B Appendix: Damage Assessment

Annual Average Damage

Sheet Nr. 1

Client/Authority
Highland Council

Project name
Nairn FRM

Project reference 2022s0654
Base date for estimates (year 0) 01/01/2022
Scaling factor (e.g. £m, £k, £) £k

Applicable year (if time varying) 2022

Option:
Do Nothing

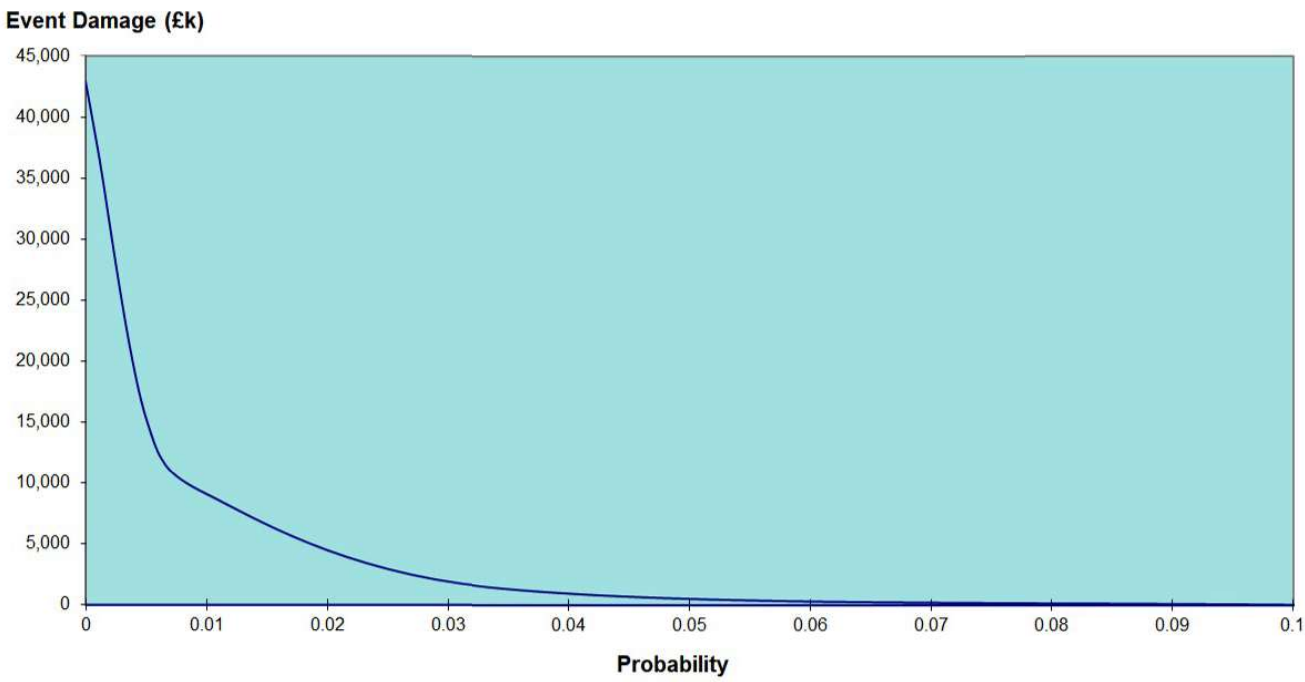
First year of damage:	0	Prepared (date)	09/05/2023
Last year of period:	99	Printed	09/05/2023
PV factor standard rate:	29.8	Prepared by	Rowan Callaghan
PV factor health rate:	54.4	Checked by	Jonathan Garret
		Checked date	09/05/2023

			Average waiting time (yrs) between events/frequency per year							Total PV	
			5	10	30	100	200	1000	Infinity	£k	
			0.200	0.100	0.033	0.010	0.005	0.001	0		
Residential property count			0	0	44	182	253	489			
Non-residential property count			0	0	8	29	41	65			
Total property counts			0	0	52	211	294	554			
Standard Discount Rate				Damage £k							**Capped damages (£k)**
Residential property	0		0	33	1,018	5,861	9,547	23,446	26,921	7353	7,333
Non-Residential property	0		0	0	82	465	1,183	3,674	4,296	803	803
Temporary accommodation	0		0	0	104	718	1,199	1,892	2,065	775	775
Vehicles	0		0	0	0	597	1,062	2,923	3,389	663	663
Indirect commercial damages	0		0	0	2	14	35	110	129	24	24
Health Discount Rate											
Mental Health	0		0	0	212	1,103	1,754	4,008	4,572	2466	2,466
Emergency services	0		0	2	57	328	535	1,313	1,508	751	751
Total Damage per event £k	**0**	**0**	**0**	**35**	**1,475**	**9,087**	**15,315**	**37,366**	**42,879**	**12,835**	**12,815**
Total damage (standard rate)	0	0	0	33	1,206	7,655	13,027	32,045	36,799		
Area (damagexfrequency)		0	0	2	41	103	52	90	34		
Total damage (health rate)	0	0	0	2	269	1,432	2,288	5,321	6,079		
Area (damagexfrequency)		0	0	0	9	20	9	15	6		

	Standard	Health			Uncapped PV	Capped PV
Total area, as above	323	59				
Present value (assuming no change in damage or event frequency)	9,618	3,217	Total	12,835	12,835	12,815

Notes
Area calculations assume drop to zero at maximum probability.
Default value for the highest possible (infinity) damage assumes continuation of gradient for last two points, an alternative value can be entered, if appropriate.
One form should be completed for each option, including 'without project', and for each representative year if profile changes during scheme life (e.g. sea-level rise)

Nairn Event Damage Curve



C Appendix: Model Log

C.1 Model log (1D)

The model log for the 1D domain below shows the 1D .dat file (geometry file), 1D event data file, 1D initial conditions file, 1D run file (simulation file), cumulative mass balance error and non-convergence outputs for the 71 model runs.

Scenario	Event	RP- Fluvial	RP- Coastal	Dat file (1D geometry)	IED file (1D fluvial input)	IED file (1D tidal input)	IIC file (1D initial conditions)	IEF (run file) / results file name	1D MB	unconverged
DM	FL	1997	1997	NAI01_FM_09A_DM_v02.dat	NAI01_AUL01_1997event_Fluvial_v02	1997_Tidal_Curve_1D2D	NAIRN_7CDM_1997_FL_1997_CO_STEADY.ZZS	Nairn_9aDM_1997_FL_1997_CO_1D2D	4.75%	0.00%
DN	FL and CO	2yr	2yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	2yr_Tidal_Curve	NAIRN_07DN_2YR_FL_2YR_CO_1D2D.IIC	Nairn_9aDN_2yr_FL_2yr_CO_1D2D	0.76%	0.00%
DN	FL	5yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_5yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_5YR_FL_2YR_CO_1D2D.IIC	Nairn_9aDN_5yr_FL_2yr_CO_1D2D	0.52%	0.00%
DN	FL	10yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_10yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_10YR_FL_2YR_CO_1D2D.IIC	Nairn_9aDN_10yr_FL_2yr_CO_1D2D	1.39%	0.00%
DN	FL	30yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_30yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_30YR_FL_2YR_CO_1D2D.IIC	Nairn_9aDN_30yr_FL_2yr_CO_1D2D	2.54%	0.00%
DN	FL	100yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_100yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_100YR_FL_2YR_CO_1D2D.IIC	Nairn_9aDN_100yr_FL_2yr_CO_1D2D	7.14%	0.00%
DN	FL	200yr	5	NAI01_FM_09E_DN.dat	NAI01_AUL01_200yr_Fluvial_v02	5yr_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_9aDN_200yr_FL_5yr_CO_1D2D	-3.60%	0.00%
DN	FL	1000yr	10	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_1000yr_AUL01_10yr_Fluvial	10yr_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_9aDN_1000y_FL_10yr_CO_1D2D	0.42%	0.00%
DN	FL (AUL)	1000yr	10	NAI01_FM_09A_DN.dat	NAI01_10yr_AUL01_1000yr_Fluvial	10yr_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_9aDN_1000y_AUL_10yr_CO_1D2D	1.50%	0.00%
DN	FL	200yrCC1	5yrCC1	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_200yrCC1_AUL01_5yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_9aDN_200yrCC1_FL_5yrCC1_CO_1D2D	1.51%	0.00%
DN	FL (AUL)	200yrCC1	5yrCC1	NAI01_FM_09A_DN.dat	NAI01_5yrCC1_AUL01_200yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_200yrCC1_AUL_5yrCC1_CO_1D2D	0.61%	0.00%
DN	FL	200yrCC2	5yrCC2	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_200yrCC2_AUL01_5yrCC2_Fluvial	5yrCC2_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_9aDN_200yrCC2_FL_5yrCC2_CO_1D2D	-2.72%	0.00%
DN	FL (AUL)	200yrCC2	5yrCC2	NAI01_FM_09A_DN.dat	NAI01_5yrCC2_AUL01_200yrCC2_Fluvial	5yrCC2_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_200yrCC2_AUL_5yrCC2_CO_1D2D	1.41%	0.00%
DN	FL	1000yrCC1	10yrCC1	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_1000yrCC1_AUL01_10yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_9aDN_1000yrCC1_FL_10yrCC1_CO_1D2D	4.87%	0.02%
DN	FL (AUL)	1000yrCC1	10yrCC1	NAI01_FM_09A_DN.dat	NAI01_10yrCC1_AUL01_1000yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_1000yrCC1_AUL_10yrCC1_CO_1D2D	1.61%	0.00%
DN	FL	1000yrCC2	10yrCC2	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_1000yrCC2_AUL01_10yrCC2_Fluvial	10yrCC2_Tidal_Curve	NAIRN_006E_200YR_UNSTEADY.IIC	Nairn_9aDN_1000yrCC2_FL_10yrCC2_CO_1D2D	-3.37%	0.00%
DN	FL (AUL)	1000yrCC2	10yrCC2	NAI01_FM_09A_DN.dat	NAI01_10yrCC2_AUL01_1000yrCC2_Fluvial	10yrCC2_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_1000yrCC2_AUL_10yrCC2_CO_1D2D	-1.27%	0.00%
DN	CO	2	5yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	5yr_Tidal_Curve	NAIRN_07DN_2YR_FL_5YR_CO_1D2D.IIC	Nairn_9aDN_2yr_FL_5yr_CO_1D2D	0.73%	0.00%
DN	CO	2	10yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	10yr_Tidal_Curve	NAIRN_07DN_2YR_FL_10YR_CO_1D2D.IIC	Nairn_9aDN_2yr_FL_10yr_CO_1D2D	0.66%	0.00%
DN	CO	2	30yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	30yr_Tidal_Curve	NAIRN_07DN_2YR_FL_30YR_CO_1D2D.IIC	Nairn_9aDN_2yr_FL_30yr_CO_1D2D	0.65%	0.00%
DN	CO	2	100yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	100yr_Tidal_Curve	NAIRN_07DN_2YR_FL_100YR_CO_1D2D.IIC	Nairn_9aDN_2yr_FL_100yr_CO_1D2D	0.62%	0.00%
DN	CO	5	200yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_5yr_Fluvial_v02	200yr_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_9aDN_5yr_FL_200yr_CO_1D2D	0.48%	0.00%
DN	CO	10	1000yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_10yr_Fluvial_v02	1000yr_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_9aDN_10yr_FL_1000yr_CO_1D2D	1.29%	0.00%
DN	CO	5yrCC1	200yrCC1	NAI01_FM_09A_DN.dat	NAI01_5yrCC1_AUL01_5yrCC1_Fluvial	200yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_5yrCC1_FL_200yrCC1_CO_1D2D	-0.09%	0.00%
DN	CO	5yrCC2	200yrCC2	NAI01_FM_09A_DN.dat	NAI01_5yrCC2_AUL01_5yrCC2_Fluvial	200yrCC2_Tidal_Curve	NAIRN_07DN_5YRCC2_FL_200YRCC2_CO_1D2D_DN.IIC	Nairn_9aDN_5yrCC2_FL_200yrCC2_CO_1D2D	-0.07%	0.00%
DN	CO	10yrCC1	1000yrCC1	NAI01_FM_09A_DN.dat	NAI01_10yrCC1_AUL01_10yrCC1_Fluvial	1000yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_9aDN_10yrCC1_FL_1000yrCC1_CO_1D2D	1.48%	0.00%
DN	CO	10yrCC2	1000yrCC2	NAI01_FM_09A_DN.dat	NAI01_10yrCC2_AUL01_10yrCC2_Fluvial	1000yrCC2_Tidal_Curve	NAIRN_7DN1_5YRCC2_FL_1000YRCC2_CO_1D2D_DN.IIC	Nairn_9aDN_10yrCC2_FL_1000yrCC2_CO_1D2D	2.17%	0.00%
S_Def	FL	10yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_10yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_10YR_FL_2YR_CO_1D2D.IIC	Nairn_S_DEF_10yr_FL_2yr_CO_1D2D	1.41%	0.00%
S_Def	FL	30yr	2	NAI01_FM_09A_DN.dat	NAI01_AUL01_30yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_30YR_FL_2YR_CO_1D2D.IIC	Nairn_S_DEF_30yr_FL_2yr_CO_1D2D	2.20%	0.00%
S_Def	FL	200yr	5	NAI01_FM_09E_DN.dat	NAI01_AUL01_200yr_Fluvial_v02	5yr_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_S_DEF_200yr_FL_5yr_CO_1D2D	-0.04%	0.00%
S_Def	FL	200yrCC1	5yrCC1	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_200yrCC1_AUL01_5yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_S_DEF_200yrCC1_FL_5yrCC1_CO_1D2D	5.27%	0.00%
S_Def	FL (AUL)	200yrCC1	5yrCC1	NAI01_FM_09A_DN.dat	NAI01_5yrCC1_AUL01_200yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_S_DEF_200yrCC1_AUL_5yrCC1_CO_1D2D	2.50%	0.00%
S_Def	FL	1000yrCC1	10yrCC1	NAI01_FM_09E_DN_LARGE_EVENTS.dat	NAI01_1000yrCC1_AUL01_10yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_S_DEF_1000yrCC1_FL_10yrCC1_CO_1D2D	-2.67%	0.02%
S_Def	FL (AUL)	1000yrCC1	10yrCC1	NAI01_FM_09A_DN.dat	NAI01_10yrCC1_AUL01_1000yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_S_DEF_1000yrCC1_AUL_10yrCC1_CO_1D2D	0.09%	0.00%
S_Def	CO	2	10yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	10yr_Tidal_Curve	NAIRN_07DN_2YR_FL_10YR_CO_1D2D.IIC	Nairn_S_DEF_2yr_FL_10yr_CO_1D2D	0.67%	0.00%
S_Def	CO	2	30yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_2yr_Fluvial_v03	30yr_Tidal_Curve	NAIRN_07DN_2YR_FL_30YR_CO_1D2D.IIC	Nairn_S_DEF_2yr_FL_30yr_CO_1D2D	0.03%	0.00%
S_Def	CO	5	200yr	NAI01_FM_09A_DN.dat	NAI01_AUL01_5yr_Fluvial_v02	200yr_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_S_DEF_5yr_FL_200yr_CO_1D2D	0.45%	0.00%
S_Def	CO	5yrCC1	200yrCC1	NAI01_FM_09A_DN.dat	NAI01_5yrCC1_AUL01_5yrCC1_Fluvial	200yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_S_DEF_5yrCC1_FL_200yrCC1_CO_1D2D	-0.29%	0.00%
S_Def	CO	10yrCC1	1000yrCC1	NAI01_FM_09A_DN.dat	NAI01_10yrCC1_AUL01_10yrCC1_Fluvial	1000yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_S_DEF_10yrCC1_FL_1000yrCC1_CO_1D2D	1.45%	0.00%
N+20	FL	10yr	2	NAI01_FM_09A_N+20.dat	NAI01_AUL01_10yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_10YR_FL_2YR_CO_1D2D.IIC	Nairn_N+20_10yr_FL_2yr_CO_1D2D	1.51%	0.00%
N+20	FL	30yr	2	NAI01_FM_09A_N+20.dat	NAI01_AUL01_30yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_30YR_FL_2YR_CO_1D2D.IIC	Nairn_N+20_30yr_FL_2yr_CO_1D2D	4.06%	0.00%
N+20	FL	200yr	5	NAI01_FM_09E_N+20.dat	NAI01_200yr_AUL01_5yr_Fluvial	5yr_Tidal_Curve	NAIRN_006E_200YR_UNSTEADY.IIC	Nairn_N+20_200yr_FL_5yr_CO_1D2D	5.97%	0.90%
N+20	FL (AUL)	200yr	5	NAI01_FM_09A_N+20.dat	NAI01_5yr_AUL01_200yr_Fluvial	5yr_Tidal_Curve	NAIRN_07DN_2YR_FL_5YR_CO_1D2D.IIC	Nairn_N+20_200yr_AUL_5yr_CO_1D2D	0.81%	0.00%
N+20	FL	200yrCC1	5yrCC1	NAI01_FM_09E_N+20_LARGE_EVENTS.dat	NAI01_200yrCC1_AUL01_5yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_N+20_200yrCC1_FL_5yrCC1_CO_1D2D	-0.96%	0.71%
N+20	FL (AUL)	200yrCC1	5yrCC1	NAI01_FM_09A_N+20.dat	NAI01_5yrCC1_AUL01_200yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_N+20_200yrCC1_AUL_5yrCC1_CO_1D2D	1.20%	0.00%
N+20	FL	1000yrCC1	10yrCC1	NAI01_FM_09E_N+20_LARGE_EVENTS.dat	NAI01_1000yrCC1_AUL01_10yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_N+20_1000yrCC1_FL_10yrCC1_CO_1D2D	-12.02%	0.52%
N+20	FL (AUL)	1000yrCC1	10yrCC1	NAI01_FM_09A_N+20.dat	NAI01_10yrCC1_AUL01_1000yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_N+20_1000yrCC1_AUL_10yrCC1_CO_1D2D	1.69%	0.00%
N+20	CO	2	10yr	NAI01_FM_09A_N+20.dat	NAI01_AUL01_2yr_Fluvial_v03	10yr_Tidal_Curve	NAIRN_07DN_2YR_FL_10YR_CO_1D2D.IIC	Nairn_N+20_2yr_FL_10yr_CO_1D2D	0.53%	0.00%
N+20	CO	2	30yr	NAI01_FM_09A_N+20.dat	NAI01_AUL01_2yr_Fluvial_v03	30yr_Tidal_Curve	NAIRN_07DN_2YR_FL_30YR_CO_1D2D.IIC	Nairn_N+20_2yr_FL_30yr_CO_1D2D	0.50%	0.00%
N+20	CO	5	200yr	NAI01_FM_09A_N+20.dat	NAI01_AUL01_5yr_Fluvial_v02	200yr_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_N+20_5yr_FL_200yr_CO_1D2D	0.94%	0.00%
N+20	CO	5yrCC1	200yrCC1	NAI01_FM_09A_N+20.dat	NAI01_5yrCC1_AUL01_5yrCC1_Fluvial	200yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_N+20_5yrCC1_FL_200yrCC1_CO_1D2D	1.85%	0.00%
N+20	CO	10yrCC1	1000yrCC1	NAI01_FM_09A_N+20.dat	NAI01_10yrCC1_AUL01_10yrCC1_Fluvial	1000yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_N+20_10yrCC1_FL_1000yrCC1_CO_1D2D	0.73%	0.00%
N-20	FL	10yr	2	NAI01_FM_09A_N-20.dat	NAI01_AUL01_10yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_10YR_FL_2YR_CO_1D2D.IIC	Nairn_N-20_10yr_FL_2yr_CO_1D2D	1.07%	0.00%
N-20	FL	30yr	2	NAI01_FM_09A_N-20.dat	NAI01_AUL01_30yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_30YR_FL_2YR_CO_1D2D.IIC	Nairn_N-20_30yr_FL_2yr_CO_1D2D	2.47%	0.05%
N-20	FL	200yr	5	NAI01_FM_09E_N-20.dat	NAI01_AUL01_200yr_Fluvial_v02	5yr_Tidal_Curve	NAIRN_006E_200YR_UNSTEADY.IIC	Nairn_N-20_200yr_FL_5yr_CO_1D2D	3.21%	0.00%
N-20	FL	200yrCC1	5yrCC1	NAI01_FM_09E_N-20_LARGE_EVENTS.dat	NAI01_200yrCC1_AUL01_5yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_S_DEF_200YRCC1_FL_5YRCC1_CO_1D2D.IIC	Nairn_N-20_200yrCC1_FL_5yrCC1_CO_1D2D	-0.77%	0.00%
N-20	FL (AUL)	200yrCC1	5yrCC1	NAI01_FM_09A_N-20.dat	NAI01_5yrCC1_AUL01_200yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_N-20_200yrCC1_AUL_5yrCC1_CO_1D2D	1.35%	0.00%
N-20	FL	1000yrCC1	10yrCC1	NAI01_FM_09E_N-20_LARGE_EVENTS.dat	NAI01_1000yrCC1_AUL01_10yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_S_DEF_200YRCC1_FL_5YRCC1_CO_1D2D.IIC	Nairn_N-20_1000yrCC1_FL_10yrCC1_CO_1D2D	5.47%	0.00%
N-20	FL (AUL)	1000yrCC1	10yrCC1	NAI01_FM_09A_N-20.dat	NAI01_10yrCC1_AUL01_1000yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_N-20_1000yrCC1_AUL_10yrCC1_CO_1D2D	5.93%	0.00%
N-20	CO	2yr	10yr	NAI01_FM_09A_N-20.dat	NAI01_AUL01_2yr_Fluvial_N-	10yr_Tidal_Curve	NAIRN_07DN_30YR_FL_2YR_CO_1D2D.IIC	Nairn_N-20_2yr_FL_10yr_CO_1D2D	0.86%	0.00%
N-20	CO	2yr	30yr	NAI01_FM_09A_N-20.dat	NAI01_AUL01_2yr_Fluvial_v03	30yr_Tidal_Curve	NAIRN_006E_200YR_UNSTEADY.IIC	Nairn_N-20_2yr_FL_30yr_CO_1D2D	1.00%	0.00%
N-20	CO	5	200yr	NAI01_FM_09A_N-20.dat	NAI01_AUL01_5yr_Fluvial_v02	200yr_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_N-20_5yr_FL_200yr_CO_1D2D	0.70%	0.00%
N-20	CO	5yrCC1	200yrCC1	NAI01_FM_09A_N-20.dat	NAI01_5yrCC1_AUL01_5yrCC1_Fluvial	200yrCC1_Tidal_Curve	NAIRN_07DN_5YRCC1_FL_200YRCC1_CO_1D2D_DN.IIC	Nairn_N-20_5yrCC1_FL_200yrCC1_CO_1D2D	0.57%	0.00%

Scenario	Event	RP- Fluvial	RP- Coastal	Dat file (1D geometry)	IED file (1D fluvial input)	IED file (1D tidal input)	IIC file (1D initial conditions)	IEF (run file) / results file name	1D MB	unconverged
N-20	CO	10yrCC1	1000yrCC1	NAI01_FM_09A_N-20.dat	NAI01_10yrCC1_AUL01_10yrCC1_Fluvial	1000yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_N-20_10yrCC1_FL_1000yrCC1_CO_1D2D	2.08%	0.04%
S_B	FL	10yr	2	NAI01_FM_09A_S_B.dat (CUL_00518 9% capacity)	NAI01_AUL01_10yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_10YR_FL_2YR_CO_1D2D.IIC	Nairn_S_B_10yr_FL_2yr_CO_1D2D	2.22%	0.00%
S_B	FL	30yr	2	NAI01_FM_09A_S_B.dat (CUL_00518 9% capacity)	NAI01_AUL01_30yr_Fluvial_v02	2yr_Tidal_Curve	NAIRN_07DN_2YR_FL_10YR_CO_1D2D.IIC	Nairn_S_B_30yr_FL_2yr_CO_1D2D	2.77%	0.00%
S_B	FL	200yr	5	NAI01_FM_09E_S_B.dat (CUL_00518 17% capacity)	NAI01_AUL01_200yr_Fluvial_v02	5yr_Tidal_Curve	NAIRN_07DN_200YR_FL_5YR_CO_1D2D.IIC	Nairn_S_B_200yr_FL_5yr_CO_1D2D	6.37%	0.00%
S_B	FL	200yrCC1	5yrCC1	NAI01_FM_09E_LARGE_EVENTS_S_B.dat	NAI01_200yrCC1_AUL01_5yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_S_B_200yrCC1_FL_5yrCC1_CO_1D2D	2.19%	0.01%
S_B	FL (AUL)	200yrCC1	5yrCC1	NAI01_FM_09A_S_B_v2.dat (CUL_00518 17% capacity)	NAI01_5yrCC1_AUL01_200yrCC1_Fluvial	5yrCC1_Tidal_Curve	NAIRN_07DN_5YR_FL_200YR_CO_1D2D.IIC	Nairn_S_B_200yrCC1_AUL_5yrCC1_CO_1D2D	0.02%	0.00%
S_B	FL	1000yrCC1	10yrCC1	NAI01_FM_09E_LARGE_EVENTS_S_B.dat	NAI01_1000yrCC1_AUL01_10yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_006_200YR_UNSTEADY.IIC	Nairn_S_B_1000yrCC1_FL_10yrCC1_CO_1D2D	4.41%	0.02%
S_B	FL (AUL)	1000yrCC1	10yrCC1	NAI01_FM_09A_S_B_v2.dat (CUL_00518 17% capacity)	NAI01_10yrCC1_AUL01_1000yrCC1_Fluvial	10yrCC1_Tidal_Curve	NAIRN_07DN_10YRCC1_FL_1000YRCC1_CO_1D2D_DN.IIC	Nairn_S_B_1000yrCC1_AUL_10yrCC1_CO_1D2D	0.01%	0.00%

C.2 Model log (2D)

The model log for the 2D domain below lists the 71 runs and shows that the same Tuflow Control file (.tcf) is used for all runs, which is control file NAI_~e2~_~e1~_~s1~_9 except for the 200-year (N+20) fluvial run, that uses the .tcf NAI_~e2~_~e1~_~s1~_9b.

Scenario	Event	RP- Fluvial	RP- Coastal	Tuflow Control file (tcf)	Tuflow geometry control (tgc)	Tuflow boundary control (tbc)	Tuflow materials file (tmf)	Tuflow log file (tlf)	2D MB (%)
DM	FL	1997	1997	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_04.tmf	NAI_1997FL_1997CO_DM_9	0.24
DN	FL and CO	2yr	2yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_2yrCO_DN_9	0.3
DN	FL	5yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrFL_2yrCO_DN_9	0.4
DN	FL	10yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrFL_2yrCO_DN_9	0.4
DN	FL	30yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_30yrFL_2yrCO_DN_9	0.31
DN	FL	100yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_100yrFL_2yrCO_DN_9	0.17
DN	FL	200yr	5	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrFL_5yrCO_DN_9	0.05
DN	FL	1000yr	10	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_1000yrFL_10yrCO_DN_9	0.04
DN	FL (AUL)	1000yr	10	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1000yrAUL_10yrCO_DN_9	0.29
DN	FL	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_200yrCC1FL_5yrCC1CO_DN_9	0.06
DN	FL (AUL)	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrCC1AUL_5yrCC1CO_DN_9	0.23
DN	FL	200yrCC2	5yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_200yrCC2FL_5yrCC2CO_DN_9	0.04
DN	FL (AUL)	200yrCC2	5yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrCC2AUL_5yrCC2CO_DN_9	0.11
DN	FL	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_1000yrCC1FL_10yrCC1CO_DN_9	0
DN	FL (AUL)	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1000yrCC1AUL_10yrCC1CO_DN_9	0.19
DN	FL	1000yrCC2	10yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_1000yrCC2FL_10yrCC2CO_DN_9	0.01
DN	FL (AUL)	1000yrCC2	10yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1000yrCC2AUL_10yrCC2CO_DN_9	0.1
DN	CO	2	5yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_5yrCO_DN_9	0.3
DN	CO	2	10yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_10yrCO_DN_9	0.29
DN	CO	2	30yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_30yrCO_DN_9	0.29
DN	CO	2	100yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_100yrCO_DN_9	0.3
DN	CO	5	200yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrFL_200yrCO_DN_9	0.38
DN	CO	10	1000yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrFL_1000yrCO_DN_9	0.37
DN	CO	5yrCC1	200yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrCC1FL_200yrCC1CO_DN_9	0.21
DN	CO	5yrCC2	200yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrCC2FL_200yrCC2CO_DN_9	0.1
DN	CO	10yrCC1	1000yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrCC1FL_1000yrCC1CO_DN_9	0.17
DN	CO	10yrCC2	1000yrCC2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrCC2FL_1000yrCC2CO_DN_9	0.08
S_Def	FL	10yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrFL_2yrCO_S_DEF_9	0.4
S_Def	FL	30yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_30yrFL_2yrCO_S_DEF_9	0.3
S_Def	FL	200yr	5	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrFL_5yrCO_S_DEF_9	0.07
S_Def	FL	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_200yrCC1FL_5yrCC1CO_S_DEF_9	0.07
S_Def	FL (AUL)	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrCC1AUL_5yrCC1CO_S_DEF_9	0.24
S_Def	FL	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_1000yrCC1FL_10yrCC1CO_S_DEF_9	0
S_Def	FL (AUL)	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1000yrCC1AUL_10yrCC1CO_S_DEF_9	0.19
S_Def	CO	2	10yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_10yrCO_S_DEF_9	0.29
S_Def	CO	2	30yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_2yrFL_30yrCO_S_DEF_9	0.28
S_Def	CO	5	200yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrFL_200yrCO_S_DEF_9	0.38
S_Def	CO	5yrCC1	200yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_5yrCC1FL_200yrCC1CO_S_DEF_9	0.22
S_Def	CO	10yrCC1	1000yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1-yrCC1FL_1000yrCC1CO_S_DEF_9	0.16
N+20	FL	10yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_10yrFL_2yrCO_N+20_9	0.33
N+20	FL	30yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_30yrFL_2yrCO_N+20_9	0.22
N+20	FL	200yr	5	NAI_~e2~_~e1~_~s1~_9b	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_200yrFL_5yrCO_N+20_9b	0.09
N+20	FL (AUL)	200yr	5	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_200yrAUL_5yrCO_N+20_9	0.29
N+20	FL	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_200yrCC1FL_5yrCC1CO_N+20_9	0.04
N+20	FL (AUL)	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_200yrCC1AUL_5yrCC1CO_N+20_9	0.2
N+20	FL	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_1000yrCC1FL_10yrCC1CO_N+20_9	0.02
N+20	FL (AUL)	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_1000yrCC1AUL_10yrCC1CO_N+20_9	0.15
N+20	CO	2	10yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_2yrFL_10yrCO_N+20_9	0.32
N+20	CO	2	30yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_2yrFL_30yrCO_N+20_9	0.32
N+20	CO	5	200yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_5yrFL_200yrCO_N+20_9	0.34
N+20	CO	5yrCC1	200yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_5yrCC1FL_200yrCC1CO_N+20_9	0.19
N+20	CO	10yrCC1	1000yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by +20%)	NAI_1-yrCC1FL_1000yrCC1CO_N+20_9	0.14
N-20	FL	10yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_10yrFL_2yrCO_N-20_9	0.46
N-20	FL	30yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_30yrFL_2yrCO_N-20_9	0.42

Scenario	Event	RP- Fluvial	RP- Coastal	Tuflow Control file (tcf)	Tuflow geometry control (tgc)	Tuflow boundary control (tbc)	Tuflow materials file (tmf)	Tuflow log file (tlf)	2D MB (%)
N-20	FL	200yr	5	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_200yrFL_5yrCO_N-20_9	0.12
N-20	FL	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_200yrCC1FL_5yrCC1CO_N-20_9	0.07
N-20	FL (AUL)	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_200yrCC1AUL_5yrCC1CO_N-20_9	0.24
N-20	FL	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_1000yrCC1FL_10yrCC1CO_N-20_9	0.01
N-20	FL (AUL)	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_1000yrCC1AUL_10yrCC1CO_N-20_9	0.22
N-20	CO	2yr	10yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_2yrFL_10yrCO_N-20_9	0.23
N-20	CO	2yr	30yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_2yrFL_30yrCO_N-20_9	0.24
N-20	CO	5	200yr	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_5yrFL_200yrCO_N-20_9	0.35
N-20	CO	5yrCC1	200yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_5yrCC1FL_200yrCC1CO_N-20_9	0.29
N-20	CO	10yrCC1	1000yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf (values multiplied by -20%)	NAI_1-yrCC1FL_1000yrCC1CO_N-20_9	0.18
S_B	FL	10yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_10yrFL_2yrCO_S_B_9	0.27
S_B	FL	30yr	2	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_30yrFL_2yrCO_S_B_9	0.24
S_B	FL	200yr	5	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrFL_5yrCO_S_B_9	-0.09
S_B	FL	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_200yrCC1FL_5yrCC1CO_S_B_9	0.06
S_B	FL (AUL)	200yrCC1	5yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_200yrCC1AUL_5yrCC1CO_S_B_9	0.13
S_B	FL	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21_Large_Events.tgc	NAI_15_Large_Events.tbc	NAI_03.tmf	NAI_1000yrCC1FL_10yrCC1CO_S_B_9	0
S_B	FL (AUL)	1000yrCC1	10yrCC1	NAI_~e2~_~e1~_~s1~_9	NAI_21.tgc	NAI_15.tbc	NAI_03.tmf	NAI_1000yrCC1AUL_10yrCC1CO_S_B_9	0.11

D Appendix: further model checks

D.1 Negative depths

None of the model runs have a negative depth error outside the default tolerance range apart from the observed 1997 (DM) run which has a singular negative depth occurrence in the vicinity of the harbour. This occurs at the beginning of the model run for one timestep only and occurs due to the tide level at the beginning of the model run (which is -0.7 m AOD, as taken from TotalTide software, i.e. an estimate of the tidal level during the historic observed event, section 2.6) flowing in to the Harbour. The base of the Harbour walls are approximately -1.2 mAOD from survey data. As the negative depth only occurs for a singular timestep, it does not have any impact on results.

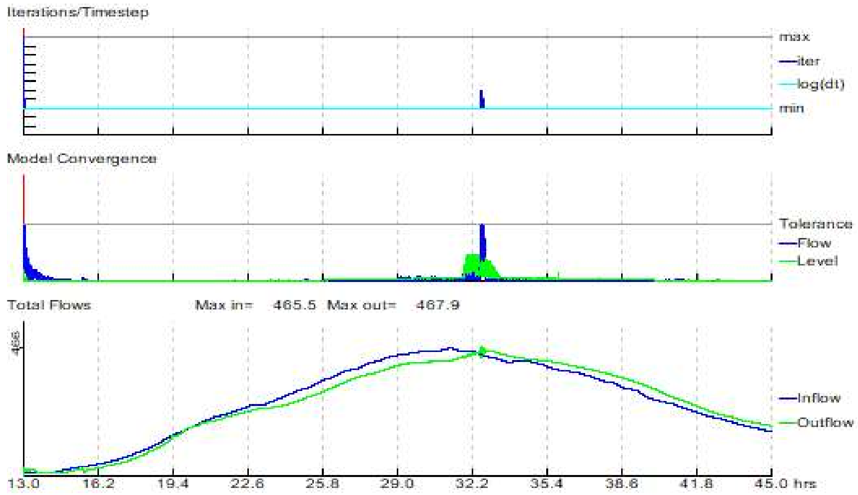
D.2 Mass balance

The 1D and 2D mass balance error outputs are shown in the model log (Appendix C). A cumulative mass error value of ±1% is the desired range. The outputs show <1% on mass balance error for the 2D outputs for all runs (regarding both the peak of the event and the mass balance error at the end of the model run, the latter of which is the value shown in the model log). For the 1D outputs, the mass balance error is slightly larger regarding the mass balance at the peak of the event (which is the value shown in the model log) though generally <1% at the end of the model run.

D.3 Model convergence

Model convergence is acceptable (within tolerable rates) for all fluvial present day events and scenarios with the exception of the 200-year (N+20) fluvial run, during which there is a very short period of non-convergence, above the tolerable rate, at the beginning of the model run. This is short-lived and the run is generally stable, as shown in Figure D-2 below. Figure D-1 shows good convergence for the DN 200-year fluvial run. Convergence is good and well within tolerable rates all of the tidal runs regarding all events and scenarios including climate change events.

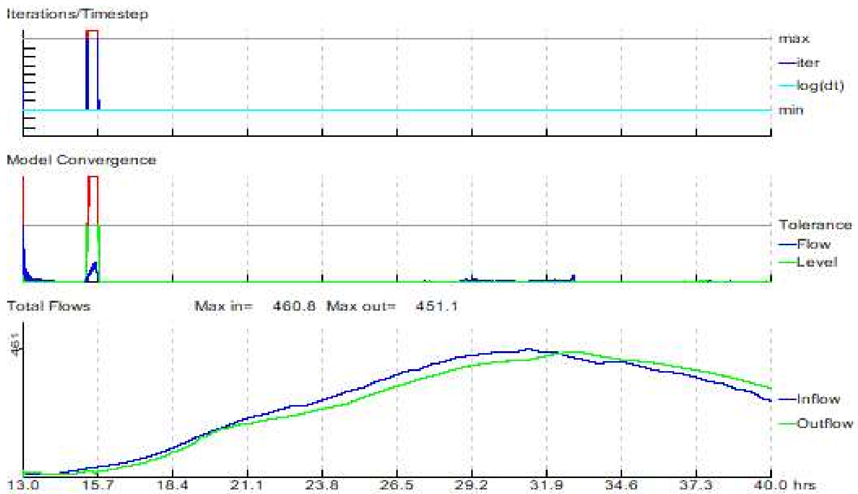
It's noted that during the fluvial climate change events, model convergence is within the default tolerable range but oscillation / poor convergence does occur at several points in the model run (mainly around the peak of the event, Figure D-3).



Datafile: ...\FM\DAT\NAI01_FM_09E_DN.DAT
Results: ...\014\NAIRN_9ADN_200YR_FL_5YR_CO_1D2D.zzl
Ran at 23:02:27 on 17/03/2023
Ended at 00:25:07 on 18/03/2023
Start Time: 13.000 hrs
End Time: 45.000 hrs
Timestep: 1.0 secs

Current Model Time: 45.00 hrs
Percent Complete: 100 %

Figure D-1: Model convergence 200-year (DN) fluvial run



Datafile: ...\FM\DAT\NAI01_FM_09E_N+20_LARGE_EVENTS.DAT
Results: ...\014\NAIRN_N+20_200YR_FL_5YR_CO_1D2D.zzl
Ran at 17:56:00 on 05/04/2023
Ended at 19:03:17 on 05/04/2023
Start Time: 13.000 hrs
End Time: 40.000 hrs
Timestep: 1.0 secs

Current Model Time: 40.00 hrs
Percent Complete: 100 %

Figure D-2: Model convergence 200-year (N+20) fluvial run

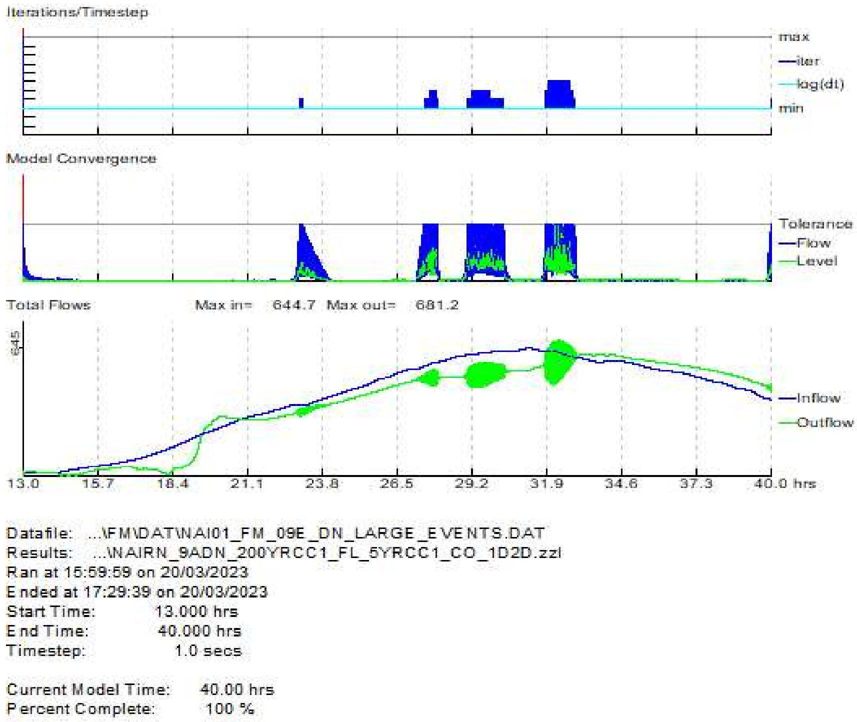


Figure D-3: Model convergence 200-year + Climate Change 1 scenario (DN) fluvial run

D.4 Fluvial climate change runs

A stability patch is used for the 1000-year and both climate change fluvial runs (i.e. the 'large fluvial events'). This small stability patch is at the harbour wall and also covers a small area downstream of the A96 road bridge on the right bank. Manning's 'n' is set to 0.15 in these areas, to help slow water down. The location of the stability patch is shown in the figure below.

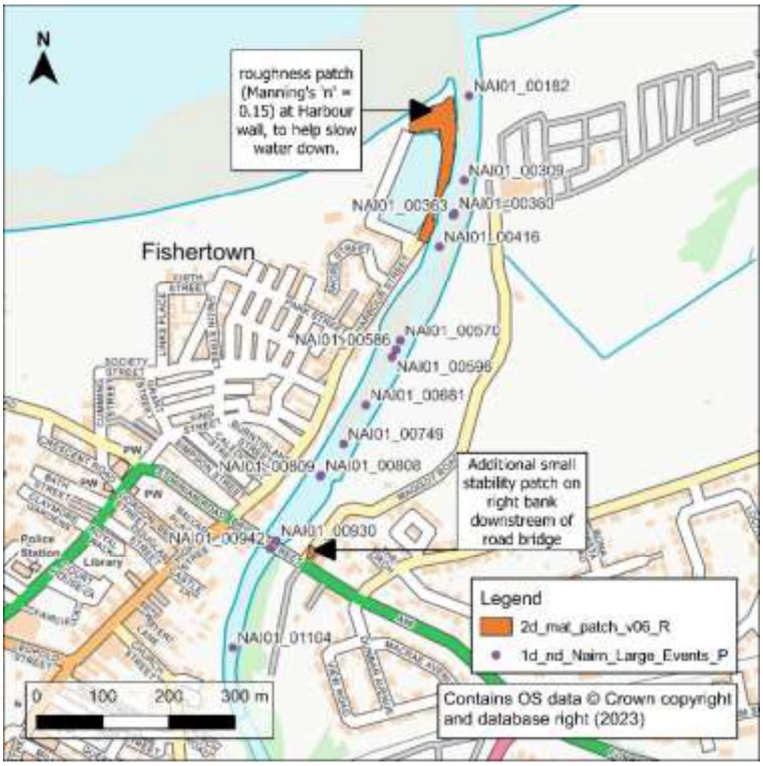


Figure D-4: Stability patch as used for large fluvial model runs.

It is noted that there is some instability on water levels near the downstream boundary during the Climate Change scenario 1 event. This occurs around the peak of the event and causes oscillation of water levels between NAI01_00596 and NAI01_00182 (approximately a 400 m long reach, with oscillations causing water levels to have a difference between the peak and trough of the oscillation of approximately +0.4m) as noted when viewing the results output on the Longitudinal section. This section of the reach is fluvially dominated for Climate Change scenario 1 i.e. the maximum water levels are a result of the fluvial Climate Change scenario 1 run as opposed to the tidal Climate Change scenario 1. For the Climate Change scenario 2 event, a similar oscillation occurs on the fluvial run, but the oscillations do not affect the maximum water levels. In addition, the reach between NAI01_00596 and NAI01_00182 is tidally dominated for Climate Change scenario 2, i.e. the maximum water levels are a result of the tidal Climate Change scenario 2 run as opposed to the fluvial Climate Change scenario 2.

A normal depth downstream boundary was tested for the Fluvial Climate Change Scenario 1 runs and showed this greatly improved the stability, as such, it is understood that the oscillations are caused by the Tidal Climate Change scenario 1 water level at the downstream boundary being significantly higher than normal depth (i.e. the normal depth was calculated in the model run as being about 1.5 mAOD, whereas the maximum peaks from the 5-year CC1 event and 10-year CC1 event used for the downstream boundary of the 200-year CC1 and 1000-year CC1 fluvial events, respectively, were 4.21 mAOD and 4.28 mAOD). However, in line with the scope, a climate change tidal boundary was used as the results give higher water levels than using a normal depth downstream boundary (by approximately +0.25 m at NAI01_00596 and +1.25 m at NAI01_00182) though the compromise is reduced confidence in the model run. As such, it is noted that the oscillation at the downstream boundary seems relatively large (0.4m) compared to the difference in water level between using a normal depth boundary and tidal curve (ranging between +0.25 and +1.25m). A conservative approach has been used for the fluvial climate change flood mapping, but if a detailed design of flood defences were undertaken in future (to incorporate a fluvial climate change allowance), the oscillations should be looked at to give greater confidence.

D.5 Tidal climate change runs

Figure D-4 below shows a large inflow into the model at circa 18 hours for the 200-year Climate Change Scenario 1 event in the tidal scenario, this is larger than the peak river flow which peaks at 31.25 hours. This phenomenon only occurs for the tidal climate change events (scenarios 1 and 2). While this initially looks like an error, on closer inspection it occurs at the peak of the first high tide (the 'climate change' events include two tidal cycles at the downstream boundary in the model run, section 2.7). At this time, the river flow is very low and the tide very high. The large inflow is thus representing the large inflow of coastal water through the pier (estuary). The largest high tide which is the second high tide is aligned with the peak of the fluvial flood flow, by this point the river channel is full and resists the coastal flow up the channel so the same extreme sudden inflow does not occur.

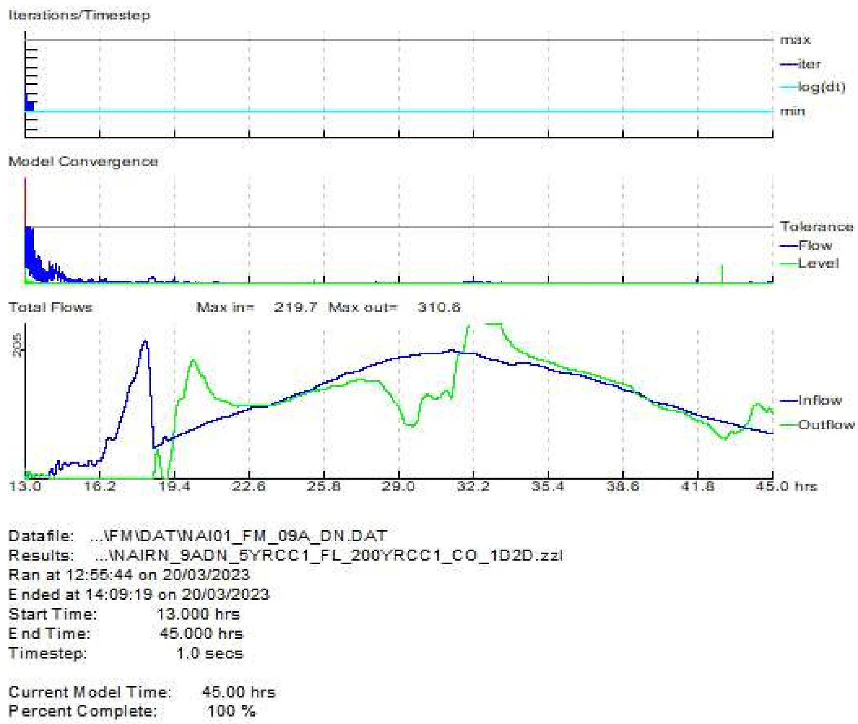


Figure D-4: Model convergence 200-year + Climate Change 1 scenario (DN) coastal run

D.6 Downstream boundary

The full tidal curve was initially directly applied to NAI01_00000, including minimum tidal levels that were of the order of -1.0 mAOD. It was found that this caused fluctuating water levels at the downstream boundary, and a steep slope on water level when a high water level was 'forced downwards' to a very low tidal level, causing instability at the downstream boundary, particularly for the larger fluvial events. Figure D-5 below shows the steep slope on water level at the downstream boundary regarding this initial set-up.

The downstream boundary was amended so that it was applied to NAI01_00000, but with a cropped minimum value on the tidal curve of 1.5 mAOD. However, it was found that a slight fluctuating water level remained and that water was still forced downwards to reach the water level of 1.5 mAOD. It was decided that either a higher minimum water level or extending the channel further out to sea would help with stability. This latter approach was more successful, and involved adding cross section NAI01_-0100, a duplicate of NAI01_00000 but widened to represent the open sea. There is a relatively steep slope between NAI01_00029 and NAI01_00000. This means there are times in the run when the water surface at the downstream boundary looks unusual, as water levels drop slightly below 1.5m at NAI01_00000 (mirroring the bed slope), but then is forced to rise slightly again at the downstream boundary (NAI01_-0100) that never drops below 1.5 mAOD. This area does not affect water levels upstream of the pier walls (as cross section NAI01_00029 is mid-way along the pier and the flux in water level does not affect any reach upstream of this cross section) and if anything, gives conservative water levels at the pier ends.

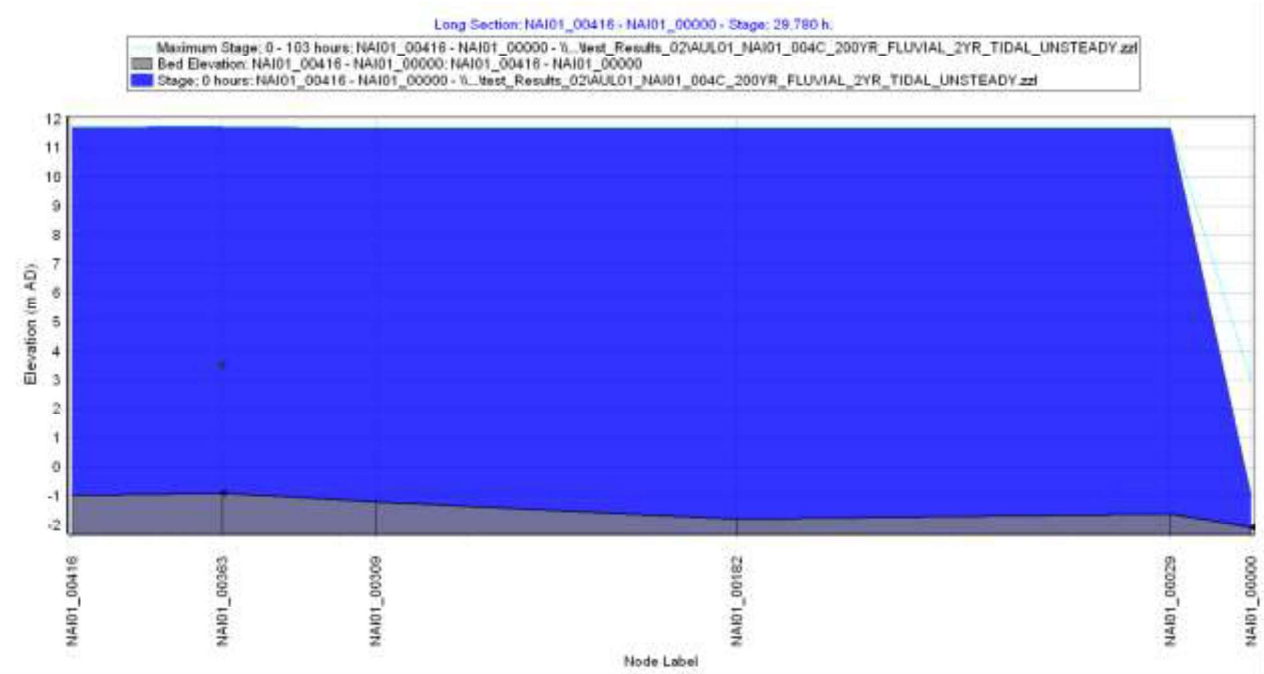


Figure D-5: 200-year fluvial event using a tidal curve with minimum value of -1.0 mAOD, from the initial model build. The water level at NAI01_00000 is unrealistically forced steeply downwards at the downstream boundary. Note that the model was run 1D-only at this stage in the project, hence the very high water levels.

D.7 Culvert stability

The purpose of the spill unit OL_00508 (OL representing outlet) at the Granny Barbour Road culvert (CUL_00518) is to give stability at the outlet from this structure, which gave significant instability when it was first implemented in the model. The spill is in mode 2 for most of the run (when flows are high), this mode means that the spill is 'drowned out' but downstream water levels can still affect the culvert (i.e. the spill doesn't disconnect the culvert from the downstream reach)[47]. The model can run without the spill unit OL_00508 in the model, but non-convergence increases. As such, it has been left it in the model to help with stability.

D.8 2D domain boundary

Analysis of properties to the east of the model domain has been undertaken to check whether they would be within the flood extents from the model. The lowest elevation of these properties, as taken from LiDAR data is understood to be of the order of 5.6 mAOD (middle property in the figure below). The water level from the 1000-year CC2 event (i.e. largest event run in the model) is around 5.3 mAOD near the model's boundary. As such, it is likely that this property would be outside of, but very close to, the largest flood extent output from the model.

47 Spill technical reference, Flood Modeller (Jacobs 2023). https://help.floodmodeller.com/docs/spill#mode-2-drowned-flow-positive-sense

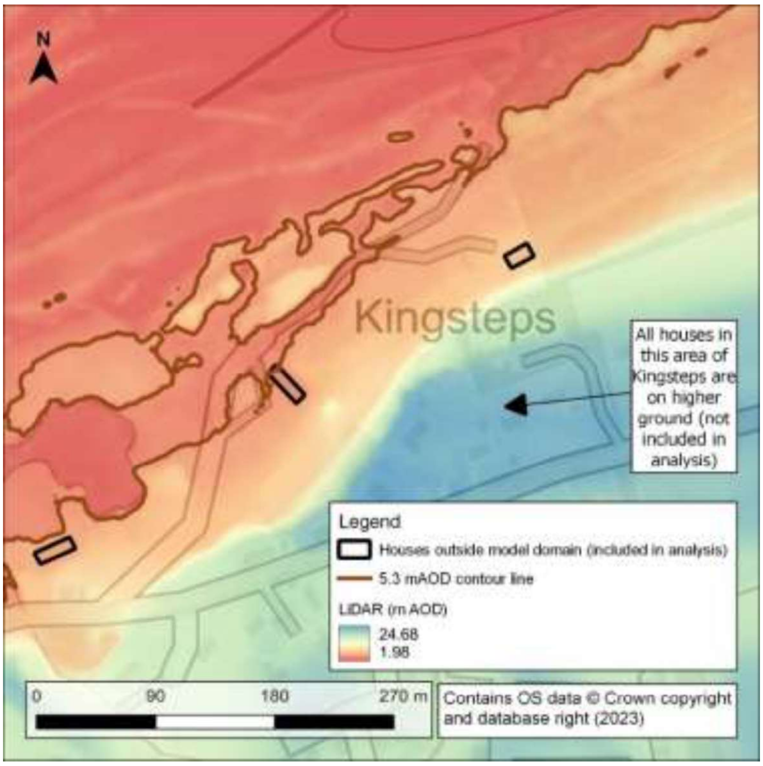


Figure D-6: Properties to the east of the model domain. The 5.3 mAOD line represents the 1000-year CC2 water level at the models boundary.

D.9 Excavated land

It is noted that there is some lowered topography near the gauge on the left bank, that is evident in the flood maps (i.e. there are greater depths in this area). This lowered topography is evident in both Phase 1 and Phase 2 Lidar data and appears to be reworked / excavated ground and is approximately 0.3 m lower than the fields to the north. Google imagery would suggest it is rough open land. It creates an artificial straight edge and forms an approximate triangular shape at the transition as shown in Figure D-7.

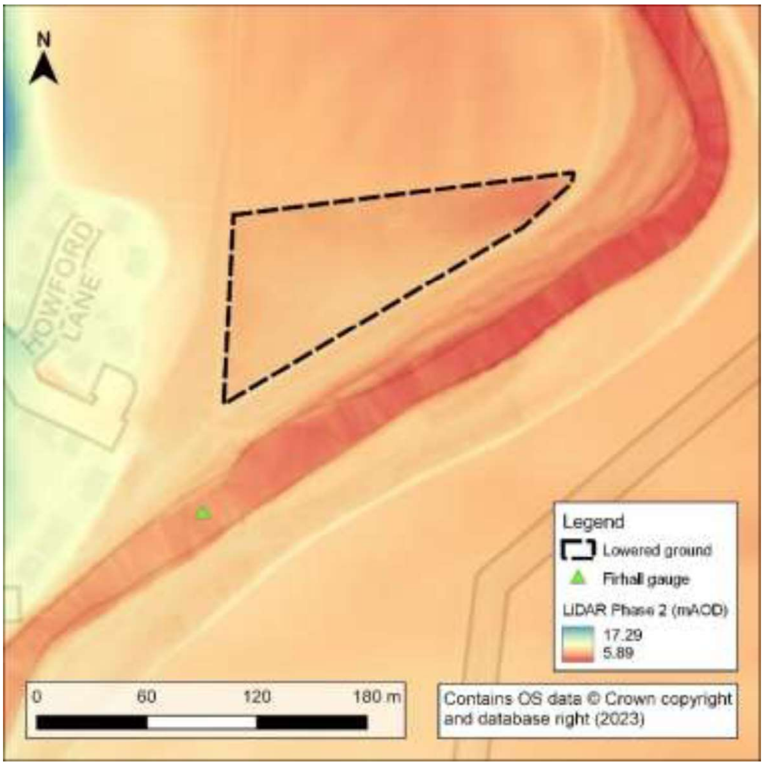


Figure D-7: Lower topography to the north of the gauge that is evident in the results grid outputs

E Appendix - climate change sensitivity tests

E.1 Longitudinal sections

The 200-year climate change scenario 1 and 1000-year climate change scenario 1 has been included in the sensitivity testing. The below longitudinal sections show comparison between the sensitivity tests, for these events. The S_DEF water levels were almost identical to the baseline, as such the latter has been omitted. Tabular results from cross sections are provided in Appendix F.

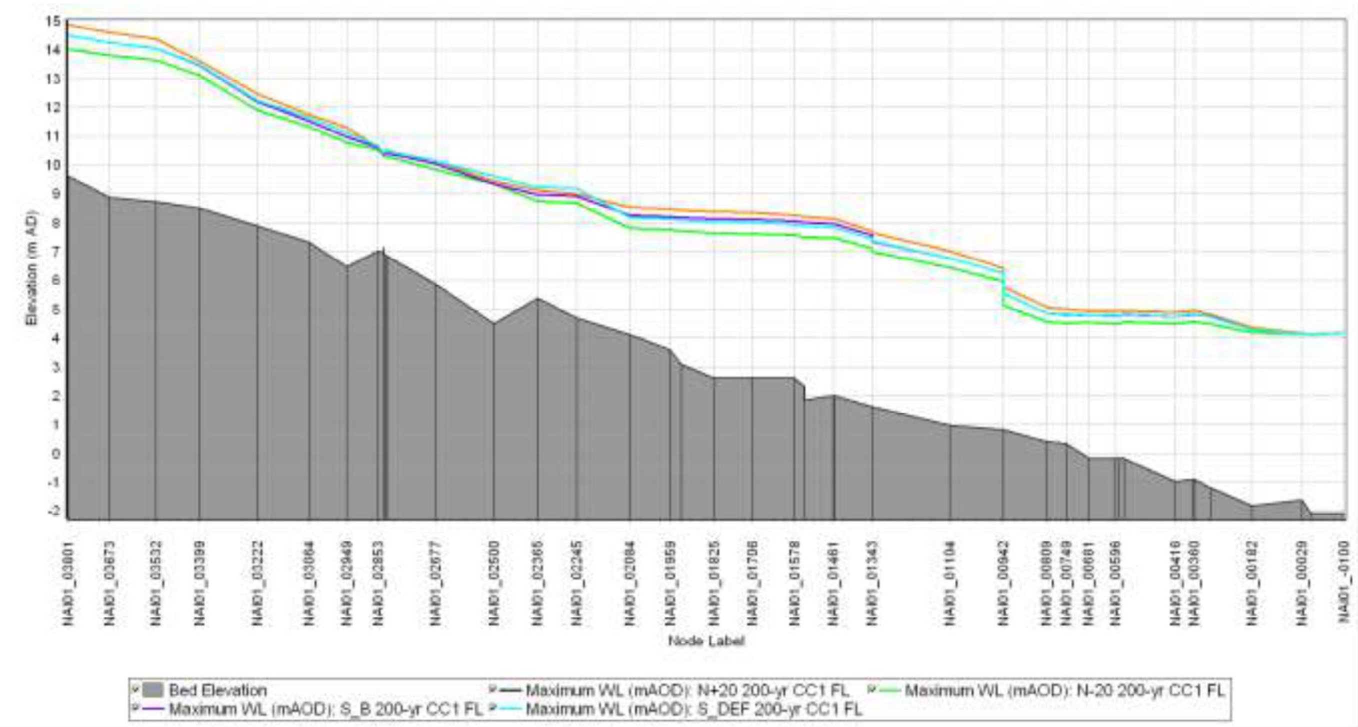


Figure E-1: Comparison for the 200-year climate change scenario 1

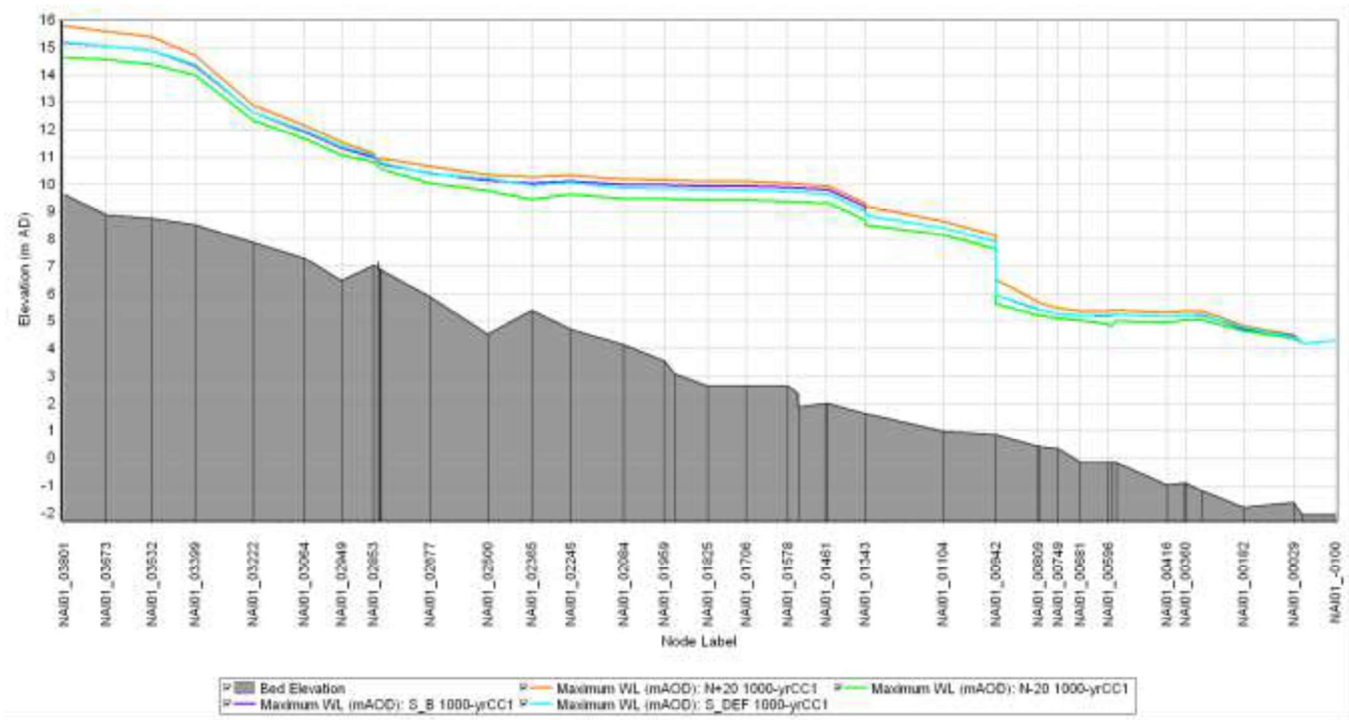


Figure E-2: Comparison for the 1000-year climate change scenario 1

E.2 Greatest change in flood extent

The flood extent between the S_DEF and DN (baseline) scenario is very similar for the 1000-year climate change scenario 1 event, hence further analysis on comparison has not been undertaken. The figures below show example areas of greatest change in flood extent on comparing the baseline to the roughness sensitivity test scenarios for the 1000-year climate change scenario 1 event. In general, there was very little difference in flood extent between these scenarios regarding this event, particularly upstream of the A96 road bridge. The greatest difference in extent is seen on the left and right banks, immediately downstream of the road bridge, as shown in the figures below.

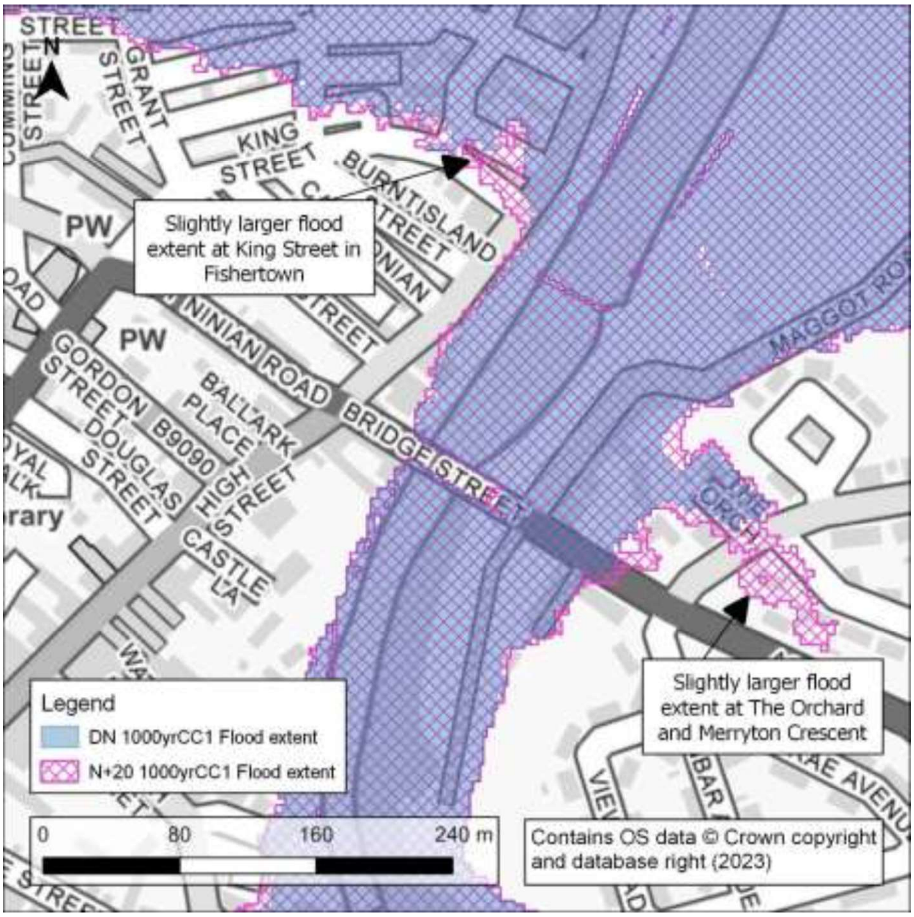


Figure E-3: Example increase in flood extent for the N+20 event.

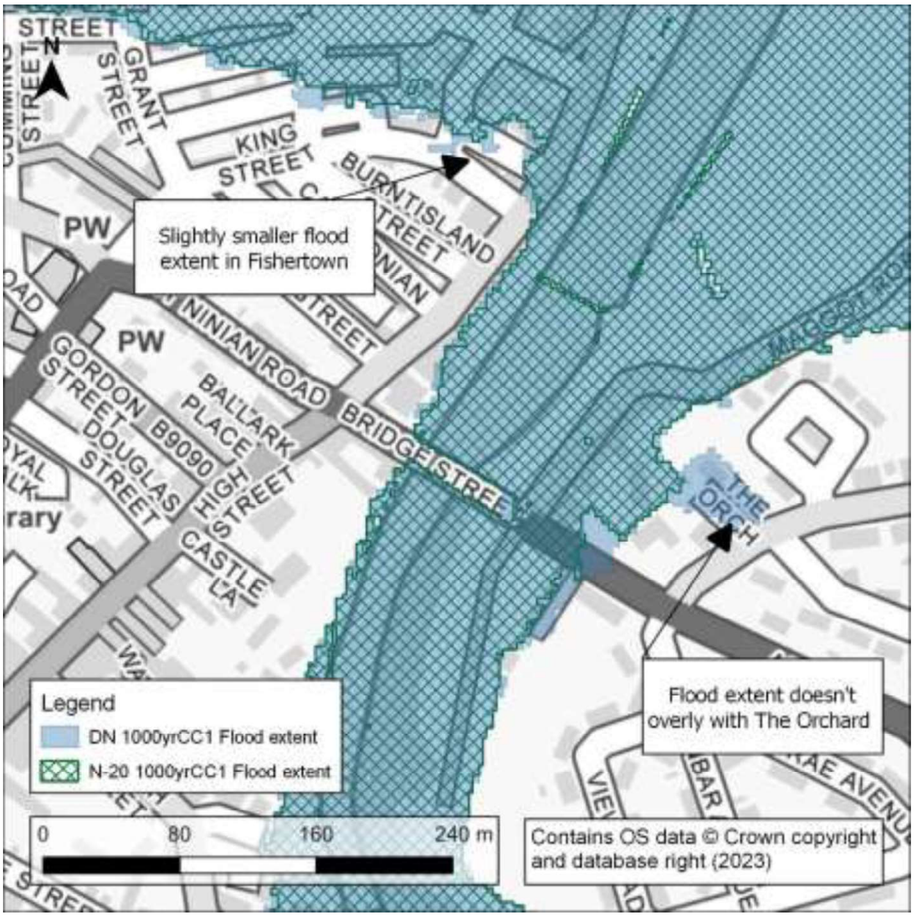


Figure E-4: Example increase in flood extent for the N-20 event.

E.3 Bridge blockage scenario

The bridges were modelled as being 'washed away' for the 1000-year event and climate change scenario events. As such, it was not possible to block the Merryton footbridge in the climate change scenario events as this bridge was not included in the model. Instead, the railway bridge piers were increased. This resulted in only a very small increase in flood extent, in the vicinity of Nairn cemetery on the right bank, upstream of the railway bridge, regarding comparison between the climate change scenario events respectively.

F Appendix - Tabulated Model Results

	bed elevation	DN Fluvial (max stage mAOD)											
Label	m AOD	1997	2-yr	5-yr	10-yr	30-yr	100-yr	200-yr	1000-yr	200-yr CC1	200-yr CC2	1000-yr CC1	1000-yr CC2
AUL01_00000	2.885	6.237	4.615	5.076	5.372	5.855	6.648	7.157					
AUL01_00000D	2.885	6.216	4.612	5.073	5.37	5.835	6.622	7.131					
AUL01_00041	3.585	6.24	4.621	5.077	5.372	5.86	6.652	7.158					
AUL01_00043	3.585	6.211	4.622	5.077	5.372	5.831	6.634	7.149					
AUL01_00087	3.667	6.328	4.674	5.097	5.38	5.966	6.73	7.214					
AUL01_00144	3.425	6.386	4.787	5.153	5.409	6.046	6.792	7.274					
AUL01_00195	3.263	6.395	4.831	5.187	5.416	6.052	6.803	7.285					
AUL01_00237	3.284	6.4	4.853	5.205	5.426	6.057	6.809	7.29					
AUL01_00258	3.294	6.4	4.865	5.215	5.43	6.058	6.81	7.291					
AUL01_00297	3.671	6.401	4.911	5.245	5.443	6.058	6.811	7.293					
AUL01_00319	3.895	6.434	5.226	5.826	6.073	6.286	6.827	7.326					
AUL01_00326	3.87	6.44	5.275	5.868	6.112	6.295	6.814	7.299					
AUL01_00327	3.87	6.442	5.787	5.915	6.136	6.3	6.819	7.304					
AUL01_00376	3.289	6.415	5.796	5.927	6.146	6.284	6.822	7.336					
AUL01_00410	3.717	6.432	5.801	5.935	6.152	6.295	6.823	7.337					
AUL01_00414	3.598	6.437	5.802	5.937	6.153	6.299	6.825	7.329					
AUL01_00427	3.635	6.442	5.804	5.94	6.156	6.302	6.826	7.311					
AUL01_00440	3.705	6.446	5.805	5.942	6.158	6.305	6.827	7.305					
AUL01_00453	3.646	6.448	5.806	5.943	6.159	6.309	6.83	7.307					
AUL01_00464	3.594	6.451	5.809	5.947	6.161	6.312	6.831	7.305					
AUL01_00475	3.465	6.454	5.81	5.949	6.163	6.315	6.832	7.308					
AUL01_00487	3.682	6.454	5.81	5.949	6.163	6.315	6.833	7.307					
AUL01_00491	3.602	6.461	5.814	5.956	6.168	6.321	6.833	7.306					
AUL01_00508	4.283	6.456	5.811	5.952	6.165	6.318	6.835	7.308					
AUL01_00518	4.389	6.591	5.924	6.181	6.442	6.737	6.969	7.314					
AUL01_00520	4.299	6.593	5.924	6.181	6.442	6.738	6.963	7.3					
AUL01_00547	4.261	6.611	5.936	6.194	6.452	6.746	6.961	7.306	Auldearn Burn modelled in 2D only				
AUL01_00573	4.126	6.629	5.945	6.204	6.46	6.754	6.967	7.309					
AUL01_00612	4.437	6.662	5.966	6.227	6.477	6.765	6.975	7.312					
AUL01_00652	4.358	6.685	5.989	6.251	6.494	6.775	6.978	7.313					
AUL01_00677	4.183	6.688	5.994	6.255	6.497	6.776	6.979	7.314					

	bed elevation	DN Fluvial (max stage mAOD)											
Label	m AOD	1997	2-yr	5-yr	10-yr	30-yr	100-yr	200-yr	1000-yr	200-yr CC1	200-yr CC2	1000-yr CC1	1000-yr CC2
AUL01_00727	4.633	6.718	6.015	6.277	6.513	6.793	6.994	7.318					
AUL01_00772	4.544	6.741	6.036	6.296	6.527	6.806	7.009	7.326					
AUL01_00853	4.441	6.797	6.071	6.333	6.557	6.842	7.043	7.342					
AUL01_00857	4.437	6.829	6.117	6.428	6.686	6.913	7.084	7.364					
AUL01_00876	4.706	6.815	6.119	6.429	6.687	6.897	7.056	7.319					
AUL01_00923	4.483	6.875	6.161	6.468	6.718	6.933	7.104	7.38					
AUL01_00977	4.642	6.916	6.194	6.496	6.738	6.958	7.13	7.387					
AUL01_01004	4.569	6.949	6.259	6.555	6.781	6.974	7.135	7.389					
B_00360	structure	2.736	3.019	3.044	3.073	3.154	3.413	3.697					
B_00363		2.786	3.026	3.061	3.099	3.204	3.509	3.89					
B_00808		3.735	3.141	3.274	3.397	3.642	4.086	4.537					
B_00809		3.889	3.161	3.319	3.469	3.789	4.775	5.413					
B_01458		6.148	4.445	4.906	5.195	5.734	6.506	7.01					
B_01461		6.148	4.452	4.914	5.206	5.737	6.608	7.133					
B_02828		10.161	8.714	9.17	9.477	9.902	10.125	10.226					
B_02830		10.161	8.718	9.171	9.477	9.902	10.125	10.24					
CUL_00297	3.71	6.401	4.911	5.245	5.443	6.058	6.811	7.293					
CUL_00319	3.9	6.434	5.226	5.826	6.073	6.286	6.827	7.326					
CUL_00508	4.44	6.467	5.817	5.96	6.171	6.325	6.836	7.308					
CUL_00518	4.46	6.591	5.924	6.181	6.442	6.737	6.969	7.314					
CUL_00853	4.44	6.797	6.071	6.333	6.557	6.842	7.043	7.342					
CUL_00857	4.44	6.829	6.117	6.428	6.686	6.913	7.084	7.364					
NAI01_00000	-2.088	1.691	2.956	2.929	2.925	2.916	2.895	2.97	3.387	4.141	4.842	4.176	4.88
NAI01_00029	-1.615	1.973	2.986	2.976	2.964	2.941	2.955	3.094	3.479	4.149	4.853	4.476	4.916
NAI01_00182	-1.813	2.25	2.997	2.997	2.998	3.008	3.105	3.284	3.895	4.314	4.86	4.794	5.124
NAI01_00309	-1.202	2.493	3.005	3.016	3.028	3.066	3.226	3.428	4.625	4.782	5.024	5.225	5.309
NAI01_00360	-0.909	2.736	3.019	3.044	3.073	3.154	3.413	3.697	4.764	4.886	5.028	5.234	5.314
NAI01_00363	-0.909	2.786	3.026	3.061	3.099	3.204	3.509	3.89	4.765	4.882	5.029	5.233	5.312
NAI01_00416	-0.981	2.771	3.026	3.059	3.096	3.197	3.499	3.84	4.669	4.753	4.998	5.161	5.241
NAI01_00570	-0.191	3.179	3.057	3.121	3.192	3.363	3.767	4.103	4.793	4.846	5.036	5.242	5.324
NAI01_00586	-0.191	3.197	3.059	3.125	3.196	3.369	3.764	4.092	4.738	4.81	4.995	5.213	5.29

	bed elevation	DN Fluvial (max stage mAOD)											
Label	**m AOD**	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_00596	-0.191	3.198	3.059	3.125	3.197	3.369	3.764	4.095	4.758	4.799	5.007	5.207	5.272
NAI01_00681	-0.155	3.347	3.077	3.158	3.241	3.429	3.81	4.143	4.797	4.82	5.044	5.217	5.294
NAI01_00749	0.343	3.603	3.11	3.218	3.326	3.555	3.967	4.302	4.823	4.842	5.054	5.267	5.358
NAI01_00808	0.405	3.735	3.141	3.274	3.397	3.642	4.086	4.537	4.901	4.873	5.081	5.43	5.544
NAI01_00809	0.405	3.889	3.161	3.319	3.469	3.789	4.775	5.413	4.913	4.88	5.088	5.438	5.551
NAI01_00930	0.844	4.37	3.315	3.55	3.751	4.132	4.952	5.341	5.738	5.586	5.675	5.971	6.099
NAI01_00942	0.844	4.603	3.372	3.664	3.908	4.369	5.267	5.788	6.741	6.269	6.461	7.904	8.206
NAI01_-0100	-2.088	1.8	2.995	2.995	2.995	2.995	2.995	3.085	3.155	4.21	4.89	4.28	4.96
NAI01_01104	0.986	4.981	3.604	3.925	4.172	4.642	5.546	6.108	7.294	6.791	6.991	8.415	8.645
NAI01_01335	1.626	5.981	4.231	4.759	5.098	5.631	6.232	6.67	7.799	7.363	7.536	8.868	9.114
NAI01_01343	1.626	6.036	4.309	4.831	5.161	5.694	6.316	6.737	7.909	7.455	7.636	9.019	9.279
NAI01_01458	1.99	6.148	4.445	4.906	5.195	5.734	6.506	7.01	8.394	7.866	8.082	9.674	9.977
NAI01_01461	1.99	6.148	4.452	4.914	5.206	5.737	6.608	7.133	8.396	7.868	8.084	9.676	9.978
NAI01_01507	1.858	6.216	4.612	5.073	5.37	5.835	6.622	7.131	8.457	7.93	8.147	9.735	10.037
NAI01_01547	2.316	6.216	4.612	5.073	5.37	5.835	6.622	7.131	8.457	7.93	8.147	9.735	10.037
NAI01_01578	2.626	6.264	4.657	5.114	5.411	5.906	6.69	7.19	8.506	7.99	8.202	9.76	10.057
NAI01_01706	2.652	6.46	5.074	5.538	5.893	6.24	6.809	7.273	8.568	8.06	8.267	9.82	10.117
NAI01_01825	2.627	6.69	5.436	5.943	6.258	6.56	6.921	7.331	8.585	8.08	8.288	9.824	10.119
NAI01_01927	3.082	7.13	5.712	6.233	6.563	6.936	7.167	7.453	8.626	8.134	8.337	9.851	10.145
NAI01_01959	3.576	7.256	5.786	6.314	6.653	7.048	7.278	7.534	8.652	8.163	8.368	9.865	10.158
NAI01_02084	4.134	7.43	6.104	6.556	6.858	7.222	7.429	7.612	8.679	8.196	8.396	9.881	10.172
NAI01_02245	4.704	8.437	6.785	7.234	7.568	8.046	8.369	8.601	9.15	8.916	9.007	10.027	10.294
NAI01_02365	5.391	8.594	7.181	7.565	7.853	8.27	8.539	8.725	9.152	8.982	9.052	9.925	10.195
NAI01_02500	4.511	9.125	7.64	8.031	8.345	8.807	9.066	9.208	9.435	9.36	9.39	10.044	10.302
NAI01_02677	5.896	9.81	8.28	8.794	9.118	9.55	9.769	9.879	10.144	10.037	10.08	10.385	10.532
NAI01_02828	6.857	10.161	8.714	9.17	9.477	9.902	10.125	10.226	10.488	10.41	10.448	10.72	10.807
NAI01_02830	6.857	10.161	8.718	9.171	9.477	9.902	10.125	10.24	10.518	10.44	10.48	10.743	10.829
NAI01_02833	6.954	9.998	8.639	9.076	9.365	9.77	9.949	10.079	10.507	10.365	10.433	10.793	10.874
NAI01_02834	6.954	10.432	8.962	9.386	9.695	10.126	10.452	10.08	10.508	10.367	10.434	10.794	10.876
NAI01_02853	7.02	10.16	8.96	9.338	9.603	9.892	10.172	10.298	10.759	10.622	10.695	10.997	11.067
NAI01_02949	6.491	10.967	9.359	9.795	10.111	10.583	10.893	10.854	11.094	10.998	11.036	11.331	11.39

	bed elevation	DN Fluvial (max stage mAOD)											
Label	**m AOD**	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_03064	7.315	11.253	9.673	10.147	10.487	10.957	11.204	11.371	11.657	11.531	11.588	11.92	11.983
NAI01_03222	7.886	11.727	10.083	10.575	10.931	11.433	11.779	11.965	12.304	12.198	12.225	12.619	12.697
NAI01_03399	8.513	12.279	10.579	11.045	11.384	11.907	12.427	12.776	13.756	13.464	13.612	14.334	14.483
NAI01_03532	8.743	12.913	11.072	11.557	11.925	12.52	13.14	13.489	14.329	14.051	14.179	14.896	15.033
NAI01_03673	8.879	13.233	11.514	12.049	12.447	12.923	13.426	13.739	14.522	14.258	14.381	15.053	15.194
NAI01_03801	9.622	13.507	11.835	12.362	12.739	13.203	13.709	14.001	14.754	14.504	14.616	15.19	15.301
OL_00508	structure	6.467	5.817	5.96	6.171	6.325	6.836	7.308	structure not included in model				
PC_02834		cross section not included in model						10.982	11.005	10.994	10.433	10.793	10.875
SP_00326		6.44	5.275	5.868	6.112	6.295	6.814	7.299	structure not included in model				
SP_00327		6.442	5.787	5.915	6.136	6.3	6.819	7.304					
Sp_00360		2.736	3.019	3.044	3.073	3.154	3.413	3.697					
Sp_00363		2.786	3.026	3.061	3.099	3.204	3.509	3.89					
Sp_00808		3.735	3.141	3.274	3.397	3.642	4.086	4.537					
Sp_00809		3.889	3.161	3.319	3.469	3.789	4.775	5.413					
SP_00853		6.797	6.071	6.333	6.557	6.842	7.043	7.342					
SP_00857		6.829	6.117	6.428	6.686	6.913	7.084	7.364					
Sp_01458		6.148	4.445	4.906	5.195	5.734	6.506	7.01					
Sp_01461		6.148	4.452	4.914	5.206	5.737	6.608	7.133					
Sp_02828		10.161	8.714	9.17	9.477	9.902	10.125	10.226					
Sp_02830		10.161	8.718	9.171	9.477	9.902	10.125	10.24					

							DN Tidal (max stage mAOD)					
Label	**bed elevation**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00000	2.885	4.615	4.618	4.62	4.624	4.631	5.078	5.371	5.6	5.842	5.927	6.189
AUL01_00000D	2.885	4.612	4.615	4.617	4.621	4.628	5.075	5.369	5.597	5.838	5.911	6.175
AUL01_00041	3.585	4.621	4.623	4.625	4.629	4.635	5.079	5.372	5.601	5.844	5.931	6.192
AUL01_00043	3.585	4.622	4.625	4.627	4.63	4.637	5.08	5.371	5.6	5.838	5.934	6.185
AUL01_00087	3.667	4.674	4.676	4.677	4.68	4.686	5.099	5.379	5.614	5.87	5.995	6.241
AUL01_00144	3.425	4.787	4.788	4.789	4.791	4.794	5.155	5.408	5.649	5.899	6.079	6.3
AUL01_00195	3.263	4.831	4.832	4.833	4.835	4.838	5.188	5.415	5.648	5.9	6.083	6.306
AUL01_00237	3.284	4.853	4.854	4.855	4.856	4.859	5.207	5.426	5.652	5.902	6.088	6.309
AUL01_00258	3.294	4.865	4.866	4.867	4.869	4.871	5.216	5.429	5.653	5.902	6.088	6.309
AUL01_00297	3.671	4.911	4.912	4.912	4.914	4.916	5.247	5.442	5.655	5.902	6.088	6.31
AUL01_00319	3.895	5.226	5.227	5.227	5.229	5.231	5.827	6.073	6.192	6.236	6.299	6.36
AUL01_00326	3.87	5.275	5.276	5.277	5.278	5.28	5.869	6.111	6.22	6.253	6.307	6.362
AUL01_00327	3.87	5.787	5.787	5.787	5.787	5.787	5.915	6.135	6.235	6.262	6.312	6.362
AUL01_00376	3.289	5.796	5.796	5.796	5.796	5.796	5.927	6.145	6.236	6.256	6.292	6.339
AUL01_00410	3.717	5.801	5.801	5.801	5.801	5.801	5.935	6.151	6.243	6.264	6.305	6.352
AUL01_00414	3.598	5.802	5.802	5.802	5.802	5.802	5.937	6.153	6.246	6.267	6.309	6.356
AUL01_00427	3.635	5.804	5.804	5.804	5.804	5.804	5.94	6.155	6.249	6.27	6.313	6.359
AUL01_00440	3.705	5.805	5.805	5.805	5.805	5.805	5.942	6.157	6.252	6.273	6.317	6.363
AUL01_00453	3.646	5.806	5.806	5.806	5.806	5.806	5.944	6.158	6.253	6.275	6.321	6.367
AUL01_00464	3.594	5.809	5.809	5.809	5.809	5.809	5.947	6.16	6.256	6.277	6.325	6.371
AUL01_00475	3.465	5.81	5.81	5.81	5.81	5.81	5.949	6.162	6.258	6.28	6.328	6.374
AUL01_00487	3.682	5.81	5.81	5.81	5.81	5.81	5.949	6.162	6.258	6.28	6.329	6.375
AUL01_00491	3.602	5.814	5.814	5.814	5.814	5.814	5.956	6.167	6.264	6.286	6.335	6.38
AUL01_00508	4.283	5.811	5.811	5.811	5.811	5.811	5.952	6.164	6.261	6.283	6.332	6.378
AUL01_00518	4.389	5.924	5.924	5.924	5.924	5.924	6.181	6.442	6.642	6.665	6.772	6.788
AUL01_00520	4.299	5.924	5.924	5.924	5.924	5.924	6.182	6.442	6.643	6.666	6.773	6.789
AUL01_00547	4.261	5.936	5.936	5.936	5.936	5.936	6.194	6.451	6.651	6.673	6.781	6.796
AUL01_00573	4.126	5.945	5.945	5.945	5.945	5.945	6.205	6.459	6.659	6.682	6.789	6.803
AUL01_00612	4.437	5.966	5.966	5.966	5.966	5.966	6.228	6.477	6.674	6.695	6.799	6.813
AUL01_00652	4.358	5.989	5.989	5.989	5.989	5.989	6.251	6.493	6.685	6.706	6.809	6.822
AUL01_00677	4.183	5.994	5.994	5.994	5.994	5.994	6.255	6.496	6.687	6.707	6.81	6.822

		DN Tidal (max stage mAOD)										
Label	**bed elevation**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00727	4.633	6.015	6.015	6.015	6.015	6.015	6.277	6.513	6.702	6.722	6.828	6.84
AUL01_00772	4.544	6.036	6.036	6.036	6.036	6.036	6.296	6.526	6.714	6.734	6.842	6.854
AUL01_00853	4.441	6.071	6.071	6.071	6.071	6.071	6.334	6.556	6.745	6.765	6.882	6.893
AUL01_00857	4.437	6.117	6.117	6.117	6.117	6.117	6.428	6.686	6.826	6.841	6.947	6.954
AUL01_00876	4.706	6.119	6.119	6.119	6.119	6.119	6.429	6.686	6.815	6.828	6.927	6.934
AUL01_00923	4.483	6.161	6.161	6.161	6.161	6.161	6.468	6.718	6.846	6.859	6.968	6.974
AUL01_00977	4.642	6.194	6.194	6.194	6.194	6.194	6.497	6.738	6.867	6.88	6.994	7
AUL01_01004	4.569	6.259	6.259	6.259	6.259	6.259	6.555	6.781	6.893	6.904	7.007	7.012
B_00360	structure	3.019	3.107	3.176	3.266	3.382	3.459	3.615	4.573	5.229	4.727	5.37
B_00363		3.026	3.115	3.183	3.273	3.388	3.472	3.641	4.597	5.239	4.759	5.391
B_00808		3.141	3.215	3.273	3.35	3.45	3.583	3.765	4.605	5.243	4.771	5.402
B_00809		3.161	3.235	3.293	3.37	3.469	3.625	3.854	4.853	5.377	5.104	5.57
B_01458		4.445	4.449	4.452	4.457	4.467	4.909	5.194	5.474	5.784	5.831	6.111
B_01461		4.452	4.456	4.459	4.464	4.474	4.917	5.205	5.478	5.787	5.839	6.128
B_02828		8.714	8.714	8.714	8.714	8.714	9.17	9.477	9.623	9.728	9.895	9.956
B_02830		8.718	8.718	8.718	8.718	8.718	9.171	9.477	9.623	9.728	9.895	9.956
CUL_00297	3.71	4.911	4.912	4.912	4.914	4.916	5.247	5.442	5.655	5.902	6.088	6.31
CUL_00319	3.9	5.226	5.227	5.227	5.229	5.231	5.827	6.073	6.192	6.236	6.299	6.36
CUL_00508	4.44	5.817	5.817	5.817	5.817	5.817	5.96	6.171	6.269	6.29	6.34	6.385
CUL_00518	4.46	5.924	5.924	5.924	5.924	5.924	6.181	6.442	6.642	6.665	6.772	6.788
CUL_00853	4.44	6.071	6.071	6.071	6.071	6.071	6.334	6.556	6.745	6.765	6.882	6.893
CUL_00857	4.44	6.117	6.117	6.117	6.117	6.117	6.428	6.686	6.826	6.841	6.947	6.954
NAI01_00000	-2.088	2.956	3.048	3.119	3.213	3.334	3.378	3.532	4.51	5.225	4.659	5.377
NAI01_00029	-1.615	2.986	3.077	3.147	3.239	3.358	3.408	3.551	4.539	5.229	4.686	5.38
NAI01_00182	-1.813	2.997	3.087	3.156	3.248	3.366	3.424	3.572	4.545	5.23	4.694	5.38
NAI01_00309	-1.202	3.005	3.095	3.164	3.255	3.372	3.436	3.584	4.569	5.228	4.727	5.38
NAI01_00360	-0.909	3.019	3.107	3.176	3.266	3.382	3.459	3.615	4.573	5.229	4.727	5.37
NAI01_00363	-0.909	3.026	3.115	3.183	3.273	3.388	3.472	3.641	4.597	5.239	4.759	5.391
NAI01_00416	-0.981	3.026	3.114	3.183	3.272	3.387	3.47	3.633	4.515	5.209	4.657	5.367
NAI01_00570	-0.191	3.057	3.143	3.21	3.296	3.407	3.51	3.687	4.589	5.222	4.745	5.37
NAI01_00586	-0.191	3.059	3.145	3.211	3.297	3.408	3.511	3.688	4.581	5.211	4.729	5.364

							DN Tidal (max stage mAOD)					
Label	**bed elevation**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_00596	-0.191	3.059	3.145	3.211	3.298	3.408	3.511	3.687	4.579	5.211	4.728	5.364
NAI01_00681	-0.155	3.077	3.16	3.224	3.308	3.416	3.524	3.7	4.589	5.231	4.746	5.385
NAI01_00749	0.343	3.11	3.188	3.249	3.33	3.434	3.556	3.738	4.599	5.245	4.765	5.405
NAI01_00808	0.405	3.141	3.215	3.273	3.35	3.45	3.583	3.765	4.605	5.243	4.771	5.402
NAI01_00809	0.405	3.161	3.235	3.293	3.37	3.469	3.625	3.854	4.853	5.377	5.104	5.57
NAI01_00930	0.844	3.315	3.37	3.414	3.476	3.559	3.769	4.016	4.875	5.33	5.094	5.484
NAI01_00942	0.844	3.372	3.421	3.461	3.516	3.591	3.845	4.115	4.934	5.405	5.197	5.599
NAI01_-0100	-2.088	2.995	3.085	3.155	3.247	3.365	3.425	3.575	4.55	5.23	4.7	5.38
NAI01_01104	0.986	3.604	3.631	3.654	3.689	3.74	4.03	4.301	5.015	5.47	5.307	5.694
NAI01_01335	1.626	4.231	4.236	4.241	4.25	4.265	4.765	5.096	5.423	5.732	5.742	6.007
NAI01_01343	1.626	4.309	4.313	4.318	4.325	4.338	4.835	5.16	5.467	5.768	5.792	6.052
NAI01_01458	1.99	4.445	4.449	4.452	4.457	4.467	4.909	5.194	5.474	5.784	5.831	6.111
NAI01_01461	1.99	4.452	4.456	4.459	4.464	4.474	4.917	5.205	5.478	5.787	5.839	6.128
NAI01_01507	1.858	4.612	4.615	4.617	4.621	4.628	5.075	5.369	5.597	5.838	5.911	6.175
NAI01_01547	2.316	4.612	4.615	4.617	4.621	4.628	5.075	5.369	5.597	5.838	5.911	6.175
NAI01_01578	2.626	4.657	4.66	4.662	4.665	4.671	5.116	5.41	5.631	5.86	5.968	6.215
NAI01_01706	2.652	5.074	5.074	5.075	5.076	5.078	5.539	5.892	6.063	6.144	6.241	6.376
NAI01_01825	2.627	5.436	5.436	5.437	5.437	5.438	5.943	6.258	6.395	6.475	6.56	6.609
NAI01_01927	3.082	5.712	5.712	5.712	5.713	5.713	6.233	6.563	6.712	6.806	6.932	6.984
NAI01_01959	3.576	5.786	5.786	5.786	5.786	5.787	6.314	6.653	6.809	6.909	7.044	7.097
NAI01_02084	4.134	6.104	6.104	6.104	6.104	6.104	6.556	6.858	6.998	7.089	7.217	7.268
NAI01_02245	4.704	6.785	6.785	6.785	6.785	6.785	7.234	7.568	7.734	7.852	8.038	8.108
NAI01_02365	5.391	7.181	7.181	7.181	7.181	7.181	7.565	7.853	7.997	8.1	8.263	8.326
NAI01_02500	4.511	7.64	7.64	7.64	7.64	7.64	8.031	8.345	8.501	8.617	8.799	8.87
NAI01_02677	5.896	8.28	8.28	8.28	8.28	8.28	8.794	9.118	9.269	9.377	9.543	9.606
NAI01_02828	6.857	8.714	8.714	8.714	8.714	8.714	9.17	9.477	9.623	9.728	9.895	9.956
NAI01_02830	6.857	8.718	8.718	8.718	8.718	8.718	9.171	9.477	9.623	9.728	9.895	9.956
NAI01_02833	6.954	8.639	8.639	8.639	8.639	8.639	9.076	9.365	9.501	9.6	9.764	9.818
NAI01_02834	6.954	8.962	8.962	8.962	8.962	8.962	9.386	9.695	9.847	9.956	10.119	10.188
NAI01_02853	7.02	8.96	8.96	8.96	8.96	8.96	9.338	9.603	9.728	9.799	9.885	9.947
NAI01_02949	6.491	9.359	9.359	9.359	9.359	9.359	9.795	10.111	10.27	10.392	10.577	10.643

		DN Tidal (max stage mAOD)										
Label	**bed elevation**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_03064	7.315	9.673	9.673	9.673	9.673	9.673	10.147	10.487	10.653	10.775	10.951	11.01
NAI01_03222	7.886	10.083	10.083	10.083	10.083	10.083	10.575	10.931	11.105	11.234	11.425	11.499
NAI01_03399	8.513	10.579	10.579	10.579	10.579	10.579	11.045	11.384	11.55	11.674	11.897	12.001
NAI01_03532	8.743	11.072	11.072	11.072	11.072	11.072	11.557	11.925	12.1	12.236	12.508	12.637
NAI01_03673	8.879	11.514	11.514	11.514	11.514	11.514	12.049	12.447	12.599	12.705	12.913	13.013
NAI01_03801	9.622	11.835	11.835	11.835	11.835	11.835	12.362	12.739	12.884	12.988	13.194	13.293
OL_00508	structure	5.817	5.817	5.817	5.817	5.817	5.96	6.171	6.269	6.29	6.34	6.385
PC_02834		cross section not included in model										
SP_00326		5.275	5.276	5.277	5.278	5.28	5.869	6.111	6.22	6.253	6.307	6.362
SP_00327		5.787	5.787	5.787	5.787	5.787	5.915	6.135	6.235	6.262	6.312	6.362
Sp_00360		3.019	3.107	3.176	3.266	3.382	3.459	3.615	4.573	5.229	4.727	5.37
Sp_00363		3.026	3.115	3.183	3.273	3.388	3.472	3.641	4.597	5.239	4.759	5.391
Sp_00808		3.141	3.215	3.273	3.35	3.45	3.583	3.765	4.605	5.243	4.771	5.402
Sp_00809		3.161	3.235	3.293	3.37	3.469	3.625	3.854	4.853	5.377	5.104	5.57
SP_00853		6.071	6.071	6.071	6.071	6.071	6.334	6.556	6.745	6.765	6.882	6.893
SP_00857		6.117	6.117	6.117	6.117	6.117	6.428	6.686	6.826	6.841	6.947	6.954
Sp_01458		4.445	4.449	4.452	4.457	4.467	4.909	5.194	5.474	5.784	5.831	6.111
Sp_01461		4.452	4.456	4.459	4.464	4.474	4.917	5.205	5.478	5.787	5.839	6.128
Sp_02828		8.714	8.714	8.714	8.714	8.714	9.17	9.477	9.623	9.728	9.895	9.956
Sp_02830		8.718	8.718	8.718	8.718	8.718	9.171	9.477	9.623	9.728	9.895	9.956

		DN Fluvial (flow m3/s)										
Label	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00000	17.355	2.444	3.372	3.779	14.446	22.741	27.573					
AUL01_00000D	17.355	2.444	3.372	3.779	14.446	22.741	27.573					
AUL01_00041	17.355	2.437	3.361	3.765	14.446	22.733	27.672					
AUL01_00043	20.757	2.437	3.36	3.756	16.912	25.315	31.418					
AUL01_00087	11.581	2.433	3.352	3.74	9.028	15.167	20.353					
AUL01_00144	6.119	2.43	3.344	3.638	3.7	10.006	14.728					
AUL01_00195	5.222	2.429	3.339	3.641	3.92	7.333	10.256					
AUL01_00237	3.433	2.427	3.331	3.548	3.418	3.308	4.439					
AUL01_00258	4.099	2.427	3.328	3.609	3.497	3.383	3.392					
AUL01_00297	4.648	2.426	3.325	3.612	3.488	3.38	3.395					
AUL01_00319	4.648	2.426	3.325	3.612	3.488	3.38	3.395					
AUL01_00326	4.65	2.425	3.324	3.612	3.492	3.985	5.873					
AUL01_00327	4.65	2.425	3.324	3.612	3.492	3.985	5.873					
AUL01_00376	6.99	2.426	3.49	4.177	5.447	6.339	4.796					
AUL01_00410	6.446	2.426	3.489	4.179	5.254	5.252	4.487					
AUL01_00414	6.324	2.426	3.489	4.179	5.198	5.114	4.597					
AUL01_00427	6.339	2.425	3.489	4.179	5.241	5.372	4.136					
AUL01_00440	6.321	2.425	3.489	4.18	5.19	5.313	4.07					
AUL01_00453	6.256	2.426	3.489	4.181	4.955	4.402	3.808					
AUL01_00464	6.266	2.426	3.489	4.181	4.85	4.15	3.821					
AUL01_00475	6.28	2.425	3.489	4.182	4.802	3.984	3.75					
AUL01_00487	6.099	2.426	3.489	4.175	4.674	3.856	3.635					
AUL01_00491	6.427	2.426	3.489	4.183	4.803	4.064	3.77					
AUL01_00508	6.574	2.425	3.489	4.183	4.781	4.044	3.81					
AUL01_00518	6.574	2.425	3.489	4.183	4.781	4.044	3.81					
AUL01_00520	6.574	2.425	3.489	4.184	4.782	4.044	5.418					
AUL01_00547	6.576	2.426	3.489	4.185	4.777	4.884	4.99	Auldearn Burn modelled in 2D only				
AUL01_00573	6.44	2.426	3.489	4.186	4.566	4.64	4.349					
AUL01_00612	6.08	2.426	3.489	4.176	4.657	4.676	4.352					
AUL01_00652	6.476	2.426	3.489	4.207	5.148	6.121	5.718					
AUL01_00677	6.655	2.426	3.489	4.208	5.424	6.438	5.996					

		DN Fluvial (flow m3/s)										
Label	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00727	6.659	2.426	3.489	4.21	5.434	6.685	6.375					
AUL01_00772	6.661	2.426	3.488	4.213	5.465	6.412	6.117					
AUL01_00853	6.025	2.426	3.488	4.203	4.311	4.884	5.067					
AUL01_00857	6.025	2.426	3.488	4.203	4.311	4.884	5.067					
AUL01_00876	6.676	2.427	3.488	4.216	5.481	7.111	9.054					
AUL01_00923	6.484	2.427	3.488	4.219	5.216	6.284	6.282					
AUL01_00977	5.649	2.428	3.489	4.177	4.373	4.284	4.984					
AUL01_01004	6.7	2.43	3.49	4.23	5.49	7.11	8.18					
B_00360	319.27	105.16	149.8	186.572	260.046	373.966	445.783					
B_00363	319.27	105.16	149.8	186.572	260.046	373.966	445.783					
B_00808	319.23	100.919	146.221	183.279	255.626	355.542	361.306					
B_00809	319.23	100.919	146.221	183.279	255.626	355.542	361.306					
B_01458	256.91	100.063	145.725	182.832	233.781	264.64	285.821					
B_01461	256.91	100.063	145.725	182.832	233.781	264.64	285.821					
B_02828	281.61	96.19	140.472	177.486	236.245	284.714	348.486					
B_02830	281.61	96.19	140.472	177.486	236.245	284.714	348.486					
CUL_00297	4.648	2.426	3.325	3.612	3.488	3.38	3.395					
CUL_00319	4.648	2.426	3.325	3.612	3.488	3.38	3.395					
CUL_00508	6.574	2.425	3.489	4.183	4.781	4.044	3.81					
CUL_00518	6.574	2.425	3.489	4.183	4.781	4.044	3.81					
CUL_00853	5.959	2.426	3.488	4.172	4.243	3.929	3.262					
CUL_00857	5.959	2.426	3.488	4.172	4.243	3.929	3.262					
NAI01_00000	319.39	112.101	155.096	191.016	263.864	377.73	458.034	703.785	623.588	646.556	842.314	872.157
NAI01_00029	319.36	111.829	154.823	190.852	263.703	377.659	452.247	703.618	617.273	639.932	842.284	872.132
NAI01_00182	319.35	110.016	153.288	189.805	262.749	376.545	452.333	703.2	619.74	642.847	842.123	871.998
NAI01_00309	319.35	108.459	152.348	188.895	261.961	375.768	452.671	574.982	536.406	549.596	677.208	715.492
NAI01_00360	319.27	105.16	149.8	186.572	260.046	373.966	445.783	573.84	524.17	553.945	799.471	846.355
NAI01_00363	319.27	105.16	149.8	186.572	260.046	373.966	445.783	573.839	522.394	552.06	798.655	845.836
NAI01_00416	319.2	104.526	149.387	186.173	259.545	372.37	440.842	581.2	529.359	551.531	758.265	799.781
NAI01_00570	319.2	102.704	147.467	184.335	256.778	359.862	428.302	678.759	615.839	653.727	932.528	984.95
NAI01_00586	319.2	102.534	147.364	184.333	256.865	363.08	436.19	708.526	625.719	666.593	946.878	1000.604

		DN Fluvial (flow m3/s)										
Label	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_00596	319.2	102.434	147.288	184.275	256.784	363.401	433.15	700.724	617.79	658.825	942.078	1000.006
NAI01_00681	319.21	101.706	146.754	183.79	256.16	367.93	433.426	699.584	615.097	652.161	942.301	996.053
NAI01_00749	315.38	101.208	146.39	183.07	254.301	358.683	412.955	699.635	612.576	647.276	925.856	981.249
NAI01_00808	319.23	100.919	146.221	183.279	255.626	357.741	376.638	715.635	618.665	653.44	949.821	1006.943
NAI01_00809	319.23	100.919	146.221	183.279	255.626	357.741	376.638	715.632	618.49	653.271	950.201	1007.376
NAI01_00930	319.3	100.506	145.958	183.069	255.466	369.329	456.878	744.636	635.474	680.48	1016.322	1074.777
NAI01_00942	319.3	100.506	145.958	183.069	255.466	369.329	456.878	744.636	635.474	680.48	1016.322	1074.777
NAI01_-0100	319.36	113.655	156.671	192.127	264.92	379.035	467.877	704.979	681.205	699.271	843.152	872.689
NAI01_01104	276.3	100.212	144.369	177.1	234.537	292.779	333.879	479.096	430.273	449.946	624.211	666.164
NAI01_01335	318.96	100.076	145.65	182.688	255.001	368.943	456.535	745.543	635.595	681.319	1039.09	1118.796
NAI01_01343	318.96	100.076	145.65	182.688	255.001	368.943	456.535	745.543	635.595	681.319	1039.09	1118.796
NAI01_01458	256.91	100.063	145.725	182.832	233.781	264.785	287.125	356.692	334.202	343.459	404.821	421.569
NAI01_01461	256.91	100.063	145.725	182.832	233.781	264.785	287.125	356.78	333.851	343.517	405.001	421.776
NAI01_01507	256	99.983	145.674	182.575	236.31	260.169	278.649	306.251	292.275	298.805	330.275	341.904
NAI01_01547	239	97.579	142.429	179.613	222.463	237.728	253.007	300.346	287.507	293.939	324.369	335.997
NAI01_01578	224.17	97.269	140.675	175.858	210.684	216.201	223.663	258.812	247.219	252.973	282.521	295.901
NAI01_01706	233.62	97.222	139.121	167.717	208.068	220.316	229.09	252.083	243.931	248.477	260.587	271.959
NAI01_01825	269.94	97.237	140.711	175.137	229.523	254.017	266.487	295.11	286.155	290.836	303.138	314.923
NAI01_01927	275.01	97.069	140.291	175.225	230.262	266.247	285.703	320.121	311.619	315.495	326.826	327.343
NAI01_01959	283.86	96.855	141.321	177.567	234.884	274.616	298.778	342.801	333.347	338.016	350.226	351.799
NAI01_02084	291.63	96.879	141.456	178.655	239.63	282.795	313.994	353.445	346.364	350.29	358.442	358.671
NAI01_02245	282.46	96.903	141.491	178.72	239.724	276.506	298.827	336.175	328.357	333.633	370.242	393.256
NAI01_02365	281.62	96.529	140.972	178.082	238.773	275.61	299.905	350.925	333.476	341.538	410.755	431.668
NAI01_02500	263.83	96.541	140.787	175.152	228.454	261.083	287.415	358.24	331.866	343.591	422.85	439.893
NAI01_02677	266.89	96.548	139.276	173.768	227.688	267.104	308.82	409.125	374.585	390.639	509.453	533.384
NAI01_02828	281.61	96.19	140.472	177.486	236.245	284.714	348.554	481.729	433.383	455.424	605.053	638.413
NAI01_02830	281.61	96.19	140.472	177.486	236.245	284.714	348.554	481.632	433.339	455.386	605.014	638.368
NAI01_02833	278.39	96.189	140.466	177.444	234.453	281.399	346.829	480.593	432.206	454.37	606.376	640.454
NAI01_02834	278.39	96.189	140.466	177.444	234.453	281.399	346.827	480.59	432.206	454.371	606.365	640.442
NAI01_02853	296.01	96.19	140.615	177.995	241.835	303.505	331.647	475.643	422.12	446.822	610.3	646.321
NAI01_02949	277.54	96.183	140.434	177.132	238.178	297.415	346.746	523.662	459.019	490.32	676.024	716.876

		DN Fluvial (flow m3/s)										
Label	**1997**	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_03064	291.04	96.197	140.448	177.147	242.3	319.521	370.4	565.247	491.018	526.954	740.574	787.102
NAI01_03222	304.65	96.231	140.487	177.087	246.991	341.525	407.583	624.334	539.135	578.544	830.322	884.064
NAI01_03399	294.12	96.277	140.545	177.167	245.151	331.712	387.857	564.378	493.229	523.228	768.638	823.942
NAI01_03532	268.23	96.311	140.592	176.427	227.838	300.713	358.983	573.279	488.628	525.434	817.332	882.441
NAI01_03673	278.84	96.265	138.117	171.126	228.856	318.598	385.131	619.564	528.516	567.946	898.09	984.009
NAI01_03801	314.11	96.432	140.721	177.472	250.346	363.111	449.805	743.184	629.79	679.42	1040.646	1122.314
OL_00508	6.574	2.425	3.489	4.183	4.781	4.044	3.81	Structure not included in model				
PC_02834	Cross section not included in model						346.828	480.591	432.206	454.37	606.37	640.448
SP_00326	2.966	2.425	3.324	3.612	3.492	3.985	5.873	Structure not included in model				
SP_00327	2.966	2.425	3.324	3.612	3.492	3.985	5.873					
Sp_00360	0	0	0	0	0	0	0.001					
Sp_00363	0	0	0	0	0	0	0.001					
Sp_00808	0	0	0	0	0	8.42	50.966					
Sp_00809	0	0	0	0	0	8.42	50.966					
SP_00853	0.52	0	0	0.045	1.066	2.525	3.361					
SP_00857	0.52	0	0	0.045	1.066	2.525	3.361					
Sp_01458	0	0	0	0	0	0.68	5.489					
Sp_01461	0	0	0	0	0	0.68	5.489					
Sp_02828	0	0	0	0	0	0.004	0.068					
Sp_02830	0	0	0	0	0	0.004	0.068					

	DN Tidal (flow m3/s)										
Label	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00000	2.444	2.445	2.445	2.446	2.448	3.373	3.778	5.449	8.23	13.968	15.467
AUL01_00000D	2.444	2.445	2.445	2.446	2.448	3.373	3.778	5.449	8.23	13.968	15.467
AUL01_00041	2.437	2.438	2.437	2.438	2.439	3.361	3.764	5.427	8.208	13.933	15.445
AUL01_00043	2.437	2.437	2.437	2.437	2.439	3.361	3.756	6.313	9.347	16.234	16.143
AUL01_00087	2.433	2.433	2.433	2.433	2.434	3.353	3.74	5.059	6.048	9.828	10.825
AUL01_00144	2.43	2.431	2.431	2.431	2.431	3.344	3.637	3.719	3.59	3.836	4.536
AUL01_00195	2.429	2.429	2.429	2.429	2.429	3.339	3.641	3.762	3.621	4.174	4.493
AUL01_00237	2.427	2.428	2.428	2.428	2.428	3.331	3.547	3.586	3.479	3.521	3.398
AUL01_00258	2.427	2.427	2.427	2.427	2.427	3.328	3.609	3.653	3.556	3.594	3.501
AUL01_00297	2.426	2.426	2.426	2.426	2.426	3.325	3.611	3.643	3.557	3.585	3.502
AUL01_00319	2.426	2.426	2.426	2.426	2.426	3.325	3.611	3.643	3.557	3.585	3.502
AUL01_00326	2.425	2.425	2.425	2.425	2.425	3.324	3.611	3.646	3.561	3.588	3.505
AUL01_00327	2.425	2.425	2.425	2.425	2.425	3.324	3.611	3.646	3.561	3.588	3.505
AUL01_00376	2.426	2.426	2.426	2.426	2.426	3.49	4.177	4.618	4.724	5.885	5.981
AUL01_00410	2.426	2.426	2.426	2.426	2.426	3.49	4.178	4.602	4.654	5.628	5.623
AUL01_00414	2.426	2.426	2.426	2.426	2.426	3.49	4.178	4.601	4.614	5.557	5.527
AUL01_00427	2.425	2.425	2.425	2.425	2.425	3.489	4.179	4.603	4.648	5.605	5.586
AUL01_00440	2.425	2.425	2.425	2.425	2.425	3.489	4.18	4.574	4.603	5.555	5.53
AUL01_00453	2.426	2.426	2.426	2.426	2.426	3.489	4.18	4.565	4.543	5.23	5.174
AUL01_00464	2.426	2.426	2.426	2.426	2.426	3.489	4.181	4.575	4.543	5.073	4.996
AUL01_00475	2.425	2.425	2.425	2.425	2.425	3.489	4.181	4.558	4.515	5.009	4.908
AUL01_00487	2.426	2.426	2.426	2.426	2.426	3.489	4.175	4.498	4.421	4.851	4.738
AUL01_00491	2.426	2.426	2.426	2.426	2.426	3.489	4.183	4.557	4.507	5.004	4.921
AUL01_00508	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
AUL01_00518	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
AUL01_00520	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
AUL01_00547	2.426	2.426	2.426	2.426	2.426	3.489	4.184	4.585	4.549	4.863	4.762
AUL01_00573	2.426	2.426	2.426	2.426	2.426	3.489	4.186	4.49	4.396	4.646	4.518
AUL01_00612	2.426	2.426	2.426	2.426	2.426	3.489	4.176	4.472	4.418	4.809	4.741
AUL01_00652	2.426	2.426	2.426	2.426	2.426	3.489	4.206	4.724	4.663	5.497	5.476
AUL01_00677	2.426	2.426	2.426	2.426	2.426	3.489	4.208	4.755	4.763	5.816	5.797

	DN Tidal (flow m3/s)										
Label	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
AUL01_00727	2.426	2.426	2.426	2.426	2.426	3.489	4.21	4.757	4.769	5.838	5.835
AUL01_00772	2.426	2.426	2.426	2.426	2.426	3.488	4.212	4.76	4.774	5.861	5.837
AUL01_00853	2.426	2.426	2.426	2.426	2.426	3.488	4.203	4.372	4.314	4.344	4.29
AUL01_00857	2.426	2.426	2.426	2.426	2.426	3.488	4.203	4.372	4.314	4.344	4.29
AUL01_00876	2.427	2.427	2.427	2.427	2.427	3.488	4.215	4.811	4.82	5.9	5.898
AUL01_00923	2.427	2.427	2.427	2.427	2.427	3.488	4.219	4.79	4.764	5.543	5.53
AUL01_00977	2.428	2.428	2.428	2.428	2.428	3.489	4.177	4.341	4.296	4.421	4.388
AUL01_01004	2.43	2.43	2.43	2.43	2.43	3.49	4.23	4.88	4.88	5.92	5.92
B_00360	105.16	106.67	107.52	108.19	110.83	156.851	195.358	257.697	277.886	307.928	323.366
B_00363	105.16	106.67	107.52	108.19	110.83	156.851	195.358	257.697	277.886	307.928	323.366
B_00808	100.92	101.16	101.29	101.47	101.56	146.953	184.164	204.84	216.585	254.851	268.109
B_00809	100.92	101.16	101.29	101.47	101.56	146.953	184.164	204.84	216.585	254.851	268.109
B_01458	100.06	100.06	100.07	100.08	100.1	145.713	182.803	199.403	206.855	229.135	233.833
B_01461	100.06	100.06	100.07	100.08	100.1	145.713	182.803	199.403	206.855	229.135	233.833
B_02828	96.19	96.191	96.191	96.192	96.191	140.473	177.489	197.126	211.862	235.19	245.133
B_02830	96.19	96.191	96.191	96.192	96.191	140.473	177.489	197.126	211.862	235.19	245.133
CUL_00297	2.426	2.426	2.426	2.426	2.426	3.325	3.611	3.643	3.557	3.585	3.502
CUL_00319	2.426	2.426	2.426	2.426	2.426	3.325	3.611	3.643	3.557	3.585	3.502
CUL_00508	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
CUL_00518	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
CUL_00853	2.426	2.426	2.426	2.426	2.426	3.488	4.173	4.318	4.256	4.277	4.216
CUL_00857	2.426	2.426	2.426	2.426	2.426	3.488	4.173	4.318	4.256	4.277	4.216
NAI01_00000	112.1	112.73	113.1	113.67	116.2	162.193	201.437	308.787	347.969	363.89	390.054
NAI01_00029	111.83	112.46	112.83	113.49	116.02	162.018	201.26	308.484	347.594	363.53	389.701
NAI01_00182	110.02	110.64	111.02	112.24	114.93	160.885	200.116	306.595	345.484	361.552	387.769
NAI01_00309	108.46	109.05	109.59	111.2	113.92	159.893	199.137	280.231	307.6	331.281	349.604
NAI01_00360	105.16	106.67	107.52	108.19	110.83	156.851	195.358	257.697	277.886	307.928	323.366
NAI01_00363	105.16	106.67	107.52	108.19	110.83	156.851	195.358	257.697	277.886	307.928	323.366
NAI01_00416	104.53	106.13	106.92	107.47	109.93	155.865	193.705	241.268	308.164	306.102	369.588
NAI01_00570	102.7	103.28	103.5	103.73	104.39	149.042	185.06	215.386	228.34	262.326	274.789
NAI01_00586	102.53	103.11	103.37	103.53	104.01	148.696	184.862	214.763	227.904	262.452	277.118

	DN Tidal (flow m3/s)										
Label	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_00596	102.43	103	103.26	103.39	103.78	148.321	184.387	213.024	226.002	260.99	281.136
NAI01_00681	101.71	102.11	102.29	102.48	102.56	147.807	184.945	206.486	218.146	256.042	269.098
NAI01_00749	101.21	101.52	101.62	101.69	101.51	146.321	182.275	201.871	213.394	250.937	264.03
NAI01_00808	100.92	101.16	101.29	101.47	101.56	146.953	184.164	204.84	216.585	254.851	268.109
NAI01_00809	100.92	101.16	101.29	101.47	101.56	146.953	184.164	204.84	216.585	254.851	268.109
NAI01_00930	100.51	100.64	100.75	100.89	100.99	146.496	183.656	204.446	222.624	257.438	278.926
NAI01_00942	100.51	100.64	100.75	100.89	100.99	146.496	183.656	204.446	222.624	257.438	278.926
NAI01_-0100	113.66	114.3	114.67	115.21	117.17	163.154	202.41	310.612	350.033	366.136	392.36
NAI01_01104	100.21	100.24	100.25	100.29	100.3	143.828	175.488	186.964	195.452	226.126	234.656
NAI01_01335	100.08	100.08	100.1	100.12	100.16	145.649	182.66	202.8	220.099	254.832	276.624
NAI01_01343	100.08	100.08	100.1	100.12	100.16	145.649	182.66	202.8	220.099	254.832	276.624
NAI01_01458	100.06	100.06	100.07	100.08	100.1	145.713	182.803	199.403	206.855	229.135	233.833
NAI01_01461	100.06	100.06	100.07	100.08	100.1	145.713	182.803	199.403	206.855	229.135	233.833
NAI01_01507	99.983	99.982	99.987	99.993	100	145.662	182.551	200.366	209.429	230.696	234.366
NAI01_01547	97.579	97.576	97.578	97.583	97.589	142.421	179.6	195.895	201.357	217.158	219.017
NAI01_01578	97.269	97.265	97.262	97.259	97.253	140.662	175.856	190.202	193.723	208.926	209.817
NAI01_01706	97.222	97.222	97.221	97.22	97.22	139.105	167.73	181.249	191.719	207.562	210.747
NAI01_01825	97.237	97.236	97.236	97.235	97.235	140.705	175.137	193.32	206.524	228.466	236.266
NAI01_01927	97.069	97.069	97.068	97.067	97.066	140.298	175.222	193.741	207.122	229.316	237.785
NAI01_01959	96.855	96.856	96.855	96.856	96.855	141.325	177.565	196.567	210.575	233.87	243.024
NAI01_02084	96.879	96.879	96.879	96.879	96.879	141.458	178.654	198.648	213.642	238.535	248.254
NAI01_02245	96.903	96.903	96.904	96.903	96.904	141.492	178.719	198.68	213.659	238.624	248.517
NAI01_02365	96.529	96.529	96.529	96.529	96.529	140.972	178.081	197.902	212.88	237.674	247.474
NAI01_02500	96.541	96.541	96.54	96.54	96.541	140.787	175.152	193.014	206.187	227.522	235.752
NAI01_02677	96.548	96.549	96.548	96.547	96.55	139.277	173.77	191.496	204.935	226.743	235.311
NAI01_02828	96.19	96.191	96.191	96.192	96.191	140.473	177.489	197.126	211.862	235.19	245.133
NAI01_02830	96.19	96.191	96.191	96.192	96.191	140.473	177.489	197.126	211.862	235.19	245.133
NAI01_02833	96.189	96.19	96.19	96.19	96.19	140.465	177.445	196.855	211.197	233.437	243.102
NAI01_02834	96.189	96.19	96.19	96.19	96.19	140.465	177.445	196.855	211.197	233.437	243.102
NAI01_02853	96.19	96.19	96.19	96.191	96.19	140.614	177.995	197.917	213.897	240.675	252.569
NAI01_02949	96.183	96.183	96.183	96.184	96.184	140.434	177.133	196.5	211.34	236.952	248.568

	DN Tidal (flow m3/s)										
Label	**2-yr**	**5-yr**	**10-yr**	**30-yr**	**100-yr**	**200-yr**	**1000-yr**	**200-yr CC1**	**200-yr CC2**	**1000-yr CC1**	**1000-yr CC2**
NAI01_03064	96.197	96.197	96.197	96.198	96.198	140.449	177.149	196.56	211.819	240.854	255.416
NAI01_03222	96.231	96.231	96.231	96.232	96.232	140.486	177.087	196.239	211.619	245.269	263.111
NAI01_03399	96.277	96.277	96.277	96.277	96.278	140.546	177.167	196.383	211.268	243.518	260.032
NAI01_03532	96.311	96.31	96.31	96.311	96.312	140.592	176.426	192.378	203.442	226.628	238.967
NAI01_03673	96.265	96.266	96.265	96.265	96.267	138.117	171.126	186.566	198.977	227.391	242.712
NAI01_03801	96.432	96.432	96.432	96.432	96.432	140.721	177.472	196.947	212.652	248.461	267.936
OL_00508	2.425	2.425	2.425	2.425	2.425	3.489	4.183	4.582	4.546	4.891	4.789
PC_02834	Cross section not included in model										
SP_00326	2.425	2.425	2.425	2.425	2.425	3.324	3.611	3.646	3.561	3.588	3.505
SP_00327	2.425	2.425	2.425	2.425	2.425	3.324	3.611	3.646	3.561	3.588	3.505
Sp_00360	0	0	0	0	0	0	0	2.405	12.268	3.531	27.224
Sp_00363	0	0	0	0	0	0	0	2.405	12.268	3.531	27.224
Sp_00808	0	0	0	0	0	0	0	12.265	48.071	27.475	64.822
Sp_00809	0	0	0	0	0	0	0	12.265	48.071	27.475	64.822
SP_00853	0	0	0	0	0	0	0.045	0.502	0.585	1.329	1.383
SP_00857	0	0	0	0	0	0	0.045	0.502	0.585	1.329	1.383
Sp_01458	0	0	0	0	0	0	0	0	0	0	0
Sp_01461	0	0	0	0	0	0	0	0	0	0	0
Sp_02828	0	0	0	0	0	0	0	0	0	0	0
Sp_02830	0	0	0	0	0	0	0	0	0	0	0

	bed elevation	N+20 Fluvial (mAOD)					N-20 Fluvial (mAOD)					S_DEF Fluvial (mAOD)					S_B Fluvial (mAOD)					S_DEF Tidal (mAOD)				
Label	m AOD	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1
AUL01_00000	2.885	5.619	6.154				5.072	5.485	6.631			5.372	5.851	7.135			5.385	5.879	7.213			4.62	4.624	5.078	5.6	5.93
AUL01_00000D	2.885	5.615	6.133				5.069	5.48	6.604			5.37	5.837	7.113			5.383	5.86	7.187			4.617	4.621	5.076	5.598	5.918
AUL01_00041	3.585	5.623	6.167				5.07	5.484	6.626			5.372	5.855	7.135			5.385	5.883	7.216			4.625	4.629	5.079	5.602	5.933
AUL01_00043	3.585	5.623	6.156				5.07	5.471	6.615			5.372	5.836	7.128			5.385	5.859	7.208			4.627	4.63	5.08	5.601	5.936
AUL01_00087	3.667	5.648	6.257				5.08	5.504	6.695			5.38	5.93	7.185			5.392	5.981	7.267			4.677	4.681	5.1	5.615	5.981
AUL01_00144	3.425	5.698	6.353				5.128	5.593	6.758			5.409	5.991	7.236			5.421	6.058	7.324			4.789	4.791	5.155	5.65	6.044
AUL01_00195	3.263	5.698	6.361				5.158	5.591	6.768			5.416	5.995	7.245			5.427	6.065	7.334			4.833	4.835	5.188	5.649	6.047
AUL01_00237	3.284	5.701	6.367				5.174	5.598	6.772			5.426	5.999	7.248			5.437	6.069	7.339			4.855	4.856	5.207	5.652	6.05
AUL01_00258	3.294	5.702	6.368				5.179	5.598	6.772			5.43	5.999	7.249			5.44	6.07	7.34			4.867	4.869	5.216	5.653	6.05
AUL01_00297	3.671	5.706	6.369				5.201	5.6	6.772			5.443	5.999	7.25			5.453	6.07	7.342			4.912	4.914	5.247	5.656	6.05
AUL01_00319	3.895	6.175	6.42				5.921	6.214	6.792			6.073	6.278	7.271			6.064	6.286	7.384			5.227	5.229	5.827	6.192	6.294
AUL01_00326	3.87	6.202	6.422				5.965	6.24	6.776			6.112	6.289	7.249			6.102	6.295	7.354			5.277	5.278	5.869	6.22	6.304
AUL01_00327	3.87	6.216	6.423				6.006	6.254	6.782			6.136	6.295	7.253			6.126	6.299	7.359			5.787	5.787	5.915	6.235	6.309
AUL01_00376	3.289	6.221	6.406				6.014	6.247	6.781			6.146	6.281	7.275			6.137	6.284	7.399			5.796	5.796	5.927	6.236	6.29
AUL01_00410	3.717	6.23	6.421				6.018	6.253	6.783			6.152	6.292	7.275			6.143	6.295	7.405			5.801	5.801	5.935	6.244	6.303
AUL01_00414	3.598	6.232	6.424				6.021	6.256	6.785			6.153	6.296	7.268			6.145	6.299	7.394			5.802	5.802	5.937	6.246	6.307
AUL01_00427	3.635	6.235	6.428				6.023	6.258	6.786			6.156	6.299	7.256			6.146	6.302	7.366			5.804	5.804	5.94	6.249	6.311
AUL01_00440	3.705	6.238	6.431				6.025	6.261	6.789			6.158	6.302	7.256			6.148	6.306	7.355			5.805	5.805	5.942	6.252	6.315
AUL01_00453	3.646	6.24	6.435				6.026	6.263	6.792			6.159	6.306	7.257			6.154	6.314	7.361			5.806	5.806	5.944	6.253	6.319
AUL01_00464	3.594	6.242	6.439				6.028	6.265	6.794			6.161	6.309	7.258			6.156	6.319	7.36			5.809	5.809	5.947	6.256	6.323
AUL01_00475	3.465	6.245	6.441				6.03	6.267	6.795			6.163	6.312	7.258			6.158	6.321	7.365			5.81	5.81	5.949	6.258	6.326
AUL01_00487	3.682	6.246	6.443				6.028	6.267	6.795			6.163	6.312	7.258			6.158	6.323	7.363			5.81	5.81	5.949	6.258	6.327
AUL01_00491	3.602	6.25	6.446				6.036	6.273	6.795			6.168	6.318	7.258			6.159	6.324	7.361			5.814	5.814	5.956	6.264	6.333
AUL01_00508	4.283	6.249	6.446				6.029	6.268	6.797			6.165	6.315	7.259			6.161	6.327	7.369			5.811	5.811	5.952	6.261	6.331
AUL01_00518	4.389	6.533	6.79				6.347	6.707	6.979			6.442	6.737	7.27			6.946	6.987	7.361			5.924	5.924	6.181	6.642	6.772
AUL01_00520	4.299	6.534	6.791				6.348	6.708	6.97	Auldearn Burn modelled in 2D only		6.442	6.738	7.256	Auldearn Burn modelled in 2D only		6.945	6.983	7.348	Auldearn Burn modelled in 2D only		5.924	5.924	6.182	6.643	6.773
AUL01_00547	4.261	6.544	6.799	Auldearn Burn modelled in 2D only			6.356	6.713	6.966			6.452	6.746	7.262			6.942	6.98	7.354			5.936	5.936	6.194	6.651	6.78
AUL01_00573	4.126	6.554	6.807				6.363	6.72	6.972			6.46	6.754	7.266			6.943	6.982	7.357			5.945	5.945	6.205	6.659	6.789
AUL01_00612	4.437	6.574	6.819				6.378	6.728	6.978			6.477	6.765	7.269			6.946	6.987	7.359			5.966	5.966	6.228	6.674	6.799
AUL01_00652	4.358	6.589	6.83				6.395	6.736	6.98			6.494	6.775	7.27			6.948	6.988	7.36			5.989	5.989	6.251	6.685	6.809
AUL01_00677	4.183	6.593	6.832				6.395	6.735	6.98			6.497	6.776	7.271			6.948	6.989	7.36			5.994	5.994	6.255	6.687	6.81
AUL01_00727	4.633	6.612	6.853				6.41	6.747	6.992			6.513	6.793	7.276			6.954	6.998	7.364			6.015	6.015	6.277	6.702	6.828
AUL01_00772	4.544	6.629	6.871				6.421	6.755	7.005			6.527	6.806	7.285			6.96	7.007	7.371			6.036	6.036	6.296	6.714	6.842
AUL01_00853	4.441	6.662	6.91				6.448	6.785	7.041			6.557	6.843	7.303			6.975	7.028	7.384			6.071	6.071	6.334	6.745	6.882
AUL01_00857	4.437	6.753	6.961				6.582	6.874	7.094			6.686	6.913	7.326			6.996	7.055	7.405			6.117	6.117	6.428	6.826	6.948
AUL01_00876	4.706	6.75	6.947				6.581	6.857	7.049			6.687	6.897	7.284			6.986	7.039	7.359			6.119	6.119	6.429	6.815	6.928
AUL01_00923	4.483	6.785	6.991				6.606	6.884	7.102			6.718	6.934	7.343			7.005	7.068	7.421			6.161	6.161	6.468	6.846	6.968
AUL01_00977	4.642	6.81	7.02				6.62	6.901	7.122			6.738	6.958	7.353			7.017	7.086	7.425			6.194	6.194	6.497	6.867	6.994
AUL01_01004	4.569	6.853	7.038				6.662	6.915	7.123			6.781	6.974	7.354			7.023	7.091	7.427			6.259	6.259	6.555	6.893	7.008
B_00360		3.124	3.247				3.027	3.068	3.537			3.074	3.16	3.696			3.073	3.153	3.662			3.176	3.267	3.46	4.573	4.728
B_00363		3.149	3.294				3.054	3.122	3.708			3.1	3.212	3.889			3.099	3.203	3.841			3.183	3.273	3.473	4.597	4.761
B_00808		3.561	3.863				3.215	3.384	4.233			3.397	3.655	4.558			3.396	3.693	4.666			3.273	3.352	3.587	4.607	4.778
B_00809	structure	3.63	4.099				3.293	3.547	5.185			3.47	3.804	5.437			4.165	4.753	5.823			3.293	3.371	3.629	4.855	5.116
B_01458		5.411	5.997				4.981	5.396	6.56			5.195	5.739	6.997			5.212	5.766	7.06			4.452	4.457	4.909	5.475	5.842
B_01461		5.416	6.008				4.995	5.408	6.577			5.206	5.742	7.124			5.224	5.771	7.201			4.459	4.465	4.918	5.479	5.851
B_02828		9.721	10.047				9.146	9.596	10.118			9.477	9.97	10.326			9.477	9.902	10.226			8.714	8.714	9.17	9.623	9.961
B_02830		9.721	10.047				9.148	9.596	10.118			9.477	9.97	10.353			9.477	9.902	10.24			8.718	8.718	9.171	9.623	9.961
CUL_00297	3.71	5.706	6.369				5.201	5.6	6.772			5.443	5.999	7.25			5.453	6.07	7.342			4.912	4.914	5.247	5.656	6.05
CUL_00319	3.9	6.175	6.42				5.921	6.214	6.792			6.073	6.278	7.271			6.064	6.286	7.384			5.227	5.229	5.827	6.192	6.294
CUL_00508	4.44	6.255	6.451				6.039	6.276	6.799			6.171	6.323	7.259			6.161	6.327	7.369			5.817	5.817	5.96	6.269	6.339
CUL_00518	4.46	6.533	6.79				6.347	6.707	6.979			6.442	6.737	7.27			6.946	6.987	7.361			5.924	5.924	6.181	6.642	6.772
CUL_00853	4.44	6.662	6.91				6.448	6.785	7.041			6.557	6.843	7.303			6.975	7.028	7.384			6.071	6.071	6.334	6.745	6.882
CUL_00857	4.44	6.753	6.961				6.582	6.874	7.094			6.686	6.913	7.326			6.996	7.055	7.405			6.117	6.117	6.428	6.826	6.948
NAI01_00000	-2.088	2.926	2.918	2.977	4.141	4.192	2.924	2.914	2.964	4.139	4.182	2.925	2.916	2.97	4.141	4.176	2.925	2.916	2.971	4.141	4.176	3.119	3.212	3.377	4.51	4.659
NAI01_00029	-1.615	2.98	2.974	3.196	4.185	4.531	2.951	2.928	3.032	4.149	4.381	2.964	2.939	3.094	4.149	4.472	2.964	2.941	3.085	4.149	4.475	3.147	3.239	3.408	4.539	4.686
NAI01_00182	-1.813	3.03	3.071	3.453	4.39	4.872	2.971	2.951	3.166	4.205	4.657	2.998	3.009	3.283	4.312	4.789	2.998	3.008	3.268	4.308	4.79	3.156	3.248	3.424	4.545	4.694
NAI01_00309	-1.202	3.075	3.156	3.657	4.865	5.371	2.986	2.983	3.256	4.51	5.043	3.028	3.069	3.428	4.774	5.219	3.028	3.066	3.407	4.779	5.223	3.164	3.255	3.437	4.569	4.728
NAI01_00360	-0.909	3.124	3.247	3.892	4.988	5.396	3.027	3.068	3.537	4.607	5.043	3.074	3.16	3.696	4.879	5.228	3.073	3.153	3.662	4.884	5.232	3.176	3.267	3.46	4.573	4.728
NAI01_00363	-0.909	3.149	3.294	3.894	4.982	5.395	3.054	3.122	3.708	4.607	5.044	3.1	3.212	3.889	4.874	5.228	3.099	3.203	3.841	4.879	5.231	3.183	3.273	3.473	4.597	4.761
NAI01_00416	-0.981	3.152	3.298	3.853	4.914	5.325	3.044	3.101	3.665	4.494	4.96	3.096	3.204	3.838	4.745	5.155	3.095	3.195	3.801	4.75	5.159	3.183	3.273	3.471	4.514	4.657
NAI01_00570	-0.191	3.27	3.49	4.202	4.973	5.405	3.115	3.239	3.907	4.59	5.006	3.192	3.373	4.096	4.841	5.239	3.191	3.361	4.069	4.844	5.24	3.21	3.298	3.512	4.588	4.744
NAI01_00586	-0.191	3.279	3.5	4.201	4.966	5.395	3.116	3.239	3.871	4.517	4.837	3.197	3.381	4.083	4.8	5.206	3.196	3.367	4.062	4.808	5.21	3.211	3.299	3.514	4.579	4.726

Label	bed elevation	N+20 Fluvial (mAOD)					N-20 Fluvial (mAOD)					S_DEF Fluvial (mAOD)					S_B Fluvial (mAOD)					S_DEF Tidal (mAOD)				
Label	m AOD	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1
NAI01_00596	-0.191	3.282	3.504	4.204	4.948	5.383	3.113	3.234	3.849	4.513	4.89	3.197	3.381	4.085	4.791	5.205	3.196	3.367	4.064	4.798	5.206	3.211	3.299	3.514	4.578	4.723
NAI01_00681	-0.155	3.357	3.599	4.302	4.968	5.387	3.123	3.243	3.871	4.556	5.053	3.242	3.444	4.142	4.819	5.214	3.241	3.426	4.133	4.819	5.215	3.224	3.31	3.529	4.588	4.747
NAI01_00749	0.343	3.465	3.752	4.422	5.022	5.494	3.179	3.336	4.026	4.543	5.108	3.327	3.569	4.331	4.855	5.271	3.325	3.555	4.354	4.84	5.265	3.249	3.332	3.561	4.602	4.774
NAI01_00808	0.405	3.561	3.863	4.524	5.106	5.693	3.215	3.384	4.233	4.577	5.208	3.397	3.655	4.558	4.886	5.431	3.396	3.693	4.666	4.87	5.427	3.273	3.352	3.587	4.607	4.778
NAI01_00809	0.405	3.63	4.099	4.531	5.112	5.706	3.293	3.547	5.185	4.584	5.213	3.47	3.804	5.437	4.893	5.438	4.165	4.753	5.823	4.876	5.435	3.293	3.371	3.629	4.855	5.116
NAI01_00930	0.844	3.951	4.442	5.204	5.802	6.53	3.516	3.838	5.105	5.155	5.639	3.751	4.143	5.359	5.583	5.968	4.275	4.825	5.534	5.583	5.967	3.414	3.477	3.772	4.878	5.104
NAI01_00942	0.844	4.061	4.607	5.546	6.425	8.144	3.748	4.19	5.609	5.994	7.635	3.908	4.38	5.8	6.267	7.901	4.349	4.944	5.955	6.265	7.897	3.461	3.517	3.847	4.936	5.21
NAI01_-0100	-2.088	2.995	2.995	3.085	4.21	4.28	2.995	2.995	3.085	4.21	4.28	2.995	2.995	3.085	4.21	4.28	2.995	2.995	3.085	4.21	4.28	3.155	3.247	3.425	4.55	4.7
NAI01_01104	0.986	4.422	4.986	6.111	7.029	8.651	3.858	4.279	5.821	6.467	8.167	4.172	4.65	6.118	6.791	8.413	4.48	5.087	6.225	6.789	8.409	3.654	3.689	4.032	5.018	5.321
NAI01_01335	1.626	5.273	5.809	6.827	7.648	9.203	4.927	5.444	6.384	7.004	8.519	5.098	5.638	6.68	7.364	8.866	5.122	5.666	6.725	7.361	8.863	4.241	4.25	4.765	5.425	5.754
NAI01_01343	1.626	5.315	5.853	6.881	7.715	9.318	5.022	5.531	6.478	7.131	8.702	5.161	5.702	6.746	7.457	9.017	5.182	5.726	6.79	7.57	9.199	4.318	4.325	4.835	5.468	5.804
NAI01_01458	1.99	5.411	5.997	7.191	8.137	9.947	4.981	5.396	6.56	7.47	9.329	5.195	5.739	6.997	7.845	9.657	5.212	5.766	7.06	7.959	9.813	4.452	4.457	4.909	5.475	5.842
NAI01_01461	1.99	5.416	6.008	7.195	8.139	9.948	4.995	5.408	6.577	7.473	9.33	5.206	5.742	7.124	7.847	9.658	5.224	5.771	7.201	7.961	9.814	4.459	4.465	4.918	5.479	5.851
NAI01_01507	1.858	5.615	6.133	7.295	8.219	10.025	5.069	5.48	6.604	7.51	9.359	5.37	5.837	7.113	7.903	9.714	5.383	5.86	7.187	8.018	9.868	4.617	4.621	5.076	5.598	5.918
NAI01_01547	2.316	5.615	6.133	7.295	8.219	10.025	5.069	5.48	6.604	7.51	9.359	5.37	5.837	7.113	7.903	9.714	5.383	5.86	7.187	8.018	9.868	4.617	4.621	5.076	5.598	5.918
NAI01_01578	2.626	5.677	6.206	7.38	8.277	10.054	5.051	5.475	6.67	7.561	9.379	5.411	5.894	7.166	7.958	9.738	5.423	5.926	7.246	8.068	9.89	4.661	4.665	5.116	5.632	5.965
NAI01_01706	2.652	6.117	6.446	7.478	8.354	10.118	5.548	6.12	6.767	7.616	9.426	5.893	6.237	7.241	8.023	9.795	5.896	6.242	7.322	8.13	9.945	5.075	5.076	5.539	6.063	6.237
NAI01_01825	2.627	6.466	6.683	7.539	8.382	10.127	6	6.396	6.876	7.645	9.429	6.258	6.584	7.296	8.043	9.799	6.26	6.561	7.374	8.147	9.949	5.437	5.437	5.943	6.395	6.584
NAI01_01927	3.082	6.784	7.036	7.66	8.44	10.158	6.304	6.759	7.176	7.71	9.449	6.563	6.982	7.437	8.098	9.825	6.564	6.936	7.484	8.197	9.973	5.712	5.713	6.233	6.712	6.976
NAI01_01959	3.576	6.881	7.15	7.73	8.474	10.171	6.386	6.867	7.335	7.769	9.463	6.653	7.097	7.553	8.136	9.841	6.654	7.049	7.559	8.226	9.986	5.786	5.786	6.314	6.809	7.091
NAI01_02084	4.134	7.135	7.409	7.855	8.526	10.191	6.514	6.972	7.54	7.828	9.47	6.858	7.27	7.684	8.18	9.859	6.859	7.222	7.629	8.254	10	6.104	6.104	6.556	6.998	7.264
NAI01_02245	4.704	7.807	8.153	8.608	9.012	10.323	7.323	7.798	8.334	8.689	9.632	7.568	8.12	8.91	9.217	10.082	7.568	8.046	8.6	8.922	10.126	6.785	6.785	7.234	7.734	8.11
NAI01_02365	5.391	8.118	8.436	8.818	9.137	10.273	7.561	7.995	8.528	8.77	9.443	7.853	8.336	8.96	9.224	9.962	7.853	8.27	8.724	8.986	10.031	7.181	7.181	7.565	7.997	8.327
NAI01_02500	4.511	8.637	8.978	9.28	9.449	10.345	8.072	8.558	9.179	9.362	9.753	8.345	8.883	9.428	9.617	10.225	8.345	8.807	9.208	9.36	10.138	7.64	7.64	8.031	8.501	8.872
NAI01_02677	5.896	9.328	9.656	9.927	10.136	10.656	8.757	9.236	9.803	9.84	10.046	9.118	9.62	10.017	10.14	10.369	9.118	9.55	9.879	10.037	10.415	8.28	8.28	8.794	9.269	9.611
NAI01_02828	6.857	9.721	10.047	10.34	10.513	10.946	9.146	9.596	10.118	10.293	10.559	9.477	9.97	10.326	10.492	10.783	9.477	9.902	10.226	10.412	10.734	8.714	8.714	9.17	9.623	9.961
NAI01_02830	6.857	9.721	10.047	10.357	10.536	10.981	9.148	9.596	10.118	10.308	10.579	9.477	9.97	10.353	10.517	10.807	9.477	9.902	10.24	10.441	10.757	8.718	8.718	9.171	9.623	9.961
NAI01_02833	6.954	9.655	9.967	10.135	10.309	10.853	9.079	9.519	10.113	10.357	10.626	9.365	9.836	10.164	10.409	10.863	9.365	9.77	10.079	10.366	10.804	8.639	8.639	9.076	9.501	9.827
NAI01_02834	6.954	9.851	10.189	10.137	10.311	10.855	9.694	10.191	10.114	10.358	10.627	9.695	10.19	10.165	10.411	10.864	9.695	10.126	10.08	10.367	10.805	8.962	8.962	9.386	9.847	10.18
NAI01_02853	7.02	9.839	10.094	10.343	10.604	11.145	9.527	9.917	10.327	10.541	10.817	9.603	9.951	10.391	10.672	11.08	9.603	9.892	10.298	10.622	11.003	8.96	8.96	9.338	9.728	9.943
NAI01_02949	6.491	10.308	10.657	11.066	11.298	11.546	9.924	10.458	10.594	10.783	11.088	10.111	10.705	10.997	11.143	11.38	10.111	10.583	10.854	10.998	11.332	9.359	9.359	9.795	10.27	10.69
NAI01_03064	7.315	10.721	11.08	11.506	11.767	12.151	10.236	10.773	11.109	11.328	11.667	10.487	11.044	11.462	11.658	11.974	10.487	10.957	11.371	11.531	11.92	9.673	9.673	10.147	10.653	11.032
NAI01_03222	7.886	11.191	11.597	12.148	12.482	12.889	10.641	11.211	11.672	11.911	12.329	10.931	11.478	11.995	12.259	12.633	10.931	11.433	11.965	12.198	12.619	10.083	10.083	10.575	11.105	11.466
NAI01_03399	8.513	11.672	12.159	13.014	13.615	14.704	11.048	11.57	12.55	13.112	14.003	11.384	11.93	12.837	13.48	14.371	11.384	11.907	12.776	13.464	14.334	10.579	10.579	11.045	11.55	11.918
NAI01_03532	8.743	12.212	12.773	13.766	14.38	15.395	11.586	12.175	13.167	13.631	14.383	11.925	12.527	13.495	14.055	14.903	11.925	12.52	13.489	14.051	14.896	11.072	11.072	11.557	12.1	12.514
NAI01_03673	8.879	12.685	13.162	14.043	14.614	15.581	12.111	12.665	13.385	13.815	14.558	12.447	12.925	13.745	14.262	15.061	12.447	12.923	13.739	14.258	15.053	11.514	11.514	12.049	12.599	12.914
NAI01_03801	9.622	12.98	13.457	14.328	14.875	15.797	12.411	12.926	13.656	14.039	14.636	12.739	13.204	14.005	14.506	15.197	12.739	13.203	14.001	14.504	15.19	11.835	11.835	12.362	12.884	13.194
OL_00508	Structure	6.255	6.451	Structure not in model			6.039	6.276	6.799	Structure not in model		6.171	6.323	7.259	Structure not in model		6.161	6.327	7.369	Structure not in model		5.817	5.817	5.96	6.269	6.339
PC_02834		XS not in model		10.061	10.981	10.848	XS not in model		10.113	10.358	10.626	XS not in model		10.982	10.994	10.863	XS not in model		10.97	10.366	10.804	XS not in model				
SP_00326		6.202	6.422	structure not included in model			5.965	6.24	6.776	structure not included in model		6.112	6.289	7.249	structure not included in model		6.102	6.295	7.354	structure not included in model		5.277	5.278	5.869	6.22	6.304
SP_00327		6.216	6.423				6.006	6.254	6.782			6.136	6.295	7.253			6.126	6.299	7.359			5.787	5.787	5.915	6.235	6.309
Sp_00360		3.124	3.247				3.027	3.068	3.537			3.074	3.16	3.696			3.073	3.153	3.662			3.176	3.267	3.46	4.573	4.728
Sp_00363		3.149	3.294				3.054	3.122	3.708			3.1	3.212	3.889			3.099	3.203	3.841			3.183	3.273	3.473	4.597	4.761
Sp_00808		3.561	3.863				3.215	3.384	4.233			3.397	3.655	4.558			3.396	3.693	4.666			3.273	3.352	3.587	4.607	4.778
Sp_00809		3.63	4.099				3.293	3.547	5.185			3.47	3.804	5.437			4.165	4.753	5.823			3.293	3.371	3.629	4.855	5.116
SP_00853		6.662	6.91				6.448	6.785	7.041			6.557	6.843	7.303			6.975	7.028	7.384			6.071	6.071	6.334	6.745	6.882
SP_00857		6.753	6.961				6.582	6.874	7.094			6.686	6.913	7.326			6.996	7.055	7.405			6.117	6.117	6.428	6.826	6.948
Sp_01458		5.411	5.997				4.981	5.396	6.56			5.195	5.739	6.997			5.212	5.766	7.06			4.452	4.457	4.909	5.475	5.842
Sp_01461		5.416	6.008				4.995	5.408	6.577			5.206	5.742	7.124			5.224	5.771	7.201			4.459	4.465	4.918	5.479	5.851
Sp_02828		9.721	10.047				9.146	9.596	10.118			9.477	9.97	10.326			9.477	9.902	10.226			8.714	8.714	9.17	9.623	9.961
Sp_02830		9.721	10.047				9.148	9.596	10.118			9.477	9.97	10.353			9.477	9.902	10.24			8.718	8.718	9.171	9.623	9.961

Label	N+20 Fluvial (m3/s)					N-20 Fluvial (m3/s)					S_DEF Fluvial (m3/s)					S_B Fluvial (m3/s)					S_DEF Tidal (m3/s)				
	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1
AUL01_00000	5.826	16.669				3.811	7.341	24.223			3.78	12.181	26.133			3.764	14.285	27.122			2.445	2.446	3.373	5.45	11.972
AUL01_00000D	5.826	16.669				3.811	7.341	24.223			3.78	12.181	26.133			3.764	14.285	27.122			2.445	2.446	3.373	5.45	11.972
AUL01_00041	5.817	16.666				3.802	7.331	24.205			3.765	12.177	26.17			3.748	14.284	27.118			2.438	2.438	3.361	5.429	11.949
AUL01_00043	6.106	18.161				3.802	8.431	26.27			3.756	14.137	29.066			3.739	16.564	30.175			2.438	2.437	3.361	6.32	13.696
AUL01_00087	4.835	11.888				3.796	6.864	16.292			3.74	7.588	19.054			3.723	8.995	19.86			2.433	2.433	3.353	5.055	8.303
AUL01_00144	3.144	5.282				3.791	3.995	10.191			3.638	3.526	13.425			3.623	3.695	14.304			2.431	2.431	3.344	3.719	3.664
AUL01_00195	3.28	5.224				3.788	4.042	6.75			3.642	3.593	9.463			3.626	3.878	9.949			2.429	2.429	3.339	3.762	3.709
AUL01_00237	3.144	3.025				3.786	3.829	3.66			3.548	3.43	4.058			3.533	3.405	4.191			2.428	2.428	3.331	3.586	3.543
AUL01_00258	3.301	3.176				3.784	3.838	3.668			3.609	3.506	3.397			3.598	3.489	3.382			2.427	2.427	3.328	3.652	3.605
AUL01_00297	3.339	3.194				3.783	3.832	3.658			3.612	3.495	3.398			3.581	3.467	3.381			2.426	2.427	3.325	3.643	3.596
AUL01_00319	3.339	3.194				3.783	3.832	3.658			3.612	3.495	3.398			3.581	3.467	3.381			2.426	2.426	3.325	3.643	3.596
AUL01_00326	3.339	3.197				3.783	3.836	4.342			3.612	3.498	5.12			3.592	3.474	5.813			2.425	2.425	3.324	3.647	3.599
AUL01_00327	3.339	3.197				3.783	3.836	4.342			3.612	3.498	5.12			3.592	3.474	5.813			2.425	2.425	3.324	3.647	3.599
AUL01_00376	4.074	5.501				4.298	5.359	8.133			4.177	5.459	4.992			4.127	5.391	4.301			2.426	2.426	3.49	4.618	5.89
AUL01_00410	4.077	5.113				4.295	5.204	6.214			4.178	5.265	4.291			3.845	5.065	4.502			2.426	2.426	3.489	4.602	5.634
AUL01_00414	4.077	5.023				4.295	5.184	6.048			4.179	5.208	4.11			3.848	5.011	4.713			2.426	2.426	3.489	4.601	5.564
AUL01_00427	4.078	5.067				4.293	5.205	6.371			4.179	5.251	4.246			3.848	5.047	4.063			2.425	2.425	3.489	4.603	5.612
AUL01_00440	4.074	5.013				4.29	5.175	6.217			4.18	5.199	4.213			3.832	4.885	3.945			2.425	2.425	3.489	4.574	5.561
AUL01_00453	4.082	4.703				4.281	4.972	5.139			4.181	4.965	3.894			2.628	3.576	3.243			2.426	2.426	3.489	4.565	5.236
AUL01_00464	4.082	4.556				4.268	4.972	4.825			4.181	4.861	3.902			2.219	2.889	2.698			2.426	2.426	3.489	4.575	5.079
AUL01_00475	4.083	4.485				4.254	4.968	4.591			4.182	4.812	3.834			2.04	2.446	2.408			2.425	2.425	3.489	4.558	5.014
AUL01_00487	4.055	4.352				4.232	4.901	4.328			4.175	4.683	3.718			1.71	1.91	2.234			2.426	2.426	3.489	4.498	4.855
AUL01_00491	4.085	4.517				4.232	4.966	4.603			4.183	4.813	3.856			1.687	1.987	2.414			2.426	2.426	3.489	4.557	5.008
AUL01_00508	4.086	4.508				4.232	4.985	4.462			4.184	4.788	3.889			0.653	0.653	1.455			2.425	2.425	3.489	4.582	4.892
AUL01_00518	4.086	4.508				4.232	4.984	4.462			4.184	4.788	3.889			0.653	0.653	1.455			2.425	2.425	3.489	4.582	4.892
AUL01_00520	4.087	4.508	Auldearn Burn modelled in 2D only			4.232	4.985	4.644	Auldearn Burn modelled in 2D only		4.184	4.788	5.332	Auldearn Burn modelled in 2D only		1.365	1.966	5.258	Auldearn Burn modelled in 2D only		2.425	2.425	3.489	4.582	4.892
AUL01_00547	4.089	4.501				4.232	4.99	5.804			4.185	4.763	5.107			2.619	3.544	4.855			2.426	2.426	3.489	4.586	4.861
AUL01_00573	4.089	4.269				4.231	4.846	5.547			4.186	4.546	4.512			2.856	3.557	4.193			2.426	2.426	3.489	4.49	4.63
AUL01_00612	4.037	4.376				4.231	4.873	5.872			4.176	4.65	4.448			2.896	3.6	4.243			2.426	2.426	3.489	4.471	4.808
AUL01_00652	4.181	4.987				4.23	5.24	7.266			4.207	5.152	5.863			3.717	4.682	5.518			2.426	2.426	3.489	4.724	5.499
AUL01_00677	4.182	5.368				4.23	5.411	7.482			4.208	5.428	6.153			3.931	4.953	5.807			2.426	2.426	3.489	4.754	5.818
AUL01_00727	4.185	5.406				4.229	5.415	7.694			4.211	5.437	6.577			4.063	5.162	6.196			2.426	2.426	3.488	4.759	5.84
AUL01_00772	4.187	5.385				4.229	5.423	7.309			4.212	5.469	6.317			3.963	4.978	5.913			2.426	2.426	3.488	4.76	5.863
AUL01_00853	4.023	4.064				4.228	4.646	5.331			4.203	4.309	5.084			3.087	3.859	5.1			2.426	2.426	3.488	4.372	4.342
AUL01_00857	4.023	4.064				4.228	4.646	5.331			4.203	4.309	5.084			3.087	3.859	5.1			2.426	2.426	3.488	4.372	4.342
AUL01_00876	4.213	5.453				4.228	5.475	8.348			4.216	5.482	8.82			4.226	5.488	9.348			2.427	2.427	3.488	4.811	5.901
AUL01_00923	4.199	5.118				4.228	5.471	7.229			4.219	5.213	6.434			3.932	4.95	6.109			2.427	2.427	3.488	4.79	5.543
AUL01_00977	3.888	3.968				4.228	4.802	5.645			4.177	4.371	4.937			2.8	3.409	5.049			2.428	2.428	3.488	4.341	4.419
AUL01_01004	4.23	5.49				4.23	5.49	8.18			4.23	5.49	8.18			4.23	5.49	8.18			2.43	2.43	3.49	4.88	5.92
B_00360	186.559	261.596				187.707	259.362	456.349			186.251	260.195	446.178			186.374	259.752	433.223			106.889	107.725	153.64	254.009	304.076
B_00363	186.559	261.596				187.707	259.362	456.349			186.251	260.195	446.178			186.374	259.752	433.223			106.889	107.725	153.64	254.009	304.076
B_00808	182.11	256.079				183.825	255.899	421.686			183.271	256.543	360.111			182.927	235.178	247.287			101.254	101.464	146.913	204.862	252.92
B_00809	182.11	256.079				183.825	255.899	421.686			183.271	256.543	360.111			182.927	235.178	247.287			101.254	101.464	146.913	204.862	252.92
B_01458	177.797	207.242				183.245	255.883	359.245			182.827	235.002	295.085			182.835	232.267	279.74			100.072	100.084	145.71	199.372	229.467
B_01461	177.797	207.242				183.245	255.883	359.245			182.827	235.002	295.085			182.835	232.267	279.74			100.072	100.084	145.71	199.372	229.467
B_02828	177.263	220.106				177.313	245.823	389.779			177.488	245.634	362.883			177.488	236.243	348.492			96.192	96.191	140.472	197.123	244.192
B_02830	177.263	220.106				177.313	245.823	389.779			177.488	245.634	362.883			177.488	236.243	348.492			96.192	96.191	140.472	197.123	244.192
CUL_00297	3.339	3.194				3.783	3.832	3.658			3.612	3.495	3.398			3.581	3.467	3.381			2.426	2.427	3.325	3.643	3.596
CUL_00319	3.339	3.194				3.783	3.832	3.658			3.612	3.495	3.398			3.581	3.467	3.381			2.426	2.426	3.325	3.643	3.596
CUL_00508	4.086	4.508				4.232	4.985	4.462			4.184	4.788	3.889			0.653	0.653	1.455			2.425	2.425	3.489	4.582	4.892
CUL_00518	4.086	4.508				4.232	4.984	4.462			4.184	4.788	3.889			0.653	0.653	1.455			2.425	2.425	3.489	4.582	4.892
CUL_00853	3.979	3.904				4.228	4.583	4.226			4.172	4.241	3.449			1.646	1.877	2.108			2.426	2.426	3.488	4.318	4.276
CUL_00857	3.979	3.904				4.228	4.583	4.226			4.172	4.241	3.449			1.646	1.877	2.108			2.426	2.426	3.488	4.318	4.276
NAI01_00000	190.778	265.49	449.038	607.53	753.807	191.419	263.596	463.645	653.005	913.528	190.871	264.166	459.727	623.333	843.365	191.072	263.584	441.014	623.165	843.17	113.098	113.624	159.072	308.622	362.747
NAI01_00029	190.618	265.287	448.289	599.76	753.778	191.246	263.419	461.491	652.85	913.289	190.707	264	452.398	617.332	843.336	190.912	263.42	440.774	617.005	843.139	112.825	113.35	158.896	308.317	362.349
NAI01_00182	189.584	264.197	447.418	604.04	752.954	190.136	262.32	460.305	651.86	911.976	189.673	263.017	452.892	619.517	843.174	189.865	262.455	439.795	619.618	842.981	111.017	111.741	157.769	306.423	360.329
NAI01_00309	188.728	263.387	447.064	480.542	595.434	189.376	261.408	459.937	618.909	763.888	188.761	262.21	453.523	537.121	676.201	188.94	261.666	439.231	536.622	675.937	109.433	110.706	156.767	279.338	329.812
NAI01_00360	186.559	261.596	443.557	467.727	688.513	187.707	259.362	456.349	604.739	874.86	186.251	260.195	446.178	524.112	798.972	186.374	259.752	433.223	523.599	798.192	106.889	107.725	153.64	254.009	304.076
NAI01_00363	186.559	261.596	443.32	466.573	686.523	187.707	259.362	456.349	604.659	874.649	186.251	260.195	446.178	522.04	798.046	186.374	259.752	433.223	521.592	797.342	106.889	107.725	153.64	254.009	304.076
NAI01_00416	186.06	261.097	433.198	471.907	664.402	187.295	258.954	450.431	577.095	822.84	185.829	259.669	442.526	529.181	758.004	185.8	259.254	425.537	528.82	757.053	106.277	106.997	152.639	241.162	308.769
NAI01_00570	183.482	256.454	410.26	562.044	841.305	185.391	256.844	450.017	644.783	992.515	184.329	257.292	435.734	616.471	931.719	183.969	256.647	408.575	615.471	931.017	103.375	103.701	148.528	217.181	264.28
NAI01_00586	183.436	256.483	420.037	558.857	847.205	185.268	257.001	462.478	669.314	1036.346	184.236	257.177	443.975	628.557	947.605	183.877	256.762	416.966	625.377	945.316	103.194	103.513	148.375	217.032	264.676
NAI01_00596	183.348	256.239	421.779	556.143	848.238	185.176	256.923	463.941	663.62	1019.564	184.178	257.109	441.359	621.834	941.531	183.824	256.664	416.124	617.049	940.609	103.083	103.398	148.476	216.328	264.095

Label	N+20 Fluvial (m3/s)					N-20 Fluvial (m3/s)					S_DEF Fluvial (m3/s)					S_B Fluvial (m3/s)					S_DEF Tidal (m3/s)				
	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1	10-yr	30-yr	200-yr	200-yr CC1	1000-yr CC1
NAI01_00681	182.527	256.471	427.715	580.622	884.843	184.499	256.402	452.069	633.963	957.134	183.78	256.82	438.593	616.954	942.27	183.386	256.096	408.34	614.505	940.85	102.267	102.551	147.763	208.208	255.71
NAI01_00749	181.036	252.472	431.872	587.199	881.352	184.072	255.613	435.564	623.108	946.109	183.063	254.342	411.261	612.361	924.659	182.704	253.645	364.355	612.484	924.383	101.604	101.708	146.212	202.808	249.502
NAI01_00808	182.11	256.079	446.99	601.472	892.701	183.825	255.899	427.7	626.994	979.806	183.271	256.543	375.14	618.22	948.791	182.927	242.071	279.794	618.816	948.479	101.254	101.464	146.913	204.862	252.92
NAI01_00809	182.11	256.079	446.989	601.344	892.414	183.825	255.899	427.7	626.879	979.792	183.271	256.543	375.14	617.988	949.144	182.927	242.071	279.794	618.739	948.78	101.254	101.464	146.913	204.862	252.92
NAI01_00930	182.006	255.84	452.445	635.575	1005.074	183.477	255.727	458.695	632.565	1030.693	183.064	256.478	458.023	636.235	1015.891	182.88	255.416	455.747	635.407	1014.977	100.722	100.883	146.496	204.439	256.664
NAI01_00942	182.006	255.84	452.445	635.575	1005.074	183.477	255.727	458.695	632.565	1030.693	183.064	256.478	458.023	636.235	1015.891	182.88	255.416	455.747	635.407	1014.977	100.722	100.883	146.496	204.439	256.664
NAI01_-0100	191.681	266.773	451.058	667.743	766.607	192.896	264.595	470.543	658.477	915.135	192.123	265.136	471.75	678.636	844.19	192.054	264.665	442.46	679.071	844.004	114.668	115.2	160.046	310.366	364.9
NAI01_01104	171.758	223.941	330.703	423.936	624.392	181.894	243.297	343.993	435.677	629.879	177.101	235.186	335.121	431.186	623.908	171.794	219.863	329.012	430.293	623.312	100.247	100.286	143.891	187.438	224.778
NAI01_01335	181.702	255.274	452.45	635.115	1040.212	183.076	255.219	458.519	632.772	1041.696	182.691	256.076	457.789	636.621	1038.538	182.715	255.116	455.753	635.104	1037.319	100.1	100.136	145.682	202.795	255.146
NAI01_01343	181.702	255.274	452.45	635.115	1040.212	183.076	255.219	458.519	632.772	1041.696	182.691	256.076	457.789	636.621	1038.538	182.715	255.116	455.753	635.104	1037.319	100.1	100.136	145.682	202.795	255.146
NAI01_01458	177.797	207.242	257.294	301.79	378.027	183.245	255.883	359.561	394.18	491.093	182.827	235.002	296.594	350.118	421.635	182.835	232.267	281.725	329.754	399.518	100.072	100.084	145.71	199.372	229.467
NAI01_01461	177.797	207.242	257.31	301.928	378.141	183.245	255.883	359.561	394.213	491.243	182.827	235.002	296.594	349.931	421.82	182.835	232.267	281.725	329.763	399.707	100.072	100.084	145.71	199.372	229.467
NAI01_01507	178.161	207.113	227.099	254.492	294.701	183.208	254.224	342.182	356.265	423.942	182.575	237.911	292.649	311.68	350.294	182.551	234.908	275.842	287.604	325.777	99.99	99.997	145.65	200.343	232.361
NAI01_01547	172.851	190.786	223.61	249.773	288.798	179.62	247.996	318.375	351.396	418.031	179.614	226.028	267.101	306.914	344.488	179.601	221.223	249.33	282.835	319.873	97.579	97.585	142.413	195.873	220.932
NAI01_01578	167.474	178.444	183.509	202.412	238.63	177.816	240.967	290.567	313.938	373.178	175.857	214.933	239.886	268.663	302.991	175.743	209.762	220.748	244.271	279.805	97.263	97.26	140.653	190.181	211.507
NAI01_01706	160.463	180.708	187.076	192.22	205.709	174.99	225.225	293.928	313.192	360.14	167.718	215.762	250.387	271.876	299.39	167.654	208.065	228.158	241.666	258.083	97.22	97.219	139.11	181.246	214.944
NAI01_01825	172.736	207.66	222.943	232.559	242.711	177.156	242.835	331.263	354.552	405.087	175.132	238.517	298.131	321.708	350.832	175.119	229.453	264.313	283.497	298.795	97.236	97.234	140.712	193.319	237.125
NAI01_01927	173.302	211.333	241.682	255.238	261.822	176.499	242.658	344.712	378.873	422.677	175.221	239.369	325.923	355.023	381.037	175.217	230.26	284.39	308.804	321.918	97.068	97.067	140.288	193.739	238.048
NAI01_01959	175.9	215.717	252.66	271.363	279.123	178.214	247.018	354.665	400.221	454.374	177.567	244.755	340.164	380.838	410.992	177.564	234.887	298.005	330.797	345.249	96.856	96.855	141.321	196.565	243.329
NAI01_02084	178.484	220.778	273.594	294.34	298.301	178.462	249.782	369.116	425.334	441.111	178.652	250.016	354.373	395.957	420.472	178.649	239.629	313.77	343.374	354.694	96.879	96.879	141.456	198.647	248.502
NAI01_02245	178.523	220.499	259.801	274.33	277.021	178.494	249.799	362.507	411.379	508.206	178.718	250.342	314.236	341.916	390.579	178.713	239.724	298.911	328.165	371.225	96.903	96.904	141.492	198.68	248.793
NAI01_02365	177.895	219.504	257.441	273.747	316.851	177.898	248.852	360.854	414.476	516.995	178.082	249.387	322.178	354.009	435.407	178.078	238.772	299.936	333.568	409.774	96.53	96.529	140.97	197.901	247.84
NAI01_02500	172.286	208.312	250.344	283.891	346.931	177.658	242.233	342.67	408.492	553.388	175.152	237.362	300.413	337.63	419.829	175.153	228.449	287.422	331.779	420.183	96.541	96.54	140.787	193.012	236.069
NAI01_02677	171.734	209.469	275.055	315.383	425.158	176.185	241.934	361.678	451.388	635.535	173.769	236.485	320.057	380.203	524.721	173.771	227.691	308.844	374.84	508.118	96.549	96.547	139.277	191.494	235.15
NAI01_02828	177.263	220.106	319.723	384.152	542.849	177.313	245.823	389.779	484.838	698.92	177.488	245.634	363.044	436.983	612.654	177.488	236.243	348.56	433.378	604.256	96.192	96.191	140.472	197.123	244.192
NAI01_02830	177.263	220.106	319.722	384.082	542.759	177.313	245.823	389.779	484.815	698.888	177.488	245.634	363.044	436.935	612.628	177.488	236.243	348.56	433.341	604.219	96.192	96.191	140.472	197.123	244.192
NAI01_02833	176.88	218.274	319.672	380.588	541.354	177.286	243.592	387.616	483.62	700.222	177.444	243.398	361.397	434.62	612.938	177.445	234.453	346.834	432.202	605.843	96.19	96.189	140.465	196.854	241.982
NAI01_02834	176.88	218.274	319.67	380.59	541.355	177.286	243.592	387.616	483.617	700.209	177.444	243.398	361.395	434.62	612.925	177.445	234.453	346.832	432.201	605.832	96.19	96.189	140.465	196.854	241.982
NAI01_02853	174.862	222.154	299.803	357.089	531.403	179.022	257.205	380.007	481.375	704.392	177.994	251.921	342.609	418.577	614.583	177.995	241.837	331.655	422.119	610.091	96.19	96.19	140.614	197.916	249.828
NAI01_02949	176.876	224.58	314.926	386.962	601.692	177.184	248.588	404.405	518.012	759.896	177.132	239.869	352.119	445.336	680.97	177.132	238.178	346.748	459.02	675.987	96.183	96.182	140.433	196.499	238.601
NAI01_03064	176.982	232.218	348.008	438.818	676.897	177.205	249.734	412.939	540.418	809.22	177.148	242.373	373.537	480.773	742.896	177.148	242.3	370.408	491.017	740.562	96.197	96.197	140.449	196.56	240.841
NAI01_03222	176.614	242.583	393.418	512.544	785.74	177.259	249.379	428.542	572.739	875.079	177.087	247.001	412.279	539.04	834.596	177.087	246.99	407.595	539.14	830.325	96.231	96.231	140.487	196.239	245.247
NAI01_03399	176.335	239.316	377.683	484.462	725.223	177.324	249.483	399.735	519.296	815.215	177.168	244.74	384.849	492.635	767.594	177.169	245.15	387.859	493.228	768.64	96.277	96.277	140.546	196.383	243.137
NAI01_03532	170.459	217.397	339.614	457.62	752.914	177.371	241.847	382.465	524.074	859.422	176.426	227.621	359.22	488.666	817.841	176.426	227.837	358.987	488.633	817.333	96.31	96.311	140.593	192.376	226.431
NAI01_03673	166.256	222.178	372.572	509.179	832.716	173.855	235.785	401.389	552.062	945.285	171.126	228.836	385.002	528.485	897.521	171.127	228.856	385.129	528.515	898.088	96.265	96.265	138.118	186.567	227.361
NAI01_03801	177.472	250.346	449.805	629.79	1040.646	177.472	250.346	449.805	629.79	1040.646	177.472	250.346	449.805	629.79	1040.646	177.472	250.346	449.805	629.79	1040.646	96.432	96.432	140.721	196.947	248.461
OL_00508	4.086	4.508	Structure not in model			4.232	4.985	4.462	Structure not in model		4.184	4.788	3.889	Structure not in model		0.653	0.653	1.455	Structure not in model		2.425	2.425	3.489	4.582	4.892
PC_02834	XS not in model		319.671	380.589	541.354	XS not in model		387.616	483.618	700.215	XS not in model		361.396	434.62	612.932	XS not in model		346.833	432.202	605.837	XS not in model				
SP_00326	3.339	3.197	structure not included in model			3.783	3.836	4.342	structure not included in model		3.612	3.498	5.12	structure not included in model		3.592	3.474	5.813	structure not included in model		2.425	2.425	3.324	3.647	3.599
SP_00327	3.339	3.197				3.783	3.836	4.342			3.612	3.498	5.12			3.592	3.474	5.813			2.425	2.425	3.324	3.647	3.599
Sp_00360	0	0				0	0	0			0	0	0.001			0	0	0			0	0	0	2.406	3.561
Sp_00363	0	0				0	0	0			0	0	0.001			0	0	0			0	0	0	2.406	3.561
Sp_00808	0	0				0	0	32.496			0	0	52.298			0	7.431	89.073			0	0	0	12.404	28.296
Sp_00809	0	0				0	0	32.496			0	0	52.298			0	7.431	89.073			0	0	0	12.404	28.296
SP_00853	0.189	1.439				0	0.79	2.665			0.045	1.068	3.282			1.442	1.982	3.466			0	0	0	0.502	1.33
SP_00857	0.189	1.439				0	0.79	2.665			0.045	1.068	3.282			1.442	1.982	3.466			0	0	0	0.502	1.33
Sp_01458	0	0				0	0	0.412			0	0	5.269			0	0	6.564			0	0	0	0	0
Sp_01461	0	0				0	0	0.412			0	0	5.269			0	0	6.564			0	0	0	0	0
Sp_02828	0	0				0	0	0			0	0	0.161			0	0	0.069			0	0	0	0	0
Sp_02830	0	0				0	0	0				0	0.161			0	0	0.069			0	0	0	0	0

G Appendix: External model methodology review

Spatial Extent of Model	Reviwer Comment	JBA Response	
Sufficient to represent assumed flood mechanism	Model extent based on SEPA 1000 year flood extent as first assumption. Model extend upstream of urban area of Nairn.		
Boundaries sufficiently far away from area of interest to have no impact on results	Model extends upstream of urban area of Nairn. Appropriate approach for coastal flooding, to be reviewed during modelling process. It is noted that there is 2D flooding predicted almost immediately downstream of the upstream model boundary. Consideration should be given to extending the model slightly upstream to allow a 1D section before substantial 2D flooding, this may help model stability.	The next cross section upstream, taken from the 2015 survey, will be added to the 1D model.	
Where possible site upstream boundaries upstream of flow gauges	Boundary set upstream of the Firhall gauge on River Nairn,		
For ungauged site, upstream boundary placed at a hydraulic control and/or where all flow is in bank for events considered	No appropriate location on Auldearn. Boundary appears set upstream of area of known flooding issues		
Site downstream boundary at tide level or sufficient downstream to ensure backwatering is minimal	Tidal boundary		
Overlap adjacent models , if possible	Overlap to historical 2015 model proposed		
Level of Assessment (assumed Local for this study)	**Comment**		
Objectives _ Detail Design of flood defences of NFM, or Site specific FRA for developments	None		
Description _ local focus, consider interaction of sources, and detailed representation of local features	None		
Scale_ Small catchment or section of larger, short length of coastline	None		
Approaches _ Fluvial / Pluvial _ 1D or 1D/2D including range of modelling scenarios, including climate change, local scale design flows and explicit use of local information	1D/2D link modelling proposed, including a range of return periods and climate change. Local gauge also to be used for hydrology and model calibration		
Calibration / sensitivity testing _ Calibration at gauges for multiple events, installation of additional gauging, comparison with historical events, sensitivity testing	Calibration against gauge rating curve and 2014 event proposed. Suggest more focus on calibration with consideration of other events. Also consideration of modelling gauge to improve accuracy of SEPA rating curve (in discussion with SEPA)	For fluvial flooding 2014 is the only event where there is sufficient data to calibrate against. The gauge will be used to calibrate against. The gauge rating will be taken as accurate. SEPA have stated that they have high confidence in this gauge rating. Both the gauge raitng and flood event will be used to calibrate the model. Also compare coastal with December 2012 event, photos online	
Data Requirements_ Fluvial _ DTM, channel Cross sections	1D cross sectional survey with LiDAR DTM proposed		y
Data Requirements_ Coastal_ DTM, Bathymetry, Defences and beach profiles	Unclear source of data for coastal part of model, LiDAR or bathymetric data	LiDAR will be used, the project is focused on extreme sea levels so the foreshore and dunes should be sufficiently represented by LiDAR. Wave run up is not being considered so bathymetric data not essential.	
Quality Control_ review of input data, detailed review of models and hydrology by independent internal or external reviewer	Review of model proposed, suggest consideration of review of LiDAR data	LiDAR will be spot checked against some topo points. The different LiDAR grid squares from different phases will be given a visual check for continuity	y
Selection of modelling software	**Comment**		
Modelling software should be set out and why it is appropriate -	Flood Modeller and Tuflow are appropriate and industry standards		
	Note that older version of FloodModeller is proposed. Consideration should be given to using most up to date method	Flood Modeller version 6 is available. For this project Flood Modeller will be updated to version 4.6 from version 4.5. Newer versions have more stringent licencing rules. Using the slightly older version will allow the model to be initially built on the modellers personal computer as the model grows the licence will be activated. For later version there is no allowance for building on personal computers and all work is then carried out remotely via a shared computer. The latest versions allow for irregular shaped culverts and linking with ICM, the need for these functions is not anticipated.	
Quality Control	**Comment**		
Provide evidence of how they will carry out quality control and quality assurance throughout project	Model audit by senior modeller and external reviewer.		
Resources	**Comment**		
Project must be adequately resourced, sufficient staff with the correct level of experience, computational resources and software	Information not provided, but as JBA are experienced consultant, appropriate resourcing is assumed		
Data	**Comment**		
Data Register _ including licensing restrictions, date of issue, location stored, date data was collected,	Data register to be provided with study	Agreed	
Licencing _ should include DTM, hydrology and model outputs, where possible should not restrict future use	Licensing to be considered by consultant and agreed with council and SEPA	LiDAR is open source, the rest of the data (excluding MasterMap) will be entirely owned by the Highland Council.	
Historical Flood information _ real flood events provides benchmark, used in calibration and verification, flood frequency curves,	Historical event to be used for calibration		
Topographical / Bathymetric Data _ Existing data should be assessed to ensure it is appropriate for new study, no major changes in study area i.e. erosion/deposition, vegetation, construction of new structures ext. same Datum,	Check survey proposed for comparison to 2015 cross sections. We recommend some check survey for comparison with LiDAR data	Yes, this will be done, a number of topo points have been taken on hard surfaces. Some of these will be used to compare against LiDAR.	
Topographical / Bathymetric Data _ new survey should use EA standard technical specification Version 3.2	Comparison to EA standards required	Survey was carried out in line with RICS. There is a slight deviation from the EA survey requirements in that threshold levels were taken using a total station. JBA used GPS instead, however, the accuracy of the GPS in combination with the GPS procedure means the accuracy of the point is within 25mm inline with the recommended accuracy.	
The appropriate cross-section spacing depends on the physical characteristics, however generally: • For large rural rivers on low slopes the maximum cross-section spacing should be around 200 m; • For smaller streams, sleeper slopes, or within urban areas the maximum cross section spacing should be around 50 m	Spacing of river sections on the Nairn appears high. It is noted that the Nairn is tidal such that there will be fewer changes in form than non-tidal channel, but a review of the spacing is recommended. Same for Auldearn where spacing is >50m in many cases.	Yes, the spacing on the Auldearn Burn is greater than 50m in most cases. The Auldearn Burn along this reach has been highly modified so that the channel is straight and largely uniform. All structures have been accounted for but the uniformity of the channel means that there should not be an increase in model uncertainty. If needed additional interpolated sections can be added to the model based on the geometry of the surveyed sections. The River Nairn spacing through the urban area is also larger than recommended by SEPA guidance, however, in these locations the channel is either deeply incised so is not estimated to leave the channel or the channel information is supplemented with top of bank/wall survey data. In addition the channel has been heavily modified in the tidal reach through the use of hard banks and the pier itself. Aside from "swan island" the change in channel topography through this reach is gradual, thereby making the placement of the cross section sufficient to represent the channel.	
Minimum 4 cross section at gauging station, 3 downstream, 1 under cableway	Only 1 cross-section at gauge proposed	There is one at the gauge, another at the pipe crossing a short distance downstream and two at the bridge so there is four cross section (the downstream face of the bridge has been taken from the 2015 survey, I agree this should have been stated more clearly in the report)	

Cross-section data is also generally required at the following points: • All major obstructions to flow, such as bridges and culverts as well as road and rail embankments across the floodplain; • Points of significant changes of shape in the channel and/or change in the floodplain width; • Significant changes in stream slope, or near control sections (e.g. rapid drops at weirs and dams; • Areas where there is a significant change in channel or bank roughness; • At existing flood protection structures; • Upstream and downstream of confluences with significant tributaries. • At gauging stations or other locations where information is available for calibration (SEPA can provide information on gauging station locations, and recommended survey requirements). • Other key areas of interest, e.g. adjacent to proposed development sites.	Cross-sections proposed at key crossings, and confluences and gauging stations	
For Detailed study _ Bridges - generally be included unless clear span, Weirs and gates should be included, Long culverts should be included in XS survey, including manholes and sewer connections, compound structures and mills, all flow pathways through should be included, Dams, embankments and spillways should be represented explicitly, flow attenuation should be modelled	Proposals include 1D survey of bridges/ culverts, pipe crossings, outfalls etc	
DTM - Rural floodplain - 0.5m vertical, horizontal 10m, Urban floodplains 0.05m vertical, horizontal 0.5m	Scottish remote sensing DTM proposed to be used, which is available data	
New Topographic survey should be according to section 111 of the EA Specification	This should be confirmed when survey is commissioned	As above
Existing Studies - should be reviewed by an experienced modeller to determine if they are suitable, questions to ask in section 5.7 of SEPA guide	Not considered in proposed methodology. Existing studies should be reviewed as outset of modelling work and used as comparative for model results	This exercise was carried out prior to writing of the model methodology.
Hydrometric data _ Data for any Scottish gauges should be requested from SEPA, time series should be requested for calibration, rain gauge data should be requested for gauges within the surrounding the catchment, met office date should eb requested	Hydrometric data from gauge to be used. Consideration should be made to obtaining rainfall data, if appropriate.	SEPA has stated that they have high confidence in the Firhall Gauge and rainfall data analysis is outwith scope.
Sea level data. Environment Agency Report Coastal Flood Boundary Conditions for UK mainland and islands (McMillan, et al., 2011)., Surge shapes from the Coastal Flood Boundary Project should be requested from SEPA.	CFB data to be used	
Where possible, flood studies should use the annual exceedance probability terminology rather than return period.	Both annual exceedance and return period given	
Fluvial	**Comment**	
Design flows should not be finalised or signed off by either the Responsible Authority or SEPA before model calibration and reconciliation is complete, and should be reviewed and revised as a modelling study progresses.	This should be noted by modellers	Calibration against the Firhall gauge will be the first exercise undertaken once the model is running
Identify key locations (reconciliation points) where it is important for flows in a hydraulic model to match hydrological estimates, and agree the locations at the inception meeting. • The variation in design flows along a catchment should be physically justifiable and explained in the modelling report. • It may be necessary to run multiple model scenarios for the same AEP event in order to match the design flow at different points in the model.	This should be noted by modellers, comment provided in main text of this review	The reconciliation principle has been used to inform the lateral inflows. SEPA have approved this approach.
Determine the robustness of all hydrometric data in consultation with local SEPA Hydrometric teams. • Compare flow estimates from statistical (single site and pooling) and rainfall-runoff methods. • Consider the method used to derive hydrograph shape and run large catchment models for multiple storm durations if required. • The modelling report should include sufficient details of the analysis to enable an experienced hydrologist to reproduce the flow estimates. • Further detail on approach to hydrological analysis is available in SEPA's Technical Guidance for Stakeholders. • Refer to specific guidance in the FEH. • Document the approach used for reconciliation in the modelling report, and give values for any scaling factors.	This should be noted by modellers, comment provided in main text of this review	The shape of the hydrograph is informed from the largest record flood event at the gauge
As a minimum the data review should cover: - Robustness of the rating for any gauges used in the statistical analysis e.g. variation of the rating with time, hysteresis, location of any discontinuities - Catchment changes which may mean that sections of the data series are no longer valid e.g. construction of reservoirs. - Gaps in the hydrometric data series. - Suitability of the data for use in hydrological analysis. This should include a review of whether the NRFA FEH indicative suitability is correct. Any apparent anomalies should be discussed with the local hydrometric team.	This should be noted by modellers, comment provided in main text of this review	
The statistical method is generally the first choice method where there is a long record of gauged flood event data available.	Appropriate for River Nairn	
Rainfall runoff method is potentially most applicable to small catchments especially where they are ungauged.	Appropriate for Auldearn Burn, with note in main text of this review related to reconciling flows for the two different watercourses	
For ungauged catchments the hydrograph shape should be generated using a rainfall-runoff model, as in section 6.3.2.2 Where there is gauged data available close to the model boundary a hydrograph shape can either be derived by either: • standardising hydrographs by their peaks and averaging (Archer, Foster, Faulkner, & Mawsdley, 2000), • using a hydrograph from a large observed flood event or • using a rainfall-runoff model	This should be noted by modellers, comment provided in main text of this review	
Joint probability analysis to investigate the potential combined effect of extreme sea levels and high fluvial flows may be required for river reaches which are tidally influenced.	Joint probability approach proposed appears reasonable	
Model Schematisation	**Comment**	
1D Fluvial Comments should be added to the model giving the source of any data, the reasons for any structure representation, and the location of structures and cross sections. • Sensitivity testing should be carried out for roughness, structure blockage, and structure representation. • The modelling report should explain the choice of flood plain representation, the channel and floodplain roughness values	This should be noted by modellers	
For a cross section spacing Δx, the following rules of thumb apply 1. Δx ≈ kB, where B is the top width of the channel, and k is a constant with a recommended range from 10-20. 2. Δx < 0.2 D/s where D is the bank full depth and s is the slope. 3. Δx < cT/Ngp where c is the speed of the flood wave, T is the period of the flood wave and Ngp is a constant between 30-50.	Grid spacing and time step proposed based on standard model requirements. These should be reviewed as modelling work continues	
Roughness values should be reasonable and defensible and able to withstand independent review. • Sensitivity testing to roughness should be carried out as in section 8.4. • The modelling report should document the values used for roughness and the reason for selection.	2D roughness Stated, but no 1D roughness stated. The proposed 2D Manning's for buildings (0.1) appears low and may need reviewed. Sensitivity analysis is proposed	The 1D roughness should have been stated. It will be informed by Chow and modeller's experience. The proposed building roughness shall be increased to 0.3.
Around structures where flow is 2D or 3D	Structures included in 1D model	
In 2D avoid representing buildings using mesh voids or full height buildings as these representations cause problems when undertaking depth damage calculations using the model results. The approach taken to represent any hydraulic structures or linear features in the DTM should be described in the modelling report, together with the data used.	Buidings represented by 'stubby' building and roughness increased. Not all buildings to have floor levels measured, so variable approach within model. See comment above related to 2D Manning's n for buildings	Noted. A representative sample of building threshold levels have been surveyed. This will be reviewed and the applied threshold level will be agreed with THC. The model will use LiDAR to represent the ground level, the threshold level of a property will be applied at damage estimtation stage. This will allow for a rapid update in the future should a acomprehesive threshold level be undertaken of all properties shown to be in the flood outline.
The roughness values assigned to different land uses should be described in the modelling report, together with the data used to determine the land use.	2D roughness values given in report	
A rule of thumb is that 3-4 grid cells are required to resolve major flow paths.	This should be noted by modellers	
The basis of the DTM should be stated in any modelling reports, as well as the date it was collected. An assessment of accuracy should also be provided.	This should be noted by modellers	
Voids and full height buildings are not recommended where depth damage calculations are required; increased roughness, or stubby buildings should be considered (0.3)	Stubby' buildings and roughness increased proposed	
Linear features may need surveyed	Informal flood defences will be surveyed	
Calibration, Sensitivity and Uncertainty	**Comment**	

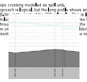
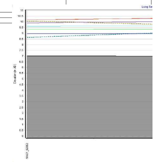
Level of calibration for Local Study _ Gauged _ calibration against Gauged data	Calibration proposed, see comments above about potential for further calibration	
Level of calibration for Local Study _ Ungauged _ calibration against historical data, sensitivity and new data collection	Calibration proposed, see comments above about potential for further calibration	
Results from the sensitivity analyses should be presented in the modelling report.	Sensitivity analysis is proposed	
Uncertainty should be considered in all flood studies.	This should be noted by modellers	

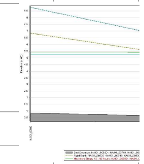
Model Scenarions	**Comment**	
Fluvial scenarios 2y 5y, 10y, 30y, 50y, 100y, 200y, 1000y,	50 year event is missing from proposed runs	Yes, this is a deviation but one that has been instructed by THC
Climate change uses most up to date guidance	See comments in main text of review regarding values used for climate change	42% uplift can be applied to the Auldearn Burn as opposed to 40% as per the river Nairn. Since the model methodology was written, SEPA have provided additional guidance specific to this project which will be used. Two sets of climate change scenarios will be modelled.

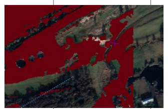
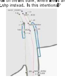
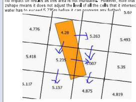
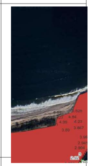
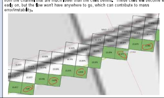
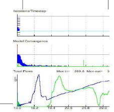
Typical Deliverables	**Comment**	
4 reports _ Technical report, non-technical report or summary, Model hand over report, model audit report	This should be noted by modellers	
Gridded output _ 1D water level and depth, 2D water level depth velocity and hazard	These are proposed	
1D tables of water level elevations, long sections, cross section	This should be noted by modellers	
Set of raw model results and run files and mass balance	This should be noted by modellers	
Flood extent and area of benefit	This should be noted by modellers	

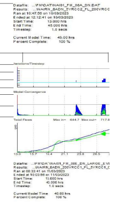
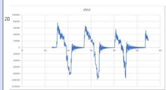
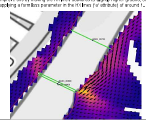
H Appendix: Internal model review

#	Review of Nairn FRM
Date of model	December 2022
Name of reviewer	I-Hsien Porter
Date of review	26/05/2023
Revision	4
Applicable standards or guidance	SEPA Flood Modelling Guidance for Responsible Authorities (v1.1); Tuflow manual
Nature of study watercourse/coastline/sewers	River Nairn and Auldearn Burn
Study objectives	Hydraulic model for flood mapping and scheme assessment.
Summary of 1st review	Fourth review: Reviewer comments have been acted upon and documented in the report where requested. Third review: Recommendations made for minor improvements and documentation in report of remaining uncertainties/recommendations for future work. Second review: Model stability is much improved and sensible decisions have been made regarding schematisation. There are a few remaining instabilities that could be improved and recommendations are given below for actions that may help achieve this. First review: A detailed model with clear and logical modelling decisions made in its construction. Poor model stability (particularly in the 200yr fluvial/5yr tidal) will need to be addressed and suggestions are given below. Considering adjustments to the schematisation of the downstream boundary is likely to have the biggest impact on model stability in the first instance (comment B-40).

Category	Detail	Prompts	ID	1st Review Comment	Suitability	Suggested actions	Consultants Response (if required)	2nd Review Comment	Suitability	Suggested actions	Consultants Response (if required)	3rd Review Comment	Suitability	Suggested actions	Consultants Response (if required)	4th Review Comment	Suitability	Suggested actions	Consultants Response (if required)
Data to be reviewed																			
Data to be reviewed	Software	• Versions	D-1	FM v5.0	Acceptable														
			D-2	TUFLOW 2020-10-AB-iSP-w64	Acceptable														
	AEPs provided / reviewed		D-3	2yr fluvial/2yr tide; 5yr fluvial/200yr tide; 200yr fluvial/5yr tide															
			D-4																
	Scenarios provided / reviewed		D-5	Baseline															
	Reports	• Reference versions • Technical reporting • Record keeping	D-6	Method statement (previously reviewed); Model review handover sheet															
1D/2D Model Modeller																			
1D/2D Model Modeller	Model build	• Reach extent / sufficient • Accuracy of model channel length	B-29																
	Schematisation	• Representation of floodplains • Representation of storage	B-30	Main river and Auldearn Burn tributary represented															
			B-31	Floodplains in 2D throughout model domain															
			B-32	Spill coefficient and bridge bypass options checks flagged – see comments under Structure Representation		See suggestions under Hydraulic Structure Representation													
	1D Health Check	• Summarise key findings • Take care to interpret findings and consider relevance	B-33	NAI01_0030 spill coefficient is the default (1.7), which is representative of a broad weir. As this is a notional spill to enable a connection to the downstream boundary, a lower coefficient (e.g. 1.2) could help stability and would be more appropriate to the location.	Minor issue	Reduce spill coefficient	Spill has been taken out of model following DSBDRY re-arrangement (i.e. DSBDRY is now only represented in the 1D domain, with no spill and 'dummy unit' taking 1D flow to the 2D boundary).	Ok	Acceptable										
			B-34	Upstream boundaries are QTBDYs, plus a FEH boundary on the Auldearn Burn. Hydrology reviewed elsewhere.															
	Boundary conditions	• Upstream boundary • Downstream boundary • Phasing of boundary conditions	B-35	All the d/s tide contain reference to the same tidal d/s boundary file 2yr_TIDE_DSBDRY and [constant level of xbm]. Is this intentional?	Clarification required	Confirm d/s boundary	Yes it was, this was a 'dummy unit' taking 1D flow to the 2D DSBDRY cut at sea, however, DSBDRY has now been rearranged (see row B-40) and 1D IED files with DSBDRY data now has full tidal curves represented (named 'Tide_Curve_XXX') – these have been copied from the previous DSBDRY used for the 2D domain, i.e. HT_NAI01_xxx, and hence are [illegible]	Ok, makes sense, thanks. There is a fairly steep drop between NAI01_00029 and NAI01_00000, then a flat bed to NAI01_-100. This means there are times in the run when the water surface at the downstream boundary looks unusual, as water levels drop below 1.5m at NAI01_00000 (mirroring the bed slope), but then are forced to rise again at the d/s boundary that never drops below 1.5m. If anything, it is likely that flood risk predictions are conservative, as if the tide level were <1.5m, water could drain more readily than is currently shown. 	Recommendations	Could test a d/s boundary tide curve that is allowed to drop below 1.5m to check impact of this assumption on key flood risk areas – but noted that the current assumption is conservative. Alternatively, applying the d/s boundary tide directly to NAI01_00000 would remove the odd water surface profile (but this only occurs at momentary points in the run, so not of great concern for flood risk predictions).	The d/s boundary was initially directly applied to NAI01_00000, with min value of 1.5 mAOD. However, it was found that having a min value of 1.5 mAOD at this location caused a fluctuating water level (instability at the DS boundary) and that water was generally being forced down to meet the level of 1.5 mAOD. As such, it was decided that I would either use a higher min water level of around 2.0 mAOD (which I tried, but lead to instability) or extending the channel further out to sea. This latter approach, in which an additional cross section in the 1D domain (NAI01_-0100) was added, which is a duplicate of NAI01_00000 but has been widenned significantly to help with stability (and as it is at the open sea) has helped with this stability issue. I'm keen to leave the DSBDRY as is now, if it is stable. I think if I lower the water level again in this area (i.e. giving a minimum value in the order of 1.0 mAOD) then water level upstream may be forced downward to try and reach it again, causing instabiltiy. In addition, the 5-yr DSBDRY will be used for a suite of Fluvial runs of varying return periods for the joint probability, and a value of 1.5 mAOD suits the downstream area for the majority of these return periods.	Ok, the report should include evidence that the choice of downstream boundary value will not impact on flood risk predictions at sites of interest (e.g. a sensitivity test or results from the tests completed so far).	Acceptable (but does not meet best practice)		To be included in the report (limitations / recommendations section)	Commentary has been added to the report on the uncertainty associated with the results. Model stability could be investigated and improved in future, to give greater confidence if the modelling was used as the basis for a design (e.g. of flood alleviation measures).	Acceptable (but does not meet best practice)		
			B-36																
			B-37																
			B-38	Section spacing based on survey (every 100m/50m)	Acceptable														
	Open channel representation	• Manning's n • Panel markers • Section spacing • Geometry	B-39	Conveyance curves generally appropriate. Check the following sections, where there are discontinuities in the conveyance curves: NAI01_02600 [illegible]; NAI01_00070 [illegible]; AULD1_00077 [illegible]	Recommendations	Apply additional panel markers to improve curves	Have added panel markers at these elevations, that correlate with a change in channel gradient, at these cross sections.	Looks much improved	Acceptable										
			B-40	Manning's n values generally appropriate (around 0.04-0.06 on Nairn; 0.045 on Auldearn Burn). Consider reviewing the following (although this would eventually be by calibration, if this produces evidence that a particular n value is needed): • NAI01_02600 • photos show rocks/boulders in the river, so a higher n value could be justified. • Downstream of about NAI01_00360 • values of 0.02 seem relatively high for a estuarine environment with sand/mud bed	Recommendations	Review and consider adjusting	Have reviewed. Downstream of about NAI_00360, with reference to survey drawings and photos, I tried amending the in bank channel bottom to 0.02 roughness ('gravel bottom, formed concrete sides') from Chow, as survey drawings indicate gravel on channel bottoms. However, the downstream boundary showed to have fluctuating water levels, and so to help stability I have kept the Manning's 'n' at 0.03 at most cross sections (although one cross section, NAI_00360, uses 0.02). The channel banks in the estuary environment use a value of 0.017 to represent the cement lined channel in this area. Between NAI01_02694 and NAI01_02828 (including at bridge), Manning's 'n' has been amended to 0.05 'mountain stream, cobble and boulder bottom'. I have also amended the Mannings 'n' values for all cross sections on the Nairn reach, at the left and right banks that go down to the channel bottom, to represent the vegetation (or paths / concrete walls) on the channel sides. I believe this is more representative of the left and right bank roughness (within channel). For instance, in the upstream reach, there is vegetation down to the water level according to the survey data and photos.	Thanks	Acceptable										
			B-41																
			B-42																
	Hydraulic structure representation	• Structure coefficients • Bypassing options • Choice of model unit • Geometry	B-43	NAI01_02694 • pipe crossing modelled as spill unit. The modelling approach is logical, but the long profile shows an unexpectedly high head loss at the spill [illegible] 	Minor issue	For flood risk modelling purposes, the spill could be removed and a statement made that the effect of the pipe crossing is assumed accounted for in the choice of Manning's n values.	Have removed the spill in FM and represented as an additional XS (named PC_02694 – PC stands for pipe crossing) that represents the top of the pipe, to show the drop in elevation on the DS side of the pipe. Have used same Manning's 'n' (0.05) as US and DS cross sections (02694 and 02650) to represent cobbles / boulders in vicinity. There is now no head loss at the pipe crossing – see figure showing green (previous water level prior to review) and blue (new water level following review).	The new approach results in much more realistic-looking results. I notice there is a slight draw down effect in water levels towards the pipe (most noticeable if plotting a larger portion of the long section), which may influence comparisons at the gauge node.	Recommendations	A sensitivity test to removal of the pipe crossing would offer reassurance about impact on predictions at the gauge.	representing the pipe crossing via a 1D XS as opposed to a spill, this has caused issues on the rating comparison for the 1997 event. In particular, for lower flows, the model results give a lower stage compared to the observed rating. Further information is provided in the rating review document '1997_observed_vs_modelled_stage_flow_comparison.xlsx'. Essentially, smaller events (i.e. 2-yr event) suit having the pipe crossing as a spill in the model, possibly as it helps hold back water and raises the stage compared to the flow. For larger events though, it is better for the pipe crossing to be modelled as a cross section. As such, two separate dat files have been created for small and large fluvial events. Dat file 'NAI01_FM_08a_DN' is used for all fluvial events up to and including the 100-yr event (as well as all coastal events). This dat file includes the pipe crossing as a spill, as this helps the rating and the head loss is not too significant (about 40-50 cm, as expected from photographs) at the pipe crossing location as the events are quite small. However, for all events larger than and including the 200-yr fluvial event, the pipe crossing is represented as a cross section (i.e. dat file NAI01_FM_08e_DN and NAI01_FM_08a_DN_Large_Events).	The modelling approach is acceptable as it replicates the rating at Firhall gauge, which the NRFA website shows is based on observed gaugings to above bankfull and QMED. A different approach, which might allow a single model to be used, would be to adjust the modular limit of the spill unit to control when the spill drowns (and remove the head loss/calibrate to the rating at high flows). This could be considered if time allows and there is a desire to have a single version of the model geometry.	Acceptable (but does not meet best practice)		The modular limit was briefly checked and tested when carrying out the calibration (NRFA rating compared to model rating) for the model. It was found that lowering the modular limit (from 0.9, default value to 0.8) made the modelled rating be 'further' from the NRFA rating. Amending the spill's modular limit, the weir co-efficient and Manning's 'n' values and general model schematisation at the gauge location were trialed on model calibration and it was found that amending the schematisation had the best effect for calibrating the model rating.	Approach is acceptable, as model rating has been calibrated to available observations.	Acceptable		
			B-44	B_02600 • USBPR with spill for bridge deck. Geometry and choice of unit ok.	Acceptable														
			B-45	B_01401 • USBPR with spill for bridge deck. Geometry and choice of unit ok. [illegible]	Acceptable														
			B-46	NAI01_01362 • no skew. Deck is in 2D allowing flow onto the bridge from the floodplain on either bank; representation is ok (although flow does not inundate the bridge deck in the events tested).	Acceptable														
			B-47	NAI01_00862 • no skew. Deck is in 2D allowing flow onto the bridge from the floodplain on either bank; representation is ok (although flow does not inundate the bridge deck in the events tested).	Acceptable														
			B-48	B_00809 • USBPR; geometry and choice of unit ok. No skew. Spill for bridge deck is set to the top of the railings, so the assumption is the railings are assumed to flow (may be ok if making an assumption the railings would be blocked by debris in a flood event • i.e. a conservative assumption). However, the risk is of the model predicting a higher water upstream of the bridge than would otherwise be the case • head loss over this structure in the 200yr fluvial event is close to 1m. 	Recommendations	Are there any flood observations locally (e.g. wrack marks, photos) that would justify one approach over the other? If observed data exists, look to modelling spill of flood of bridge deck, with a lower coefficient (e.g. 1.2) to account for the energy losses caused by the railings. Otherwise ensure assumption regarding spill modelling approach is documented.	There are no photos available of the bridge during flood events, so uncertain whether blockage occurs as a result of the rails. Flooding on the right bank near the bridge occurred during the 1997 event (as noted in The_Flood_Incidents shapefile) and water level appears about 1.2 m below deck of footbridge at 00809 during event on 15/11/12 (which was mainly a coastal event). Water is in bank at this location during this event. I've decided to lower the spill level to represent the top of the [illegible] instead of the top of the railings. It is likely that a considerable amount of water would be able to flow through it, and the results currently show considerable head loss (about 1m drop, for the 200yr fluvial event) at the bridge as a result of the spill representing the top of the railings. This head loss has reduced slightly, on making this amendment (see screenshot of long section). I've also lowered the spill co-efficient to 1.5, to [illegible]		Acceptable										
			B-49	B_00683 • USBPR; geometry and choice of unit ok. 31 degree skew applied. Spill level for bridge deck is set to top of railings • comments as for B_00809. However, head loss over the structure is 0.2m at peak of 200yr flood, so given that the more conservative approach has been used, altering this will have limited impact. Assuming the spill is blocked in this case is perhaps more justified due to the wire mesh on the railings that might catch debris.	Acceptable (but does not meet best practice)	Ensure assumption regarding spill modelling approach is documented.															
			B-50	AULD1_00520 • spill for culvert deck in 1D domain, but the deck of the culvert is also represented in the 2D domain, so the road surface is represented twice. In the 2D representation is retained, an HX line allows flow to connect between the channel and road surface at the upstream face of the structure only. Any flow on the road therefore cannot re-enter the channel directly from the downstream face of the structure.	Minor issue	Either remove the 1D spill or deactivate the culvert deck in the 2D code layer. In deciding which approach, consider the main flow routes and whether the 1D or 2D will be better at representing these. In this instance, there is flow moving along the road as well as across. If 2D representation is kept, add an HX line on the downstream face of the structure (but may be justified in omitting this if it leads to instability).	I have decided to remove the spill from the 1D domain (so_00510) as there is considerable out of bank flooding at both left and right banks, and along the road bridge and as such, I think flow routes are better represented in the 2D domain. I tried adding a HX line at the DS face of the structure, however there was generally instability on water levels along the Auldearn Burn so I decided to remove this (i.e. HX line is only included at US face of structure). Usually I would allow overtopping in the 2D domain where there are at least 3 grid cells at the structure location. There is about 2 cells at this location, however, given flow routes in surrounding vicinity, I think the overtopping is best represented in the 2D domain.		Acceptable										
			B-51	CUL_00919 • as for AULD1_00520; road surface is represented in both the 1D and 2D. HX line on upstream face of structure only.	Minor issue	As for AULD1_00520	Spill unit removed (so_00926) from 1D and HX line included at US face of structure, but not DS face (due to [illegible])		Acceptable										
			B-52	CUL_00667 • as for AULD1_00520, regarding road surface and HX line positions.	Minor issue	As for AULD1_00520. As the length of the structure (120m) is less than the 2D grid cell size, it won't be possible to accurately represent the deck in 2D.	HX line (v12) amended to not overlap with the structure within the channel (i.e. this structure is now only represented within the 1D domain).		Acceptable										
			B-53	CUL_00508 • as for AULD1_00520, regarding road surface and HX line positions. As spill is [illegible] for the purpose of OL_00508 [illegible] downstream of the culvert. Is this needed for stability?	Minor issue	As for AULD1_00520. Please also clarify purpose of OL_00508	As noted in B-50, I tried adding a HX line (v12) at the downstream face of the structure, but the removed. The purpose of the spill unit OL_00508 (OL representing Outlet) was to give stability at the outlet from this structure, which gave significant instability when it was first implemented (and is sensitive to initial conditions). I could possibly try taking this spill unit out again but I think the model is more stable with this kept in [illegible]	Ok. Noted that bed level of the spill is invert level of the culvert, so may improve stability for water weiring out of the culvert outlet. The spill is in mode 2 for most of the run (when flows are high), so downstream water levels can still affect culvert (i.e. the spill doesn't disconnect the culvert from the downstream reach).	Acceptable (but does not meet best practice)		Just by way of further update – I have tried taking the spill OL_00508 out, the model did run but non-convergence increased. As such, I have left it in the model. I also tried adding culvert inlet and outlet structures to the three culverts on Auldearn Burn. However, these increased non-convergence so I took them out again in final dat files (9a – small FL events and 9e – large FL events).	Ok, ensure the decision about the culvert inlets/outlets is documented with the reasons why.	Acceptable (but does not meet best practice)		This will be included in the reporting, including the reason for not using them (increased instability and non-convergence) and what could be done about it (included in recommendations section). Roughness has been included in the sensitivity testing (including increasing roughness for the 1D channel structures) and comparison of water levels / velocity at the inlet / outlets of culverts along the Auldearn Burn could be undertaken, though this may just show the influence of increasing Manning's 'n' values along the channel upstream and downstream of the culverts. Roughness values used for the culverts were chosen from Chow's, and are 0.025 for concrete and 0.017 for corrugated iron. These were taken from photos and are accurate (not conservative) values.	Commentary included in report.	Acceptable		
			B-54	FC_00007 • pipe crossing. No noticeable head loss throughout simulation, so minimal impact.	Acceptable														
	Floodplain representation	• Suitability of approach • Embankments • Elevation	B-55	Floodplains in 2D throughout.	Acceptable														
			B-56	Defences in IED [illegible] represented	Acceptable														
			B-57	Unsteady flood timestep 1s [illegible]	Acceptable														
			B-58	dH and dQ/s of 1000m is very high and may mask instabilities elsewhere within the model [illegible]	Major issue	See suggestions elsewhere in this review to improve stability. The comment under TUFLOW domain boundary conditions will possibly have the biggest impact of [illegible]	Model now runs with dH and of 10m for 200-yr FL, 5yr [illegible]	Good work	Acceptable										



	Run parameters and output data	~ Results generated ~ Temporal resolution of results ~ Run parameters	B-59	Other run parameters at default values.	Acceptable	If a stable model cannot be achieved following the geometry suggestions (for FM or TUFLOW), then you could try adjusting the: - theta parameter (try 1 first of all to see if it's stable, then work back towards 0.7 to find the minimum value you can get away with). - the alpha parameter (try 0.5 to begin with, then as above) There are very small oscillations in the stage hydrograph at the downstream-most cross section and these parameters may help reduce these. The trade off is a reduction in accuracy.													
			B-60	Initial conditions - top of Auldearn Burn in 200yr fluvial run. Initial water levels at AUL01_01004 are higher than the peak of the flood event, so if extracting the peak water level, the initial condition will be selected. Further downstream of this point, the initial level is lower than the peak. However, the initial level is still higher than the banks, resulting in water spilling onto the TUFLOW domain more as an artefact of the initial condition rather than because of flooding. 	Major issue	Start with a lower initial condition. The model runs stably with a lower initial condition in the 5yr fluvial and problems of the 200yr fluvial crashing do not occur until much later in the run, so are less likely to be influenced by the initial condition.	Lower initial conditions as taken from 1 hour timestep in to the model run has been re-input in to the model, these are much lower on the Auldearn burn (\\EDI-RDC03\LIVE DATA\2022\PROJECTS\2022S0654 - HIGHLAND COUNCIL - NAIRN FRM\1_WIP\HM\NON_GRAPHICAL\GZ-JBAU-00-00-M2-HM-0003-MODELLING\FM\RESULTS\1D_ONLY\NAIRN_006E_200YR_UNSTEADY.IIC)		Acceptable										
TUFLOW domain (1)																			
TUFLOW domain (1)	General Schematisation	~ Grid orientation ~ Grid resolution ~ Grid extent ~ Active domain extent ~ Use of water level lines	B-123	Grid oriented in line with dominant direction of main River Nairn.	Acceptable														
			B-124	Grid resolution is 4m, ok. Method statement says 2m will be used in urban areas, but this isn't the case.	Clarification required	Model deivates from method statement - has this been agreed?	The buildings were originally going to be represented by Z layers showing the threshold level of the buildings, however it has now been agreed with the client that the buildings are only represented by Manning's 'n' and not stamped in from Z data, as damage estimates will be done at a later date. Jonathan and I have provisionally decided to keep the grid as 4 m in the urban areas, and he will discuss this with the client. I will likely set the model going with a 2m grid resolution as part of the sensitivity testing, but not necessarily report too much on it		Recommendations	Jonathan has discussed with the client, email dated 06 February 2023 from Duncan Sharp to Jonathan Garrett		Ok	Acceptable	[illegible]					
			B-125	Edge of active area prevents flow spreading towards Kingsteps in the downstream area of the domain (around 289841, 857328). Can the active area be extended to higher ground in the LiDAR?	Minor Issue	Extend active area	as an inflow in to the field drain. It was thought, prior to the review, that the main inflow in to the field drain would be from sea water overtopping the dunes and in to the field drain. However, I have had a look at the LiDAR in this area compared to the calculated tidal curves, and there is higher ground at the dunes (above the 200-yr coastal level, 3.425 mAOD) between the sea to the east and the field drain (higher topography above 3.425 mAOD blocked in red in figure). It's possible that some water might reach the field drain via a potential culvert below this level (marked with an X in the figure), but the volume of water would be limited by this culvert. As such, the representation of the field drain has been taken out of the model. From previous client meetings, it was flagged that for the smaller return period events, there appeared to be way too much flooding in the vicinity of the field drain. This is likely because the tidal DSBDRY used wasn't considering the higher elevations of the dunes, between the sea and the field drain. The field drain itself is included in the LiDAR data and overtops from the Nairn flooding. I've expanded code layer to cover field drain in the LiDAR regardless, to prevent any glasswalling in this area, but it is now represented in the geometry only (as a flow route) and doesn't have an inflow or DSBDRY.	Glass walling resolved	Acceptable										
	Geometry	~ Representation of flow paths ~ Representation of topographic obstructions ~ Other modifications to ground model	B-126	gis\2d_zsh_NAI_v09_P.shp | gis\2d_zsh_NAI_v07_L.shp Bank levels. Assume these are point inspected from LiDAR? There appears to be a rogue point at the very downstream end of the reach, left bank, with a value of 7.62m (grid ref 288654, 857501)	Clarification required	Check rogue value (but may not be necessary - see comment about downstream boundary arrangement below first)	Agreed this is a typo / rogue value. Has been omitted following amendments to DSBDRY area (described in B-50)		Acceptable										
			B-127	gis\2d_zsh_harbour_P.shp | gis\2d_zsh_harbour_R.shp Harbour levels, used in conjunction with IWL shape within the harbour.	Acceptable														
			B-128	gis\2d_zsh_pier_wall_P.shp | gis\2d_zsh_pier_wall_R.shp Estuary wall. Compared to OS map, there appears to be a gap between the edge of the coastline and the wall on the left bank, where levels are applied from 2d_zsh_NAI_v09_P.shp instead. Is this intentional? 	Clarification required	Check representation is intentional	Yes this was intentional as there was sufficient LiDAR along the length of the pier, that is missing in the shapefile, to represent the pier wall. However, due to reschematisation of the DSBDRY, the code layer (2D domain) now ends at the narbour wall, prior to the pier justting out to sea, so these Z polygon and point shapefiles are no longer used		Acceptable										
			B-129	gis\2d_zsh_Fishertown_wall_v04_P.shp | gis\2d_zsh_Fishertown_wall_v04_L.shp Surveyed levels	Acceptable														
			B-130	gis\2d_zsh_bridges_P.shp | gis\2d_zsh_bridges_R.shp Bridge decks, levels match survey.	Acceptable														
			B-131	gis\2d_zsh_field_ditch_P.shp | gis\2d_zsh_field_ditch_L.shp Cell centres and a cell side elevation value adjusted, so a continuous flow route is maintained	Acceptable														
			B-132	gis\2d_zsh_sand_dune_gap_P.shp | gis\2d_zsh_sand_dune_gap_R.shp No impact on results as this area is not inundated. However, note that the size of the zshape means it does not adjust the level of all the cells that it intersects with (so that water has to exceed 5.235m before it can progress any further) 	Acceptable (but does not meet best practice)	Only necessary if this area is inundated in a future model run - increase size of zshape.	Have extended so that 2D grid can capture and represent this. May be used in the case of climate change runs (though the 1000-yr tidal curve, 3.575 mAOD, is lower than these levels)												
			B-133	gis\2d_zsh_embankment_P.shp | gis\2d_zsh_embankment_L.shp Embankment from survey	Acceptable														
	Model parameterisation	~ Schematisation of materials layers ~ Manning's n values ~ Flow constriction factors ~ Storage reduction factors	B-134	TMF - Manning's n values chosen are sensible	Acceptable														
			B-135	2d_mat_NAI_v03_R.shp - coverage of complete domain, except a small area on the right bank between NAI01_03801 - NAI01_03673 where default value (0.06) is used.	Acceptable (but does not meet best practice)														
			B-136	2d_mat_patch_v02_R.shp - stability patch. Preferable to address instabilities through suggestions above for adjustment to downstream boundary arrangement.	Acceptable (but does not meet best practice)		Model is run without stability patch, following reschematisation of DSBDRY			[illegible]		[illegible]	Clarification required	[illegible]					
			B-137																
	Representation of buildings		B-138	Manning's n 0.5, no change to ground levels	Acceptable														
			B-139																
	Boundary conditions	~ Location & implementation of boundaries ~ Internal boundaries (HX & SX) ~ External boundaries	B-140	I'm a little unsure about the representation at the downstream boundary, as there are a number of geometry modifications to the 1D and 2D domains that are made to enable the 2D downstream boundary arrangement to be applied (rather than real features). This also seems to be the source of model instability in the 200yr fluvial/5yr tidal. In the events tested, there doesn't appear to be any direct interaction between the sea and the rest of the floodplain, except via the 1D channel. - If this is the case in all the design tides to be tested, does the 2D downstream boundary add any extra information, or could the model be truncated at the end of the 1D domain at NAI01_00000, with just a 1D HTBDY representing the tide level? - If the design tide levels will overtop ground levels along the coastline, could the 2D boundary be applied directly along the coast instead? This would avoid the need for the more complex set up/interaction at the bottom end of the 1D domain. 		Consider adjusting schematisation of downstream boundary arrangement	I have amended schematisation of DSBDRY such that the DSBDRY is now in the 1D only. From analysis of the max tidal curve for the 1000-yr coastal event against LiDAR, it is evident that this event would not be large enough to overtop the pier walls or dunes. As such, the 2D domain of the model can be contained to the area to the south of the dunes. Historic flooding has shown that there is some overtopping of the harbour walls, however, this is understood to be from wave action / overtopping, as tidal curves (based on still water levels) do not show this event to be large enough to overtop the harbour or dunes. Schematisation may need to be considered again on running the climate change runs, as these could be large enough to overtop the harbour and dunes. In essence, the 2D domain is now cropped at the harbour area / beginning of the pier walls, and the 1D domain covers the channel between the pier walls out to sea, with an additional cross section in the 1D domain (NAI01_-0100) added, which is a duplicate of NAI01_00000 but has been widenned significantly to help with stability (and as it is at the open sea)		Recommendations	[illegible]	As noted in B-60. [illegible]	[illegible]	Recommendations	[illegible]			Acceptable		
			B-141	HX boundaries sensibly located and match widths of channel in FM/location of deactivation markers	Acceptable														
			B-142	A few locations (e.g. the NAI01_01343 deck shown below) where the HX lines pick up cells from the channel that are much lower than the cells behind. These cells will become wet early on, but the flow won't have anywhere to go, which can contribute to mass error/instability. 	Acceptable (but does not meet best practice)	Consider adjusting position of HX lines slightly, or adjusting zshapes that are used to enforce ground levels. (I'd put on the gridded results and make them a really garish colour, then do a quick pan through for any isolated wet cells).	Have adjusted HX line so that is runs over the deck of the structure, instead of US face, so that cells at the channel bottom can't be selected and water would have to flow on to the level of the deck structure and overtop this area only		Acceptable										
			B-143	2d_iwl_Harbour_1.5m_R. Harbour water level, applied as intended and matches initial condition in 1D.	Acceptable														

	Initial conditions	- IC	B-144	2d_zsh_field_drain_R.shp - I'm worried about field drain. Because there is a gradient in the topography of the field drain, water starts to flow through the drain, leading to out-of-bank flow (there are no other boundaries or connections to the main river and floodplain that would result in inundation of land around the field drain).	Major issue	I'd suggest either assuming the field drain is dry at the start of the run, or raise the ground level by 1m (if the assumption is that there is always 1m of water in the drain).	As described in row B-125, there was a DS tidal boundary as the inflow in to the field drain. It was thought that the main inflow in to the field drain would be from sea water overtopping the dunes and in to the field drain. However, there is high ground and culverts in hte field drain, restricting the effect of the tides on the field drain. The field drain is now only represented in the LiDAR data in the model. Further description in B-125		Acceptable										
			B-145	2d_zsh_NAI_V3m_R.shp - Water level around d/s boundary - see early comment on d/s boundary schematisation.															
	Use of event and scenario controls		B-146																
			B-147																
	Run parameters and output data	- Results generated - Temporal resolution of results - PO lines - Run parameters	B-148	Map outputs every 15 minutes	Acceptable														
			B-149	2x timestep (quotes value for 4m cell size)	Acceptable														
			B-150	PO line used at Fishertown gauge, extends across full flow width.	Acceptable														
Model results, interpretation, verification and stability																			
Model results, interpretation, verification and stability	Model stability	- 1d/2d, IE - Model warnings and errors - Non-convergence - Mass balance - Unrealistic oscillations (water level / flow / boundaries / HX)	B-151	1D - significant number of non-convergence messages, concentrated around the downstream boundary.	Major issue	See comments above for suggestions	From using the non convergence plot too, I think that there are now no 1D cross sections with a significant number of non convergence messages (NAIRN_006I_5YR_FL_200YR_CO_1D2D.zzd)	Minimal poor convergence. There are slight wibbly elements in the FM outflow hydrographs (e.g. around 32.25 hours in 200yr_FL_5YR_CO - see plot to right).	Recommendations	The oscillation at the peak of the 200yr_FL_5YR_CO run seems to originate at the downstream boundary, so comment B-35 mentioned above may help remove this.	The DSBDRY is quite sensitive in that I have tried using higher / lower levels than 1.5 mAOD (as the minimum level) before and it can affect fluctuating water levels. It's been quite tricky to find a minimum water level that works for all the return periods (i.e. the 2-yr and 5-yr tidal curves are run with the majority of fluvial return periods) and it takes quite a long time to amend the DSBDRY in terms of altering initial conditions and finding a minimum level that works well for all return periods. I think I could spend quite a lot of time on this, with relatively little improvement. As such, I am keen to keep the DSBDRY as is. I have read in all zzd's from the final runs in to the 'Read multiple zzd_V5_013.xlsx' under 1D results folder '013' and majority of runs (all but 3) don't have many error messages and appear stable. The more instable runs are the N+20% climate change runs, at a bridge location. The baseline scenario (DN) has no error messages for most of the runs	Thanks for the explanation. On the whole, there are few convergence errors indicating an instability. Runs with the larger numbers of errors are sensitivity tests, which is of less concern as these results will not ultimately be used for flood mapping. I looked at the .bmp files in the results folder '013' and there are a couple of anomalies that should be investigated. These relate to the '8ADN' runs - I'm unsure of naming conventions, so it may be that these runs have been superseded by others, in which case these comments may not be of concern, but the later runs should be checked for the same issues. There are two types of issue that affect the runs. (1) E.g. NAIRN_8ADN_5YRCC2_FL_200YRCC2_CO_1D2D There is an early inflow around 10 hours, which in some cases is higher than the peak of the event around 30 hours. This might be entirely reasonable, e.g. the Auldearn Burn responding faster than the main Nairn. However, I'd suggest checking the boundaries are being applied as intended. (2) E.g. NAIRN_8ADN_200YRCC1_FL_5YRCC1_CO_1D2D_001 High frequency oscillations around the peak. Although not resulting in a poor convergence error, it looks unexpected and adds greater uncertainty to the flows predicted by the model.	Recommendations	I had a look at the second issue (oscillations) and from the long profile, it looks to be concentrated between NAI01_00596 and NAI01_00182. The TUFLOW vectors suggest there could be some flow recirculating (e.g. coming out of bank around 00596, circulating upstream and re-entering the channel - see plot to right). You could try applying a form loss to the HX lines through this reach (using the 'a' parameter of the HX line .shp; try a value like 1). Rozy's comments: Thanks for spotting this and for your suggestions. I've had a look in to this and checked for oscillating water levels for all of the 71 model runs. I've noticed that for the 200-yr and 1000-yr FL CC1 scenarios, there is oscillation between NAI01_00596 and NAI01_00182 that affects max water levels. For the CC2 scenarios, this oscillation occurs but it does not affect maximum levels. The oscillation doesn't occur for any of the present day runs or for the coastal climate change events. I tried altering the alpha parameter as you suggest, in the vicinity along the HX lines. I've also tried using a normal depth boundary, instead of a HT boundary. This has greatly improved the stability and there are no oscillations on using a NDB, and therefore I think the oscillations are caused by the downstream boundary. On using a NDB, the water level at the Downstream boudnary is about 1.5 mAOD. This is significantly lower than the 5-yr CC1 tidal curve level that was used (in the order of 4.2 mAOD) and as such, I think water is being forced up to this level at the DSBDRY, causing the oscillations. However, in line with the scope, a climate change tidal boundary needs to be used and does give higher water levels (though increases instability).	Regarding the first issue, I have noticed this occurs during the coastal climate change events only. All hydrology and coastal boundary inputs have been checked and time offset values are correct. The first large peak in inflow in to the model is understood to be the first tidal curve, this is almost as large as the second tidal curve (that has the calculated maximum climate change level, peaking at 31.25 hours in to the model run, the same time as the fluvial inputs peak) and then there is a third tidal curve, that is significantly smaller. The large increase in inflow at around 18 hours, seen during hte 5yrCC2FL_200yrCC2 CO run, is understood to be the first tidal curve filling the river capacity up from the downstream extent, when water levels are generally low (from the initial conditions). The tidal curves are steep and peak just after 19 hours, when there is a sudden decrease in dVol. It's understood this is caused by the falling limb of the tidal curve and water exiting the model at the 1D downstream boundary (via the falling limb of the tidal curve). The tidal curves are input as calculated and have been reviewed independently and it was informed in the method statement that at least two tidal peaks would be run, so that model outputs account for a realistic tide, i.e. the first tide takes the majority of the capacity and a second tide would therefore be expected to cause further flooding as considerable capacity has already been taken during the first tide	Discussed initial high peak in FM flow outputs and this is associated with the initial high tide/low fluvial flows. At the peak of the event, the FM .bmp displays lower flows, as the ingress from the tide is counteracted by high fluvial flows. As for comment B-35, the residual uncertainty has been acknowledged in the report and should be investigated in future if greater confidence is required in model predictions (e.g. for design)	Acceptable (but does not meet best practice)		
			B-152	2D - high mass balance error when flow first spills onto floodplain at start of run (5-6%), but this diminishes and is within guidance values of +/-1% at the peak of the event. The only areas that are wet at the very start of the run are the sea, and the field drain on the right bank - see earlier comment about IC, in the field drain.	Minor issue	See comment B-144	Code layer now doesn't overly with sea and field drain only represented as a potential flow path. MB plot for 200-yr FL shown, now always below 0.5%	Mass error much improved and within +/-1% tolerance	Acceptable										
			B-153	2D 	Major issue	Review position of HX lines where there are isolated cells/a row of low lying cells with high ground behind, such that water cannot progress. If possible, move HX line outward or review ground levels in these cases. 	Tuflow shapefiles widened slightly along the reach where there is only one cell wet along the boundary, so that no water overtops the boundary line where it is then 'stuck / causing instability'. About 6 sections of the Nairn and Auldearn reach have been widened slightly, with channel bank elevations raised. These are at the following locations: - LB DS and US of NAI01_01104 - LB DS of NAI01_01335 - RB DS and US of NAI01_01461, and DS of AUL01_00041 on the Auldearn burn. Essentially, 1D domain has been widened at the confluence, to help with stability. RB between AUL01_00258 and AUL01_00087. The right bank of the four 1D cross sections along this reach (AUL01_00258, AUL01_00237, AUL01_00144 and AUL01_00087) has been widened to cover steep ground in this area within the 1D domain. There was an issue with fluctuating water levels / instability in this area, and widenning the 1D cross sections on the right bank in this area has helped to resolve this. 2D shapefile (hxi line (v17), code layer (v15), z point (v19) and lines (v15)) have been amended accordingly. -LB US of NAI01_02949 -LB US of NAI01_03064 -RB US and DS of NAI01_03532	dVol is much improved. There is still some evidence of oscillation in the plots, which could be investigated with a view to improving further. E.g. on the right bank at NAI01_00809, there is an area of higher velocity flow (up to 5m/s) and larger MB error in the MB grid outputs. It might be possible to improve this by moving the HX lines outwards to slightly higher ground, or applying a form loss parameter in the HX lines ('a' attribute) of around 1. 	Minor issue	Review velocity/MB outputs to indetify any locations of high velocity or MB error, for targeted improvements through HX form loss parameters. It may be that the the dVol is associated with the harbour, where flow can connect between 1D and 2D at quite a low elevation. It might be possible to resolve this by modelling the harbour with a 1D reservoir unit linked to the main channel via a spill - although this has its own instability risks. Eliminating any other causes of abrupt changes in dVol, as described above, may offer quicker benefits.	MB error grids have been looked over in TUFLOW viewer. HX lines downstream of NAI01_00809 were moved outwards to slightly higher ground on right bank, however, this caused fluctuating water levels upstream so reverted back to where they currently are.	% MB is acceptable. The plot shows some oscillations in dVol between 10-20 hours on the first tide cycle, although the peak of the event around 25-30 hours looks more stable. It would be helpful for the report to identify locations contributing to the oscillations in dVol (possibly related to the issue in the earlier comment above) and comment on whether this is likely to affect flood risk predictions in areas of interest.	Recommendations	The dVol oscillations have been looked in to and it's understood that oscillations mainly occur for the coastal runs. The 200-yr coastal run, as you note, has a large degree of oscillations during the first tidal run, and the total volume drop at the end of the first tidal cycle is ~2250 cumecs (in 15 minutes). The 200-yr CC2 coastal run has less oscillations though a very large drop of ~14000 cumecs at the end of the first tidal cycle, though this occurs over a few hours. It's thought that there are more oscillations during the 200-yr coastal run as the peak water level from this event is 3.43 mAOD, which is a very similar level to the banks in the downstream extent area (harbour and piers, as well as banks at Fishertown) of the model whereas the 200CC2 max tidal curve level is considerably higher (5.23 mAOD) and so out of bank flooding occurs more 'smoothly'. I have increased the form loss (a) parameter to 1 on the HX lines in the vicinity of NAI01_00570 (both left and right banks) including at the harbour entrance and run as a sensitivity test for the 200-yr CO runs. However, this didn't reduce the oscillation in the dVol. The screenshots below shows how much the velocity vectors change in a 15 minute timestep at the peak of the event. Sudden change in flow direction is also seen during the first tidal curve. I think this is attributable to the steepness of the tidal curve and shallow depths along the banks, meaning water is dragged water away to the downstream boundary. This occurs regardless of whether the form loss is increased to 1 along the HX boundary near the downstream extent of the model. I have checked the large decrease in flow (i.e. 2250 cumecs) leaving the model in 15 minutes at the 1D downstream boundary at the pier (i.e. between timestep 19.25 hours and 19.5 hours, shown in your screenshot for dVol change for the 200-yr Coastal event. The decrease in flow per second is 2250 / 900 (there are 900 seconds in 15 minutes) which equals 2.5. From the model outputs, the mean velocity 2.1 m/s		Some ongoing changes in dVol throughout the model runs, but not rapid oscillations that would indicate instability at the boundaries. As for Comment B35, residual uncertainty has been acknowledged in the report	Acceptable (but does not meet best practice)		
			B-154																
			B-155																
			B-156																
			B-157																
			B-158																
	Sensitivity testing	- Suitability of sensitivity testing undertaken - Results & interpretation of sensitivity testing	B-159																
	Calibration / performance		B-160																

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