Appendix A – 2006 Flood Extent

GRAIGUENAMANAGH FLOODING MAP

Keating's Well
FB
10Kv
T
MAIN STREET
School
28.59
23.01
27.30
CHAPEL STREET
18.34
Church (Cath)
15.30
Grave Yard
BARROW LANE
Lady's Well
HIGH STREET
28.51
14.82
25.70
19.63
CR
10.83
Old Abbey (Site of)
THE QUAY
Turf Market
10.58
11.93
15.47
12.63
THE DOCK
UND
CW
CF
FW
Weir

LEGEND

- INDICATES RIVER DUISKE / BARROW
- EXTENT OF FLOODING
- EXTENT OF DOMESTIC DWELLINGS FLOODED
- EXTENT OF COMMERCIAL PROPERTIES FLOODED

Buildings Legend

1. HUGHES
2. DAVID SNELL BOOKMAKERS
3. DUISKE VETERINARY
4. ANGLERS REST
5. KITTY BLANCHFIELD RESIDENCE
6. BARRON SPORTS
7. O'CONNOR BUTCHERS
8. THE ANCHOR
9. F.J. MURRAY
10. DOMESTIC RESIDENCE'S

Photographic Legend

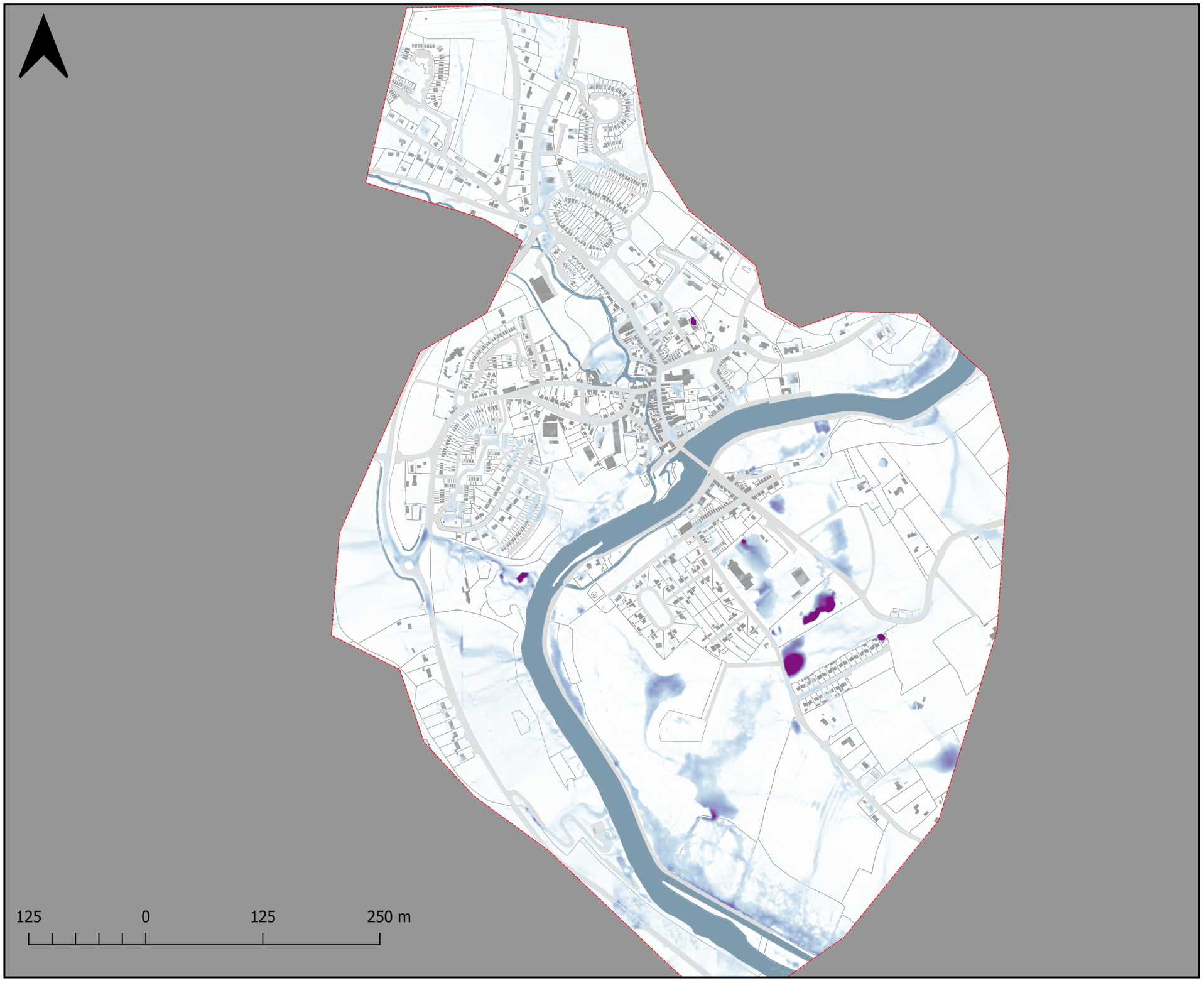
1. VIEW NORTH FROM BRIDGE AT JUNCTION OF MAIN STREET/HIGH STREET
2. VIEW SOUTH FROM BRIDGE AT JUNCTION OF MAIN STREET/ HIGH STREET
3. VIEWS OF CLAPPER BRIDGE
4. VIEW TOWARDS RAISED WALL PARALLEL TO DUISKE RIVER
5. VIEW AT THE QUAY 1995
6. VIEW AT TURF MARKET
7. VIEW OF ENTRANCE AT THE QUAY 1995
8. VIEW OF SILT BUILD UP
9. VIEWS OF BRIDGES ACROSS RIVER

Kilkenny County Council
Ladywell
Thomastown
Co. Kilkenny

GRAIGUENAMANAGH FLOODING MAP			
Drawing No :	SK.003	Scale:	NOT TO SCALE
Drawing Title :	MAP 3	Drawn:	RM
Date:	FEBRUARY 2008	Checked:	RM

...\graigue flood map final.dgn 06/03/2008 09:34:31

Appendix B – Rainfall and Pluvial Analysis



NOTES

LEGEND

Scheme Area

1% AEP 480min Pluvial Event

Depth [m]

- <0.10
- 0.10
- 0.20
- 0.30
- 0.40
- 0.50
- 0.60
- 0.70
- 0.80
- 0.90
- >1.00

BYRNELOOBY

Client:

Kilkenny County Council

Project:

Graiguenmanagh-Tinnahinch Flood Relief Scehme

Title:

Pluvial Modelling Assessmnet

Status: For Information

Map Area: Graiguenamanagh

Drawn by: DM	Jun 2021	Scale: 1:8,000
Checked by: SH	Jun 2021	
Approved by: SH	Jun 2021	Original @ A3

Map No.: 01 Sheet: 1 of 1

Prepared by: David Moran, Senior Engineer
Checked by: Seán Harrington, Associate Director
Approved by: Seán Harrington, Associate Director

Rainfall Analysis

Station Name: GRAIGUENAMANAGH
Station Height: 27 M
Latitude:52.534
Longitude: -6.951

Year	AMAX Rain [mm]	AEP
1951	28.1	96%
1952	30.5	87%
1953	37.4	62%
1954	36.8	64%
1955	28.5	94%
1956	28.1	96%
1957	61.0	5%
1958	44.7	36%
1959	32.1	81%
1960	45.0	35%
1961	45.6	33%
1962	36.5	65%
1963	40.3	52%
1964	31.4	84%
1965	35.1	71%
1966	43.5	40%
1967	26.5	102%
1968	35.0	71%
1969	28.7	94%
1970	31.4	84%
1971	24.1	110%
1972	33.4	77%
1973	39.1	56%
1974	45.6	33%

Year	AMAX Rain [mm]	AEP
1975	39.30	55%
1976	49.60	19%
1977	58.30	7%
1978	46.90	28%
1979	41.50	47%
1980	30.30	88%
1981	42.10	45%
1982	40.70	50%
1983	43.50	40%
1984	41.20	49%
1985	47.60	25%
1986	51.20	16%
1987	28.70	94%
1988	45.00	35%
1989	31.50	84%
1990	30.40	87%
1991	49.30	20%
1992	36.70	65%
1993	49.30	20%
1994	28.50	94%
1995	33.80	75%
1996	54.70	10%
1997	69.90	2%
1998	28.60	94%

Rainfall Analysis

Station Name: GRAIGUENAMANAGH-Ballyogan_House
Station Height: 30 M
Latitude:52.509
Longitude: -6.940

Year	AMAX Rain [mm]	AEP
2001	38.8	71%
2002	32.1	91%
2003	28.6	101%
2004	36.9	76%
2005	34.6	83%
2006	36.0	79%
2007	33.0	88%
2008	37.6	74%
2009	35.3	81%
2010	43.9	55%
2011	39.2	69%
2012	43.9	55%
2013	42.7	59%
2014	44.0	55%
2015	43.5	56%
2016	29.2	100%
2017	35.7	80%
2018	36.6	77%
2019	43.5	56%

Rainfall Analysis

Station Name: M.THOMASTOWN FOREST
Station Height: 247 M
Latitude:52.526
Longitude: -7.020

Year	AMAX Rain [mm]	AEP
1995	18.9	136%
1996	34.9	83%
1997	91.3	0.5%
1998	33.2	89%
1999	35.5	81%
2000	54.2	20%
2001	40.0	66%
2002	35.1	82%
2003	30.9	96%
2004	39.1	69%
2005	37.1	76%
2006	24.9	116%
2007	29.5	101%
2008	35.5	81%
2009	41.4	62%
2010	49.8	34%
2011	42.1	59%

Appendix C – Hydrometric Station Records' Timelines

Griaguenamanagh Tinnahinch FRS

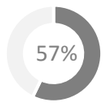
Water Level | Water Level and Flow | Spot Flow

Hydrometeric Station Review

Project Number W3451 GTFRS

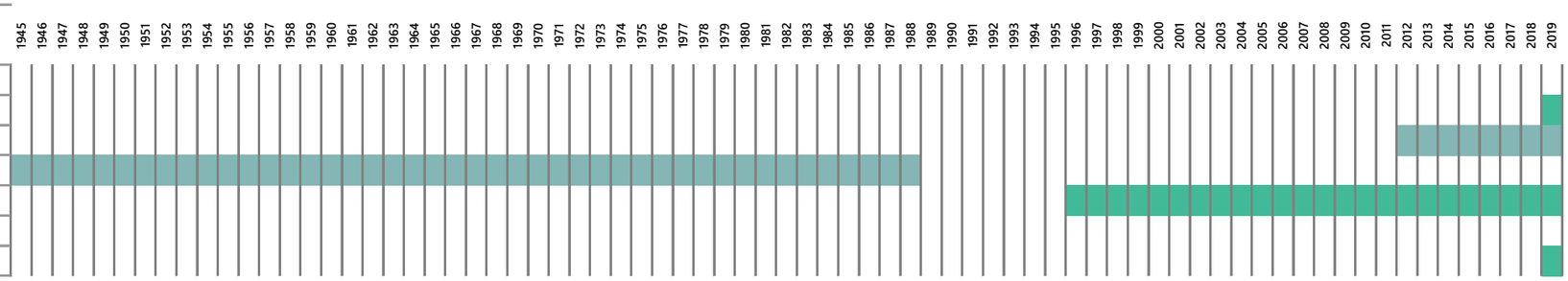
Date Sept 2020

Active Stations



Guage Data Type

Station Name	Station Number	Waterbody
BALLYKEENAN	14051	BARROW
COOLROE	14123	DUISKE
GRAIGNAMANAGH	14119	BARROW
GRAIGUENAMANAGH	14023	BARROW
GRAIGUENAMANAGH U/S	14029	BARROW
PRIESTVALLEY INTAKE U/S	14049	DUISKE
TURF MARKET	14122	DUISKE



Appendix D – Rating Review

BYRNELOOBY

To File	**From:** David Moran, Senior Engineer
Date Dec 2020	**Methodology Checked:** Stephen Neill, Senior Engineer
Subject Rating Reviews	**Approved:** Seán Harrington, Associate Director

1. Graiguenamanagh u/s 14029

The Graiguenamanagh u/s hydrometric station (14029) is located on the right bank of the River Barrow in Graiguenamanagh town (Figure 1-1). It is an active station and has been continuous logging sub-daily water level data since 1996.

The gauging station has been visited to assess the physical characterises of the river and identify features that would affect flow conditions. The Barrow is a navigable waterway with several weirs, canals and locks gates which alter the natural river regime. Locally the controlling structures are the masonry arch Graiguenamanagh Bridge 275m downstream and a L-shaped weir 325m downstream.

Figure 1-1: View from Graiguenamanagh u/s station upstream [left] and downstream [right]

The station is rated A2 having ratings confirmed to be measured up to 1.3 times Qmed. Bank full is at a stage of 2.3m which is 0.79m above Qmed. This provides good confidence in the calculation of Qmed. However, it is recommended spot gauging's are taken at higher flow levels to increase confidence in deriving extreme flows.

Rating updated

As part of the CFRAM a rating curve has been created for this station. The curve is a composite, the first two limbs are based on a rating equation developed by the gauge operator (OPW) using spot gauging's and the top limb was developed using the CFRAM hydraulic model for flow above the maximum spot gauging water levels. This review will update the first two limbs using the spot gauging and the top limb using the 1D rating review hydraulic model built for this Project.

The rating curve and spot gaugings are presented in Figure 1-2. The plot includes 11 new spot gauging's recorded post-CFRAM. The gaugings were fitted to a best fit relationship in the form of:

$$Q = c(h + a)^B \qquad \text{Eqt. 1}$$

A best fit equation was created based on Root Mean Square Error (RMSE). For Section 1 of the rating curve the new equation improved the RMSE from 3.26 to 2.99. For Section 2 the new equation improved the RMSE from 7.06 to 7.00. From visual inspection of the post-CFRAM spot gauging they are seen to have a good fit with previous gaugings. While the equations have been updated, the effects to the rating

curve shape are relatively minor. By comparing the previous and new rating the highest gauging on the section two has reduced by 0.2%. Similarly, the application of the new top limb based on the hydraulic modelling has made a minor change the flows compared to the previous rating. This update has slightly increased flows, with Qmed increasing by 0.3m^3/s.

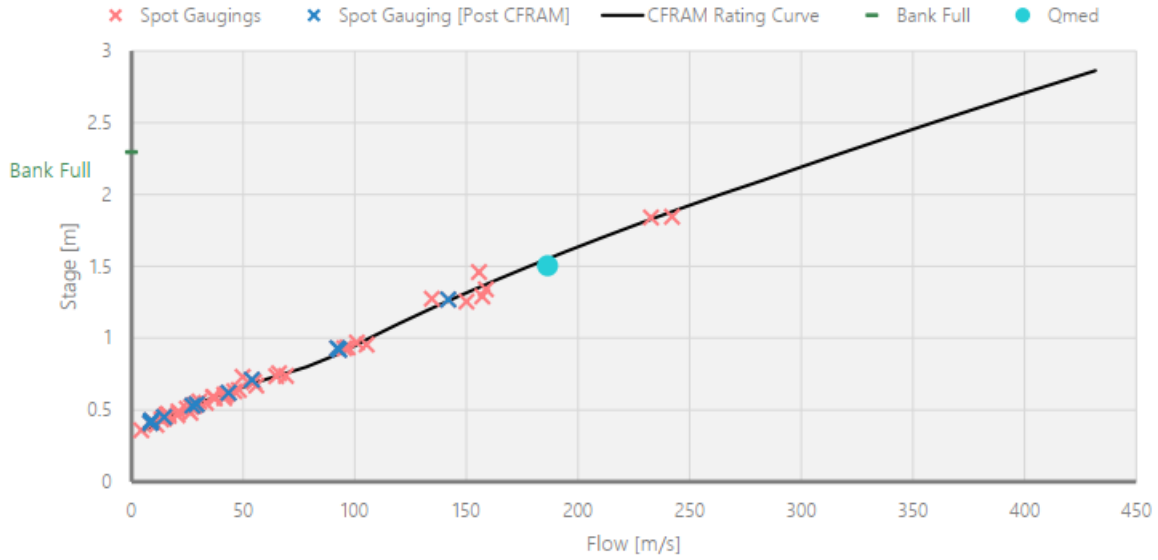
Station 14029 Graiguenamanagh u/s

Name	GRAIGUENAMANAGH U/S	**Station Number**	14029
Watercourse	BARROW	**Operator**	OPW

Spot Gauging Summary

Gauging's recorded	57	**Gauge Zero [mOD P]**	12.017
First gauging date	03/09/1996	**Max gauged stage [m]**	1.845
Last gauging date	12/02/2020	**Qmed stage [m]**	1.505

Rating Curve



Section	Min Stage (m)	Max Stage (m)	C	a	b
1	0.36	0.838	167.652	-0.35	1.037
2	0.839	2.001	74.348	0.25	1.564
3	2.002	3.561	59.901	0.7	1.526

Where: $Q = C(h+a)^b$ and h = stage readings (metres)

Note: Section 1 & 2 updated as part of the GTFRS and Section 3 is base on GTFRS hydraulic model

Figure 1-2: Graiguenamanagh u/s rating review summary

2. Royal Oak 14018

The Royal Oak hydrometric station (14018) is located on a road bridge on the Barrow 23km upstream of Graiguenamanagh town (Figure 1-1). It is an active station and has been continuous logging sub-daily water levels since 1954.

The gauge is located on the downstream side of one of the bridge arches (Figure 2-1). The bridge is a concrete five-span bridge with flat soffits at each opening. The gauge was installed in 1941 and was automated in 1954. The OPW are the operators for the station.

Figure 2-1: 14018 View of road bridge where station is located [left] and zoomed in view of staff gauge [right]

The station is rated A2 having ratings confirmed to be measured up to 1.3 times the flow above Qmed. Bank full is a stage 1.24m which is 1.16m below Qmed but flows are confined in the floodplain. A number of high flow spot gaugings around the Qmed point have been recorded but it is recommended spot gauging's are taken at higher flow levels to increase confidence in deriving extreme flows.

Rating updated

As part of the CFRAM a rating curve has been created for this station. The curve is based on spot gaugings taken since 03/07/1981. Prior to this were three datum changes to the gauge. This update will look at spot gaugings since 03/07/1981 and include the 14 spot gaugings taken post-CFRAM.

The rating curve is a composite, the first three limbs are based on a rating equation developed by the gauge operator (OPW) using spot gauging's and the top two limbs were developed using the CFRAM hydraulic model for flow above the maximum spot gauging water level. The focus of this review is on the first three limbs. The top limbs require hydraulic modelling which is out of the scope of this assessment.

The rating curve and spot gauging are presented in Figure 2-2. The plot includes 14 new spot gauging's recorded post-CFRAM. The gaugings were fitted to a best fit relationship in the form of Eqt 1.

A best fit equation was created based on Root Mean Square Error (RMSE). For Section 1 of the rating curve the new equation improved the RMSE from 2.63 to 1.79. For Section 2 the new equation improved the RMSE from 5.37 to 5.14. For Section 3 the new equation improved the RMSE from 8.94 to 8.60. From visual inspection of the post-CFRAM spot gauging they are seen to have a good fit with previous gaugings, apart from one slight outlier at stage 2.08m. While the equations have been updated the effects to the updated rating curve shape are relatively minor. By comparing the previous and new rating the highest gauging on the section two has reduced by 1.3%.

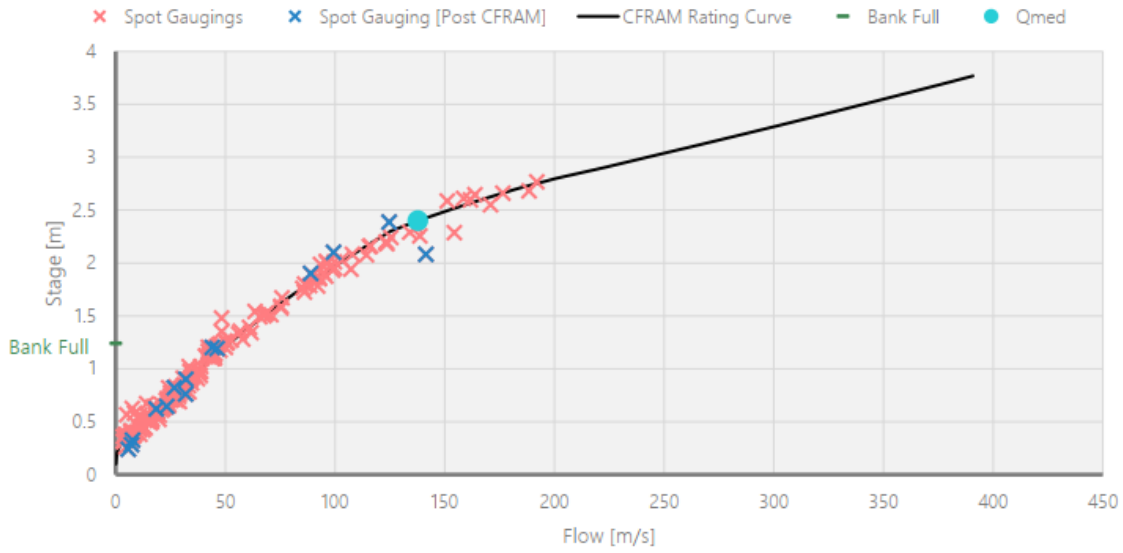
Station 14018 Royal Oak

Name	ROYAL OAK	**Station Number**	14018
Watercourse	BARROW	**Operator**	OPW

Spot Gauging Summary

Gauging's recorded	181	**Gauge Zero [mOD P]**	33.78
First gauging date	08/11/1972	**Max gauged stage [m]**	2.765
Last gauging date	16/10/2019	**Qmed stage [m]**	2.4

Rating Curve



Section	Min Stage (m)	Max Stage (m)	C	a	b
1	0	0.45	48.729	0.06	2.167
2	0.45	2.314	16.375	0.5	2.015
3	2.314	2.8	6.241	0.5	2.892
4	2.8	3	214.901	-1.865	1.000
5	3	3.769	251.037	-2.042	0.811

Where: $Q = C(h+a)^b$ and h = stage readings (metres)

Note: Section 1, 2 & 3 are updated as part of the GTFRS and Sections 4 & 5 are based on CFRAM hydraulic model

Figure 2-2: Royal Oak rating review summary

Appendix E – Physical Catchment Descriptors

	Name	Unit	Symbol	Dusike HEP														
				14_1116_1	14_1116_2	14_1116_3	14_200_2	14_200_3	14_201_2	14_201_3	14_1364_3	14_1364_4	14_1571_2	14_559_3	14_560_3	14_560_4	14_560_5	No Node
PCD	Node		NODE_ID	14_1116_1	14_1116_2	14_1116_3	14_200_2	14_200_3	14_201_2	14_201_3	14_1364_3	14_1364_4	14_1571_2	14_559_3	14_560_3	14_560_4	14_560_5	0
	River Segment Code		RWSEG_CD	14_1116	14_1116	14_1116	14_200	14_200	14_201	14_201	14_1364	14_1364	14_1571	14_559	14_560	14_560	14_560	0
	Easting		NODE_EAST	268791	269256	269663	270339	270661	270901	270901	269782	269870	270687	270661	270116	270522	270687	0
	Northing		NODE_NORTH	144526	144446	144266	144181	144046	143670	143480	143603	144115	144647	144046	145004	144728	144647	0
	Area	km^2	**AREA**	**12.711**	**13.758**	**14.095**	**20.070**	**20.175**	**24.652**	**24.657**	**5.218**	**5.483**	**1.434**	**4.054**	**1.893**	**2.227**	**2.273**	**0.058**
	Catchment Centroid Easting		CENTE	267180	267510	267560	267900	268040	268410	268410	269190	269190	270760	269960	269400	269540	269600	0
	Catchment Centroid Northing		CENTN	143290	143290	143290	143290	143290	143530	143530	141960	142210	145390	145610	146090	145920	145900	0
	Mean Catchment Elevation	m	ALTBAR	182.7	177	173.4	169.5	168.7	156.4	156.2	177.2	169.8	79	100.8	128.5	121.6	119.8	55
	Standard-period average annual rainfall	mm	**SAAR**	**1075.86**	**1076.92**	**1078.35**	**1088.87**	**1089.12**	**1088.17**	**1088.21**	**1112.27**	**1112.48**	**1090.94**	**1080.64**	**1059.44**	**1067.85**	**1069.45**	**1085.28**
	Index of flood attenuation by reservoirs and lakes		FARL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Urban extent proportion		**URBEXT**	**0.000**	**0.000**	**0.000**	**0.000**	**0.004**	**0.014**	**0.015**	**0.000**	**0.000**	**0.000**	**0.032**	**0.000**	**0.000**	**0.000**	**0.000**
	Forest cover proportion		FOREST	0.1549	0.1449	0.1401	0.1485	0.1474	0.1225	0.1224	0.1976	0.1839	0	0.0017	0.0012	0.003	0.0029	**0**
	Peat bog proportion		PEAT	0.0528	0.0494	0.0476	0.0505	0.0502	0.0416	0.0416	0.0674	0.0627	0	0	0	0	0	**0**
	Grassland/pasture/agriculture proportion		PASTURE	0.808	0.8204	0.827	0.8146	0.8133	0.834	0.8332	0.7572	0.774	0.9877	0.9712	1	1	0.9999	**1**
	Alluvial deposit proportion		ALLUV	0.0181	0.0204	0.0221	0.0212	0.0217	0.0198	0.02	0.0122	0.0136	0.0002	0.0106	0.0108	0.0148	0.0158	0
	proportion of time soils expected to be typically quite wet		FLATWET	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0
	Standard-period average annual potential evapotranspiration	mm	SAAPE	516.98	517.79	518.48	518.8	518.93	521.22	521.23	516.47	517.81	533.38	531.97	529.33	530.24	530.46	0
	Flood attenuation index		FAI	0.0523	0.0532	0.0544	0.0549	0.0559	0.0594	0.06	0.0493	0.0513	0.0323	0.0707	0.0619	0.074	0.0778	0
	Soil baseflow index		BFISOIL	0.65989111	0.65980675	0.65979004	0.65053587	0.65057104	0.66077813	0.66080796	0.64435509	0.6442113	0.67637662	0.66199171	0.64863929	0.64872535	0.64888946	**0.65**
	Total length of river network above gauge	km	NETLEN	13.054	13.554	14.054	19.24	19.598	23.664	23.87	3.877	4.407	1.012	3.564	1.234	1.735	1.921	0
	stream frequency	jtn/km^2	STMFRQ	15	15	15	19	19	23	23	3	3	1	3	1	1	1	0
	Drainage density	km/km^2	DRAIND	1.028	0.998	0.997	0.957	0.968	0.97	0.977	0.759	0.803	0.748	0.917	0.644	0.787	0.856	0
	main stream length	km	MSL	5.648	6.15	6.649	7.426	7.786	8.288	8.494	3.34	3.868	1.012	2.552	1.233	1.735	1.921	**0.6**
	slope between 10%-85%	m/km	S1085	34.7261	33.31416	30.562	27.17754	26.76616	25.67919	25.05218	66.17023	55.2094	25.69304	32.59751	31.20101	33.91594	33.67063	**38**
	Taylor-Schwartz measure of mainstream slope	m/km	TAYSLO	26.883937	26.549199	22.79395	23.396178	21.985307	18.568329	22.124988	51.983821	40.853291	0.697355	33.509182	35.161093	34.545477	33.9535	0
	Arterial drainage schemes area proportion		ARTDRAIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arterial drainage schemes river length proportion		ARTDRAIN2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: Values in bold have been updated from orginal values. See Chapter 6 of Hydrology Report for commentry.

	Name	Unit	Symbol	Barrow HEP								
				14_193_3	14_193_4	14_193_5	14_198_2	14_198_3	14_199_1	14_199_2	14_193_6	14029
PCD	Node		NODE_ID	14_193_3	14_193_4	14_193_5	14_198_2	14_198_3	14_199_1	14_199_2	14_193_6	14029
	River Segment Code		RWSEG_CD	14_193	14_193	14_193	14_198	14_198	14_199	14_199	14_193	14_193
	Easting		NODE_EAST	271662	271587	271255	270684	270924	271287	271867	270901	259960
	Northing		NODE_NORTH	144403	143947	143709	143108	142671	142447	142367	143480	188020
	Area	km^2	**AREA**	**2836.65**	**2837.33**	**2838.08**	**2863.74**	**2864.21**	**2864.70**	**2867.75**	**2838.22**	**2838.08**
	Catchment Centroid Easting		CENTE	259960	259960	259960	259960	259960	259960	259960	259960	259960
	Catchment Centroid Northing		CENTN	188020	188020	188020	187110	187110	187110	187110	188020	188020
	Mean Catchment Elevation	m	ALTBAR	101.1	101.1	101.1	101.6	101.6	101.6	101.6	101.1	101.1
	Standard-period average annual rainfall	mm	**SAAR**	**907.09**	**907.15**	**907.18**	**908.57**	**908.62**	**908.75**	**908.82**	**907.20**	**907.18**
	Index of flood attenuation by reservoirs and lakes		FARL	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
	Urban extent proportion		**URBEXT**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**
	Forest cover proportion		FOREST	0.0755	0.0755	0.0755	0.0759	0.076	0.0762	0.0763	0.0755	0.0755
	Peat bog proportion		PEAT	0.0865	0.0865	0.0865	0.086	0.086	0.086	0.086	0.0864	0.0865
	Grassland/pasture/agriculture proportion		PASTURE	0.8164	0.8164	0.8164	0.8166	0.8166	0.8164	0.8164	0.8164	0
	Alluvial deposit proportion		ALLUV	0.0547	0.0547	0.0547	0.0544	0.0544	0.0544	0.0545	0.0547	0.0547
	proportion of time soils expected to be typically quite wet		FLATWET	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
	Standard-period average annual potential evapotranspiration	mm	SAAPE	514.88	514.89	514.89	514.95	514.96	514.96	514.97	514.89	514.89
	Flood attenuation index		FAI	0.2259	0.2259	0.2258	0.2244	0.2243	0.2242	0.2241	0.2258	0.23
	Soil baseflow index		BFISOIL	0.68724806	0.68733755	0.68732659	0.68185263	0.68184869	0.68153531	0.68134457	0.68753969	0.6878
	Total length of river network above gauge	km	NETLEN	2085.035	2085.536	2086.036	2110.856	2111.356	2112.415	2113.009	2086.485	2086.485
	stream frequency	jtn/km^2	STMFRQ	1763	1763	1763	1787	1787	1789	1789	1763	1763
	Drainage density	km/km^2	DRAIND	0.751	0.751	0.751	0.753	0.753	0.753	0.753	0.751	0.751
	main stream length	km	MSL	136.895	137.395	137.895	138.844	139.347	139.774	140.368	138.345	137.917
	slope between 10%-85%	m/km	S1085	0.48933	0.47627	0.5028	0.52609	0.49212	0.49342	0.52585	0.51826	0.50327
	Taylor-Schwartz measure of mainstream slope	m/km	TAYSLO	0.156173	0.156876	0.155968	0.156876	0.156336	0.157224	0.156934	0.156872	0.155964
	Arterial drainage schemes area proportion		ARTDRAIN	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
	Arterial drainage schemes river length proportion		ARTDRAIN2	0	0	0	0	0	0	0	0	0

Note: Values in bold have been updated from orginal values. See Chapter 6 of Hydrology Report for commentry.

Appendix F – River Barrow Hydrometric Stations Review

BYRNELOOBY

To File	**From:** David Moran, Senior Engineer
Date Dec 2020	**Methodology Checked:** Stephen Neill, Senior Engineer
Subject River Barrow Hydrometric Stations Assessment	**Approved:** Seán Harrington, Associate Director

1. Introduction

The purpose of this note is to assess the hydrometric stations at Royal Oak (14018) and Graiguenamanagh d/s (14023) in relation to Graiguenamanagh u/s (14029). The later gauge is located within the scheme area while the other two are outside but have long record lengths. The assessment will focus on the suitability of integrating these data sets into the determination of Qmed at Hydrological Estimation Points on the Barrow.

2. Gauge overview

Table 2-1 provides an overview of the three stations. The Graiguenamanagh u/s station is in active operation since 1992. The station at Royal Oak is active since 1954 and has an overlapping period with the Graiguenamanagh u/s gauge. The record lengths are shown graphically in Appendix B to the GTFRS Hydrology Report.

Station Number	Station Name	Waterbody	Station	FSU Catchment Area [km^2]	Records Start	Records End
14018	ROYAL OAK	BARROW	Active	2419.4	01/09/1954	
14023	GRAIGUENAMANAGH	BARROW	Inactive	2808.13	26/09/1945	01/01/1988
14029	GRAIGUENAMANAGH U/S	BARROW	Active	2778.14	01/09/1996	

Table 2-1: Hydrometric Station Summary Details

3. Calculation of Qmed

The most reliable estimates of Qmed are obtained directly from suitable quality flood peak hydrometric data, as the median of the annual maximum (AMAX) series. For ungauged locations Qmed can be calculated using the FSU seven-variable regression equation. To refine the initial estimate of Qmed by this method data can be transferred from a suitable station. This is achieved by using an adjustment factor for Qmed calculated as the ratio of the gauged to the ungauged estimate of QMED at the gauging station. For this Scheme, the three Barrow stations were assessment to determine their impact on the calculation of Qmed.

The full record for Royal Oak (14018), Graiguenamanagh u/s (14029) and Graiguenamanagh d/s (14023) are compared in Table 3-1. Qmed is calculated using both Single Site Analysis (SSA) and the FSU seven-variable equation with urban adjustment applied. The ratio of these two are used to calculate the adjustment factor. The results show a higher adjustment factor at the Graiguenamanagh u/s station compared to the other two.

Hydrology Estimation	Station		
	14018	14029	14023
Qmed FSU [m^3/s]	142.7	175.5	170.9
Qmed SSA [m^3/s]	137.7	186.7	160.9
Adj. Factor	0.96	1.06	0.94

Table 3-1: Qmed and Adjustment Factors for Royal Oak, Graiguenamanagh u/s and Graiguenamanagh d/s stations

As shown in Table 2-1 the station record for the three gauges covers different start and finish dates. To make a direct comparison the overlapping period between Royal Oak (14019) and Graiguenamanagh u/s (14028) are compared. This is to determine if there is a consistency between the two gauges. If the two gauge are similar over this period it could merit adopting the longer record at Royal Oak as a donor site. Table 3-2 compares the two gauge records from 1996-2018 and shows that Royal Oak Station has increased its Adjustment Factor from 0.96 in its full record to 1.01 in this shortened record. However, it is still 0.05 lower than the Graiguenamanagh u/s station.

Hydrology Estimation	Station	
	14018*	14029
Qmed FSU [m^3/s]	142.7	175.5
Qmed SSA [m^3/s]	144.6	186.7
Adj. Factor	1.01	1.06

Table 3-2: Qmed and Adjustment Factors for Royal Oak, Graiguenamanagh u/s from 1996-2018

4. Royal Oak Overlap Analysis

To assess the difference in the estimation of Qmed at Royal Oak and Graiguenamanagh u/s the overlapping record period (1996-2018) was further examined. To do this the relationship and coincidence of peak Annual Maxima Flow (AMF) between the two stations was assessed to see if the peak annual maxima flow occurs at both stations during the same event. Table 4-1 shows the time difference in days between the AMF event occurring at each station on a given year. The days between peaks are colour- coded with events occurring within three days considered to be the same event [shaded in green]. Of the 23 events just 13 (59%) are found to have occurred during the same event.

Water Year	Days between AMF Peaks	Water Year	Days between AMF Peaks
1996	192.6	2008	0.4
1997	1.4	2009	4.2
1998	0.2	2010	2.7
1999	0.4	2011	135.8
2000	0.2	2012	63.9
2001	22.6	2013	0.2
2002	10.8	2014	0.9
2003	16.7	2015	0.7
2004	0.8	2016	0.2
2005	0.9	2017	51.1
2006	13.4	2018	81.4
2007	1.3		

Table 4-1: Difference in Time between of AMF Events at Royal Oak and Graiguenamanagh u/s

Figure 4-1 plots the relationship between these events. The plot shows a strong linear relationship defined by the R^2 value of 0.899. While the analysis highlights a positive relationship between the two stations a

significant proportion of AMF (Annual Maxima Flow) peaks occur during different events. These events cannot be included in the analysis and any relationship would be coincidental.

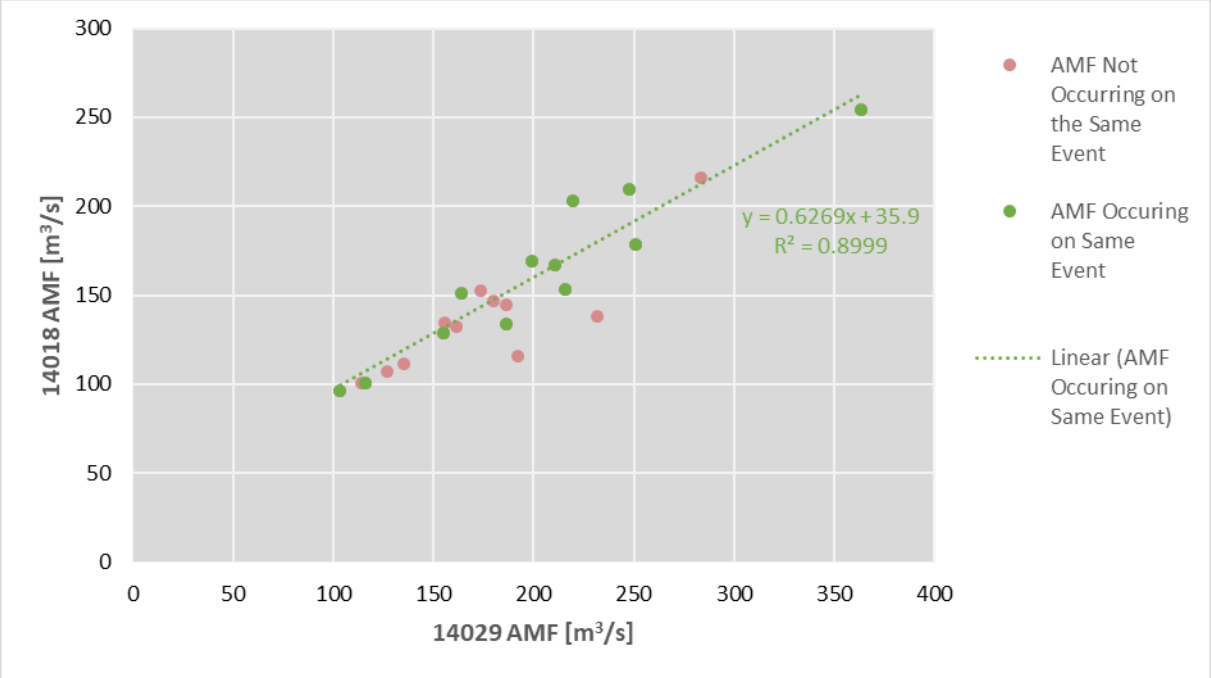


Figure 4-1: Relation Between Royal Oak 14018 and Graiguenamanagh 14029 AMF

5. Graiguenamanagh d/s Record Quality

The Graiguenamanagh u/s gauge was installed five years after the Graiguenamanagh d/s was decommissioned. As such there is no overlapping period between the two stations that could be assessed. While the new station was installed in a different location the impact and suitability of combining the two station records was considered.

Table 5-1 shows the Qmed and Adjustment factor for the two stations and also the combined record of both stations. The impact of combining the records would decrease the Qmed and Adjustment factor by 9%.

Hydrology Estimation	**Station**		
	14029	**14023**	**14023+14029**
Qmed FSU [m^3/s]	175.5	170.9	167.4
Qmed SSA [m^3/s]	186.7	160.9	162.5
Adjustment Factor	1.06	0.94	0.97

Table 5-1: : Qmed and Adjustment Factors for Graiguenamanagh u/s, Graiguenamanagh d/s and combined records

To assess the appropriate of using the Graiguenamanagh d/s the quality of the data was assessed. The rating for the site is based on a rating curve with flow gaugings up to 198m^3/s. There is no hydraulic modelled extrapolation of the record like the two other gauges as it was not modelled as part of the CFRAM study. However, this high flow gauging covers up to the fourth highest AMAX value and gives good confidence in the rating.

The completeness of the record was assessed to determine any gaps in the recorded data. Table 5-2 shows three years with no data, in addition to the four-year gap between the new gauge. There are also several years with only partial data. This will impact the analysis as during these gaps extreme events that may have occurred are not recorded. These gaps and the omission of the associated extreme in the gap period would reduce the confidence in the Qmed and frequency analysis completed, should this approach be adopted.

Water Year	Record Completeness	Water Year	Record Completeness	Water Year	Record Completeness
1945	93%	1961	94%	1977	30%
1946	84%	1962	90%	1978	57%
1947	94%	1963	90%	1979	43%
1948	94%	1964	94%	1980	71%
1949	100%	1965	71%	1981	70%
1950	74%	1966	85%	1982	54%
1951	68%	1967	71%	1983	85%
1952	73%	1968	68%	1984	70%
1953	100%	1969	77%	1985	88%
1954	83%	1970	72%	1986	87%
1955	98%	1971	24%	1987	24%
1956	99%	1972	10%	1988	0%
1957	100%	1973	52%	1989	75%
1958	100%	1974	8%	1990	100%
1959	89%	1975	0%	1991	65%
1960	88%	1976	0%		

Table 5-2: Record Completeness of Graiguenamanagh d/s station

6. Discussion

The station records at Royal Oak and Graiguenamanagh d/s were assessed to determine if they could supplement the shorter record length for the station at Graiguenamanagh u/s location in the Scheme Area. The following conclusions were found:

- The calculation of the Qmed adjustment Factor shows a lower value for both Royal Oak and Graiguenamanagh d/s compared to Graiguenamanagh u/s. When comparing the overlapping period of Royal Oak and Graiguenamanagh u/s a similar result is found. The impact of integrating data to the Graiguenamanagh u/s from the other gauges would lower the estimation of Qmed.
- There is a strong relationship between AMF flow at Royal Oak and Graiguenamanagh u/s for there overlapping records. However, only 59% of these events were shown to be occurring on the same event. This would indicate that Royal Oak is not representative of Graiguenamanagh u/s for all AMF events. Given the difference in overlapping periods it is not considered suitable to integrate the Royal Oak data.
- No overlapping period was available between the Graiguenamanagh u/s and Graiguenamanagh d/s station. The completeness record of Graiguenamanagh d/s shows several missing and partial years of data which reduces the certainty of the record.

7. Conclusion

The station records at Royal Oak and Graiguenamanagh d/s were assessed to determine if they could supplement the smaller record length for the station at Graiguenamanagh u/s location in the Scheme Area. Royal Oak is not considered suitable given the difference in the occurrence of peak events in overlapping periods. Combining Graiguenamanagh d/s with Graiguenamanagh u/s is not considered suitable due to the data gaps making the record less reliable.

Appendix G – Hydrology Estimation Inputs

Hydrological Estimation Calculations Inputs

	Name	Unit	Symbol	Dusike HEP														
				14_1116_1	14_1116_2	14_1116_3	14_200_2	14_200_3	14_201_2	14_201_3	14_1364_3	14_1364_4	14_1571_2	14_559_3	14_560_3	14_560_4	14_560_5	No Node
PCD			NODE_ID	14_1116_1	14_1116_2	14_1116_3	14_200_2	14_200_3	14_201_2	14_201_3	14_1364_3	14_1364_4	14_1571_2	14_559_3	14_560_3	14_560_4	14_560_5	0
			RWSEG_CD	14_1116	14_1116	14_1116	14_200	14_200	14_201	14_201	14_1364	14_1364	14_1571	14_559	14_560	14_560	14_560	0
			NODE_EAST	268791	269256	269663	270339	270661	270901	270901	269782	269870	270687	270661	270116	270522	270687	0
			NODE_NORTH	144526	144446	144266	144181	144046	143670	143480	143603	144115	144647	144046	145004	144728	144647	0
	Area	km2	AREA	**12.711**	**13.758**	**14.095**	**20.07**	**20.175**	**24.652**	**24.657**	**5.218**	**5.483**	**1.434**	**4.054**	**1.893**	**2.227**	**2.273**	**0.058**
			CENTE	267180	267510	267560	267900	268040	268410	268410	269190	269190	270760	269960	269400	269540	269600	0
			CENTN	143290	143290	143290	143290	143290	143530	143530	141960	142210	145390	145610	146090	145920	145900	0
	Mean Catchment Elevation	m	ALTBAR	182.7	177	173.4	169.5	168.7	156.4	156.2	177.2	169.8	79	100.8	128.5	121.6	119.8	**55**
	Standard-period average annual rainfall	mm	SAAR	**1075.8636**	**1076.91696**	**1078.35336**	**1088.86568**	**1089.12104**	**1088.17408**	**1088.206**	**1112.27368**	**1112.47584**	**1090.94048**	**1080.64096**	**1059.43544**	**1067.85168**	**1069.44768**	**1085.28**
	Index of flood attenuation by reservoirs and lakes		FARL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**1**
	Urban extent proportion		URBEXT	**0.000**	**0.000**	**0.000**	**0.000**	**0.004**	**0.014**	**0.015**	**0.000**	**0.000**	**0.000**	**0.032**	**0.000**	**0.000**	**0.000**	**0.000**
	Forest cover proportion		FOREST	0.1549	0.1449	0.1401	0.1485	0.1474	0.1225	0.1224	0.1976	0.1839	0	0.0017	0.0012	0.003	0.0029	**0**
	Peat bog proportion		PEAT	0.0528	0.0494	0.0476	0.0505	0.0502	0.0416	0.0416	0.0674	0.0627	0	0	0	0	0	**0**
	Grassland/pasture/agriculture proportion		PASTURE	0.808	0.8204	0.827	0.8146	0.8133	0.834	0.8332	0.7572	0.774	0.9877	0.9712	1	1	0.9999	**1**
	Alluvial deposit proportion		ALLUV	0.0181	0.0204	0.0221	0.0212	0.0217	0.0198	0.02	0.0122	0.0136	0.0002	0.0106	0.0108	0.0148	0.0158	**0**
	proportion of time soils expected to be typically quite wet		FLATWET	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	**0**
	Standard-period average annual potential evapotranspiration	mm	SAAPE	516.98	517.79	518.48	518.8	518.93	521.22	521.23	516.47	517.81	533.38	531.97	529.33	530.24	530.46	**0**
	Flood attenuation index		FAI	0.0523	0.0532	0.0544	0.0549	0.0559	0.0594	0.06	0.0493	0.0513	0.0323	0.0707	0.0619	0.074	0.0778	**0**
	Soil baseflow index		BFISOIL	0.659891114	0.659806751	0.659790039	0.650535867	0.650571038	0.660778129	0.66080796	0.644355085	0.644211304	0.676376618	0.661991712	0.648639289	0.648725352	0.648889462	**0.650**
	Total length of river network above gauge	km	NETLEN	13.054	13.554	14.054	19.24	19.598	23.664	23.87	3.877	4.407	1.012	3.564	1.234	1.735	1.921	**0**
	stream frequency	jtn/km^2	STMFRQ	15	15	15	19	19	23	23	3	3	1	3	1	1	1	**0**
	Drainage density	km/km^2	DRAIND	1.028	0.998	0.997	0.957	0.968	0.97	0.977	0.759	0.803	0.748	0.917	0.644	0.787	0.856	**1**
	main stream length	km	MSL	5.648	6.15	6.649	7.426	7.786	8.288	8.494	3.34	3.868	1.012	2.552	1.233	1.735	1.921	**0.6**
	slope between 10%-85%	m/km	S1085	34.7261	33.31416	30.562	27.17754	26.76616	25.67919	25.05218	66.17023	55.2094	25.69304	32.59751	31.20101	33.91594	33.67063	**38**
	Taylor-Schwartz measure of mainstream slope	m/km	TAYSLO	26.883937	26.549199	22.79395	23.396178	21.985307	18.568329	22.124988	51.983821	40.853291	0.697355	33.509182	35.161093	34.545477	33.9535	0
	Arterial drainage schemes area proportion		ARTDRAIN	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Arterial drainage schemes river length proportion		ARTDRAIN2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others	Length	m	L	5648	6150	6649	7426	7786	8288	8494	3340	3868	1012	2552	1233	1735	1921	600
	Slope	m/m	S	3.47%	3.33%	3.06%	2.72%	2.68%	2.57%	2.51%	6.62%	5.52%	2.57%	3.26%	3.12%	3.39%	3.37%	0.038
	RM SI unit conversion	constant	k	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.02778	0.027777778
	RM runoff factor	constant	C	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
	RM ToC	hr	ToC	0.92	1.00	1.09	1.25	1.30	1.38	1.42	0.48	0.57	0.27	0.51	0.30	0.37	0.40	0.16
	2-year Rainfall	mm	d	11.40	11.90	12.50	12.90	13.10	13.40	13.50	9.30	10.00	7.50	9.40	7.70	8.30	8.60	8.10
	2-year Rainfall i	mm/hr	i	12.42	11.95	11.44	10.36	10.09	9.68	9.48	19.47	17.44	27.35	18.43	25.99	22.24	21.25	51.36
	FSU adjustment factor		FSU adj															
	Winter Rainfall		WRAP Class	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2	S2
	Runoff potential based on soil type		SOIL	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Rainfall event	mm	M5-2day	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	Catchment Wetness Index	mm	CWI	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
	Ratio of M5-2day to M5-24hr		r	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
	Attenutation		Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Effective Rainfall	mm	RSMD	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
	Maximum Catchment width	m	W	2900	2900	2900	5000	5000	5000	5000	2100	2100	1100	1900	1000	1000	1000	350
	Elevation of HEP	m		37	37	37	20	20	12	10	37	37	40	20	40	40	40	20
	Average Catchment Height	m	Z	145.7	140	136.4	149.5	148.7	144.4	146.2	140.2	132.8	39	80.8	88.5	81.6	79.8	35

Barrow HEP								
14_193_3	14_193_4	14_193_5	14_198_2	14_198_3	14_199_1	14_199_2	14_193_6	14029
14_193_3	14_193_4	14_193_5	14_198_2	14_198_3	14_199_1	14_199_2	14_193_6	14029
14_193	14_193	14_193	14_198	14_198	14_199	14_199	14_193	14_193
271662	271587	271255	270684	270924	271287	271867	270901	259960
144403	143947	143709	143108	142671	142447	142367	143480	188020
2836.651	**2837.334**	**2838.082**	**2863.741**	**2864.213**	**2864.699**	**2867.752**	**2838.224**	**2838.082**
259960	259960	259960	259960	259960	259960	259960	259960	259960
188020	188020	188020	187110	187110	187110	187110	188020	188020
101.1	101.1	101.1	101.6	101.6	101.6	101.6	101.1	101.1
907.0947	**907.14645**	**907.1775**	**908.57475**	**908.61615**	**908.7507**	**908.82315**	**907.1982**	**907.1775**
0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
0.020	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**	**0.020**
0.0755	0.0755	0.0755	0.0759	0.076	0.0762	0.0763	0.0755	0.0755
0.0865	0.0865	0.0865	0.086	0.086	0.086	0.086	0.0864	0.0865
0.8164	0.8164	0.8164	0.8166	0.8166	0.8164	0.8164	0.8164	0
0.0547	0.0547	0.0547	0.0544	0.0544	0.0544	0.0545	0.0547	0.0547
0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
514.88	514.89	514.89	514.95	514.96	514.96	514.97	514.89	514.89
0.2259	0.2259	0.2258	0.2244	0.2243	0.2242	0.2241	0.2258	0.23
0.687248061	0.687337548	0.687326592	0.681852626	0.681848694	0.681535312	0.68134457	0.687539692	0.6878
2085.035	2085.536	2086.036	2110.856	2111.356	2112.415	2113.009	2086.485	2086.485
1763	1763	1763	1787	1787	1789	1789	1763	1763
0.751	0.751	0.751	0.753	0.753	0.753	0.753	0.751	0.751
136.895	137.395	137.895	138.844	139.347	139.774	140.368	138.345	137.917
0.48933	0.47627	0.5028	0.52609	0.49212	0.49342	0.52585	0.51826	0.50327
0.156173	0.156876	0.155968	0.156876	0.156336	0.157224	0.156934	0.156872	0.155964
0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
0	0	0	0	0	0	0	0	0
1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04

Appendix H – Small Catchment Qmed Estimations

Small Catchment Calculations

HEP	14_1116_1
FSU Node	14_1116_1

Summary Results

Formula	Qmed [m^3/s]
FSU Rural	3.48
FSU Urban	3.48
FSU SC	6.27
FSU SC Urb	6.27
FSU 3 Var	2.49
FSU 3 Var Urb	2.49
IH124	2.58
FEH Stat	3.32
Rational Method	1.84
ADAS345	6.49

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	12.71	
BFISOIL		0.66	
SAAR	mm	1075.864	
FARL		1	
DRAIND	km/km2	1.028	
S1085	m/km	34.73	
ARTDRAIN2		0	
Qmed Rural	m3/s	3.48	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	3.48	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	12.71	
SAAR	mm	1075.86	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	34.73	
Qmed SC	m3/s	6.27	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	6.27	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	12.71	
SAAR	mm	1075.86	
BFISOIL		0.66	
Qmed	m3/s	2.49	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	2.49	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	12.71	
SOIL		0.30	
SAAR	mm	1075.86	
Q_{BAR}	m3/s	2.68	
Qmed adj	m3/s	2.58	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.662	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	2.68	
Qmed Urb	m3/s	2.58	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	12.71	
SAAR	mm	1075.86	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	3.32	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	5648	SI unit Conversion
S	m/m	0.03	
ToC	mins	55.06	
d	mm	11.40	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	12.42	
Area	km2	12.71	
Qmed	m3/s	1.84	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	12.71	
SAAR	mm	1075.86	
SOIL		0.30	
W	m	2900	
Z	m	145.70	
T	hrs	12.06	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	12.71	
Qbar	m3/s	6.76	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	6.49	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_1116_2
FSU Node	14_1116_2

Summary Results

Formula	Qmed [m^3/s]
FSU Rural	3.69
FSU Urban	3.69
FSU SC	6.69
FSU SC Urb	6.69
FSU 3 Var	2.66
FSU 3 Var Urb	2.66
IH124	2.77
FEH Stat	3.55
Rational Method	1.92
ADAS345	6.95

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	13.76	
BFISOIL		0.66	
SAAR	mm	1076.917	
FARL		1	
DRAIND	km/km2	0.998	
S1085	m/km	33.31	
ARTDRAIN2		0	
Qmed Rural	m3/s	3.69	

FSU Urban

Qmed = UAF Qmed Rural

$$UAF = (1+URBEXT)^{1.482}$$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	3.69	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	13.76	
SAAR	mm	1076.92	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	33.31	
Qmed SC	m3/s	6.69	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	6.69	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	13.76	
SAAR	mm	1076.92	
BFISOIL		0.66	
Qmed	m3/s	2.66	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	2.66	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	13.76	
SOIL		0.30	
SAAR	mm	1076.92	
Q_{BAR}	m3/s	2.88	
Qmed adj	m3/s	2.77	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.662	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	2.88	
Qmed Urb	m3/s	2.77	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	13.76	
SAAR	mm	1076.92	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	3.55	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	6150	SI unit Conversion
S	m/m	0.03	
ToC	mins	59.74	
d	mm	11.90	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	11.95	
Area	km2	13.76	
Qmed	m3/s	1.92	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	13.76	
SAAR	mm	1076.92	
SOIL		0.30	
W	m	2900	
Z	m	140.00	
T	hrs	12.25	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	13.62	
Qbar	m3/s	7.24	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	6.95	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_1116_3
FSU Node	14_1116_3

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	3.72
FSU Urban	3.72
FSU SC	6.70
FSU SC Urb	6.70
FSU 3 Var	2.72
FSU 3 Var Urb	2.72
IH124	2.83
FEH Stat	3.64
Rational Method	1.88
ADAS345	7.08

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	14.10	
BFISOIL		0.66	
SAAR	mm	1078.353	
FARL		1	
DRAIND	km/km2	0.997	
S1085	m/km	30.56	
ARTDRAIN2		0	
Qmed Rural	m3/s	3.72	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	3.72	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	14.10	
SAAR	mm	1078.35	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	30.56	
Qmed SC	m3/s	6.70	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	6.70	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	14.10	
SAAR	mm	1078.35	
BFISOIL		0.66	
Qmed	m3/s	2.72	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	2.72	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	14.10	
SOIL		0.30	
SAAR	mm	1078.35	
Q_{BAR}	m3/s	2.95	
Qmed adj	m3/s	2.83	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.661	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	2.95	
Qmed Urb	m3/s	2.83	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	14.10	
SAAR	mm	1078.35	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	3.64	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	6649	SI unit Conversion
S	m/m	0.03	
ToC	mins	65.58	
d	mm	12.50	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	11.44	
Area	km2	14.10	
Qmed	m3/s	1.88	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	14.10	
SAAR	mm	1078.35	
SOIL		0.30	
W	m	2900	
Z	m	136.40	
T	hrs	12.38	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	13.87	
Qbar	m3/s	7.38	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	7.08	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_200_2
FSU Node	14_200_2

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	5.13
FSU Urban	5.13
FSU SC	9.25
FSU SC Urb	9.26
FSU 3 Var	3.75
FSU 3 Var Urb	3.76
IH124	3.93
FEH Stat	5.18
Rational Method	2.43
ADAS345	7.74

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.07	
BFISOIL		0.65	
SAAR	mm	1088.866	
FARL		1	
DRAIND	km/km2	0.957	
S1085	m/km	27.18	
ARTDRAIN2		0	
Qmed Rural	m3/s	5.13	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.001	
Qmed Urb	m3/s	5.13	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.07	
SAAR	mm	1088.87	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	27.18	
Qmed SC	m3/s	9.25	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.001	
Qmed SC Urb	m3/s	9.26	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.07	
SAAR	mm	1088.87	
BFISOIL		0.65	
Qmed	m3/s	3.75	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.001	
Qmed SC Urb	m3/s	3.76	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.07	
SOIL		0.30	
SAAR	mm	1088.87	
Q_{BAR}	m3/s	4.09	
Qmed adj	m3/s	3.92	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.659	
CIND		30.72	
Q_U/Q_R		1.001	
Qbar Urb	m3/s	4.09	
Qmed Urb	m3/s	3.93	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	20.07	
SAAR	mm	1088.87	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	5.18	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	7426	SI unit Conversion
S	m/m	0.03	
ToC	mins	74.70	
d	mm	12.90	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	10.36	
Area	km2	20.07	
Qmed	m3/s	2.43	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	20.07	
SAAR	mm	1088.87	
SOIL		0.30	
W	m	5000	
Z	m	149.50	
T	hrs	18.26	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	15.16	
Qbar	m3/s	8.06	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	7.74	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_200_3
FSU Node	14_200_3

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	5.16
FSU Urban	5.19
FSU SC	9.26
FSU SC Urb	9.31
FSU 3 Var	3.77
FSU 3 Var Urb	3.79
IH124	3.97
FEH Stat	5.21
Rational Method	2.37
ADAS345	7.77

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.18	
BFISOIL		0.65	
SAAR	mm	1089.121	
FARL		1	
DRAIND	km/km2	0.968	
S1085	m/km	26.77	
ARTDRAIN2		0	
Qmed Rural	m3/s	5.16	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.006	
Qmed Urb	m3/s	5.19	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.18	
SAAR	mm	1089.12	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	26.77	
Qmed SC	m3/s	9.26	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.006	
Qmed SC Urb	m3/s	9.31	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.18	
SAAR	mm	1089.12	
BFISOIL		0.65	
Qmed	m3/s	3.77	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.006	
Qmed SC Urb	m3/s	3.79	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	20.18	
SOIL		0.30	
SAAR	mm	1089.12	
Q_{BAR}	m3/s	4.11	
Qmed adj	m3/s	3.94	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.659	
CIND		30.72	
Q_U/Q_R		1.006	
Qbar Urb	m3/s	4.13	
Qmed Urb	m3/s	3.97	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	20.18	
SAAR	mm	1089.12	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	5.21	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	7786	SI unit Conversion
S	m/m	0.03	
ToC	mins	77.93	
d	mm	13.10	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	10.09	
Area	km2	20.18	
Qmed	m3/s	2.37	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	20.18	
SAAR	mm	1089.12	
SOIL		0.30	
W	m	5000	
Z	m	148.70	
T	hrs	18.30	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	15.22	
Qbar	m3/s	8.10	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	7.77	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_201_2
FSU Node	14_201_2

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	6.09
FSU Urban	6.22
FSU SC	10.86
FSU SC Urb	11.09
FSU 3 Var	4.34
FSU 3 Var Urb	4.43
IH124	4.82
FEH Stat	5.92
Rational Method	2.78
ADAS345	9.41

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.65	
BFISOIL		0.66	
SAAR	mm	1088.174	
FARL		1	
DRAIND	km/km2	0.97	
S1085	m/km	25.68	
ARTDRAIN2		0	
Qmed Rural	m3/s	6.09	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.021	
Qmed Urb	m3/s	6.22	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.65	
SAAR	mm	1088.17	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	25.68	
Qmed SC	m3/s	10.86	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.021	
Qmed SC Urb	m3/s	11.09	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.65	
SAAR	mm	1088.17	
BFISOIL		0.66	
Qmed	m3/s	4.34	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.021	
Qmed SC Urb	m3/s	4.43	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.65	
SOIL		0.30	
SAAR	mm	1088.17	
Q_{BAR}	m3/s	4.90	
Qmed adj	m3/s	4.71	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.01	Urban same as URBEXT
NC		0.659	
CIND		30.72	
Q_U/Q_R		1.024	
Qbar Urb	m3/s	5.02	
Qmed Urb	m3/s	4.82	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	24.65	
SAAR	mm	1088.17	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	5.92	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	8288	SI unit Conversion
S	m/m	0.03	
ToC	mins	83.09	
d	mm	13.40	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	9.68	
Area	km2	24.65	
Qmed	m3/s	2.78	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	24.65	
SAAR	mm	1088.17	
SOIL		0.30	
W	m	5000	
Z	m	144.40	
T	hrs	18.51	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	18.43	
Qbar	m3/s	9.80	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	9.41	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_201_3
FSU Node	14_201_3

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	6.08
FSU Urban	6.21
FSU SC	10.80
FSU SC Urb	11.03
FSU 3 Var	4.34
FSU 3 Var Urb	4.44
IH124	4.83
FEH Stat	5.92
Rational Method	2.73
ADAS345	9.44

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.66	
BFISOIL		0.66	
SAAR	mm	1088.206	
FARL		1	
DRAIND	km/km2	0.977	
S1085	m/km	25.05	
ARTDRAIN2		0	
Qmed Rural	m3/s	6.08	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.022	
Qmed Urb	m3/s	6.21	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.66	
SAAR	mm	1088.21	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	25.05	
Qmed SC	m3/s	10.80	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.022	
Qmed SC Urb	m3/s	11.03	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.66	
SAAR	mm	1088.21	
BFISOIL		0.66	
Qmed	m3/s	4.34	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.01	
UAF		1.022	
Qmed SC Urb	m3/s	4.44	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	24.66	
SOIL		0.30	
SAAR	mm	1088.21	
Q_{BAR}	m3/s	4.90	
Qmed adj	m3/s	4.71	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.01	Urban same as URBEXT
NC		0.659	
CIND		30.72	
Q_U/Q_R		1.025	
Qbar Urb	m3/s	5.03	
Qmed Urb	m3/s	4.83	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	24.66	
SAAR	mm	1088.21	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	5.92	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	8494	SI unit Conversion
S	m/m	0.03	
ToC	mins	85.49	
d	mm	13.50	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	9.48	
Area	km2	24.66	
Qmed	m3/s	2.73	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	24.66	
SAAR	mm	1088.21	
SOIL		0.30	
W	m	5000	
Z	m	146.20	
T	hrs	18.42	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	18.50	
Qbar	m3/s	9.84	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	9.44	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_1364_3
FSU Node	14_1364_3

Summary Results

Formula	Qmed [m^3/s]
FSU Rural	1.64
FSU Urban	1.64
FSU SC	3.45
FSU SC Urb	3.45
FSU 3 Var	1.27
FSU 3 Var Urb	1.27
IH124	1.21
FEH Stat	1.75
Rational Method	1.19
ADAS345	3.29

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.22	
BFISOIL		0.64	
SAAR	mm	1112.274	
FARL		1	
DRAIND	km/km2	0.759	
S1085	m/km	66.17	
ARTDRAIN2		0	
Qmed Rural	m3/s	1.64	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	1.64	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.22	
SAAR	mm	1112.27	
BFISOIL		0.64	
FARL		1.00	
S1085	m/km	66.17	
Qmed SC	m3/s	3.45	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	3.45	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.22	
SAAR	mm	1112.27	
BFISOIL		0.64	
Qmed	m3/s	1.27	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	1.27	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.22	
SOIL		0.30	
SAAR	mm	1112.27	
Q_{BAR}	m3/s	1.26	
Qmed adj	m3/s	1.21	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.649	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	1.26	
Qmed Urb	m3/s	1.21	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	5.22	
SAAR	mm	1112.27	
FARL		1.00	
BFISOIL		0.64	BFISOIL=BFIHOST
Qmed	m3/s	1.75	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	3340	SI unit Conversion
S	m/m	0.07	
ToC	mins	28.67	
d	mm	9.30	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	19.47	
Area	km2	5.22	
Qmed	m3/s	1.19	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	5.22	
SAAR	mm	1112.27	
SOIL		0.30	
W	m	2100	
Z	m	140.20	
T	hrs	9.52	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	6.45	
Qbar	m3/s	3.43	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	3.29	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_1364_4
FSU Node	14_1364_4

Summary Results

Formula	Qmed [m^3/s]
FSU Rural	1.69
FSU Urban	1.69
FSU SC	3.45
FSU SC Urb	3.45
FSU 3 Var	1.32
FSU 3 Var Urb	1.32
IH124	1.27
FEH Stat	1.83
Rational Method	1.12
ADAS345	3.41

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.48	
BFISOIL		0.64	
SAAR	mm	1112.476	
FARL		1	
DRAIND	km/km2	0.803	
S1085	m/km	55.21	
ARTDRAIN2		0	
Qmed Rural	m3/s	1.69	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	1.69	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.48	
SAAR	mm	1112.48	
BFISOIL		0.64	
FARL		1.00	
S1085	m/km	55.21	
Qmed SC	m3/s	3.45	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	3.45	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.48	
SAAR	mm	1112.48	
BFISOIL		0.64	
Qmed	m3/s	1.32	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	1.32	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	5.48	
SOIL		0.30	
SAAR	mm	1112.48	
Q_{BAR}	m3/s	1.32	
Qmed adj	m3/s	1.27	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.649	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	1.32	
Qmed Urb	m3/s	1.27	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	5.48	
SAAR	mm	1112.48	
FARL		1.00	
BFISOIL		0.64	BFISOIL=BFIHOST
Qmed	m3/s	1.83	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	3868	SI unit Conversion
S	m/m	0.06	
ToC	mins	34.41	
d	mm	10.00	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	17.44	
Area	km2	5.48	
Qmed	m3/s	1.12	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	5.48	
SAAR	mm	1112.48	
SOIL		0.30	
W	m	2100	
Z	m	132.80	
T	hrs	9.72	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	6.67	
Qbar	m3/s	3.55	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	3.41	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_1571_2
FSU Node	14_1571_2

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	0.38
FSU Urban	0.38
FSU SC	0.77
FSU SC Urb	0.77
FSU 3 Var	0.40
FSU 3 Var Urb	0.40
IH124	0.38
FEH Stat	0.50
Rational Method	0.46
ADAS345	0.89

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.43	
BFISOIL		0.68	
SAAR	mm	1090.94	
FARL		1	
DRAIND	km/km2	0.748	
S1085	m/km	25.69	
ARTDRAIN2		0	
Qmed Rural	m3/s	0.38	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	0.38	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.43	
SAAR	mm	1090.94	
BFISOIL		0.68	
FARL		1.00	
S1085	m/km	25.69	
Qmed SC	m3/s	0.77	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.77	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.43	
SAAR	mm	1090.94	
BFISOIL		0.68	
Qmed	m3/s	0.40	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.40	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.43	
SOIL		0.30	
SAAR	mm	1090.94	
Q_{BAR}	m3/s	0.39	
Qmed adj	m3/s	0.38	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.658	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	0.39	
Qmed Urb	m3/s	0.38	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	1.43	
SAAR	mm	1090.94	
FARL		1.00	
BFISOIL		0.68	BFISOIL=BFIHOST
Qmed	m3/s	0.50	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	1012	SI unit Conversion
S	m/m	0.03	
ToC	mins	16.45	
d	mm	7.50	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	27.35	
Area	km2	1.43	
Qmed	m3/s	0.46	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	1.43	
SAAR	mm	1090.94	
SOIL		0.30	
W	m	1100	
Z	m	39.00	
T	hrs	9.47	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	1.73	
Qbar	m3/s	0.92	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	0.89	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_559_3
FSU Node	14_559_3

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	1.14
FSU Urban	1.19
FSU SC	2.15
FSU SC Urb	2.25
FSU 3 Var	0.96
FSU 3 Var Urb	1.01
IH124	0.99
FEH Stat	1.25
Rational Method	0.87
ADAS345	2.23

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	4.05	
BFISOIL		0.66	
SAAR	mm	1080.641	
FARL		1	
DRAIND	km/km2	0.917	
S1085	m/km	32.60	
ARTDRAIN2		0	
Qmed Rural	m3/s	1.14	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.03	
UAF		1.048	
Qmed Urb	m3/s	1.19	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	4.05	
SAAR	mm	1080.64	
BFISOIL		0.66	
FARL		1.00	
S1085	m/km	32.60	
Qmed SC	m3/s	2.15	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.03	
UAF		1.048	
Qmed SC Urb	m3/s	2.25	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	4.05	
SAAR	mm	1080.64	
BFISOIL		0.66	
Qmed	m3/s	0.96	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.03	
UAF		1.048	
Qmed SC Urb	m3/s	1.01	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	4.05	
SOIL		0.30	
SAAR	mm	1080.64	
Q_{BAR}	m3/s	0.98	
Qmed adj	m3/s	0.94	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.03	Urban same as URBEXT
NC		0.661	
CIND		30.72	
Q_U/Q_R		1.055	
Qbar Urb	m3/s	1.03	
Qmed Urb	m3/s	0.99	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	4.05	
SAAR	mm	1080.64	
FARL		1.00	
BFISOIL		0.66	BFISOIL=BFIHOST
Qmed	m3/s	1.25	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	2552	SI unit Conversion
S	m/m	0.03	
ToC	mins	30.60	
d	mm	9.40	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	18.43	
Area	km2	4.05	
Qmed	m3/s	0.87	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	4.05	
SAAR	mm	1080.64	
SOIL		0.30	
W	m	1900	
Z	m	80.80	
T	hrs	10.92	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	4.38	
Qbar	m3/s	2.33	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	2.23	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_560_3
FSU Node	14_560_3

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	0.49
FSU Urban	0.49
FSU SC	1.05
FSU SC Urb	1.05
FSU 3 Var	0.52
FSU 3 Var Urb	0.52
IH124	0.46
FEH Stat	0.67
Rational Method	0.57
ADAS345	1.49

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.89	
BFISOIL		0.65	
SAAR	mm	1059.435	
FARL		1	
DRAIND	km/km2	0.644	
S1085	m/km	31.20	
ARTDRAIN2		0	
Qmed Rural	m3/s	0.49	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	0.49	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.89	
SAAR	mm	1059.44	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	31.20	
Qmed SC	m3/s	1.05	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	1.05	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.89	
SAAR	mm	1059.44	
BFISOIL		0.65	
Qmed	m3/s	0.52	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.52	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	1.89	
SOIL		0.30	
SAAR	mm	1059.44	
Q_{BAR}	m3/s	0.48	
Qmed adj	m3/s	0.46	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.666	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	0.48	
Qmed Urb	m3/s	0.46	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	1.89	
SAAR	mm	1059.44	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	0.67	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	1233	SI unit Conversion
S	m/m	0.03	
ToC	mins	17.78	
d	mm	7.70	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	25.99	
Area	km2	1.89	
Qmed	m3/s	0.57	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	1.89	
SAAR	mm	1059.44	
SOIL		0.30	
W	m	1000	
Z	m	88.50	
T	hrs	6.39	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	2.92	
Qbar	m3/s	1.55	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	1.49	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_560_4
FSU Node	14_560_4

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	0.62
FSU Urban	0.62
FSU SC	1.25
FSU SC Urb	1.25
FSU 3 Var	0.60
FSU 3 Var Urb	0.60
IH124	0.54
FEH Stat	0.78
Rational Method	0.58
ADAS345	1.73

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.23	
BFISOIL		0.65	
SAAR	mm	1067.852	
FARL		1	
DRAIND	km/km2	0.787	
S1085	m/km	33.92	
ARTDRAIN2		0	
Qmed Rural	m3/s	0.62	

FSU Urban

Qmed = UAF Qmed Rural

$$UAF = (1+URBEXT)^{1.482}$$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	0.62	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.23	
SAAR	mm	1067.85	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	33.92	
Qmed SC	m3/s	1.25	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	1.25	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.23	
SAAR	mm	1067.85	
BFISOIL		0.65	
Qmed	m3/s	0.60	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.60	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.23	
SOIL		0.30	
SAAR	mm	1067.85	
Q_{BAR}	m3/s	0.56	
Qmed adj	m3/s	0.54	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.664	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	0.56	
Qmed Urb	m3/s	0.54	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	2.23	
SAAR	mm	1067.85	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	0.78	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	1735	SI unit Conversion
S	m/m	0.03	
ToC	mins	22.39	
d	mm	8.30	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	22.24	
Area	km2	2.23	
Qmed	m3/s	0.58	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	2.23	
SAAR	mm	1067.85	
SOIL		0.30	
W	m	1000	
Z	m	81.60	
T	hrs	6.59	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	3.39	
Qbar	m3/s	1.80	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	1.73	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	14_560_5
FSU Node	14_560_5

Summary Results

Formula	Qmed [m^3/s]
FSU Rural	0.65
FSU Urban	0.65
FSU SC	1.28
FSU SC Urb	1.28
FSU 3 Var	0.61
FSU 3 Var Urb	0.61
IH124	0.55
FEH Stat	0.79
Rational Method	0.56
ADAS345	1.76

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.27	
BFISOIL		0.65	
SAAR	mm	1069.448	
FARL		1	
DRAIND	km/km2	0.856	
S1085	m/km	33.67	
ARTDRAIN2		0	
Qmed Rural	m3/s	0.65	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	0.65	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.27	
SAAR	mm	1069.45	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	33.67	
Qmed SC	m3/s	1.28	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	1.28	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.27	
SAAR	mm	1069.45	
BFISOIL		0.65	
Qmed	m3/s	0.61	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.61	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	2.27	
SOIL		0.30	
SAAR	mm	1069.45	
Q_{BAR}	m3/s	0.58	
Qmed adj	m3/s	0.55	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.663	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	0.58	
Qmed Urb	m3/s	0.55	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	2.27	
SAAR	mm	1069.45	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	0.79	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	1921	SI unit Conversion
S	m/m	0.03	
ToC	mins	24.29	
d	mm	8.60	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	21.25	
Area	km2	2.27	
Qmed	m3/s	0.56	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	2.27	
SAAR	mm	1069.45	
SOIL		0.30	
W	m	1000	
Z	m	79.80	
T	hrs	6.65	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	3.44	
Qbar	m3/s	1.83	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	1.76	Qbar to Qmed = 0.96 GF

Small Catchment Calculations

HEP	No Node
FSU Node	No Node

Summary Results

Formula	**Qmed [m^3/s]**
FSU Rural	0.02
FSU Urban	0.02
FSU SC	0.05
FSU SC Urb	0.05
FSU 3 Var	0.03
FSU 3 Var Urb	0.03
IH124	0.02
FEH Stat	0.04
Rational Method	0.03
ADAS345	0.07

FSU STATISTICAL METHOD

$$Q_{med} = 1.237 \times 10^{-5} Area^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARDDRAIN2)^{0.408}$$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	0.06	
BFISOIL		0.65	
SAAR	mm	1085.28	
FARL		1	
DRAIND	km/km2	1	
S1085	m/km	38.00	
ARTDRAIN2		0	
Qmed Rural	m3/s	0.02	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed Urb	m3/s	0.02	

FSU SMALL CATCHMENTS STATISTICAL METHOD

$Q_{med} = 2.3848 \times 10^{-5} Area^{0.9245} SAAR^{1.2695} BFI^{-0.9030} FARL^{2.3163} S1085^{0.2513}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	0.06	
SAAR	mm	1085.28	
BFISOIL		0.65	
FARL		1.00	
S1085	m/km	38.00	
Qmed SC	m3/s	0.05	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.05	

FSU 3 Variable

$Q_{med} = 0.000302 Area^{0.829} SAAR^{0.898} BFI^{-1.539}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	0.06	
SAAR	mm	1085.28	
BFISOIL		0.65	
Qmed	m3/s	0.03	

FSU Urban

Qmed = UAF Qmed Rural

$UAF = (1+URBEXT)^{1.482}$

Symbol	*Unit*	*Value*	*Comment*
URBEXT		0.00	
UAF		1.000	
Qmed SC Urb	m3/s	0.03	

IH124

$QBAR=0.00108AREA^{0.89}SOIL^{2.17}SAAR^{1.17}$

Symbol	*Unit*	*Value*	*Comment*
AREA	km2	0.06	
SOIL		0.30	
SAAR	mm	1085.28	
Q_{BAR}	m3/s	0.02	
Qmed adj	m3/s	0.02	Qbar to Qmed = 0.96 GF

IH124 Urban

$Q_U/Q_R = (1+URBAN)^{2NC}[1+URBAN((21/CIND)-0.3)]$

Where:

NC = 0.92-0.00024(SAAR) [for 500<=SAAR<= 1100mm]

NC = 0.74-0.000082(SAAR) [for 1100<=SAAR<= 3000mm]

CIND = 102.4(SOIL)+0.28(CWI-125)

Symbol	*Unit*	*Value*	*Comment*
CWI	mm	125	
URBEXT		0.00	Urban same as URBEXT
NC		0.660	
CIND		30.72	
Q_U/Q_R		1.000	
Qbar Urb	m3/s	0.02	
Qmed Urb	m3/s	0.02	Qbar to Qmed = 0.96 GF

FEH Stat

$$QMED = 8.3062 AREA^{0.851} 0.1536^{\left(\frac{1000}{SAAR}\right)} FARL^{3.4451} 0.046^{BFIHOST^2}$$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	0.06	
SAAR	mm	1085.28	
FARL		1.00	
BFISOIL		0.65	BFISOIL=BFIHOST
Qmed	m3/s	0.04	

Rational Method

$Q = k\ C\ i\ A$

Where duration of i is equal to ToC

$ToC = 0.0195\ L^{0.77}\ S^{-0.385}$

Symbol	*Unit*	*Value*	*Comment*
L	m	600	SI unit Conversion
S	m/m	0.04	
ToC	mins	9.46	
d	mm	8.10	2-yr rain depth from FSU portal for ToC duration

Symbol	*Unit*	*Value*	*Comment*
k	constant	0.02778	SI unit Conversion
C	constant	0.42	
i	mm/hr	51.36	
Area	km2	0.06	
Qmed	m3/s	0.03	

ADAS345

$Q = Area\ (0.0443\ SAAR - 11.19)\ SOIL^{2.0} * [(18.79T^{0.28} - 1) / 10T]$

Where:

$T = 0.1677\ (W^{0.78}/Z^{0.39})$

Symbol	*Unit*	*Value*	*Comment*
Area	km2	0.06	
SAAR	mm	1085.28	
SOIL		0.30	
W	m	350	
Z	m	35.00	
T	hrs	4.04	

Symbol	*Unit*	*Value*	*Comment*
Q	m3/s	0.13	
Qbar	m3/s	0.07	*Q = 75-year RT = 1.88 regional GF [FSR 1975]*
Qmed	m3/s	0.07	Qbar to Qmed = 0.96 GF

Appendix I – Pooling Groups

BYRNELOOBY

To File	**From:** David Moran, Senior Engineer
Date Dec 2020	**Methodology Checked**: Stephen Neill, Senior Engineer
Subject Duiske Pooling Group	**Approved**: Seán Harrington, Associate Director

POOLING GROUP STATIONS FOR HEP 5B

Station	Euclidean DIST(ij)	# years in FSU database	Cumulative # station-years	
25040	0.259	19	19	✖
16051	0.821	13	32	✖
13002	0.893	19	51	✖
22009	0.947	24	75	✖
06031	1.062	18	93	✖
26022	1.144	33	126	✖
16006	1.161	33	159	✖
19020	1.201	28	187	✖
19046	1.204	9	196	✖
26010	1.253	35	231	✖
26018	1.322	48	279	✖
25023	1.356	33	312	✖
09010	1.362	19	331	✖
29001	1.41	40	371	✖
16005	1.417	30	401	✖
10022	1.43	17	418	✖
10021	1.445	24	442	✖
26009	1.446	35	477	✖
14009	1.449	25	502	✖
25044	1.475	40	542	
26020	1.486	33	575	
09035	1.501	9	584	
06026	1.506	46	630	
06012	1.511	47	677	

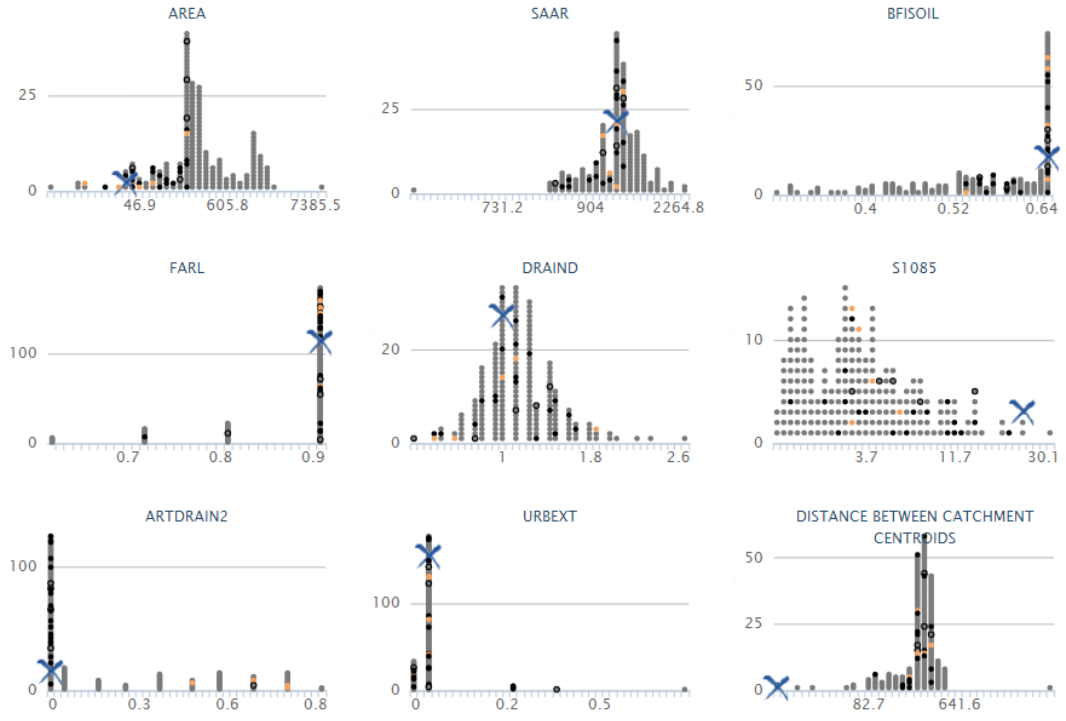
Legend: Pooled Auxiliary Selected

Excluded Station	Euclidean DIST(ij)	# years in FSU database
30020	0.899	16
25034	0.959	26
26058	1.048	24
24022	1.158	20
25027	1.253	42

Cancel Accept Group

POOLING GROUP STATION CATS PLOTS FOR HEP 5B

Table View | CATs



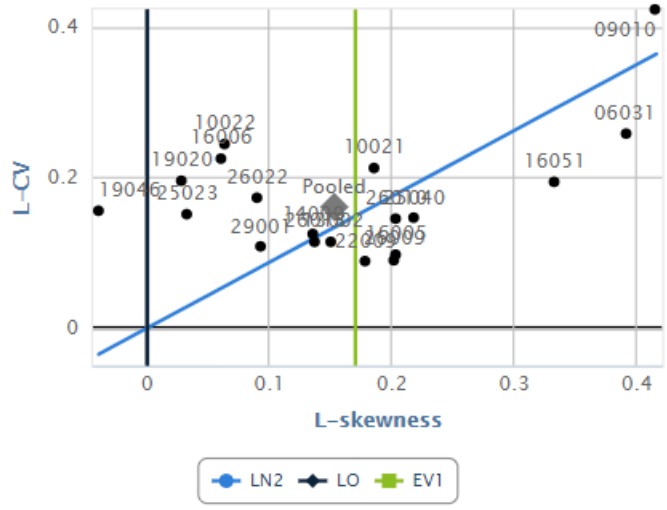
subject site station

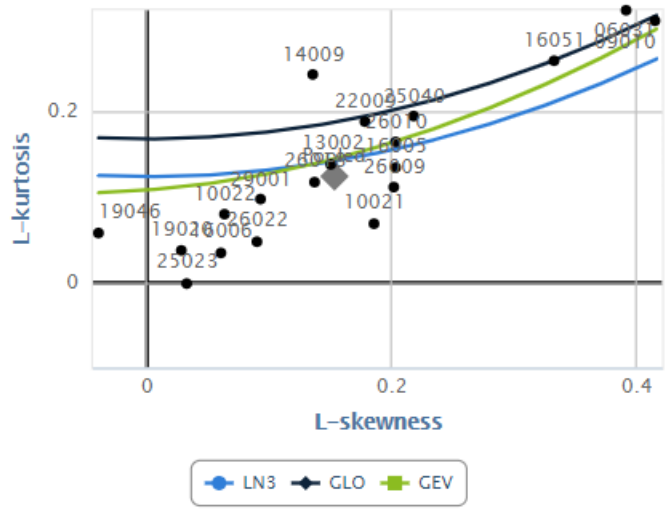
pooled station auxiliary station excluded station

Query the black discs that plot a long way from the subject site by pressing the "Filter" button

Filter | Cancel | Accept Group

POOLING GROUP ANALYSIS PLOTS FOR HEP 5B





Appendix J – Design Flows

Current

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_193_3	2836.651	186.356	244.127	281.398	318.669	367.122	402.529	437.937	519.934
Lateral 14_193_3 to 14_193_4	0.683	0.045	0.059	0.068	0.077	0.088	0.097	0.105	0.125
14_193_4	2837.334	186.401	244.185	281.465	318.746	367.210	402.626	438.042	520.059
Lateral 14_193_4 to 14029	0.748	0.049	0.064	0.074	0.084	0.097	0.106	0.115	0.137
14029	2838.082	186.450	244.250	281.540	318.830	367.307	402.732	438.158	520.196
Lateral 14029 to 14_193_6	0.142	0.009	0.012	0.014	0.016	0.018	0.020	0.022	0.026
14_193_6	2838.224	186.459	244.262	281.554	318.846	367.325	402.752	438.180	520.222
Duiske Lateral 14_193_6	24.66 0.86	6.267	7.961	9.090	10.158	11.476	12.481	13.423	15.560
14_198_2	2863.741	192.726	252.223	290.644	329.003	378.802	415.233	451.603	535.781
Lateral 14_198_2 to 14_198_3	0.472	0.031	0.041	0.047	0.053	0.061	0.067	0.073	0.087
14_198_3	2864.213	192.757	252.264	290.691	329.056	378.863	415.300	451.676	535.868
Lateral 14_198_3 to 14_199_1	0.486	0.032	0.042	0.048	0.055	0.063	0.069	0.075	0.089
14_199_1	2864.699	192.789	252.306	290.739	329.111	378.926	415.369	451.751	535.957
Lateral 14_199_1 to 14_199_2	3.053	0.201	0.263	0.303	0.343	0.395	0.433	0.471	0.560
14_199_2	2867.752	192.990	252.568	291.042	329.454	379.321	415.802	452.222	536.517

Duiske

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1116_1	12.711	3.202	4.066	4.642	5.187	5.859	6.371	6.851	7.940
Lateral 14_1116_1 to 14_1116_2	1.047	0.264	0.335	0.382	0.427	0.483	0.525	0.564	0.654
14_1116_2	13.758	3.465	4.401	5.025	5.614	6.341	6.896	7.416	8.594
Lateral 14_1116_2 to 14_1116_3	0.492	0.124	0.157	0.180	0.201	0.227	0.247	0.265	0.307
14_1116_3	14.095	3.550	4.509	5.148	5.751	6.497	7.065	7.597	8.804
Lateral 14_1116_3 to 14_200_2	5.82	1.466	1.862	2.126	2.375	2.683	2.917	3.137	3.635
14_200_2	20.07	5.055	6.420	7.330	8.189	9.251	10.060	10.818	12.537
Lateral 14_200_2 to 14_200_3	0.105	0.026	0.034	0.038	0.043	0.048	0.053	0.057	0.066
14_200_3	20.175	5.082	6.454	7.368	8.232	9.299	10.112	10.875	12.602
Lateral 14_200_3 to 14_201_2	4.477	1.128	1.432	1.635	1.827	2.064	2.244	2.413	2.797

14_201_2	24.652	6.209	7.886	9.003	10.059	11.363	12.356	13.288	15.399
Lateral 14_201_2 to 14_201_3	0.005	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003
14_201_3	24.657	6.210	7.887	9.005	10.061	11.365	12.359	13.290	15.402

Duiske South

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1364_3	5.218	1.314	1.669	1.906	2.129	2.405	2.615	2.813	3.259
Lateral 14_1364_3 to 14_1364_4	0.265	0.067	0.085	0.097	0.108	0.122	0.133	0.143	0.166
14_1364_4	5.483	1.381	1.754	2.002	2.237	2.527	2.748	2.955	3.425

Kileen

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
Kileen u/s	1.151	0.290	0.368	0.420	0.470	0.531	0.577	0.620	0.719
Lateral Kileen u/s to 14_1364_4	0.283	0.071	0.091	0.103	0.115	0.130	0.142	0.153	0.177
14_1571_2	1.434	0.361	0.459	0.524	0.585	0.661	0.719	0.773	0.896
Lateral 14_1571_2 to 14_559_3	2.62	0.660	0.838	0.957	1.069	1.208	1.313	1.412	1.637
14_559_3	4.054	1.021	1.297	1.481	1.654	1.869	2.032	2.185	2.532

Note: HEP Kileen u/s added for u/s extent of model, no FSU node at location

Newtown

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_560_3	1.893	0.477	0.606	0.691	0.772	0.873	0.949	1.020	1.182
Lateral 14_560_3 to 14_560_4	0.334	0.084	0.107	0.122	0.136	0.154	0.167	0.180	0.209
14_560_4	2.227	0.561	0.712	0.813	0.909	1.026	1.116	1.200	1.391
Lateral 14_560_3 to 14_560_4	0.046	0.012	0.015	0.017	0.019	0.021	0.023	0.025	0.029
14_560_5	2.273	0.573	0.727	0.830	0.927	1.048	1.139	1.225	1.420

R705

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
R705 u/s	0.021	0.005	0.007	0.008	0.009	0.010	0.011	0.011	0.013
Lateral Kileen u/s to 14_1364_4	0.037	0.009	0.012	0.014	0.015	0.017	0.019	0.020	0.023
14_561_1	0.058	0.015	0.019	0.021	0.024	0.027	0.029	0.031	0.036

Note: HEP R705 u/s added for u/s extent of model, no FSU node at location

MRFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_193_3	2836.651	223.627	292.952	337.677	382.403	440.546	483.035	525.524	623.920
Lateral 14_193_3 to 14_193_4	0.683	0.054	0.071	0.081	0.092	0.106	0.116	0.127	0.150
14_193_4	2837.334	223.681	293.022	337.759	382.495	440.652	483.151	525.651	624.070
Lateral 14_193_4 to 14029	0.748	0.059	0.077	0.089	0.101	0.116	0.127	0.139	0.165
14029	2838.082	223.740	293.100	337.848	382.596	440.768	483.279	525.789	624.235
Lateral 14029 to 14_193_6	0.142	0.011	0.015	0.017	0.019	0.022	0.024	0.026	0.031
14_193_6	2838.224	223.751	293.114	337.865	382.615	440.790	483.303	525.816	624.266
Lateral 14_193_6	24.657 0.86	7.520	9.554	10.909	12.189	13.772	14.977	16.108	18.671
14_198_2	2863.741	231.272	302.668	348.773	394.804	454.562	498.280	541.923	642.938
Lateral 14_198_2 to 14_198_3	0.472	0.037	0.049	0.056	0.064	0.073	0.080	0.087	0.104
14_198_3	2864.213	231.309	302.717	348.829	394.867	454.635	498.360	542.011	643.042
Lateral 14_198_3 to 14_199_1	0.486	0.038	0.050	0.058	0.066	0.075	0.083	0.090	0.107
14_199_1	2864.699	231.347	302.767	348.887	394.933	454.711	498.443	542.101	643.148
Lateral 14_199_1 to 14_199_2	3.053	0.241	0.315	0.363	0.412	0.474	0.520	0.566	0.672
14_199_2	2867.752	231.588	303.082	349.251	395.345	455.185	498.963	542.666	643.820

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1116_1	12.711	3.842	4.879	5.571	6.224	7.031	7.645	8.222	9.528
Lateral 14_1116_1 to 14_1116_2	1.047	0.316	0.402	0.459	0.513	0.579	0.630	0.677	0.785
14_1116_2	13.758	4.158	5.281	6.030	6.736	7.610	8.275	8.899	10.313
Lateral 14_1116_2 to 14_1116_3	0.492	0.149	0.189	0.216	0.241	0.272	0.296	0.318	0.369
14_1116_3	14.095	4.260	5.410	6.177	6.902	7.796	8.478	9.117	10.565
Lateral 14_1116_3 to 14_200_2	5.82	1.759	2.234	2.551	2.850	3.219	3.501	3.764	4.363
14_200_2	20.07	6.066	7.704	8.796	9.827	11.101	12.072	12.981	15.044
Lateral 14_200_2 to 14_200_3	0.105	0.032	0.040	0.046	0.051	0.058	0.063	0.068	0.079
14_200_3	20.175	6.098	7.744	8.842	9.879	11.159	12.135	13.049	15.123
Lateral 14_200_3 to 14_201_2	4.477	1.353	1.719	1.962	2.192	2.476	2.693	2.896	3.356

14_201_2	24.652	7.451	9.463	10.804	12.071	13.635	14.828	15.945	18.479
Lateral 14_201_2 to 14_201_3	0.005	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.004
14_201_3	24.657	7.453	9.465	10.806	12.073	13.638	14.831	15.948	18.482

MRFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1364_3	5.218	1.577	2.003	2.287	2.555	2.886	3.138	3.375	3.911
Lateral 14_1364_3 to 14_1364_4	0.265	0.080	0.102	0.116	0.130	0.147	0.159	0.171	0.199
14_1364_4	5.483	1.657	2.105	2.403	2.685	3.033	3.298	3.546	4.110

MRFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
Kileen u/s	1.151	0.348	0.442	0.504	0.564	0.637	0.692	0.744	0.863
Lateral Kileen u/s to 14_1364_4	0.283	0.086	0.109	0.124	0.139	0.157	0.170	0.183	0.212
14_1571_2	1.434	0.433	0.550	0.628	0.702	0.793	0.863	0.928	1.075
Lateral 14_1571_2 to 14_559_3	2.62	0.792	1.006	1.148	1.283	1.449	1.576	1.695	1.964
14_559_3	4.054	1.225	1.556	1.777	1.985	2.242	2.438	2.622	3.039

MRFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_560_3	1.893	0.572	0.727	0.830	0.927	1.047	1.139	1.224	1.419
Lateral 14_560_3 to 14_560_4	0.334	0.101	0.128	0.146	0.164	0.185	0.201	0.216	0.250
14_560_4	2.227	0.673	0.855	0.976	1.090	1.232	1.339	1.440	1.669
Lateral 14_560_3 to 14_560_4	0.046	0.014	0.018	0.020	0.023	0.025	0.028	0.030	0.034
14_560_5	2.273	0.687	0.873	0.996	1.113	1.257	1.367	1.470	1.704

MRFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
R705 u/s	0.021	0.006	0.008	0.009	0.010	0.012	0.013	0.014	0.016
Lateral Kileen u/s to 14_1364_4	0.037	0.011	0.014	0.016	0.018	0.020	0.022	0.024	0.028
14_561_1	0.058	0.018	0.022	0.025	0.028	0.032	0.035	0.038	0.043

HEFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_193_3	2836.651	242.263	317.364	365.817	414.270	477.258	523.288	569.318	675.914
Lateral 14_193_3 to 14_193_4	0.683	0.058	0.076	0.088	0.100	0.115	0.126	0.137	0.163
14_193_4	2837.334	242.321	317.441	365.905	414.369	477.373	523.414	569.455	676.076
Lateral 14_193_4 to 14029	0.748	0.064	0.084	0.096	0.109	0.126	0.138	0.150	0.178
14029	2838.082	242.385	317.525	366.002	414.479	477.499	523.552	569.605	676.255
Lateral 14029 to 14_193_6	0.142	0.012	0.016	0.018	0.021	0.024	0.026	0.028	0.034
14_193_6	2838.224	242.397	317.540	366.020	414.499	477.523	523.578	569.634	676.288
Lateral 14_193_6	24.657 0.86	8.147	10.350	11.818	13.205	14.919	16.225	17.450	20.227
14_198_2	2863.741	250.544	327.890	377.838	427.704	492.442	539.803	587.084	696.516
Lateral 14_198_2 to 14_198_3	0.472	0.040	0.053	0.061	0.069	0.079	0.087	0.095	0.112
14_198_3	2864.213	250.585	327.943	377.898	427.773	492.521	539.890	587.178	696.628
Lateral 14_198_3 to 14_199_1	0.486	0.042	0.054	0.063	0.071	0.082	0.090	0.098	0.116
14_199_1	2864.699	250.626	327.997	377.961	427.844	492.603	539.980	587.276	696.744
Lateral 14_199_1 to 14_199_2	3.053	0.261	0.342	0.394	0.446	0.514	0.563	0.613	0.727
14_199_2	2867.752	250.887	328.339	378.355	428.290	493.117	540.543	587.889	697.472

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1116_1	12.711	4.994	6.343	7.242	8.091	9.140	9.939	10.688	12.386
Lateral 14_1116_1 to 14_1116_2	1.047	0.411	0.522	0.597	0.666	0.753	0.819	0.880	1.020
14_1116_2	13.758	5.406	6.865	7.838	8.757	9.893	10.758	11.568	13.406
Lateral 14_1116_2 to 14_1116_3	0.492	0.193	0.246	0.280	0.313	0.354	0.385	0.414	0.479
14_1116_3	14.095	5.538	7.034	8.030	8.972	10.135	11.021	11.852	13.735
Lateral 14_1116_3 to 14_200_2	5.82	2.287	2.904	3.316	3.705	4.185	4.551	4.894	5.671
14_200_2	20.07	7.886	10.015	11.435	12.775	14.431	15.693	16.876	19.557
Lateral 14_200_2 to 14_200_3	0.105	0.041	0.052	0.060	0.067	0.076	0.082	0.088	0.102
14_200_3	20.175	7.927	10.068	11.494	12.842	14.507	15.775	16.964	19.659
Lateral 14_200_3 to 14_201_2	4.477	1.759	2.234	2.551	2.850	3.219	3.501	3.765	4.363

14_201_2	24.652	9.686	12.302	14.045	15.692	17.726	19.276	20.729	24.022
Lateral 14_201_2 to 14_201_3	0.005	0.002	0.002	0.003	0.003	0.004	0.004	0.004	0.005
14_201_3	24.657	9.688	12.304	14.048	15.695	17.730	19.280	20.733	24.027

HEFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_1364_3	5.218	2.050	2.604	2.973	3.321	3.752	4.080	4.388	5.085
Lateral 14_1364_3 to 14_1364_4	0.265	0.104	0.132	0.151	0.169	0.191	0.207	0.223	0.258
14_1364_4	5.483	2.154	2.736	3.124	3.490	3.943	4.287	4.610	5.343

HEFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
Kileen u/s	1.151	0.452	0.574	0.656	0.733	0.828	0.900	0.968	1.122
Lateral Kileen u/s to 14_1364_4	0.283	0.111	0.141	0.161	0.180	0.203	0.221	0.238	0.276
14_1571_2	1.434	0.563	0.716	0.817	0.913	1.031	1.121	1.206	1.397
Lateral 14_1571_2 to 14_559_3	2.62	1.029	1.307	1.493	1.668	1.884	2.049	2.203	2.553
14_559_3	4.054	1.593	2.023	2.310	2.581	2.915	3.170	3.409	3.950

HEFS

HEP	Area [km2]	AEP							
		50%	20%	10%	5%	2%	1%	0.5%	0.1%
14_560_3	1.893	0.744	0.945	1.079	1.205	1.361	1.480	1.592	1.845
Lateral 14_560_3 to 14_560_4	0.334	0.131	0.167	0.190	0.213	0.240	0.261	0.281	0.325
14_560_4	2.227	0.875	1.111	1.269	1.418	1.601	1.741	1.873	2.170
Lateral 14_560_3 to 14_560_4	0.046	0.018	0.023	0.026	0.029	0.033	0.036	0.039	0.045
14_560_5	2.273	0.893	1.134	1.295	1.447	1.634	1.777	1.911	2.215

HEFS

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		50%	20%	10%	5%	2%	1%	0.5%	0.1%
R705 u/s	0.021	0.008	0.010	0.012	0.013	0.015	0.016	0.018	0.020
Lateral Kileen u/s to 14_1364_4	0.037	0.015	0.018	0.021	0.024	0.027	0.029	0.031	0.036
14_561_1	0.058	0.023	0.029	0.033	0.037	0.042	0.045	0.049	0.057