Appendix B

Stream Hydrographs and Flow Duration Curves

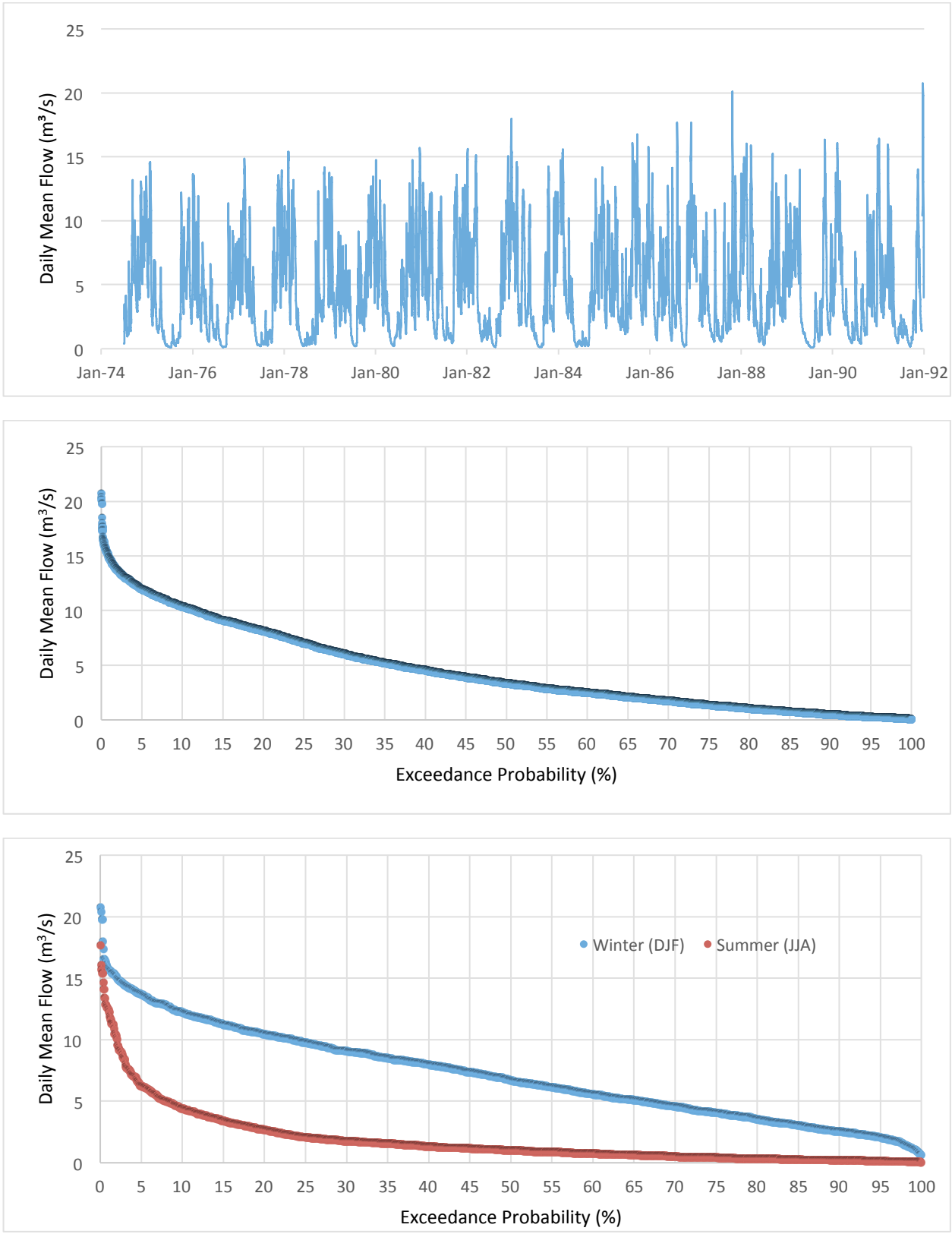


Figure B.1. Hydrograph and flow duration curve – Aghoo (36028).

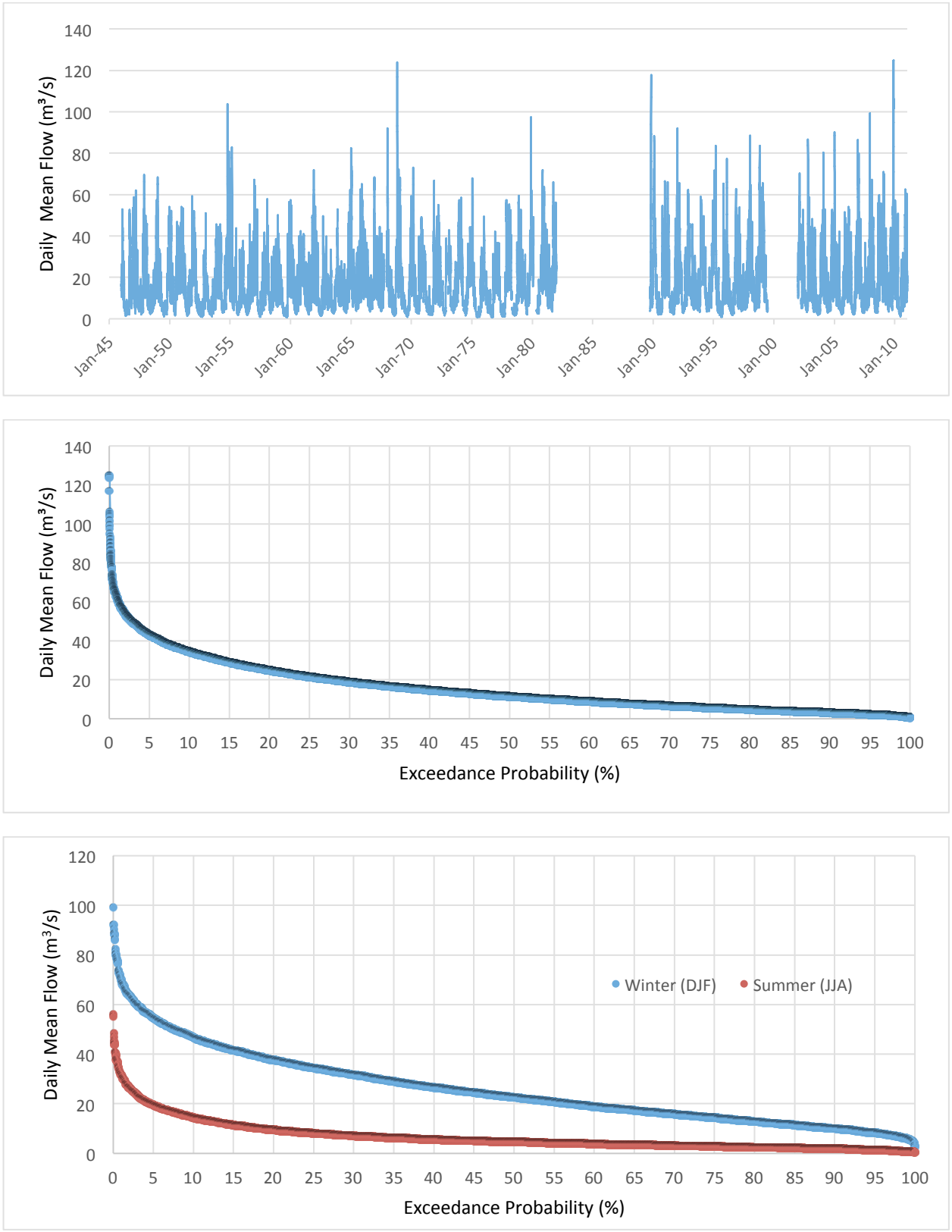


Figure B.2. Hydrograph and flow duration curve – Ballysadare (35005).

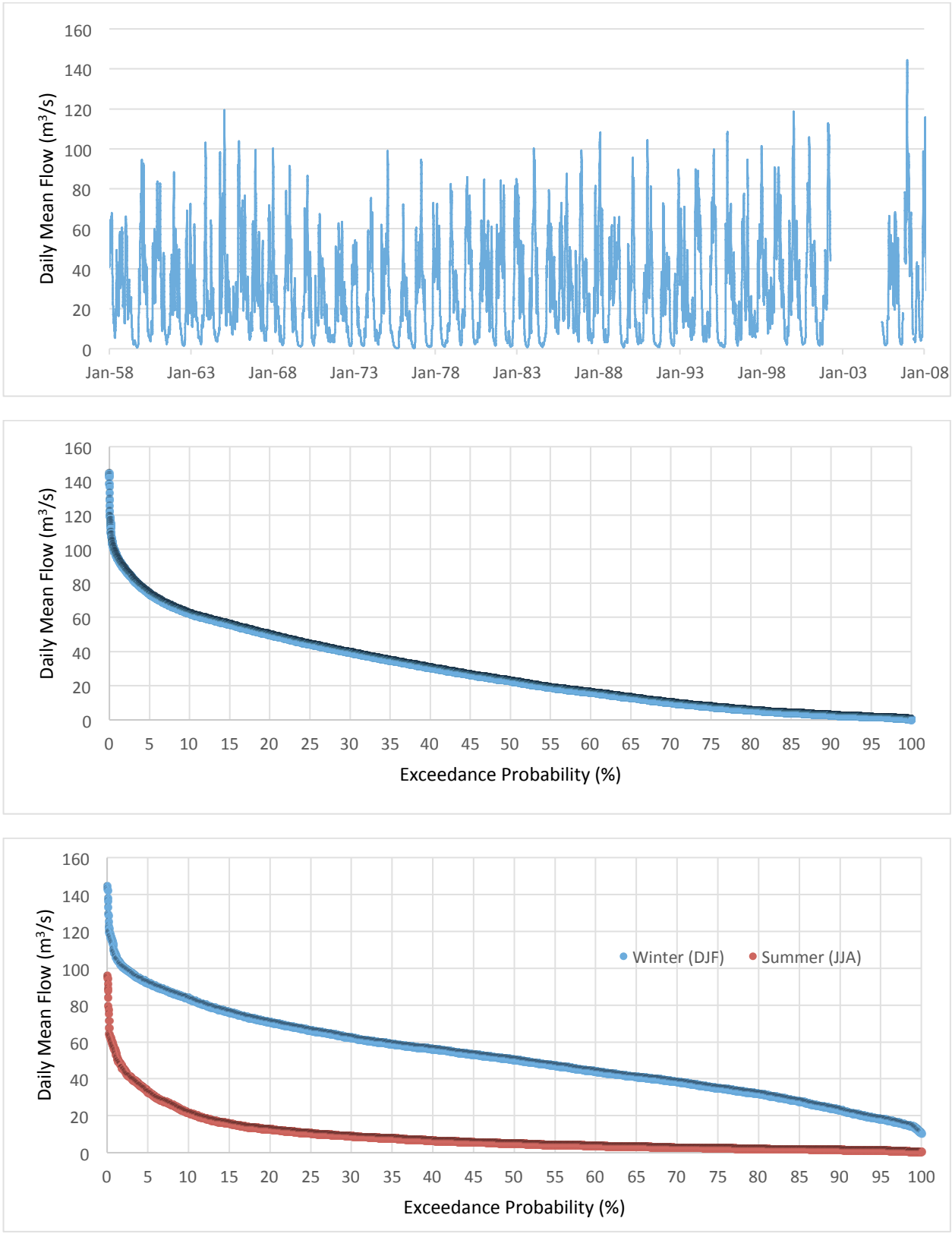


Figure B.3. Hydrograph and flow duration curve – Belturbet (36019).

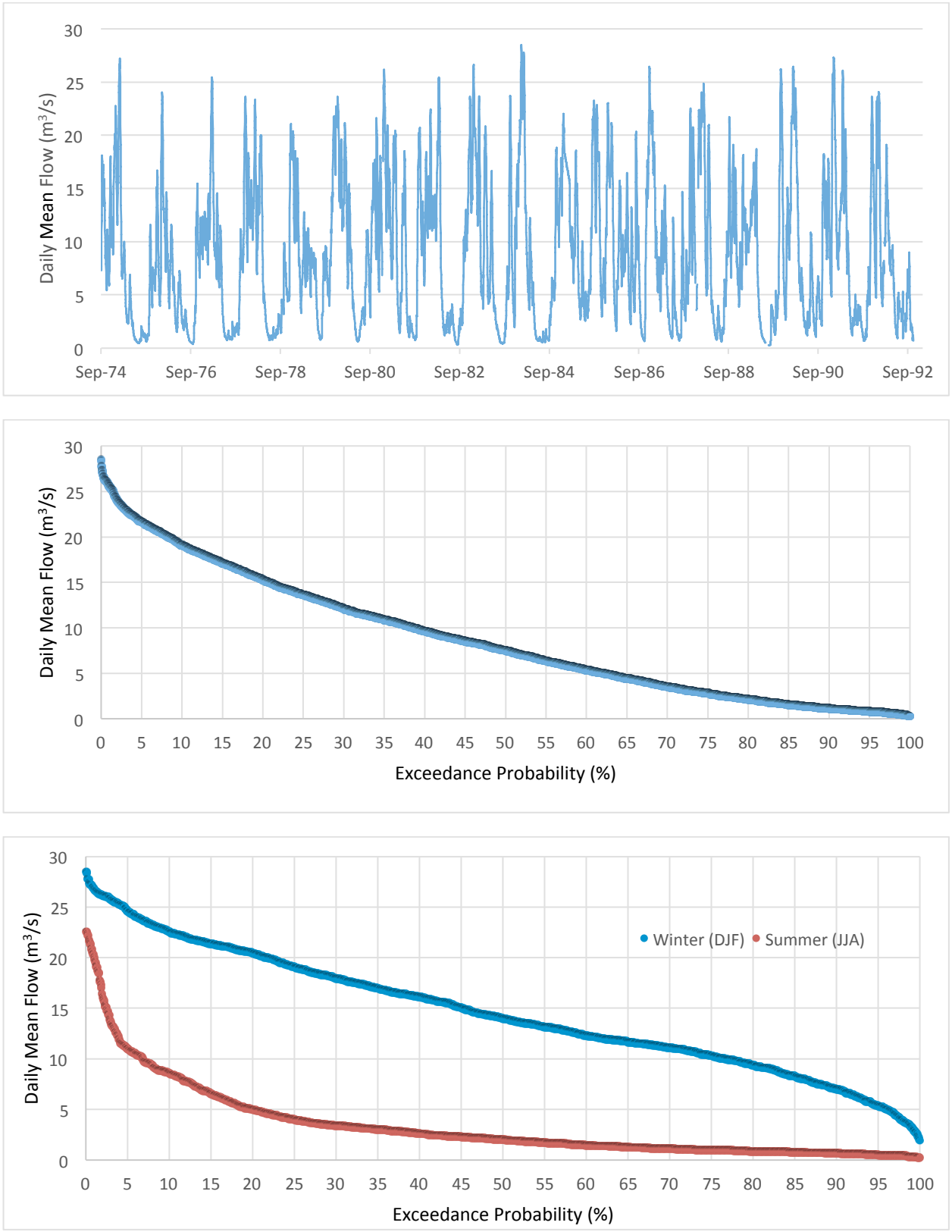
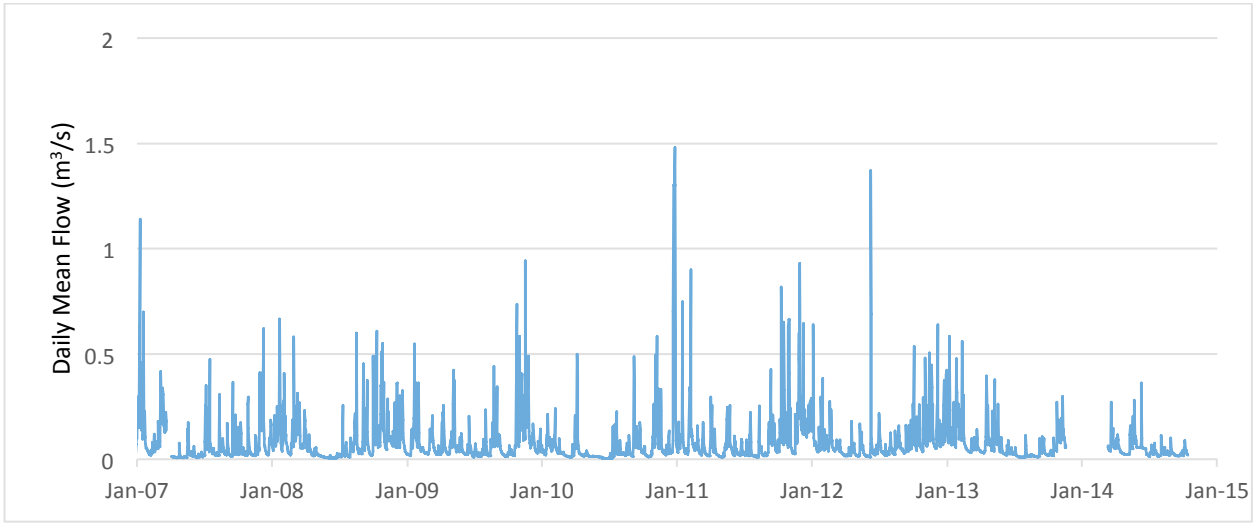
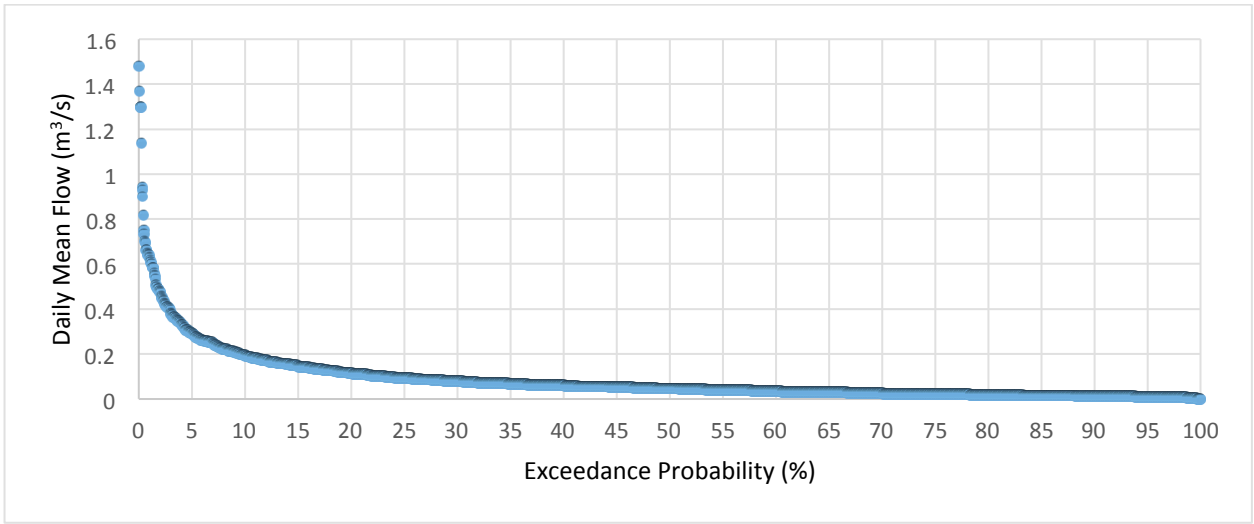


Figure B.4. Hydrograph and flow duration curve – Bellaheady (36027).





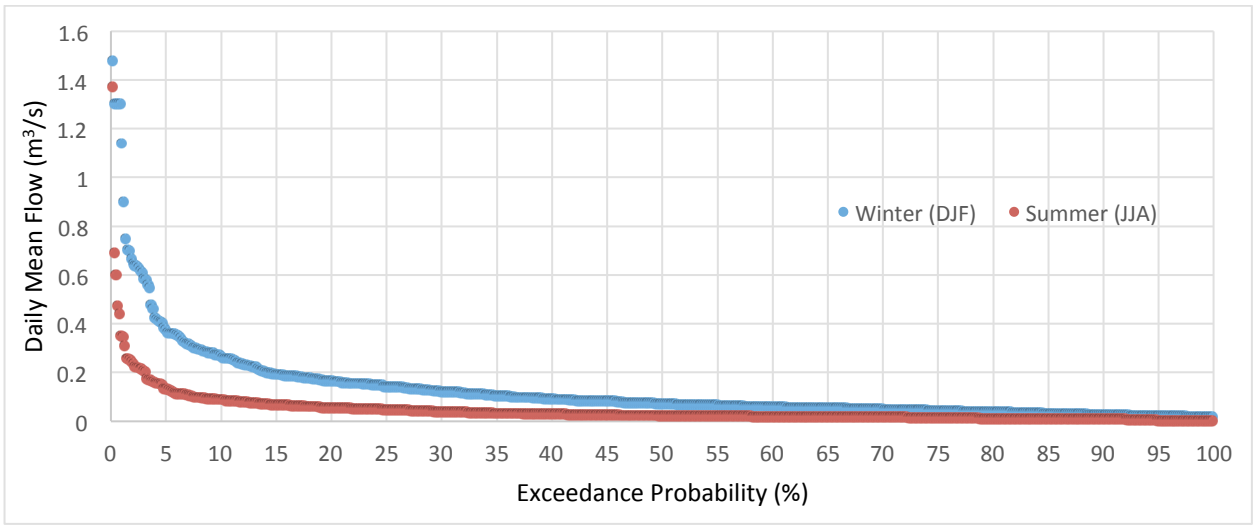
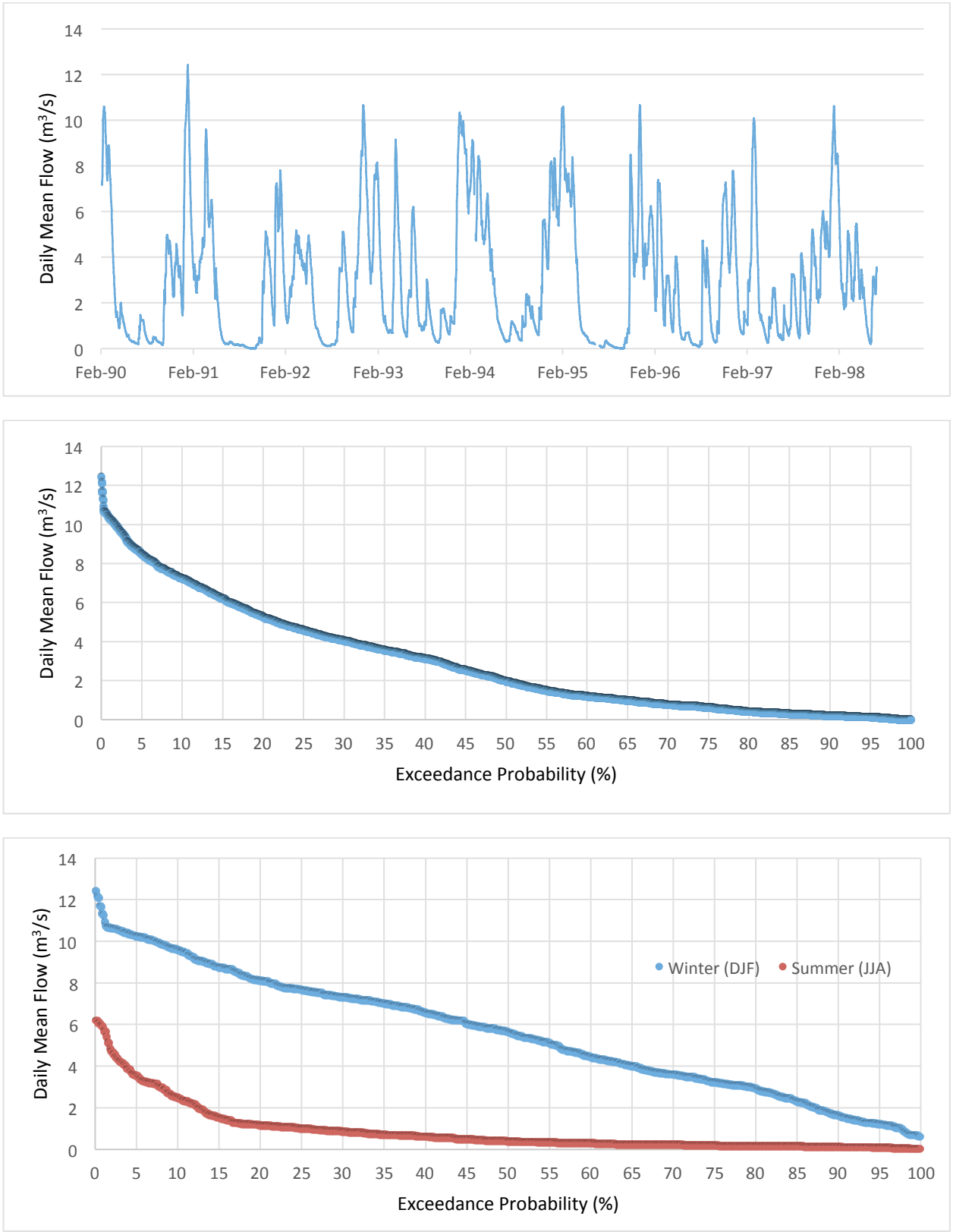


Figure B.5. Hydrograph and flow duration curve – Bomahas (35053).



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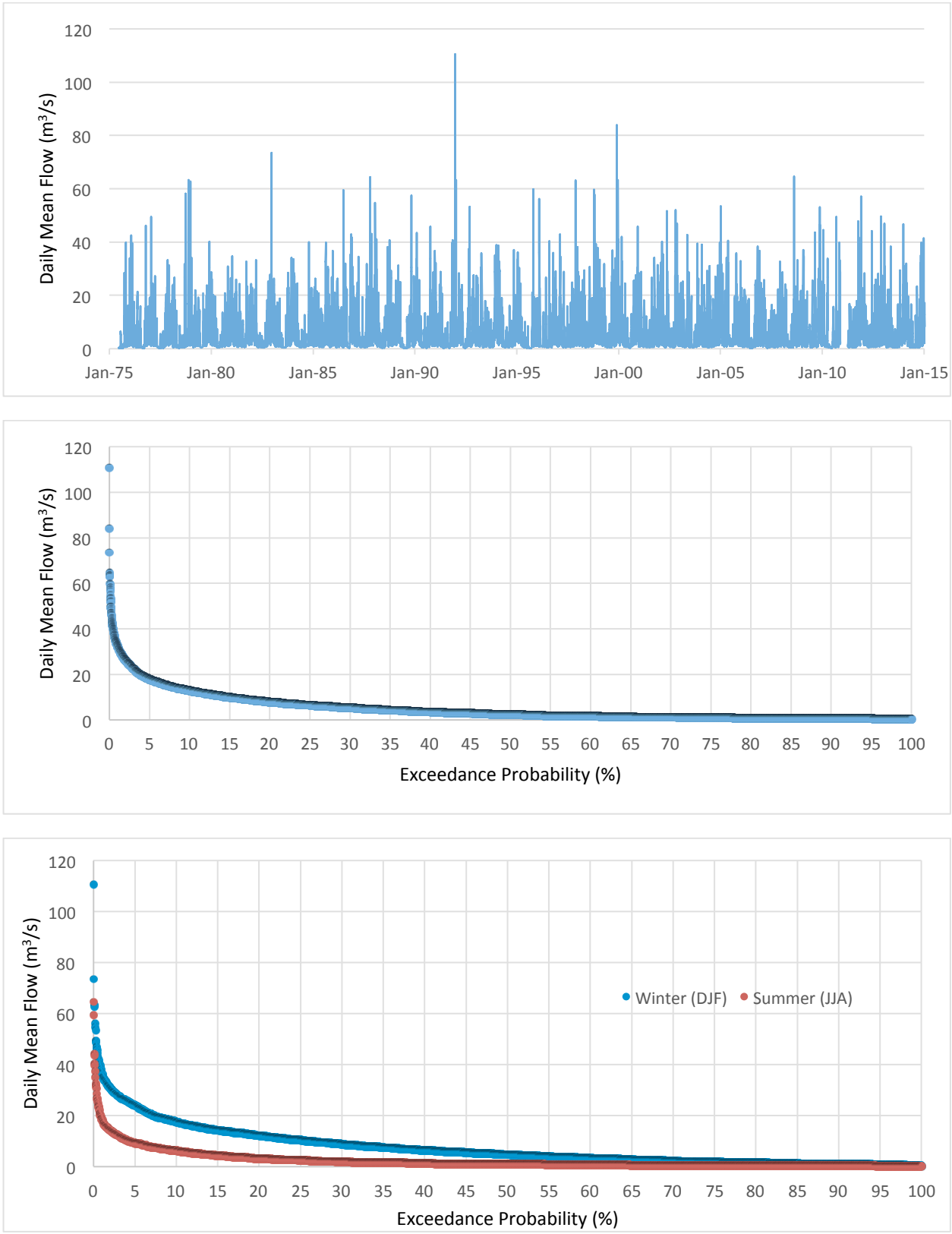

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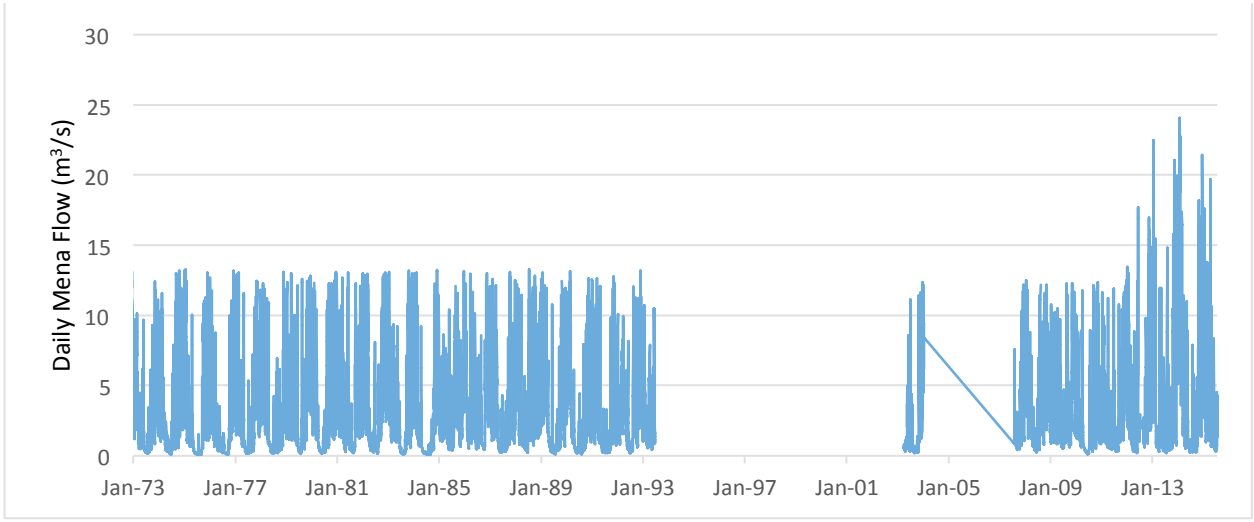
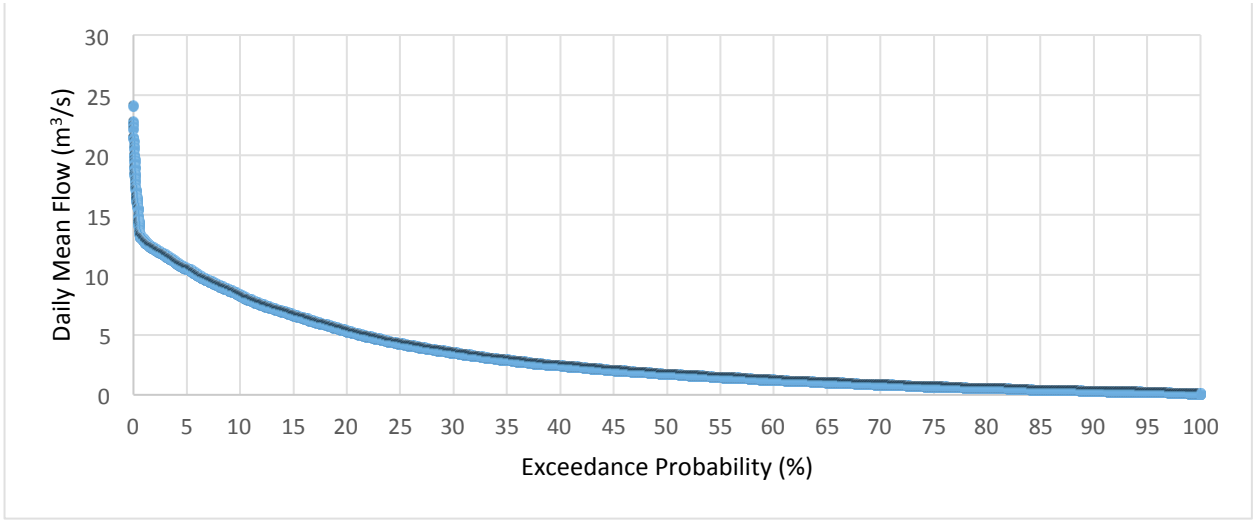




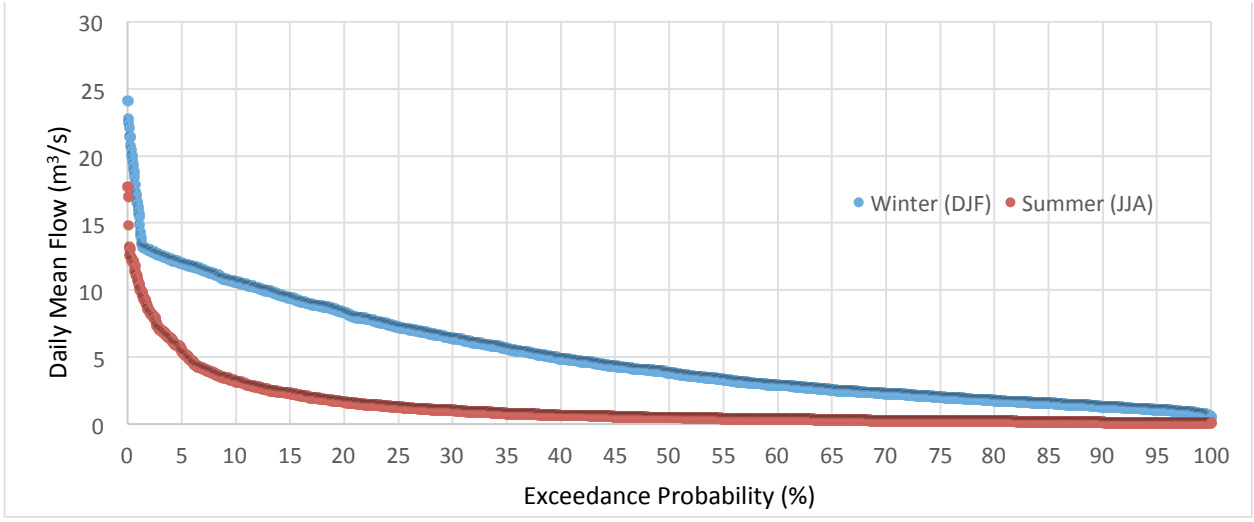
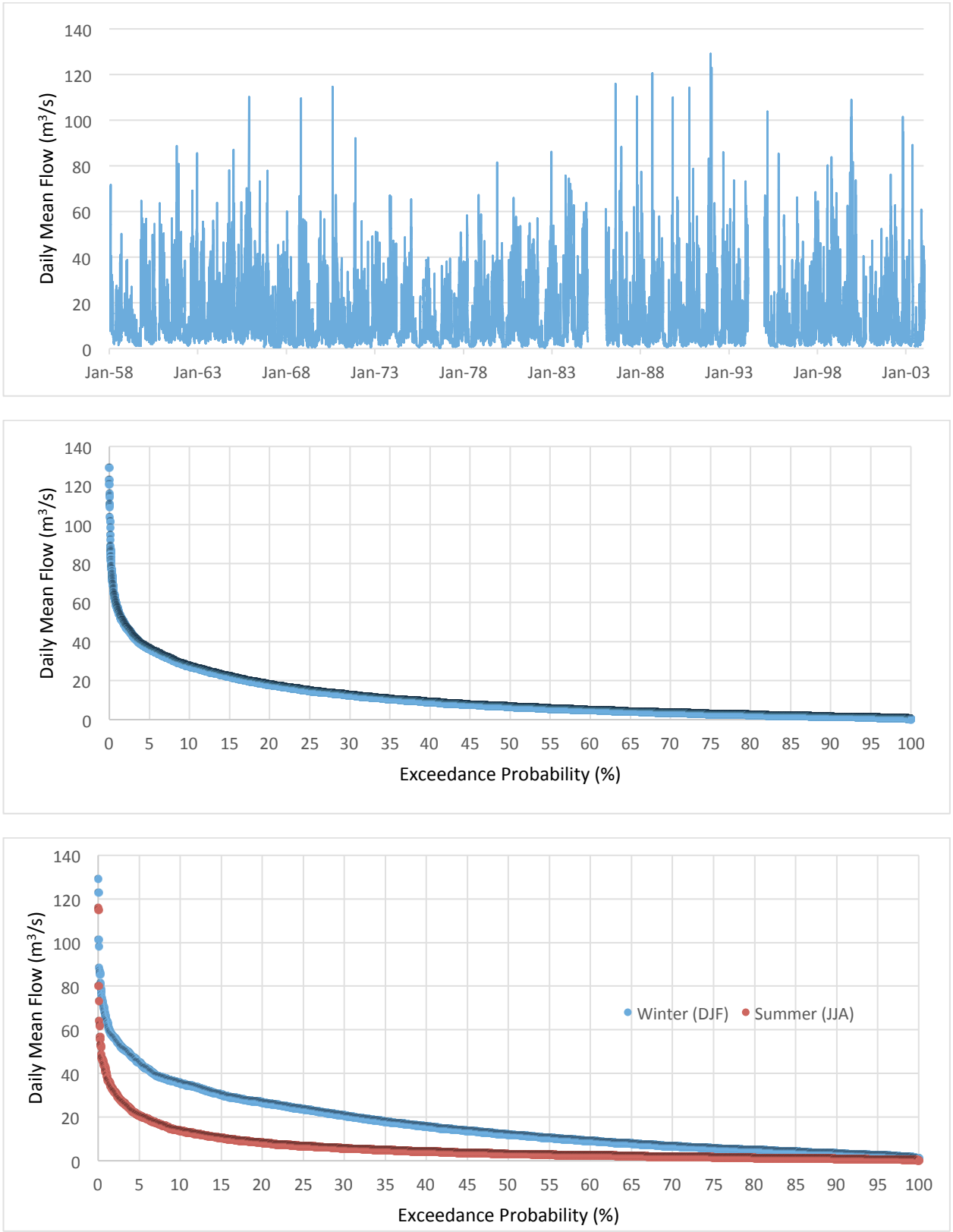


Figure B.8. Hydrograph and flow duration curve – Doonbeg (28002).



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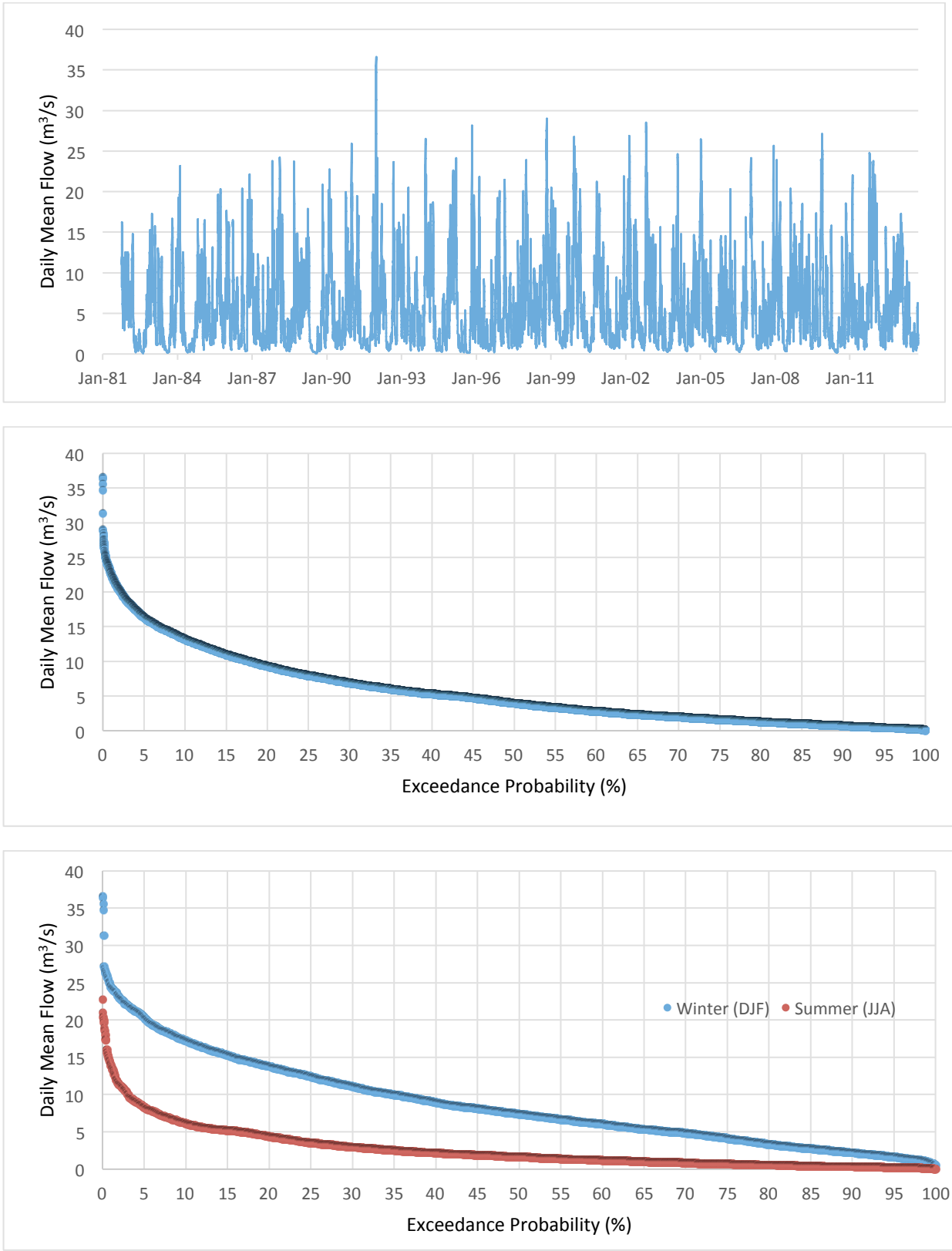
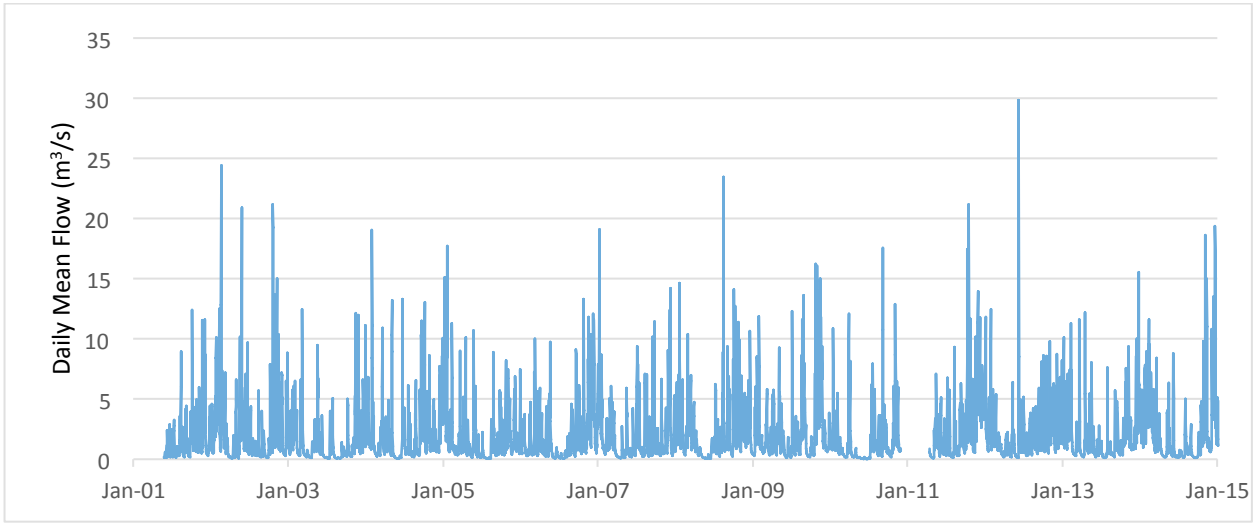
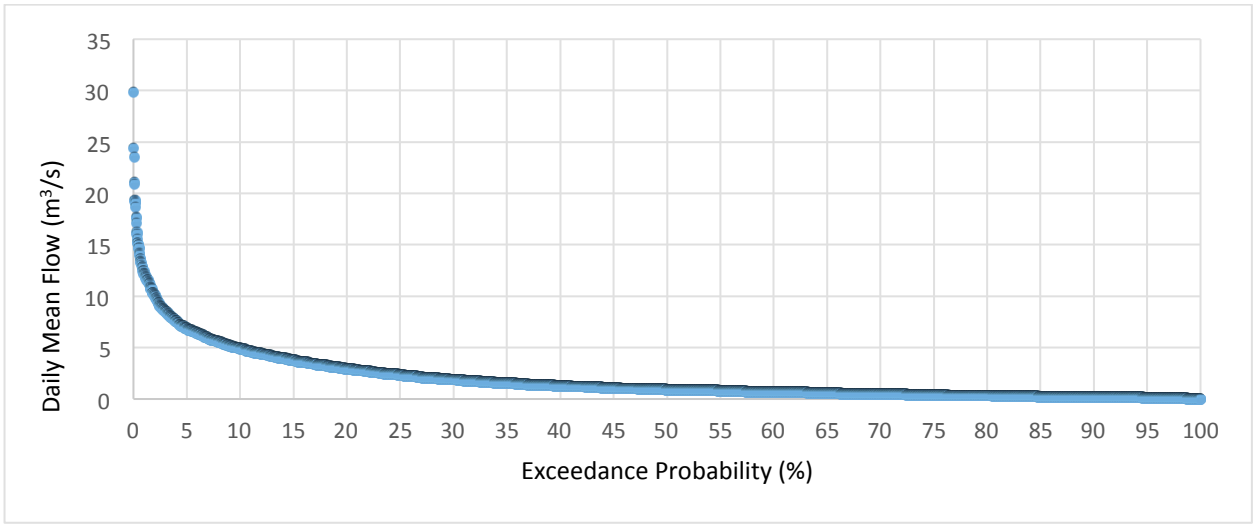


Figure B.10. Hydrograph and flow duration curve – Drumrainey Bridge (236007).





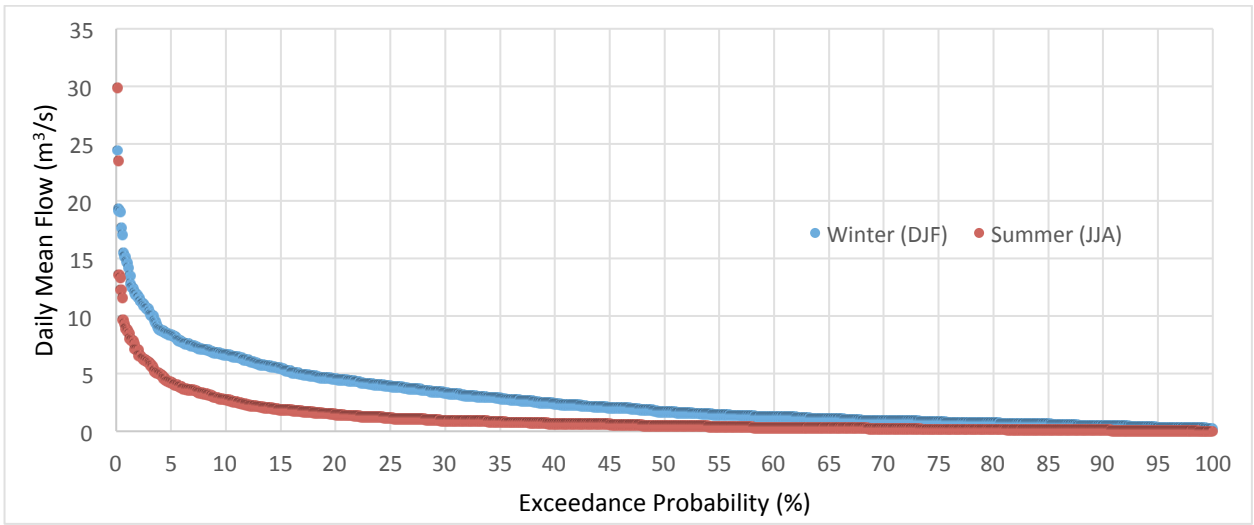
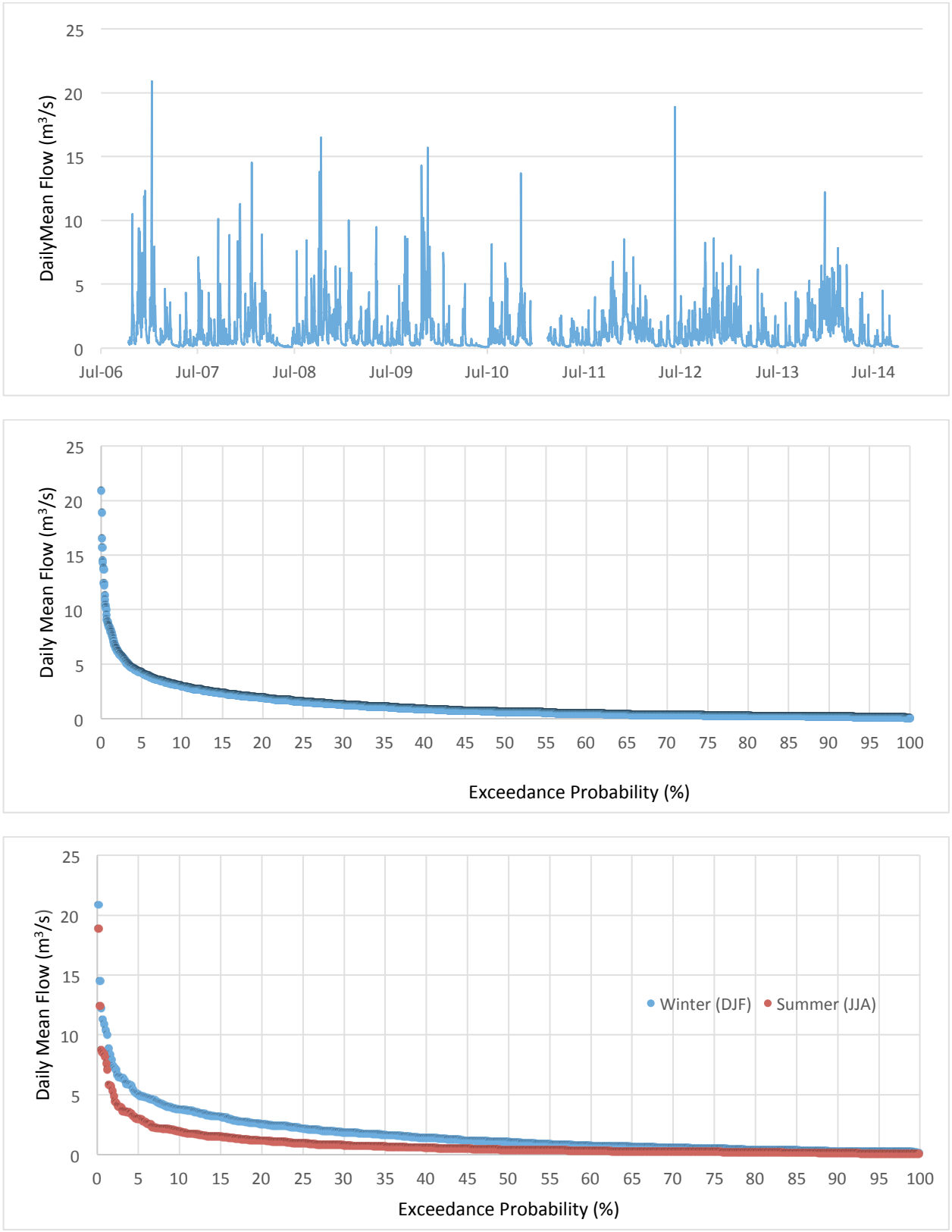


Figure B.11. Hydrograph and flow duration curve – Garrison (235050).



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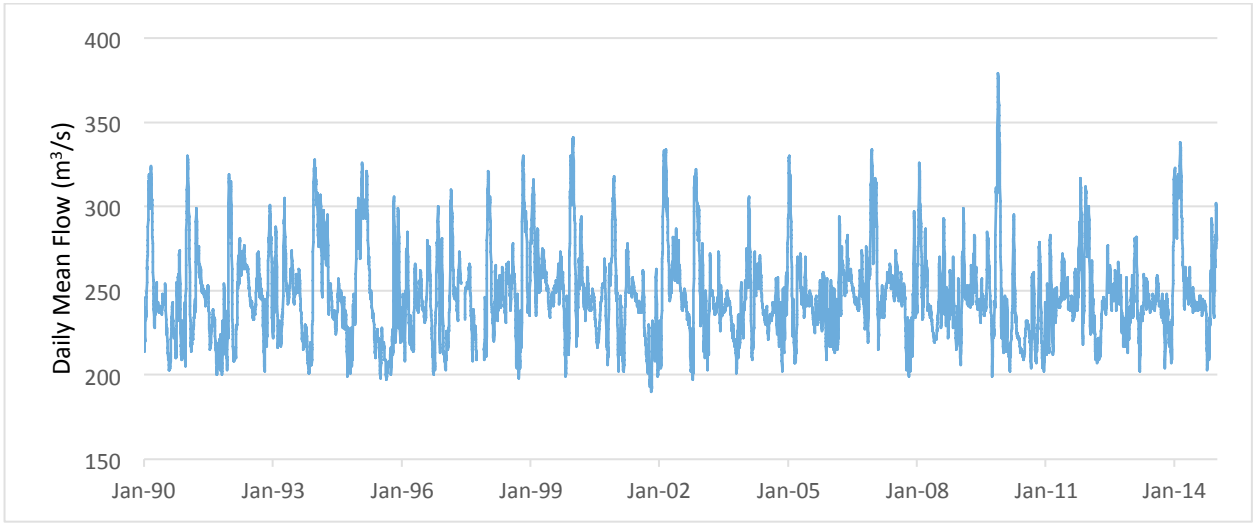
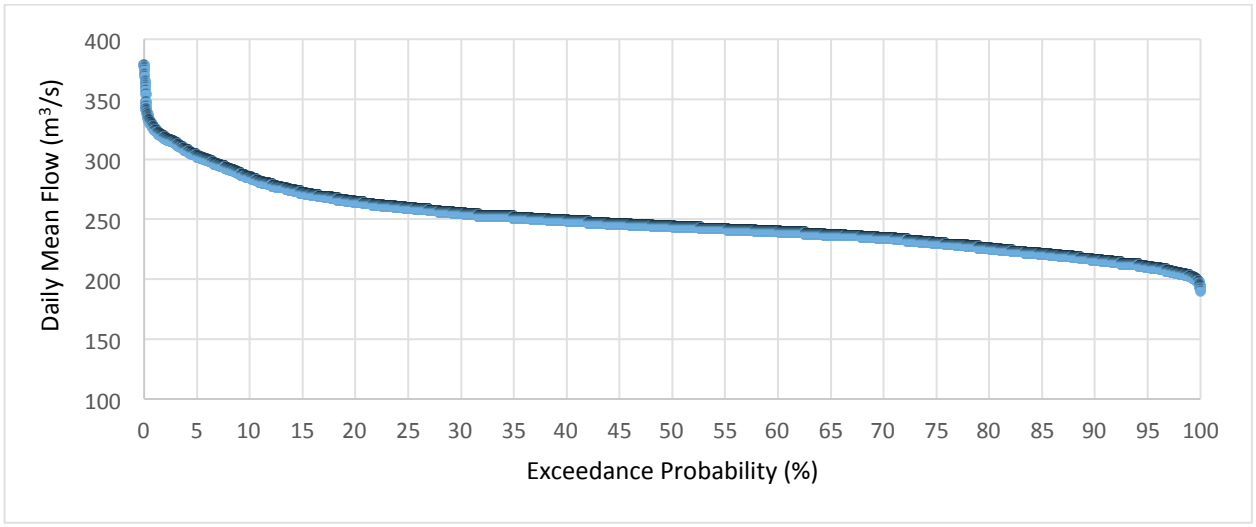




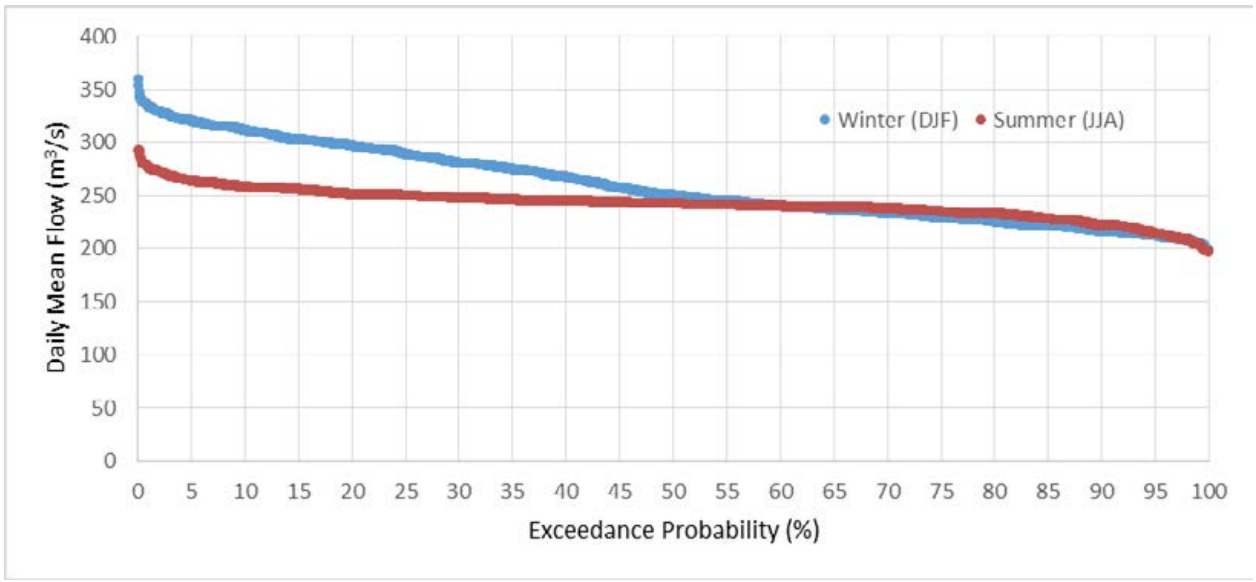


Figure B.13. Hydrograph and flow duration curve – Killyhevlin (236006).

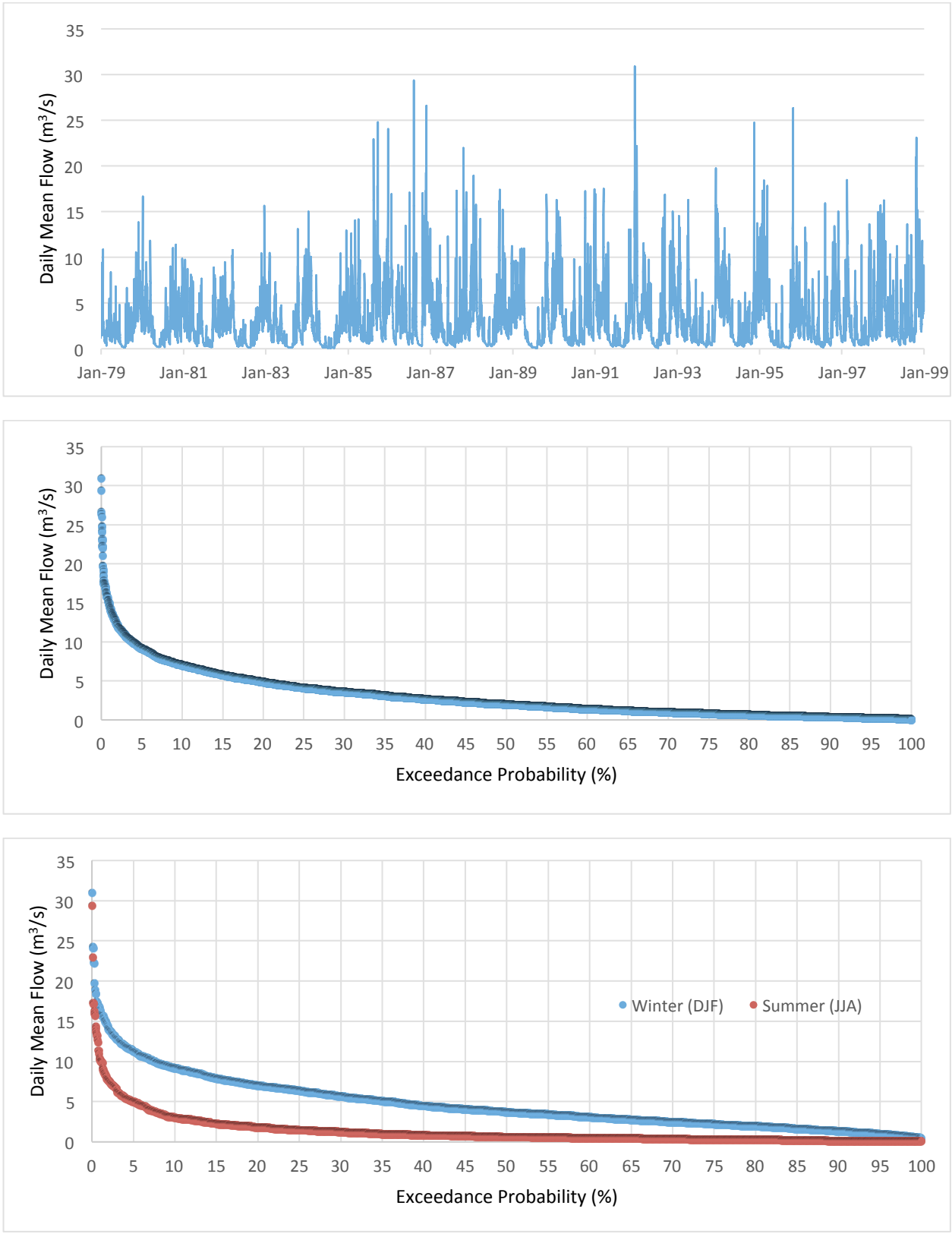


Figure B.14. Hydrograph and flow duration curve – Killywillin (36020).

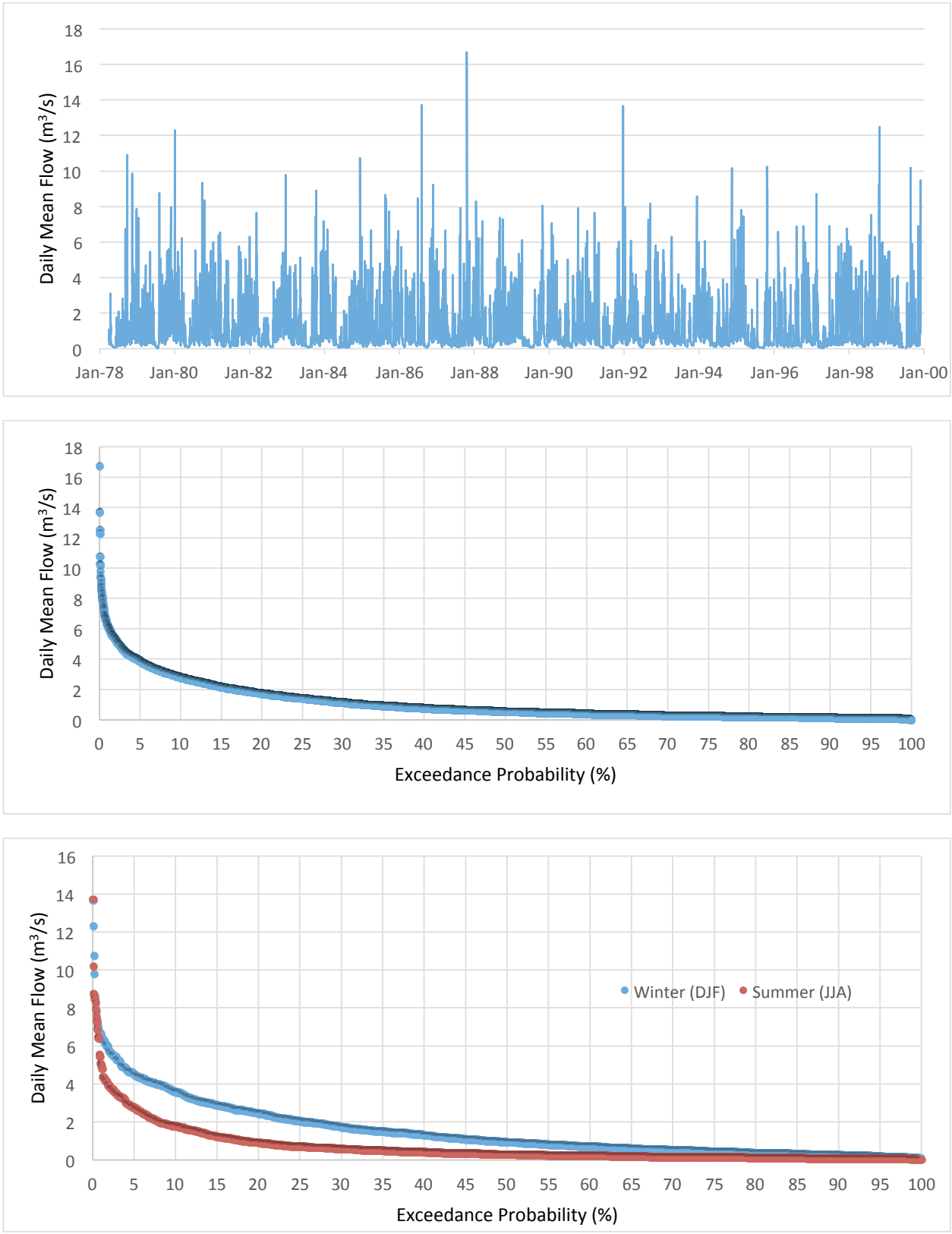
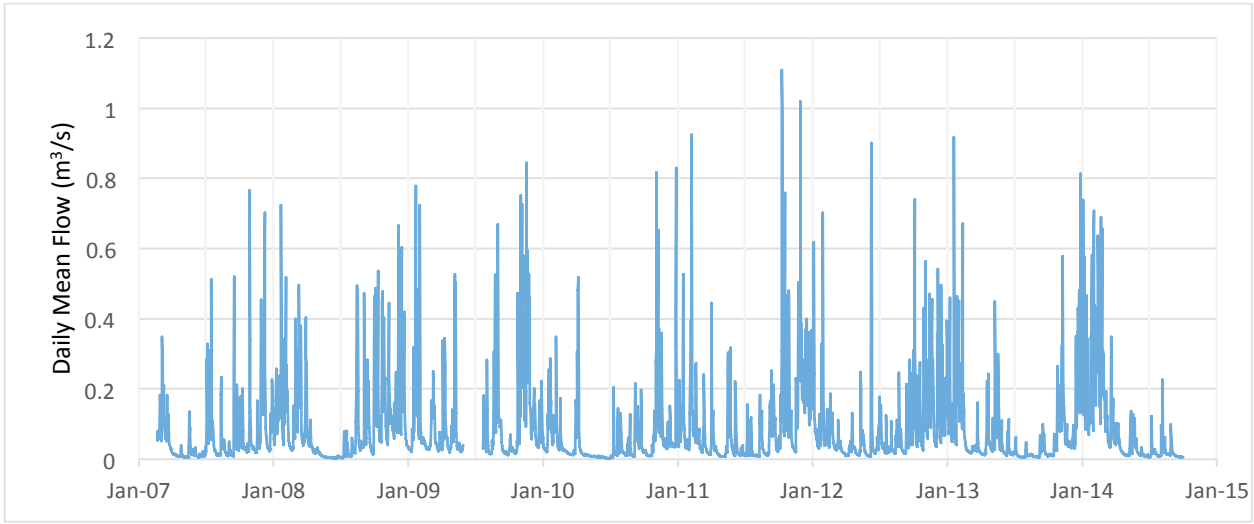
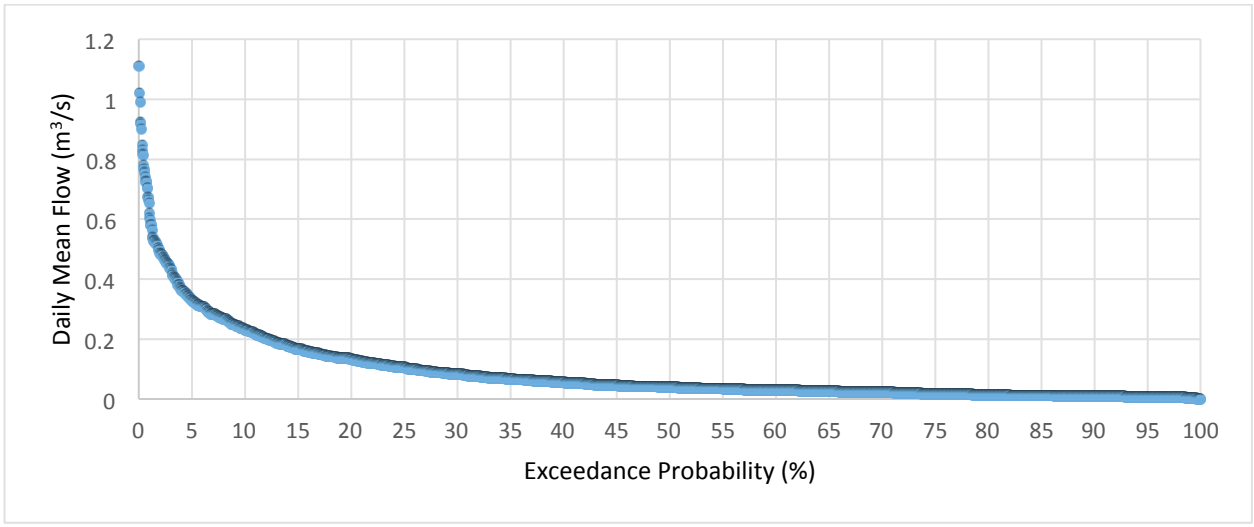


Figure B.15. Hydrograph and flow duration curve – Kiltybardan (36021).





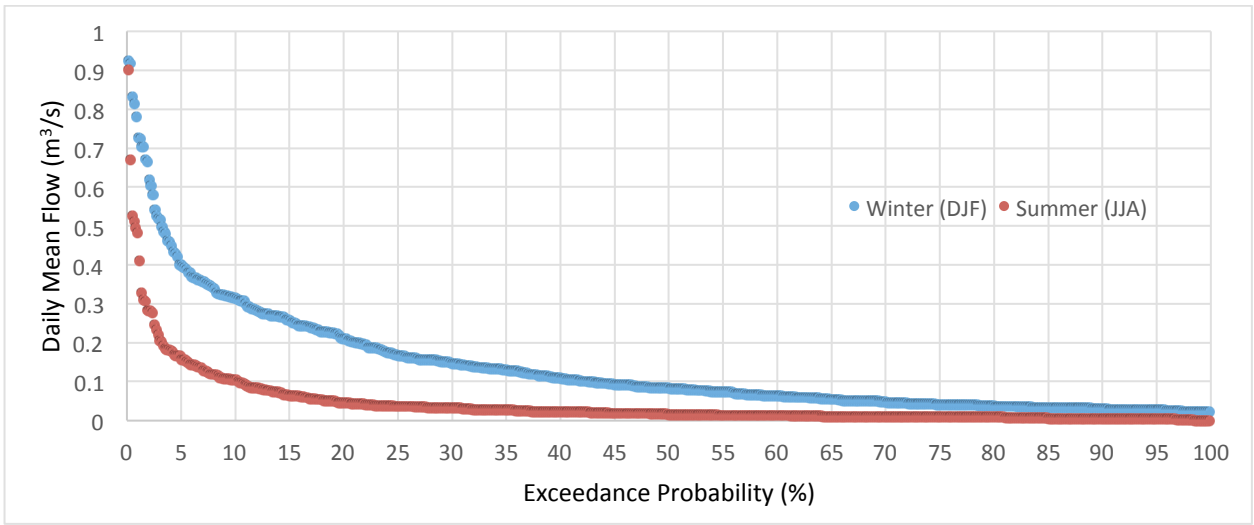


Figure B.16. Hydrograph and flow duration curve – Kinlough (35021).

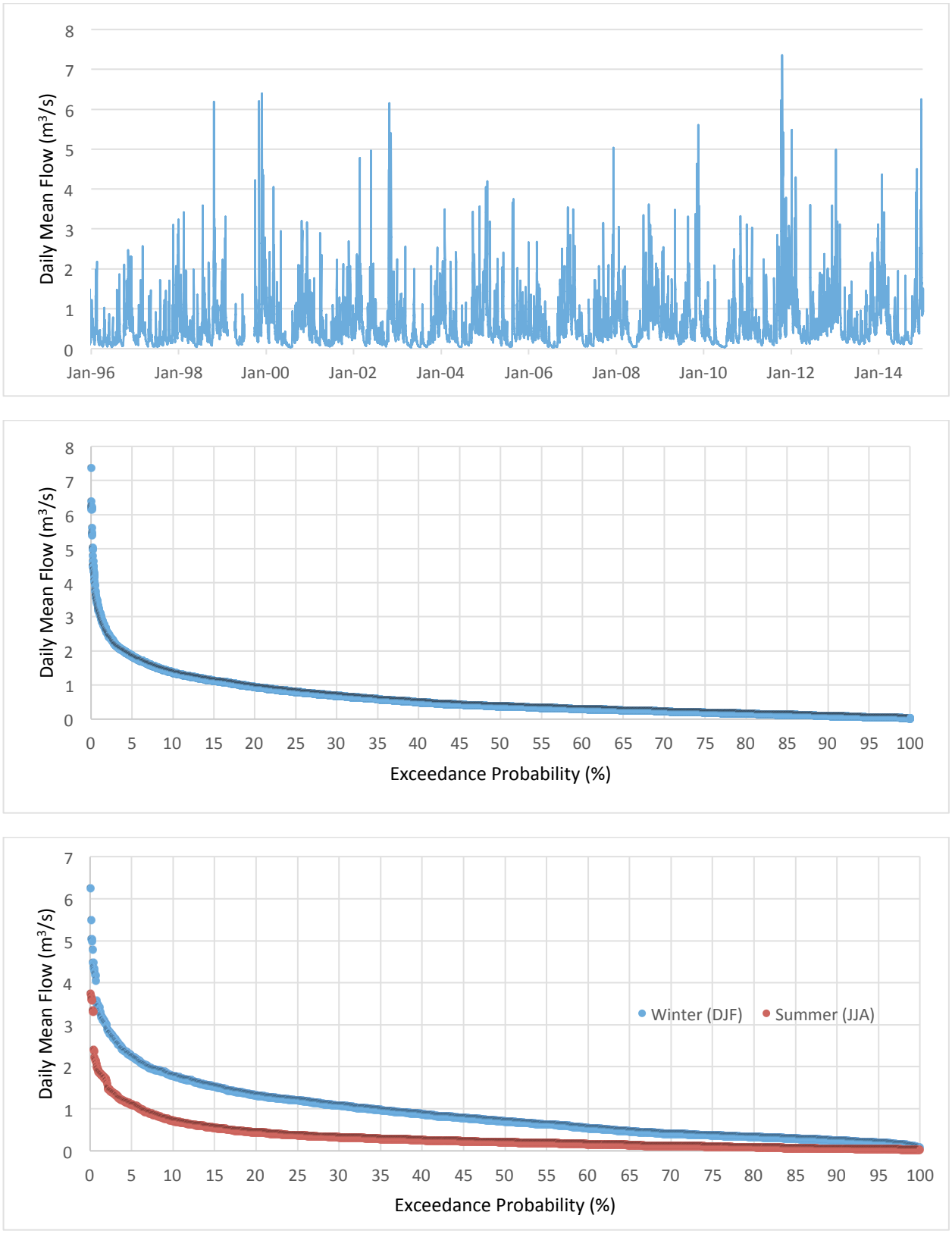
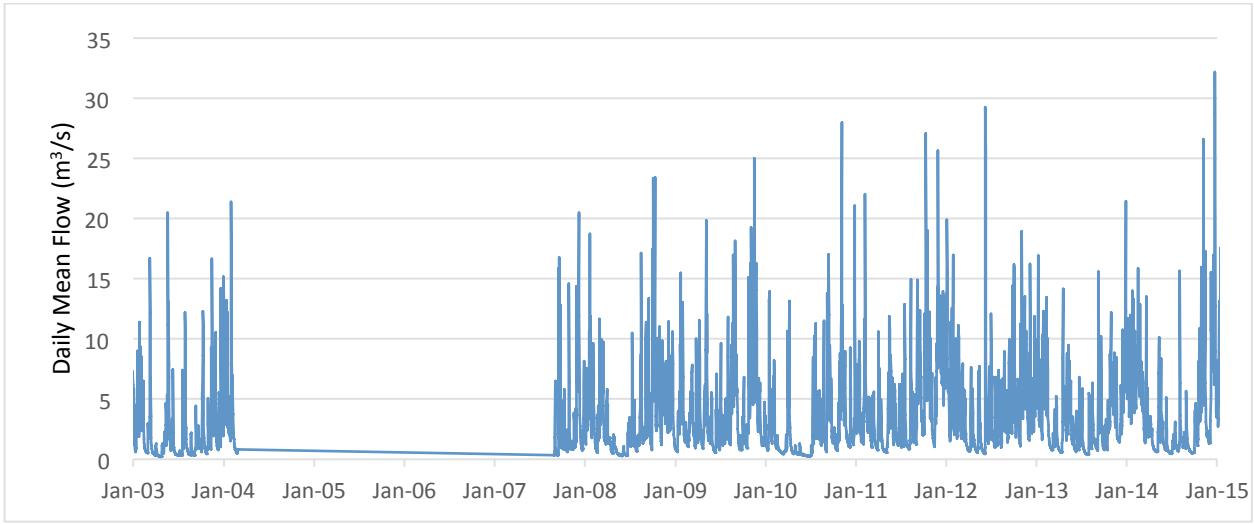
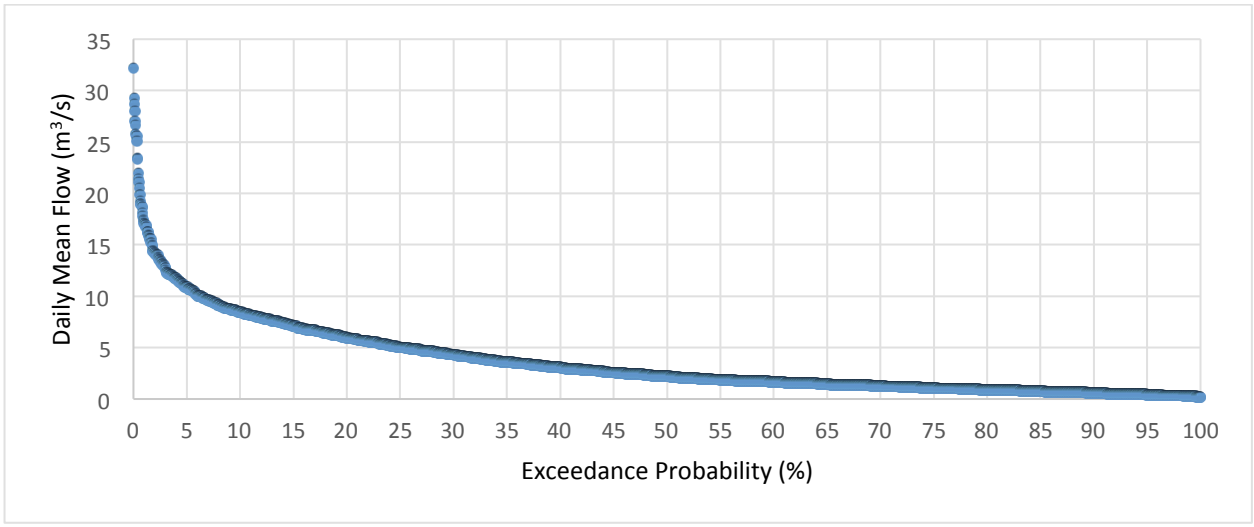


Figure B.17. Hydrograph and flow duration curve – Larkhill (Garvery) (236056).





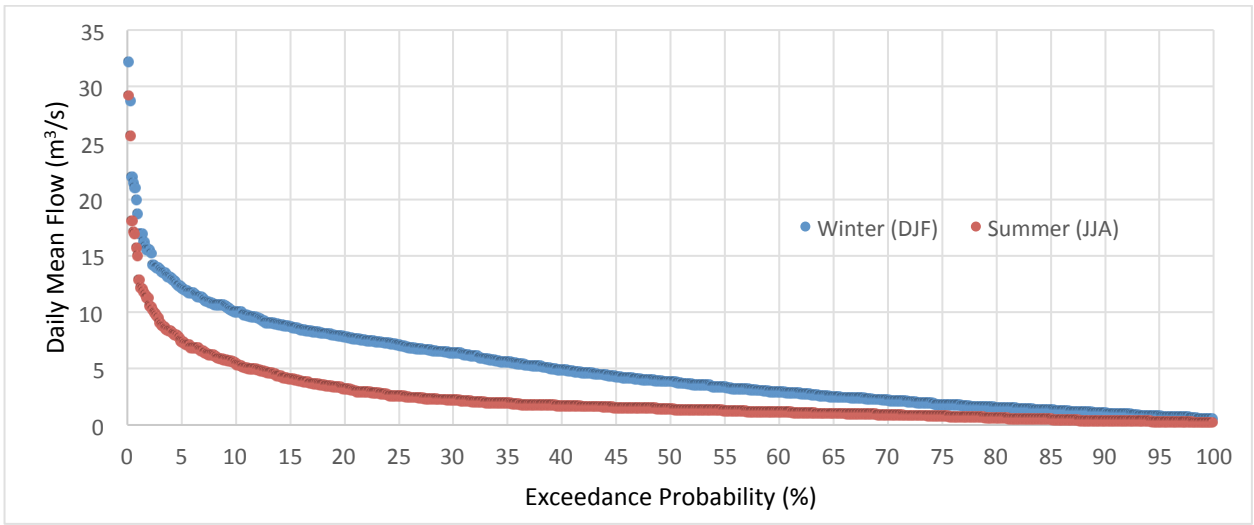


Figure B.18. Hydrograph and flow duration curve – New Br. Bonet (Manorhamilton) (35028).

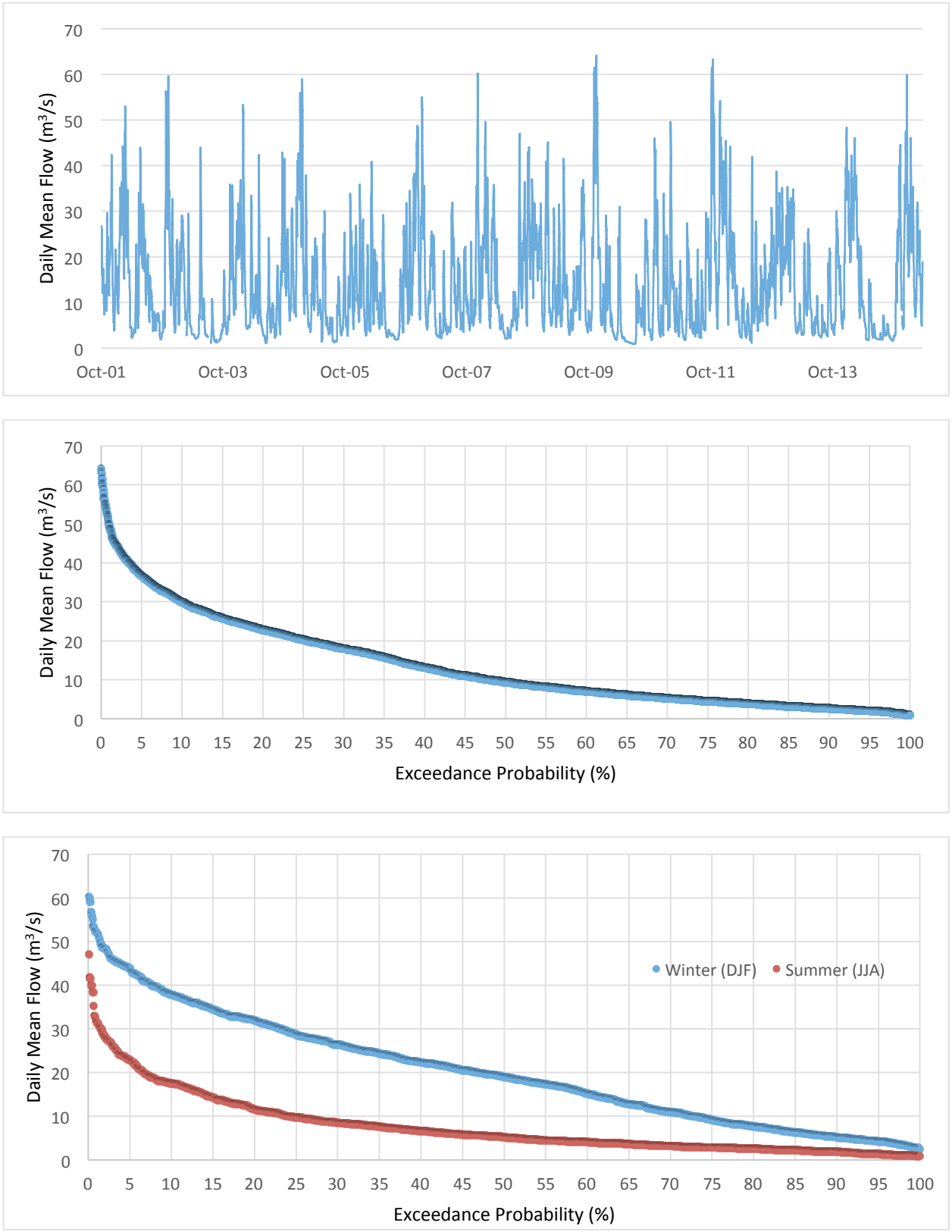


Figure B.19. Hydrograph and flow duration curve – New Br. Garravogue (35012).

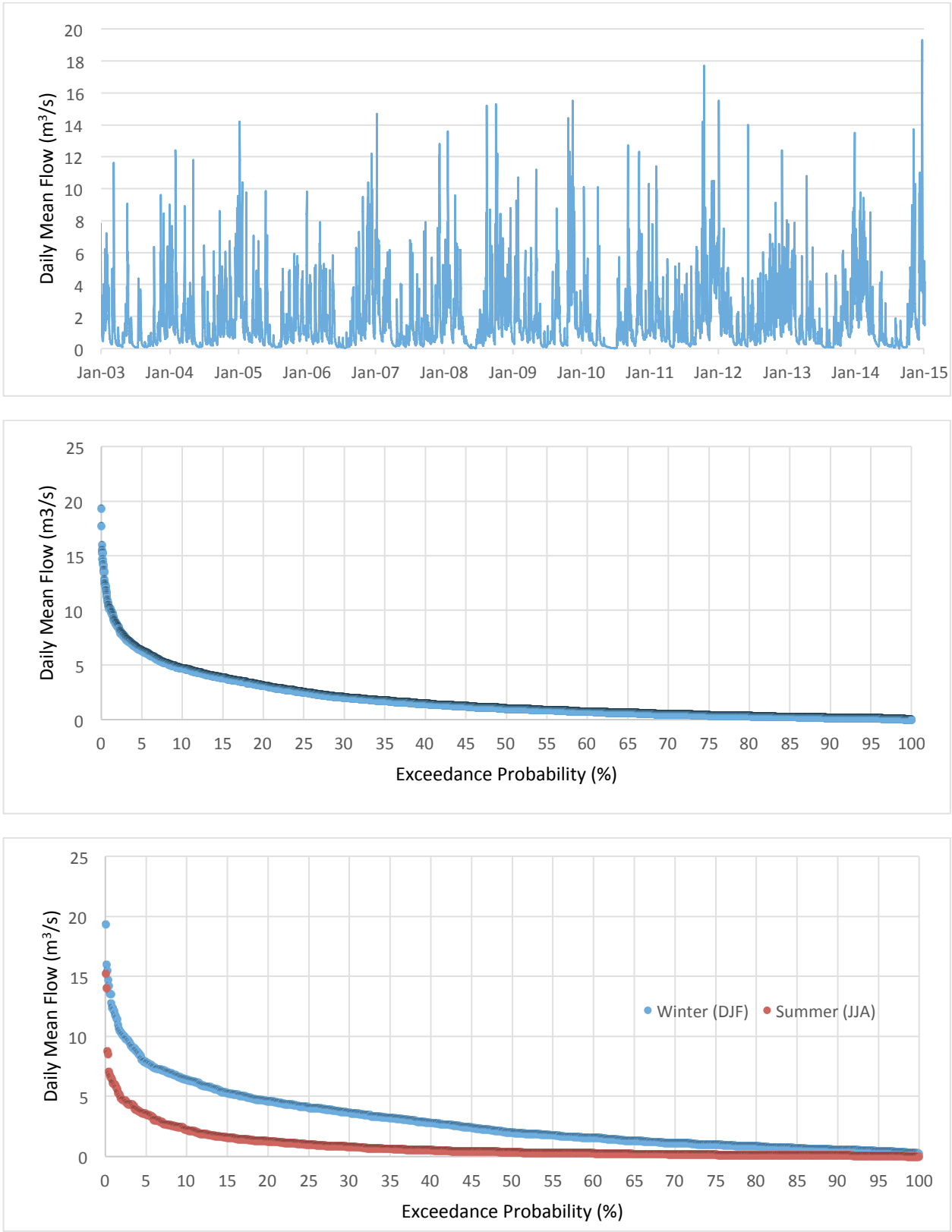


Figure B.20. Hydrograph and flow duration curve – Rockstown (County River) (235052).

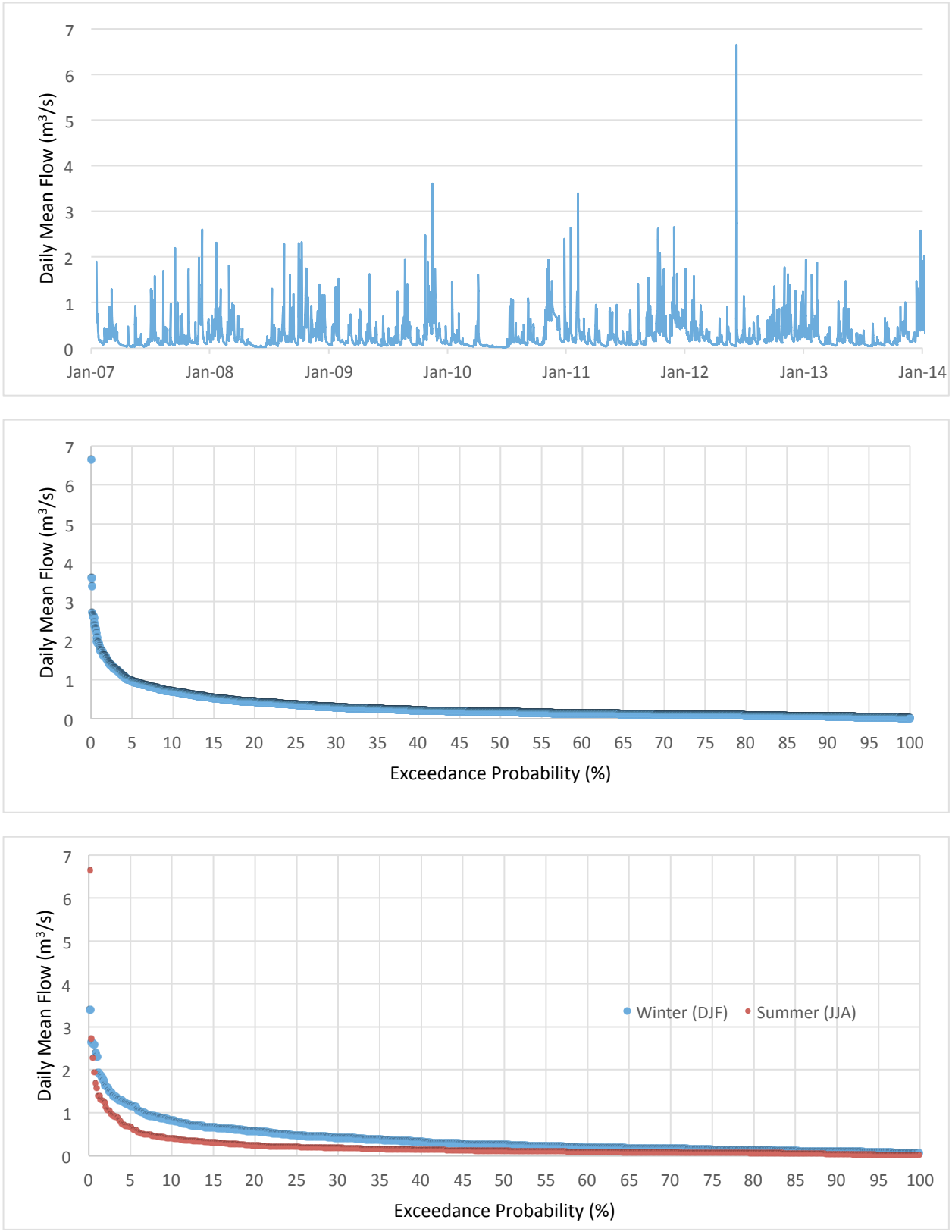


Figure B.21. Hydrograph and flow duration curve – Stracummer (35052).

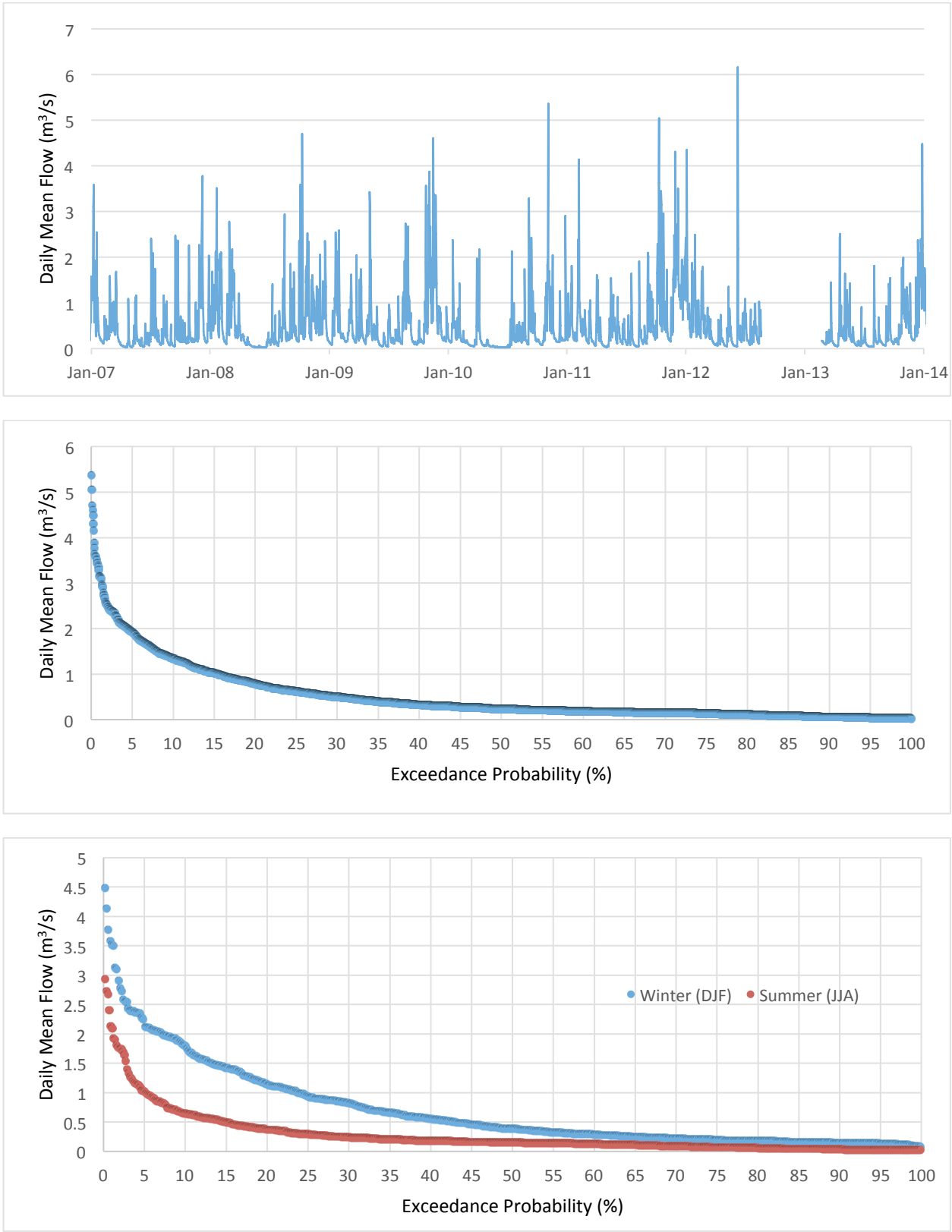


Figure B.22. Hydrograph and flow duration curve – Sraud (35055).

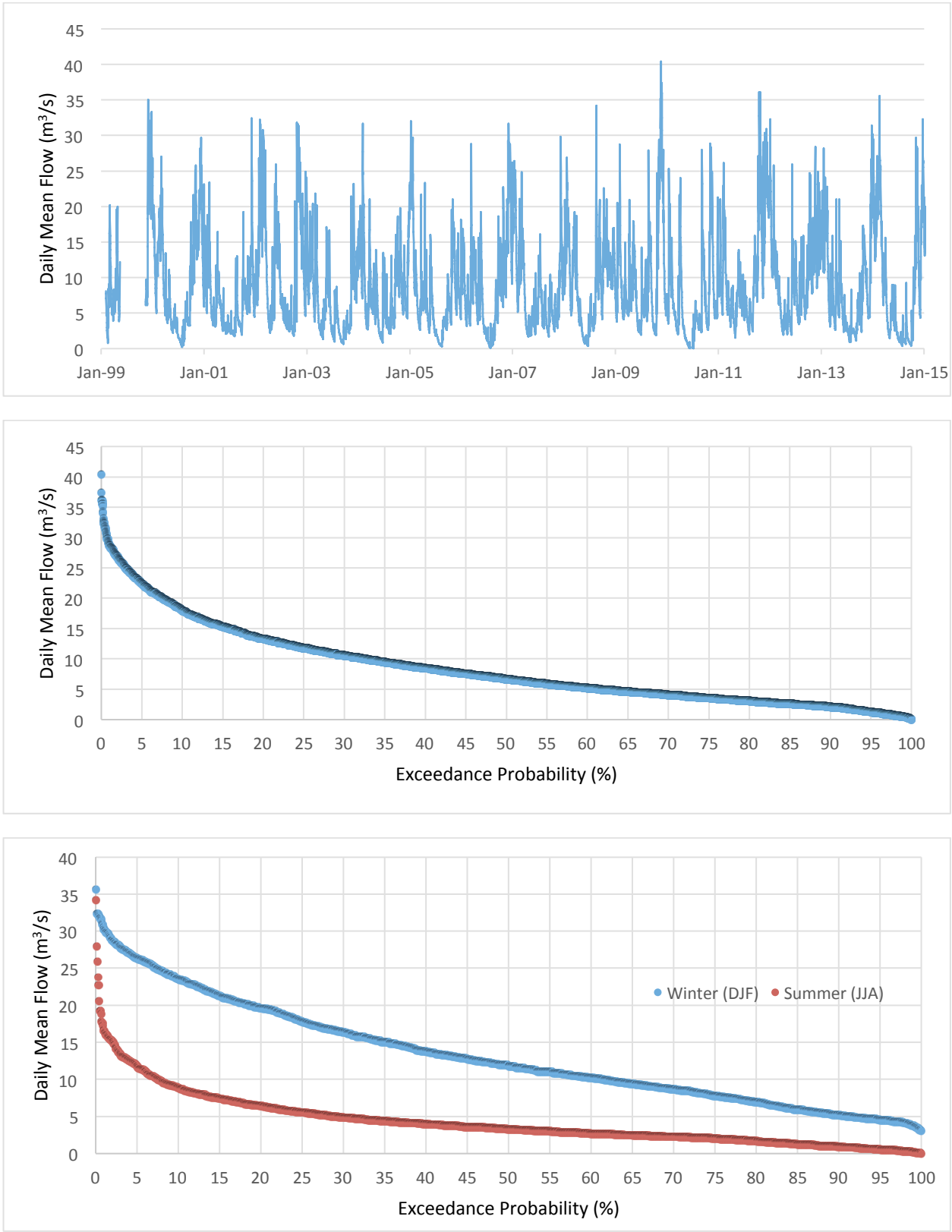


Figure B.23. Hydrograph and flow duration curve – Tilery Bridge (236058).

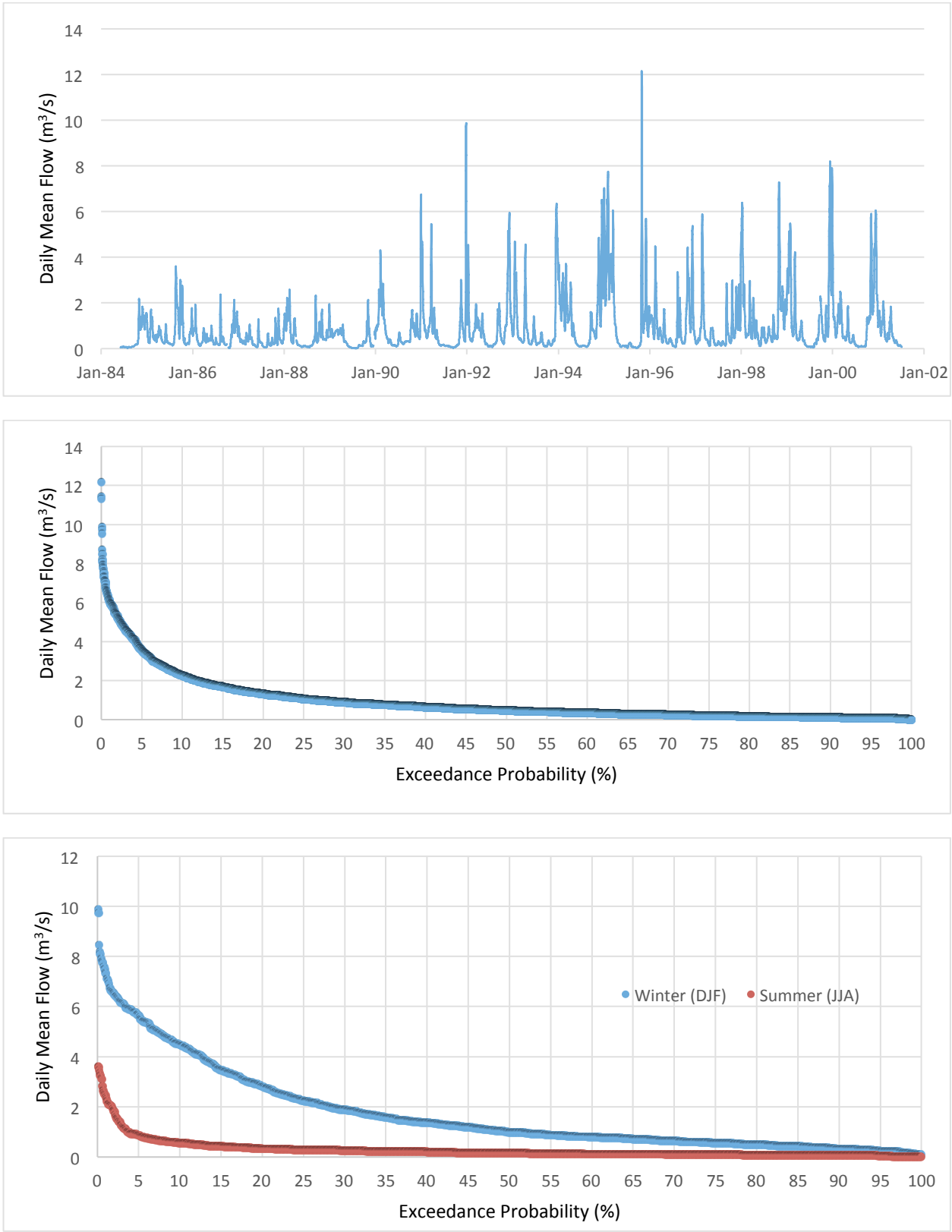


Figure B.24. Hydrograph and flow duration curve – Tomkinroad Bridge (36029).

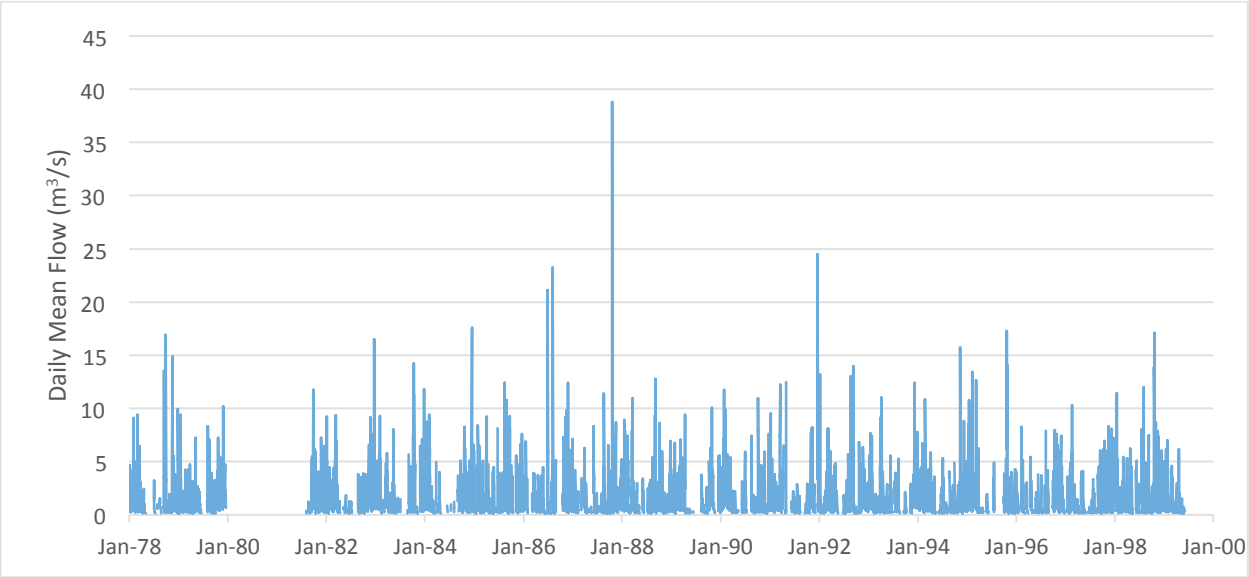


Figure B.25. Hydrograph – Aghacashlaun (36022).

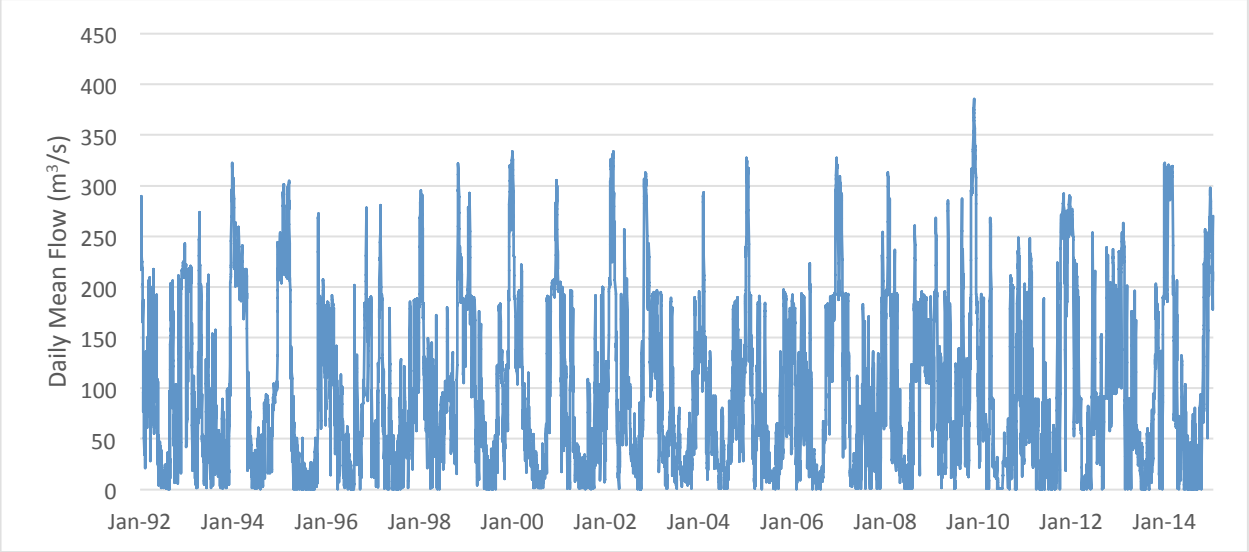


Figure B.26. Hydrograph – Cathleen Falls PS (36092).

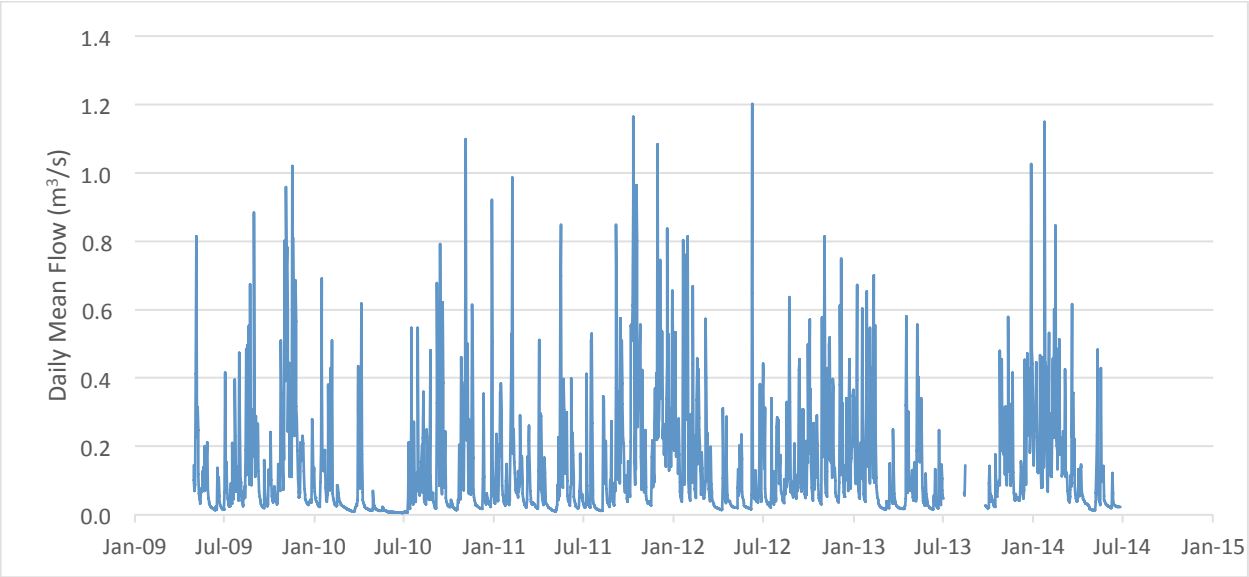


Figure B.27. Hydrograph – Manorhamilton Spring (35056).

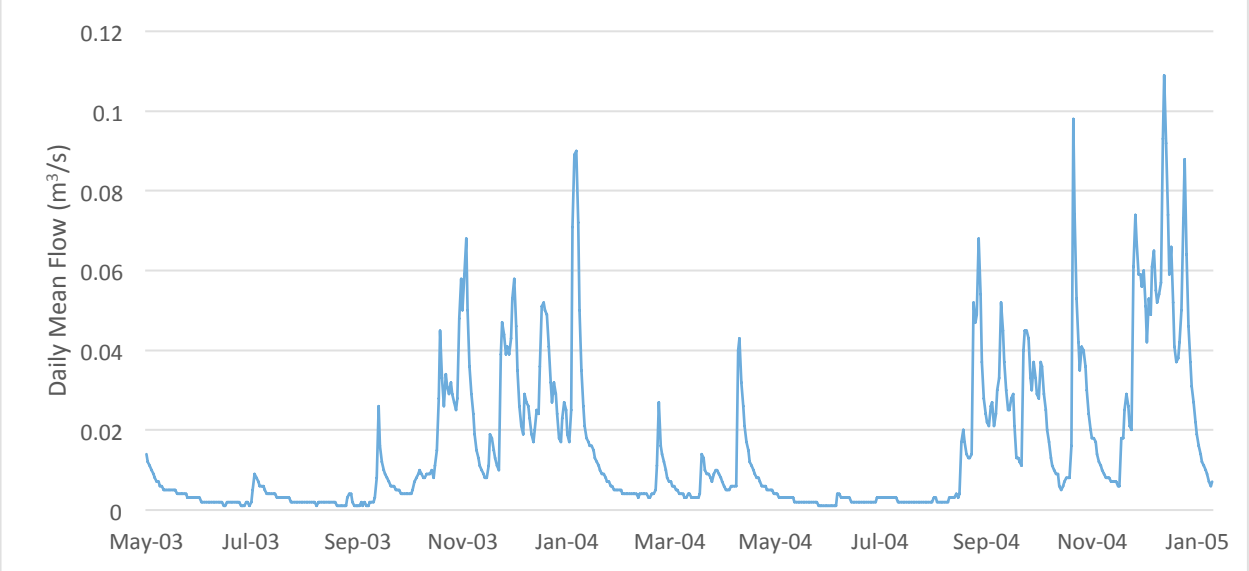


Figure B.28. Hydrograph – Parkhill (36131).

Appendix C

Lithological Details – Northwest Carboniferous Basin

1 Tyrone Group

1.1 Sligo Syncline

1.1.1 Twigspark formation:

The Twigspark Formation comprises coarse-grained pebbly sandstone, calcareous sandy limestone, black shale and oolite units (Philcox, 1983a; Philcox *et al*., 1992; MacDermot *et al*., 1996) with a total estimated thickness of 100 m (Somerville & Waters, 2011). The formation is equivalent to the Moy Sandstone Formation in the Ballymote Syncline.

1.1.2 Ballyshannon limestone formation:

The type section was determined at a borehole drilled near Ballyshannon, where the formation is 331 m thick. The majority of this formation is composed of monotonous, thick-bedded, massive, stylolitic packstones. Finer-grained, darker limestones with chert nodules and interbedded thin calcareous shales occur at the base and top of the formation (MacDermot *et al*. 1996). It includes the Abbeytown Limestone Member, which has a maximum total thickness of 70 m, and occurs at the base of the formation. This member consists of calcarenites with thin shaly interbeds and a top unit consisting of a cross-bedded coarse sandy calcarenite. The Ballyshannon Limestone Formation correlates with the Oakport and Dargan Limestone Formations (Somerville & Waters, 2011) in the Ballymote to Lough Allen subdivision (see Section 2.5.1).

1.1.3 Bundoran shale formation:

The Bundoran Shale Formation is a primary shale gas target for UGEE activity in the NCB area. The type section is at Bundoran (Avbovbo, 1973) where it is composed of a basal 33 m of shale with intervals of thin-bedded fossiliferous limestone and 53 m of micaceous siltstones with abundant fossiliferous shale. A maximum total thickness of 150 m is quoted for the NCB Basin (Somerville & Waters, 2011).

1.1.4 Mullaghmore sandstone formation:

This formation comprises up to 200 m of subarkosic calcareous, medium to coarse-grained sandstones separated by thin beds of siltstone and mudstone (Somerville & Waters, 2011).

1.1.5 Benbulben shale formation:

The Benbulben Shale Formation comprises laminated calcareous mudstone with thin lenticular beds of bioclastic limestone and siltstone. The formation has a maximum known thickness of 365 m (Somerville & Waters, 2011).

1.1.6 Glencar limestone formation:

This formation comprises well-bedded cherty limestone with mudstone interbeds. The proportion and thickness of argillaceous wackestone and packstone increases through the formation (MacDermot *et al*.. 1996; Cózar *et al*., 2005) which is up to 170 m thick (Somerville & Waters, 2011). The formation is, in places, difficult to distinguish from the underlying Benbulben Shale Formation (MacDermot *et al*., 1996). The Glencar Limestone and the overlying Dartry Limestone Formations correlate with the Bricklieve Limestone Formation in the Ballymote – Lough Allen subdivision (Somerville & Waters, 2011).

1.1.7 Dartry limestone formation:

The Dartry Limestone Formation comprises massive fine-grained, mud-mound facies limestones at its base, overlain by well-bedded, silty and bituminous, cherty, fine-grained limestones. The total thickness is up to 280 m (Somerville & Waters, 2011).

1.2 Ballymote Syncline to Lough Allen

1.2.1 Moy Sandstone Formation:

This formation comprises a "Basal Clastic Layer" of alternating quartz pebble conglomerate and pebbly subarkosic sandstones overlain by sandstones, siltstones and mudstones. Quartz pebble conglomerates are also present in the top of the formation (Philcox,1983b). It is up to 140 m thick in its type section (Dixon, 1972).

1.2.2 Dargan limestone formation:

The Dargan Limestone Formation comprises a variable sequence of carbonate and siliciclastic rocks (Dixon, 1972). The base of the formation is composed of sandy biosparite followed by cross-bedded sandy skeletal ooidal limestone. The upper part is a cherty argillaceous biomicrite with shale partings. It has a total maximum thickness of 60 m (Somerville and Waters, 2011). This unit correlates with the Kilbryan Limestone Formation on the SE side of the Ballymote Syncline; see Section 2.5.1 (Somerville and Waters, 2011).

1.2.3 Oakport limestone formation:

The formation comprises a basal member of fine-grained calcarenite that is overlain by massive ooidal and crinoidal limestone interbedded with fenestral-algal micrite. It has a total thickness of 270 m (Somerville & Waters, 2011).

1.2.4 Lisgorman shale formation:

This formation comprises calcareous shale interbedded with thin, very fine-grained limestone. The formation is up to 335 m thick (Somerville & Waters, 2011). The Lisgorman Shale Formation is shown as a correlative of both the Bundoran and Benbulben shale formations (MacDermot *et al*., 1996).

1.2.5 Bricklieve limestone formation:

This formation comprises up to 335 m of medium to thick-bedded bioclastic limestone with chert nodules and bands, especially in the upper part. The Bricklieve Limestone Formation correlates with the Glencar Limestone and Dartry Limestone Formations (Somerville & Waters, 2011).

1.3 Derrygonnelly, Cuilcagh Mountain, Marble Arch

1.3.1 Keenaghan shale formation:

The Keenaghan Shale Formation comprises a 20 m thick silty mudstone with thin sandstones and stromatalitic and micritic limestone (Mitchell, 2004b).

1.3.2 Ballyshannon limestone formation:

The Ballyshannon Limestone Formation is exposed along the SW side of Lower Lough Erne and along the western coastline, and displays numerous karstic features. In the Big Dog borehole, 345 m of the formation is represented where it has been informally divided into three members (Mitchell & Somerville, 2011; Legg *et al*., 1998). The lowest member is comprised of well-bedded, crinoidal packstones separated by thin silty shales. The middle member is composed of coarse-grained crinoidal grainstones. The upper member is composed of fine to medium-grained bioclastic packstones. The formation is estimated to range in thickness from 200 m to 355 m. The Ballyshannon Limestone Formation correlates with the Oakport and Dargan Limestone Formations in the Ballymote – Lough Allen subdivision (Somerville & Waters, 2011).

1.3.3 Bundoran shale formation:

This formation comprises fossiliferous, calcareous mudstone with thin, fine-grained beds of bioclastic packstone. It is up to 555 m thick in the Big Dog borehole, 438 m thick at Kilcoo Cross, 427 m thick in the Slisgarrow borehole, and a minimum of 60 m thick north of Derrygonnelly (Legg *et al*., 1998). It includes the Dowra Sandstone Member which is composed of calcareous, micaceous cross-laminated sandstone and pebble conglomerate with micaceous shale and sandy micritic limestone (Legg *et al*., 1998). The Dowra

Sandstone Member has also been targeted for gas exploration in the past, and ranges in thickness across the area from 0 to 53 m (Mitchell, 2004b). It is mostly present in the northern part of the study area.

1.3.4 Mullaghmore sandstone formation:

The Mullaghmore Sandstone Formation comprises calcareous, fine to medium-grained subarkosic sandstones with thin siltstone and mudstone. It is up to 200 m thick (Mitchell, 2004b). Like the Dowra Sandstone Member of the Bundoran Shale Formation, it has also been targeted for gas exploration in the past, and is present in in the study area to the north of Lough Allen.

1.3.5 Benbulben shale formation:

This formation comprises calcareous mudstone with thin lenticular limestones and mudstones (Mitchell, 2004b), and is between 90 and 365 m thick.

1.3.6 Glencar limestone formation:

The Glencar Limestone Formation comprises cherty limestone and mudstone in equal proportions, and is between 170 and 187 m thick (Mitchell, 2004b).

1.3.7 Dartry limestone formation:

This formation comprises fine-grained spicular, cherty limestones which range in thickness from 130 to 280 m (Mitchell, 2004b). Combined, the Glencar Limestone and the overlying Dartry Limestone Formation correlate with the Bricklieve Limestone Formation further south (Somerville & Waters, 2011).

1.4 Lisnaskea

1.4.1 Fearnaght formation:

This formation is mapped SE of the Ballyconnell-Belturbet Fault (GSNI, 2005) and outside of the immediate area of interest. However, it is included for description as it may occur at depth along with the Cooldarragh and Ulster Canal Formations below the Ballysteen Limestone Formation elsewhere. It incorporates quartz pebble conglomerates with sandy matrix, subarkosic micaceous flaggy sandstones and quartzites (Morris, 1979) and may not be more than 20 m thick.

1.4.2 Cooldarragh formation:

This formation comprises siltstones and mudstones with algal, evaporitic and argillaceous micrites (Ni Bhroin, 1993). It is estimated to be up to 125 m thick in places (Mitchell & Somerville, 2011).

1.4.3 Ulster canal formation:

The Ulster Canal Formation comprises mixed sandy limestones, calcareous sandstones, limestones and shales (Ni Bhroin, 1993), and is estimated to be less than 60 m thick, averaging 30 m (Mitchell & Somerville, 2011).

1.4.4 Ballysteen formation:

This formation comprises limestone and calcareous mudstone up to 120 m thick (Mitchell & Somerville, 2011).

1.4.5 Kilbryan limestone formation:

In the Boyle area, south of the Curlew Mountains, this formation consists of nodular-bedded limestone with interbedded calcareous shale and argillaceous limestones. The type section is 100 m thick (Philcox *et al*., 1992). In the Lough Allen Basin, specifically in the Drumkeeran, Slisgarrow and Big Dog wells, it is much thicker (430 m) and more argillaceous. It can be difficult to distinguish from the overlying Ballyshannon Limestone Formation. The Kilbryan Limestone Formation correlates with the Dargan Limestone Formation in the Ballymote – Lough Allen subdivisions (Somerville & Waters, 2011).

1.4.6 Ballyshannon limestone formation:

This formation includes three distinct members: a) a lower member comprising well-bedded, crinoidal packstones separated by thin silty shales; b) a middle member comprising coarse-grained crinoidal grainstones; and c) an upper member comprising fine to medium-grained bioclastic packstones. The total estimated thickness is 300 m (Mitchell & Somerville, 2011).

1.4.7 Bundoran shale formation:

The Bundoran Shale Formation comrpises fossiliferous calcareous mudstone with thin, fine-grained beds of bioclastic packstone. It is estimated to be up to 500 m thick. Based on the Big Dog exploration borehole, it includes up to 53 m of the Dowra Sandstone Member which is composed of calcareous, micaceous cross-laminated sandstone and pebble conglomerate with micaceous shale and sandy micritic limestone (Legg *et al*., 1998).

1.4.8 Mullaghmore sandstone formation:

This formation is up to 220 m thick further west, and thins out gradually towards the Lisnaskea area where it is absent approximately 3 km west of the top of Upper Lough Erne (Mitchell & Somerville, 2011).

1.4.9 Benbulben shale formation:

The Benbulben Shale Formation comprises calcareous mudstone with thin lenticular limestones and mudstones, and is up to 300 m thick (Mitchell, 2004b).

1.4.10 Dartry limestone formation:

This formation comprises fine-grained spicular, cherty limestones up to 280 m thick (Mitchell, 2004b).

2 Leitrim Group

2.1 Sligo Syncline

2.1.1 Meenymore Formation:

The Meenymore Formation comprises 15 m of mudstone, siltstone, sandstone and micritic limestone (Mitchell, 2004b).

2.1.2 Glenade Sandstone Formation:

This formation comprises only 4 m of pebbly sandstones with thin siltstones (Mitchell, 2004b).

2.1.3 Bellavally Formation:

The Bellavally Formation comprises 33 m of cyclical mudstone with subordinate siltstone, sandstone and stromatalitic, fossiliferous limestone (Mitchell, 2004b).

2.1.4 Carrun Shale Formation:

The Carrun Shale Formation comprises 50 m of mudstone with five thin limestone members toward the top (Legg *et al*., 1998).

2.2 Ballymote Syncline to Lough Allen

2.2.1 Meenymore Formation:

The Meenymore Formation comprises up to 240 m of mudstone, siltstone, sandstone and micritic limestone. The latter contains residual gypsum and anhydrite and has been the subject of mineral exploration. The formation displays rapid lateral and vertical facies, as well thickness, variations (Legg *et al*., 1998). Of note within the Meenymore Formation is the Quarry Sandstone Member which is exposed west of Derrygonnelly and is composed of 20 m of fine- to medium-grained calcareous sandstone (Legg *et al*., 1998).

2.2.2 Glenade Sandstone Formation:

The Glenade Sandstone Formation comprises up to 350 m of pebbly sandstones with thin siltstones (Mitchell, 2004b).

2.2.3 Bellavally Formation:

This formation comprises up to 45 m of cyclical mudstone with subordinate siltstone, sandstone and stromatalitic, fossiliferous limestone (Mitchell, 2004b). Of note within the Bellavally Formation is the Doobally Sandstone Member which, at Cuilcagh Mountain, is composed of 15 m of medium-grained to pebbly sandstone (Legg *et al*., 1998).

2.2.4 Carrun Shale Formation:

This formation comprises up to 160 m of mudstone with five thin limestone members toward the top (Legg *et al*., 1998).

2.2.5 Dergvone Shale Formation:

The Dergvone Shale Formation comprises up to 168 m of ferruginous mudstone with siderite nodules, calcareous mudstone and sandstone in thin beds and dykes (Somerville & Waters, 2011).

2.2.6 Briscloonagh Sandstone Formation:

This formation comprises up to 76 m of sandstone beds that coarsen and thicken upwards with siltstone and mudstone interbeds (Mitchell, 2004b; Somerville & Waters, 2011).

2.2.7 Gowlaun Shale Formation:

The Gowlaun Shale Formation comprises up to 78 m of calcareous fossiliferous mudstone (Mitchell, 2004b; Somerville & Waters, 2011).

2.2.8 Lackagh Sandstone Formation:

This formation comprises approximately 90 m (in the Lackagh Hills) of pebbly, coarse-grained sandstone with interbedded siltstone, mudstone and thin coals (MacDermot *et al*., 1996).

2.2.9 Bencroy Shale Formation:

The Bencroy Shale Formation comprises 58 m of shale in Co. Leitrim (Somerville & Waters, 2011).

2.3 Derrygonnelly, Cuilcagh Mountain, Marble Arch

2.3.1 Meenymore Formation:

This formation comprises up to 240 m of mudstone, siltstone, sandstone and micritic limestone. The formation displays rapid lateral and vertical facies, as well thickness, variations (Legg *et al*., 1998). Thickness variations are due to syn-depositional faulting with 100 m to 240 m represented on Cuilcagh Mountain (Mitchell, 2004b).

2.3.2 Glenade Sandstone Formation:

This formation comprises up to 300 m of pebbly sandstones with thin siltstones (Mitchell, 2004b).

2.3.3 Bellavally Formation:

This formation comprises up to 45 m of cyclical mudstone with subordinate siltstone, sandstone and stromatalitic, fossiliferous limestone (Mitchell, 2004b).

2.3.4 Carrun Shale Formation:

This formation comprises up to 55 m of mudstone with five thin limestone members toward the top (Legg *et al*., 1998).

2.3.5 Dergvone Shale Formation:

This formation comprises up to 130 m of ferruginous shale with thin beds of calcareous mudstone (Legg *et al*. 1998).

2.3.6 Briscloonagh Sandstone Formation:

The Briscloonagh Sandstone Formation comprises up 52 m of sandstone beds that coarsen and thicken upwards with siltstone and mudstone interbeds (Mitchell, 2004b; Somerville & Waters, 2011).

2.3.7 Gowlaun Shale Formation:

This formation comprises approximately 55 m of fossiliferous, calcareous mudstone (Mitchell, 2004b; Somerville & Waters, 2011).

2.3.8 Lackagh Sandstone Formation:

The Lackagh Sandstone Formation is present only at Cuilcagh Mountain where 36 m of coarse-grained, pebbly sandstone are recorded (Somerville & Waters, 2011).

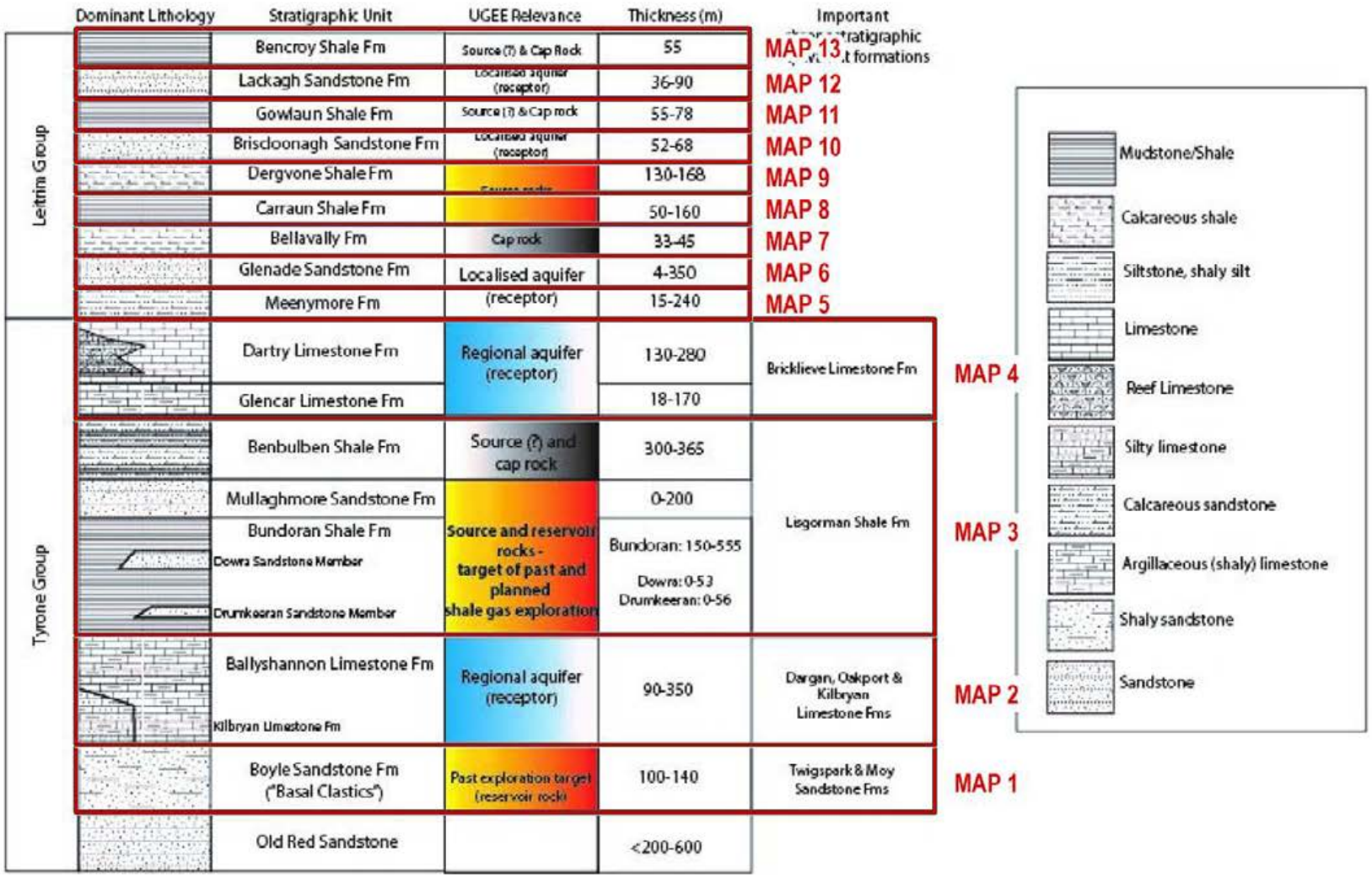
2.4 Lisnaskea

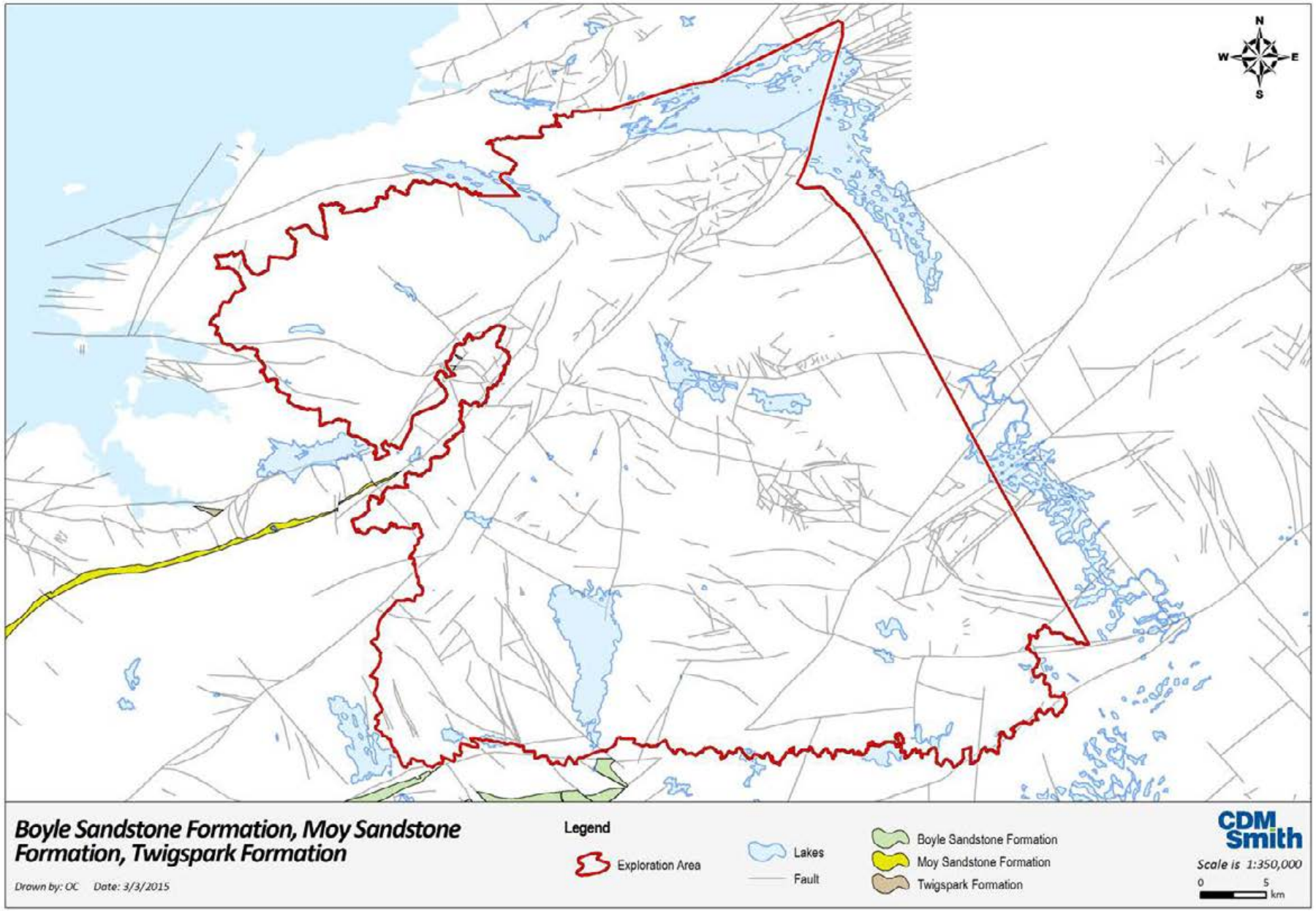
2.4.1 Meenymore Formation:

This comprises up to 500 m mudstone, siltstone, sandstone and micritic limestone. The formation displays rapid lateral and vertical facies, as well as thickness, variations (Legg *et al*., 1998), interpreted to be the result of syn-depositional faulting with vertical displacements between 100 m and 240 m represented on Cuilcagh Mountain (Mitchell, 2004b).

Appendix D

Outcrop Patterns of Bedrock Formations – Northwest Carboniferous Basin


Dominant Lithology
Stratigraphic Unit
UGEE Relevance
Thickness (m)
Important stratigraphic formations
Leitrim Group
Tyrone Group
Bencroy Shale Fm
Source (?) & Cap Rock
55
MAP 13
Lackagh Sandstone Fm
Localised aquifer (receptor)
36-90
MAP 12
Gowlaun Shale Fm
Source (?) & Cap rock
55-78
MAP 11
Briscloonagh Sandstone Fm
Localised aquifer (receptor)
52-68
MAP 10
Dergvone Shale Fm
130-168
MAP 9
Carraun Shale Fm
50-160
MAP 8
Bellavally Fm
Cap rock
33-45
MAP 7
Glenade Sandstone Fm
Localised aquifer
4-350
MAP 6
Meenymore Fm
(receptor)
15-240
MAP 5
Dartry Limestone Fm
Regional aquifer (receptor)
130-280
Bricklieve Limestone Fm
MAP 4
Glencar Limestone Fm
18-170
Benbulben Shale Fm
Source (?) and cap rock
300-365
Mullaghmore Sandstone Fm
0-200
Bundoran Shale Fm
Dowra Sandstone Member
Drumkeeran Sandstone Member
Source and reservoir rocks - target of past and planned shale gas exploration
Bundoran: 150-555
Dowra: 0-53
Drumkeeran: 0-56
Lisgorman Shale Fm
MAP 3
Ballyshannon Limestone Fm
Kilbryan Limestone Fm
Regional aquifer (receptor)
90-350
Dargan, Oakport & Kilbryan Limestone Fms
MAP 2
Boyle Sandstone Fm ("Basal Clastics")
Past exploration target (reservoir rock)
100-140
Twigspark & Moy Sandstone Fms
MAP 1
Old Red Sandstone
<200-600
Mudstone/Shale
Calcareous shale
Siltstone, shaly silt
Limestone
Reef Limestone
Silty limestone
Calcareous sandstone
Argillaceous (shaly) limestone
Shaly sandstone
Sandstone


N
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Boyle Sandstone Formation, Moy Sandstone Formation, Twigspark Formation
Drown by: OC Date: 3/3/2015
Legend
Exploration Area
Lakes
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Boyle Sandstone Formation
Moy Sandstone Formation
Twigspark Formation
CDM Smith
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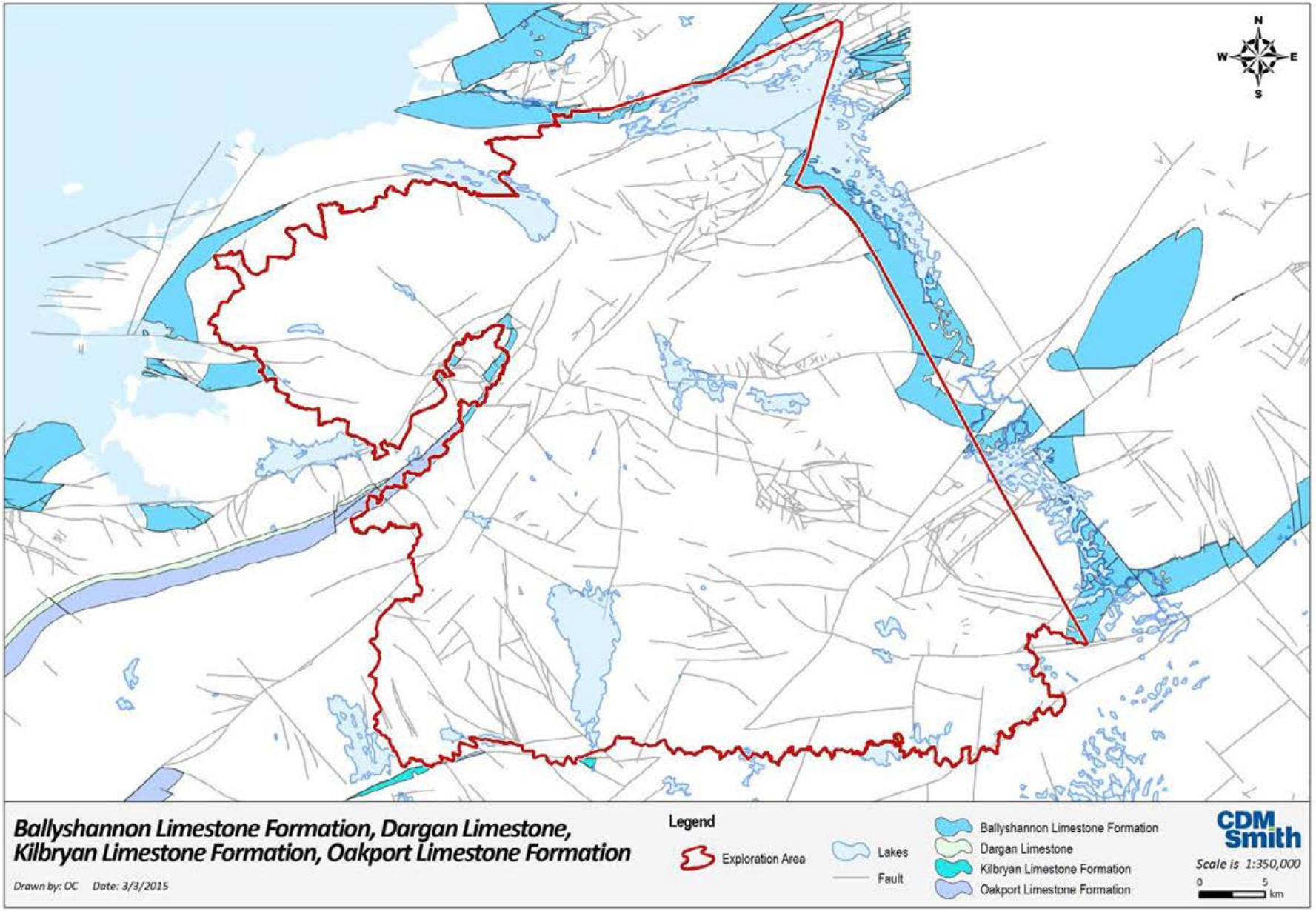
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Ballyshannon Limestone Formation, Dargan Limestone,
Kilbryan Limestone Formation, Oakport Limestone Formation
Drawn by: OC Date: 3/3/2015
Legend
Exploration Area
Lakes
Fault
Ballyshannon Limestone Formation
Dargan Limestone
Kilbryan Limestone Formation
Oakport Limestone Formation
CDM Smith
Scale is 1:350,000
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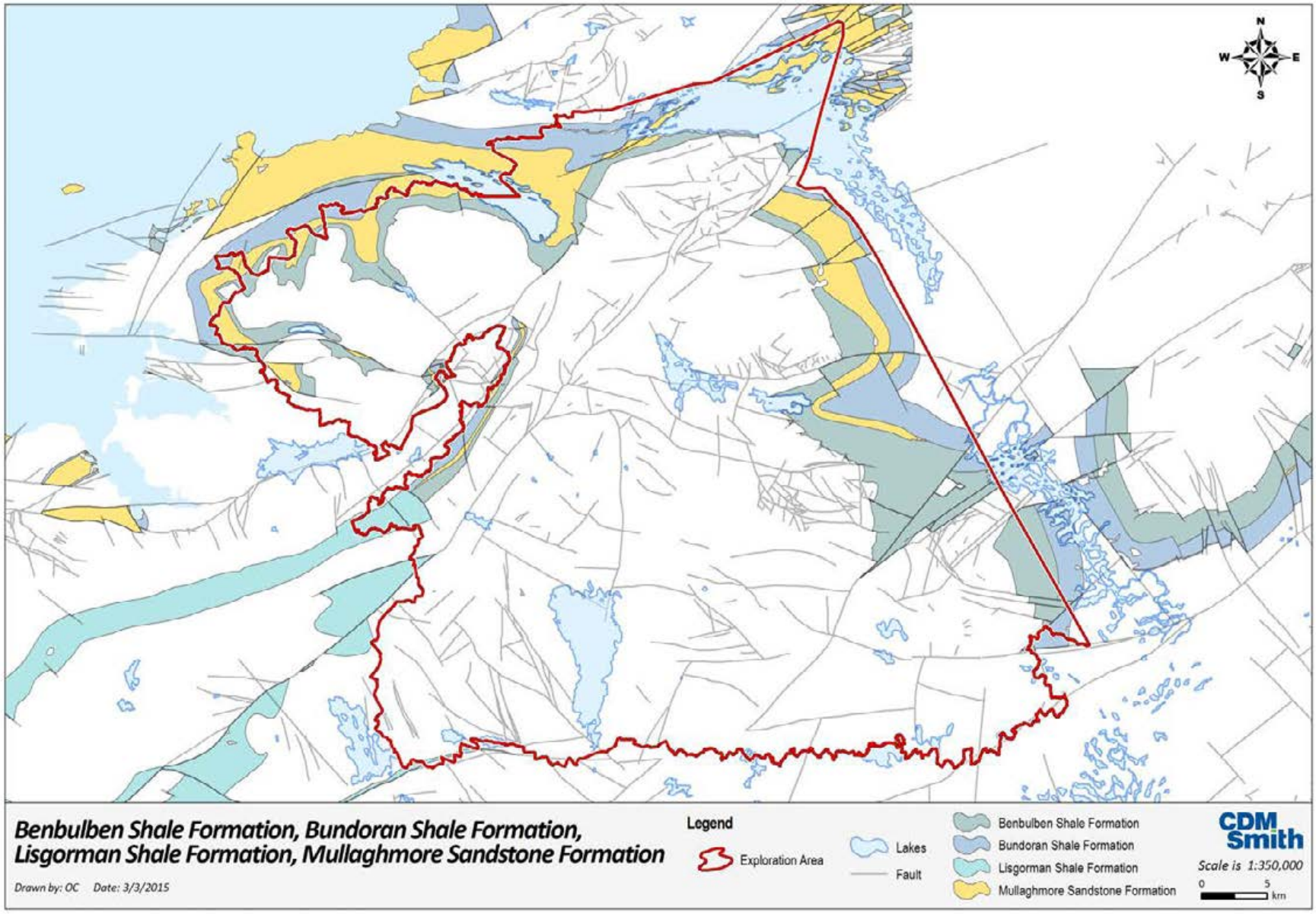
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Benbulben Shale Formation, Bundoran Shale Formation,
Lisgorman Shale Formation, Mullaghmore Sandstone Formation
Drawn by: OC Date: 3/3/2015
Legend
Exploration Area
Lakes
Fault
Benbulben Shale Formation
Bundoran Shale Formation
Lisgorman Shale Formation
Mullaghmore Sandstone Formation
CDM Smith
Scale is 1:350,000
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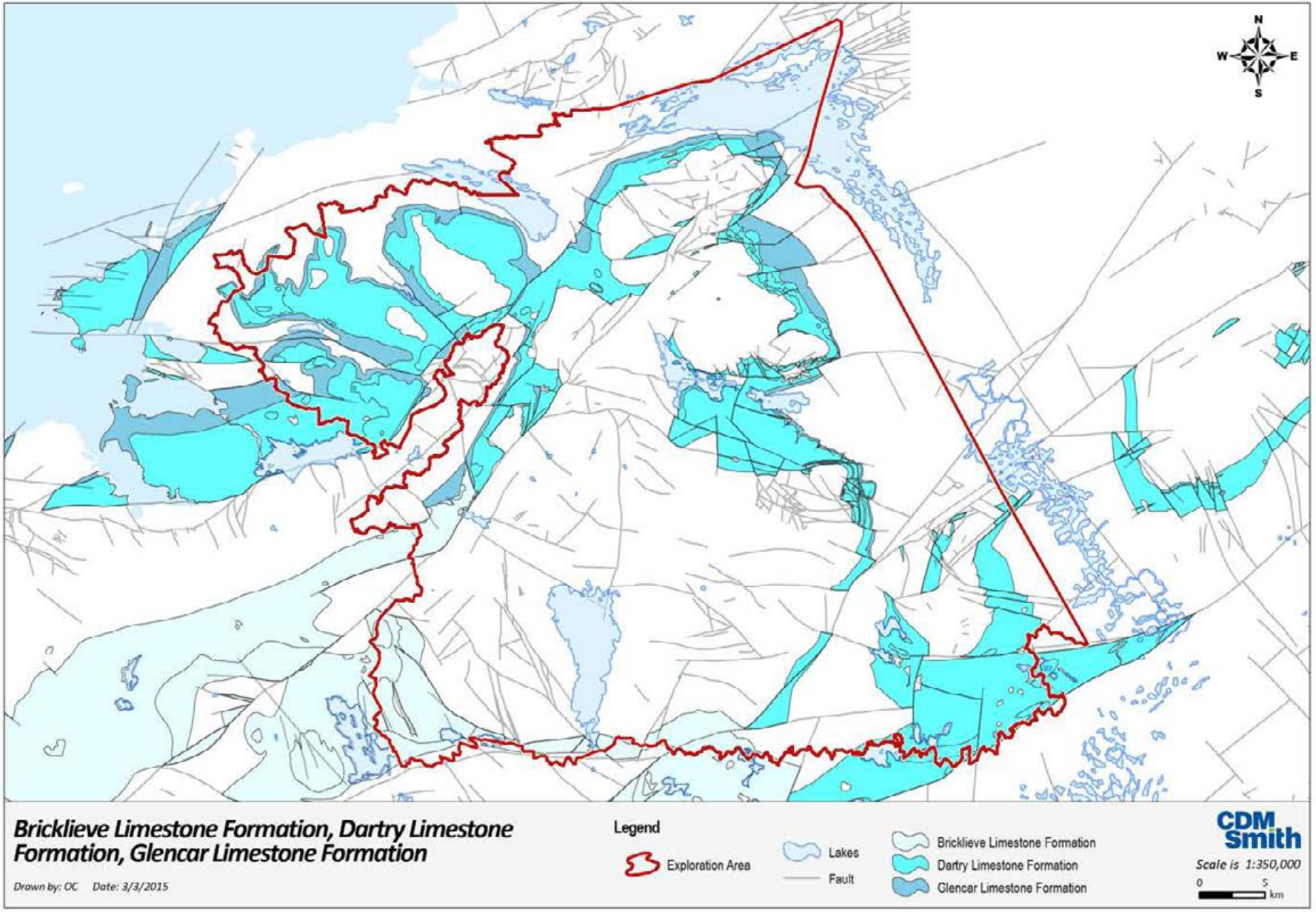
km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Bricklieve Limestone Formation, Dartry Limestone Formation, Glencar Limestone Formation
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Legend
Exploration Area
Lakes
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Bricklieve Limestone Formation
Dartry Limestone Formation
Glencar Limestone Formation
CDM Smith
Scale is 1:350,000
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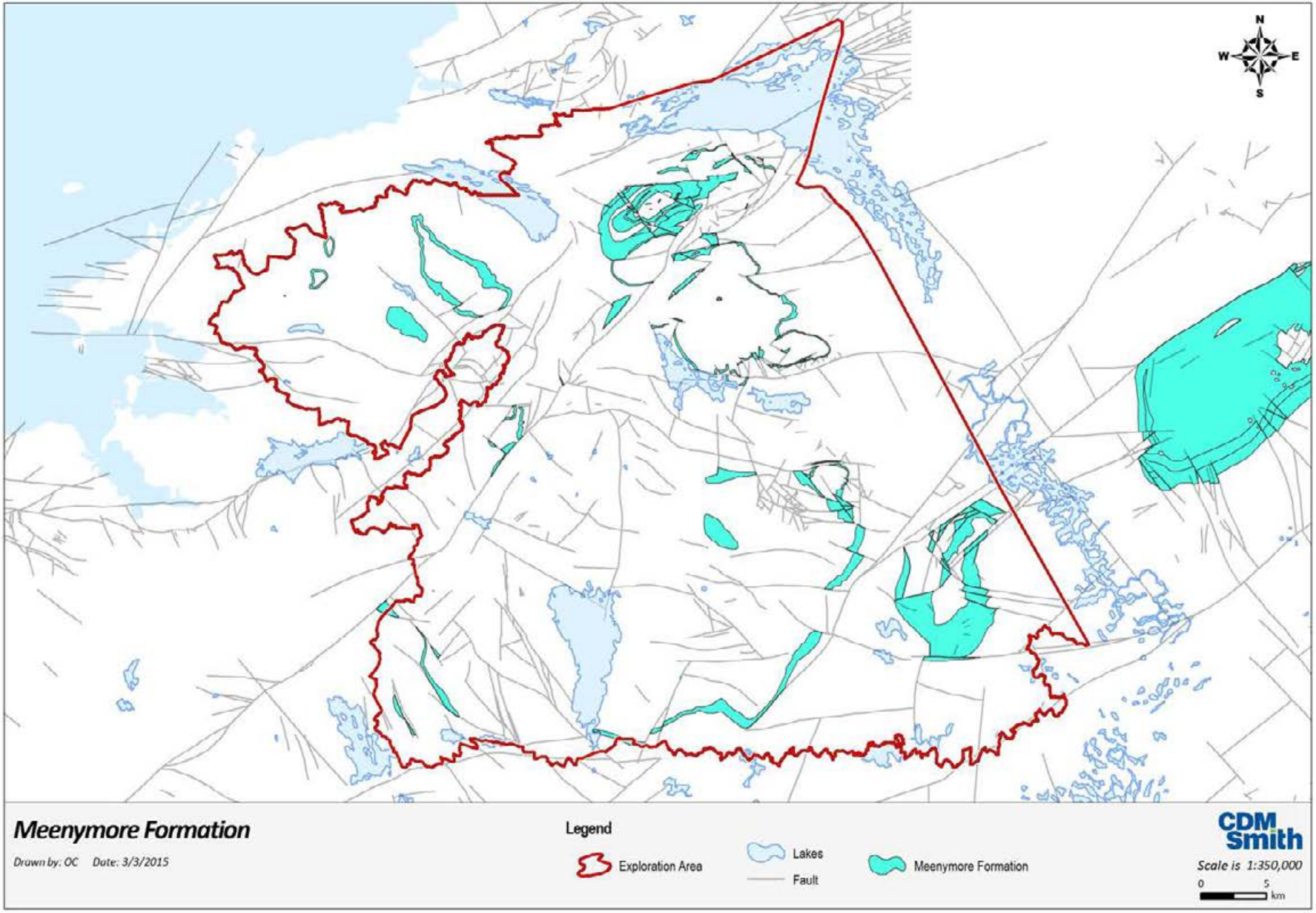
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Meenymore Formation
Drawn by: OC Date: 3/3/2015
Legend
Exploration Area
Lakes
Fault
Meenymore Formation
CDM Smith
Scale is 1:350,000
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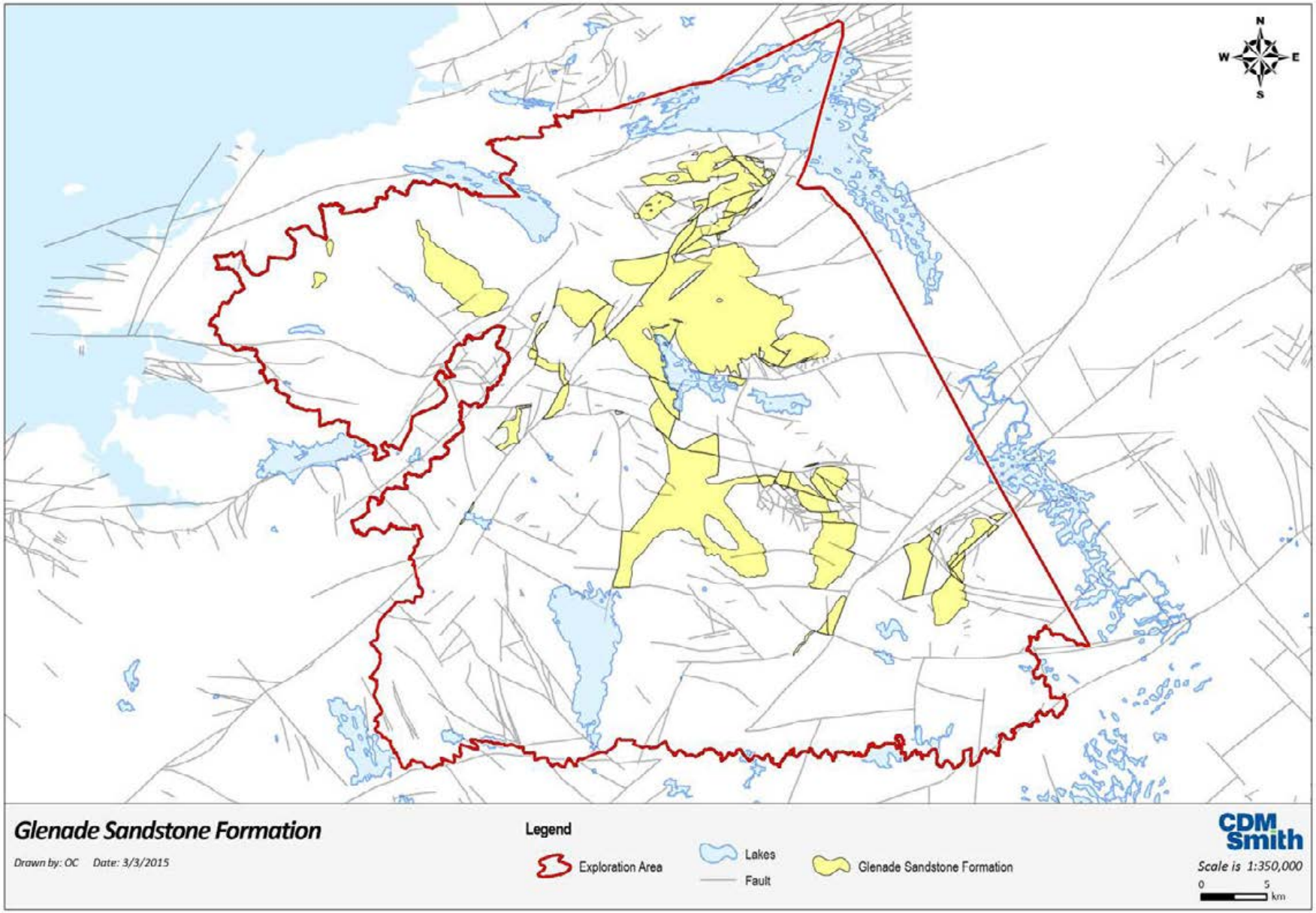
km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Glenade Sandstone Formation
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Legend
Exploration Area
Lakes
Fault
Glenade Sandstone Formation
CDM Smith
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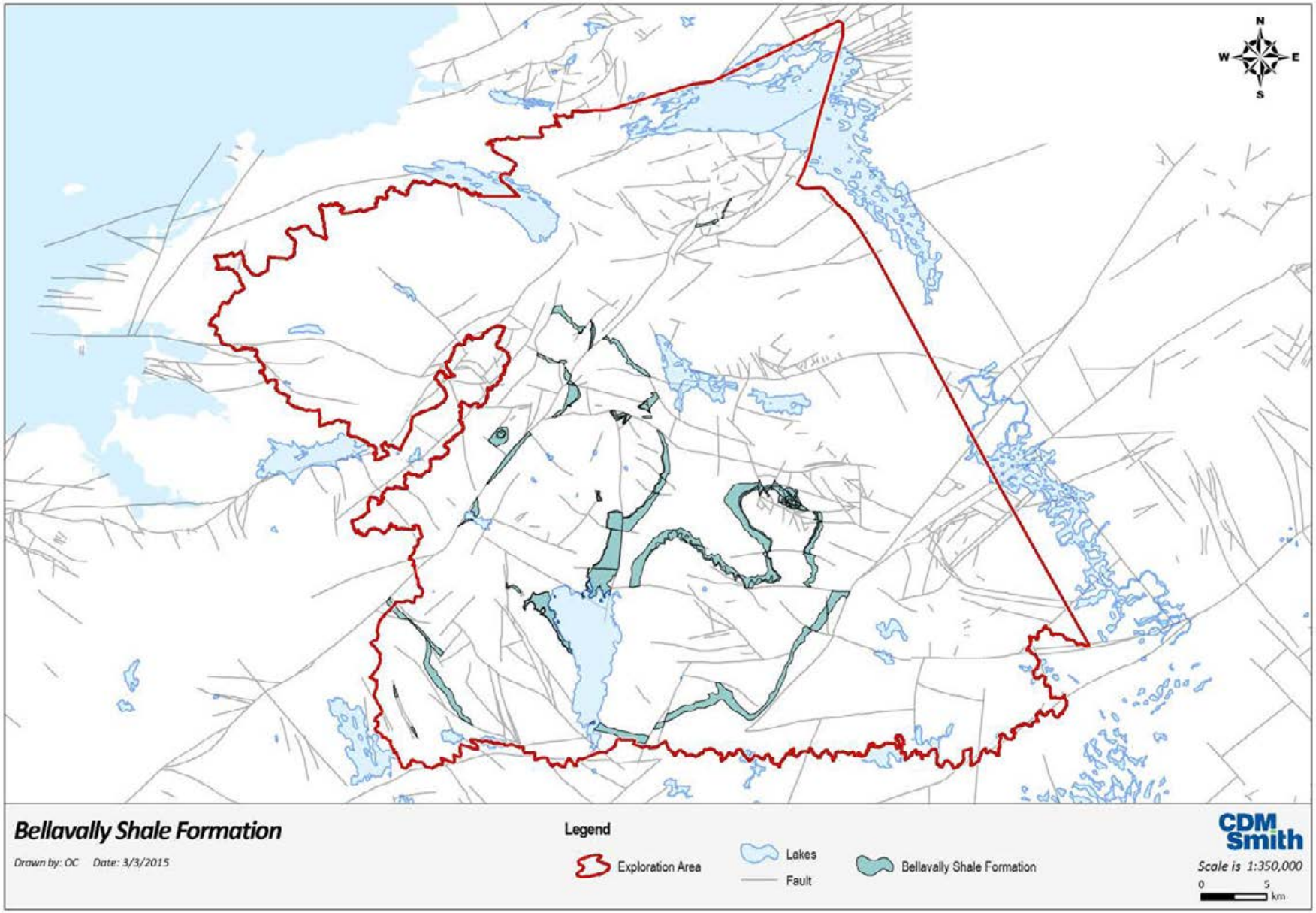
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Bellavally Shale Formation
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Legend
Exploration Area
Lakes
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Bellavally Shale Formation
CDM Smith
Scale is 1:350,000
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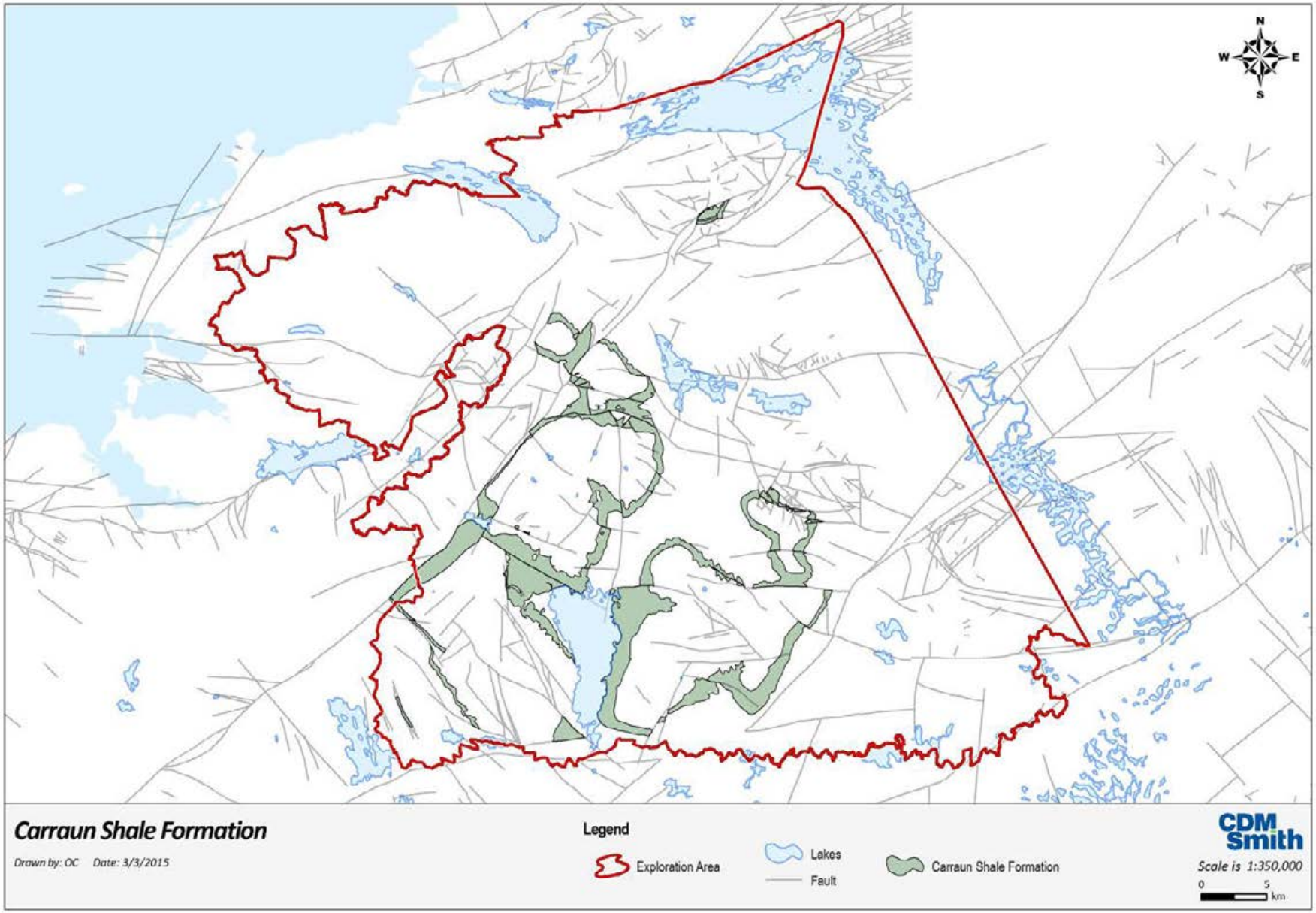
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Carraun Shale Formation
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Exploration Area
Lakes
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Carraun Shale Formation
CDM Smith
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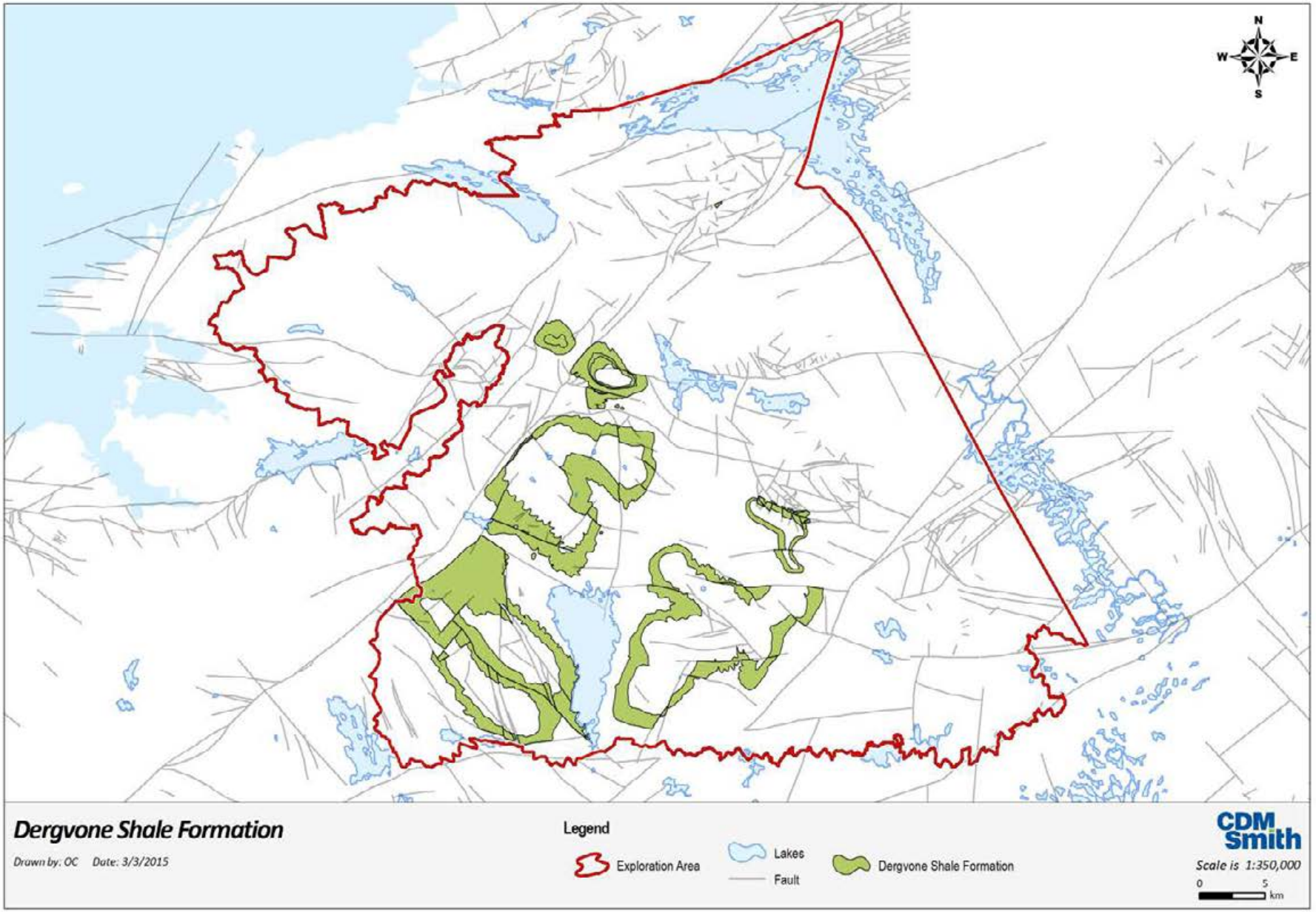
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Dergvone Shale Formation
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Exploration Area
Lakes
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Dergvone Shale Formation
CDM Smith
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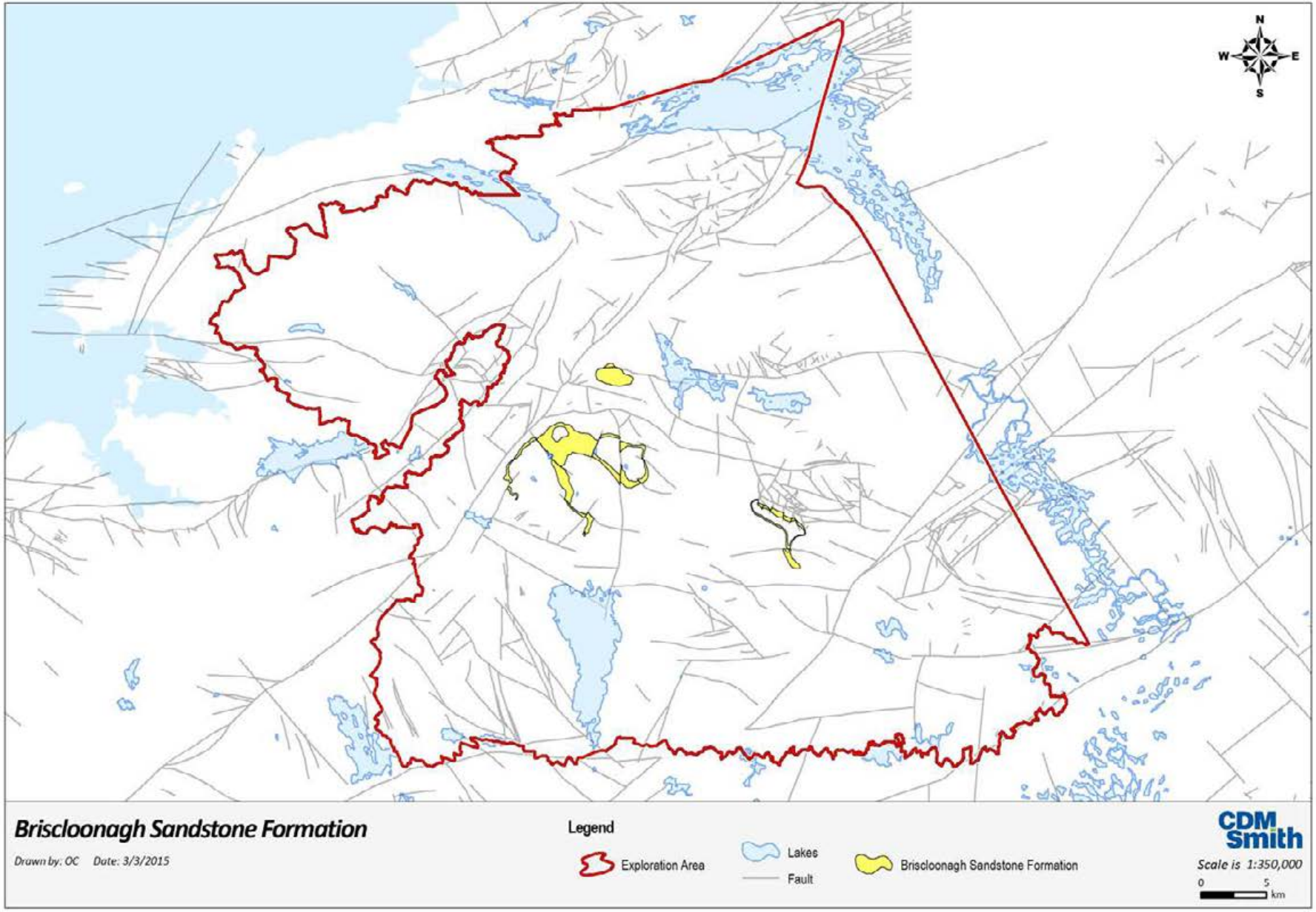
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Briscloonagh Sandstone Formation
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Exploration Area
Lakes
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Briscloonagh Sandstone Formation
CDM Smith
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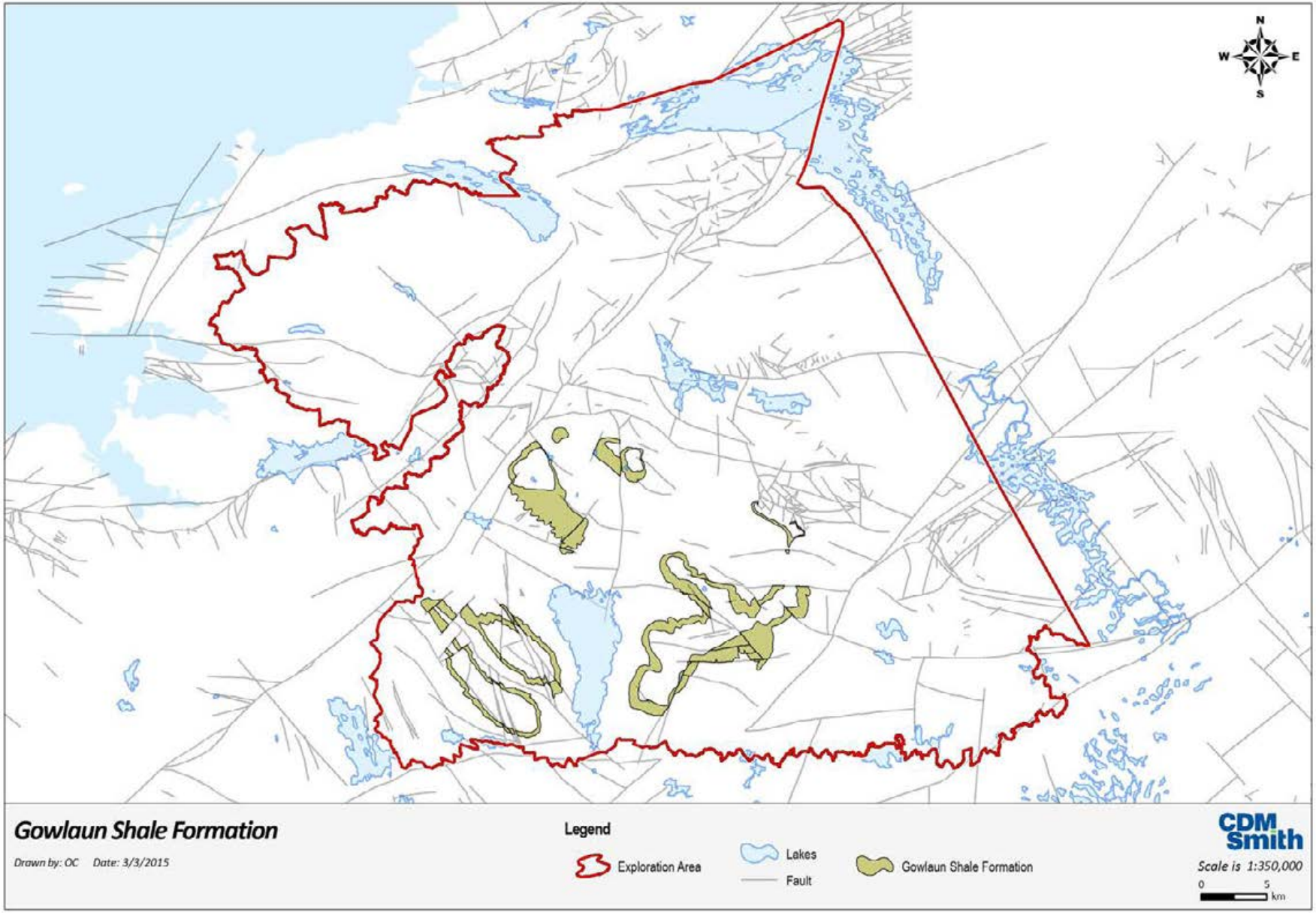
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Gowlaun Shale Formation
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Exploration Area
Lakes
Fault
Gowlaun Shale Formation
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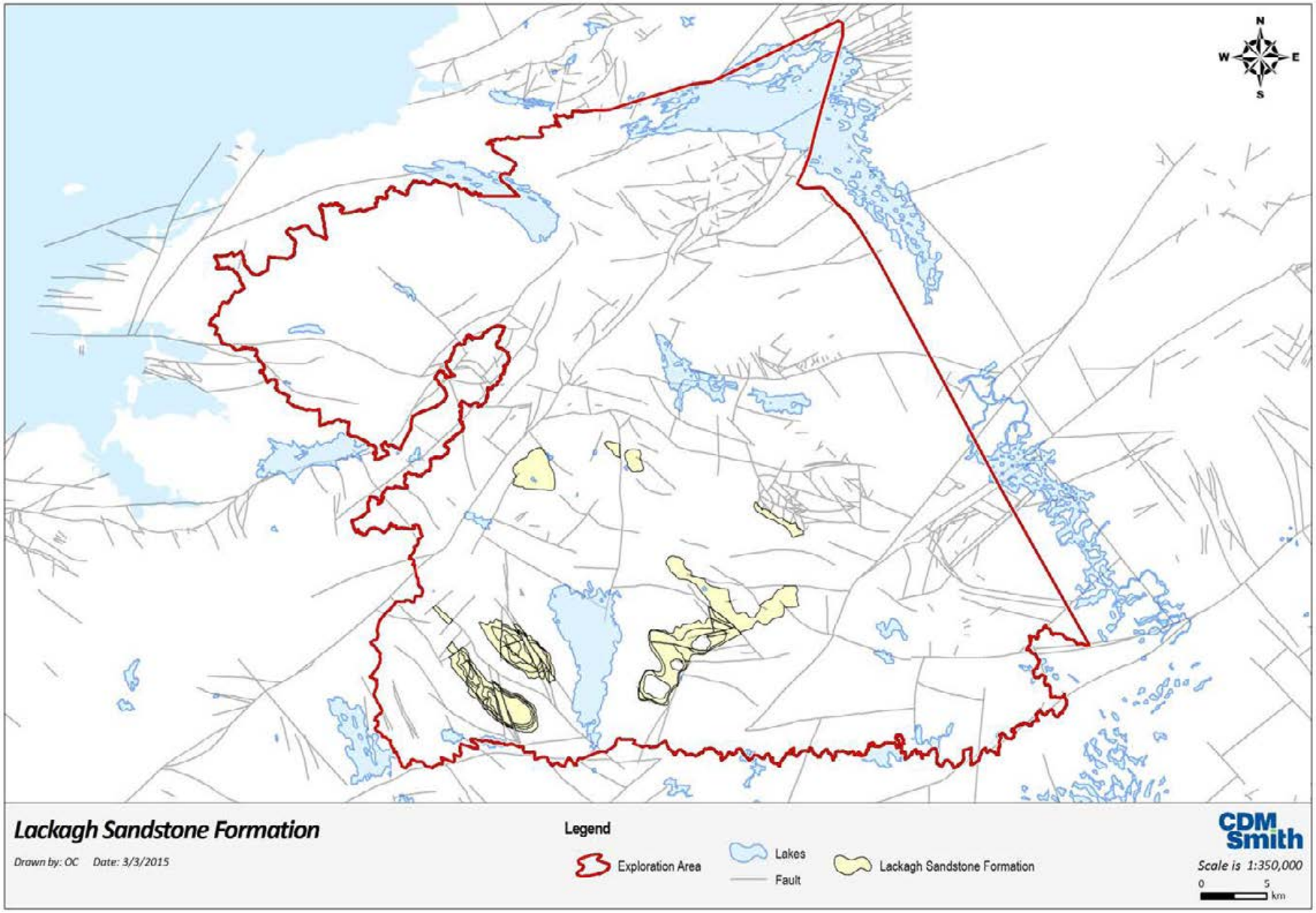
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Lackagh Sandstone Formation
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Lakes
Fault
Lackagh Sandstone Formation
CDM Smith
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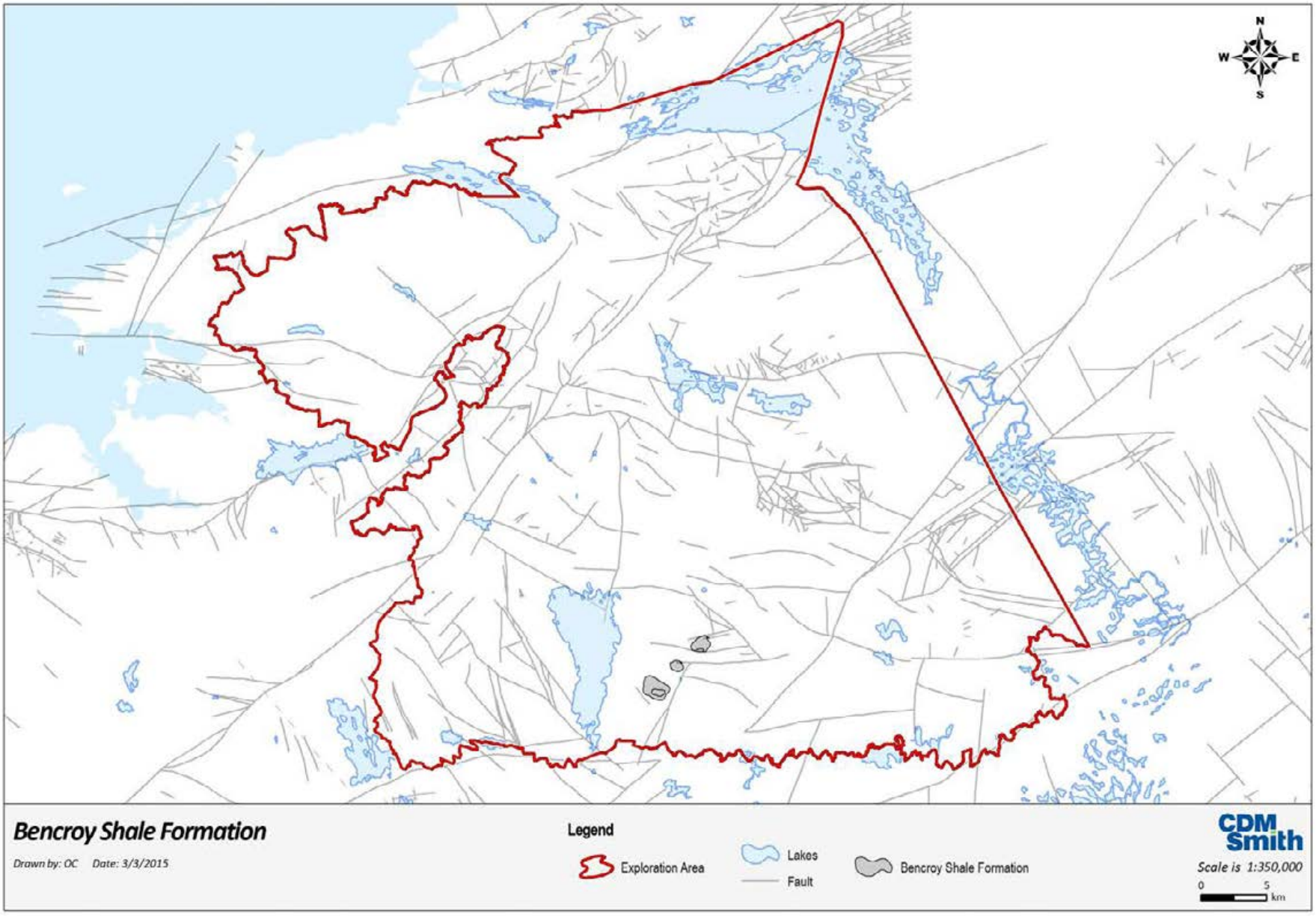
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Bencroy Shale Formation
Drawn by: OC Date: 3/3/2015
Legend
Exploration Area
Lakes
Fault
Bencroy Shale Formation
CDM Smith
Scale is 1:350,000
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km

Appendix E

Aquifer Classification in Ireland and Northern Ireland

Aquifer Type Classification – Geological Survey of Ireland

Box 5.1. Aquifer Classification

Based on the hydrogeological characteristics and on the value of the groundwater resource, all of the Republic of Ireland's land surface is divided into nine aquifer categories. Eight of the aquifer categories are defined in Groundwater Protection Schemes (DELG/EPA/GSI, 1999), and they are as follows:

Regionally Important (R) Aquifers

1. Karstified bedrock (Rk)
2. Fissured bedrock (Rf)
3. Extensive sand & gravel (Rg)

Locally Important (L) Aquifers

4. Bedrock which is Generally Moderately Productive (Lm)
5. Bedrock which is Moderately Productive only in Local Zones (Ll)
6. Sand & gravel (Lg)

Poor (P) Aquifers

7. Bedrock which is Generally Unproductive except for Local Zones (Pl)
8. Bedrock which is Generally Unproductive (Pu)

During the course of the National Aquifer Classification Programme (completed in 2004) undertaken for the Water Framework Directive, a further aquifer category was established:

9. Locally important karstified bedrock (Lk)

Note that, depending on the degree and nature of the karstification, regionally important karstified bedrock aquifers (Rk) may be further characterised as either:

- Regionally important karstified bedrock aquifers dominated by conduit flow (Rkc); or
- Regionally important karstified bedrock aquifers dominated by diffuse flow (Rkd).

Source: www.gsi.ie

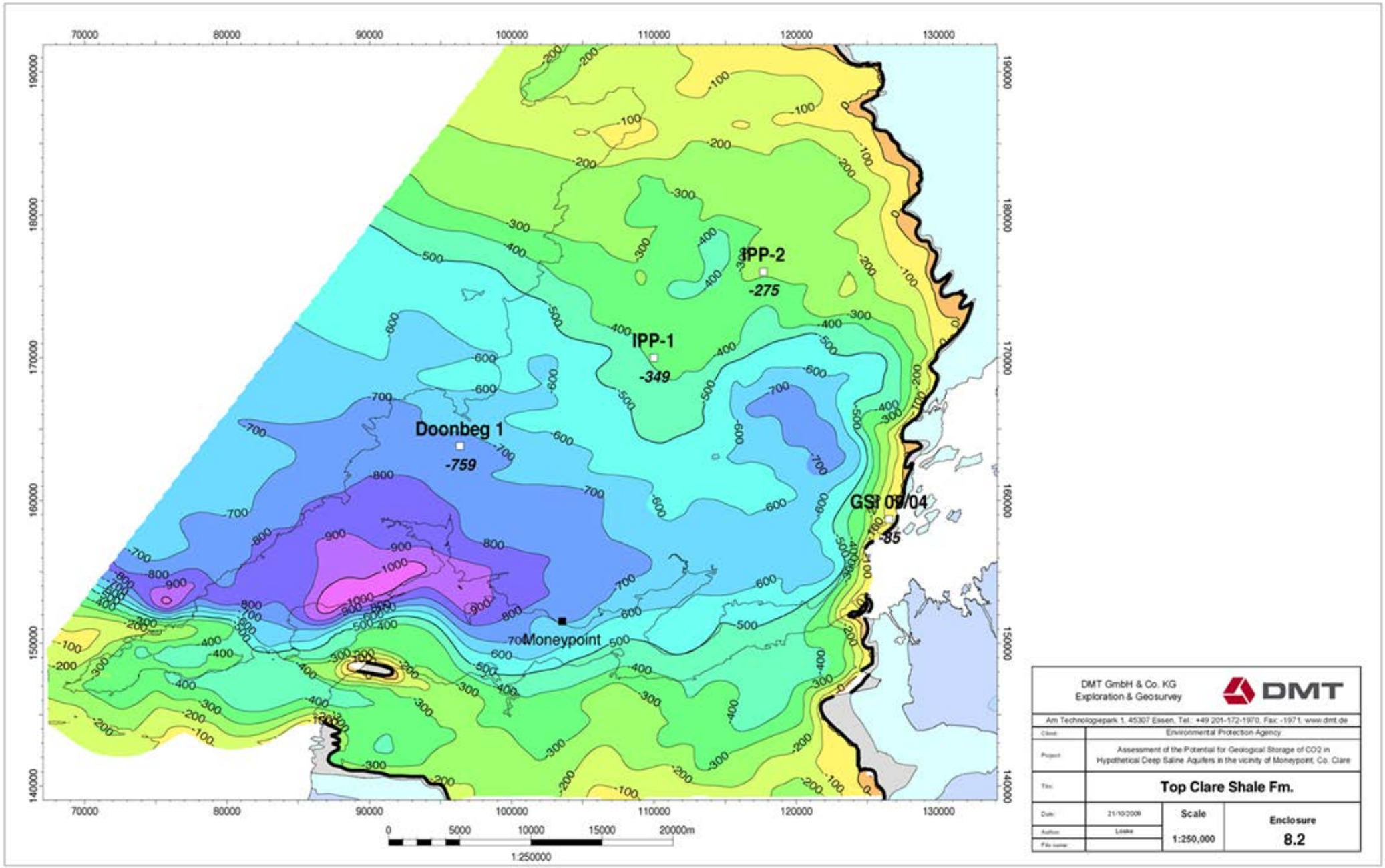
Aquifer Type Classification – Geological Survey of Northern Ireland

Aquifer Category	Symbol	Typical Rock Units / Formations
High productivity Fracture Flow	Bh (f)	Certain Carboniferous basal formations
High Productivity Fracture/Intergranular Flow	Bh (I-f)	Permo-Triassic Sandstones
High Productivity Fracture flow with karstic element	Bh (f-k)	Carboniferous Darty Limestone with Knockmore Limestone Member (in places) Carboniferous Ballyshannon Limestone Formation Ulster White Limestone Formation (Chalk)
Moderate Productivity Fracture Flow	Bm (f)	Palaeogene Basalts Certain Carboniferous Dinatian Sandstones
Limited Productivity Fracture Flow	Bl (f)	Ordovician/Silurian strata Dalradian strata Devonian strata Granites and Intrusives
Poor Productivity Fracture Flow	Bp (f)	Lough Neagh Clay Group Mercia Mudstone Group Waterloo Mudstone Formation

Source: Ball, D., McConvey, P. and Campbell E., 2005. *A groundwater vulnerability screening methodology for Northern Ireland*. British Geological Survey Commissioned Report, CR/05/103N. 41pp.

Appendix F

Structural Geological Maps – Clare Basin



DMT GmbH & Co. KG
Exploration & Geosurvey

DMT

Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client:	Environmental Protection Agency
Project:	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title:	**Top Clare Shale Fm.**
Date:	21/10/2009
Author:	Leake
File name:	
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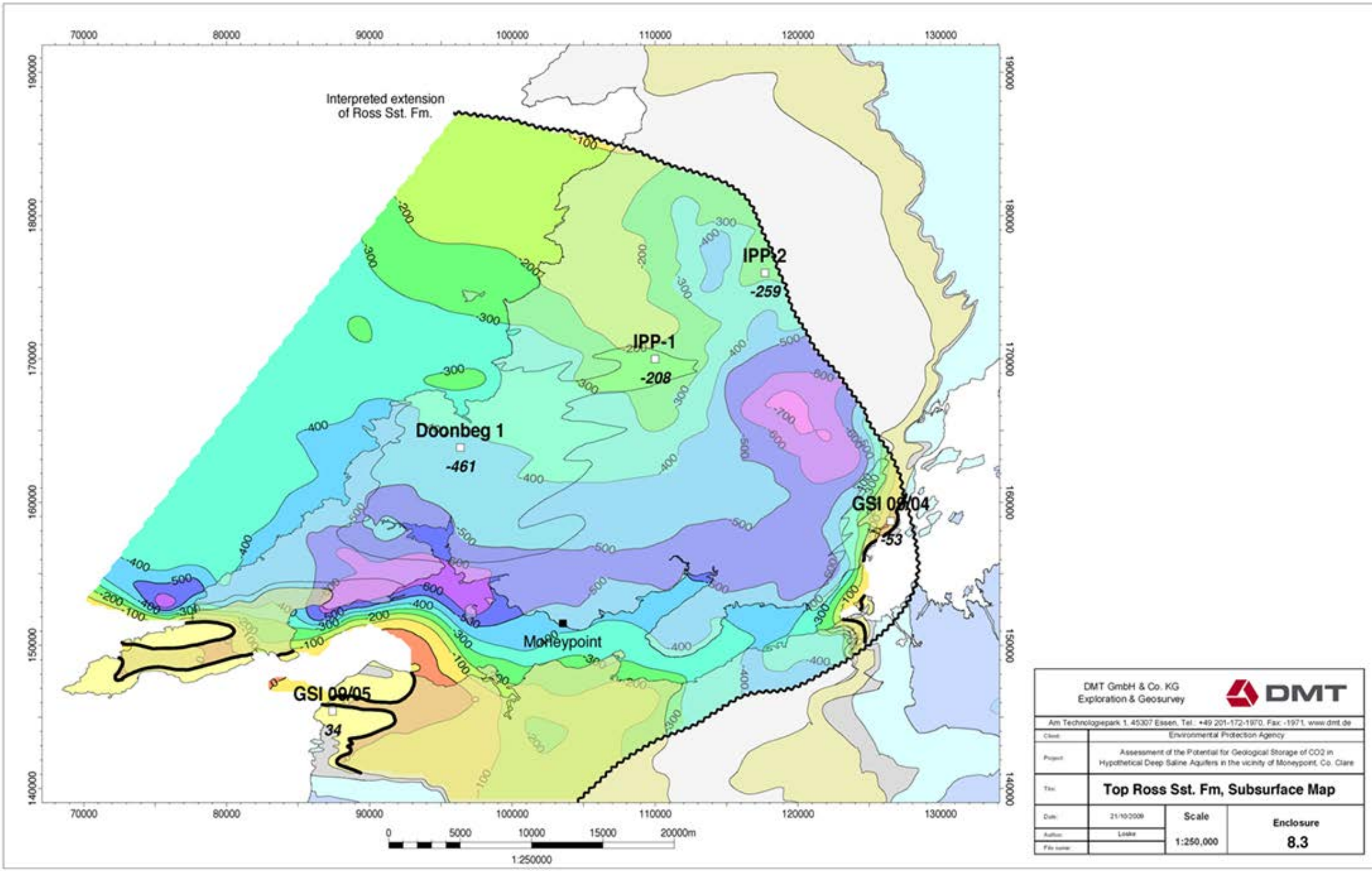
Enclosure:	**8.2**



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DMT

Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client:	Environmental Protection Agency
Project:	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title:	**Top Ross Sst. Fm, Subsurface Map**
Date:	21/10/2009
Author:	Loske
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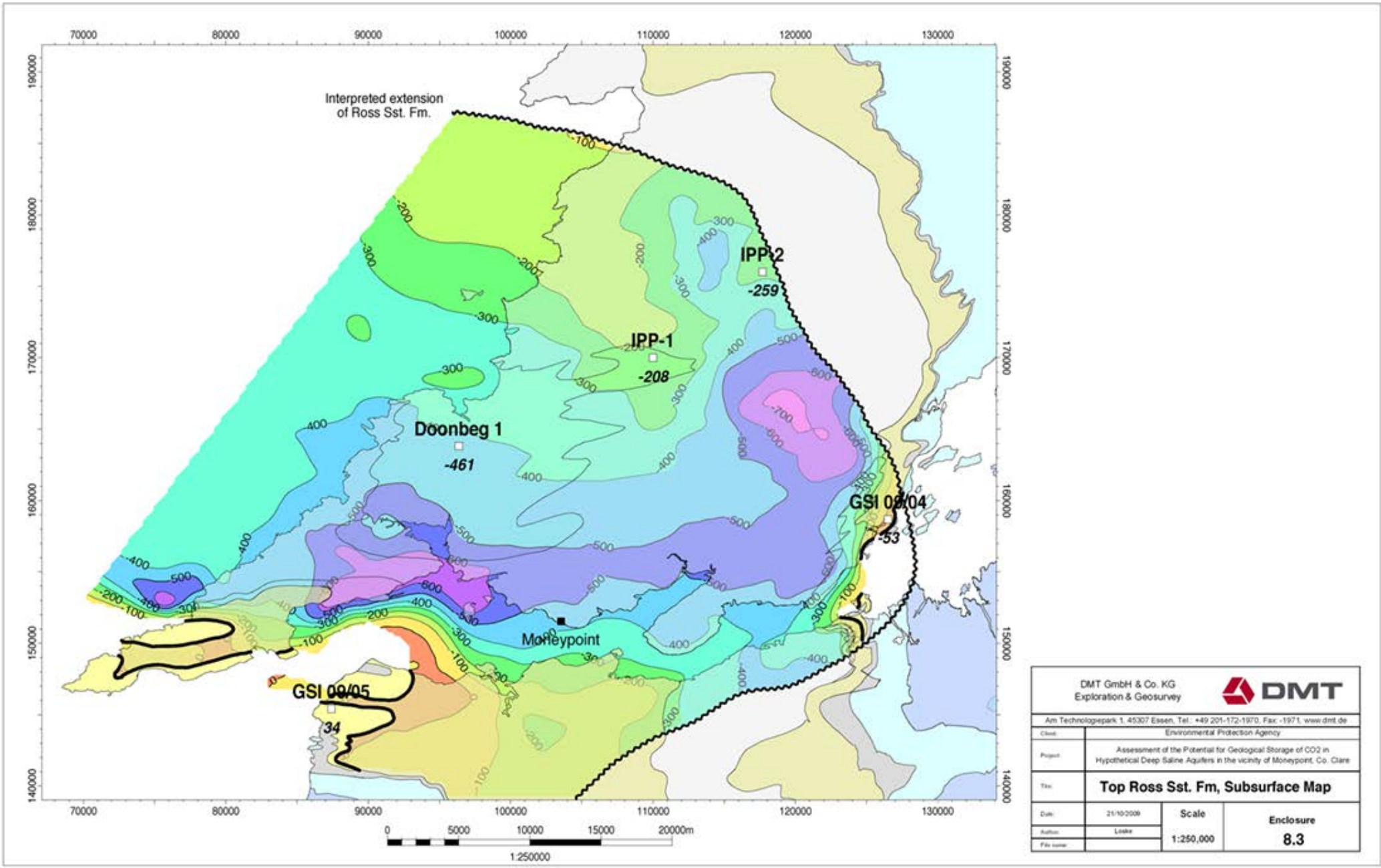
Enclosure	**8.3**



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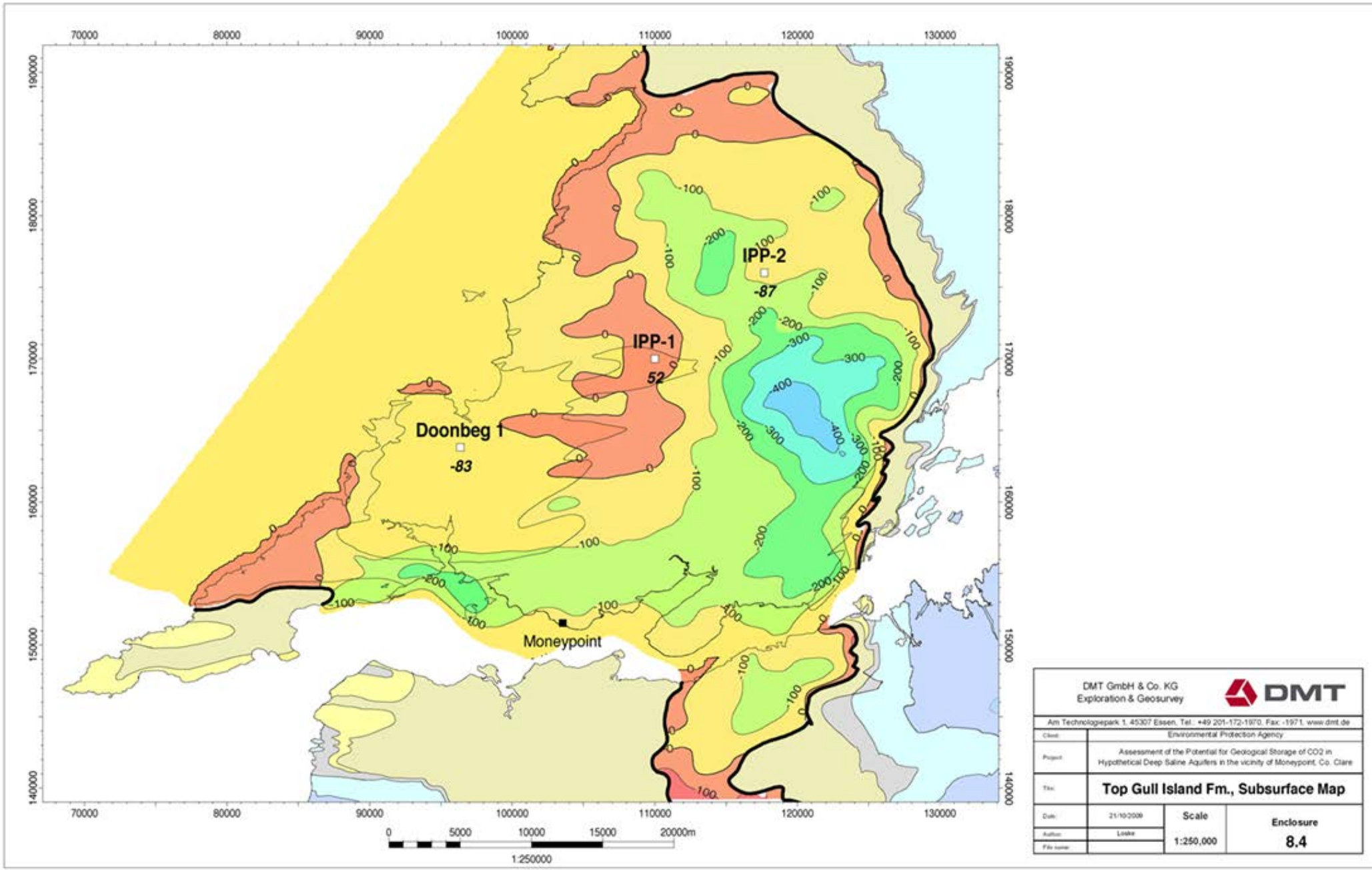
Exploration & Geosurvey

DMT

Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title	**Top Ross Sst. Fm, Subsurface Map**
Date	21/10/2009
Author	Loske
File name	
Scale	1:250,000
Enclosure	**8.3**



DMT GmbH & Co. KG
Exploration & Geosurvey

DMT

Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
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File name	
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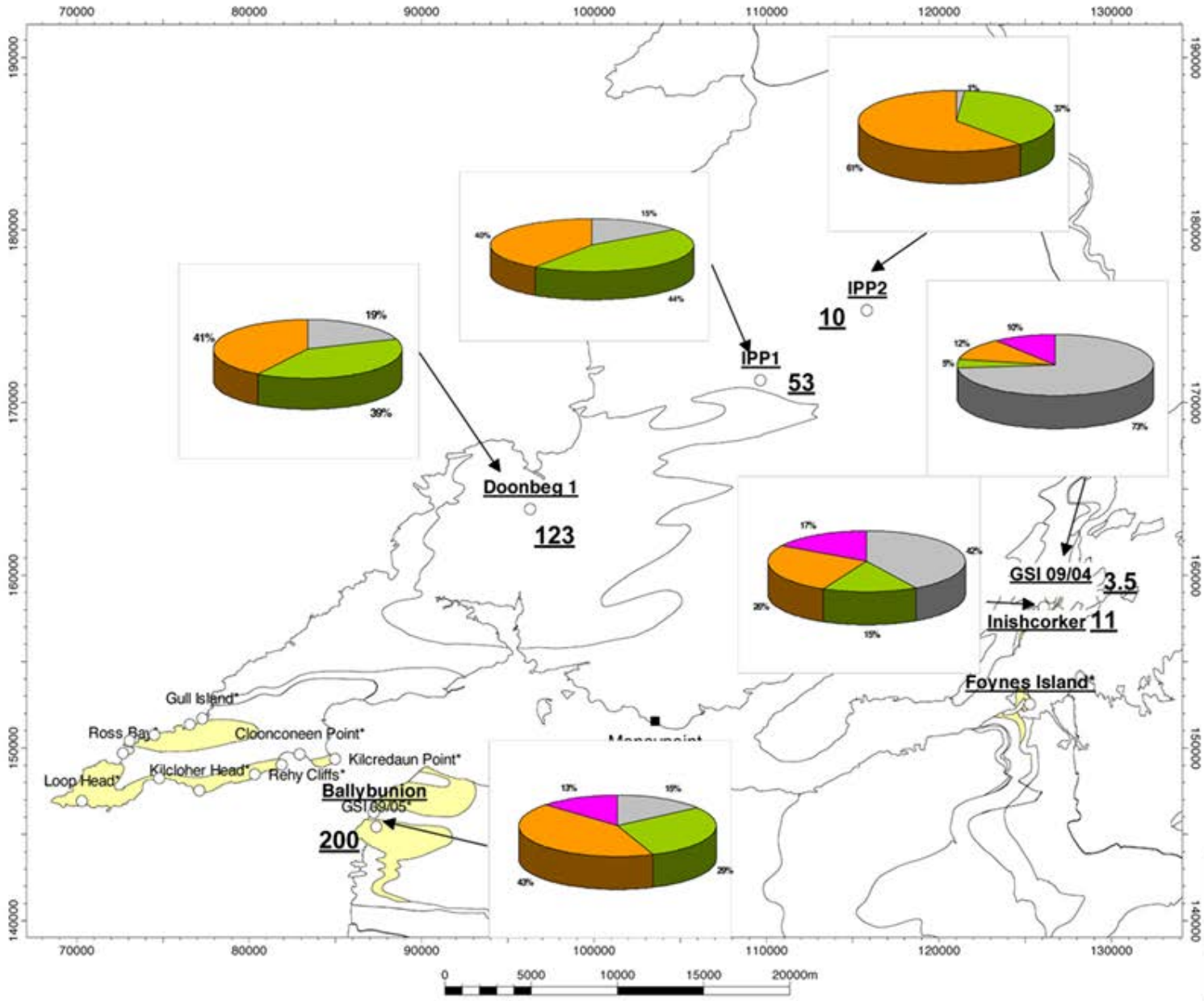
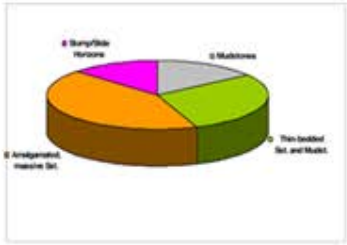
Enclosure	**8.4**





53 Cumulative sandstone thickness (m) within amalgamted, massive packages

Bold and underlined names and figures=complete section
***=incomplete**

DMT GmbH & Co. KG Exploration & Geosurvey			DMT
Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de			
Client:	Environmental Protection Agency		
Project:	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare		
Title:	**Ross Sandstone Fm. - Facies Proportions and Cumulative Sandstone Thickness**		
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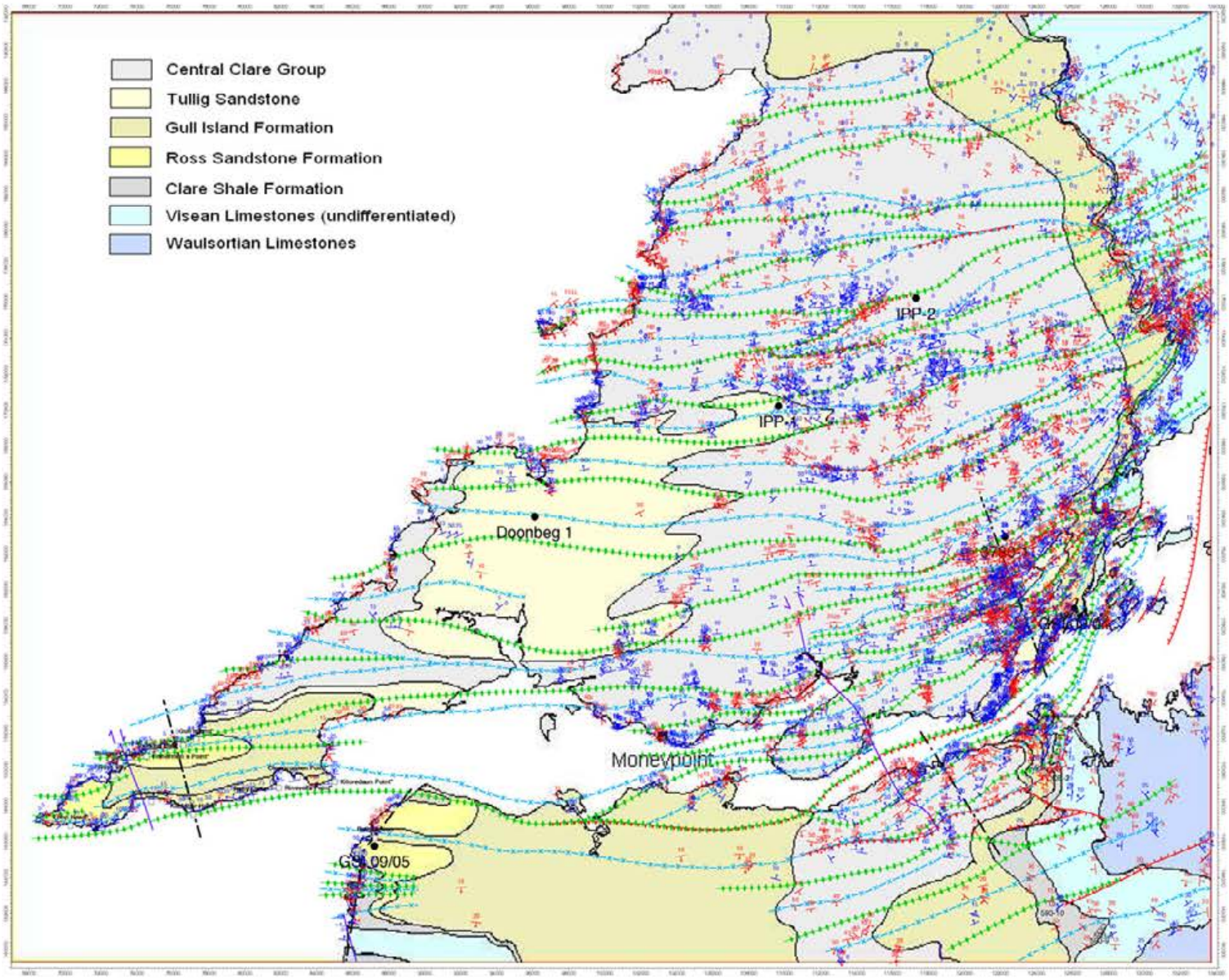

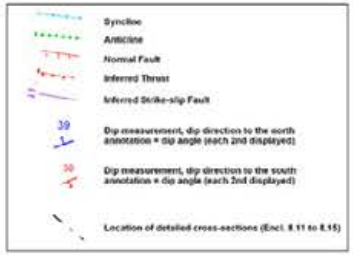

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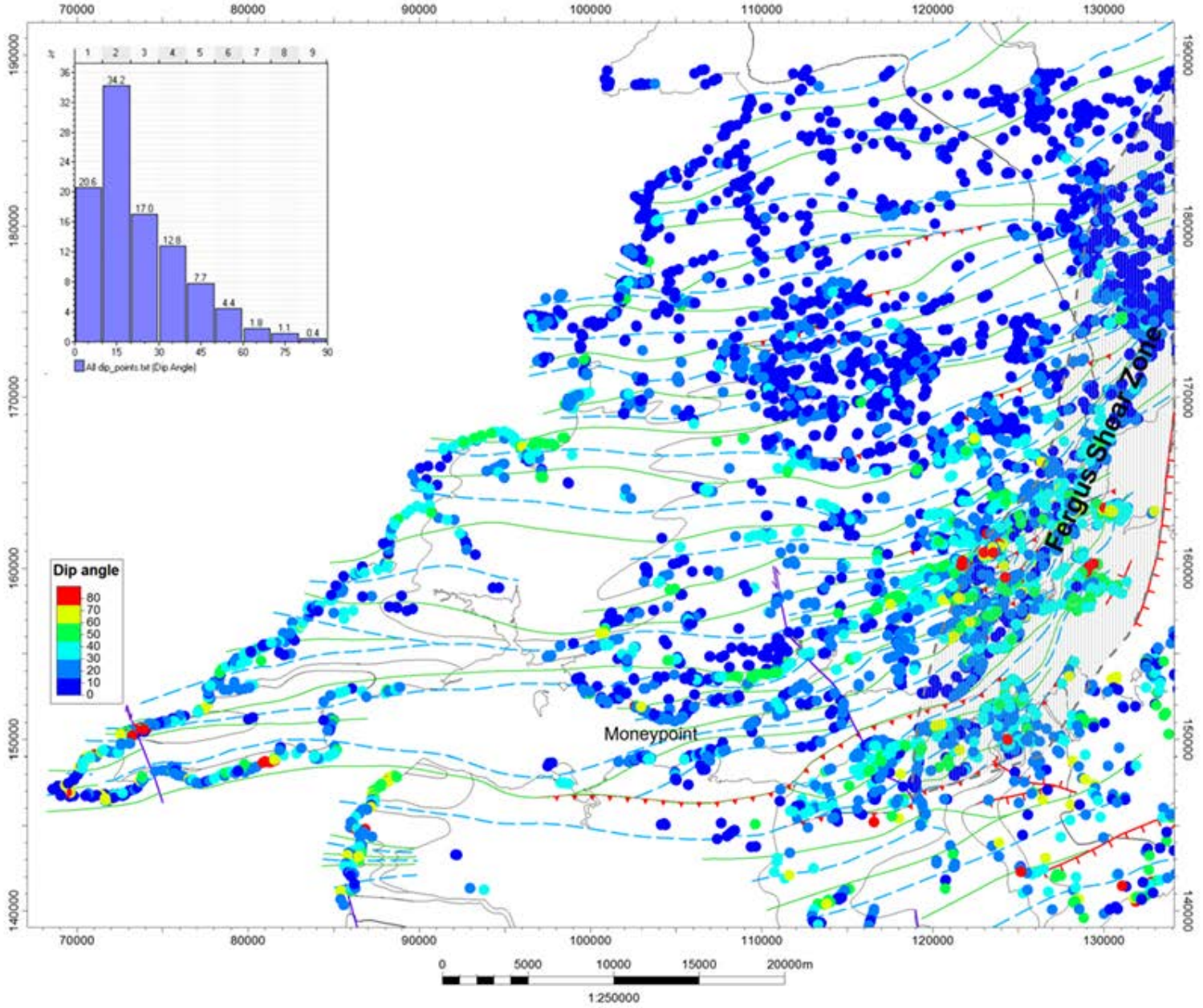
Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title	**Tectonic Map**
Date	21/10/2009
Author	LMMI
File name	
Scale	1:100,000
Enclosure	8.6



Syncline

Anticline

Normal Fault

Inferred Thrust

Inferred Strike-slip Fault

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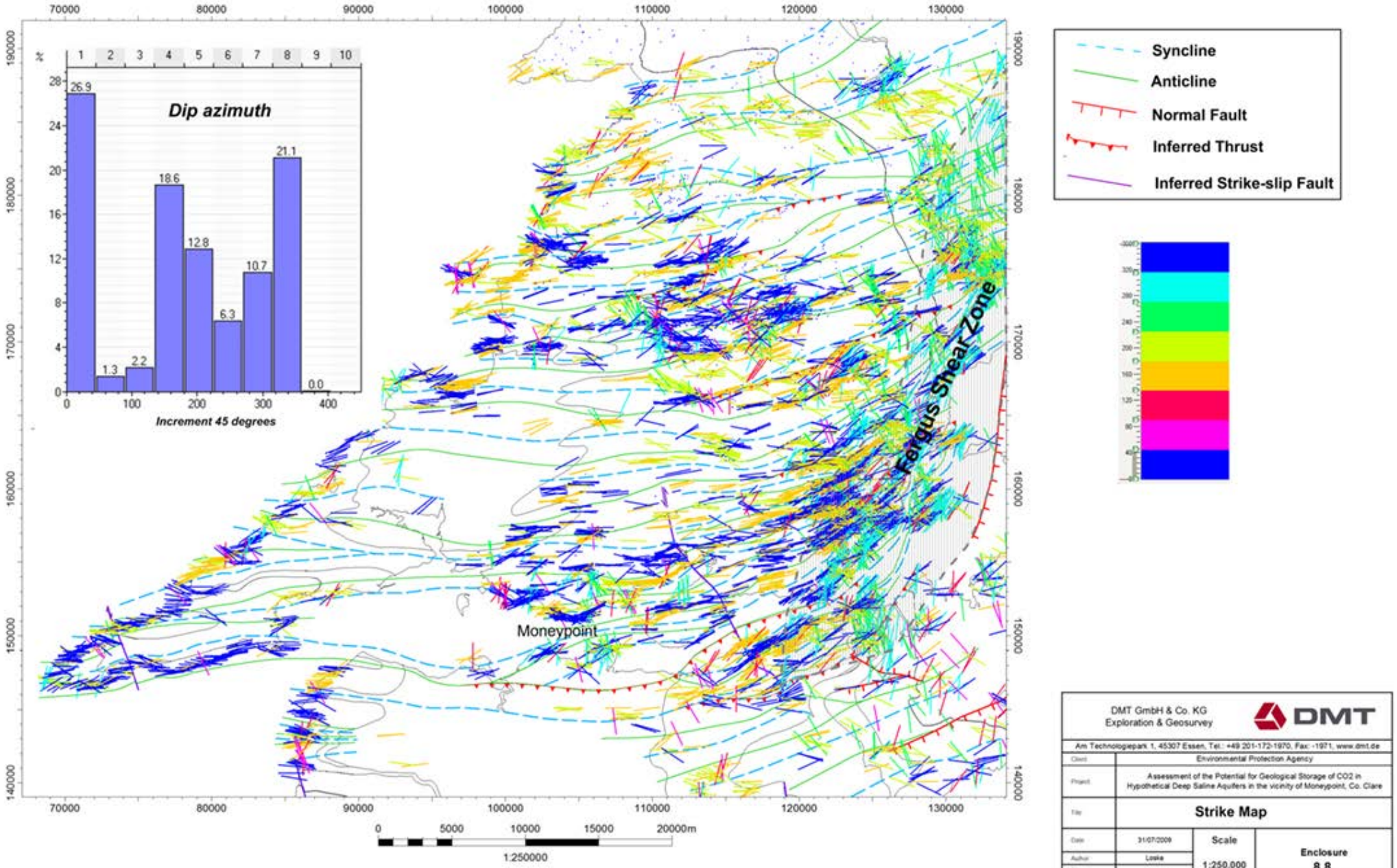
Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title	Dip magnitudes
Date	31/07/2009
Author	Loske
File name	dip magnitudes.wf
Scale	1:250,000
Enclosure	8.7



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Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
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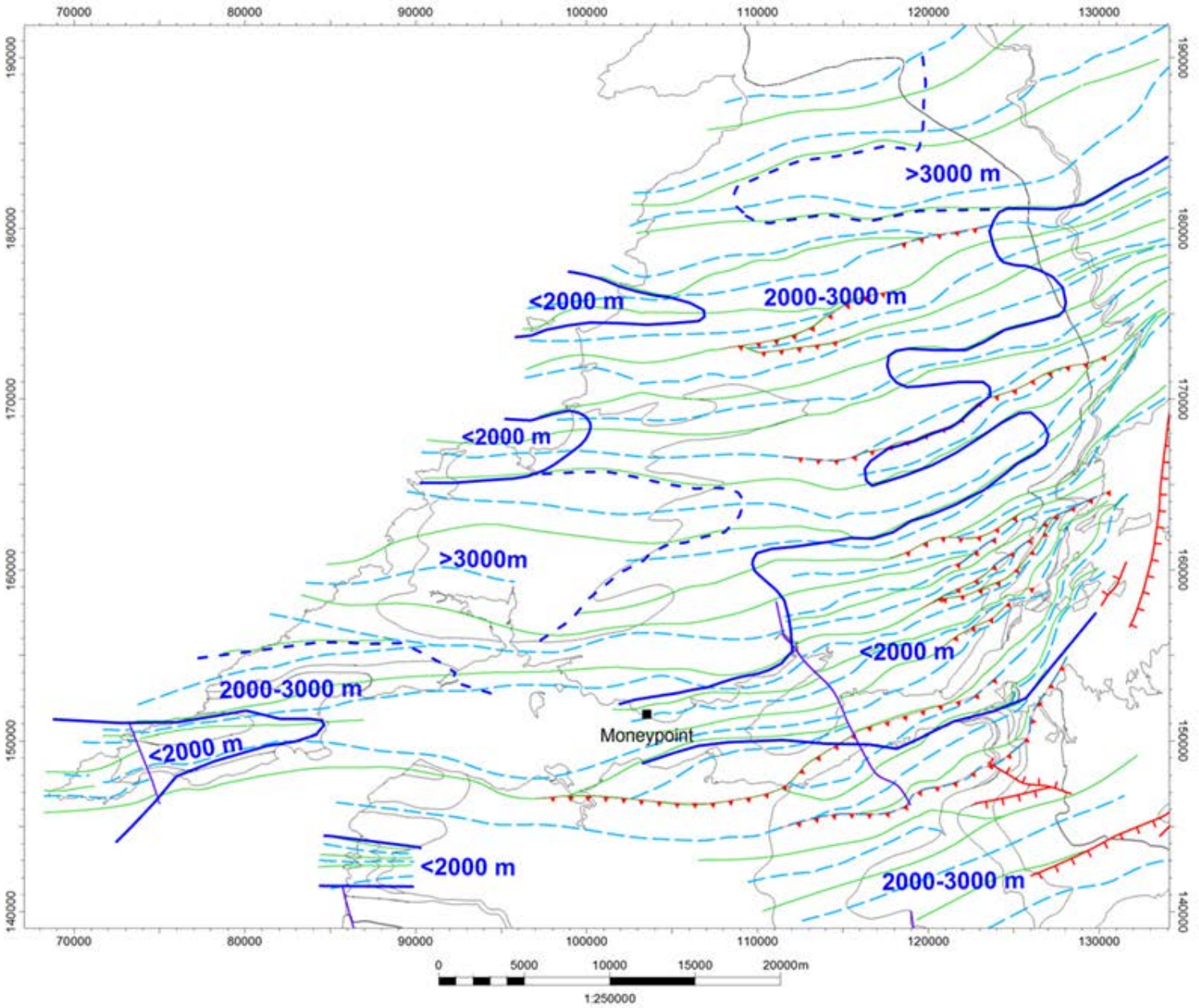
Date	31/07/2009
Author	Looke
File name	strike map.pdf
Scale	1:250,000
Enclosure	**8.8**



Syncline

Anticline

Normal Fault

Inferred Thrust

Inferred Strike-slip Fault

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Am Technologiepark 1, 45307 Essen, Tel.: +49 201-172-1970, Fax: -1971, www.dmt.de

Client	Environmental Protection Agency
Project	Assessment of the Potential for Geological Storage of CO2 in Hypothetical Deep Saline Aquifers in the vicinity of Moneypoint, Co. Clare
Title	**Fold wavelengths**
Date	31/07/2009
Author	Lowe
File name	fold-wavelength.ai
Scale	1:250,000
Enclosure	**8.9**

Appendix G

Ground-truthing Survey of Abstractions

1 Summary of Groundwater Abstractions Survey

On completion of Task 1 (baseline monitoring best practice) of Project A1, it was concluded that sub-regional baseline monitoring of groundwater quality in the Northwest Carboniferous Basin (NCB) and Clare Basin (CB) study areas should consider and would benefit from sampling of existing abstraction wells and springs that are used for public and private water supplies. Accordingly, surveys of abstraction wells and springs were undertaken in two stages: between 25 February and 21 March 2015, and between 24 April and 10 May 2015. The objectives, methodology, results and ensuing recommendations from the surveys are summarised below.

1.1 Objectives

The main objectives of the survey were:

1. To research and verify the extent of groundwater usage for public and private water supply purposes in respective study areas; and
2. To locate and inspect existing abstraction wells and springs that might be suitable for sub-regional baseline monitoring of groundwater quality, with the emphasis on wells and boreholes that are deemed suitable for sampling of dissolved natural gas constituents, and requiring minor improvement works at wellheads only.

The identification of existing wells suitable for sampling was recommended as a potential overall cost saving to the UGEE Joint Research Programme, which otherwise would require extensive drilling of new monitoring wells throughout both study areas.

Active pumping wells are preferred over dedicated individual monitoring wells for sampling purposes because samples collected from pumping wells (and springs) draw on greater volumes and areas of aquifers, hence samples are more representative of true water quality conditions in the associated aquifer system(s). Accordingly, the technical objectives of the project are better served with pumping wells, provided that suitable abstractions can be identified and are field verified.

The sub-regional groundwater monitoring network is receptor-focused and should provide adequate coverage of geological variation across the study areas, including potential methane- bearing formations.

1.2 Methodology

The methodology that was followed in both case study areas included the following basic steps:

1. Establishing contact with owners and/or operators of known public and private regulated water supplies (primarily local authorities, Irish Water and the National Federation of Group Water Schemes);
2. Researching and establishing contact with the owners and/or operators of other potential groundwater-sourced abstractions such IPPC facilities, quarries, hotels, golf courses, and commercially active facilities (e.g. bottling plants, food or drinks manufacturers);
3. Identifying large farms from aerial imagery available through online services;
4. Ground-truthing known and candidate abstraction sources by visiting each source in the field; and
5. Inspecting each source in terms of suitability for sampling purposes and requesting permission to access the source in the future.

The survey was conducted using a tiered approach. Highest priority was assigned to public water supplies and group water schemes. Second priority was assigned to private regulated supplies which are used for

consumption purposes and are monitored by local authorities. Third priority was assigned to private "other" sources of groundwater, notably wells associated with farms and single homes.

In order to conduct the survey in a timely and efficient manner, prior scheduling of visits with facility caretakers was organised as much as possible, guided by logistics of movement through respective study areas. Facilities that could not be scheduled ahead of time were followed up and visited when it made logistical sense during the survey period. Many other facilities were visited on the basis of cold-calls, notably those which became known during survey implementation, either from observation while moving through the project areas or from conversation with local residents. Time constraints did not allow for visits to all planned or identified locations or farms/ dwellings, and also meant that some sites that were initially visited, but where nobody was home at the time of the visit, could not be re-visited within the assigned duration of the survey.

The key information that was collated and verified (to the extent possible) from the site visits included:

- Location of sources (wells/springs);
- Contact information (owners);
- Volumes abstracted (especially for larger abstractions such as Public and Group Water Schemes);
- Well construction details and wellhead integrity;
- Details on whether and/or how raw (untreated) groundwater samples can be collected;
- Minor works that may be needed to protect or improve wellheads; and
- Permission to sample or conditions by which permission to sample from owners would be granted.

For springs, both abstraction volumes and potential overflows were estimated at the time of the site visit. Spring visits were prioritised according to their known or suspected use for water supply purposes, discharge volumes (*i.e.* "size") and/or hydrogeological interest in connection with Task 2 of Project A1 (conceptual hydrogeological models).

1.3 Results

The results of the abstraction survey can be summarised as follows:

- The survey confirmed prior obtained information about important public water supplies (PWS) and group water schemes (GWS);
- The survey resulted in updated information relevant to public and private abstractions which was added to an updated abstractions database for the study areas;
- The survey clarifies the extent to which groundwater is sourced and used in both case study areas;
- The survey identified a need for minor works at most of the existing wells in order to be able to collect representative raw water samples; and
- The survey identified an opportunity for incorporating both abandoned or inactive wells, as well as existing (but unequipped) trial wells, into the sampling programme.

1.3.1 Clare basin study area

A total of 139 potential abstractions, see *Figure G.1*, were researched, contacted and/or visited in the survey periods. These included group water schemes, industry, quarries, commercial facilities (e.g. bottling plant and ice-cream factory), dairy farms and private dwellings.

Public water supply in the CB study area is sourced entirely from Doo Lough which is distributed via public water mains. Accordingly, there are no groundwater-based public water supplies within the UGEE licence area in the CB.

Two groundwater-based group water schemes are located marginally outside the UGEE licence area to the east/northeast: a) Lissacasey GWS; and b) Kilmaley-Inagh GWS. The Lissacasey GWS consists of two active supply wells (the "Frure" wells) and one inactive (to be decommissioned) supply well. The Kilmaley-Inagh GWS drilled two trial wells near Lough Naminna in 2007/2008, but these have not yet been commissioned.

There are numerous private wells throughout the study area, and groundwater is important for both the commercial and farming sectors. Groundwater tends to be sourced from either shallow dug wells (few metres deep) or from boreholes/wells which are generally between 40 and 150 m deep.

The national abstraction registry of 2009, which formed the starting point of the abstraction survey, is outdated. The present survey, as documented in *Annex 1* and in *Figure g.2,* represents a significant advance in the documentation of groundwater usage in western Co. Clare.

Figure G.2 shows the 139 potential abstraction sites colour-coded as follows:

- Green circles – these represent visited locations where the well/borehole in question was inspected and deemed suitable for sampling purposes, subject to minor works, such as installation of a raw water sampling tap. The majority of these are farm wells.
- Orange circles – these represent locations where:
- Wells/boreholes reportedly exist but could not yet be inspected (*i.e.* remain 'to be verified');
- Wells/boreholes were inspected and deemed suitable, but permission to sample was not received in the period of the survey (but could yet be received, pending follow up); or
- Wells/borehole exist, but require additional investigation and potential rehabilitation in order to be used.
- Red circles – these represent sites that were visited but do not have suitable wells for sampling purposes or permission to sample was not granted.
- Purple triangles – these represent sites visited, but where wells do not exist.

On this basis, 22 green circle wells are retained as candidates to be considered for the baseline monitoring programme, which is documented in Final Report 1 of the UGEE Joint Research Programme. Thirty-one orange circle wells are also retained as candidates, pending verification of details and permissions for sampling to be granted (*i.e.* requiring follow-up). Only a small number of identified sites or facilities (<5) did not respond to the requests for information or could not be visited.

Springs in the CB study area are generally very small (<5 l/s), and none are used for public or private regulated water supply.

1.3.2 Northwest carboniferous basin study area

Approximately 250 potential well sites and spring locations, see *Figure G.3*, were researched, contacted and/or visited during the survey periods. These included public water supplies, group water schemes, industry, quarries, commercial facilities, dairy farms and private dwellings.

Public water supply is sourced from a wide range of wells, springs, streams and lakes across the UGEE licence area. The emphasis of the abstraction survey was on groundwater-based sources, so the field work focused on documenting wells and springs abstracted for water supply purposes.

Results are summarised in *Annex 2* and *Figure G.4*, and much like the survey in the CB, results represent a significant advance in the understanding of groundwater use in the NCB study area. Importantly, results have both verified and corrected the knowledge about the extent of groundwater sourced public water supplies, which is important in the context of Task 5 (receptor identification) of Project A1 of the UGEE Joint Research Programme.

From Annex 2 and Figure G.4:

- Thirty-eight (38) green circle sites were retained as candidate sites to be considered for the groundwater baseline monitoring programme;
- Forty (40) orange circle sites require verification of details and/or permissions to sample. Of the 40 sites, it is estimated that 5 sites can be converted to 'green candidate sites' with minimal additional follow-up effort, but the remainder of the sites (*i.e.* 35) would require a longer time-commitment in the field, should this be needed.

A total of 9 boreholes used for public water supply (6) and group water schemes (3) were confirmed as suitable for sampling purposes within the UGEE licence area (e.g., North Sligo PWS). Additional public and group water scheme boreholes that are located near but outside the UGEE licence area, and which source groundwater from the same bedrock formations that define the NCB, were also visited and deemed suitable for sampling purposes (e.g. Riverstown PWS in Co. Sligo, Boyne PWS in Co. Roscommon and Ballyshannon PWS in Co. Donegal).

Compared to the CB, springs are an important source of water in the NCB, both for public and private water supplies. There are two main types of springs: a) large karst springs associated with karstified limestones, which can discharge several hundreds of l/s; and b) much smaller springs (generally <50 l/s) associated with all bedrock formations, and which include discharges in upland settings, notably sandstone and shale hills surrounding Lough Allen.

Springs were visited with priority given to public water supplies and group water schemes. Other springs were also visited, notably springs which are not abstracted from but which were suspected to be relatively 'large' (in terms of natural discharge) and associated with non-karstified limestones/bedrock (large karst springs are relatively well described in existing literature). For prioritised springs where contact details of caretakers were incomplete or unavailable in the survey period, investigative surveying was carried out using approximate GPS coordinates (where available) and personal communication with local residents.

A total of 31 springs were visited and/or verified, see *Annex 3 and 4*. Of these, 20 springs are active groundwater abstraction sources used for potable water supply, 1 spring is abstracted by a private regulated industry (fish farm), and 10 springs are not used for potable water supply. Two of the latter 10 were once active abstractions (one PWS and one GWS)

1.4 Well Construction and Integrity

Wells that supply public and group water schemes tend to be properly constructed following best practice guidelines (e.g. IGI, 2007; EPA Advice Note No. 14). As such, they are afforded priority for baseline monitoring purposes. In contrast, private wells serving domestic houses and/or farms tend not to be constructed according to best practice, usually as a means of cutting cost to the well owner. Typical designs for domestic/farm wells

that have been observed during the abstraction survey are shown in *Figure G.5*. A common feature is that the annular space between the drilled borehole wall and steel casing (which is most often installed through subsoils to bedrock) is not cement-grouted. Rather, the annular space is filled with drill cuttings or available soil/subsoil material, and at best, bentonite pellets may have been inserted close to the surface. The absence of neat cement grout in the annular space implies that surface and near-surface pollutants can enter into the well via the borehole annular space (acting as a vertical pathway), which in turn may impact on groundwater quality results. Accordingly, groundwater quality data from such wells must be reviewed with care.

The absence of proper grouting is not best practice but is reality for private wells in both case study areas. Such wells nonetheless retain relevance to the sub-regional baseline monitoring programme because the monitoring is receptor-focused and the wells are representative of how water is accessed for private and agricultural uses generally. Their acceptance for monitoring purposes is weighed against the knowledge that some baseline water quality parameters may be affected by organic contaminants (e.g. from landspreading applications) but that other key parameters, notably dissolved natural gas and naturally occurring radioactive materials (NORM), will not be affected.

1.5 Recommended Further Investigations of Identified Wells

A small number of the identified wells require additional investigation to determine and verify if they can be used for sampling purposes. These include wells that are known to exist but are no longer used, and are covered over (e.g. by a combination of steel plates, flagstones and/or rubble). An example is the former creamery well in the centre of Kilrush in the CB study area. Now owned by the family running the Museum of Irish Rural Life, the well is available to the UGEE Joint Research Programme and accessible for investigation. This would require a simple operation of removing approximately 0.5 m of coarse rubble, removing the flagstone on top of the well casing, and checking the total depth of the well and its integrity using a downhole camera. The well could be usable for sampling purposes following minor rehabilitation works, such as airlifting out any bottom sediment that may have accumulated, and constructing a new simple protective cover.

Such instances are recommended under Task 3 of Project A1 (technical specifications for a subregional baseline monitoring programme) as a means of achieving overall capital cost savings to the UGEE Joint Research Programme (in this case, rehabilitation of an existing well compared to the cost of drilling a new monitoring well).

Actions to rehabilitate existing idle wells would be carried out as part of future tendering under Task 4 of Project A1. The works would likely be carried out by the same drilling contractor that would be engaged to drill new dedicated monitoring wells.

Since the field survey work was concluded, permission has been granted for sampling of identified but not yet inspected wells, as follows:

- A borehole adjacent to a quarry (west of Lough Allen) owned and operated by the Quinn group;
- Loughran House (prison) - 3 boreholes;
- Corlough GWS – information has been received to suggest that the borehole is not in use – but could be activated pending removal of the pump or checking with the GWS owners if the pump could be maintained in working order;
- Kildallon GWS – one borehole; and
- Doon quarry (Quinn Group).

These sites would require site visits for inspection purposes, which could be accomplished in 2/3 days, pending availability and coordination of site visits with caretakers. It is recommended that this work be carried out to help build up the database of candidate wells to be considered for baseline monitoring purposes.

1.6 Recommendations Moving Forward on Private Wells

The incorporation of private wells into the baseline monitoring programme has many documented advantages. An item of concern, however, is the potentially significant lag time between the abstraction survey and the implementation of the baseline monitoring activity. The risk is that wells for which permission to sample has been granted (with minor works) may not be available in the future, which could leave data gaps or interruptions to the baseline monitoring programme.

To date, well owners have been very accommodating of the survey team members. It is recommended that further effort be made to build on the good relations to date and keep the future sampling activity "in view" with respective well owners, by contacting and updating each on plans and anticipated schedules, and by engaging on questions they may have related to parameters that will be tested and why, the parameters that are most relevant and important to them, and outlining how and when results can be shared (e.g. following QA of lab results). Some owners have expressed concern about what might happen if something "shows up" in their wells and what information will be made public. These are items which will need clear answers.

Formalities will also have to be followed up regarding agreements to both sample and conduct minor works at wellheads. This will likely require letters of agreement with individual owners, but this action is not recommended until well selection is finalised.

There are many details that will have to be tended to with regard to private wells, and this is part of the overall sample management process. For example, the supplies and activities of well owners should not be disrupted, thus flexibility in approach and timing of future minor works will require careful coordination with the well owners.

1.7 Recommendations on Minor Works

Most of the wells visited and inspected to date will require the installation of sampling taps in order to be able to obtain representative raw water samples. These can in most cases be installed with little effort on HDPE discharge lines from submersible pumps prior to reservoirs or treatment units. Minor works will in some cases also be needed at wellheads in order to reduce the potential for surface water and contaminant ingress into the selected wells. Opportunities for wellhead improvements have been noted which involve one or more of the following:

- Extension of height of the protective steel casing and discharge lines (which are most often simple HDPE hoses);
- Surface water drainage improvement (*i.e.* drainage diversion) in the immediate vicinity of wellheads; and
- Small, concrete plinths around the protruding steel casings.

Simple, minor works at wellheads can help to reduce the susceptibility to contamination of wells without proper grouted casing, and is recommended, since the use of private wells, even with minor works, can result in significant cost savings to the UGEE Joint Research Programme overall. The minor works recommended for each of the candidate wells are noted in *Annexes 1 and 2.*

Most well owners have not expressed any concern about the need for minor works, but this is an item that should not be underestimated in terms of its importance to the project or complexities it may cause if not properly communicated or arranged formally.

1.8 Conclusions

The abstractions surveys have been successful in:

- Section 1: Verifying and documenting existing abstraction wells/boreholes in the two study areas;
- Section 2: Improving the understanding of groundwater usage in the two study areas;
- Section 3: Identifying suitable, existing wells and springs which should be considered for sampling in the sub-regional baseline monitoring programme; and
- Section 4: Guiding the investments that may be needed for investigation of the integrity of idle wells, minor works on existing wells, drilling of new dedicated monitoring wells, and the installation of equipment (e.g. pressure transducers and multi-parameter probes) on both wells and springs.

It is concluded that most, if not all, public and group water schemes can be included in the baseline monitoring programme. This is based on good cooperation with local authorities, the NFGWS and caretakers, as well as an interest stated by the same in receiving the sample results. It is also expected that the majority of suitable private regulated supplies and several private wells (mainly supplies to farms) can be incorporated, pending further work required to consolidate the impressions and results to date.

The identification and verification of existing suitable wells has resulted in a potential cost saving of up to €300,000 to the UGEE Joint Research Programme, but it is anticipated that a number of new monitoring wells will still be required to meet the technical requirements and objectives of the sub-regional baseline monitoring programme. Most of these will be in the NCB, but a small number will also be required in the CB. The greater need for monitoring wells in the NCB reflects its size and numerous different formations throughout the study area, which are all used for water supply. Accordingly, the drilling of new dedicated monitoring wells is anticipated under Task 4 of the UGEE Research Programme.

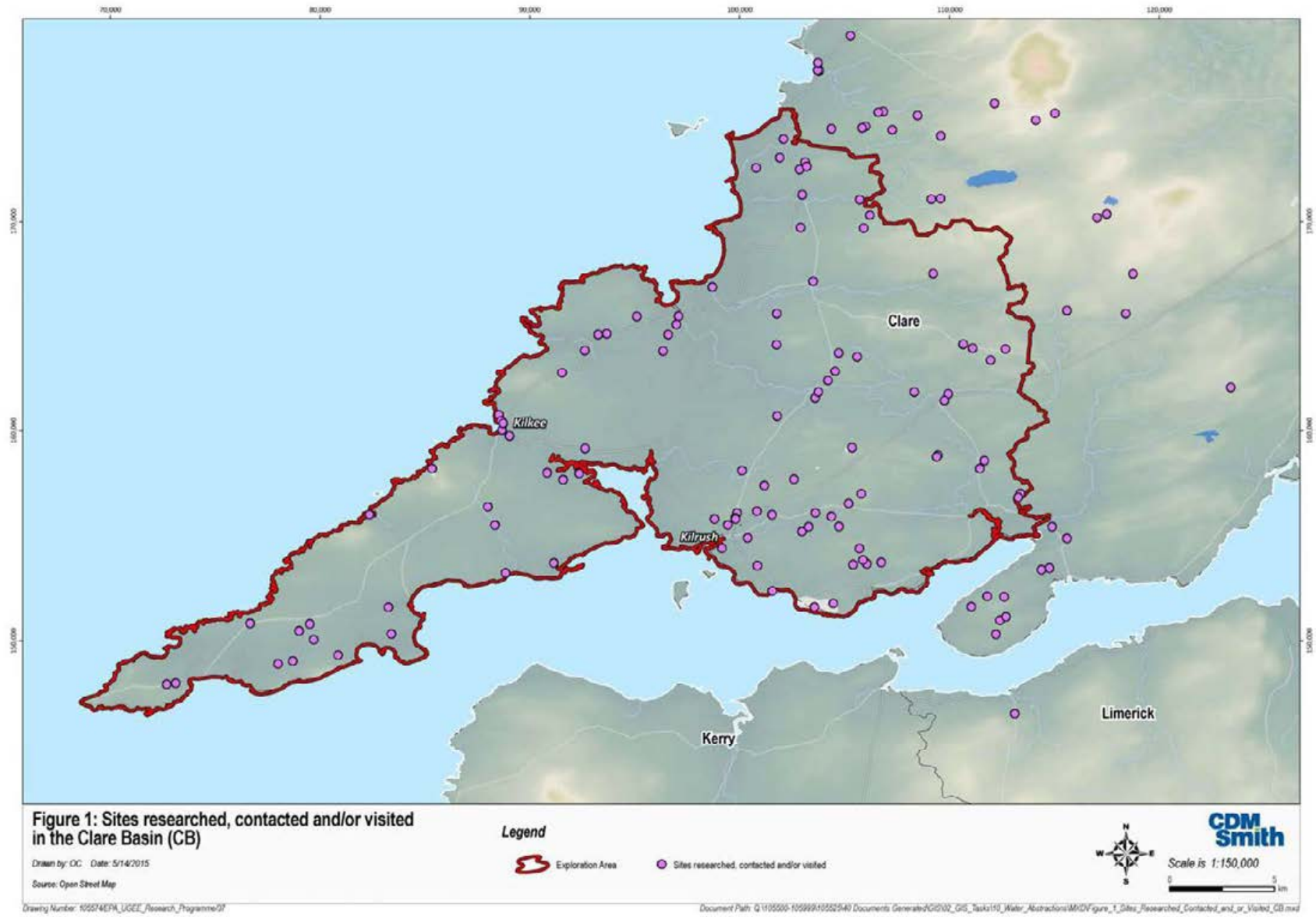

Figure G.1. Sites researched, contacted and/or visited in the Clare Basin.

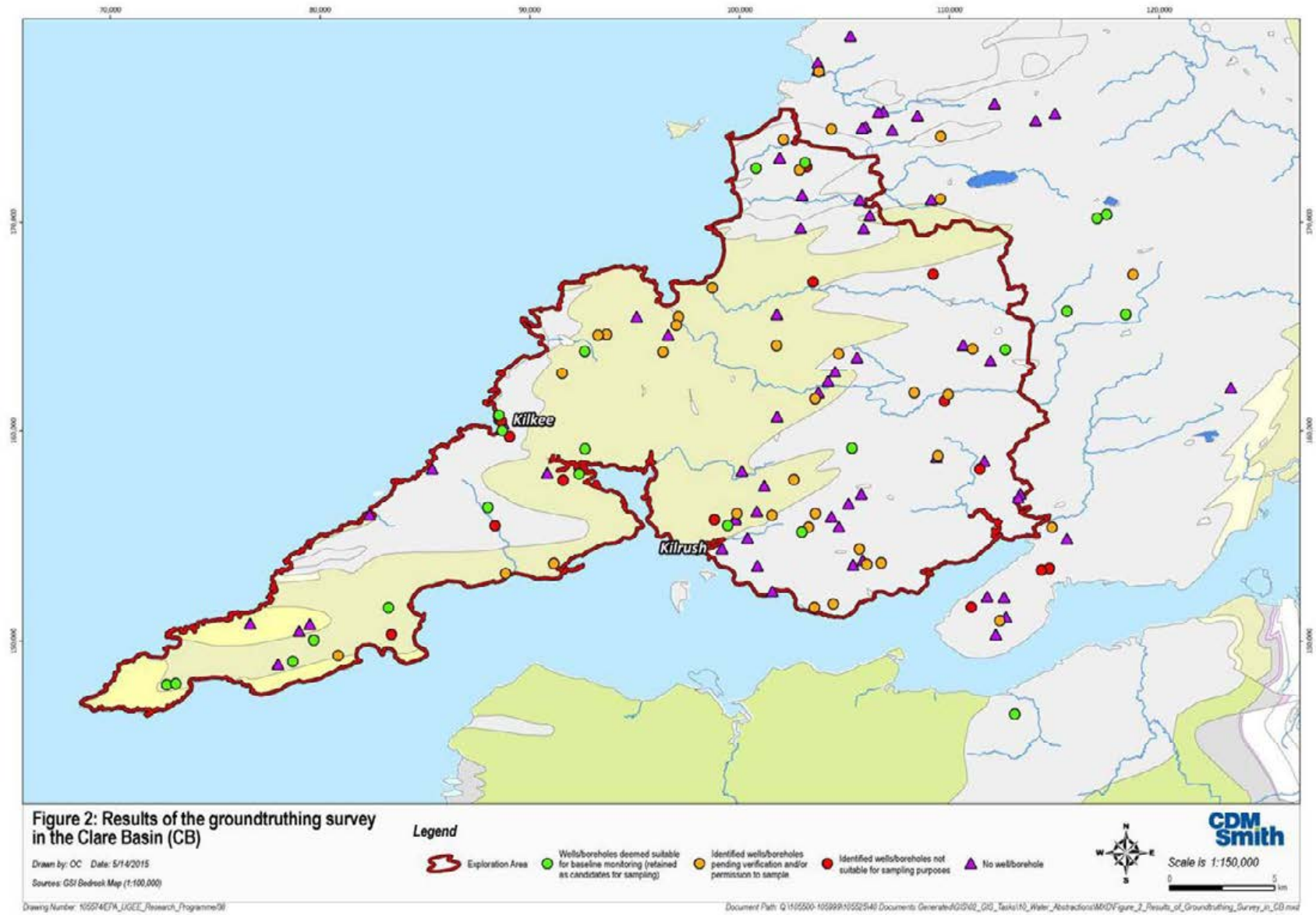

Figure G.2. Results of the groundtruthing survey in the Clare Basin.

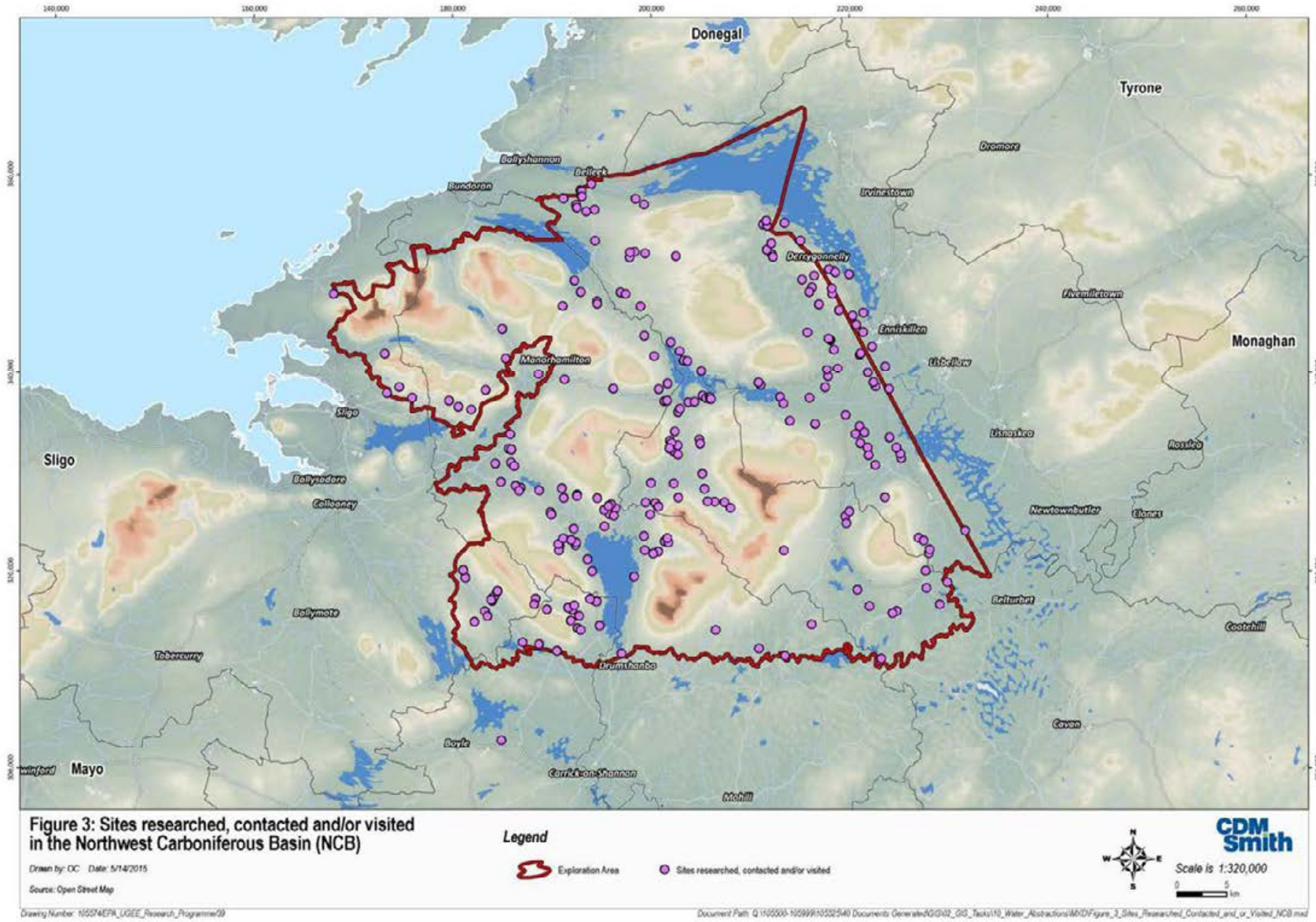

Figure G.3. Sites researched, contacted and/or visited in the Northwest Carboniferous Basin.

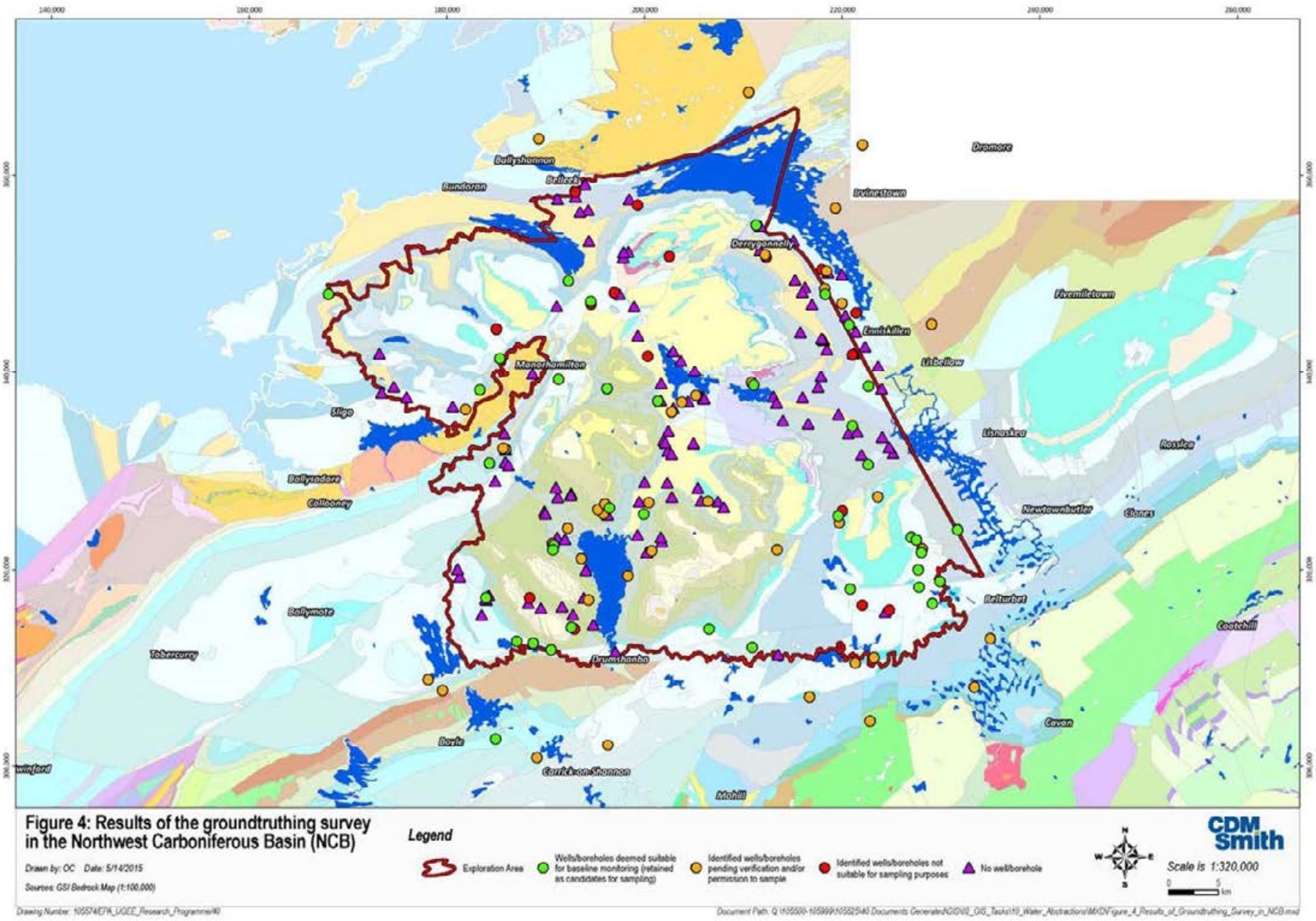

Figure G.4. Results of the groundtruthing survey in the Northwest Carboniferous Basin.

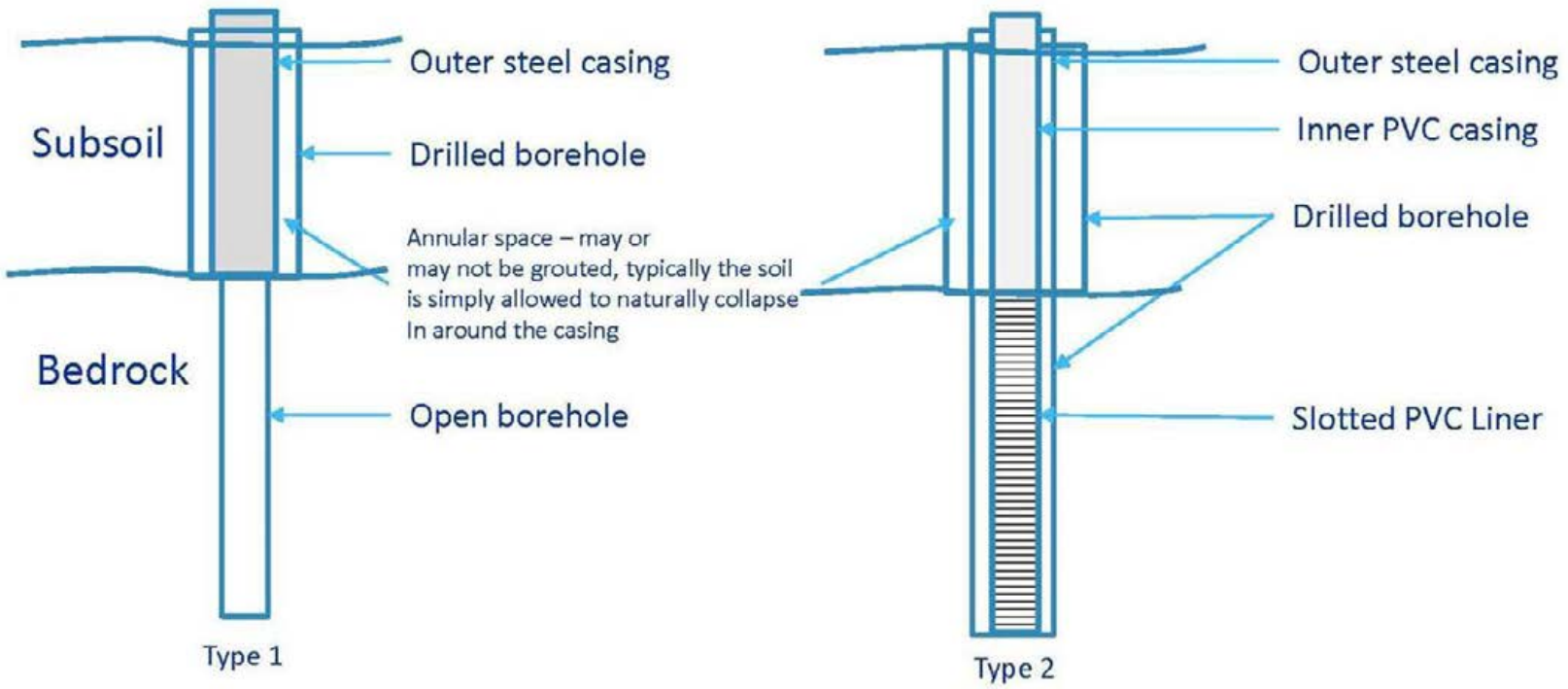

Figure G.5. Typical construction of private well.

Annexes

Annex 1: Summary of Abstraction Survey Results – CB

Annex 2: Summary of Abstraction Survey Results – NCB

Annex 3: Photographs of Springs Visited

Annex 4: Spring Survey Results

Annex 1. Summary of Abstraction Survey Results – CB

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
1	72690.90	147905.86	Y	Y, minor works	Y	Y		Dairy farm. Well is away from main farm buildings, in back yard of farmer's house. Neighbour's well is a preferred option, but owner not at home at time of visit.	Wellhead protection, surface drainage, sample tap on HDPE discharge line in shed
2	78697.20	149022.14	Y	Y, minor works	Y	Possibly		Dairy farm. Site cluttered, with fertilizer bags and poorly maintained equipment surrounding well. Would prefer to use a different well in same area.	Wellhead protection, sample tap on HDPE discharge line in shed
3	87996.21	156383.78	Y	Y, minor works	Y	Y		Dairy farm. Well is located in field used by horses. Well is in below-ground chamber with steel plate covers.	Sample tap on HDPE discharge line in shed, fence around well in field
4	105362.97	159195.49	Y	Y, minor works	Y	Y		Well has "low yield" (unspecified, to be verified).	Sample tap, concrete wellhead protection, bollards, extend HDPE pipe carrying wastewater effluent further away from well
5	112672.55	163927.55	Y	To be verified. Investigative work required	Y	Y		Old Lacken PWS. Video log and total depth measurement would have to be carried out to examine integerity of well which has not been operational since approx. 1990.	Investigation and potential rehabilitation required
6	115608.18	165750.96	Y	Y	Y	Y		Back-up well. Also known as 'Frure 3' or 'Johnny Kelly's well'. Old but equipped with pump. Is less likely to be used in future, as GWS has plans to use lake water to supplement Lissacasey 1. Engineered to pump straight into mains.	None
7	118417.79	165604.95	Y	Y	Y	Y		New supply well drilled in 2014. "High yield" (est. 70 m3/hr). Also known as 'Frure 2' ('Frure 1' being the old supply well at the same site, which is equipped for pumping) or 'Martin Kelly's well'. Pumps to main reservoir. Supervised by EPS and IE Consulting. Borehole log was received.	None
8	117049.48	170184.93	Y	Y	Y	Y		Trial well - Kilmaley-Inagh GWS. C.110 m deep. Tested by Minerex. Test report was received.	Minor fence or bollards around wellhead. Willl require lowering of pump

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
9	117507.57	170361.97	Y	Y	Y	Y		Trial well - Kilmaley-Inagh GWS. C. 110 m deep. Tested by Minerex. Test report was received.	Minor fence or bollards around wellhead. Will require lowering of pump
10	83257.19	151594.72	Y	Y	Y	Y		Caravan site. Well is below ground in parking area. Pump operates on demand, can pump >400 m3/d during summer. Submersible pump was installed with 20 pieces of 18 ft long steel discharge pipe - i.e. 360 ft pump setting.	Exclude parking on top of well access lid
11	113117.00	146507.00	Y	Y	Y	Y		Already part of EPA's national groundwater monitoring network.	None
12	73115.99	147951.87	Y	Y	Y	Y		Dairy farm. Well drilled in 2014, apparently artesian. Owner was not home at time of visit but found the borehole and took photos. Would prefer to use neighbour's well as priority.	Sample tap, concrete wellhead protection
13	92346.15	157984.15	Y	Y	Y	Y		Dairy farm. 380 ft deep. 6-inch steel, 4-inch PVC liner with vertical slots. "Great water" according to owner.	Sample tap on HDPE discharge line above ground near bridge crossing
14	92627.21	159163.41	Y	Y	Y	Y		Pub and B&B. TJ Cross drillers indicated they drilled a high-yielding well for a pub/hotel between Kilkee and Moyasta. From observation, this must be the referenced well. Reportedly approx. 200 ft deep. Was not working at time of visit - maintenance issue with filtration unit (clogged).	Sample tap on HDPE discharge line in shed
15	88524.00	160746.00	Y	Y	Y	Y		Well is used for irrigation and cleaning purposes only. Approximately 120 ft deep with iron and manganese problem. Submersible pump is activated on opening valve. Very high pressure. 8-inch steel casing and 5-inch PVC slotted liner to 120 ft.	Sample tap on HDPE discharge line above ground (note very high water pressure when submersible pump is on)
16	99434.00	155516.00	Y	To be verified. Investigative work required	Y	Y		Located outside the museum of Irish rural life (formerly the Kilrush creamery). Well has been covered up with flagstone and rubble on top, but is reportedly in good condition.	Investigation and potential rehabilitation required

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
17	79694.00	150041.00	Y	To be verified. Investigative work required	Y	Y		Well in poor shape but usable. Reportedly c. 300 ft deep, and artesian in winter.	Investigation and potential rehabilitation required
18	88679.00	160021.00	Y	Y	Y	Y		Enclosed in main building. 120 ft deep. Has never gone saline. Used for all hotel purposes.	Sample tap
19	92616.00	163846.00	N	Y	Y	Y		Domestic well, but owner also has a deeper and larger yielding well at a farm c. 6 kms to the N towards Doonbeg. This will require a follow up visit.	Sample tap
20	102968.00	155196.00	Y	Y	Y	Y			Sample tap, reinforce wellhead chamber
21	100791.00	172561.00	Y	Y	Y	Y		Well is in below ground vault in field, and covered over by steel plates	Sample tap, fencing around vault in field
22	103120.00	172835.00	Y	Y	Y	Y		150 ft well, poor wellhead construction	Sample tap, wellhead reinforcement
23	104728.00	163739.00	Y	To be verified	Y	Y		Wellhead not accessible, below ground, within asphalted section of farmyard. No information on well depth - well is accessible for project but will probably not be selected for sampling	Sample tap on HDPE discharge line
24	88848.40	153225.11	Y	Y	To be followed up	Y		Caravan site. Met a person supervising expansion works of campgrounds. Expecting to hear back on approval to sample.	Sample tap, concrete wellhead protection
25	103572.61	151605.85	N	To be verified	Y	Possibly		Site has monitoring wells, but are shallow and small diameter. Probably not suited for UGEE but will be considered as a reserve. Also, further research is required on two wells drilled in 1980s by K. Cullen - reportedly used for water supply initially.	Not yet defined
26	80855.67	149310.22	Y	To be verified	To be followed up	Y		Horse farm. No one home at time of visit. Will require follow-up visit	Not yet defined

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
27	99872.79	156093.79	Possibly	To be verified	To be followed up	Y		Well may have been found in field, but will require visit with someone from county council. A well appears to exist in a concrete chamber along the main road by the Kilrush industrial estate, and chamber is located with keypad. Well was reportedly put out of commission sometime in the 1990s.	Not yet defined
28	108329.61	161846.08	Y	To be verified	To be followed up	Y		Dairy farm. Not at home at time of visits. Reportedly a "high yield" well nearby. Follow up visit is needed.	Not yet defined
29	109572.85	171097.08	Y	Unlikely, investigative work required	To be followed up	Y		Gas exploration well. Still in existence though covered by rocks and dirt. Condition of well must be investigated prior to use.	Investigation and potential rehabilitation required
30	96357.01	163819.43	Y	To be verified. Investigative work required	To be followed up	Y		Gas exploration well. Still in existence but condition of well must be investigated prior to use.	Investigation and potential rehabilitation required
31	97095.16	165484.79	N	To be verified	To be followed up	Y		Tried to establish contact and have left contact details. Awaiting call-back. Well is visible from main road.	Not yet defined
32	96987.14	165096.71	N	To be verified	To be followed up	Y		Tried to establish contact. Awaiting call-back.	Not yet defined
33	98699.51	166880.10	Y	To be verified	To be followed up	Y		Have written and spoken with attendant of site, who is trying to chase down an answer. A drilled trial well is visible on the road to the hotel. Photograph e-mailed to attendant.	Not yet defined
34	98699.51	166868.10	Y	To be verified	To be followed up	Y		A second well is visible on the same access road, a few metres away, but could be a shallow dug well.	Not yet defined
35	102095.23	173934.64	N	To be verified	To be followed up	Y		Tried to establish contact. Awaiting call-back.	Not yet defined

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
36	118762.85	167510.36	N	To be verified	To be followed up	Y		Have written and left numerous messages. Awaiting call-back. Reportedly 3 active wells at site.	Not yet defined
37	111110.00	163970.00	Y	To be verified	To be followed up	Y		Awaiting call back.	Not yet defined
38	103610.59	161544.99	N	To be verified	To be followed up	Y		Tried to establish contact. Awaiting call-back. Reports of well to 700 ft" but "dry".	Not yet defined
39	104475.00	151763.00	Y	To be verified	To be followed up	Y		Informed by neighbouring farm that supply well exists for farm. No one at home at time of visit (x2)	Not yet defined
40	106067.00	153668.00	Y	Y	Y	Y		Dairy farm, approx. 30 cattle. Well is reportedly 120 ft deep. Backup well in case others in area are not found.	Sample tap on HDPE discharge line above ground
41	103624.00	156085.00	Y	To be verified	To be followed up	Y		Not home at time of visit. Saw well - new, with well constructed wellhead.	Not yet defined
42	102586.00	157698.00	Y	To be verified	To be followed up	Y		Well located in shed in field across road from cattle farm. Reportedly 160 ft deep. Well is no longer in use, but accessible. Could not inspect well at time of visit . Will require field visit on another occasion.	Existing submersible pump will have to be removed as it is not functional and has been idle for many years
43	112404.00	150963.00	Y	To be verified	To be followed up	Y		Not home at time of visit. Left contact details with family member.	Not yet defined
44	109594.00	174094.00	N	To be verified	To be followed up	Y		No well onsite, but reports of nearby well which may be usable - requires visit.	Not yet defined
45	102854.00	172489.00	Y	To be verified	To be followed up	Y		Not possible to inspect at time of visit.	Not yet defined

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
46	93660.00	164646.00	Y	Possibly	Y	Y		Large cattle farm. There are two candidate wells - one on the farm visited, and the other on farmland near White Strand. The well on the farm visited is only approx. 40 ft deep, and was reportedly just drilled into bedrock, where sufficient water was developed for demands of farm - possibly a transition zone well beneath deep till. The second well is approx. 300 ft deep, but needs to be visited.	Not yet defined
47	93259.00	164613.00	Y	To be verified	To be followed up	Y		A 400 ft well was drilled very recently with good yield. House-sitter will contact owners for permission to inspect/sample. Left contact details with house-sitter, and will require follow up in person.	Not yet defined
48			N	To be verified	To be followed up	Y		Abandoned facility for sale . Apparent well is visible at back of building.	Not yet defined
49	91148.90	153705.23	N	To be verified	To be followed up	Y		Dairy farm. Reportedly has well/borehole.	Not yet defined
50	91538.97	162768.17	Y	To be verified	To be followed up	Y		Large dairy farm. No one home except a very old man with poor hearing. We were unable to communicate. Left contact details and am awaiting call-back. Will probably have to re-visit.	Not yet defined
51	105716.00	154383.00	Y	To be verified	To be followed up	Y		Not home at time of visit	Not yet defined
52	106753.00	153719.00	Y	To be verified	To be followed up	Y		Not home at time of visit	Not yet defined
53	101546.00	156005.00	Y	To be verified	To be followed up	Y		Not home at time of visit	Not yet defined
54	103294.00	155429.00	Y	To be verified	To be	Y		Not home at time of visit	Not yet defined

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
					follow ed up				
55	109460.00	158850.00	Y	To be verified	To be follow ed up	Y			Not yet defined
56	114894.00	155429.00	Y	To be verified	To be follow ed up	Y		Not home at time of visit	Not yet defined
57	104385.00	174433.00	Y	To be verified	To be follow ed up	Y		No one at home at time of visit	Not yet defined
58	109945.00	161750.00	Y	To be verified	To be follow ed up	Y		No one at home at time of visit	Not yet defined
59	101762.00	164134.00	Y	To be verified	To be follow ed up	Y		No one at home at time of visit	Not yet defined
60	98810.56	155792.72	Y	To be verified	To be follow ed up	N		Met facility caretaker who did not want to show well without manager's permission. Have tried to contact manager on several occasions, and am awaiting call-back. Facility caretaker has passed on messages, and has indicated that manager/owner is probably not interested in participating.	Not yet defined
61	89037.00	159750.00	N	To be verified	To be follow ed up	N		Seasonal hotel. Opens May 1.	–
62	83395.23	150304.45	Y	N	N	N		Shallow dug well, actively used	–
63	88335.29	155509.59	Y	N	Y	N		Shallow dug well, not used in 20 years. Was in 2009 abstractions registry.	–
64	109766.92	161433.00	Y	N	Y	N		Shallow (6 m) dug well.	–
65	111054.00	151615.00	Y	N	Y	N		Shallow dug well	–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
66	103502.00	167151.00	Y	N	n/a	N		Old well covered over with steel plate and asphalt, located near main intersection in Creegh. Used to serve as water supply for Creegh more than 25 years ago.	–
67	88646.00	160470.00	N	To be verified	To be followed up	N		Idle hotel for sale. Not known if hotel has its own water well. Requirs follow up.	–
68	103204.00	172628.00	Y	N	Y	N		Shallow dug well	–
69	91594.99	157678.08	Y	N	Y	N		Large dairy farm. PWS mains and shallow dug well.	–
70	109237.79	167518.31	Y	N	Y	N		Dairy farm. Met farmer at gate. PWS mains and shallow dug well.	–
71	111458.00	158215.00	Y	N	Y	N		c. 100 ft deep. Wellhead uncapped and flush with ground, casing damaged.	–
72	114779.00	153456.00	Y	N	Y	N		Shallow (13 ft) dug well	–
73	114394.00	153376.00	Y	N	Y	N		Old well, c. 100 ft deep	–
74	103789.00	177170.00	N	No well/borehole	n/a	N			–
75	105281.00	178860.00	N	No well/borehole	n/a	N		Mains water only	–
76	99810.00	155865.00	N	No well/borehole	n/a	N		Mains water only	–
77	100375.00	154900.00	N	No well/borehole	n/a	N		Mains water and onsite spring. Clare Co Co test pumped spring at 36 m3 over an 8 hr period.	–
78	79514.38	150790.52	Y	No well/borehole	n/a	N		Mains water only	–
79	100829.00	156172.82	Y	No well/borehole	n/a	N		Believed to be main water only.	–
80	111962.39	163392.44	Y	No	n/a	N			–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
				well/borehole					
81	103800.59	177232.36	N	No well/borehole	n/a	N		Mains water only	–
82	99807.78	155798.73	Y	No well/borehole	n/a	N		Mains water only. IPPC licence	–
83	76667.53	150810.00	Y	No well/borehole	n/a	N		Dairy farm. Mains water only.	–
84	82355.99	156007.66	Y	No well/borehole	n/a	N		Inactive quarry.	–
85	88729.36	160344.63	N	No well/borehole	n/a	N		Mains water only	–
86	99162.64	154399.42	Y	No well/borehole	n/a	N		Mains water only. The site is in the 2009 abstraction registry, but no one at site knows about a well.	–
87	100110.84	158113.23	Y	No well/borehole	n/a	N		Inactive quarry. Storage site for asbestos with warning signs posted.	–
88	101180.07	157400.08	Y	No well/borehole	n/a	N		Inactive quarry now used for stone cutting business. Water used is derived from standing water (groundwater) in open quarry pit. Asbestos with warning signs is stored along entrance road.	–
89	104213.72	162390.17	Y	No well/borehole	n/a	N		Well is in 2009 abstractions registry. Derelict site. Well was not found at time of visit, and no one who was asked know of its existence.	–
90	104560.79	162848.27	Y	No well/borehole	n/a	N		Inactive quarry.	–
91	101788.19	160685.79	Y	No well/borehole	n/a	N		Large dairy farm. Mains water only.	–
92	110656.11	164145.59	Y	No well/borehole	n/a	N		Mains water only	–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
93	110673.11	164155.59	Y	No well/borehole	n/a	N		Mains water only	–
94	95101.73	165472.78	Y	No well/borehole	n/a	N		Active site. No well/borehole. No mains water either. Water is pumped from an open pool in quarry (groundwater) Only an equipment maintenance person was at site - indicated he did not have name or contact details for owner.	–
95	85342.63	158204.15	Y	No well/borehole	n/a	N		Inactive quarry. No well/borehole visible.	–
96	103722.57	177238.36	Y	No well/borehole	n/a	N		Mains water only	–
97	103728.57	177580.44	N	No well/borehole	n/a	N		Mains water only	–
98	112153.40	175637.07	Y	No well/borehole	n/a	N		Mains water only	–
99	102984.43	171281.08	Y	No well/borehole	n/a	N		Mains water only	–
100	123419.88	162054.21	Y	No well/borehole	n/a	N		Mains water only	–
101	113382.72	157016.07	Y	No well/borehole	n/a	N		Mains water only	–
102	105807.08	157005.02	Y	No well/borehole	n/a	N		Mains water only	–
103	109009.00	181050.00	N	No well/borehole	n/a	N		Mains water only	–
104	78000.00	148889.00	Y	No well/borehole	n/a	N		Mains water only	–
105	105881.00	153846.00	Y	No well/borehole	n/a	N		Mains water only	–
106	113287.00	156843.00	Y	No	n/a	N		Mains water only	–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
				well/borehole					
107	115609.00	154866.00	Y	No well/borehole	n/a	N		Mains water only	–
108	115043.00	175170.00	Y	No well/borehole	n/a	N		Mains water only	–
109	114124.00	174839.00	Y	No well/borehole	n/a	N		Mains water only	–
110	101912.00	173041.00	Y	No well/borehole	n/a	N		Mains water only	–
111	105917.00	169696.00	Y	No well/borehole	n/a	N		Mains water only	–
112	109145.76	171074.07	Y	No well/borehole	n/a	N		Dairy farm. Mains water only	–
113	96597.06	164608.60	Y	No well/borehole	n/a	N		Small farm. Mains water only	–
114	79000.27	150462.45	Y	No well/borehole	n/a	N		Mains water only	–
115	90826.82	158004.15	Y	No well/borehole	n/a	N		Horse farm. Mains water only	–
116	100852.00	153575.00	Y	No well/borehole	n/a	N		Mains water only	–
117	101559.00	152360.00	Y	No well/borehole	n/a	N		Mains water only	–
118	105411.00	153630.00	Y	No well/borehole	n/a	N		Mains water only	–
119	104742.00	155446.00	Y	No well/borehole	n/a	N		Mains water only	–
120	104382.00	155929.00	Y	No	n/a	N		Mains water only	–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
				well/borehole					
121	105191.00	156542.00	Y	No well/borehole	n/a	N		Mains water only	–
122	109401.00	158773.00	Y	No well/borehole	n/a	N		Mains water only	–
123	111678.00	158579.00	Y	No well/borehole	n/a	N		Mains water only	–
124	112705.00	151128.00	Y	No well/borehole	n/a	N		Mains water only	–
125	112218.00	150294.00	Y	No well/borehole	n/a	N		Mains water only	–
126	111808.00	152110.00	Y	No well/borehole	n/a	N		Mains water only	–
127	112612.00	152085.00	Y	No well/borehole	n/a	N		Mains water only	–
128	106858.00	175254.00	Y	No well/borehole	n/a	N		Mains water only	–
129	106621.00	175218.00	Y	No well/borehole	n/a	N		Mains water only	–
130	108485.00	175073.00	Y	No well/borehole	n/a	N		Mains water only	–
131	107278.00	174378.00	Y	No well/borehole	n/a	N		Mains water only	–
132	106003.00	174552.00	Y	No well/borehole	n/a	N		Mains water only	–
133	105839.00	174471.00	Y	No well/borehole	n/a	N		Mains water only	–
134	102908.00	169724.00	Y	No	n/a	N		Mains water only	–

Site	Approx. Easting	Approx. Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
				well/borehole					
135	105725.00	171056.00	Y	No well/borehole	n/a	N		Mains water only	–
136	106210.00	170320.00	Y	No well/borehole	n/a	N		Mains water only	–
137	105604.00	163546.00	Y	No well/borehole	n/a	N		Mains water only	–
138	103756.00	161837.00	Y	No well/borehole	n/a	N		Mains water only	–
139	101772.00	165606.00	Y	No well/borehole	n/a	N		Mains water only	–

Annex 2. Summary of Abstraction Survey Results – NCB

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
1	227770	318229	Y	Y	Y	Y		One borehole - currently sampled annually	–
2	220809	318039	Y	Y	Y	Y		Part of the EPA's groundwater monitoring network (see epa site folder)	–
3	231674	324047	Y	Y	Y	Y		One borehole used for cattle. Former piggery.	Fix leak in surface water pipe/install raw water sampling tap
4	226999	323267	Y	Y	Y	Y		2 abstraction boreholes and one water level monitoring well	Install raw water sampling tap
5	229129	316590	Y	Y	Y	Y		Three boreholes on site	Install raw water sampling tap (TBC)
6	206537	313987	Y	Y	Y	Y		Water in above-ground chambers	Construct adequate surface water drainage
7	194558	347211	Y	Y	Y	Y		1 house on scheme/ raw sampling tap = kitchen tap.	Install raw water sampling tap
8	185374	341427	Y	Y	Y	Y		One borehole located in quarry yard	Construct adequate surface water drainage/ Install raw water sampling tap & well cap
9	196217	338315	Y	Y	Y	Y		Artesian borehole used for stone washing. High levels of sulphur	Install raw water sampling tap
10	192296	349278	Y	Y	Y	Y		One borehole. Unable to survey sampling tap at time of visit	Verify presence of raw water sampling tap
11	191307	339272	Y	Y	Y	Y		No pump installed - plans to install pump in 2015/2016	Assess well integrity/ Discuss future pumping arrangments
12	188723	312541	Y	Y	Y	Y		One borehole supplying large hotel	Install raw water sampling tap
13	187068	312722	Y	Y	Y	Y		Currently being upgraded (new borehole)	–
14	184939	302850	Y	Y	Y	Y		Three boreholes on site	–
15	192609	314178	Y	Y	Y	Y		Obsolete in May 2015.	Discuss future access and pumping arrangements with Local Authority/ Install well cap

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
16	190551	311856	Y	Y	Y	Y		Obsolete in May 2015 (Part of the EPA's groundwater monitoring network)	Discuss future access and pumping arrangements with Local Authority
17	168008	347932	Y	Y	Y	Y		One borehole - recently drilled	Install raw water sampling tap
18	227683	319966	Y	Y	Y	Y		Two abstraction boreholes. No raw water sampling tap	Install raw water sampling tap/ verify borehole details
19	227515	322992	Y	Y	Y	Y		No raw water sampling tap	Install raw water sampling tap
20	228012	321739	Y	Y	Y	Y		Abstraction borehole and monitoring boreholes	Install raw water sampling tap/ Assess borehole integrity
21	219599	325435	Y	Y	Y	Y		One borehole located in farmyard - possiblity of animals/machinery in close proximity to well cover	Possibly construct superior wellhead protection (TBC)
22	222625	330655	Y	Y	Y	Y		One borehole supplying farm and house	–
23	222660	338549	Y	Y	Y	Y		One borehole located on hill above farmyard - Well head not covered	Install well cap
24	221038	334511	Y	Y	Y	Y		Confussion over raw tap (before/after filtration)	Verify presence of raw water sampling tap
25	218301	347949	Y	Y	Y	Y		One borehole supplying farm and house - well head not covered	Install well cap
26	220700	344852	Y	Y	Y	Y		9 monitoring wells. Landfill/quarry. Pump set up in one borehole down gradient of landfill.	–
27	229878	318801	Y	Y	Y	Y		2 boreholes. Located very close to lake.	Assess influence of adjacent lake
28	211053	338703	Y	Y	Y	Y		One recently drilled borehole	Verify presence of raw water sampling tap
29	201360	337047	Y	Y	Y	Y		One borehole supplying house - no raw water sampling tap	Install raw water sampling tap
30	183956	317164	Y	Y	Y	Y		Wellhead uncovered. Raw tap = kitchen tap.	Install well cap
31	190805	322447	Y	Y	Y	Y		Raw tap = kitchen tap	–
32	190726	322010	Y	Y	Y	Y		Unable to survey wellhead. No raw sampling tap	Install raw water sampling tap

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
33	184296	330779	Y	Y	Y	Y		One borehole supplying house	–
34	199927	325636	Y	Y	Y	Y		One borehole supplying house - no raw water sampling tap	Install raw water sampling tap
35	196437	326252	Y	Y	Y	Y		Pump due to be connected to power in the coming months	Verify that pump is connected to power prior to sampling.
36	211314	354928	Y	Y (TBC)	Y	Y		2 boreholes supplying large farm - possibility of animals/machinery in close proximity of well cover	–
37	210884	312110	Y	Y (TBC)	Y	Y		One borehole used for clubhouse only - possible surface water issue	Construct alternative well cap
38	183344	338169	Y	Y (TBC)	Y	Y		Not currently in use - should be connected in a few months.	Confirm borehole/pump are operating
39	177147	315569	Y	Y(TBC)	Y	Y		Two backup boreholes	Not yet defined
40	213419	221990	Y	TBC	Y	Y		2 boreholes - not in operation	Assess whether pumps are still operational/remove pumps.
41	223220	311109	Y	TBC	Y	Y		Possible surface water issue	Confirm adequate surface water drainage (In progress)
42	210846	338952	Y	TBC	TBC	Y		Security clearance required	Confirm permission to sample/survey additional wells (In progress)/Install well cap
43	198313	319363	Y	TBC	Y	Y		Drilled for geothermal - no pump. In close proximity to Lough Allen.	Assess well integrity (bottom of well has collapsed) & influence of surface water. Possible rehabilitation work required.
44	205197	337602	Y	TBC	TBC	Y		Unable to gain access (approval to survey granted subsequently)	–
45	228100	322100	Y	TBC	TBC	TBC		Unable to gain access or get contact details.	–
46	219703	324772	Y	TBC	Y	Y		Several monitoring wells and abstraction borehole (not suitable for sampling)	Assess suitability for pumping
47	223597	327374	Y	TBC	Y	Y		No raw sampling tap - two boreholes on site	Install raw water sampling tap/ Assess

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
									borehole integrity
48	218419	350304	Y	TBC	TBC	Y		Redundant borehole - according to local woman it belongs to the forestry service.	Assess well integrity/ Make contact with relavent owner. Possible rehabilitation works required.
49	218239	348518	Y	TBC	TBC	Y		Water pooled in below ground chamber	Investigate source of water ponding/verify borehole details
50	206432	326932	Y	TBC	TBC	Y		Former exploration well - unable to gain access. Located in county council yard.	Assess well integrity/suitability for sampling. Possible rehabilitation work required.
51	202749	335932	Y	TBC	Y	Y		Unable to survey wellhead at time of survey	Survey wellhead to assess suitability for sampling
52	193606	321096	Y	TBC	Y (TBC)	Y		Borehole and pump no longer in use - unable to survey wellhead during visit.	Assess suitability for sampling/ survey wellhead
53	192235	324206	Y	TBC	Y (TBC)	Y		Redundant borehole located at rear of empty house.	Assess well integrity/suitability for sampling. Possible rehabilitation work required.
54	195839	325654	Y	TBC	Y	TBC		Borehole and pump no longer in use. Pump is not currently connected to power.	Assess suitability for sampling
55	185946	332178	Y	TBC	Y	Y		Rusted outter casing above ground	Assess borehole integrity
56	190672	322645	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
57	194338	316920	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
58	203767	336934	Y	TBC	TBC	TBC		Possible redundant well on farm - owner wasn't available during survey	Not yet defined
59	200430	326796	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
60	195277	326080	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
61	195997	326651	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
62	185685	332273	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
63	181894	336213	Y	TBC	TBC	TBC		Deliberating on decision to allow survey/sampling	Not yet defined
64	200742	321898	Y	TBC	TBC	TBC		Unable to gain access to possible borehole	Not yet defined
65	212197	351907	Y	TBC	TBC	TBC		Deliberating on decision to allow survey/sampling	Not yet defined
66	189289	363667	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
67	210536	368359	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
68	222052	363023	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
69	219320	356660	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
70	229057	344897	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
71	234990	313000	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
72	233400	308100	N	TBC	TBC	Y		Located in the study buffer zone (may no longer exist)	Not yet defined
73	221319	310535	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
74	222822	304662	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
75	216700	307100	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
76	196300	302200	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
77	189103	300887	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
78	179575	307736	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
79	178107	308863	N	TBC	TBC	Y		Located in the study buffer zone	Not yet defined
80	322028	316404	Y	N	Y	N		Surface water flooding chamber/borehole	–
81	224772	315902	Y	N	Y	N		Shallow dug well supplying one house	–
82	221422	346029	Y	N	Y	N		Shallow dug well supplying one farm/business	–
83	217934	350418	Y	N	N	Y		No cooperation at present	Further engagement necessary
84	212291	351666	N	N	N/A	N		Unable to locate site	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
85	185010	344407	Y	N	TBC	N		Surface water draining into borehole	–
86	192935	313972	Y	N	Y	N		Possible surface water issue/contamination	–
87	219988	325954	Y	N	TBC	N		Surace water ponding around borehole	–
88	221026	341810	Y	N	Y	N		Spring well - dug with digger	–
89	196950	348100	Y	N	N/A	N		Former exploration well - Cemented over	–
90	202526	351762	Y	N	N/A	N		Former exploration well - no longer exists	–
91	199296	356963	Y	N	Y	N		Spring well - dug with digger	–
92	193005	358289	Y	N	Y	N		Spring well - dug with digger	–
93	194570	346935	Y	N	Y	N		No opportunity to install raw water sampling tap	–
94	200326	341680	Y	N	N/A	N		Former exploration well - no longer exists	–
95	188370	317158	Y	N	Y	N		Surface water flowing into borehole	–
96	202928	336281	Y	N/A	N	N		Permission to survey/sample denied	–
97	220615	333733	Y	N/A	N/A	N		Farmyard - no borehole	–
98	221102	332824	Y	N/A	N/A	N		Farmyard - nobody home	–
99	221840	332393	Y	N/A	N/A	N		Farmyard - nobody home	–
100	221959	331617	Y	N/A	N/A	N		Farmyard - no borehole	–
101	225242	331336	Y	N/A	N/A	N		Farmyard - nobody home	–
102	225157	331793	Y	N/A	N/A	N		Farmyard - no borehole	–
103	224071	333375	Y	N/A	N/A	N		Farmyard - no borehole	–
104	224000	338275	Y	N/A	N/A	N		Farmyard - no borehole	–
105	223630	340614	Y	N/A	N/A	N		Farmyard - no borehole	–
106	222292	342637	Y	N/A	N/A	N		Quarry - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
107	222431	338978	Y	N/A	N/A	N		Farmyard - nobody home	–
108	219632	335664	Y	N/A	N/A	N		Farmyard - no borehole	–
109	218846	340414	Y	N/A	N/A	N		Farmyard - nobody home	–
110	221149	341955	Y	N/A	N/A	N		Golf Course - reopening in May 2015	–
111	221391	344109	Y	N/A	N/A	N		Farmyard - no borehole	–
112	220325	345728	Y	N/A	N/A	N		Nursery home - no borehole	–
113	218979	346276	Y	N/A	N/A	N		Farmyard - nobody home	–
114	216949	346889	Y	N/A	N/A	N		B&B - no borehole	–
115	216450	349769	Y	N/A	N/A	N		Castle/est., nobody home	–
116	215221	349378	Y	N/A	N/A	N		Farmyard - no borehole	–
117	211685	352381	Y	N/A	N/A	N		Garage - no borehole	–
118	212134	353044	Y	N/A	N/A	N		Large farmyard - nobody home	–
119	211698	354810	Y	N/A	N/A	N		Farmyard - no borehole	–
120	211638	355321	Y	N/A	N/A	N		Farmyard - nobody home	–
121	213460	355085	Y	N/A	N/A	N		Farmyard - nobody home	–
122	215070	353323	Y	N/A	N/A	N		Farmyard - no borehole	–
123	218599	350097	Y	N/A	N/A	N		Farmyard - no borehole	–
124	219967	349921	Y	N/A	N/A	N		Hotel - no borehole	–
125	218454	342338	Y	N/A	N/A	N		Farmyard - no borehole	–
126	218139	343270	Y	N/A	N/A	N		Farmyard - no borehole	–
127	218033	343385	Y	N/A	N/A	N		House - no borehole	–
128	217902	343424	Y	N/A	N/A	N		House - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
129	215780	344056	Y	N/A	N/A	N		Farmyard - no borehole	–
130	216220	348620	Y	N/A	N/A	N		Farmyard - no borehole	–
131	215957	348114	Y	N/A	N/A	N		Farmyard - no borehole	–
132	221873	340003	Y	N/A	N/A	N		House - nobody home	–
133	221517	333911	Y	N/A	N/A	N		Farmyard - no borehole	–
134	224743	332393	Y	N/A	N/A	N		FY - no borehole, attempted drilling in the past (dry)	–
135	216566	334730	Y	N/A	N/A	N		Farmyard - no borehole	–
136	214011	335068	Y	N/A	N/A	N		Farmyard - no borehole	–
137	213028	337488	Y	N/A	N/A	N		Farmyard - no borehole	–
138	213366	336835	Y	N/A	N/A	N		Farmyard - no borehole	–
139	216000	337390	Y	N/A	N/A	N		Farmyard - no borehole	–
140	217562	338454	Y	N/A	N/A	N		Farmyard - no borehole	–
141	217846	339564	Y	N/A	N/A	N		Farmyard - no borehole	–
142	217763	340260	Y	N/A	N/A	N		Farmyard - nobody home	–
143	205072	340125	Y	N/A	N/A	N		Farmyard - no borehole	–
144	203299	341248	Y	N/A	N/A	N		Farmyard - nobody home	–
145	203692	341191	Y	N/A	N/A	N		House - no borehole	–
146	202016	343092	Y	N/A	N/A	N		House - nobody home	–
147	202898	342157	Y	N/A	N/A	N		Farmyard - no borehole	–
148	198933	346698	Y	N/A	N/A	N		Farmyard - no borehole	–
149	197448	347929	Y	N/A	N/A	N		Farmyard - no borehole	–
150	197852	351635	Y	N/A	N/A	N		Farmyard - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
151	199400	352026	Y	N/A	N/A	N		Farmyard - nobody home	–
152	198363	352187	Y	N/A	N/A	N		Mass rock/spring well. Not suitable.	–
153	197897	352135	Y	N/A	N/A	N		Farmyard - no borehole	–
154	194351	353305	Y	N/A	N/A	N		Farmyard - no borehole	–
155	194309	356446	Y	N/A	N/A	N		Primary school - no borehole	–
156	198460	357540	Y	N/A	N/A	N		Farmyard - no borehole	–
157	193975	359008	Y	N/A	N/A	N		Pottery - no borehole	–
158	191180	357551	Y	N/A	N/A	N		Farmyard - no borehole	–
159	193038	357784	Y	N/A	N/A	N		Insulation facility - no borehole	–
160	192479	356942	Y	N/A	N/A	N		Farmyard - nobody home	–
161	192512	356624	Y	N/A	N/A	N		Farmyard - nobody home	–
162	193460	356248	Y	N/A	N/A	N		House - no borehole	–
163	192928	348134	Y	N/A	N/A	N		Primary school, nobody available to discuss	–
164	194574	346922	Y	N/A	N/A	N		FY/hse - nobody home	–
165	199330	343724	Y	N/A	N/A	N		Farmyard - no borehole	–
166	200794	338254	Y	N/A	N/A	N		Farmyard - nobody home	–
167	201675	338818	Y	N/A	N/A	N		Farmyard - no borehole	–
168	205559	337372	Y	N/A	N/A	N		Primary school, nobody available to discuss	–
169	205904	337473	Y	N/A	N/A	N		Farmyard - no borehole	–
170	205964	337269	Y	N/A	N/A	N		House - no borehole	–
171	206046	337246	Y	N/A	N/A	N		House - no borehole	–
172	204866	333205	Y	N/A	N/A	N		House - nobody home	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
173	204957	332749	Y	N/A	N/A	N		House - no borehole	–
174	205172	329752	Y	N/A	N/A	N		House - nobody home	–
175	205399	328245	Y	N/A	N/A	N		Farmyard - no borehole	–
176	207431	326890	Y	N/A	N/A	N		House - no borehole	–
177	208012	326315	Y	N/A	N/A	N		Farmyard - no borehole	–
178	205730	326954	Y	N/A	N/A	N		House - no borehole	–
179	202763	327345	Y	N/A	N/A	N		House - no borehole	–
180	202298	328774	Y	N/A	N/A	N		House - no borehole	–
181	200430	326797	Y	N/A	N/A	N		House - nobody home	–
182	200763	326452	Y	N/A	N/A	N		Farmyard - nobody home	–
183	199465	326843	Y	N/A	N/A	N		Garage - no borehole	–
184	200007	328840	Y	N/A	N/A	N		House - no borehole	–
185	202369	331993	Y	N/A	N/A	N		House - no borehole	–
186	202732	331676	Y	N/A	N/A	N		Farmyard - no borehole	–
187	202698	332604	Y	N/A	N/A	N		House - nobody home	–
188	204380	336989	Y	N/A	N/A	N		Farmyard - no borehole	–
189	202409	333986	Y	N/A	N/A	N		House - no borehole	–
190	201913	333055	Y	N/A	N/A	N		Farmyard - no borehole	–
191	202095	332806	Y	N/A	N/A	N		Farmyard - no borehole	–
192	201860	332293	Y	N/A	N/A	N		House - nobody home	–
193	183989	316898	Y	N/A	N/A	N		Primary school - no borehole	–
194	184228	317381	Y	N/A	N/A	N		House - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
195	184459	317830	Y	N/A	N/A	N		House - nobody home	–
196	184561	317925	Y	N/A	N/A	N		House - nobody home	–
197	183903	317022	Y	N/A	N/A	N		House - no borehole	–
198	183240	315863	Y	N/A	N/A	N		Farmyard - nobody home	–
199	183513	315378	Y	N/A	N/A	N		Farmyard - no borehole	–
200	182219	314827	Y	N/A	N/A	N		Farmyard - nobody home	–
201	181312	319251	Y	N/A	N/A	N		House - no borehole	–
202	181060	320008	Y	N/A	N/A	N		House - no borehole	–
203	181092	320011	Y	N/A	N/A	N		House - no borehole	–
204	191914	314926	Y	N/A	N/A	N		House - nobody home	–
205	189506	316072	Y	N/A	N/A	N		House - no borehole	–
206	192082	316031	Y	N/A	N/A	N		House - nobody home	–
207	191649	316242	Y	N/A	N/A	N		Farmyard - no borehole	–
208	192762	315409	Y	N/A	N/A	N		House - no borehole	–
209	192279	316486	Y	N/A	N/A	N		House - nobody home	–
210	194528	316859	Y	N/A	N/A	N		Farmyard - nobody home	–
211	191158	323213	Y	N/A	N/A	N		Dog pound - no borehole	–
212	192409	322522	Y	N/A	N/A	N		House - nobody home	–
213	192453	322801	Y	N/A	N/A	N		House - nobody home	–
214	194075	319920	Y	N/A	N/A	N		House - redundant BH - covered over	–
215	194834	314400	Y	N/A	N/A	N		Primary school - no borehole	–
216	191962	323060	Y	N/A	N/A	N		House - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
217	196260	325534	Y	N/A	N/A	N		House - no borehole	–
218	195321	324440	Y	N/A	N/A	N		Farmyard - nobody home	–
219	195722	326488	Y	N/A	N/A	N		House - no borehole	–
220	194589	327276	Y	N/A	N/A	N		House - nobody home	–
221	192574	327674	Y	N/A	N/A	N		House - no borehole	–
222	192547	327489	Y	N/A	N/A	N		House - no borehole	–
223	191209	327300	Y	N/A	N/A	N		House - no borehole	–
224	189863	325880	Y	N/A	N/A	N		House - no borehole	–
225	189961	325626	Y	N/A	N/A	N		Farmyard - no borehole	–
226	191037	328298	Y	N/A	N/A	N		House - no borehole	–
227	188733	328058	Y	N/A	N/A	N		Farmyard - nobody home	–
228	186892	328349	Y	N/A	N/A	N		Farmyard - nobody home	–
229	186380	328538	Y	N/A	N/A	N		House - nobody home	–
230	186729	328055	Y	N/A	N/A	N		Farmyard - nobody home	–
231	184870	328946	Y	N/A	N/A	N		Farmyard - no borehole	–
232	185907	330881	Y	N/A	N/A	N		Farmyard - no borehole	–
233	185946	332178	Y	N/A	N/A	N		Farmyard - no borehole	–
234	185839	333704	Y	N/A	N/A	N		House - no borehole	–
235	200219	321699	Y	N/A	N/A	N		Farmyard - no borehole	–
236	199377	322023	Y	N/A	N/A	N		Farmyard - nobody home	–
237	201381	322933	Y	N/A	N/A	N		Farmyard - nobody home	–
238	201762	322824	Y	N/A	N/A	N		House - no borehole	–

Site	Easting	Northing	Visited?	Suitable for sampling?	Approval to sample?	Further consideration?	Code	Comments	Minor works
239	201647	323255	Y	N/A	N/A	N		House - no borehole	–
240	199304	323475	Y	N/A	N/A	N		GAA club - no borehole	–
241	216195	314535	Y	N/A	N/A	N		Farmyard - nobody home	–
242	173374	337857	Y	N/A	N/A	N		Playschool - no borehole	–
243	174645	338478	Y	N/A	N/A	N		House - no borehole	–
244	175946	337386	Y	N/A	N/A	N		House - no borehole	–
245	179641	337098	Y	N/A	N/A	N		Farmyard - nobody home	–
246	180609	336473	Y	N/A	N/A	N		Farmyard - no borehole	–
247	173157	341926	Y	N/A	N/A	N		Quarry - no borehole	–
248	213535	311367	Y	N/A	N/A	N		No borehole - mains supply	–
249	224371	315678	Y	N/A	N/A	N		Piggery - no borehole	–
250	201615	337100	Y	N/A	N/A	N		Closed during survey	–
251	186235	330546	Y	N/A	N/A	N		Quarry - no borehole	–
252	188236	316588	Y	N/A	N/A	N		Quarry - no borehole	–
253	193849	317116	Y	N/A	N/A	N		Quarry, Closed during survey	–
254	191098	346703	Y	N/A	N/A	N		Quarry - no borehole	–
255	197035	311630	Y	N/A	N/A	N		No borehole - mains supply	–
256	188681	339804	Y	N/A	N/A	N		No borehole - mains supply	–

Annex 3. Photographs of Springs Visited

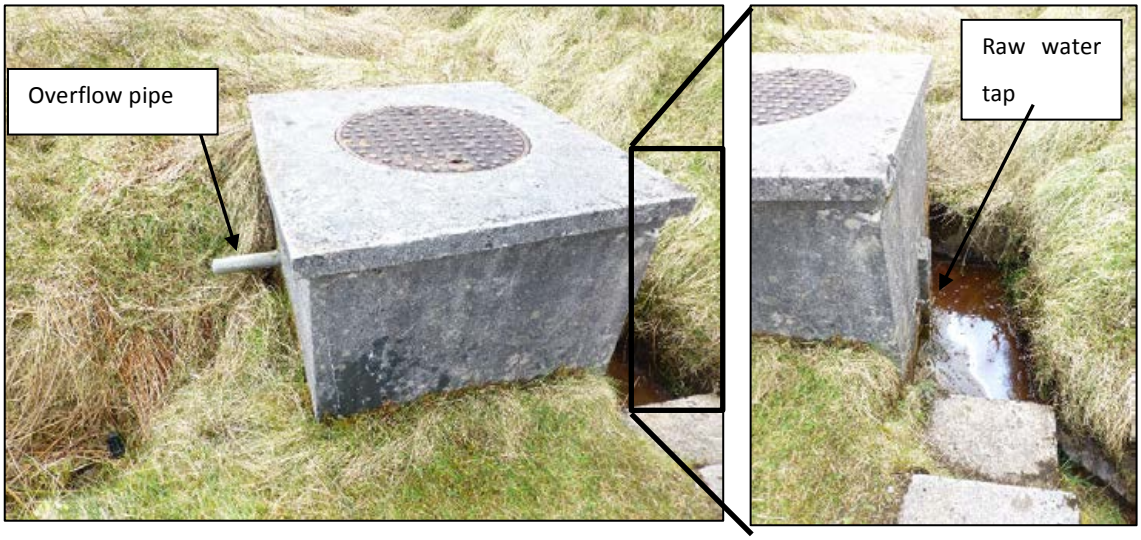

Figure G3.1. Arigna Rover P.W.S. spring water collecting chamber.

Figure G3.2. Ballintrillick G.W.S. spring collecting chamber.

Figure G3.3. Saint Patricks well showing (a) the piped spring flow and (b) the spring source.

Figure G3.4. Benbulbin G.W.S. (a) spring chamber, (b) the spring source and (c) unpiped overflow.

Figure G3.5. Carrownadargney G.W.S. spring chamber.

Figure G3.6. Corlough G.W.S. showing (a) view from front and (b) view from back of the spring chamber to which all springs flow before being pumped.

Figure G3.7. Corracloona/ Aughvanny G.W.S. showing the (a) spring rising and (b) overflow.

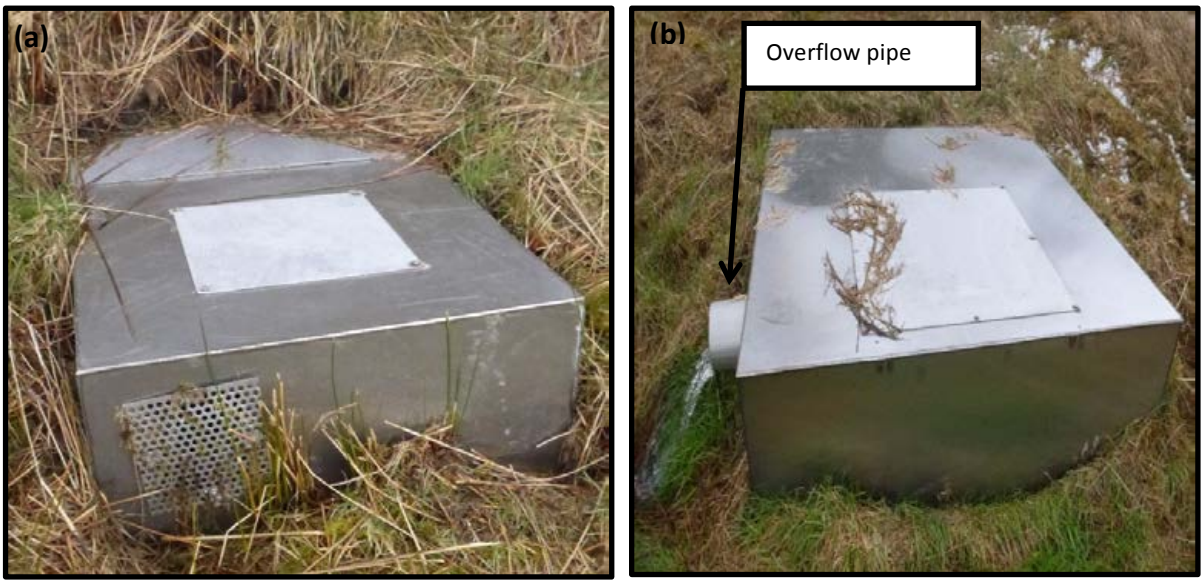

Figure G3.8. Glangevlin G.W.S. showing the (a) collection chamber and (b) secondary collection chamber with spring overflow pipe.

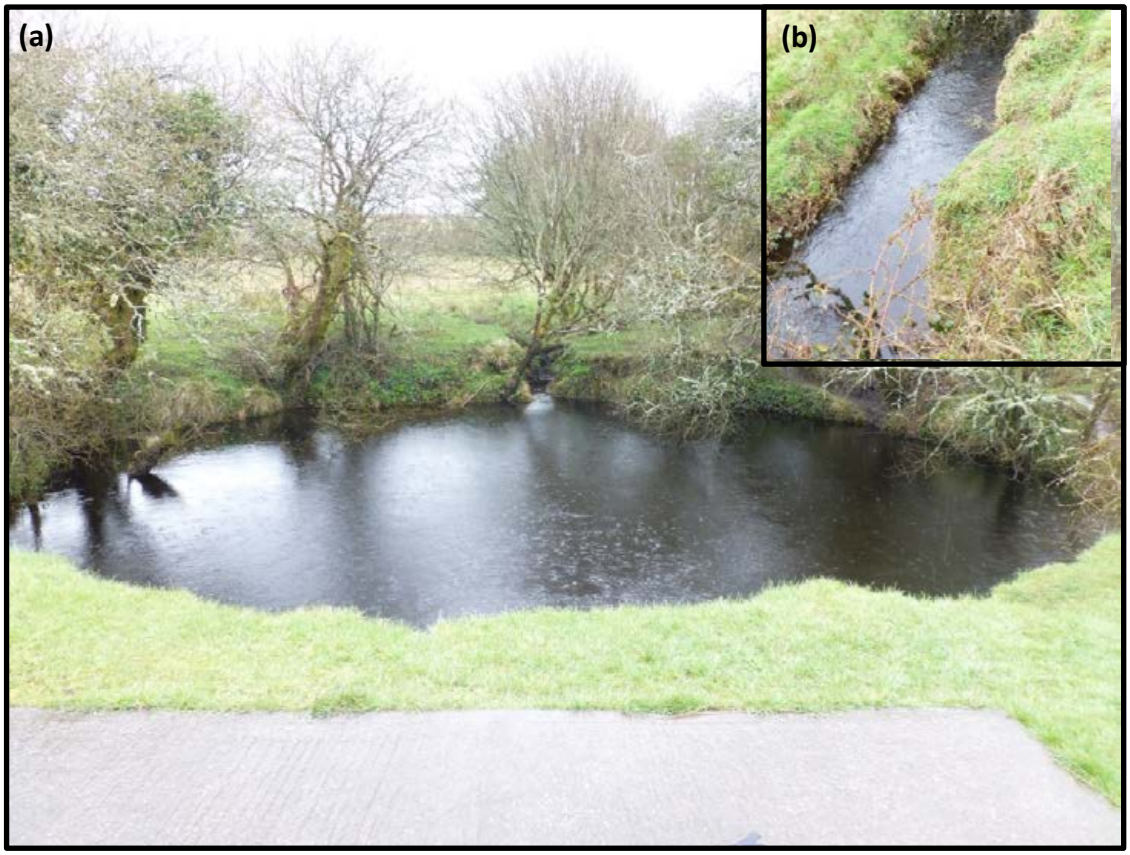

Figure G3.9. Shannon pot showing the (a) spring rising or 'pot' and (b) 10m spring stream section.

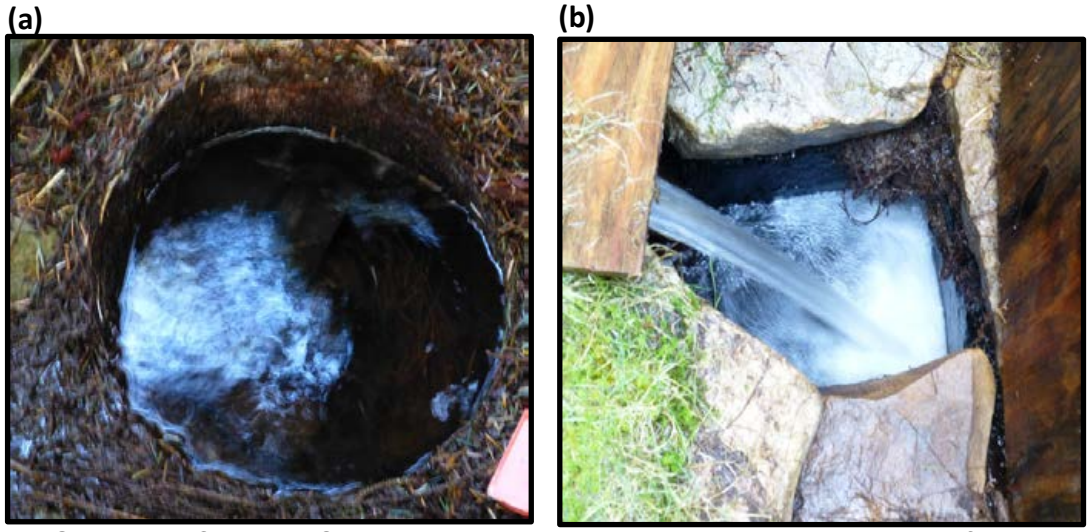

Figure G3.10. Mrs. Creamers Spring showing (a) spring rising and (b) piped spring flow.

Figure G3.11. Barran rising showing (a) locations of spring sources and circular 'pot' (b) locations of two spring sources and (c) 10 m spring stream section.

Figure G3.12. Hanging Rock rising showing (a) one of the spring sources, (b) two spring streams, one deriving from either of the two spring sources and (c) 10 m spring stream section.

Figure G3.13. Ture rising showing (a) spring source emerging from rocks (arrow indicates direction of flow) and (b) 10 m spring stream section.

Figure G3.14. White Fathers Cave showing (a) spring source and (b) 10 m spring stream section. Note, water in photo is blurred due to high flow velocity.

Figure G3.15. Glenfarne G.W.S. Water holding chamber only. Unable to access spring source.

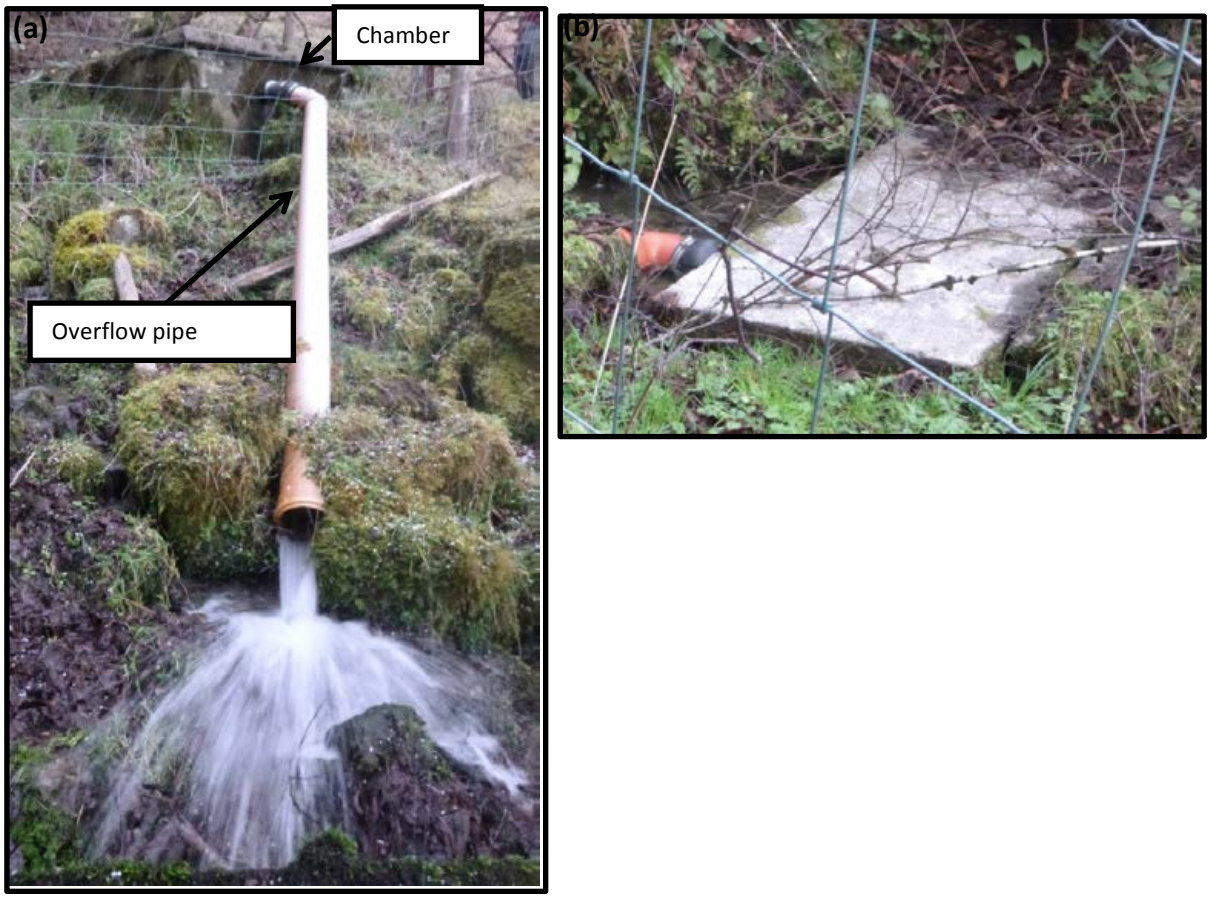

Figure G3.16. Keelogeboy G.W.S. showing (a) the front of the collection chamber at which two springs join and the overflow pipe and (b) back and top of same chamber.

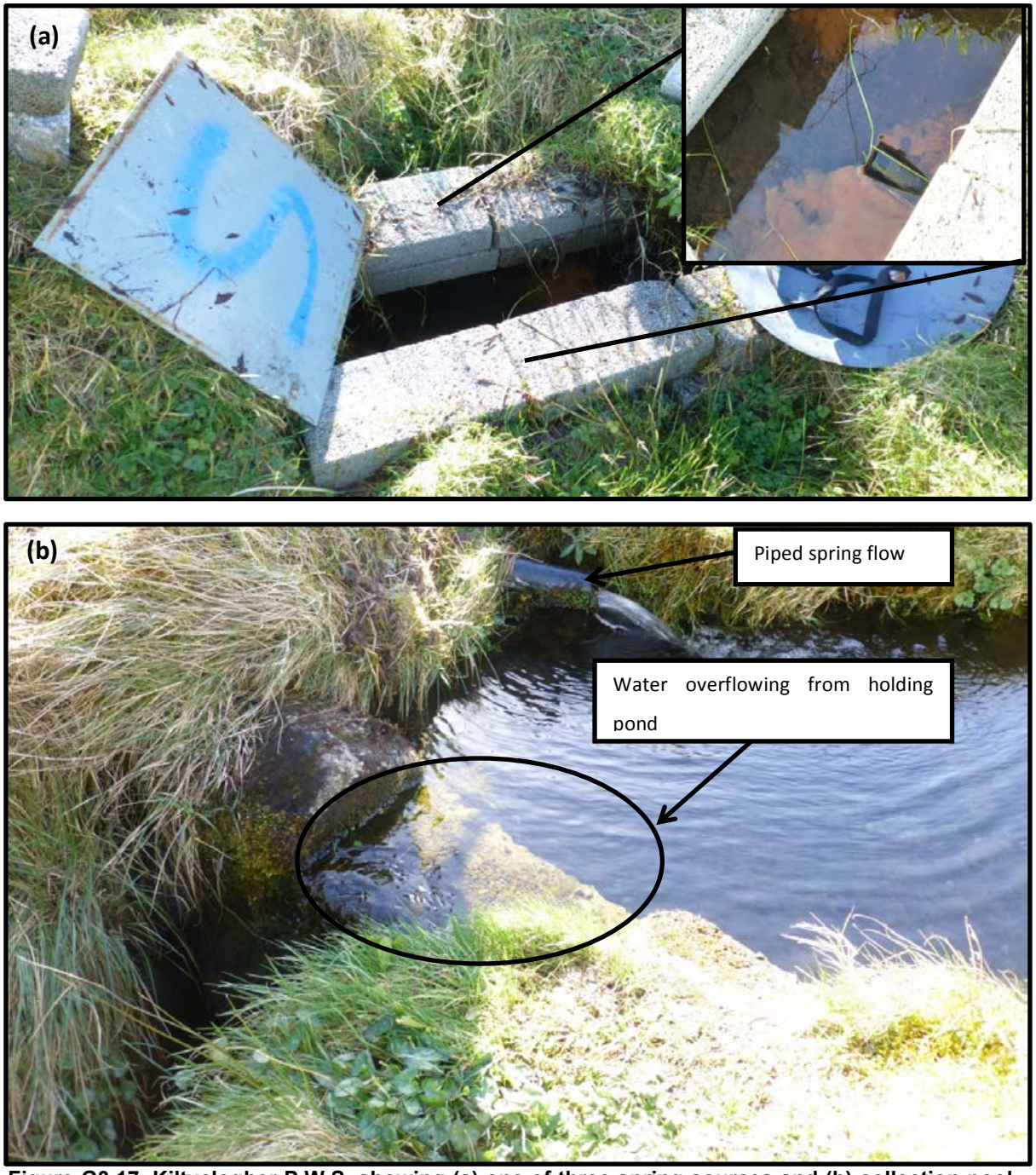

Figure G3.17. Kiltyclogher P.W.S. showing (a) one of three spring sources and (b) collection pool to which all three springs are piped.

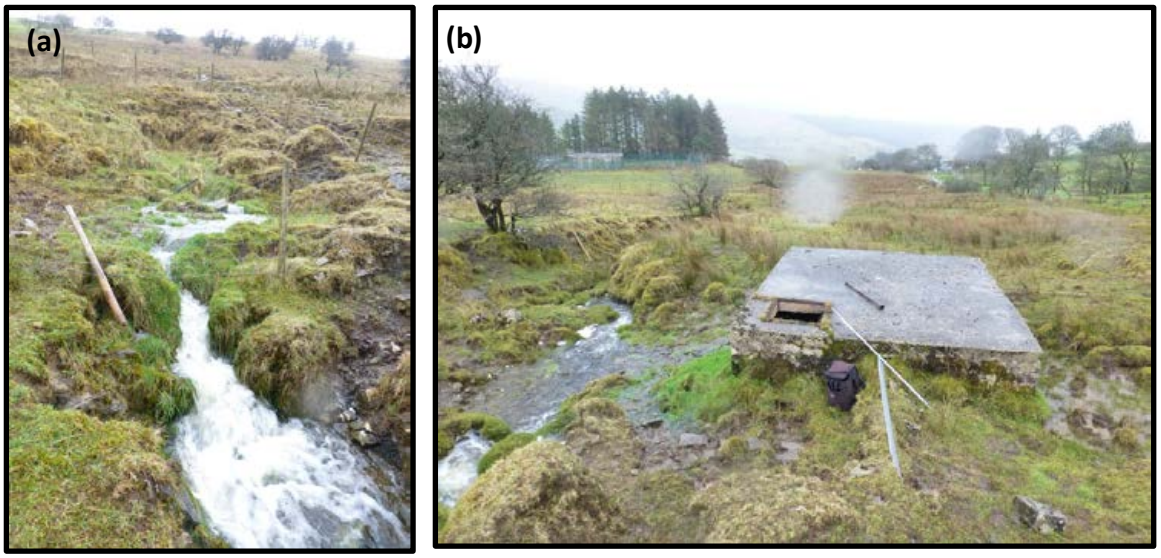

Figure G3.18. Brackymore spring showing (a) spring source and (b) disused water holding chamber.

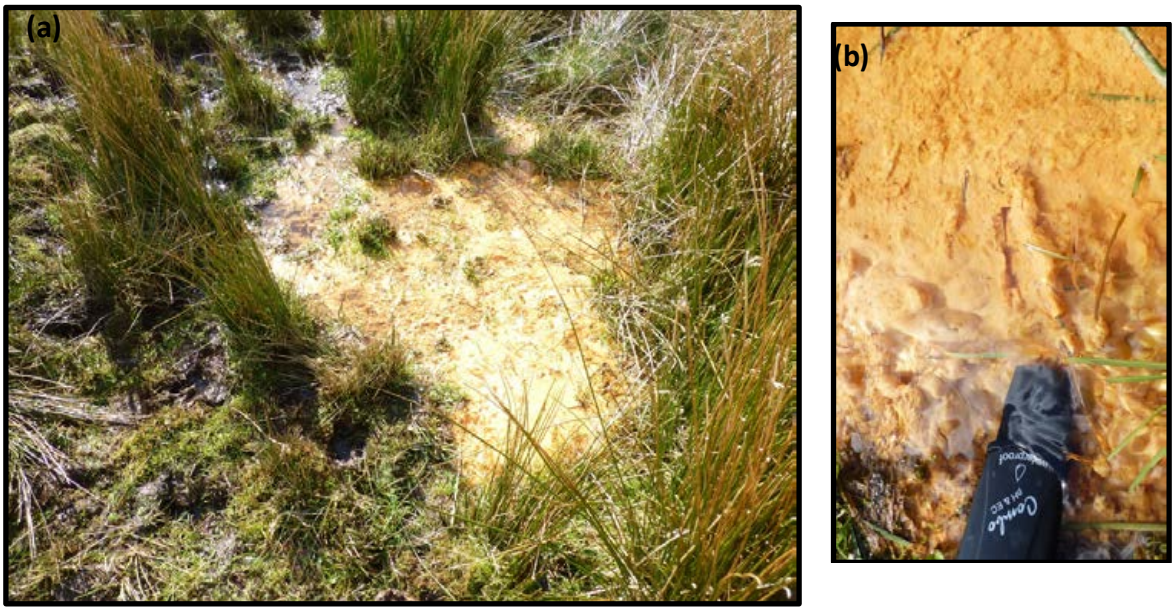

Figure G3.19. Largan G.W.S. showing (a) the unpiped overflow. Note, discoloration around overflow (b).

Figure G3.20. Riverstown G.W.S. showing the (a) external view, and (b) internal view, of the spring chamber.

Figure G3.21. Coolodonnell G.W.S.

Figure G3.22. Rossinver P.W.S. showing (a) spring chamber and (b) piped overflow.

Figure G3.23. Aghacashel G.W.S. showing (a) spring water flowing down rock face to harvesting tank and (b) piped overflow.

Figure G3.24. Swanlinbar P.W.S. showing the (a) spring chamber and (b) unpiped spring overflow.

Figure G3.25. Upper Aughagrainia G.W.S. showing (a) water channelled from spring source and (b) dry overflow pipe.

Annex 4. Spring Survey Results

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (°C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Arigna Rover	P.W.S.	2600PUB1008	Roscommon	189237	316144	Y	27-Mar-15	Y	50	N	–	6.81	8.4	357	Open access - located adjacent to regional road. Sample from raw water tap on chamber.	LH	Lackagh Sandstone Formation	Pl
Ballintrillick	G.W.S.	2700PRI1019	Sligo	174687	347699	Y	25-Feb-15	Y	100	N	–	7.79	9.1	273	Access granted by Coffey Water Ltd. Sampling access from manhole.	BB	Benbulben Shale Formation	Ll
Saint Patricks Well	–	–	Leitrim	202245	311749	Y	23-Mar-15	N	–	Y	7.5	7.49	11.1	333	Access via approx. 5 minute walk through flat field. H&S issue: potentially animals in the field.	BK	Bricklieve Limestone Formation	Rkc
Benbulben	G.W.S.	2700PRI1023	Sligo	168320	344499	Y	25-Feb-15	Y	50–70	Y	~3	7.19	10.2	458	Access granted by Coffey Water Ltd. Sampling access from spring chamber.	MU	Mullaghmore Sandstone Formation	Lm
Carron road	G.W.S.	–	Fermanagh	217854	330286	Y	1-Apr-15	Y		Y	<5	–	–	–	Open access, visible from road side.	BB	Benbulben Shale Formation	2B
Carrownadargney	G.W.S.	2700PRI1027	Sligo	184203	320458	Y	9-Mar-15	Y	28	Y	~ 1	6.73	8.5	89	Acess through caretaker - barrier needs to be unlocked at base of	DE	Dergvone Shale Formation	Pu

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
															mountain.			
Corlough	G.W.S.	0200PRI0291	Cavan	212371	322732	Y	5-Mar-15	Y	300	N	–	5.22	7.2	43	Access through caretaker - let him know in advance and he will accompany sampler to source. 3 springs in use all year - 2 additional springs used as backup in dry periods. All springs in use flow into a large chamber (also a spring source); piped to pressure chamber; and then piped to treatment plant. Possible to sample from spring chamber, however access via 15 minute quad ride.	GO	Gowlaun Shale Formation	Pu
Corracloona/ Aughvanny	G.W.S.	–	Leitrim	200425	341172	Y	11-Mar-15	Y	7	Y	<0.5	6.76	6.3	71	Located on adjacent to R281 half way between Kiltyclogher and Glenfarne. Open access. Sample where spring	GD	Glenade Sandstone Formation	Lm

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (°C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
															rises. Sample from raw water tap at pump house.			
Glangevlin	G.W.S.	0200PRI2018/ 0200PRI0248	Cavan	210638	328338	Y	27-Feb-15	Y	350	Y	1-2	6.83	6.7	36	Access to source: caretaker. Access to pumphouse: EPS. Located on Cuilcagh mountain. Access by half hour ride on quad bike. Sample from raw water tap in pump house.	BR	Briscloonagh Sandstone Formation	Pl
Shannon pot	–	–	Cavan	205325	331753	Y	30-Mar-15	N	–	–	692	7.24	7	123	Open, signposted access from road. Tourist attraction therefore pathway from car park to spring.	ME	Meenymore Formation	Ll
Mrs. Creamers Spring	–	–	Leitrim	192090	334912	Y	26-Mar-15	N	–	Y	5-10	4.36	8	43	Located in a dense forested area. Very unever terrain, swap/marsh terrain with many deep, hidden depressions. Springs cannot	BR	Briscloonagh Sandstone Formation	Pl

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
															be visited unaccompanied by caretaker.			
Barran rising	–	–	Cavan	204124	335933	Y	30-Mar-15	N	–	–	220	7.46	7.3	144	Open access. Located in the front garden of a residential house. Request permission of home owner.	DAmk	in Dartry Limestone Formation	Rkc
Hanging Rock rising	–	–	Fermanagh	210434	336626	Y	31-Mar-15	N	–	–	472	7.69	7.9	280	–	GC	Glencar Limestone Formation	2C
Ture rising	–	–	Cavan	207802	337294	Y	31-Mar-15	N	–	–	450	7.7	7.8	228	Located on farm. Request permission proir to access. Approx. 10 minute walk across uneven field to access spring head. Health and safety issue - animals in field.	DAkn	Knockmore Limestone Member	Rkc
White Fathers Cave	–	–	Cavan	205193	337537	Y	30-Mar-15	N	–	–	50	7.45	6.7	161	Open access. Signposted from road and access via pedestrian gate. Flow not measured due to dangerously high flow at time of survey.	DAmk	in Dartry Limestone Formation	Rkc

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Glenfarne	G.W.S.	–	Leitrim	198738	340100	Y	10-Mar-15	Y	30	N	–	–	–	–	Unable to access water at source. Unable to take measurements. The spring is located on the northern side of Thur Mountain, east of Manorhamilton.	BR	Briscloonagh Sandstone Formation	Pl
Keelogeboy	G.W.S.	2700PRI1024	Sligo	176433	337842	Y	26-Feb-15	Y	150	Y	3-5	7.93	8.9	233	Operated by Coffey water Ltd. Contact in advance. Steep walk to source. Caution needed when carrying equipment. Unable to locate spring source. The two springs join at chamber and gravity fed to treatment plant. Sample at source or at chamber.	DA	Dartry Limestone Formation	Rkc
Kiltyclogher spring	P.W.S.	1700PUB4500	Leitrim	194177	343985	Y	10-Mar-15	Y	60	Y	<1	6.55/ 6.84/ 6.86	8.9/ 9.1/ 9.1	200/ 346/ 360	Three springs. Contact caretaker in advance to arrange access. Sample from source or raw water tap.	CN	Carraun Shale Formation	Pl

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Brackymore	na	–	Leitrim	189387	343960	Y	12-Mar-15/ 24-Mar-15	N	–	Y	–	7.6/ 7.39	8.0/ 9.0	185/ 441	Access relatively easy. Good quality road most of the way, final 10 minute walk through wet boggy field and must climb barbed wire fence.	DA	Dartry Limestone Formation	Rkc
Largan	G.W.S.	–	Leitrim	200075	313696	Y	23-Mar-15	Y	–	Y	<3	6.53	10	339	Contact caretaker for access. Access difficult - 20 minute quad ride over very uneven terrain. Spring source covered with two cement caps. Much discolouration of sediment at point of spring overflow.	DE	Dergvone Shale Formation	Pu
Riverstown	P.W.S.	2700PUB2708	Sligo	177159	315584	Y	25-Feb-15	Y	22.5	N	–	7.03	9.2	519	Last entrance (laneway) on right before the crossroads in the village. Ring caretaker in advance. Unsuitable for sampling. Fish present in spring chamber.	BKL	Bricklieve Limestone Formation (lower)	Rkc

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Coolodonnell	Inactive G.W.S.	Inactive (1700PRI1060)	Leitrim	192114	345559	Y	25-Mar-15	N	11	Y	<10	7.92	7.8	327	Contact caretaker to arrange access. Open access. Located in field with unever terrain. Spring flows into a holding chamber which is not covered. Would need to purge chamber before sampling to ensure a representative pure spring water sample.	DA	Dartry Limestone Formation	Rkc
Rossinver	Inactive P.W.S.	Inactive (1700PUB5000)	Leitrim	192431	346889	Y	24-Mar-15	N	–	Y	<10	6.93	9.3	596	Access from road through gate. Gate may be locked. Contact caretaker to arrange access. Sample from man-hole in spring chamber, or overflow pipe.	DA	Dartry Limestone Formation	Rkc
Stralongford spring	G.W.S.	–	Leitrim	205351	318909	Y	27-Mar-15	Y	–	Y	<10	7.31	7.2	66	Open access, visible from road side. Surface water inputs upstream of abstraction point.	GO	Gowlaun Shale Formation	Pu

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Swanlinbar	P.W.S.	0200PUB0117	Cavan	217893	328131	Y	29-Apr-15	Y	220	Y	–	–	–	–	Contact caretaker to arrange access. Sample from man-hole in spring chamber.	BB	Benbulben Shale Formation	Ll
Upper Aughagrainia	G.W.S.	–	Leitrim	199766	312314	Y	23-Mar-15	Y	–	N	<10	–	–	–	Accessed via 20 minute quad ride escorted by caretaker. Very uneven terrain, located in boggy fields. Not accessible without quad. Located 10 meters from Largan G.W.S. spring. Sample from spring source.	BE	Bellavally Shale Formation	Ll
Ballaghnabehy	G.W.S.	1700PRI1031	Leitrim	195111	335667	N	–	Y	–	Y	<5	–	–	–	Access very difficult. Spring details obtained from correspondance with contact.	BR	Briscloonagh Sandstone Formation	Pl
Gowlan/ Blacklion	G.W.S.	0200PRI2019/ 0200PRI0251	Cavan	206650	332850	N	–	Y	450	N	–	–	–	–	Access very difficult , via quad and weather dependant. Contact caretaker to arrange access.	DA	Dartry Limestone Formation	Rk

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
Marble Arch Cascades	Private (industry)	AIL\2008\0021	Fermanagh	212200	334500	N	–	Y	5,300	–	–	–	–	–	Fish farm with 5300m^3/day abstraction but all returned, therefore, no net abstraction	DAkn	Knockmore Limestone Member	2A
Mohercregg	G.W.S.	1700PRI1086	Leitrim	201478	314420	N	–	Y	39	–	–	–	–	–	Three springs. Overflow only sometimes and very small. Access to spring heads possible but very difficult involving approx. 2 mile walk through a forst. Contact caretaker for access.	GO	Gowlaun Shale Formation	Pu
Glencar	G.W.S.	–	Leitrim	188542	339598	N	–	Y	***	–	–	–	–	–	Three or four springs located above Glencar waterfall. Springs not sampled due to health and safety concerns associated with access. Access via mountain road through forestry to the top of a mountain. Phone contact if access is required to be accompanied to	BS	Ballyshannon Limestone Formation	Rkc

Spring name	Scheme type	Drinking water code	County	Easting	Northing	Visited	Date visited	Current abstraction	Abstraction rate (m^3/day)	Overflow (Y/N)	Overflow flow (L/s)	pH	Temp (˚C)	Conductivity (µS/cm)	Access, Health and safety, sampling details	Bedrock (Code)	Bedrock (Unit)	Aquifer (Code)
															springs.			

***Data unavailble at time of publication.

Appendix H

WFD Analytical Monitoring Suites

Details of Metals, VOC, PAH, and Pesticide Monitoring Suites in Rivers in Ireland

Metals
Aluminium, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Strontium, Thallium, Uranium, Vanadium, Zinc
VOC suite
1 1 1 2-Tetrachloroethane, 1 1 1-Trichloroethane, 1 1 2 2-Tetrachloroethane, 1 1 2-Trichloroethane, 1 1-Dichloroethane, 1 1-Dichloroethene, 1 1-Dichloropropene, 1 2 3-Trichlorobenzene, 1 2 3-Trichloropropane, 1 2 4-Trichlorobenzene, 1 2 4-Trimethylbenzene, 1 2-Dibromo-3-Chloropropane, 1 2-Dibromoethane, 1 2-Dichlorobenzene, 1 2-Dichloroethane, 1 2-Dichloroethene (Cis), 1 2-Dichloroethene (Trans), 1 2-Dichloropropane, 1 3 5-Trimethylbenzene, 1 3-Dichlorobenzene, 1 3-Dichloropropane, 1 3-Dichloropropene (Cis), 1 3-Dichloropropene (trans), 1 4-Dichlorobenzene, 2 2-Dichloropropane, 2-Chlorotoluene, 4-Chlorotoluene, 4-Isopropyltoluene, Benzene, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon Tetrachloride, Chlorobenzene, Chloroform, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Ethylbenzene, Hexachlorobutadiene, Isopropylbenzene, Malathion, meta + para-Xylene, Methylene Chloride / Dichloromethane, n-Butylbenzene, n-Propylbenzene, ortho-Xylene
PAH Suite
Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g h i)perylene, Benzo(k)fluoranthene, Indeno(1 2 3-c d)pyrene, Total Petroleum Hydrocarbons, Naphthalene
Pesticides Suite
2 4-D, 2 6-Dichlorobenzamide, AMPA, Atrazine, Dichlobenil, Diuron, Fluoranthene, Glyphosate, Isoproturon, Linuron, MCPA, Mecoprop, Simazine, Chlorpyriphos, Diazinon, Dimethoate, Epoxiconazole, Pentachlorophenol.

Details of PAH Monitoring Suites in Lakes in Northern Ireland

PAH
Anthracene, Bentazone, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Naphthalene

Details of Metals, VOC, PAH, and Pesticide Monitoring Suites in Lakes in Ireland

Metals Aluminium, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Thorium, Tin, Uranium, Vanadium, Zinc, Strontium
VOC suite 1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,1-Dichloropropene, 1,2,3-Trichlorobenzene, 1,2,3-Trichloropropane, 1,2,4-Trichlorobenzene, 1,2,4-Trimethylbenzene, 1,2-Dibromo-3-Chloropropane, 1,2-Dibromoethane, 1,2-Dichlorobenzene, 1,2-Dichloroethane, 1,2-Dichloroethene (Cis), 1,2-Dichloroethene (Trans), 1,2-Dichloropropane, 1,3,5-Trimethylbenzene, 1,3-Dichlorobenzene, 1,3-Dichloropropane, 1,3-Dichloropropene (Cis), 1,3-Dichloropropene (trans), 1,4-Dichlorobenzene, 2,2-Dichloropropane, 2-Chlorotoluene, 4-Chlorotoluene, 4-Isopropyltoluene, Benzene, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Carbon Tetrachloride, Chlorobenzene, Chloroform, Dibromochloromethane, Dibromomethane, Dichlorodifluoromethane, Ethylbenzene, Hexachlorobutadiene, Isopropylbenzene, meta + para-Xylene, Methylene Chloride / Dichloromethane, n-Butylbenzene, n-Propylbenzene, Naphthalene, ortho-Xylene, sec-Butylbenzene, Styrene, tert-Butylbenzene, Tetrachloroethene, Toluene, Trichloroethene (all isomers), Trichlorofluoromethane, Vinyl Chloride
PAH Suite Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Indeno(1,2,3-c,d)pyrene
Pesticides Suite 2,4-D, AMPA, Diuron, Fluoranthene, Glyphosate, Isoproturon, Linuron, MCPA, Mecoprop, Simazine, 2,6-Dichlorobenzamide, Chlorpyriphos, Diazinon, Dichlobenil, Dimethoate, Epoxiconazole, Malathion, Pentachlorophenol

Details of PAH Monitoring Suites in Lakes in Northern Ireland

PAH Anthracene, Bentazone, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Fluoranthene, Indeno(1,2,3-c,d)pyrene, Naphthalene

Details of VOC, PAH and Pesticide Monitoring Suites in Groundwater Bodies in Ireland

VOC suite
Tetrachloroethene, Trichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, 1,1,1,2-Tetrachloroethane, 1,1,2,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2-Trichloroethane, 1,1-Dichloroethane, 1,1-Dichloroethene, 1,2-Dichloroethane, Phenol, Benzene, Toluene, Ethylbenzene, m+p-Xylene, o-Xylene, MTBE, Chloroform, Bromoform, Bromodichloromethane, Dibromochloromethane, (Total) Trihalomethanes
PAH Suite
Napthalene, Pyrene, Anthracene, Benzo[a]pyrene, (Total) PAHs, (Total) Petroleum Hydrocarbons
Pesticides Suite
Atrazine, MCPA, 2,4-D, Isoproturon, Mecoprop, Chlortoluron, Glyphosate, Bentazone, Cypermethrin, Dieldrin, DDT, Lindane, Diuron, Simazine, Dichlobenil, Total Pesticides

Details of VOC and Pesticide Monitoring Suites in Groundwater Bodies in Northern Ireland

VOC suite
1,2,3-Trichlorobenzene, 1,2,4-Trichlorobenzene, 1,3,5-Trichlorobenzene, Hexachlorobenzene, Hexachlorobutadiene
Pesticides Suite
2,3,6-TBA, 2,4-D, 2,4-DB, 2,4,5-T, Aldrin, alpha-Chlordane, alpha-Endosulphan, alpha-HCH, Ametryn, Azinphos-ethyl, Azinphos-methyl, Benazolin, Bentazone, beta-Endosulphan, beta-HCH, Bromoxynil, Carbophenothion, Chlopyralid, Chlordane-alpha, Chlordane-gamma, Chlorfenvinphos, Chlorpyriphos, Chlortoluron, Cypermethrin, Demeton-S-methyl, Diazinon, Dicamba, Dichlobenil, Dichlorprop, Dichlorvos, Dieldrin, Diflufenican, Dimethoate, Disulfoton, Disulphoton, Diuron, Endosulphan alpha, Endosulphan beta, Endrin, EPTC, Ethofumesate, Fenitrothion, Fenoprop, Fenpropidin, Fenpropimorph, Fenthion, Fluoroxypyr, Flutriafol, gamma-Chlordane, gamma-HCH, HCH-alpha, HCH-beta, HCH-gamma, Heptachlor Epoxide, Ioxynil, Isodrin, Isoproturon, Linuron, Malathion, MCPA, MCPB, Mecoprop, Metazachlor, Methabenzthiazuron, Mevinphos, Monolinuron, o,p-DDE, o,p-DDT, o,p-TDE, p,p-DDE, p,p-DDT, p,p-TDE, Parathion-ethyl, Parathion-methyl, Pendimethalin, Phorate, Phosalone, Pirimicarb, Pirimiphos-methyl, Prometryne, Propachlor, Propazine, Propetamphos, Propiconazole, Total, Propyzamide, Tecnazene, Terbutryn, Triademefon, Triallate, Triazophos, Triclopyr, Trietazine, Trifluralin

Appendix I

Hydrometric Gauging Stations and Associated Geology

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
26029	Dowra	Shannon	Active	Recorder	116.9	River	13/06/75		Water Level and Flow	Shannon Upr
26030	L. Allen d/s	Shannon	Active	Recorder	442.1	River	09/08/01		Water Level and Flow	Shannon Upr
26073	L. Allen u/s	L. Allen	Active	Recorder	442.1	Lake			Water Level Only	Shannon Upr
26074	Blackrock lock	L. Allen	Active	Recorder	442.1	Lake	22/07/94		Water Level Only	Shannon Upr
26077	Kilronan	L. Meelagh	Inactive	Staff Gauge Only	7.0	Lake			No Data Recorded	Shannon Upr
26078	Drumcormick	L. Key	Inactive	Staff Gauge Only	593.6	Lake			No Data Recorded	Shannon Upr
26094	Creevagh	L. Skean	Inactive	Recorder	14.3	Lake	12/12/05	13/08/09	Water Level Only	Shannon Upr
26107	Altagowlan	Arigna	Inactive	Staff Gauge Only	21.5	River	16/02/84	01/05/85	Flow Measurements	Shannon Upr
26109	Drumshambo	Stream	Active	Staff Gauge Only	11.6	River	04/09/80		Flow Measurements	Shannon Upr
26117	Ballyfarnan	Feorish	Active	Staff Gauge Only	59.5	River	26/05/84		Flow Measurements	Shannon Upr
26120	Arigna	Arigna	Active	Staff Gauge Only	41.4	River	04/11/86		Flow Measurements	Shannon Upr
26129	Barragh beg	Owengar	Active	Staff Gauge Only	14.1	River	20/06/90		Flow Measurements	Shannon Upr
26240	Annagherry	Owengar	Inactive	Staff Gauge Only	18.5	River	24/09/98	23/10/09	Flow Measurements	Shannon Upr
26241	Cloonmeone br.	Diffagher	Inactive	Staff Gauge Only	60.4	River	24/09/98	24/08/07	Flow Measurements	Shannon Upr
26256	Stonyriver br.	Stony	Inactive	Staff Gauge Only	6.8	River	27/08/98	01/05/07	Flow Measurements	Shannon Upr
26257	Owenboy br.	Yellow	Inactive	Staff Gauge Only	35.7	River	27/08/98	17/09/09	Flow Measurements	Shannon Upr
26258	Metal br.	Yellow	Inactive	Staff Gauge Only	12.5	River	27/08/98	24/06/04	Flow Measurements	Shannon Upr
26259	Derrintawy glebe	Owennayle	Inactive	Staff Gauge Only	37.1	River	24/09/98	17/10/06	Flow Measurements	Shannon Upr
26325	Clooncruffer	Feorish	Inactive	Recorder	64.1	River	12/12/05	16/09/09	Water Level Only	Shannon Upr
27006	Carrowniska	Crompaun	Inactive	Staff Gauge Only	35.6	River	18/02/82	24/01/91	Flow Measurements	Shannon Est Nth
27013	Kilrush	Wood	Inactive	Staff Gauge Only	17.9	River	28/06/84	28/09/95	Flow Measurements	Shannon Est Nth
28002	Doonbeg	Doonbeg	Active	Recorder	108.2	River	01/10/57		Water Level and Flow	Doonbeg

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
28005	Kilmihil	Doonbeg trib.	Inactive	Staff Gauge Only	7.3	River	06/12/80	12/02/92	Flow Measurements	Doonbeg
28007	Goolburne br	Doonbeg	Inactive	Staff Gauge Only	29.5	River	28/06/84	09/12/97	Flow Measurements	Doonbeg
28008	Mountrivers br.	Creegh	Inactive	Staff Gauge Only	82.9	River	23/08/84	09/12/97	Flow Measurements	Creegh
35003	Ballygrania	Unshin	Active	Recorder	202.3	River	01/10/55		Water Level and Flow	Ballysadare
35005	Ballysadare	Ballysadare	Active	Recorder	639.7	River	01/08/45		Water Level and Flow	Ballysadare
35006	Collooney	Owenmore	Inactive	Staff Gauge Only	411.2	River	10/10/79	24/02/06	Flow Measurements	Ballysadare
35008	Riverstown	Unshin	Inactive	Staff Gauge Only	86.6	River	14/09/79	15/10/08	Flow Measurements	Ballysadare
35009	Rinroe ford	Grange	Inactive	Staff Gauge Only	32.6	River	30/05/80	15/04/98	Flow Measurements	Coastal
35011	Dromahair	Bonet	Active	Recorder	263.7	River	01/10/57		Water Level and Flow	Garvogue
35012	New br.	Garravogue	Active	Recorder	368.7	River	04/10/01		Water Level and Flow	Garvogue
35013	Lennox's br.	Drowes	Inactive	Staff Gauge Only	251.8	River	15/08/72	26/02/01	Flow Measurements	Drowes
35018	Drumcliff	Drumcliff	Inactive	Staff Gauge Only	61.3	River	24/03/76	21/03/06	Flow Measurements	Drumcliff
35020	Windy br	Owenmore	Inactive	Staff Gauge Only	51.6	River	01/12/83	15/09/08	Flow Measurements	Garvogue
35021	Kinlough	Stream	Active	Recorder	0.7	River	24/10/06		Water Level and Flow	Drowes
35023	Milltown	Bonet	Inactive	Staff Gauge Only	50.8	River	15/02/84	08/06/95	Flow Measurements	Garvogue
35024	Kiltyclogher	County	Inactive	Staff Gauge Only	22.6	River	13/03/84	29/07/93	Flow Measurements	Drowes
35025	Ardnaglass br	Grange	Inactive	Staff Gauge Only	5.6	River	16/07/84	10/11/97	Flow Measurements	Coastal
35027	Ballinphull	Cliffony stream	Inactive	Staff Gauge Only	4.2	River	26/06/90	12/04/07	Flow Measurements	Coastal
35028	New br.(manorhamilton)	Bonet	Active	Recorder	47.1	River	01/05/90		Water Level and Flow	Garvogue
35029	Mullanaleck bridge	Drowes	Active	Recorder	250.0	River	01/02/92		Water Level and Flow	Drowes
35030	Brickeen	Brickeen stream	Inactive	Staff Gauge Only	3.7	River	03/11/93	04/06/02	Flow Measurements	Ballysadare
35031	Ballinafad	Ballinafad	Inactive	Staff Gauge Only	13.0	River	03/11/93	08/01/03	Flow Measurements	Ballysadare

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
		stream								
35032	Lecarrow lodge	Stream	Inactive	Staff Gauge Only	1.5	River	04/11/93	20/06/02	Flow Measurements	Ballysadare
35033	Castlefield house	Stream	Inactive	Staff Gauge Only	1.6	River	04/11/93	20/11/02	Flow Measurements	Ballysadare
35034	Derrylea	Stream	Inactive	Staff Gauge Only	1.2	River	04/11/93	20/11/02	Flow Measurements	Ballysadare
35035	Heapstown	Stream	Inactive	Staff Gauge Only	3.1	River	03/11/93	27/09/05	Flow Measurements	Ballysadare
35036	St. Dominic's well	Monastery stream	Inactive	Staff Gauge Only	0.2	River	29/06/94	15/05/06	Flow Measurements	Ballysadare
35037	Abbey wood	Spring	Inactive	Staff Gauge Only		River	29/06/94	26/05/04	Flow Measurements	Ballysadare
35038	Aghanagh	Stream	Inactive	Staff Gauge Only	0.7	River	30/06/94	08/01/03	Flow Measurements	Ballysadare
35039	Moneyduff	Stream	Inactive	Staff Gauge Only	5.4	River	13/05/96	02/05/06	Flow Measurements	Garvogue
35040	Fivemilebourne	O/l doon lough	Inactive	Staff Gauge Only	7.2	River	20/05/96	11/10/04	Flow Measurements	Garvogue
35041	Kilmore	Stream	Inactive	Staff Gauge Only	1.6	River	20/05/96	31/01/05	Flow Measurements	Garvogue
35042	Killerry	Stream	Inactive	Staff Gauge Only	2.2	River	24/04/96	02040708	Flow Measurements	Garvogue
35043	Gortlownan	Stream	Inactive	Staff Gauge Only	3.7	River	24/04/96	20/06/05	Flow Measurements	Garvogue
35044	Slishwood	Stream	Inactive	Staff Gauge Only	12.6	River	24/04/96	28/06/06	Flow Measurements	Garvogue
35045	Aghamore	Stream	Inactive	Staff Gauge Only	3.1	River	24/04/96	11/08/05	Flow Measurements	Garvogue
35046	Tobernalt	Stream	Active	Staff Gauge Only		River	15/02/96		Flow Measurements	Garvogue
35047	Curley br.	Owenmore	Inactive	Staff Gauge Only	41.6	River	25/06/03	28/09/06	Flow Measurements	Garvogue
35048	Manorhamilton dump	Leachate stream	Inactive	Staff Gauge Only		River	25/06/03	01/03/04	Flow Measurements	Garvogue
35049	Carrick leitrim	Bonet	Inactive	Staff Gauge Only	141.5	River	25/06/03	25/05/06	Flow Measurements	Garvogue
35052	Stracummer	Stream	Active	Recorder		River	10/10/06		Water Level and Flow	Drowes
35053	Bomahas	Stream	Active	Recorder		River	11/10/06		Water Level and Flow	Drowes
35054	Glenaniff bridge	Glenaniff	Active	Recorder		River	11/10/06		Water Level and Flow	Drowes

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
35055	Sraud	Stream	Active	Recorder		River	10/10/06		Water Level and Flow	Drowes
35056	Manorhamilton spring	Spring	Active	Recorder		Spring	30/04/09		Water Level and Flow	Garvogue
35060	Rosses point	Donegal bay	Active	Recorder		Tidal	30/07/08		Water Level Only	Coastal
35071	Lareen	L. Melvin	Active	Recorder	247.2	Lake	01/12/74		Water Level and Flow	Drowes
35073	L. Gill	L. Gill	Active	Recorder	362.6	Lake	20/03/75		Water Level Only	Garvogue
35074	Barroe	L. Arrow	Inactive	Staff Gauge Only	66.2	Lake	06/11/79	03/06/98	Flow Measurements	Ballysadare
35076	Glencar	Glencar l.	Inactive	Staff Gauge Only	41.0	Lake	10/06/80	01/11/94	Flow Measurements	Drumcliff
35077	Glenade	Glenade l	Inactive	Staff Gauge Only	14.9	Lake	01/08/85	01/11/88	Flow Measurements	Garvogue
35081	Inishfree	L. Gill	Inactive	Staff Gauge Only	362.6	Lake			Water Level Only	Garvogue
35086	Bellarush	L. Arrow	Inactive	Staff Gauge Only	66.3	Lake	27/10/76	07/05/08	Flow Measurements	Ballysadare
35087	Ballynary	L. Arrow	Active	Recorder	66.2	Lake	01/06/87	05/09/06	Water Level and Flow	Ballysadare
36013	Derreskit	Cullies	Active	Recorder	167.6	River	01/08/55		Water Level and Flow	Erne
36014	Ballyshannon	Lower Erne	Inactive	Recorder	4,333.7	River				Erne
36019	Belturbet	Erne	Active	Recorder	1,491.8	River	01/12/57		Water Level and Flow	Erne
36020	Killywillin	Blackwater [newtowngore]	Active	Recorder	93.5	River	01/10/78		Water Level and Flow	Erne
36021	Kiltybardan	Yellow	Active	Recorder	23.4	River	01/03/78		Water Level and Flow	Erne
36022	Aghacashlaun	Aghacashlaun	Active	Recorder	26.7	River	01/05/77		Water Level and Flow	Erne
36026	Drumcong	Inter lake channel	Inactive	Recorder	5.1	River	01/12/95	01/01/00		Erne
36027	Bellaheady	Woodford	Active	Recorder	333.8	River	01/08/74		Water Level and Flow	Erne
36028	Aghoo	Woodford	Active	Recorder	170.2	River	01/06/74		Water Level and Flow	Erne
36029	Tomkinroad	Rag	Active	Recorder	34.7	River	01/05/84		Water Level and Flow	Erne

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
36032	Tullymore	Abbey	Inactive	Staff Gauge Only	37.3	River	10/10/72	02/07/02	Flow Measurements	Erne
36034	Ballinamore	Stream	Active	Staff Gauge Only	20.2	River	11/04/84		Flow Measurements	Erne
36035	Roshin	O/l ballywara l.	Inactive	Staff Gauge Only	8.1	River	26/07/84	13/10/99	Flow Measurements	Erne
36036	Kilconny	Erne	Active	Recorder	1,492.1	River	01/08/88		Water Level and Flow	Erne
36071	Gowly	L. Scur	Active	Recorder	68.0	Lake	01/11/73		Water Level and Flow	Erne
36073	Wood island	St. John's lake	Active	Recorder	100.1	Lake	01/06/74		Water Level Only	Erne
36091	Ballinacur	Garadice lake	Active	Recorder	202.8	Lake	01/06/74		Water Level Only	Erne
36092	Cathaleen's fall p.s.	Erne	Active	Recorder	4,333.7	River			Water Level and Flow	Erne
36131	Parkhill	Abbey	Inactive	Recorder	36.1	Spring	27/05/03	07/02/05	Water Level and Flow	Erne
36156	Cornaclea	Cullies	Active	Staff Gauge Only	184.8	River	03/09/80		Flow Measurements	Erne
36158	Bawnboy	Bawnboy	Inactive	Staff Gauge Only	21.9	River	27/07/89	21/08/95	Flow Measurements	Erne
36159	Swanlinbar	Cladagh	Inactive	Staff Gauge Only	21.5	River	27/07/89	26/06/97	Flow Measurements	Erne
36170	Lough unshin	L. Unshin	Inactive	Staff Gauge Only	4.3	Lake	25/07/78	29/06/06	Flow Measurements	Erne
36171	Foalies br	L. Erne upper	Active	Recorder	1,508.9	Lake	01/08/82		Water Level and Flow	Erne
235050	Garrison	Roogagh river	Active	Recorder		River			Water Level and Flow	Erne
235052	County @ rockstown	County river	Active	Recorder		River			Water Level and Flow	Drowes
236006	Killyhevlin	Erne	Active	Recorder	2891.0	River			Water Level Only	Erne
236007	Drumrainey bridge	Sillees	Active	Recorder	166.3	River			Water Level and Flow	Erne
236009	Thompsons bridge	Swanlinbar	Inactive	Recorder		River			Water Level and Flow	Erne
236056	Garvery @ larkhill	Garvery	Active	Recorder		River			Water Level and Flow	Erne
236058	Tilery bridge	Arney	Active	Recorder		River			Water Level and Flow	Erne
236060	Black bridge	Black	Active	Recorder		River			Water Level and Flow	Erne
236061	Cladagh bridge	Cladagh	Active	Recorder		River			Water Level and Flow	Erne

Code	Station name	Water body	Station status	Station type	Catchment size km^2	Water body type	Record start	Record end	Data type	Catchment
236062	Boho	Sillees	Active	Recorder		River			Water Level and Flow	Erne
236601	Rosscor	Lough Erne	Active	Recorder		Lake			Water Level Only	Erne
236602	Portora	Lough Erne	Active	Recorder		Lake			Water Level Only	Erne
236603	Erne @ bellise	Lough Erne	Active	Recorder		Lake			Water Level Only	Erne

Code	Bedrock name	Bedrock description
26029	Glenade Sandstone Formation	Pale orthoquartzitic sandstone
26030	Dergvone Shale Formation	Shale & minor turbiditic sandstone
26073	Dergvone Shale Formation	Shale & minor turbiditic sandstone
26074	Mudbank limestone	Mudbank limestone
26077	Bricklieve Limestone Formation	Bioclastic cherty limestone
26078	No Data	No Data
26094	No Data	No Data
26107	Dergvone Shale Formation	Shale & minor turbiditic sandstone
26109	Bricklieve Limestone Formation	Bioclastic cherty limestone
26117	Bricklieve Limestone Formation (upper)	Bioclastic cherty limestone
26120	Dergvone Shale Formation	Shale & minor turbiditic sandstone
26129	Carraun Shale Formation	Grey/black shale with minor limestone
26240	Carraun Shale Formation	Grey/black shale with minor limestone
26241	Carraun Shale Formation	Grey/black shale with minor limestone
26256	Carraun Shale Formation	Grey/black shale with minor limestone
26257	Carraun Shale Formation	Grey/black shale with minor limestone
26258	Dergvone Shale Formation	Shale & minor turbiditic sandstone

Code	Bedrock name	Bedrock description
26259	Carraun Shale Formation	Grey/black shale with minor limestone
26325	Bricklieve Limestone Formation (upper)	Bioclastic cherty limestone
27006	Central Clare Group	Sandstone, siltstone & mudstone
27013	Central Clare Group	Sandstone, siltstone & mudstone
28002	Gull Island Formation	Grey siltstone & sandstone
28005	Central Clare Group	Sandstone, siltstone & mudstone
28007	Central Clare Group	Sandstone, siltstone & mudstone
28008	Gull Island Formation	Grey siltstone & sandstone
35003	Oakport Limestone Formation	Pale grey massive limestone
35005	Abbeytown Limestone	Crinoidal calcarenite
35006	Dargan Limestone	Bioclastic limestone, sandy & oolitic
35008	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35009	Dartry Limestone Formation	Dark fine-grained cherty limestone
35011	Oakport Limestone Formation	Pale grey massive limestone
35012	Dartry Limestone Formation	Dark fine-grained cherty limestone
35013	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35018	Bundoran Shale Formation	Dark shale, minor fine-grained limestone
35020	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
35021	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35023	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
35024	Dartry Limestone Formation	Dark fine-grained cherty limestone
35025	Bundoran Shale Formation	Dark shale, minor fine-grained limestone
35027	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35028	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite

Code	Bedrock name	Bedrock description
35029	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35030	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35031	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35032	Mudbank limestone	Mudbank limestone
35033	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35034	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35035	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35036	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35037	Bricklieve Limestone Formation (upper)	Bioclastic cherty limestone
35038	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35039	in Dartry Limestone Formation	Mudbank limestone
35040	Dartry Limestone Formation	Dark fine-grained cherty limestone
35041	in Dartry Limestone Formation	Mudbank limestone
35042	Slishwood Division, Pelitic & semi-pelitic paragneiss	Granoblastic kyanite pelite/ -semipelite
35043	Slishwood Division, Pelitic & semi-pelitic paragneiss	Granoblastic kyanite pelite/ -semipelite
35044	Slishwood Division, Pelitic & semi-pelitic paragneiss	Granoblastic kyanite pelite/ -semipelite
35045	Dartry Limestone Formation	Dark fine-grained cherty limestone
35046	*No Data*	*No Data*
35047	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35048	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
35049	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
35052	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
35053	Benbulben Shale Formation	Calcareous shale with minor calcarenite
35054	Benbulben Shale Formation	Calcareous shale with minor calcarenite

Code	Bedrock name	Bedrock description
35055	Benbulben Shale Formation	Calcareous shale with minor calcarenite
35056	Dartry Limestone Formation	Dark fine-grained cherty limestone
35060	*No Data*	*No Data*
35071	*No Data*	*No Data*
35073	*No Data*	*No Data*
35074	Bricklieve Limestone Formation (upper)	Bioclastic cherty limestone
35076	*No Data*	*No Data*
35077	Glencar Limestone Formation	Dark fine limestone & calcareous shale
35081	*No Data*	*No Data*
35086	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
35087	Bricklieve Limestone Formation (lower)	Bioclastic cherty limestone
36013	Ulster Canal Formation	Calcareous sandstone, shale, micrite
36014	Ballyshannon Limestone Formation	Pale grey calcarenite limestone
36019	Drumgesh Shale Formation	Dark shale, fine-grained limestone
36020	Dartry Limestone Formation	Dark fine-grained cherty limestone
36021	Ballymore Limestone Formation	Dark fine-grained limestone & shale
36022	Bricklieve Limestone Formation	Bioclastic cherty limestone
36026	Bricklieve Limestone Formation	Bioclastic cherty limestone
36027	Dartry Limestone Formation	Dark fine-grained cherty limestone
36028	Dartry Limestone Formation	Dark fine-grained cherty limestone
36029	in Dartry Limestone Formation	Coarse crinoidal limestone
36032	Ballyshannon Limestone Formation	Pale grey calcarenite limestone
36034	Drumgesh Shale Formation	Dark shale, fine-grained limestone
36035	Ballyshannon Limestone Formation	Pale grey calcarenite limestone

Code	Bedrock name	Bedrock description
36036	Drumgesh Shale Formation	Dark shale, fine-grained limestone
36071	Bricklieve Limestone Formation	Bioclastic cherty limestone
36073	*No Data*	*No Data*
36091	*No Data*	*No Data*
36092	Ballyshannon Limestone Formation	Pale grey calcarenite limestone
36131	Ballyshannon Limestone Formation	Pale grey calcarenite limestone
36156	Ballysteen Formation	Dark muddy limestone, shale
36158	Dartry Limestone Formation	Dark fine-grained cherty limestone
36159	Benbulben Shale Formation	Calcareous shale with minor calcarenite
36170	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
36171	Ballysteen Formation	Dark muddy limestone, shale
235050	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
235052	Mullaghmore Sandstone Formation	Sandstone, siltstone & shale
236006	*No Data*	*No Data*
236007	Bundoran Shale Formation	Dark shale, minor fine-grained limestone
236009	Benbulben Shale Formation	Calcareous shale with minor calcarenite
236056	Slishwood Division, Psammitic Paragneiss	Granoblastic quartzofeldspathic psammite
236058	Bundoran Shale Formation	Dark shale, minor fine-grained limestone
236060	Glenade Sandstone Formation	Pale orthoquartzitic sandstone
236061	Benbulben Shale Formation	Calcareous shale with minor calcarenite
236062	Glencar Limestone Formation	Dark fine limestone & calcareous shale
236601	*No Data*	*No Data*
236602	Ballyshannon Limestone Formation	Pale grey calcarenite limestone
236603	*No Data*	*No Data*

Final Report 1: Baseline Characterisation of Groundwater, Surface Water and Aquatic Ecosystems

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Unconventional gas exploration and extraction (UGEE) involves hydraulic fracturing ("fracking") of low permeability rock to permit the extraction of natural gas on a commercial scale from unconventional sources, such as shale gas deposits, coal seams and tight sandstone.

The UGEE Joint Research Programme (JRP) (**www.ugeeresearch.ie**) is composed of five interlinked projects and involves field studies (baseline monitoring of water and seismicity), as well as an extensive desk-based literature review of UGEE practices and regulations worldwide. The UGEE JRP was designed to provide the scientific basis that will assist regulators - in both Northern Ireland and Ireland - to make informed decisions about whether or not it is environmentally safe to permit UGEE projects/operations involving fracking. As well as research in Ireland, the UGEE URP looks at and collates evidence from other countries.

The JRP is funded by the Department of Communications, Climate Action and Environment, DCCAE (formerly the Department of Communications, Energy and Natural Resources (DCENR) and the Environment Division of the Department of Environment, Community and Local Government (DECLG)) and the Northern Ireland Environment Agency (NIEA). The research programme was managed by a steering committee comprising the EPA, representatives from DCCAE, the Geological Survey of Ireland, Commission for Energy Regulation, An Bord Pleanála, NIEA, the Geological Survey of Northern Ireland and the Health Service Executive.

List of Outputs:

- Final Report 1: Baseline Characterisation of Groundwater, Surface Water and Aquatic Ecosystems
- Summary Report 1: Baseline Characterisation of Groundwater, Surface Water and Aquatic Ecosystems
- Final Report 2: Baseline Characterisation of Seismicity
- Summary Report 2: Baseline Characterisation of Seismicity
- Final Report 3: Baseline Characterisation of Air Quality
- Summary Report 3: Baseline Characterisation of Air Quality
- Final Report 4: Impacts & Mitigation Measures
- Summary Report 4: Impacts & Mitigation Measures
- Final Report 5: Regulatory Framework for Environmental Protection
- Summary Report 5: Regulatory Framework for Environmental Protection
- UGEE Joint Research Programme Integrated Synthesis Report

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