PROPOSED CONSTRUCTION OF THE FENLAND CARAVAN CENTRE AT CARRINGTONS DROVE SOUTH, CROWLAND PE6 0BZ

FLOOD RISK ASSESSMENT AND SURFACE WATER PLAN



Existing poultry Houses and IDB Drain

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This flood risk assessment and surface water plan has been prepared solely to support the planning application for the proposed development at Carringtons Drove South, Crowland. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete.

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FLOOD RISK ASSESSMENT

Introduction

An application has been submitted (Reference No H02/0026/15) to South Holland District Council for planning permission for a Caravan Sales and Repair Facility at Carrington Drove South, Crowland (phase 1 of the development). The planning application also includes proposals for a touring caravan site to the north of the new building (phase 2 of the development). There are four large poultry sheds on the site at the present time two of which will be demolished as part of the project, and two will be used for the Sales and Repair facility. Some new extensions will be constructed adjacent to the existing buildings, and storage areas will be formed where the two buildings will be demolished.

The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The Planning Application requires a Flood Risk Assessment to be carried out as required in the Technical Guidance to the National Planning Policy Framework.

The site is shown within the defended area of the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA) map and is located in the North Level Internal Drainage Board district.

Application Site

The development is located on the eastern side of the new Crowland By Pass. The National Grid Reference of the site is 524350 308800.

The position and extent of the site is shown on the plan at the end of this document.

The proposed development is within Flood Zone 3(a) "High Probability" as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, the Caravan Sales and Repair area is classified "less vulnerable" and the area designated for touring caravans is classified as "more vulnerable". Table 3 of the Guidance states that Caravan Sales and Repair is an acceptable use but for the touring caravan site the exception test is required.

Sequential Test

As the proposed development is located in Flood Zone 3(a) the NPPF requires the sequential test to be applied to determine if there are any reasonably available and

suitable alternative sites at a lower flood risk for this type of development. The developers have not been able to find any alternative site with a lower flood risk where there are buildings available for conversion to repair and storage buildings. Therefore the site can be considered as brownfield with potential for redevelopment. It is unlikely that there would be a similar site with a lower flood risk in this area, as the whole of this locality is within Flood Zone 3(a), is at a similar level and therefore will have the same flood risk. The touring caravan site is part of the overall scheme and therefore needs to be on the same site.

Therefore the sequential test can be considered to be passed.

Exception Test

For the Exception Test to be passed:

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA;

b) The development should be on developable previously developed land or, if not, it must be demonstrated there is no such alternative land available; and

c) A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, reducing flood risk overall.

All three parts of this test must be satisfied in order for the development to be considered appropriate in terms of flood risk. There must be robust evidence in support of every part of the test.

Section (a) will be demonstrated by the supporting planning statement.

Section (b) is satisfied as this site is previously developed land.

This flood risk assessment will demonstrate that Section (c) is passed.

Strategic Flood Risk Assessment

The following information about the flood risk at the location of the proposed development has been gained from the maps produced for the South Holland District Council Strategic Flood Risk Assessment:

1. **Report Maps**

- Map 5 indicates the site to be low or medium risk and protected by flood defences.
- Map 6 indicates the peak depth is zero for the present day 1% / 0.5% tidal event probability.
- Map 7 indicates the peak velocity is zero for the present day 1% fluvial / 0.5% tidal event probability.

- Map 12 indicates the actual risk extent for the year 2055 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 13 indicates the actual risk extent site for the year 2115 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 16 indicates the site is not within the rapid inundation zone.

2. Flood Maps Table D1

- The maps illustrate the actual flood hazard which is as follows:

For the present day	Depth of flooding … zero
	Extent of flooding .. low or medium
	Velocity … Nil
For year 2115	Depth of flooding … Zero
	Extent of flooding …low or medium
	Velocity ... Nil

- The maps also illustrate the residual flood hazard which is as follows:-

For the present day	Depth of flooding ...zero
	Extent of flooding .. low or medium
	Velocity .. zero
For the year 2115	Depth of flooding ...zero
	Extent of flooding .. Low to medium
	Velocity .. zero

3. Maximum flood levels:

Maximum fluvial flood levels in the River Welland at Crowland at chainages between 10km and 14km are shown in the reports as follows:

	Present	Present + Climate Change
1 in 100 year	4.76 - 4.99	4.81 - 5.03
1 in 1,000 year	4.79 - 5.03	4.82 - 5.05

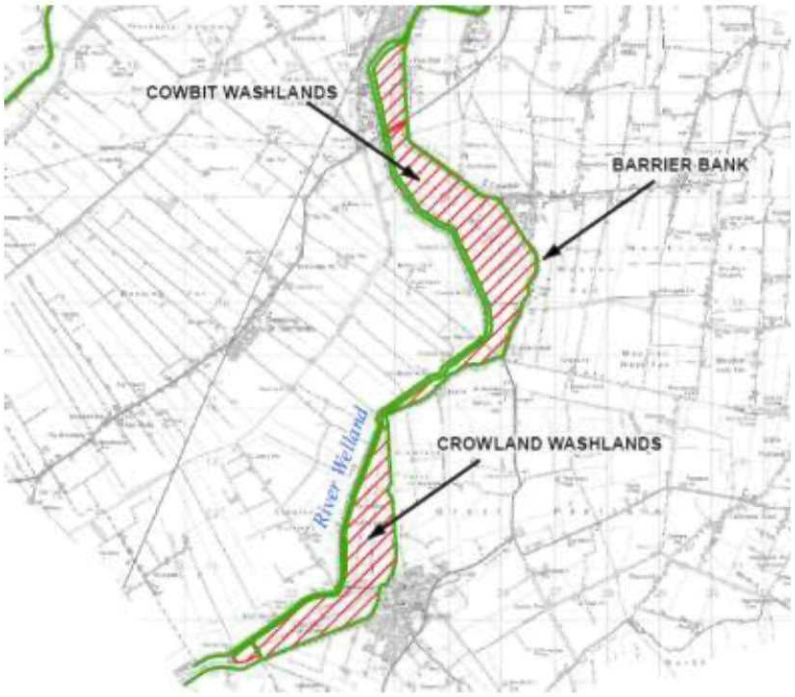
The lowest level of the Barrier Bank of the River Welland stated in the SFRA is 5.81m OD at 10km and 6.08m OD at 14km.

Existing Flood Alleviation Measures

The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains" and is considered to be passive until such time that a flood greater than the defences can

withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The section of the River Welland from south of Crowland to the southern outskirts of Spalding has two washlands located on the east side of the River, called Crowland Washlands and Cowbit Washlands. These areas are designed to alleviate very high flows in the River Welland. When the water level in the River Welland reaches a level of approximately 5.10m OD large syphons are activated which discharge excess water onto the Washes. The Barrier Bank is located on the east side of the Washes to contain the water in the Washlands and is the main flood defence bank on the east side of the river.



The development site is approximately 1.4km from the Barrier Bank, the south bank of the River Welland.

Existing Ground Levels

The level of the site where the existing poultry houses are located is between 2.40m and 2.50m OD. The field to the north east of the poultry houses, which forms part of the proposed site, is lower at between 2.25m and 2.35m OD. The field northwest of the site between the IDB Drain and the new By pass is slightly lower at around 2.10m OD. The By Pass has been elevated by about 900mm above the surrounding land at approximately 3.00m OD.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the Barrier Bank
2. Flooding from IDB Drain

1. **Overtopping of the Barrier Bank.**

The Barrier bank is the eastern bank of the Crowland Washes. The Washes are only flooded in extreme conditions (around 1 in 50 years) and are used the rest of the time as agricultural land. There are two syphons which operate automatically to allow water to flood on to the Washes and alleviate high water levels in the River Welland. When this occurs the level of water in the washes will quickly rise to around 5.00m OD.

If a breach occurred in the Barrier Bank in this scenario then flood water would flow eastwards towards the development site. In Appendix 1 (pages 9 and 10) there are predictions of the hazard and water depths that could occur at the development site if a breach occurred. These indicate the hazard is mainly in the "Low Hazard Caution" category with flood depths probably between 200mm and 300mm. However these predictions can be considered to be in excess of the true hazard because:

1) The flow of flood water eastwards would be held back by the new A16 Crowland By pass which has been constructed approximately 900mm above original field level (as shown below)



2) A large breach would result in a rapid reduction in the levels in the River Welland which would reduce the computed flow through the breach.

Therefore taking a precautionary approach it is unlikely that the depth of flood water on the fields around the development site would exceed 250mm in depth.

2. **Flooding from IDB Drain**

The normal water level in the North Level IDB maintained drain called Kings Dyke on the north western boundary of the site is approximately 0.80m OD, which is about 1.4 metres below the fields alongside the development.

IDB drains were designed to provide at least a 1 in 10 year standard of service with a freeboard of at least 900mm. This normally provides at least a 1 in 50 year standard of service against overtopping and in many cases a 1 in 100 year standard at the present time.

North level IDB have a policy of monitoring standards of protection in all their catchments and will carry out improvements to pumping stations, sluices and drainage channels to ensure they do not fall due to higher run-offs predicted with climate change.

It is unlikely that any failure of assets such as pumping stations, sluices or drainage channels would lead to overtopping of the watercourse because North Level IDB have an excellent maintenance regime and monitor all assets with a modern telemetry system.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the last 50 years. The last time that a breach occurred in the River Welland was 1947, and since that date considerable investment has been made to raise banks and provide a banks which are above the 1 in 100 year flood level.

Probabilities and Trends of Flooding

The probability of this site flooding from Environment Agency main river is very low. In an extreme event any effect on this location would not be sudden and there would be time for residents to take precautionary measures to limit the impact of any flooding that may occur.

Residual Risk

There is a residual flood risk to the site if the Barrier Bank approximately 1 to 2km south of Crowland breached when the Crowland Washes are full. Water would flood eastwards towards the proposed development site. However this flow would be stopped by the new A16 By pass which has been constructed 900mm above the level of the fields. Therefore flood water would not flow unimpeded to the site as assumed in Appendix 1.

However there are a number of culverts under the new A 16 and these would allow flood water to flow at a substantially increased rate into the area east of the new By pass. The Kings Dyke would probably fill with water and start to flood onto the fields, and there would be a risk of the development site flooding. This scenario is not likely to produce greater flood depths than shown in Appendix 1.

Conclusions

The following conclusions can be made:

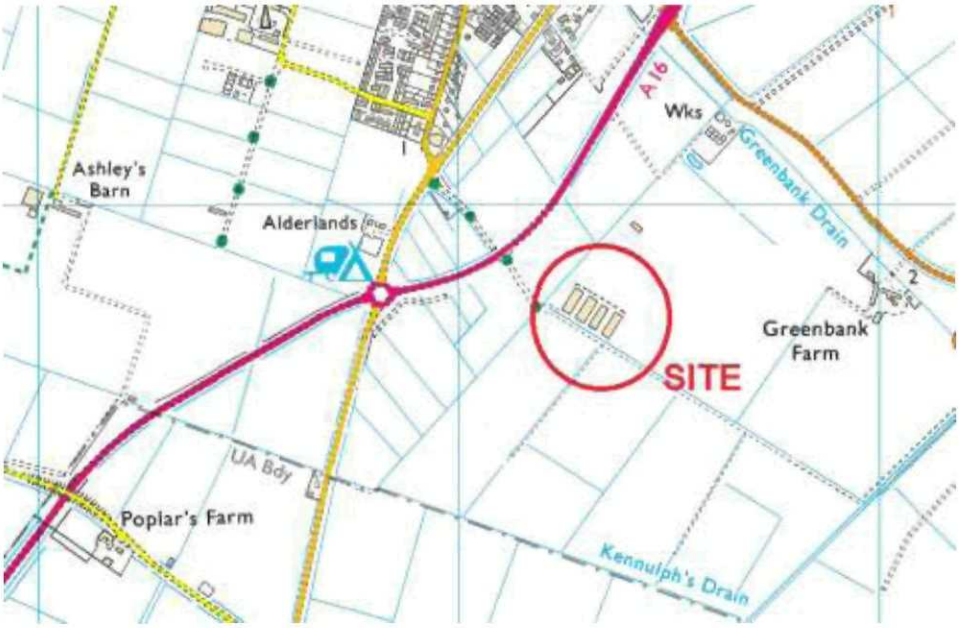
- The proposed development is not in a functional flood plain as defined by the Guidance.
- Although the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency water course is very low.
- There is no actual risk of flooding at the present time or in 2115.
- There is a residual risk that the site could flood if a breach occurs in the Barrier Bank after the Crowland Washes have been flooded. It is likely that flood water from this source would substantially increase the flow in Kings Dyke which would overflow onto the adjoining fields and the site of the development. As the risk of flooding the Crowland Washes is between 1 in 20 years and 1 in 50 years, the risk that the Barrier bank would fail is considerably less than this, and must be less than 1 in 1000
- In a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

Recommendations

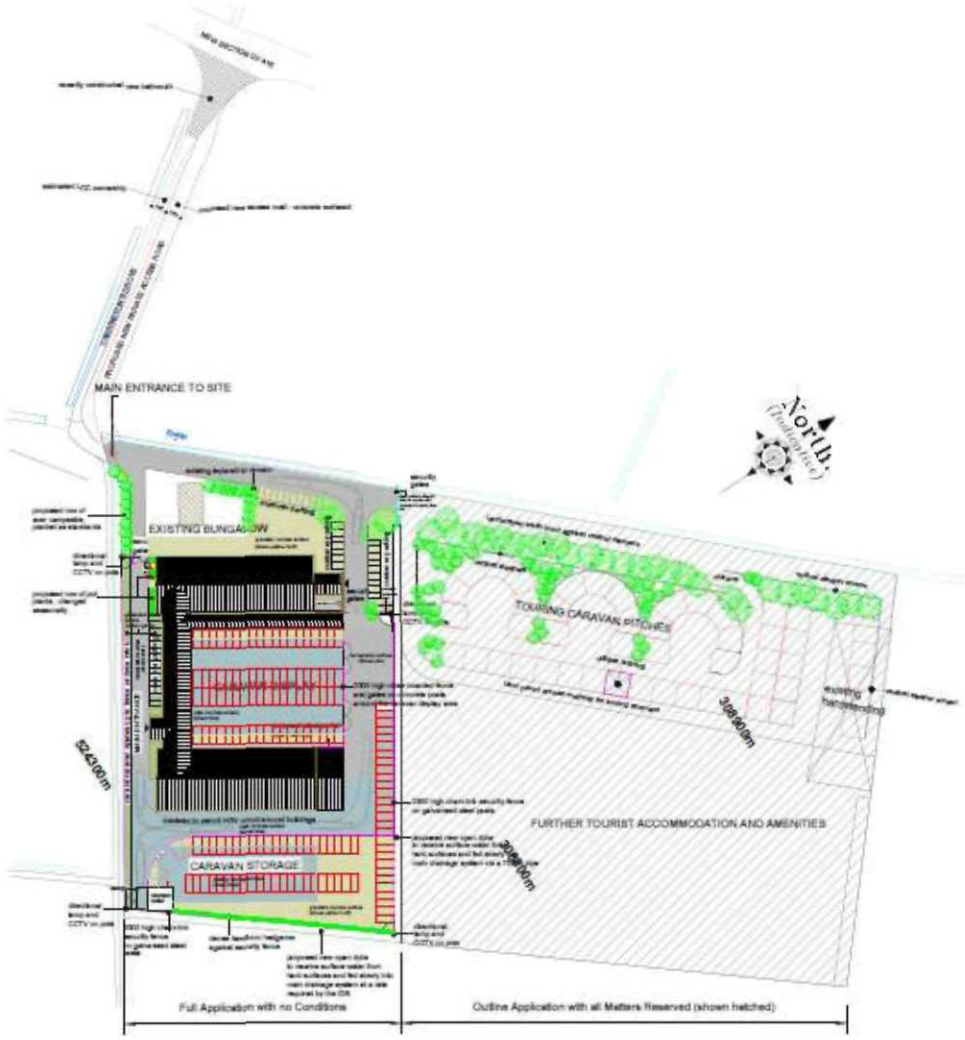
- The floor level of the proposed new extensions should be placed at the same level as the floor level of the existing poultry houses which are to be converted, and which are approximately 250mm above the level of the surrounding fields.
- Occupiers of the property should register with the Environment Agency's Floodline Warnings Direct Service. As soon as there is a warning that the Washes could be flooded the Touring Caravan site should be immediately evacuated, and preferably the owners of the touring caravans should take them away from the site to a safer place. The sales and repair buildings should also be closed until an all clear is given.
- Management of the site should prepare a flood plan, similar to outline in Appendix 2, which will detail how the situation would be managed in an emergency.
- For phase 1 on site surface water drainage will be discharged from roofs and impermeable hardstandings into a surface water drainage system which then will discharge into attenuation dykes as detailed in the Surface Water Drainage Plan. For phase 2 there will be no impermeable surfacing and no surface water drainage system.
- All future owners and occupiers of the building should be given a copy of the Flood risk Assessment so that they are fully aware of the risk of flooding in this area.

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LOCATION PLAN



SITE PLAN



APPENDIX 1

BREACH CALCULATIONS FOR BARRIER BANK

This calculation will work out an assumed volume that will flow through a 40 metre wide breach of the Barrier Bank when the water level in the flood storage area is the maximum 1 in 100 year level in 2115.

A calculation of this volume will then be carried out at the development site to work out probable water depths, velocities and hazard rating for the site in this situation.

Maximum level of the River Welland = 5.03m OD

Average level of land immediately behind the Barrier Bank = 2.0m OD

Width of breach = 40 metres

Assume the breach is a broad crested Weir

Maximum Volume through Breach = $1.7 \times b \times H^{3/2}$

$= 1.7 \times 40 \times 3.03^{3/2}$

$= 358.4$ cumecs

Velocity of water through breach = $358.4/(40 \times 3.03)$ = 3.2m/sec

The site is approximately 1450 metres from the nearest breach position.

Assume that water will be flowing away from the breach along the dotted blue line at the same depth and velocity.



The length of the dotted blue line is 0.5 x 3.142 x 1450 x 2 = 4557 metres

Therefore if we assume the same volume (358.4 cumecs) is flowing through the blue line we can work out flood depths for different chosen velocities.

For example choose velocity of 0.2 m/sec, therefore area of flow = 1792 sm

Therefore flood depth = 1792/4557 = 0.393 metres

Velocity	Flood depth	Hazard Rating	Hazard
0.2	393mm	(0.393 x 0.7) + 0.5 = 0.77	Danger for some
0.3	262mm	(0.262 x 0.8) + 0.5 = 0.63	Low Hazard Caution
0.4	196mm	(0.196 x 0.9) + 0.5 = 0.68	Low Hazard Caution
0.5	157mm	(0.157 x 1.0) + 0.5 = 0.66	Low Hazard Caution

The hazard have been worked out following the guidance shown in the Supplementary Note to FD2320 and FD2321 on Flood Hazard Ratings and Thresholds for Development Planning.

It can be seen that in the case of the higher flood velocities the hazard rating is low and for a velocity of 0.2 m/sec the hazard is only just above the 0.75 rating which bring it into the “Danger for Some” category.

APPENDIX 2

FLOOD WARNING AND EVACUATION PLAN FOR CROWLAND TOURING CARAVAN SITE

There is a risk of flooding to the Crowland Touring Caravan Site if a breach occurred in the Barrier Bank after the Crowland Washes had been flooded. The Flood Risk Assessment indicates that the flooding could be approximately 250mm deep on the fields adjacent to the site. If the flood depths exceed 250mm then the Caravan repair and Storage Buildings could become flooded.

The first visual indication of the flooding would be the rapid rise in levels of the Kings Dyke on the north west side of the development. If the water rose to the top of the Dyke flooding would start to occur on the adjoining fields. Flood water would continue to rise until either the breach was repaired or the level in the River Welland fell to a suitable level.

It is recommended that occupiers of the site should sign up to receive the Environment Agency's (EA) Floodline Warnings Direct Service. This service will telephone them to give them warnings of either FLUVIAL or TIDAL flooding.

Three levels of warning are sent by the EA:

1) Flood Alert: This will give between 2 days and 2 hours warning of very high water levels in the area.

2) Flood Warning: This will be given out when there is a greater chance of very high water levels occurring, typically between 1 day and half an hour before these high levels are likely to occur.

3) Severe Flood Warning: When the flooding poses a danger to life.

Management of the site should enquire as soon as a warning is received if the Washes are beginning to flood. As soon as they are aware that the Washes are flooding then the Touring Caravan site should immediately be evacuated, and preferably visitors should drive away from the site with their caravans to a safer location. This will most likely be around Peterborough.

If these warnings are received then visitors should prepare themselves, using their plan that they have devised. If flood water is surrounding the site caravan owners should evacuate the area but leave the caravans on the site.

Management and Visitors should particularly listen to local radio which will give information on the situation.

A safe area to evacuate to is central Peterborough where ground levels are higher than the maximum flood level possible in the area.

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PROPOSED CONSTRUCTION OF THE FENLAND CARAVAN CENTRE AT CARRINGTONS DROVE SOUTH, CROWLAND PE6 0BZ

SURFACE WATER PLAN

The construction of a new Caravan Display and Repair Centre is proposed at Carrington Drove, Crowland. This report details how the surface water will be attenuated and the flow into the IDB drain will be reduced to Greenfield rates.

Two of the four existing buildings are to be retained and used as part of the new development. At the present time these buildings have no rainwater gutters and roof water falls into a small grip behind the poultry houses. These grips drain through a100mm pipe into the dyke on the south western boundary of the development. This design assumes that when refurbished the buildings will be fitted with rainwater gutters and downpipes and the rainwater will discharge into the surface water system.

The table below shows a schedule of the impervious areas on the site:

	To Storage	Separate	Gravel
Roofs to Main Buildings	4091		
Boiler and Canopy	125		
Concrete Surface to Caravan Display	2256		
Gravel Run off Bands in Caravan Display			400
Concrete Surface to Caravan Storage	1225		
Gravel Run off Bands in Caravan Storage			1664
Concrete/Tarmac Roadways outside Secure Fence Area	1610		
Gravel Surfaces outside Secure Fence Area			1566
Existing Bungalow Footprint		146	
Existing Bungalow Garden			793
Concrete/Tarmac Roadways inside Security Fence	3333		
Gravel Surfaces inside Security Fence			761
Concrete Access Road		284	
	12640	430	5184

Design of Storage Dykes for Discharge at Greenfield rates

North Level will not charge a development fee if the rate of discharge is reduced to 1.4 cumecs /1000ha. This will be achieved by providing wide storage dykes and allowing these to discharge very slowly into the Board's drain. The area of the caravan display and storage area, which includes the various hardstandings, but not the existing bungalow, is 1.735ha. For this area the maximum discharge into the

IDB system would be 0.002429 cumecs or 2.43 litres/ second. In the table below the maximum volume of rainfall for different storm durations is worked out.

Duration	M5_60min	Z1	M5-D	Z2	M100-D	Intensity mm/hour	Areal Factor	Areal Intensity mm/hour	Area (ha)	Volume cum/hr	Vol + 30% climate Change cum/hr	Total Volume cu m
15	20	0.64	12.8	1.98	25.34	101.38	0.94	95.29	1.264	1204.509	1565.86	391.5
30	20	0.81	16.2	1.97	31.91	63.83	0.95	60.64	1.264	766.447	996.38	498.2
60	20	1	20	1.93	38.60	38.60	0.96	37.06	1.264	468.388	608.90	608.9
120	20	1.2	24	1.89	45.36	22.68	0.97	22.00	1.264	278.075	361.50	723.0
240	20	1.42	28.4	1.86	52.82	13.21	0.97	12.81	1.264	161.916	210.49	842.0
360	20	1.57	31.4	1.83	57.46	9.58	0.98	9.39	1.264	118.632	154.22	925.3
600	20	1.74	34.8	1.81	62.99	6.30	0.98	6.17	1.264	78.024	101.43	1014.3
1440	20	2.16	43.2	1.81	78.19	3.26	0.98	3.19	1.264	40.357	52.46	1259.2

From this the volume of storage required can be tabulated:

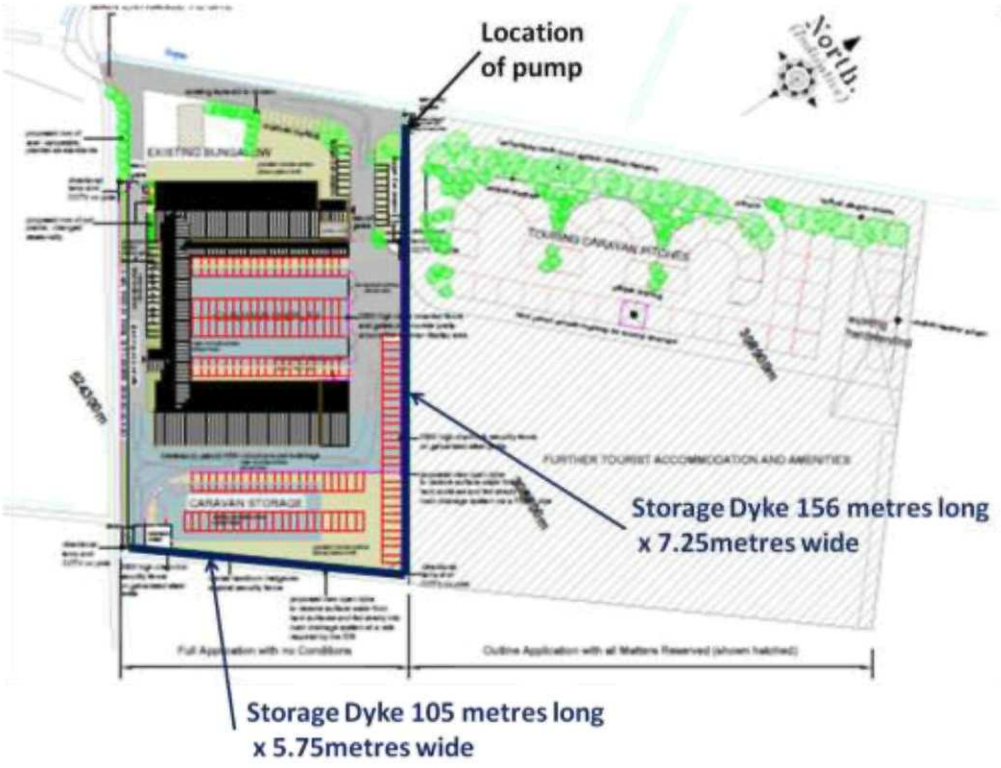
Duration	Total Volume cu m	Maximum Outflow cumecs	Outflow in storm duration	Total Volume in Storage Lagoon	Equivalent Rainfall mm	Time to Empty hours
15	391.5	0.00243	2.19	389.3	31.0	44.7
30	498.2	0.00243	4.37	493.8	39.4	56.9
60	608.9	0.00243	8.75	600.2	48.2	69.6
120	723.0	0.00243	17.50	705.5	57.2	82.6
240	842.0	0.00243	34.99	807.0	66.6	96.2
360	925.3	0.00243	52.49	872.8	73.2	105.8
600	1014.3	0.00243	87.48	926.8	80.2	115.9
1440	1259.2	0.00243	209.95	1049.2	99.6	143.9

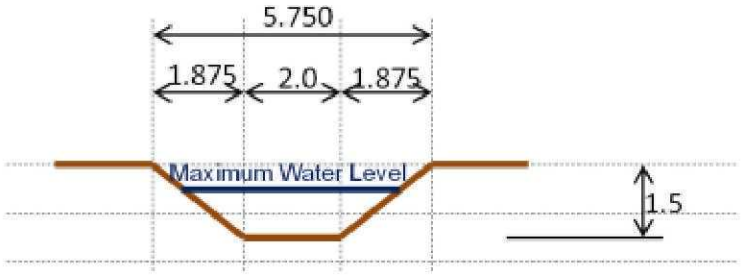
From this we can see that the volume of storage required is approximately 1050cu m and the storage lagoon would take nearly 6 days to completely empty.

The storage dykes to be used will be a 105 metre long dyke on the south east side and a 156 metre length between the development phases. The 105 metre length south east of the caravan storage area would have a base width of 2.0 metres, depth of 1.5 metres and 1:1.25 side slopes. This will make the top width of this section of storage dyke 5.75 metres. The 156 metre length between the phases would have a base width of 3.5 metres, depth of 1.5 metres, 1:1.25 side slopes and a top width of 7.25 metres The design allows for a maximum of 1.0 metre depth of water. Cross sections of the proposed dykes are shown below.

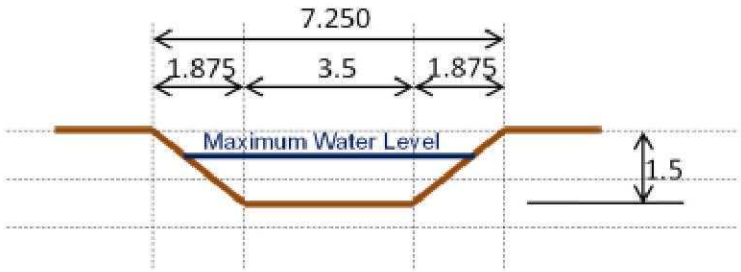
Length	Depth	Average water width	Volume
105	1.0	3.25	341.25
156	1.0	4.75	741.0

Total Storage Volume = 1082.25 cu metres





Dyke 105 metres long on South Eastern Boundary



Dyke 156 metres long in between the Phases

A very small pipe would be required to reduce the outflow into the Board's Drain to 2.43 litres per second. Therefore it is suggested that a small pump should be installed which will discharge this volume into the Board's drain on the north western boundary of the development.

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