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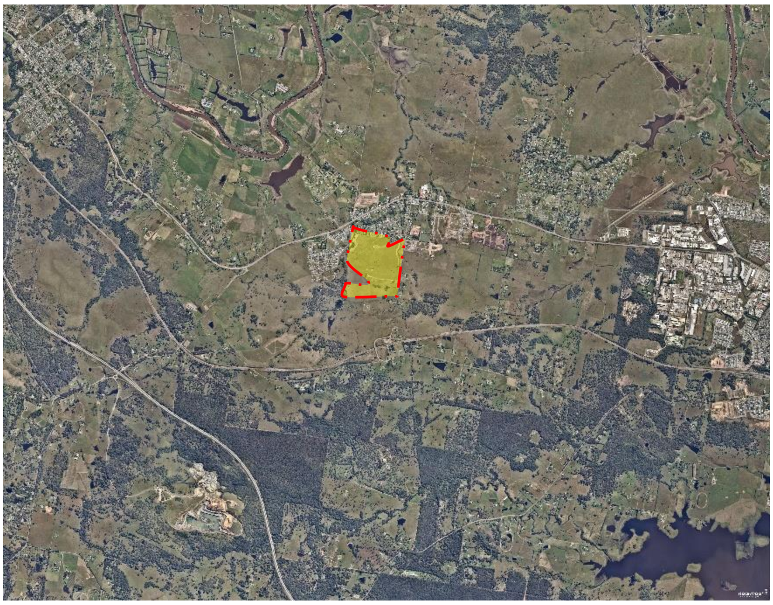
Civil Engineering Report Development Application

Kaludah Subdivision, Station Lane, Lochinvar

Prepared for:	**McCloy Project Management Pty Ltd**
Address:	**Lot 3 DP 564631, Lot 4 DP 634523, Lot 2 DP 634523, Station Lane, Lochinvar**
Project no:	**NSW212012**
Date:	**04/05/2022**
Document no:	**NSW212012_ R01_Civil Engineering DA Report.docx**
Revision no:	**Revision A**



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Revisions

Revision	Description	Date	Prepared by	Approved by
A	Development Application Issue	04/05/2022	Brandon Gathercole	Greg Couch

Review Panel

Division/ office	Name
Newcastle	Greg Couch, Brandon Gathercole

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1 Introduction

1.1 General

ACOR Consultants have been engaged by McCloys Project Management Pty Ltd to prepare an Engineering Report to support the Development Application for a proposed development at Lot 3 DP 564631, Lot 4 DP 634523, Lot 2 DP 634523, Station Lane, Lochinvar, known as Kaludah Subdivision. The development will front and access Station Lane, Lochinvar.

Engineering items addressed in this report include:

- Preliminary Road Design;
- Site grading and Earthworks;
- Stormwater Quantity
- Stormwater Quality
- Flooding assessment

Stormwater quantity items addressed in this report include:

- Stormwater conveyance/network;
- Stormwater detention

Stormwater quality items to be addressed in this report include:

- Operational water quality management incorporating Water Sensitive Urban Design principles (WSUD);
- Construction water quality management incorporating soil and water management.

2 Site

2.1 Location

The site is located at 51, 134 & 146 Station Lane, Lochinvar. The property IDs are Lot 3 DP 564631, Lot 4 DP 634523, Lot 2 DP 634523. The development is located to the West of Station Lane, is bound by a property boundary with future development opportunities to the South, A Property boundary & 3rd order stream to the West, and existing development to the North. Refer to DA201-002 for the locality of the development.

2.1 Topography

The existing site has a high point through the centre and grades generally to the surrounding streams and Dams. The grades on the site range between 1 to 10% with grades getting steeper near the existing streams. The levels on the site currently range from approximate RL 57m AHD at the south boundary to RL 30m & 32m AHD on along the stream at the North-eastern & North-western discharge points. Refer to Existing Topography Plan DA201-010.

2.2 Existing/Previous Land Use and Vegetation

The site in its current condition is a rural holding with some agricultural uses. Most of the site has been cleared through previous uses. Refer to Existing Site Aerial Photograph Plan DA201-010.

2.3 Existing Site Drainage

The site drains generally from the centre highpoint to the east or west where the existing streams drain the site to the North. The stream to the East of the site is referred to as Grady Creek and the stream to the West is referred to as Lochinvar Creek.

2.4 External Catchments

There are large external catchments draining through the edges of the site. These catchments drain around the site utilising the existing streams and floodplain. The external catchments are further addressed later in the report and further addressed in the Flood Report.

2.5 Site Clearing & Demolition

There are existing structures and vegetation on site which shall be demolished or cleared and removed prior to construction of the development. Refer to DA101-016 for clearing plan. Refer to DA101-017 for demolition plan.

3 Proposed Development

The proposed development will consist of 347 residential allotments ranging from 450m^2 to 1200m^2, 5 Super allotments ranging from 1870m^2 to 2100m^2, one large lot of approximately 1.6ha. Further to this the development also includes a public reserve/proposed park, 4 allotments for stormwater drainage infrastructure including detention/water quality basins, and two residue allotments. In addition to the allotments there is associated road & drainage infrastructure. Refer to DA101-014 for an allotment break down.

Access to the site will be via Station Lane & an extension of Terriere Drive.

The total area of the proposed development including all roadworks and batters is approximately 36.36 hectares. Refer to DA202-001 for the development layout.

4 Concept Civil Design

4.1 Concept Road Design

The concept road layout has been adopted to suit the development layout. Terriere Drive is extended in accordance with the DCP requirements with an additional collector road running North South. Perimeter roads have been included to meet RFS requirements.

The concept road grading for the proposed development was undertaken generally following the natural topography of the site. Road gradings range from minimum 0.75% to maximum 6%.

The road widths of the development have been adopted from MCC MOES requirements or adopted from the Lochinvar DCP. Terriere Drive is extended with the DCP profile of 29.2m, the North South Collector Road (Road 2) is proposed to alter from the MOES to be 25m instead of 24m, this is to accommodate a wider off-road cycle way on one side of the development as required in the DCP. Perimeter roads are to be constructed with a 19.5m Road Reserve to RFS requirements. All other road reserves are to be constructed in accordance with the MCC MOES 17m wide road.

An additional 6 laneways have been incorporated into the development. These have a 10m wide reserve and a 6m wide carriage way. They shall have a layback & cross over from the road reserve and will appear as a driveway.

- Figures DA203-001 to DA203-010 Are the General Arrangement Plan's for the development.
- Figures DA204-101 to DA204-2101 Are the Road Longitudinal Sections for the development.
- Figures DA204-3001 to DA204-3006 Are the longitudinal sections for the Laneways.
- Figures DA205-101 and DA205-102 Are the Typical Road Cross Sections for the development.

4.2 Concept Intersection Layout

The concept intersection layout of Station Lane & Terriere Drive is subject to final design and discussions with MCC and shall be undertaken by Council using nominated developer contributions. It is understood from discussions the preferred option is a set of TCS signals.

The concept roundabout design of Terriere Drive and Road 2 was generally undertaken in accordance with AUSTROADS Guide to Road Design with modifications to suit the MCC requirements of other roundabouts in the Lochinvar Precinct. FigureDA206-001 details the proposed Roundabout Layout.

4.3 Concept Site Grading

The concept site grading for the proposed development was undertaken generally following the natural topography of the site. Retaining walls have been provided across the site to reduce allotment grades, these have been shown on the General Arrangement plans with maximum heights noted. Overall, the maximum height used is 1.5m. Figures DA203-001 to DA203-0010 are the General Arrangement Plan's for the development.

4.4 Bulk Earthworks

The proposed cut & fill earthworks for the site are detailed on Figures DA207-001 to DA207-010 in way of an isopach plan (cut/fill). The Figure provides the cut and fill depths associated with the concept site grading. There is an estimated 153,900m^3 cut and 237,200m^3 of fill. With trenching spoil and footpath works, there is expected to be a requirement to import a small amount of fill material for earthworks to balance. This could also be achieved by borrowing from the residue of the site. Final site earthworks will be finetuned during the detailed design phase.

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5 Stormwater Quantity

5.1 Stormwater Conveyance

5.1.1 Minor Storm Event Conveyance

Minor system stormwater conveyance for the development will be a via a traditional pit and pipe system. The minor stormwater system will have the capacity to convey the peak flows from a 10% AEP storm event. For Stormwater Layout Plans refer to DA209-001 to DA209-010.

5.1.2 Major Storm Event Conveyance

Major system stormwater conveyance for the proposed development will be via overland flow. This will be via the road carriage way and footpath. The major stormwater system will have the capacity to convey the peak flows from a 1% AEP storm event, containing flows within the road reserve. The overland flows will flow to the stormwater management basin. The peak flows from the basin will be reduced to predeveloped peak flows and discharged to the existing drainage lines.

5.2 Stormwater Detention

5.2.1 General

Stormwater detention has been provided for the development. DRAINS modelling was undertaken adopting the IL/CL modelling procedure with ARR 2019 Data.

5.2.2 Pre Development Catchment

The site has many defined catchments in the predeveloped scenario. For Pre Development Stormwater Catchment Plans refer to DA209-101. The Predeveloped catchment areas and fraction impervious for the predeveloped models are shown in Table 1.

Table 1: Predeveloped Catchments

Catchment	Area (ha)	Predeveloped % Impervious	Pervious Flow Length (m)	Pervious Flow Slope %	Pervious Roughness	Pervious Additional Timing (min)	Impervious Time of Concentration	Pervious Time of Concentration	Supplementary Time of Concentration
C-SH1	112.5352	0	100	8.5	0.21	52.5			
C-SH2	4.4442	40					5	30	5
C-SH3	6.5151	60					5	10	5
C-SH4	3.3933	0	100	3	0.21	12.75			
C-SH5	21.2731	60					5	30	5
C-SH6	7.9345	60					5	30	5
C-L1B	55.644	0	100	8	0.21	30	30	30	30
C-L1A	78.5888	0	100	8	0.21	46.5			
C-L2	11.545	0	100	2.25	0.21	10.5			
C-L3	3.8535	0	67	3.4	0.21	10.5			

Catchment	Area (ha)	Predeveloped % Impervious	Pervious Flow Length (m)	Pervious Flow Slope %	Pervious Roughness	Pervious Additional Timing (min)	Impervious Time of Concentration	Pervious Time of Concentration	Supplementary Time of Concentration
C-G1	109.3366	0	100	7.5	0.21	39			
C-G2	5.556	0	100	2.5	0.21	11.4			
C-G3	4.4404	0	55	7.3	0.21	21			
C-F1	9.3971	0	765	2.55	0.21	0			
C-F2	10.5597	0	670	2.25	0.21	0			
C-MC1	13.3564	0	100	3.5	0.21	6.75			
C-MC2	37.092	0	100	1.5	0.21	18			
C-MC3	6.923	0	100	1.5	0.21	11.25			
C-MC3A	2.92	0	100	3.5	0.21	4.5			
C-MC4	12.6	0	100	2.5	0.21	16.5			
C-MC5	16.891	0	100	2.5	0.21	19.5			

The pervious additional timing was determined through the use of QUDM additional flow path timing graphs with the use of a 3x multiplier for natural channels. The timing graphs have been provided in Appendix A. Catchments SH1, SH2, SH3, SH5, SH6, F1 and F2 have had their time of concentration taken from the various supplied design reports for the adjacent subdivisions. These all discharge through detention basins with the properties shown in Table 2.

Table 2: Existing Detention Basin Details

Property	SH1 Basin Details		SH2 Basin Details		SH6 Basin Details	
Basin Storage Details	RL	Surface Area	RL	Surface Area	RL	Surface Area
	34.5	1510	33.7	4642	40	0
	35	2020	35.7	2859	41	2054
	36.5	5708	37.7	6695	42	6669
	37	5708	38	7138	43	14606
			38.1	7138	43.5	20623
					44	27803
Outlet 1						
Orifice Level RL (m)	34.6		35.70		35.00	
Orifice Size (mm)	150		450		375	
Outlet 2						
Weir Level RL (m)			36.80			
Weir Length (m)			2.40			
Orifice Level RL (m)	35.00		35.40		40.00	
Orifice Size (mm)	375		450		600	
Outlet 3						

Property	SH1 Basin Details	SH2 Basin Details	SH6 Basin Details
Weir Level RL (m)		37.70	42.00
Weir Length (m)		7.20	10
Orifice Level RL (m)	35.00		
Orifice Size (mm)	375		

5.2.3 Post Development Catchment

The site has many defined catchments in the Post Developed scenario. The external catchments for the site are kept the same between the predeveloped and post developed scenarios. For Post development Stormwater Catchment Plans refer to DA209-102. The Predeveloped catchment areas and fraction impervious for the predeveloped and developed models are shown in Table 3.

Table 3: Postdeveloped Catchments

Catchment	Area (ha)	Predeveloped % Impervious	Pervious Flow Length (m)	Pervious Flow Slope %	Pervious Roughness	Pervious Additional Timing (min)	Impervious Time of Concentration	Pervious Time of Concentration	Supplementary Time of Concentration
C-SH1	112.5352	0	100	8.5	0.21	52.5			
C-SH2	4.4442	40					5	30	5
C-SH3	6.5151	60					5	10	5
C-SH4	3.3933	0	100	3	0.21	12.75			
C-SH5	21.2731	60					5	30	5
C-SH6	7.9345	60					5	30	5
C-L1A	78.5888	0	100	8	0.21	46.5			
C-L1B	55.644	0	100	8	0.21	30			
C-L2	11.545	0	100	2.25	0.21	10.5			
C-L3A	2.375	0	67	3.4	0.21	10.5			
C-L3B	0.3032	80					5	10	5
C-L3C	1.175	0	67	3.4	0.21	10.5			
C-F1	9.3971	0	670	2.25	0.21	0			
C-F2	10.5597	0	765	2.55	0.21	0			
C-MC1	13.3564	0	100	3.5	0.21	6.75			
C-MC2	39.115	75					6	12	0
C-MC3	7.363	75					6	12	0
C-MC4	10.076	75					6	12	0
C-MC5	19.92	75					6	12	0
C-G1	109.3366	0	100	7.5	0.21	39			
C-G2	5.556	0	100	2.5	0.21	11.4			
C-G3A	1.1176	0	55	7.3	0.21	21			

Catchment	Area (ha)	Predeveloped % Impervious	Pervious Flow Length (m)	Pervious Flow Slope %	Pervious Roughness	Pervious Additional Timing (min)	Impervious Time of Concentration	Pervious Time of Concentration	Supplementary Time of Concentration
C-G3B	0.4525	80					5	10	5
C-G3C	2.789	0	55	7.3	0.21	21			

For the developed model of the site, fraction impervious of 75% was adopted, this is to be confirmed at the detailed design stage. The fraction impervious for lots was developed off similar developments ACOR Consultants have completed. Existing Detention basins as per the Pre Development conditions have been utilised.

5.2.4 Hydrology

The hydrology & hydrological process at the site have been determine in accordance with ARR 2019 & Maitland Council design requirements. Initial & Continuing Loss models have been adopted with the parameters in table 4.

Table 4: Hydrological Parameters

Initial Continuing Loss Parameters	
Impervious Area Initial Loss (mm)	1
Impervious Area Continuing Loss (mm/hr)	0
Pervious Area Initial Loss (mm)	37
Pervious Area Continuing Loss (mm/hr)	3.3
Overland Flow Equation	Kinematic Wave

Rainfall data has been adopted of ARR Data Hub utilising a good rainfall gauge. The rainfall gauge has been selected to closely match the flow rates of the ADWJ Lochinvar Flood Study 2015 at the boundary conditions of our site.

5.2.5 Drains Catchment Modelling

DRAINS modelling was undertaken to determine the predeveloped and developed peak flows for a range of AEPs from 20% to 1%, for storm durations ranging from 5 minutes to 9 hours for the proposed development to confirm detention was required. Comparisons have been undertaken at the two creek outlet points of Lochinvar Creek & Grady Creek. Table 5 shows the Peak flows at the Grady Creek Outlet and Table 6 shows the Peak flows at the Lochinvar Creek Outlet.

Table 5: Grady Creek - Predeveloped vs Developed (without Detention) Peak Flows

Storm Event AEP	Peak Discharge m^3/s:			
	Pre-Development	Post Development	Difference	Difference %
20%	10.897	12.465	1.568	14.39%
10%	14.720	15.564	0.844	5.73%
5%	18.864	19.718	0.854	4.53%
2%	25.539	25.964	0.425	1.66%
1%	32.780	33.877	1.097	3.35%

Table 6: Lochinvar Creek - Predeveloped vs Developed (without Detention) Peak Flows

Storm Event AEP	Peak Discharge m^3/s:			
	Pre-Development	Post Development	Difference	Difference %
20%	15.622	15.655	0.033	0.21%
10%	21.093	20.269	-0.824	-3.91%
5%	27.233	27.089	-0.144	-0.53%
2%	36.143	35.724	-0.419	-1.16%
1%	46.055	44.041	-2.014	-4.37%

As can be seen from Table 5 & Table 6, some detention is required to reduce the peak flows from the development to the predeveloped peak flows. It is recommended by ACOR that detention not be provided on Grady Creek due to the timing of development flows. Some detention is required on Lochinvar Creek, it is recommended that this be best solved via a single regional basin on Grady Creek.

Following preliminary discussions with Maitland City Council, they have requested that subcatchment flows are not to exceed predevelopment values and that they will be providing regional basins to adjust timings. As a result, detention basins are required for each subcatchment of the proposed development.

5.2.6 DRAINS Detention Basin Parameters

Detention basins have been modelled to reduce the peak flow rates off a subcatchment in accordance with Maitland City Council's request.

A Detention basin has been modelled for catchment MC5; however, this will be subject to a future development application. Its modelling is to understand the full impact of the site's overall development.

For Stormwater Detention Basin Plans refer to DA209-301 to DA209-305, DA209-401 & DA209-403. Detention Basin's with the following attributes were modelled to reduce the total peak flows leaving the site to below the existing peak flows:

Table 7: Detention Basin Details

Property	MC2 Detention Basin Details	MC3 Detention Basin Details	MC4 Detention Basin Details	MC5 Detention Basin Details
Basin Invert Level RL (m)	33.00	34.40	35.50	40.00
Basin Crest Level RL (m)	36.50	36.50	37.00	41.10
Emergency Weir Level RL (m)	36.00	36.00	37.50	41.60
Volume to Weir (m^3)	10,815	3,103	2,848	5,691
Volume to Crest (m^3)	14,338	4,546	4,346	8,911
Outlet 1				
Weir Level RL (m)		34.40	35.50	40.00
Weir Length (m)		2.70	2.70	2.70
Orifice Level RL (m)	33.00	33.00	34.10	38.6
Orifice Size (mm)	Twin 825dia Pipe	400	550	630
Outlet 2				
Weir Level RL (m)	35.00	35.26	36.45	40.90

Property	MC2 Detention Basin Details	MC3 Detention Basin Details	MC4 Detention Basin Details	MC5 Detention Basin Details
Weir Length (m)	9.60	2.70	3.60	3.60
Orifice Level RL (m)	33.00	33.00	34.10	38.60
Orifice Size (mm)	Twin 600dia Pipe	375dia pipe	675dia pipe	750dia pipe
Outlet 3				
Weir Level RL (m)	35.70	35.58		
Weir Length (m)	9.60	3.60		
Orifice Level RL (m)	33.00	33.00		
Orifice Size (mm)	Twin 675dia Pipe	375dia pipe		

It is noted that the weir is for emergency flows only. The outlet configuration from the basin caters for events up to and including the 1% AEP peak flow. Available storage volumes from residential rainwater tanks were not allowed for in the modelling

The stage storage for the basin's is shown in Table 5.

Table 8: Basin Stage & Volume

MC2 Detention Basin			MC3 Detention Basin			MC4 Detention Basin			MC5 Detention Basin		
Height (m)	Surface Area (m^2)	Volume (m^3)	Height (m)	Surface Area (m^2)	Volume (m^3)	Height (m)	Surface Area (m^2)	Volume (m^3)	Height (m)	Surface Area (m^2)	Volume (m^3)
33	10	0	34.4	1300	0	35.5	1170	0	40	4340	0
34	2950	1095	34.5	1380	134	36	1640	699	40.5	5090	2355
34.399	3520	2385	35	1760	917	36.5	2140	1641	41	5880	5095
34.4	4000	2388	35.5	2180	1900	37	2700	2849	41.5	6710	8240
34.5	4150	2796	36	2640	3103	37.5	3300	4346			
35	4930	5063	36.5	3140	4547						
35.5	5750	7730									
36	6600	10816									
36.5	7500	14338									

5.2.7 Subcatchment DRAINS Detention Basin Modelling

A comparison of the predeveloped and the developed subcatchment peak flows with the basins for each AEP from 20% through to 1% is shown in Table 9 to Table 12.

Table 9: MC2 - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m^3/s:				Water Depth in Basin
	Pre-Development	Post Development	Difference	Difference %	Depth (m)
20%	3.103	2.876	-0.227	-7.32%	1.92
10%	4.386	4.379	-0.007	-0.16%	2.22

Storm Event AEP	Peak Discharge m³/s:				Water Depth in Basin
	Pre-Development	Post Development	Difference	Difference %	Depth (m)
5%	5.926	5.873	-0.053	-0.89%	2.53
2%	8.040	7.794	-0.246	-3.06%	2.94
1%	10.562	10.586	0.024	0.23%	3.18

Table 10: MC3 - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m³/s:				Water Depth in Basin
	Pre-Development	Post Development	Difference	Difference %	Depth (m)
20%	0.454	0.447	-0.007	-1.54%	0.72
10%	0.614	0.497	-0.117	-19.06%	0.90
5%	0.849	0.839	-0.010	-1.18%	1.07
2%	1.167	1.155	-0.012	-1.03%	1.22
1%	1.545	1.481	-0.064	-4.14%	1.34

Table 11: MC4 - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m³/s:				Water Depth in Basin
	Pre-Development	Depth (m)	Difference	Difference %	Depth (m)
20%	0.834	0.825	-0.009	-1.08%	0.61
10%	1.105	0.938	-0.167	-15.11%	0.81
5%	1.517	1.444	-0.073	-4.81%	0.97
2%	2.099	2.094	-0.005	-0.24%	1.12
1%	2.692	2.760	0.068	2.53%	1.24

Table 12: MC5 - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m³/s:				Water Depth in Basin
	Pre-Development	Depth (m)	Difference	Difference %	Depth (m)
20%	1.056	1.046	-0.010	-0.95%	0.77
10%	1.390	1.190	-0.200	-14.39%	0.96
5%	1.902	1.713	-0.189	-9.94%	1.13
2%	2.675	2.532	-0.143	-5.35%	1.30
1%	3.404	3.298	-0.106	-3.11%	1.44

The negligible increases in flows on basin MC2 – 1% AEP & MC4 – 1% AEP will be solved during detailed design with final site catchments, impervious area, and timings.

5.2.8 Overall Site DRAINS Post Development Modelling

Additionally, to the subcatchments meeting pre development vs post development flows the flows at each stream outlet point must meet the pre development vs post development flows. A comparison of the predeveloped and the developed peak flows at the outlet point of each stream for each AEP from 20% through to 1% are shown in Table 13 and Table 14.

Table 13: Grady Creek - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m^3/s:			
	Pre-Development	Post Development	Difference	Difference %
20%	10.897	10.779	-0.118	-1.08%
10%	14.720	14.151	-0.569	-3.87%
5%	18.864	18.585	-0.279	-1.48%
2%	25.539	24.487	-1.052	-4.12%
1%	32.780	31.863	-0.917	-2.80%

Table 14: Lochinvar Creek - Predeveloped vs Developed (with Detention) Peak Flows

Storm Event AEP	Peak Discharge m^3/s:			
	Pre-Development	Post Development	Difference	Difference %
20%	15.622	15.246	-0.376	-2.41%
10%	21.093	20.509	-0.584	-2.77%
5%	27.233	26.452	-0.781	-2.87%
2%	36.143	35.911	-0.232	-0.64%
1%	46.055	45.363	-0.692	-1.50%

As can be seen from Table 13 & Table 14, by constructing the detention basins with the volume and outlet configuration's discussed above, the peak flows at the outlet points of the development are reduced to below the predeveloped peak flows

It is noted that by providing detention basins on Grady creek the post developed flow with basins is typically higher than the post developed flow without basins. This is due to the timing of the development getting closer to the timing of the stream.

5.2.9 Detention Basin Spillways

The Basin spillway was to be designed to cater for the entire 1% AEP storm event in the case of the staged discharge being blocked. The proposed weir design (refer design plans for details) more than caters for the 1% event and additional capacity has been provided for safety. Refer to Appendix B for the spillway calculations.

5.2.10 Detention Basin Modelling Conclusion

As can be seen from the above results, by constructing the detention basins with the volume and outlet configuration discussed above, the peak flows for the catchment of the development are reduced to below the predeveloped peak flows. The DRAINS model for the detention modelling has been provided with the submission for Council review

5.3 Scour Protection

Scour protection shall be nominated on the design plans for the pipe outlets from the detention basin at detailed design. The scour protection designs shall be in accordance with Catchments & Creek guidelines on rock sizing for both single, multi-pipe outlets and spillways.

6 Stormwater Quality - Operational Phase

6.1 Objectives

The objectives of the stormwater quality management for the site are:

- Meet the water quality objectives of Maitland City Council for the operational phase of the site by using best practice stormwater treatment measures. The water quality reductions required by Maitland City Council are:
- % Reductions from the developed site of:
  - 80% reduction in Total Suspended Solids (TSS)
  - 45% reduction in Total Phosphorus (TP)
  - 45% reduction in Total Nitrogen (TN)
  - 70% reduction in litter/gross pollutants

6.2 Operational Phase Water Quality Management

6.2.1 General

To meet the water quality requirements of Maitland City Council a range of water quality improvement devices are proposed. The proposed water quality improvement devices for the site are:

- Rainwater Tanks
- Gross Pollutant Traps
- Bioretention Basins

The above water quality improvement devices act as a treatment train, progressively reducing pollutants as they pass through each one.

6.2.2 Stormwater Quality Modelling

6.2.2.1 Introduction

The MUSIC model version 6 was used to assess the pollutant generation from the development and the performance of the stormwater quality treatment train. MUSIC modelling was undertaken in accordance with the Maitland City Council MUSIC Modelling Guidelines in their MOES and the NSW MUSIC Modelling Guidelines (WBM, 2015).

6.2.2.2 Rainfall Data, Evaporation Data, and soil type

Maitland City Council advised to adopt the Lake Macquarie City Council (LMCC) MUSIC Link Data. As a result, the LMCC Northern Catchment MUSIC Link rainfall data and evapotranspiration data was adopted for the project

6.2.2.3 MUSIC Model Source Inputs

The source data for the MUSIC model for the developed model were adopted from the LMCC MUSIC Link and checked against NSW MUSIC Model Guideline values for urban residential. The area for each roof of 250 m^2 was adopted for the modelling. An overall lot fraction impervious of 60% was adopted (including the roof area) for lots. A fraction impervious of 70% was adopted for the road catchments.

6.2.2.4 Catchments Pollutant Mean Concentrations

The pollutant Event Mean Concentration (EMC) values for the development were adopted from Lake Macquarie City Council's MUSIC link (and checked against the NSW MUSIC Modelling Guideline values) for both base flows and storm flows. The catchments were divided into roofs, residential lots (remaining yards) and road areas.

6.2.2.5 MUSIC Model Treatment Train

The stormwater quality treatment train consist of three parts; rainwater tanks, a gross pollutant traps and bioretention basins.

A brief description on each treatment measure is listed below.

Rainwater Tanks.

Rainwater tanks receive water from the roof area of each lot. A 4kL rainwater tank was assumed for each standard residential lot. Water captured in the rainwater tanks is expected to be reused for toilet flushing, clothes washing, hot water and garden irrigation. An average of 4 persons was assumed for each house. The reuse per house was adopted from the NSW MUSIC Modelling Guidelines, Table 6-1. The reuse adopted for each lot is shown in Table 15.

Table 15: Rainwater Tank Reuse (per lot)

Rainwater Reuse	
Internal (L/day/dwelling)	425
External (L/day/dwelling)	151
High flow Bypass (m^3/dwelling)	0.005

Gross Pollutant Traps

A HumeGard GPT is proposed upstream of each detention basin. These products remove gross pollutants, sediment and attached nutrients. The MUSIC node for the GPT was provided by Humes. The removal efficiencies have been confirmed via independent testing. An equivalent product could be used. The flows to the GPT were limited to the 3-month peak flow (4EY) with larger flows flowing directly into the downstream basin. The design plans for the GPT locations are shown in DA209-301 to DA209-304. Information on the GPT's can be found in Appendix C. Table 16 shows the removal efficiencies of the HumeGard GPT.

Table 16: HumeGard Removal Efficiencies

Inflow (m^3/s)	Gross Pollutant Removal (%)	TSS Removal (%)	TP Removal (%)	TN Removal (%)
4EY Flow	90	41	34	24

Bioretention Basins

A bioretention basin is the final part of the treatment train for the site. Bioretention systems remove sediments (TSS) as well as nutrients (TN and TP) for the stormwater. The bioretention basin consists of a shallow dry basin with deep rooted vegetation and grass on the surface, over an infiltration/filtration area and an underdrain area. Vegetation in the bioretention basins will be in accordance with Maitland City Council requirements.

There are 4 nominated bioretention basins for the overall development, with 3 of these being in this development application. The design plans for the bioretention basin locations are shown in DA209-301 to DA209-304. Details of the bioretention basins are shown in Table 17.

Table 17: Bioretention Basin Details

Property	MC2 Bioretention Details	MC3 Bioretention Details	MC4 Bioretention Details	MC5 Bioretention Details
Extended Detention Depth (m)	0.3	0.3	0.3	0.3
Surface Area (m^2)	430 (Surface Area halfway between Basin invert & Bioretention Media)	650 (Surface Area halfway between Basin invert & Bioretention Media)	580 (Surface Area halfway between Basin invert & Bioretention Media)	2170 (Surface Area halfway between Basin invert & Bioretention Media)
Filter Area (m^2)	300	100	100	100
Unlined Filter Material (m)	0.01	0.01	0.01	0.01
Saturated Hydraulic Conductivity (mm/hr)	100	100	100	100
Filter Depth (m)	0.4	0.4	0.4	0.4
TN Content of Filter Media (mg/kg)	400	400	400	400
Orthophosphate of Filter Media (mg/kg)	40	40	40	40
Exfiltration Rate (mm/hr)	0	0	0	0
Base Lined	Yes	Yes	Yes	Yes
Vegetation Properties	Vegetated with Effective Nutrient Removal Plants	Vegetated with Effective Nutrient Removal Plants	Vegetated with Effective Nutrient Removal Plants	Vegetated with Effective Nutrient Removal Plants
Overflow Weir Width (m)	10.00	40.00	40.00	40.00
Under Drain Present	Yes	Yes	Yes	Yes
Submerged Zone with Carbon Present	No	No	No	No

6.2.3 Stormwater Quality Modelling Results

The results of the overall site MUSIC model for the total catchment showing the mean annual pollutant loads for the existing and the developed catchment are shown in Table 18.

Table 18: Overall Site MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	% Required Reduction
TSS (kg/yr)	72800	9770	86.6	80
TP (kg/yr)	142.0	46.9	67.1	45
TN (kg/yr)	954.0	488.0	48.8	45
Gross Pollutants (kg/yr)	12200	195	98.4	70

Additionally, to the overall site meeting the TSS, TN, TP and gross pollutants are reduced below the requirements of Maitland City Council, the reductions from each catchment and basin meet the requirements of council. This is shown through tables 19 through 22.

Table 19: MC2 Basin MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	% Required Reduction
TSS (kg/yr)	33200	4590	86.2	80
TP (kg/yr)	65.8	23.3	64.6	45
TN (kg/yr)	446.0	243.0	45.5	45
Gross Pollutants (kg/yr)	5710	0	100.0	70

Table 20: MC3 Basin MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	% Required Reduction
TSS (kg/yr)	6920	1300	81.2	80
TP (kg/yr)	13.4	4.5	66.2	45
TN (kg/yr)	90.0	41.6	53.8	45
Gross Pollutants (kg/yr)	1170	71	93.9	70

Table 21: MC4 Basin MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	% Required Reduction
TSS (kg/yr)	11500	2180	81.1	80
TP (kg/yr)	22.1	8.1	63.6	45
TN (kg/yr)	143.0	77.8	45.7	45
Gross Pollutants (kg/yr)	1810	124	93.2	70

Table 22: MC5 Basin MUSIC Model Results

	Source Load	Residual Load	% Achieved Reduction	% Required Reduction
TSS (kg/yr)	21100	1710	91.9	80
TP (kg/yr)	41.1	11.0	73.2	45
TN (kg/yr)	275.0	126.0	54.2	45
Gross Pollutants (kg/yr)	3520	0	100.0	70

6.2.4 Stormwater Quality Modelling Conclusion

As can be seen from the results in Tables 18 to Table 22, the TSS, TN, TP and gross pollutants are reduced below the requirements of Maitland City Council. A copy of the MUSIC model has been submitted to Council.

7 Stormwater Quality - Construction Phase

7.1 General

During the construction phase of the development, an Erosion and Sediment Control Plan will be implemented to minimise the water quality impacts. The erosion and sediment controls will be in accordance with Landcom's Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition (Landcom, 2004) and the requirements of Maitland City Council. Erosion and sediment controls will be required preconstruction, during construction and post construction until the site is stabilized. The expected erosion and sediment control measures will include stabilized site access, sediment fence, gully pit sediment barriers, rock outlet scour protection and a temporary sediment basin.

7.2 Pre-Construction Erosion and Sediment Control

Due to the topography of the site, the preconstruction erosion and sediment controls will be limited to stabilized site access, sediment fence and a temporary sediment basin until the initial bulk earthworks is undertaken. The proposed detention/water quality basin will be used as a sediment basin while construction is being undertaken. Figures DA210-001 to DA210-010 detail preliminary erosion and sediment control plans for the development.

7.3 During Construction Erosion and Sediment Control

During the construction phase of the development, the erosion and sediment controls will consist of installed sediment fence, a constructed sediment basin, gully pit sediment barriers and permanent rock outlet scour protection.

Regular inspection and maintenance of the erosion and sediment controls is required during the construction process.

As the soils on site are clay, a sediment basin volume was calculated using the Blue Book for type F soils. During construction, if the soils are found to be dispersive, the contractor will need to provide a flocculating agent to ensure discharge from the basin meets the requirements of the Blue Book. The sediment basin calculations are shown in Appendix D. Design of sediment basins will be carried out as part of detailed design and subject to staging of the development. The sediment basin calculations are based upon a greater than 6month construction with a sensitive downstream receiver, resulting in a 6month, 5day 85th percentile storm depth of 31mm.

7.4 Post Construction Erosion and Sediment Control

The contractor/developer will be responsible for the maintenance of the erosion and sediment control devices from the practical completion of the works for a minimum of 6 months or until stabilization has occurred to the satisfaction of Maitland City Council.

It is proposed to delay the construction of the bioretention filtration media in the basin until a significant proportion of the contributing lots are built on and established to avoid the system being filled with sediments and be coming ineffective.

8 Stormwater Quality Operation & Maintenance Plan

8.1 General

Maitland City Council has established a maintenance plan for its existing water quality infrastructure. The proposed infrastructure will be like the existing.

General maintenance will involve implementation of a regular inspection and maintenance schedule. As a minimum, the inspection and maintenance program are to follow any significant rain event. The inspection regime may be increased when housing construction commences to determine if a more frequent maintenance period is required.

8.2 Stormwater Quality Summary

Stormwater quality for the development has been modelled in MUSIC. The water quality treatment will consist of rainwater tanks for each lot, and a bioretention in the detention basins

All water is to be piped to the detention facilities where it will pass through a Gross Pollutant Trap prior to entering the basin.

8.3 Maintenance of Stormwater Quality Devices

For correct operation and performance regular maintenance of the SQUIDS is paramount. GPT's require clearing and ongoing maintenance of the vegetation and bioretention material in the Basin are critical to the performance of the treatment train for the development.

8.3.1 Gross Pollutant Traps – HumeGard GPT

The GPTs proposed to be installed upstream of the basin are HumeGard proprietary products. These proprietary products were specified as it met the requirements of the site by allowing inline treatment and catering for tailwater impacts from the downstream basin. Post construction of the development catchment inspections are recommended quarterly with only an annual requirement for maintenance and cleaning. During construction of the development catchment inspections should be undertaken more regularly with the higher risk of runoff from housing construction. Refer to Appendix E for the HumeGard Inspection and Maintenance Guide

8.3.2 Gross Pollutant Traps – HumeGard GPT

It is proposed that the bioretention and water quality basin construction will be staged. It will act a sediment basin until 90% of the catchment has been development or two years post release of the Subdivision Certificate.

Following conversion to an operating water quality device the bioretention basin should be inspected regularly. Regular inspections until the vegetation is established and then typically monthly or following significant storm events. Maintenance will be more regular during the initial vegetation establishment period. During this period regular watering, mulching, weeding, soil treatment, removal and replacement of dead/diseased vegetation may be required. An appropriate long-term maintenance frequency can usually be determined after 2 years of operation when the catchment and bioretention measure have stabilised. The typical long-term maintenance frequency varies with aesthetics and seasonal influences. Grass cutting and weeding are typically required either fortnightly or monthly (depending on the species) during spring and summer. Less frequent grass cutting, and weeding (typically every 2 to 3 months) typically occurs during autumn and winter where other factors (e.g. aesthetics, litter removal, erosion, vegetation damage) may control the maintenance frequency.

Testing of the biofiltration media should be undertaken every 2 years to determine the content of orthophosphate and Total Nitrogen. The media will need to be replaced when the content of each of these nutrients exceeds the recommended levels from the Facility for Advancing Biofiltration (FAWB).

8.4 Safety – Inspections & Maintenance

Only suitably qualified and authorised personnel should undertake inspections and maintenance of the Stormwater Quality Improvement Devices. Safe Work Methods Statements are required prior to the commencement of any works, and their correct implantation is the responsibility of all authorised personnel undertaking the works.

9 Conclusion

This Civil Engineering Report addresses the concept civil design, stormwater quantity and quality of the residential development known as Kaludah Subdivision, Lochinvar.

Stormwater quantity and stormwater quality (both operational and construction phases) have been addressed.

Stormwater conveyance for the site will be in accordance with the minor/major system philosophy and the requirements of Maitland City Council. The minor system consisting of surface inlet pits and pipes has been designed for an AEP of 10 %. The major stormwater system will consist of the road reserve and will be designed for an AEP of 1%.

Detention modelling for the site determined that the peak flows from AEPs for 20% to 1% AEP have been reduced to or below the predeveloped peak flows.

Water quality management for the site will consist of a treatment train utilizing rainwater tanks, GPT, swales and a bioretention basin to reduce the pollutant runoff from the site in accordance with the requirements of Maitland City Council.

Construction phase erosion and sediment control will be undertaken in accordance with Landcom's Managing Urban Stormwater and Maitland City Council.

If you have any questions regarding the information provided in this Civil Engineering DA Report, please call the undersigned or Greg Couch to discuss

Yours faithfully,

ACOR Consultants (NSW) Pty Ltd

B. G

Brandon Gathercole
Newcastle Civil Design Manager & Civil Engineer

10 Figures

DA210-102 .... EROSION AND SEDIMENT CONTROL DETAILS - SHEET 2

Appendix A QUDM Timing Graphs

Appendix B Detention Basin Spillway Calculations

Level 1, 54 Union St
Cooks Hill NSW 2300
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PROJECT NAME:	Lochinvar Subdivision	PROJECT NUMBER:	NSW211201	DISCIPLINE:	CIV
CLIENT:	McCloy Project Developments	AUTHOR:	BJG	DATE:	3/05/2022
DESCRIPTION:	Weir Spillway Check	CHECKER:	GPC	ITEM:	1

MC2 - Spillway Check - 1% AEP Event - Staged Outlet 100% Blocked

WEIR FLOW

Trapezoidal Weir Equation = Qweir = $CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent =	1.67	Total Weir Flow =	19.484	m^3/s
C_s = Weir Coefficent Side Slope =	1.67	Total Weir Velocity =	1.025	m/s
L = Crest Length =	28	TOTAL 1% AEP Event flow = 19.406		
h = Height over Wier =	0.5			
S = Side Slope 1 in	10			

MC3 - Spillway Check - 1% AEP Event - Staged Outlet 100% Blocked

WEIR FLOW

Trapezoidal Weir Equation = Qweir = $CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent =	1.67	Total Weir Flow =	4.133	m^3/s
C_s = Weir Coefficent Side Slope =	1.67	Total Weir Velocity =	0.689	m/s
L = Crest Length =	2	TOTAL 1% AEP Event flow = 3.752		
h = Height over Wier =	0.5			
S = Side Slope 1 in	10			

MC4 - Spillway Check - 1% AEP Event - Staged Outlet 100% Blocked

WEIR FLOW

Trapezoidal Weir Equation = Qweir = $CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent =	1.67	Total Weir Flow =	5.314	m^3/s
C_s = Weir Coefficent Side Slope =	1.67	Total Weir Velocity =	0.759	m/s
L = Crest Length =	4	TOTAL 1% AEP Event flow = 5.134		
h = Height over Wier =	0.5			
S = Side Slope 1 in	10			

MC5 - Spillway Check - 1% AEP Event - Staged Outlet 100% Blocked

WEIR FLOW

Trapezoidal Weir Equation = Qweir = $CLh^{1.5} + C_sSh^{2.5}$

C = Weir Coefficent =	1.67	Total Weir Flow =	10.628	m^3/s
C_s = Weir Coefficent Side Slope =	1.67	Total Weir Velocity =	0.924	m/s
L = Crest Length =	13	TOTAL 1% AEP Event flow = 10.150		
h = Height over Wier =	0.5			
S = Side Slope 1 in	10			

Appendix C HumeGard Technical Manual

Humes

Strength. Performance. Passion.

HumeGard® GPT
Technical manual

Issue 5

Contents

HumeGard® GPT

The HumeGard® system is a Gross Pollutant Trap (GPT) that is specifically designed to remove gross pollutants and coarse sediments ≥ 150 microns, from stormwater runoff. A wide range of models are available to provide solutions for normal and super-critical flow conditions.

The HumeGard® GPT incorporates a unique floating boom and bypass chamber to enable the continued capture of floating material, even during peak flows. The configuration also prevents re-suspension and release of trapped materials during subsequent storm events.

The HumeGard® GPT is designed for residential and commercial developments where litter and sediment are the target pollutants. It is particularly useful in retrofit applications or drainage systems on flat grades where low head loss requirements are critical, and in high backwater situations.

The value of the HumeGard® GPT has proven it to be one of the most successful treatment devices in Australia today:

- **The system provides high performance with negligible head loss**
  The HumeGard® GPT has a head loss 'k' factor of 0.2, important for retrofit and surcharging systems.
- **It captures and stores a large volume of pollutants**
  For pollutant export rates reported by Australia Runoff Quality (1 m^3/hectare/year), the HumeGard® GPT is sized for maintenance intervals up to annual durations.
- **It uses independently proven technology**
  The system was developed and tested by Swinburne University of Technology, Australia, in 1998, to demonstrate compliance with operational criteria from the Victorian EPA. The ability of the HumeGard® to capture and retain Total Suspended Solids (TSS), Total Phosphorous (TP), and Total Nitrogen (TN), was tested in 2015 by Sunshine Coast University.
- **It has low operational velocities**
  Flow velocity in the storage chamber is <0.2 m/s to ensure the comb self-cleans and improves settling of coarse sediment.
- **It retains floating material even in bypass**
  All GPTs bypass at high flows. The floating boom will capture and retain floating materials even when bypass occurs.
- **It provides cost effective treatment for litter and coarse sediments**
  The system's large capacity and long maintenance intervals reduces the overall lifecycle costs in comparison with other treatment measures.
- **It can reduce the footprint of the stormwater treatment train**
  Installation of a HumeGard® GPT prior to vegetated treatment measures can assist in reducing their overall footprint.
- **It maximises above ground land use**
  The HumeGard® GPT is a fully trafficable solution, so it can be installed under pavements and hardstands to maximise land use on constrained sites. Further, customised HumeGard® models can be designed to accommodate almost any design loads.
- **It is easy to maintain**
  Cleanout of the HumeGard® GPT can be performed safely and effectively from the surface using a vacuum truck. A full maintenance procedure is provided as a separate document.
- **It is made from quality componentry**
  All internal metal components are made from 304 stainless steel or fibreglass, and the system undergoes rigorous quality control prior to dispatch. The standard HumeGard® has a design life of 50 years.

System operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow.

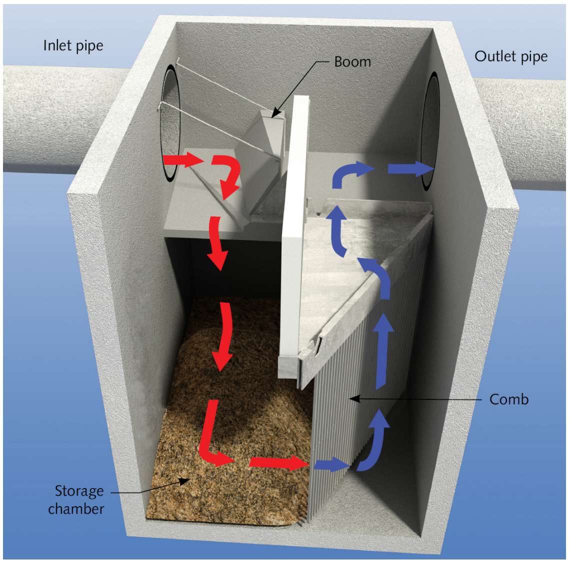
Bypass chamber

1. Stormwater flows into the inlet (boom) area of the bypass chamber (refer to Figure 1).
2. During flows up to and including the design treatment flowrate, the angled boom, acting as a weir, directs the total flow into the storage/treatment chamber.
3. The treatment flow rate will be exceeded once the depth of flow entering the HumeGard® has reached 50% of the height of the boom. Even during these higher flow conditions, the angled boom continues to direct all floating litter from the bypass chamber into the storage/treatment chamber. The inlet area of the bypass chamber floor is angled towards the treatment chamber to ensure the bed load sediment material continues to be directed into the storage chamber even when the boom is floating.
4. At peak design flows, the boom remains semi-submerged and enables excess flow to pass underneath, regulating the flow into the storage/treatment chamber. This ensures that higher flows, which could otherwise scour and re-suspend previously trapped materials, are not forced into the storage/treatment chamber. The floating boom bypass ensures previously trapped floating materials are retained. Each HumeGard® GPT is designed to achieve an operating velocity below 0.2 m/s through the storage chamber to ensure the settling of coarse sediment and keep the comb clean.

Treatment chamber

1. Once diverted into the treatment chamber, the flow continues underneath the internal baffle wall, passes through the stainless steel comb and flows over the flow controlling weir to the outlet.
2. Pollutants with a specific gravity less than water (S.G.<1) remain floating on the water surface in the storage/treatment chamber. Sediment and other materials heavier than water (S.G.>1) settle to the bottom of the chamber. The design and depth of the chamber minimises turbulent eddy currents and prevents re-suspension of settled material. The comb prevents any neutrally buoyant litter in the treatment chamber from escaping under the baffle wall.

Figure 1 – Operation during design flow conditions



Independent verification testing

Laboratory and field testing of the HumeGard® GPT for hydraulic performance and litter capture was conducted in Australia by Swinburne University of Technology, during 1996 and 1998.

Laboratory and field testing (Waste Management Council of Victoria 1998, Trinh 2007, Woods 2005, Swinburne University of Technology 2000) has proven the performance outlined in Table 1 below.

Further field testing was conducted by the University of the Sunshine Coast from 2013 to 2015, including a minimum of 15 qualifying storm events, to determine TSS, TP and TN removal efficiencies, which are also outlined in Table 1 below.

Table 1 – HumeGard® GPT performance summary

Pollutant	Removal efficiency	Details
Gross pollutants (litter, vegetation)	90%	Annually
TSS	49%	Annually (including bypass)
Hydrocarbons	90%	In an emergency spill event
TP	40%	Particulate-bound
TN	26%	Particulate-bound

Notes:

1. Nutrient removal is influenced by individual catchment characteristics and partitioning between dissolved and particulate nitrogen.
2. For further details on performance testing contact Humes.
3. Gross pollutant traps are not specifically designed to capture hydrocarbons, though may do so during emergency spill events. When this occurs, maintenance is required immediately.
4. The unique design of the HumeGard® floating boom allows it to be modified to treat higher flows and capture more gross pollutants and sediment on request.

System options

A wide range of sizes are available to suit catchment pollutant generation rates and Water Quality Objectives (WQO). Table 2 below presents the standard model dimensions and total storage chamber volume. We recommend that designers contact Humes Water Solutions for detailed sizing on each project and for advice with larger units.

Pollutant export rates detailed in Australian Runoff Quality (Engineers Australia 2006) suggests that a typical urban catchment will produce 1 m^3/hectare/year of gross pollutants and sediment. Humes Water Solutions advises that this be taken into account when selecting an appropriate model.

Table 2 – HumeGard® model range and dimensions

HumeGard® model	Treatment flow rate (L/s)	Storage chamber volume (m^3)	Pipe DN @ max. pipe grade %		
			0 - 1%	> 1 - 2.5%	> 2.5% - 5%
HG12	85	3	375	300	300
HG12A	100	3	450	375	375
HG15	130	3	525	450	450
HG15A	150	3	600	525	525
HG18	600	3	675	600	600
HG24	1,050	8	750	675	675
HG27	1,110	7	900	825	675
HG30	1,330	12	1050	900	825
HG30A	1,160	11	900	900	825
HG35	1,540	12	1050	1,050	900
HG35A	1,370	11	1050	900	900
HG40	1,910	16	1,200	1,200	900
HG40A	1,750	14	1,200	1,050	1,050
HG40B	1,580	12	1,200	1,050	900
HG45	1,960	19	1,500	1,350	1,200
HG45A	1,780	19	1,350	1,350	1,200
HG50 and above	Custom				

Notes:

1. The unique design of the HumeGard® floating boom allows it to be modified to treat a wide range of flowrates. Contact Humes for details on the model to suit your project.
2. HumeGard® can be modified to suit a box culvert, larger pipe or skewed outlet. Please contact your Humes Water Solutions Manager.
3. HumeGard® should be sized for either pipe diameter or treatment flow rate.
4. Units listed are standard configurations. Custom units can be provided to meet specific project requirements.
5. For confirmation of HumeGard® sizing or to discuss project specific requirements please contact your Humes Water Solutions Manager.
6. Refer to current Humes Terms and Conditions of Sale.
7. Australian Rainfall Quality recommend a pollutant export rate for a typical residential catchment is up to 1m^3/ha/yr of mixed waste and sediment.
8. HumeGard® can be modified to suit typical tail-water effects from downstream areas such as basins. Please contact Humes for design advice.
9. HumeGard® can be modified to suit high groundwater conditions. Please contact Humes for design advice.

Variants

A number of additional innovations have been made to the HumeGard® GPT to facilitate their effective operation in a wider range of applications:

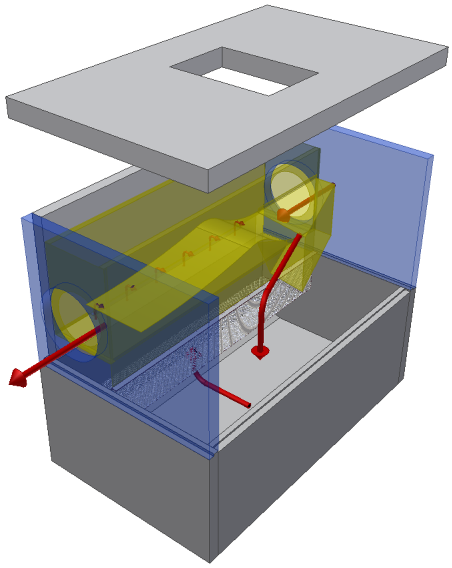
- Super-critical HumeGard® GPT – designed to operate under supercritical flow conditions in steep, high velocity drainage networks.
- Angled HumeGard® GPT – designed to replace a 45° or 90° junction in a drainage network.
- Dual outlet HumeGard® GPT – designed to divert the treatment flow to downstream natural Water Sensitive Urban Design (WSUD) elements such as wetlands and bio-retention whilst bypassing excess flows through a second outlet.

- **Super-critical HumeGard® GPT**

  The super-critical HumeGard® GPT (refer to Figure 2) was borne out of the original HumeGard® GPT, with modifications to deliver even greater performance under super-critical flow conditions. This model replaces the floating boom with a broad-crested weir that diverts the treatment flows into the treatment chamber under super-critical flow (Fr>1) conditions without creating hydraulic jumps and adversely impacting on performance.

  Flow into the treatment chamber passes through a stainless steel screen at a velocity <0.2 m/s and exits the device via a slot beneath the broad-crested weir (refer to the red arrows in Figure 2). The inserts in these models are manufactured from fibreglass for increased durability. The stainless steel screen can be shaped with a curved profile upon request. When the treatment flow rate is exceeded, the excess flow bypasses over the broad-crested weir to the outlet. This maintains the treatment flow into the chamber but protects against scour of captured material.

Figure 2 – Super-critical HumeGard® GPT



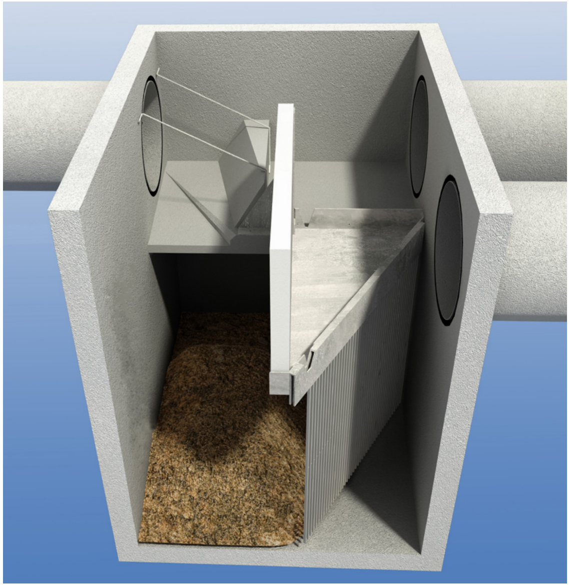
- **Angled HumeGard® GPT**
  The angled HumeGard® GPT (refer to Figure 3), was developed to facilitate the replacement of junction pits while still providing the treatment capabilities of the original HumeGard® device. These units simply alter the outlet location to allow for a change of pipe direction of 45° or 90°. The Angled HumeGard® GPT can be supplied in any of the standard unit sizes, however, the designer must allow for a minor head loss factor 'k' of 1.3 instead of 0.2 (which applies to the standard HumeGard® GPT design).

- **Dual Outlet HumeGard® GPT**
  The Dual Outlet HumeGard® GPT has been designed to operate as a diversion structure upstream of natural WSUD options such as constructed wetlands, ponds, lakes, and bio-retention systems.

  The units are designed such that one outlet conveys the treated flow into the natural WSUD measure and the standard outlet bypasses the excess flow around the downstream system (refer to Figure 4). Dual Outlet HumeGard® units are available in the same sizes as the standard HumeGard® units (refer Table 2 on page 4).

Figure 3 – Angled HumeGard® GPT

Figure 4 – Dual Outlet HumeGard® GPT



Inundation/tidal applications

The boom of the HumeGard® GPT enables the capture of floating pollutants even at peak flows, often when other fixed weir devices are in bypass mode. This unique feature also makes the HumeGard® GPT ideal for applications that are subject to both tidal and tail water effects.

In tidal applications the floating boom effectively traps the floating pollutants and prevents the loss of the gross pollutants from the system. In fixed weir devices, previously trapped floating litter may be backwashed out of the GPTs during the rising phase, to later bypass the GPT during the falling phase of the tide. As this happens twice daily, spring tides could quickly empty devices relying upon a fixed weir.

Marine grade 316 stainless steel is used for all internals in devices installed in tidal applications. In acidic/aggressive environments, these may also be epoxy-coated. Contact Humes Water Solutions for specific designs to suit these applications.

A plinth can also be added to the false floor under the boom to ensure sediment loads are captured and retained during inundation.

Design information

To design a system suitable for your project it is necessary to review the configuration of the stormwater system, the location and purpose of other stormwater management (WSUD) controls, the catchment area and the hydrology.

Configuration of the stormwater system

The configuration of the stormwater system is important since the HumeGard® GPT operates with an "in-line", 45° or 90° alignment. Inlet pipe grades between 0.5% and 5% are recommended for at least five pipe diameters upstream of the HumeGard® GPT. The pipe grade and flow velocity will determine whether a super-critical unit is required.

Location in the stormwater system

Depending upon the site, the GPT can be oriented to have the treatment chamber on the left or right side of the pipe to suit constraints. Humes Water Solutions can work closely with stormwater designers to select the appropriate location and orientation for their system.

Catchment area

Research presented in Australian Runoff Quality (Engineers Australia 2006) concluded that roughly 1 m^3/hectare/year of gross pollutants and sediment could be expected from a typical residential catchment. Therefore, GPTs designed for an annual maintenance interval should have a pollutant storage capacity roughly equal to the number of hectares of catchment it treats (e.g. 10 hectare catchment = 10 m^3 pollutant storage).

Sizing HumeGard® GPTs

The large storage volumes of the HumeGard® GPT enables more pollutants to be captured before maintenance is required, which greatly reduces its lifecycle costs. In accordance with accepted hydraulic principles the larger volumes in the HumeGard® GPT results in lower velocities through the device, minimising scour and re-suspension of sediment.

Humes Water Solutions has developed a design request form (see page 30) for stormwater designers to complete and return to obtain a detailed design of the appropriate device.

MUSIC/pollutant export model inputs

Many local authorities utilise MUSIC or other pollutant export models to assist in stormwater treatment train selection, and recommend generic inputs for GPTs. Considering these against the independent research results, the following conservative removal efficiencies (refer to Table 3 below) are recommended for the HumeGard® GPT on an annual basis (i.e. no bypass).

Table 3 – MUSIC inputs for HumeGard® GPTs

Pollutant	Removal efficiency
Gross pollutants (litter, vegetation)	90%
TSS	49%
TP	40%
TN	26%

System installation

Top:
Preparing the aggregate base (Step 2)

Middle:
Installing the main bypass chamber (Step 4)

Bottom:
Placing the main chamber lid (Step 7)

The installation of the HumeGard® unit should conform to the local authority's specifications for stormwater pit construction. Detailed installation instructions are dispatched with each unit.

The HumeGard® unit is installed as follows:

1. Prepare the excavation according to plans.
2. Prepare the compacted aggregate base.
3. Install the main treatment chamber section.
4. Install the main bypass chamber section/s (if required).
5. Fit the stainless steel comb (if required).
6. Connect the inlet and outlet pipes.
7. Place the main chamber lid.
8. Install the frame and access covers.
9. Backfill to specified requirements.

System maintenance

The design of the HumeGard® GPT means that maintenance is best performed by vacuum trucks which avoids entry into the unit.

Additional access covers can be designed upon request.

A typical maintenance procedure includes:

1. Remove access covers.
2. With a vacuum hose, remove the floating litter from the treatment chamber.
3. Determine the depth of water and sediment layers.
4. Insert sluice gate into the upstream manhole.
5. Decant water from the treatment chamber into the upstream manhole until the sediment layer is exposed.
6. Remove the sediment layer with the vacuum hose; jet with a high pressure hose if required.
7. Remove sluice gate from the upstream manhole and allow water to return to the HumeGard® GPT.
8. Replace access covers.

Left:
Floating litter captured in the treatment chamber

FAQs

- **Can the boom become stuck?**
  The boom can weight up to hundreds of kilograms depending on the model, with the smallest boom in the HG18 weighing in at 35 kg. Unless there is a large branch, car wheel, or other large item carried through the drainage network, the mass of the boom will ensure it returns to the floor.
- **Will the gross pollutants bypass when the boom floats?**
  All treatment measures are designed to treat a specific flow. Once this is exceeded, any entrained pollutants in the flow will bypass the treatment chamber. Often this is less than 5% of the annual load. A significant quantity of gross pollutants are buoyant when entering a GPT and, unlike fixed weir systems which bypass these floatable items, the HumeGard® boom provides continuous treatment of them, even in bypass.
- **Will the retention of water in the treatment chamber lead to the release of nutrients as pollutants break down?**
  Over time, captured organic materials will breakdown and release nutrients in all treatment measures whether natural or manufactured. As part of a treatment train, downstream vegetated measures can remove the small proportion of nutrients released during dry weather flows. A regular maintenance program will reduce the amount of breakdown occurring.
- **What is the design life of a HumeGard® GPT?**
  The entire product is designed to last a minimum of 50 years.
- **Why is the HumeGard® GPT larger than other GPTs?**
  The design of the HumeGard® GPT is to ensure a velocity through the treatment chamber <0.2 m/s to ensure the comb self-cleans and the coarse sediments settle in the sump. From engineering principles, a larger cross-sectional area is required to reduce the loading rate. As proven by Stokes Law, lower chamber velocities mean smaller sediment particles can be captured.
- **Why would I use a HumeGard® GPT upstream of a biofilter?**
  Using a HumeGard® GPT upstream of a biofilter acts as a sediment forebay and removes litter, containing it to a confined location for easy removal by a vacuum truck. This protects the biofilter, lengthens its lifespan and reduces the ongoing maintenance costs.

References

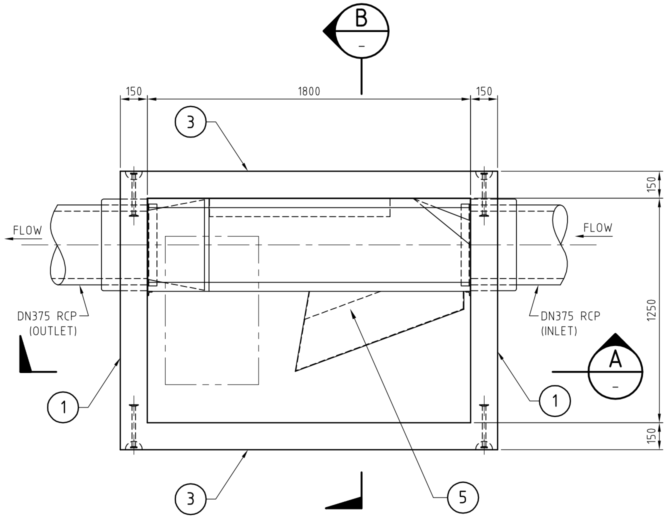
- Waste Management Council of Victoria (1998) “Inline Litter Separator: Installation and Monitoring Project”, EcoRecycle, Victoria.
- Trinh, N. An Investigation into the Trapping Efficiencies of Gross Pollutant Traps. Thesis. Brisbane, Queensland: Queensland University of Technology, 2007.
- Woods, S. Performance Evaluation of an In-Line Separator. Masters Thesis. Melbourne, Victoria: Swinburne University of Technology, 2005.
- Swinburne University of Technology (2000) “HumeGard® In-line Litter Separator Sediment Capture Testing”, School of Engineering and Science.
- Engineers Australia (2006) “Australian Runoff Quality”.
- Lucke, T. 2015, Characterisation of Water Quality Improvement Processes by GPTs at University of the Sunshine Coast (Humegard HG27 Monitoring Program), School of Science and Engineering, University of the Sunshine Coast, QLD, Australia.
- Nichols P., & Lucke T., 2016, Field Evaluation of the Nutrient Removal Performance of a Gross Pollutant Trap (GPT) in Australia, Sustainability, 8, 669; doi:10.3390/su8070669

Appendix

HumeGard® GPT technical drawings

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	——	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG12-20
2	BASE SLAB	HG12-21
3	SIDE WALL	HG12-22
4	PRECAST LID	HG12-07
5	GRP INSERT ASSEMBLY DETAILS	HG12A/L-08



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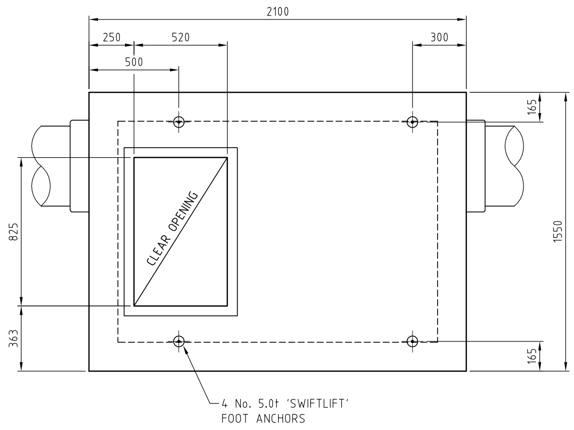
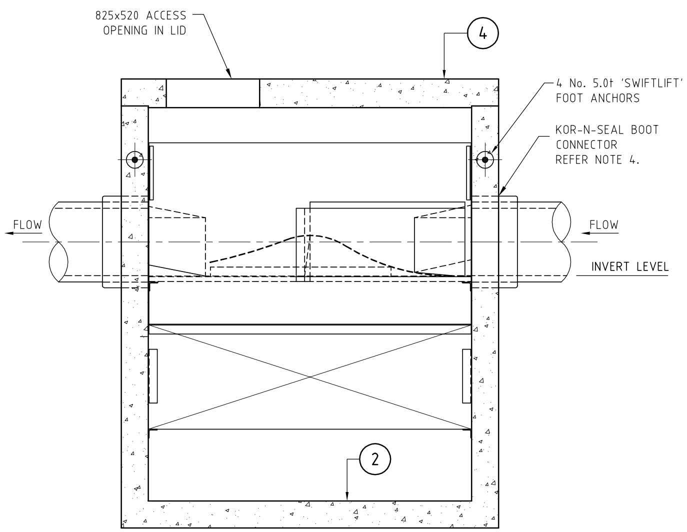
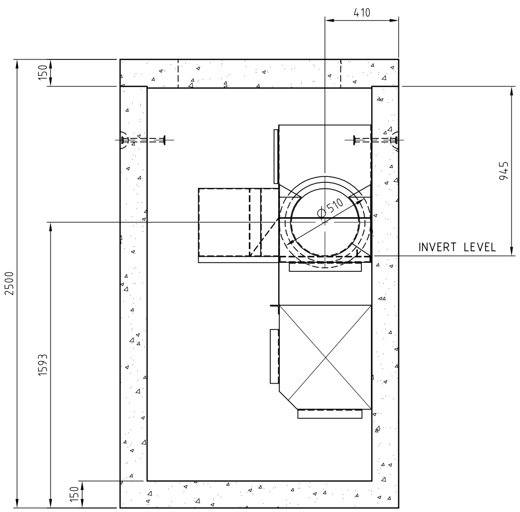
SCALE 1:20



PLAN ON LID
SCALE 1:20



SECTION A
SCALE 1:20



SECTION B
SCALE 1:20

NOTES

1. GRP INSERT MANUFACTURED FROM 5mm GRP.
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.0t (WITHOUT LID)
   LID = 1.2t
4. KOR-N-SEAL BOOT CONNECTOR P/N = S106-20WP
5. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

Holcim (Australia) Pty Ltd ABN 87 099 732 297

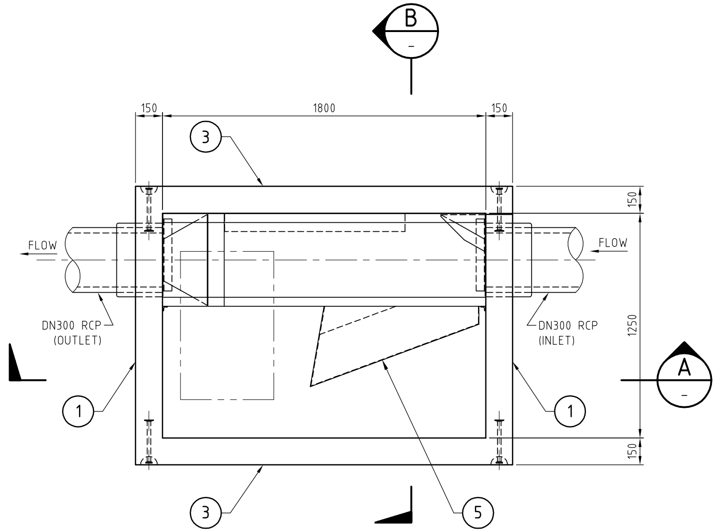
DSN.	WST	02-09-10
DWN.	MZ	02-09-10
CKD.	RM	——
APP.	WST	——
SUPERSEDES	HG12A/L-01 ISSUE 1	

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG12A/L
DN375/DN375 RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG12A/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	—	RM

ITEM No	DRAWING DESCRIPTIONS	DWG No
1	END WALL	HG12-20
2	BASE SLAB	HG12-21
3	SIDE WALL	HG12-22
4	PRECAST LID	HG12-07
5	GRP INSERT ASSEMBLY DETAILS	HG12/L-08



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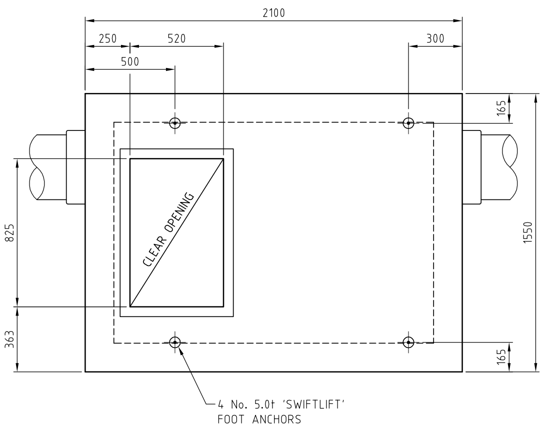
SCALE 1:20



PLAN ON LID
SCALE 1:20

NOTES

1. GRP INSERT MANUFACTURED FROM 5mm GRP.
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.0t (WITHOUT LID)
   LID = 1.2t
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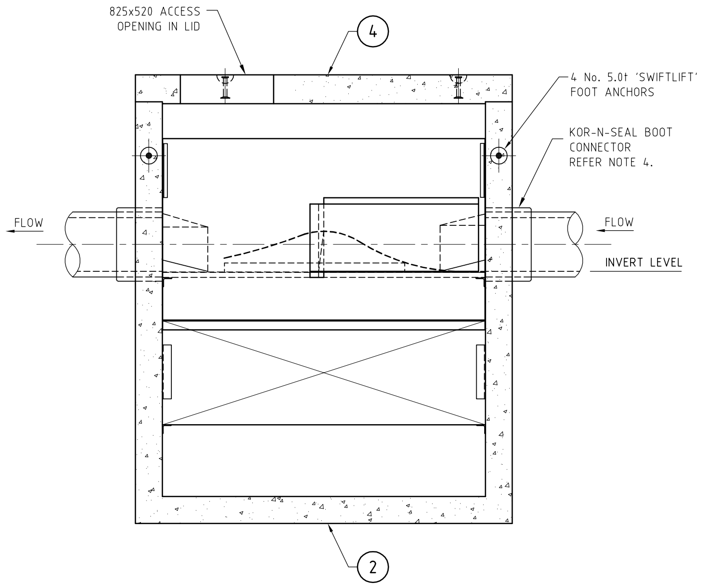
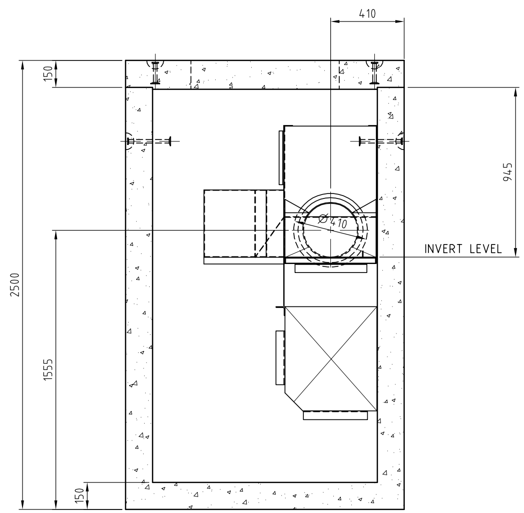
. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE



SECTION A
SCALE 1:20



SECTION B
SCALE 1:20

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

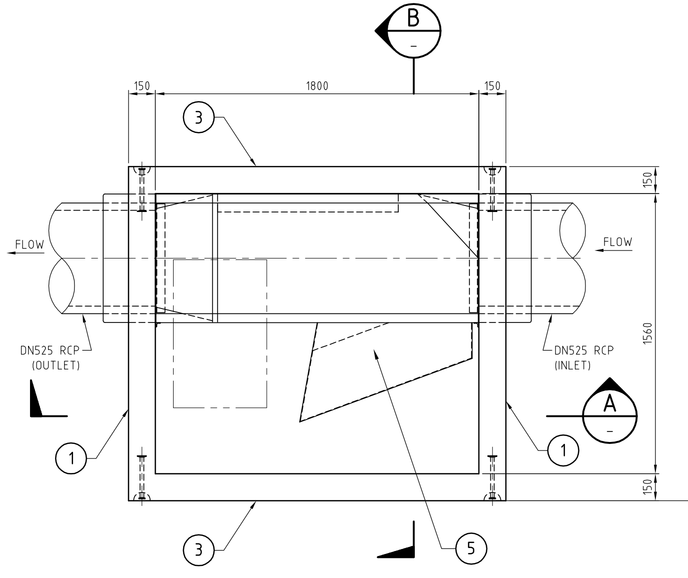
HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG12/L
DN300/DN300 RCP
GENERAL ASSEMBLY

DSN.	WST	14-03-07
DWN.	MZ	14-03-07
CKD.	RM	—
APP.	WST	—

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG12/L-01 REV 1	1:1	A2	HG12/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	——	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG15-20
2	BASE SLAB	HG15-21
3	SIDE WALL	HG15-22
4	PRECAST LID	HG15-07
5	GRP INSERT ASSEMBLY DETAILS	HG15A/L-08



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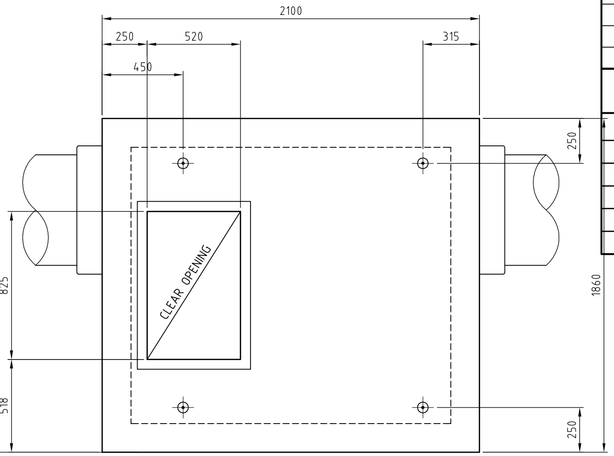
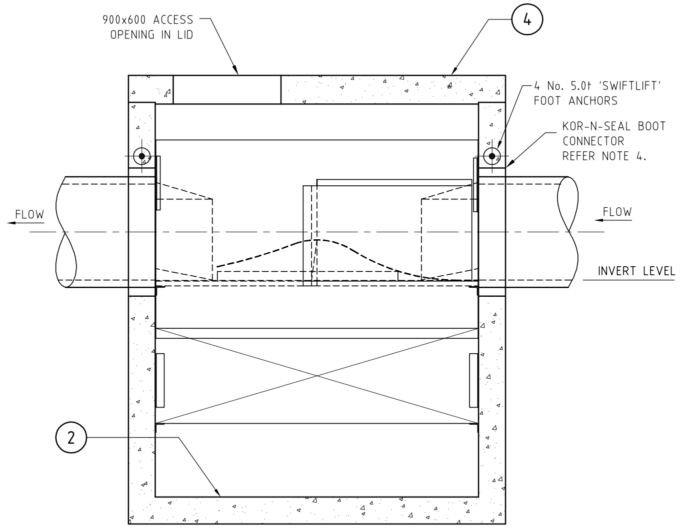
SCALE 1:20



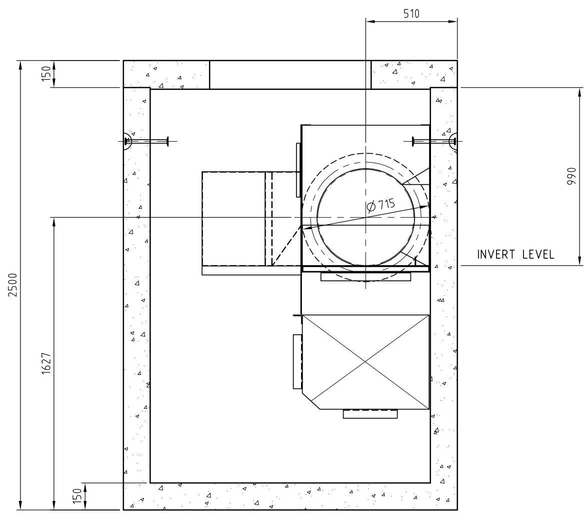
PLAN ON LID
SCALE 1:20

NOTES

1. GRP INSERT MANUFACTURED FROM 5mm .
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.7t (WITHOUT LID) LID = 1.4t
4. KOR-N-SEAL BOOT CONNECTOR P/N = S206-28
5. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE.



SECTION A
SCALE 1:20



SECTION B
SCALE 1:20

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

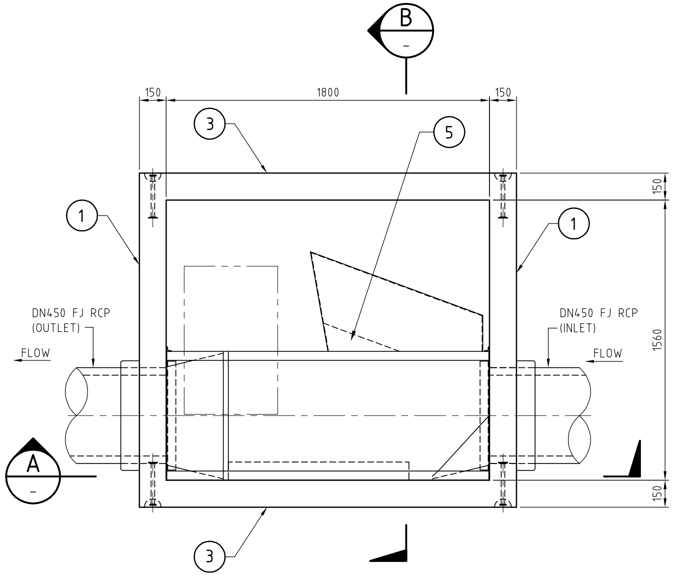
Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG15A/L
DN525/DN525 RCP
GENERAL ASSEMBLY

DSN.	WST	07-09-10
DWN.	MZ	07-09-10
CKD.	RM	
APP.	WST	

Holcim (Australia) Pty Ltd ABN 87 099 732 297

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG15A/L-01 ISSUE 1	1:1	A2	HG15A/L-01	2



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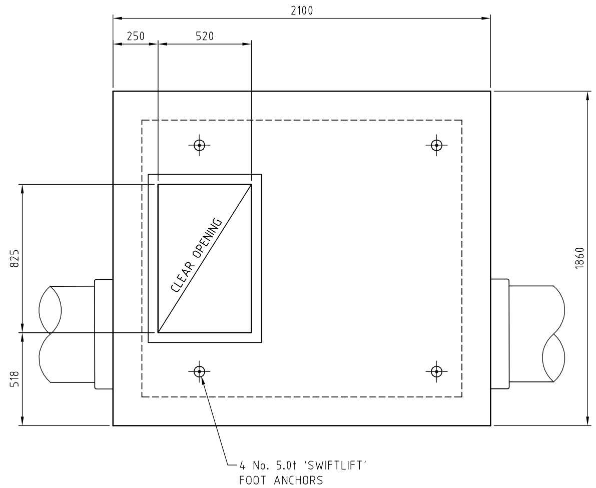
SCALE 1:20



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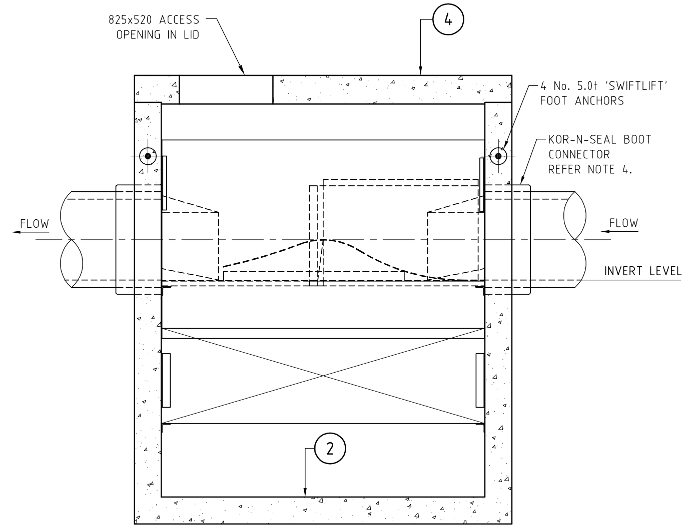
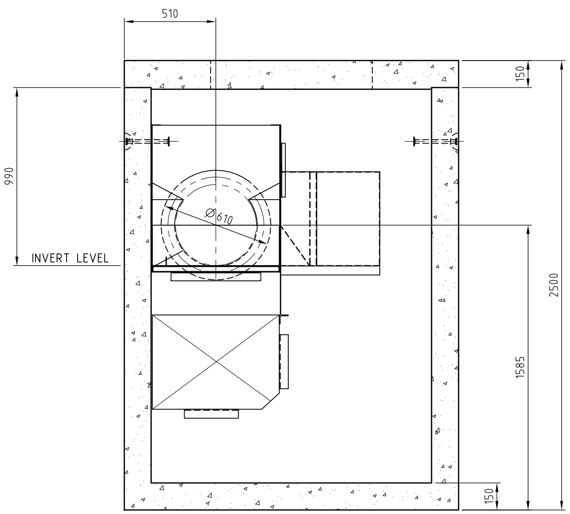


SECTION A
SCALE 1:20



SECTION B
SCALE 1:20

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	GENERAL REVISION	MZ	——	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG15-20
2	BASE SLAB	HG15-21
3	SIDE WALL	HG15-22
4	PRECAST LID	HG15-07
5	GRP INSERT ASSEMBLY DETAILS	HG15/R-08

NOTES

1. GRP INSERT MANUFACTURED FROM 5mm GRP.
2. ALL CONCRETE COMPONENTS TO BE HANDLED VIA CAST-IN SWIFTLIFT ANCHORS AT ALL TIMES.
3. UNIT MASS: CHAMBER (ASSEMBLED) = 7.7t (WITHOUT LID)
   LID = 1.5t
4. KOR-N-SEAL BOOT CONNECTOR P/N = S106-24WP
5. SEE DRAWING HG-CAST 2 FOR CASTING SEQUENCE

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH M1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	10-07-08
DWN.	MZ	10-07-08
CKD.	DFW	——
APP.	WST	——

SUPERSEDES HG15/R-01 REV 1

HUMES
STANDARD DRAWING
HUMEGARD HG15/R
DN450/DN450 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
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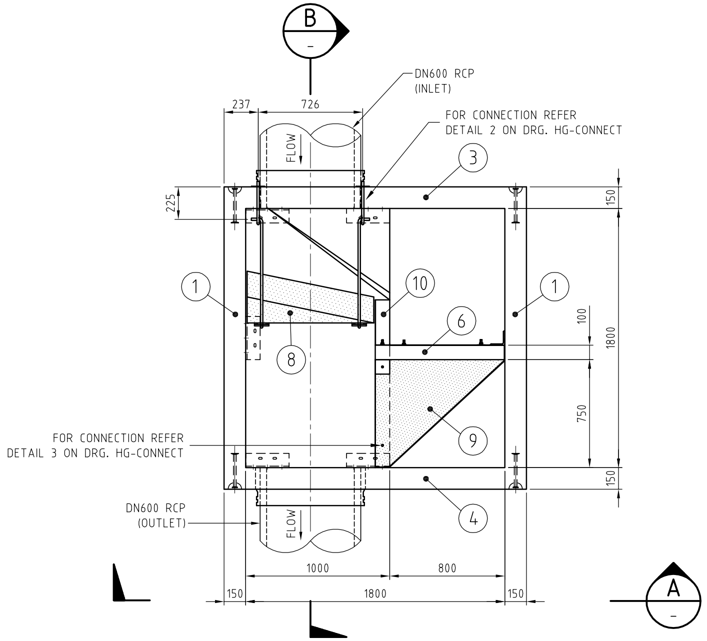

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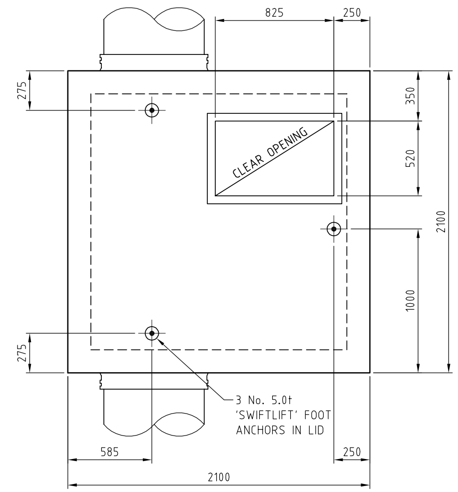
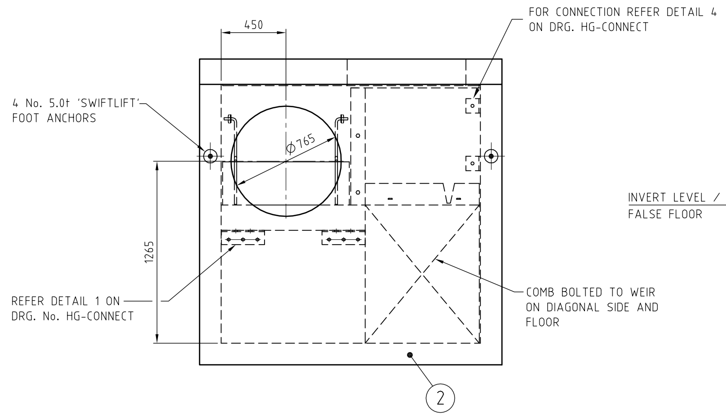
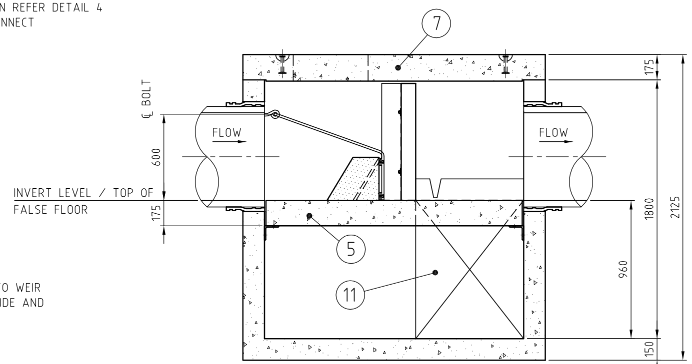
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
3	REFERENCE DWG No. REVISED - REISSUED FOR MANUFACTURE	MZ	24-11-10	RM

ITEM No	DRAWING DESCRIPTION	DWG No
1	END WALL	HG18-02
2	BASE SLAB	3 HG18-03
3, 4	SIDE WALL	HG18-04
5	FALSE FLOOR	HG18/L-05
6	CONCRETE BAFFLE WALL	HG18/L-05
7	PRECAST LID	HG18/L-06
8	FLOATING BOOM	HG18/L-07
9	WEIR	HG18/L-08
10	BAFFLE SIDE WALL	HG18/L-09
11	COMB	HG18/L-10

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 7.8 t (WITHOUT LID).
   MASS OF LID = 1.9 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-30L (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

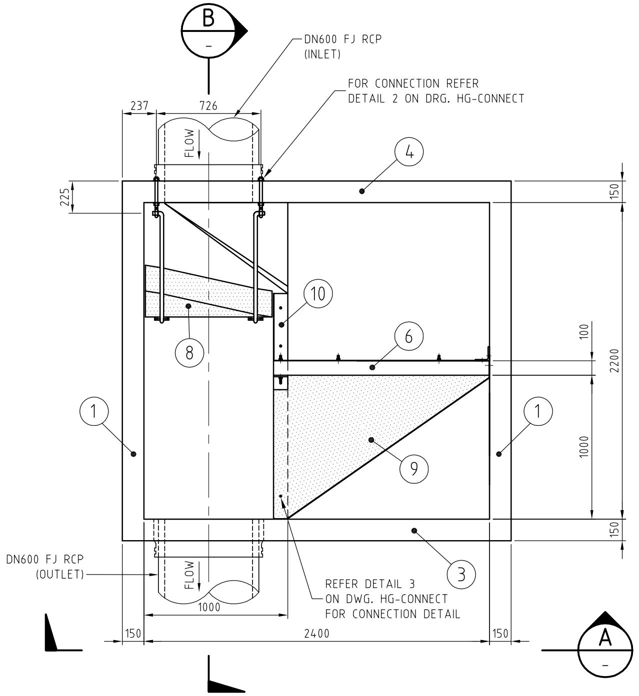
Holcim (Australia) Pty Ltd ABN 87 099 732 297

DSN.	WST	24-11-10
DWN.	MZ	24-11-10
CKD.	RM	24-11-10
APP.	WST	24-11-10

SUPERSEDES HG18/L-01 REV. 2

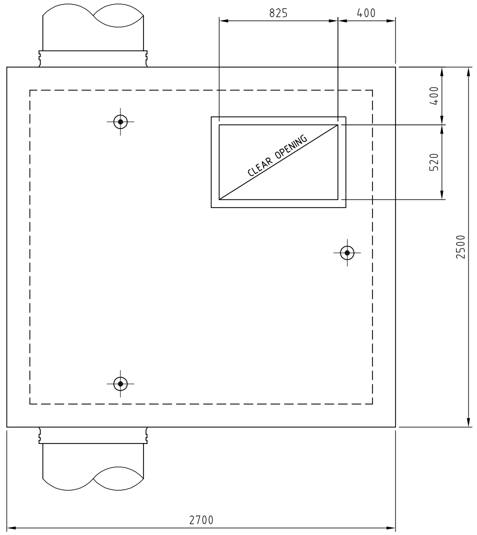
HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG18/L DN600/DN600 RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG18/L-01	3



PLAN VIEW (LID REMOVED)

SCALE 1:25



PLAN ON LID

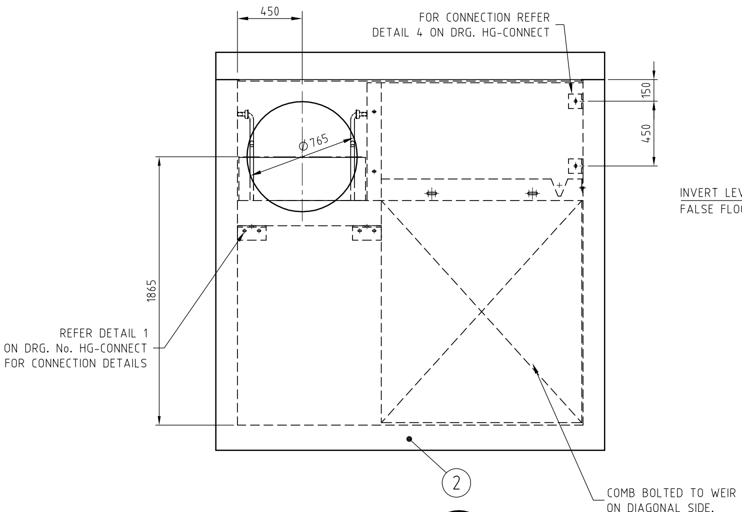
SCALE 1:25

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG24/L-02
2	BASE SLAB	HG24/L-03
3, 4	SIDE WALL	HG24/L-04
5	FALSE FLOOR	HG24/L-05
6	CONCRETE BAFFLE WALL	HG24/L-05
7	PRECAST LID	HG24/L-06
8	FLOATING BOOM	HG24/L-07
9	WEIR	HG24/L-08
10	BAFFLE SIDE WALL	HG24/L-09
11	COMB	HG24/L-10
	SITE LAYOUT	HG24/L-11

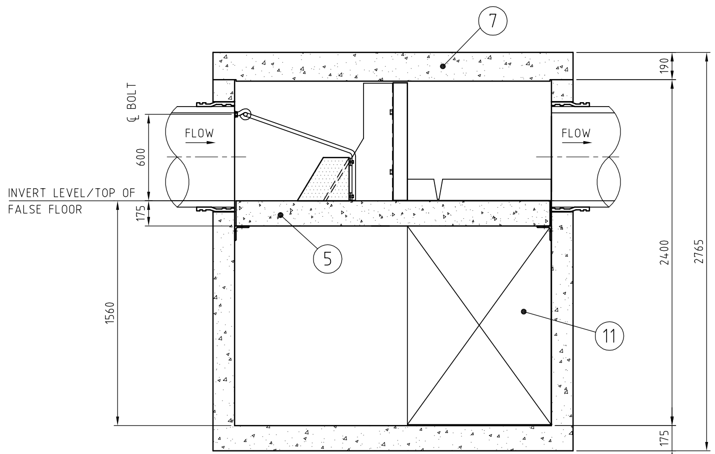
NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 13.0 t (WITHOUT LID).
   MASS OF LID = 3.2 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-30L (INLET & OUTLET)



VIEW A

SCALE 1:25



SECTION B

SCALE 1:25

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

Rinker Australia Pty Limited ABN 87 099 732 297

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

SUPERSEDES HG24/L-01 REV. 0

HUMES STANDARD DRAWING

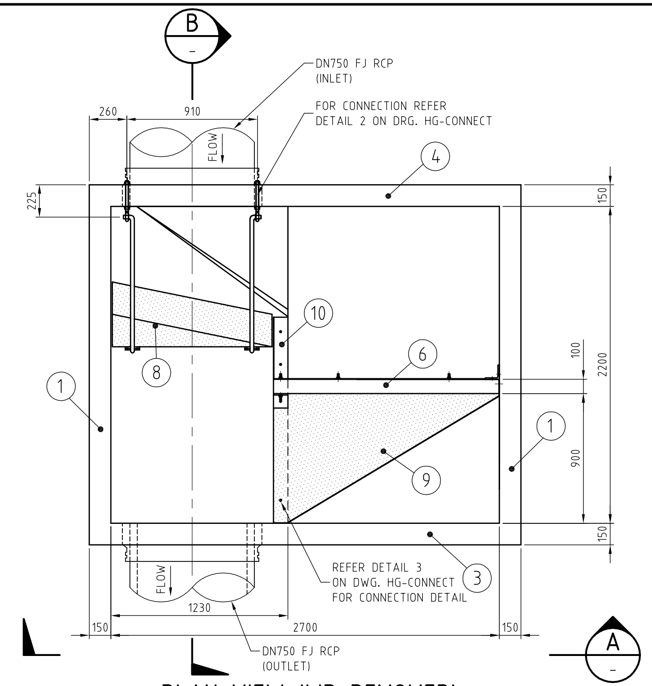
HUMEGARD HG24/L DN600/DN600 FJ RCP

GENERAL ASSEMBLY

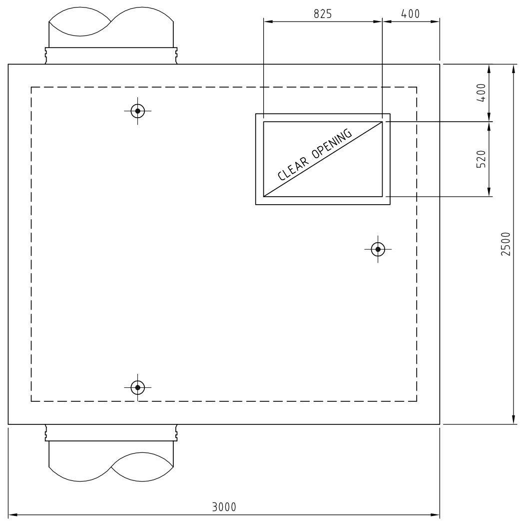
PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG24/L-01	1

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG27/L-02
2	BASE SLAB	HG27/L-03
3, 4	SIDE WALL	HG27/L-04
5	FALSE FLOOR	HG27/L-05
6	CONCRETE BAFFLE WALL	HG27/L-05
7	PRECAST LID	HG27/L-06
8	FLOATING BOOM	HG27/L-07
9	WEIR	HG27/L-08
10	BAFFLE SIDE WALL	HG27/L-09
11	COMB	HG27/L-10
	SITE LAYOUT	HG27/L-11



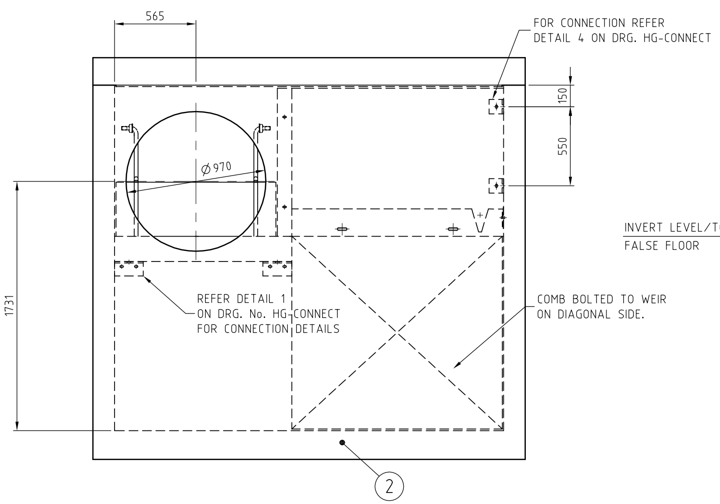
PLAN VIEW (LID REMOVED)
SCALE 1:25



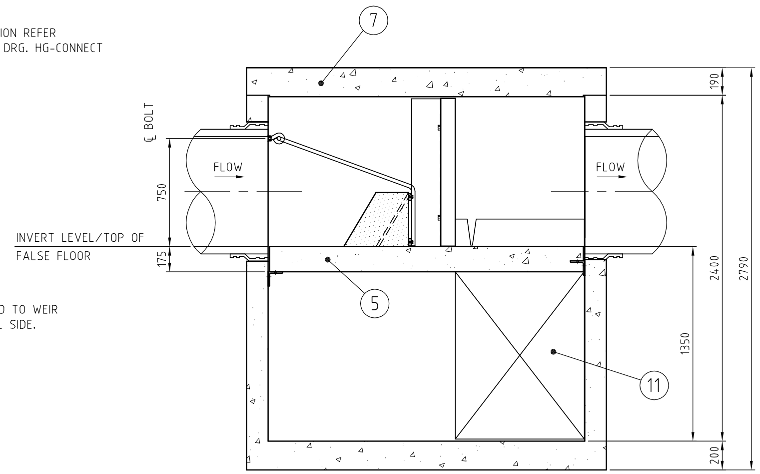
PLAN ON LID
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 14.4 t (WITHOUT LID).
   MASS OF LID = 3.6 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-38 (INLET & OUTLET)



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	SG	12-03-07

SUPERSEDES HG27/L-01 REV. 0

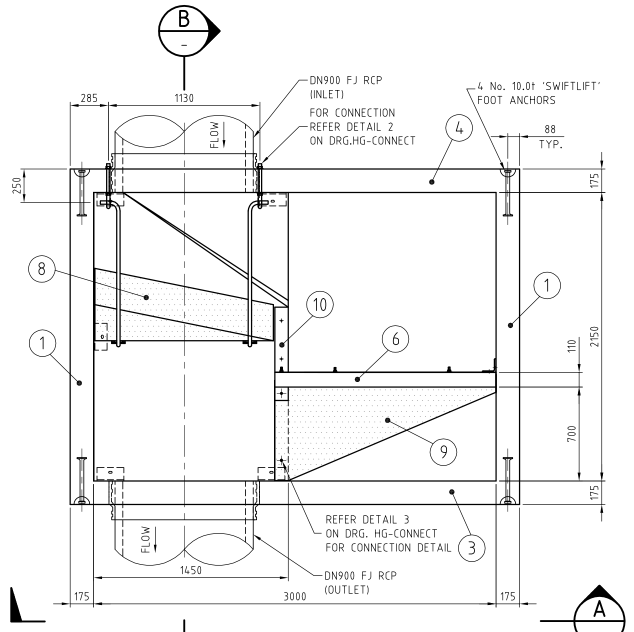
HUMES
STANDARD DRAWING
HUMEGARD HG27/L
DN750/DN750 FJ RCP
GENERAL ASSEMBLY

PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG27/L-01	2

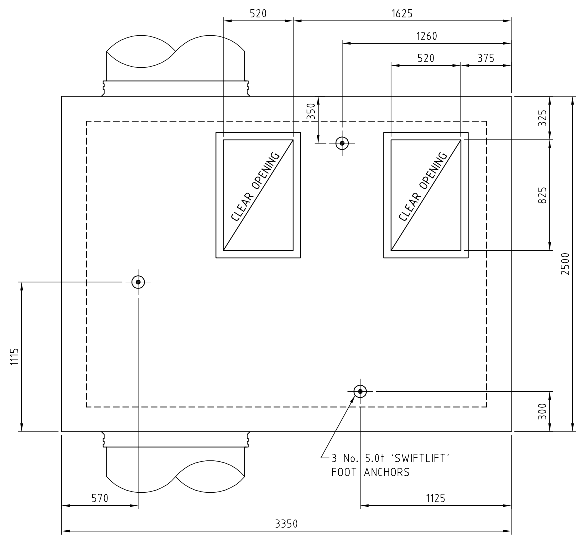
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	REFERENCE DWG No. REVISED, REISSUED FOR MANUFACTURE	MZ	—	RM

ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG30A-02
2	BASE SLAB	HG30-04
3, 4	SIDE WALL	HG30A-05
5	FALSE FLOOR	HG30A/L-07
6	CONCRETE BAFFLE WALL	HG30A/L-07
7	PRECAST LID	HG30A/L-08
8	FLOATING BOOM	HG30A/L-09
9	WEIR	HG30A/L-10
10	BAFFLE SIDE WALL	HG30A/L-11
11	COMB	HG30A/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST

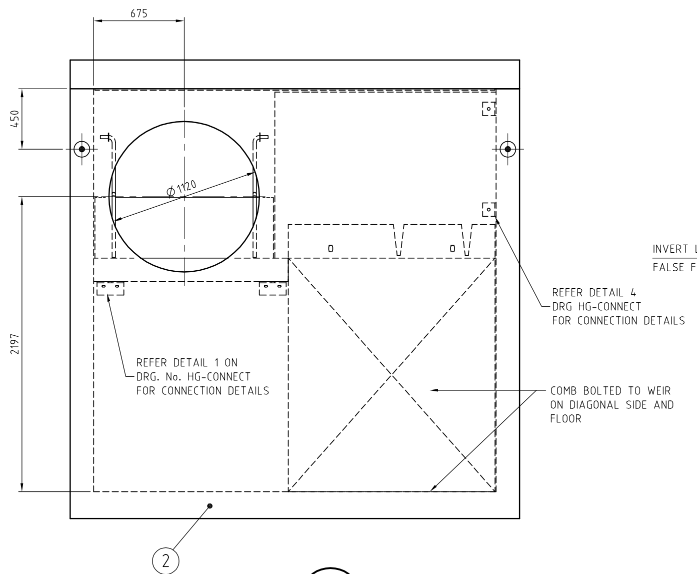
2



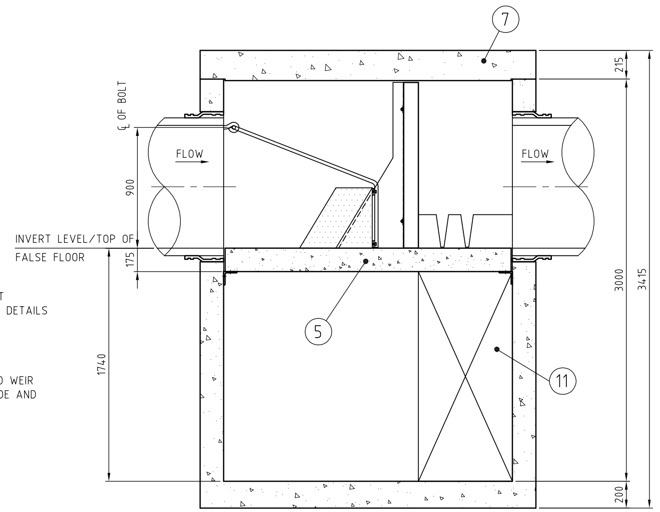
PLAN
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 20.2 t (WITHOUT LID).
   MASS OF LID = 4.3 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3)
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

Humes TECHNICAL (DESIGN) SERVICES BRISBANE, QUEENSLAND

CEMEX Australia Pty Limited ABN 87 099 732 297

DSN.	DFW	06-08-08
DWN.	MZ	06-08-08
CKD.	DFW	—
APP.	WST	—

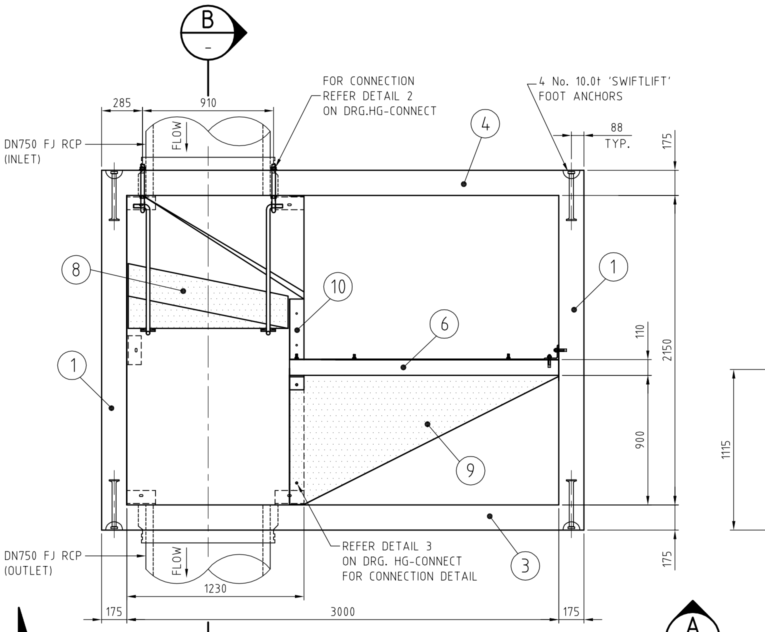
HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG30A/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG30A/L-01 REV 1	1:1	A2	HG30A/L-01	2

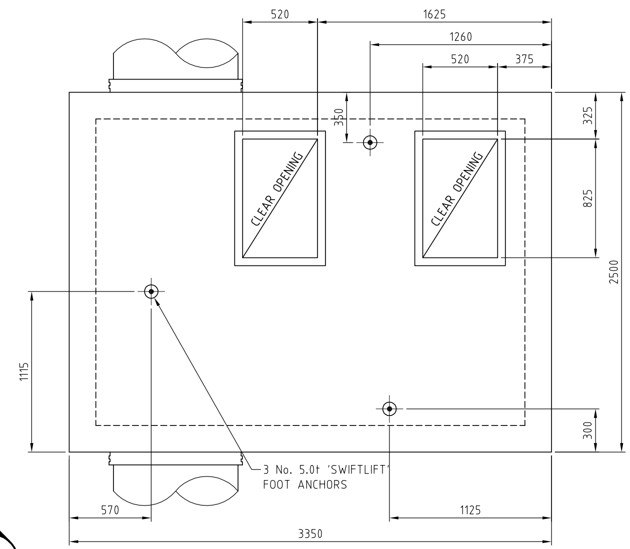
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
2	REFERENCE DWG No. REVISED, REISSUED FOR MANUFACTURE	MZ	—	RM

ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG30-02
2	BASE SLAB	HG30-04
3, 4	SIDE WALL	HG30-05
5	FALSE FLOOR	HG30/L-07
6	CONCRETE BAFFLE WALL	HG30/L-07
7	PRECAST LID	HG30-08
8	FLOATING BOOM	HG30/L-09
9	WEIR	HG30/L-10
10	BAFFLE SIDE WALL	HG30/L-11
11	COMB	HG30/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST

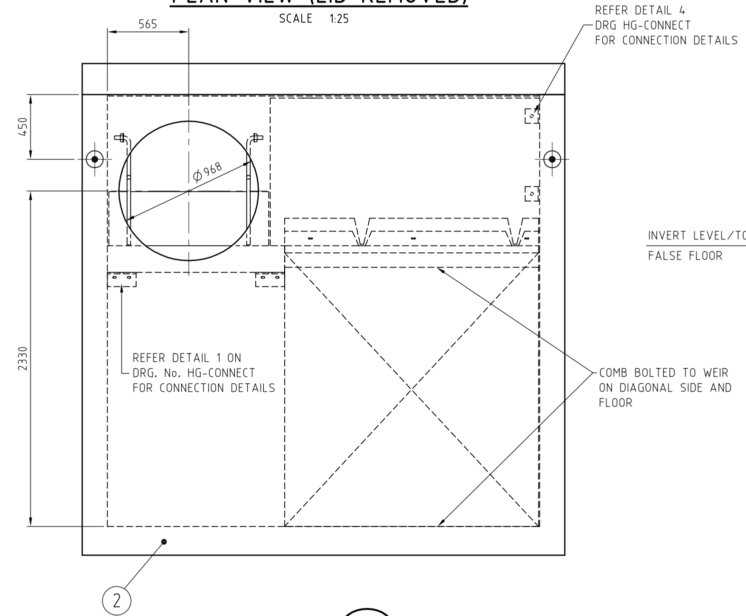
2



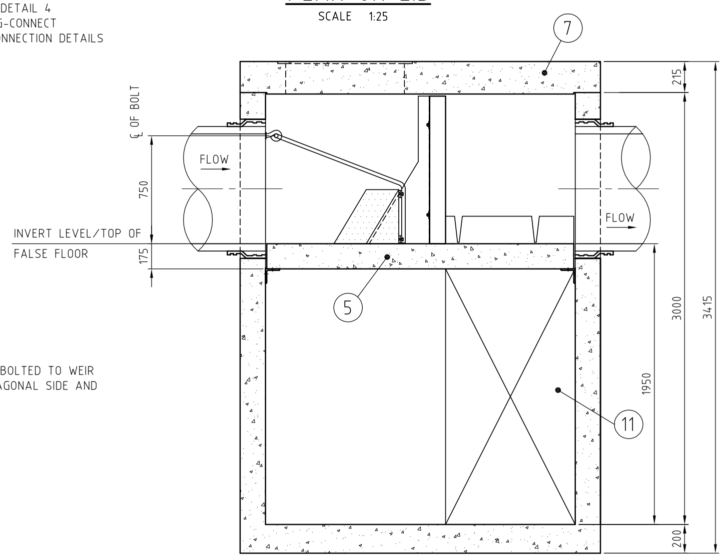
PLAN VIEW (LID REMOVED)
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES: 2

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 20.3 t (WITHOUT LID).
   MASS OF LID = 4.3 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3)
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-38 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

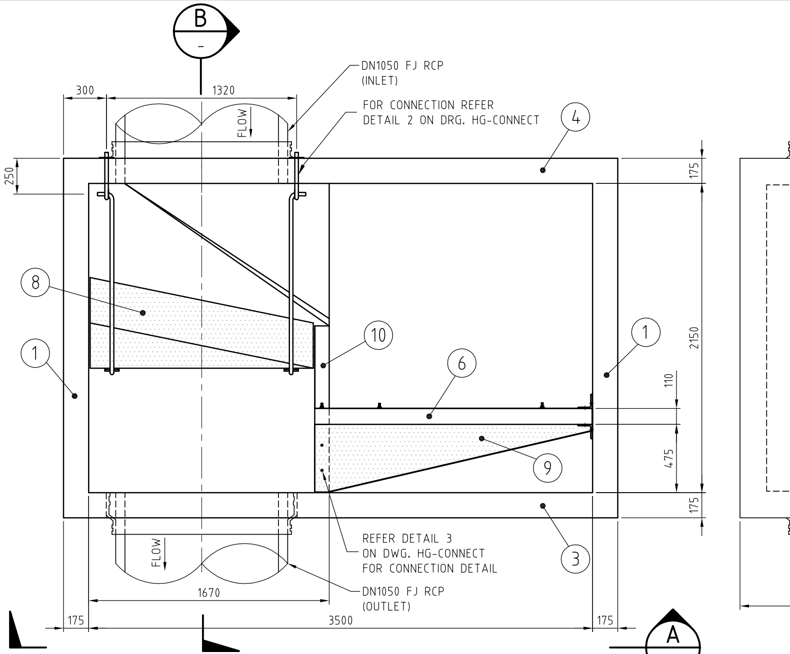
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG30/L
DN750/DN750 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG30/L-01 REV 1	1:1	A2	HG30/L-01	2

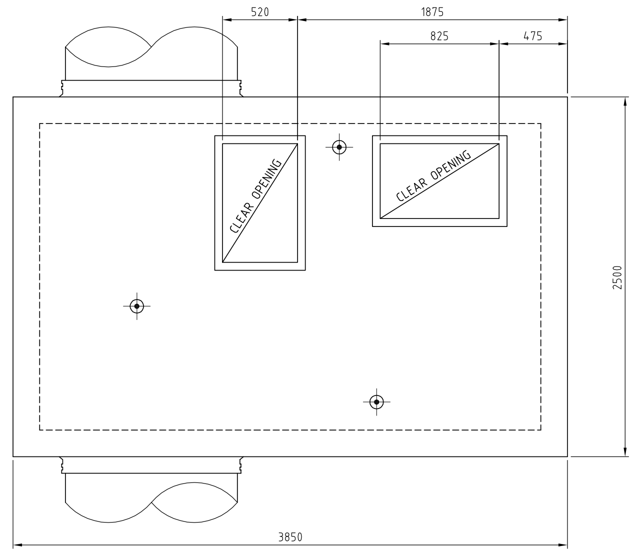
ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL	HG35A/L-02
2	BASE SLAB	HG35A/L-04
3, 4	SIDE WALL	HG35A/L-05
5	FALSE FLOOR	HG35A/L-07
6	CONCRETE BAFFLE WALL	HG35A/L-07
7	PRECAST LID	HG35A/L-08
8	FLOATING BOOM	HG35A/L-09
9	WEIR	HG35A/L-10
10	BAFFLE SIDE WALL	HG35A/L-11
11	COMB	HG35A/L-12
	SITE LAYOUT	HG35A/L-13



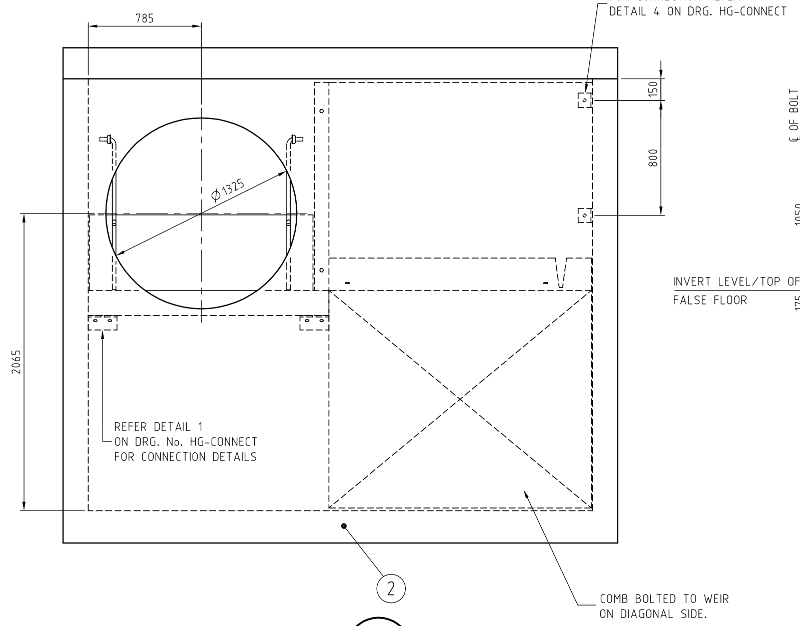
PLAN VIEW (LID REMOVED)

SCALE 1:25



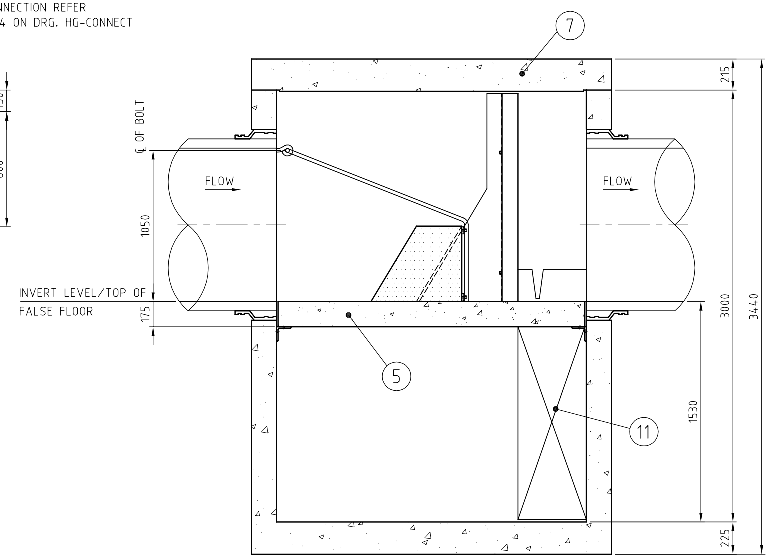
PLAN ON LID

SCALE 1:25



VIEW A

SCALE 1:25



SECTION B

SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 22.9 t (WITHOUT LID).
   MASS OF LID = 5.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-52 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

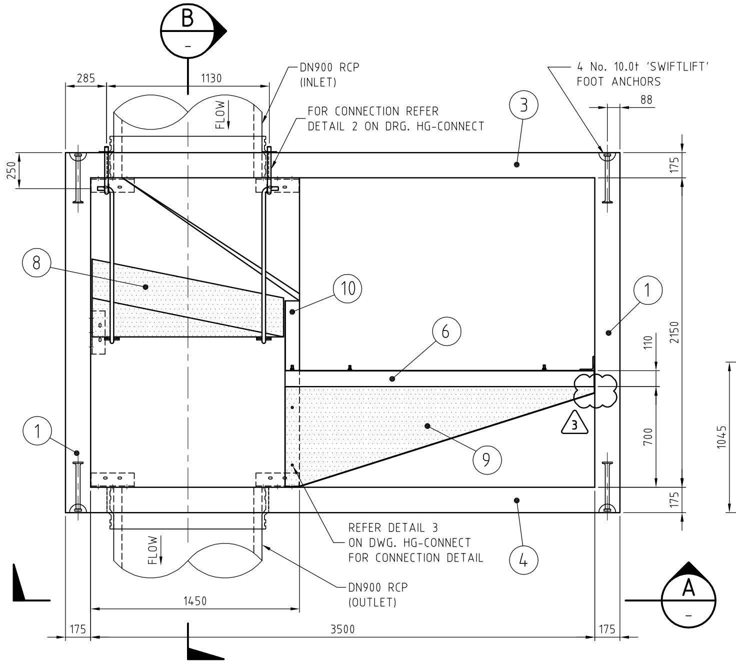
SUPERSEDES HG35A/L-01 REV 0

HUMES
STANDARD DRAWING
HUMEGARD HG35A/L
DN1050/DN1050 FJ RCP
GENERAL ASSEMBLY

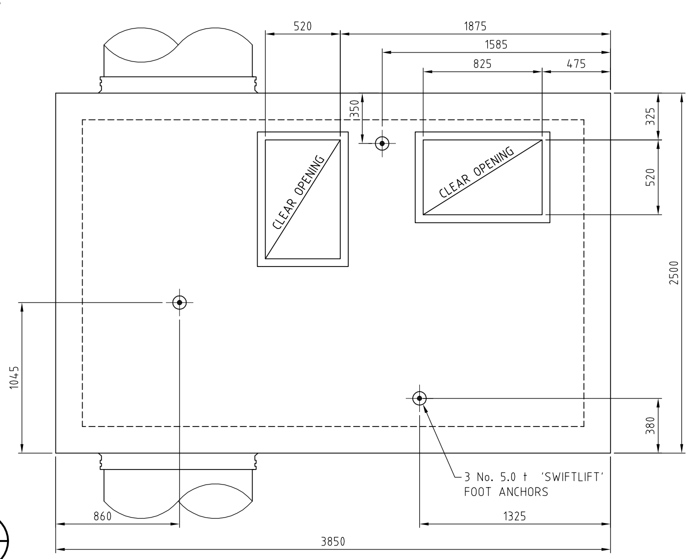
PLOT SCALE	SIZE	DRG. NO.	ISSUE
1:1	A2	HG35A/L-01	1

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
3	REFERENCE DWG No. REVISED, BRACKET REMOVED, REISSUED FOR MANUFACTURE	MZ	—	RM

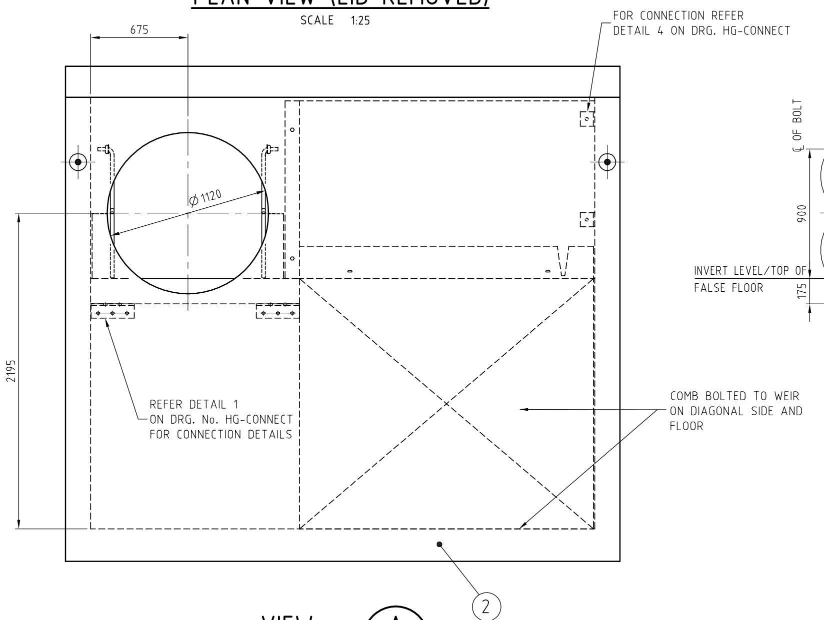
ITEM No.	DRAWING DESCRIPTION	DWG No.
1	END WALL	HG35-02
2	BASE SLAB	HG35-04
3, 4	SIDE WALL	HG35-05
5	FALSE FLOOR	HG35/L-07
6	CONCRETE BAFFLE WALL	HG35/L-07
7	PRECAST LID	HG35-08
8	FLOATING BOOM	HG35/L-09
9	WEIR	HG35/L-10
10	BAFFLE SIDE WALL	HG35/L-11
11	COMB	HG35/L-12
	CONNECTION DETAILS	HG-CONNECT
	CASTING SEQUENCE	HG-CAST



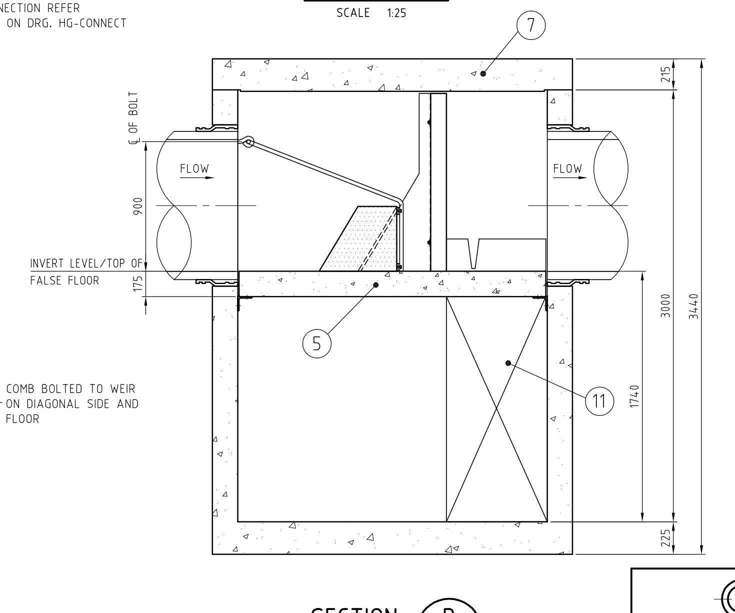
PLAN VIEW (LID REMOVED)
SCALE 1:25



PLAN ON LID
SCALE 1:25



VIEW A
SCALE 1:25



SECTION B
SCALE 1:25

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF COMPLETE UNIT = 22.8 t (WITHOUT LID).
   MASS OF LID = 5.0 t
   (SELF WEIGHT CONCRETE @ 2500 kg/m3
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

SITE LIFT:
LID - 3 No. 5 t SWIFTLIFT FOOT ANCHORS
HUMEGARD UNIT - 4 No. 10 t SWIFTLIFT FOOT ANCHORS

Humes TECHNICAL SERVICES
BRISBANE, QUEENSLAND

Holcim (Australia) Pty Ltd ABN 87 099 732 297

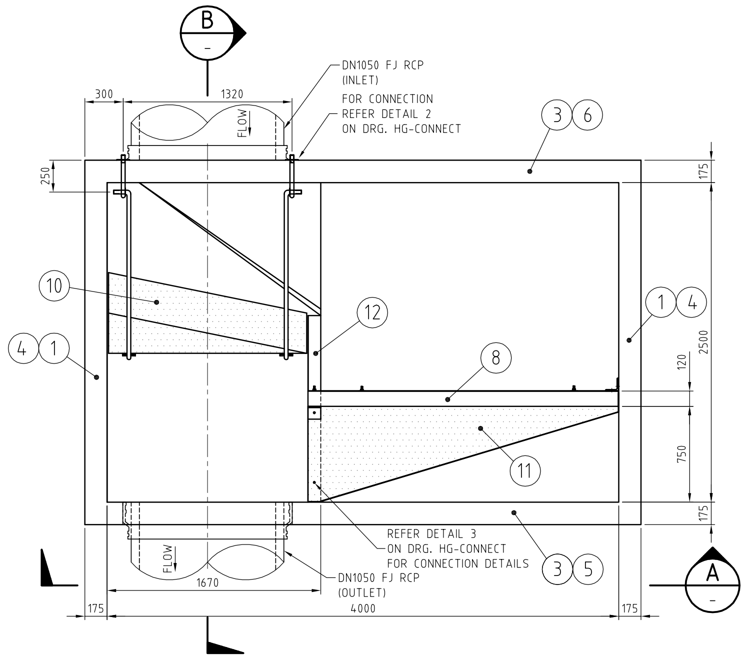
DSN.	WST	25-11-10
DWN.	MZ	25-11-10
CKD.	RM	—
APP.	WST	—

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG35/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

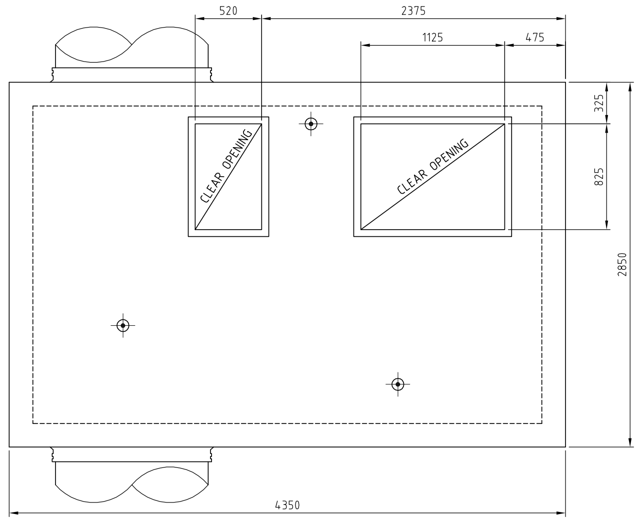
SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG35/L-01 REV 2	1:1	A2	HG35/L-01	3

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
0	ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
1	GENERAL REVISION	MZ	—	DFW

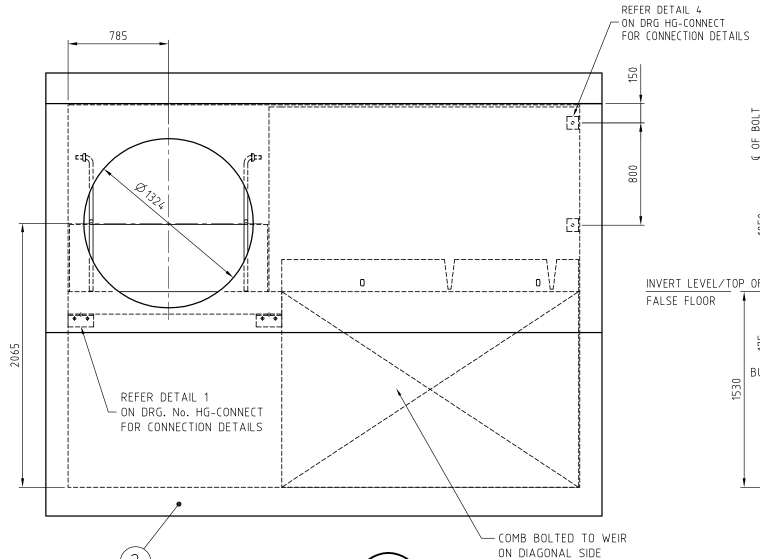
ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



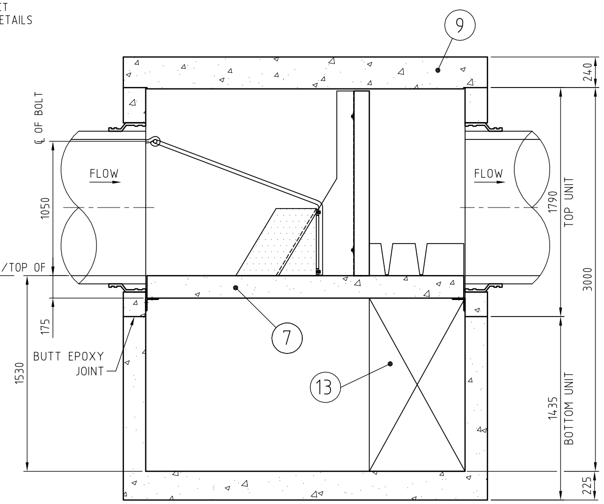
PLAN VIEW (LID REMOVED)
SCALE 1:20



PLAN ON LID
SCALE 1:20



VIEW A
SCALE 1:20



SECTION B
SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 14.8 t
   MASS OF TOP UNIT = 12.9 t
   MASS OF LID = 7.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

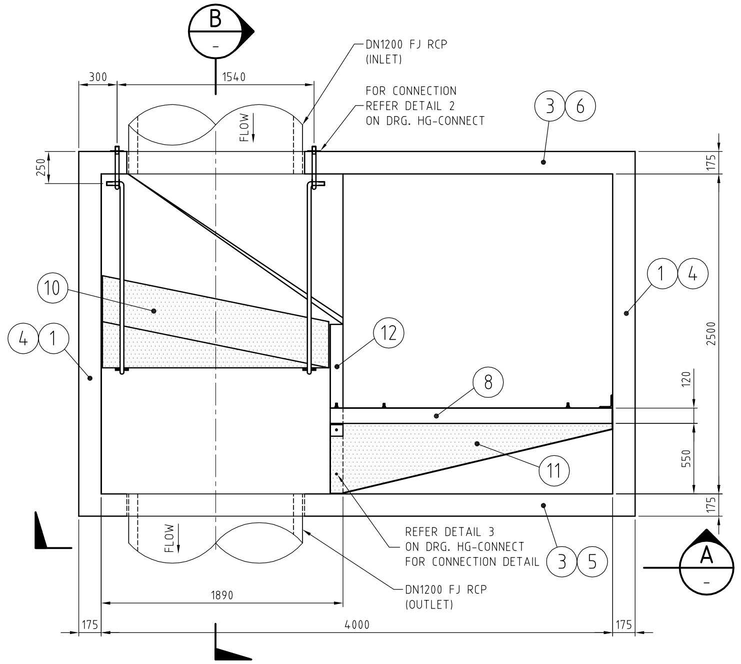
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES
STANDARD DRAWING
HUMEGARD HG40A/L
DN1050/DN1050 FJ RCP
GENERAL ASSEMBLY

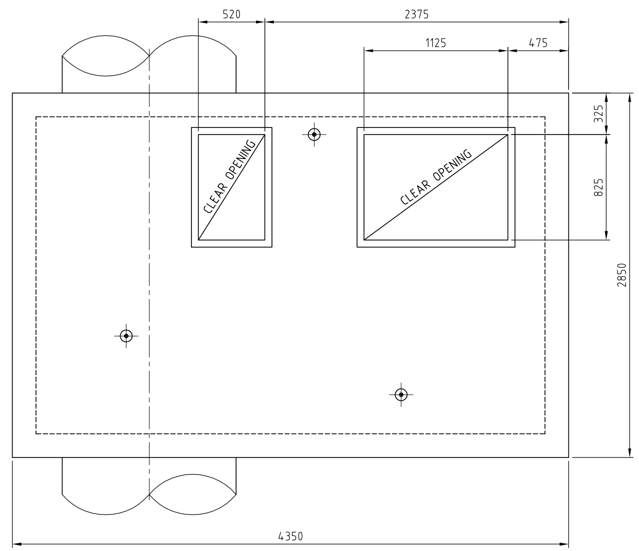
SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
	1:1	A1	HG40A/L-01	1

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
0	ISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
1	GENERAL REVISION	MZ	—	DFW

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



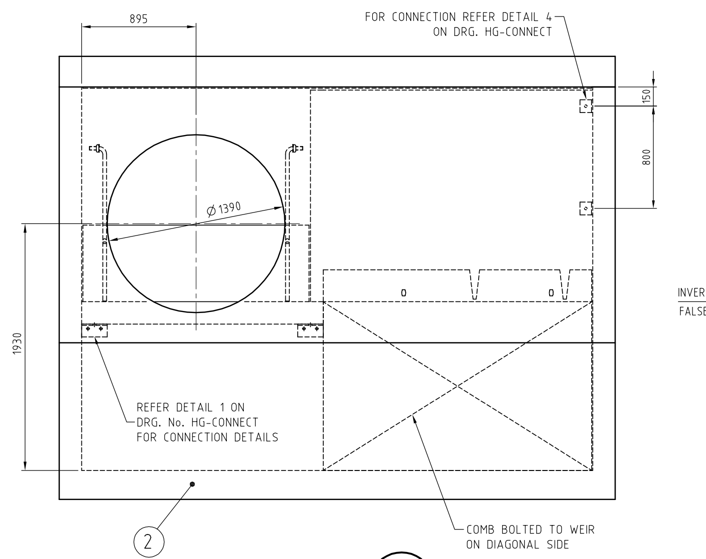
PLAN VIEW (LID REMOVED)
SCALE 1:20



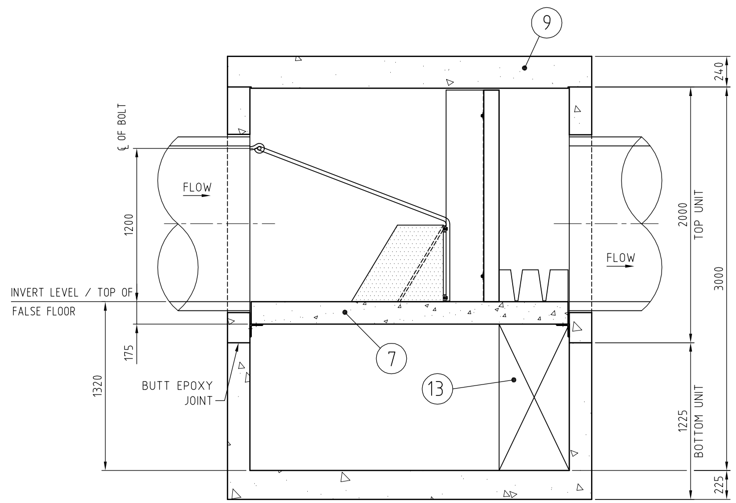
PLAN ON LID
SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 13.4 t
   MASS OF TOP UNIT = 14.4 t
   MASS OF LID = 7.0 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.



VIEW A
SCALE 1:20



SECTION B
SCALE 1:20

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

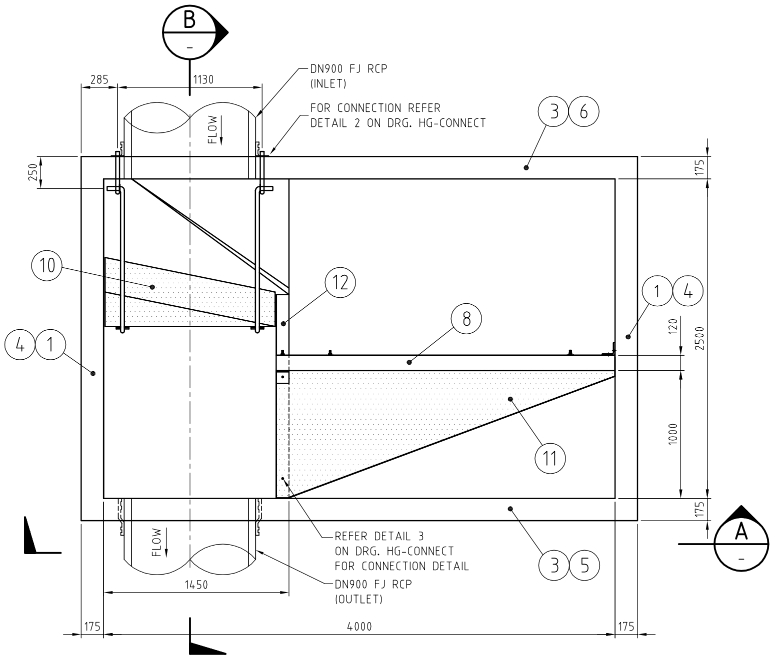
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES
STANDARD DRAWING
HUMEGARD HG40B/L
DN1200/DN1200 FJ RCP
GENERAL ASSEMBLY

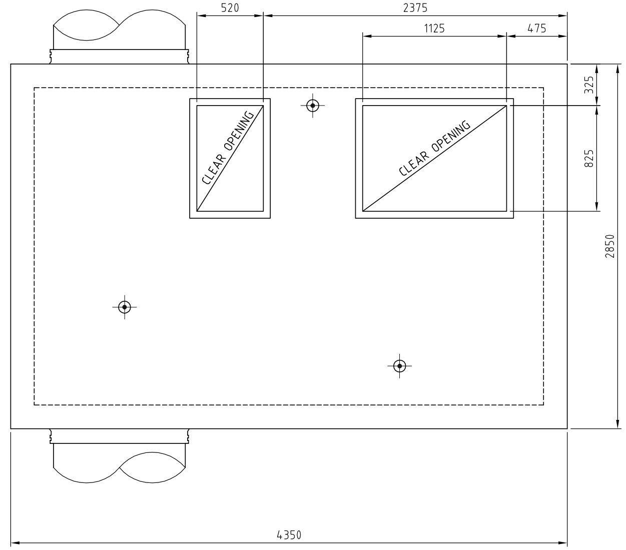
SUPERSEDES HG40B/L-01 REV. C | PLOT SCALE 1:1 | SIZE A1 | DRG. NO. HG40B/L-01 | ISSUE 1

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION - REISSUED FOR MANUFACTURE	MZ	12-03-07	DFW
2	ITEM NUMBERS REVISED, REISSUED FOR MANUFACTURE	MZ	—	DFW

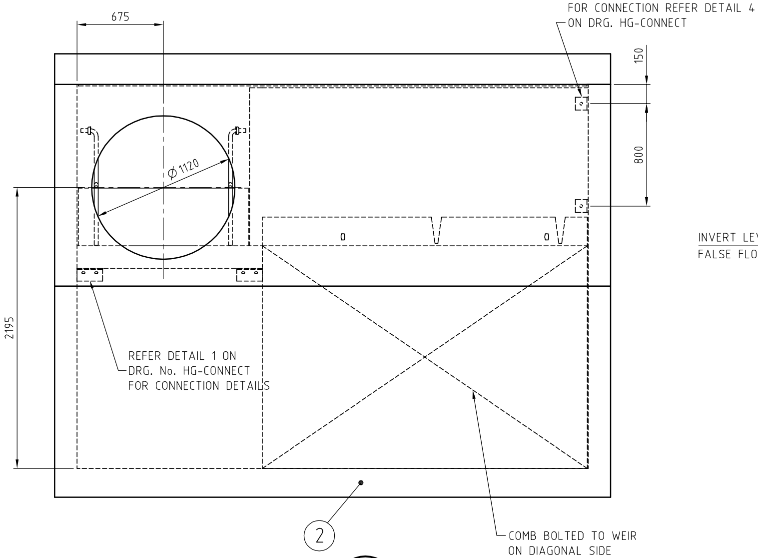
ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG40B/L-02
2	BASE SLAB	HG40B/L-04
3	SIDE WALL - BOTTOM UNIT	HG40B/L-05
4	END WALL - TOP UNIT	HG40B/L-03
5,6	SIDE WALL - TOP UNIT	HG40B/L-06
7	FALSE FLOOR	HG40B/L-07
8	CONCRETE BAFFLE WALL	HG40B/L-07
9	PRECAST LID	HG40B/L-08
10	FLOATING BOOM	HG40B/L-09
11	WEIR	HG40B/L-10
12	BAFFLE SIDE WALL	HG40B/L-11
13	COMB	HG40B/L-12



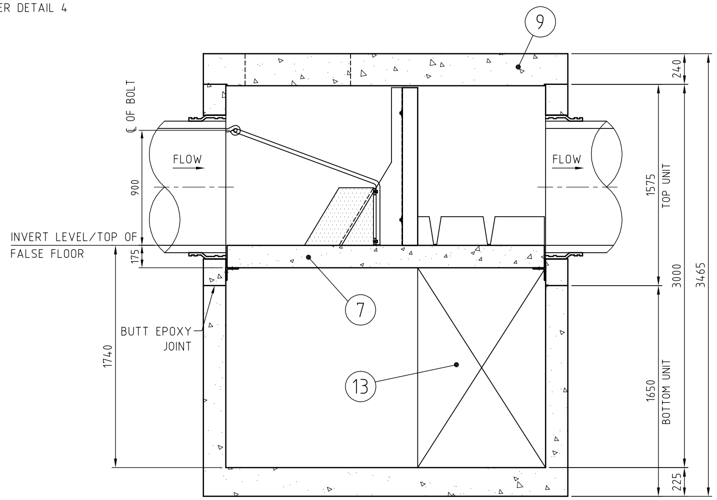
PLAN VIEW (LID REMOVED)
SCALE 1:20



PLAN ON LID
SCALE 1:20



VIEW A
SCALE 1:20



SECTION B
SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 16.2 t
   MASS OF TOP UNIT = 11.6 t
   MASS OF LID = 7.0 t
6. KOR-N-SEAL BOOT CONNECTOR P/N = S206-44 (INLET & OUTLET)

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL (DESIGN) SERVICES
BRISBANE, QUEENSLAND

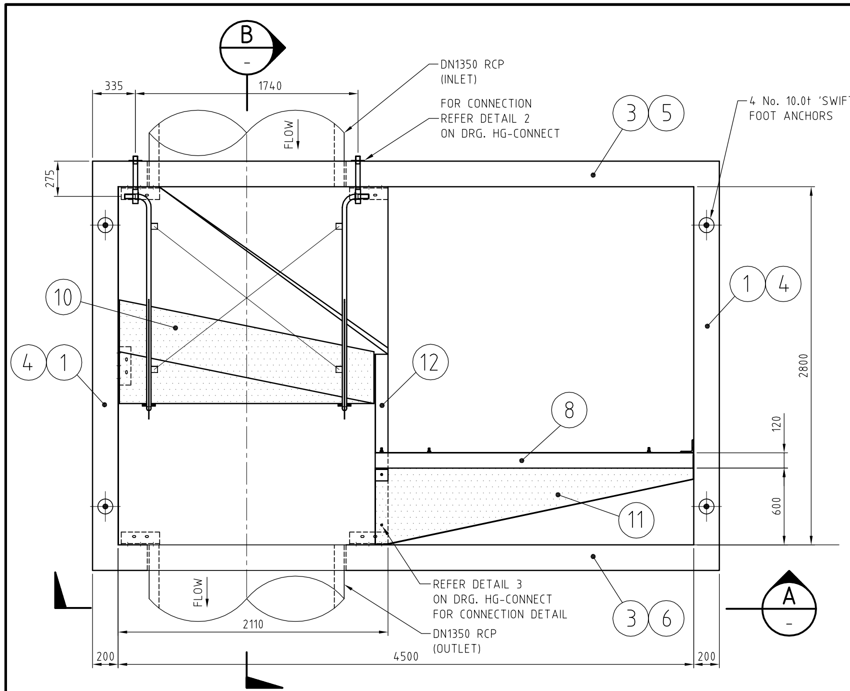
DSN.	DFW	12-03-07
DWN.	MZ	12-03-07
CKD.	DFW	12-03-07
APP.	DFW	12-03-07

HUMES
STANDARD DRAWING
HUMEGARD HG40/L
DN900/DN900 FJ RCP
GENERAL ASSEMBLY

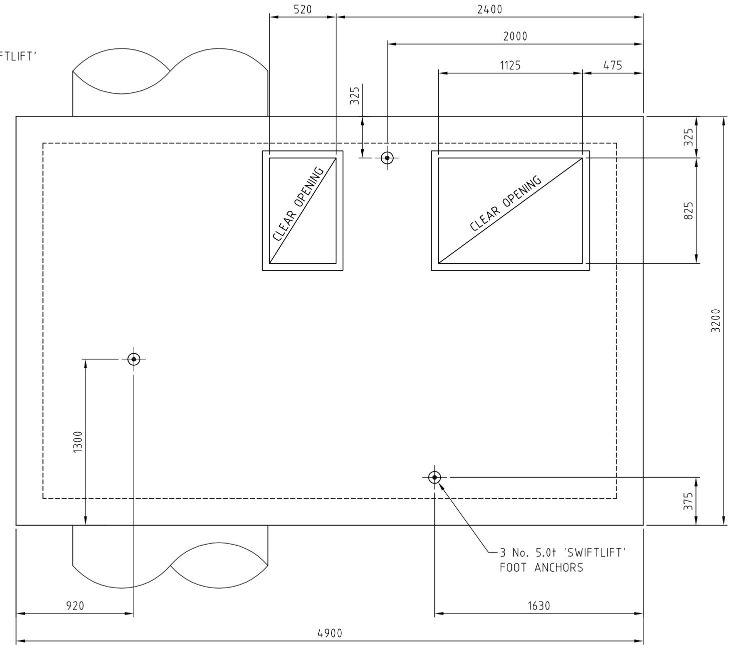
SUPERSEDES	PLOT SCALE	SIZE	DRG. No.	ISSUE
HG40/L-01 REV. 1	1:1	A1	HG40/L-01	2

ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	15-12-10	RM

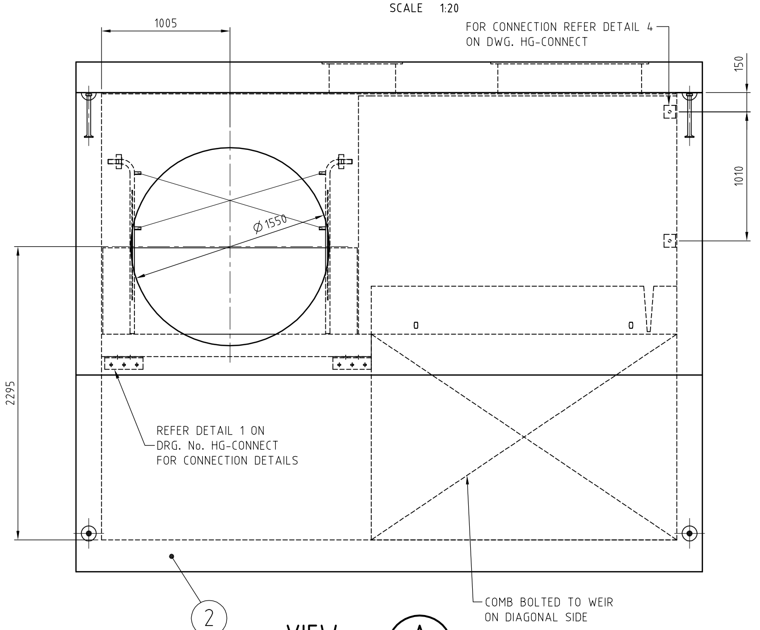
ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG45A-02
2	BASE SLAB	HG45A-04
3	SIDE WALL - BOTTOM UNIT	HG45A-05
4	END WALL - TOP UNIT	HG45A-03
5,6	SIDE WALL - TOP UNIT	HG45A-06
7	FALSE FLOOR	HG45A/L-07
8	CONCRETE BAFFLE WALL	HG45A/L-07
9	PRECAST LID	HG45A/L-08
10	FLOATING BOOM	HG45A/L-09
11	WEIR	HG45A/L-10
12	BAFFLE SIDE WALL	HG45A/L-11
13	COMB	HG45A/L-12



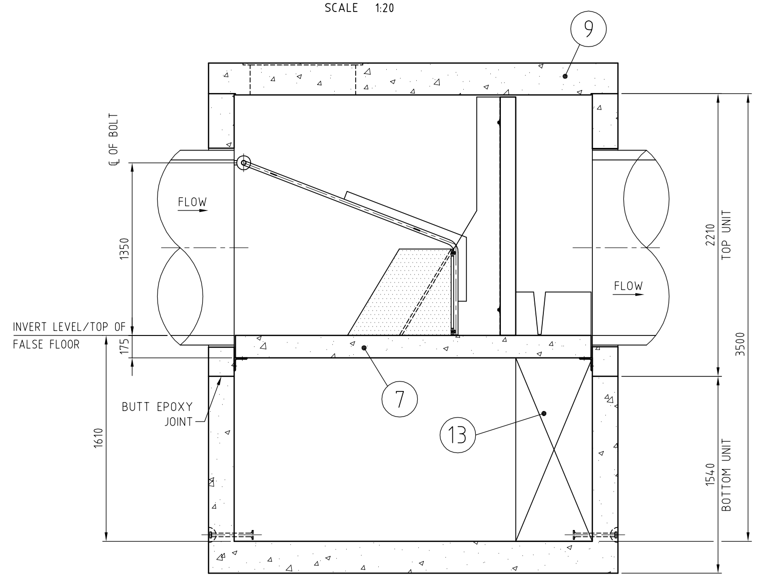
PLAN VIEW (LID REMOVED)
SCALE 1:20



PLAN ON LID
SCALE 1:20



VIEW A
SCALE 1:20



SECTION B
SCALE 1:20

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 20.7 t
   MASS OF TOP UNIT = 19.7 t
   MASS OF LID = 9.1 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

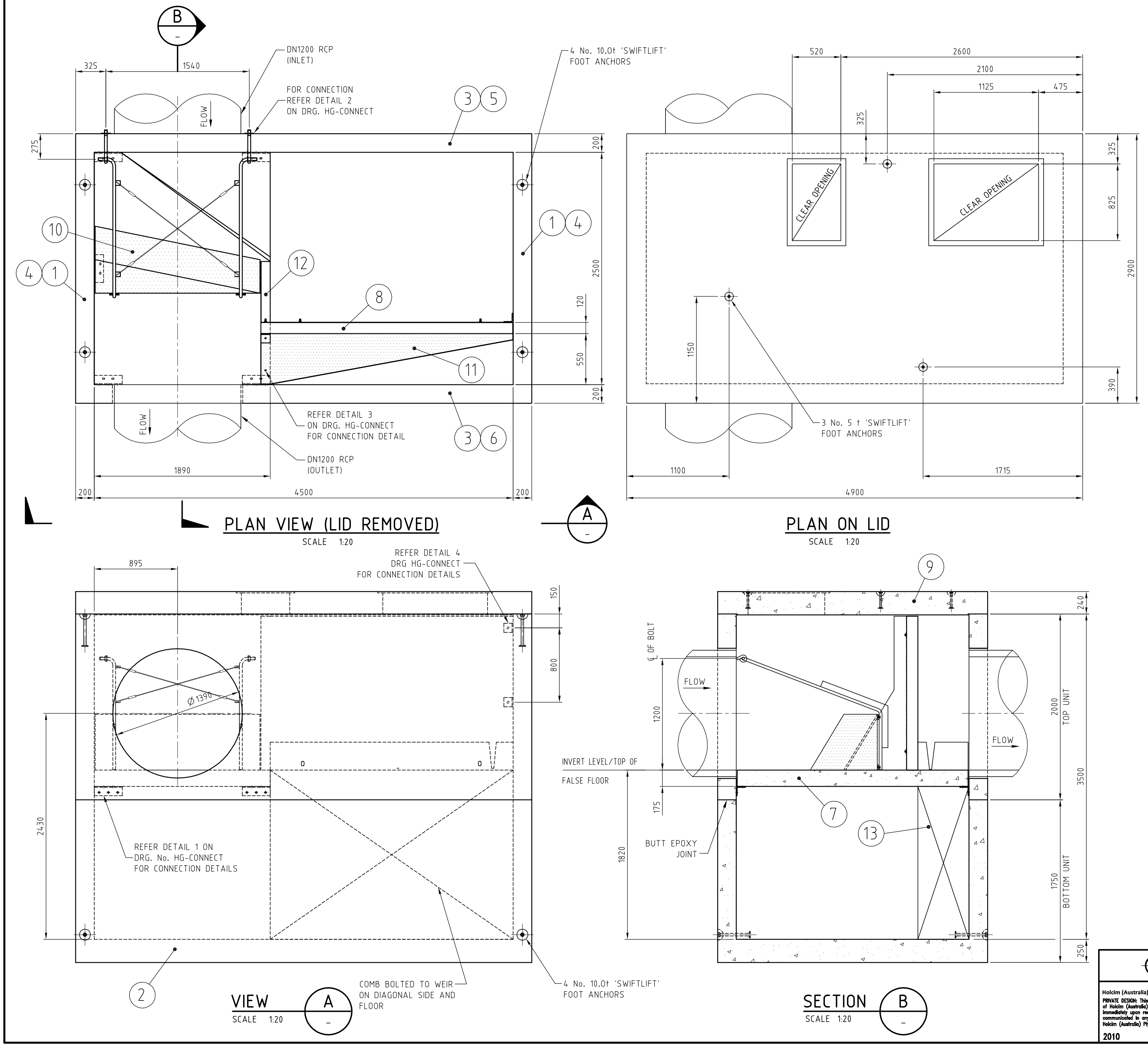
Humes

TECHNICAL SERVICES
BRISBANE, QUEENSLAND

DSN.	WST	07-12-10
DWN.	MZ	07-12-10
CKD.	RM	15-12-10
APP.	WST	15-12-10

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG45A/L
DN1350/DN1350 RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. No.	ISSUE
HG45A/L-01 REV. 0	1:1	A1	HG45A/L-01	1



ISSUE	DETAILS OF ALTERATIONS	DWN	DATE	CKD
1	GENERAL REVISION, REISSUED FOR MANUFACTURE	MZ	15-12-10	RM

ITEM No	DWG DESCRIPTIONS	DWG No
1	END WALL - BOTTOM UNIT	HG45-02
2	BASE SLAB	HG45-04
3	SIDE WALL - BOTTOM UNIT	HG45-05
4	END WALL - TOP UNIT	HG45-03
5,6	SIDE WALL - TOP UNIT	HG45-06
7	FALSE FLOOR	HG45/L-07
8	CONCRETE BAFFLE WALL	HG45/L-07
9	PRECAST LID	HG45/L-08
10	FLOATING BOOM	HG45/L-09
11	WEIR	HG45/L-10
12	BAFFLE SIDE WALL	HG45/L-11
13	COMB	HG45/L-12

NOTES:

1. WHEN LIFTING ENTIRE UNIT FROM FOOT ANCHORS, SPREADER BEAM MUST BE USED TO ENSURE 4 POINT LIFT.
2. ALL METAL COMPONENTS ARE TO BE MADE FROM 304-GRADE STAINLESS STEEL.
3. SEE DRAWING HG-CAST FOR CASTING SEQUENCE.
4. SEE DRAWING HG-CONNECT FOR ALL CONNECTION DETAILS.
5. MASS OF BOTTOM UNIT = 20.8 t
   MASS OF TOP UNIT = 17.3 t
   MASS OF LID = 8.1 t
6. PIPE HOLE SIZE ALLOWS FOR PIPE MORTAR CONNECTION.

DESIGN BASIS

1. DESIGN SPECIFICATION AS3600 CONCRETE STRUCTURES.
2. DESIGN LOADS 0-2m FILL WITH SM1600 VEHICLE LOAD TO AS5100 BRIDGE DESIGN.
3. DESIGN FOR UP TO B2 EXPOSURE CLASSIFICATION TO AS3600 CONCRETE STRUCTURES.

Humes

TECHNICAL SERVICES
BRISBANE, QUEENSLAND

Holcim (Australia) Pty Ltd ABN 87 099 732 297

DSN.	WST	01-12-10
DWN.	MZ	01-12-10
CKD.	RM	15-12-10
APP.	WST	15-12-10

HUMES WATER SOLUTIONS
STANDARD HUMEGARD
HUMEGARD HG45/L
DN1200/DN1200 FJ RCP
GENERAL ASSEMBLY

SUPERSEDES	PLOT SCALE	SIZE	DRG. NO.	ISSUE
HG45/L-01 REV 0	1:1	A1	HG45/L-01	1

Precast solutions

Top:
StormTrap® system

Middle:
RainVault® system

Bottom:
Segmental shaft

Stormwater

Stormwater treatment

Primary treatment

HumeGard® Gross Pollutant Trap

Secondary treatment

HumeCeptor® hydrodynamic separator

Detention and infiltration

StormTrap® system

Soakwells

Harvesting and reuse

RainVault® system

ReserVault® system

RainVault® Mini system

Precast concrete cubes

Segmental shafts

Stormwater drainage

Steel reinforced concrete pipes – trench

Steel reinforced concrete pipes – salt water cover

Steel reinforced concrete pipes – jacking

Box culverts

Uniculvert® modules

Headwalls

Stormwater pits

Access chambers/Manholes

Kerb inlet systems

Floodgates

Geosynthetics

Sewage transfer and storage

Bridge and platform

Tunnel and shaft

Walling

Potable water supply

Irrigation and rural

Traffic management

Cable and power management

Rail

Contact information

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Fax: (02) 6763 7301

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Fax: (03) 5482 3090

Melbourne
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Fax: (03) 9360 3887

Tasmania

Launceston
Ph: (03) 6335 6300
Fax: (03) 6335 6330

South Australia

Adelaide
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Fax: (08) 8168 4549

Western Australia

Gnangara
Ph: (08) 9302 8000
Fax: (08) 9309 1625

Perth
Ph: (08) 9351 6999
Fax: (08) 9351 6977

Northern Territory

Darwin
Ph: (08) 8984 1600
Fax: (08) 8984 1614

National sales 1300 361 601
humes.com.au
info@humes.com.au

A Division of Holcim Australia

Appendix D Sediment Basin Calculations

Note: These "Standard Calculation" spreadsheets relate only to low erosion hazard lands as identified in figure 4.6 where the designer chooses to not use the RUSLE to size sediment basins. The more "Detailed Calculation" spreadsheets should be used on high erosion hazard lands as identified by figure 4.6 or where the designer chooses to run the RUSLE in calculations.

1. Site Data Sheet

Site name: Kaludah Subdivision - Overall Basins

Site location: Lochinvar

Precinct: Lochinvar -> Maitland City Council

Description of site: Rural to Residential Development

Site area	Site						Remarks
	1	2	3	4	5	6	
Total catchment area (ha)	52.471	7.363	10.076	19.92			
Disturbed catchment area (ha)	39.115	7.363	10.076	19.92			

Soil analysis

Soil landscape							DIPNR mapping (if relevant)
Soil Texture Group	F	F	F	F			Sections 6.3.3(c), (d) and (e)

Rainfall data

Design rainfall depth (days)	5	5	5	5			See Sections 6.3.4 (d) and (e)
Design rainfall depth (percentile)	85	85	85	85			See Sections 6.3.4 (f) and (g)
x-day, y-percentile rainfall event	31	31	31	31			See Section 6.3.4 (h)
Rainfall intensity: 2-year, 6-hour storm	8.78	8.78	8.78	8.78			See IFD chart for the site
Rainfall erosivity (R-factor)	1780	1780	1780	1780			Automatic calculation from above data

Comments:

2. Storm Flow Calculations

Peak flow is given by the Rational Formula:

$$Qy = 0.00278 \times C_{10} \times F_Y \times I_{y,\,tc} \times A$$

where:

- Q_y is peak flow rate (m^3/sec) of average recurrence interval (ARI) of "Y" years
- C_{10} is the runoff coefficient (dimensionless) for ARI of 10 years. Rural runoff coefficients are given in Volume 2, figure 5 of Pilgrim (1998), while urban runoff coefficients are given in Volume 1, Book VIII, figure 1.13 of Pilgrim (1998) and construction runoff coefficients are given in Appendix F
- F_y is a frequency factor for "Y" years. Rural values are given in Volume 1, Book IV, Table 1.1 of Pilgrim (1998) while urban coefficients are given in Volume 1, Book VIII, Table 1.6 of Pilgrim (1998)
- A is the catchment area in hectares (ha)
- $I_{y,\,tc}$ is the average rainfall intensity (mm/hr) for an ARI of "Y" years and a design duration of "tc" (minutes or hours)

Time of concentration (t_c) = $0.76 \times (A/100)^{0.38}$ hrs (Volume 1, Book IV of Pilgrim, 1998)

Note: For urban catchments the time of concentration should be determined by more precise calculations or reduced by a factor of 50 per cent.

Peak flow calculations, 1

Site	A (ha)	tc (mins)	Rainfall intensity, I, mm/hr						C_{10}
			$1_{yr,tc}$	$5_{yr,tc}$	$10_{yr,tc}$	$20_{yr,tc}$	$50_{yr,tc}$	$100_{yr,tc}$	
1	52.4714	36	67.3	114	130	150	178	200	0.76
2	7.363	17	67.3	114	130	150	178	200	0.76
3	10.076	19	67.3	114	130	150	178	200	0.76
4	19.92	25	67.3	114	130	150	178	200	0.76
5									
6									

Peak flow calculations, 2

ARI yrs	Frequency factor (F_y)	Peak flows						Comment
		1	2	3	4	5	6	
		(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m^3/s)	(m3/s)	
$1_{yr,\,tc}$	0.8	5.969	0.838	1.146	2.266			
$5_{yr,\,tc}$	0.95	12.006	1.685	2.306	4.558			
$10_{yr,\,tc}$	1	14.412	2.022	2.768	5.471			
$20_{yr,\,tc}$	1.05	17.461	2.450	3.353	6.629			
$50_{yr,\,tc}$	1.15	22.693	3.184	4.358	8.615			
$100_{yr,\,tc}$	1.2	26.607	3.734	5.109	10.101			

3. Volume of Sediment Basins: *Type C* Soils

Basin volume = settling zone volume + sediment storage volume

Settling Zone Volume

The settling zone volume for *Type C* soils is calculated to provide capacity to allow the design particle (e.g. 0.02 mm in diameter) to settle in the peak flow expected from the design storm (e.g. 0.25-year ARI). The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle. Peak flow/discharge for the 0.25-year, ARI storm is given by the Rational Formula:

$$Q_{tc,\,0.25} = 0.5 \times [0.00278 \times C_{10} \times F_y \times I_{1yr,\,tc} \times A]\ (m^3/sec)$$

where:

$Q_{tc,0.25}$ = flow rate (m^3/sec) for the 0.25 ARI storm event

C_{10} = runoff coefficient (dimensionless for ARI of 10 years)

F_y = frequency factor for 1 year ARI storm

$I_{1\,yr,tc}$ = average rainfall intensity (mm/hr) for the 1-year ARI storm

A = area of catchment in hectares (ha)

Basin surface area (A) = area factor x $Q_{tc,\,0.25}$ m^2

Particle settling velocities under ideal conditions (Section 6.3.5(e))

Particle Size	Area Factor
0.100	170
0.050	635
0.020	4100

Volume of settling zone = basin surface area x depth (Section 6.3.5(e)(ii))

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 100 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.5(e)(iv)), in which case the "Detailed Calculation" spreadsheets should be used.

Total Basin Volume

Site	$Q_{tc,\,0.25}$ (m^3/s)	Area factor	Basin surface area (m^2)	Depth of settling zone (m)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)	Basin shape		
								L:W Ratio	Length (m)	Width (m)
1	2.984	4100	12236	0.6	7342	7342	14683	3	191.6	63.9
2	0.419	4100	1717	0.6	1030	1030	2060	3	71.8	23.9
3	0.573	4100	2350	0.6	1410	1410	2820			
4	1.133	4100	4645	0.6	2787	2787	5574			
5		4100								
6		4100								

4. Volume of Sediment Basins, *Type D* and *Type F* Soils

Basin volume = settling zone volume + sediment storage zone volume

Settling Zone Volume

The settling zone volume for *Type F* and *Type D* soils is calculated to provide capacity to contain all runoff expected from up to the y-percentile rainfall event. The volume of the basin's settling zone (V) can be determined as a function of the basin's surface area and depth to allow for particles to settle and can be determined by the following equation:

$$V = 10 \times C_v \times A \times R_{y\text{-\%ile, x-day}} \ (m^3)$$

where:

10 = a unit conversion factor

C_v = the volumetric runoff coefficient defined as that portion of rainfall that runs off as stormwater over the x-day period

R = is the x-day total rainfall depth (mm) that is not exceeded in y percent of rainfall events. (See Sections 6.3.4(d), (e), (f), (g) and (h)).

A = total catchment area (ha)

Sediment Storage Zone Volume

In the standard calculation, the sediment storage zone is 50 percent of the setting zone. However, designers can work to capture the 2-month soil loss as calculated by the RUSLE (Section 6.3.4(i)(ii)), in which case the "Detailed Calculation" spreadsheets should be used.

Total Basin Volume

Site	C_v	R x-day y-%ile	Total catchment area (ha)	Settling zone volume (m^3)	Sediment storage volume (m^3)	Total basin volume (m^3)
1	0.51	31	52.4714	8295.72834	4148	12443.5925
2	0.51	31	7.363	1164.0903	582	1746.13545
3	0.51	31	10.076	1593.0156	797	2389.5234
4	0.51	31	19.92	3149.352	1575	4724.028
5						
6						

Appendix E HumeGard Inspection and Maintenance Guide

Strength. Performance. Passion.

HumeGard® GPT
Inspection and maintenance guide

Issue 1

Purpose of this guide

This guide outlines the maintenance procedures and requirements for HumeGard® GPT units.

Where the contents of this guide differ from project specifications and drawings, supervisory personnel should consult with a Humes engineer. In the event of any conflict between the information in this guide and local legislative requirements, the legislative requirements will take precedence.

It is the responsibility of the site owner and its contractors to determine the site's suitable access and location for maintenance plant and equipment.

Nothing in this guide is to be construed as a representation, endorsement, promise, guarantee or warranty whether expressed or implied.

Humes makes no representation or warranty, implied or otherwise that, amongst others, the content of this guide is free from errors or omissions or in relation to the adequacy of the information contained in this guide and where appropriate you will seek verification from an independent third party before relying on any information in this guide. Humes is not liable or responsible to any person for any use or reliance of any information arising out of or in connection with this guide.

Safety advice

The HumeGard® GPT must be maintained in accordance with all relevant health and safety requirements, including the use of PPE and fall protection where required.

Confined space entry

Maintenance of the HumeGard® should not require entry, however, if entry into the unit is required, then the device is deemed a confined space. As such, if entering the unit, all equipment and training must comply to SHE regulations. It is the responsibility of the contractor or person/s entering the unit to proceed safely at all times.

Personal safety equipment

The contractor is responsible for the provision of appropriate personal protection equipment including, but not limited to safety boots, hard hat, reflective vest, protective eyewear, gloves and fall protection equipment. Make sure all equipment is used by trained and certified personnel, and is checked for proper operation and safety features prior to use.

Handling

The customer, or their contractor, is responsible for the removal of access lids from the HumeGard® unit. The customer or contractor should familiarise themselves with the device and site constraints, and particular attention should be given to safety hazards such as overhead power lines and other services in the vicinity when considering the position of plant and equipment.

Maintenance overview

To ensure ongoing long-term environmental protection HumeGard® needs to be maintained (generally annually). The actual on-going maintenance frequency requirements will be determined through quarterly inspections undertaken during the first year. However, only an annual maintenance period is anticipated for most HumeGard® units installed within drainage infrastructure.

Inspection can be performed by anyone, and procedures for inspection are provided in this document.

Generally, comprehensive maintenance is performed from the surface via vacuum truck. Companies capable of performing this maintenance can be found in the Yellow Pages or online by searching sewer cleaning or liquid waste removal.

Additionally large litter items may also be removed utilizing the optional stainless steel basket arrangement within the HumeGard®. Alternatively the litter can be removed during eduction/vacuum clean out, which will be required in order to remove the sediment component of the stormwater pollution.

HumeGard® operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom (or broad-crested weir for small units) that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow. There are two types of HumeGard® - the super-critical version, which incorporates a broad-crested weir approach for treatment flow diversion, and a larger, standard version, which incorporates a floating boom arrangement to divert treatable flows.

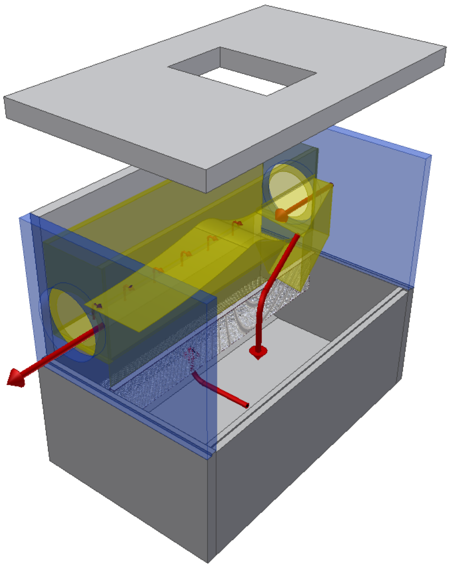
Super-critical HumeGard® (HG12 & HG15)

The super critical Humegard® consists of an internal broad crested weir and holding chamber.

A specially designed patented broad crested weir diverts material entrained in the flow into the adjacent holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the weir diverts all flows into the sump area where pollutants are captured and retained. The velocity in this sump is controlled and never exceeds a maximum average velocity of 0.2m/s.
- **High/Bypass flow operation**
  During high flows, the weir diverts up to the treatable flowrate into the sump and any excess flow is able to flow over the hump and through to the outlet. This ensures that the previously caught pollutants are not disturbed, resuspended and diverted out of the outlet pipe.

Figure 1 – Super-critical HumeGard® GPT



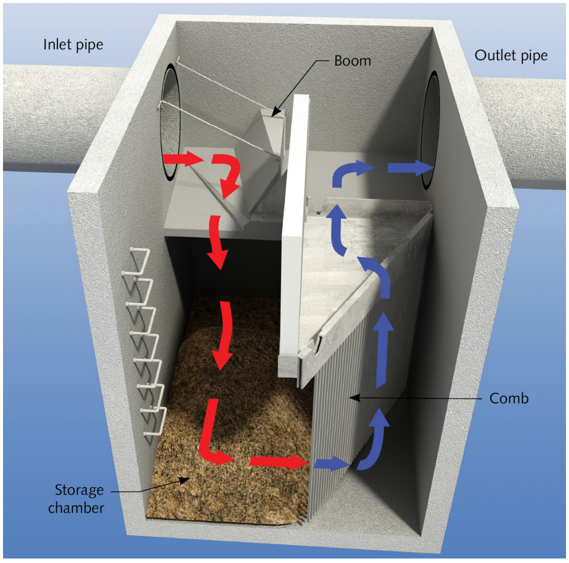
Standard HumeGard® (HG18 – HG45)

The standard HumeGard® consists of an internal separation channel and holding chamber.

A specially shaped boom, which is supported by hangers hinged to the upstream wall, diverts material entrained in the flow from the separator to the adjacent, off line, holding chamber. This consists of the holding sump and another baffle/weir/channel arrangement designed to retain floating material while guiding flow through to the outlet.

- **Low/Treatment flow operation**
  During low to moderate flows, the boom remains on the floor of the separation channel and imparts an upward and sideways motion to the incoming flow. This action causes deflection into the holding chamber, where heavy and saturated materials settle to the bottom of the sump, while buoyant material is trapped behind the baffle wall arrangement.
- **High/Bypass flow operation**
  During infrequent high flows, the boom lifts, which permits the flow to pass beneath it while continuing to deflect buoyant material to the holding chamber. Once the pipeline flows full, the boom lifts clear, allowing unobstructed flow through the unit, whilst at the same time retaining the floating materials on the upstream side of the device.

Figure 2 – Standard HumeGard® - low flow conditions



Maintenance frequency

It is recommended and good practice for an inspection of the HumeGard® to be carried out on a quarterly basis. The quarterly inspection is to check the operation of the boom, volume of pollutants in the holding sump, etc. But generally, only an annual maintenance period for cleaning is anticipated.

It is important during the quarterly inspections to check that the operation of the boom is satisfactory. The boom should not be impeded by large pieces of litter i.e. logs, etc. or have objects lodged underneath the boom or between it and the baffle plate that may prevent it from rising, or sitting flat on the false floor.

Cleaning maintenance frequency requirements will vary with the amount of stormwater pollution generated in your catchment (amount of litter, sediment, etc.). So it is recommended that as the 3-monthly inspections are performed, the frequency of maintenance be increased or reduced based on local conditions and pollutant capture rates.

The need for maintenance can be determined easily by inspecting the unit from the surface by:

- Checking if litter can be readily seen in the holding chamber once the cover has been removed.
- Using a dipstick or sludge judge (sediment sampling tube) to assess how much sediment or organic material has been captured in the bottom of the holding chamber. A sediment depth over 400mm would indicate cleaning is recommended to minimise the potential for scour.

Sediment sampling tubes are available for purchase from Humes (contact your local sales rep for more details).

Occasionally it may be beneficial to only remove captured litter and not siphon the entire contents of the holding chamber.

Maintenance procedure

Maintenance of Humegard® units is generally performed using vacuum/eduction trucks.

No entry into the unit is required for maintenance. The vacuum service industry is a well-established sector, that services underground tanks, sewers and catch basins.

HumeGard® units are cleaned by adhering to the following steps:

1. Complete a Job Hazard Analysis (JHA) and a Work Method Statement (WMS) before undertaking the maintenance procedure.
2. Prepare the site around the Humegard for cleaning. This involves establishing the job site (traffic control if required), assembling cleaning equipment, positioning the vacuum truck and ensuring correct equipment is available to use (including PPE).
3. Remove the rectangular lid above the holding chamber and conduct a visual inspection to assess the condition of the Humegard® and note if there are any blockages or lodged debris.
4. Lower the suction hose to the surface of the water in the holding tank and skim across the top to capture floating litter.
5. Lower the suction hose to the base of the holding chamber to remove sediment, organic matter and litter which has sunk.
6. Dislodge materials trapped in the screen using a water jet or brush/broom.
7. Remove the second rectangular access cover over the diversion boom and ensure there is no debris trapped underneath the boom.
8. Clean the interior of the pit using water jet.
9. Replace lids, ensuring they are firmly and securely in place.

It may be convenient on larger units to de-water some of the water in the holding chamber. This will minimise maintenance costs as disposal of essentially clean stormwater can be avoided. Often this can be done onto adjacent ground or into the council sewer system. However, this should only be done with the appropriate authorities' consent.

If a HumeGard® has been fitted with an optional removable basket, the basket can be used to periodically remove litter in between scheduled eduction/vacuum maintenance visits. The baskets must also be removed prior to vacuuming/educting the HumeGard® for the sediment load.

Maintenance cost

The costs to clean out a HumeGard® will vary based on the size of the unit, pollutant volume/type and transportation distances.

A typical cost (equipment and personnel) is estimated to be approximately $1500-$3500 (based on best information at time of installation) - exclusive of disposal costs.

This estimated cost is based on the clean out of a single unit. Economies of scale will be achieved where there are multiple units for a given location. The time to clean a single unit is approximately 3-4 hours (including transportation and cleaning).

Disposal costs are estimated to be in the order of $350-$600 dependent upon volume and type of pollutants removed from the holding sump.

Removal of hazardous material

A wide range of hazardous materials may be intercepted by the HumeGard® gross pollutant trap, although instances of this have been minimal. Hazardous materials may include high levels of heavy metals accumulated within the collected sediments, certain inorganic chemicals, used syringes, glass, and other matter.

As noted, the potential presence of hazardous material is primarily the reason why eduction is the preferred cleaning method, since this minimises the potential for maintenance personnel and nearby communities to come into contact with such material. Where baskets are required, the majority of the collected material will fall from the basket into the maintenance truck upon opening of the trap door. Any and all contact with the basket should be undertaken with suitable protective clothing, including heavy duty hand protection. If material is caught within the basket, it should be removed using suitable equipment.

Removal of this material by hand is not recommended. It is noted that it is not necessary to have the sumps/ baskets completely clean. The removal of 95% of the material is satisfactory, and the prospect of completely removing every piece of material increases the occupational health and safety risks.

The presence of certain toxicants may need to be considered for the disposal of material and appropriate locations. If elevated levels of toxicants are suspected, then analytical screening of material should be completed to determine an appropriate disposal response according to local and state government regulations.

Example Job Safety Analysis (JSA)/Work Method Statement (WMS)

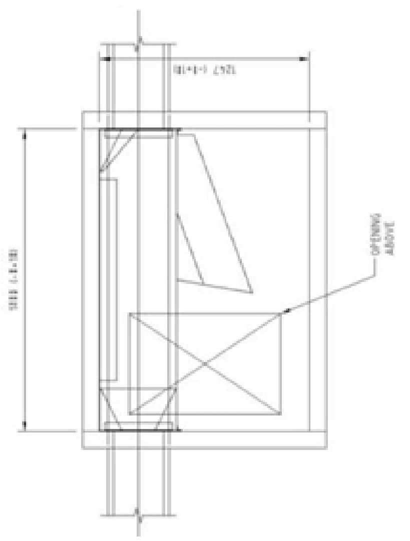
The following JSA/WMS is a guide only. It is the responsibility of the cleaning contractor or asset owner to develop their own JSA/WMS in line with their own WHS requirements and constraints. It also assumes that there will be no entry into the unit during maintenance.

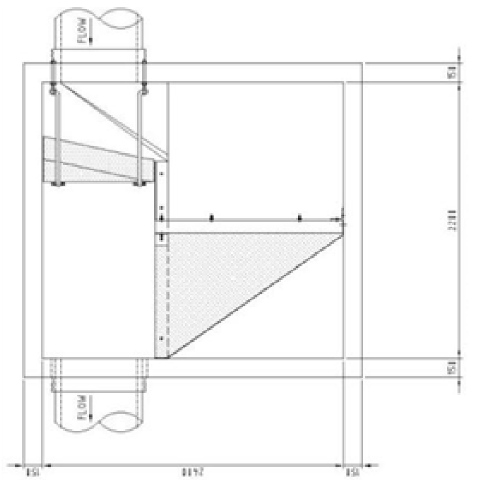
Project/ Address:				**Date:**	
Job: Clean out of HumeGard unit				**Operator:**	
Risk Level:	1 - Extreme	2 - High	3 - Medium	4 – Low	5 - Negligible
Consequence:	Likely to cause very serious harm	Clear potential for serious harm	Similar to risk of driving a car	Little likelihood of any harm	Virtually Harmless
Response:	STOP THE JOB	STOP and Reassess to find better way	Control & ensure controls work	Monitor to ensure risk remains low	Continue work

PROCEDURE	POSSIBLE HAZARDS	INITIAL RISK	CONTROLS	PERSON RESPONSIBLE	END RISK
1. Preliminaries: • Confirm GPT locations and types • Familiarise with GPT technical manual	Nil	-	Refer to relevant manuals	Operator	-
2. Plan the Job: • Room to access & work on the GPT without impacting other property or vehicles • Consider water flows & if excessive note & move onto next job • Condition & status of GPT • Identify water fill point • Identify waste dump point	• Climbing in/out/around of truck • All GPT have a high risk of containing syringes	3 4	• Refer to safety plan on moving around vehicles • Wear PPE and never reach into or lift accumulated matter with hands. If a needle stick injury occurs, wash the affected area with soap & water & report the incident to the branch and seek medical attention ASAP.	Operator	4 5
3.Establish Job Site: • Over 60 km/hr will require traffic management • Within 6.4m of overhead power lines will require spotter	• Traffic • Pedestrians • Overhead power lines	3	• Devise a relevant Traffic Management WMS • Ensure barriers and signs redirect pedestrians • Ensure spotter is present	Operator	5
4. Assemble Cleaning Equipment • Position vacuum hose to remove debris from GPT	• Infection • Sharp edges • Manual handling • Falling equipment • High pressure water	3	• Personal hygiene (wash hands prior to smoking/eating) • Wear gloves & remove sharp edges/burrs on equipment • Follow a manual handling WMS • Store equipment securely on vehicle • Inspect vacuum hose fittings firmly secured • Inspect hose daily 7 ensure it has been tested (6 monthly) • Never cap jetting hose • Inspect jetting hose for damage • Never adjust pump pressures or regulators • Maximum reducer on 1” hose is ¾” • No reducers on ½” hose • Fittings to be firmly secured using a spanner	Operator	5
5. Open the GPT Cover • Remove lid using the manhole lifting procedure • If lid is mass concrete & exceeds safe lifting limits, use mechanical lifting device	• Manual Handling • Open Manholes	3	• Refer to a SWP for manual handling • Refer to a SWP for manhole lifting	Operator	5
6. Start Cleaning • Position bottom end of vacuum hose to remove debris from GPT • Run vacuum prior to remove debris • If there is any requirement to enter the pit for any reason, confined Space Entry Procedure is to be followed • Vacuum all material out of the sump until empty clear 7 clean • Dislodge materials trapped in the screen using water jet ot brush/broom • Remove access cover over diversion boom/weir, ensure there are no debris trapped underneath boom/around weir • Clean the interior of the pit using water jet &/or brush/broom • Vacuum all materials out of the pit	• Manual handling • Eye injury from flying debris • Noise • People inside exclusion zone • Confined Space Entry (If required)	3	• Follow a SMP for manual handling • Wear eye protection • Wear hearing protection • Stop operation until area clear. Only essential personnel within exclusion zone • Ensuring minim slack in hose to prevent whipping • Refer to confined space manuals and SWPs	Operator	5
7. Finish Cleaning • Replace lid ensuring it is fimly & securely in place • Ensure all waste is vacuumed and site is clean prior to packing up • Complete the CWS recording all details and any problems	• Manual handling	3	• Follow a SMP for manual handling	Operator	5

HumeGard® unit maintenance record

Customer details			
Company		Phone	
Contact name		Email	
Address		Date	
State		Operator name	
HumeGard® unit details			
Model		Type (circle one)	Small (weir) | Standard (boom)
Cleaning method (circle one)	Vacuum | Eduction	Lid type	
Plan view (circle one)			
Small HumeGard® (weir)		Standard HumeGard® (boom)	





Pollutant removal results			
Estimated volume of water removed (L)		Litter (%)	
Estimated volume of pollutants (m^3)		Vegetation (%)	
Percentage of pollutant content (%)		Sediments (%)	
Percentage of pollutant capacity (%)		**Total volume (%)**	

Any evidence of hydrocarbons (grease/oil) contamination?	YES	NO
Any evidence of sewage contamination?	YES	NO
Any evidence of any other unexpected contamination?	YES	NO

Describe unexpected contamination (if any):

Any problems cleaning the HumeGard® unit (describe briefly):

If problems were experienced were they thenresolved satisfactorily (describe briefly):

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