Norwich Western Link

Drainage Strategy Report Appendix 10: Basins Options Technical Note

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Document Reference: 4.04.10
Version Number: 00

Date: March 2024

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1 Basins 3, 4 and 3_4 – Options Development

1.1 Background

During the preliminary design of the refined alignment, basin 3 was omitted from the layout due to the perceived gains obtained additional trial pit infiltration testing. Also, the value of the climate change up-lift issued by the government under the NPPF increased from 40% to 45%. There was thus a need to redesign all basins and review the drainage network for capacity.

This study illustrates the options for different layouts of basins 3, 4, 3_4 and 5. Outline network MicroDrainage models were used and a summary of the findings are shown below:

A recommended layout is shown and before taking this forward will need to be presented for comment to Norfolk County Council and the Lead Local Flood Authority (LLFA).

1.2 Basin Option study

Basin 5

Basin design parameters:

- Capacity: 1 in 100 year storm plus 45% climate change
- Forebay: Minimum 10% of basin plan area
- Catchment area – 9.466ha
- Control output: Dual flow control “Hydrobrake” set to FEH greenfield run-off rates:
  - 1 in 1 year – 10.04 l/s
  - 1 in 30 year – 28.28 l/s
  - 1 in 100 year – 41.09 l/s
- Layout:
  - Basin and PED avoid disturbance to the ancient tree

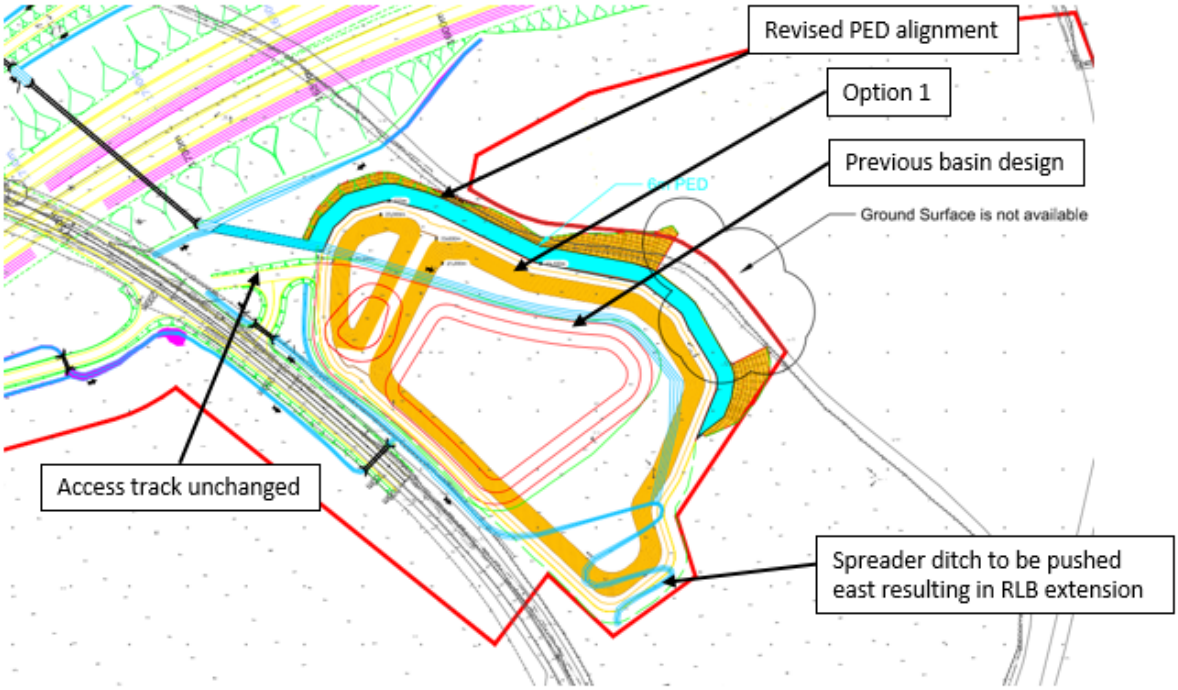
- Access by vehicle provided to basin perimeter hard standing
- Adjacent environment bund fore-shortened without compromising noise attenuation to properties
- All structures kept within the highway boundary
- Scrapes added main basin providing more areas for reed planting
- Basin base area: 2490m2
- Basin depth: 2.0m
- Design volume: 4470m3

Figure 1.1

Basin 3_4 Option 1 single infiltration basin

- Basin design parameters:
- Capacity: 1 in 100 year storm plus 45% climate change
- Forebay: Minimum 10% of basin plan area
- Catchment Area: 10.995ha
- Infiltration basin design base and sides k: 2.47x10-6 m/s
- Infiltration rate FoS: 5.0
- Layout:
  - Merged Basin and PEDs fit into previous highway boundary but with little room for manoeuvring
  - Access road arrangement unchanged from previous, GW1
  - Downstream spreader ditch is outside the highway boundary
  - Cut and fill volumes: Cut – 13646, fill – 1751m³
  - Basin base area: 6212m²
  - Basin depth: 2.0m
  - Design volume: 14520m³

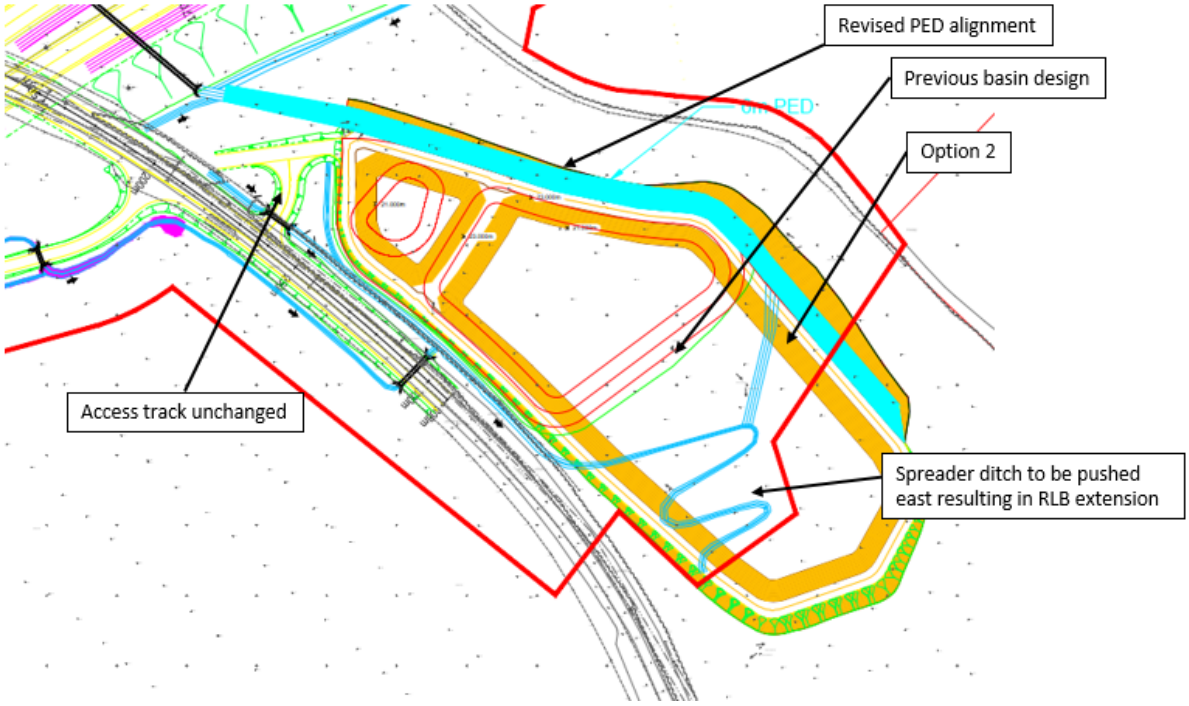
Figure 1.2


Revised PED alignment
Option 1
Previous basin design
Ground Surface is not available
Access track unchanged
Spreader ditch to be pushed east resulting in RLB extension

Basin 3_4 Option 2 single infiltration basin

- Basin design parameters:
- Capacity: 1 in 100 year storm plus 45% climate change
- Forebay: Minimum 10% of basin plan area
- Catchment area: 10.995ha
- Infiltration basin design base and sides k: 2.47x10-6 m/s
- Infiltration rate FoS: 5.0
- Layout:
- Basins and PEDs spread out south-east beyond the previous highway boundary
- Downstream spreader ditch excluded from this sketch
- Cut and fill volumes: Cut – 8948m³, fill – 1998m³
- Basin base area: 6193m²
- Basin depth: 2.0m
- Design volume:14370m³

Figure 1.3

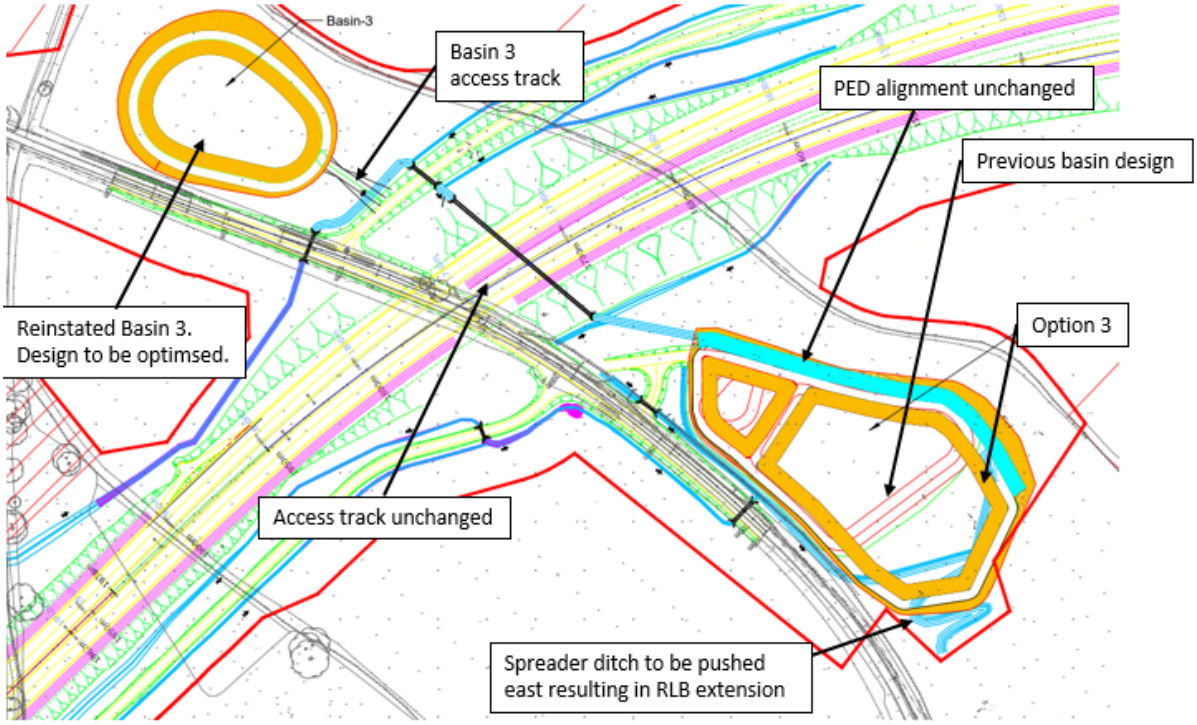

Revised PED alignment
Previous basin design
Option 2
Access track unchanged
Spreader ditch to be pushed east resulting in RLB extension

Option 3 Basin 3 and 4 separate infiltration basins

- Option for two basins – basin 3 to the NW and basin 4 to the SE of the NWL highway.
- Basin design parameters:
- Total capacity of both basins: 1 in 100 year storm plus 45% climate change
- Forebay: Minimum 10% of basin plan area
- Catchment split to be confirmed in detailed design, 40:60 split considered at this stage
- Catchment area: Basin 3 – 4.398ha, Basin 4 – 6.597ha
- Infiltration basin design base and sides k: 2.47x10-6 m/s. Note worst case infiltration rate taken for optioneering purposes, should this option be selected, basin specific infiltration rate will be used for detailed design.
- Infiltration rate FoS: 5.0
- Layout:
- Constraint: ground water table?
- Basins follow in principle the layout in the reference design and lie just within the previous highway boundary*
- Infiltration is spread over a larger gross area of the natural valley than options 1 and 2. Thus reducing the risk of overwhelming the underlying ground water load in the natural valley.
- Assigning basin 3 as an attenuation basin with a low controlled discharge to basin 4, say at 5 l/s gives no benefit as the effective infiltration rate at basin 4 is less than 5 l/s. Because of this, this sub-option has been discarded.

- Downstream spreader ditch is outside the highway boundary
- Cut and fill volumes: Cut – 17641m³, fill – 1519m³ (sum of both basins)
- Basin 3 base area: 2078m²
- Basin 3 depth: 2.0m
- Basin 3 design volume:4960m³
- Basin 4 base area: 4004m²
- Basin 4 depth:2.0m
- Basin 4 design volume:9590m³

Figure 1.4



*optimisation in detailed design should improve this layout to be within the highway boundary

1.3 Approximate volumes of cut and fill for the basin 3_4 and 3, 4 options are shown below:

Item	Cut Volume(m^3)	Fill Volume(m^3)	Remarks
Basin -3 & 4(Option-3)	17641	1519	Sum of both basins
Basin -3-4(Option-2)	8948	1998	
Basin -3-4(Option-1)	13646	1751	

- Note: The Volume calculation is based on Bulk quantity.
- Basin 3_4 option 2 has lowest cut and fill volumes
- Basin 3&4 option 3 has highest cut and fill volumes

If basins are connected, the hydraulics would need to be assessed to ensure this is feasible. Connecting the basins would negate the need for a forebay at both basins but probably provides more of a challenge hydraulic profile wise and with road crossings.

A flow control device such as an actuated valve would be needed if basins are at different levels, to ensure all the contents of 3 don't drain down to basin 4 by default of head difference. In this case there is no benefit to having a single forebay, as the total forebay area would be the same for both options.

If basins are independent of each other, a forebay area is needed for both basins (based on tender design). Split of flows would need to be assessed in order to efficiently utilise both basins. Splitting flows between NB and SB carriageways would make more efficient use of available space for basins.

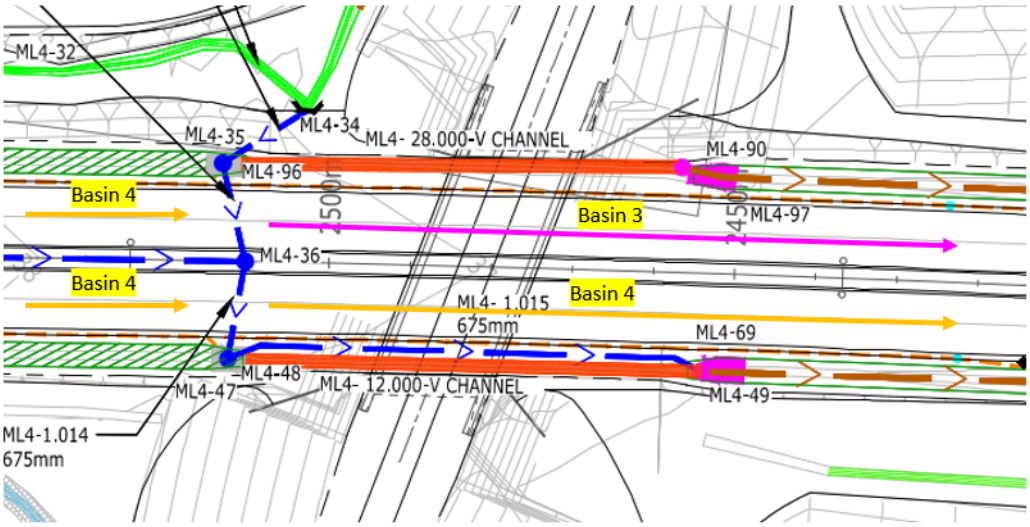
A flow splitter chamber for both the north and south catchment areas would split flows 50:50 or other to either basin:

a) Catchpit with one pipe incoming and 2 pipes outgoing set at the same IL. 50:50 split.

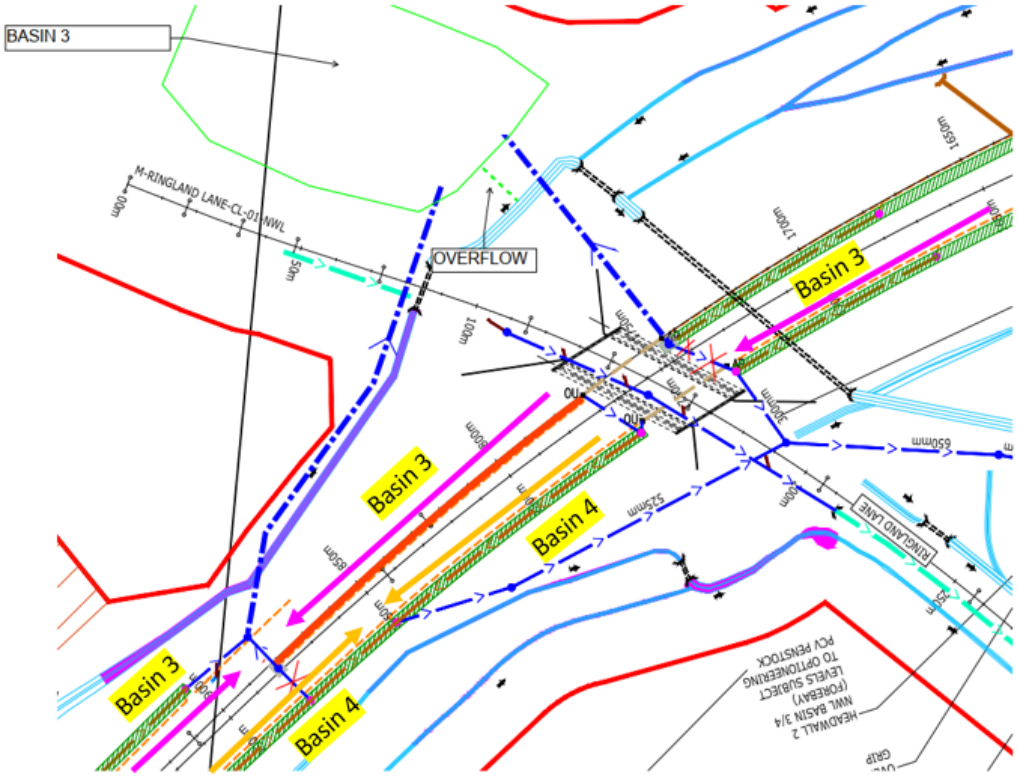
b) Weir chamber: 1 pipe in pipe 2 and 3 outgoing. Low flows in part full pipe directed to outlet pipe 2 (say basin 3). Once water level in channel exceeds weir height, overflows to pipe 3 outlet (to say basin 4- difficult to design and would need to cover up to 1 in 100yr +CC distributed to both basins.

Split the network into NB and SB flows at Morton Green bridge (a) and at Ringland La.(b)

a) Figure 1.5



b) Figure 1.6



1.4 Conclusions

1) All options for basin 3_4 appear to be feasible but option 3 has the least risk of ground water flooding.

2) Option 3, basins 3 and 4 separated, accords with the contract reference design, although the basin sizes are larger.

3) Options 1 and 3, with optimisation should fit within the present highway boundary and other site spatial constraints.

4) Option 3 basin 3 layout can be optimised to reduce the volumes of cut and fill in the construction.

5) Splitting the network to equally divide drainage areas between each basin is straight forward.

6) Option 3 is the best technical solution.

1.5 Recommendation

Option 3 with separate basins 3 and 4 to be taken forward to detailed design.