BEFORE AN EXPERT PANEL
SOUTHLAND WIND FARM PROJECT

Under the	**FAST-TRACK APPROVALS ACT 2024**
In the matter of	an application for resource consents, a concession, wildlife approvals, an archaeological authority and approvals relating to complex freshwater fisheries activities in relation to the Southland Wind Farm project
By	**CONTACT ENERGY LIMITED**
	Applicant

SOUTHLAND WIND FARM TECHNICAL ASSESSMENT #10: CONCEPTUAL HYDROLOGICAL DESIGN

BROOKE JAMES AND JONATHAN WILLIAMSON

18 August 2025

Conceptual Hydrological Design

Southland Wind Farm at Jedburgh Station Plateau

CONTACT ENERGY

WWLA1505 | Rev. 4

4 July 2025

Southland Wind Farm at Jedburgh Station Plateau

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Williamson Water & Land Advisory

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Contents

1. Introduction

Williamson Water & Land Advisory (WWLA) were commissioned in May 2025 to develop a hydrological model of the Jedburgh Plateau. The Jedburgh Plateau is an area of approximately 530 ha located at the southern end of Jedburgh Station – and the southern end of the Southland Wind Farm Site (**Appendix A**). The extent of the plateau has been defined based on the topography, geology, vegetation and ecology. The plateau is covered with a mix of exotic grassland and low stature indigenous vegetation, and contains a number of bog and fen wetlands as identified and mapped by the ecologists engaged to assess the effects of the proposed wind farm. It is the high point of a cuesta dipslope bounded to the south by a steep scarp. Competent impermeable sandstone bedrock is close to the surface, and this is responsible for a perched water table that sustains a wetland mosaic (comprising approximately 130 ha of bog and fen wetlands) spread across the Plateau. The area is used for low intensity farming, and has been in this land use for over 100 years.

The purpose of the hydrological model is to:

- enable assessment of flow conditions in specific areas adjacent to wetlands (bogs and fens); and
- design engineering mitigation to minimise hydrological impact on the wetlands and/or maintain water balance neutrality from proposed linear infrastructure construction.

This document provides a technical report, which describes a concept water management design that can be used as an input into the civil work design to ensure that adverse impacts on wetlands are minimised. The work in this report is considered conservative, and as the design is conceptual, opportunities for refinements (reduction of number and size of culverts, and change of location of culverts, while still protecting wetlands from indirect loss) may be investigated during the detailed design stage.

1.1 Statement of Qualifications and Experience

WWLA is a niche employee-owned consultancy with core expertise in the fields of water resources and contaminated land. WWLA conducts hydrological and hydrogeological assessments and provides related advice to a wide range of clients. Our services include modelling, monitoring, site investigations and undertaking regulatory assessments to support resource consent applications.

The qualifications and experience of the author and reviewer of this report are summarised below.

1.1.1 Report Author

Brooke James is an Experienced Graduate Hydrologist at WWLA. She has been employed at WWLA since July 2024.

Brooke’s qualifications include a Bachelor of Science (Technology) in Earth Science and Environmental Science and a Master of Science (Research) in Earth Science from University of Waikato completed in 2021 and 2024, respectively.

Since joining WWLA, Brooke has gained experience in catchment delineation and peak runoff analysis; hydrological analysis; modelling; field investigations; and technical report writing.

1.1.2 Report Reviewer

Jonathan (Jon) Williamson holds a Bachelor of Science in Earth Science, and a Master of Science and Technology first class honours in Hydrology and Geology from the University of Waikato, completed in 1993 and 1995, respectively.

Jon is the Managing Director of WWLA, a firm he founded in January 2015. Jon has 30 years of professional experience in New Zealand, Australia and the Pacific regions. For the 15 years prior to starting WWLA, he held various technical and managerial roles in the water resource management and irrigation sectors within the Auckland office of Sinclair Knight Merz (now Jacobs). Prior to that, Jon was employed in a global multidisciplinary consulting firm in Sydney and undertook a range of hydrogeological work in the mining and municipal water supply sectors.

Jon has specialist technical expertise in hydrogeology, hydrology and irrigation engineering in a wide spectrum of services including data collection and analysis; field investigations and testing; modelling; engineering design; construction management; technical report writing; community and stakeholder consultation; resource consent hearings; and technical working panels.

1.2 Code of Conduct

We confirm that we have read the Code of Conduct for expert witnesses contained in the Environmental Court Practice Note 2023. This assessment has been prepared in compliance with that Code, as if it were evidence being given in Environment Court proceedings. In particular, unless we state otherwise, this assessment is within our area of expertise, and we have not omitted to consider material facts known to us that might alter or detract from the opinions we express.

2. Design Objectives and Assumptions

This report provides a conceptual design of culvert locations and diameters, which aims to maintain hydrological connectivity and water balance neutrality between wetlands to minimise wetland loss. As indicated above, it is envisaged that a condition of consent will require preparation of a Construction Environmental Management Plan (CEMP), which will be defined during the detailed design prior to construction.

2.1 Design Objectives

The primary objective of the water management system is ultimately to minimise loss of wetland due to removal of water supply. To achieve this, the key design objectives are to:

- Maintain continuity of surface water and soil water flows to wetland areas; and
- Minimise soil dewatering effects in wetlands both upgradient and downgradient of proposed linear infrastructure.

2.2 Design Assumptions

The concept design is premised on the following design assumptions:

- Vertical soil permeability and hydraulic conductivity of the underlying weathered bedrock are assumed to be very low (i.e. in the order of $1x10^{-7}$ to $<1x10^{-9}$ m/s);
- Soil water is the perched above the weathered bedrock;
- The hydrological regime is dominated by surface water inputs and flow rather than true groundwater flow dynamics;
- Clay bunds will be impermeable (K $<1x10^{-9}$ m/s) and maintain water in wetland behind upgradient of cuts;
- Culverts are required where an overland flow path with a minimum upstream catchment of 1,500 m^2 intersects linear infrastructure required for the project. Catchments smaller than 1,500 m^2 (i.e. approximately 40 m x 40 m) are not considered to provide significant flow to the wetlands;
- The Niwa HIRDS v4 10-year ARI, 10-minute duration RCP 8.5 climate change scenario design storm (60.1 mm/hr) was used to calculate peak runoff events (refer to detailed analysis in **Section 4.2**). A 10-minute duration storm is based on the time of concentration (Tc) of 10 minutes, which is appropriate for catchments up to 1,500 m^2. In larger catchments the Tc (and therefore storm duration) increases, resulting in a lower rainfall intensity and reduced flows, which implies the 10-minute duration storm is conservative, when applied to larger catchments. The Tc may be refined for the individual catchments at the detailed design stage, although it is recommended a 2D hydraulic model is developed for detailed design;
- Culverts were sized for their minimum internal diameter using the Mannings formula. Parameters including slope and peak runoff was calculated for each culvert uniquely (refer to bullet point above). Manning roughness (n) was assumed uniform at 0.013 according to the technical specification for the range of culvert types utilised[1]. The actual minimum diameter includes consideration for pipe embedment on all culverts, this will be refined at the detailed design stage;
- Culverts will be embedded up to 33%[2] of their diameter to meet the Regional Plan provisions allowing for fish passage. This provision is conservative in that not all catchments will require fish passage, hence it is envisaged that this may be amended during detailed design stage once freshwater ecologists have assessed if upstream catchments are suitable fish habitats on a case-by-case basis;
- A minimum culvert size of 160 mm has been implemented in order to reduce potential blockages;
- The downstream end of proposed culverts have been positioned as close as possible to development infrastructure to avoid downstream loss of wetland;

[1] https://www.hynds.co.nz/wp-content/uploads/D3.1-Civilboss-Twin-Wall-Polypropylene-Pipe.pdf
[2] Based on Rule 59(a)(v) of the Proposed Southland Water and Land Plan (SWLP)– Part A (2024).

- All culverts are unpunched;
- Where culverts are located within Surface Fill Disposal Areas (SFDs), the culverts will be lengthened or a surface drain used across the SFD to maintain the flow paths.
- Potential areas where wetland may be impaired (but not lost) have been identified immediately upstream of embedded culverts. The area of potential impairment has been calculated based on a ratio of culvert invert embedment depth to radius from the culvert. A ratio of 30 was selected on the basis of pragmatic experience with primary consideration to the low permeability soils. For example, a 160 mm culvert is embedded 53 mm, the impairment radius is 1.58 m.

Please note:

- The plans produced in this report do not include the re-aligned overland flow paths. Modified overland flow paths will be updated as part of the detailed design stage.

3. Situation Types

Haul roads and flat turbine building platforms need to be constructed as key infrastructure requirements of the proposed windfarm at the Jedburgh Plateau. Bog and fen[3] wetlands at the Jedburgh Plateau have been identified by Wildlands (2025), and although efforts have been taken to avoid the wetlands in both the identification of the wind turbine layout and the civil design (Riley, 2025), some of the roads and platforms will inevitably intersect wetland areas. In total, approximately 2 ha of mapped wetland area across the Jedburgh Plateau are directly impacted by the proposed indicative civil design. The objective of the hydrological modelling of different scenarios or 'situations' is to identify works to minimise additional loss of wetland through either diversion of maintenance flows or soil dewatering.

Three main topographic situation types have been determined where construction intersects with wetlands. The order of the typing is based on potential risk to wetland hydrology, with Type I having the greatest potential hydrological risk, and Type III has the lowest potential hydrological risk.

3.1 Type I

Type I occurs where there is a wetland (bog or fen) upstream of a cut, and a downstream wetland that is dependent on water inflow from the upstream wetland.

Three specific Type I situations occur:

- Type I(A) – Bog upstream and downstream of cut;
- Type I(B) – Bog upstream of cut and fen downstream;
- Type I(C) – Fen upstream of cut and fen downstream[4].

Water connectivity between the wetlands in a Type I situation (refer **Figure 1**) is proposed to be managed by the construction of a small clay bund along the upstream edge of the cut, which will prevent water flowing directly out of the wetland. Wetland water will only exit indirectly via flow perpendicular to the bund, and naturally flow out of the side of the wetland. In this scenario, it is proposed that a culvert is positioned outside of the wetland at a low point to directly convey water under the cut/road to the wetland on the other side of the cut. In doing this, the clay bund and culvert allows hydrological connectivity between the wetlands without dewatering the wetland upstream of the cut. A scruffy dome may need to be located at the head of the culvert, however, not all Type I situations require a scruffy dome.

A clay bund will also be constructed on the downgradient side of the cut to ensure reverse soil-water gradients do not form that could potentially induce localised dewatering of the wetland.

[3] Bog wetlands are wetlands that are primarily fed by rainwater and therefore tend to lack minerals and are acidic, while fen wetlands receive mineralised water from either surface water or groundwater, or a combination of both.
[4] Noting that there are no scenarios where a bog is downstream of a fen. This is because bogs are typically upstream of fens.

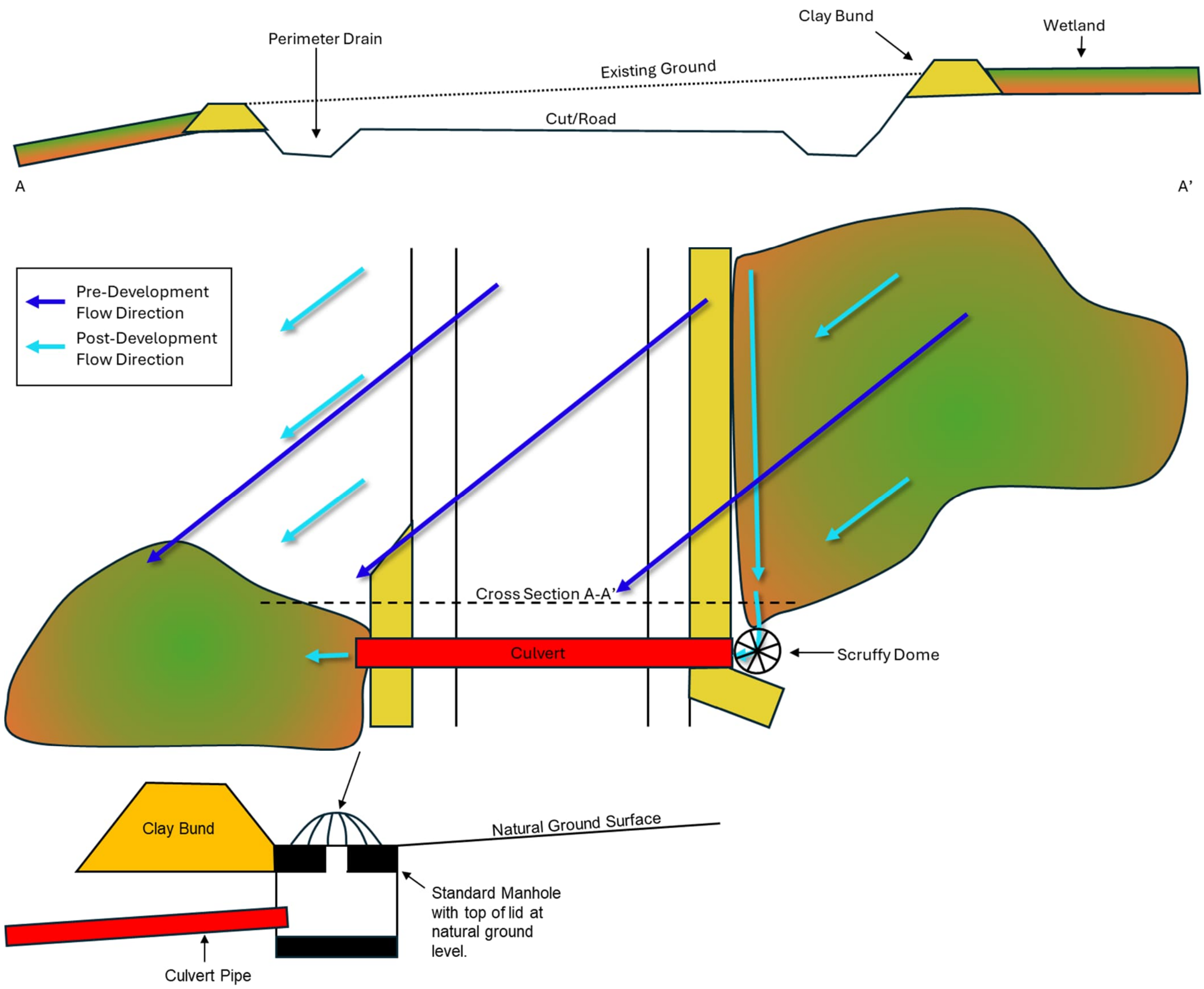


Figure 1. Cross section of Type I Situation.

3.2 Type II

Type **II** occurs where there is a road situated on embankment fill over a gully with the embankment separating wetlands (bog or fen). Two specific Type **II** situations occur:

- Type **II**(A) – Embankment separating independent wetlands (bog or fen) on either side (but not dissecting) in close proximity to the embankment; or
- Type **II**(B) – Embankment dissecting a wetland.

Water connectivity at a Type **II** situation (refer **Figure 2**) is proposed to be managed by a culvert placed along the gully floor and underneath the road embankment fill. During dry periods, if water levels drop below the culvert invert, it is likely that flow within the wetland would have stopped naturally given the shallow soil profile sitting on weathered bedrock.

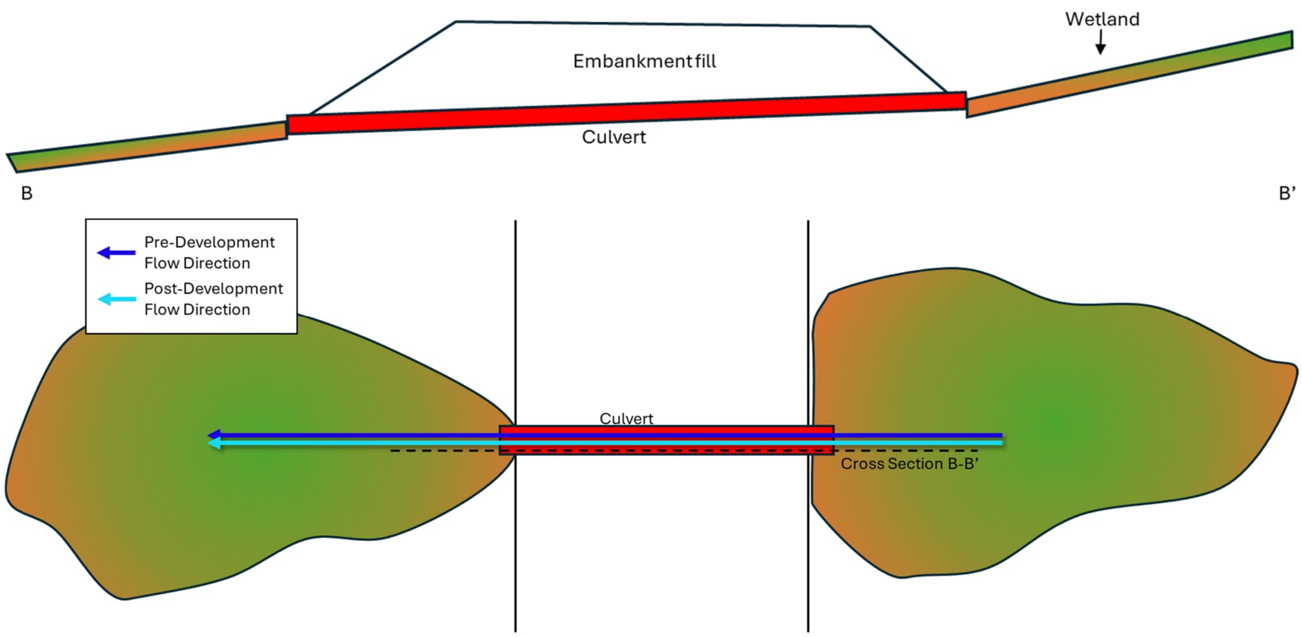


Figure 2. Cross section of Type II Situation.

3.3 Type III

Type III occurs where there is a wetland (bog or fen) downstream of a road where the road intersects the wetlands natural surface water catchment, which the wetland is dependent on.

Two specific Type III Scenarios occur:

- Type III(A) – No wetland in the upstream catchment;
- Type III(B) – A wetland is in the upstream catchment but is not in close proximity to the road.

Water connectivity at a Type III situation (refer **Figure 3**) is proposed to be managed by the installation of culverts underneath the road which is capable of conveying the entire upstream surface water catchment. This is the most common situation out of the three situation types in respect of the Southland Wind Farm civil works footprint on the Jedburgh Plateau.

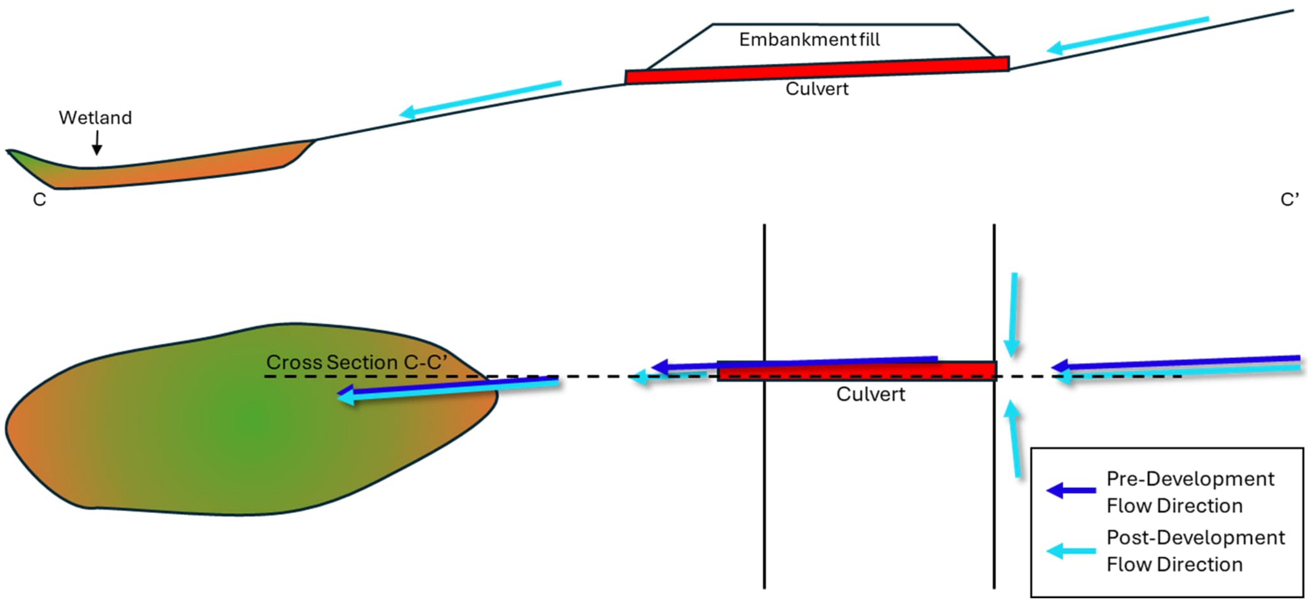


Figure 3. Cross section of Type III situation.

4. Concept Design

4.1 Overview

Land drainage is required to convey surface water flows and maintain hydrologic connectivity to and between wetlands as discussed in **Section 3**. Thus, it is proposed that appropriately sized culverts will convey surface water beneath the proposed roads.

4.2 Methodology and Design

The steps in the concept design included:

1. Identification of catchments intersecting proposed linear infrastructure using overland flow path analysis;
2. Calculation of the peak design storm flow; and
3. Sizing of culverts.

The following sub-section discus each aspect.

4.2.1 Overland Flow Path Analysis

As mentioned in **Section 2.2,** overland flow paths (OLFPs) were determined using the existing land surface 1 m Digital Elevation Model (DEM) provided by Contact Energy.

The OLFPs were identified at different intensities based on the catchment area upstream of the headwaters of the OLFP. An OLFP upstream area of 1,500 m^2 was selected for defining spacing and delineation of culvert crossings.

The surface water catchments, OLFPs, and mitigation design is presented in the figures provided in **Appendix B**.

4.2.2 Peak Runoff and Culvert Sizing

The sizing and positioning of the culverts were based on the design assumptions discussed in **Section 2.2**. The peak runoff for the catchments that the culverts provide for was based on the Rational Method[5] with the following parameters:

- An average rainfall intensity of <u>60.1 mm/hr</u> for the 10-year ARI, 10-minute duration, with RCP 8.5 climate change scenario design storm from NIWA's HIRDS v4 rainfall intensity.
- A runoff coefficient of <u>0.35</u> for heavy clay soil types with bush and scrub cover as recommended in the NZ Building Code[6] was utilised.
- Catchment areas as listed in **Table 1.**

The culvert catchment area, length and internal diameters are listed in **Table 1**. The culvert numbers in **Table 1** relate to the culvert numbers shown in the figure set (**Appendix B**). The actual internal diameter is based on commercially available culvert sizes such as the Hynds Civil Boss[7] pipe, the Iplex Novaflo[8] pipe and the EuroFlo Civil pipe[9].

Culvert diameters are subject to change due to ecological provisions for fish passage. It is very unlikely that fish will be present in any of the wetlands located at the Jedburgh Plateau, thus culvert sizes may be reduced to the minimum internal diameter (**Table 1**) if fish passage is considered unnecessary as very little embedment would

[5] https://www.ccc.govt.nz/assets/Documents/Environment/Water/waterways-guide/21.RainfallAndRunoff.pdf
[6] https://www.building.govt.nz/assets/Uploads/building-code-compliance/e-moisture/e1-surface-water/asvm/e1-surface-water-amendment-6.pdf
[7] https://www.hynds.co.nz/product/civilboss-twin-wall-polypropylene-pipe/
[8] https://www.iplex.co.nz/products/novaflo-single-wall-corrugated-bore-pe-land-drainage-pipe/
[9] https://pandfglobal.com/products/euroflo-civil/

be required in this case. Additionally, culverts that require scruffy domes or grates will not require embedment. However, for the purposes of this conceptual design, we have included additional diameter in all of the culverts to allow for 33% embedment.

Some additional works to the culverts that will be required are as follows:

- Culverts that are located within a perimeter drain will require a grate or scruffy dome to direct water into the culvert;
- Culverts that are located inside of the clay bunds will require a scruffy dome as shown in **Figure 1**;
- Culverts that are not within a topographical low point will require some configuration of the surrounding land to direct the flow into the culvert (i.e., dig out small channel, or construct small bund);
- Some downstream culverts may require channel work – this hasn't been considered in this concept design and would be picked up in the detailed design;
- Culvert 35 is proposed to be a siphon; and
- Work required for each category is not explicit, as some additional minor works for each culvert may be required, for example, bogs are located in culvert catchment 59 that would require clay bunding as they are located at a cut surface. However, culvert 59 is classified as Type III(B) situation.

The culvert figures and catchment analysis are detailed in **Section 4.2.1**. Culverts with a relatively large diameter compared to the catchment area are due to the comparatively flat gradient of the culvert. During detailed design, large culverts may be substituted for multiple small culverts.

Table 1. Culvert specifications.

Culvert Number	Culvert Catchment (ha)	Length (m)	Minimum Internal Diameter (mm)*	Actual Internal Diameter (mm)	Situation Type
1	0.18	24	114	160	Type III(A)
2	0.20	18	89	160	Type III(A)
3	0.67	12	149	225	Type III(B)
4	0.80	12	174	300	Type I(C)
5	0.80	12	183	300	Type I(C)
6	0.93	18	373	500	Type III(B)
7	0.47	12	125	225	Type III(B)
8	0.19	12	114	160	Type III(B)
9	0.18	12	101	160	Type III(B)
10	0.21	12	97	160	Type III(B)
11	0.58	18	155	225	Type III(A)
12	0.53	12	115	160	Type III(A)
13	0.57	18	135	225	Type III(A)
14	0.36	12	201	300	Type III(A)
15	0.25	24	106	160	Type III(A)
16	0.16	18	122	225	Type I(A)
17	1.09	12	340	500	Type II(A)
18	0.34	12	120	160	Type III(A)
19	0.37	12	126	225	Type III(A)
20	5.86	42	531	800	Type II(B)

Culvert Number	Culvert Catchment (ha)	Length (m)	Minimum Internal Diameter (mm)*	Actual Internal Diameter (mm)	Situation Type
21	1.18	18	195	300	Type III(B)
22	0.38	12	113	160	Type III(B)
23	4.46	12	330	450	Type III(B)
24	0.19	30	123	225	Type III(B)
25	0.28	6	121	225	Type III(A)
26	0.25	30	151	225	Type III(B)
27	0.44	18	138	225	Type III(B)
28	0.41	12	138	225	Type III(B)
29	0.71	12	152	225	Type III(B)
30	0.50	12	131	225	Type III(B)
31	0.33	18	111	160	Type III(B)
32	0.47	18	125	225	Type III(B)
33	1.00	12	177	300	Type III(B)
34	0.20	12	91	160	Type III(A)
35	0.22	36	159	225	Type I(A)
36	0.33	30	129	225	Type I(B&C)
37	0.52	24	201	300	Type I(C)
38	0.91	54	308	450	Type I(B)
39	0.34	42	233	375	Type III(B)
40	0.25	36	236	375	Type III(B)
41	0.28	30	148	225	Type III(B)
42	0.87	24	248	375	Type III(B)
43	0.75	12	147	225	Type III(B)
44	1.27	18	184	300	Type III(B)
45	1.56	24	194	300	Type II(B)
46	1.16	24	212	300	Type III(B)
47	0.26	12	96	160	Type III(B)
48	0.92	12	192	300	Type I(B)
49	0.12	30	89	160	Type III(A)
50	0.28	30	122	225	Type III(B)
51	3.05	18	267	375	Type III(B)
52	0.50	18	120	160	Type III(A)
53	0.56	18	134	225	Type III(A)
54	0.25	18	94	160	Type III(A)
55	0.18	18	84	160	Type III(A)
56	0.20	18	93	160	Type III(A)
57	0.41	12	126	225	Type III(B)
58	0.30	12	108	160	Type III(A)
59	1.22	18	201	300	Type III(B)
60	0.07	18	54	160	Type III(A)

Culvert Number	Culvert Catchment (ha)	Length (m)	Minimum Internal Diameter (mm)*	Actual Internal Diameter (mm)	Situation Type
61	0.12	12	85	160	Type III(A)
62	0.19	18	138	225	Type III(A)
63	0.33	42	266	375	Type III(B)
64	0.32	30	133	225	Type III(B)
65	0.17	12	83	160	Type III(B)
66	0.49	12	119	160	Type III(B)
67	0.26	12	95	160	Type III(B)
68	0.46	18	116	160	Type III(B)
69	0.11	12	64	160	Type III(B)
70	0.52	12	122	225	Type III(B)
71	0.45	12	114	160	Type III(B)
72	0.34	12	98	160	Type III(B)
73	0.50	12	112	160	Type III(B)
74	0.17	12	87	160	Type III(B)
75	0.31	24	125	225	Type III(B)
76	0.21	42	125	225	Type III(B)
77	4.53	12	365	500	Type II (B)
78	1.19	18	258	375	Type III(B)
79	0.43	12	156	225	Type III(B)
80	0.44	12	141	225	Type III(B)
81	0.26	18	107	160	Type III(B)
82	0.46	12	129	225	Type III(B)
83	0.20	18	86	160	Type II(B)
84	5.01	18	313	450	Type II(B)
85	0.86	12	240	375	Type III(B)
86	0.74	18	137	225	Type III(A)
87	0.73	24	147	225	Type III(A)
88	0.31	12	123	225	Type III(A)
89	0.23	12	94	160	Type III(A)
90	0.44	30	148	225	Type III(A)
91	0.29	12	104	160	Type III(A)
92	33.41	24	627	800	Type II(B)
93	0.31	18	117	160	Type III(B)
94	1.55	12	188	300	Type II(B)
95	0.21	12	92	160	Type III(B)
96	0.63	12	151	225	Type II(B)
97	0.52	18	129	225	Type III(B)
98	0.44	18	157	225	Type III(A)
99	0.65	30	152	225	Type III(B)
100	0.40	24	179	300	Type III(B)

Culvert Number	Culvert Catchment (ha)	Length (m)	Minimum Internal Diameter (mm)*	Actual Internal Diameter (mm)	Situation Type
101	0.75	18	160	225	Type III(B)
102	0.44	12	129	225	Type III(B)
103	0.19	18	94	160	Type III(A)
104	0.46	42	184	300	Type III(A)
105	0.39	24	169	225	Type III(A)
106	0.47	12	123	225	Type III(B)
107	0.51	6	154	225	Type III(B)
108	52.86	6	900	1,200	Type III(B)
109	0.26	12	102	160	Type III(B)
Notes: * provided for information purposes for the situation where fish passage is not required.					

Clay bunding is required at 27 different wetlands (Bog or Fen) that are located at cut surfaces, in order to mitigate dewatering of the wetlands. The clay bund ID numbers, approximate lengths and the wetland type it corresponds to is listed in **Table 2**. The clay bund ID number corresponds to the number shown in the figure set in **Appendix B**. The culvert catchment ID indicates which catchment the clay bund is located in and corresponds to the culvert numbers in **Table 1**.

Table 2. Clay Bunds.

Clay Bund Number	Culvert Catchment ID	Bog/Fen	Approximate Length (m)
CB1	-	Fen	27.6
CB2	-	Fen	27.3
CB3	-	Fen	46.8
CB4	-	Fen	125.4
CB5	4	Fen	16.0
CB6	5	Fen	37.4
CB7	6	Bog	24.7
CB8	-	Bog	35.5
CB9	16	Bog	22.9
CB10	-	Fen	25.4
CB11	17	Fen	16.6
CB12	16, 17, 20	Bog	35.7
CB13	20	Bog	28.6
CB14	-	Bog	50.6
CB15	35, 36	Bog & Fen	203.9
CB16	38	Bog	29.8
CB17	48	Bog	8.1
CB18	48	Bog	7.1
CB19	-	Bog	11.3
CB20	-	Fen	10.7

Clay Bund Number	Culvert Catchment ID	Bog/Fen	Approximate Length (m)
CB21	59	Bog	19.0
CB22	59	Bog	9.7
CB23	-	Fen	17.7
CB24	77	Fen	15.6
CB25	-	Bog	107.6
CB26	-	Bog	135.4
CB27	-	Bog	53.9
		Total	**1,150.4**

4.3 Wetland of Direct Loses and Partial Losses

Exiting wetlands that are located under the proposed civil works extent, will be considered directly lost. The total area of wetlands that will be lost is tabulated in **Table 3**, and are shown in the figure suite in **Appendix B**.

Table 3. Area of wetlands lost

Located Near	Bog Wetland Lost (ha)	Fen Wetland Lost (ha)
JED 23	-	0.41
JED 24	0.18	0.13
JED 25	0.11	0.26
JED 26	0.20	0.02
JED 29	0.007	0.02
Substation	0.09	0.02
JED 16	-	0.15
JED 07	0.08	0.06
JED 27	-	0.007
Total	**0.95**	**1.08**

To provide for fish passage, culverts would be required to be embedded as described in **Section 2.2**. Embedment of culverts may lead to minor dewatering of the bog or fen at the upstream end of the culvert, partially impairing the wetland.

The impaired wetland areas, calculated using the formula described in the design assumptions (**Section 2.2**) as summarised in in **Table 4** for each culvert where relevant, is considered conservative in that the area will reduce if provisions for fish passage is determined unnecessary.

Table 4. Embedment depths, impaired radius and area.

Culvert No.	Culvert Diameter (mm)	Embedment Depth (mm)	Impaired Radius (m)	Impaired Area (m^2)
17	500	165	4.95	42.0
20	800	264	7.92	78.6
38	450	149	4.46	54.9
39	375	124	3.71	578.3

40	375	124	3.71	
41	225	74	2.23	
42	375	124	3.71	
45	300	99	2.97	8.4
77	500	165	4.95	12.3
83	160	53	1.58	4.8
84	450	149	4.46	44.8
92	1,000	300*	9.00	133.9
94	300	99	2.97	15.1
96	225	74	2.23	8.3
			Total	981.4

Notes: * Rule 59(a)(v) of the SWLP states that embedment depth shall be 1/3 of culvert diameter or 300 mm whichever is the lesser.

5. Summary and Conclusions

Management of hydrological connectivity between wetlands will occur via a water management system of regular and carefully maintained clay bunds and culverts. Strategic position of these devices will maintain water balance neutrality for three different infrastructure situation types (Type I, Type II, and Type III) that were identified.

At this concept design stage, 109 culverts and approximately 1.2 km of clay bunding located at cut surfaces, will be required to maintain flows and to minimise dewatering of wetlands.

While significant design effort has been made to minimise effects, direct losses of wetland is inevitable and, based on the concept design, amounts to 2.03 ha across the Jedburgh Plateau. Further to direct loss, a small amount of minor wetland impairment is also anticipated. With the proposed water management devices in place, the area of impaired wetland is estimated to be 0.09 ha of fen, while no bog area is estimated to be impaired. The estimation of impaired wetland area may be reduced during detailed design if ecological provisions for fish passage are demonstrated to be unnecessary.

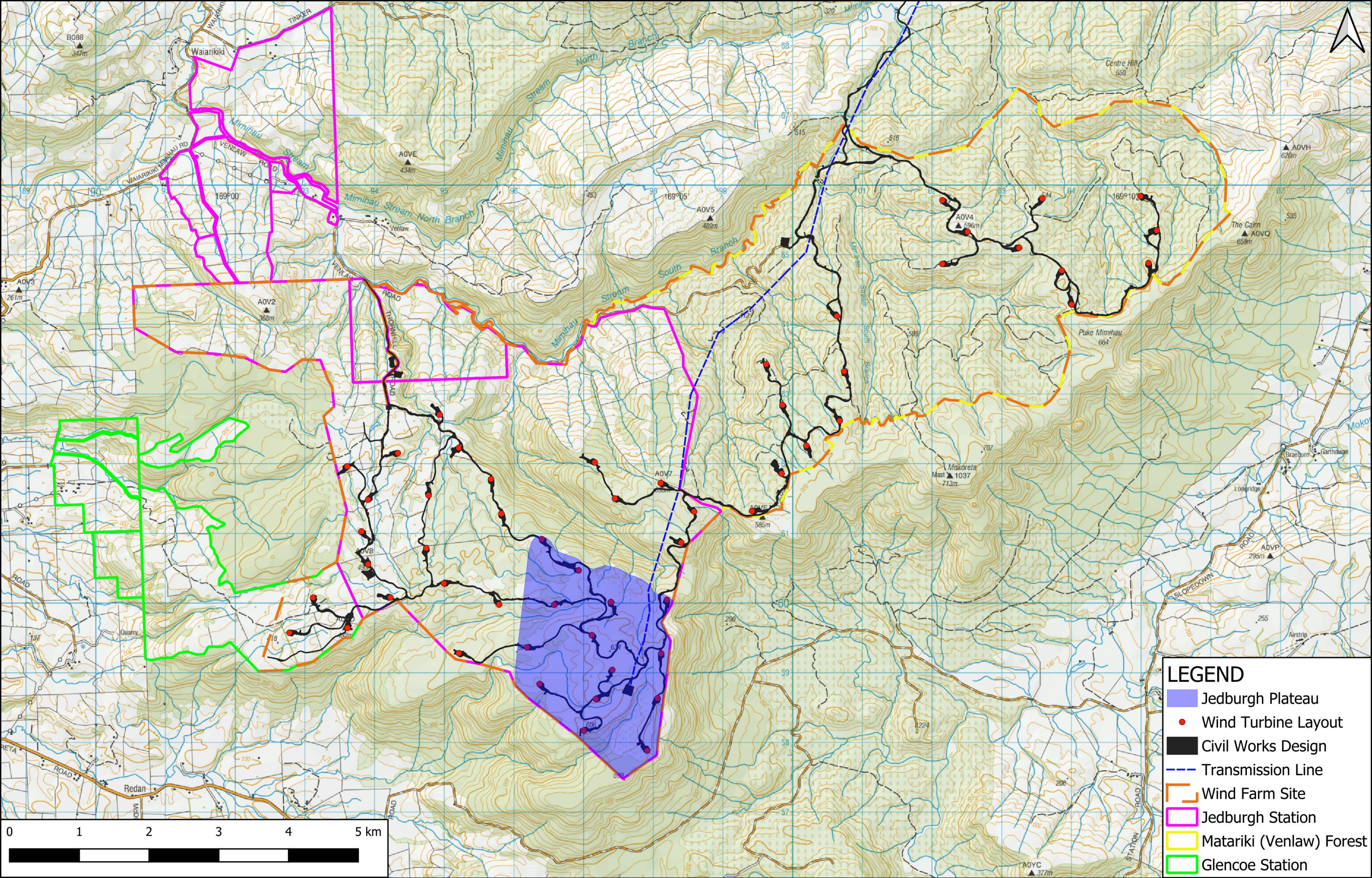
A survey was undertaken in 2008 by Ryder Consulting[10] which found no migratory fish present in the streams at the Jedburgh Plateau. It is likely that the only culverts that may require fish passage would be culverts 92 (33 ha catchment) and 108 (53 ha catchment), and possibly the next five largest catchments (culverts 20, 84, 77, 23, and 51), with the remaining culverts' catchments considered too small to necessitate provision of fish passage[11]. In this regard, culvert diameters may be revised in the detailed design stage.

Wetlands downstream of earthworks will not be impaired, as culvert discharge point is designed to be as close as possible to the boundary of the directly lost wetland, and flows from catchments smaller than the chosen minimum catchment size (1,500 m^2) are considered to be unnecessary for conveyance. As the current estimated area of impaired wetland is small, wetland impairment is considered to be minor.

It is understood that directly lost wetlands and impaired wetland areas will be fully compensated for in the Ecological Offset and Compensation Package.

[10] Ryder Consulting. April 2009. Slopedown Wind Farm – Aquatic ecology assessment.
[11] Personal communication with aquatic ecologist G. Ryder (June 2025).

Appendix A. Jedburgh Plateau Overview

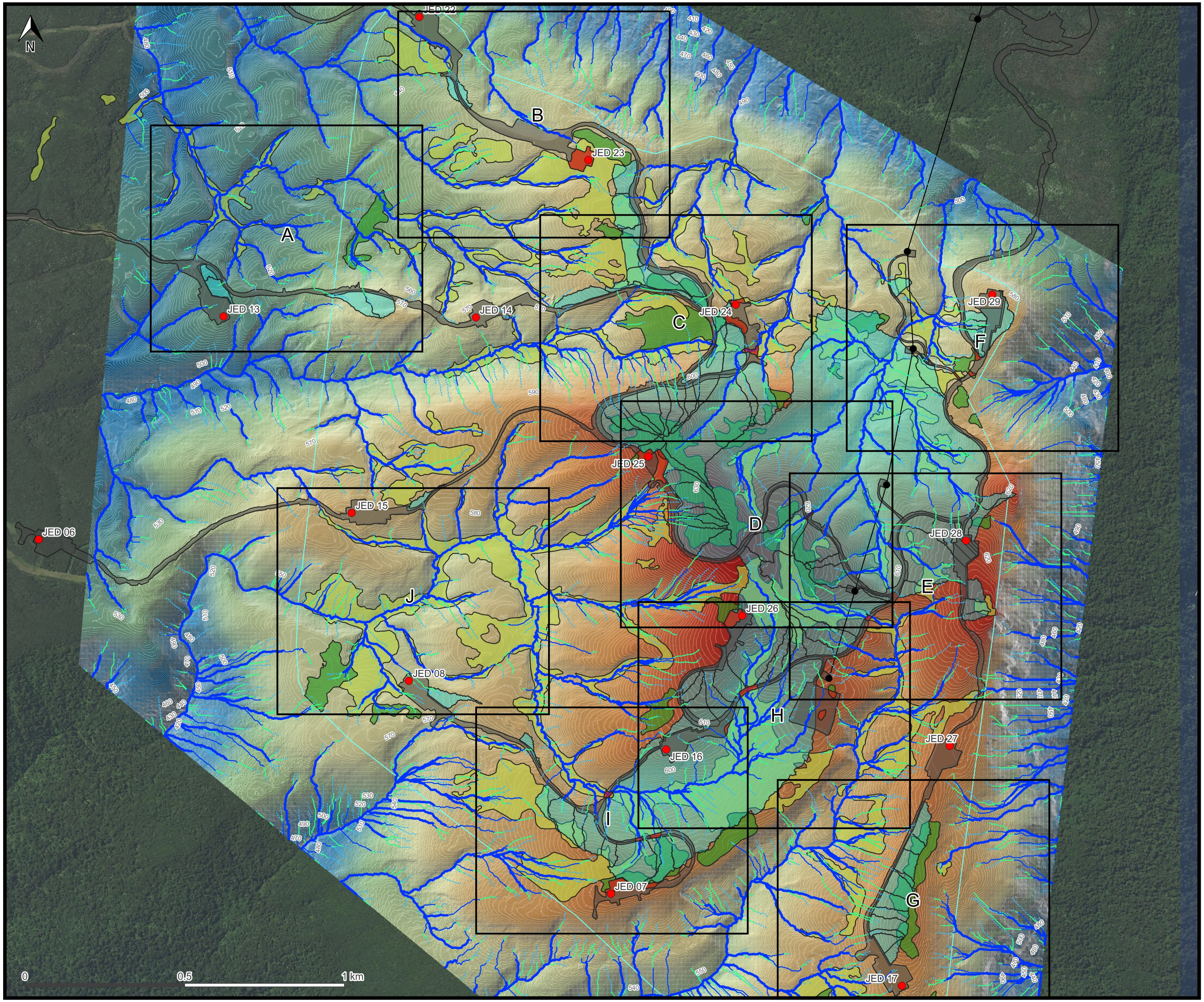

LEGEND
Jedburgh Plateau
Wind Turbine Layout
Civil Works Design
Transmission Line
Wind Farm Site
Jedburgh Station
Matariki (Venlaw) Forest
Glencoe Station
0 1 2 3 4 5 km
Waiarikiki
Mimihau Stream North Branch
Mimihau Stream South Branch
Centre Hill
The Cairn
Puke Mimihau
Mokoreta
Redan
Quarry

Appendix B. Catchments and Mitigation Design Figure Set

An overview of the OLFP's and associated catchments is presented in **Figure 4**.

The following figures show the catchments and clay bunds for the following culverts:

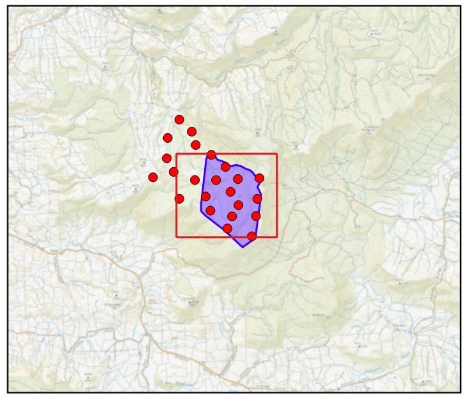
- **Figure 5 (A)** - Culverts 12 to 15;
- **Figure 6 (B)** – Culverts 1 to 4;
- **Figure 7 (C)** – Culverts 5 to 11, 16 to 33, and 105;
- **Figure 8 (D)** – Culverts 35 to 49, and 77;
- **Figure 9 (E)** – Culverts 47 to 58, 63 to 65, and 77;
- **Figure 10 (F)** – Culverts 59 to 62, 98, and 106 to 109;
- **Figure 11 (G)** – Culverts 66 to 76;
- **Figure 12 (H)** – Culverts 77 to 91;
- **Figure 13 (I)** – Culverts 86, 87, 90 to 97, 99 to 103; and
- **Figure 14 (J)** – Culverts 34 and 104.



Map Title:
Catchments Overview

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy



Legend

- Propsoed Wind Turbine
- Proposed 1 m Contour
- Exisiting OLFP (>1,000 m2 catchment)
- Exisiting OLFP (>1,500 m2 catchment)
- Exisiting OLFP (>2,500 m2 catchment)
- Exisiting OLFP (>5,000 m2 catchment)
- Transmission Line
- Transmission Tower
- Jedburgh Plateau
- Surface Water Catchment
- Earthworks Extent

Wetland

- Bog Wetland
- Fen Wetland
- Impaired Wetland
- Lost Wetland

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
19/06/2025

Layout & Project File
Catchments

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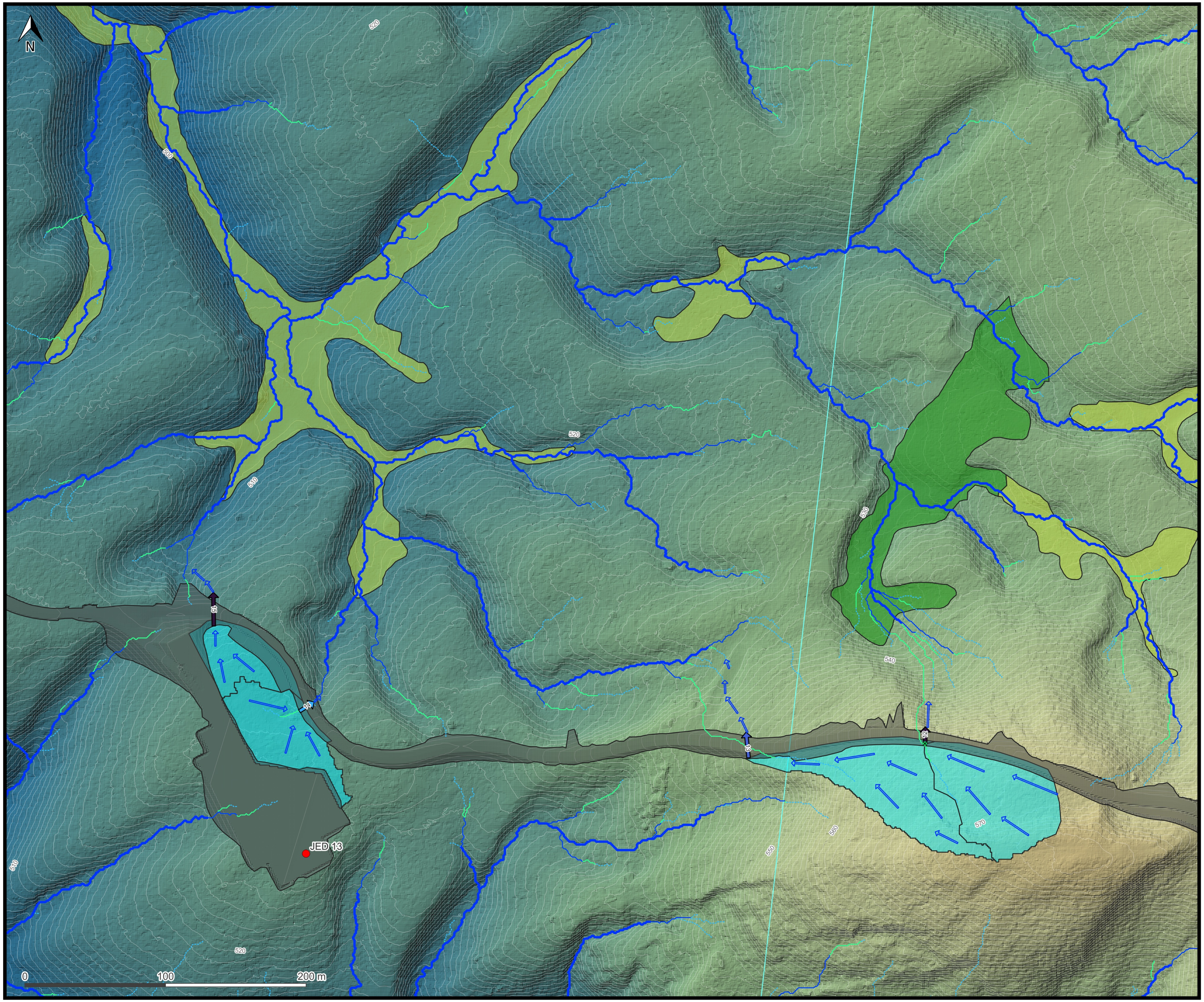
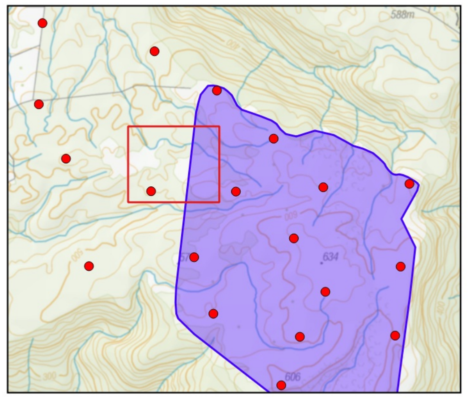
Figure 4.



Map Title:
Catchments - A

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy



Legend

- **Propsoed Wind Turbine**
- **Scruffy Dome/Grate**
- **Proposed 1 m Contour**

Culvert (Diameter mm)

- **160**
- **225**
- **300**
- **Flow Direction**
- **Exisiting OLFP (>1,000 m2 catchment)**
- **Exisiting OLFP (>1,500 m2 catchment)**
- **Exisiting OLFP (>2,500 m2 catchment)**
- **Exisiting OLFP (>5,000 m2 catchment)**
- **Jedburgh Plateau**
- **Surface Water Catchment**
- **Earthworks Extent**

Wetland

- **Bog Wetland**
- **Fen Wetland**

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
16/06/2025

Layout & Project File
Catchments

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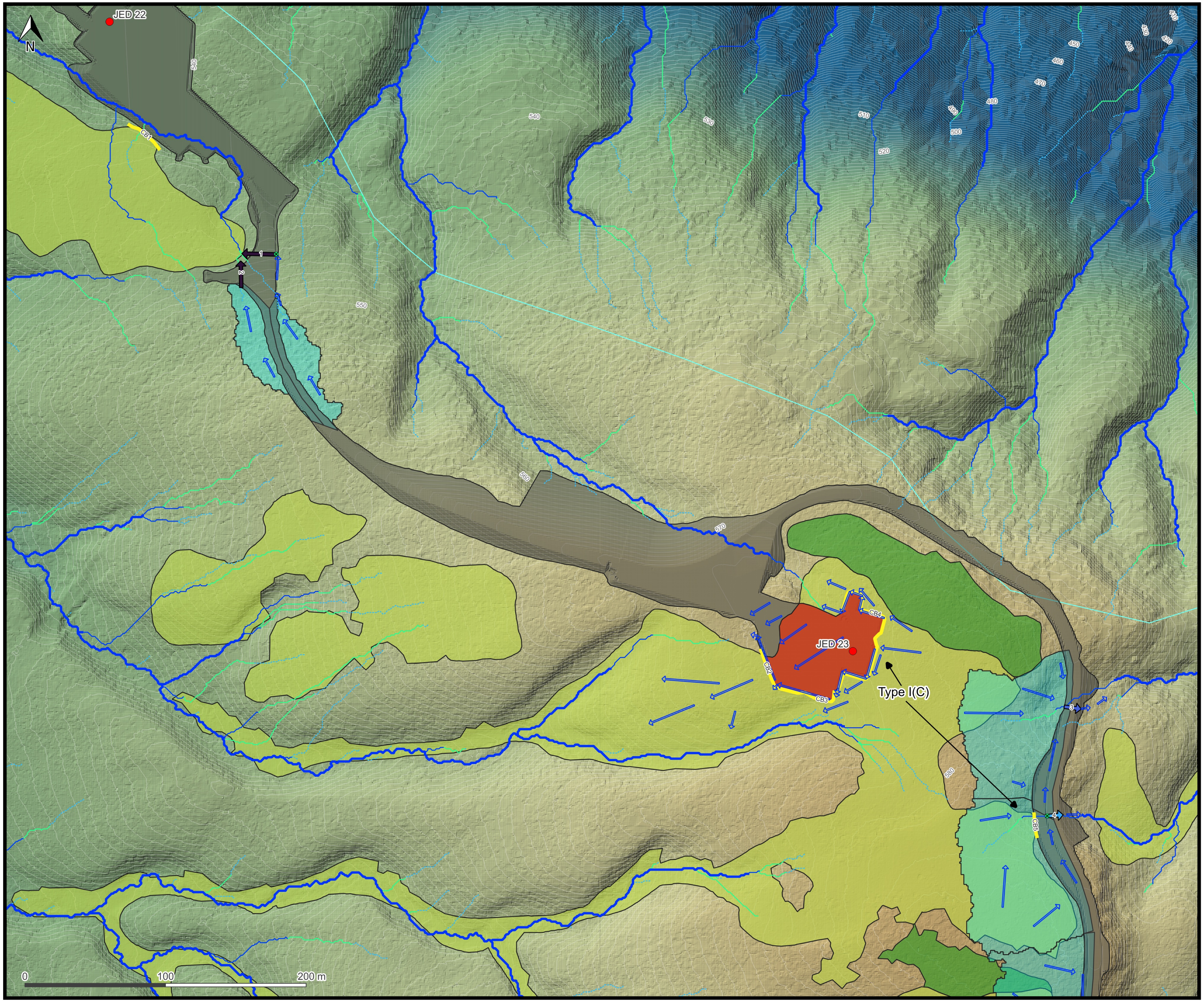
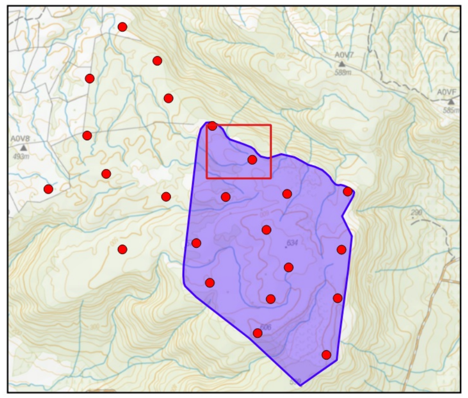
Figure 5.



Map Title:
Catchments - B

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy



Legend

- Propsoed Wind Turbine
- Scruffy Dome/Grate
- Proposed 1 m Contour

Culvert (Diameter mm)

- 160
- 225
- 300
- Flow Direction
- Clay Bund
- Exisiting OLFP (>1,000 m2 catchment)
- Exisiting OLFP (>1,500 m2 catchment)
- Exisiting OLFP (>2,500 m2 catchment)
- Exisiting OLFP (>5,000 m2 catchment)
- Jedburgh Plateau
- Surface Water Catchment
- Earthworks Extent

Wetland

- Bog Wetland
- Fen Wetland
- Lost Wetland

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
16/06/2025

Layout & Project File
Catchments

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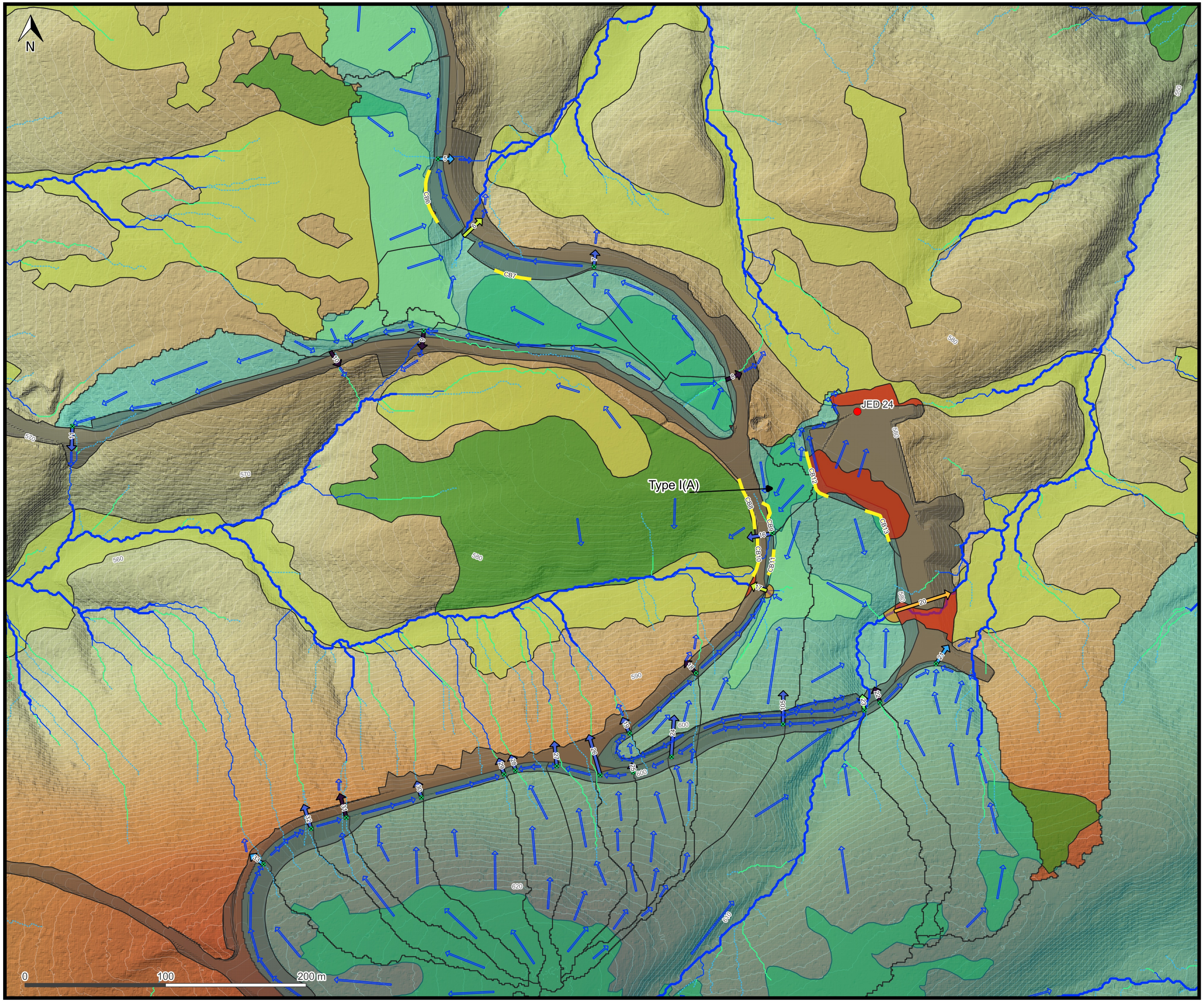
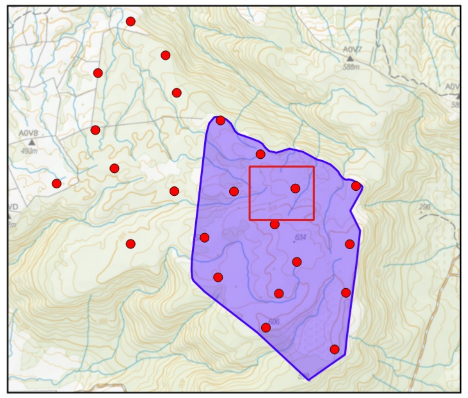
Figure 6.





Map Title:
Catchments - C

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy

Legend

- Propsoed Wind Turbine
- Scruffy Dome/Grate
- Proposed 1 m Contour

Culvert (Diameter mm)

- 160
- 225
- 300
- 450
- 500
- 800
- Flow Direction
- Clay Bund
- Exisiting OLFP (>1,000 m2 catchment)
- Exisiting OLFP (>1,500 m2 catchment)
- Exisiting OLFP (>2,500 m2 catchment)
- Exisiting OLFP (>5,000 m2 catchment)
- Surface Water Catchment
- Earthworks Extent

Wetland

- Bog Wetland
- Fen Wetland
- Impaired Wetland
- Lost Wetland

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
16/06/2025

Layout & Project File
Catchments

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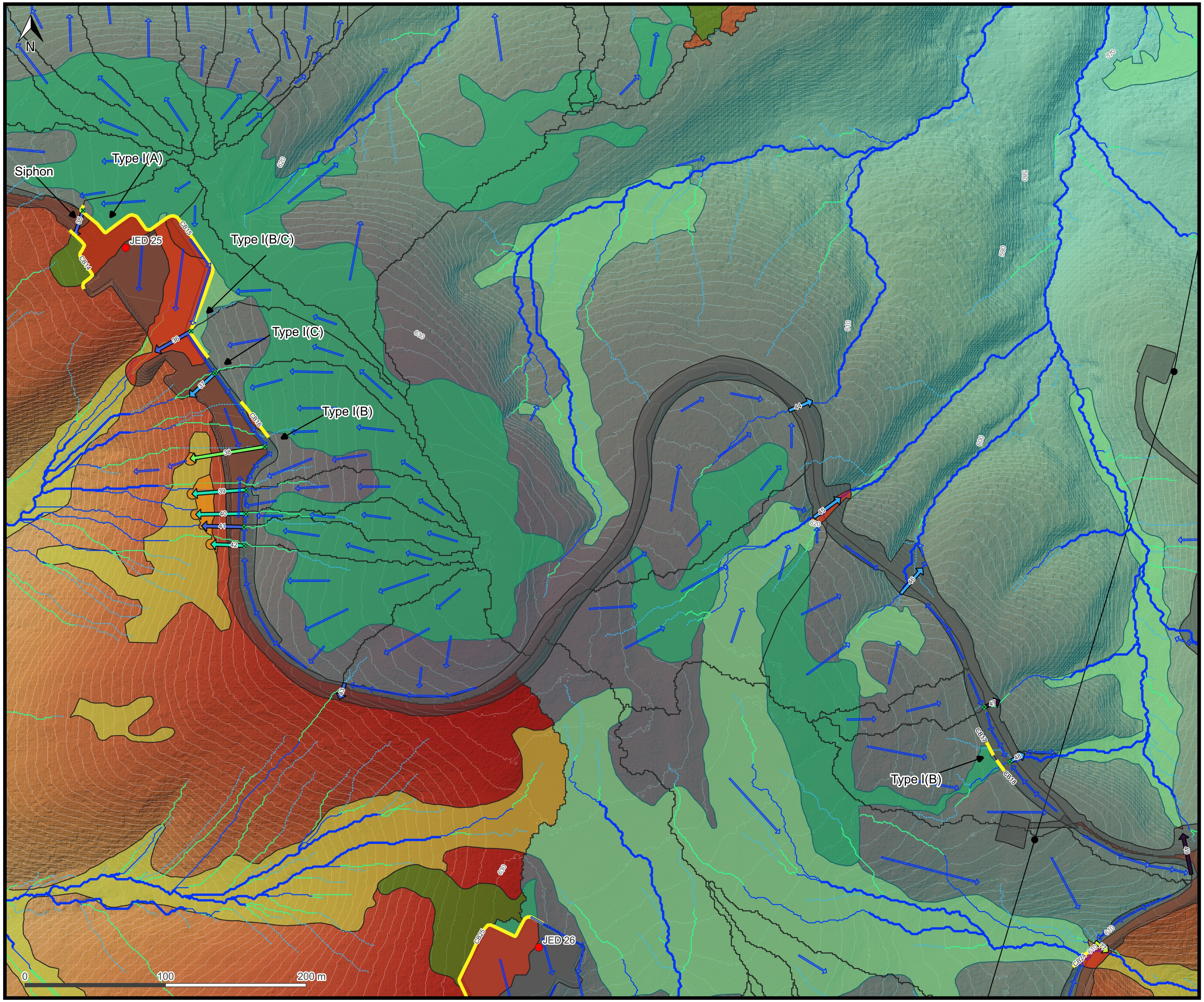
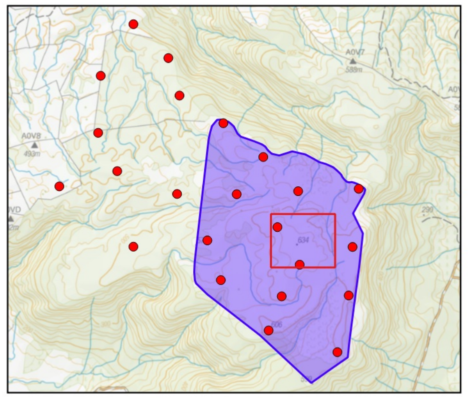
Figure 7.



Map Title:
Catchments - D

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy



Legend
- Propsoed Wind Turbine
- Scruffy Dome/Grate
- Proposed 1 m Contour

Culvert (Diameter mm)
- 160
- 225
- 300
- 375
- 450
- 500
- Flow Direction
- Clay Bund
- Exisiting OLFP (>1,000 m2 catchment)
- Exisiting OLFP (>1,500 m2 catchment)
- Exisiting OLFP (>2,500 m2 catchment)
- Exisiting OLFP (>5,000 m2 catchment)
- Surface Water Catchment
- Earthworks Extent

Wetland
- Bog Wetland
- Fen Wetland
- Impaired Wetland
- Lost Wetland

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
27/06/2025

Layout & Project File
Catchments

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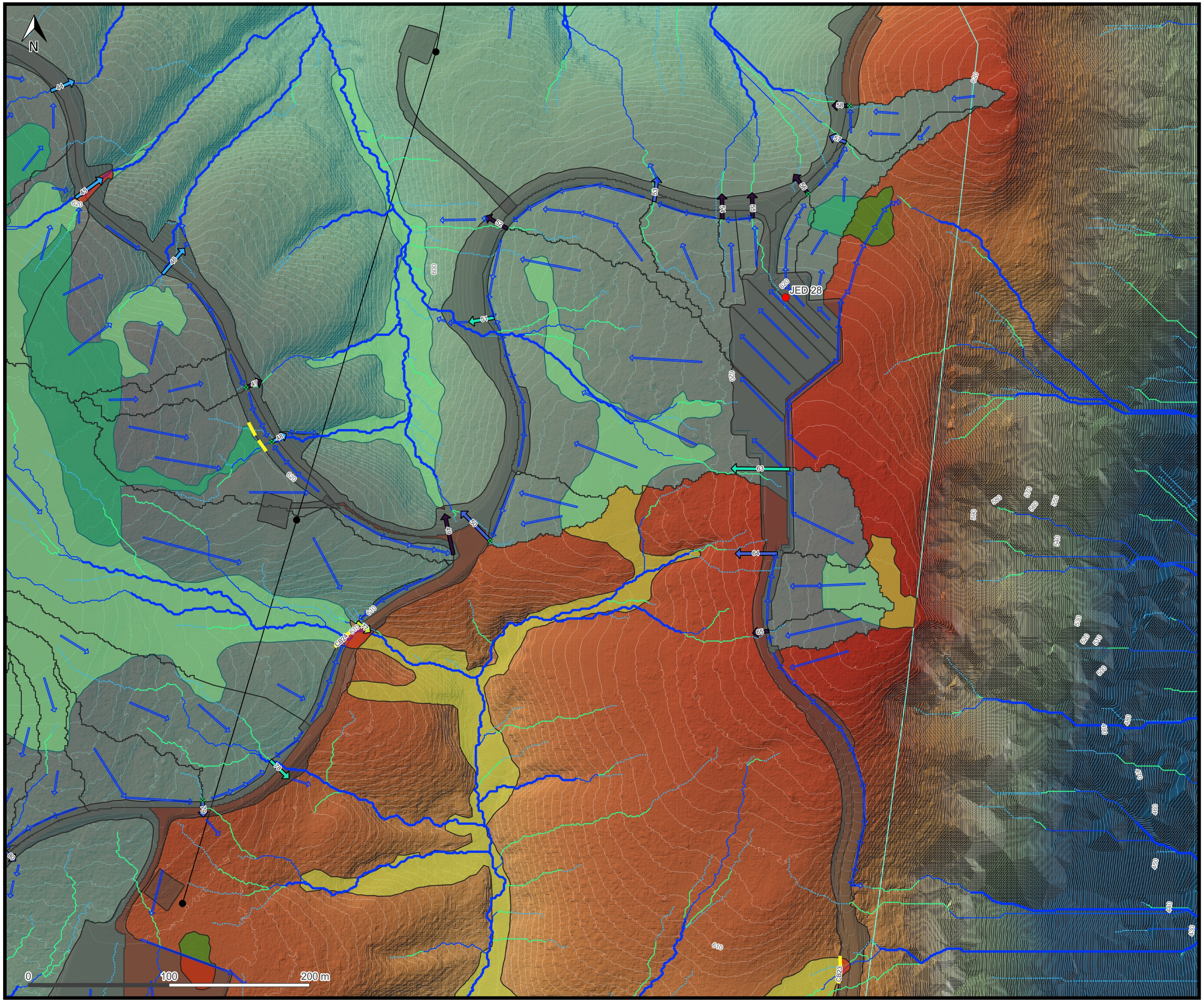
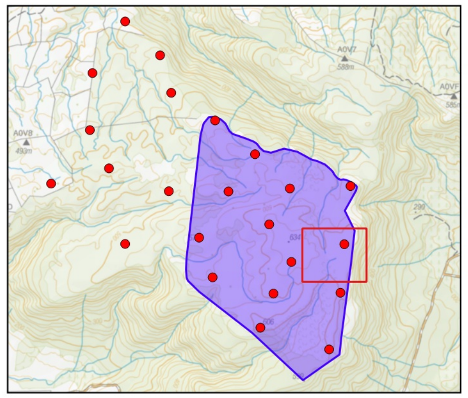
Figure 8.



Map Title:
Catchments - E

Project:
Southland Wind Farm (Jedburgh Station Plateau (JSP))

Client:
Contact Energy



Legend

- Propsoed Wind Turbine
- Scruffy Dome/Grate
- Proposed 1 m Contour

Culvert (Diameter mm)

- 160
- 225
- 300
- 375
- 500
- Flow Direction
- Clay Bund
- Exisiting OLFP (>1,000 m2 catchment)
- Exisiting OLFP (>1,500 m2 catchment)
- Exisiting OLFP (>2,500 m2 catchment)
- Exisiting OLFP (>5,000 m2 catchment)
- Jedburgh Plateau
- Surface Water Catchment
- Earthworks Extent

Wetland

- Bog Wetland
- Fen Wetland
- Impaired Wetland
- Lost Wetland

Proposed Earthworks 1 m DEM
Elevation (m)
635
500

Data Provenance

Drawn by: Brooke James
16/06/2025

Layout & Project File
Catchments

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Figure 9.