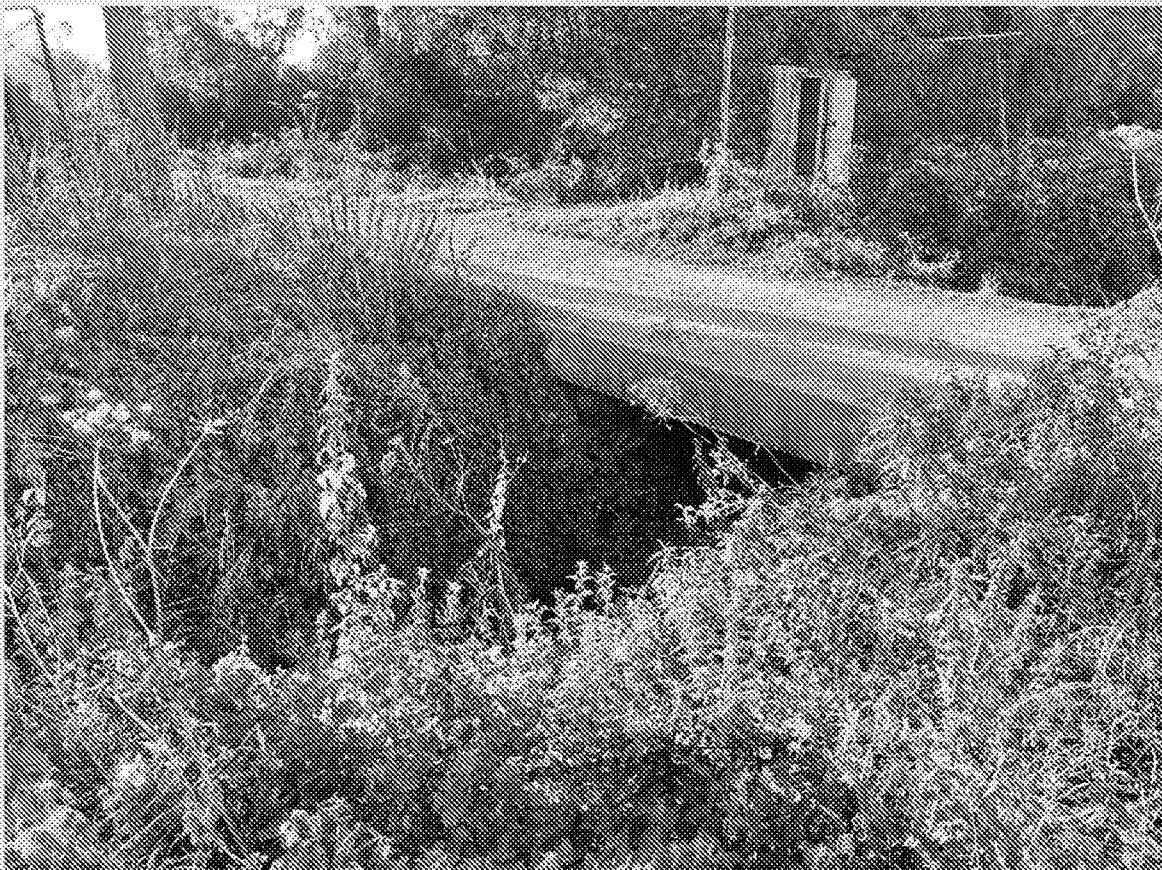


Hallam Land Management

NEW BOGNOR REGIS GOLF COURSE

Surface Water Drainage Strategy





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NEW BOGNOR REGIS GOLF COURSE

Surface Water Drainage Strategy

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WSP

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APPENDIX A



GREENFIELD RATES

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1 INTRODUCTION

1.1 BACKGROUND

- 1.1.1. WSP UK Ltd (WSP) was instructed by Hallam Land Management (HLM) to prepare a surface water drainage strategy to support the application for redevelopment of Bognor Regis Golf Club to provide up to 480 dwellings and associated open space.
- 1.1.2. The objective of the study is to demonstrate that the site can be drained safely, without exposing the development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:
- ⌘ Determine the greenfield runoff rates;
 - ⌘ Establish the magnitude of storage required; and
 - ⌘ Demonstrate the principles that will be required to facilitate gravity drainage.
- 1.1.3. This drainage strategy should be read in conjunction with the Flood Risk Assessment.

1.2 LIMITATIONS

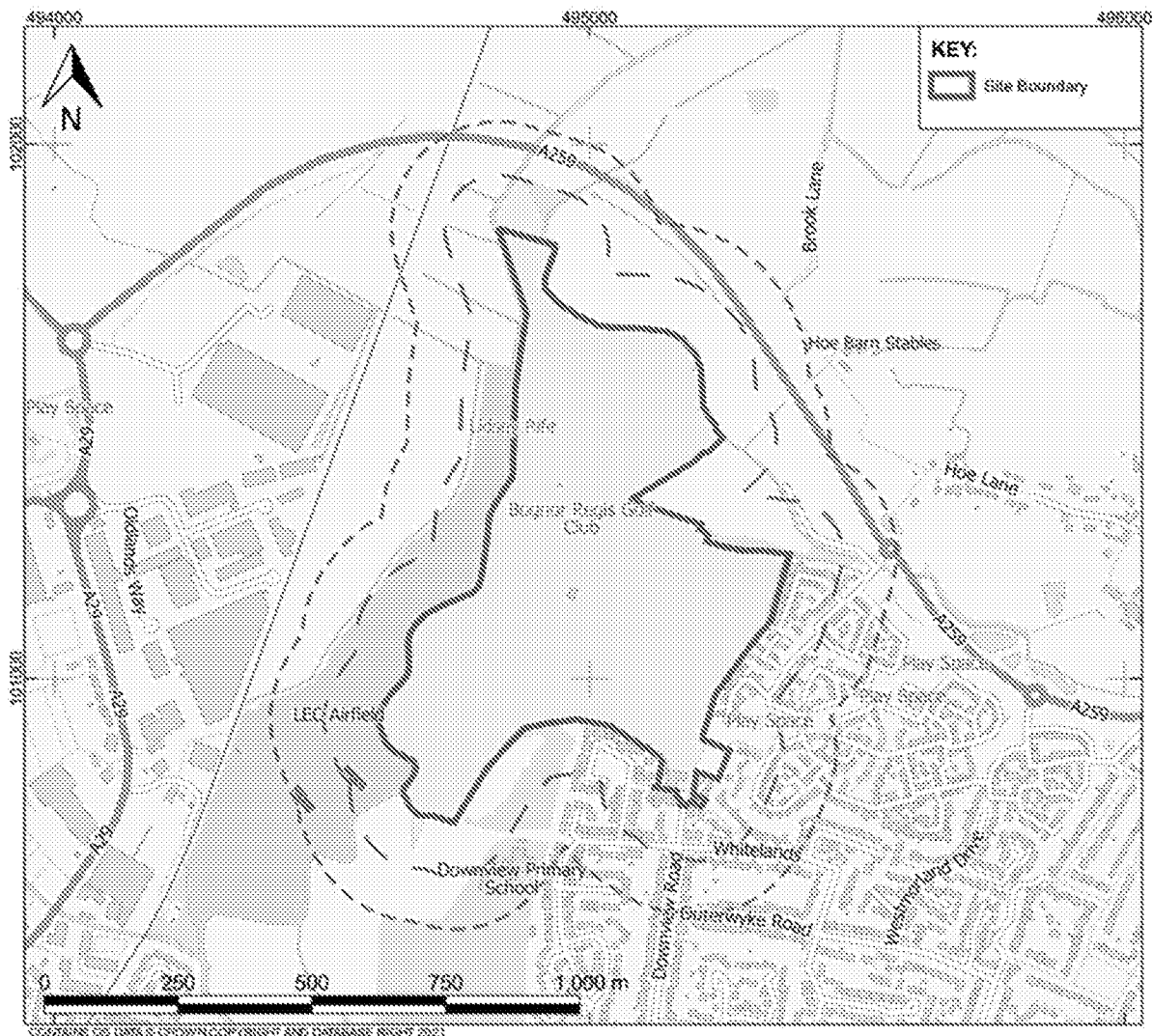
- 1.2.1. WSP has prepared this report in accordance with the instructions of their client, HLM, for their sole and specific use relating solely to the above site. Any person who uses any information contained herein does so at their own risk and shall hold WSP harmless in any event.
- 1.2.2. Whilst this report was prepared using the reasonable skill and care ordinarily exercised by engineers practicing under similar circumstances and reasonable checks have been made on data sources and the accuracy of the data, WSP accepts no liability in relation to the report should any data, information or condition be incorrect or have been concealed, withheld, misrepresented, or otherwise not fully disclosed to WSP.

2 SITE SETTING

2.1 LOCATION

- 2.1.1. The Site is located at Bognor Regis Golf Course, Felpham in West Sussex, with nearest postcode PO22 8JD, at an approximate National Grid Reference 494990, 101210. The site extends over an area of approximately 40ha. The Site currently comprises the existing Bognor Regis Golf Course and associated Club House and car parking. Vehicular and pedestrian access is provided from Golf Links Road. The golf course comprises fairways, fairway trees with occasional drainage ditches, and a practice green located close to the Club House.
- 2.1.2. The Site is located to the north of Felpham and Bognor Regis and is adjacent to the north-western edge of the built up area of Felpham. It is bounded to the west by Lidsey Rife, beyond which is the LEC Airfield, the Railway Line and beyond which are areas of commercial development. To the north is the A259. To the east is the existing residential environs of Felpham and Downview Primary School. To the south are open fields extending to the B2259 and further afield Felpham.
- 2.1.3. The Site currently comprises a few trees and hedgerows as part of the golf course layout and its boundaries. A Tree Preservation Order exists (ref: TPO/FP/1/07) which covers trees on the eastern extent of the golf course. The site location plan is shown in Figure 2-1 - Site Location.

Figure 2-1 - Site Location



2.2 DEVELOPMENT PROPOSALS

- 2.2.1. The project consists of two proposed developments, the relocation of the existing Bognor Golf Course and the construction of new housing on the existing Bognor Golf course.
- 2.2.2. The re-location is proposed as “ *[The] laying out of an 18 hole par 4 golf course, a 9hole par 3, practice greens and a driving range; the formation of a new access onto the A259; the construction of a club house with associated golf club facilities; the construction of a maintenance building and external area of hardstanding; the laying out of a car park and new roads and paths; new landscape planting, surface water drainage basins and water storage reservoir, and other earthworks and infrastructure*”.
- 2.2.3. The development of new houses is proposed as “*The construction of up to 480 new homes (C3), the formation of a new means of access onto Golf Links Road, the creation of new surface water drainage, new landscaping and habitat creation, ground works and other infrastructure. It includes the retention and re-purposing of the retained club house (F2(b)).*”
- 2.2.4. This assessment is based on the proposed development of new houses on the existing Bognor Golf Course. It does not provide an assessment of the flood risk, which is covered by a standalone FRA.
- 2.2.5. An extract of the Illustrative Masterplan is provided in Figure 2-2 below. Further details and plans are provided in **Appendix A**.

Figure 2-2 - Illustrative Masterplan



2.3 TOPOGRAPHY

- 2.3.1. The topography of the site has been assessed using both a site specific topographical survey (as provided in Appendix B) and LiDAR from the Environment Agency. The Environment Agency LiDAR is shown in Figure 2-3. This shows that the site is in a low elevation and slopes from an approximate elevation of 1mAOD in the north to an approximate elevation of 3mAOD by the southeast site boundary adjacent to Downview Road. Within the site boundary are localised areas of depressions that range from approximately 0mAOD to 1mAOD. These areas of depressions correspond to drainage ditches, the Lidsey Rife and the holes within the golf course.



3 GREENFIELD RUNOFF RATES

- 3.1.1. The greenfield runoff rate for the site has been estimated to be 3.46 l/s/ha through the Microdrainage ICP SuDS method utilising the following parameters (see details in Appendix C):
- ※ SAAR 710mm;
 - ※ Soil 0.4; and
 - ※ Region 7.
- 3.1.2. This equates to a site wide discharge greenfield rate equivalence $Q_{bar} = 51.9\text{l/s}$, assuming:
- ※ 15ha of developable area;
 - ※ Roads are 100% impermeable; and
 - ※ Platforms are 60% impermeable.

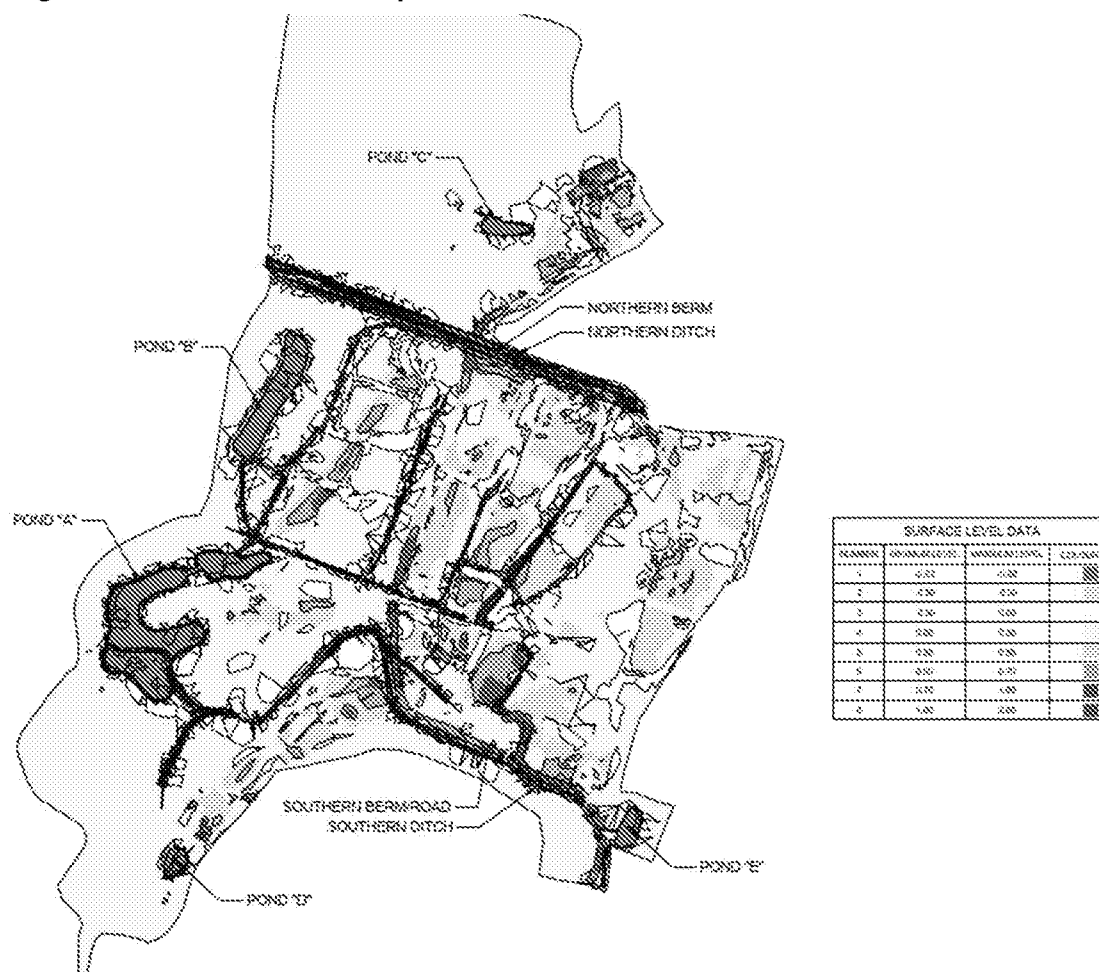
4 SEPARATION OF FLUVIAL FLOOD WATERS AND DEVELOPMENT AREA

4.1.1. The development area has been designed to prevent flood water ingress (a system of berms and cut off ditches, to divert offsite flood waters away from the area), this means that the surface water drainage for the development platforms only has to manage the direct rainfall runoff. This has been achieved by the use of a ditch and a berm on the north and south to direct flood water from external influence directly to river on the to the west, as shown in Figure 4-1 (reproduced in Appendix C).

※ Berm height to maximum water elevations in the hydraulic model plus 300mm freeboard:

- Southern ditch: 2.37m; and
- Northern ditch: 1.54m.

Figure 4-1 – Flood Water Separation Plan



5 ELEVATION OF BUILDING PLATFORMS

5.1.1. Given the relatively flat nature of the site, it was established that to facilitate a gravity based surface water drainage strategy the construction of elevated building platforms would be required. These platforms have been established through an interactive and sequential process as part of the masterplan development. To inform this process a digital model in AutoCAD Civil 3D was created, the key principles were:

- ※ Accommodate the existing category A trees by limiting the platform raising to 300mm above existing topography;
- ※ Sides slopes of 0,5% to 1% towards the direction of ditch, where feasible; and
- ※ Rising the platforms to the immediate north and south of the cut-off ditches to levels above the 1 in 100 year plus climate change flood level (as detailed in the FRA).

5.1.2. The resultant ground model is shown in Figure 5-1 (extract of Appendix C).

Figure 5-1 - Proposed Ground Levels



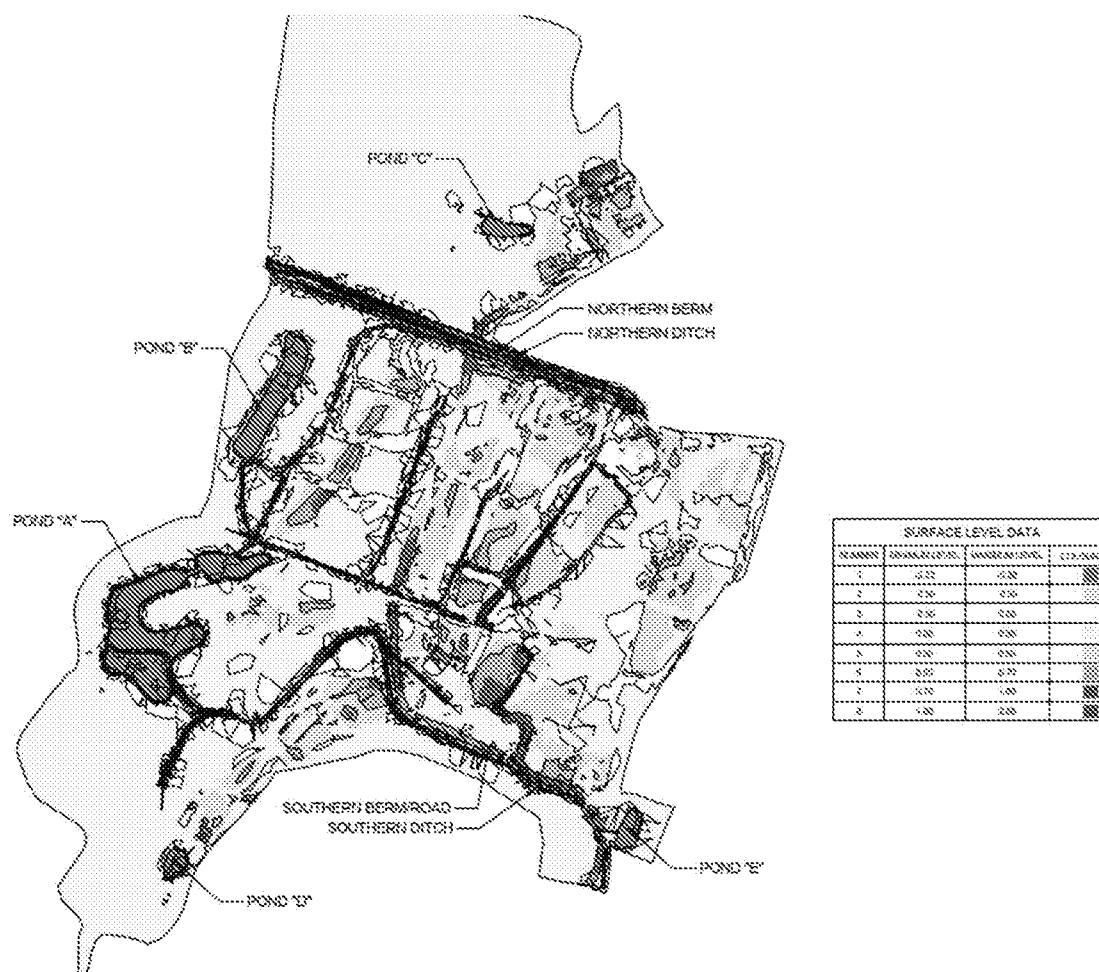
6 PLATFORM DRAINAGE

- 6.1.1. A network of ditches / swales have been incorporated within the design to channel the surface water from the development platforms to the attenuation ponds. It is envisaged that parts of these ditches / swales will be designed as raingardens as part of the detailed design process, however, checks will be undertaken to ensure that there is no loss of storage capacity or increase in flood risk.
- 6.1.2. As the site is very flat, the channels are very flat in grade and will likely stand wet to elevation of 1.00m in large storm events due to SuDs top water level. This design principle has been incorporated within the design of the platform levels, in addition the FFL of the individual properties will be set 300mm above the platform level, to provide additional freeboard and exceedance flow routes.
- 6.1.3. It is understood that parts of the site currently become water logged during heavy rainfall events as some of the existing ditches are deeper than the level of the Lidsey Rife. It has been assumed that the bed level of these ditches will be raised through infilling as part of the construction works. Alternatively the detailed design of the Scheme may identify through consultation with biodiversity specialist a method of de-watering the existing deeper ditches that are lower than the proposed ditches connecting to the SuDs spaces, to avoid drowning trees during these events.

7 ATTENUATION PONDS

- 7.1.1. To restrict the surface water runoff from the site to the greenfield rates five attenuation ponds are proposed outside the 1 in 100 year floodplain (as identified through the site specific hydraulic modelling, as detailed in the FRA), the location of the ponds are shown in Figure 7-1 (extract of Appendix C). These attenuation ponds will be designed in accordance with the principles detailed within the SuDS manual and may have a permeant water level to aid biodiversity.

Figure 7-1 - SuDS Location Plan



- 7.1.2. At this stage the following design principles have been adopted (further detail is provided in the blue / green infrastructure parameter plan):

- ❖ The ponds will discharge via an existing ditch connection into the Lidsey Rife;
- ❖ The ponds are sufficiently elevated that the attenuated volume of water can empty as the flood levels in the Lidsey Rife drop (acknowledging that the Lidsey Rife, at this location, is tidally influenced);
- ❖ A one way flap valve will be required on the outfall to prevent the ingress of fluvial floodwaters;
- ❖ Top water level of Pond "A" and Pond "B" is 1.00m;
- ❖ It is considered likely that the groundwater in the area of the ponds will be significantly elevated / be in hydraulic connectivity with the Lidsey Rife, the attenuation ponds will need to be lined with an impermeable membrane, suitably designed to prevent floating;



- ▄ The ponds have been sized to restrict the surface water runoff to the greenfield rate (51.9l/s) from the impermeable area of approximately 15ha, of which 7ha is impermeable. On this basis a Microdrainage quick storage estimate is that 6428 m³ of storage is required.

8 CONCLUSION

- 8.1.1. This strategy demonstrates a feasible strategy for the management of surface water runoff across the development through the use of raised platforms, ditches / swales and attenuation ponds, all of which will be based upon SuDS principles, during the detailed design phase.

Appendix A

GREENFIELD RATES

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Figure A-1 - Greenfield Rates

Rural Runoff Calculator

ICP SUDS

ICP SUDS Input (FSR Method)

Return Period (Years): 100

Area (ha): 15.000

SAAR (mm): 710

Soil: 0.400

Growth Curve: (None)

Partly Urbanised Catchment (GBAR)

Urban: 0.000

Region: Region 7

Results

GBAR rural (l/s): 51.9

GBAR urban (l/s): 51.9

Return Period Flood

	Region	GBAR (l/s)	Q (100 yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
BH 124						
ICP SUDS	Region 1	51.9	128.7	44.1	98.0	128.7
	Region 2	51.9	136.5	45.1	98.4	136.5
ADAS 345	Region 3	51.9	107.9	44.6	91.2	107.9
FEH	Region 4	51.9	133.4	43.1	101.7	133.4
	Region 5	51.9	184.7	45.1	124.7	184.7
RefH2	Region 6/Region 7	51.9	165.5	44.1	117.6	165.5
Greenfield Volume	Region 8	51.9	125.6	40.5	98.9	125.6
	Region 9	51.9	113.1	45.7	91.5	113.1
Greenfield Volume (RefH2)	Region 10	51.9	107.9	45.1	88.0	107.9

OK Cancel Help

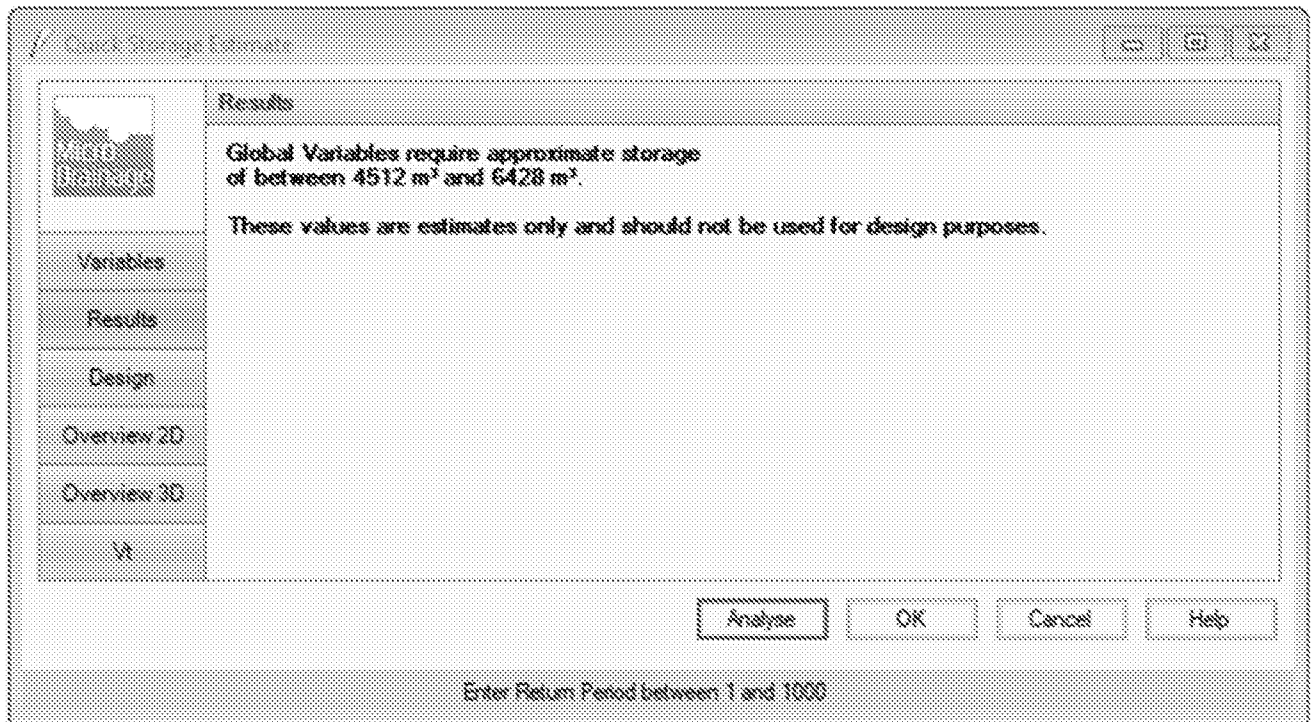
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Appendix B

STORAGE REQUIREMENTS

115/1

Figure B-1 - Storage Requirements

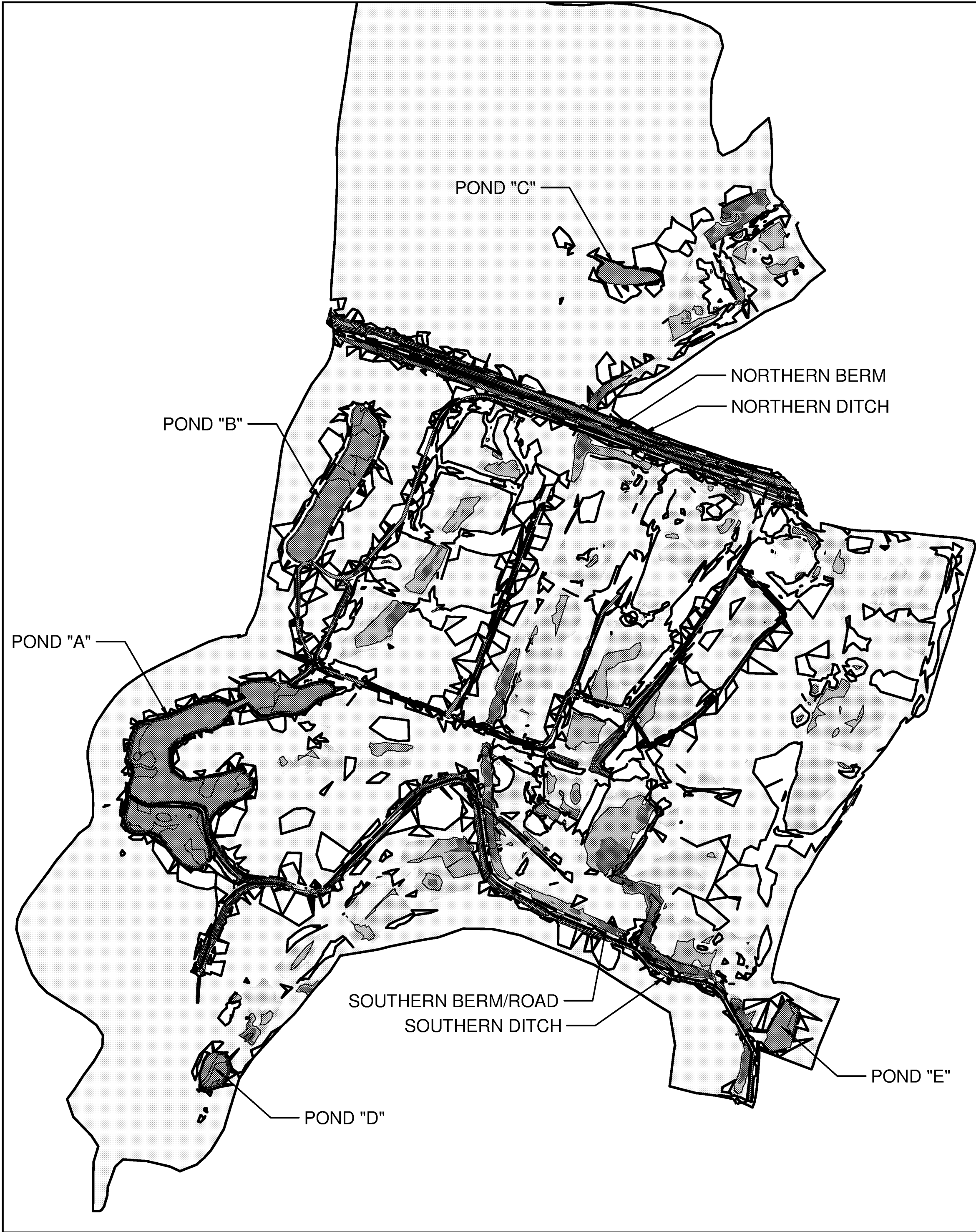


Appendix C

DRAWINGS

115/1

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5	0.30	0.50	
6	0.50	0.70	
7	0.70	1.00	
8	1.00	2.65	

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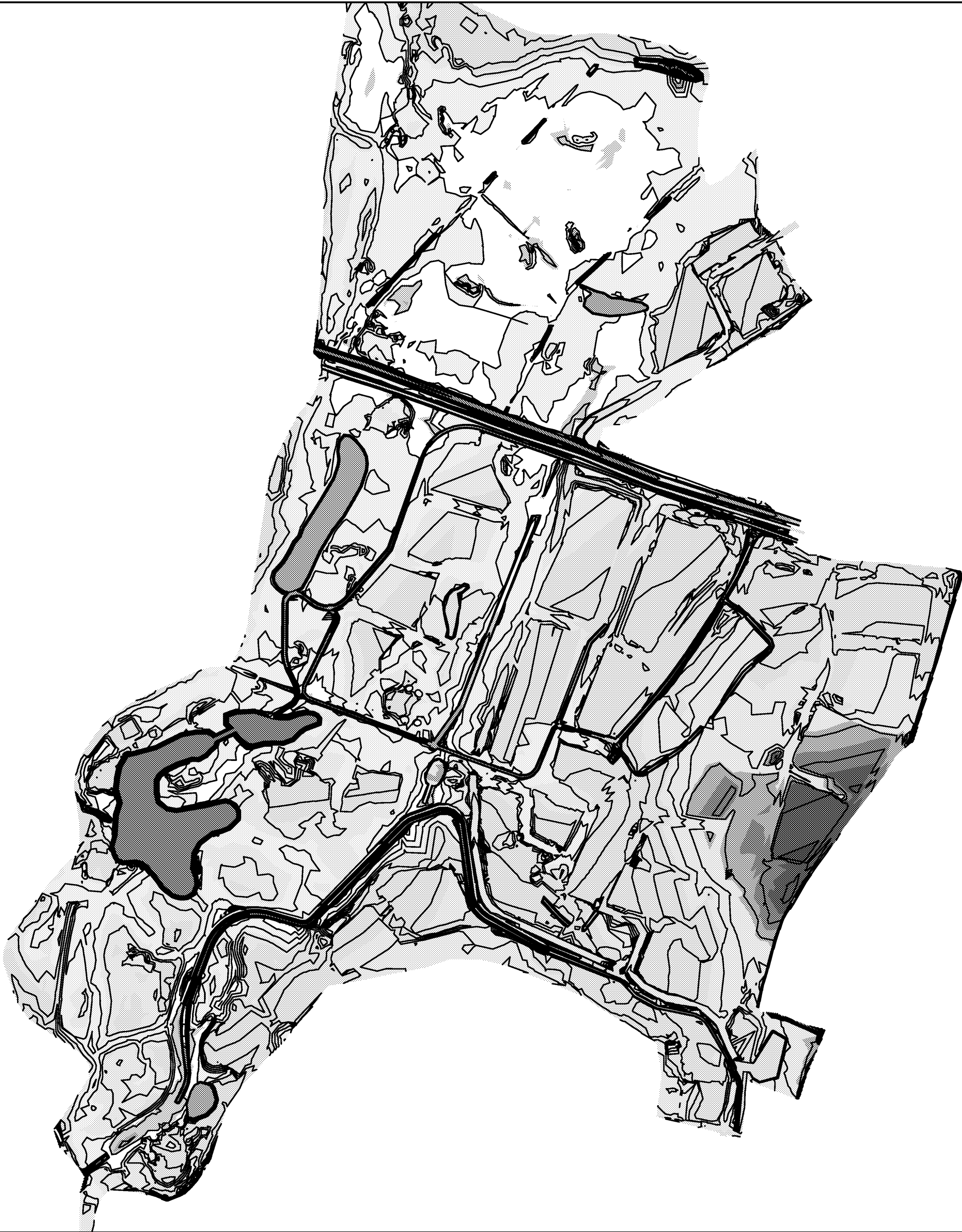
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11	1.40	1.60	
12	1.60	1.80	
13	1.80	2.00	
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