Northern Fringe of Ipswich

Preliminary SuDS Strategy
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DRAFT

PRODUCED BY:
IPSWICH BOROUGH COUNCIL
DRAINAGE ENGINEERING SERVICES
GRAFTON HOUSE,
15-17 RUSSELL ROAD
IPSWICH

TELEPHONE: (01473) 432854
Email Denis.Cooper @ipswich.gov.uk

CONTACT: D.COOPER

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1 INTRODUCTION

This initial Sustainable Surface Water Drainage Strategy is intended to be included in a new supplementary planning document (SPD) which will guide the preparation of a master plan for a number of sites (195 Ha) on the Northern Fringe of Ipswich.

This initial strategy has been prepared broadly in accordance with the proposal dated March 2013 which was circulated to the SPD steering group.

David Lock Associate's (DLA's) draft layout received in June 2013 which includes a road layout has been used in the preparation of this strategy. Changes to this layout are suggested that would help reduce SuDS requirements.

This initial strategy and the allocation of green space need to be developed further before it can support an outline planning application. The resultant strategy will require further updates as the development progresses and as the National SuDS guidance and Standards and any local requirements become effective.

The initial strategy:

- Highlights how road / SuDS layouts affect spatial requirements for SuDS,
- Demonstrates how the SuDS strategy helps prevent worsening of flood risk and could reduce flooding in Westerfield.
- Provides information to enable typical street cross sections including swales to be provided in the SPD. Provides illustrations depicting SuDS.
- Identifies approximate space requirements for SuDS within a) Residential development areas and b) Green spaces and so informs the SPD regarding allocations of green space and development areas and achievable housing density.
- Identifies the approximate volume of excavated material arising from SuDS construction (to be disposed of on site?).
- Highlights issues associated with phasing and construction of the development – including pollution prevention and protection of SuDS that need to be addressed in the developing SuDS strategy.
- Some other issues that need to be resolved during subsequent stages of planning are identified (such as drainage of Westerfield Road and flooding at the Mersea Homes site due to limited railway culvert capacity).

2 BROAD STRATEGY

The site has predominantly clayey soil, so attenuation type SuDS which attenuate, treat and convey runoff are required. Open landscaped SuDS are proposed so some runoff will also be intercepted – i.e. lost by infiltration into the topsoil and transpiration via vegetation (up to 5mm of rainfall is absorbed).

Soakage tests have not been undertaken across the whole development area but in places there may be some limited infiltration capacity which might usefully further reduce the spatial requirement for SuDS.

Peak flows from the SuDS system will drain to the Westerfield Watercourse at no more than the green field (pre development rate) for all storms with less than a 100 year return period. An increase in volume of discharge will be prevented by provision of long term storage.

This will prevent the development from worsening flooding and water quality in the Westerfield Watercourse.

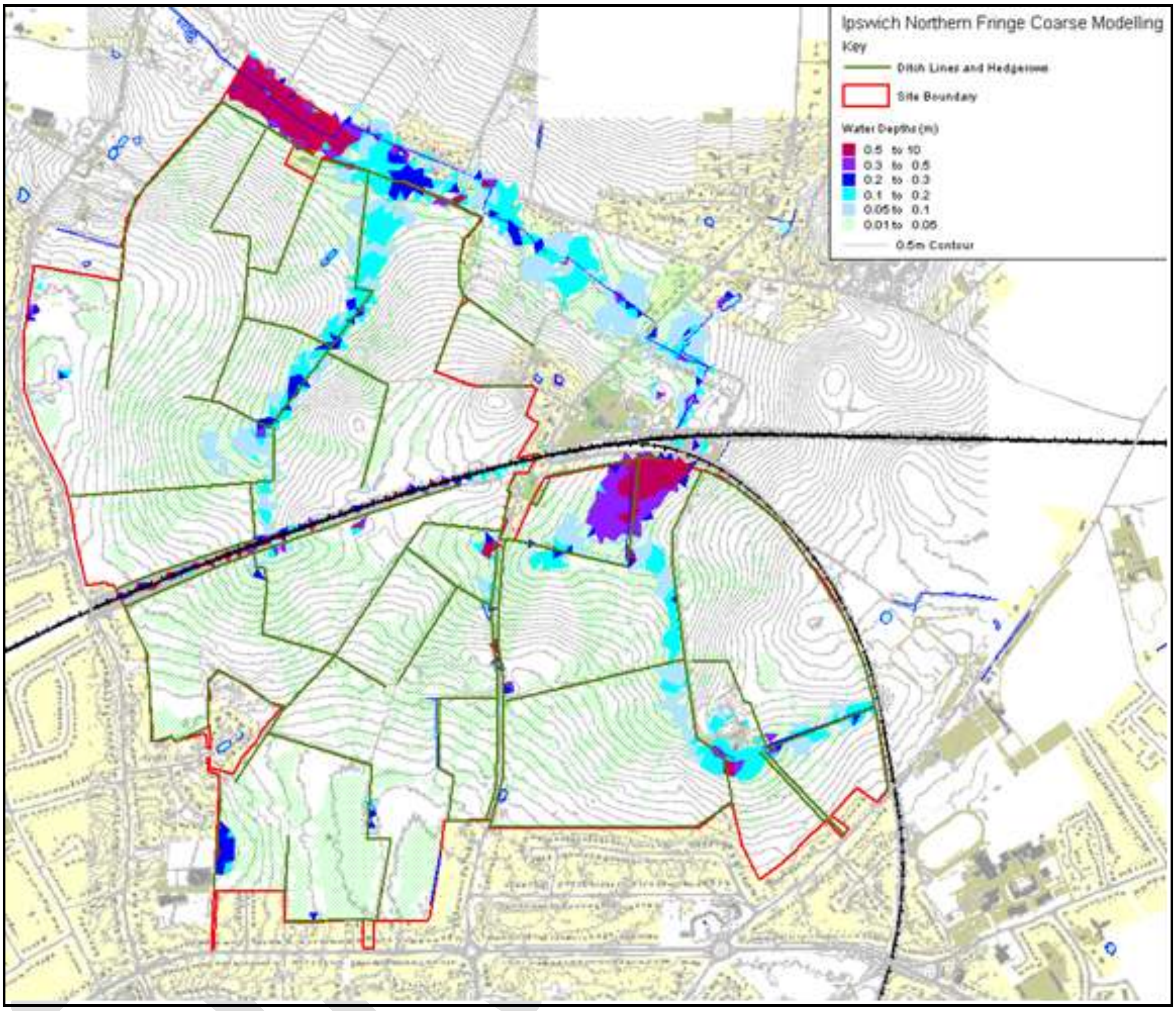
In some locations surface runoff from higher land in one ownership will have to be conveyed through lower parts of the site in another ownership.

3 EXISTING SURFACE WATER DRAINAGE

Low resolution 2D modelling undertaken using LiDAR ground level data obtained from the Environment Agency has been used to produce the following plan.
Coloured areas indicate locations most likely to flood. The areas are indicative because LiDAR data does include ditch or culvert details and 100% runoff is assumed, however they do indicate areas that are most of risk of flooding and should be used for siting strategic SuDS.

Ditches should be generally retained or improved and utilised as strategic routes for flow conveyance.

Ground level contours at 0.5m intervals are also shown



The large purple / red area just south of the railway is the area that could flood if the 634mm diameter railway culvert were to block. This culvert has limited capacity.

At present not all the development site drains to the Westerfield Watercourse; Part of the South West site including parts of Ipswich School and CBRE land drains in / on to the railway cutting and then into Ipswich and on to Dales Rd / Norwich Rd junction where it drains into the combined sewerage system. This is pumped and can overflow into the river Gipping and Orwell Estuary Orwell and flooding has occurred at Dales Rd area.

This is not an acceptable discharge route for surface water from the development.

3.1 Flooding at Westerfield

Flooding of gardens and the highway at Lower Road has been reported by several residents. Ipswich Borough Council staff visited and inspected the watercourses and now have photos and a video of flooding. Reported flooding affects the area opposite Sandy lane.

It is apparent the Ordnance Survey maps and the EA flood zone map are incorrect. They do not show the main watercourse which is routed to the South of homes in Lower Road.

The roadside watercourse with bridges / piped crossings is a tributary that flows towards the West and connects into the main watercourse just before the bridge to the property called “Westbrook”. This bridge is partially blocked by sediment.

This tributary carries flows from the highway, Sandy Lane & AW’s water supply pumping station, and another small roadside ditch that intercepts highway drainage and runoff from fields on the North side of Lower Road.

One resident, at “Chilterns”, reported flooding from the main watercourse that has occurred twice in about 30 years.

The video supplied showed flooding in December 2012. Floodwater was flowing from the ditch on the North side of Lower Rad, across and along the road towards the tributary ditch on the south side as shown below:

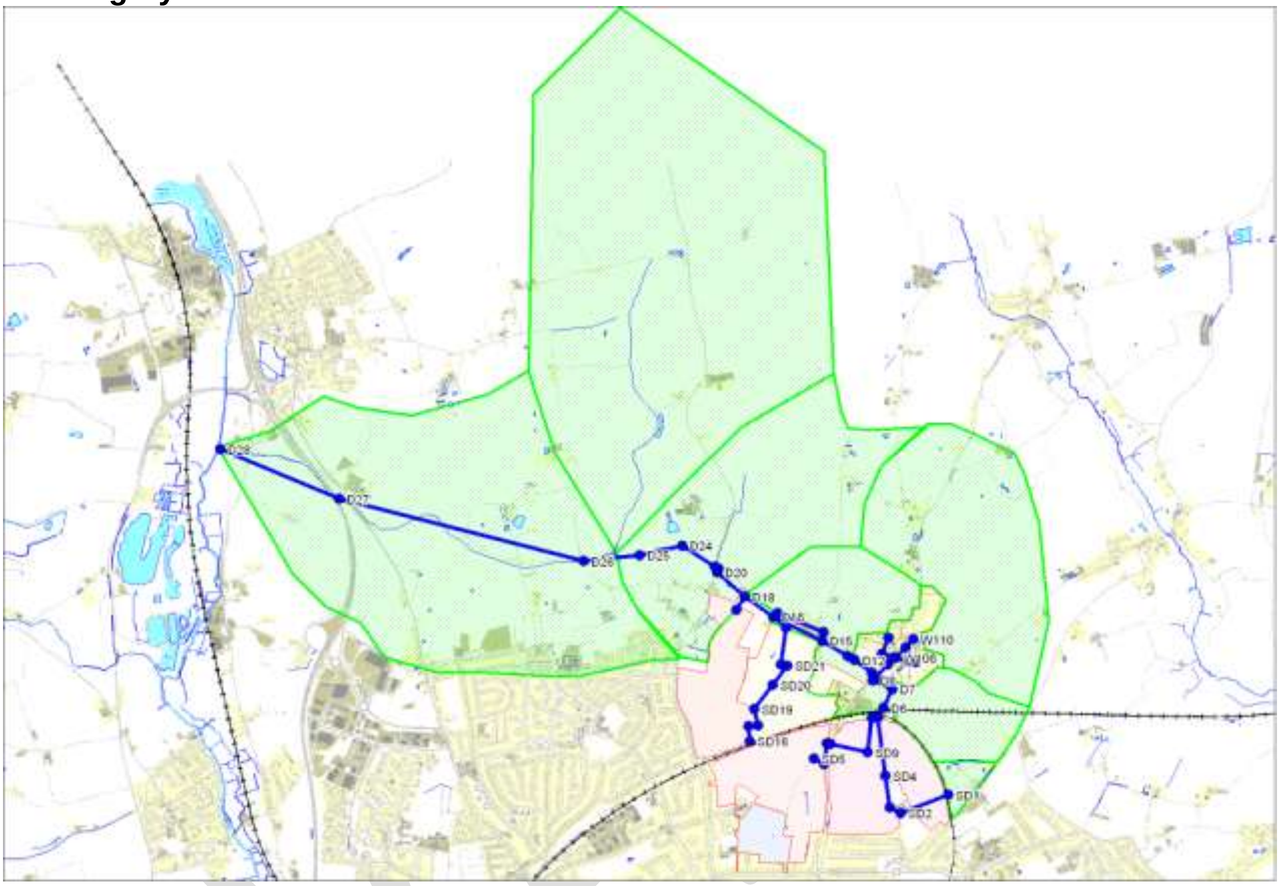
An ICM model developed by IBC uses Mersea Homes' survey data for culverts and bridges along the Westerfield watercourse. However, the downstream invert level of the 80m long culvert under the railway is unknown and was interpolated.
The channel is very overgrown and a constant trapezoidal channel section assumed with 1m base and 1 in 1 side slopes and 0.5 m depth at nodes and a "Manning's n" roughness value of 0.05.

Field ditches in the development site are also overgrown and no accurate survey data exists. Following a site inspection these were represented using 0.5m deep trapezoidal channels with 1 in 1 side slopes and 1.25m wide base and Manning's roughness 0.05.

Flows from the urbanised part of Westerfield derive from subcatchment areas with 10% road, 20% roof and 70 % pervious.

Rural inflows, including those from the proposed but undeveloped site, are represented by the following hydrographs derived using the FEH CD-ROM v3. These were initially found to use catchment descriptors relevant to permeable soils whereas local Geological Mapping and local knowledge indicates the development site is predominantly clayey. The BFI HOST was adjusted accordingly.

Existing System Model and catchments



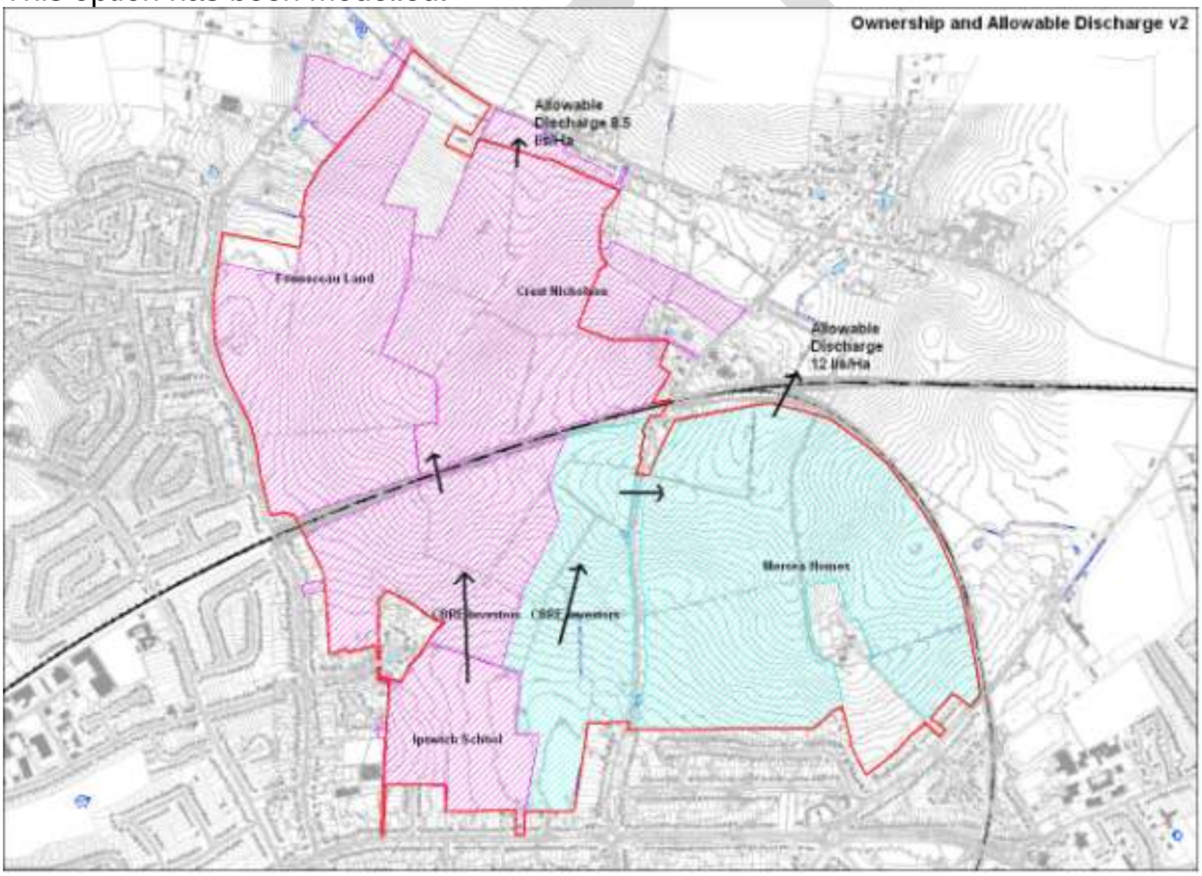
The critical duration rainfall event for flooding at Lower Rd Westerfield was found to be 720 minutes.

The model predicts flooding at Lower Rd in a 30 year return period but not a 10 year return period which is consistent with reports from residents. The base (existing) model was considered verified and then edited and copied to create a model of the developed site. (using ICM's Scenario Manager)

4 OPTIONS FOR SITE SW DRAINAGE ROUTES

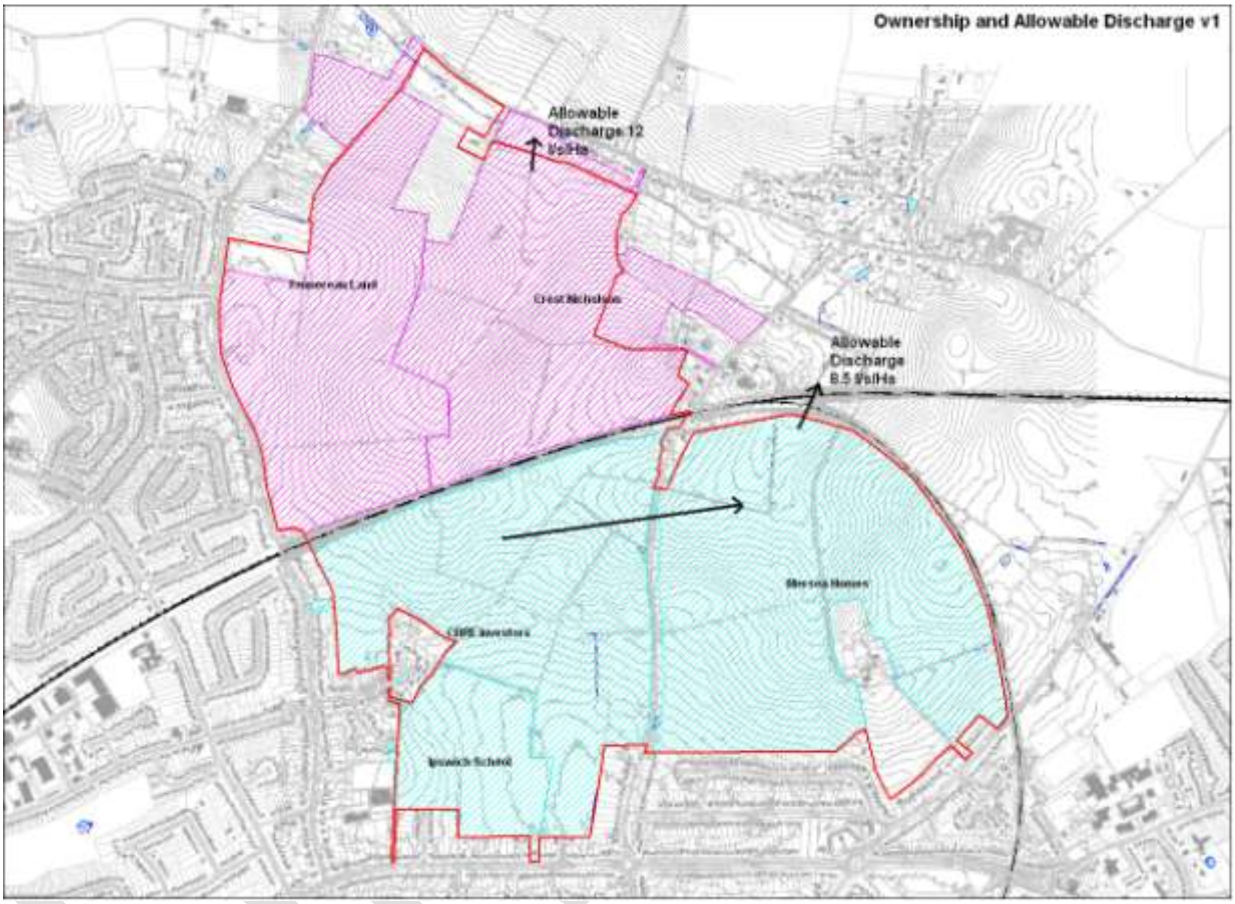
Two options exist as shown on the following plans. These indicate allowable discharges in a 100 year return period based on a 12 l/sec/ha greenfield rate from the existing development site catchment (estimated using IH124 as per JBA's FRA for Mersea Homes).

Option1 – Surface water from parts of Ipswich School and CBRE is drained back to the natural, pre-railway route, discharging into the watercourse downstream of Westerfield. A new pipe under the railway would be required. A lower allowable greenfield flow (8.5 l/sec/ha) would apply to the Western sites to ensure the additional catchment does not add to flooding problems. This option has been modelled.



A swale up to 4 metres deep and 35m wide would be required to drain surface water (SW) from the Western part of the Ipswich School site.

Option 2 shown below, drains surface water from Ipswich School and CBRE land eastwards into Mersea Homes' site and into the watercourse upstream of Westerfield. A lower allowable greenfield flow per hectare would apply to the Eastern sites to ensure the additional catchment does not add to flooding problems. This has not yet been modelled.



5 TYPE OF SUDS AND SPACE REQUIRED

For the development to proceed, both planning and SuDS Adoption Body approval will be required.

If the space requirement for SuDS and affect on street scene is not properly considered there is a high risk that any future SuDS / SW drainage application would be refused by the future SuDS Adoption Body (SAB – Suffolk CC).

National SuDS standards are expected to require open swales and basins at source which will attenuate, treat, and convey surface runoff. Wherever possible these should be multifunctional. Suffolk CC has indicated it will not adopt underground storage systems such as plastic crates in this type of development.

The proposed development will have large areas of green space and is intended to have a "garden city character" so there is expected to be sufficient space for open SuDS at source.

SUDS at source will reduce the size of downstream drainage.

6 SUDS WITHIN RESIDENTIAL AREAS

An excel workbook has been developed and used to estimate the space requirements and capacity of open swales sited in residential areas. The overall achievable housing density is also estimated. Various factors can be varied if necessary to look at local variations.

Assumptions

- Detached homes with 98 sq. m floor area and an average of 2.3 storeys
- Rear garden minimum length 9m, minimum area 75 sq. m
- Road width 5.5m
- Verge / service strip 1m wide
- Road side swales 3.7m wide 400mm deep 1 in 4 side slopes (This is the minimum size to comply with guidance and permit driveway crossings using pipes) – one each side of residential streets.

Two generic housing layouts were considered, both with road side swales as above:-

- Conventional street layout with every two homes sharing a driveway / swale crossing.

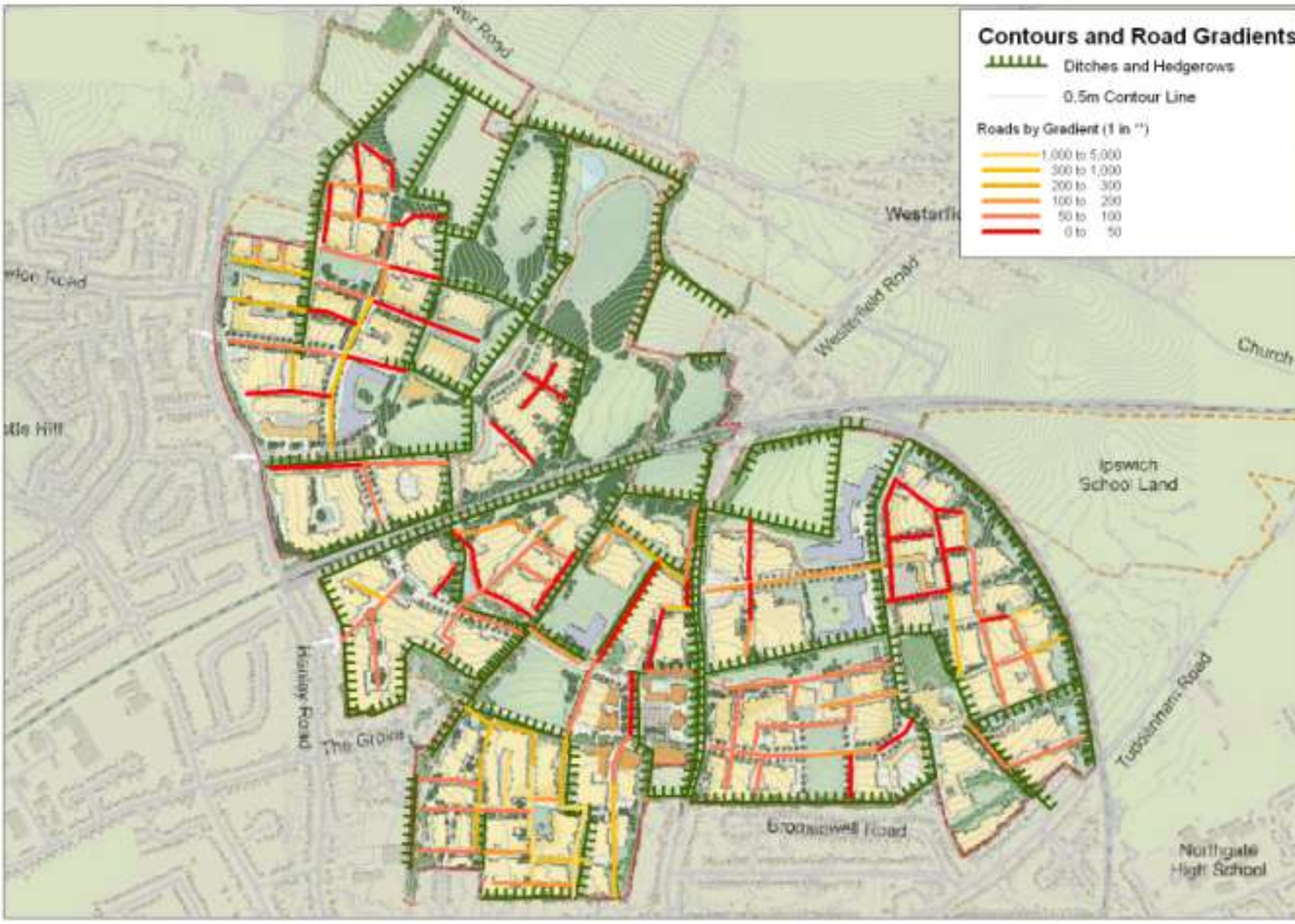
- Layout with 6 homes around a mews court, the private courtyard is assumed to be permeable paving, which helps provide attenuation storage and treatment functions. There would be fewer driveways crossing swales - which therefore would store more water.

The conclusions are:

- **An overall housing density of about 32 homes / ha appears achievable** with either a conventional street layout or with mews courts.

- **12 % of residential areas would be greenspace including verges, swales and play areas.**

The road layout shown by DLA's layout received during June 2013 was used to estimate the storage provided in swales sited either side of residential streets. The following plan highlights some of the roads which are assumed to have swales. (An adjustment was carried out to allow for missing roads and roads adjacent to district centres or schools)



The excavated volume for road side swales in the residential areas is about 25,000 m3 and area of swales 10.9 Ha (not including a 1m wide roadside grass service strip).

The amount of storage provided by road side swales (note they also have conveyance function) depends on the longitudinal gradient of the roads.

Roads & swales following contours will be more effective. More storage would be provided if the roads coloured red on the above plan could be aligned more closely with contours.

If all homes were sited conventionally alongside roads, the swales would provide at least 12,500 m3. (Attenuation + interception + treatment storage).

If all homes were sited in mews courts, the swales and permeable paving serving the courts would provide at least 20,000 m3

A mix of housing layouts with residential road side swales providing 10,680 cu m of attenuation storage, 818 cu m of interception storage and 5,085 cu m of treatment storage is assumed in the following estimates. (With interception and attenuation storage totalling 11,497 cum - for a mixed layout with approx. 50% mews and 50% conventional)

The following table shows the storage capacity in residential swales in each land area.

	Attenuation Volume Provided within Residential Swales (m3)	Interception Storage Volume Provided within Residential Swales (m3)	Attenuation + Interception Storage Provided within Residential Swales (m3)	Treatment Storage Volume Provided within Residential Swales (m3)
Mersea S	2361	153	2,514	739
Mersea N	561	41	602	237
CBRE E	1604	120	1,724	858
Ipswich School	2437	229	2,666	1,823
CBRE W	1214	74	1,288	395
Fonnereau S	2160	176	2,336	981
Crest	168	12	180	0
Fonnereau N	175	12	187	52
Totals	10,680	817	11,497	5,085

The above figures include storage provided in permeable paving – which will drain into the swales. The area of permeable paving is about 7.45 Ha - assumed to be in the mews courts only - about 37 sq. m per home.

7 SUDS IN STRATEGIC GREENSPACE - SW ROUTE OPTION 1

7.1 Initial SUDS Requirements for SW route Option 1

Initial estimates of SuDS storage required in each site (land ownership) were made using UK Sustainable Drainage Guidance and Tools web site (HR Wallingford). http://geoservergisweb2.hrwallingford.co.uk/uksd/

Contributing areas were measured in MapInfo using a copy of Masterplan Option 2 from David Locks in October 2012.

The workbook found the percentage impermeable (PIMP) was similar for the Mews court and Conventional housing layouts - as shown below.

Roof and paved areas were estimated by applying the following percentages to the contributing areas:

	Residential Land	School	District / Local Centre	Green Space
% Impermeable	60%	40%	100%	10% runoff
% Paved	40%	20%	50%	0%
% Roof	20%	20%	50%	0%
% Pervious	40%	60%	0%	90%

Initial SuDS storage requirements are listed below. Note some revisions are made to the storage requirements following testing using the ICM model.

Initial estimated SUDS requirements for Residential Areas SW route - Option1

			Estimated SUDS storage requirement						
Land area / main owner	Total Area (Ha)	Impermeable Area (Ha)	Interception (cu m)	Attenuation (cu m)	Long Term (cu m)	Treatment (cu m)	Nr of homes based on 32/Ha	100 Yr RP Allowable Discharge (l/s/ha)	100 yr RP Allowable Discharge l/s
Mersea S	32.79	19.67	787	12,426	163	2,360	1049	12	393
Mersea N	5.52	3.31	132	2,087	27	397	177	12	67
CBRA E	10.34	6.21	248	3,925	55	745	307	12	124
CBRE W	14.43	8.66	346	6,059	74	1,039	486	8.5	124
Ipswich School	10.40	6.24	250	4,371	52	749	333	8.5	89
Crest	7.08	4.25	170	2,980	37	510	226	8.5	60
Fonnereau S	23.01	13.81	552	9,671	118	1,657	736	8.5	196
Fonnereau N	1.19	0.71	28	499	4	85	38	8.5	10
Totals	104.76	62.86	2,514	42,019	530	7,543	3352		1062

Initial estimated SUDS requirements for District centres and Schools

			Estimated SUDS storage requirement					
Land area / main owner	Total Area (Ha)	Impermeable Area (Ha)	Interception (cu m)	Attenuation (cu m)	Long Term (cu m)	Treatment (cu m)	100 Yr RP Allowable Discharge (l/s/ha)	100 yr RP Allowable Discharge l/s
Mersea S	8.29	0.15	6	0	0	18	12	98
Mersea N	12.45	4.36	174	2,039	0	523	12	150
CBRA E	17.17	3.41	136	524	0	409	12	206
CBRE W	1.01	0.00	0	0	0	0	9	9
Ipswich School	1.83	0.00	0	0	0	0	9	16
Crest	27.41	0.00	0	0	0	0	9	233
Fonnereau S	8.96	1.54	62	151	0	185	9	76
Fonnereau N	2.91	0.00	0	0	0	0	9	25
	7.89	0.00	0	0	0	0	9	67
Totals	87.93	9.45	378	2,715	0	1,135		879

This method overestimates storage requirements, especially for very large sites and the ICM model was used to refine the above storage estimates and demonstrate the development will not worsen flooding in Westerfield as follows.

7.2 Post Development ICM Model – SW Route Option1

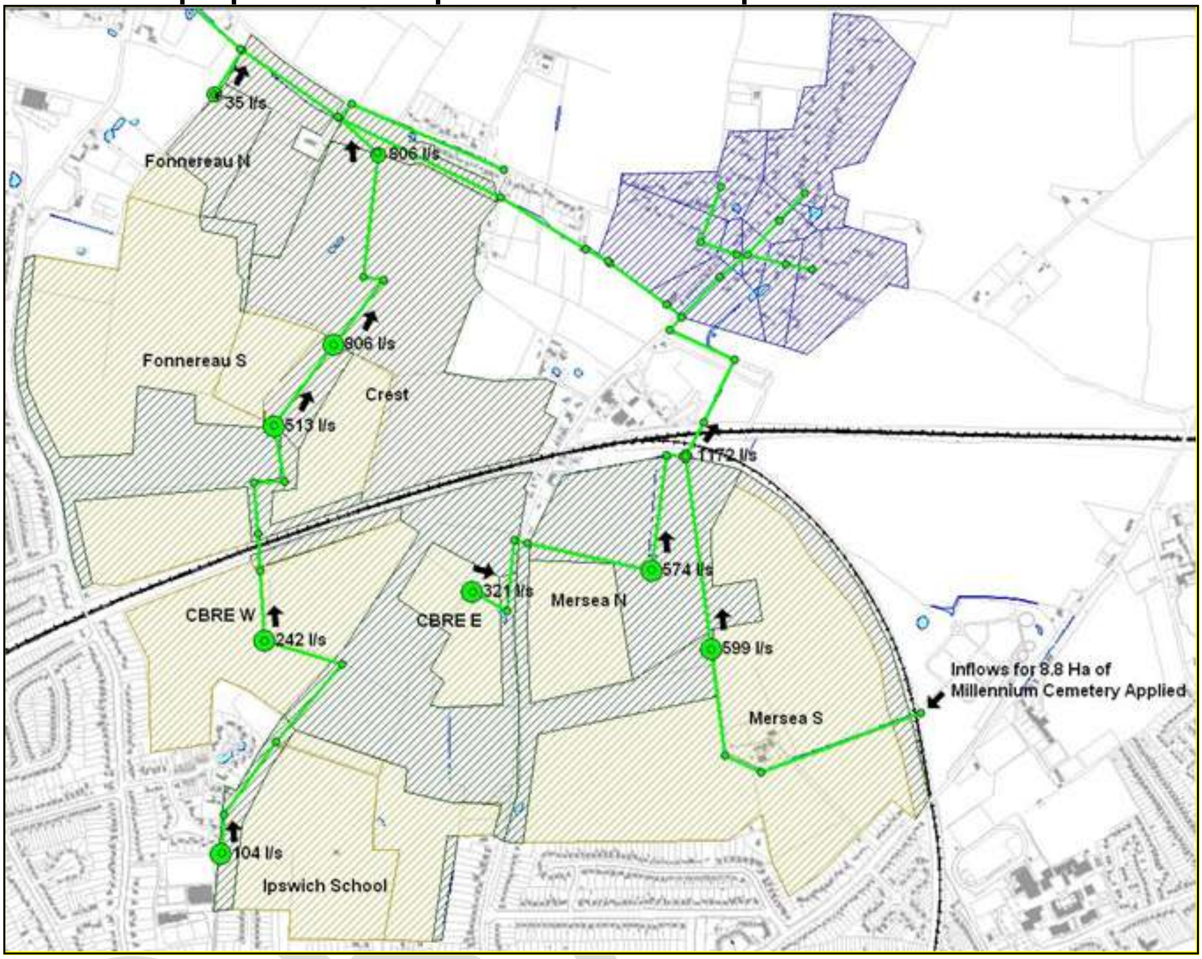
The model of the existing system was edited to represent the post development situation. SuDS are greatly simplified and represented as just 10 nodes i.e. - one or two for each land ownership. At each of these nodes multiple open swales or basins are represented by a 0.5m deep tank with a flow control. Interception storage is provided by reducing the floor level of the node below the outlet.

All inflows from the development are from subcatchment areas, all other flows are applied as for the existing scenario. Inflow hydrographs from rural areas are included later in this report.

Flow controls were set to pass the allowable discharges for the 100 year RP including 106 l/sec from the Millennium cemetery along the upstream part of the Westfield Watercourse. The resulting allowable, controlled flows gradually increase down the drainage system as shown below.

Whilst an allowable flow of 1172 l/sec is shown from Mersea Homes N Site under the railway this flow cannot pass through the culvert without flooding. The culvert cannot be improved to increase pass forward flow because this will increase flooding in Westerfield.

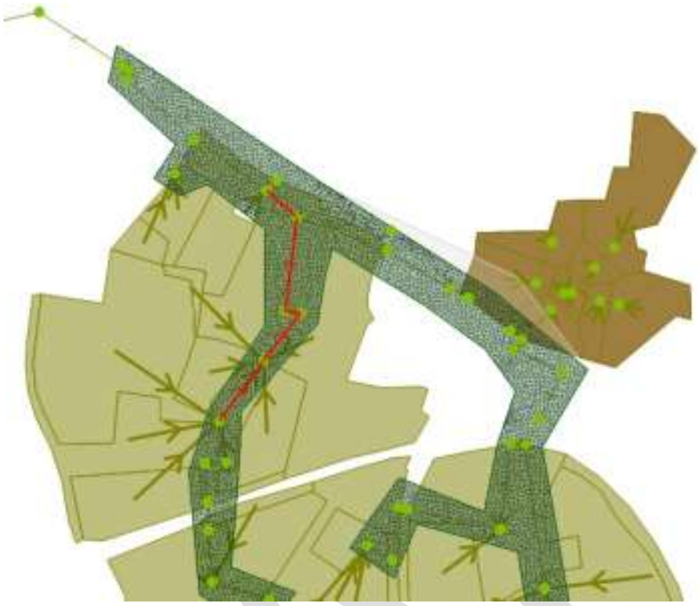
Model with proposed development – SW route Option1.



Large nodes represent SUDS in each land ownership. In reality SUDS would be spread across the development.

The two nodes adjacent to the two final discharge points to the Westerfield watercourse included long term storage to limit volumes. 250 cu m for the East outfall and 280 cu m for the Western outfall. Allowable discharge from these is set at 2 l /sec/Ha. Once full, these nodes overflow via a weir to the watercourse.

Ditch sections had to be upsized to 3.5 m wide at locations shown below in order to carry the allowable flows. These widened ditches would form part of the SuDS storage and are only included in post development models.



The proposed new pipe under the railway from CBRE land to Fonnereau land will need to be designed to carry the 242 l/sec greenfield flow without surcharging.

Initially storage volumes in the nodes representing SuDS were the sum of the attenuation volumes for residential areas, district centres and schools from the tables on the previous page. This storage was adjusted until each storage node just filled in a 30 year RP. Various storm durations were tested (the critical duration for most nodes within residential areas was 240 minutes). In most cases the storage requirement reduced as expected however for the Mersea Homes N and the CBRE E nodes it increased because the railway culvert restricts flows and causes “backing up”.

The critical storm duration for the post development scenario for flooding and flows in the Westerfield Watercourse was found to be 720 minutes with both pre and post development scenarios.

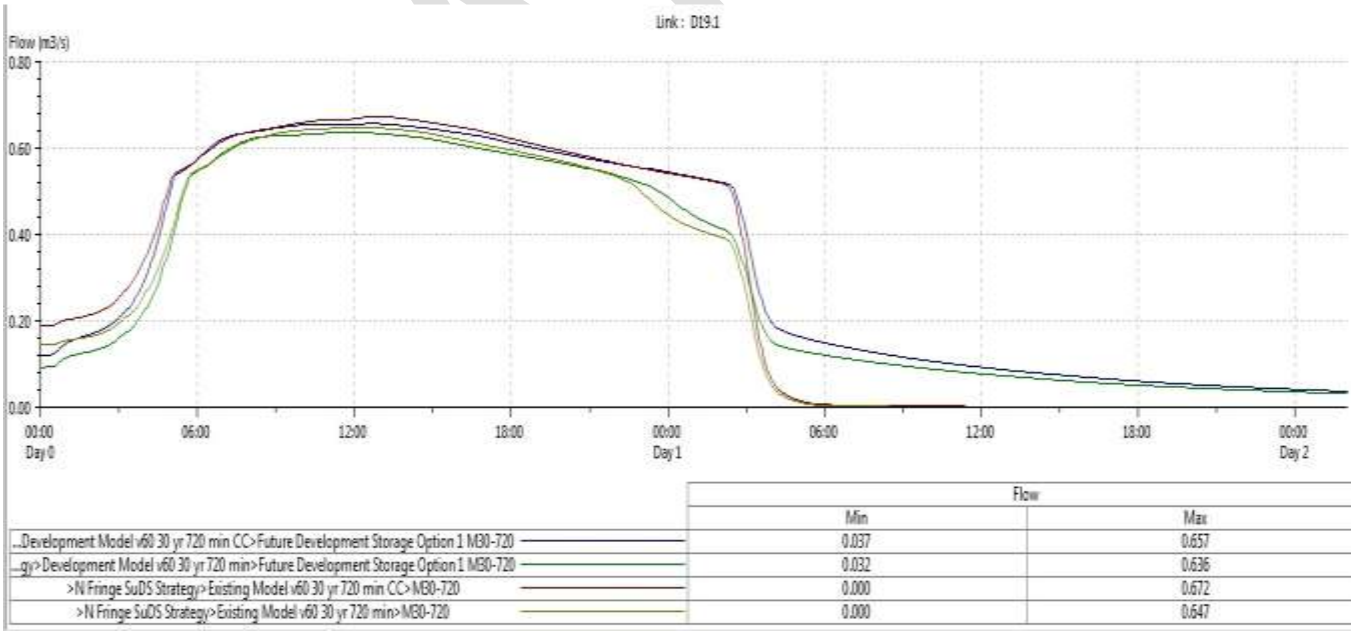
7.3 Affect of Development on Flooding at Westerfield – SW Route Option1

Simulations undertaken to compare pre and post development scenarios provided the following results with and without the expected effect of climate change over 100 years:

		No Development		With Development		
		Now	100 yrs time	Now	100 yrs time	Acceptability
Max Flow through Watercourse (Q) (l/s)	100 yr	676	706	658	681	OK
	30 yr	647	672	636	657	OK
	2 yr	591	615	580	606	OK
Water Depth in rear Garden of Chiltern (m)	100 yr	0.073	0.101	0.064	0.087	OK
	30 yr	0.039	0.071	0.037	0.063	OK
	2 yr	0	0	0	0	OK

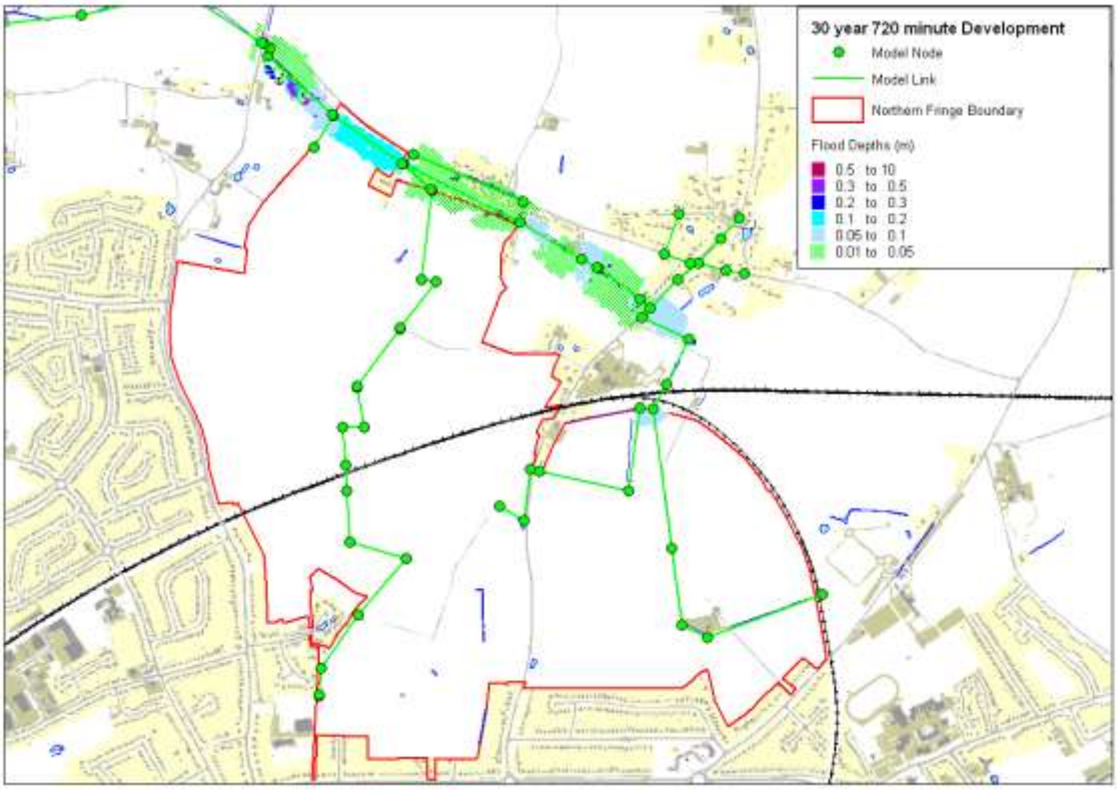
This table demonstrates **the SuDS strategy can enable the development to proceed without worsening flooding at Lower Road, Westerfield.**

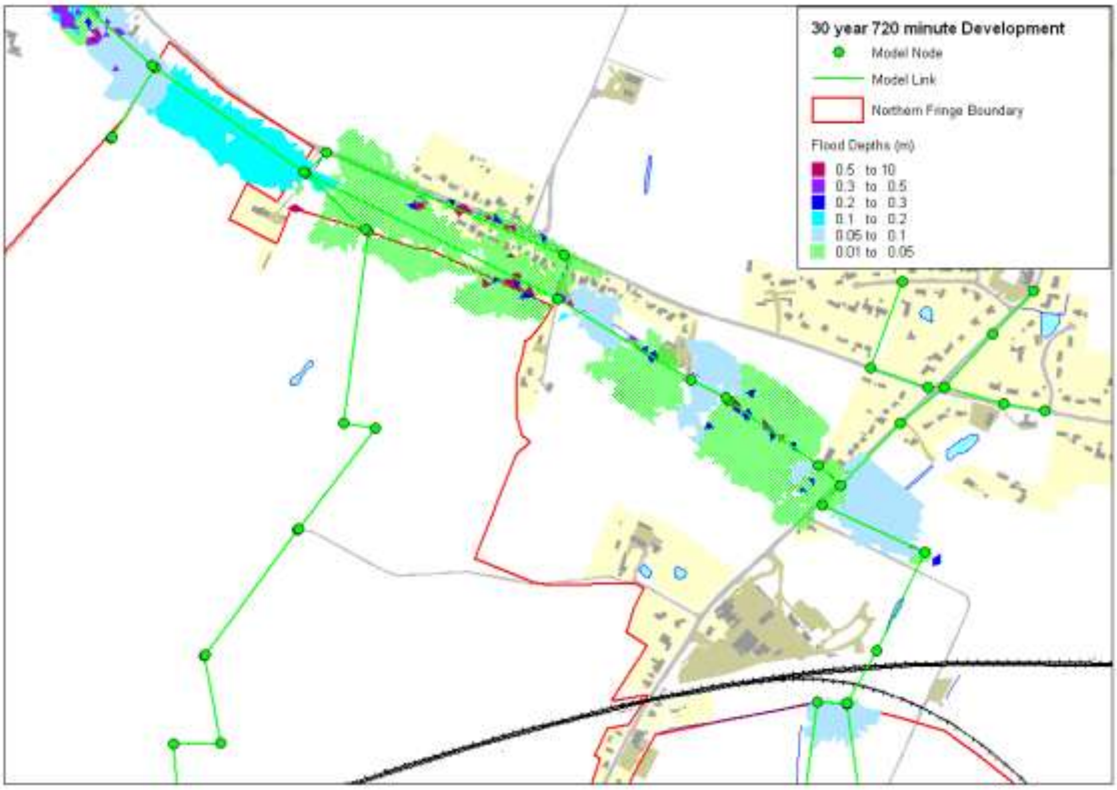
The graphs below compare predicted flows for the pre development and post development scenarios for a 30 year return period with the critical duration of 720 minutes at a point just downstream of Westerfield. These confirm a reduction in peak flows.

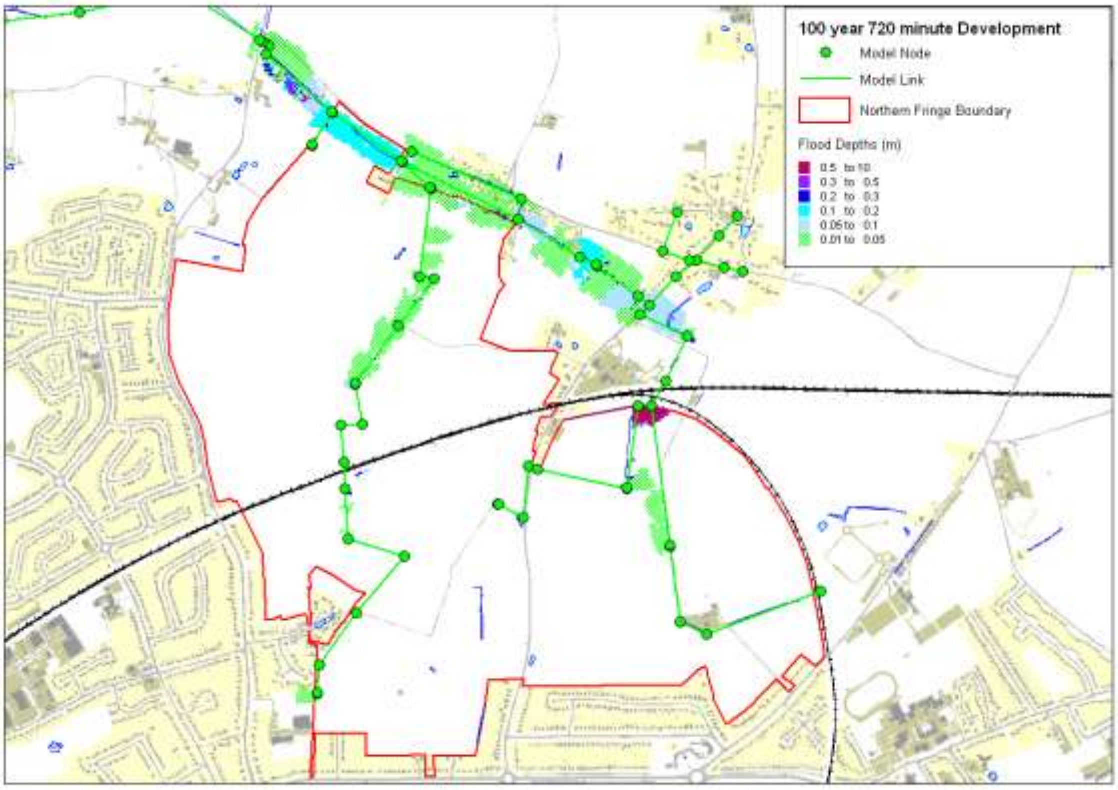


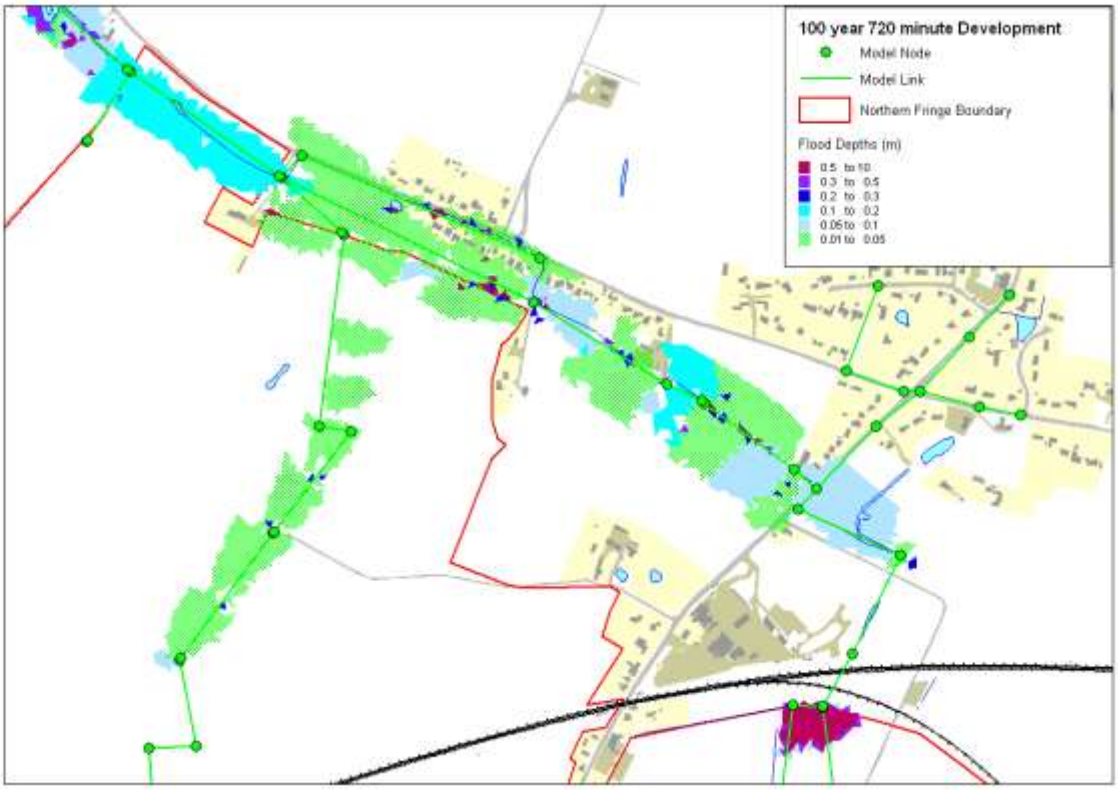
Graphs are similar for other return periods.

The following maps show predicted flooding in two extreme events in 100 years' time (allowing for climate change)






100 year 720 minute Development
Model Node
Model Link
Northern Fringe Boundary
Flood Depths (m)
0.5 to 10
0.3 to 0.5
0.2 to 0.3
0.1 to 0.2
0.05 to 0.1
0.01 to 0.05


100 year 720 minute Development
Model Node
Model Link
Northern Fringe Boundary
Flood Depths (m)
0.5 to 10
0.3 to 0.5
0.2 to 0.3
0.1 to 0.2
0.05 to 0.1
0.01 to 0.05

7.4 Estimated SUDS Volumes and Areas – SW Route Option 1

The space taken up by swales in residential areas as described above was 10.9 Ha.

With the current road layout, the storage capacity of swales in residential areas in each land area is insufficient. Thus additional storage for residential areas will be needed in strategic green space and/or schools.

The residential swales will therefore drain into the strategic SUDS which would be interconnected by existing ditches and some strategic conveyance swales.

The volume of SuDS required in strategic green space and schools was estimated by subtracting the capacity of residential swales from the required modelled volumes in the ICM model as follows:

Estimated volumes & areas required for SUDS in Strategic Green Space & Schools for attenuation and interception storage

Average depth of water stored in Strategic Green Space & Schools 0.45 m

	Attenuation + Interception Storage Provided within Residential Swales (m3)	Initial Estimate of Total Interception +Attenuation Storage Required (m3)	Adjusted Total Attenuation & Interception Storage requirement following modelling (m3)	Volume of Storage Required within Strategic Green Space (m3)	Approximate Area of SuDS Required within Strategic Green Space and schools (m2)
Mersea S	2,514	13,218	11,204	8,690	19,311
Mersea N	602	4,432	4,529	3,927	8,726
CBRE E	1,724	4,832	5,433	3,709	8,242
Ipswich School	2,666	4,620	3,701	1,035	2,301
CBRE W	1,288	6,405	4,709	3,421	7,602
Fonnereau S	2,336	10,436	9,119	6,783	15,073
Crest	180	3,146	3,344	3,164	7,031
Fonnereau N	187	526	435	248	551
Totals	11,497	47,615	42,474	30,977	68,837

Areas of SUDS in green space are estimated based on an average depth of water stored of 0.45m. This depth was calculated assuming a typical SuDS basin would have a trapezoidal cross section with a flat base and side slopes of 1in 4. The maximum depth of water would be 0.5m in a 100 year return period. Such a basin would be typically formed by damming the main valley plus excavation.

Long Term storage requirements in the final SUDS basins sited close to the Westerfield Watercourse are 250 cum at the East outfall and 280 cum for the western outfall. However, up to about 4,700 cu m of additional treatment storage may need to be included if velocities of flow through the upstream attenuation and interception SuDS are too high (i.e.> 0.3m/sec in a 1 in 1 year storm event). The additional storage should be sited below the long term storage areas to help prevent pollution of the watercourse during the construction phase. These ponds could therefore be permanent water up to, say 2m deep. With this depth gentle side slopes would be required with deterrent emergent planting and other safety measures.

Thus the above permanent ponds may each need to be up to about 2,000 sq m (45m X 45m) with the water level fluctuating about 200mm as the long term storage fills and empties. However the pond at Mersea Homes (N) may also flood to a much greater depth and extent (see flood map) due to surcharging of the railway culvert.

Other swales or flood paths/ditch widening identified so far are:

- To drain Ipswich School site as shown on pages 9 & 10 - Area 1.08 Ha
- To provide extra conveyance capacity in Crest land (proposed park) very approximate 0.6 Ha
- To convey attenuated flows from N Fonnerau land to Westerfield water course 0.13 Ha

Thus, SUDS could take up about 8.6 Ha of strategic green space and school sites and 10.9 ha of residential land. Apart from the final treatment and long term storage ponds, most of the time the SuDS would be green spaces.

A very preliminary layout showing 75 Strategic SuDS basins required in addition to the residential road-side swales follows.

Indicative Strategic SuDS - SW Route Option 1

SUDS in Strategic green space are shown in light blue are required in addition to road side swales in residential areas.

The total area of SUDs shown on the plan approximates to the requirement estimated in the preceding table.

The purple area is the area flooded in a 100 year RP event with climate change due to lack of capacity in the adjacent railway culvert.

Dark blue indicates existing ponds (which should be retained) and some key watercourses.

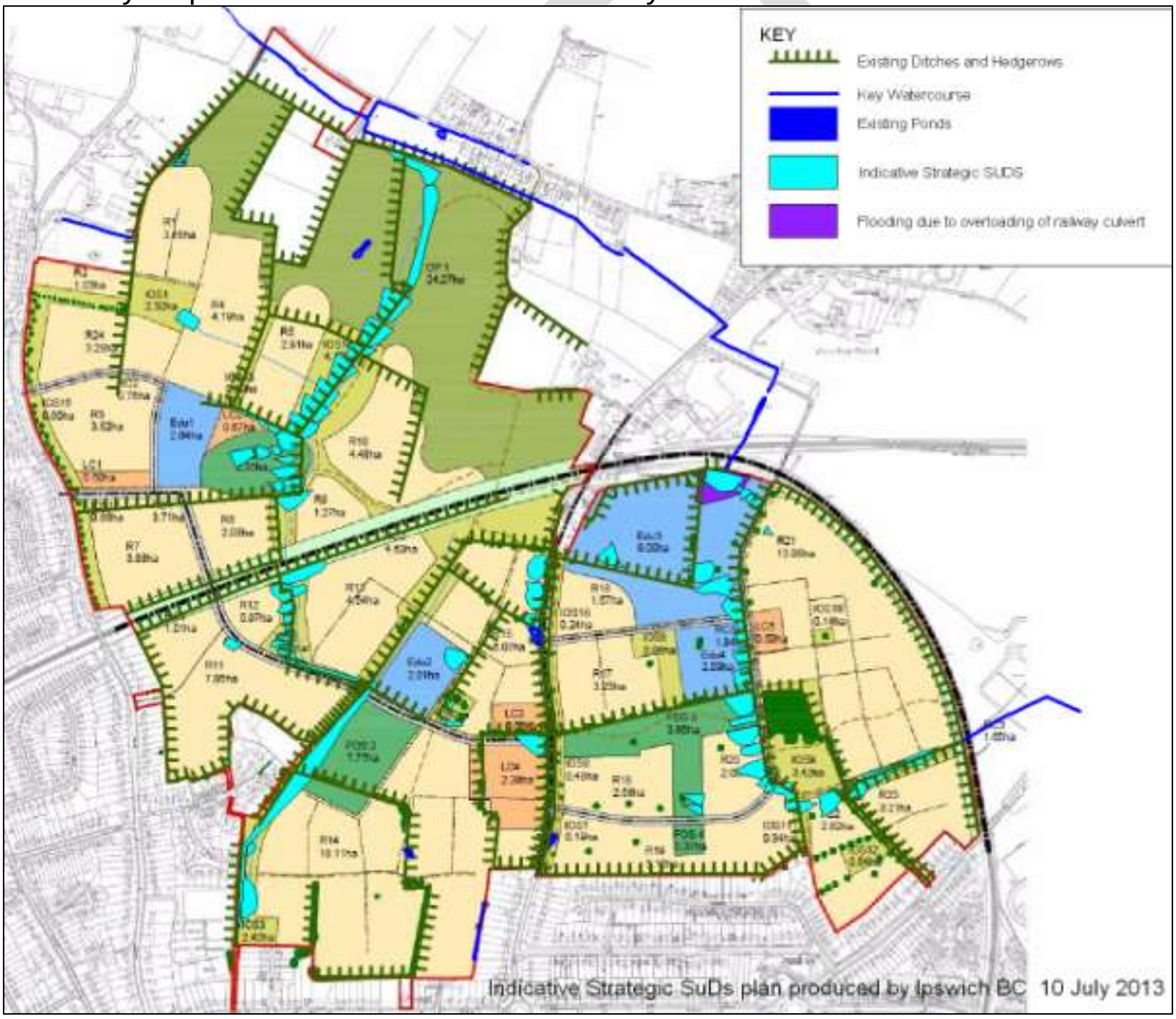
Individual basins have been located and sized using engineering judgement guided by contours, the development layout plan and predicted flooding locations. No account has been taken of existing trees, hedges or of any potential soil infiltration.

The final size and location of basins would need to be determined using computer modelling for inclusion in detailed planning and SAB applications. Basins need to be close to the areas they serve in order to prevent high velocities of flow in the conveyance swales and ditches. SuDS will need to be located to avoid damaging protected hedges or trees.

In several locations insufficient green space has been allowed in development layout plan in valley bottoms and the SUDS and flood paths impinge on proposed buildings.
Overall there is sufficient space for SuDS but some localised re-allocations of green space are necessary. The development master plan will be expected to show a layout with sufficient space in the correct locations.

Strategic SuDS requirements would probably reduce following detailed modelling and could be reduced if the roads coloured red or orange on the plan are aligned more closely with contours (this would increase storage within residential swales.)

The SuDS shown on the above plan are repeated below, overlaid on the most recent layout plan received from DLA on 10 July.



Road side swales and permeable paving required in residential areas are not shown on this plan.

7.5 Phasing – SW Option 1

The long term and treatment storage ponds adjacent to the Westerfield watercourse should be constructed first to prevent sediment laden site runoff from affecting the watercourse. No flows from the development should be allowed to enter the railway cutting or track drainage.

SUDS in strategic green spaces should be built as the green spaces are created in advance of the upstream development and installation of foul sewerage or other services that are required in close proximity to SUDS.

Water should not enter SUDS basins until vegetation is established.

As the development proceeds sufficient SUDS need to be provided to prevent an increase in downstream flood risk.

It appears only the small (4 Ha) Fonnereau N site and Mersea Homes Land can be drained independently of the others. In such a circumstance, within the Mersea Homes land, strategic swales, ditches etc. would need to be provided to enable flows from future upstream developments to connect.

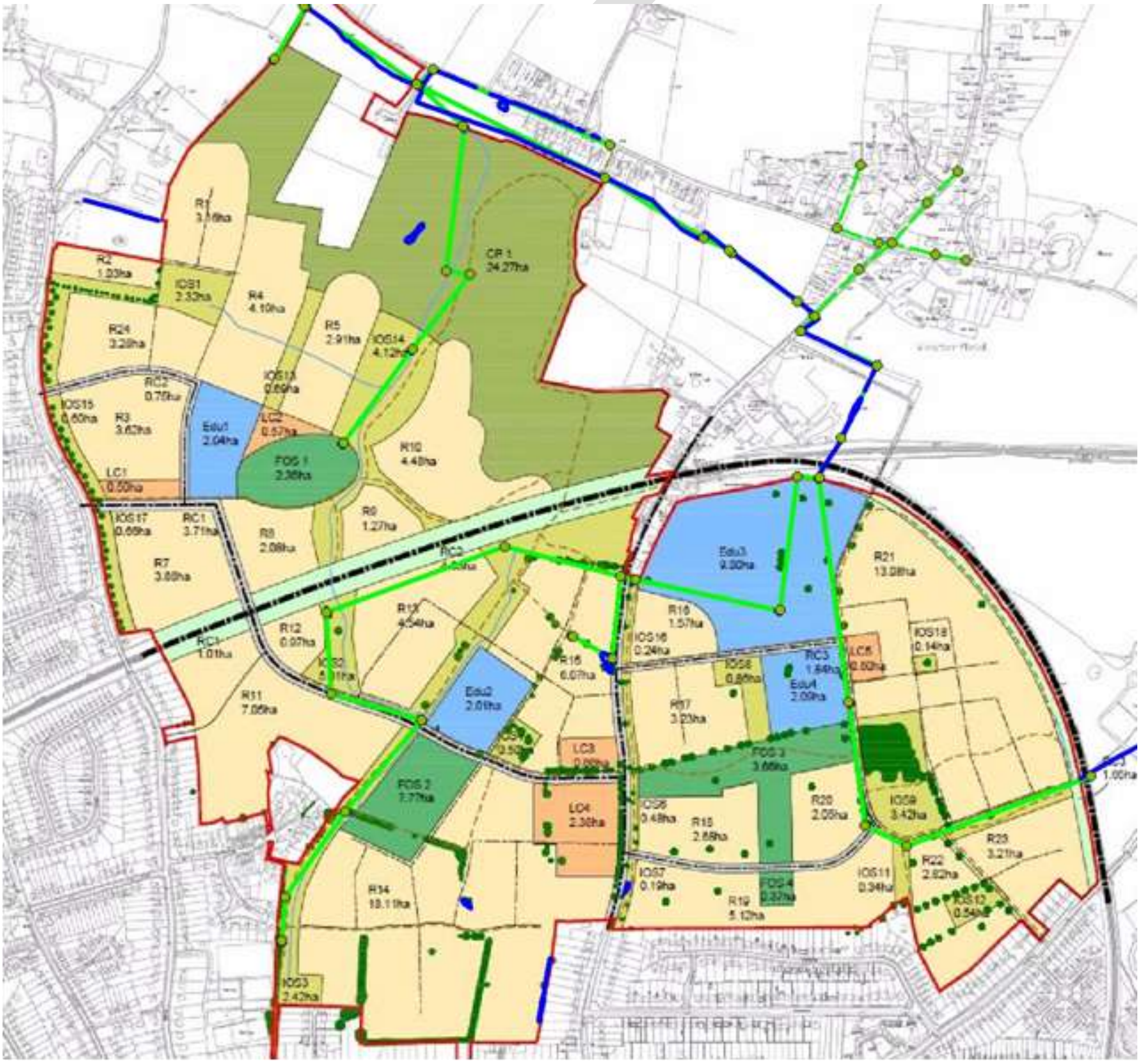
If Phase 1 is to be the CBRE and Ipswich School land between Westerfield Road and Henley Rd, then the new railway culvert would be required as well as the deep swale to drain the Ipswich School Site. Some additional attenuation SUDS may be needed to prevent flooding of Mersea Homes' or Fonnereau / Crest land along with 2 long term storage/treatment ponds - these might be provided as additional temporary storage within CBRE land.

8 SUDS IN STRATEGIC GREENSPACE - SW ROUTE OPTION 2

This option drains surface water from Ipswich School and CBRE land eastwards through Mersea Homes' land and avoids the need for new pipe crossing the railway.

Residential swales are assumed to be the same as for Option1

The preliminary model network for this option is shown below in green overlaid on DLA's July 2013 layout.



SuDs will need to be larger in the eastern parts of the development - i.e. Mersea Homes and (CBRE East) land. Thus more land will need to be allocated as strategic green space along the valley bottoms.

In addition a new swale is required parallel to the railway. This could be up to 2-3m deep and 25m wide. Alternatively ground levels in the low area adjacent to the railway might be raised and the swale routed to the South

SUDS will be smaller in sites N of the railway.

Modelling for this option has not been completed but will need to be if the developers want a second option put forward in the development master plan

Initial estimated SUDS requirements for Residential Areas – SW route Option 2

			Estimated SUDS storage requirement						
Land area / main owner	Total Area (Ha)	Impermeable Area (Ha)	Interception	Attenuation	Long Term	Treatment	Nr of homes based on 32/Ha	Green field Discharge (l/s/ha)	100 yr RP Green Field Discharge l/s
Mersea S	32.79	19.67	787	13,793	163	2,360	1049	8.5	279
Mersea N	5.52	3.31	132	2,313	27	397	177	8.5	47
CBRA E	10.34	6.21	248	4,342	55	745	0	8.5	88
CBRE W	14.43	8.66	346	6,059	74	1,039	0	8.5	123
Ipswich School	10.40	6.24	250	4,371	52	749	333	8.5	88
Crest	7.08	4.25	170	2,677	37	510	226	12	85
Fonnereau S	23.01	13.81	552	8,707	118	1,657	736	12	276
Fonnereau N	1.19	0.71	28	450	4	85	38	12	14
Totals	104.76	62.86	2,514	42,713	530	7,543	3352		1000

Initial estimated SUDS requirements for District centres and Schools – SW Route Option2

			Estimated SUDS storage requirement					
Land area / main owner	Total Area (Ha)	Impermeable Area (Ha)	Interception (cu m)	Attenuation (cu m)	Long Term (cu m)	Treatment (cu m)	100 Yr RP Greenfield Discharge (l/s/ha)	100 yr RP Greenfield Discharge l/s
Mersea S	8.29	0.15	6	0	0	18	9	70
Mersea N	12.45	4.36	174	2,328	0	523	9	106
CBRA E	17.17	3.41	136	727	0	409	9	146
CBRE W	1.01	0.00	0	0	0	0	9	9
Ipswich School	1.83	0.00	0	0	0	0	9	16
Crest	27.41	0.00	0	0	0	0	12	329
Fonnereau S	8.96	1.54	62	62	0	185	12	108
Fonnereau N	2.91	0.00	0	0	0	0	12	35
0	7.89	0.00	0	0	0	0	12	95
Totals	87.93	9.45	378	3,117	0	612		912

More refined SuDS requirements including likely areas required for strategic SuDs will be required.

9 OTHER ASPECTS OF THE PRELIMINARY MASTERPLAN.

Westerfield Road

No formal drainage system exists for the part of the road between Mersea Homes and CBRE land. This is partly within cutting and SW flows are known to flow onto the road from CBRE land as below.

This preliminary master plan assumes the road is drained equally into CBRE and Mersea land.

A district centre is proposed close to this point in CBRE land which would naturally drain towards the road.

It is suggested a new SW sewer is installed in the road to drain the district centre and highway. This has not been modelled or tested in any detail.

Existing railway culvert

This 80m long 630mm diameter culvert appears to be too small to convey the greenfield runoff with deep flooding predicted in a 30 year and 100 year RP events even with the SUDS system in place.

A site level survey is required to provide data for up and downstream invert levels which will provide more certainty regarding the frequency, extent and depth of upstream flooding.

The SPD will need to demonstrate the acceptability of this flooding especially on a school site, bearing in mind the culvert will have to be provided with a grille to prevent access by children. The grille could block and cause severe flooding so it will need to be carefully designed.

Residential Swales

The 400 mm deep residential swales should enable 100-225 mm diameter pipes to be used for driveway crossings. These crossing pipes will double as flow controls which mobilise storage and limit flow velocities along the swales and so prevent erosion. The maximum length of a swale will be limited and intermediate strategic SUDS may be required. Some are shown on the preceding plan however hydraulic modelling is needed to determine the locations/size required for such SUDS. - (if any are needed).

Whilst this master-plan has assumed 3.7m wide road side swales each side of all residential streets, there are likely to be circumstances where the swales could be narrower or even be replaced by an open rill or channel. These are unlikely to provide all the functions of the grassed swale but would reduce the spatial requirement for SUDS in residential areas.

The upstream ends of swales might also be shallower and therefore narrower.

If some smaller residential swales or rills/channels are used, then the Strategic SuDS shown on the plan on page 24 would need to be larger. Compensatory attenuation, interception and treatment storage would be required in addition to the volumes and areas shown in table on page 21

Residential swales might be sited in gardens, highway verges or in public open space. One side might be part of a garden the other perhaps a highway verge.

Strategic Swales

The space requirement for Strategic SuDS is dependent on the form and layout of residential areas and also which drainage route option is chosen. If the option 2 SW drainage route is chosen Strategic SUDs will need to be even larger in the areas draining towards the East.

10 CONCLUSIONS

It appears there is more than sufficient green space for open SuDS throughout the development but some alterations to allocation of areas are needed. More green space is needed in some valley bottoms.

The SuDS strategy should therefore be mainly open road side, landscaped swales, which convey runoff from both roads and homes towards more strategic SuDS sited close to the ditch routes, and finally through detention pond(s) before the Westerfield watercourse.

To reduce excavation volumes and land take, SuDS need to be shallow. To enable this and create an easily maintainable system, there should be little or no SW drainage pipework or road gullies. Roof drainage should be conveyed overland via rills / channels to the swales.

Most “in development swales” will be a standard minimum size dictated by 1 in 4 allowable side slopes and a depth of about 400mm (probably 3.7m wide with a 1 m wide flatter service strip adjacent to the highway).

However there are likely to be some circumstances where the swales could be narrower or even be replaced by an open rill or channel. These would not provide all the functions of the grassed swale and additional strategic SUDS would be required.

Swales are most efficient at storing and attenuating flows if roads follow contours and have relatively flat gradients. Swales generally need to be flatter than 1/50 to limit velocities of flow and erosion risk (actual gradient depends on area drained), and 1/100 to provide interception storage. **However the addition of dividing walls may reduce velocities and allow steeper swales. A swale with a 1/1000 gradient will provide about 20 times more storage than one with a 1/50 gradient.**

Roads drained by swales, where the longitudinal gradient of the swale is less than 1:100 have been assumed to comply with the requirement for interception storage (no runoff from first 5mm of rain) where the impermeable surface area is less than 3.5x the vegetated surface receiving the runoff. If future National SuDS standards and guidance change this may affect SUDS requirements.

Driveways will need to cross swales; these crossings would also function as flow controls. The spacing between flow controls / crossings (and hence building layout) is another major factor on efficiency and cost of SuDS.

Even if all roads could be reasonably flat (longitudinal), there is a need to provide some attenuation storage and the “long term storage” required to control volumes in the strategic public open space areas.

At present it is envisaged these would be created by a combination of bunds and excavation with 2 final basins, including open water providing final treatment for the discharges to the watercourse.

Such a system will be visually different to previous developments in Ipswich, could be very attractive and will fit in with the garden city concept and good SuDS practise put forward in many recent publications. The SPD and outline planning application should contain typical cross sections and illustrations depicting this.

Topography will generally dictate location of strategic SuDS.

Certain small details will have a major effect e.g. use of rills for roof water, whether road gullies are needed, how driveways cross swales and side slopes and depth of swales. Where runoff from roads drains directly into swales, side slopes may need to be gentler than elsewhere.

For the development of this master-plan, IBC assumed standards similar to its own, which have been applied successfully in Ipswich since 2001 and included requirements from the Consultation Draft National Standards and Guidance.

In Ipswich, SuDS standards are currently described in IBC's Drainage & Flood Defence Policy (2001). These are similar to those described in the "Framework for SuDS in England and Wales" and the CIRIA SuDS manual C697. However these are expected to be replaced shortly by the National SUDS standards, guidance and an updated C697.

This initial strategy and the allocation of green space need to be developed further before it can support an outline planning application. The resultant strategy will require further updates as the development progresses and as the National SuDS guidance and Standards and any local requirements become effective.

11 APPENDIX - RURAL INFLOW HYDROGRAPHS.

These are applied along the model links shown – for post development scenarios.