frac{1}{n}) \times A \times R^{\frac{2}{3}} \times \sqrt{S}$$

Q = channel flowrate, n = surface roughness, A = flow area, R = hydraulic radius, S = slope

Drain	Diameter (m)	Hydraulic radius	Volumetric Flowrate (m^3/s)	Volumetric Flowrate (m^3/hour)
1	0.6	0.15	0.12	435.39
2	1	0.25	0.47	1700.10
3	1.1	0.275	0.61	2192.08
4	0.8	0.2	0.26	937.67
5	0.8	0.2	0.26	937.67
6	1.05	0.2625	0.54	1936.33
7	1.15	0.2875	0.69	2467.95

Drain size including the 20% safety margin

Drain	Diameter (m)
1	0.72
2	1.2
3	1.32
4	0.96
5	0.96
6	1.26
7	1.38

11.1.3 SIZING OF THE INFILTRATION BASIN

Additional Assumptions/ Basis:

- The surface area of the infiltration basin is expected to be 3000 m^2.
- The acceptable depth of water within the infiltration basin was taken as 1 meter.
- Since the infiltration basin appeared to be oversized the effect of water pressure was not considered. This is acceptable as any additional pressure will result in more water being adsorbed into the ground.
- The infiltration basin was assumed to have an active area of 90%, due to stone pitching being implemented on the drain inlets to prevent corrosion. The stone pitching is not backed or sealed, which allows water to drain.

Calculation Inputs:

Parameter	Value	Unit	Reference
Rainfall	45.9	mm/hour	Table 2
Hydraulic Conductivity	3.31776	m/day	[2]
Filtration pond depth	1	m	Stated in assumptions
Area of filtration	3000	m2	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	[9]
Time of peak flowrate	1	hour/s	Time period in hours the peak flowrate corresponds to

Calculation:

The below calculation was completed using rainfall data from a 1-hour peak period, although this calculation was completed multiple times using the rainfall data provided in table 2 (other rainfall periods are shown in 11.3). This was conducted to ensure that the pond was able to meet both peak immediate rainfall and able to meet rainfall over longer time periods.

Area of each facility section (can be seen in section 5.2)

Section	Area	Unit
1	4200	m^2
2	7950	m^2
3	9860	m^2
4	3280	m^2
5	8350	m^2

$$Q = A \times C \times rainfall\ (\frac{m}{hr})$$

Q = flowrate, A = section area, C = runoff coefficient

Water from each facility section (using the above formula)

Section	Water Flowrate	Unit
1	134.946	m^3/hour
2	255.4335	m^3/hour
3	316.8018	m^3/hour
4	105.3864	m^3/hour
5	268.2855	m^3/hour
Pond	137.7	m3/hour

Total water captured is the sum of the water from each section of the plant.

Drainage flowrate was calculated by the active infiltration basin area multiplied by the hydraulic conductivity.

$$Drainage\ Flowrate = 90\% \times 3000 \times hydraulic\ conductivity$$

The calculated pond size varied greatly and was calculated by the below equation.

$$V = time\ \times\ (Captured\ Water - Drainage\ Flowrate)$$

Parameter	Value	Unit
Total Water Captured	1218.5532	m^3/hour
Drainage Flowrate	373.248	m^3/h
Calculated Pond Size	845.3052	m^3

11.2 LABORATORY PERMEABILITY REPORT

WESTERN GEOTECHNICAL & Laboratory Services

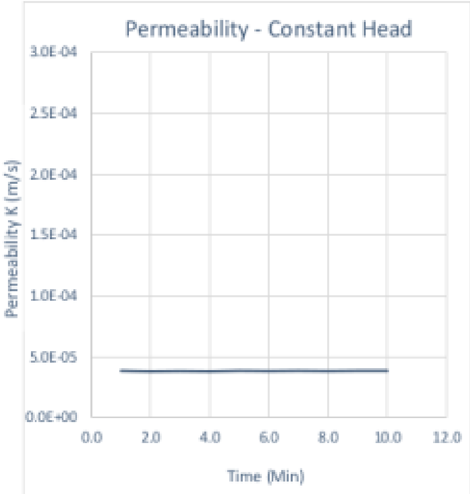
SOIL | AGGREGATE | CONCRETE | CRUSHING

TEST REPORT - AS 1289.6.7.1

Client:	Blacktop Materials Engineering	*Ticket No.*	S1804
Client Address:	111 Anderson St, Webberton WA 6530	*Report No.*	WG20/9105_2_CHPERM
Project:	West Erregulla Upstream Compound	*Sample No.*	WG20/9105
Location:	West Erregulla - TP3 @ 0-1200mm, Sample 1 Easting: 335,516, Northing: 6,745,359	*Date Sampled:*	29-09-2020
Sample Identification:	20BME3909	*Date Tested:*	2-10-2020

TEST RESULTS - CONSTANT HEAD PERMEABILITY

Sampling Method: **Sampled by Client, Tested as Received**



Compaction Details	
Compaction Method	AS 1289.5.2.1
Hammer Type	Modified
% Retained on 19.0mm	0
Maximum Dry Density (t/m3)	1.916
Optimum Moisture (%)	9.1
Target Dry Density Ratio	90
Target Moisture Ratio	100

Specimen Conditions at Compaction	
Laboratory Density Ratio (%)	90.1
Laboratory Moisture Ratio (%)	99.1
Surcharge (kPa)	3.0
Hydraulic Gradient (mm)	0.7

Coefficient of Permeability K_{20} (m/s): 3.84E-05

Comments:

Approved Signatory:
Name: Matt van Herk
Date: 05-October-2020

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WG_AS 1289.6.7.1_TR_3 Page 1 of 1

11.3 FILTRATION BASIN SIZING CASES

Title: **Filtration pond sizing using 1 minute of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	255	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	0.016666667	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	749.7	m3/hour
2	1419.075	m3/hour
3	1760.01	m3/hour
4	585.48	m3/hour
5	1490.475	m3/hour
Pond	765	m3/hour

Total Water	9343.2	m3/hour

Total Water Captured	6769.74	m3/hour
Total Water Captured	162473.76	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	112.2665	m3

Adjusted Pond Size	134.7198	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 5 minutes of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	167	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	0.083333333	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	490.98	m3/hour
2	929.355	m3/hour
3	1152.634	m3/hour
4	383.432	m3/hour
5	976.115	m3/hour
Pond	501	m3/hour

Total Water	6118.88	m3/hour

Total Water Captured	4433.516	m3/hour
Total Water Captured	106404.384	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	366.6471667	m3

Adjusted Pond Size	439.9766	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 30 minutes of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	72.1	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	0.5	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	211.974	m3/hour
2	401.2365	m3/hour
3	497.6342	m3/hour
4	165.5416	m3/hour
5	421.4245	m3/hour
Pond	216.3	m3/hour

Total Water	2641.744	m3/hour

Total Water Captured	1914.1108	m3/hour
Total Water Captured	45938.6592	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	940.1804	m3

Adjusted Pond Size	1128.21648	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 1 hour of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	45.9	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	1	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	134.946	m3/hour
2	255.4335	m3/hour
3	316.8018	m3/hour
4	105.3864	m3/hour
5	268.2855	m3/hour
Pond	137.7	m3/hour

Total Water	1681.776	m3/hour

Total Water Captured	1218.5532	m3/hour
Total Water Captured	29245.2768	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	1184.8032	m3

Adjusted Pond Size	1421.76384	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 2 hours of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	28.9	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	2	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	84.966	m3/hour
2	160.8285	m3/hour
3	199.4678	m3/hour
4	66.3544	m3/hour
5	168.9205	m3/hour
Pond	86.7	m3/hour

Total Water	1058.896	m3/hour

Total Water Captured	767.2372	m3/hour
Total Water Captured	18413.6928	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	1466.9744	m3

Adjusted Pond Size	1760.36928	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 12 hours of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	8.99	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	12	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	26.4306	m3/hour
2	50.02935	m3/hour
3	62.04898	m3/hour
4	20.64104	m3/hour
5	52.54655	m3/hour
Pond	26.97	m3/hour

Total Water	329.3936	m3/hour

Total Water Captured	238.66652	m3/hour
Total Water Captured	5727.99648	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	2458.99824	m3

Adjusted Pond Size	2950.797888	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 1 day of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	5.51	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	24	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	16.1994	m3/hour
2	30.66315	m3/hour
3	38.03002	m3/hour
4	12.65096	m3/hour
5	32.20595	m3/hour
Pond	16.53	m3/hour

Total Water	201.8864	m3/hour

Total Water Captured	146.27948	m3/hour
Total Water Captured	3510.70752	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	2700.70752	m3

Adjusted Pond Size	3240.849024	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 2 days of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	3.16	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	48	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	9.2904	m3/hour
2	17.5854	m3/hour
3	21.81032	m3/hour
4	7.25536	m3/hour
5	18.4702	m3/hour
Pond	9.48	m3/hour

Total Water	115.7824	m3/hour

Total Water Captured	83.89168	m3/hour
Total Water Captured	2013.40032	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	2406.80064	m3

Adjusted Pond Size	2888.160768	m3

Is the pond sufficient	Yes

Title: **Filtration pond sizing using 1 week of peak rainfall**

Inputs:

Parameter	Value	Unit	Reference
Rainfall	1.04	mm/hour	BOM
Hydraulic Conductivity	0.3	m/day	Geotechnical Investigation Estimate
Area of filtration	3000	m2	Stated in assumptions/ basis
Pond Current Volume	7243	m3	Stated in assumptions/ basis
Active Area	90	%	Stated in assumptions
Runoff Coefficient	0.7	N/A	http://www.fao.org/3/t0099e/t0099e04.htm
Time of peak flowrate	168	hour	BOM
Design Margin	20	%	Stated in assumptions

Calculations:

Section	Area	Unit
1	4200	m2
2	7950	m2
3	9860	m2
4	3280	m2
5	8350	m2

Section	Water	Unit
1	3.0576	m3/hour
2	5.7876	m3/hour
3	7.17808	m3/hour
4	2.38784	m3/hour
5	6.0788	m3/hour
Pond	3.12	m3/hour

Total Water	38.1056	m3/hour

Total Water Captured	27.60992	m3/hour
Total Water Captured	662.63808	m3/day

Drainage Flowrate	810	m3/day
Drainage Flowrate	33.75	m3/h

Results:

Calculated Pond Size	0	m3

Adjusted Pond Size	0	m3

Is the pond sufficient	Yes

Figure 1-2: Existing monitoring bore network

- Eastern monitoring bore
- Production Bore 1 (PB1)
- Western monitoring bore
- Drainage lines
- Development Envelope
- MDWES (2015) sampled bores

0 1.25 2.5 5
Kilometers

Datum/Projection:
GDA 1994 MGA Zone 50

N

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A TETRA TECH COMPANY

Prepared by: LS Date: 23/10/2020