AUSTRALIAN RAINFALL AND RUNOFF

REVISION PROJECT 6
Loss models for catchment simulation: Phase 4 Analysis of Rural Catchments

APPENDICES A to M

Appendix A Excluded catchments

The table below lists the gauge and pluviograph number of the catchments that were identified but not able to be included in the analysis. Where inclusion criteria was not met, a comment has been included. Other catchments have been excluded because data was not able to be collected or the catchment was located close to other catchments with a better match to inclusion criteria.

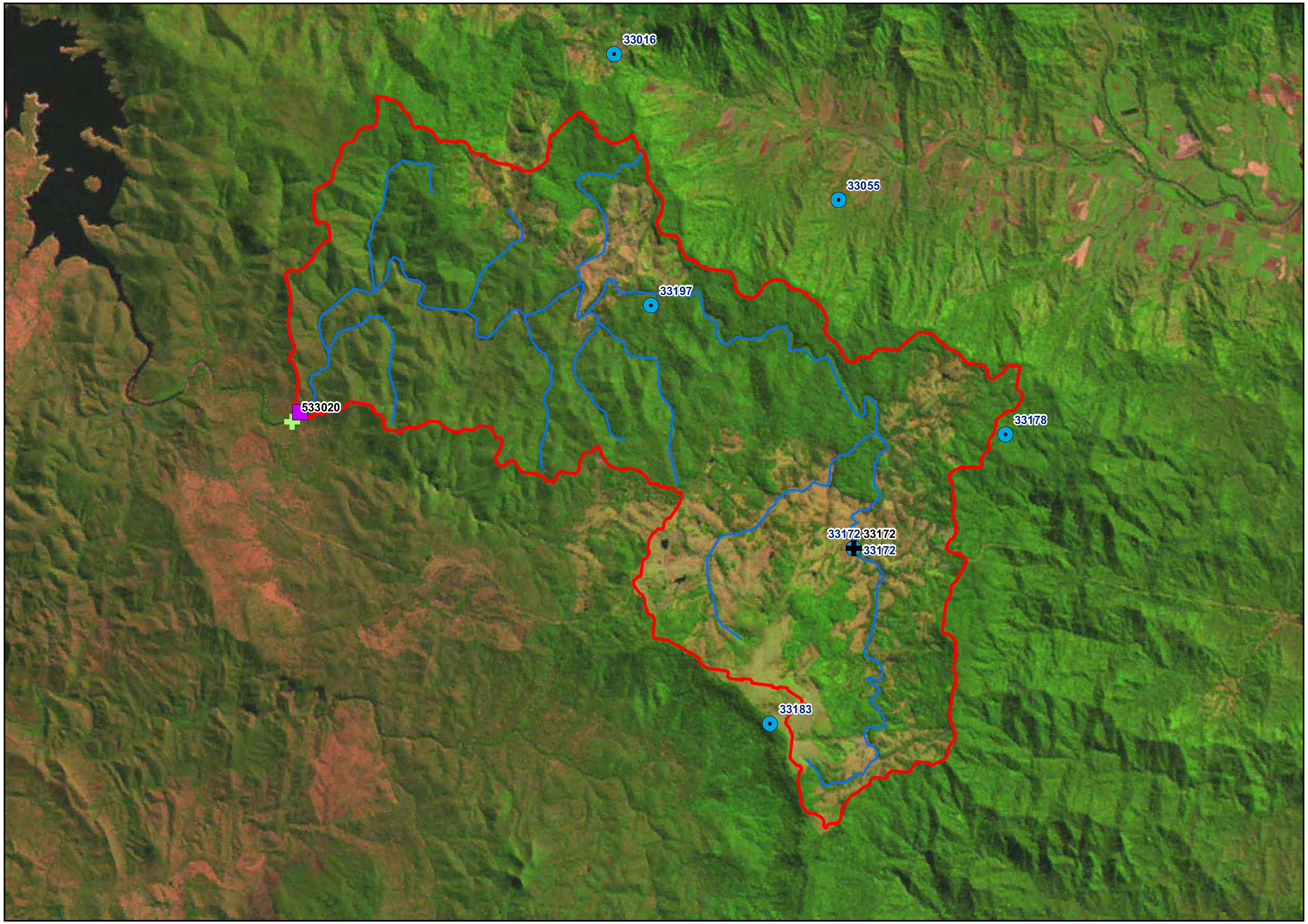
Table A-1 Catchments excluded from analysis

Gauge	Pluvio	State	Comment
410739	570967	ACT	Data not received/available
12001	12002	NSW	No data available
203013	P58072	NSW	15 yrs overlapping data only; 77% missing flow data
203025	P58131	NSW	62% missing flow data
206010	P57104	NSW	11% missing flow data
206026	206026	NSW	Catchment area <20km^2
208002	208002	NSW	11% missing flow data; 43% missing pluvio data
210072	P61325	NSW	No overlapping data; 62% missing flow data
210076	210076	NSW	No useable data
212001	568058	NSW	Affected by transfers
212014	563071	NSW	Data not received/available
214003	568102	NSW	Timing of rainfall and streamflow not matching
219001	219005	NSW	No flow data available
410077	410077	NSW	47% missing flow data; 75% missing pluvio data
410112	410112	NSW	No useable data
418034	418034	NSW	35% missing pluvio data
421034	P63108	NSW	10 years overlapping data only
G8150097	R8150205	NT	Close to other catchments
G8150200	R8150205	NT	18% missing flow data
G8210012	R8210009	NT	No data in file provided
G8260052	P14508	NT	Only equivalent of 16 years overlapping data
G8260054	P14508	NT	Catchment area <20km^2
122004A	122004	QLD	11% missing flow data
122004A	122004	QLD	Insufficient events could be extracted
140002A	P40465	QLD	7 yrs overlapping data only
143032A	P40528	QLD	Also known as 533021; No overlapping data
145018A	540006	QLD	18 years overlapping data only
AW426558	AW426665	SA	3 yrs overlapping data only
AW503503	AW503529	SA	25% missing flow data; 63% missing pluvio data
AW503507	AW503507	SA	14 yrs overlapping data only; 14% missing flow data
AW504528	AW504563	SA	Zero flows from 1993 to end of record
AW505518	AW505537	SA	34% missing flow data
AW507502	AW507506	SA	Equivalent of 17yrs overlapping data; measures the reservoir level & associated storage volumes.
108	122	TAS	No data available
597	597	TAS	Catchment area <20km^2
629	91168	TAS	Lake in catchment

792	321	TAS	No data available
805	97008	TAS	2yrs of pluvio data only
1012	P94153	TAS	<1yr overlapping data only
1061	1024	TAS	No pluvio data available
1435	283	TAS	No flow data available
1457	91186	TAS	No flow data available
2208	P92093	TAS	6 years overlapping data only
6202	94137	TAS	Data not received/available
227225	P85263	VIC	4 years overlapping data only
229652	586021	VIC	27% missing pluvio data
229658	502264A	VIC	37% missing flow data
225020A	585056	VIC	15% missing flow data; 25% missing pluvio data
226017A	585001	VIC	70% missing flow data
226218A	226218A	VIC	16 yrs overlapping data only; 12% missing pluvio data
226410A	P85263	VIC	4 years overlapping data only
228207A	228207A	VIC	No data available
228233A	P86244	VIC	Approx. 1 year pluvio only
229218A	586051	VIC	7 yrs overlapping data only
231218B	P87075	VIC	Only 17 years useable flow data
233214A	233801A	VIC	17 yrs overlapping data only
234209A	234209A	VIC	18 years overlapping data only
235204A	P90083	VIC	Catchment area <20km^2
235216B	233803A	VIC	15 yrs overlapping data only
601005	512250	WA	27% missing flow data
601006	512235	WA	Catchment area <20km^2
609001	509184	WA	56% missing flow data; 21% missing pluvio data
609006	510039	WA	Catchment area <20km^2
610003	509064	WA	Uncertain data
610006	509191	WA	27% missing pluvio data
610007	509354	WA	Catchment area <20km^2
610008	509355	WA	16% missing flow data
610028	509191	WA	7 yrs overlapping data only; 27% missing pluvio data
612003	509177	WA	74% missing flow data
612005	509111	WA	Catchment area <20km^2
612012	509202	WA	Catchment area <20km^2
612016	509321	WA	Catchment area <20km2
612019	509356	WA	19 years overlapping data only
613007	509115	WA	Catchment area <20km^2
613014	509369	WA	21% missing flow data
613018	509368	WA	28% missing flow data; 28% missing pluvio data
613146	509227	WA	Catchment area <20km^2
614028	509135	WA	Dirk Bk already used - 614005
614123	509082	WA	9 years overlapping data only
615011	510038	WA	16 yrs overlapping data only
616007	509154	WA	12 yrs overlapping data only
616009	509159	WA	16% missing flow data; 18% missing pluvio data

616010	509155	WA	16% missing flow data; 17% missing pluvio data
616023	509271	WA	Catchment area <20km2
616041	509269	WA	Difficulties with quality codes/streamflow
617165	509153	WA	17% missing flow data
803003	503006	WA	14% missing pluvio data
806003	501003	WA	11% missing pluvio data
410736	570999	ACT	
210068	P61238	NSW	
401571	P72060	NSW	
410114	410114	NSW	
AW503502	AW503504	SA	
AW504525	AW504563	SA	
232210A	232223A	VIC	
602003	510601	WA	
602005	509353	WA	
603005	509453	WA	
603013	509439	WA	
606002	509413	WA	
609004	509259	WA	
609008	509259	WA	
615017	510048	WA	
616012	509157	WA	

Appendix B Catchment maps



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
- Waterbody
- Built-Up Areas

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[GDA94 | MGA55]

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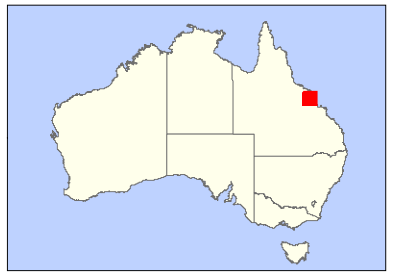
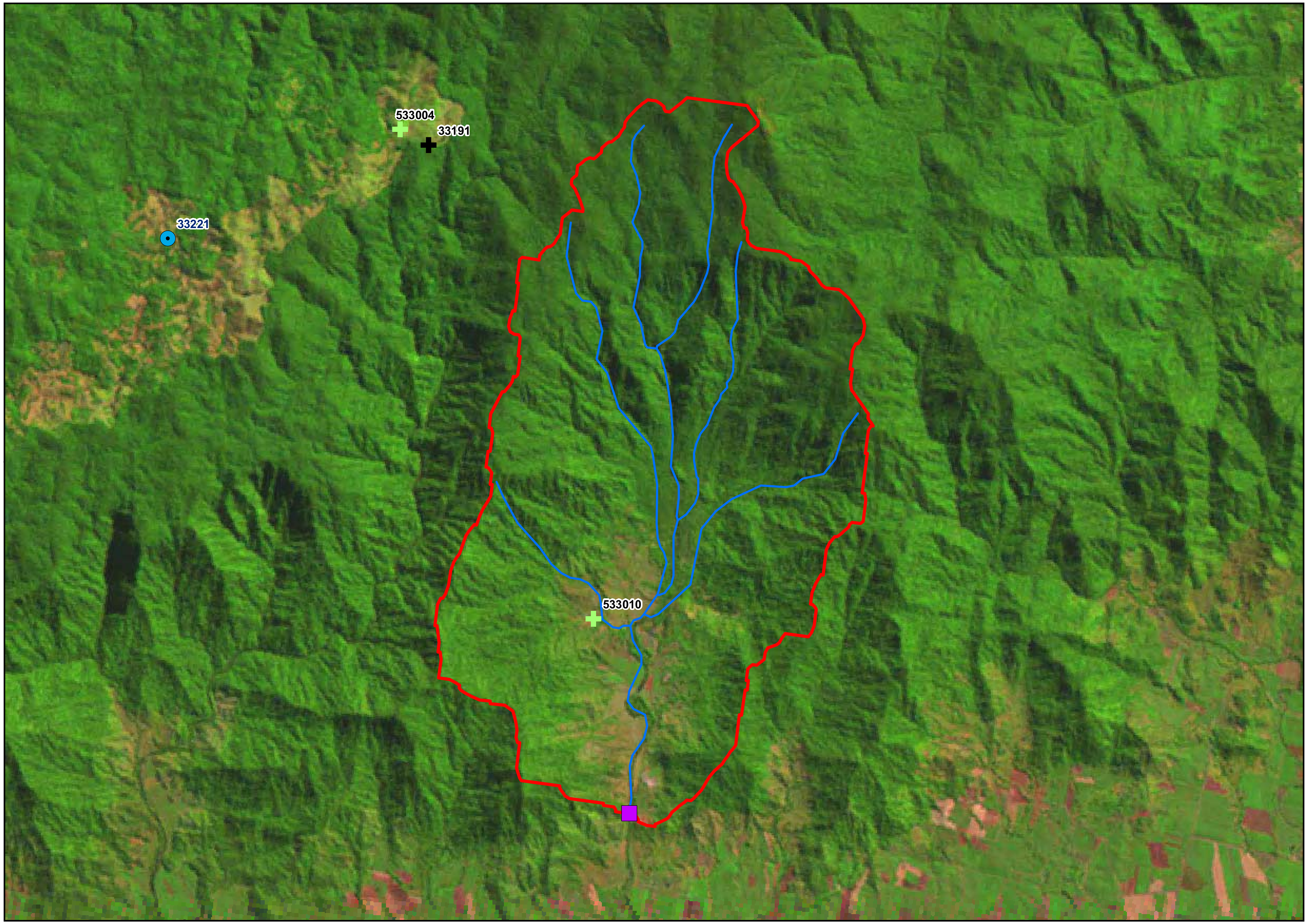


120216A; Broken River @ Old Racecourse



Legend

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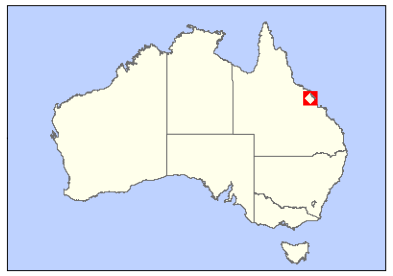
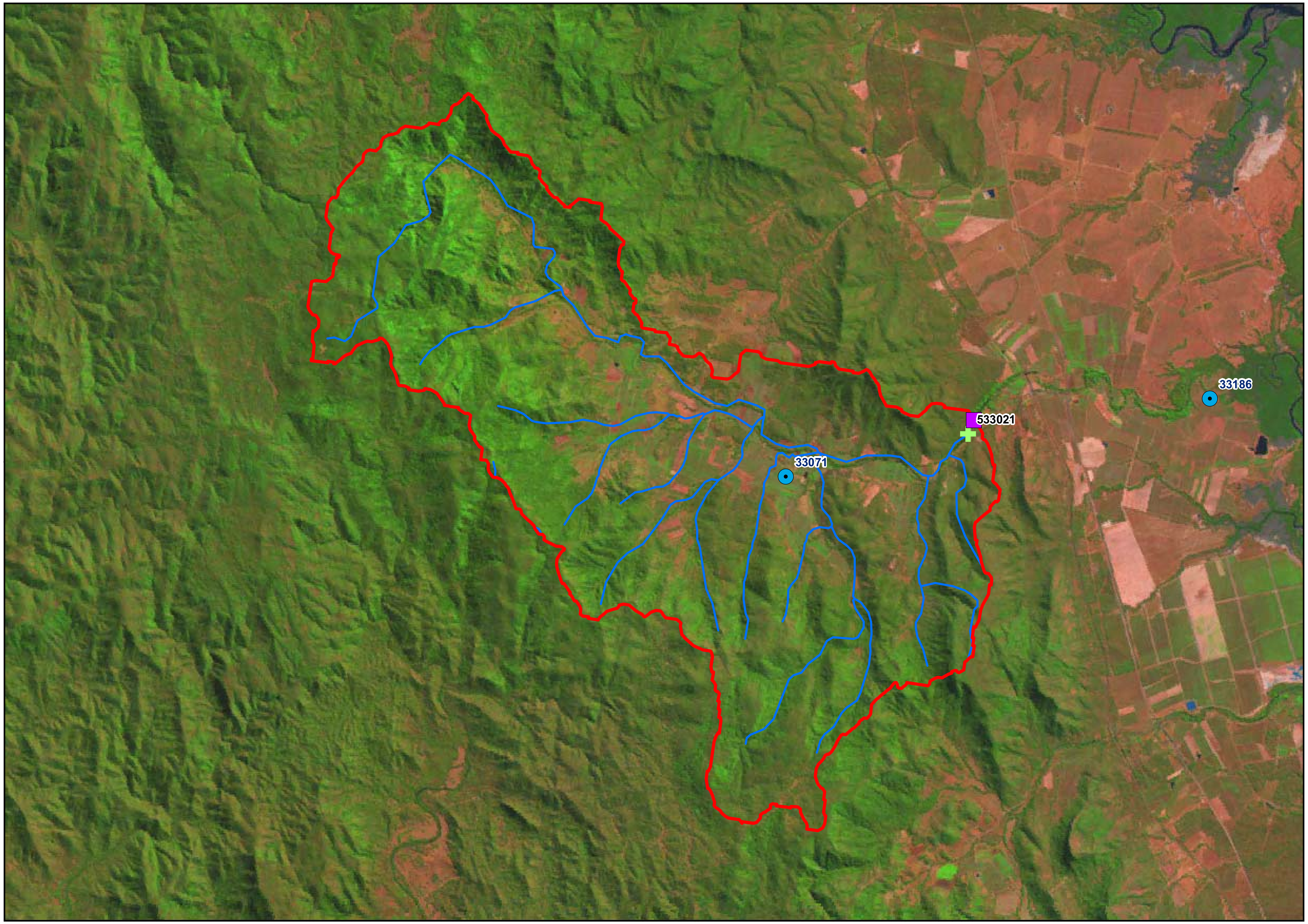


125006; Finch Hatton Creek @ Finch Hatton Creek



Legend

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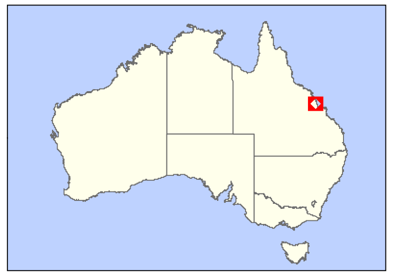
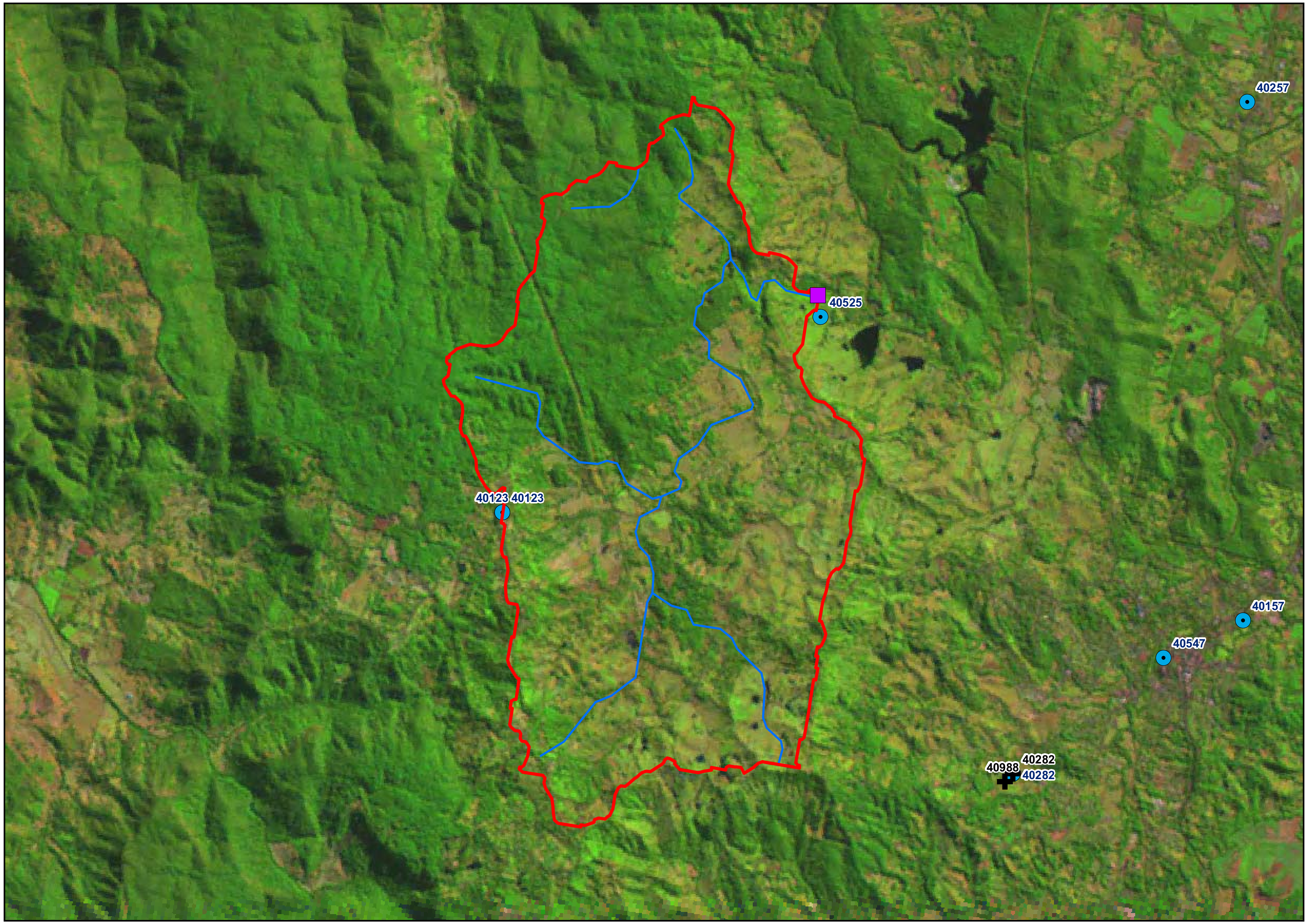


126003A; Carmila Creek @ Carmila

SKM



Legend

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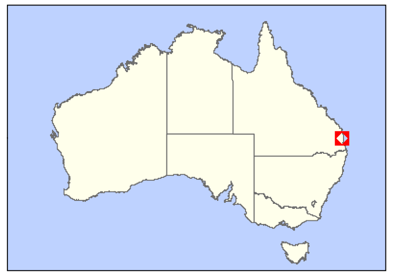
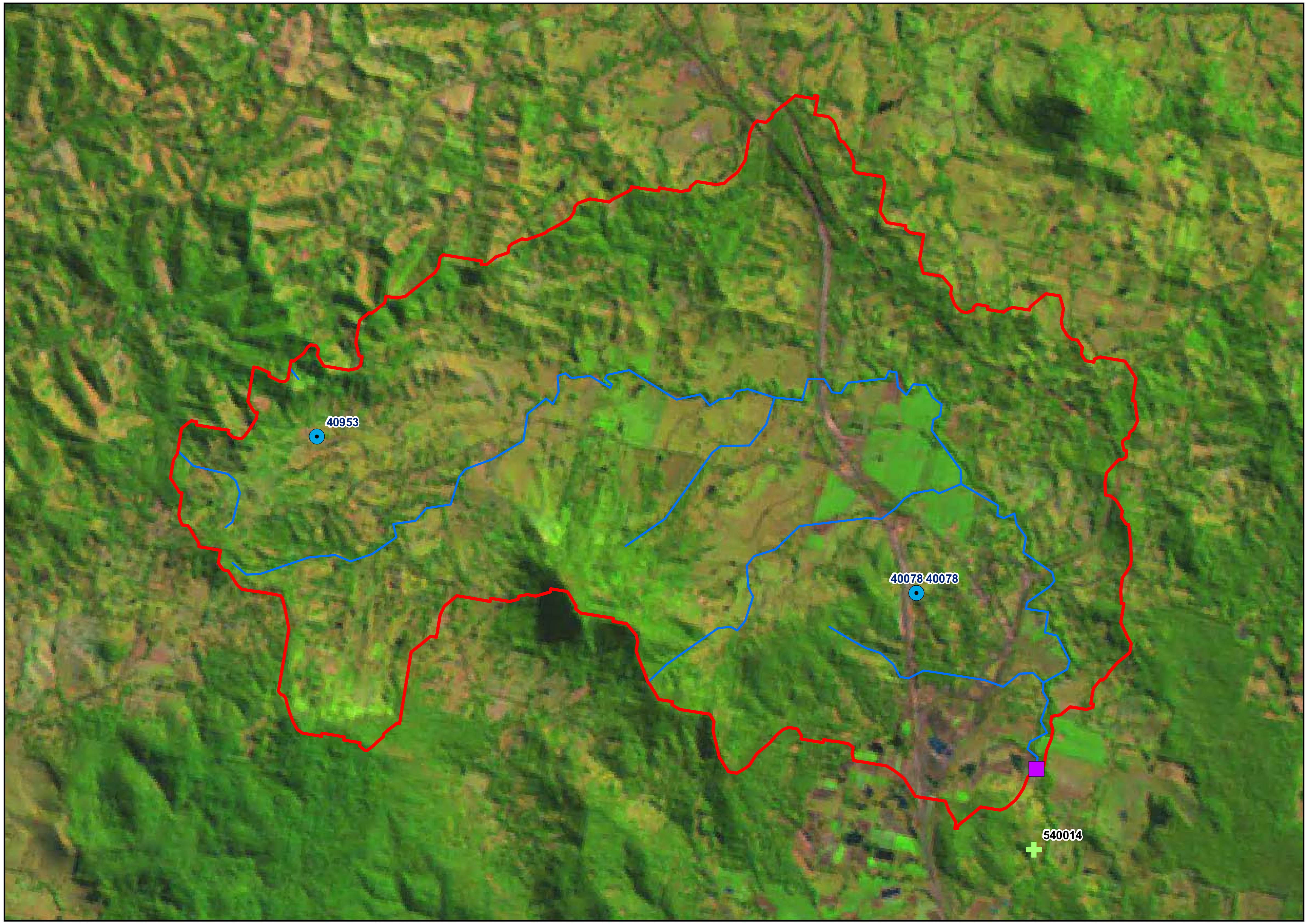


141001B; South Maroochy River @ Kiamba

SKM



Legend

Gauge Location
Catchment Boundary
Rainfall Gauge
Pluviograph Stations
Bureau of Meteorology
Other Sources
Watercourse
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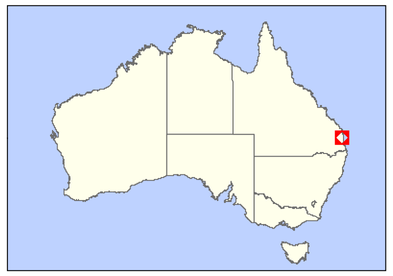
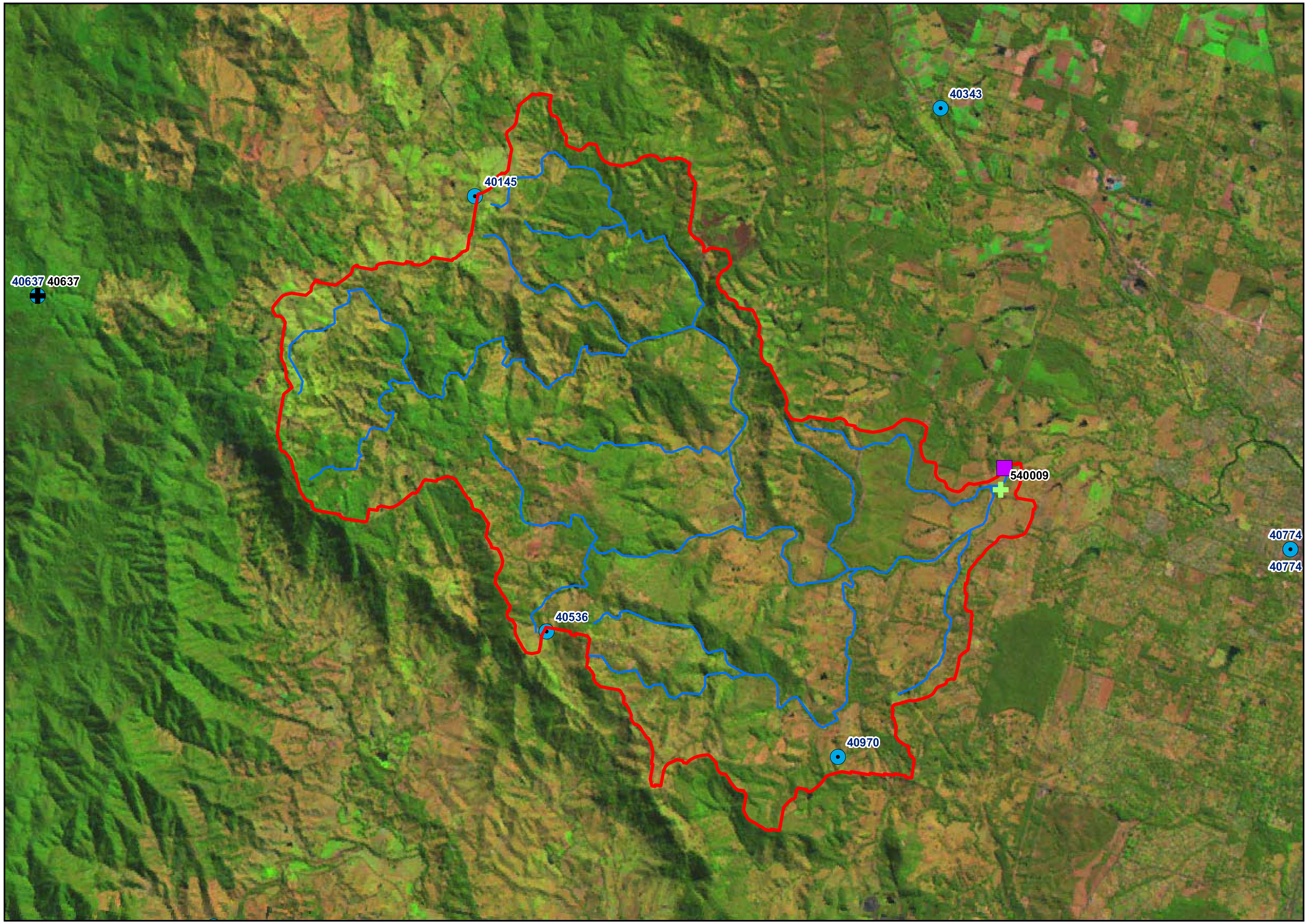


141009; N. Maroohy River @ Eumundi



Legend

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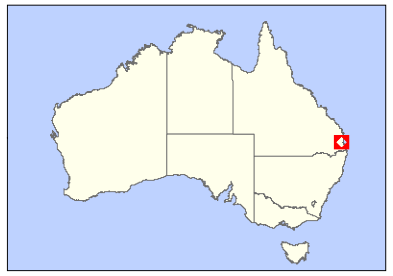
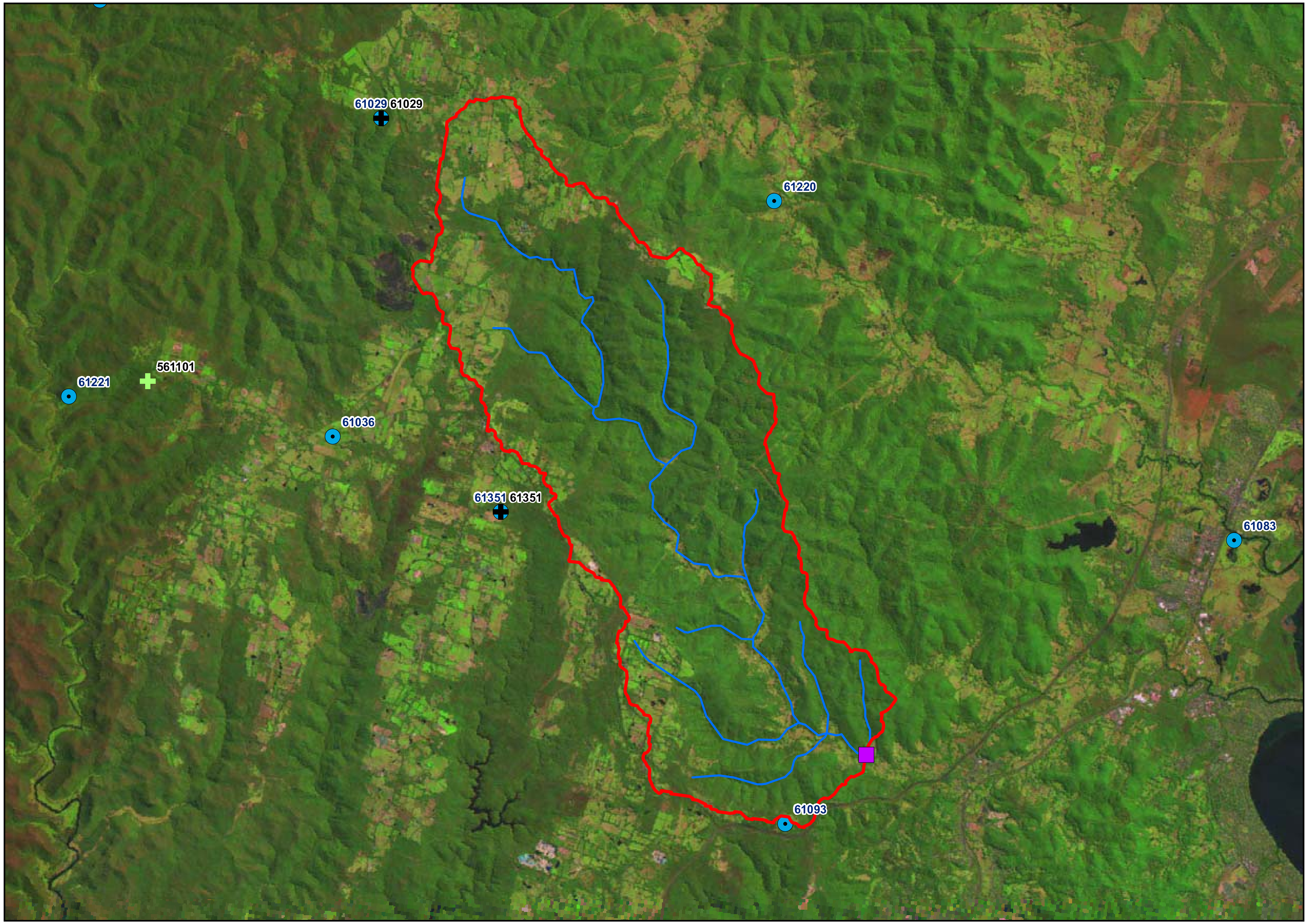


142001A; Caboolture River @ Upper Caboolture



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[GDA94 | MGA55]

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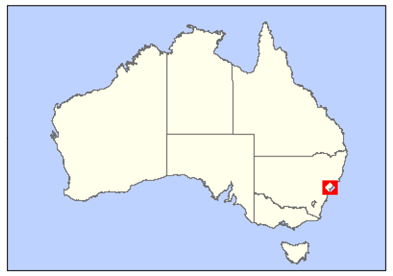
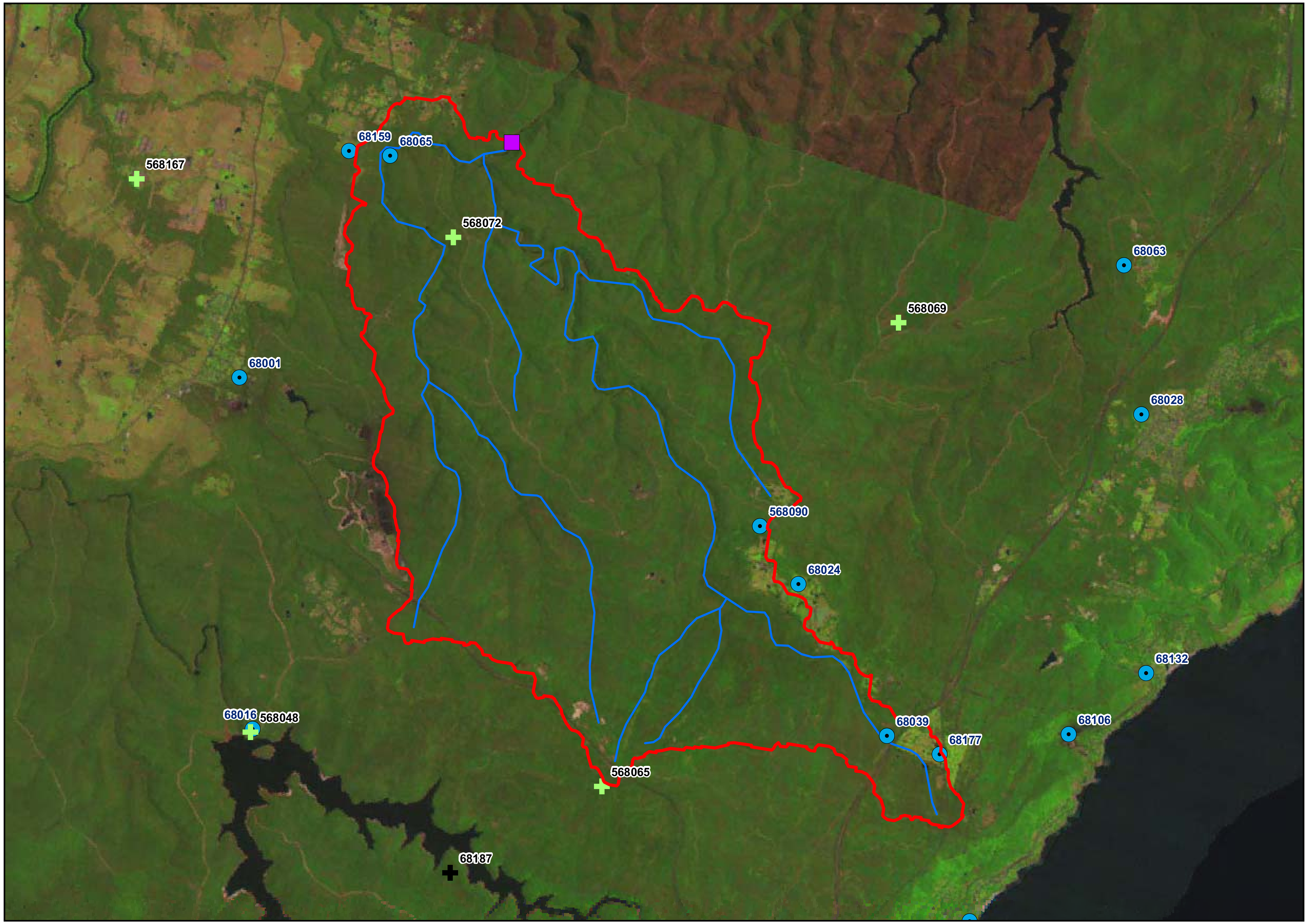


211013; Ourimbah Creek @ U/S Weir



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[GDA94 | MGA55]

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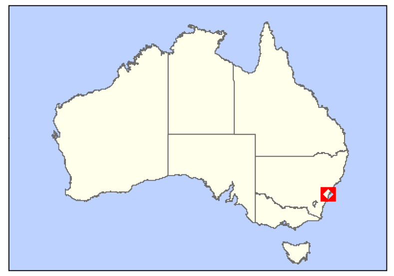
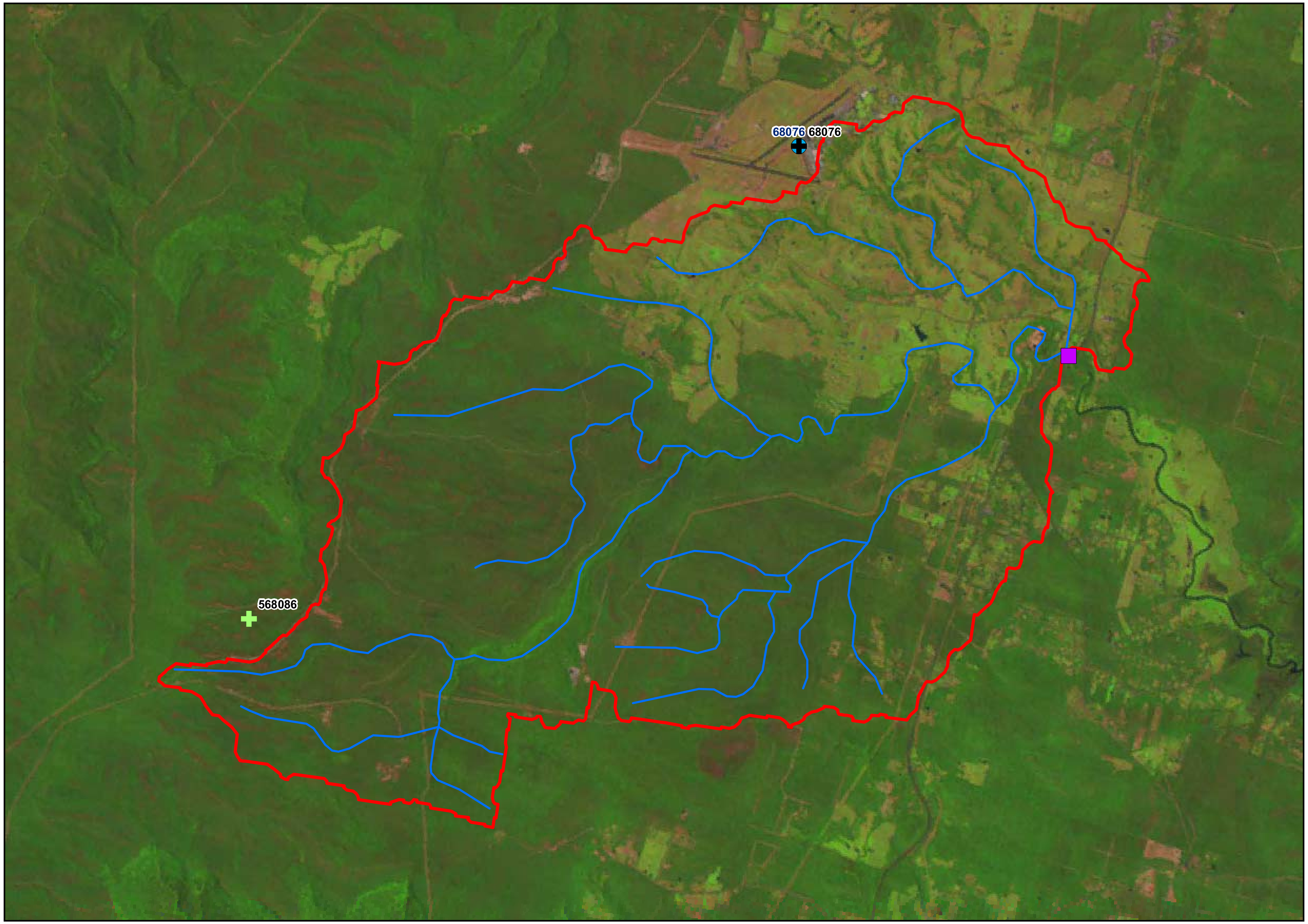


213200; O'Hares Creek @ Wedderburn



Legend

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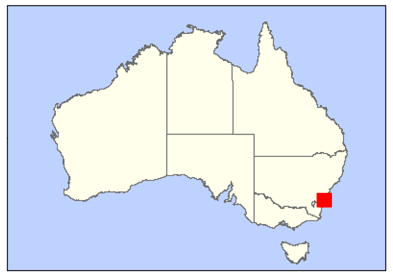
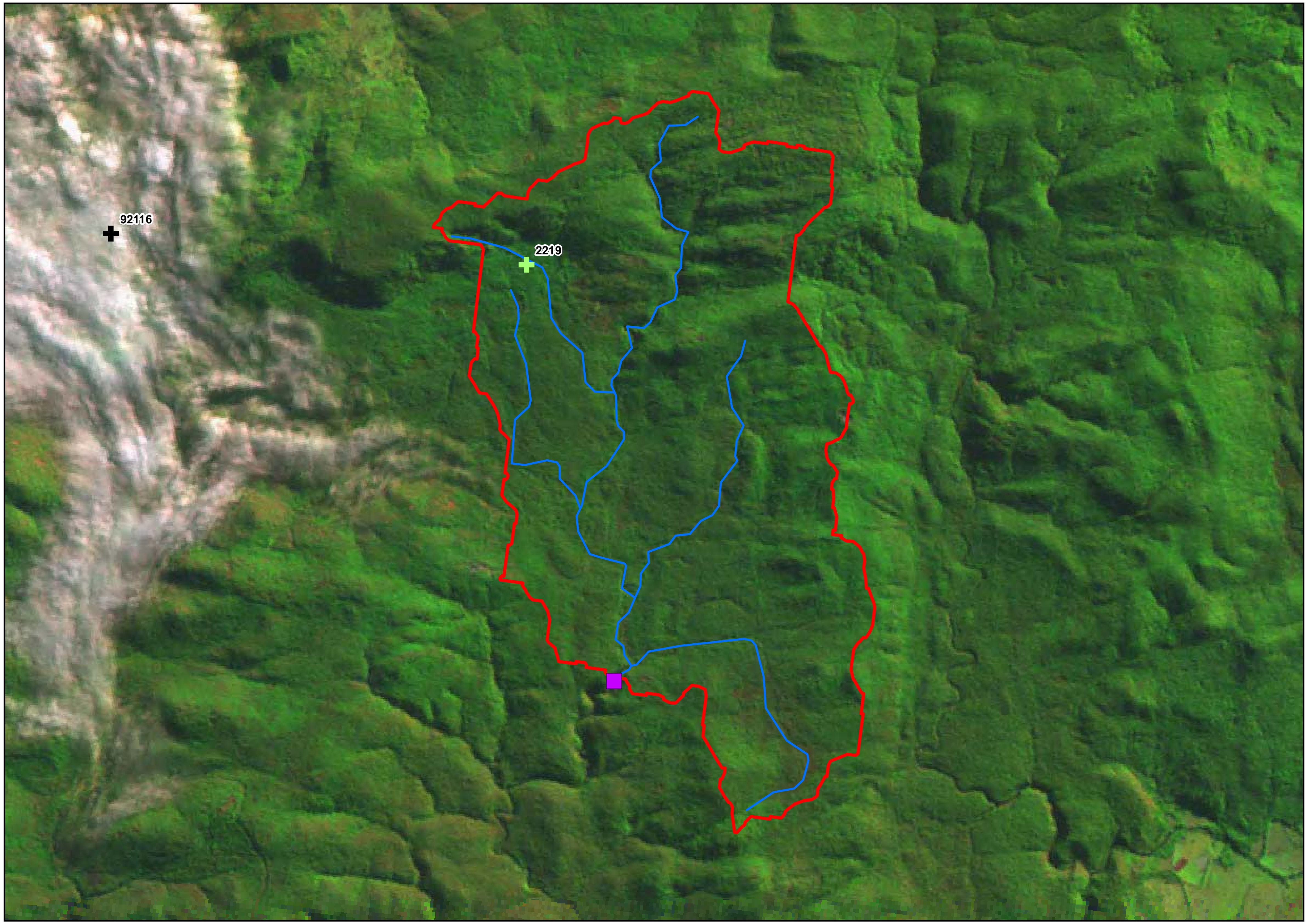


216004; Currambene Creek @ Falls Ck

SKM



Legend

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[GDA94 | MGA55]

0 1,080
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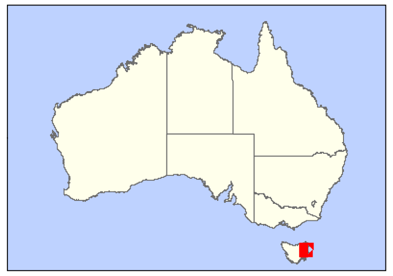
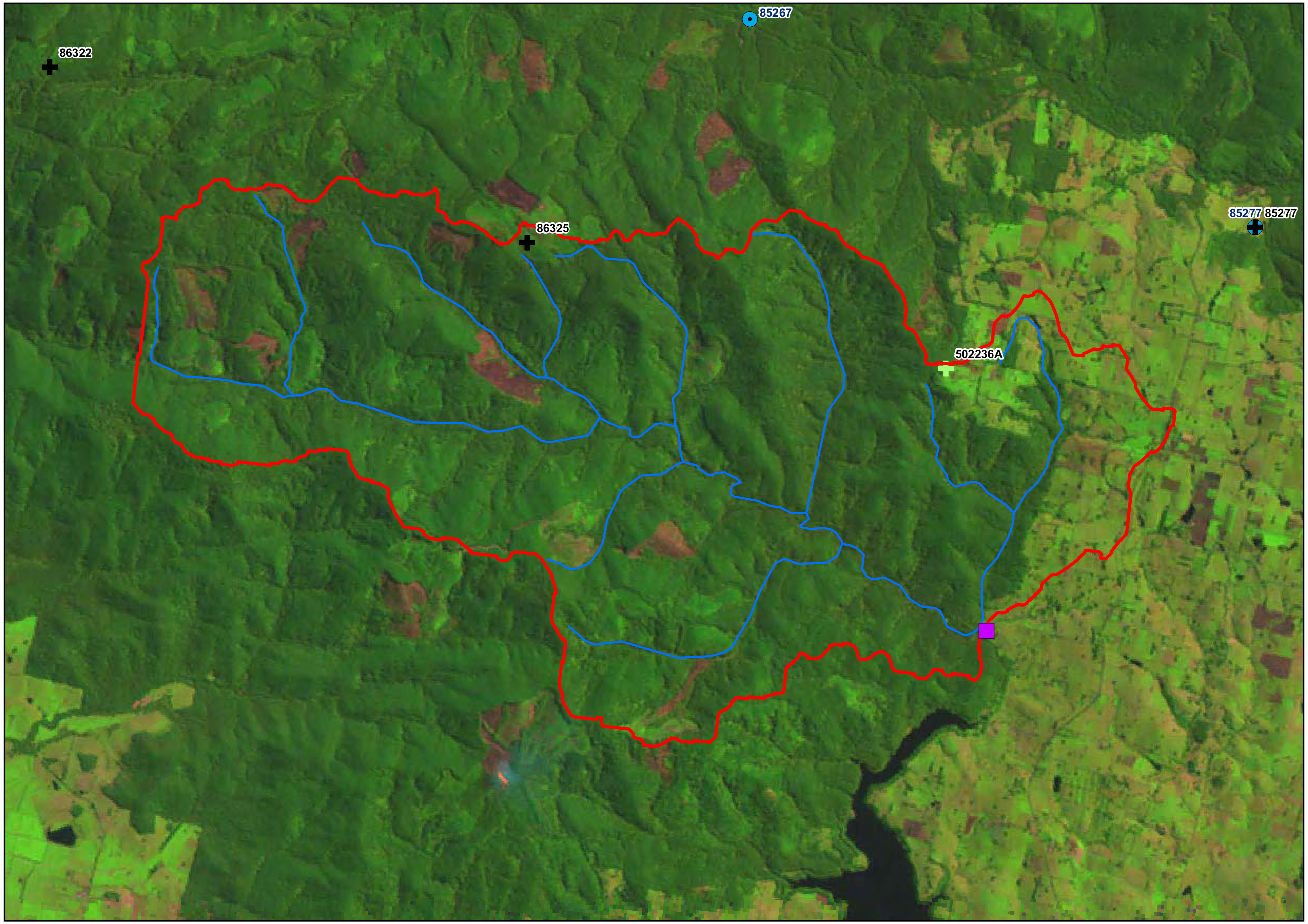


2219; Swan River u/s Hardings Falls



Legend

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[GDA94 | MGA55]

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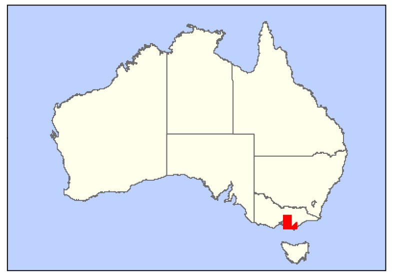
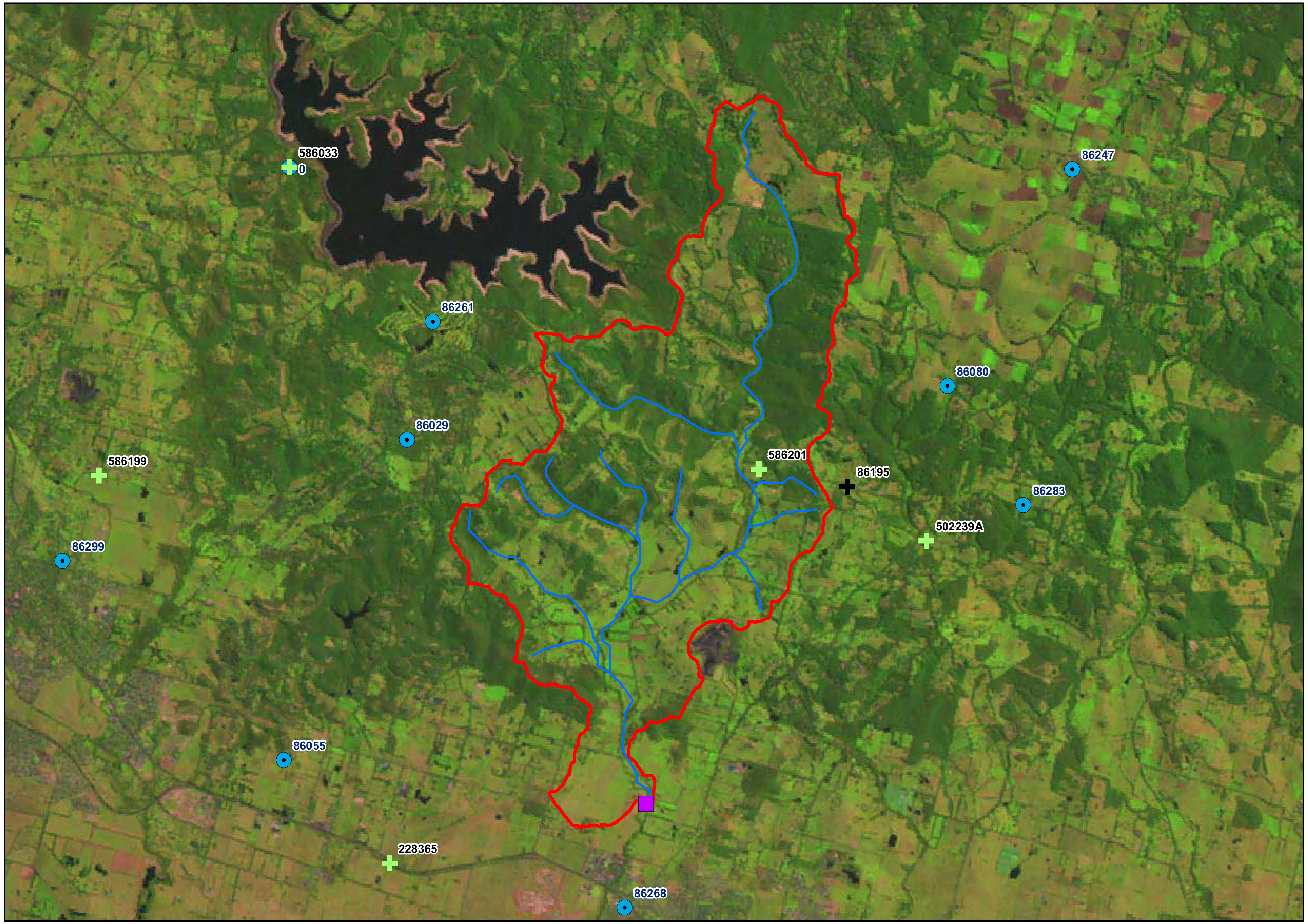


228206B; Tarago River @ Neerim



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[GDA94 | MGA55]

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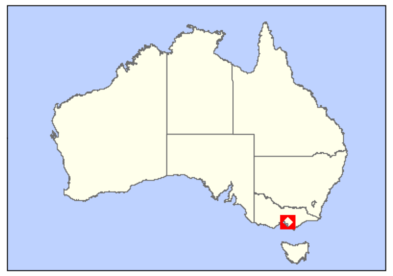
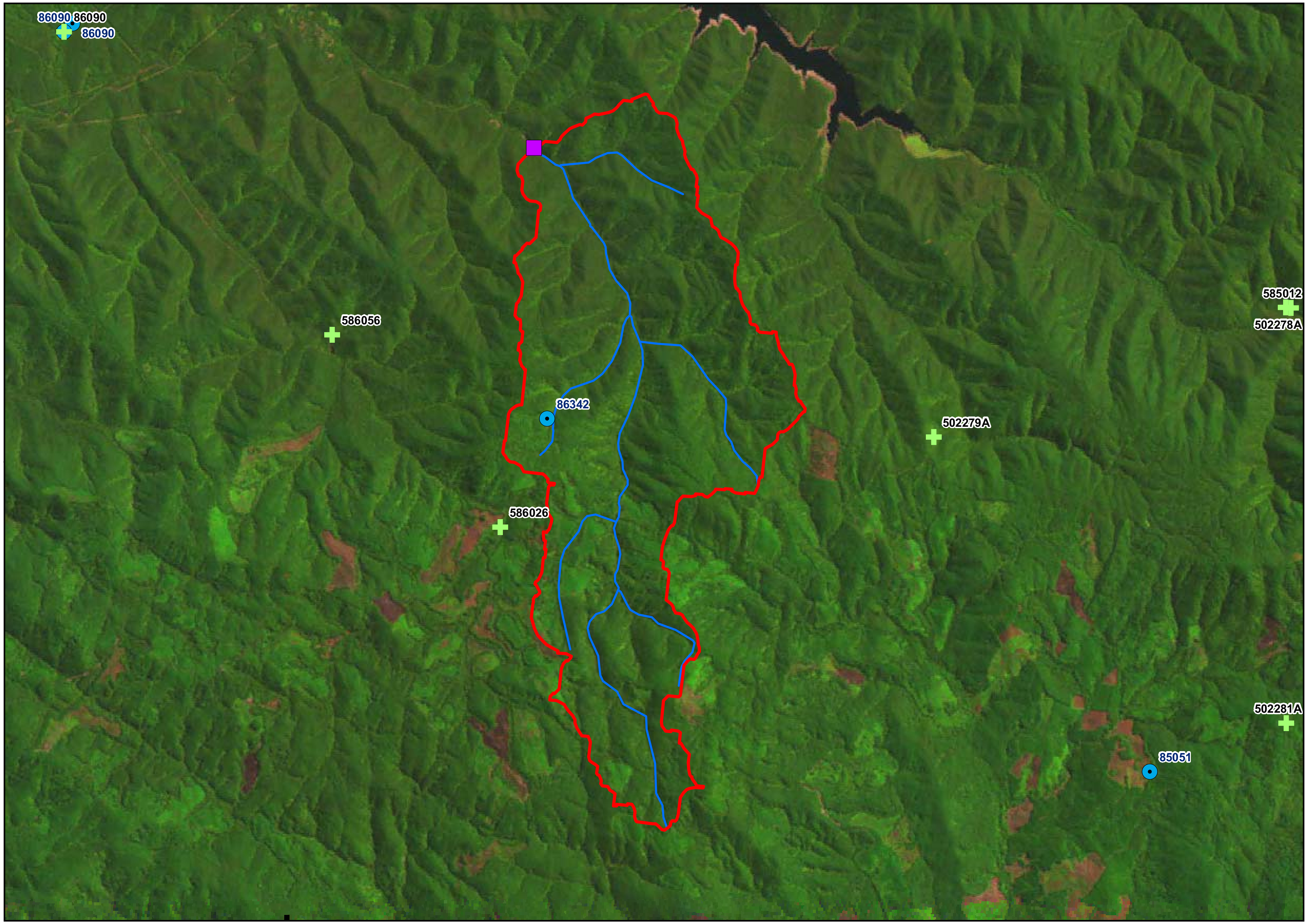


228217; Toomuc Creek @ Pakenham



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[GDA94 | MGA55]

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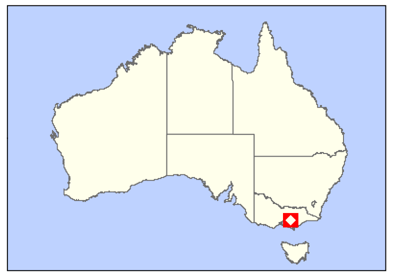
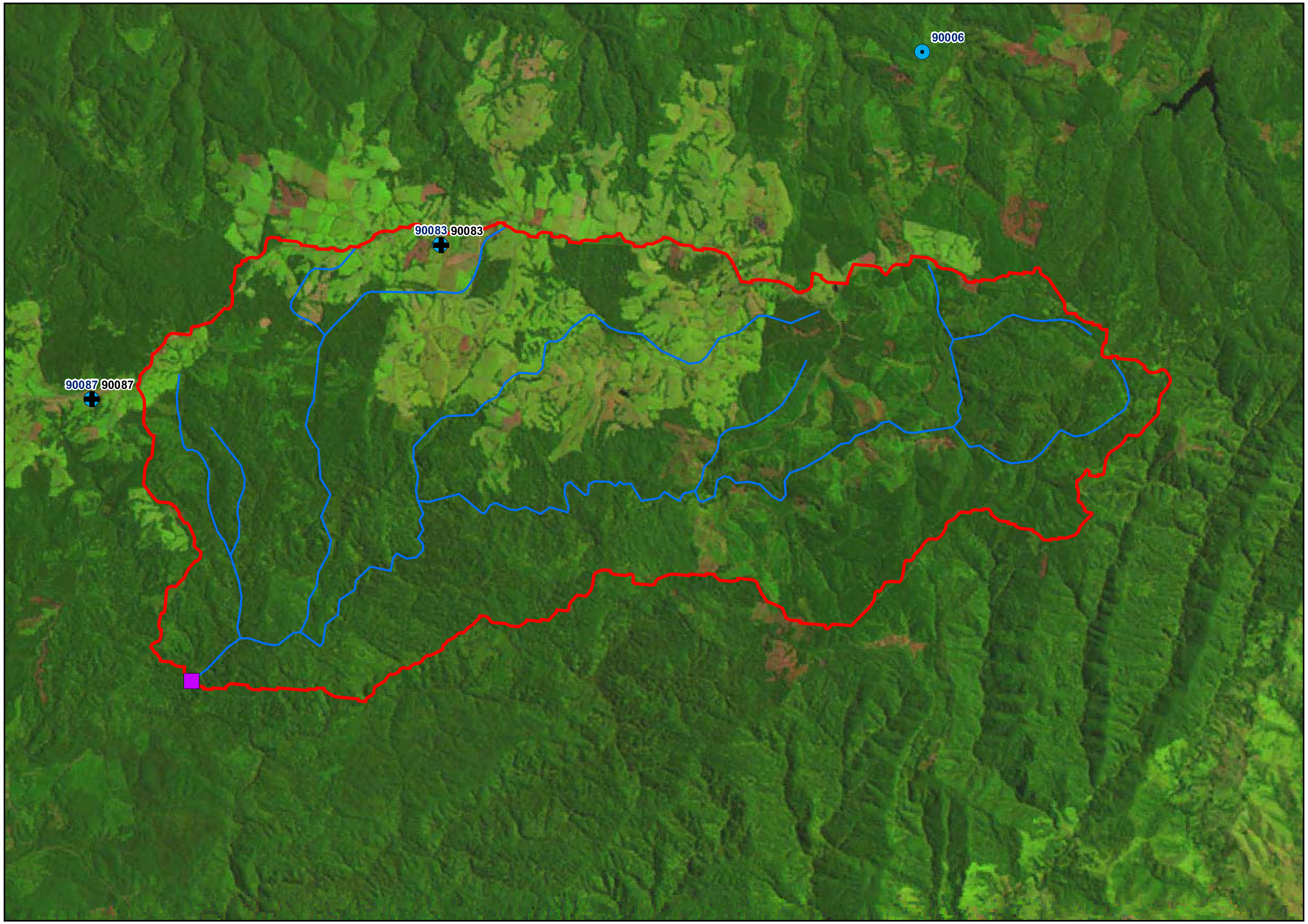


229106; McMahons Creek @ Upstreams Weir

SKM



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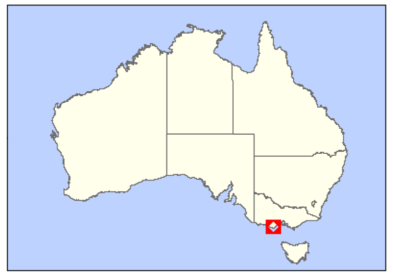
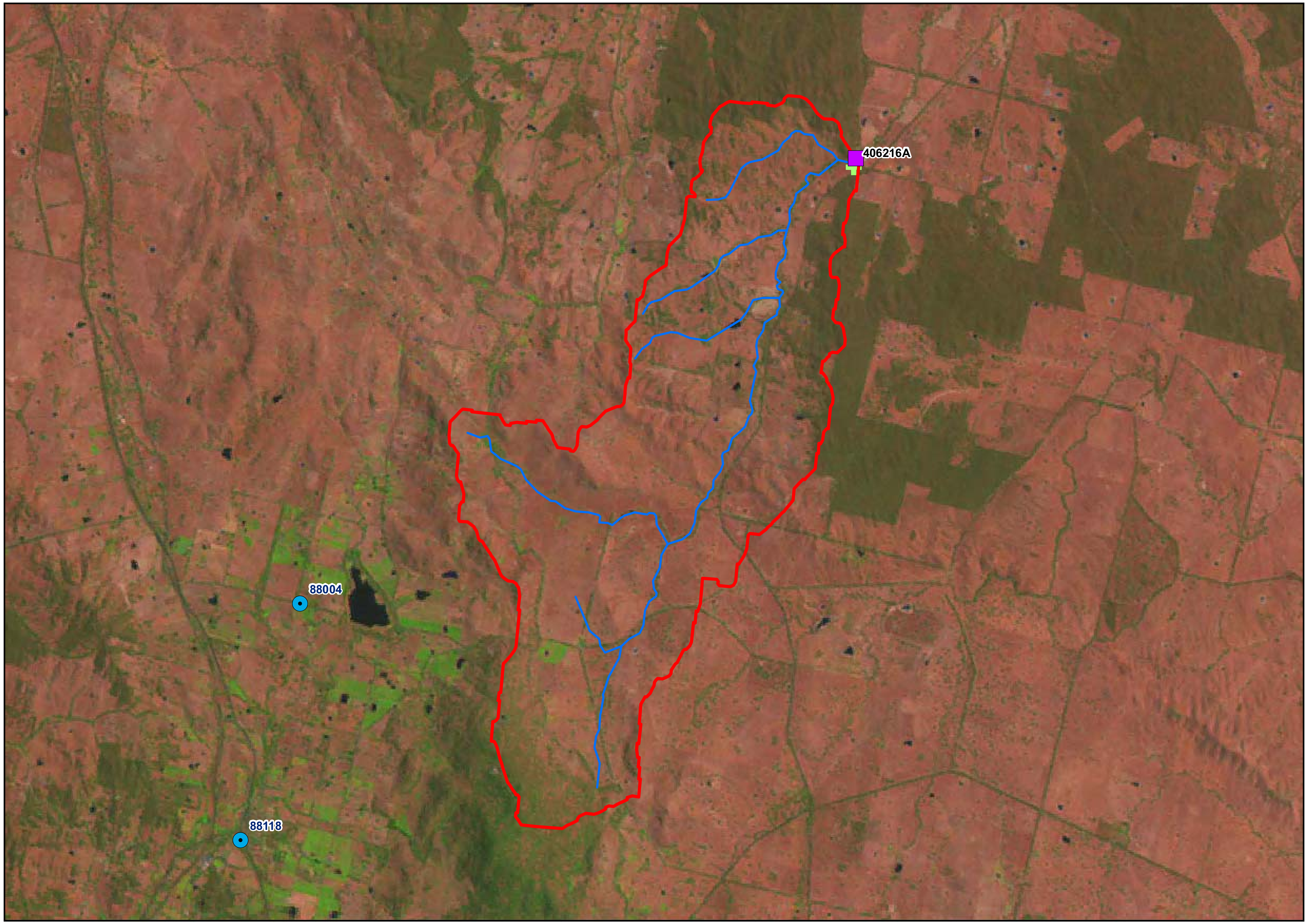
[GDA94 | MGA55]

0 1,300
Meters



235219A; Aire @ Wyelangta



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
- Waterbody
- Built-Up Areas

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[GDA94 | MGA55]

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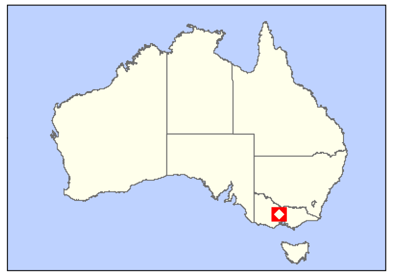
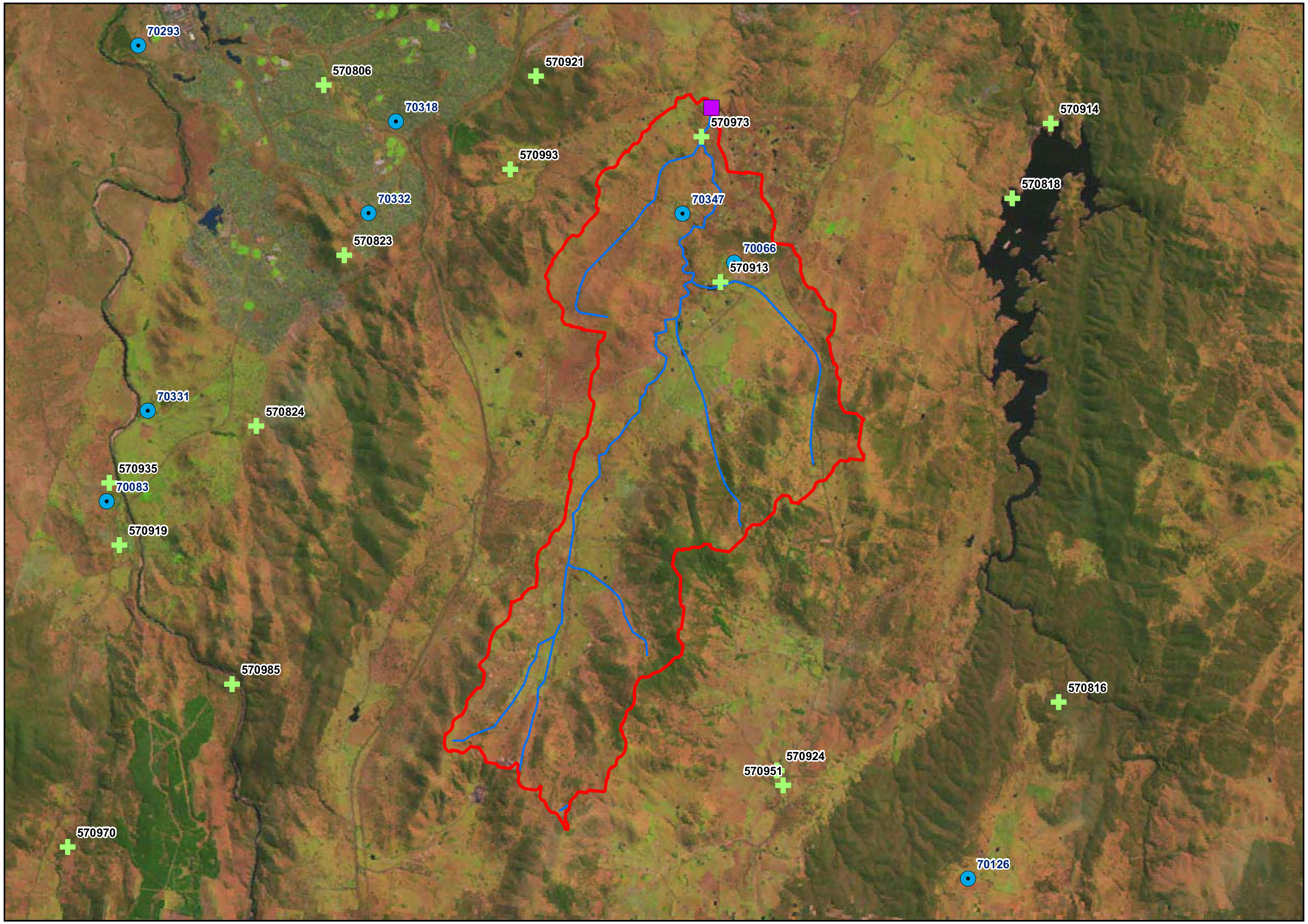


406216A; Axe Creek @ Sedgewick



Legend

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[GDA94 | MGA55]

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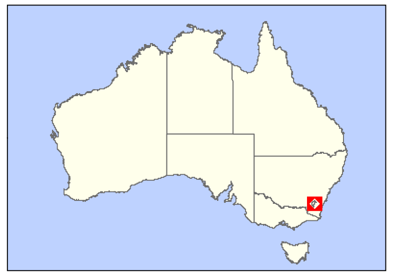
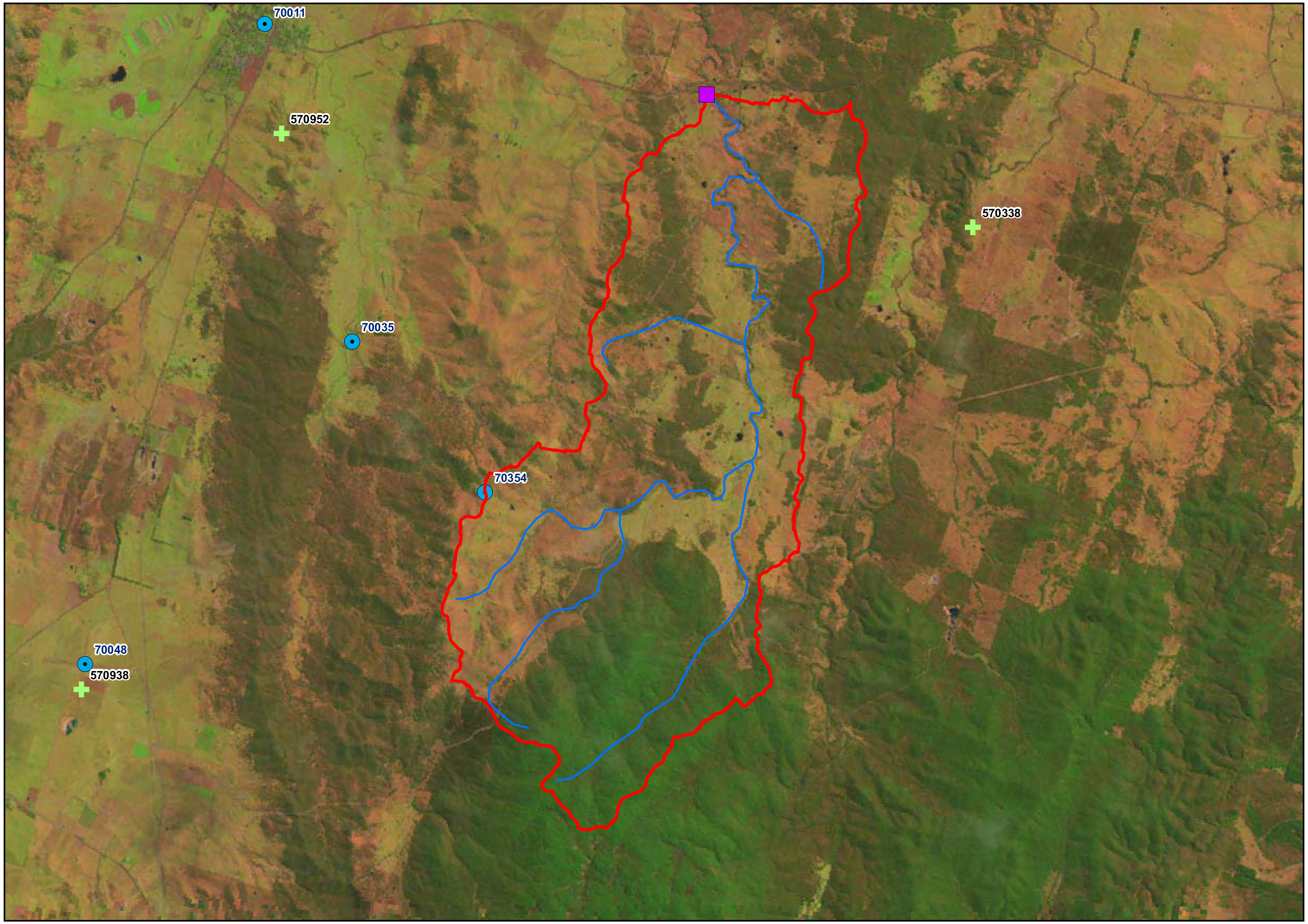


410743; Jerrabomberra Creek @ Four Mile Creek



Legend

Gauge Location
Catchment Boundary
Rainfall Gauge
Pluviograph Stations
Bureau of Meteorology
Other Sources
Watercourse
Waterbody
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[GDA94 | MGA55]

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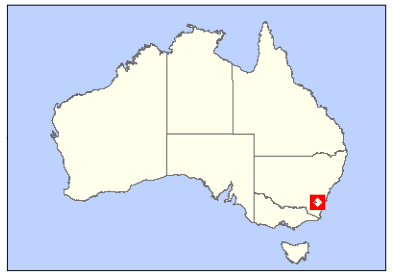
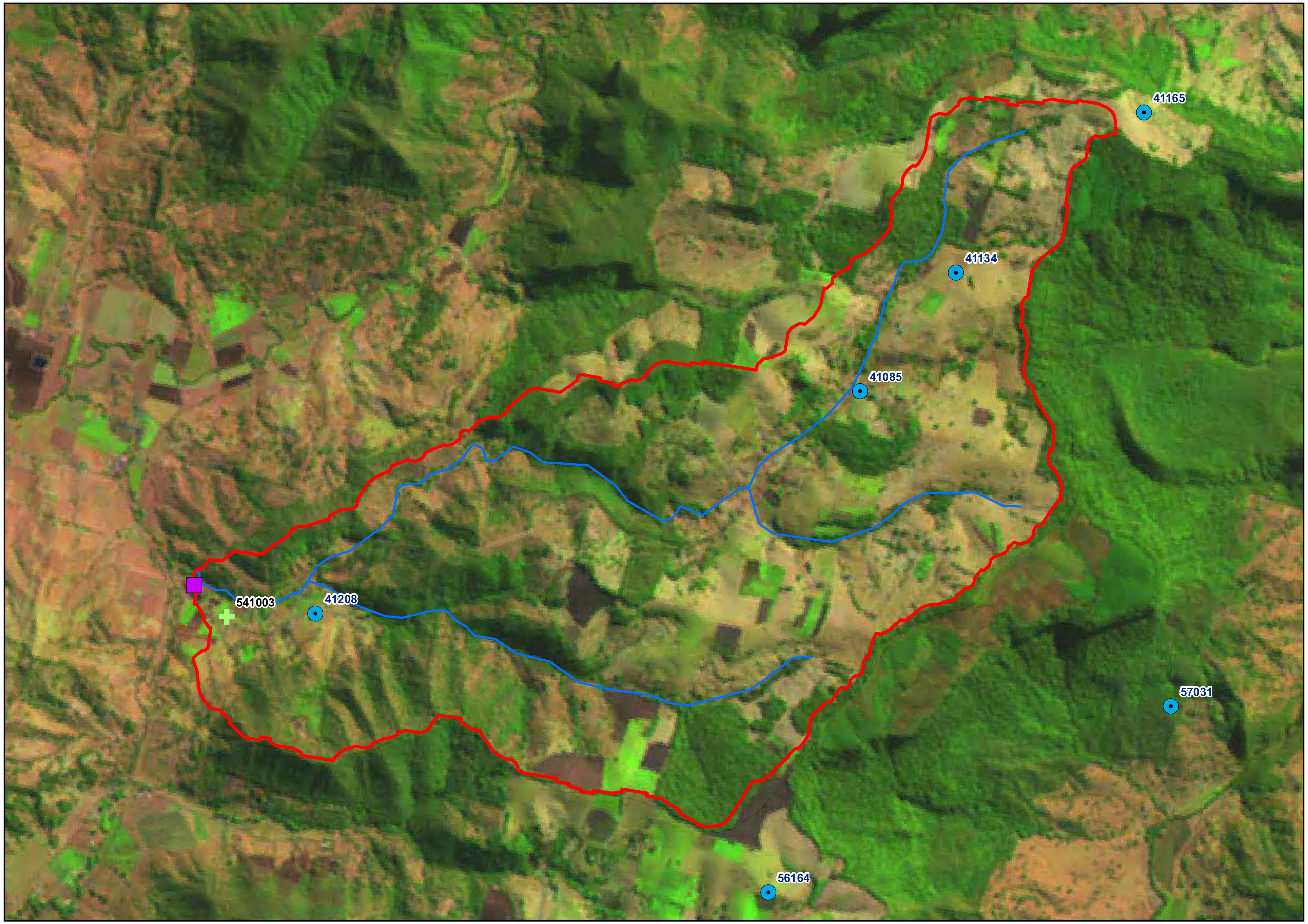


411003; Butmaroo Creek @ Butmaroo



Legend

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Pluviograph Stations

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[GDA94 | MGA55]

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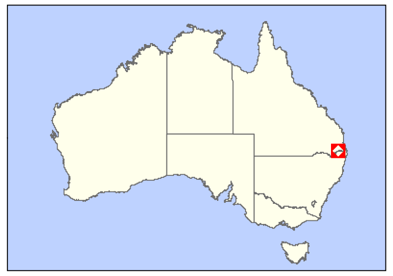

422321; Spring Creek @ Killarney

Legend

Gauge Location

Catchment Boundary

Rainfall Gauge

Pluviograph Stations

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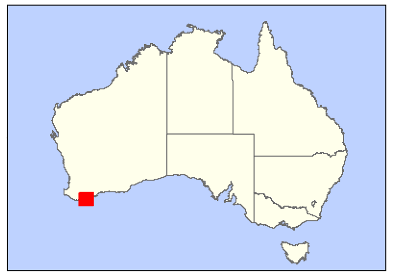
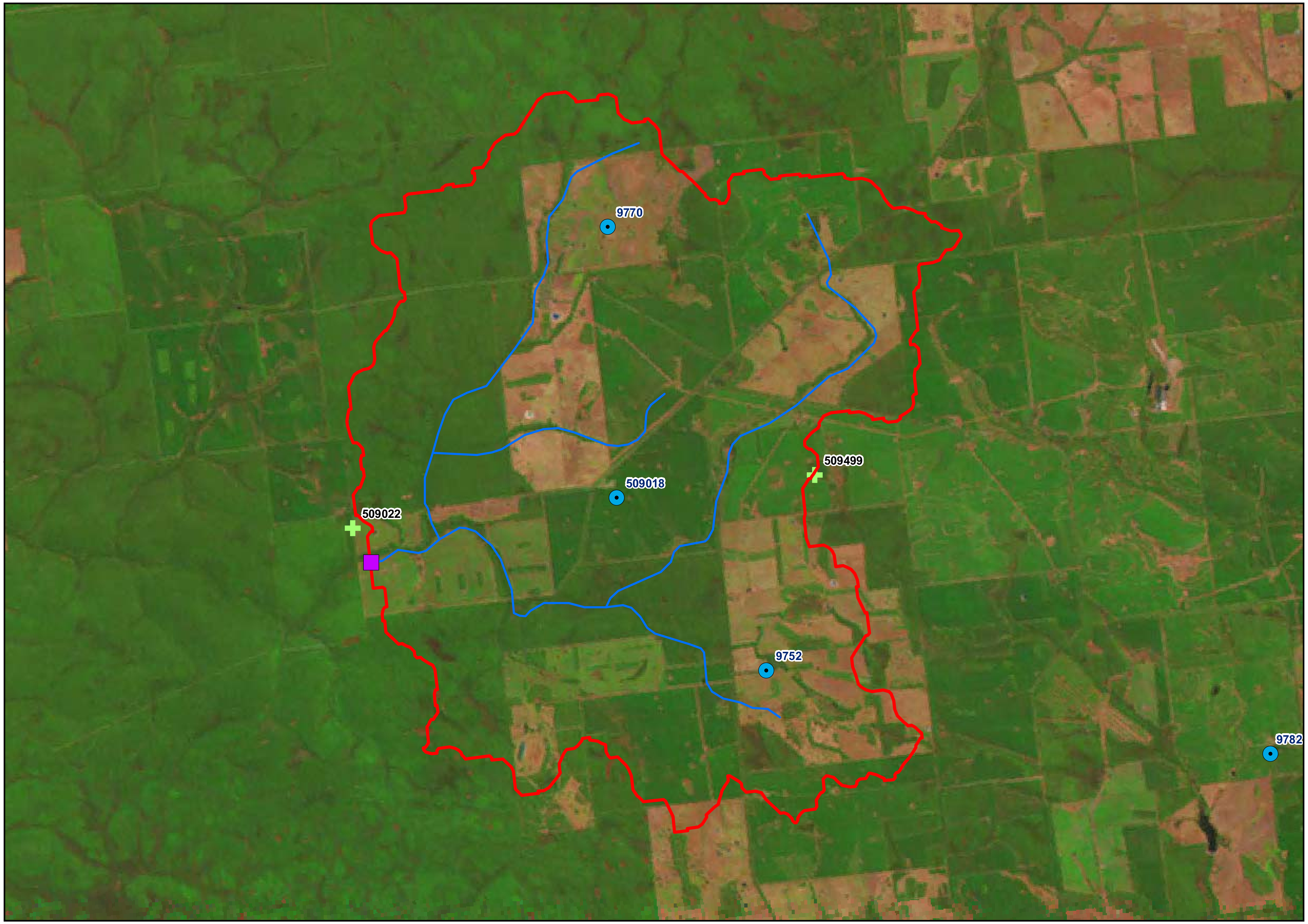
[GDA94 | MGA55]

0 1,040
Meters



602199; Goodga River @ Black Cat

October 22, 2013 | II:\VWES\Projects\VW07245\Technical\Spatial\ArcGIS\VW07245_FinalCatchmentMaps_v2.mxd
Prepared by : SI
Checked by : ZG



Legend

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[GDA94 | MGA55]

0 1,100
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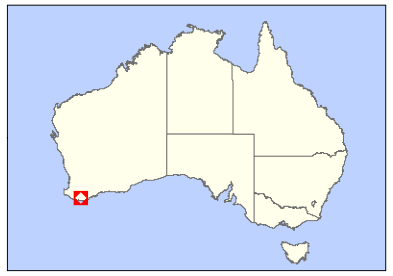

603190; Yates Flat Creek @ Yates Flat Creek

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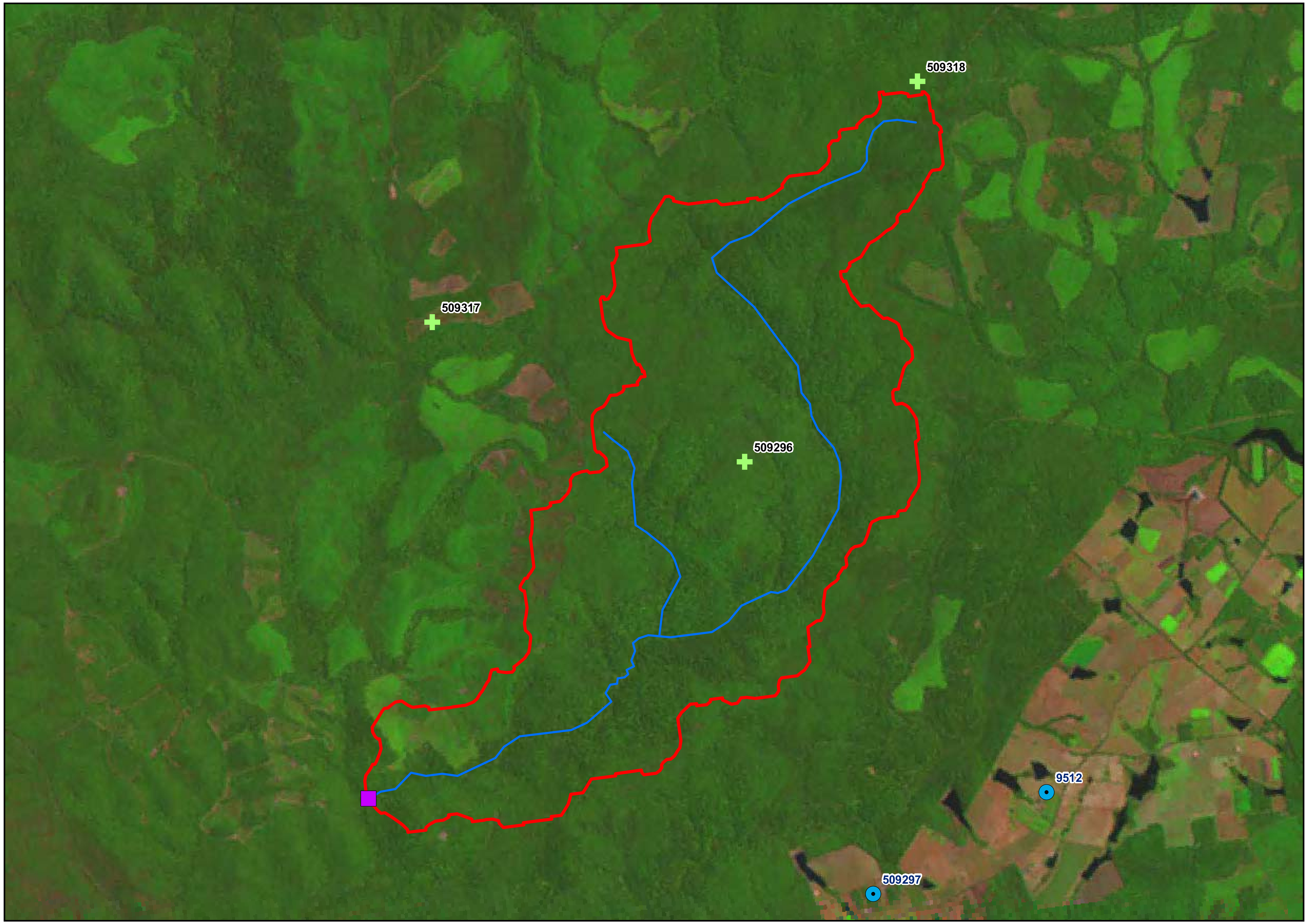
Prepared by : SI
Checked by : ZG



Legend

Gauge Location
Catchment Boundary
Rainfall Gauge

Pluviograph Stations

Bureau of Meteorology
Other Sources
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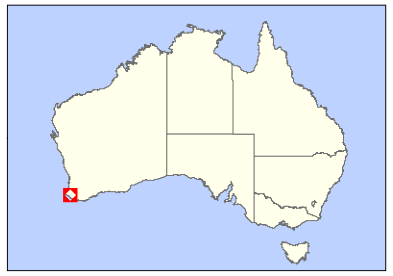
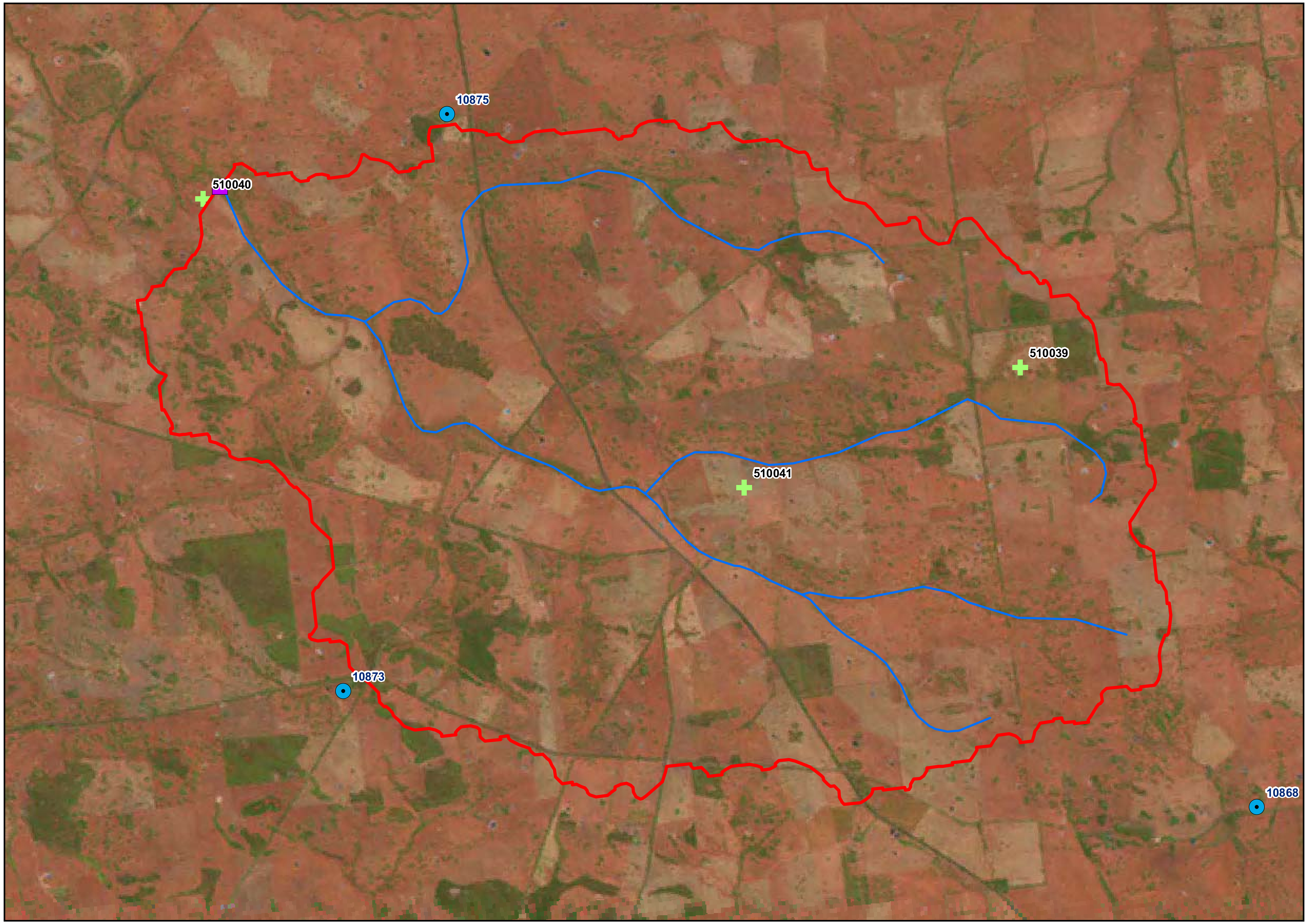
[GDA94 | MGA55]

0 1,000
Meters



608002; Carey Brook @ Staircase Rd



Legend

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Pluviograph Stations

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[GDA94 | MGA55]

0 1,000
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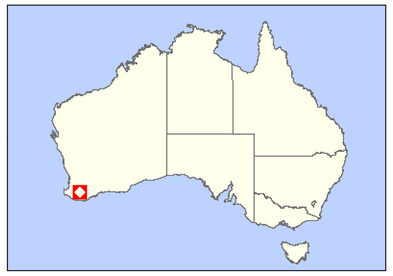

609005; Balgarup River @ Mandelup Pool

Legend

Gauge Location
Catchment Boundary
Rainfall Gauge

Pluviograph Stations

Bureau of Meteorology
Other Sources
Watercourse
Waterbody
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[GDA94 | MGA55]

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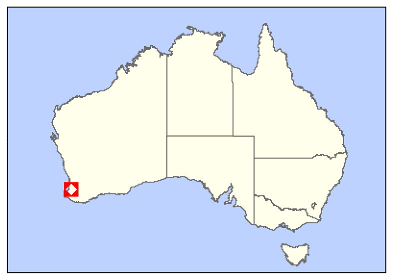

612004; Hamilton River @ Worsley

Legend

Gauge Location
Catchment Boundary
Rainfall Gauge

Pluviograph Stations

Bureau of Meteorology
Other Sources
Watercourse
Waterbody
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[GDA94 | MGA55]

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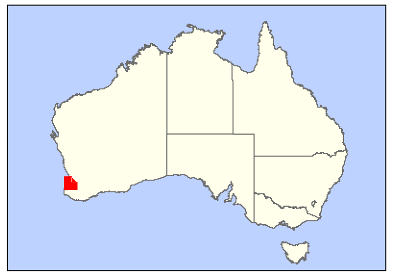
Meters



614003; Marrinup Brook @ Brookdale Siding

Legend

- Gauge Location
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Pluviograph Stations

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[GDA94 | MGA55]

0 760
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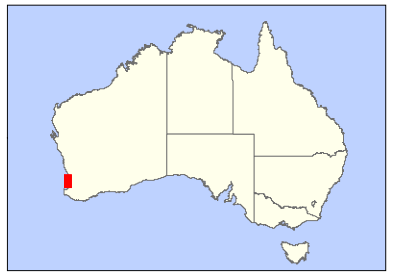

614005; Dirk Brook @ Kentish Farm

October 22, 2013 | II:\VWES\Projects\VW07245\Technical\Spatial\ArcGIS\VW07245_FinalCatchmentMaps_v2.mxd
Prepared by : SI
Checked by : ZG

Legend

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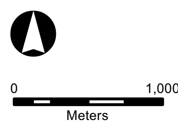
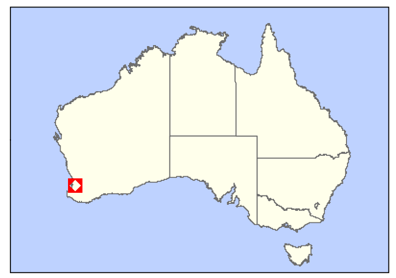
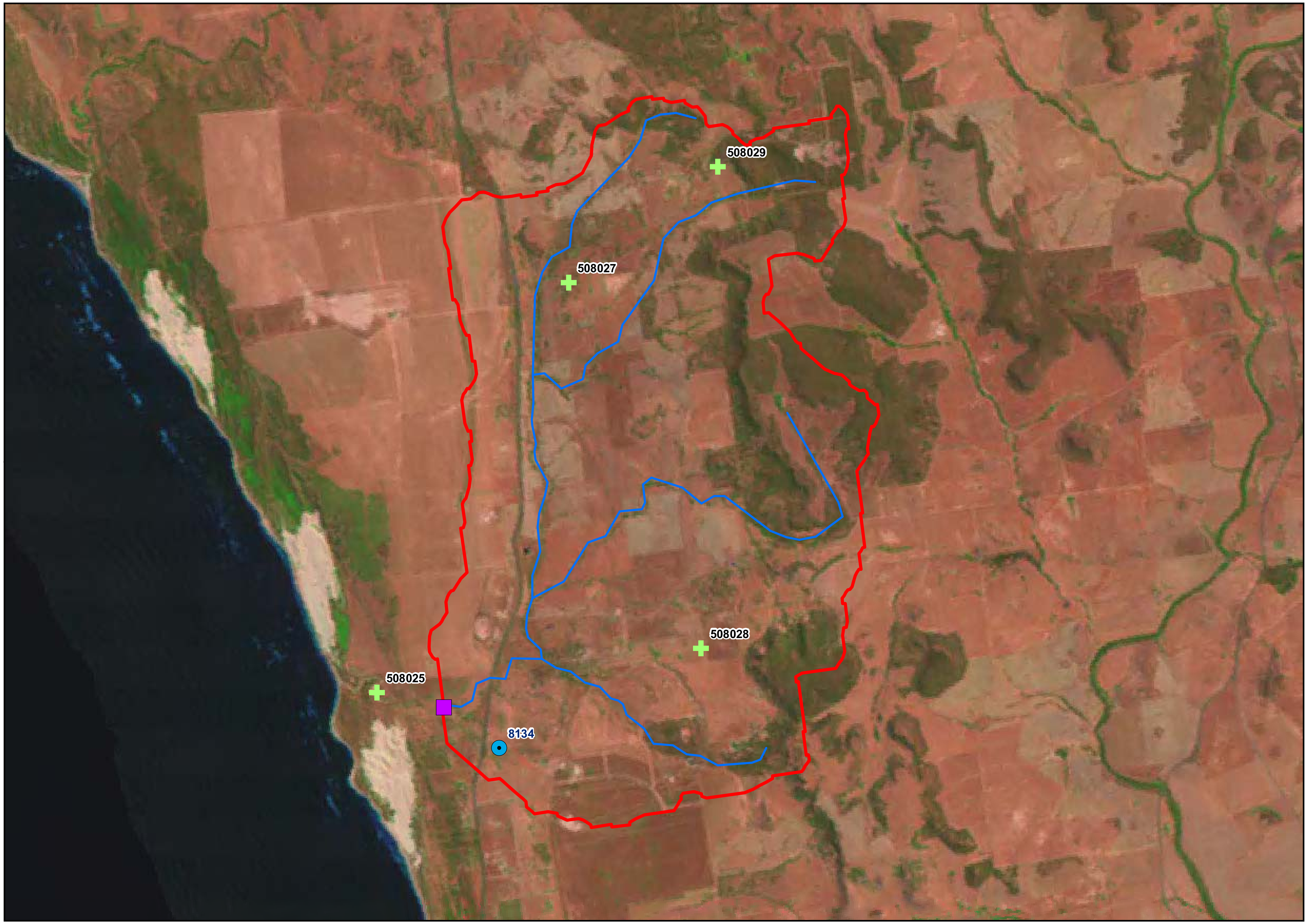




614047; Davis Brook @ Murray Valley Plntn



Legend

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[GDA94 | MGA55]

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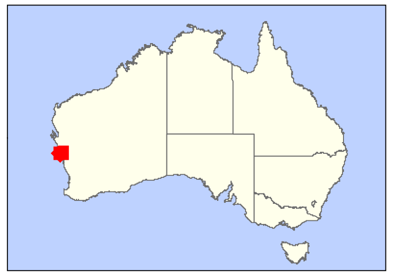
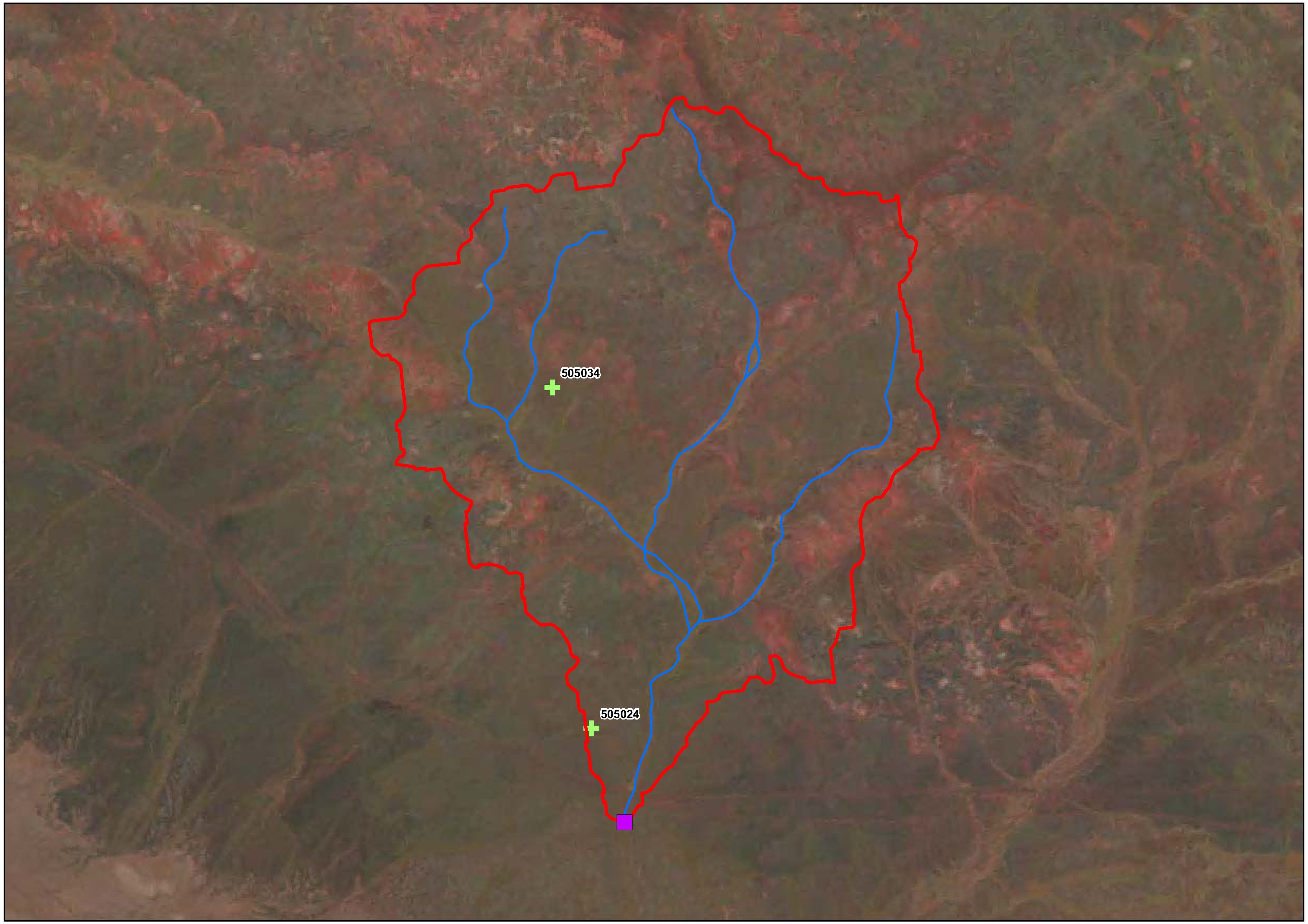


701006; Buller River @ Buller

October 22, 2013 | II:\VWES\Projects\VW07245\Technical\Spatial\ArcGIS\VW07245_FinalCatchmentMaps_v2.mxd
Prepared by : SI
Checked by : ZG



Legend

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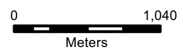
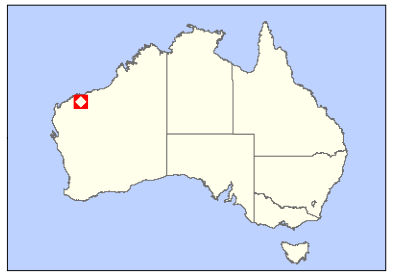
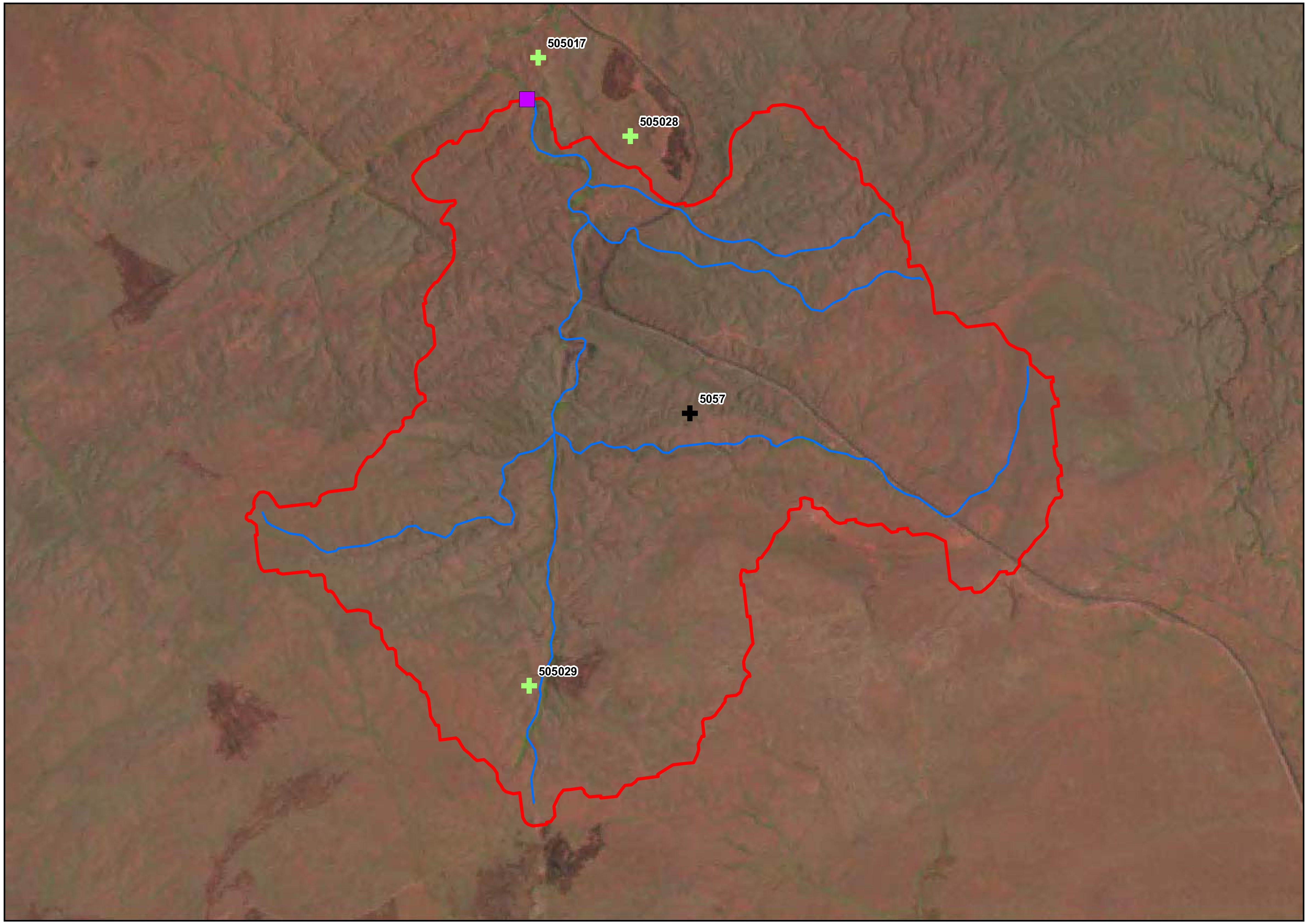




708009; Kanjenjie Creek Trib. @ Fish Pool



Legend

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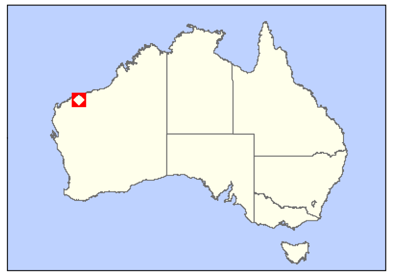
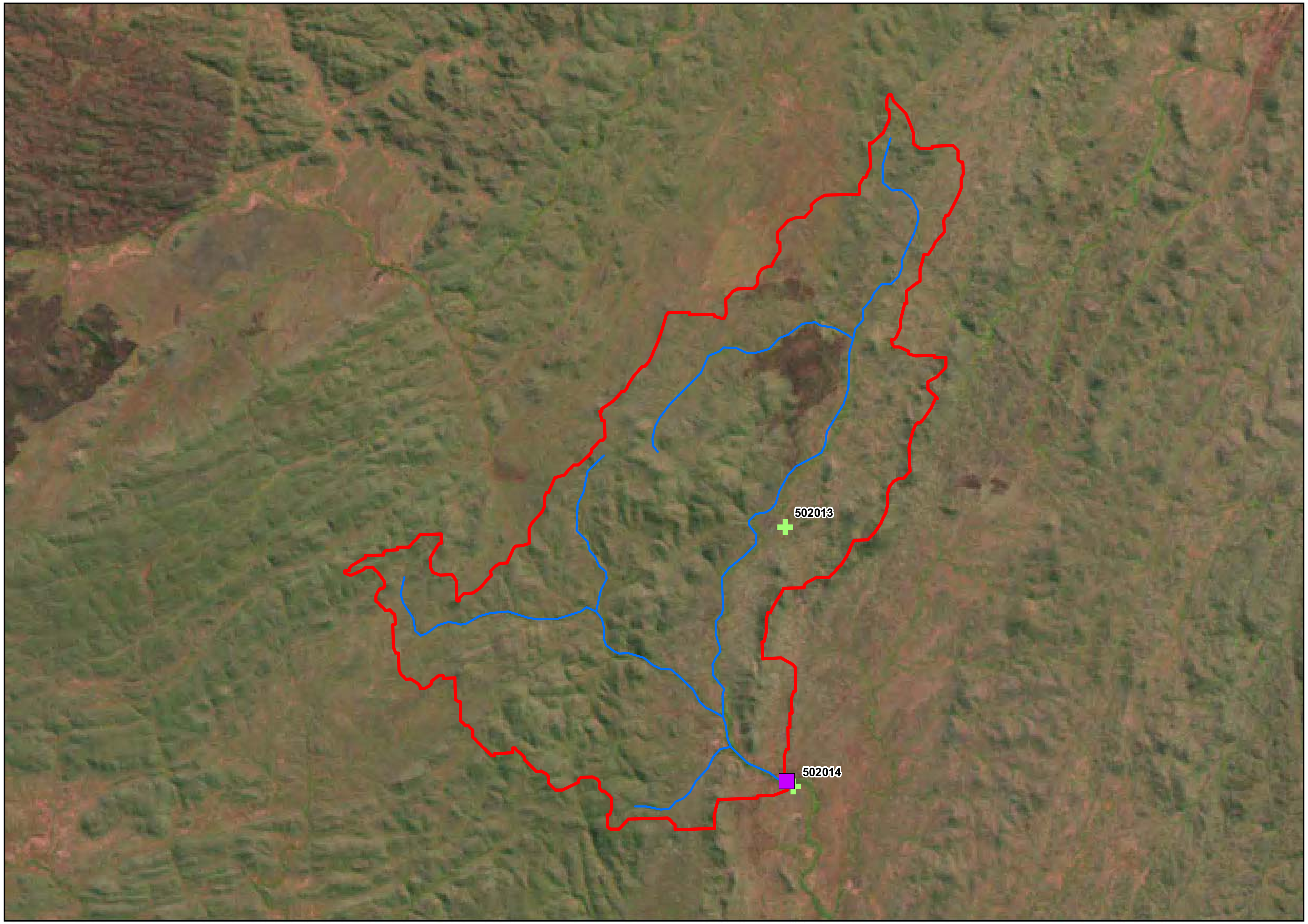
[GDA94 | MGA55]

0 1,000
Meters



709007; Harding River @ Marmurrina Pool U-South



Legend

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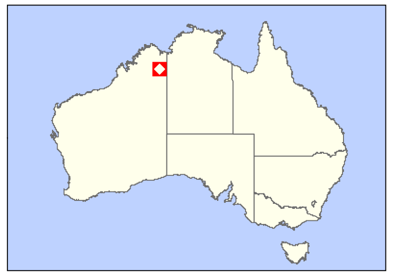
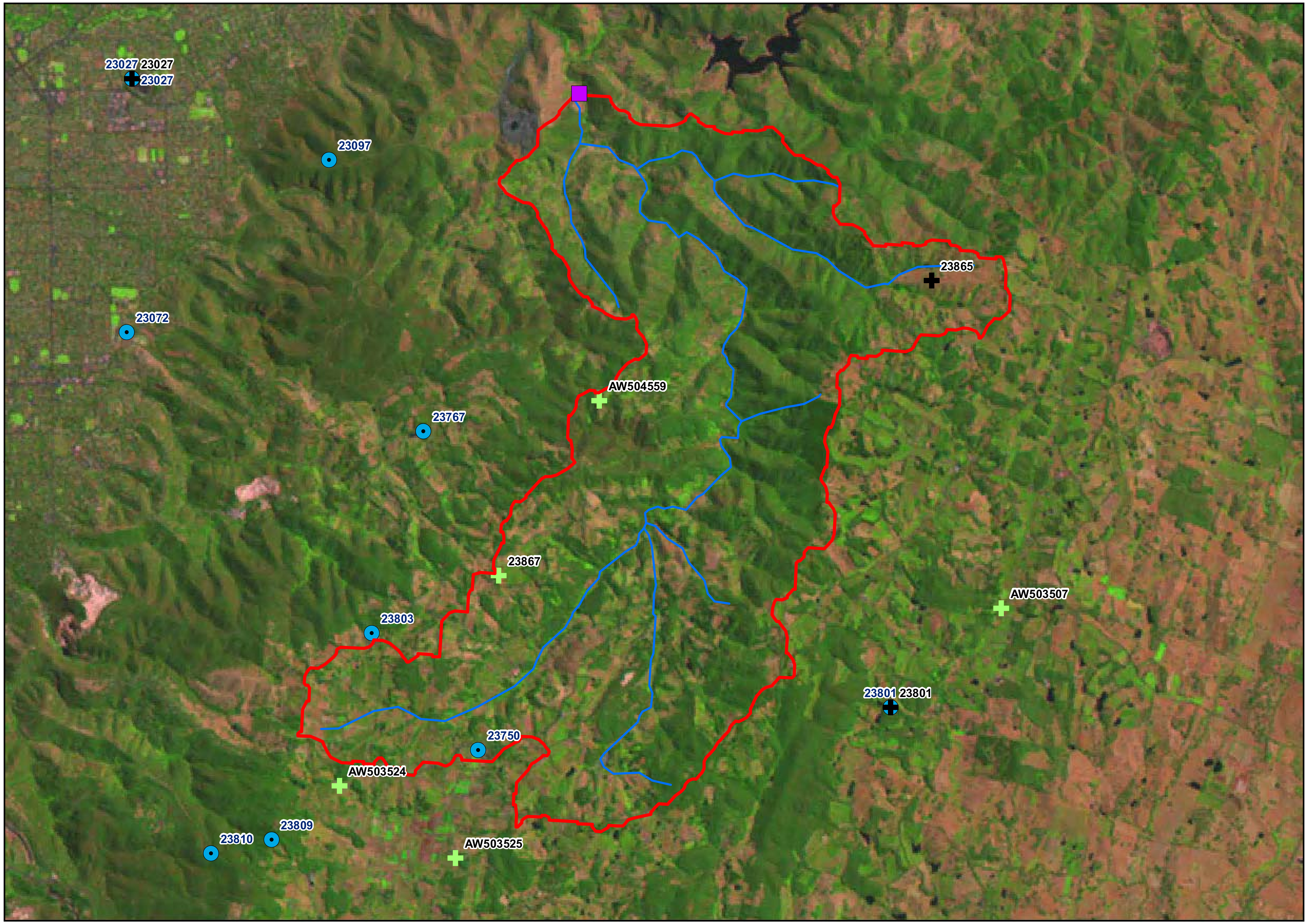
[GDA94 | MGA55]

0 1,000
Meters



809312; Fletcher Creek Trib @ Frog Hollow

SKM



Legend

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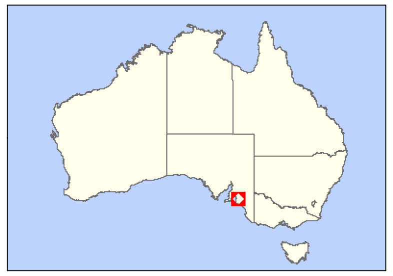
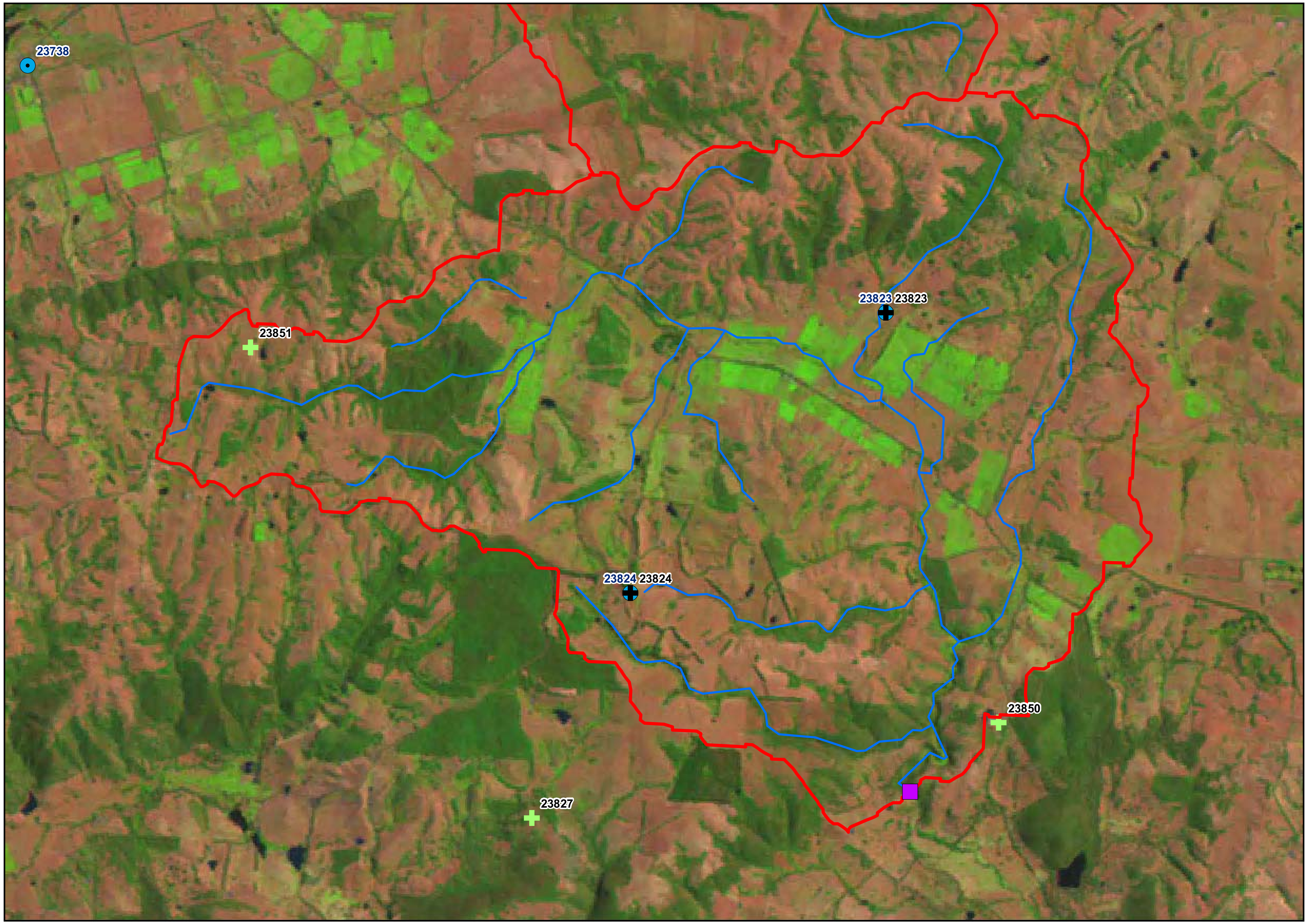
[GDA94 | MGA55]

0 1,120
Meters



A5040523; Castambul @ Sixth Creek



Legend

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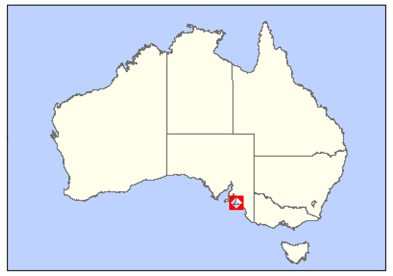
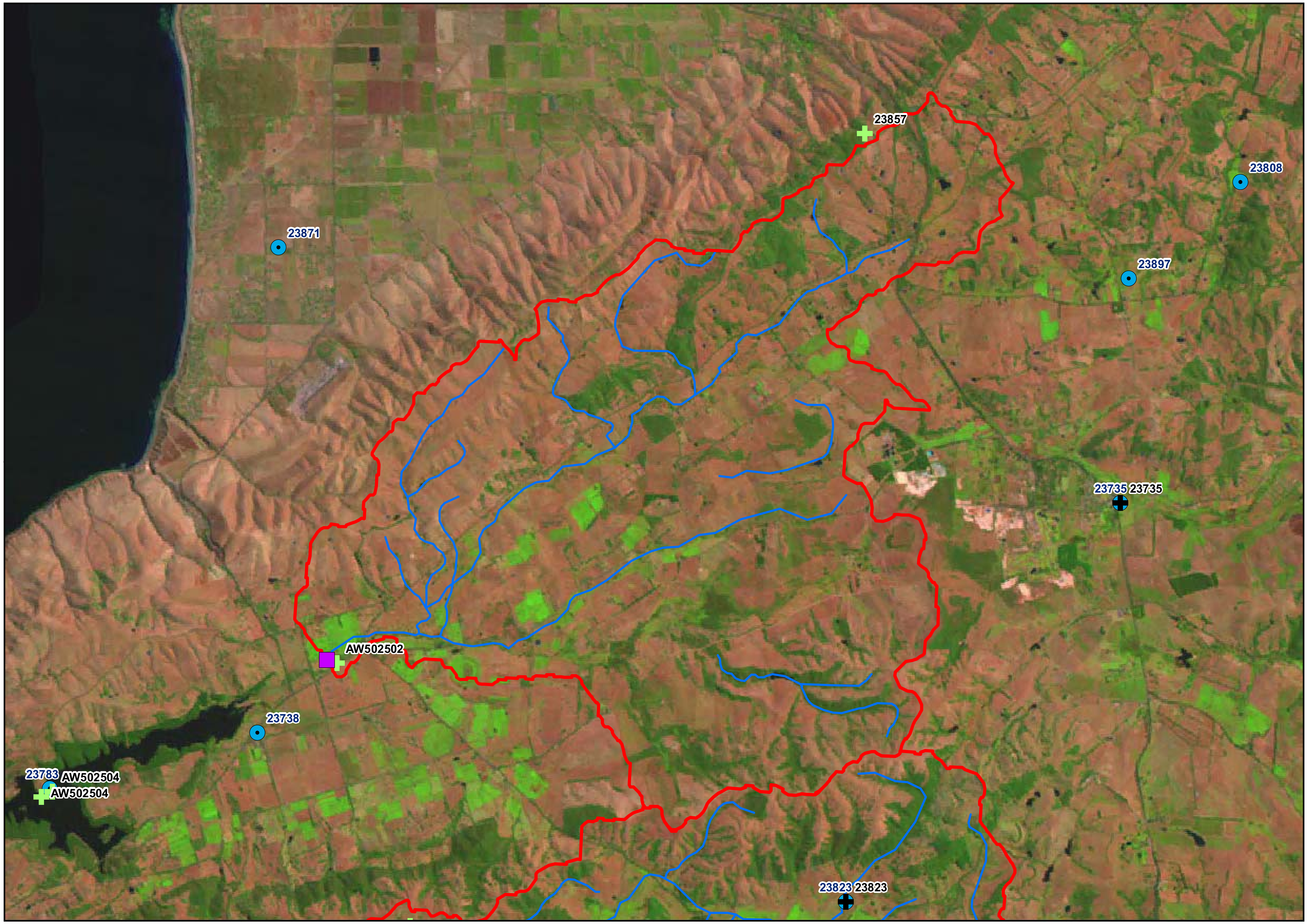
[GDA94 | MGA55]

0 920
Meters



AW501500; Hindmarsh @ Hindmarsh Vy Res Offtake W



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
- Waterbody
- Built-Up Areas

DATA SOURCES
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Bureau of Meteorology - Pluviograph Station Locations
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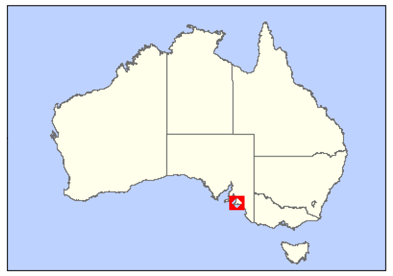
[GDA94 | MGA55]

0 1,360
Meters



AW502502; Myponga River u/s Dam and Rd Br

Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
- Waterbody
- Built-Up Areas

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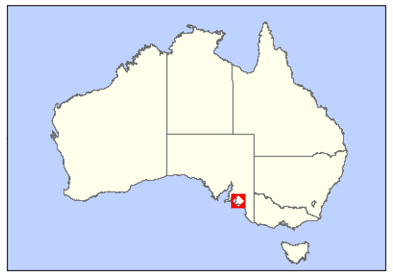
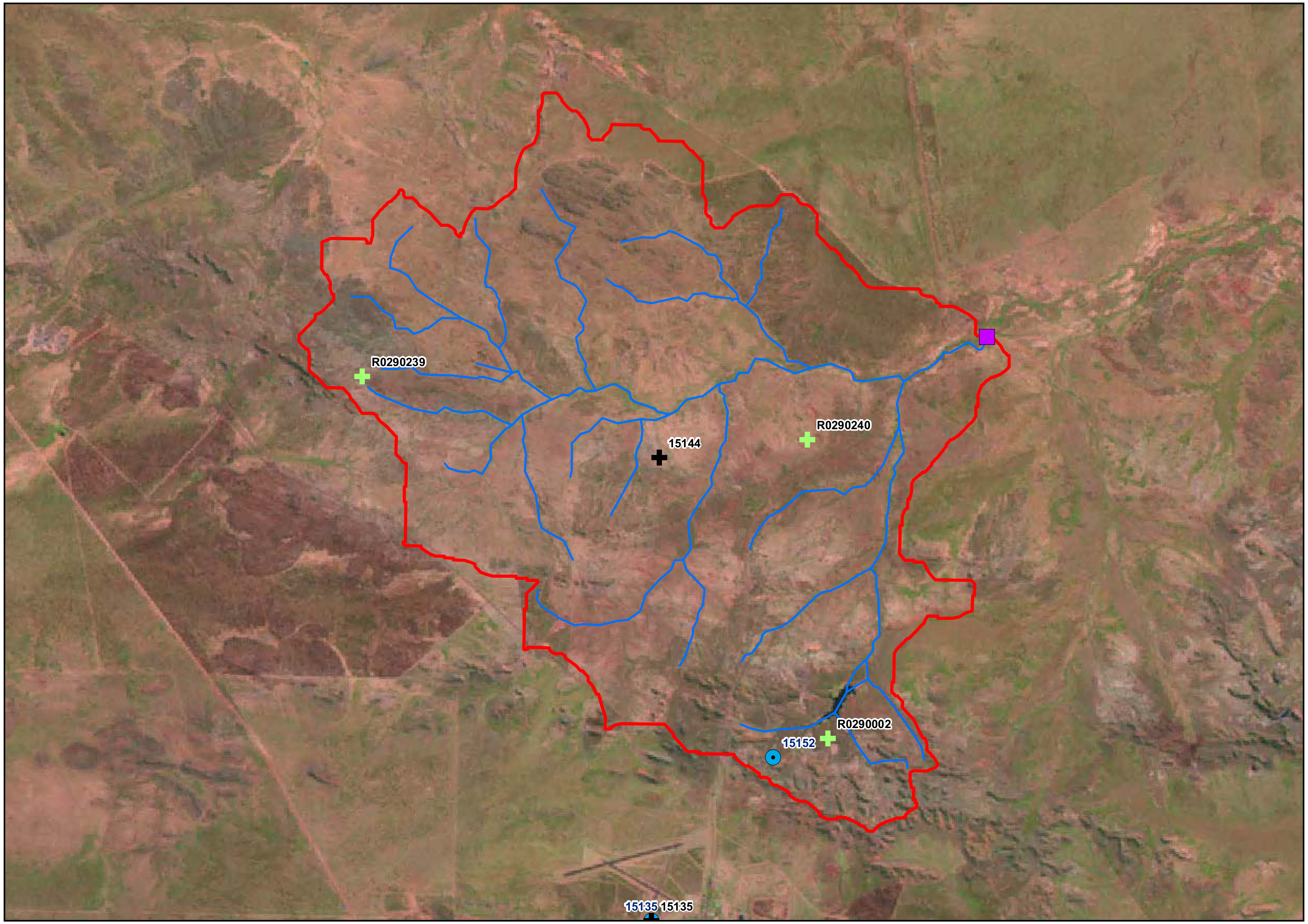
[GDA94 | MGA55]

0 800
Meters



AW503506; Echunga Creek u/s Mt Bold Reserve



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
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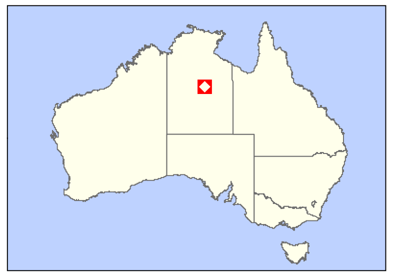
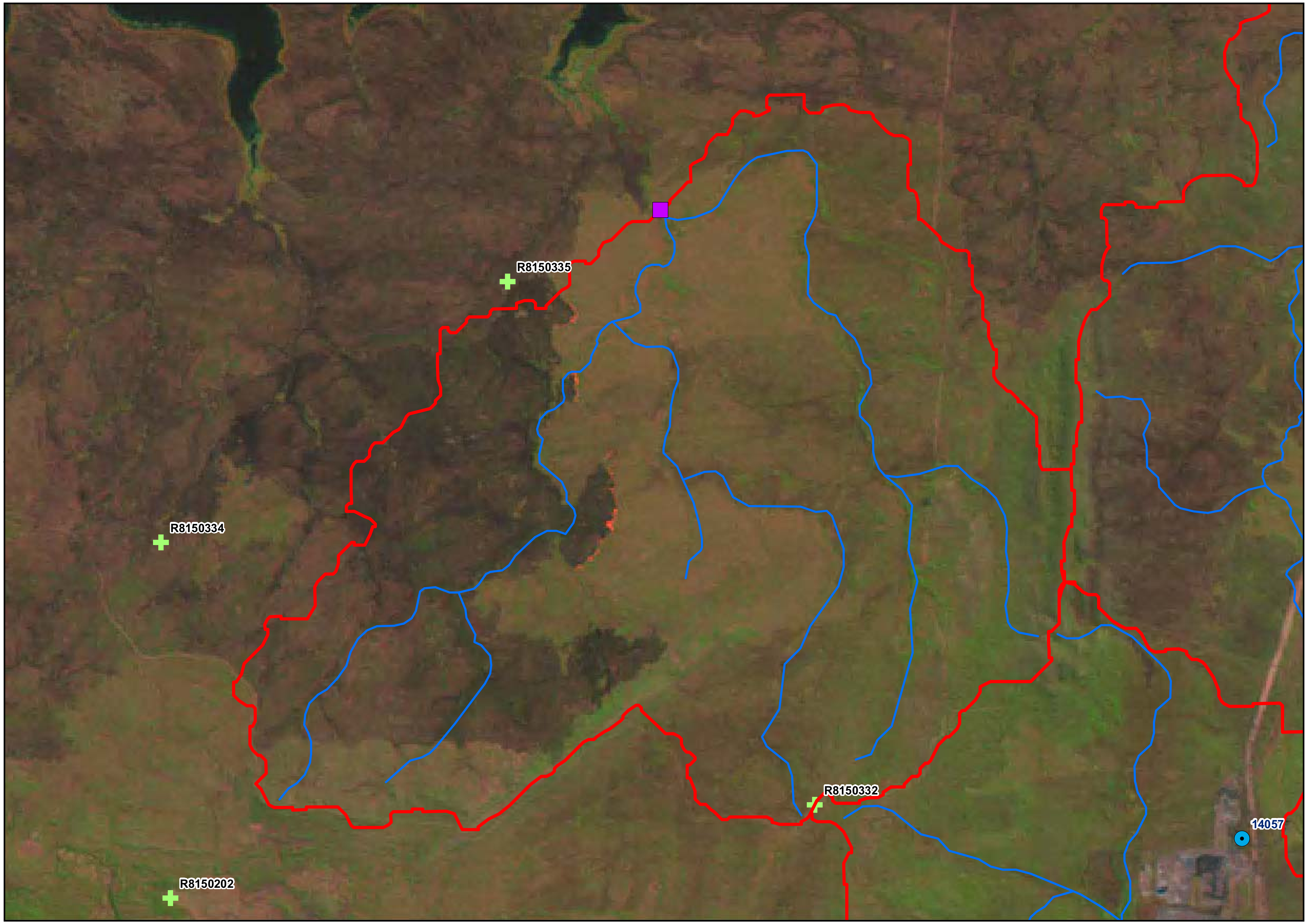
[GDA94 | MGA55]

0 1,300
Meters



G0290240; Tennant Creek @ Old Telegraph Station



Legend

Gauge Location
Catchment Boundary
Rainfall Gauge

Pluviograph Stations

Bureau of Meteorology
Other Sources
Watercourse
Waterbody
Built-Up Areas

DATA SOURCES
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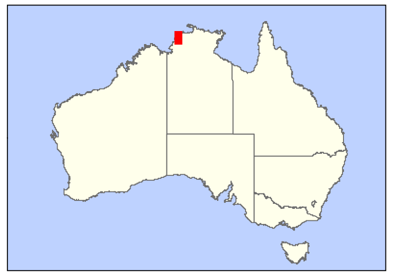
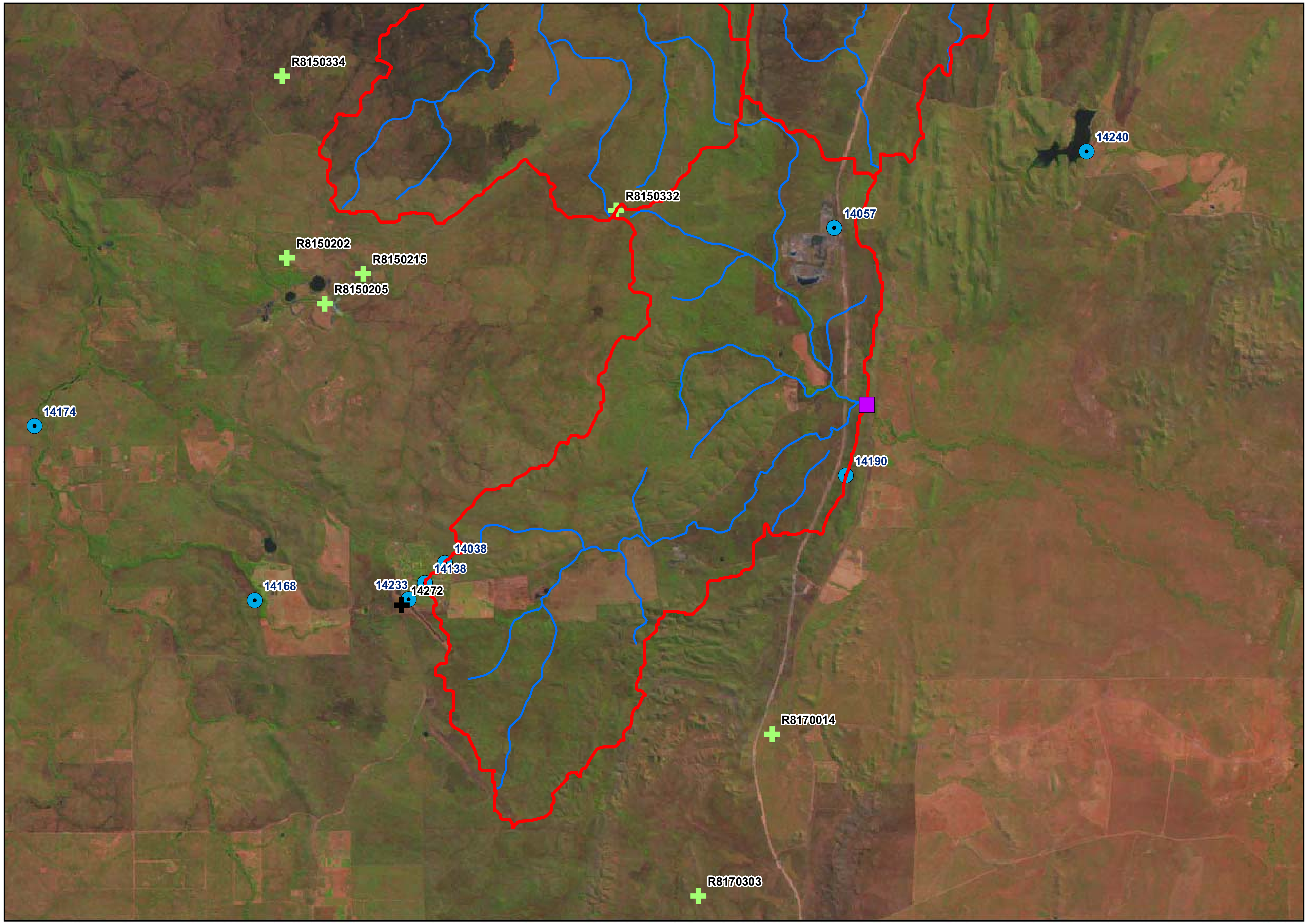
[GDA94 | MGA55]

0 920
Meters



G8150151; Celia Creek u/s Darwin River Dam



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

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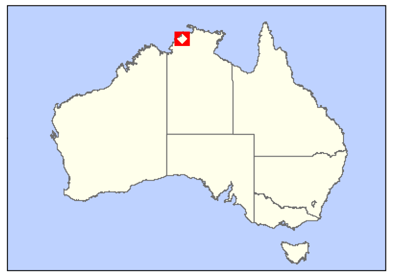
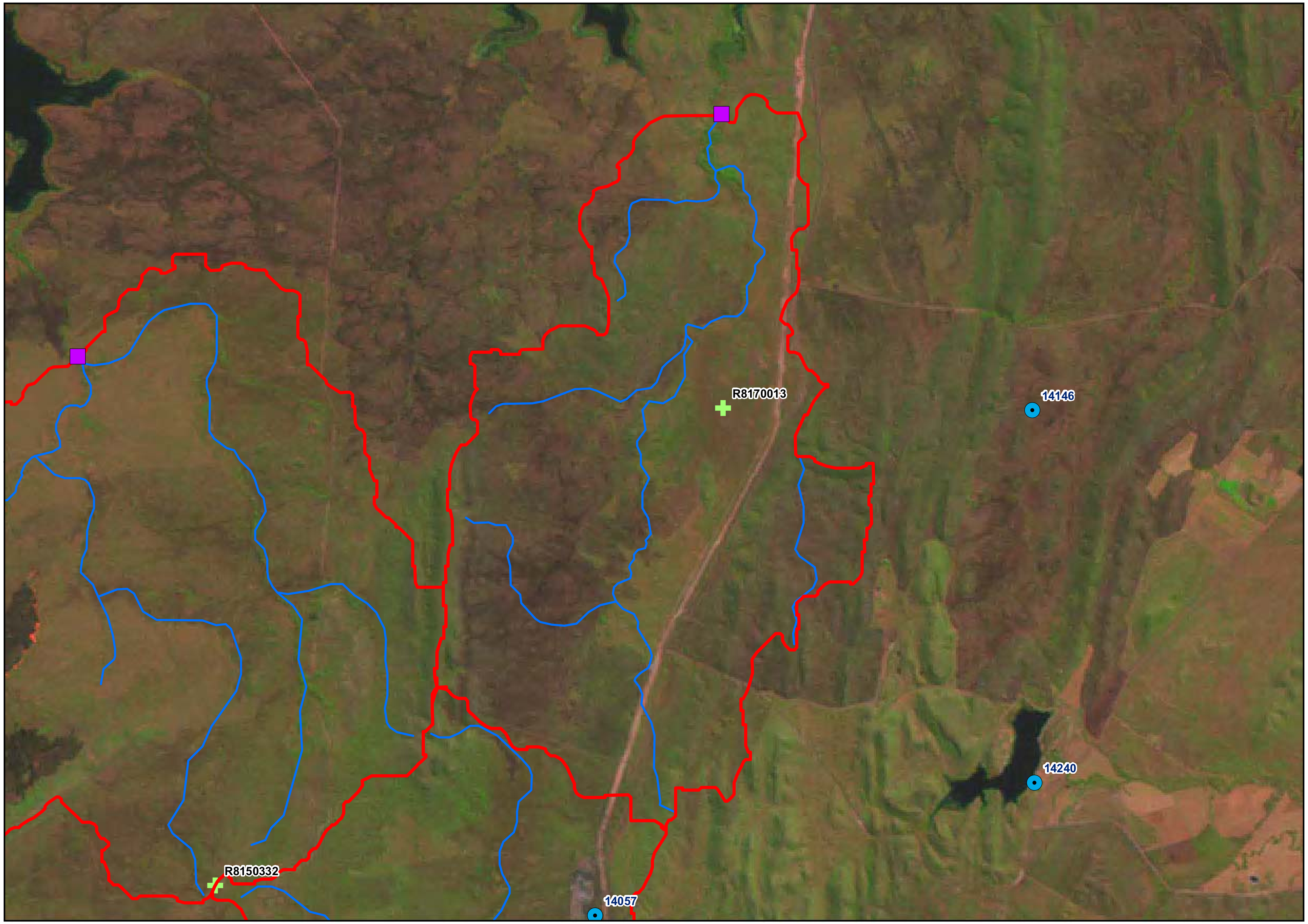
[GDA94 | MGA55]

0 1,800
Meters



G8170066; Coomalie Creek @ Stuart Highway



Legend

- Gauge Location
- Catchment Boundary
- Rainfall Gauge

Pluviograph Stations

- Bureau of Meteorology
- Other Sources
- Watercourse
- Waterbody
- Built-Up Areas

DATA SOURCES
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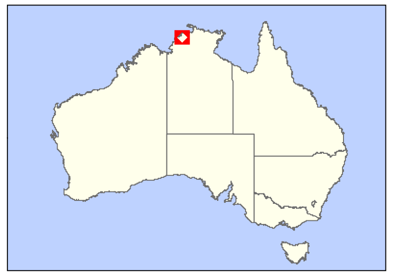
[GDA94 | MGA55]

0 1,040
Meters



G8170075; Manton River u/s Manton Dam

Appendix C Pre-burst distribution for each duration

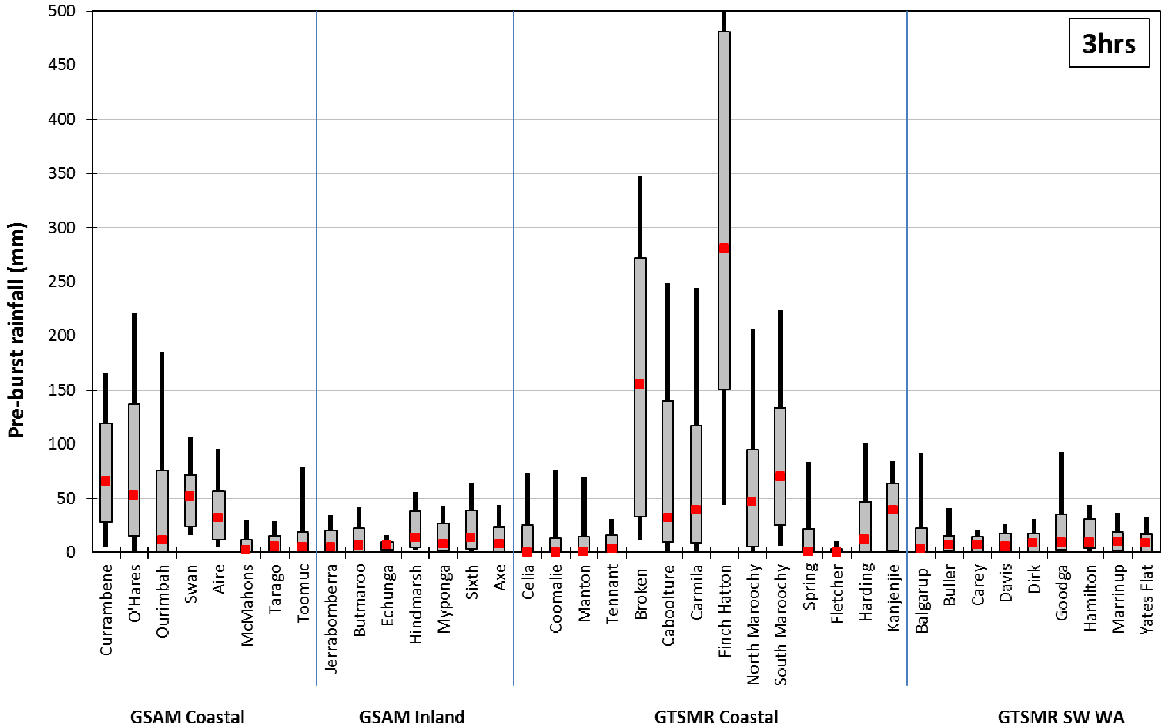


Figure C-1 Range of pre-burst rainfall for 3-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

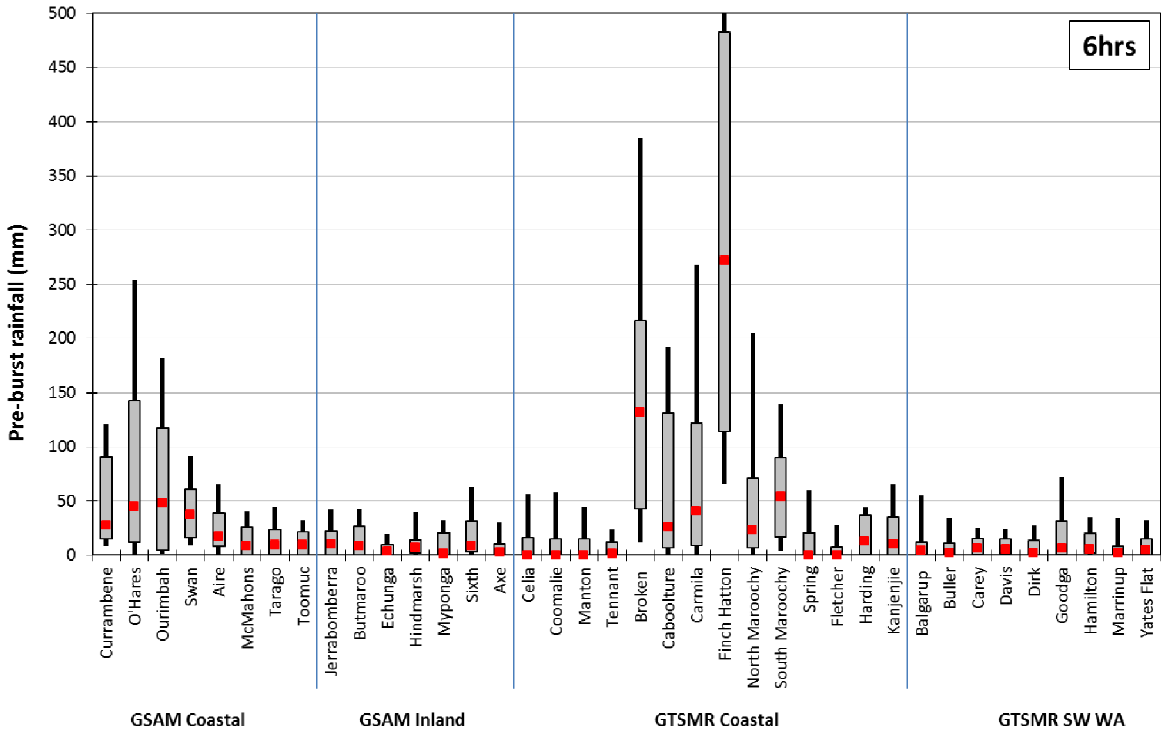


Figure C-2 Range of pre-burst rainfall for 6-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

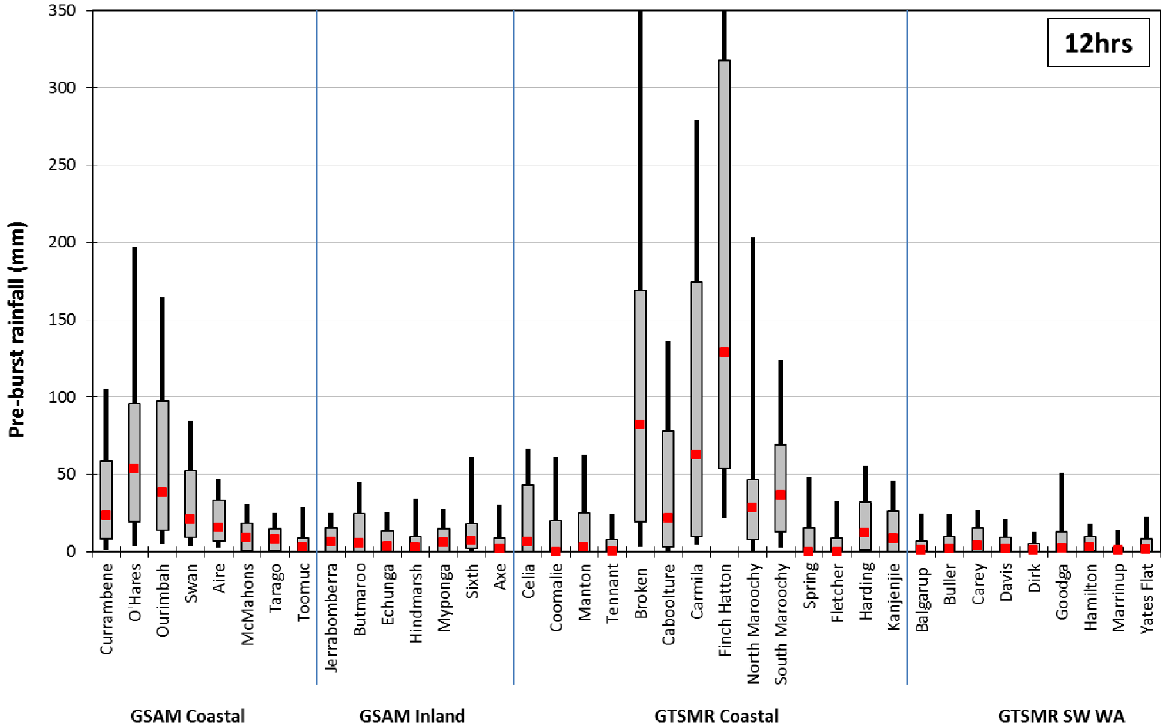


Figure C-3 Range of pre-burst rainfall for 12-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

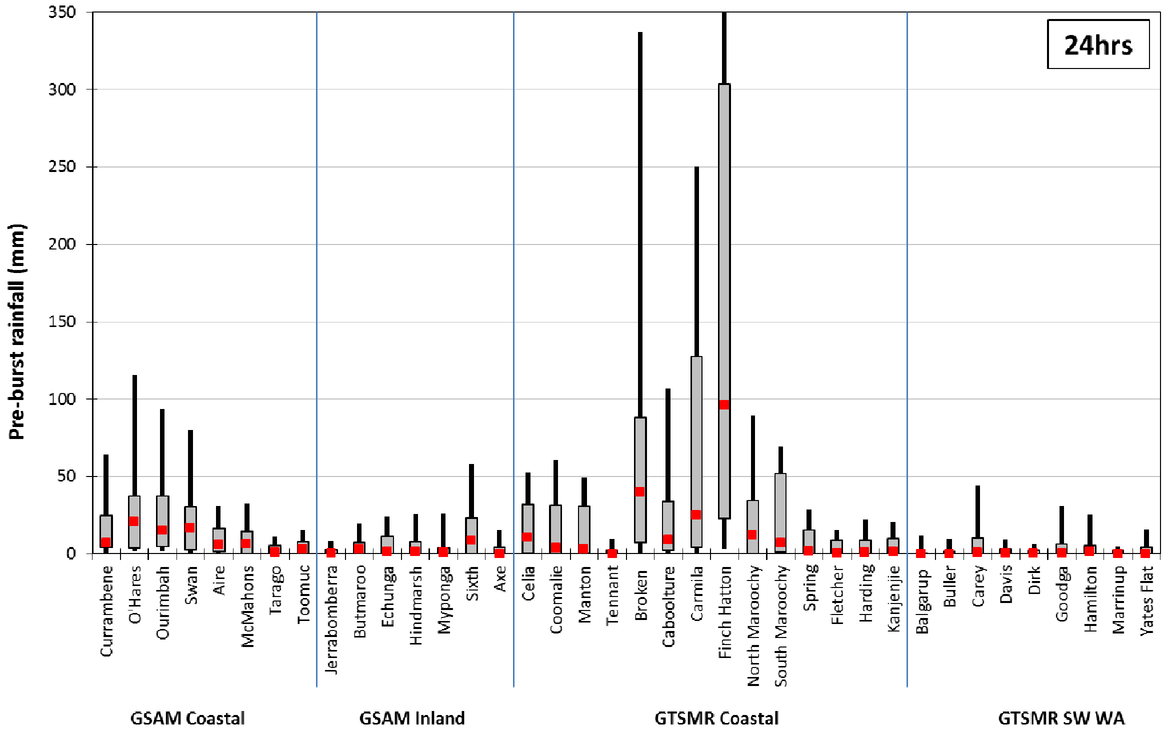


Figure C-4 Range of pre-burst rainfall for 24-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

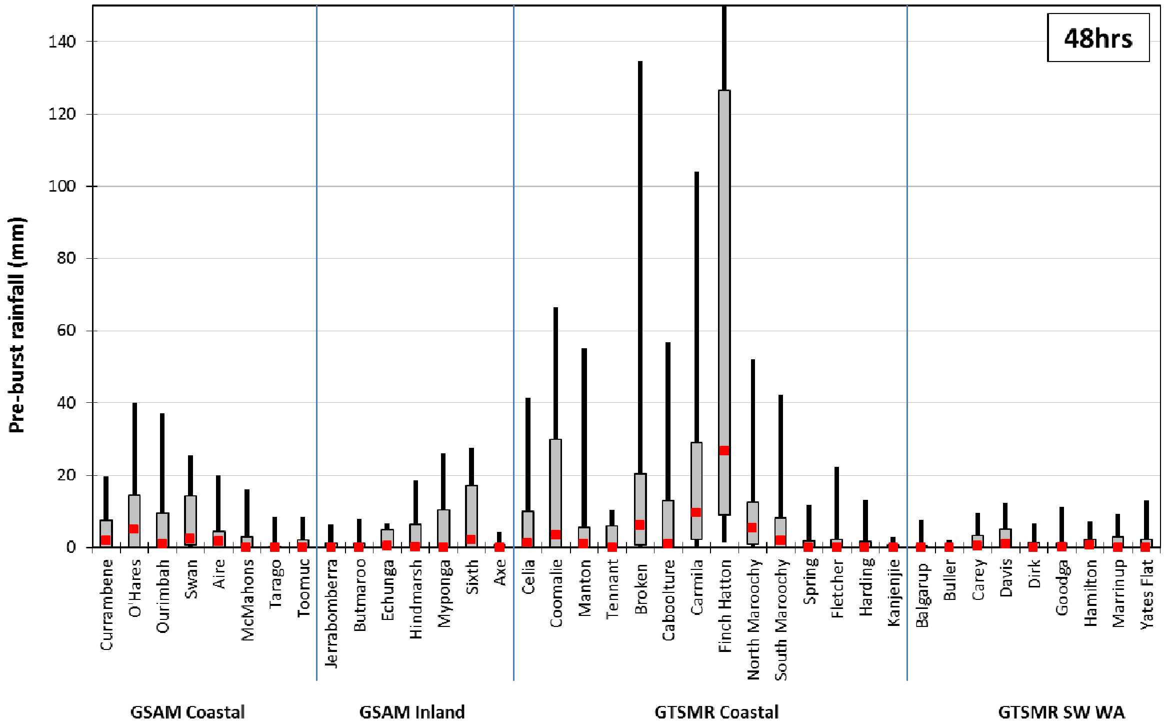


Figure C-5 Range of pre-burst rainfall for 48-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

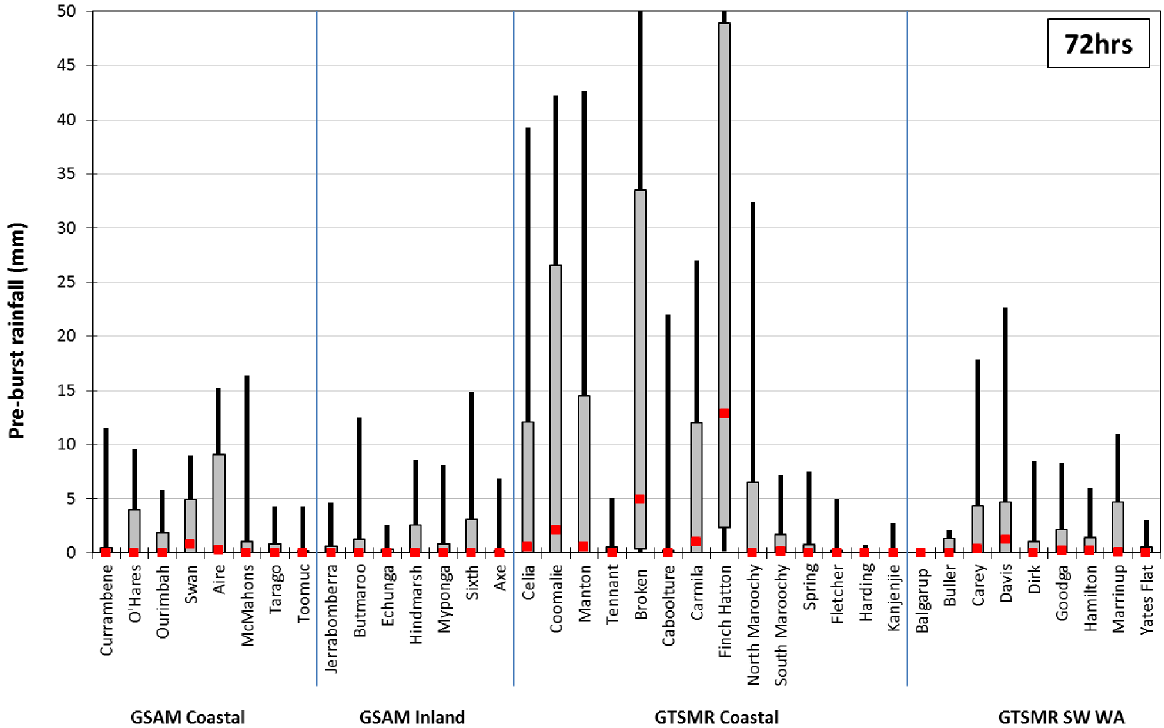
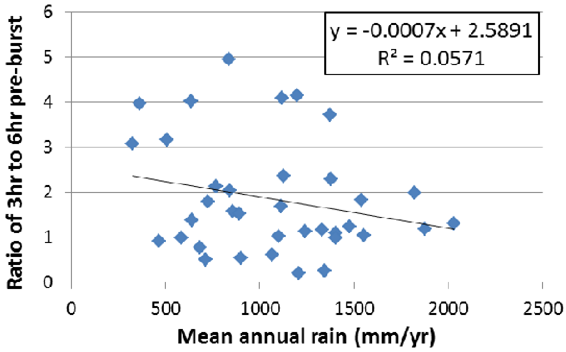
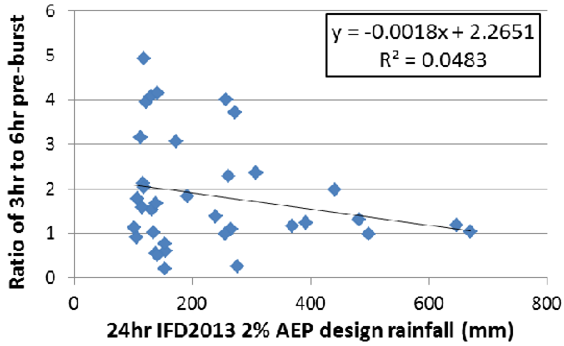
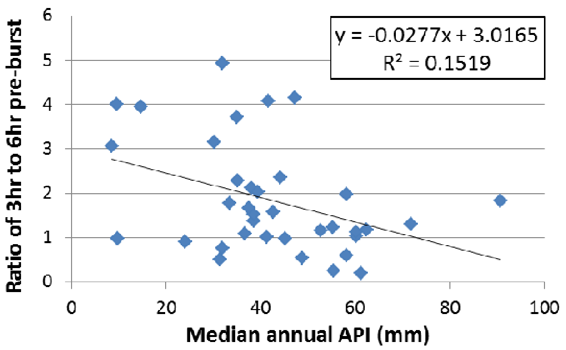


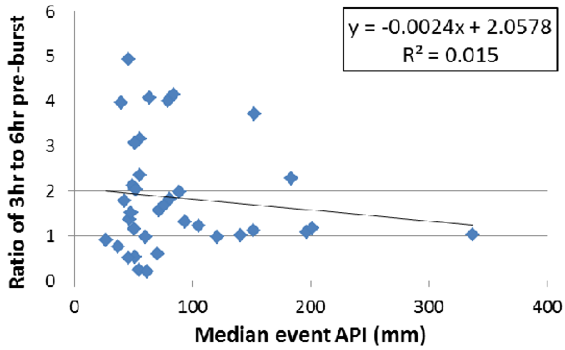
Figure C-6 Range of pre-burst rainfall for 72-hour bursts (box indicates quartiles and line shows 10th and 90th percentile values)

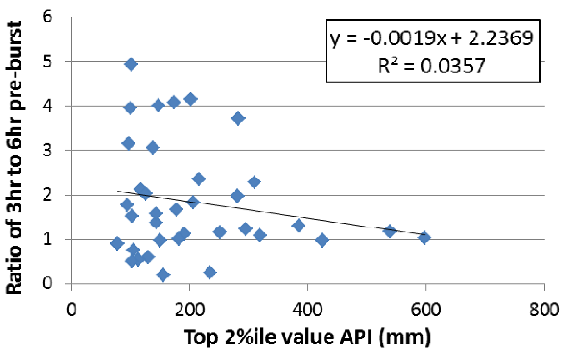
Appendix D Ratio of 3 hour to 6 hour pre-burst relationships

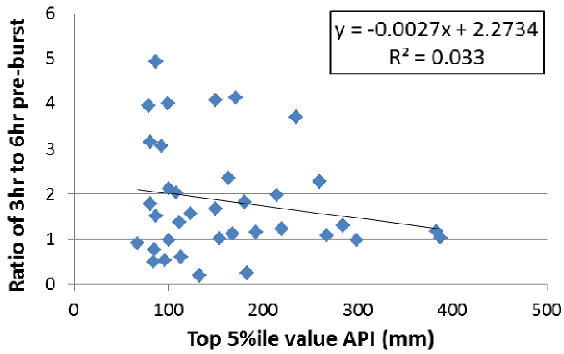


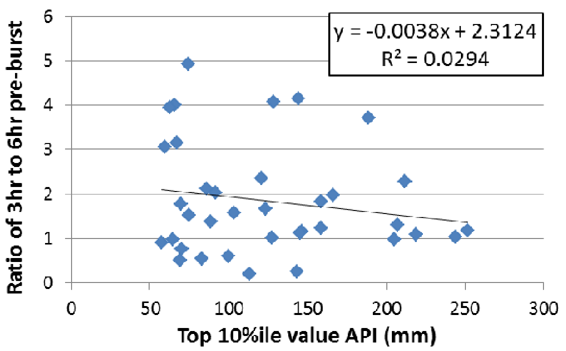


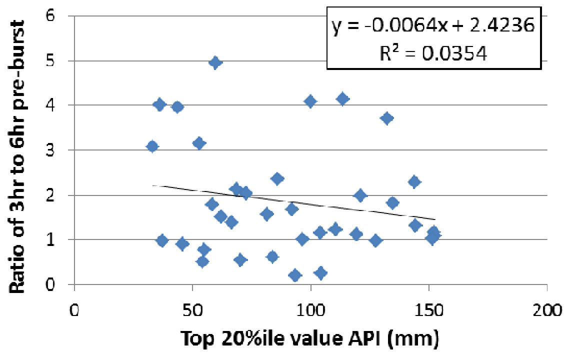






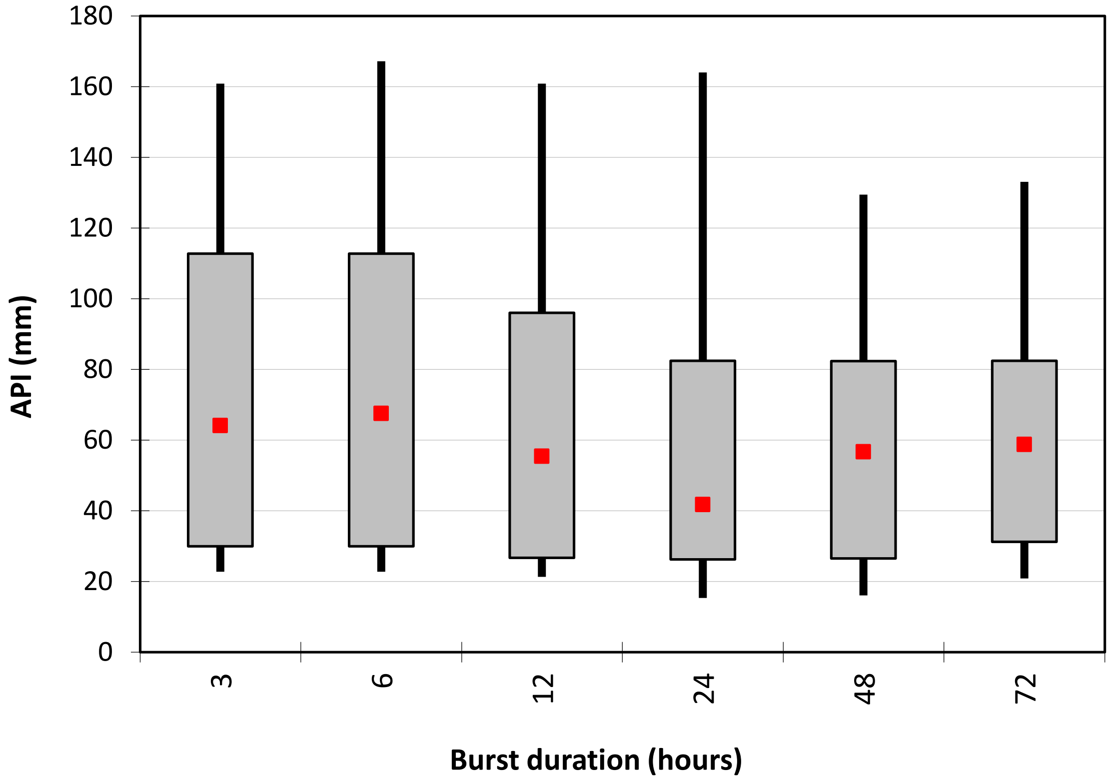


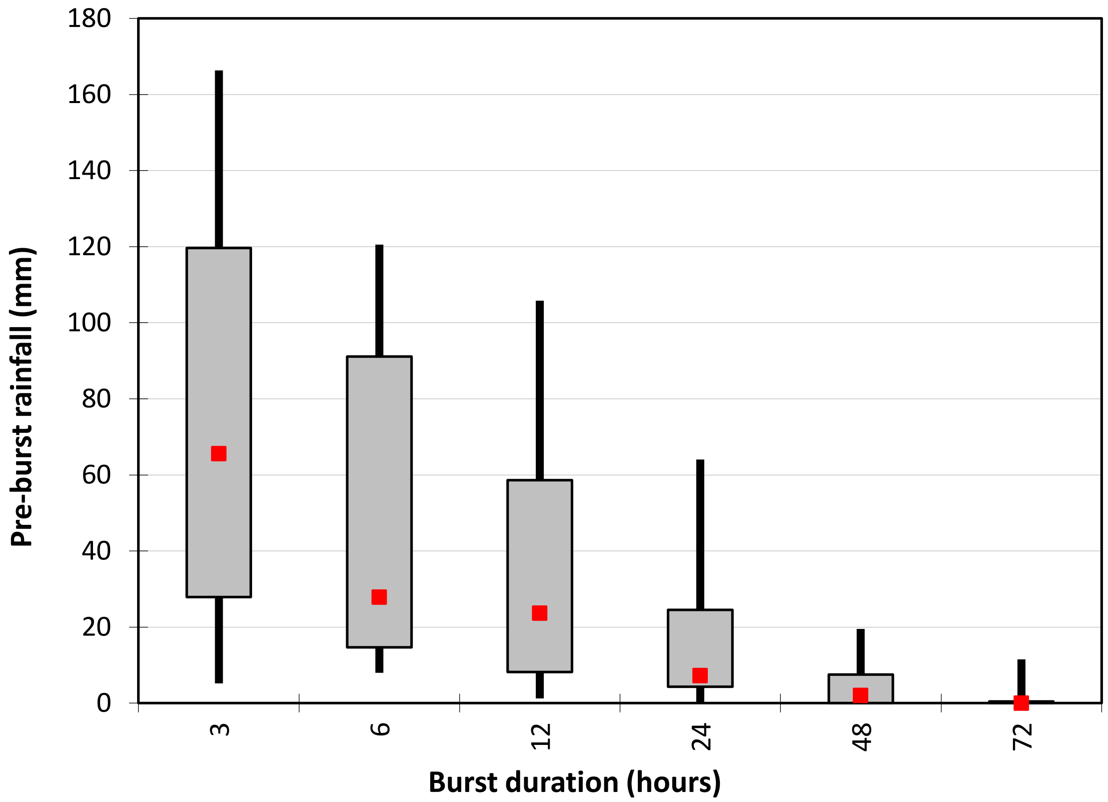




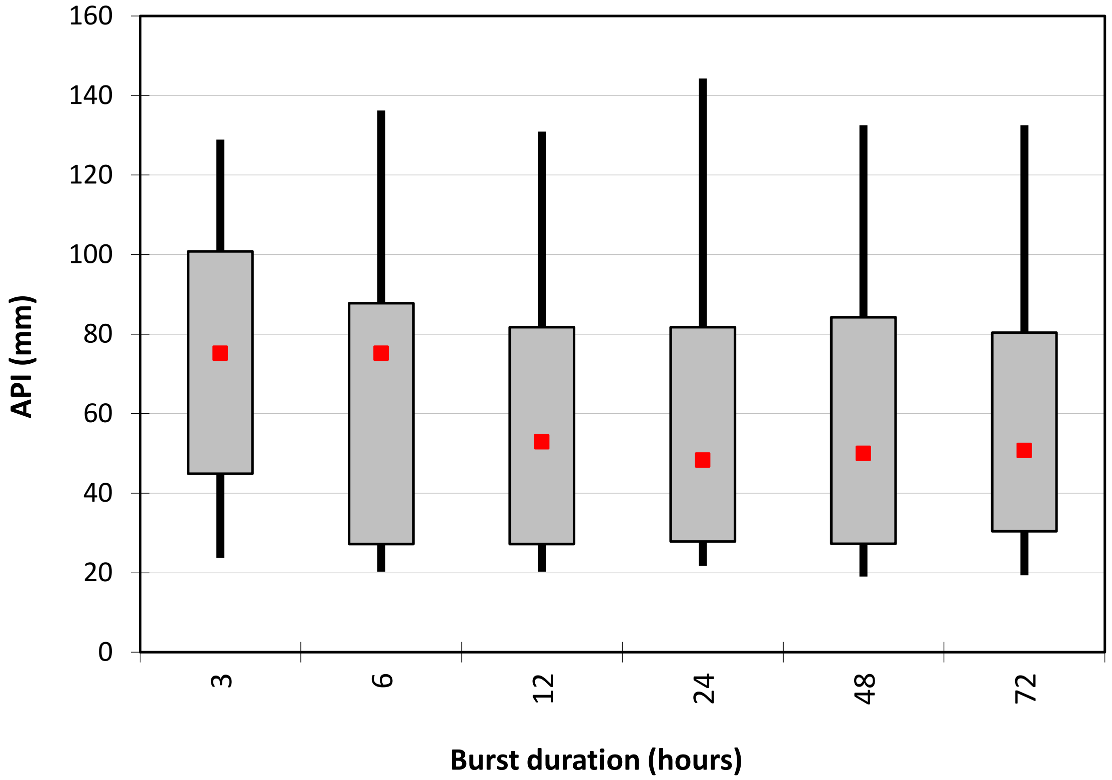
Appendix E Pre-burst distributions and API for each site and duration

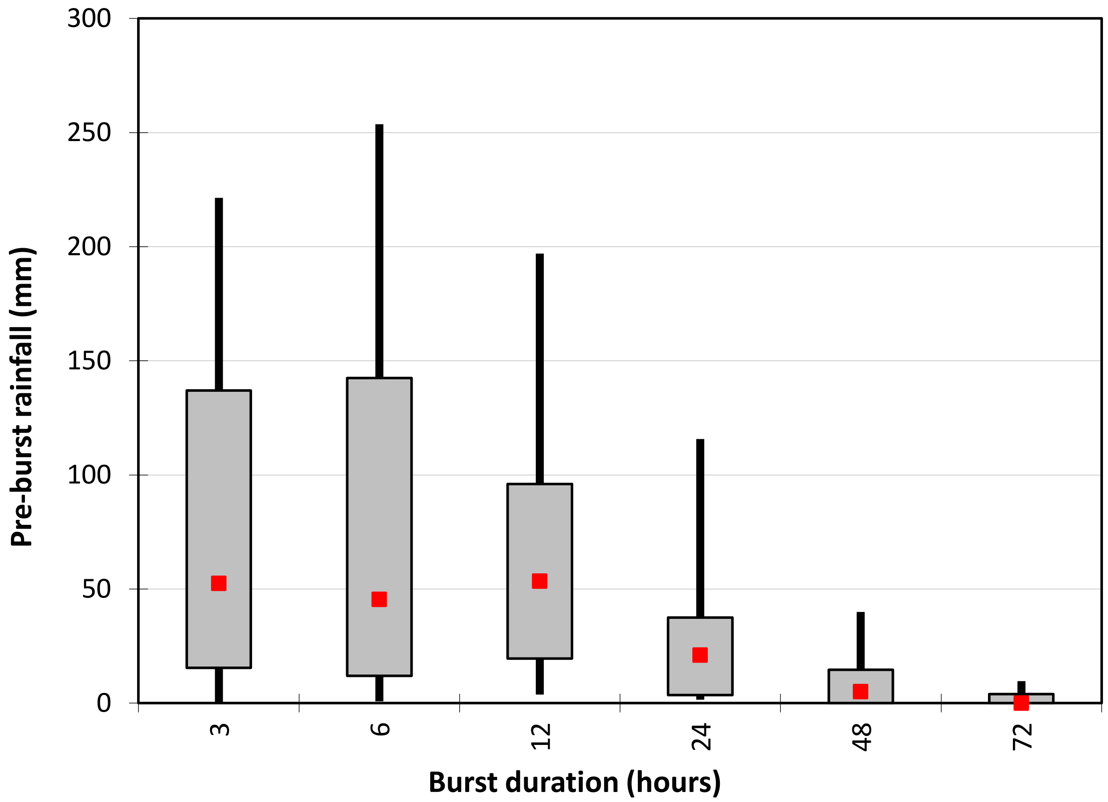
Currambene Creek @ Falls Ck (NSW)



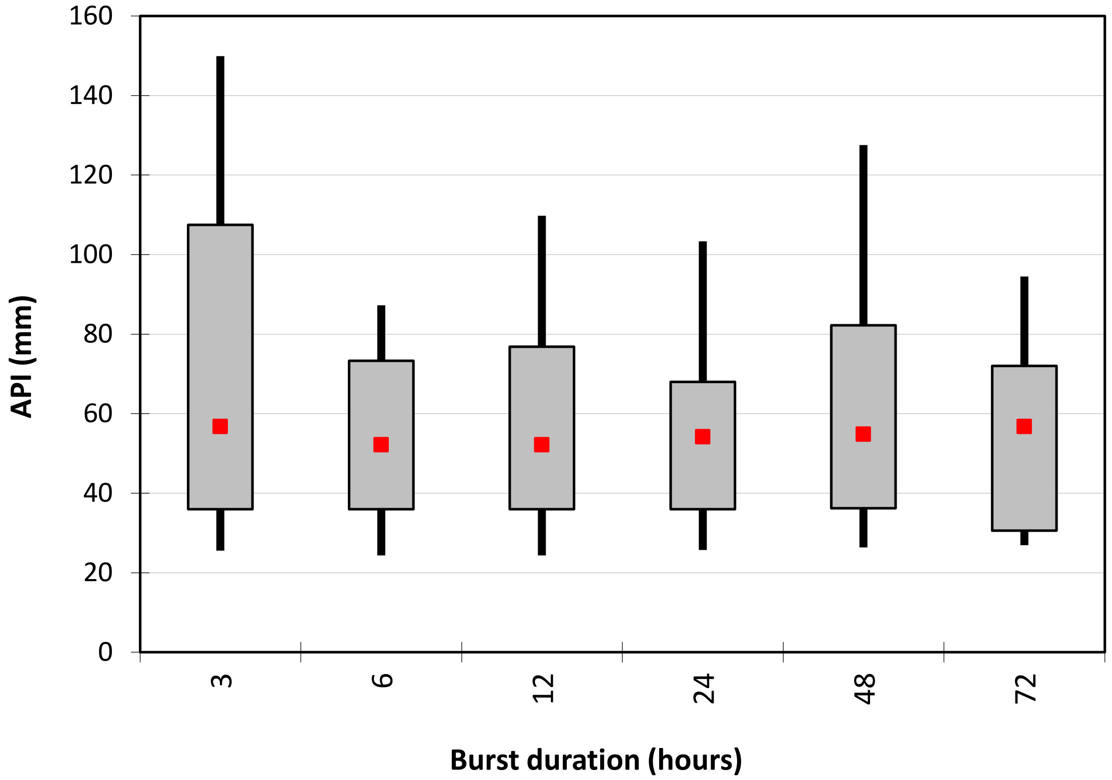


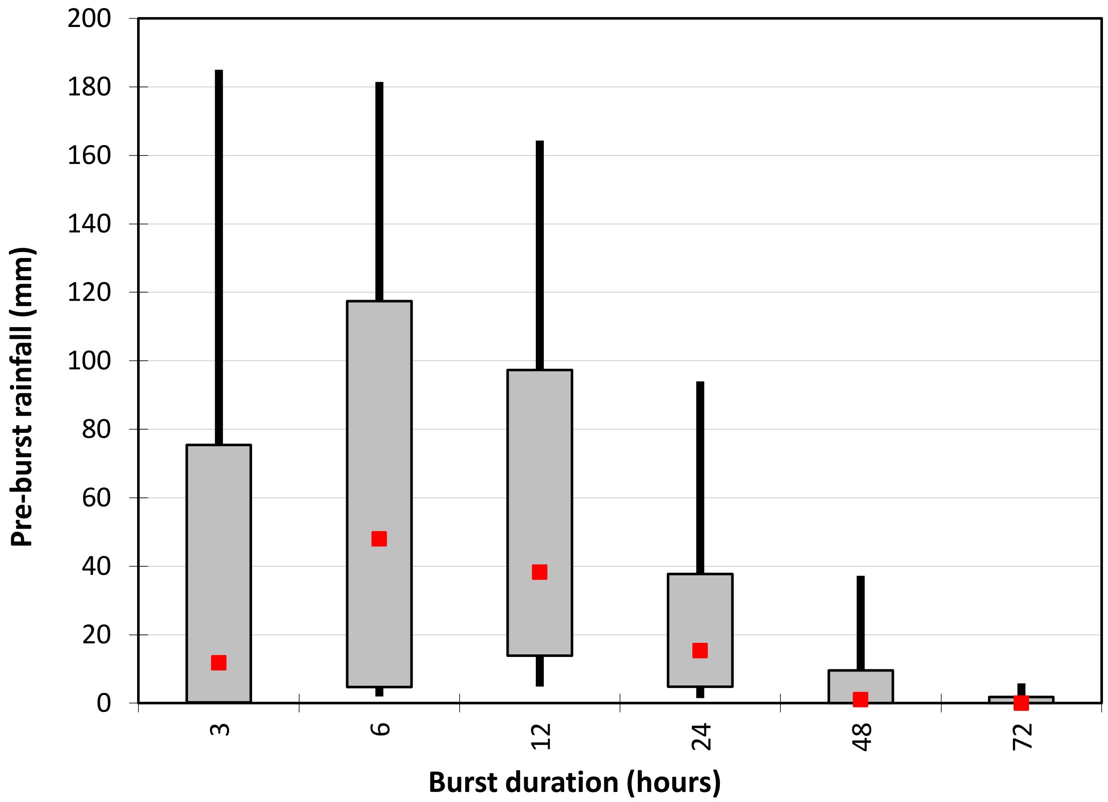
O'Hares Creek @ Wedderburn (NSW)



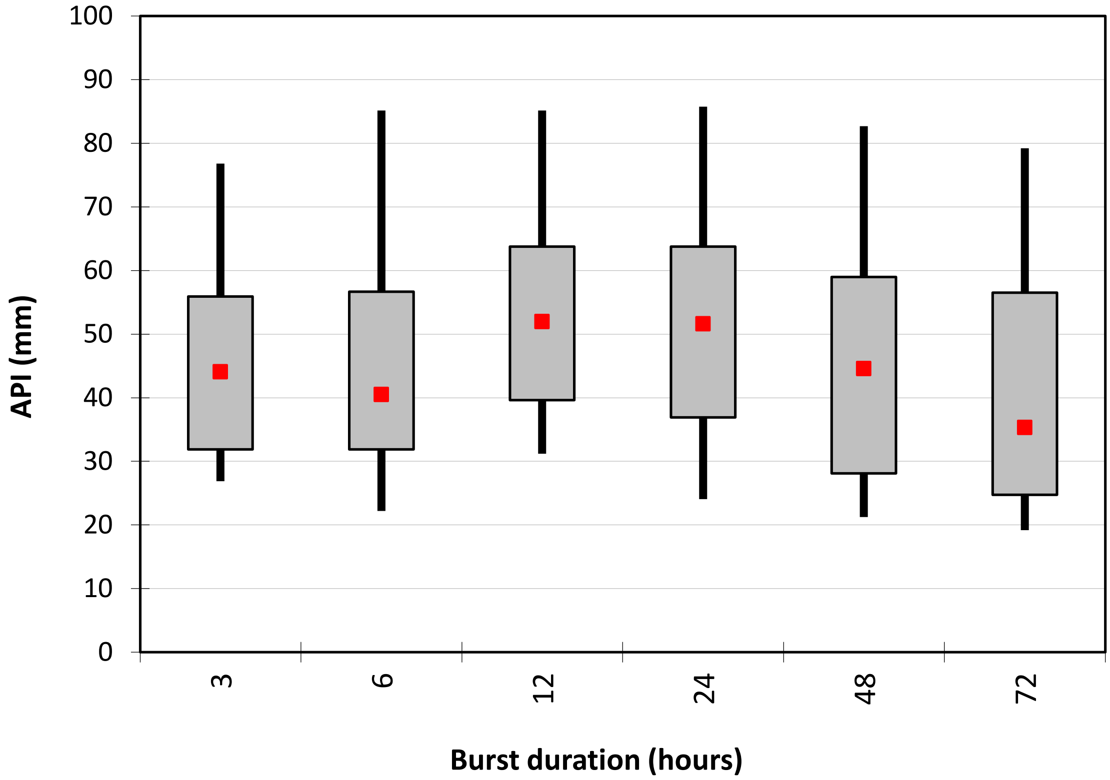


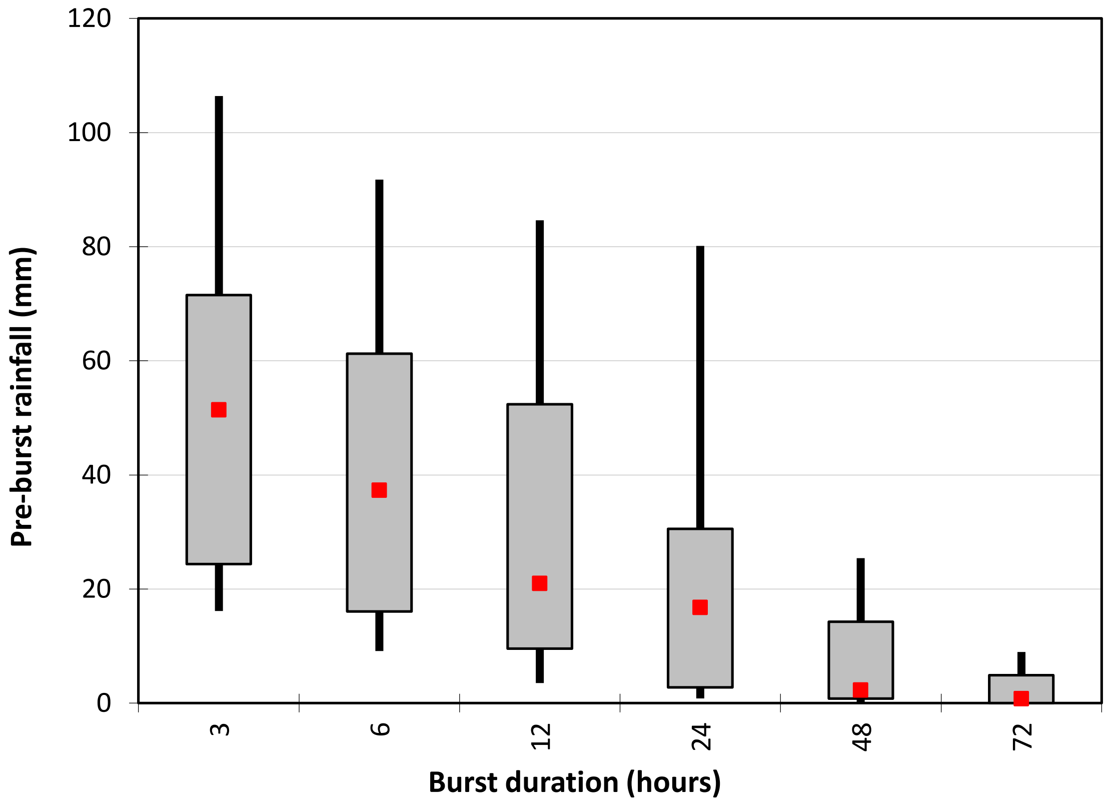
Ourimbah Creek @ U/S Weir (NSW)



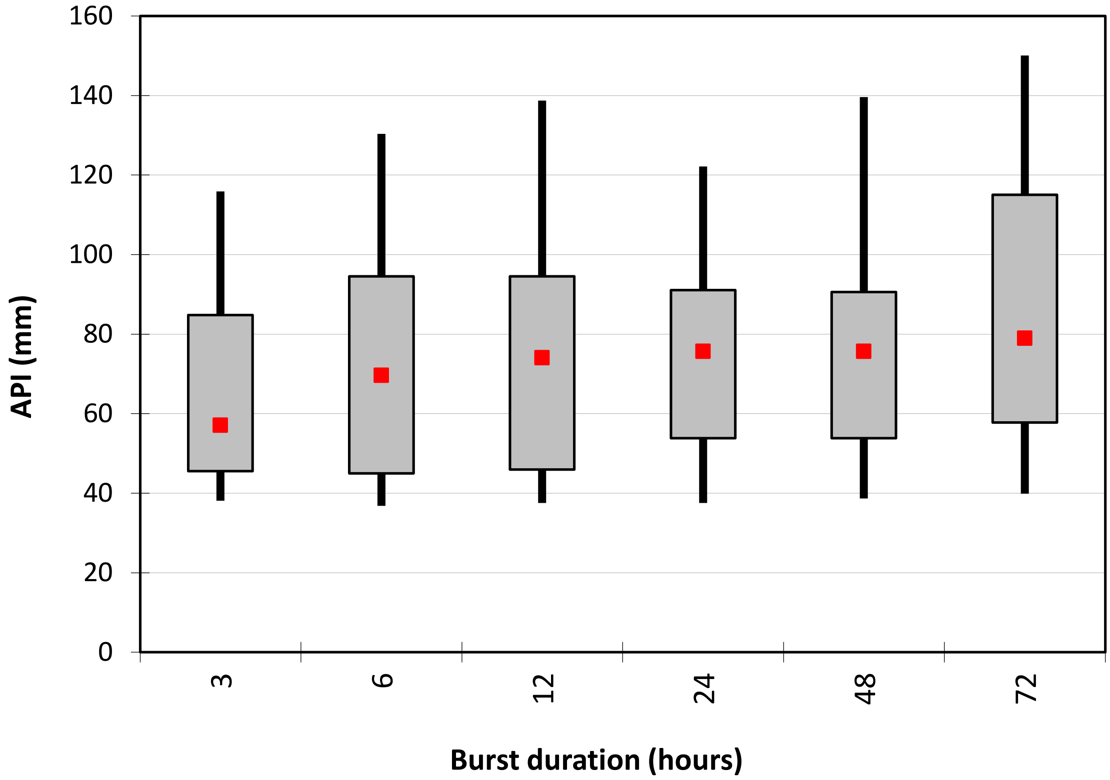


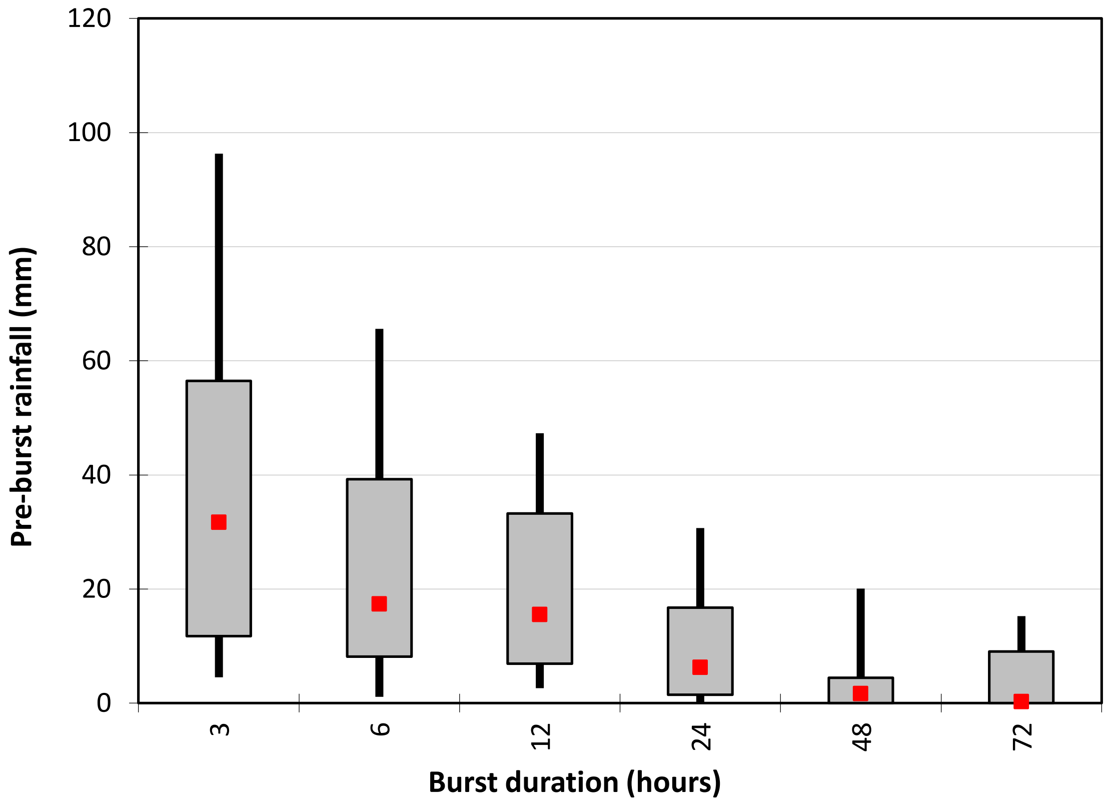
Swan River @ U/S Hardings Falls (TAS)



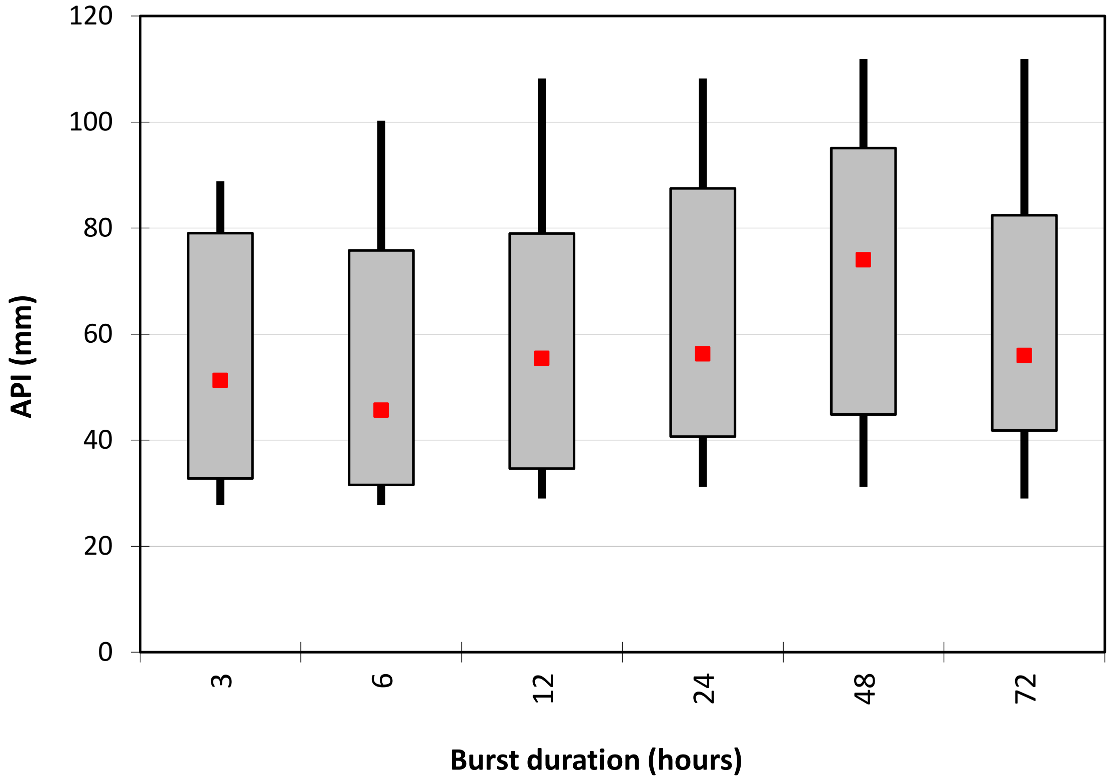


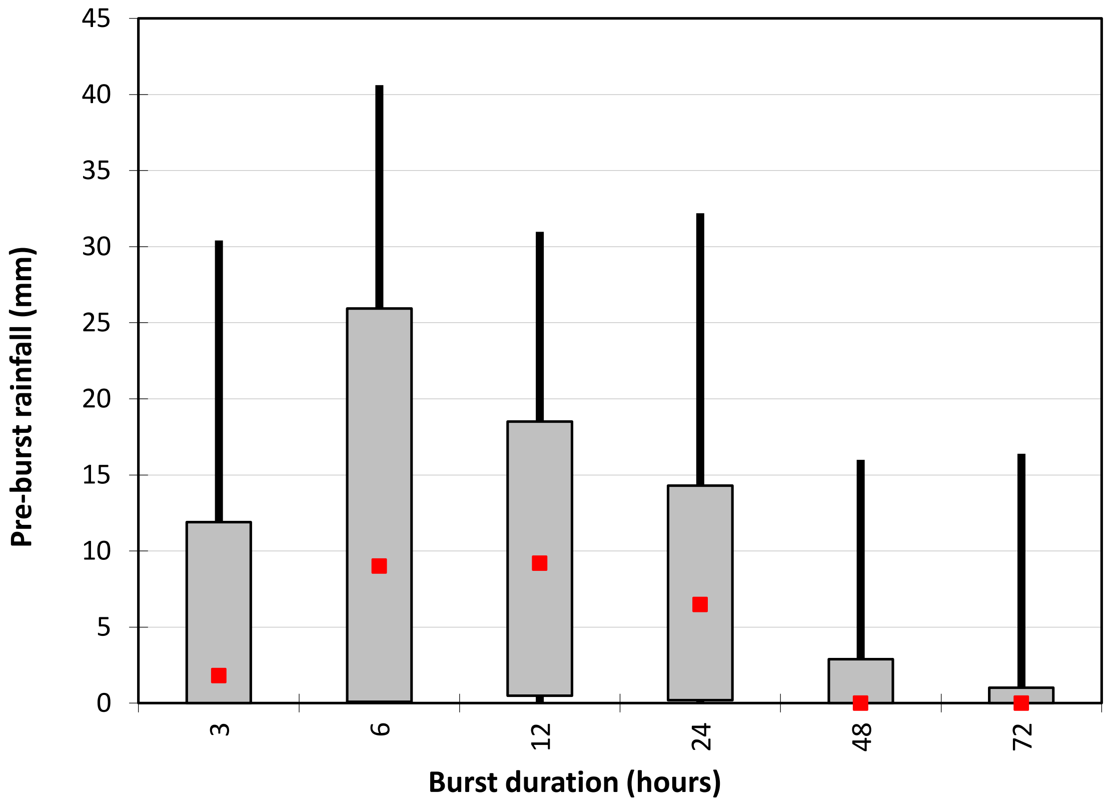
Aire River @ Wyelangata (VIC)



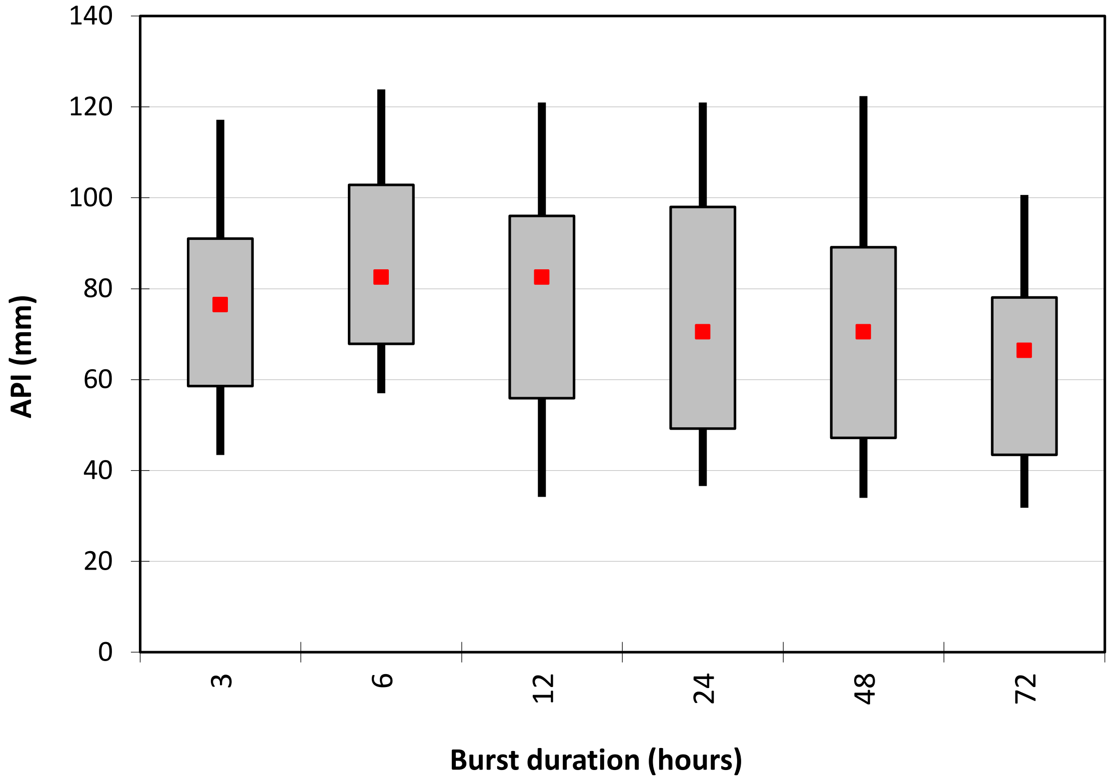


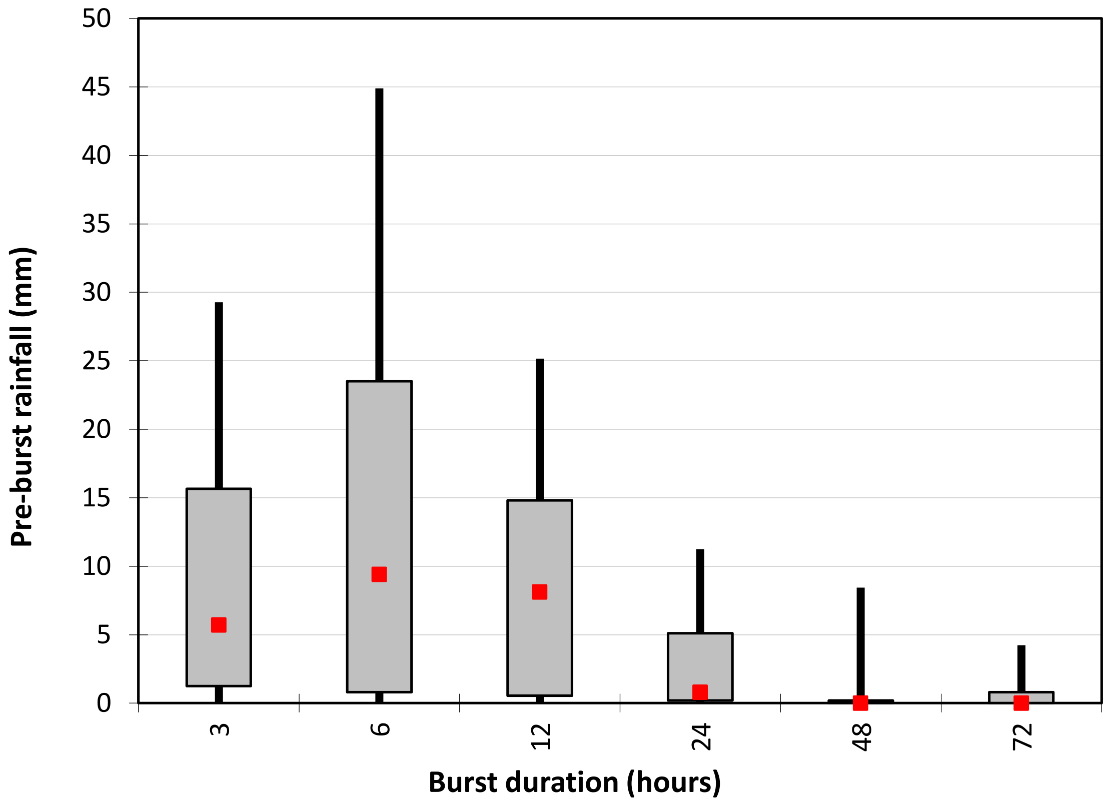
McMahons Creek @ U/S Weir (VIC)



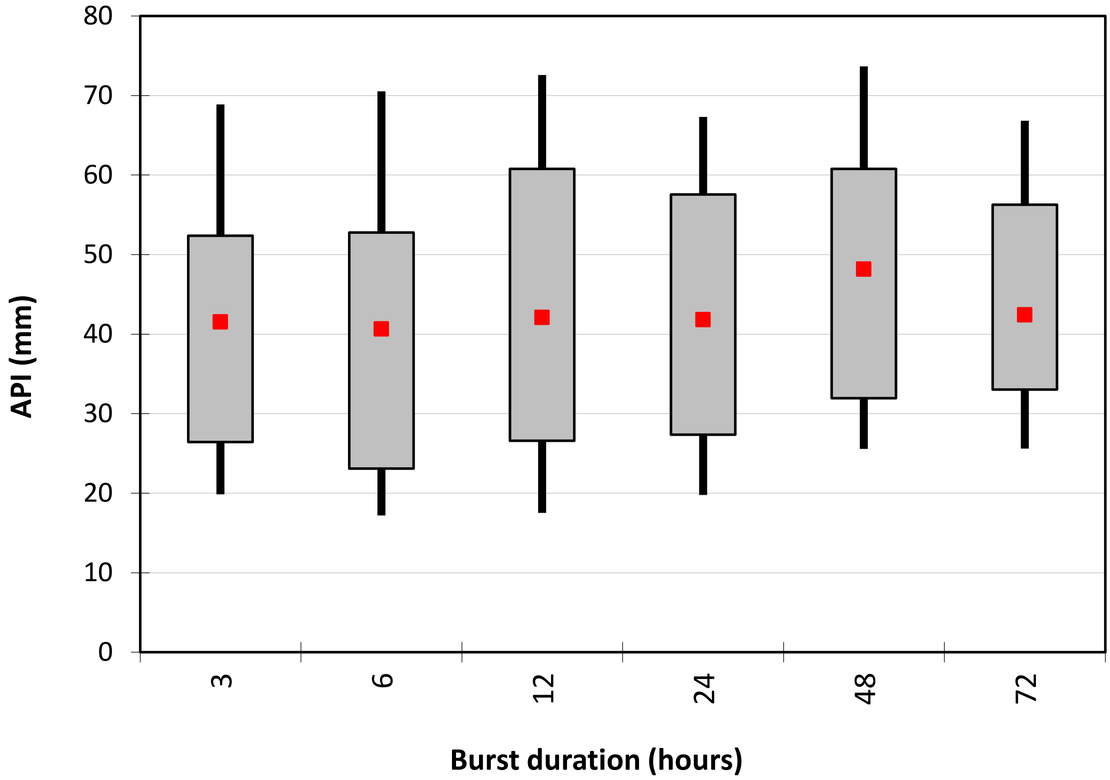


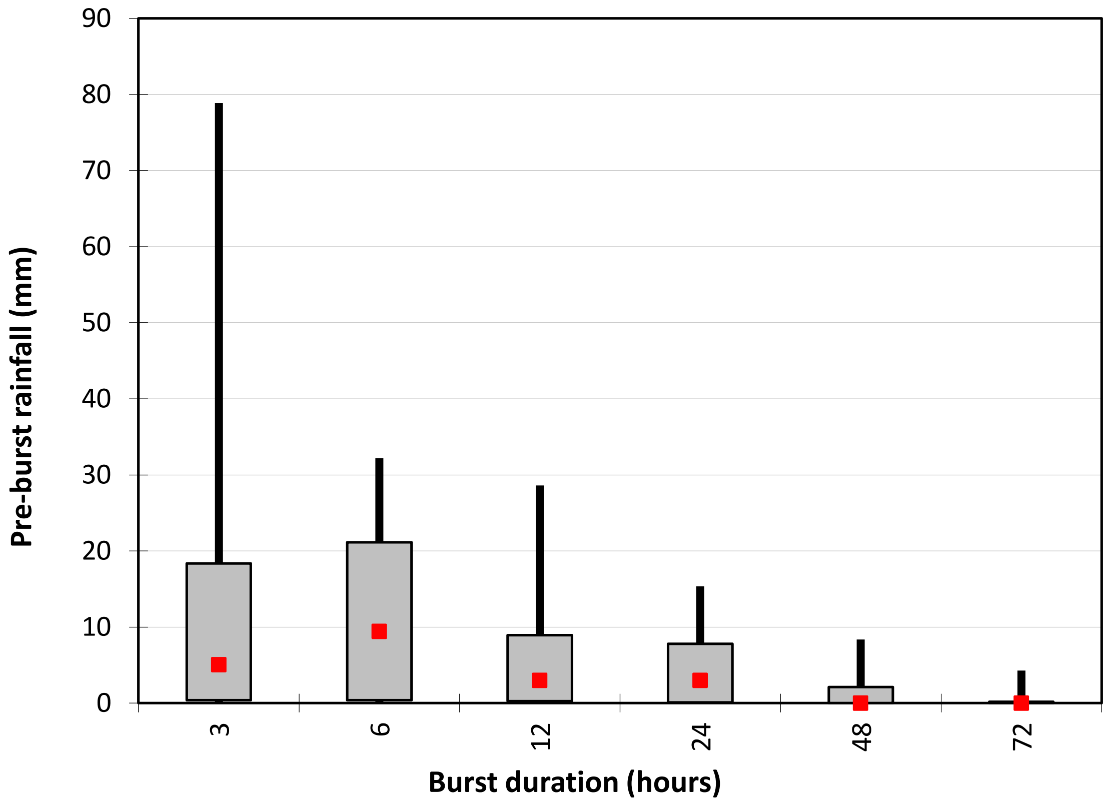
Tarago @ Neerim (VIC)



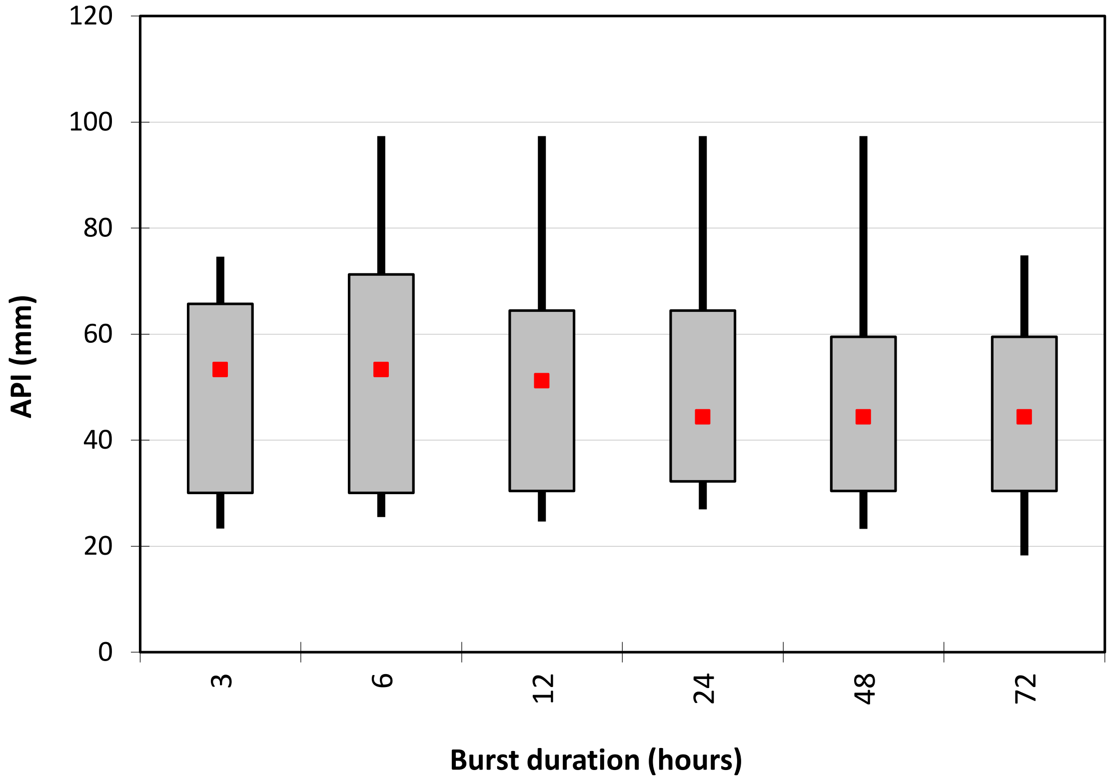


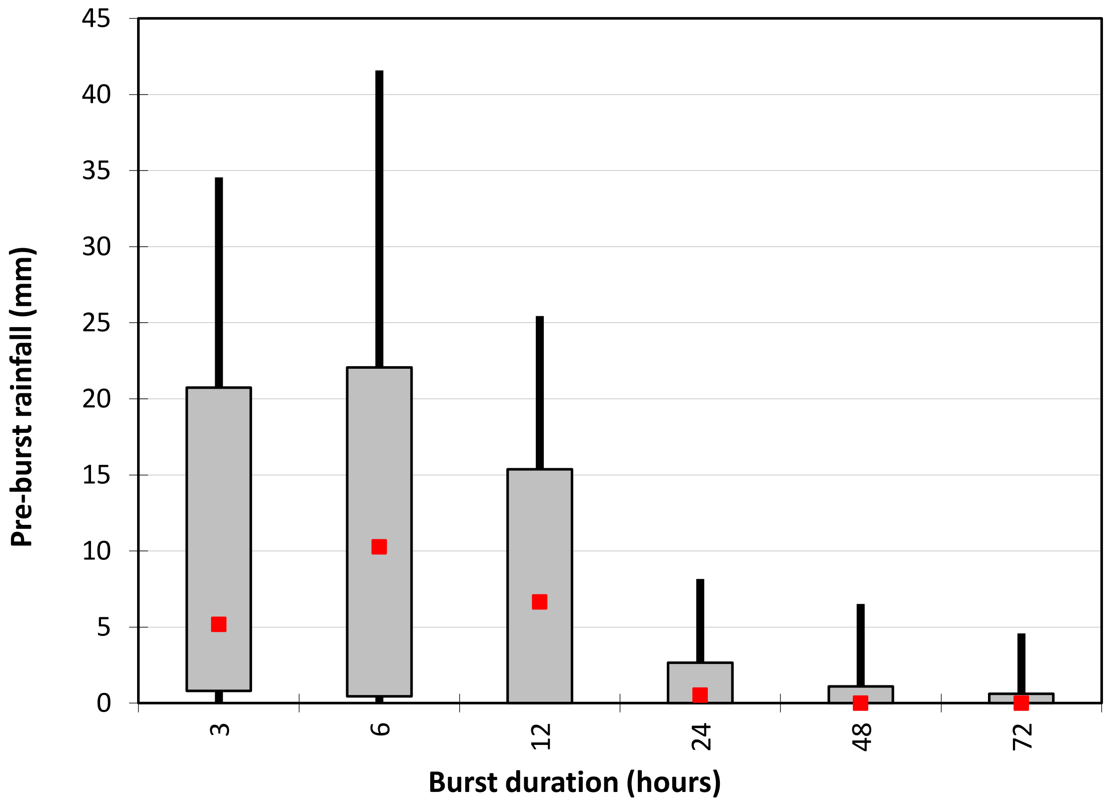
Toomuc Creek @ Pakenham (VIC)



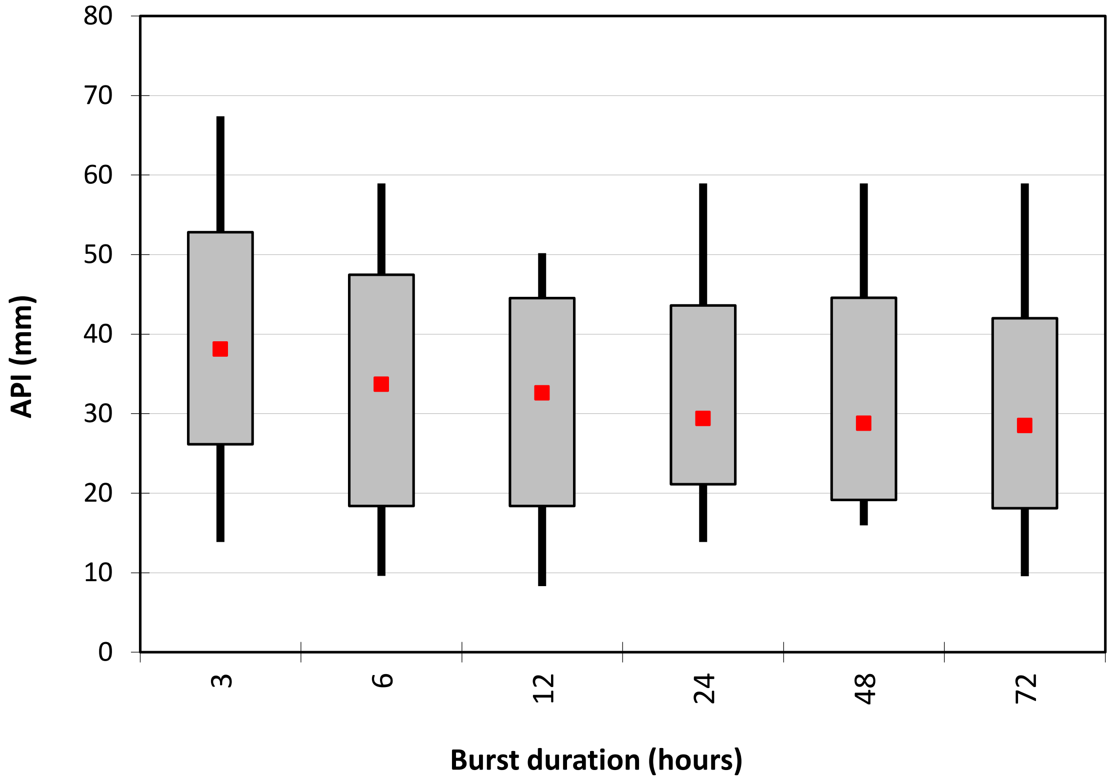


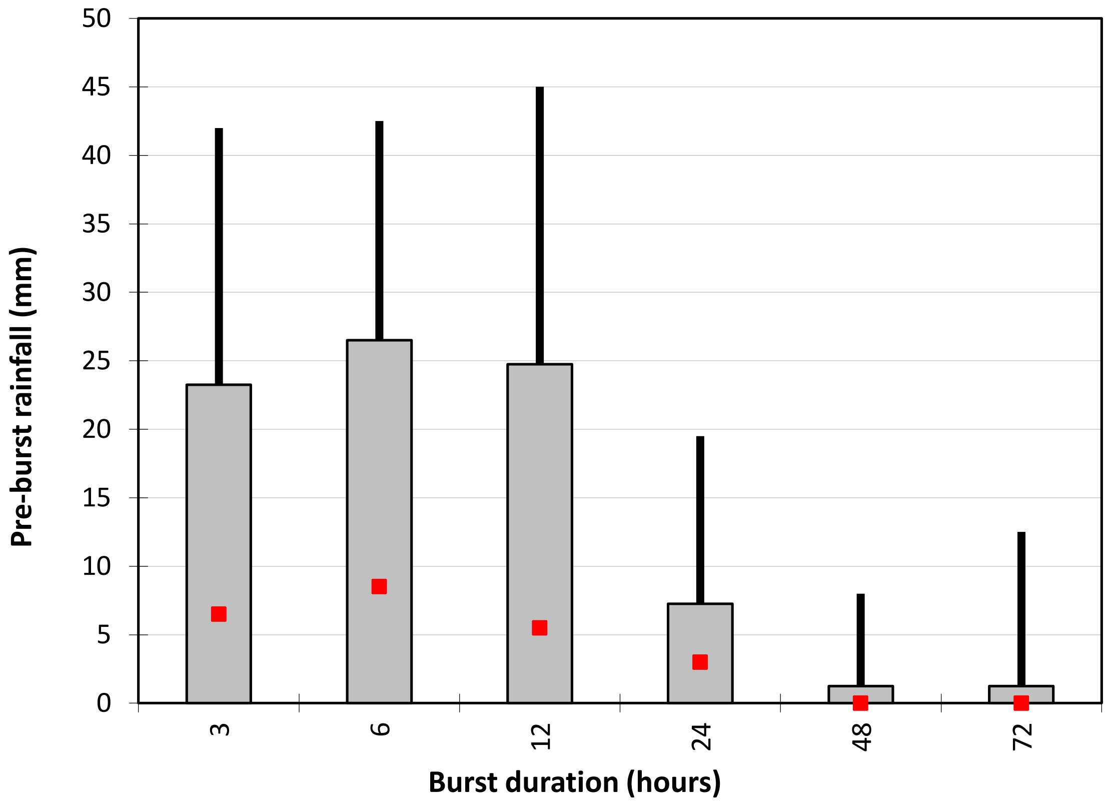
Jerrabomberra Creek @ Four Mile Creek (ACT)



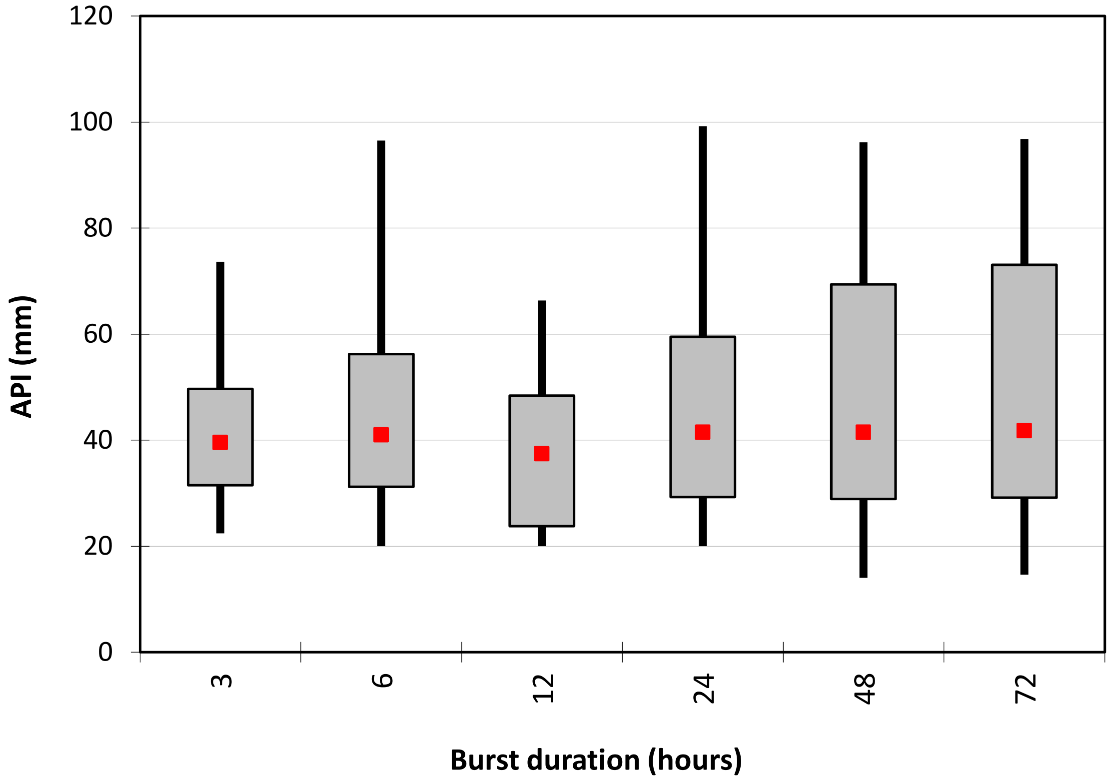


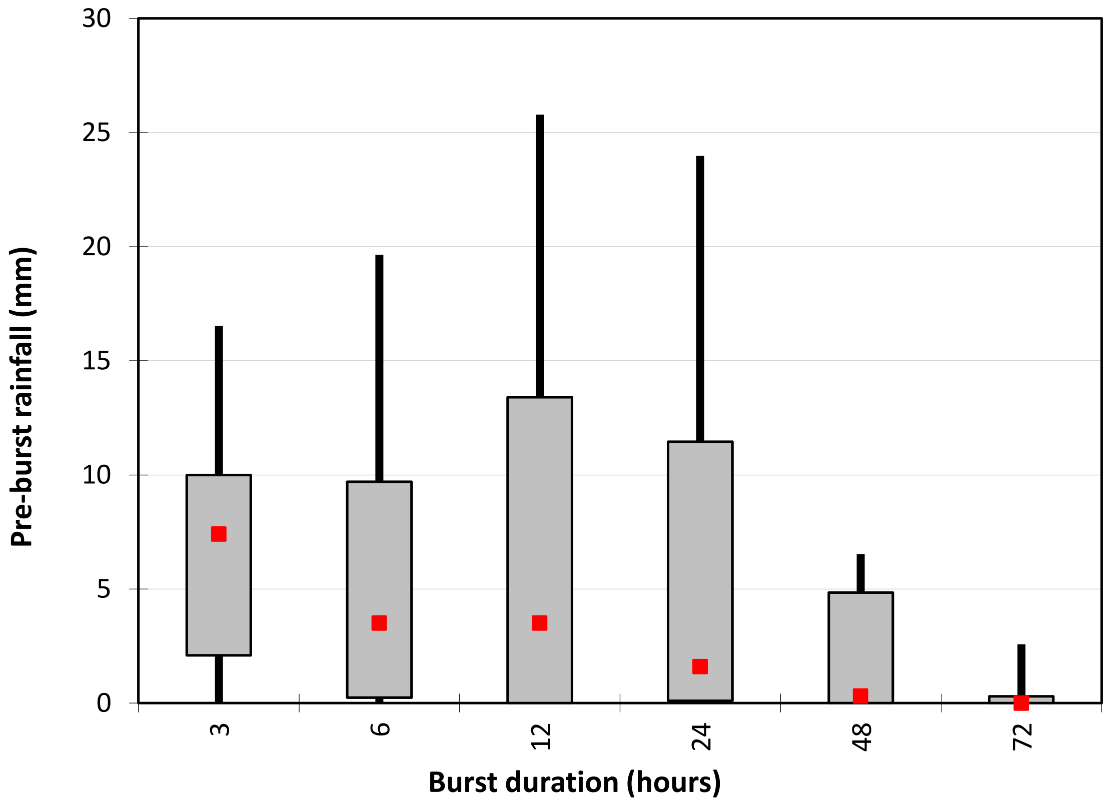
Butmaroo Ck @ Butmaroo (NSW)



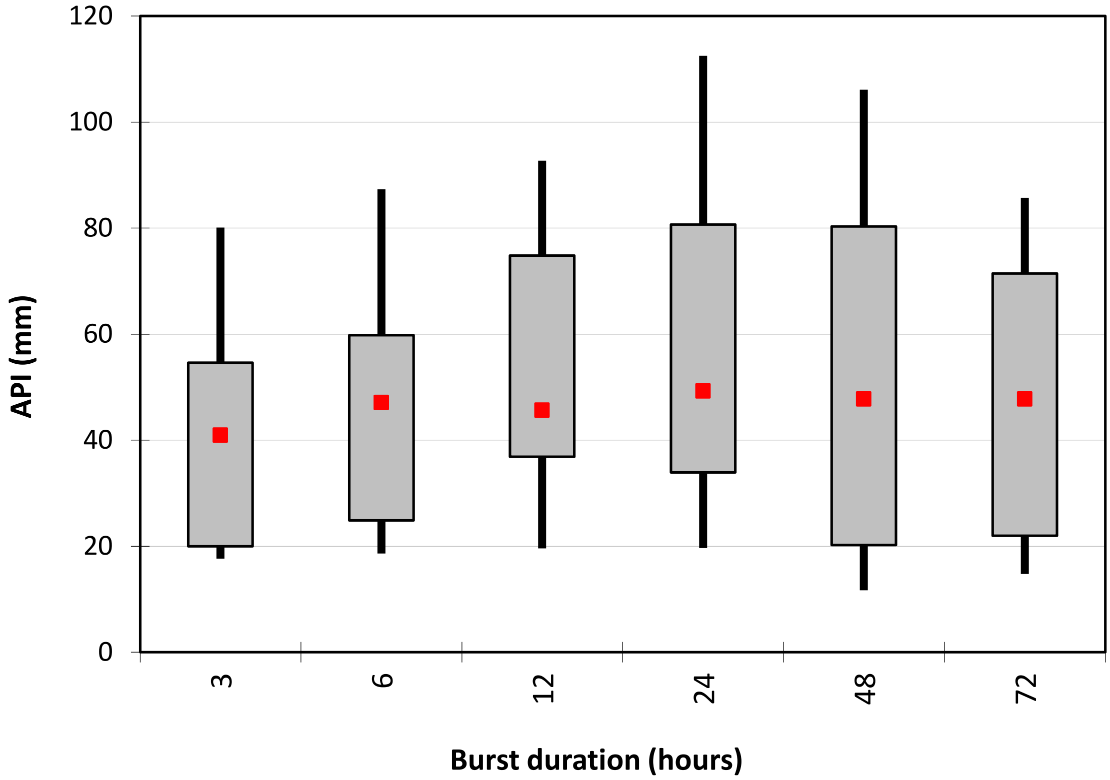


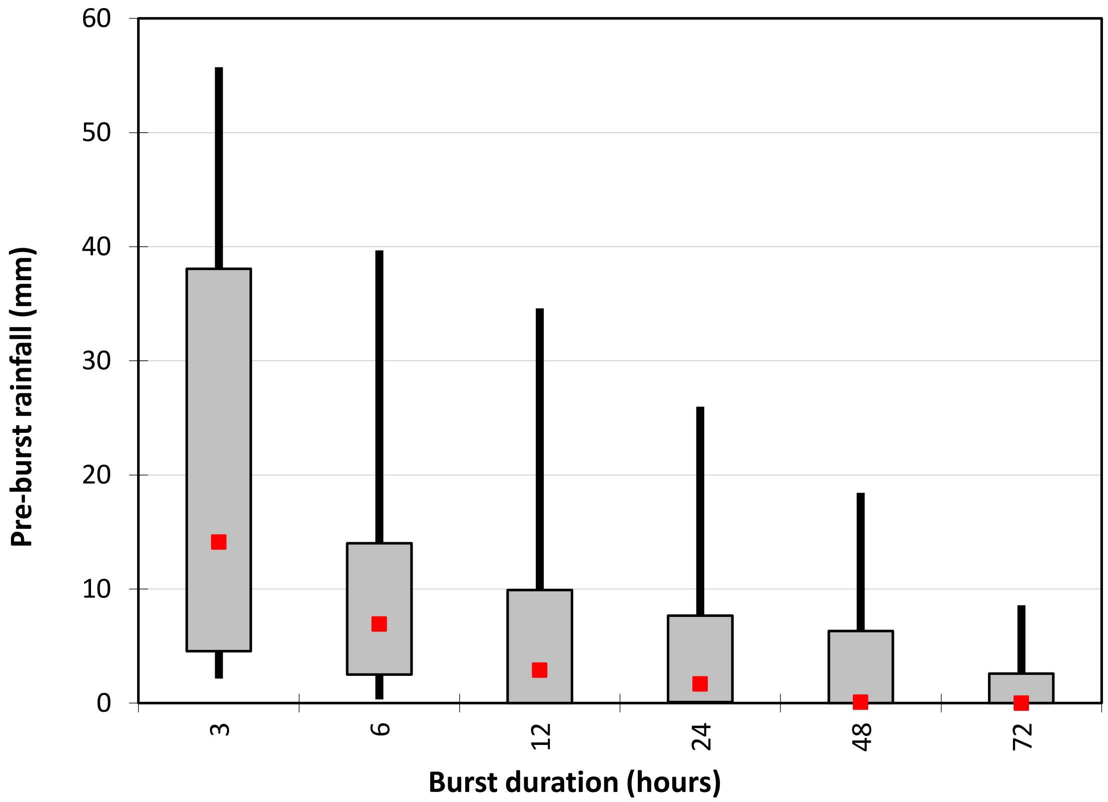
Echunga Creek @ U/S Mt Bold Res. (SA)



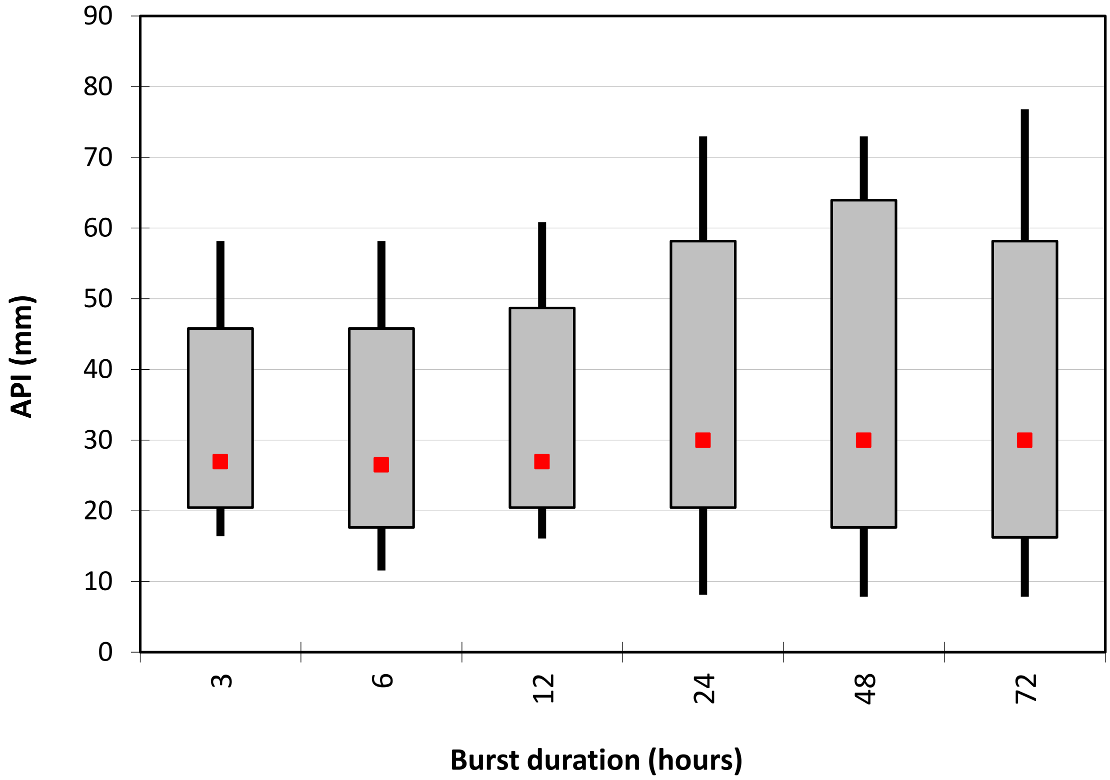


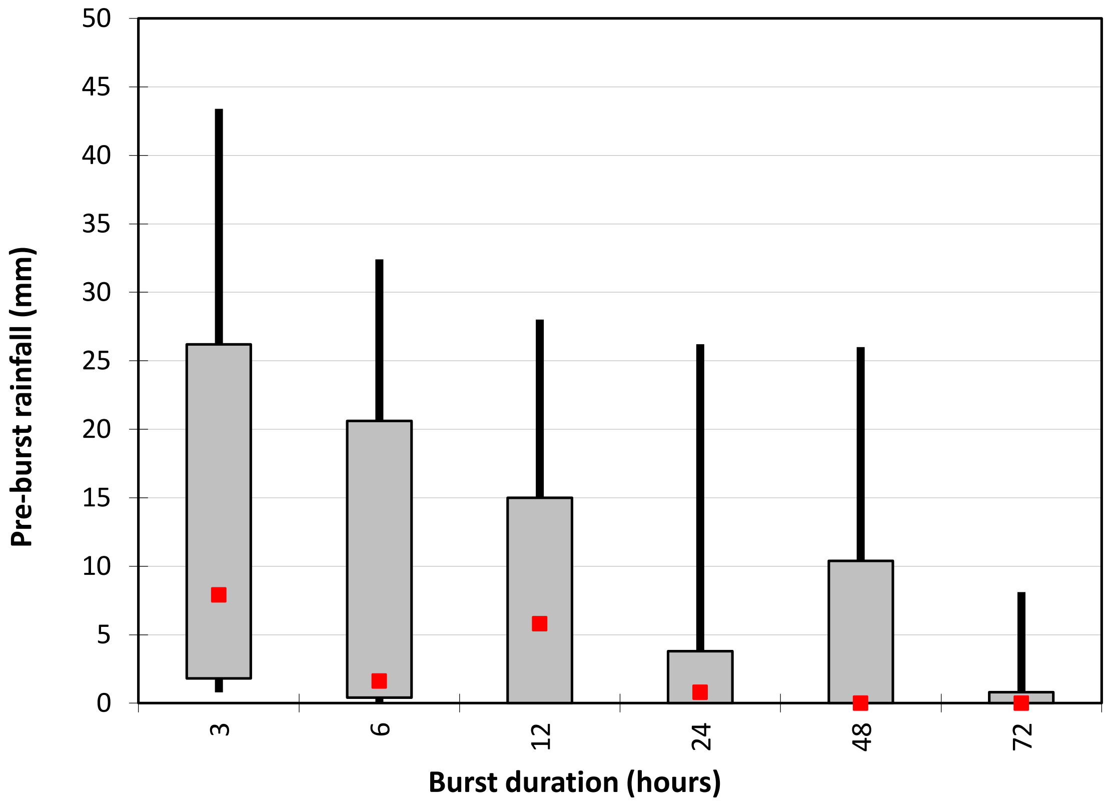
Hindmarsh River @ Hindmarsh Vy Res Offtake (SA)



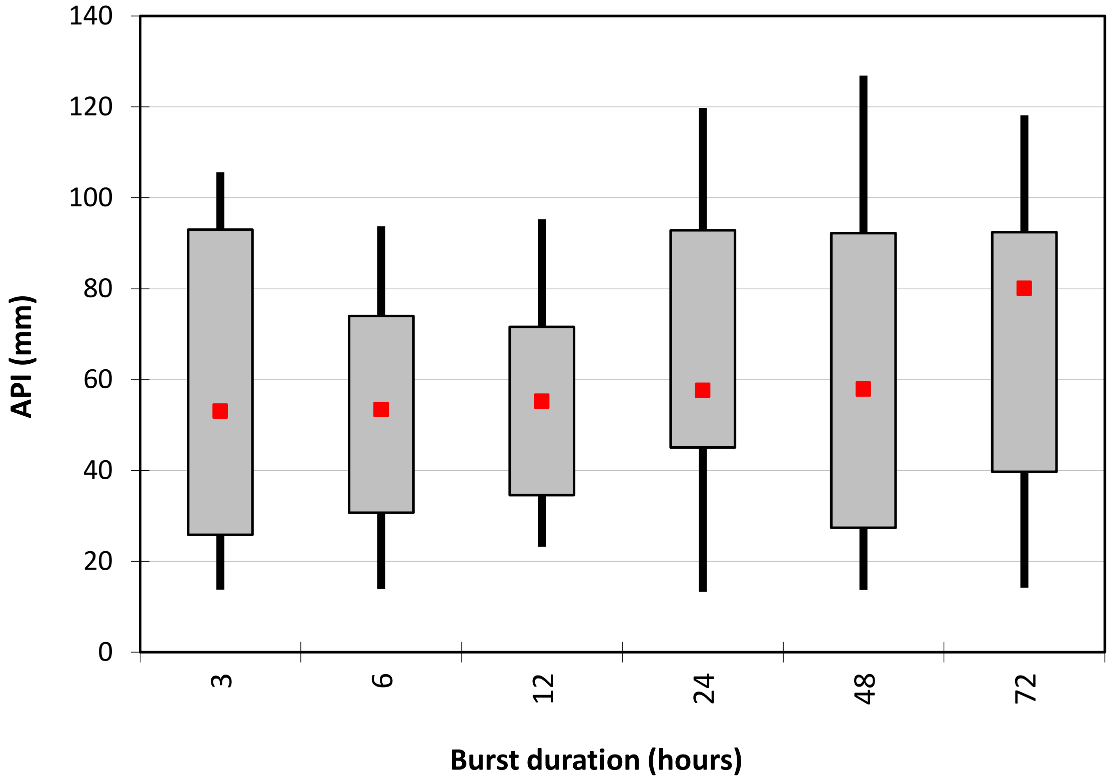


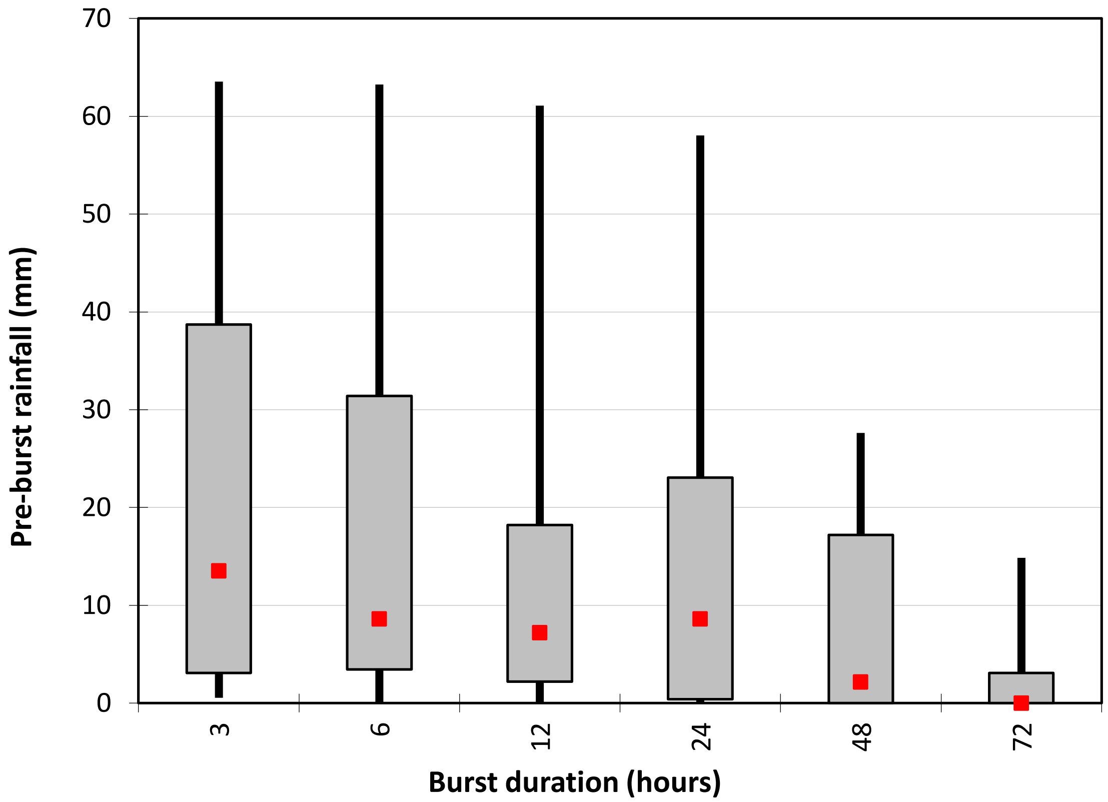
Myponga River @ U/S Dam and Rd Br (SA)



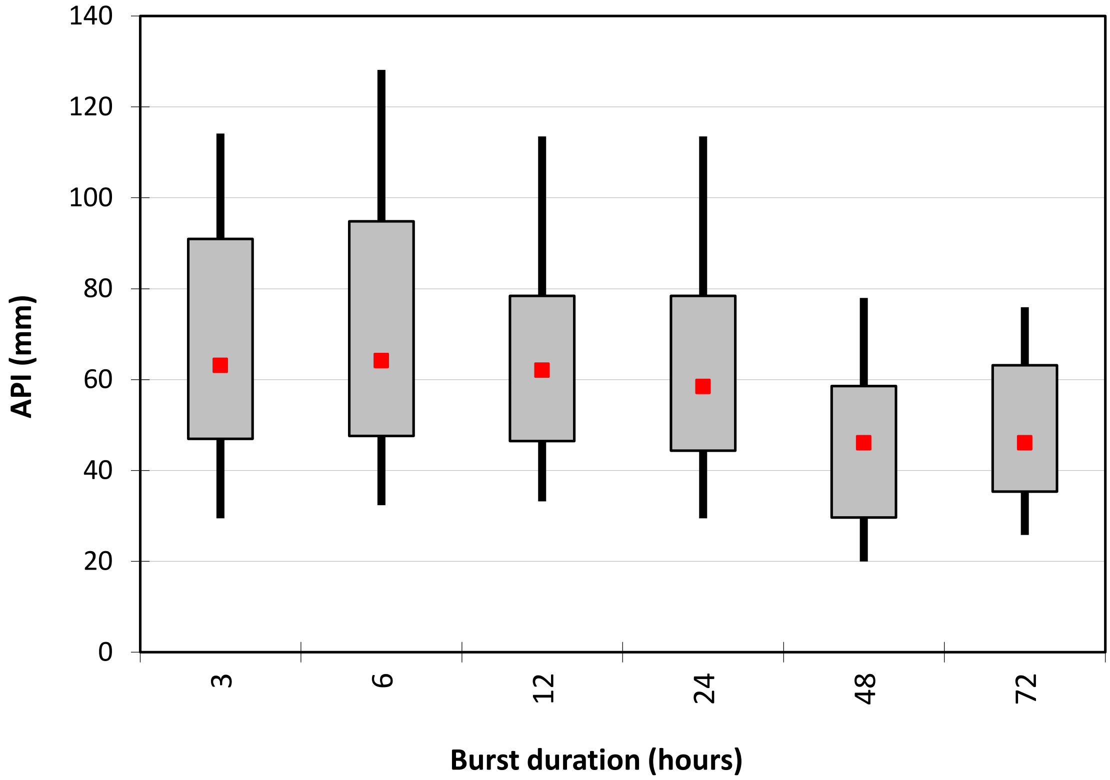


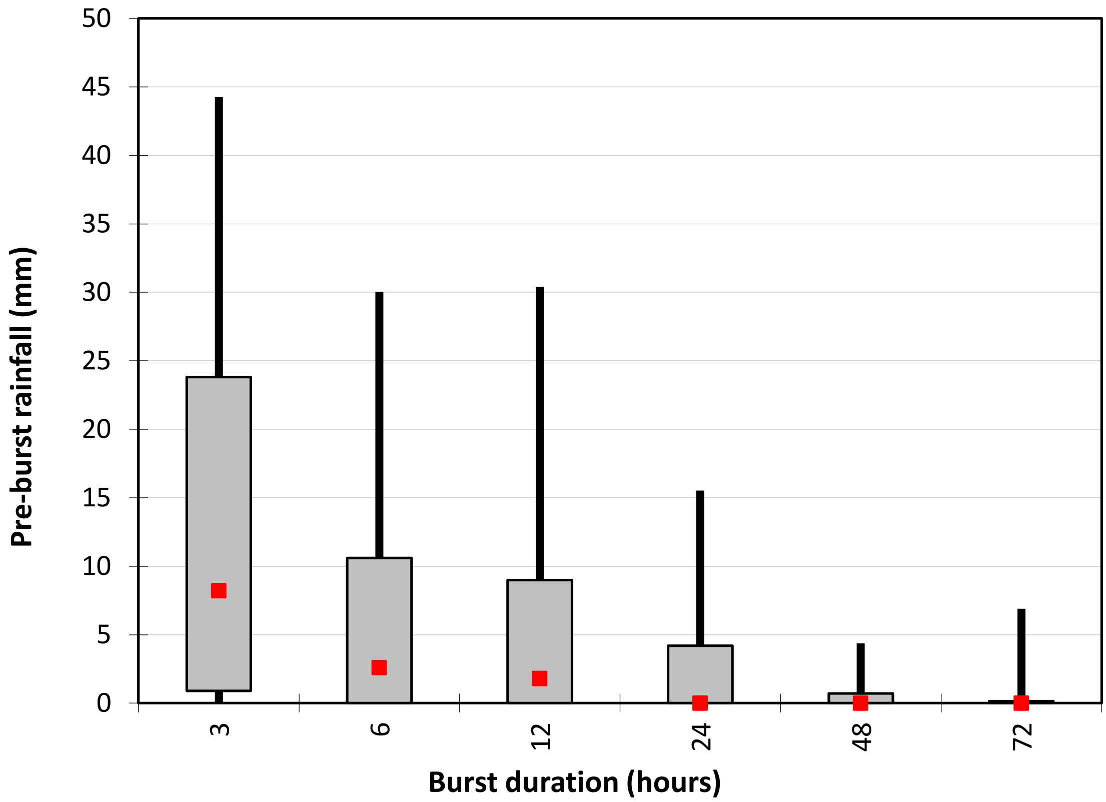
Sixth Creek @ Castambul (SA)



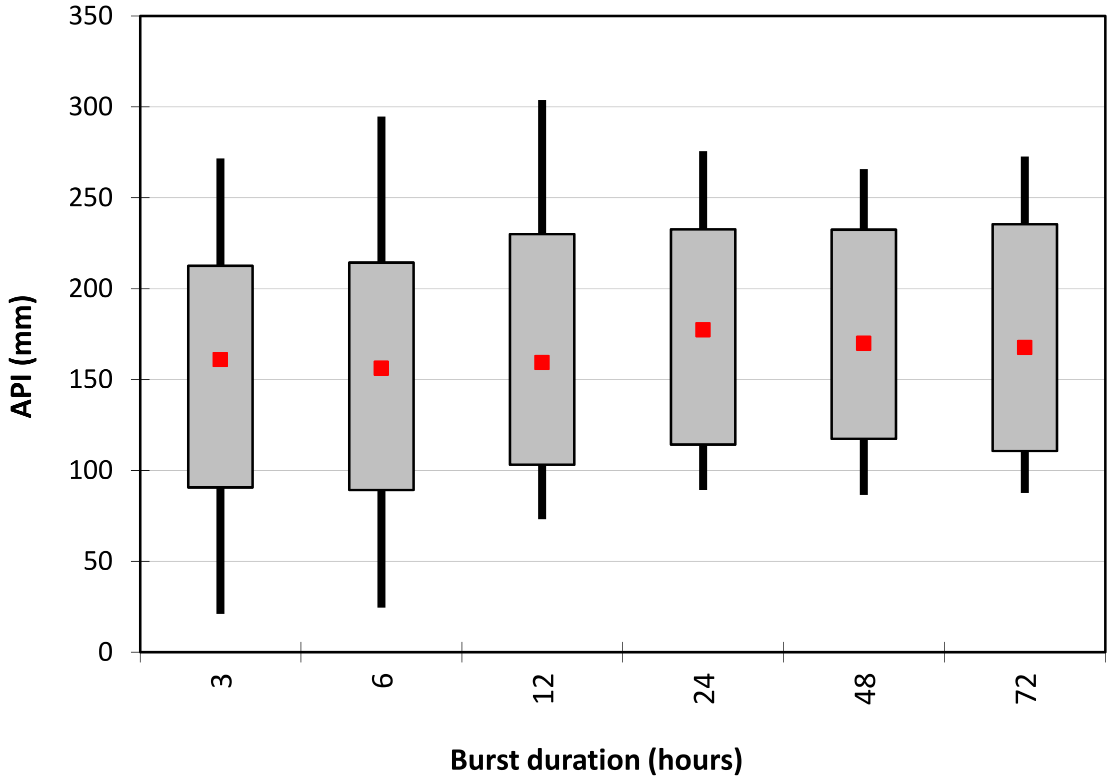


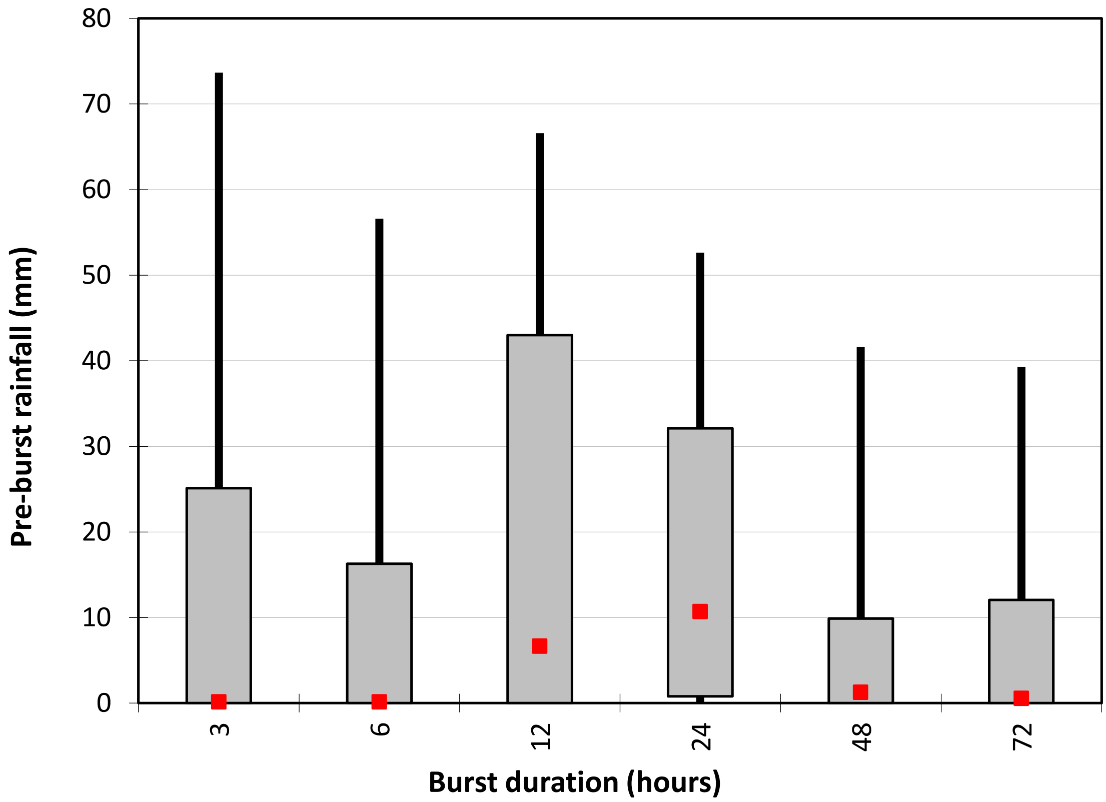
Axe Creek @ Sedgewick (VIC)



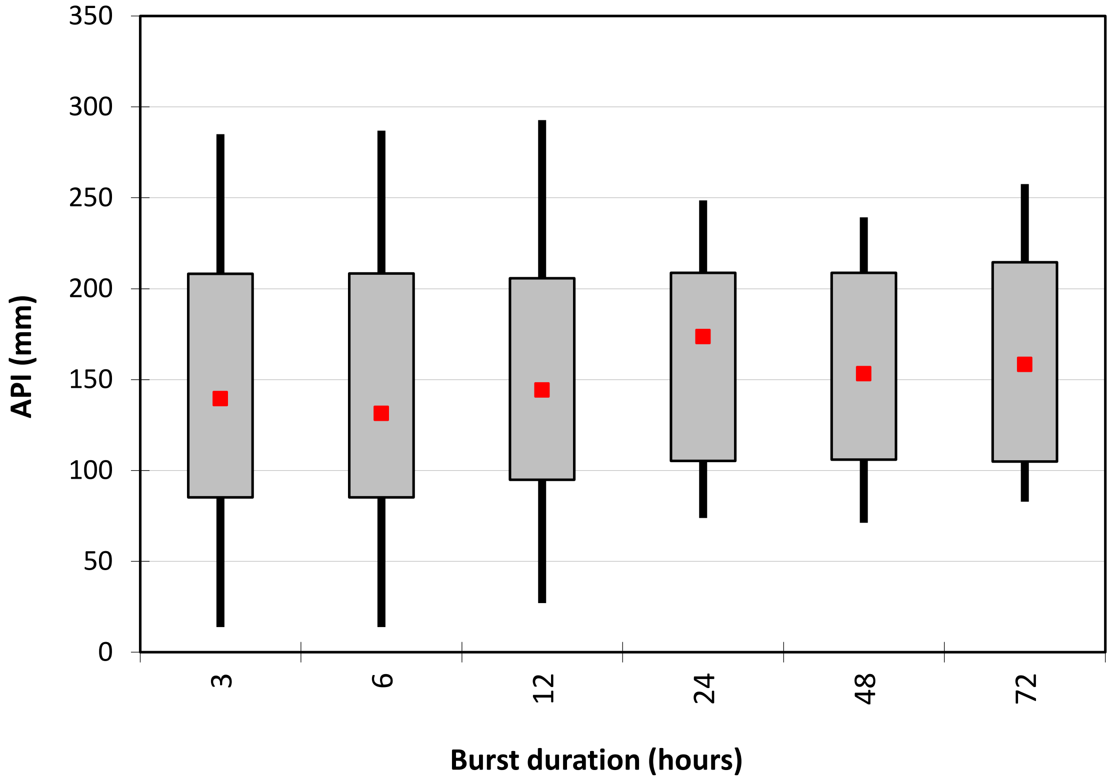


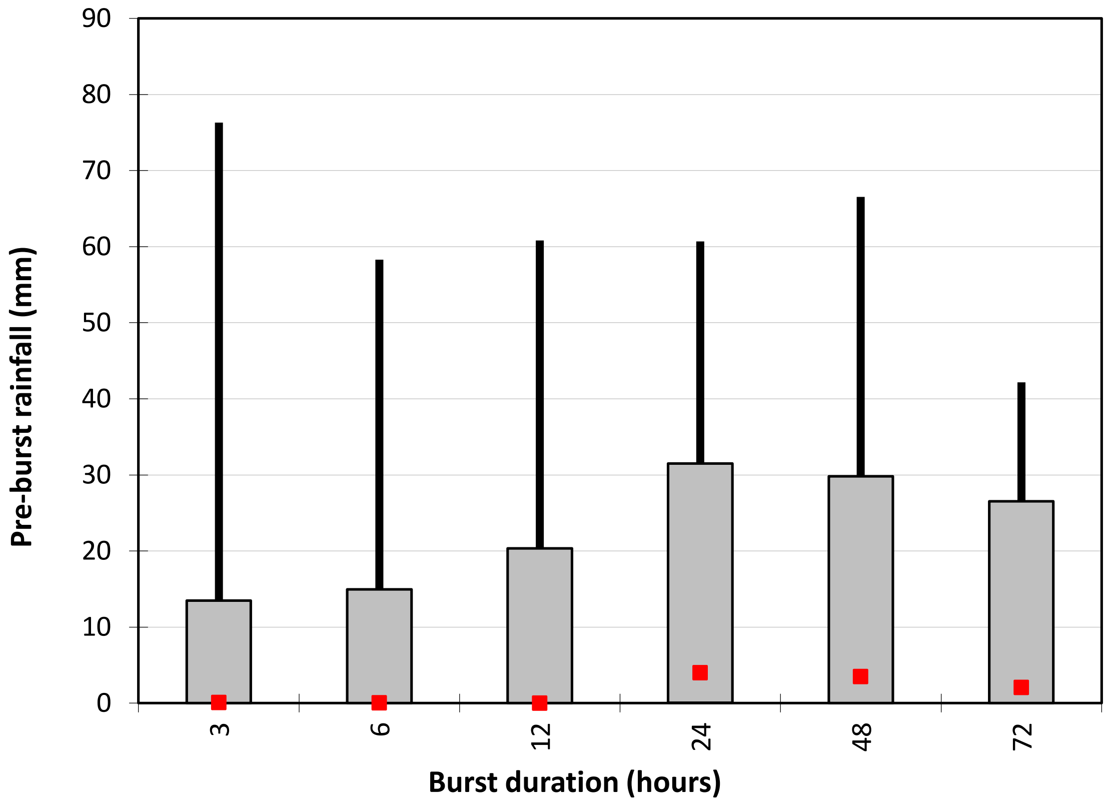
Celia Ck @ U/S Darwin R Dam (NT)



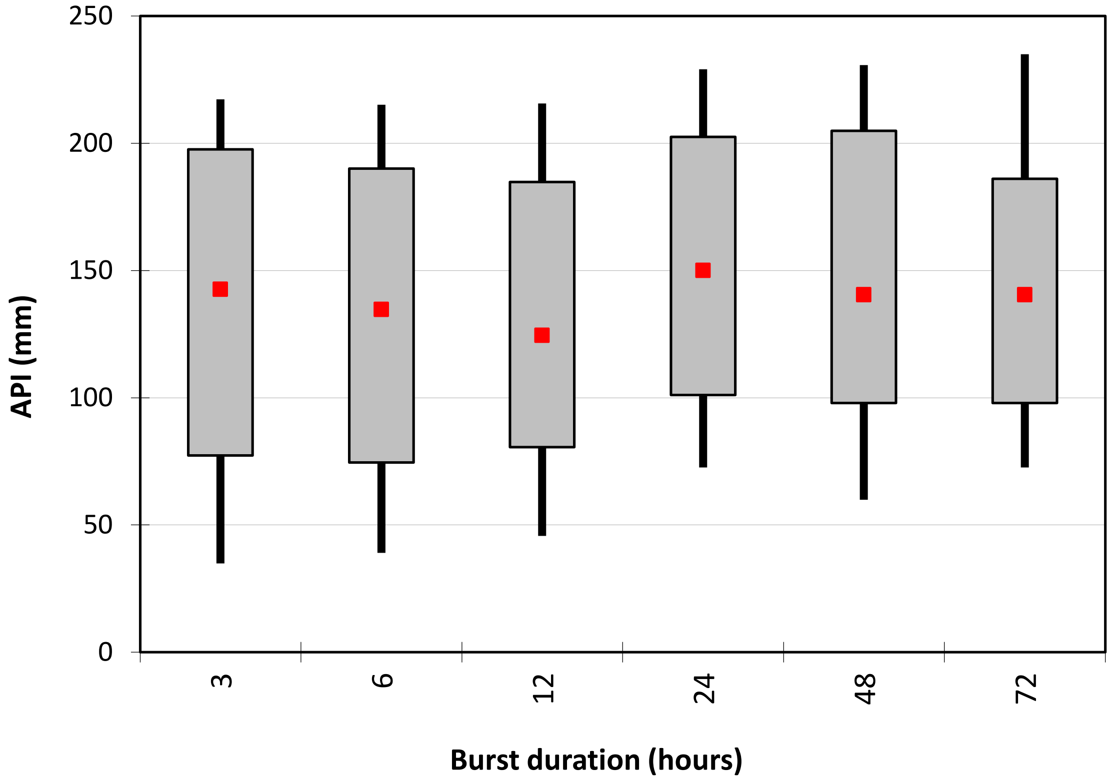


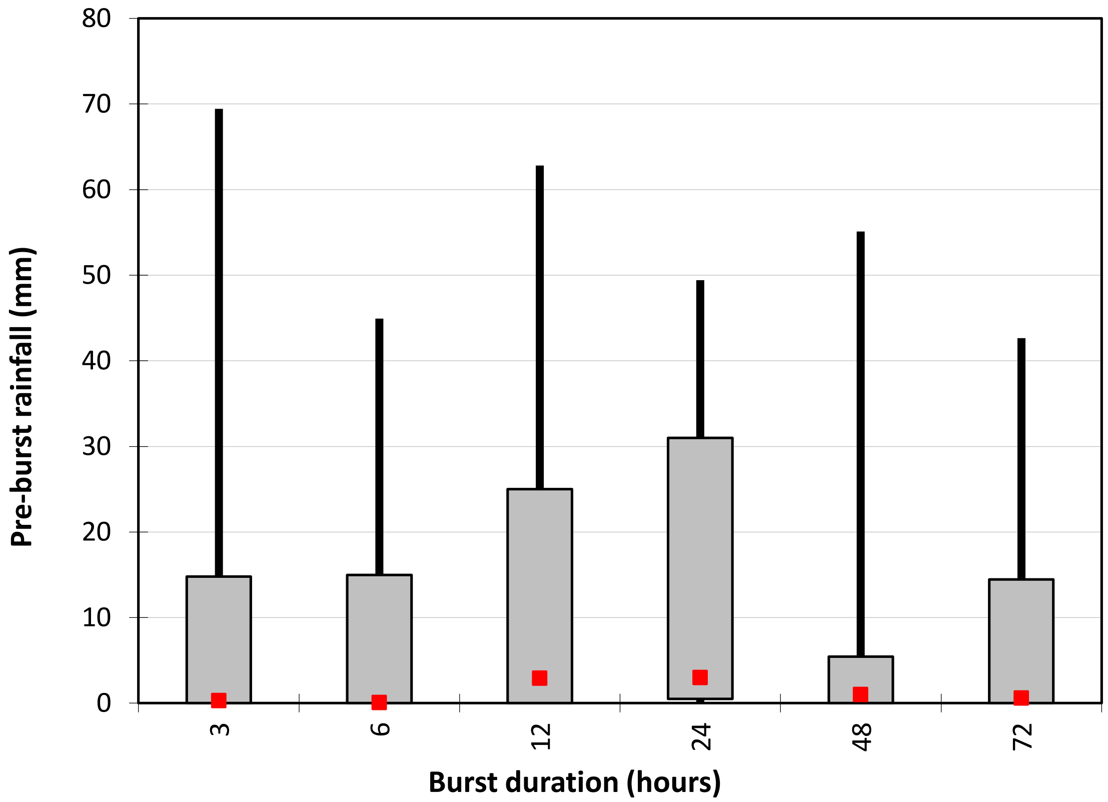
Coomalie @ Stuart Highway (NT)



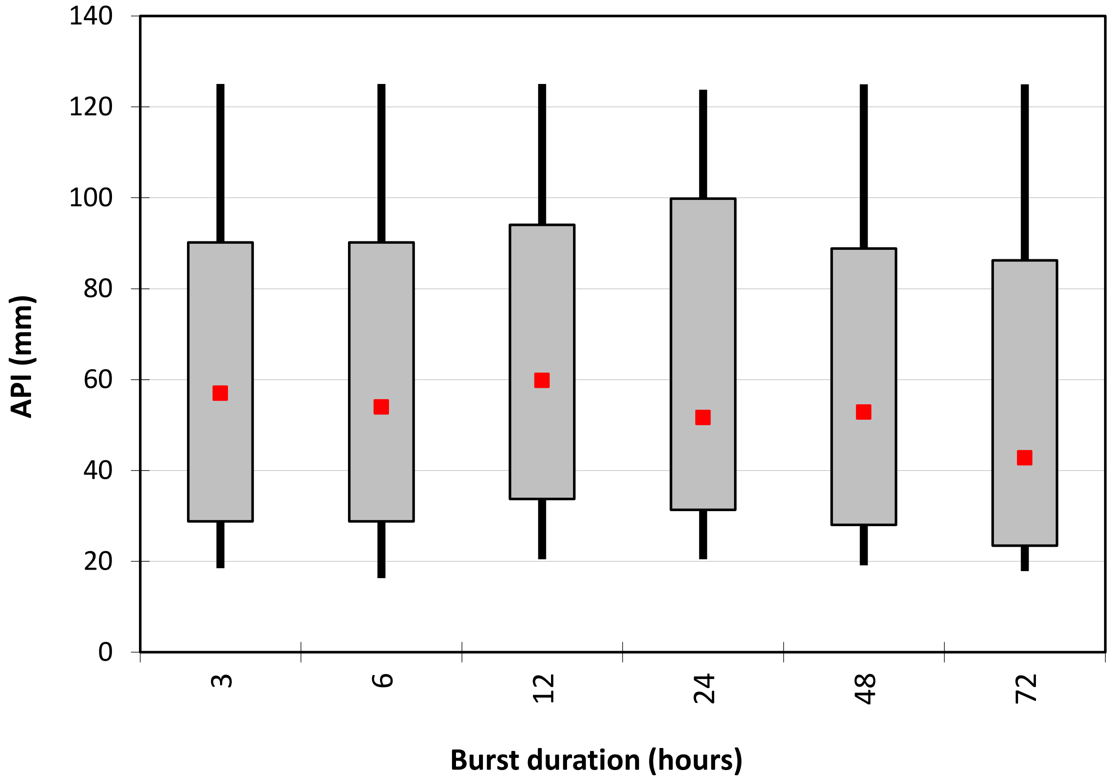


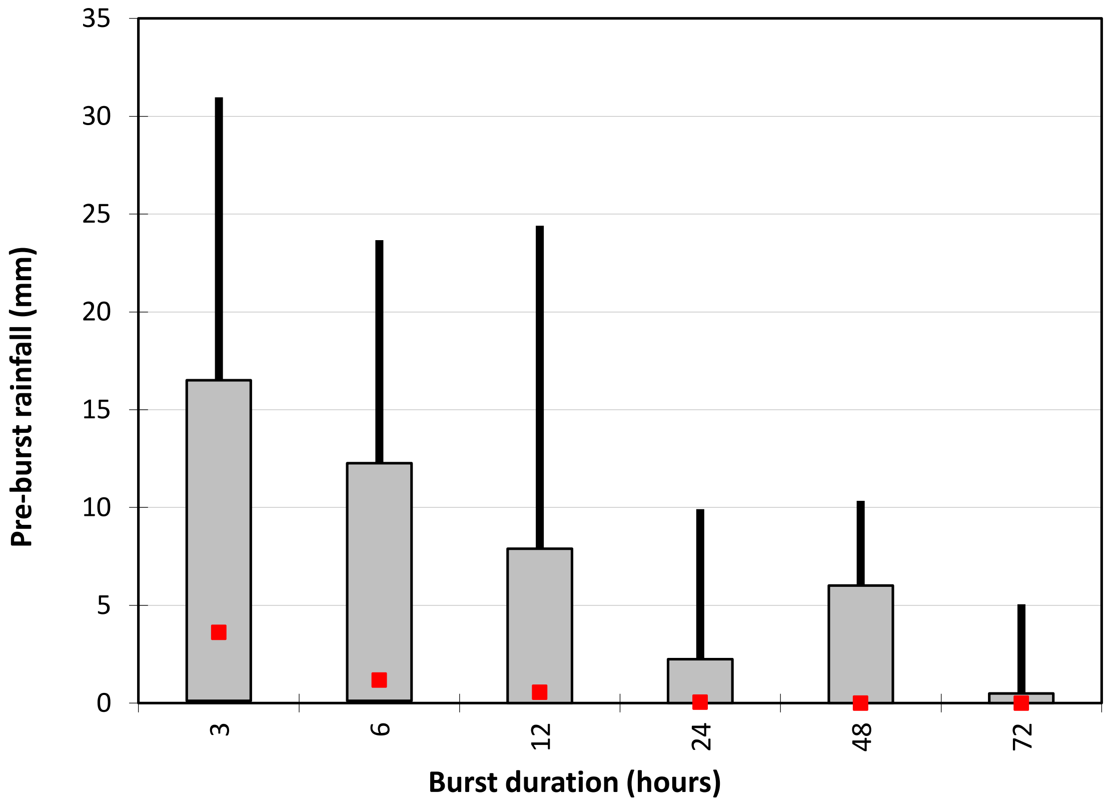
Manton River @ U/S Manton Dam (NT)



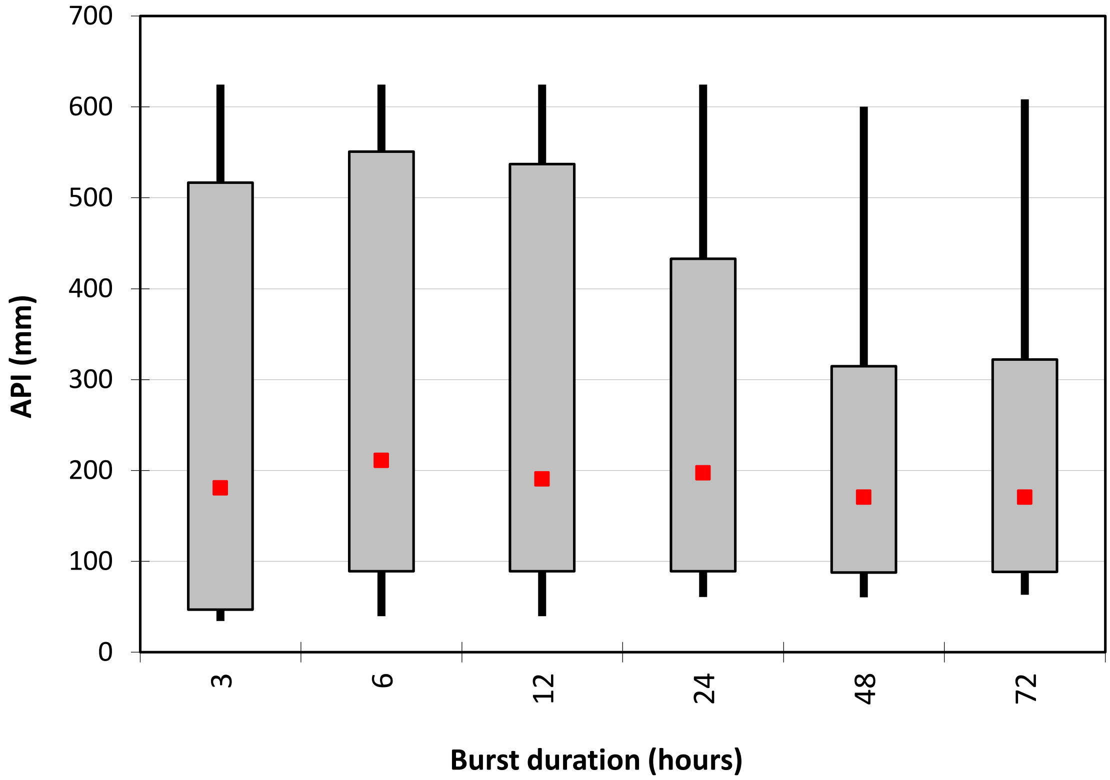


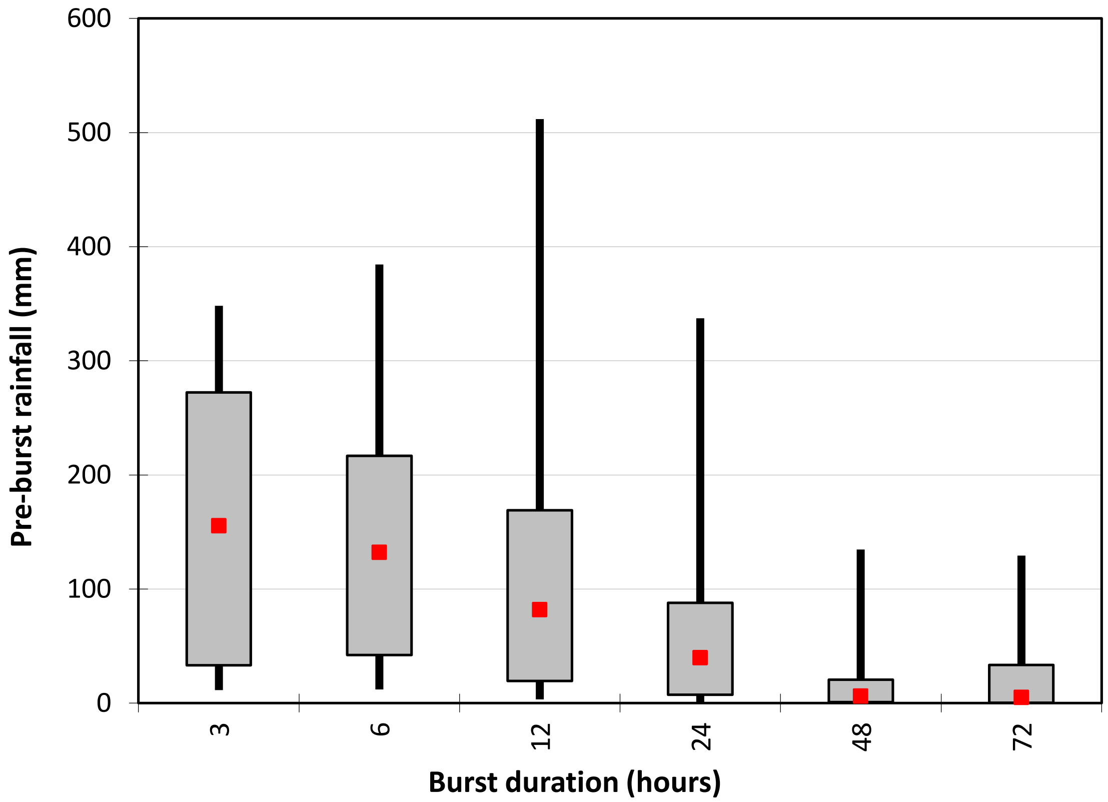
Tennant Ck @ Old Telegraph Station (NT)



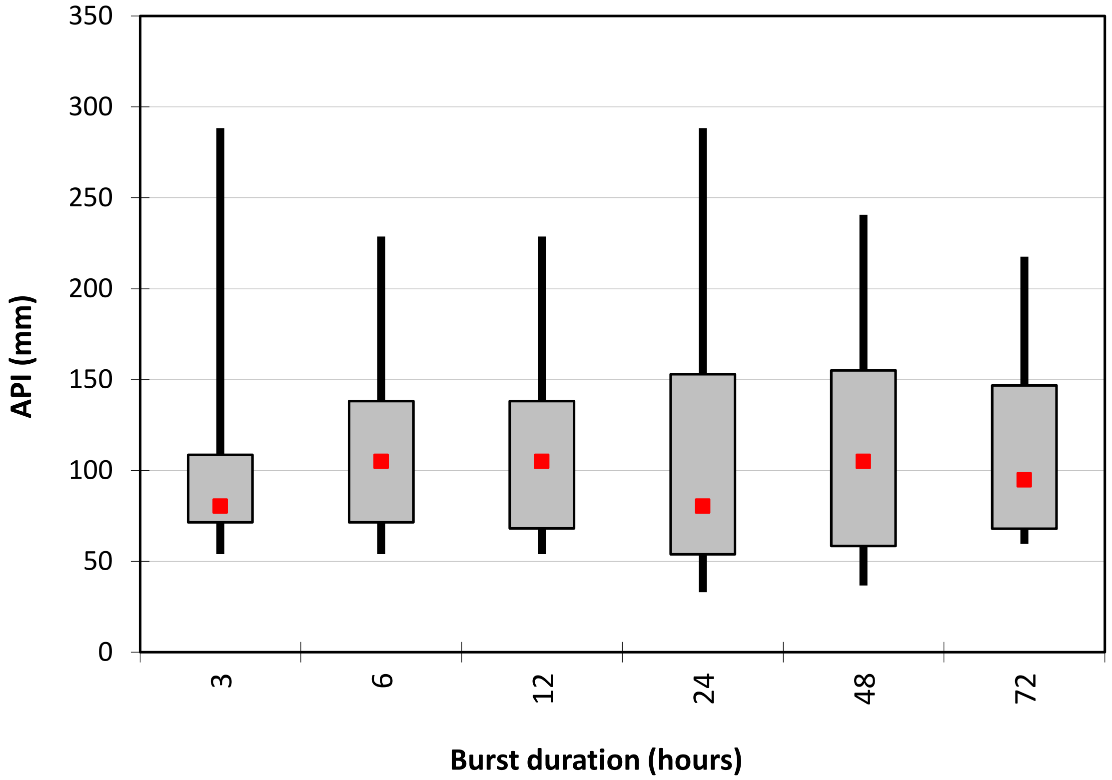


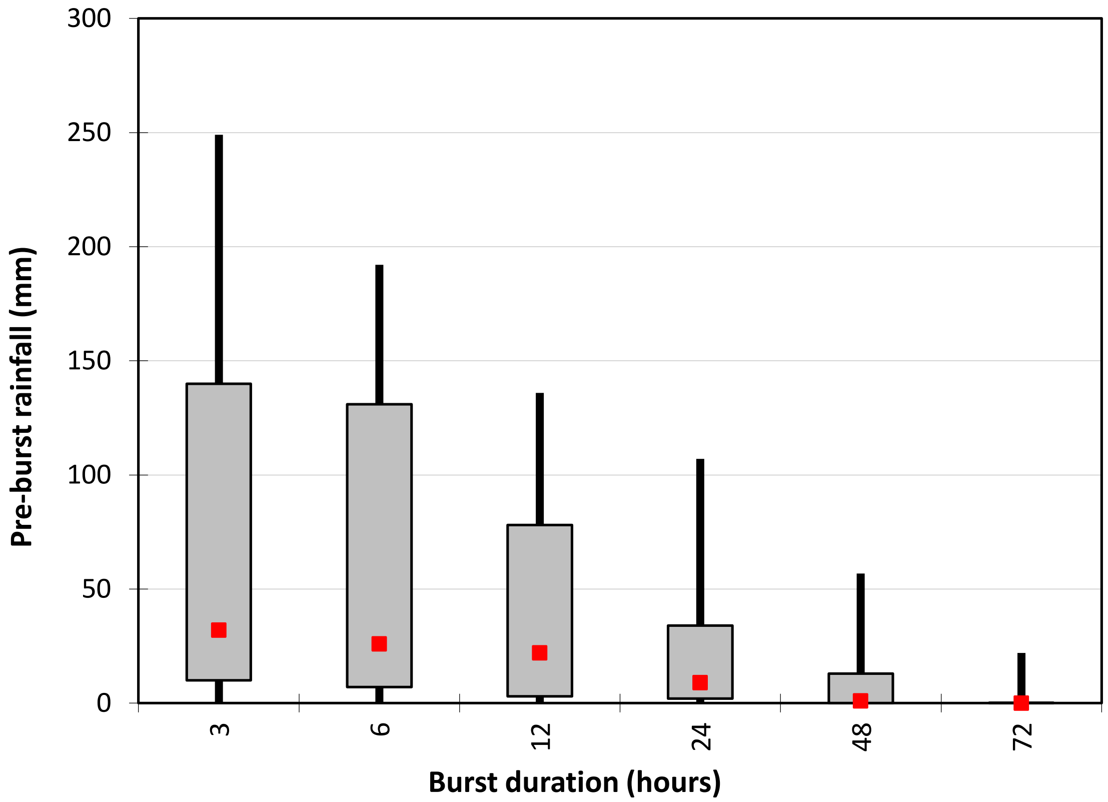
Broken River @ Old Racecourse (QLD)



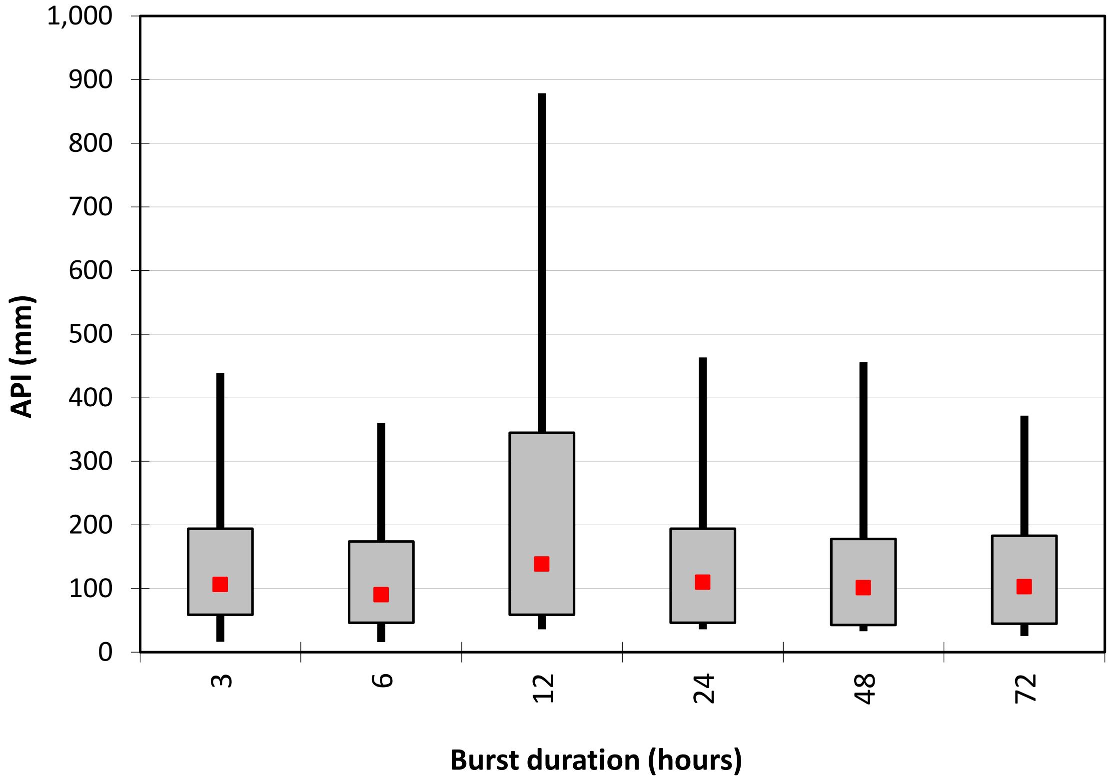


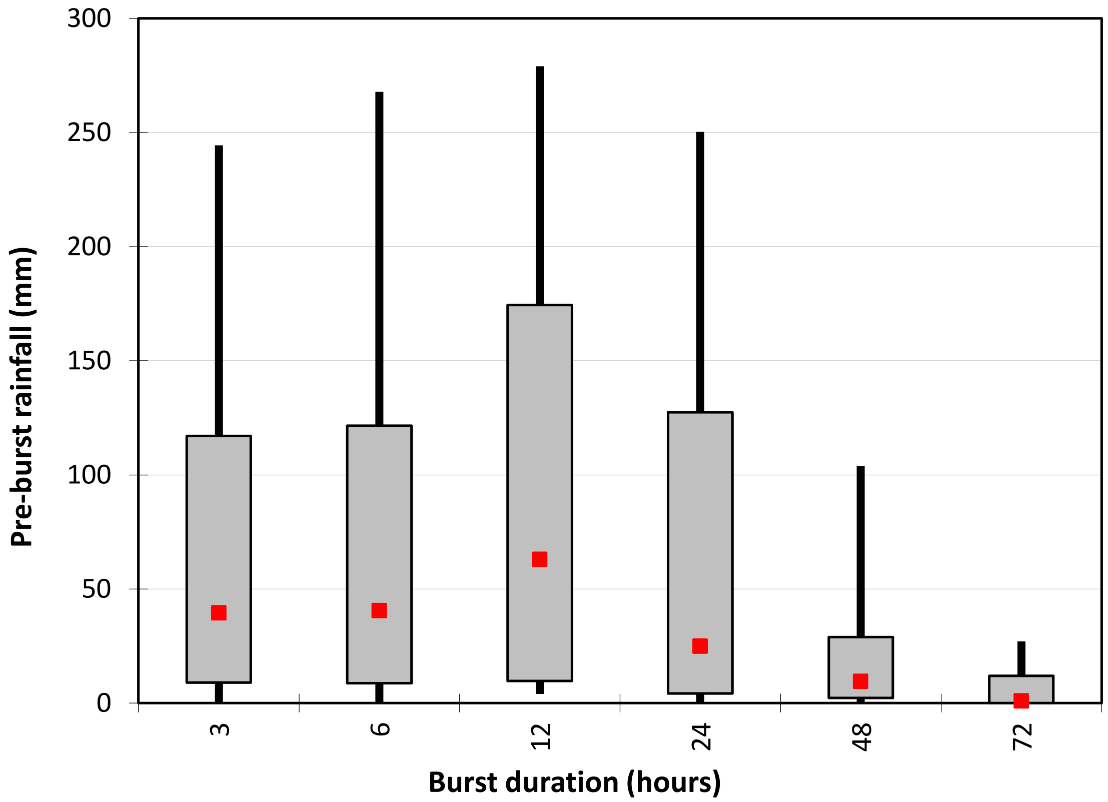
Caboolture River @ Upper Caboolture (QLD)



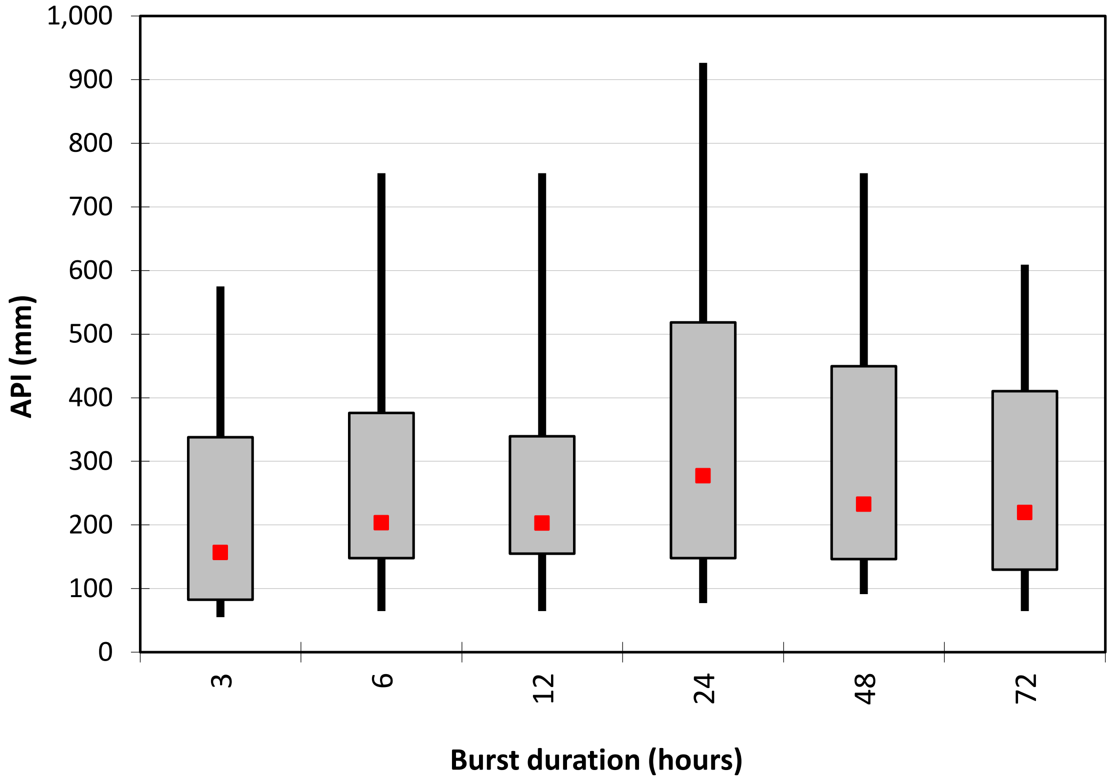


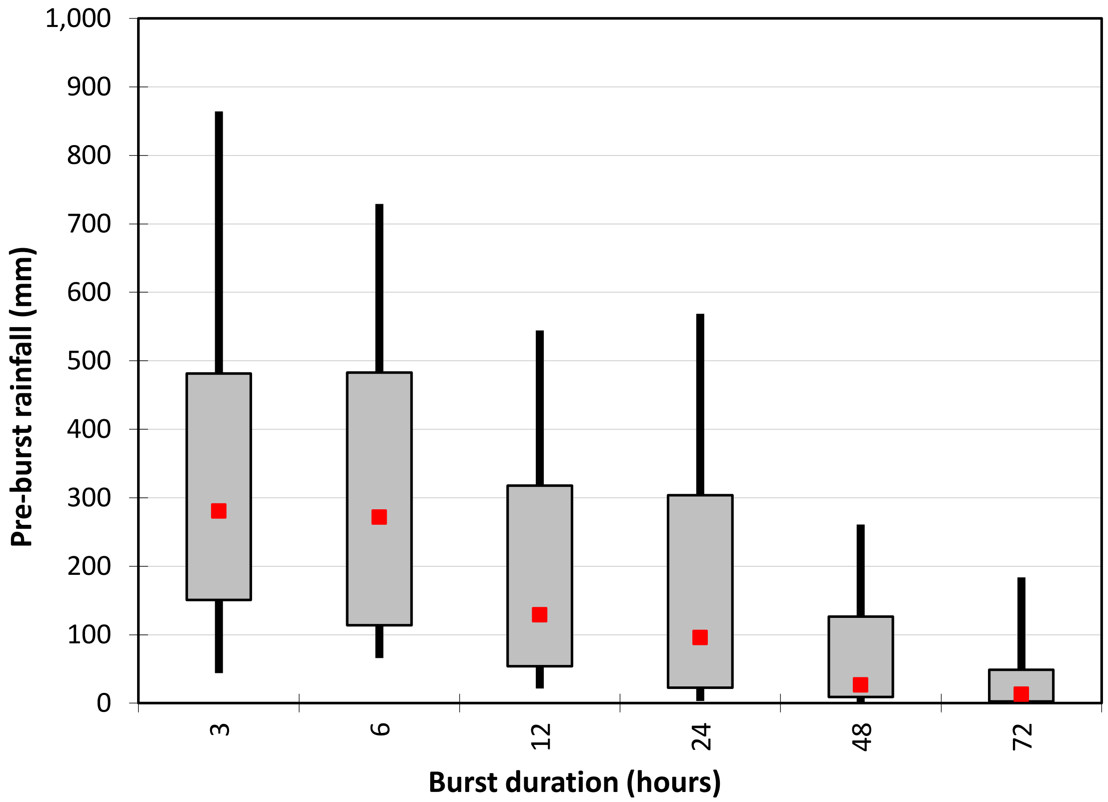
Carmila Creek @ Carmila (QLD)



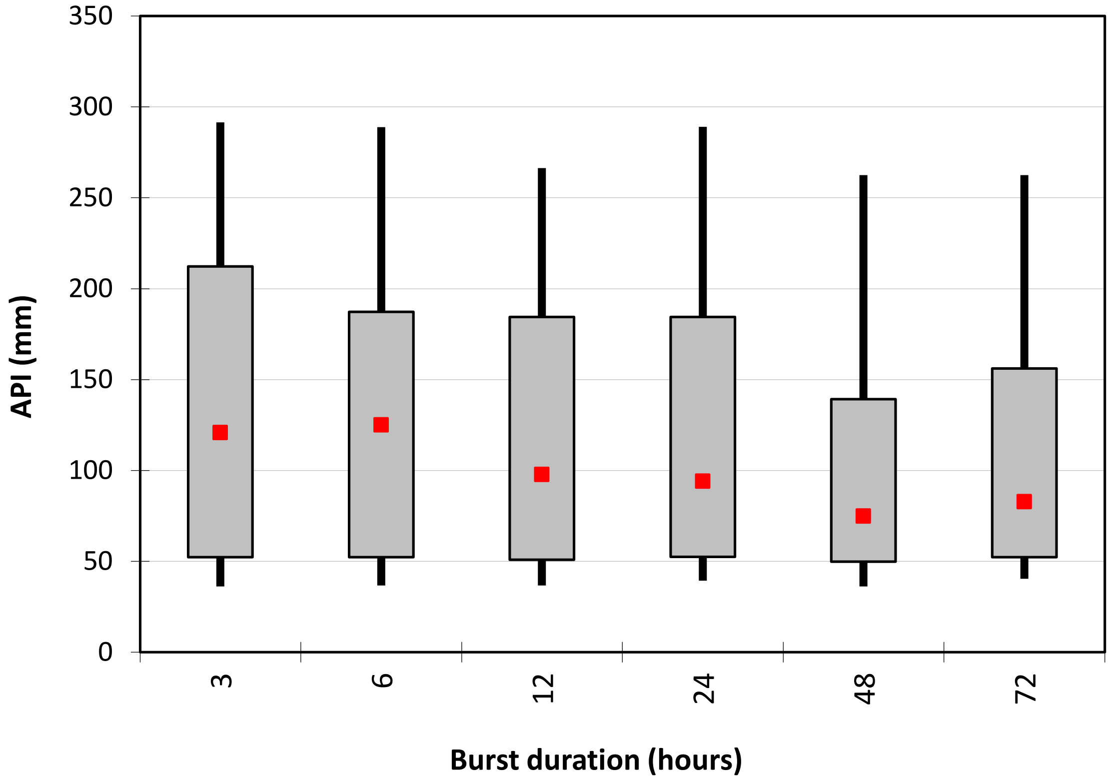


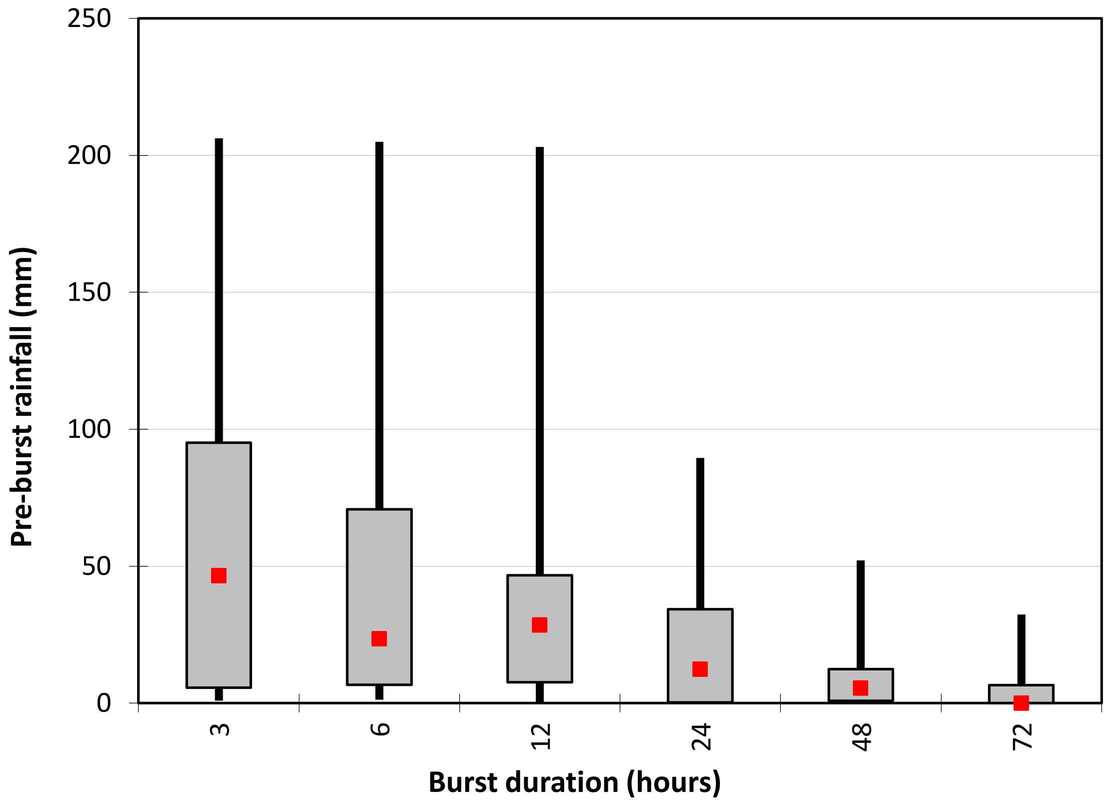
Finch Hatton Ck @ Dam Site (QLD)



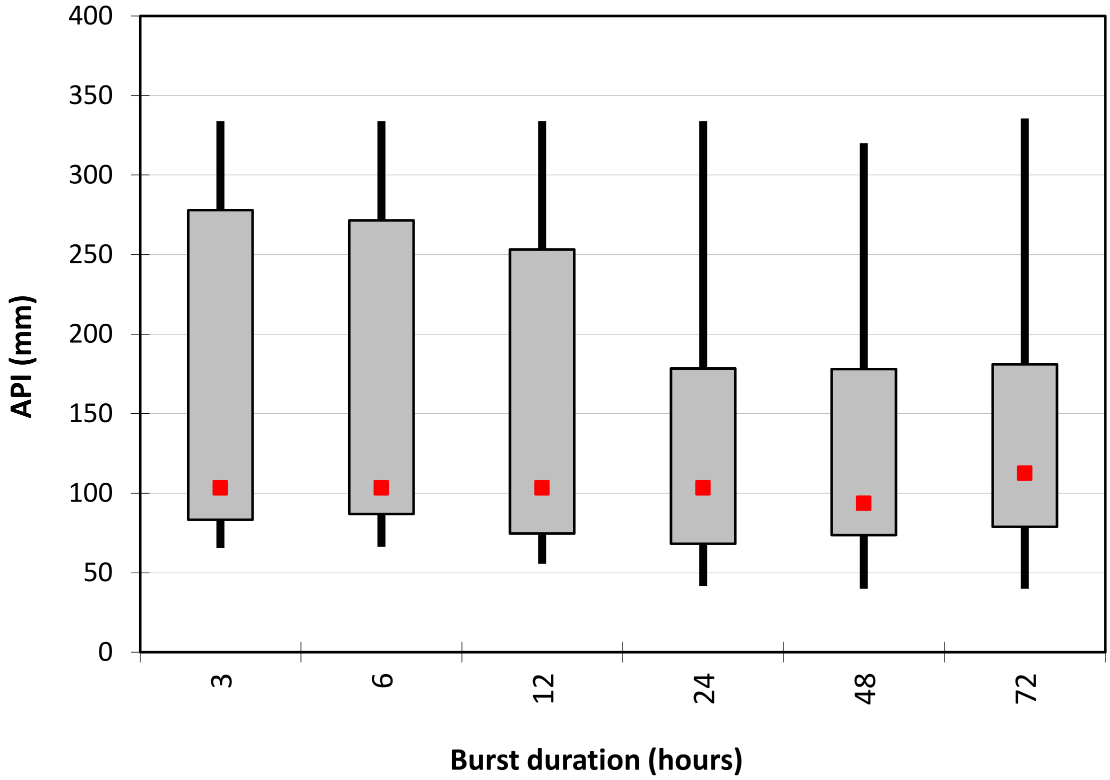


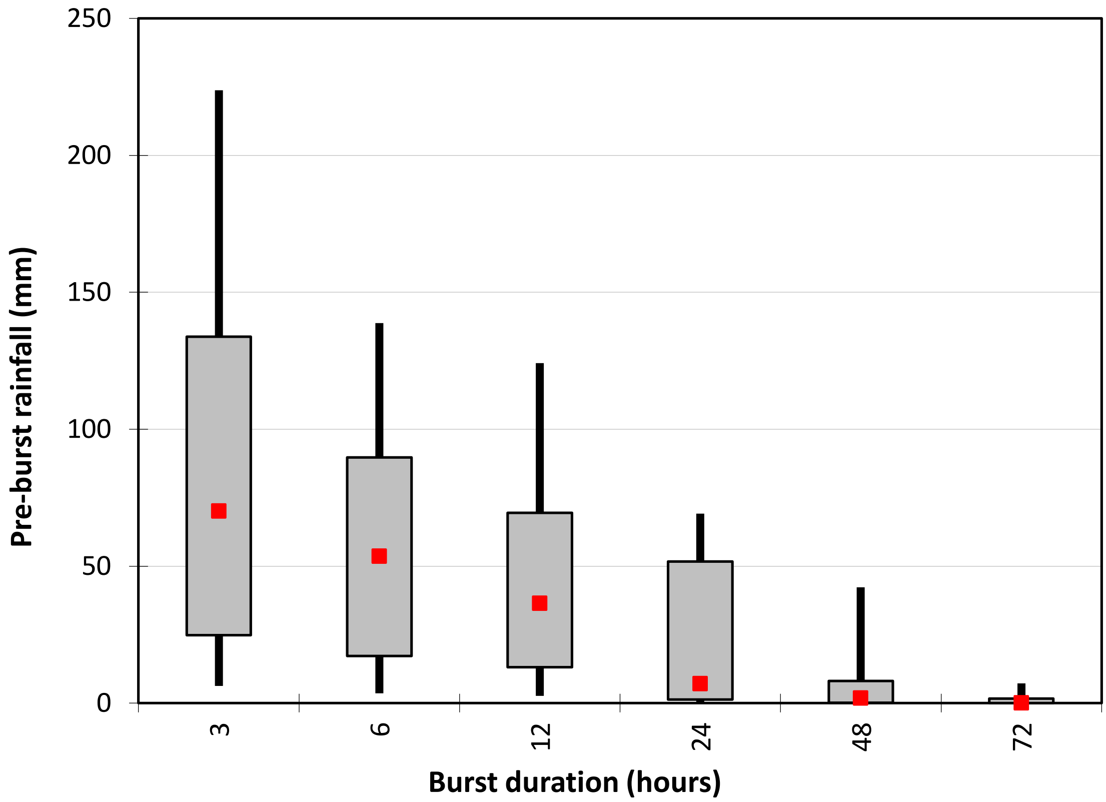
North Maroochy River @ Eumundi (QLD)



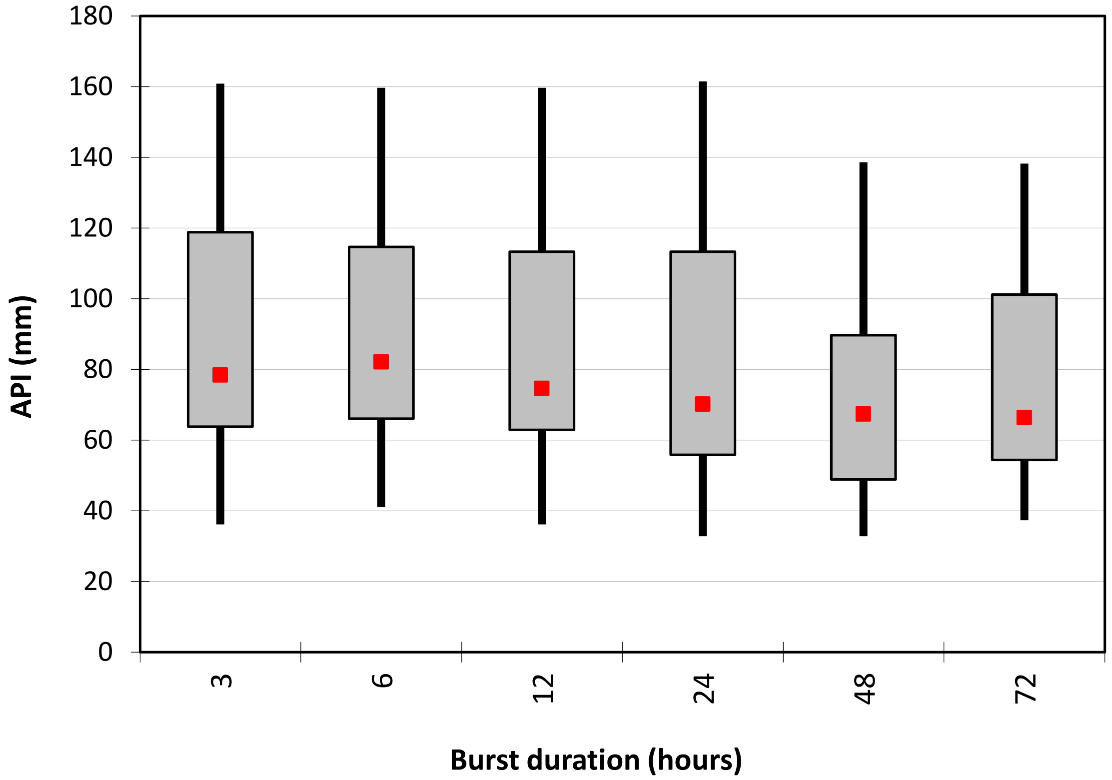


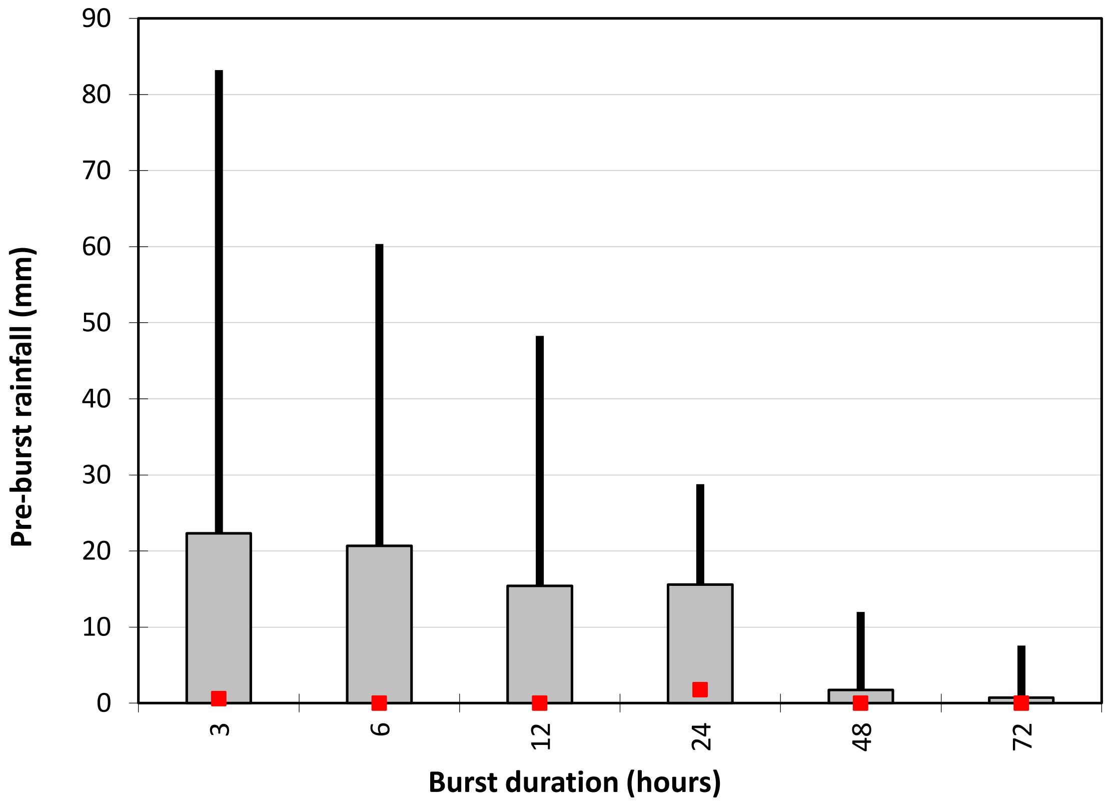
South Maroochy @ Kiamba (QLD)



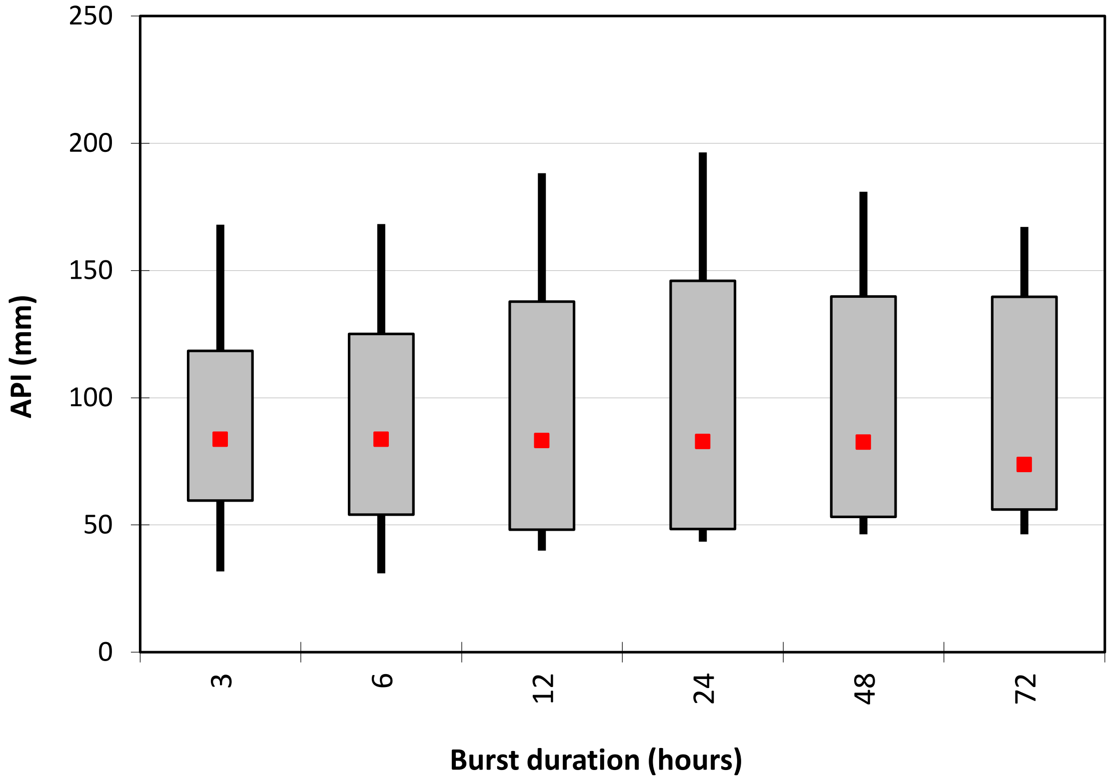


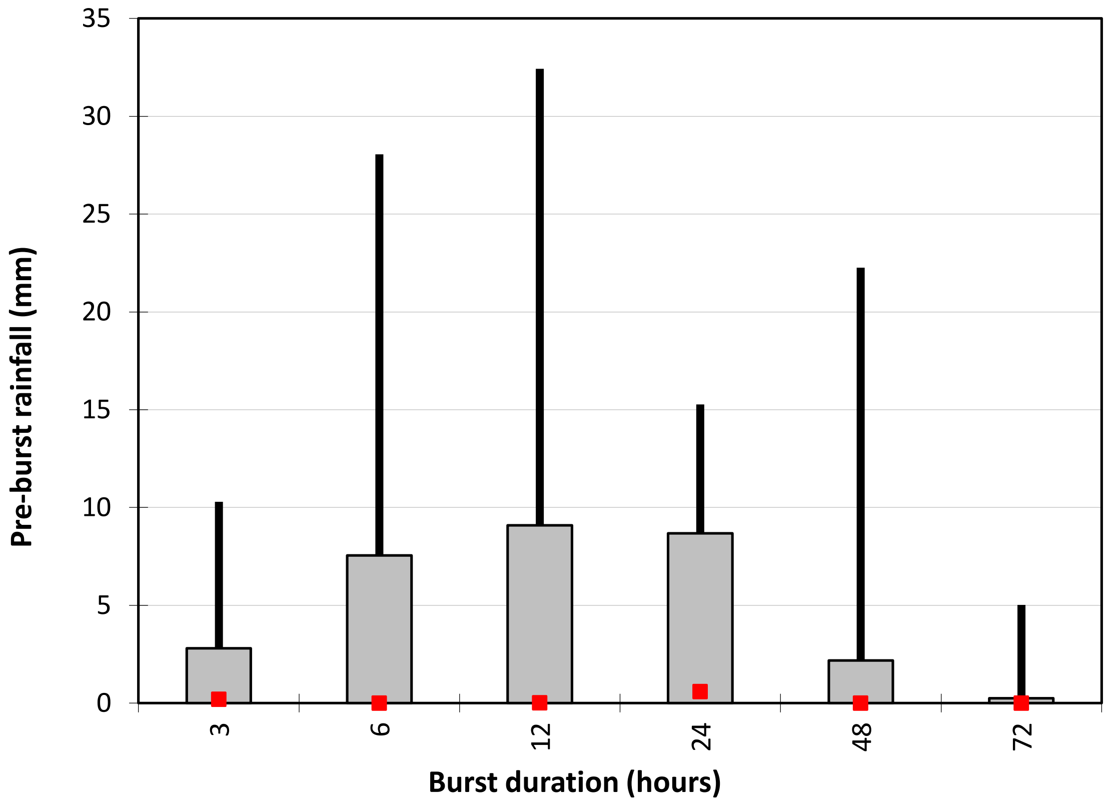
Spring Creek @ Killarney (QLD)



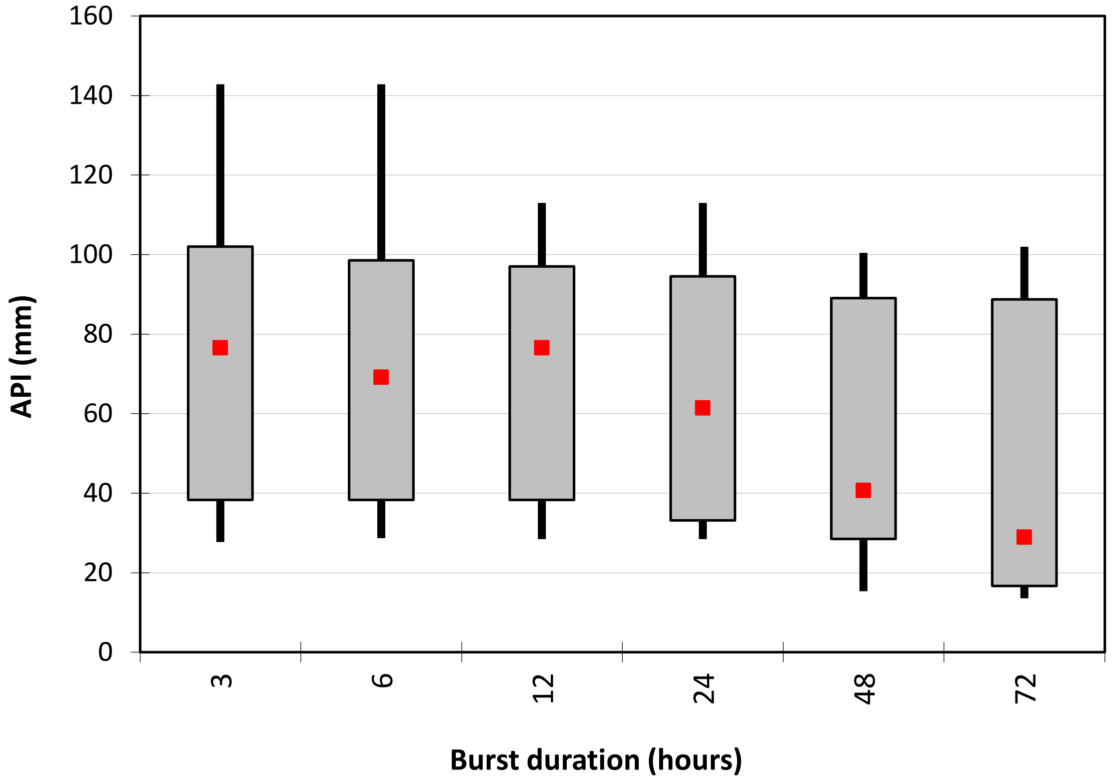


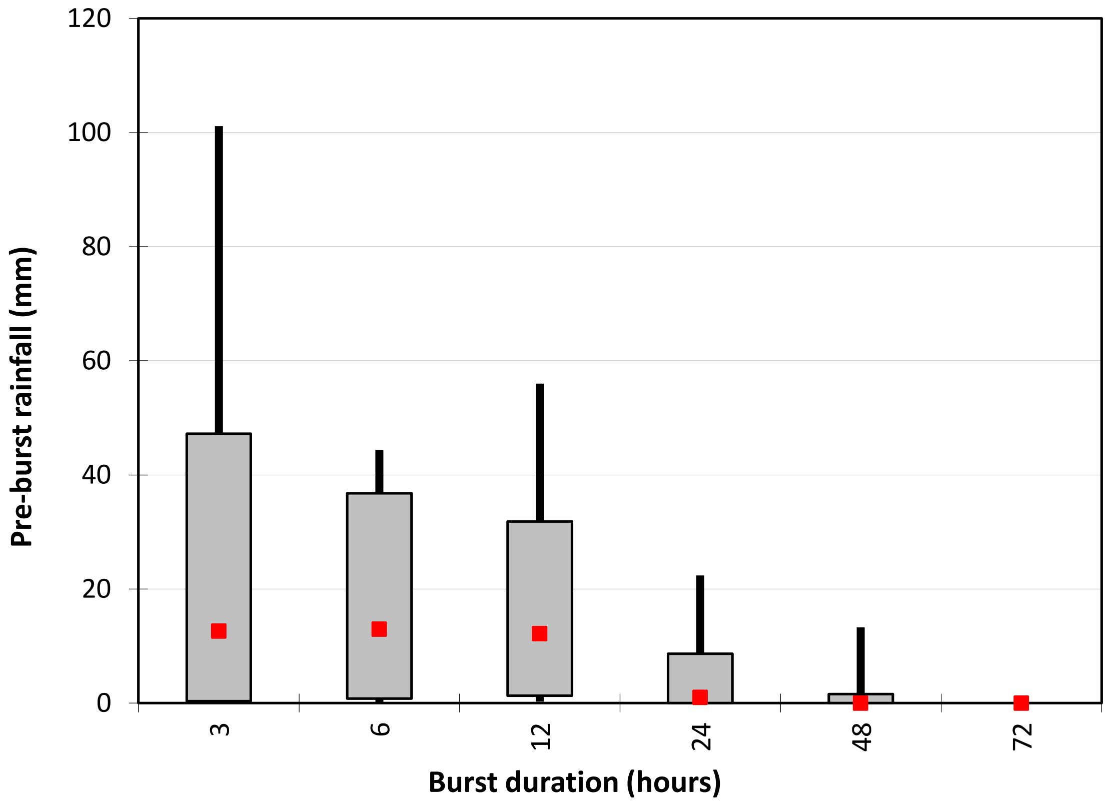
Fletcher Creek Trib. @ Frog Hollow (WA)



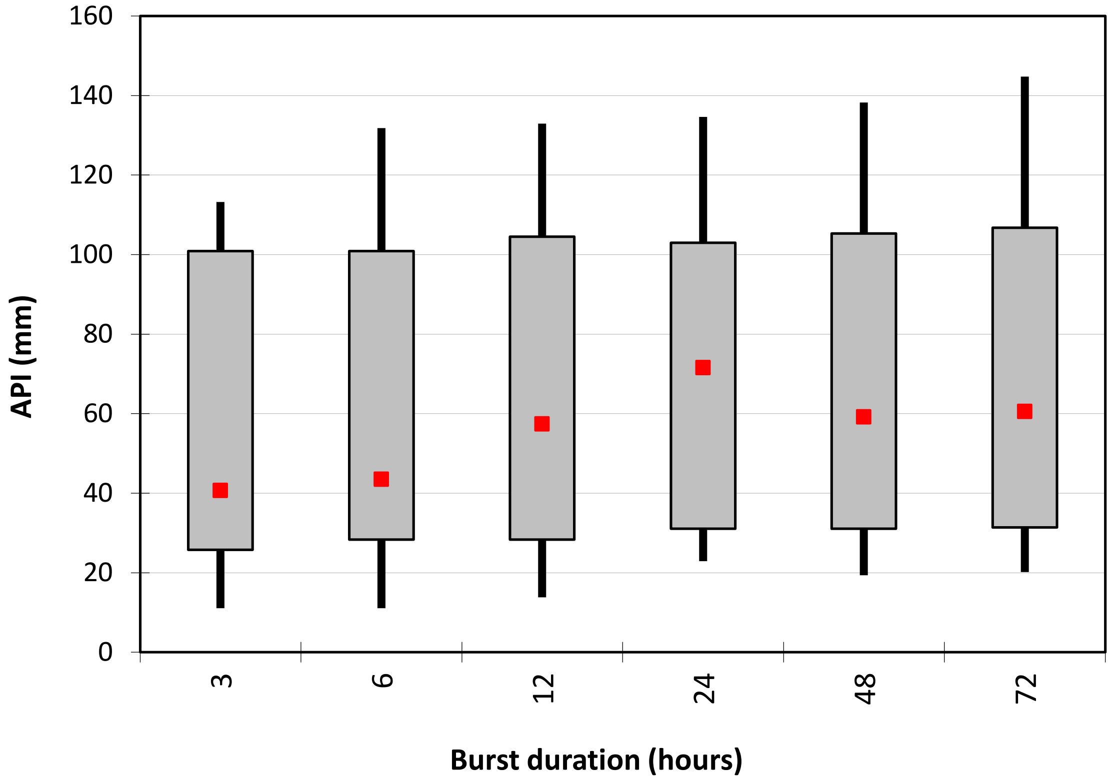


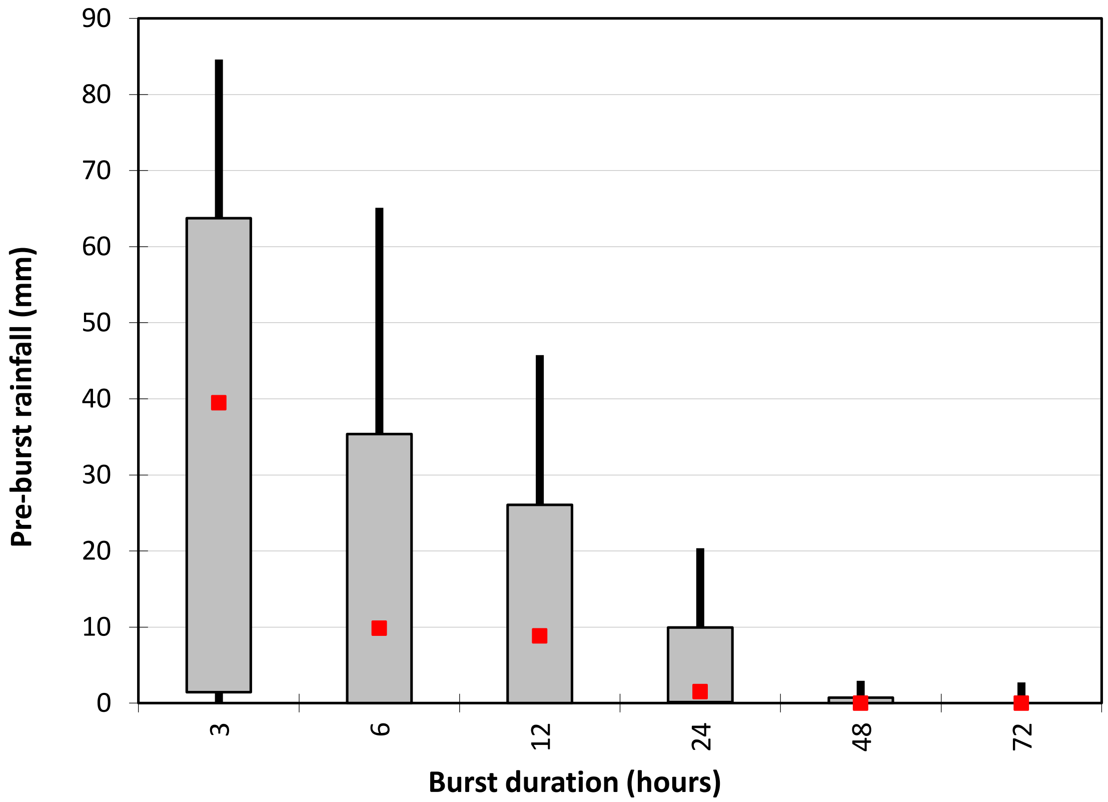
Harding River @ Marmurrina Pool U-South (WA)



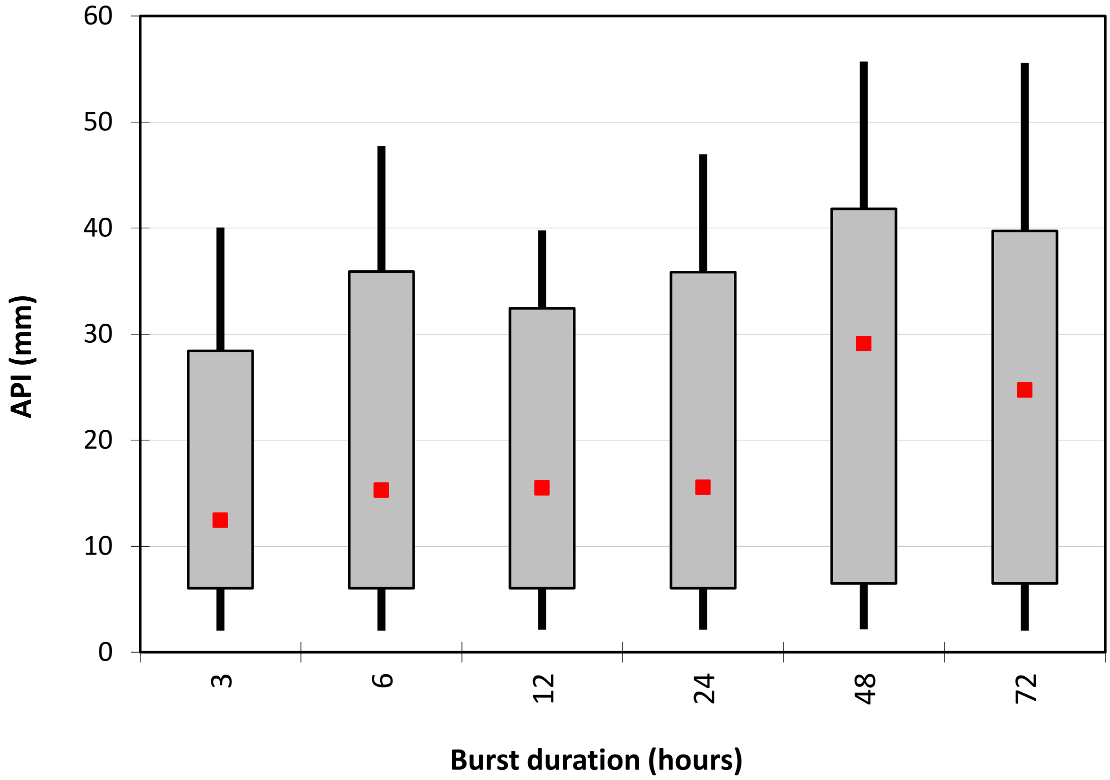


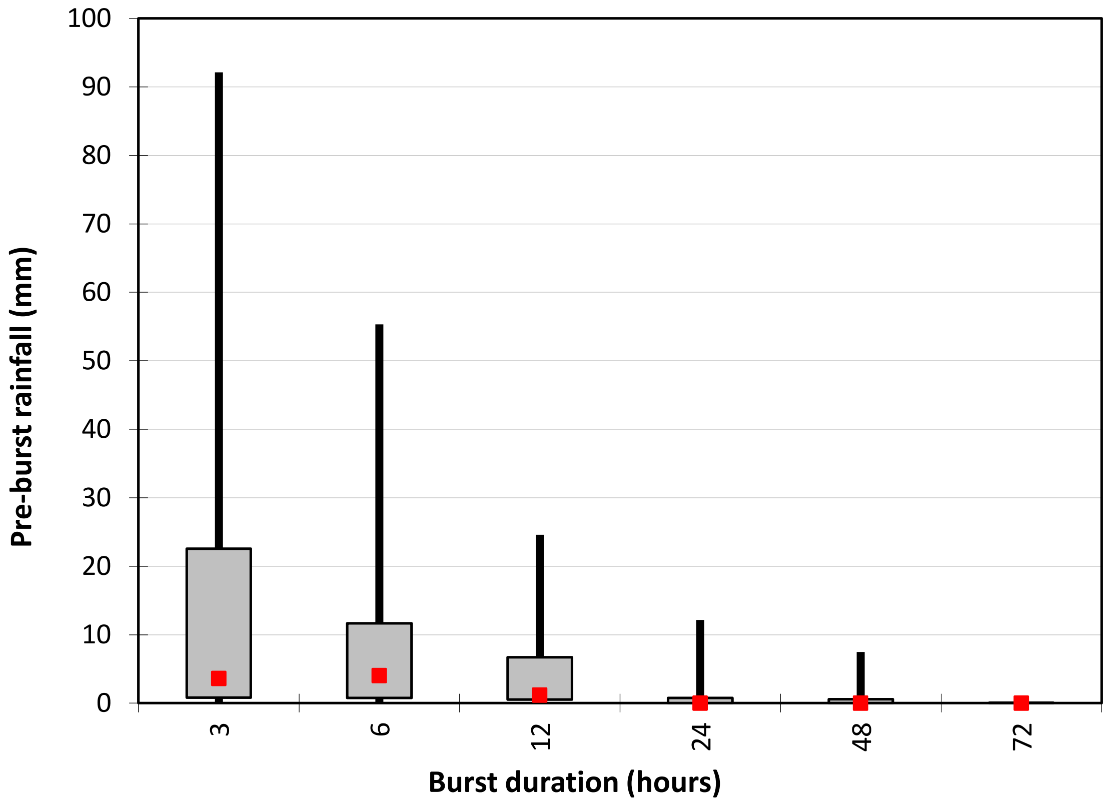
Kanjenjie Creek Trib. @ Fish Pool (WA)



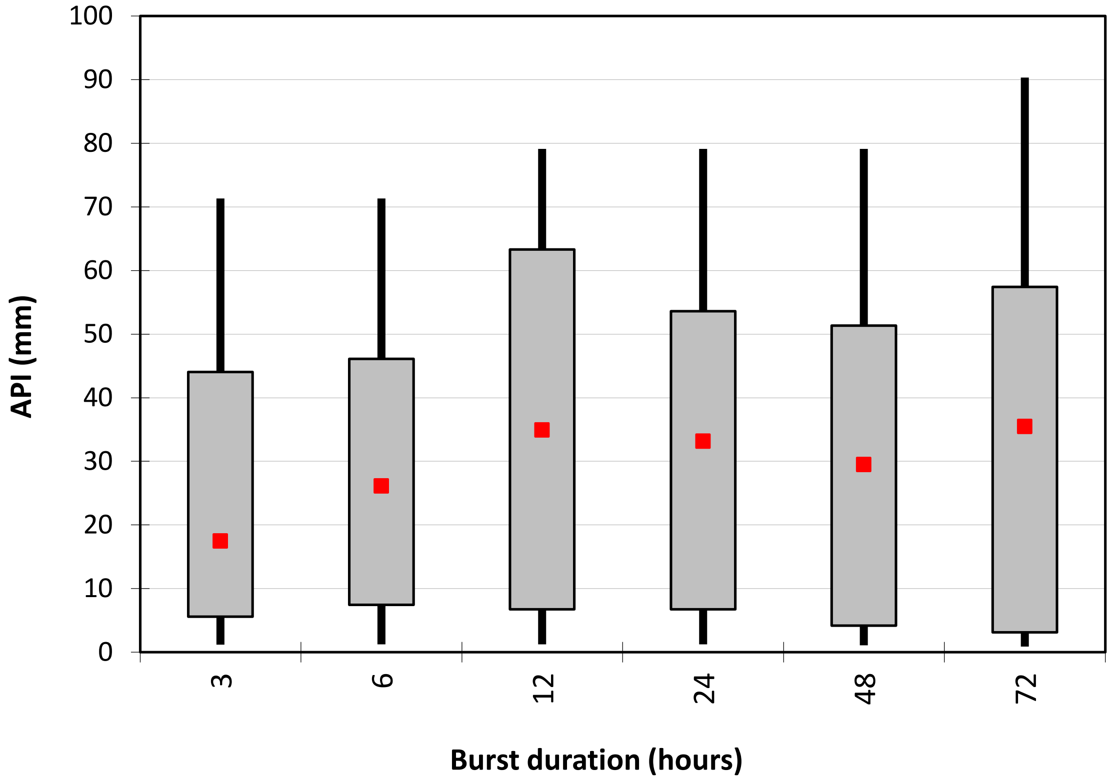


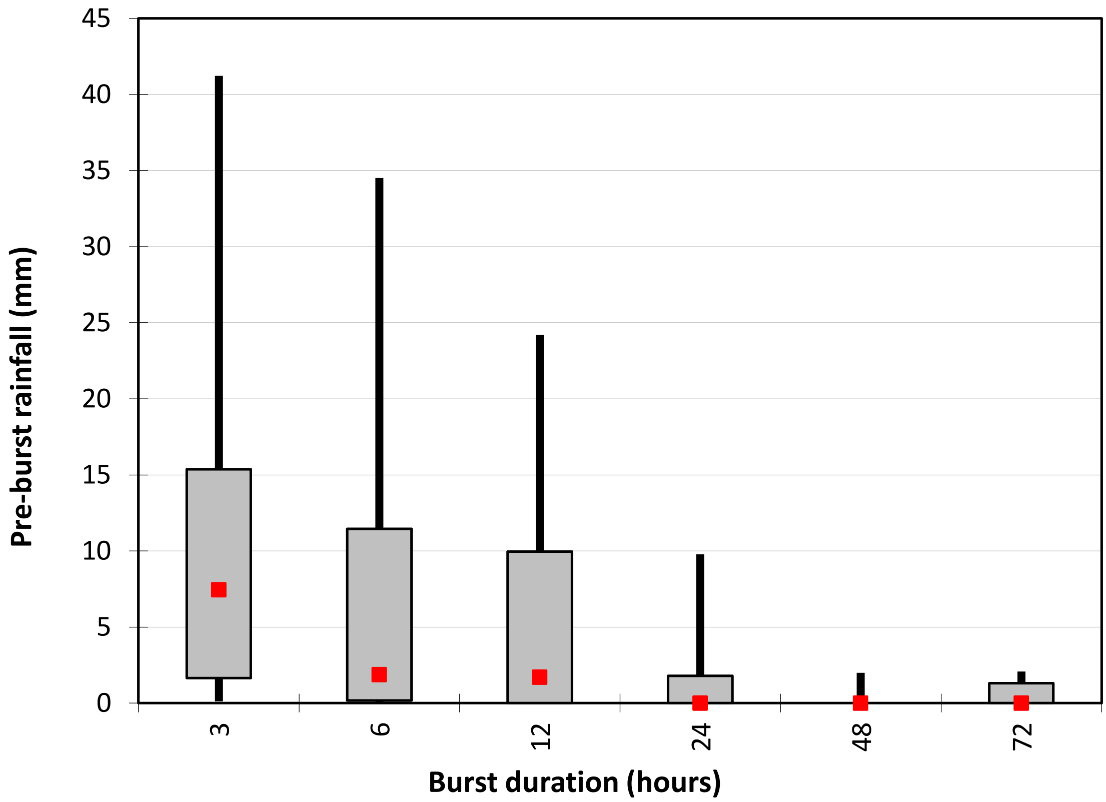
Balgarup River @ Mandelup Pool (WA)



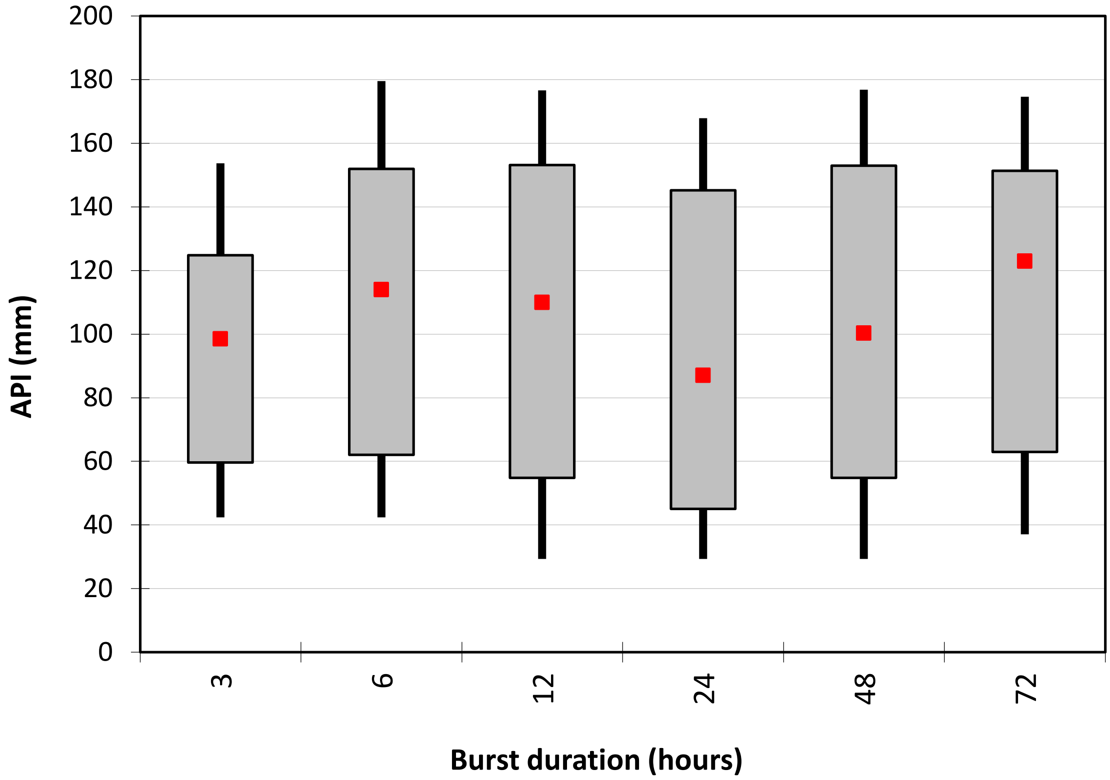


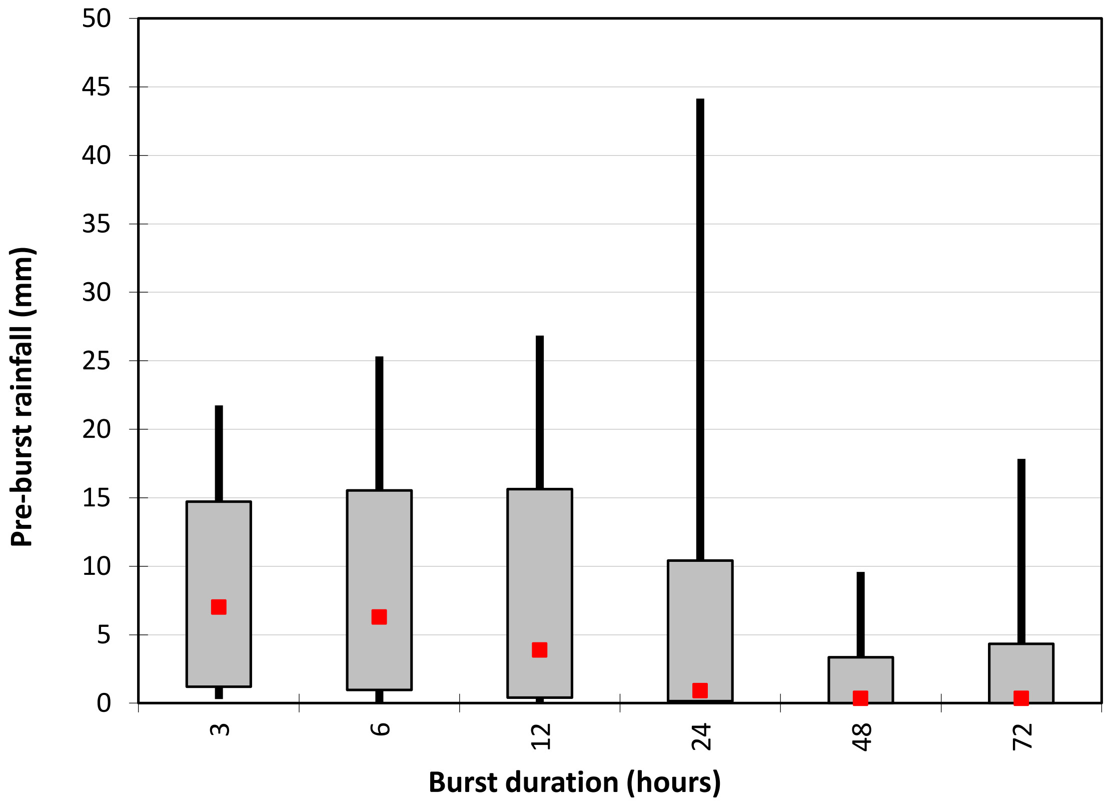
Buller River @ Buller (WA)



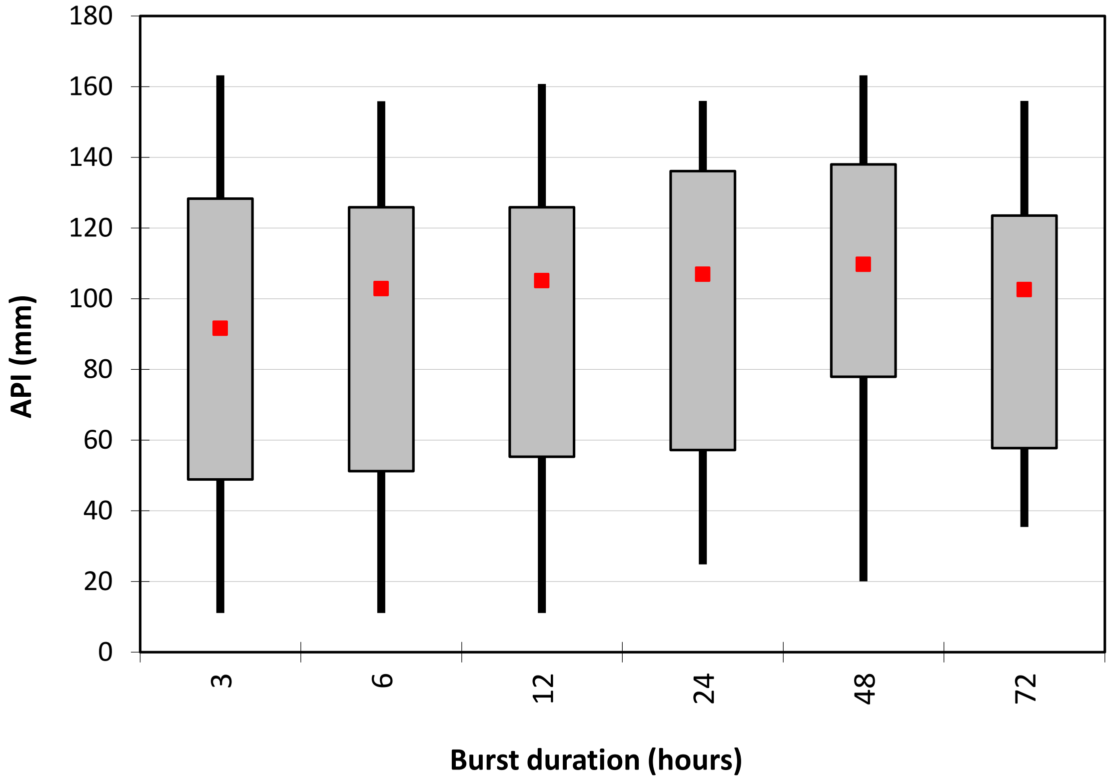


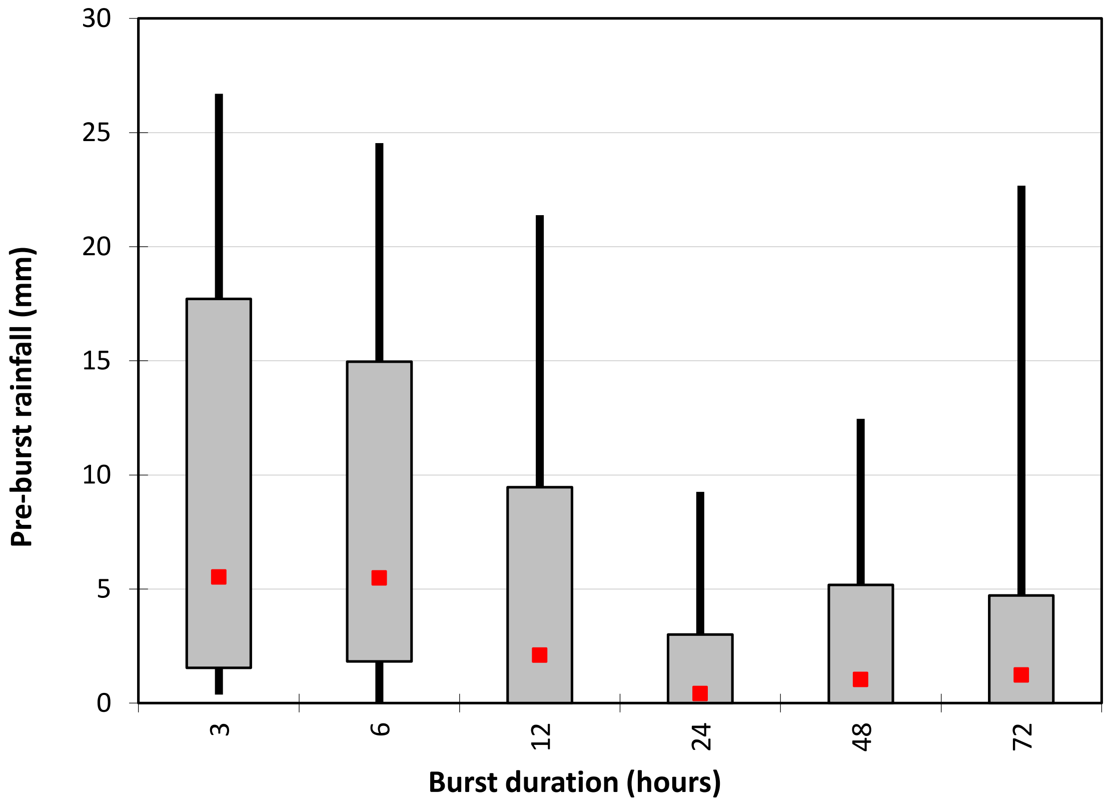
Carey Brook @ Staircase Rd (WA)



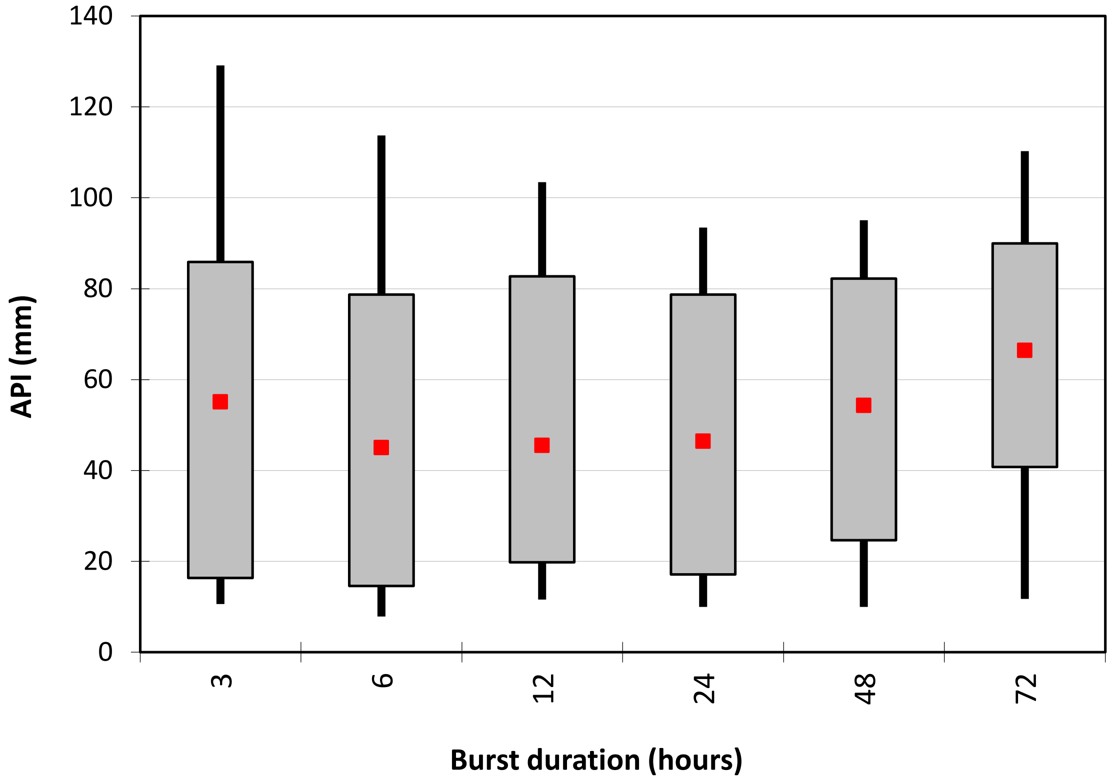


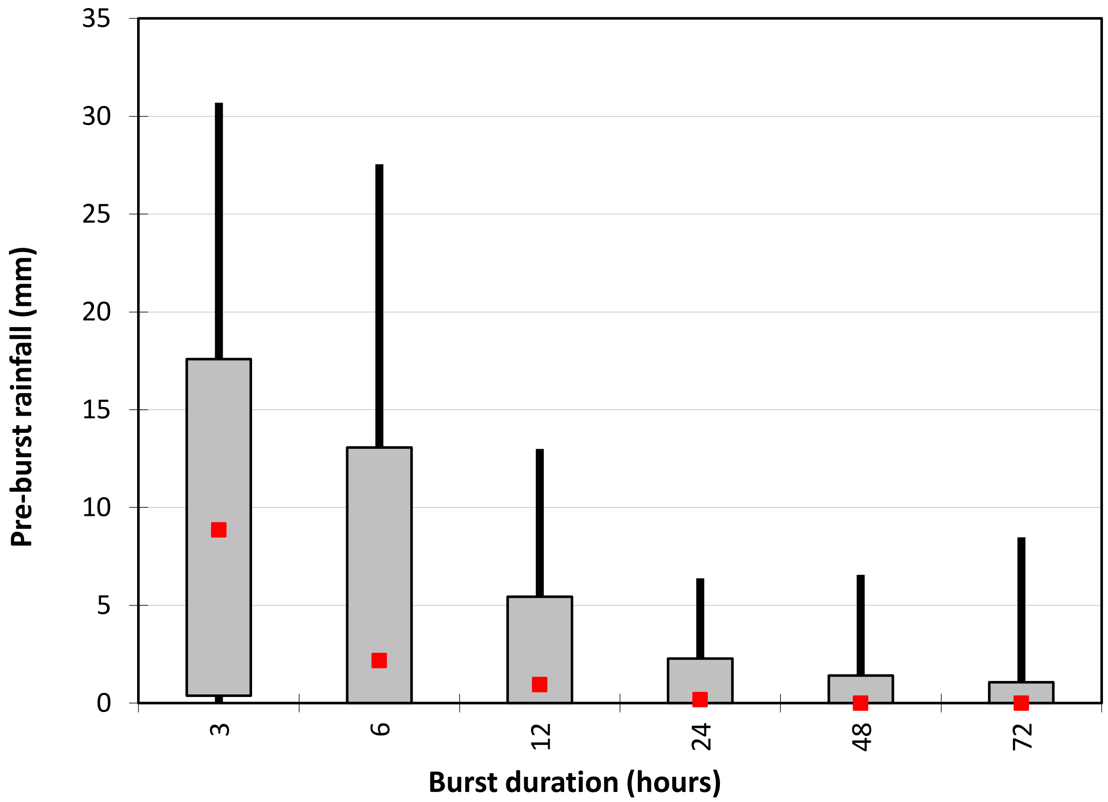
Davis Brook @ Murray Valley Plntn (WA)



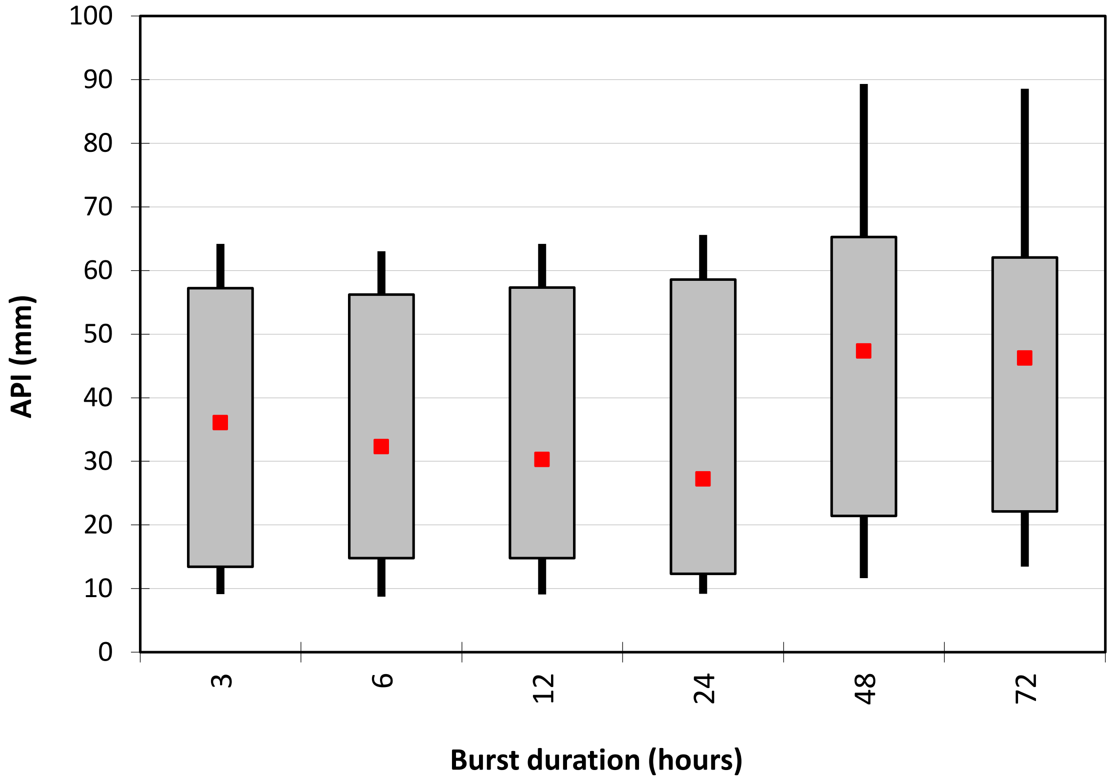


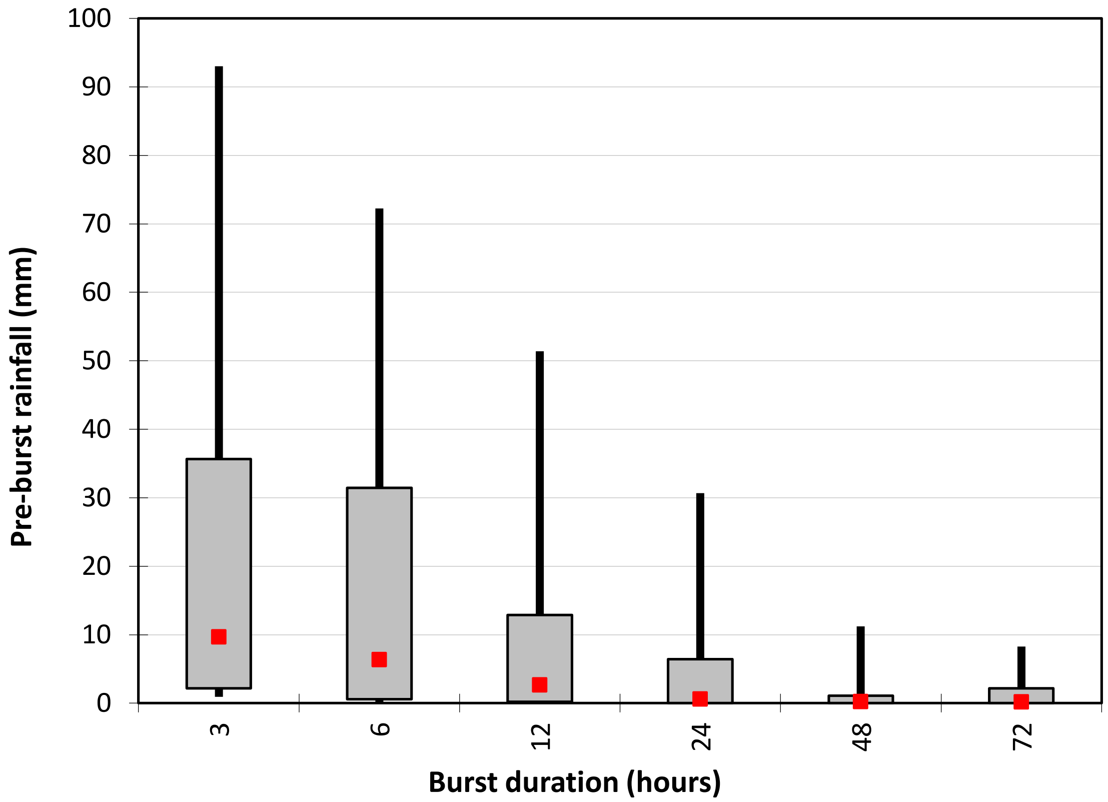
Dirk Brook @ Kentish Farm (WA)



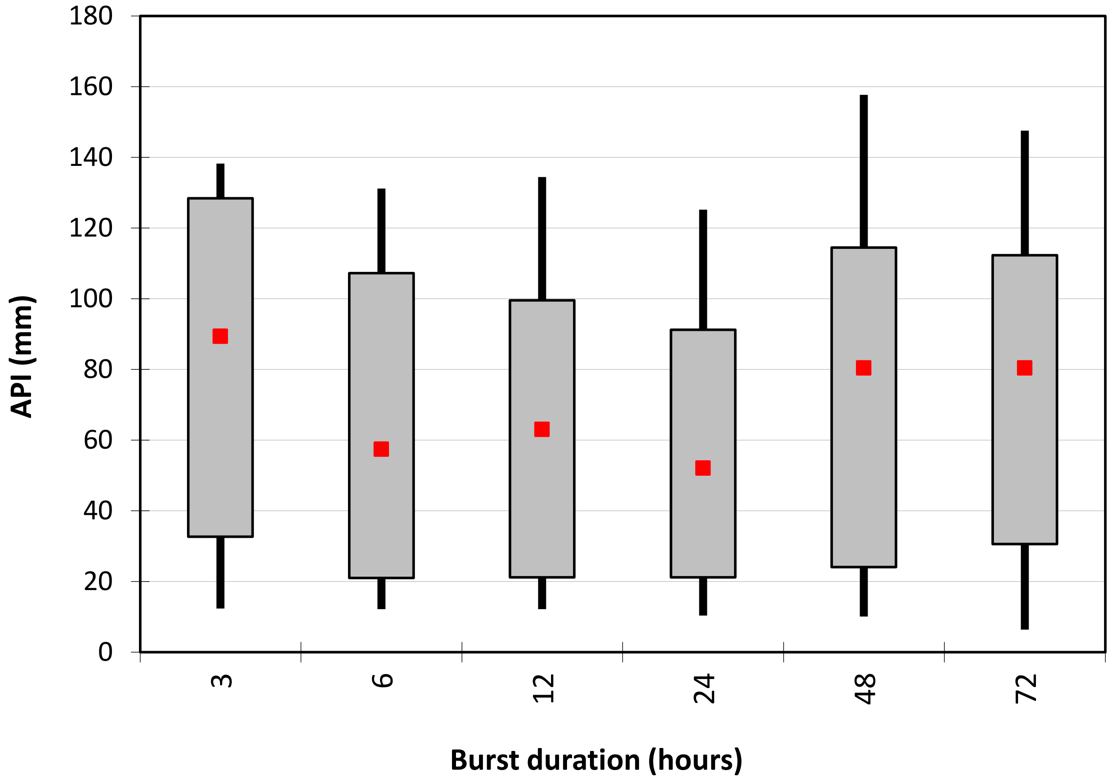


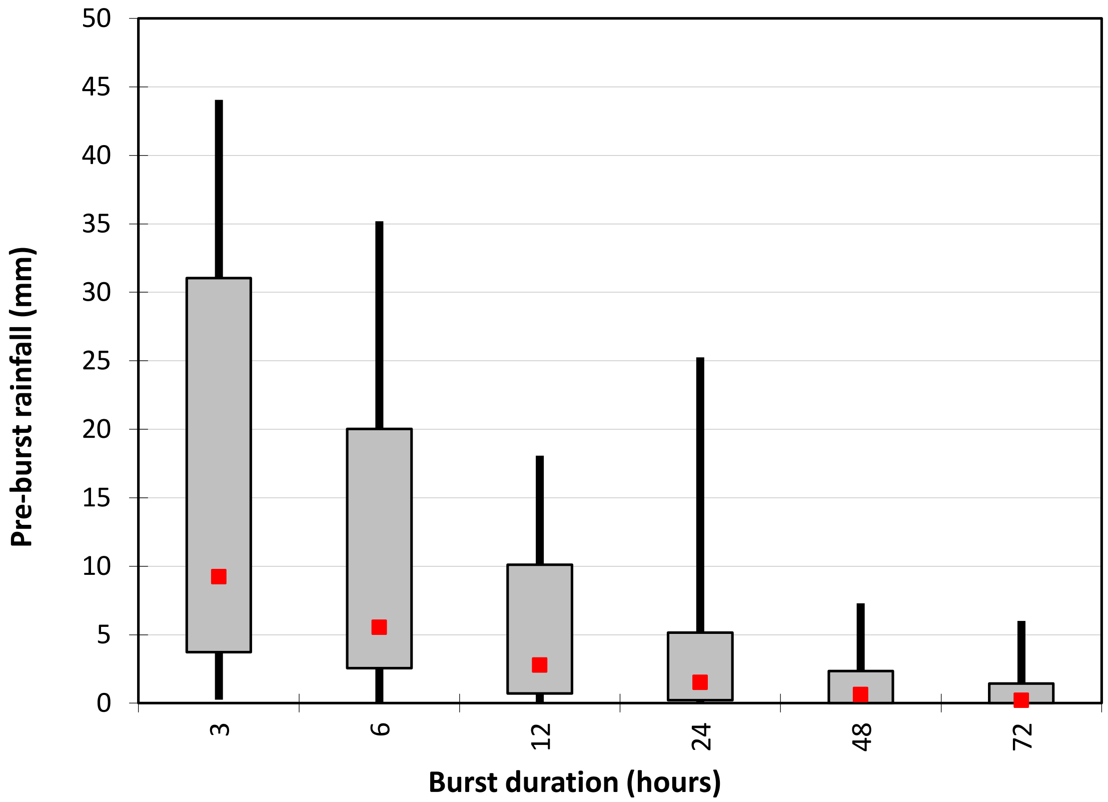
Goodga River @ Black Cat (WA)



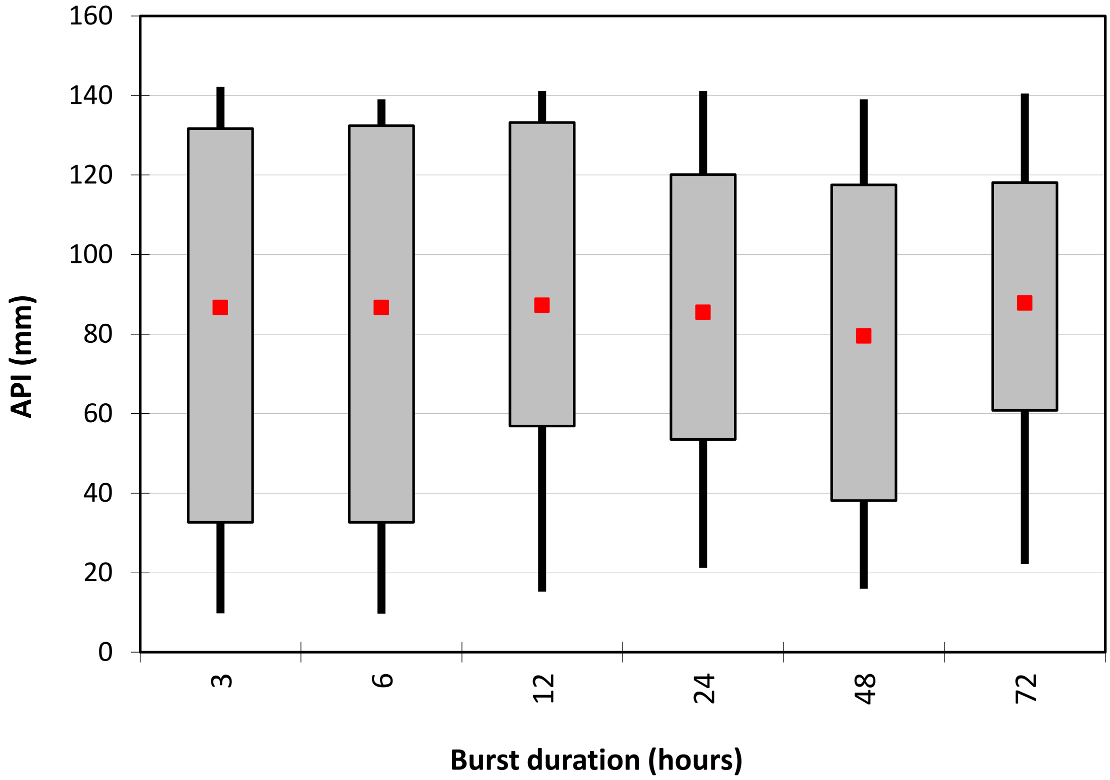


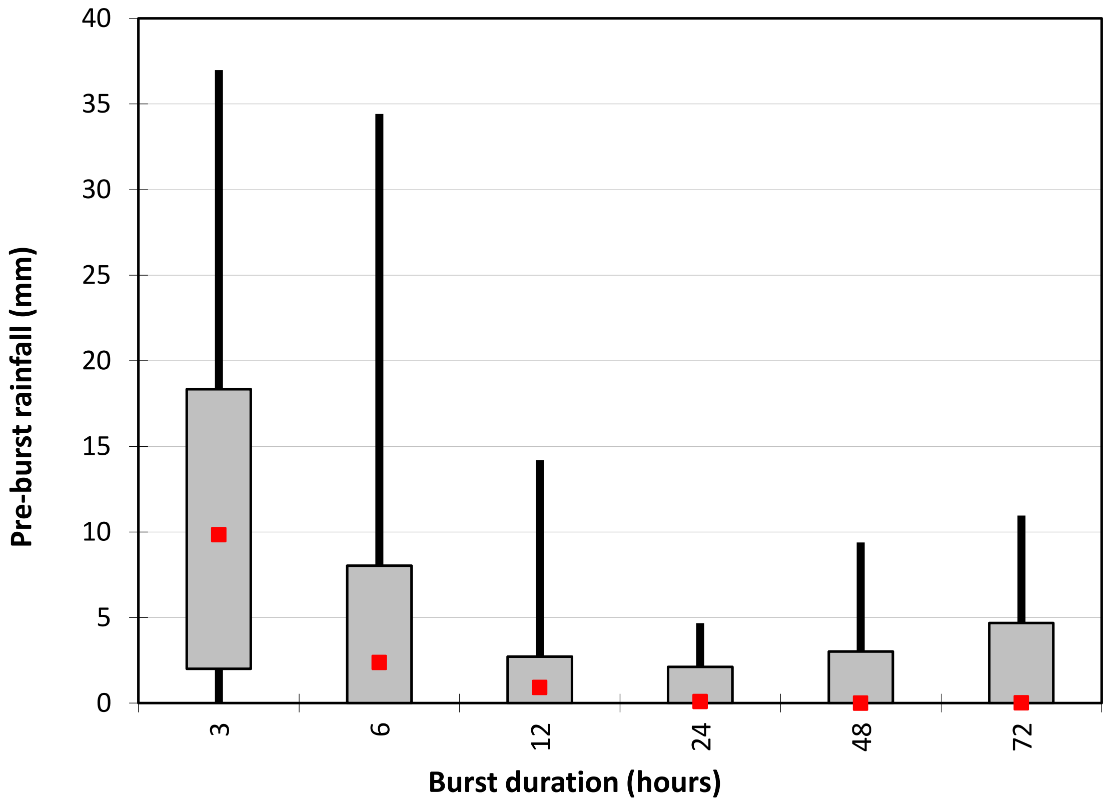
Hamilton River @ Worsley (WA)



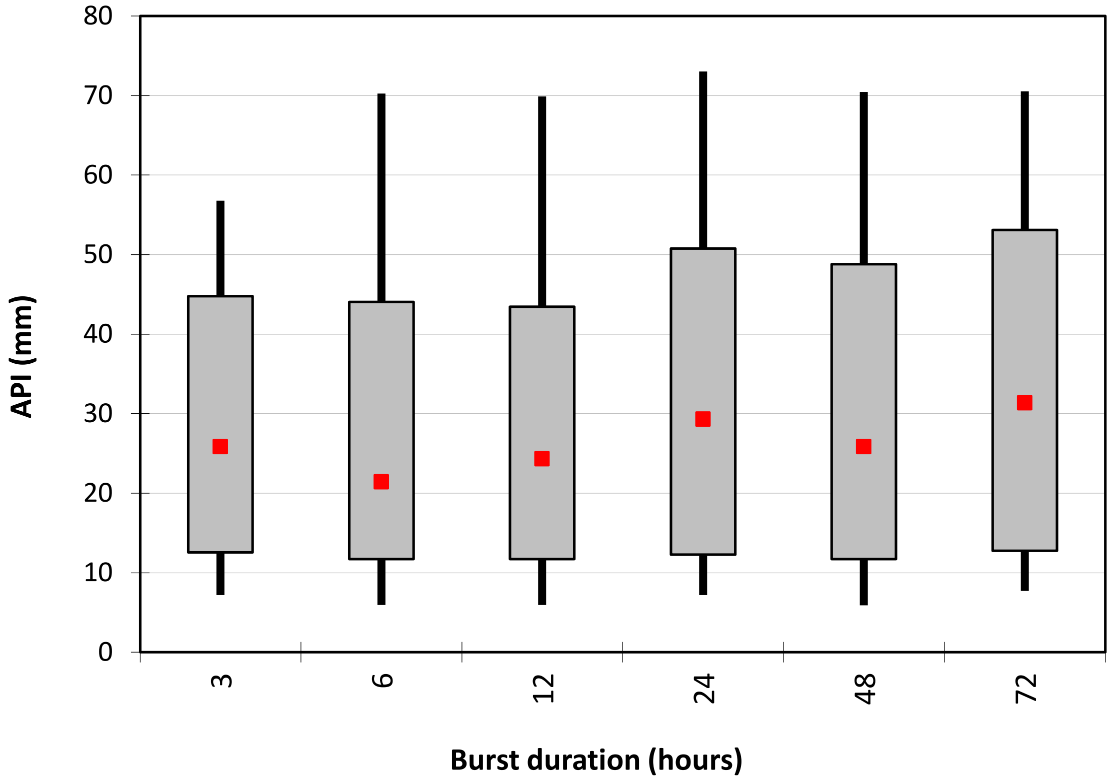


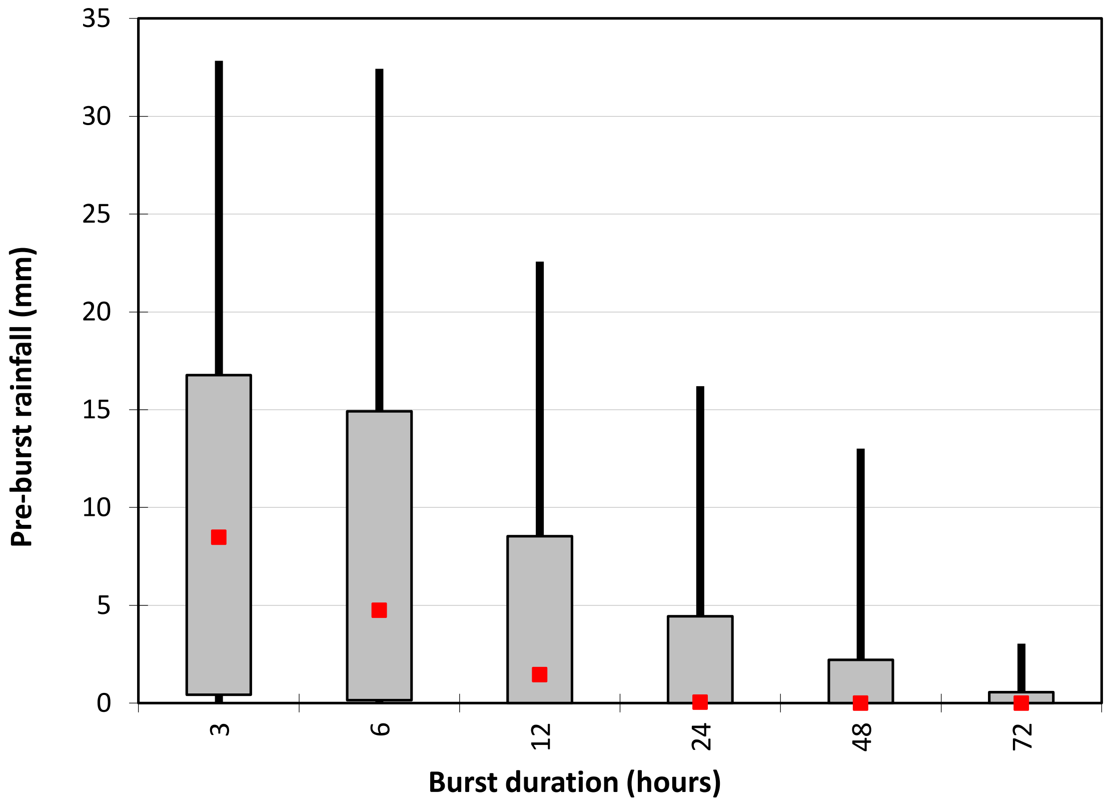
Marrinup Brook @ Brookdale Siding (WA)





Yates Flat @ Woonanup (WA)





Appendix F Distribution of pre-burst rainfall for each region

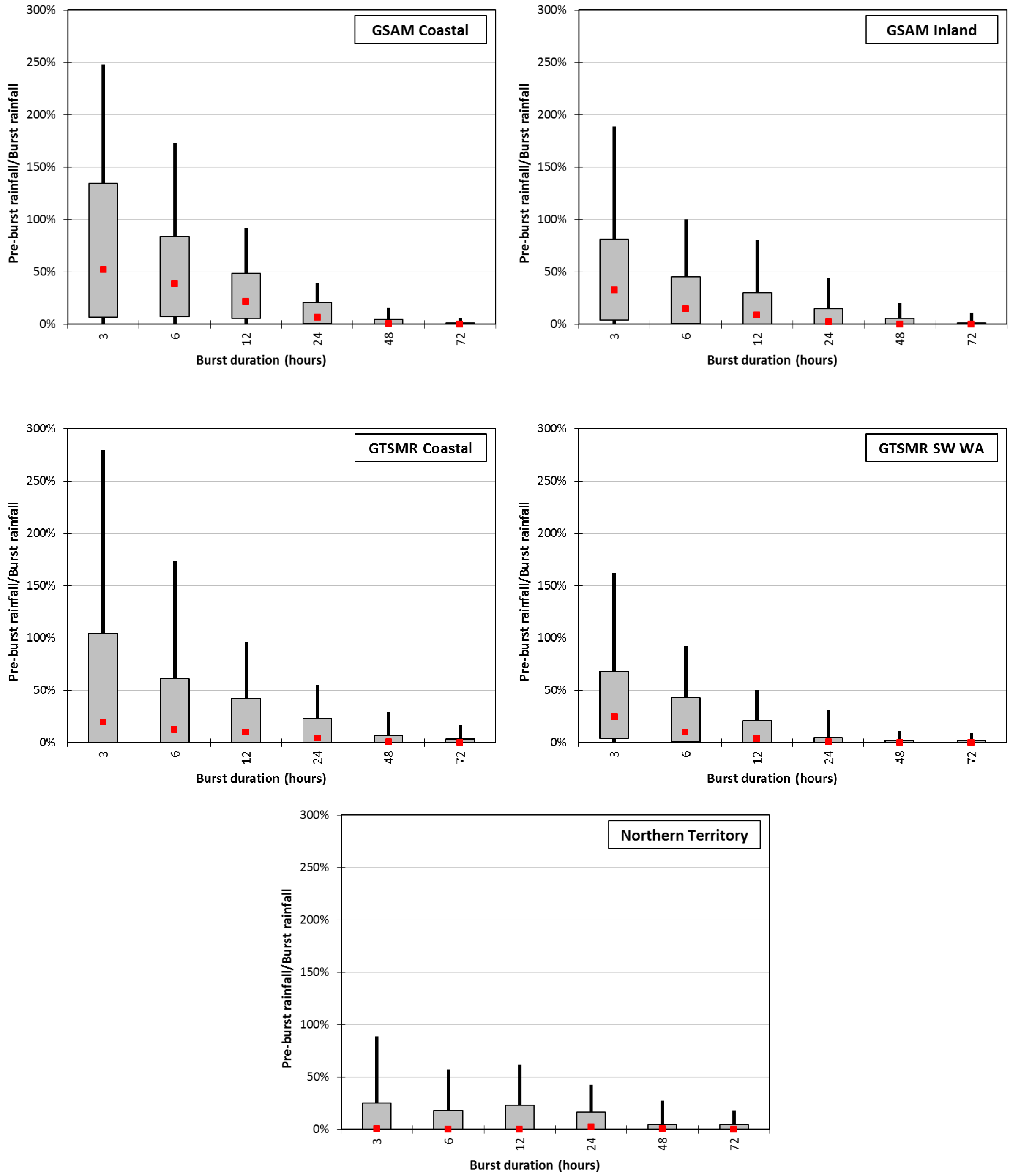


Figure F-1 Distribution of pre-burst rainfall normalized by burst rainfall for each PMP method region. Northern Territory catchments and Fletcher Creek are shown in a separate plot.

Appendix G Sensitivity of loss values to approach

G.1 Introduction

Prior to commencing to Phase 4 the ARR Technical Committee endorsed some additional investigations to explore different approaches to estimate loss values. The variability between users is considered in terms of both losses and modelled flow volume error. The sensitivity of the model to the routing characteristics is tested by repeating the calibrations using three methods of selecting RORB routing parameter k_c. Finally, the influence of the runoff routing model structure is assessed by calibrating losses using the URBS runoff routing model and comparing these values to those achieved using RORB.

This appendix documents the sensitivity of the Initial Loss – Continuing Loss (IL/CL) conceptual loss model to the subjective nature of user calibration, the selection of routing parameter and the flood model utilized. The work concentrated on the Initial Loss – Continuing Loss (IL/CL) model but the broad conclusions are expected to also be applicable to the application of SWMOD.

Phase 1 also noted that the application of SWMOD was constrained by the lack of information on the hydraulic properties of soils. Some further analysis was undertaken to explore the sensitivity of the SWMOD parameters to assumptions regarding the soil hydraulic properties.

G.2 IL/CL - Sensitivity to modeller

Introduction

In estimating the loss values for the pilot catchments, the modelled hydrograph is fitted to the surface runoff (derived from recorded streamflow with the baseflow removed). The goodness of fit is assessed subjectively using the following criteria:

- Volume
- Overall shape
- Peak
- Timing

This subjective procedure leads to changes in loss estimates based on the user calibrating the model. To assess the sensitivity of the calibration to this subjectivity, calibrations performed as part of the Phase 1 pilot study are revisited using different modellers in a blind test.

Table G-1 Summary of catchments examined

Gauge	Catchment	Area (km^2)	State	Mean Annual Rainfall (mm)	No. events
614005	Dirk Brook @ Kentish Farm	36	WA	1150	20
125006	Finch Hatton Creek @ Dam Site	36	QLD	1800	27
410743	Jerrabomberra Creek @ Four Mile Creek	52	ACT	820	20
G8170075	Manton River u/s Manton Dam	29	NT	1430	28
141009	North Maroochy River @ Eumundi	41	QLD	1650	27
A5040523	Sixth Creek @ Castambul	44	SA	1000	15
422321	Spring Creek @ Killarney	32	QLD	1210	29
2219	Swan River u/s Hardings Falls	38	TAS	920	20
228217	Toomuc Creek @ Pakenham	42	VIC	1060	10
603190	Yates Flat Creek @ Woonanup	53	WA	800	7

Variation in Initial Loss values

The resulting estimates of loss are summarised in the following figures and tables. Although there are significant differences for some individual events (Figure G-1), there is no bias; both the pilot and revisited calibrations have a similar distribution of Initial Loss values across the events (this is seen by the low changes in median losses for each catchment seen in Table G-2).

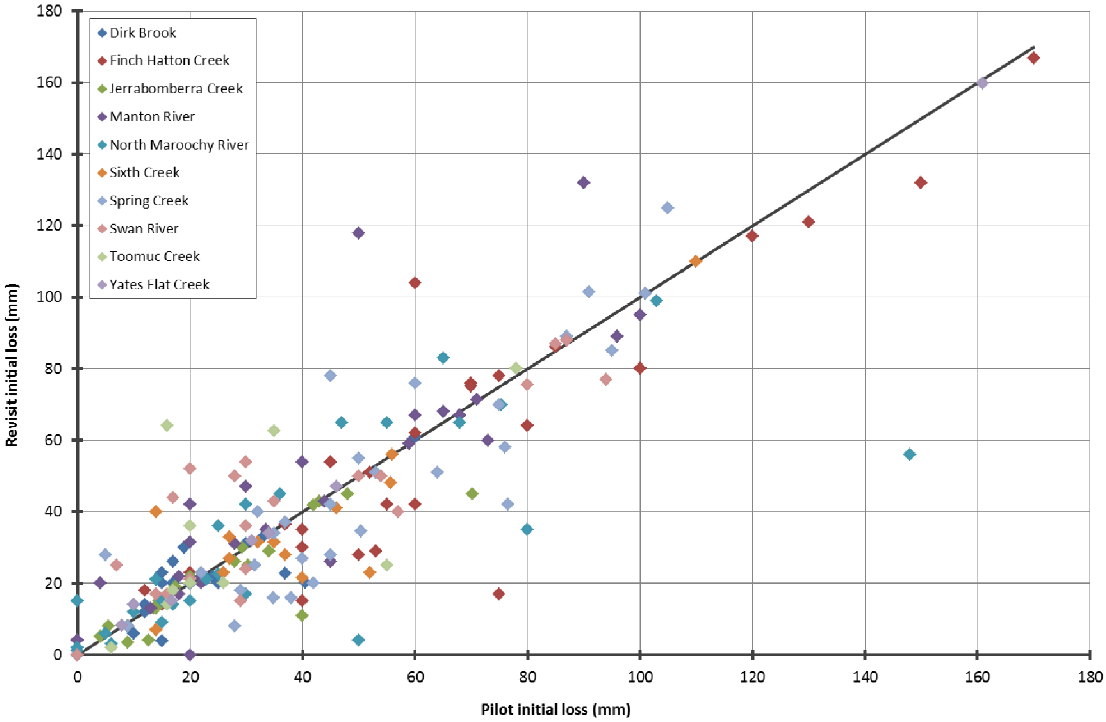


Figure G-1 Initial Loss values for the original pilot calibration and the revisited calibration

Table G-2 Median Initial Loss values for pilot and revisited calibrations

Gauge	Catchment	Initial Loss (mm)	
		Pilot calibration	Revisited calibration
614005	Dirk Brook @ Kentish Farm	17	20
125006	Finch Hatton Creek @ Dam Site	60	51
410743	Jerrabomberra Creek @ Four Mile Creek	19	17
G8170075	Manton River u/s Manton Dam	32	39
141009	North Maroochy River @ Eumundi	25	21
A5040523	Sixth Creek @ Castambul	36	32
422321	Spring Creek @ Killarney	45	40
2219	Swan River u/s Hardings Falls	30	44
228217	Toomuc Creek @ Pakenham	20	23
603190	Yates Flat Creek @ Woonanup	31	32

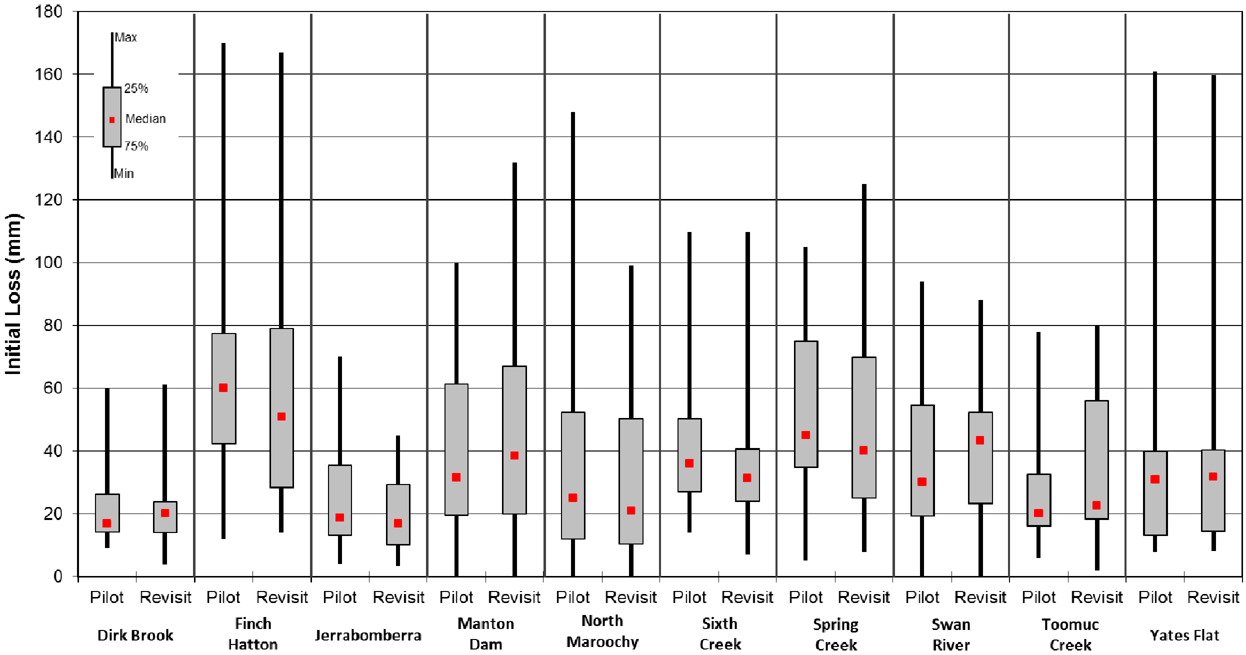


Figure G-2 Comparison of Initial Loss boxplots for pilot and revisited calibrations

Variation in Continuing Loss values

The results for Continuing Loss are presented in the following figures and table. Similar to Initial Loss, estimates of Continuing Loss are sensitive to the user. Additionally, there is a small bias present; the revisited calibration has slightly higher Continuing Loss than the original pilot study. Furthermore, the median Continuing Loss for the revisit is slightly higher than the pilot study value for seven of the ten catchments (Table G-3).

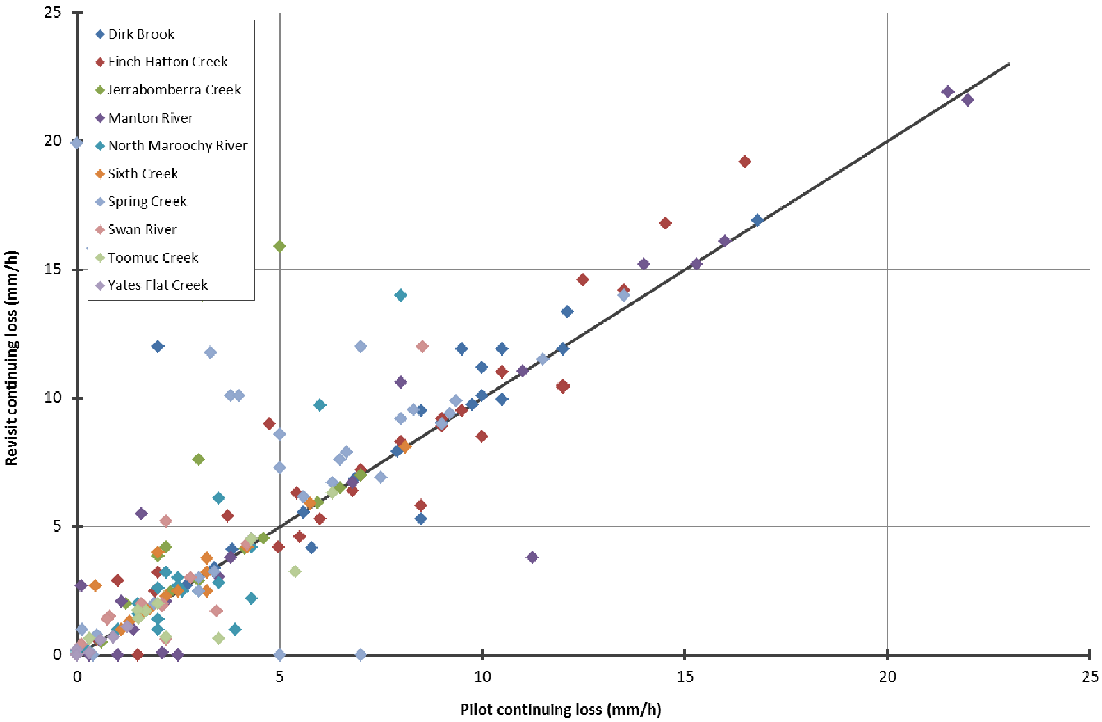


Figure G-3 Continuing Loss values for the original pilot calibration and the revisited calibration

Table G-3 Median Continuing Loss values for pilot and revisited calibrations

Gauge	Catchment	Continuing Loss (mm/h)	
		Pilot calibration	Revisited calibration
614005	Dirk Brook @ Kentish Farm	8.8	9.6
125006	Finch Hatton Creek @ Dam Site	7.0	7.2
410743	Jerrabomberra Creek @ Four Mile Creek	2.3	3.4
G8170075	Manton River u/s Manton Dam	2.4	2.4
141009	North Maroochy River @ Eumundi	2.0	1.7
A5040523	Sixth Creek @ Castambul	2.4	2.6
422321	Spring Creek @ Killarney	5.0	7.9
2219	Swan River u/s Hardings Falls	1.2	1.5
228217	Toomuc Creek @ Pakenham	2.1	1.7
603190	Yates Flat Creek @ Woonanup	0.3	0.2

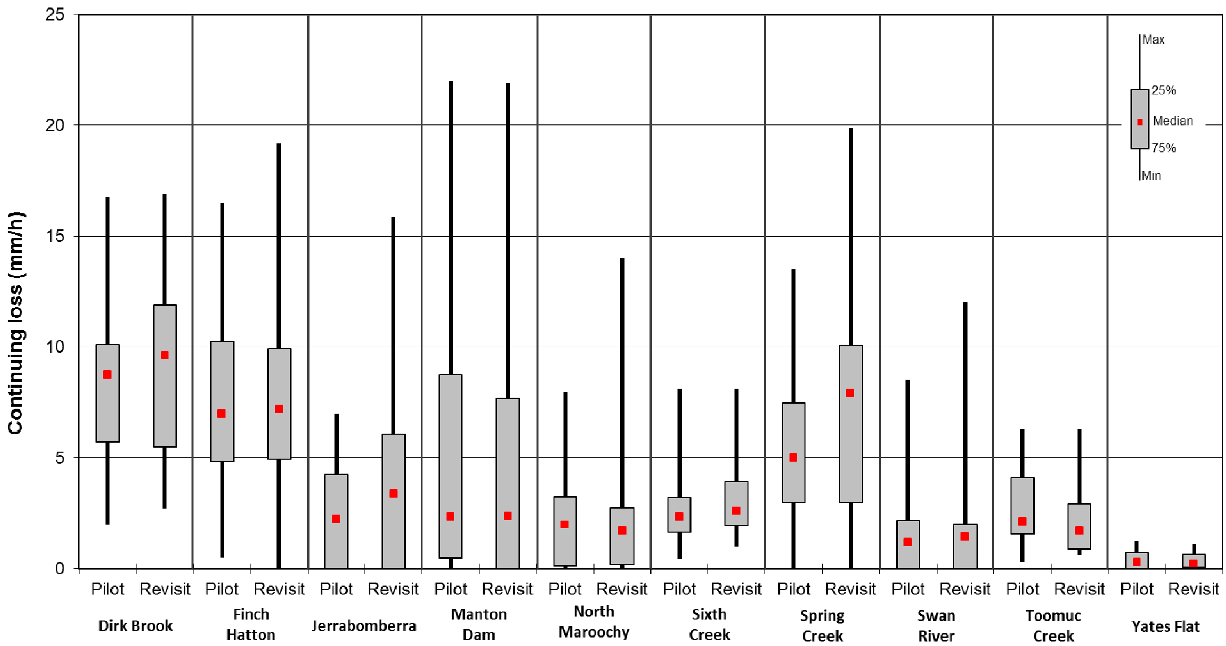


Figure G-4 Comparison of Continuing Loss boxplots for pilot and revisited calibrations

Variation in volume error

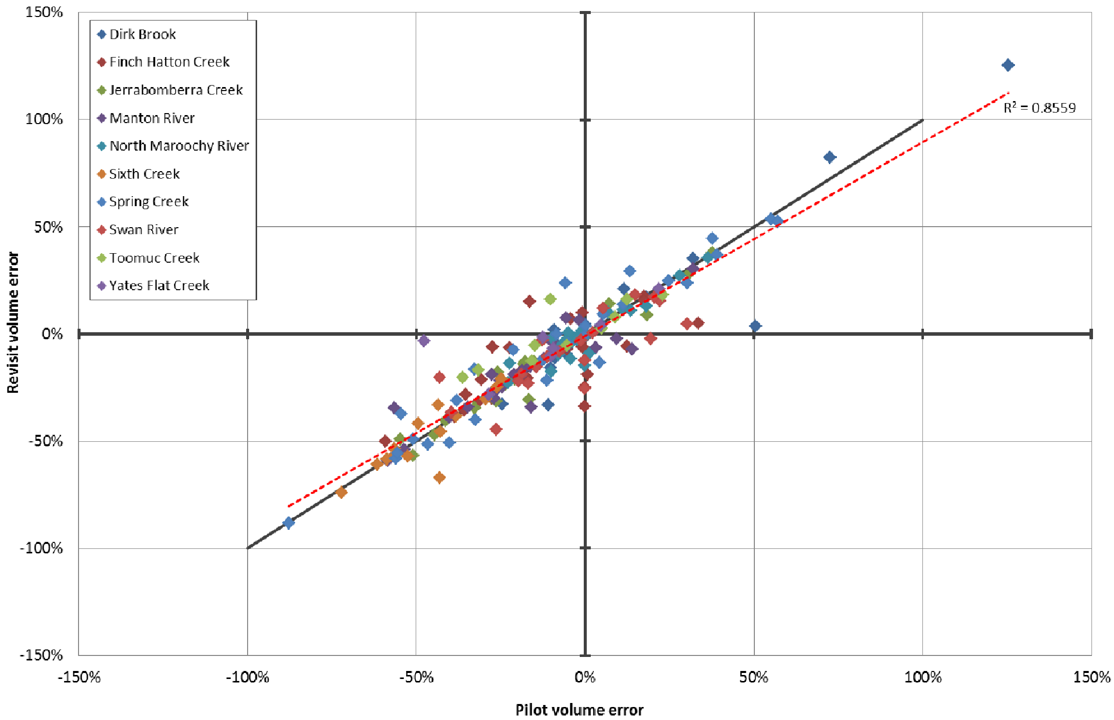


Figure G-5 Volume error for the original pilot calibration and the revisited calibration

In the revisited calibrations matching flow volume was prioritised over matching peaks. Resultantly, the volume error tends to be closer to zero in the revisited calibrations (Figure G-5). This is particularly apparent in the Yates Flat, Toomuc Creek and Dirk Brook catchments (as seen in Figure G-6). For Sixth Creek there is a consistent underestimation of the volume which indicates an error in the separation of baseflow, or else possibly in the adopted routing parameters or in the representativeness of the input rainfalls.

Table G-4 Median volume error for pilot and revisited calibrations

Gauge	Catchment	Volume Error (%)	
		Pilot calibration	Revisited calibration
614005	Dirk Brook @ Kentish Farm	-4.4%	-0.8%
125006	Finch Hatton Creek @ Dam Site	-6.8%	-7.0%
410743	Jerrabomberra Creek @ Four Mile Creek	-17.9%	-16.0%
G8170075	Manton River u/s Manton Dam	-17.5%	-17.9%
141009	North Maroochy River @ Eumundi	-4.3%	-2.8%
A5040523	Sixth Creek @ Castambul	-49.4%	-49.7%
422321	Spring Creek @ Killarney	-8.5%	-7.3%
2219	Swan River u/s Hardings Falls	-4.4%	-9.4%
228217	Toomuc Creek @ Pakenham	-7.9%	-1.4%
603190	Yates Flat Creek @ Woonanup	-10.1%	-3.3%

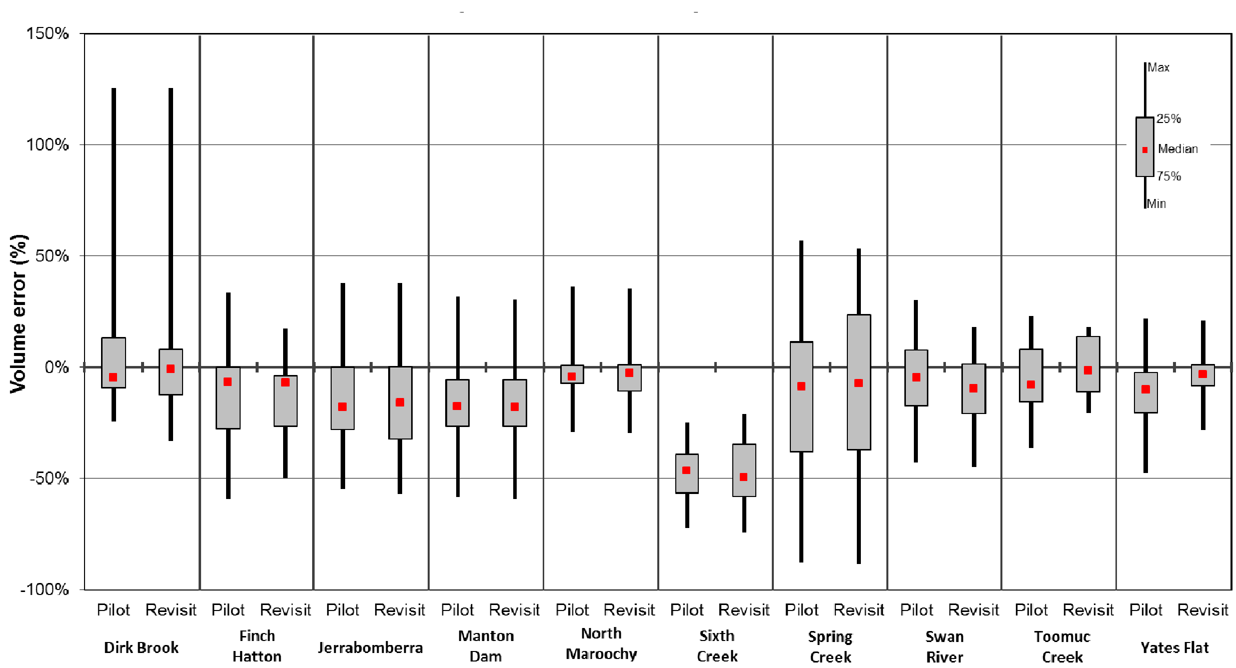


Figure G-6 Comparison of volume error between the pilot and revisited calibrations

G.3 IL/CL - Sensitivity to routing parameter

Introduction

The results from stage 1 of this investigation (SKM, 2012) made it clear that to reduce errors in the identification of the loss parameters some account needs to be given to the time-lags involved in the travel of rainfall-excess through the catchment. While it was apparent that simple empirical equations are not adequate to represent the lag, it is worth exploring the improvements that can be gained by adopting routing approaches based on different levels of accuracy. To this end, the sensitivity of loss values was evaluated for 3 different approaches to specifying the routing parameter, k_c, namely:

- Variable k_c – The routing parameter was adjusted for each event to ensure the best fit to the surface runoff hydrograph. Due to the freedom of not having a fixed k_c this method is time intensive for a large number of events but resulted in the best match to the recorded hydrographs
- Adopted k_c – As part of Phase 1, k_c values were derived for each catchment from calibration to the largest events on record. Using this fixed k_c value for all events in a catchment is less demanding than having a variable value; however, the procedure of calibrating k_c for each catchment takes time.
- Regional k_c – The routing parameter was based upon the regional prediction procedure described in Pearse et al. (2002) where the k_c is a simply a product of the average flow distance in the catchment. A value of 1.14 was adopted as this was the median of the CRCCH data set compiled by Dyer (1994). The simplicity of this method makes it considerably more time effective than either the variable or adopted k_c procedures.

Range of routing parameter values examined

The range of k_c values to estimate the loss values is shown in Table G-5 and Figure G-7.

Table G-5 Adopted and regional routing parameter values

Gauge	Catchment	Adopted k_c	Regional k_c
614005	Dirk Brook @ Kentish Farm	14	6.9
125006	Finch Hatton Creek @ Dam Site	4	6.4
410743	Jerrabomberra Creek @ Four Mile Creek	4	9.4
G8170075	Manton River u/s Manton Dam	8	8.4
141009	North Maroochy River @ Eumundi	20	9.1
A5040523	Sixth Creek @ Castambul	6	9.8
422321	Spring Creek @ Killarney	6	6.6
2219	Swan River u/s Hardings Falls	10	8.1
228217	Toomuc Creek @ Pakenham	12	10.2
603190	Yates Flat Creek @ Woonanup	10	7.0

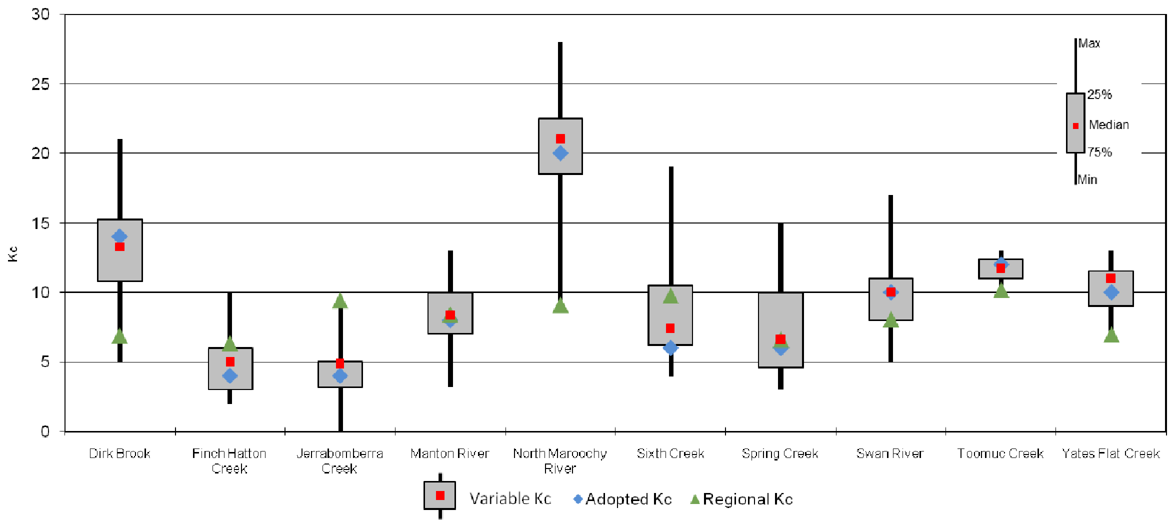


Figure G-7 Range of routing parameter values used

It can be seen that for all 10 catchments the adopted k_c values are similar to the median value from the variable k_c calibrations. This confirms that the routing characteristics of a catchment can be effectively estimated from a "handful" of events.

The effectiveness of the regional k_c approach varies between catchments. For Finch Hatton, Manton River and Toomuc Creek the regional k_c is close to the adopted and median values, however, for Jerrabomberra, North Maroochy and Yates Flat the regional approach resulted in values that were towards the end of the observed range.

Variation of Initial Loss values

The Initial Loss values resulting from the application of the different routing parameters are shown in Figure G-8 and the median values are summarised in Table G-6.

Table G-6 Median Initial Loss values for different k_c values

Gauge	Catchment	IL (mm)		
		Variable k_c	Adopted k_c	Regional k_c
614005	Dirk Brook @ Kentish Farm	20	20	24
125006	Finch Hatton Creek @ Dam Site	54	51	30
410743	Jerrabomberra Creek @ Four Mile Creek	15	17	17
G8170075	Manton River u/s Manton Dam	32	39	31
141009	North Maroochy River @ Eumundi	24	21	45
A5040523	Sixth Creek @ Castambul	25	32	33
422321	Spring Creek @ Killarney	35	40	37
2219	Swan River u/s Hardings Falls	40	44	41
228217	Toomuc Creek @ Pakenham	22	23	23
603190	Yates Flat Creek @ Woonanup	28	32	18

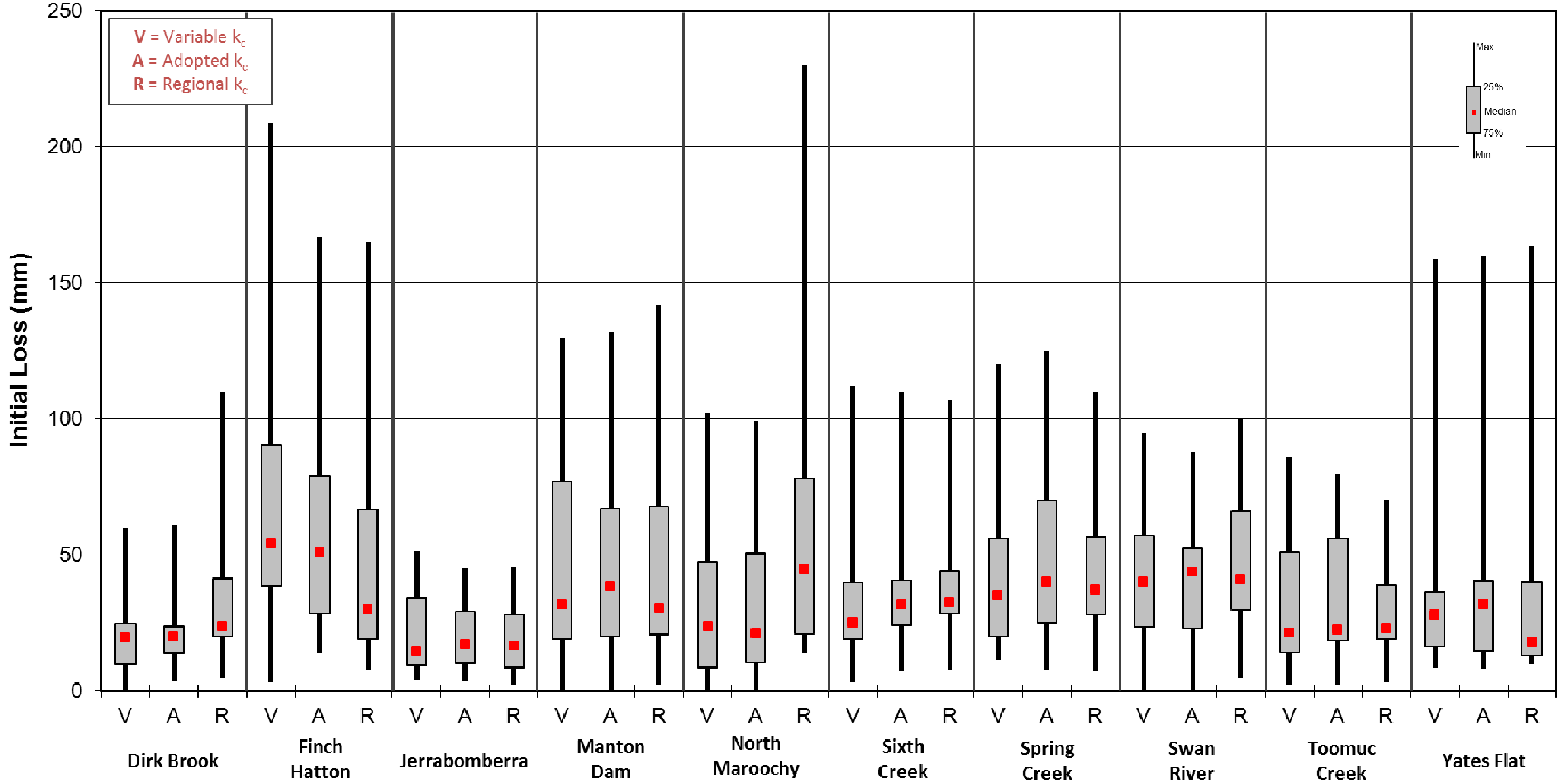


Figure G-8 Comparison of Initial Loss for different routing parameter values

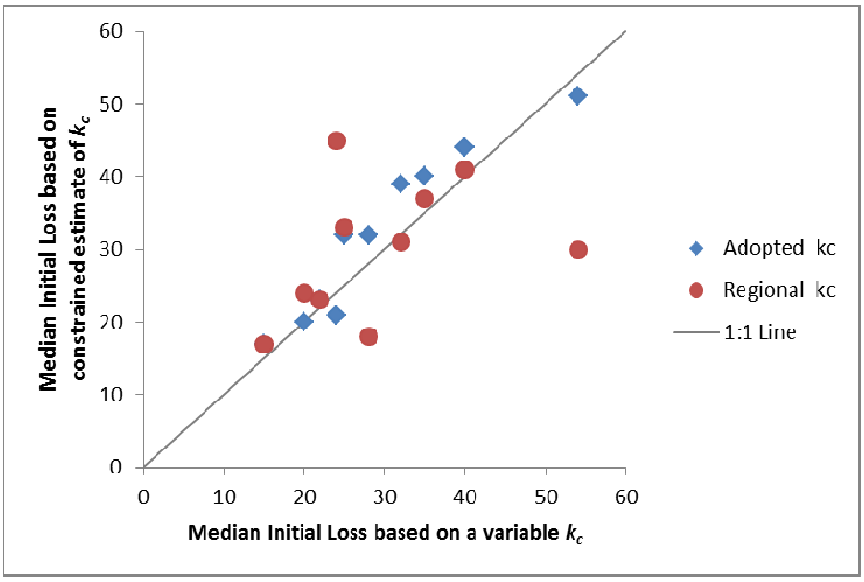


Figure G-9 Comparison of median Initial Loss obtained from using different routing approaches

The increase in scatter in Initial Loss associated with adoption of the simpler (more constrained) approach to specification of the routing parameter is evident in Figure G-10.

Variation in Continuing Loss values

The Continuing Loss values resulting from the application of the different routing parameters are shown in Figure G-10 and the median values are summarised in Table G-7.

Table G-7 Median Continuing Loss values for different k_c values

Gauge	Catchment	CL (mm/h)		
		Variable k_c	Adopted k_c	Regional k_c
614005	Dirk Brook @ Kentish Farm	9.5	9.6	8.5
125006	Finch Hatton Creek @ Dam Site	6.0	7.2	6.3
410743	Jerrabomberra Creek @ Four Mile Creek	2.5	3.4	0.7
G8170075	Manton River u/s Manton Dam	2.2	2.4	1.9
141009	North Maroochy River @ Eumundi	1.7	1.7	3.4
A5040523	Sixth Creek @ Castambul	2.7	2.6	1.9
422321	Spring Creek @ Killarney	8.2	7.9	5.0
2219	Swan River u/s Hardings Falls	1.2	1.5	7.2
228217	Toomuc Creek @ Pakenham	1.8	1.7	2.3
603190	Yates Flat Creek @ Woonanup	0.2	0.2	0.3

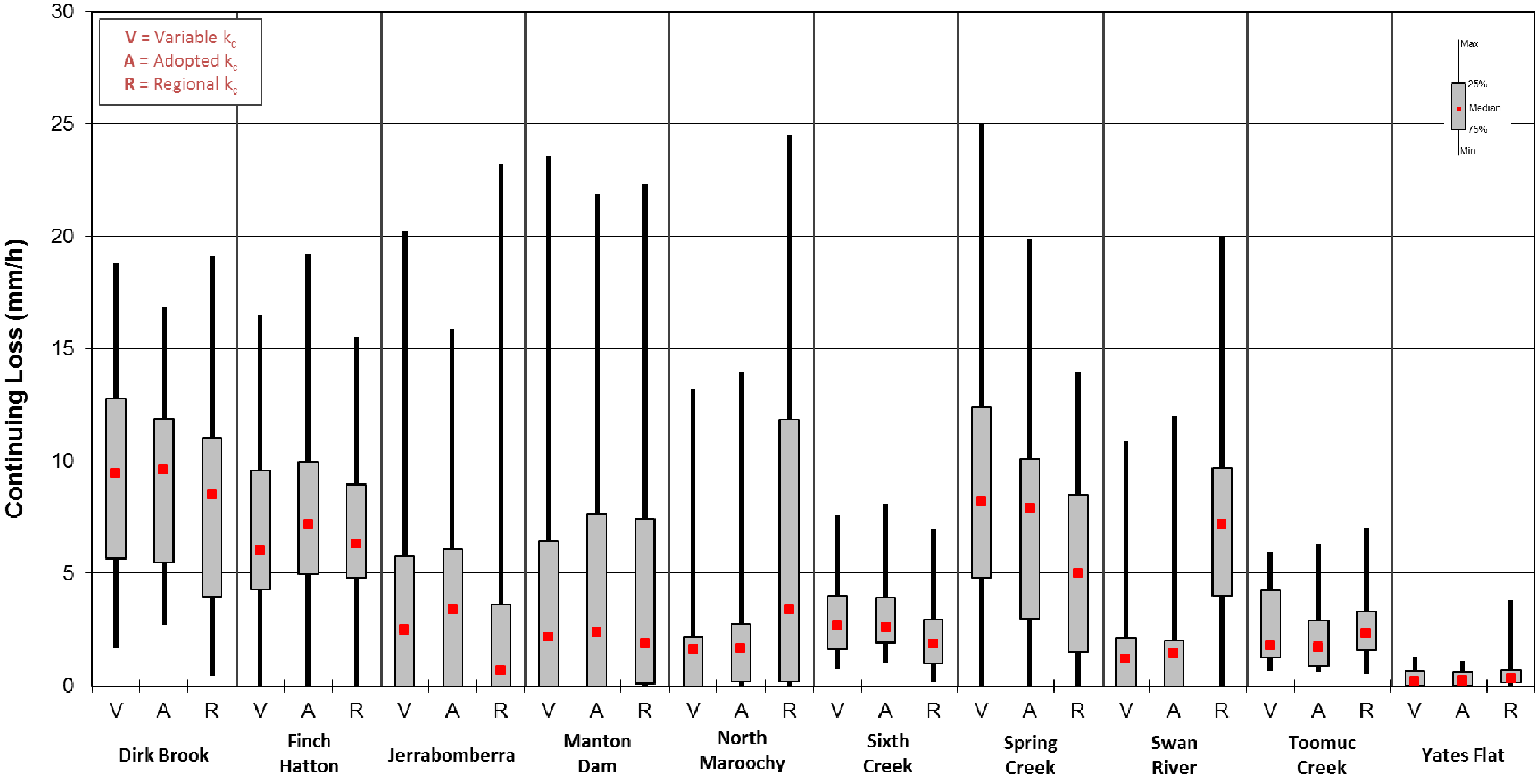


Figure G-10 Comparison of Continuing Loss for different routing parameter values

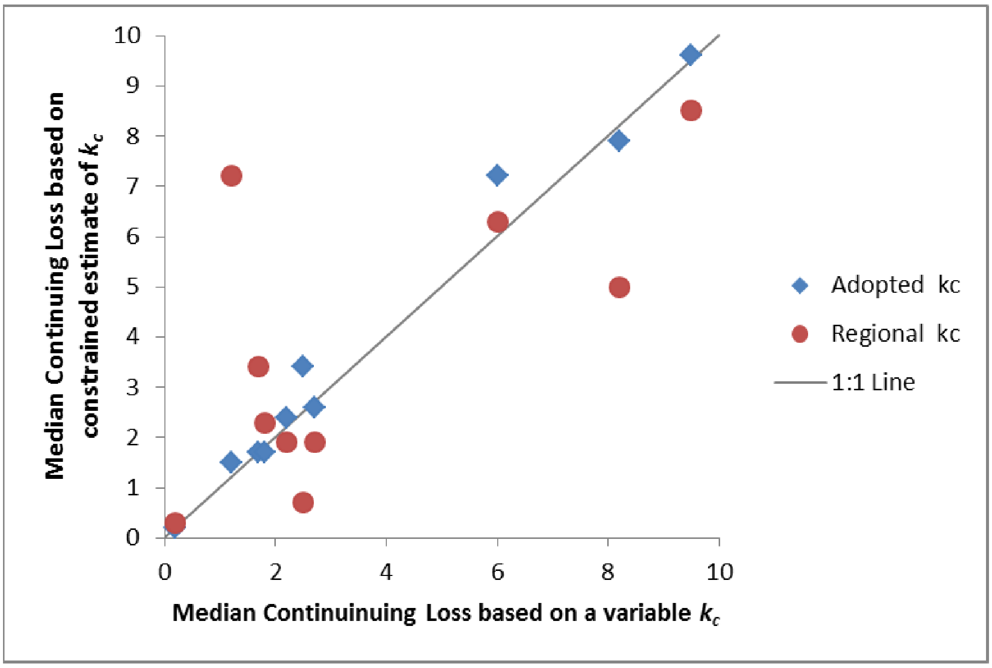


Figure G-11 Comparison of median Continuing Loss obtained from using different routing approaches

The increase in scatter in Continuing Loss associated with adoption of the simpler (more constrained) approach to specification of the routing parameter is evident in Figure G-11.

Variation of volume error

The volume errors resulting from the application of the different routing parameters are shown in Figure G-12 and the median values are summarised in Table G-8.

Table G-8 Median continuing volume error for different k_c values

Gauge	Catchment	Volume Error (%)		
		Variable k_c	Adopted k_c	Regional k_c
614005	Dirk Brook @ Kentish Farm	-7.2%	-0.8%	-44.1%
125006	Finch Hatton Creek @ Dam Site	-8.4%	-7.0%	-2.7%
410743	Jerrabomberra Creek @ Four Mile Creek	-1.9%	-16.0%	31.4%
G8170075	Manton River u/s Manton Dam	-4.4%	-17.9%	-16.9%
141009	North Maroochy River @ Eumundi	-0.4%	-2.8%	-42.6%
A5040523	Sixth Creek @ Castambul	-36.3%	-49.7%	-17.9%
422321	Spring Creek @ Killarney	-8.3%	-7.3%	-9.9%
2219	Swan River u/s Hardings Falls	-5.1%	-9.4%	0.0%
228217	Toomuc Creek @ Pakenham	0.3%	-1.4%	-14.3%
603190	Yates Flat Creek @ Woonanup	-2.5%	-3.3%	-22.2%

It is shown in Figure G-12 that the variable k_c approach represents the best hydrograph fitting in terms of volume (in terms of both the median and spread of error for all catchments). This is an expected result – the freedom afforded by a variable k_c allows more events to be fitted suitably.

The adopted k_c calibrations perform largely better than the regional k_c approach. The poorest performing catchments using the regional method are the same catchments with large differences between the regional and adopted k_c (Dirk Brook, Jerrabomberra and North Maroochy). A notable exception is Sixth Creek, which performed better under the regional method. It can be seen that regardless of the chosen method the volume is consistently under predicted for Sixth Creek events. As investigated in the Phase 1 pilot study, this underestimation is also present when using the IL/PL and SWMOD models. This implies that the baseflow separation for this catchment needs to be revisited.

An increase in k_c generally corresponded to an increase in the absolute value of the median volume error for most catchments. For given losses an increase in the routing parameter leads to a smoother hydrograph and lower peak flows that occur over a longer time, whereas a smaller k_c leads to shorter, more intense peak flows. Once the losses are estimated and the peaks fitted a lower k_c typically results in a lower flow volume. This translates into a correlation between correlation between k_c and volume error.

The increase in scatter in volume error associated with adoption of the simpler (more constrained) approach to specification of the routing parameter is evident in Figure G-13.

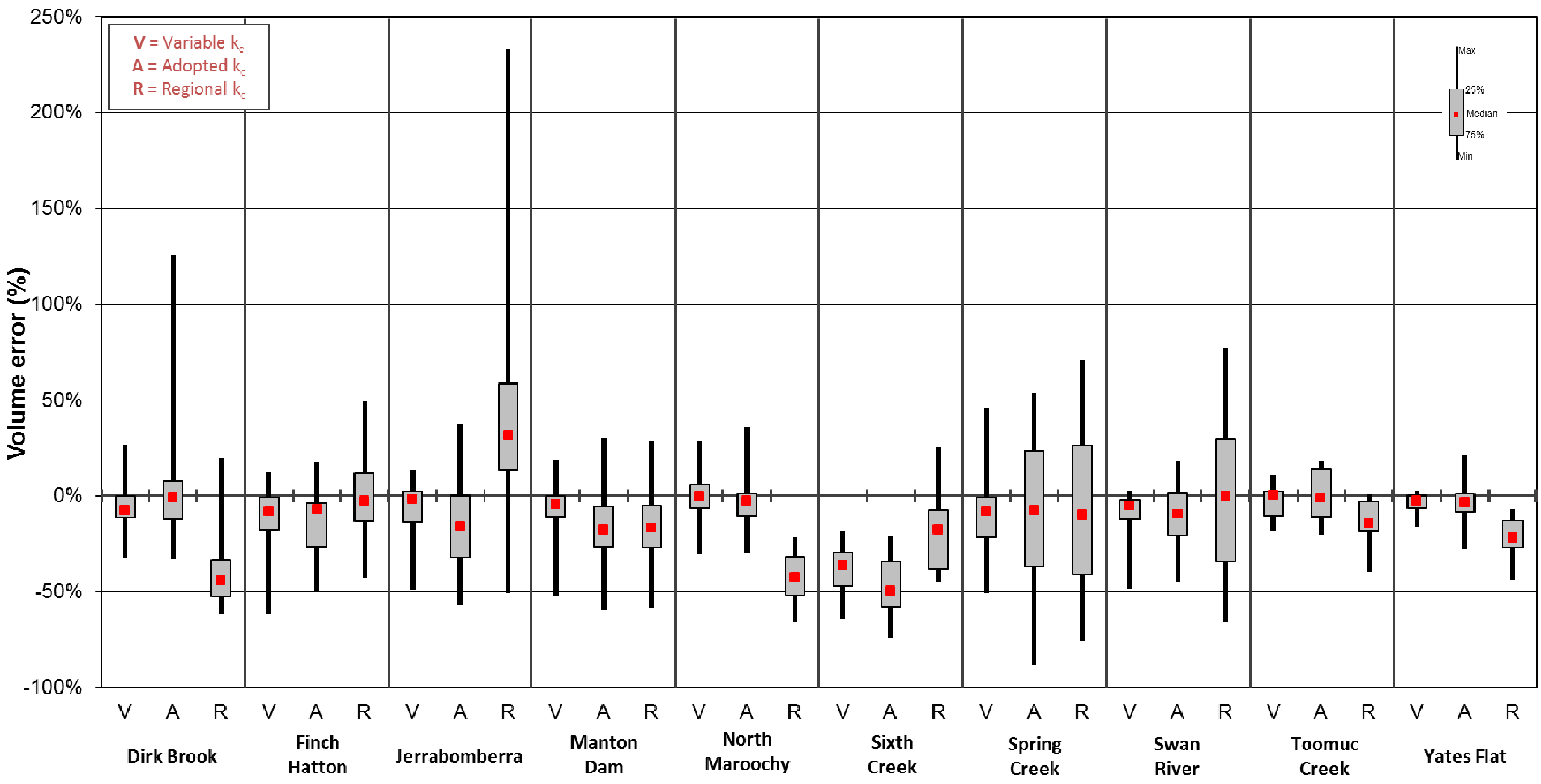


Figure G-12 Comparison of volume error for different routing parameter values

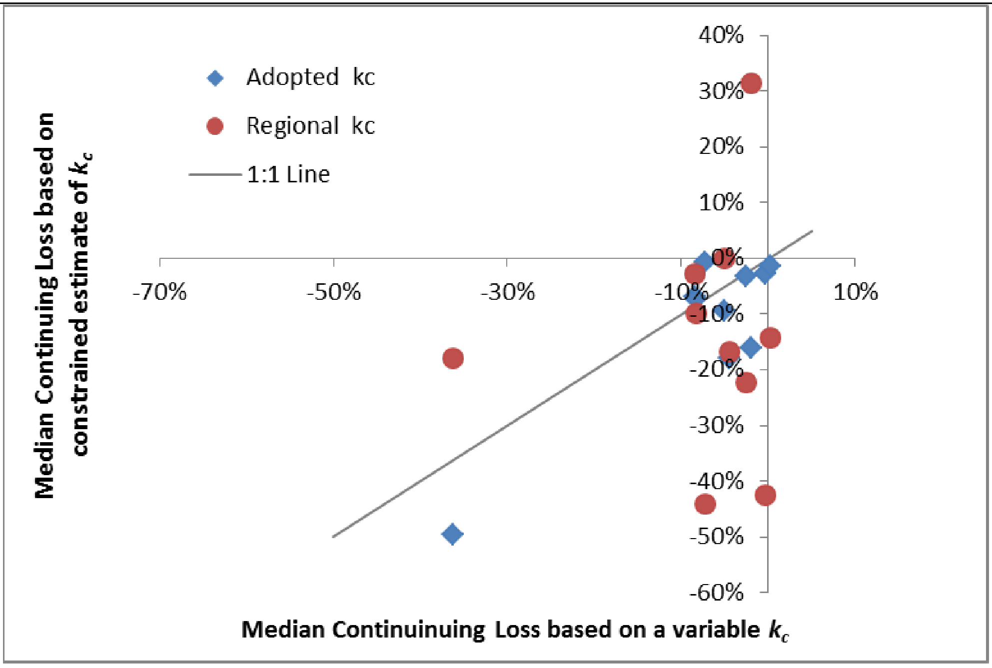


Figure G-13 Comparison of median volume error obtained from using different routing approaches

G.4 IL/CL - Sensitivity to model selection

Introduction

To test whether the estimation of losses is sensitive to the runoff routing model selected, loss values were also estimated using an URBS model with separate routing parameter defined for channel and overland routing (α and β). Given that regional predictions are not available for URBS, these parameters were varied for each event. The estimated loss values were then compared to those estimated using RORB where the k_c parameter was varied with each event.

Variation in Initial Loss values

The comparison of the Initial Loss values estimated from the 2 models is shown in Figure G-14. Although there are a small number of events which have large differences, the majority of loss values derived from the two models are similar and there is no obvious bias in the values.

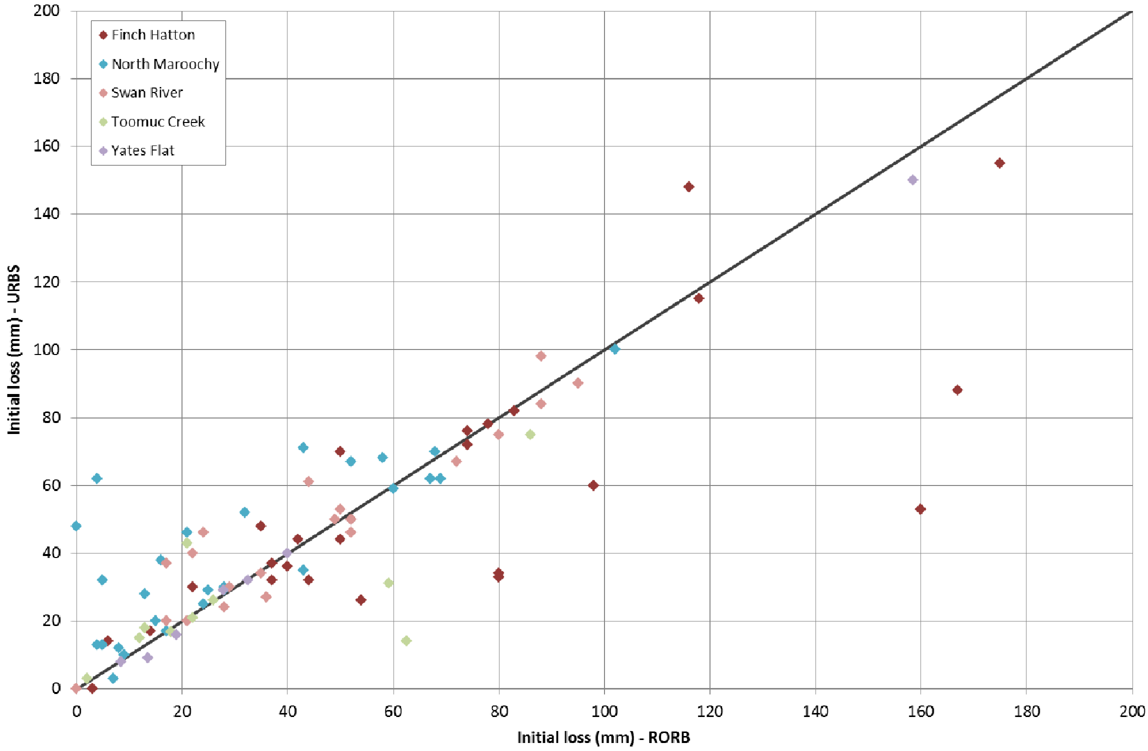


Figure G-14 Initial Loss values for the RORB and URBS calibrations

This is reinforced by the similarity of the two boxplots for each catchment, seen in Figure G-15. It should be noted that Toomuc Creek had few storm events suited to calibration and consequently the shape of the boxplot is more sensitive to changes in the losses of individual events than the other catchments.

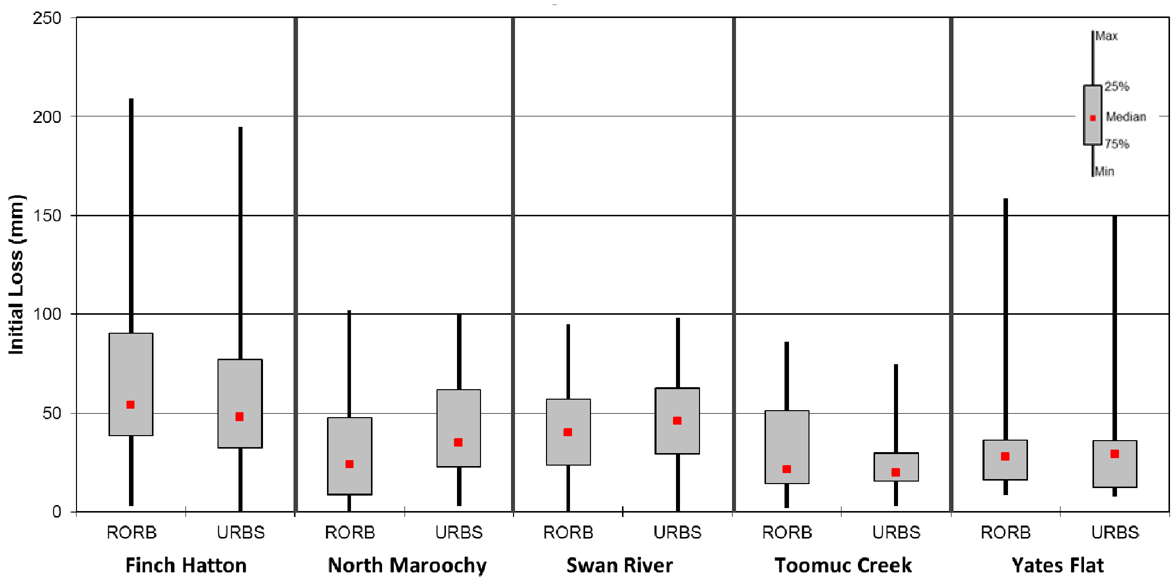


Figure G-15 Comparison of Initial Loss boxplots for RORB and URBS calibrations

Variation in Continuing Loss values

Figure G-16 shows the Continuing Loss values from the two different models. Once again although there are some events with quite different values of loss, there is no obvious bias in the results and the median values from the two models are quite similar (Figure).

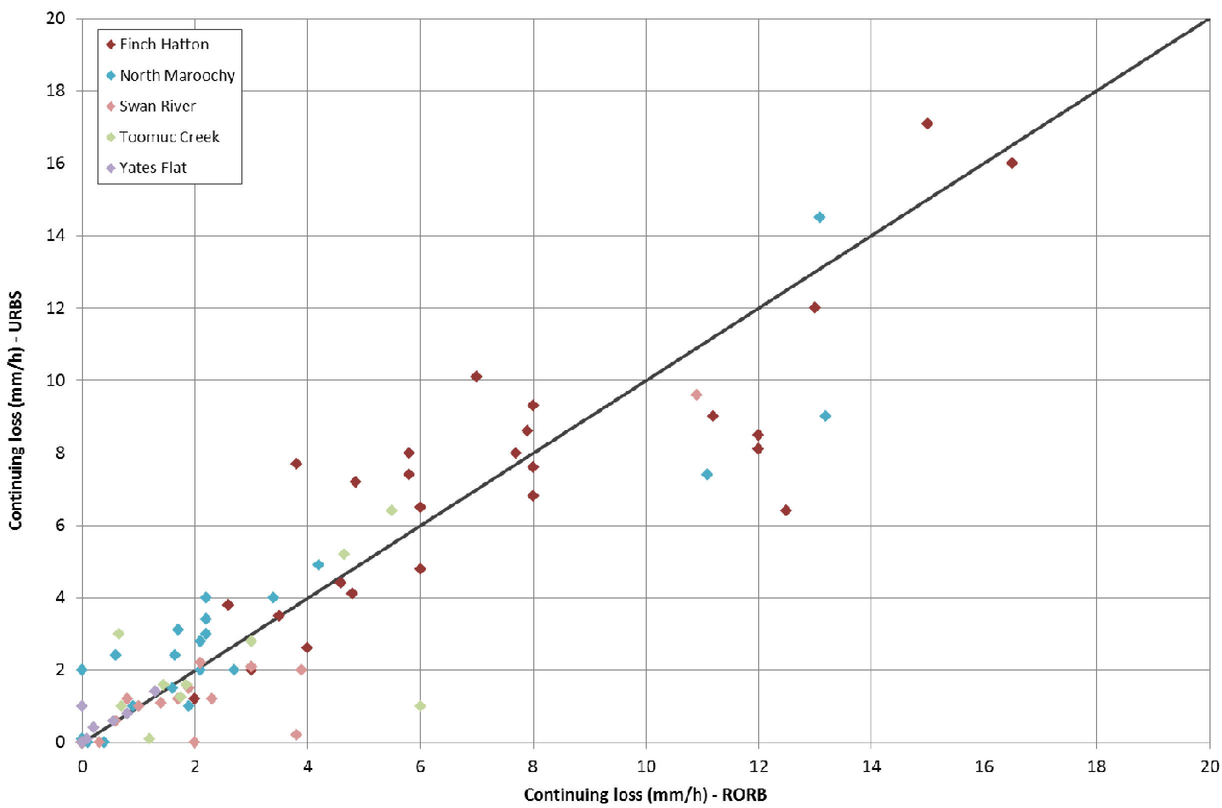


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Figure G-16 Initial Loss values for the RORB and URBS calibrations

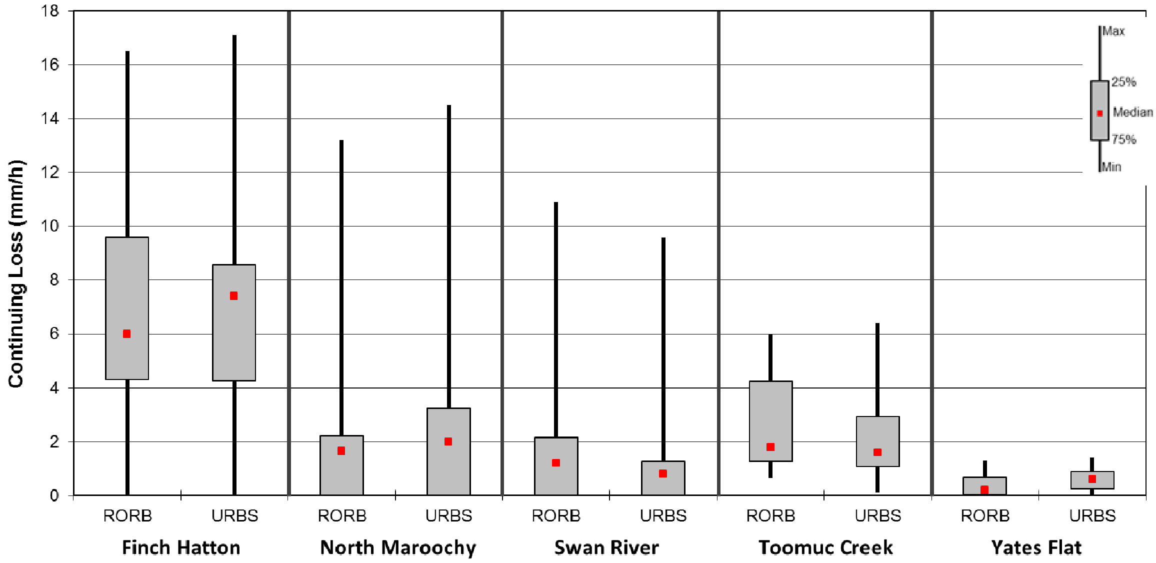


Figure G-17 Comparison of Continuing Loss boxplots for RORB and URBS calibrations

Variation in volume error

The volume error from the each of the models is compared in Figure G-18. It can be seen in that in terms of volume error the URBS model performed marginally better than the RORB model. Of the performed calibrations, URBS described flow volume better for 55% of the events. This result can be attributed to the greater freedom afforded in URBS by the separation of routing into overland and in-channel routing (which provides additional fitting flexibility).

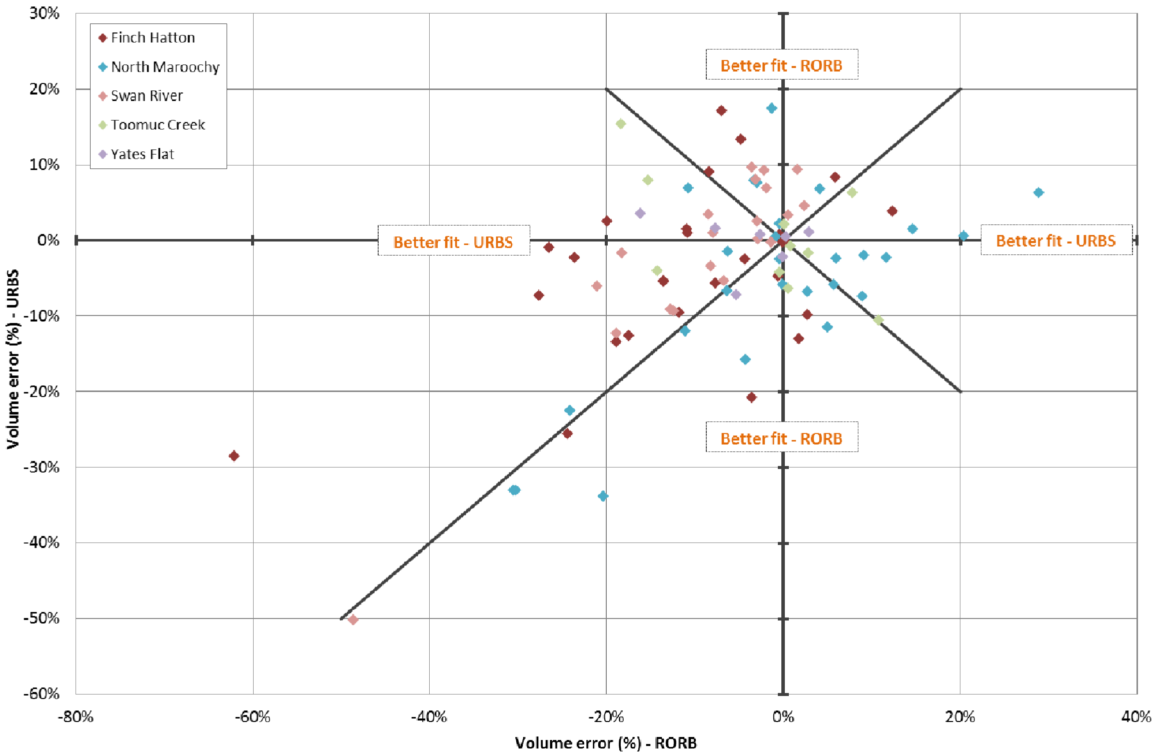


Figure G-18 Volume error for the RORB and URBS calibrations

G.5 SWMOD - Sensitivity to soil water storage curve shape

Introduction

As a variable infiltration capacity model, the SWMOD model utilizes a relationship between infiltration capacity and the saturated fraction of the catchment. This relationship is governed by:

$$C_f = C_{\max} - (C_{\max} - C_{\min}) \times \left(\frac{1}{F}\right)^{\frac{1}{\beta}}$$

Where

C_f is the infiltration capacity at fraction F of the sub-catchment;
F is the saturation fraction of the sub-catchment;
β is the shape parameter;
$C_{\max}$ is the maximum infiltration capacity; and
$C_{\min}$ is the minimum infiltration capacity

In this study, the soil water retention curve was constructed using properties provided by McKenzie et al (2000). 5th percentile and 95th percentile estimates of the soil water holding capacity were used as estimates for minimum and maximum infiltration capacity respectively, and were used in conjunction with the median estimate to fit shape parameter β.

This analysis is concerned with testing if there is any appreciable increase in model performance when using a fitted β over assuming a linear relationship (that is, $\beta = 1$). Calibrations using both fitted β values and linear relationships were performed for four of the pilot catchments.

Table G-9 Fitted β values for each soil type

Catchment	Soil id	β	Proportion of catchment area
Dirk Brook	19482	1.7	90.8%
	19505	1.26	9.2%
Spring Creek	15532	5.2	61.7%
	16358	1.6	38.1%
	16530	1.05	0.1%
	16585	1.05	0.1%
Finch Hatton Creek	7364	1.39	100%
Toomuc Creek	21769	1.33	74.5%
	21885	1.24	21.1%
	21990	1.0	4.4%

Initial Moisture Content

Figure G-19 shows the different Initial Moisture contents estimated for the linear and Beta infiltration capacity relationships. The Initial Moisture content was not sensitive to the shape of the infiltration capacity relationship. This is an expected result; altering β does not change the minimum infiltration capacity – resultantly, the Initial Moisture deficit for a given Initial Moisture content should not be affected.

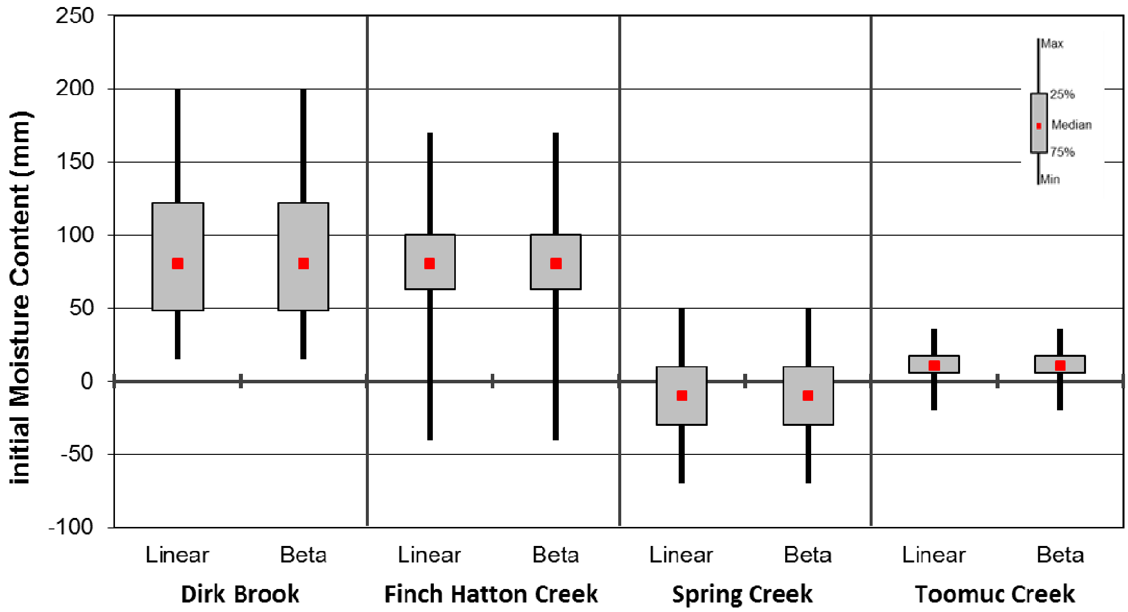


Figure G-19 Comparison of Initial Moisture content boxplots for both the linear and fitted beta infiltration capacity relationships

Capacity Factor

In initial conceptualization SWMOD only used one parameter – Initial Moisture content. After it was shown that this parameter did not allow the model to match observations effectively the Capacity Factor was introduced to increase flexibility.

Figure G-20 shows the resulting Capacity Factors for the 2 infiltration capacity relationships. For all catchments the Capacity Factor is no closer to one for the β calibrations than the linear calibrations. In fact, for Spring Creek both the median Capacity Factor and the range of values are larger for the β calibrations. This implies that there is no advantage to using the fitted infiltration capacity relationship in terms of Capacity Factor.

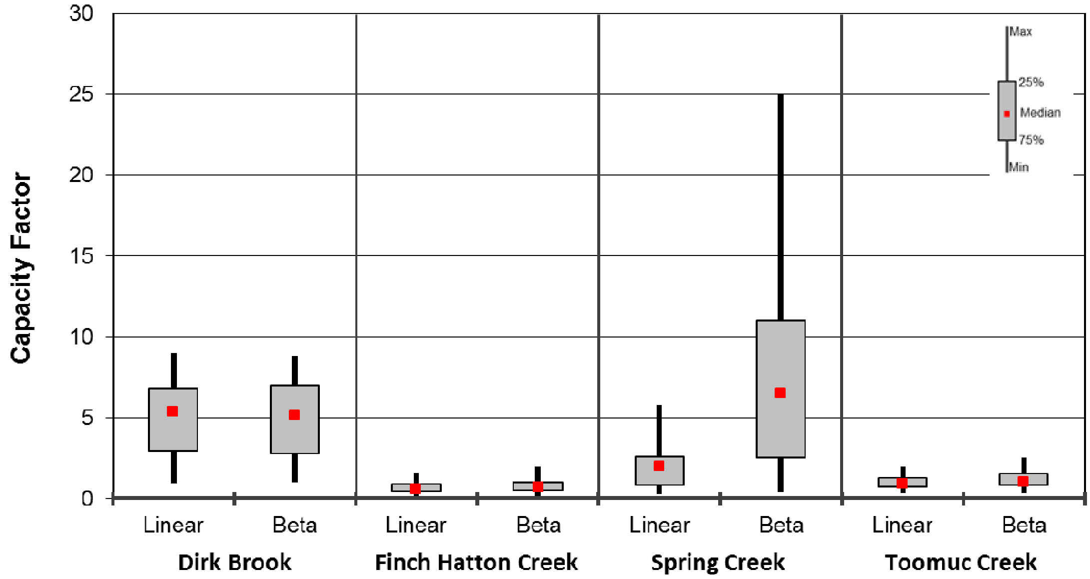


Figure G-20 Comparison of Capacity Factor boxplots for both the linear and fitted beta infiltration capacity relationships

Volume Error

Figure G-21 shows the volume errors for the 2 infiltration capacity relationships. It can be seen that volume error is consistent between calibrations for all but the Dirk Brook catchment, where model performance has improved significantly. It is therefore highlighted that the potential benefits of using fitted β values are catchment specific. All of the catchments use relationships with β significantly larger than one; however, the change in performance does not correspond with how non-linear the infiltration capacity relationship is.

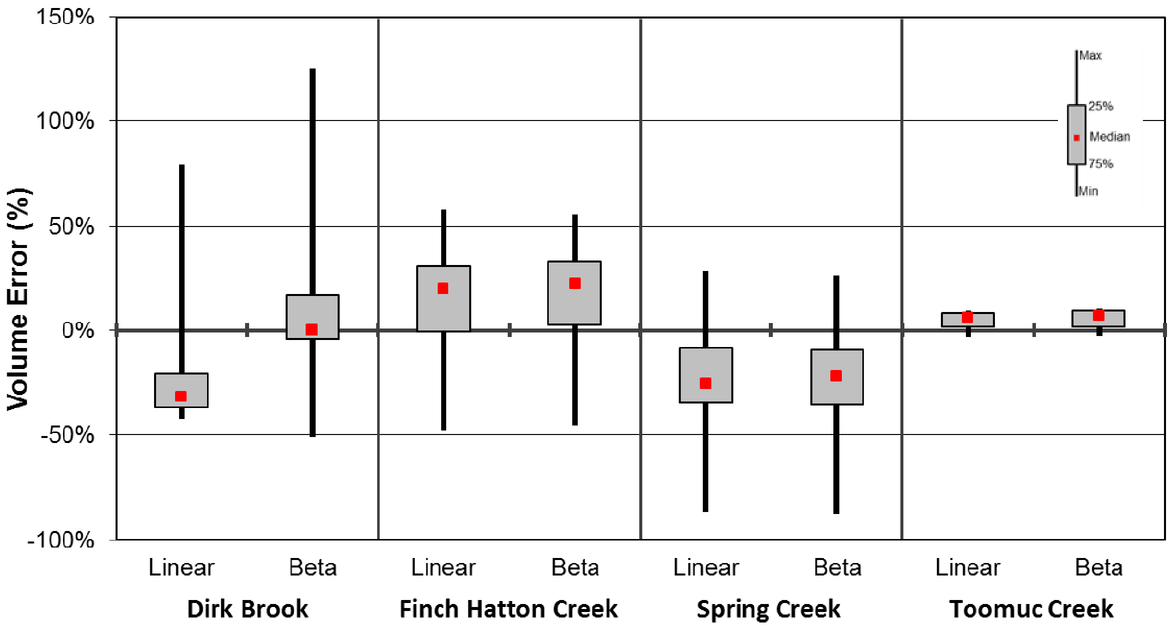


Figure G-21 Comparison of volume error content boxplots for both the linear and fitted beta infiltration capacity relationships

G.6 SWMOD - Sensitivity to scaling of soil water holding capacity

Introduction

As detailed in the pilot study, estimates of water holding capacity compiled by the Water Corporation in Western Australia and the findings of Ladson et al. (2006) have highlighted the possibility that water holding capacity values estimated using the values presented by McKenzie et al. (2000) may lead to an under-prediction of water holding capacity. Indeed, in a comparison of four Western Australian catchments, estimates calculated McKenzie et al. (2000) were over three times smaller than those compiled with the Department of Water data.

Table G-10 Comparison of water holding capacity calculated using McKenzie et al. (2000) values and calculated using soil water storage relationships in SWMOD by DoW, WA (Leanne Pearce, Water Corporation., pers. Comm.)

Catchment	Calculated using McKenzie et al. (2000) (mm)	Department of Water (mm)	Ratio of difference
Serpentine Creek	132	447	0.29
Samson Brook Dam	141	525	0.26
South Dandalup Dam	127	467	0.27
Wellington Dam	285	521	0.54

To explore potential improvements to model performance gained by addressing this discrepancy, the linear relationship ($\beta = 1$) calibrations are compared to a revisited set of calibrations where all soil water holding capacity values have been multiplied by three (denoted "linear x3 calibrations"). This analysis is performed for six of the pilot catchments.

Initial Moisture Content

As expected, the Initial Moisture content is higher in the "linear x3 calibration". Figure G-22 shows that when the infiltration capacity values are scaled there are fewer negative values used (particularly in Spring Creek). This is a desirable result; negative Initial Moisture content represents where $C_{\min}$ is not high enough for an Initial Moisture content of zero to give a high enough Initial Moisture deficit (which somewhat corresponds with Initial Loss). The reduction in negative values for the "linear x3 calibrations" suggests that the scaled infiltration capacity values may be closer to the actual capacity for some catchments.

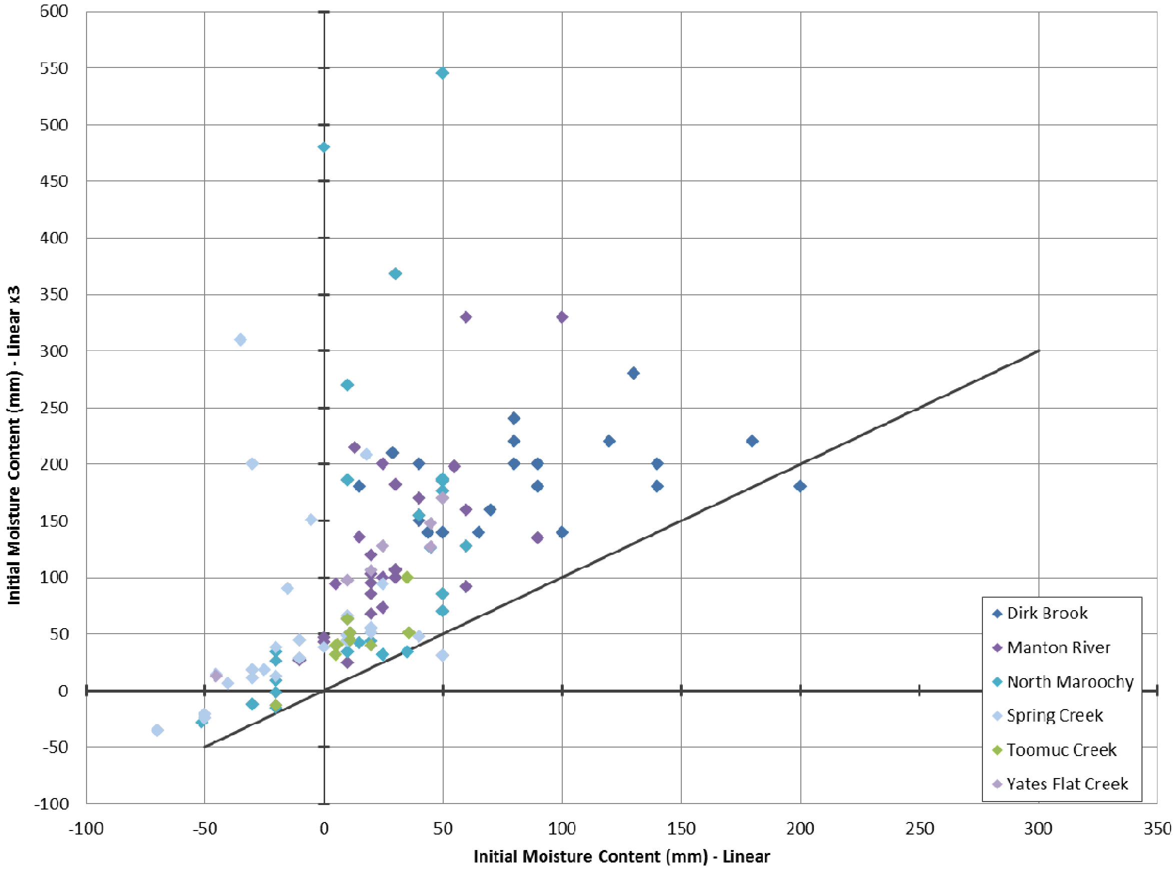


Figure G-22 Initial Moisture Content values for the 3x multiplier both not applied and applied to the linear infiltration capacity relationship

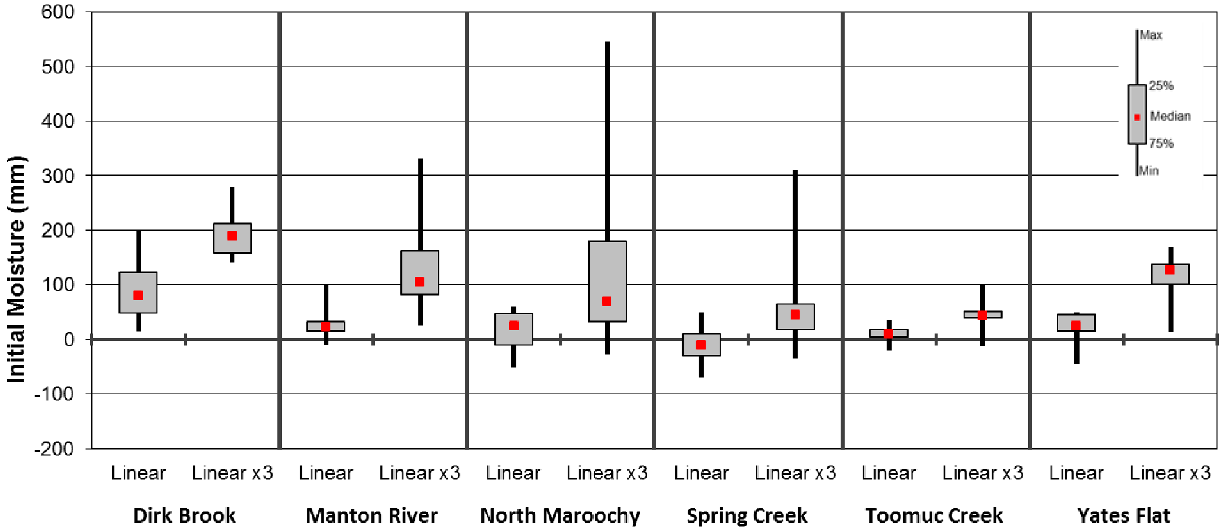


Figure G-23 Comparison of Initial Moisture content boxplots for the 3x multiplier both not applied and applied to the linear infiltration capacity relationship

Capacity Factor

Figure G-24 shows the impact of increasing the capacities on the Capacity Factor. The Capacity Factor is systematically higher without the application of the multiplier than it is with it. This reduction is particularly apparent in the Dirk Brook and Spring Creek catchments (which have high median Capacity Factor values without the multiplier).

It should be noted that the Capacity Factor reduction also occurs in catchments where the value is acceptable before applying the multiplier. This can be seen in Toomuc Creek, Yates Flat and North Maroochy, where the Capacity Factor values are further from one after applying the multiplier.

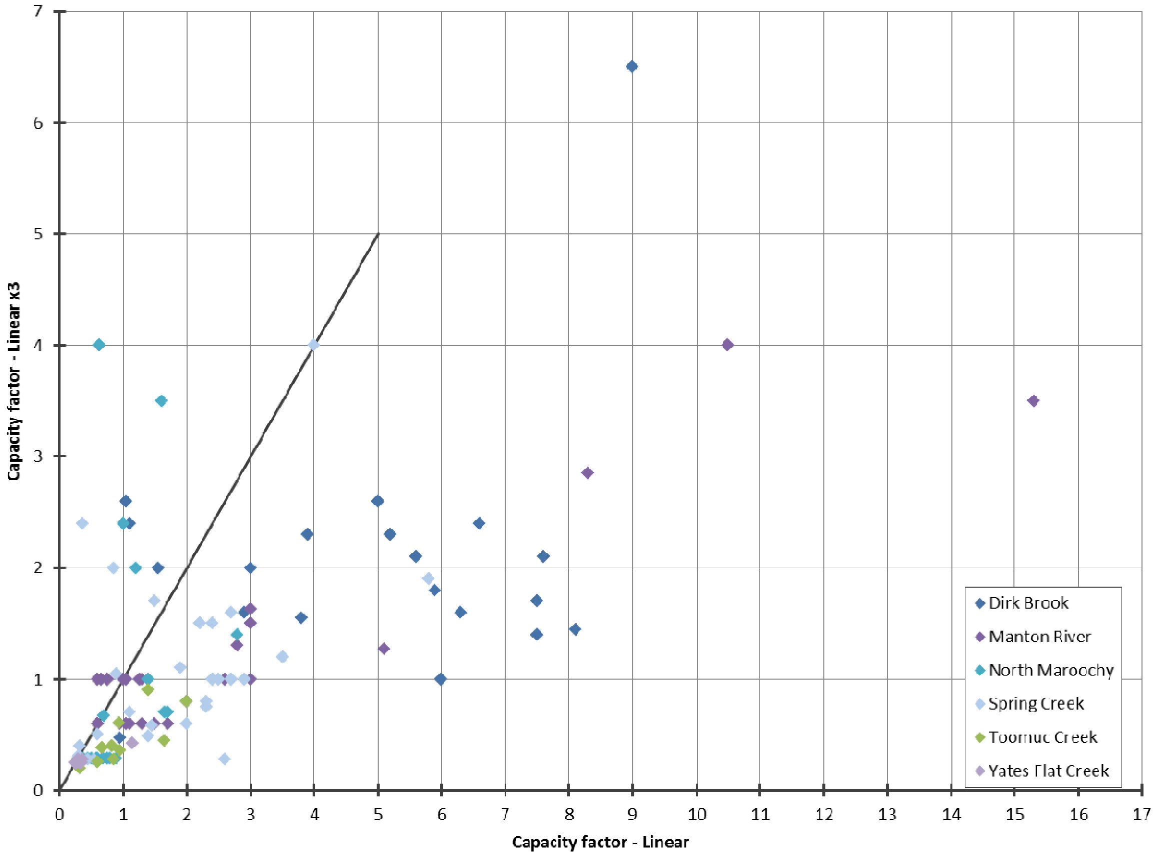


Figure G-24 Capacity Factor values for the 3x multiplier applied to the linear infiltration capacity relationship

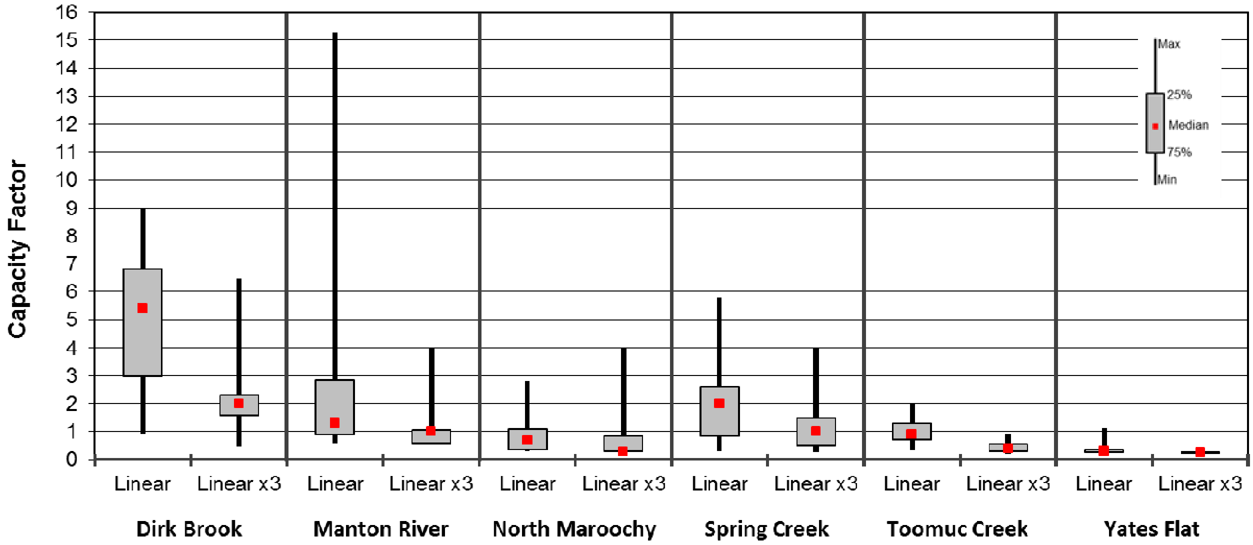


Figure G-25 Comparison of Capacity Factor boxplots for the 3x multiplier both not applied and applied to the linear infiltration capacity relationship

Volume error

It is seen in Figure G-27 that the volume error is largely consistent between the linear and "linear x3 calibrations" except for Spring Creek (where there is moderate improvement when the multiplier is used).

Though similar volume errors between calibrations may suggest that model performance has not changed significantly, the resulting value of the Capacity Factor must be considered. The Capacity Factor was originally introduced to the model when the Initial Moisture content alone did not allow the model to adequately fit observations and therefore a better fit can also be attributed to a Capacity Factor closer to unity.

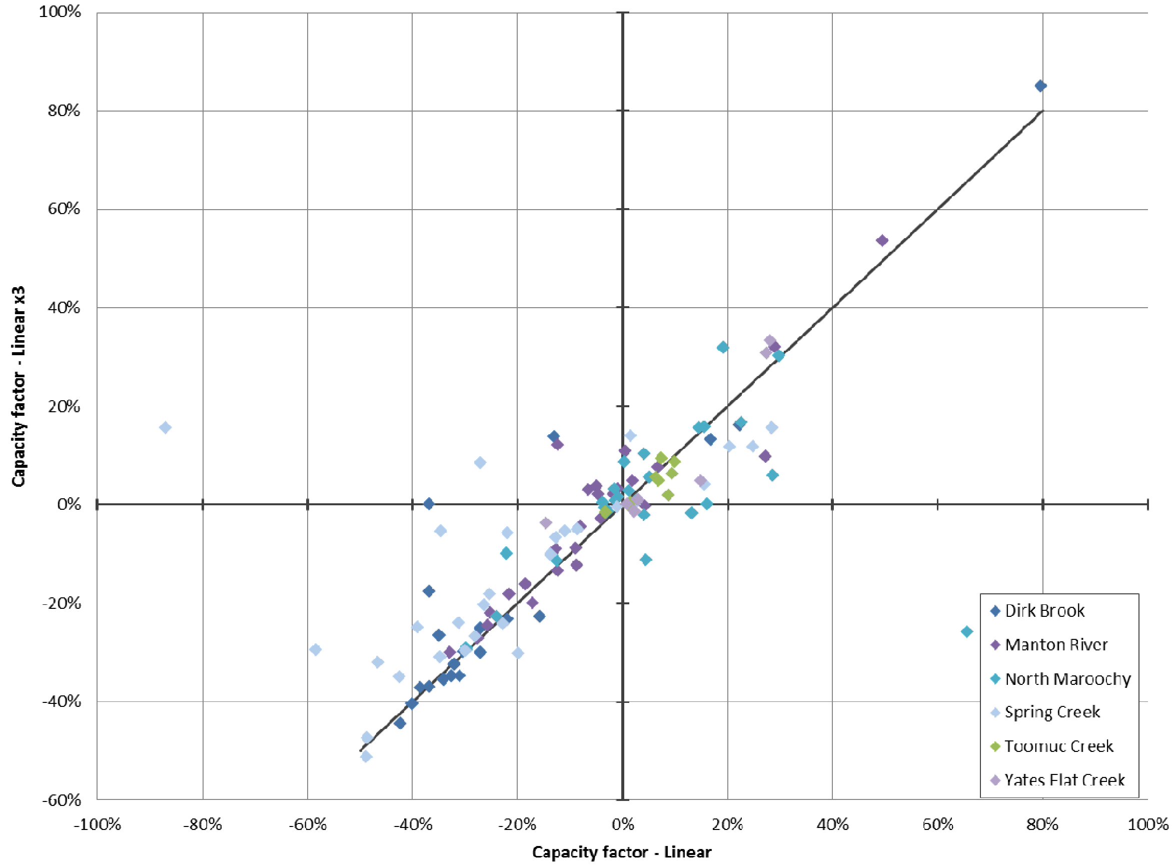


Figure G-26 Volume error for the 3x multiplier both not applied and applied to the linear infiltration capacity relationship

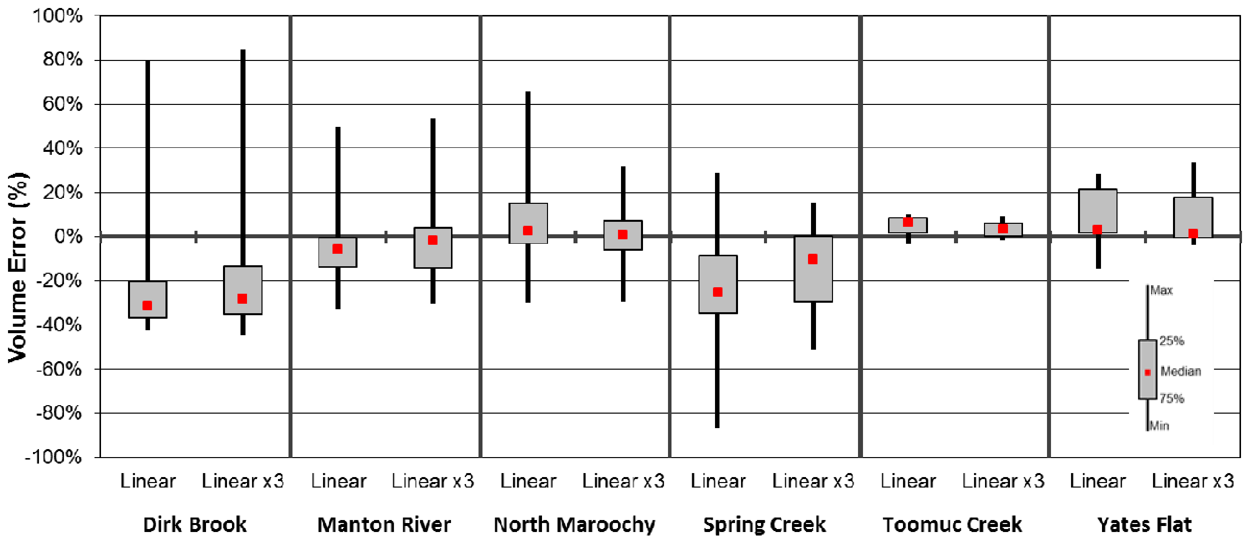


Figure G-27 Comparison of volume error boxplots for the 3x multiplier both not applied and applied to the linear infiltration capacity relationship

G.7 Correlation between Initial Loss and SWMOD Initial Moisture deficit

Introduction

Initial Moisture deficit is defined as $C_{\min}$ minus the Initial Moisture content. This represents the amount of moisture that initially must enter the soil before runoff can commence – in this regard it is conceptually similar to Initial Loss in the IL/CL loss model.

This analysis is concerned with examining the correlation between Initial Loss and Initial Moisture deficit. A representative $C_{\min}$ for each catchment is defined by weighted average where each soil's associated $C_{\min}$ is scaled by catchment area that soil type covers. The Initial Moisture deficit for each event in all ten catchments is compared to the Initial Loss value derived in the adopted k_c IL/CL RORB calibrations.

Results

It can be seen in Figure G-28 that some moderate correlation exists between IL and Initial Moisture deficit in some catchments (in particular North Maroochy and Spring Creek). It is clear that this relationship is catchment-specific – for instance, there is no correlation seen in Finch Hatton or Toomuc Creek.

The use of a weighted average $C_{\min}$ could be re-evaluated in further analysis – a weighted average was chosen to ensure that the infiltration properties of each soil in a catchment are adequately represented, however runoff will begin in soils with the lowest $C_{\min}$ value first (hence minimum $C_{\min}$ may be a useful alternate representative value).

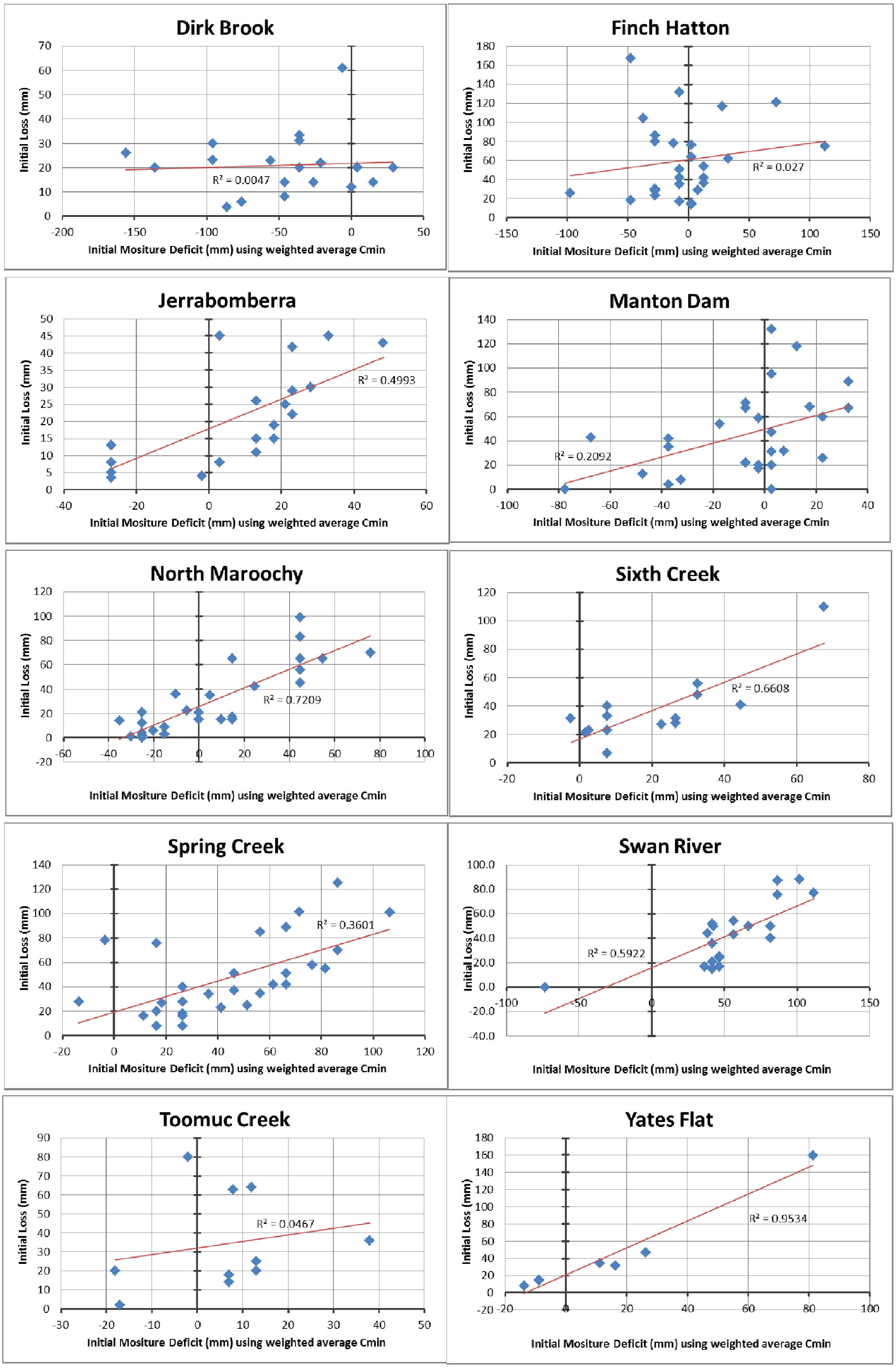


Figure G-28 Initial Moisture deficit vs. Initial Loss for each catchment

G.8 Conclusions

The investigation described in this report is based on limited scope of work, however on the basis of the results presented it can be concluded that:

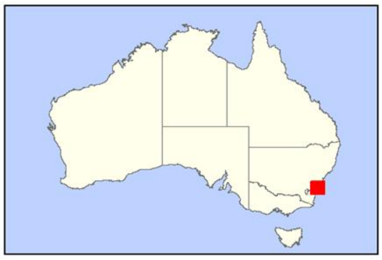
- Differences in results arising from subjective judgements by different practitioners has a negligible to small influence on estimates of initial and Continuing Loss rates;
- Calibration performance improves when site- and event-specific characteristics are considered, and any increase in the uncertainty in the timing of simulated hydrographs propagates through to additional uncertainty in estimates of loss parameters;
- The selection of an alternative routing model structure has little influence on the derived estimates of the loss parameters;
- Loss parameters are not sensitive to the shape of the soil water storage curve adopted for the variable infiltration capacity (SWMOD) model;
- While it is necessary to scale regional estimates of soil water holding capacity to yield values that are consistent with site-specific analyses, the impact on calibration performance is low; and,
- There is moderate correlation between Initial Loss characteristics obtained from fixed- and variable- infiltration models, though further investigation would be required to understand whether it would be possible to use this for predictive purposes.

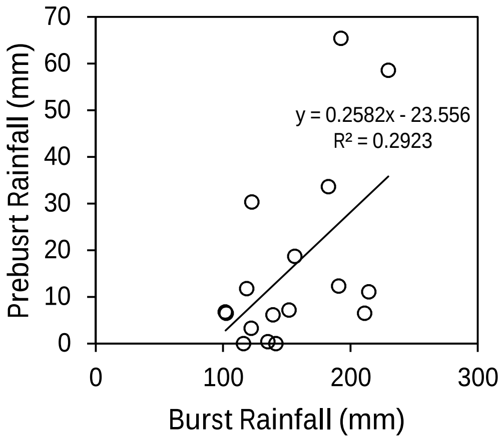
Appendix H Adopted routing and baseflow parameters

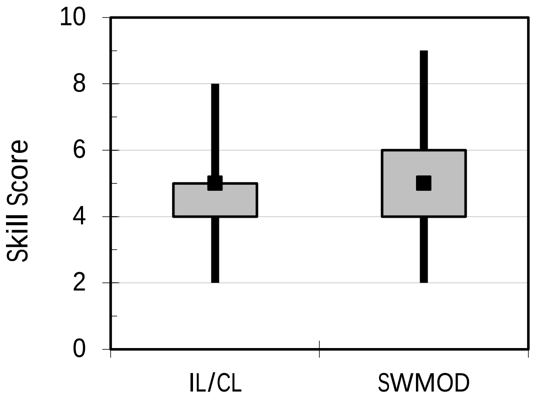
	Name		Location	$c_{0.8}$		d_{av}		Baseflow separation	
	Gauge No.	Stream	State	IL/CL	SWMOD	IL/CL	SWMOD	Factor	No. Passes
GSAM - Coastal	216004	Currambene	NSW	1.07	0.97	11	10	0.925	7
	213200	O'Hares	NSW	0.87	0.72	9	7.5	0.925	7
	211013	Ourimbah	NSW	2.05	1.86	22	20	0.925	9
	2219	Swan	Tas	1.41	1.41	10	10	0.925	7
	235219	Aire	VIC	1.58	1.21	17	13	0.925	7
	229106	McMahons	VIC	3.30	1.82	20	11	0.925	7
	228206B	Tarago	VIC	2.06	1.61	16	12.5	0.925	7
	228217	Toomuc	VIC	1.62	1.12	14.5	10	0.925	7
GSAM - Inland	410743	Jerrabomberra	NSW	0.85	0.57	7	4.75	0.925	7
	411003	Butmaroo	NSW	0.61	0.44	7	5	0.925	7
	AW503506	Echunga	SA	1.14	0.82	6.92	5	0.925	7
	AW501500	Hindmarsh	SA	1.40	1.14	11	8.94	0.925	9
	AW502502	Myponga	SA	2.04	1.73	16.5	14	0.925	7
	A5040523	Sixth	SA	1.16	0.64	10	5.5	0.925	7
	406216	Axe	VIC	1.21	1.00	8.5	7	0.925	7
GTSMR - Coastal	G8150151	Celia	NT	2.35	2.01	14	12	0.925	7
	G8170066	Coomalie	NT	2.26	1.76	18	14	0.925	9
	G8170075	Manton	NT	1.62	1.22	12	9	0.925	7
	G0290240	Tennant	NT	1.17	0.52	8.9	4	0.925	9
	120216A	Broken	Qld	0.78	0.57	11	8	0.925	9
	142001A	Caboolture	Qld	0.89	0.77	11	9.5	0.925	7
	126003A	Carmila	Qld	1.03	0.87	9.5	8	0.925	9
	125006	Finch Hatton	Qld	1.14	0.72	6.38	4	0.925	7
	141009	North Maroochy	Qld	2.25	2.25	18	18	0.925	9
	141001	South Maroochy	Qld	1.54	1.23	10	8	0.925	7
	422123	Spring	Qld	1.29	1.55	7.5	9	0.925	7
	809312	Fletcher	WA	0.47	0.37	2.5	2	0.925	7
	709007	Harding	WA	0.68	0.41	5	3	0.925	7
	708009	Kanjenjie	WA	1.50	1.34	9.5	8.5	0.925	7
GTSMR – SW WA	609005	Balgarup	WA	1.14	0.95	9.56	8	0.925	7
	701006	Buller	WA	0.60	0.38	3.2	2	0.925	7
	608002	Carey	WA	3.40	2.45	25	18	0.925	7
	614047	Davis	WA	2.98	2.10	18.5	13	0.925	7
	614005	Dirk	WA	2.88	1.81	17.5	11	0.925	9
	602199	Goodga	WA	2.63	2.14	16	13	0.925	9
	612004	Hamilton	WA	4.44	3.74	19	16	0.925	7
	614003	Marrinup	WA	3.33	1.90	17.5	10	0.925	7
	603190	Yates Flat	WA	2.04	1.63	12.5	10	0.925	7

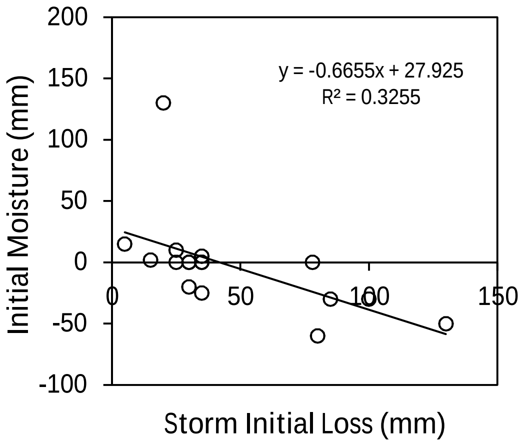
Appendix I Loss summaries for 24h bursts

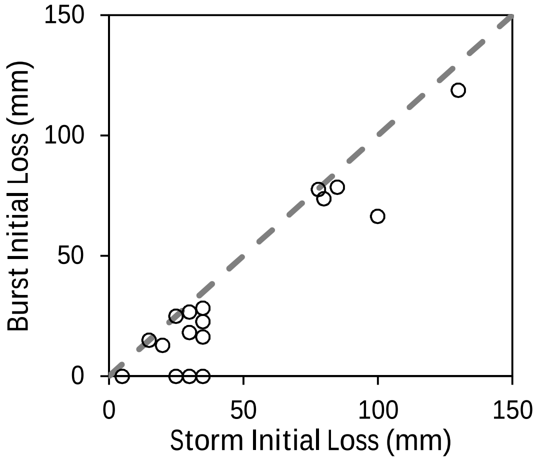
Currambene Ck @ Falls Ck (NSW) - 24 hour bursts

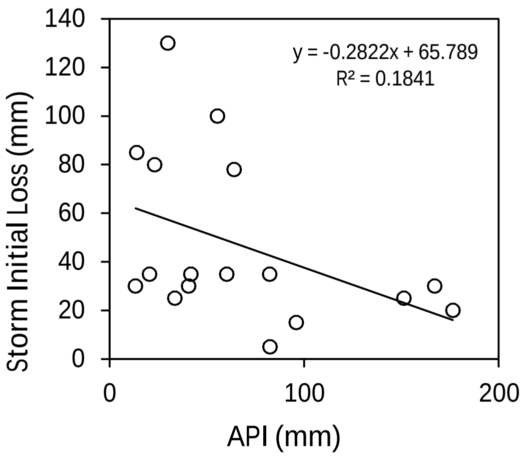


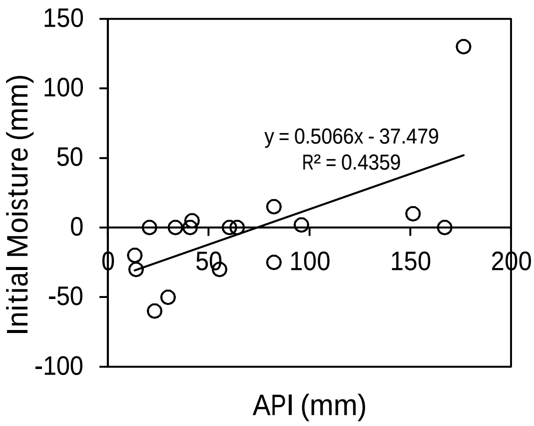




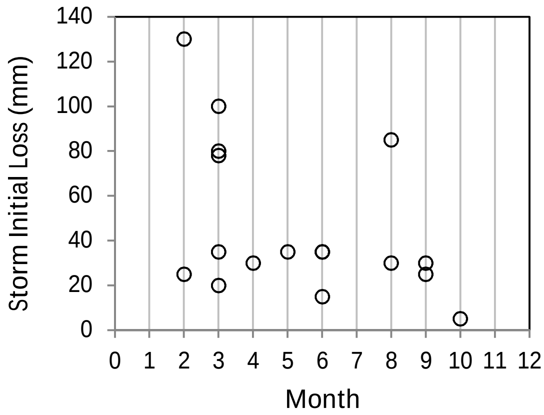


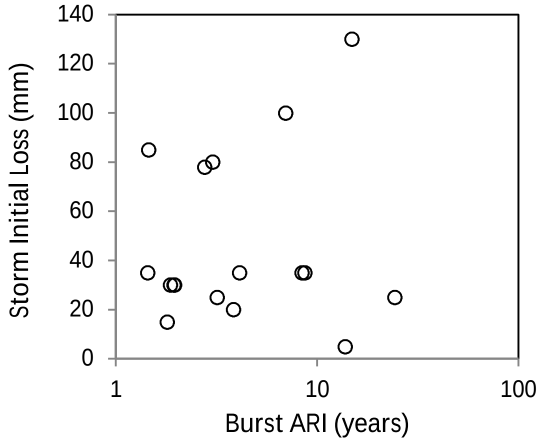


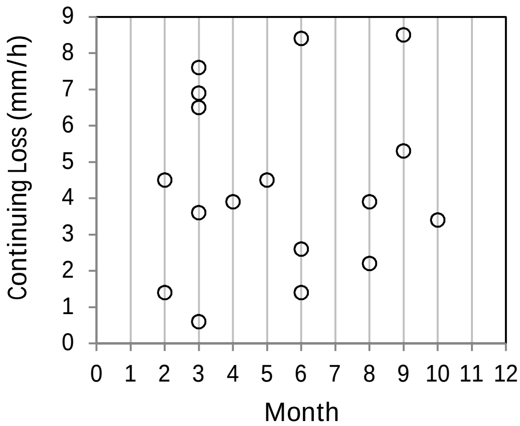


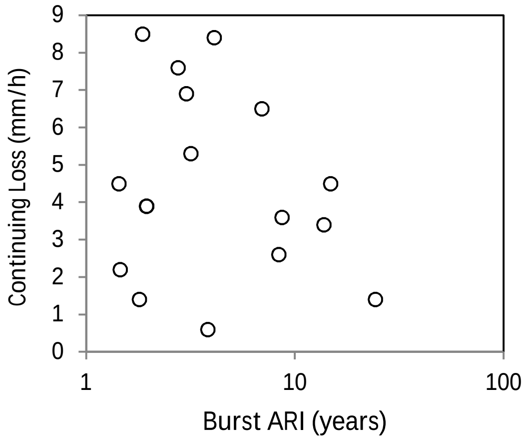


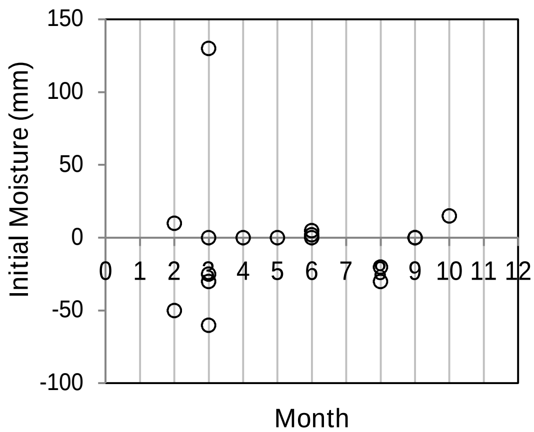
Currambene Ck @ Falls Ck (NSW) - 24 hour bursts

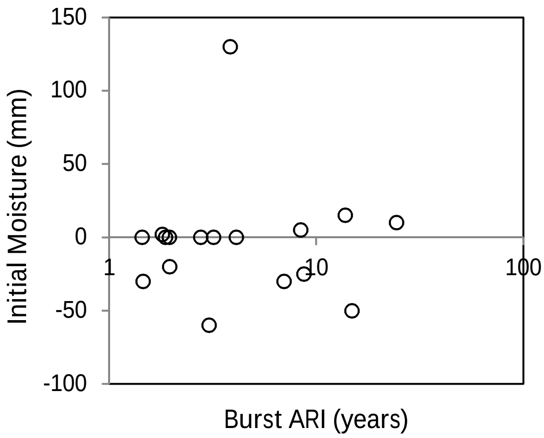


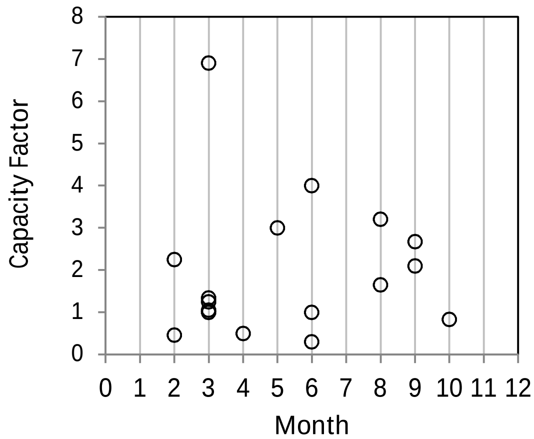


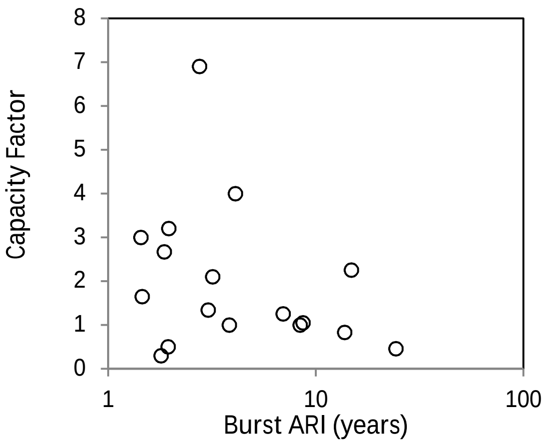




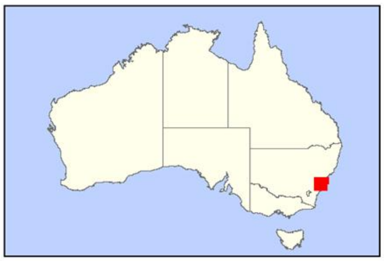


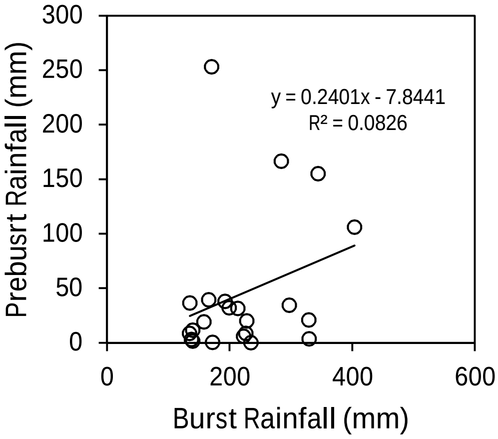


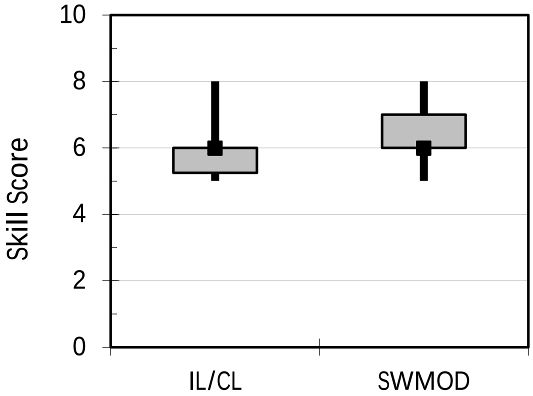


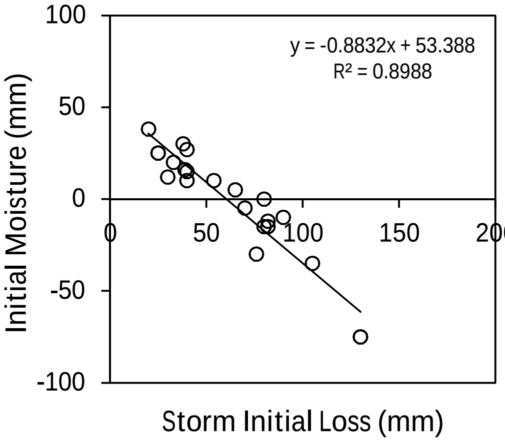


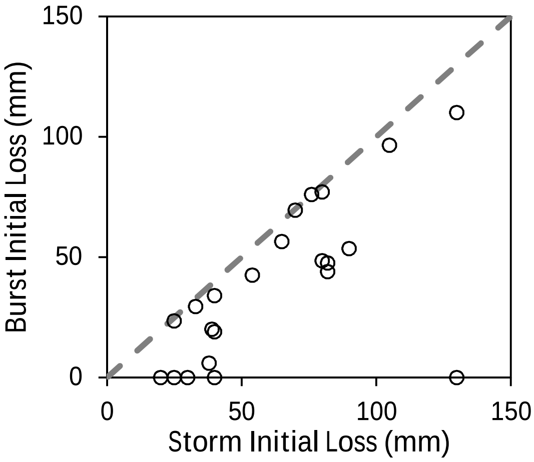
O'Hares Ck @ Wedderburn (NSW) - 24 hour bursts

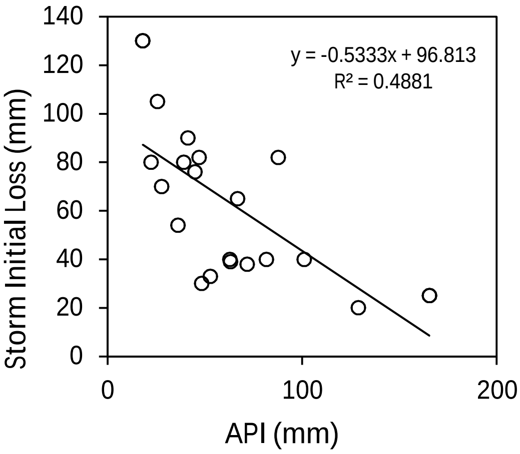


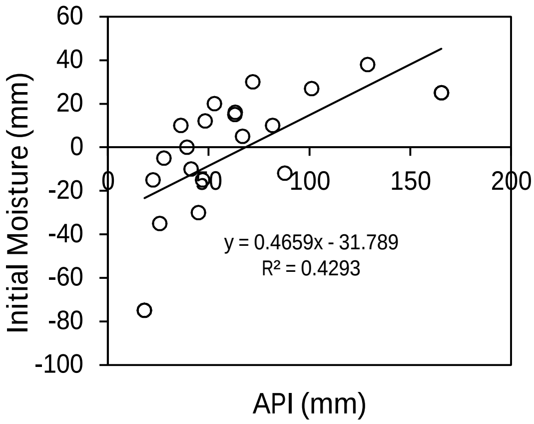




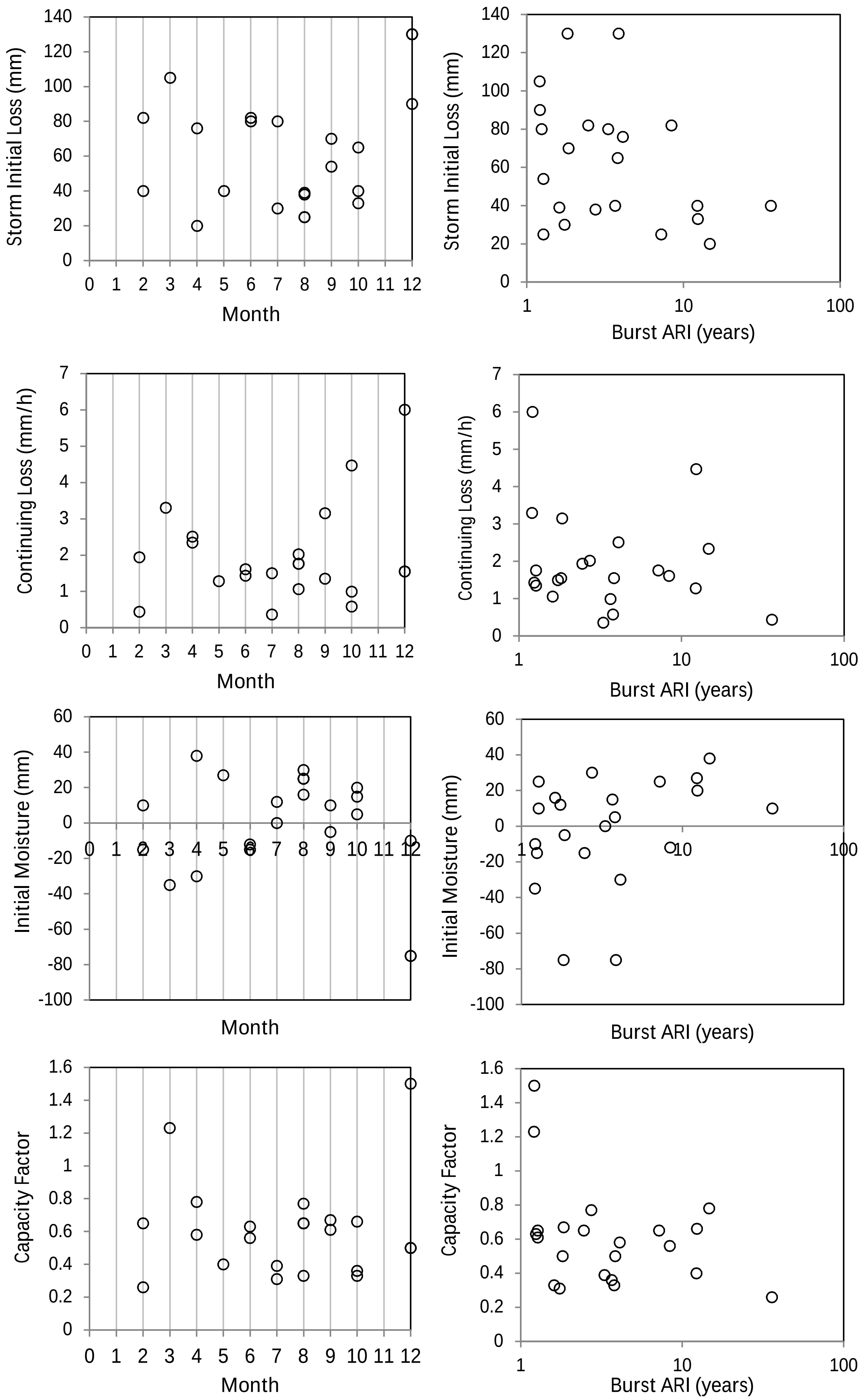




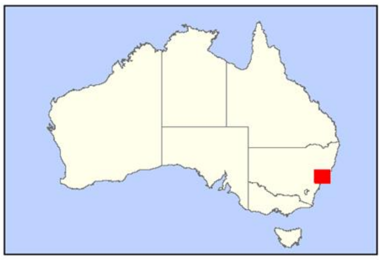


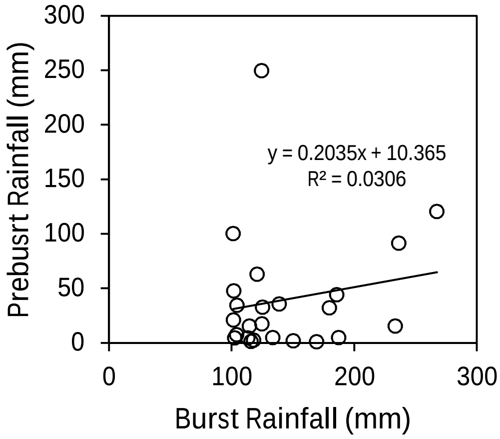


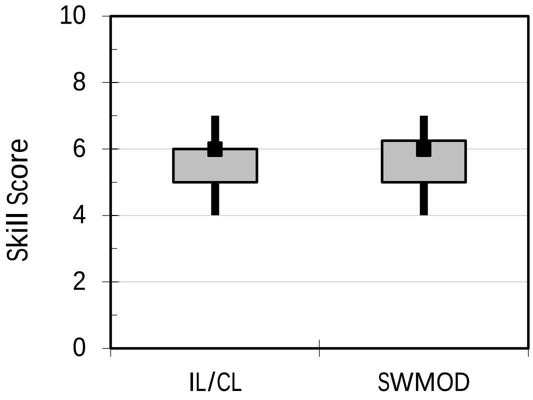
O'Hares Ck @ Wedderburn (NSW) - 24 hour bursts

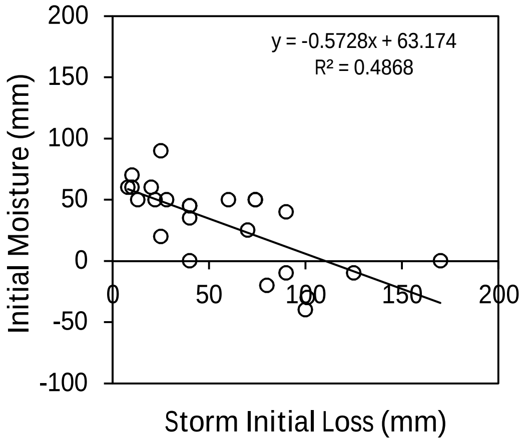


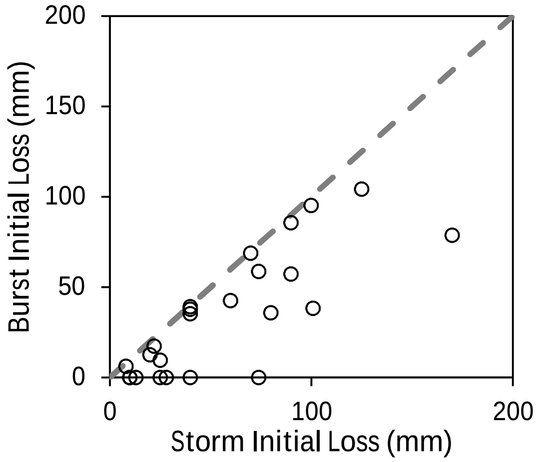
Ourimbah Ck @ U/S Weir (NSW) - 24 hour bursts

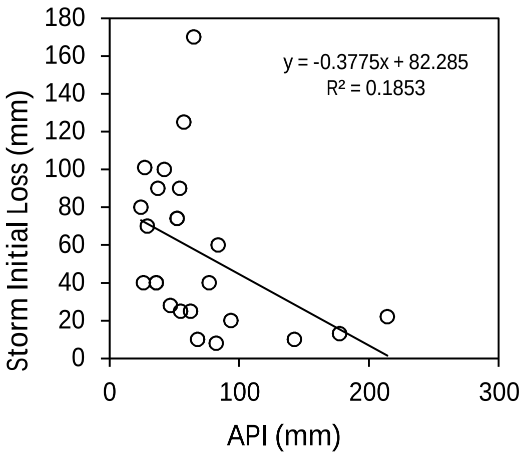


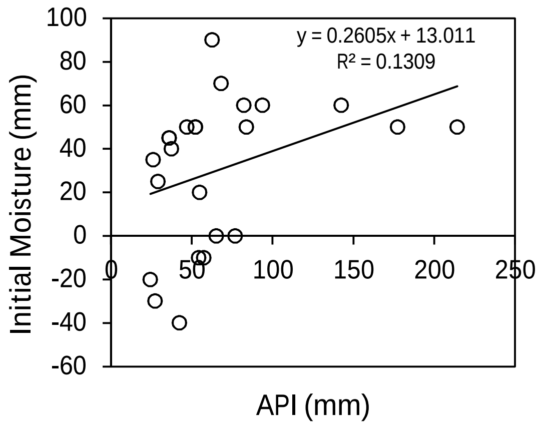




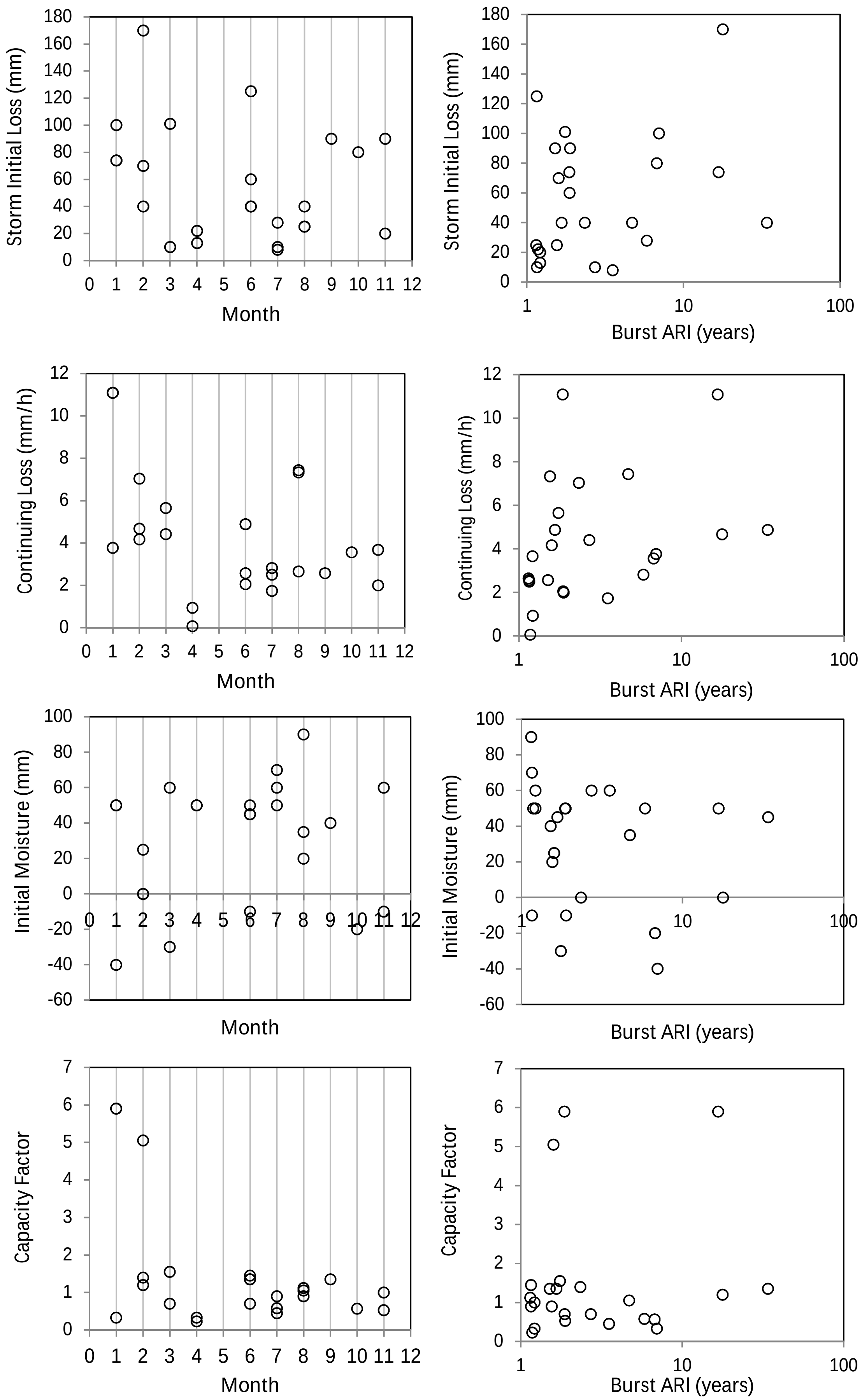




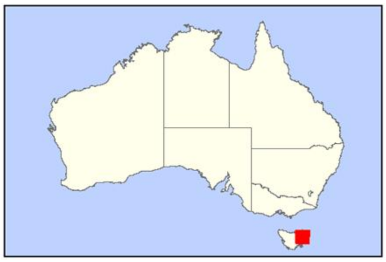


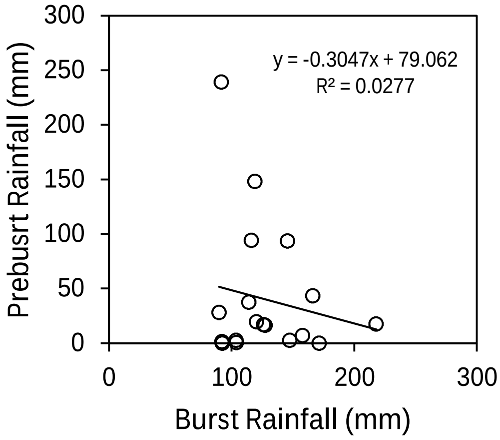


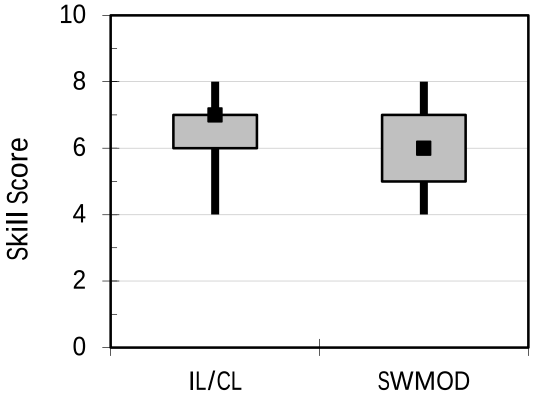
Ourimbah Ck @ U/S Weir (NSW) - 24 hour bursts

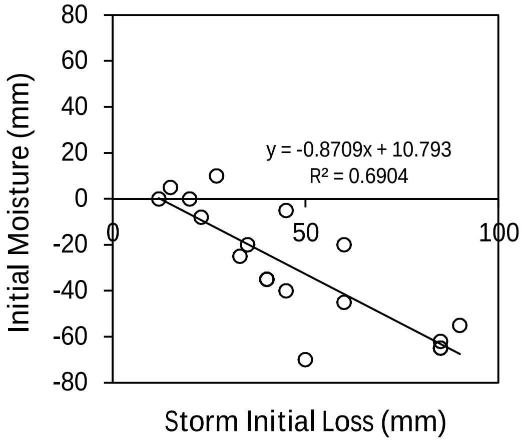


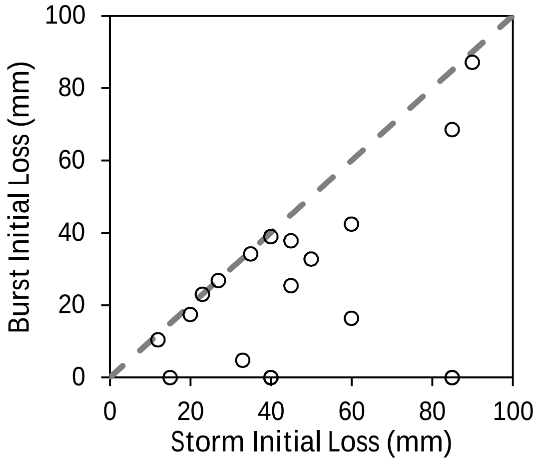
Swan River @ Harding Falls (Tas) - 24 hour bursts

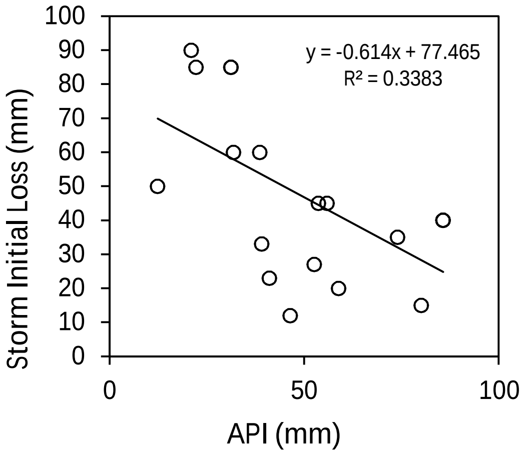


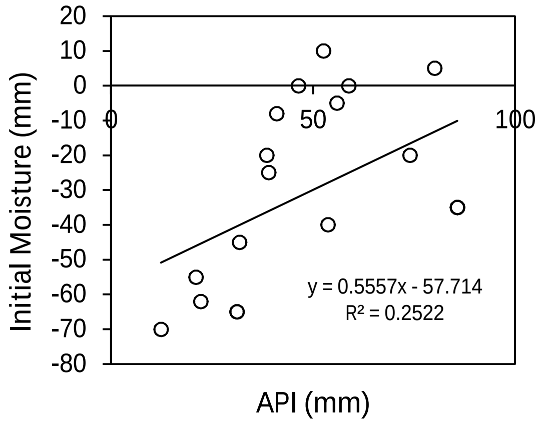




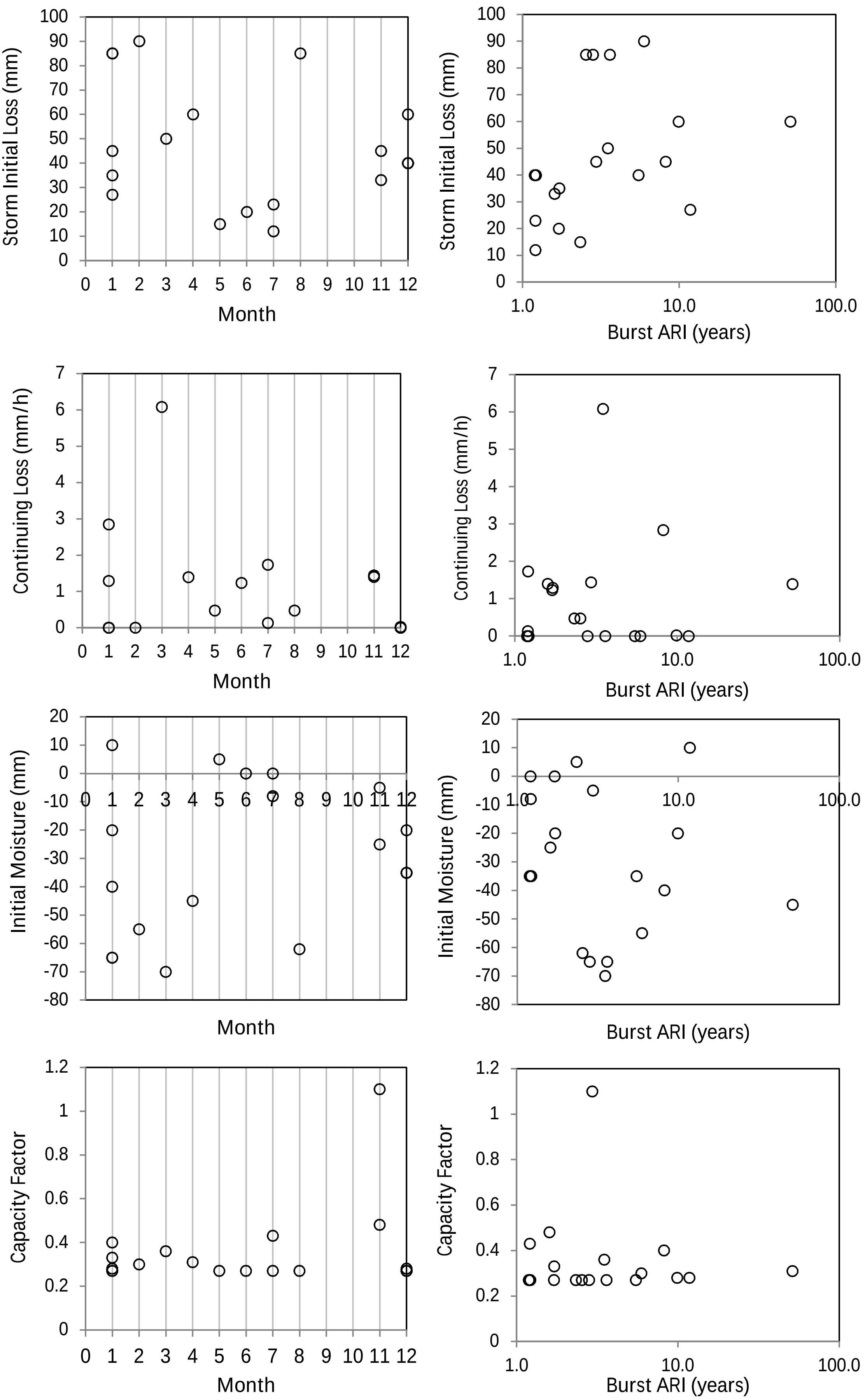




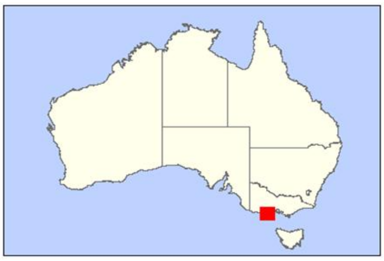


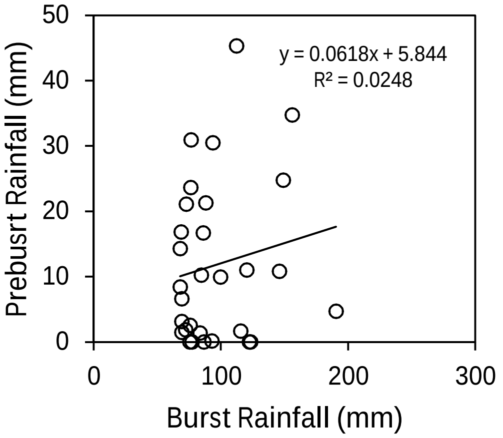


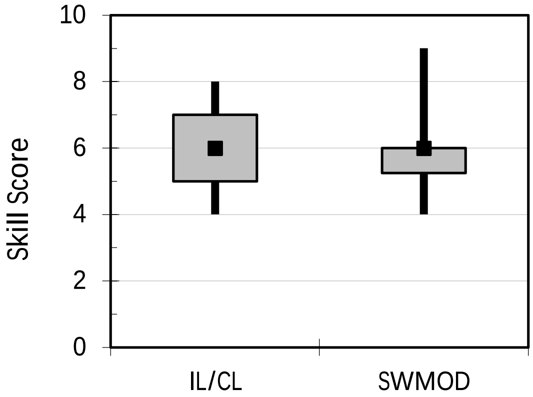
Swan River @ Harding Falls (Tas) - 24 hour bursts

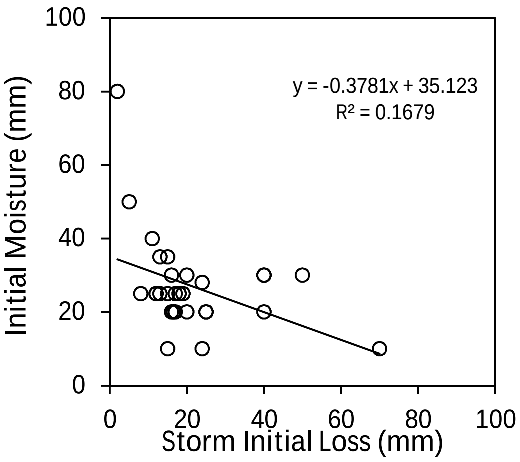


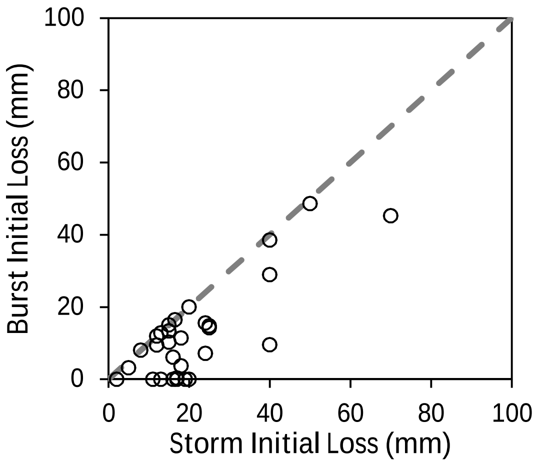
Aire @ Wyelangta (VIC) - 24 hour bursts

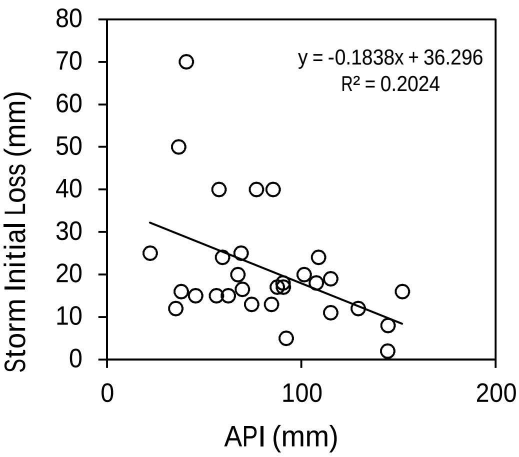


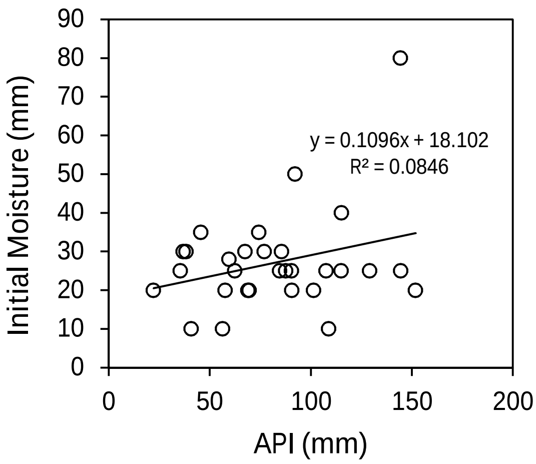




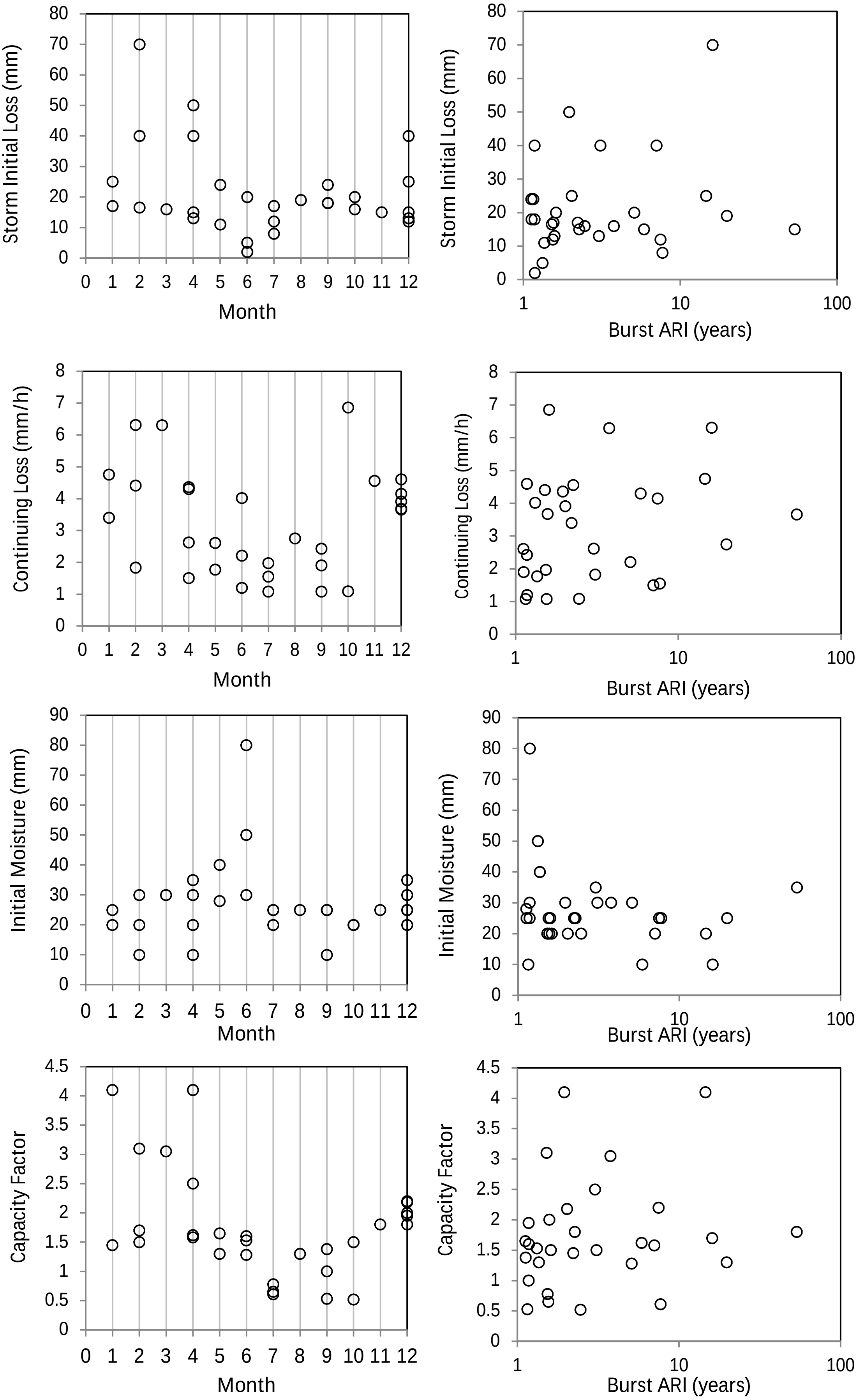




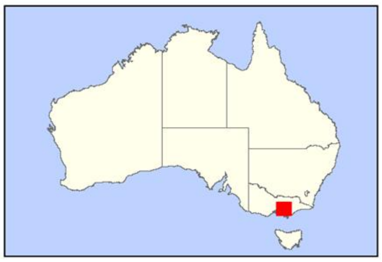


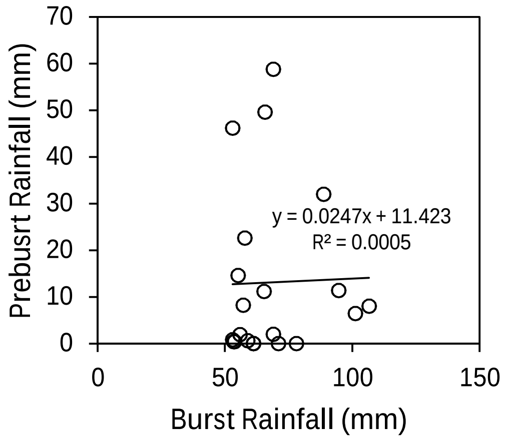


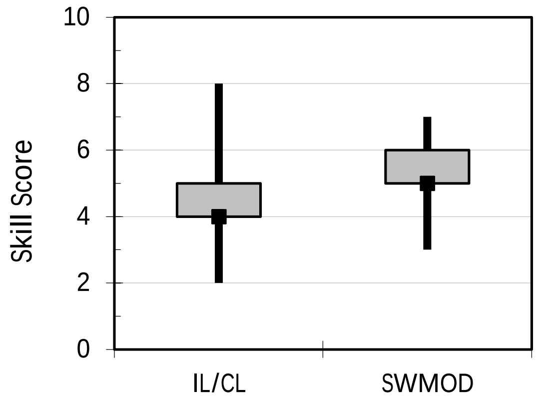
Aire @ Wyelangta (VIC) - 24 hour bursts

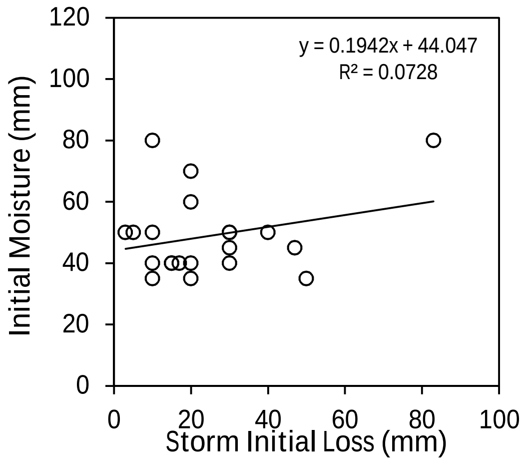


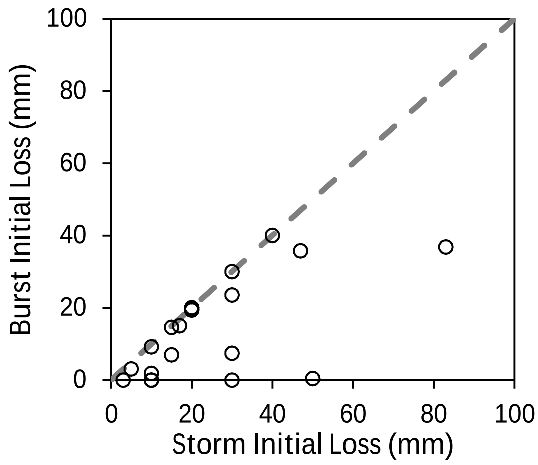
McMahons Ck @ Upstreams Weir (VIC) - 24 hour bursts

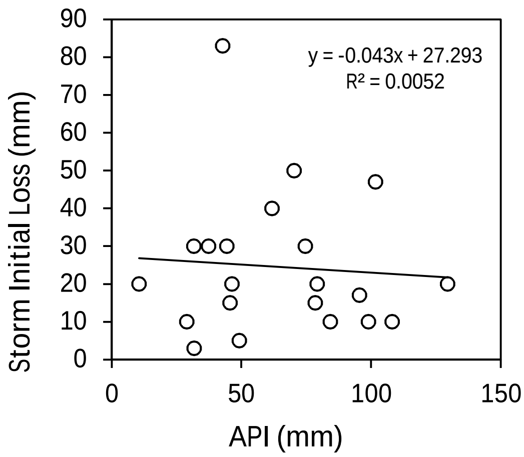


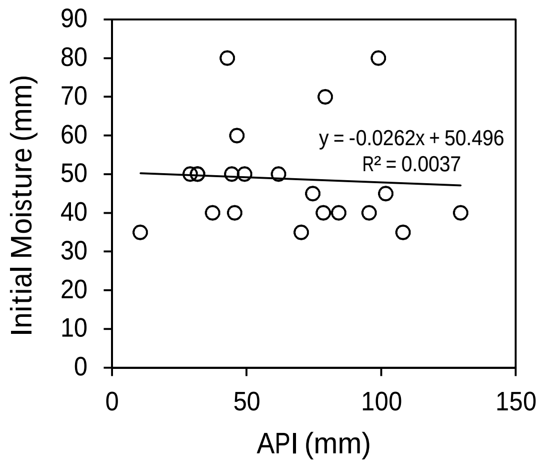




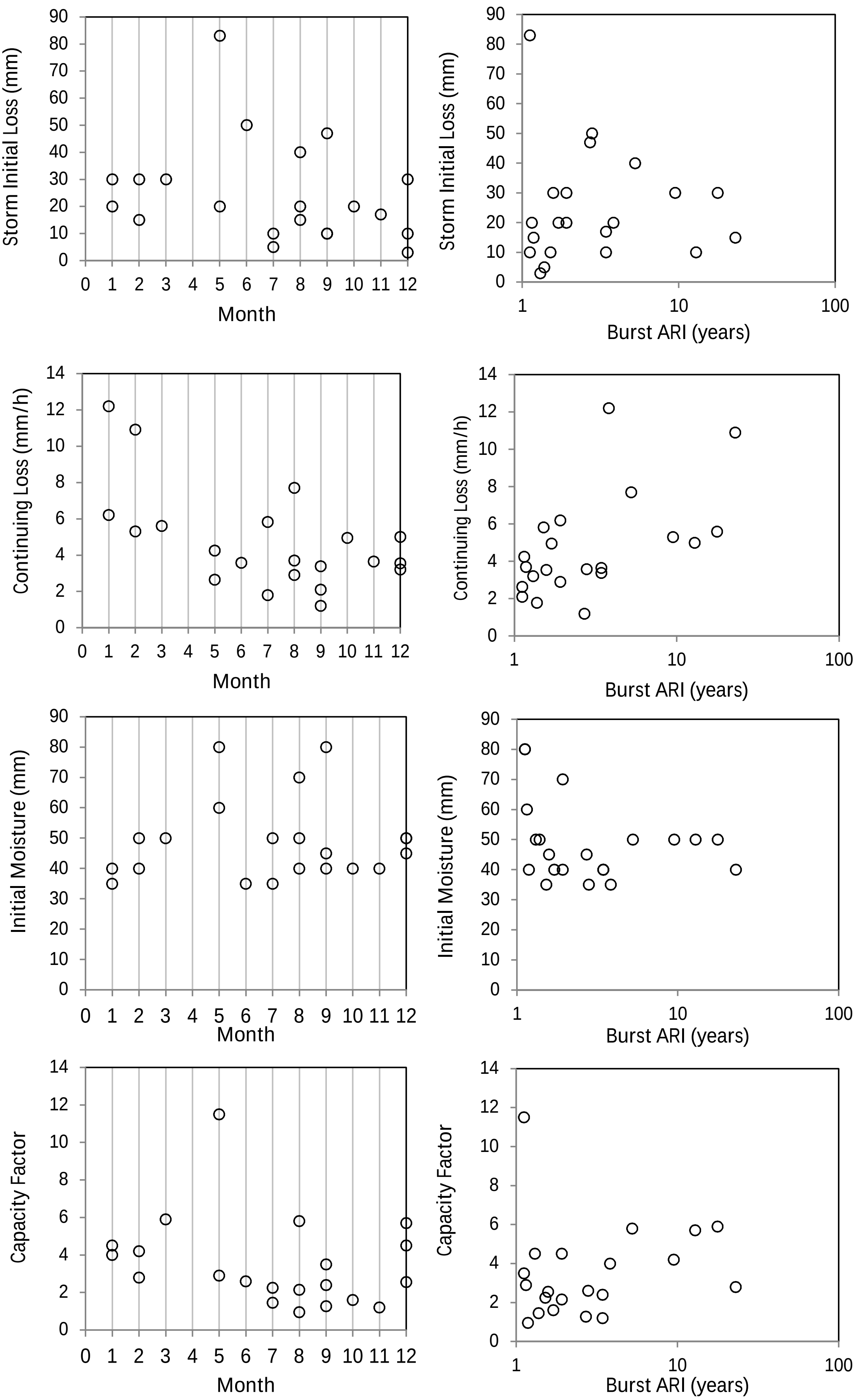




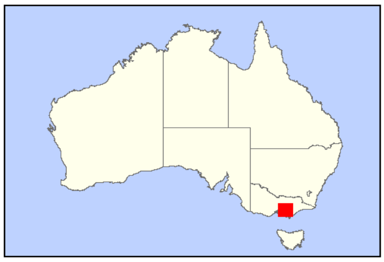


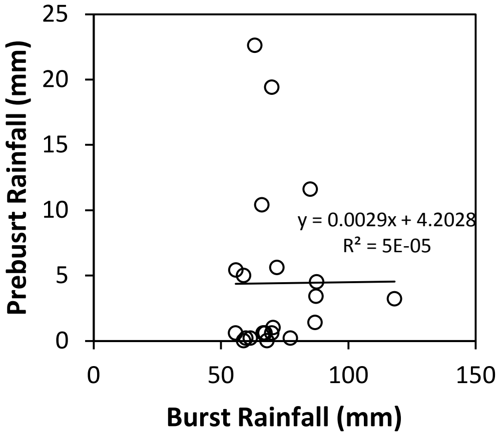


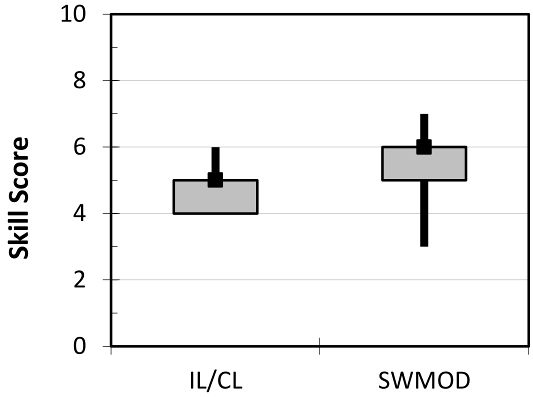
McMahons Ck @ Upstreams Weir (VIC) - 24 hour bursts

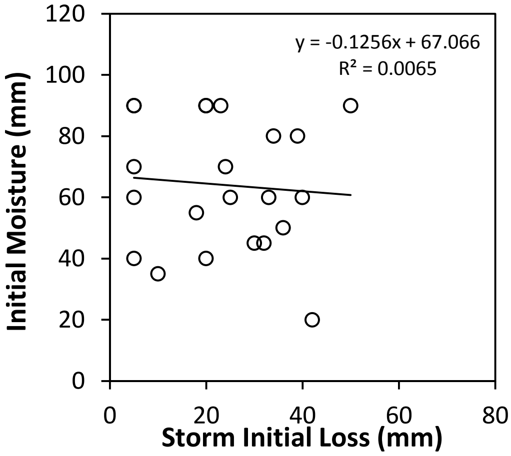


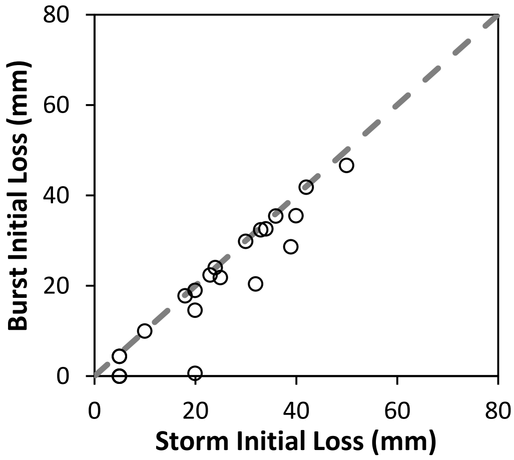
Tarago @ Neerim (VIC) - 24 hour bursts

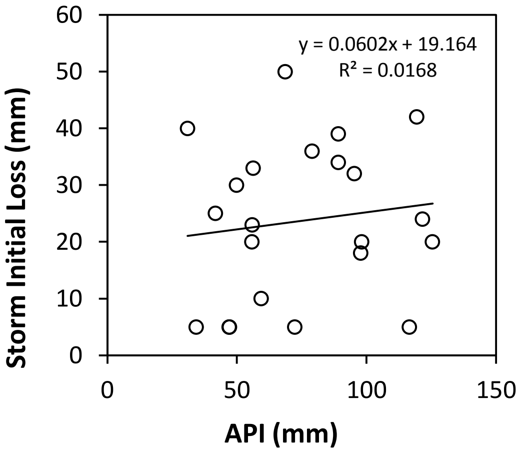


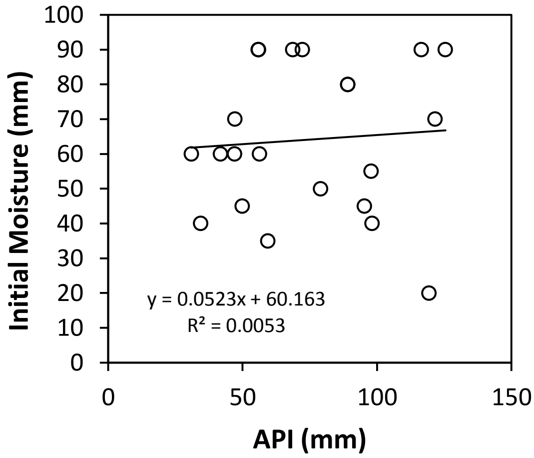




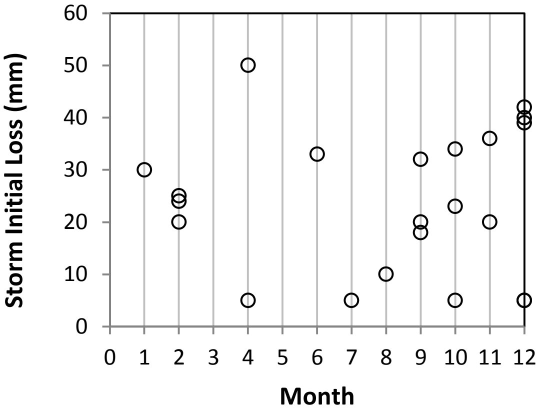


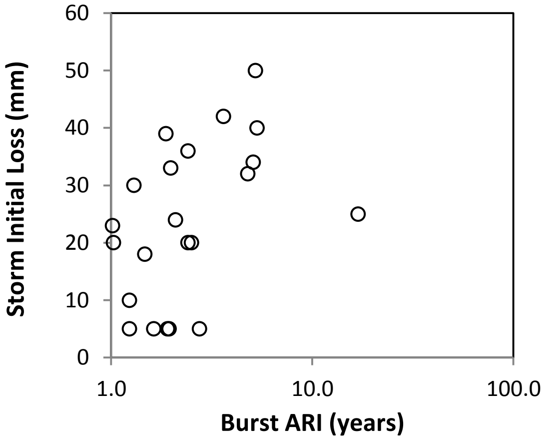


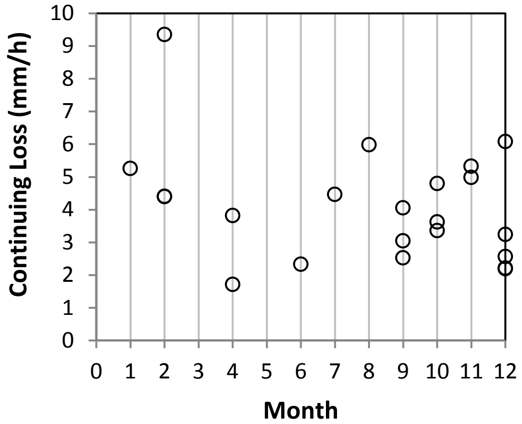


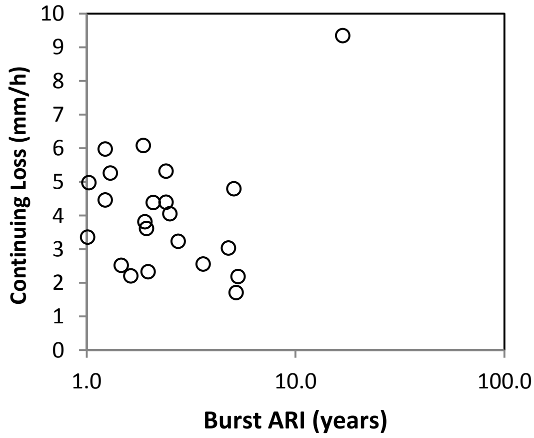


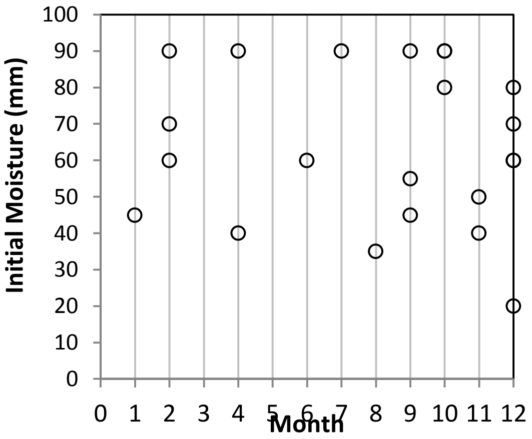
Tarago @ Neerim (VIC) - 24 hour bursts

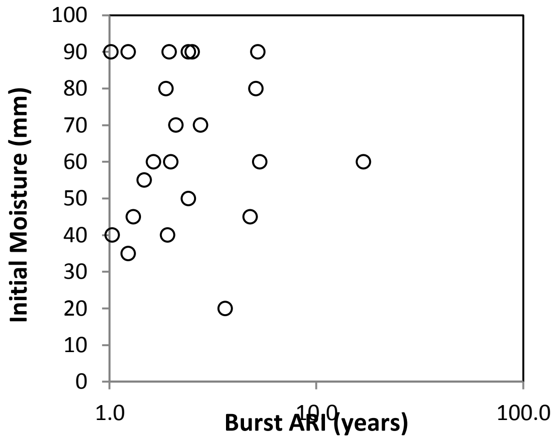


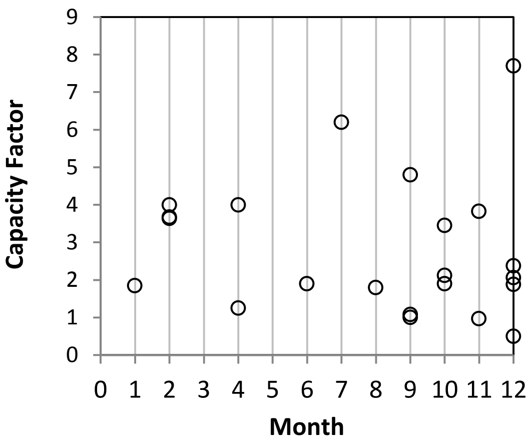


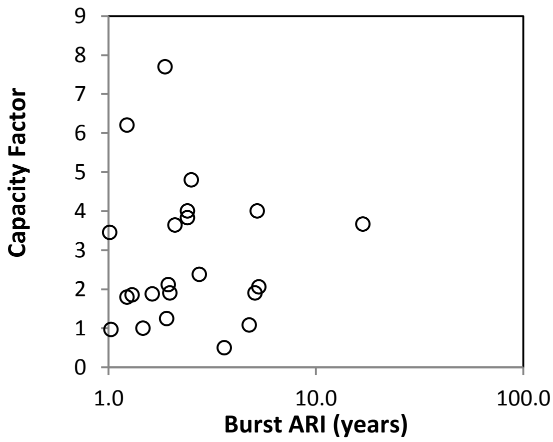




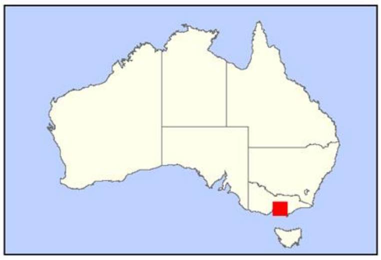


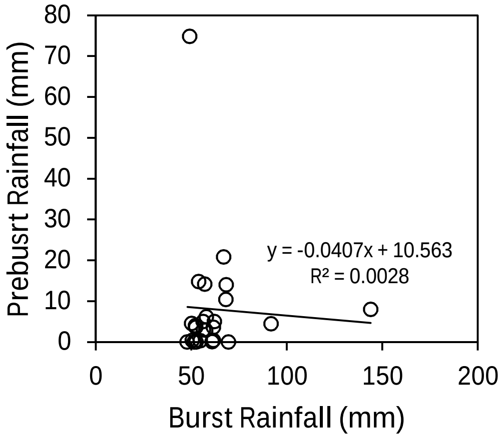


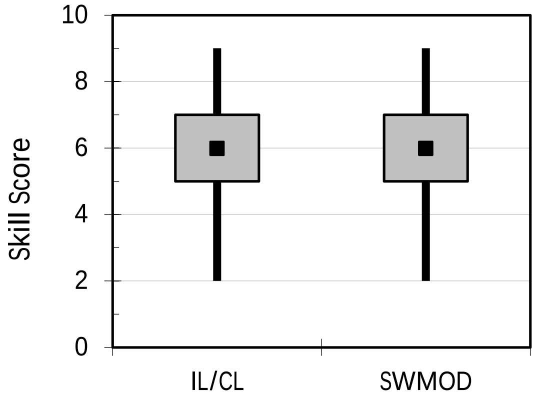


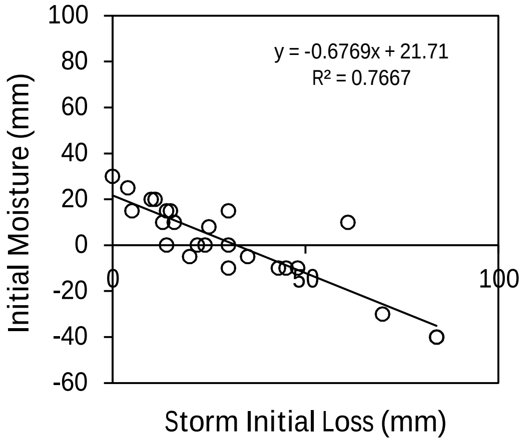


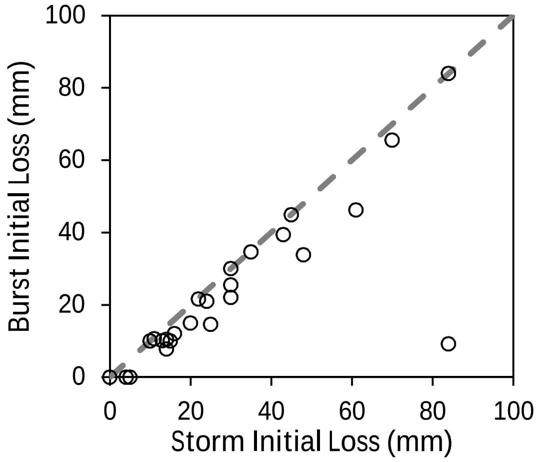
Toomuc Ck @ Pakenham (VIC) - 24 hour bursts

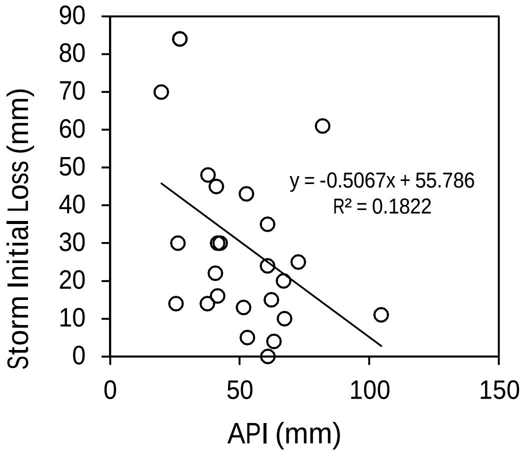


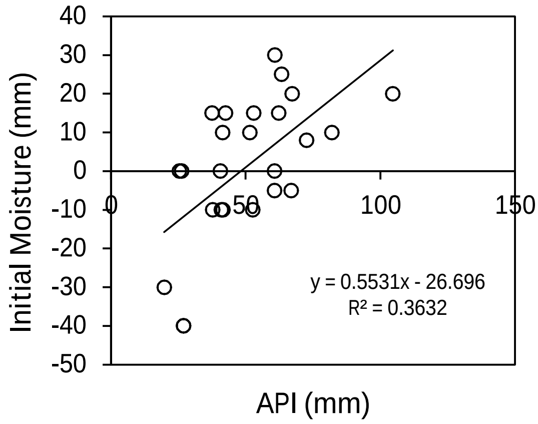




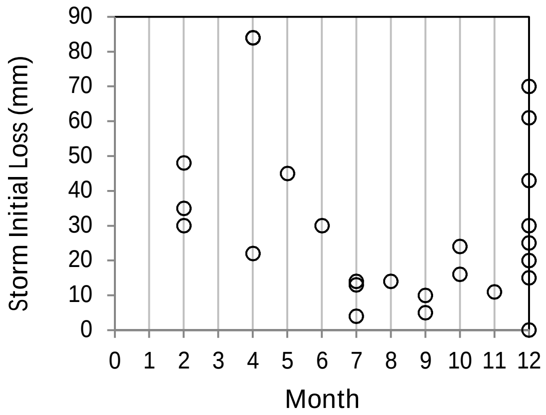


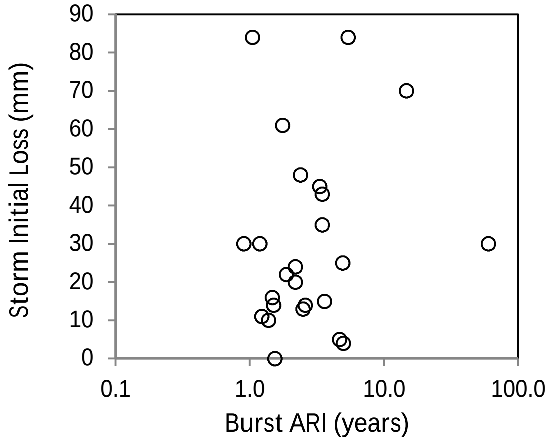


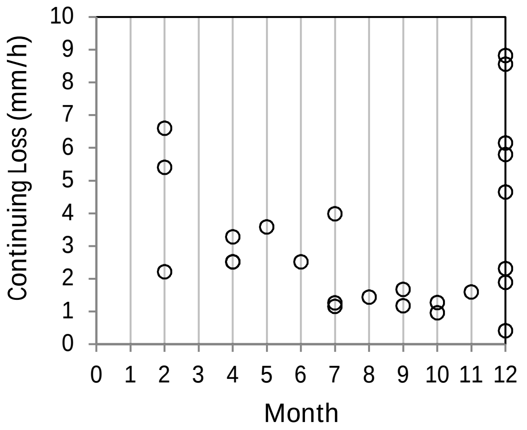


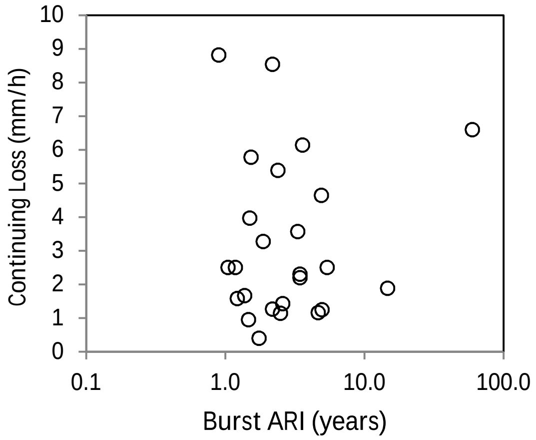


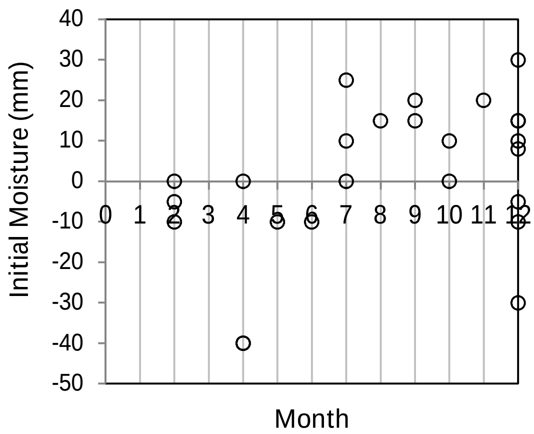
Toomuc Ck @ Pakenham (VIC) - 24 hour bursts

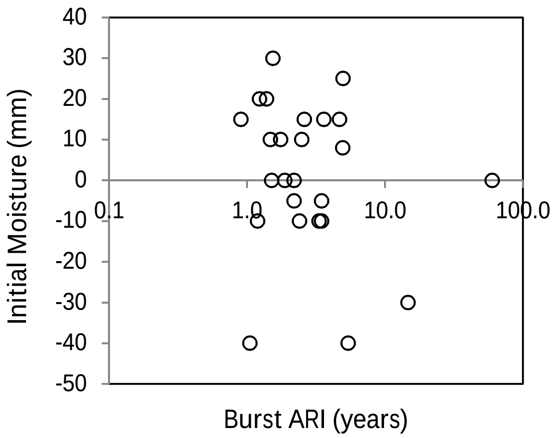


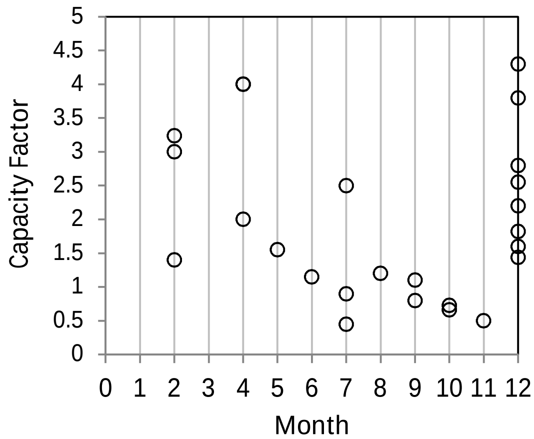


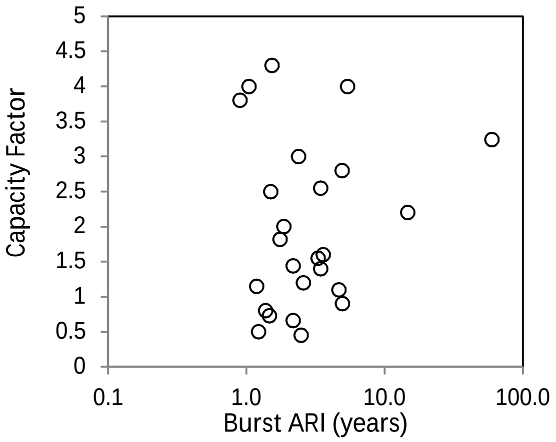




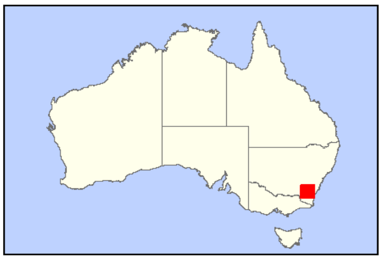


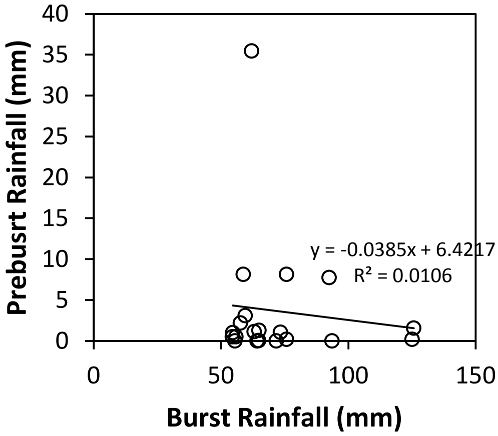


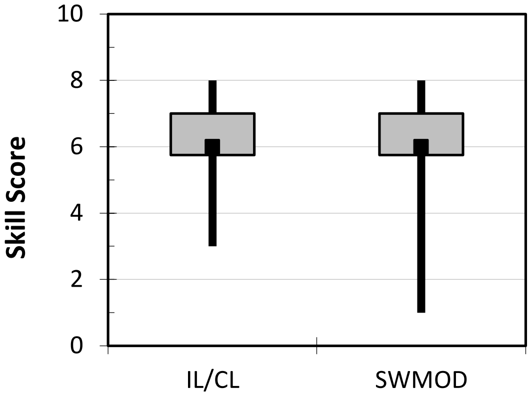


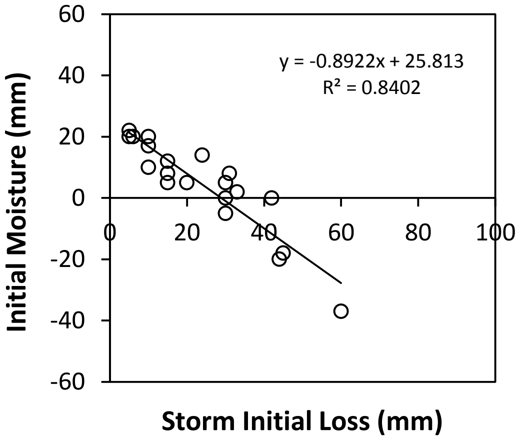


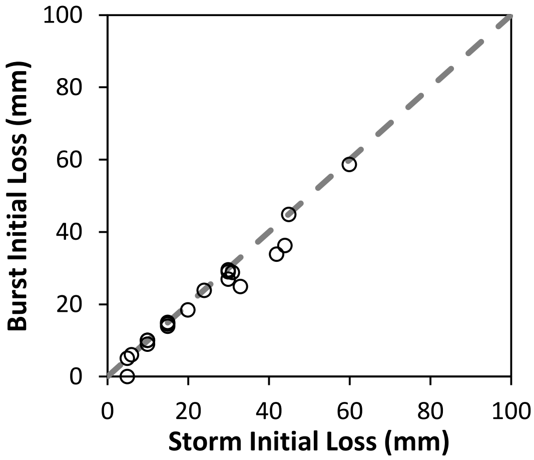
Jerrabomberra Ck @ Four Mile Creek (ACT) - 24 hour bursts

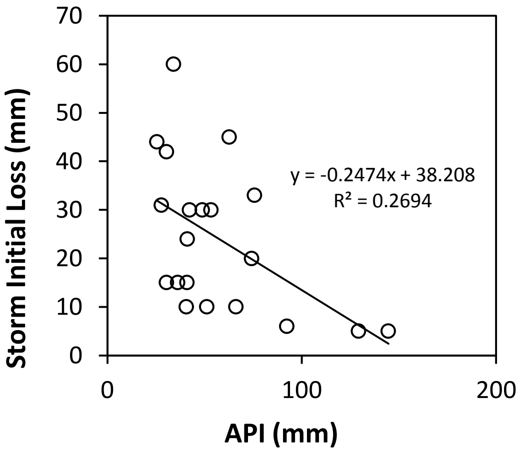


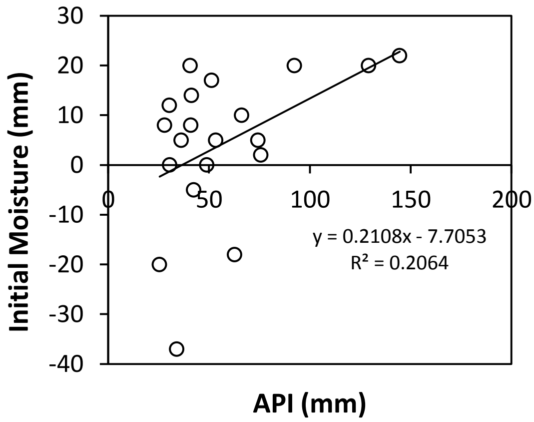




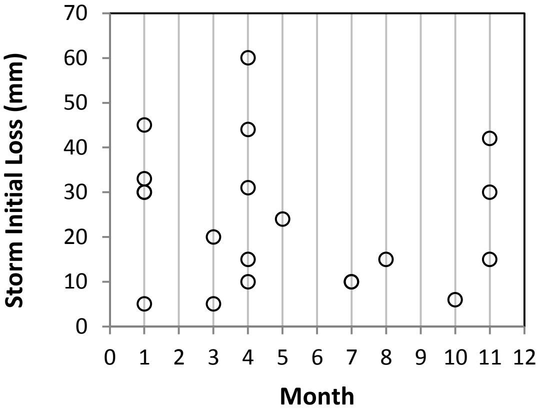


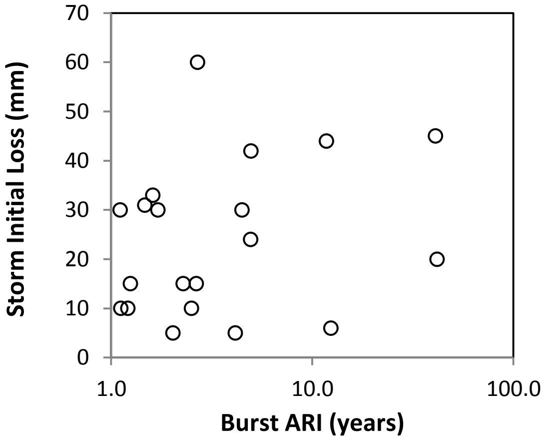


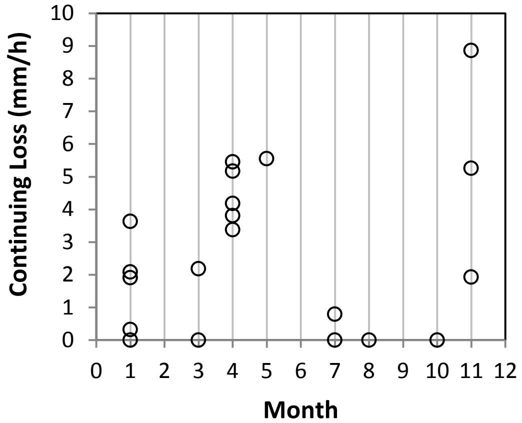


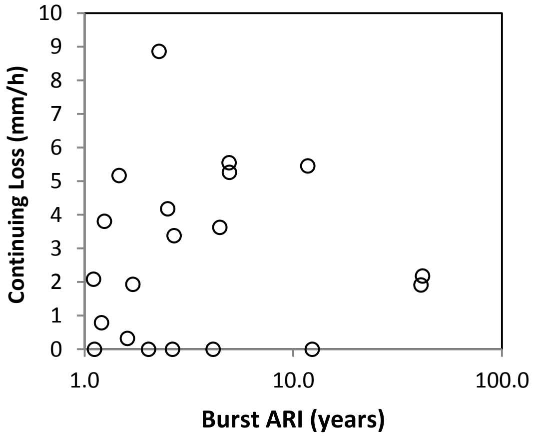


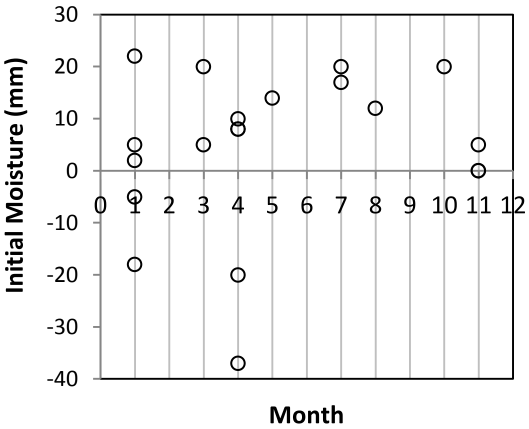
Jerrabomberra Ck @ Four Mile Creek (ACT) - 24 hour bursts

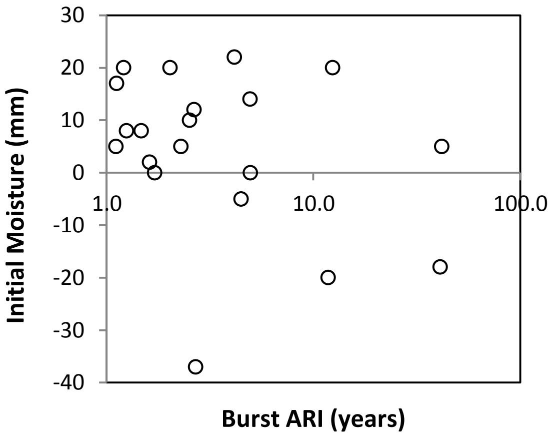


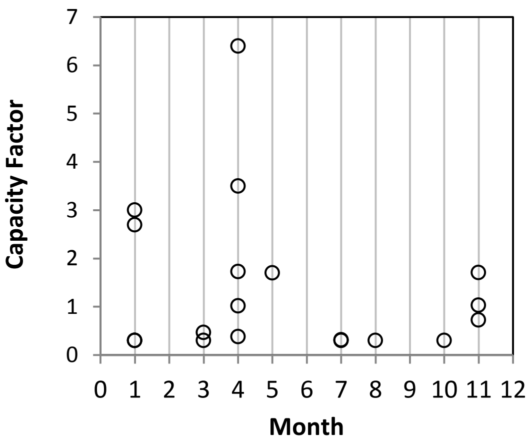


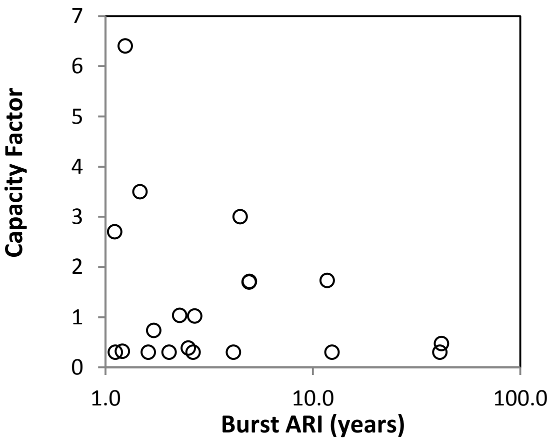




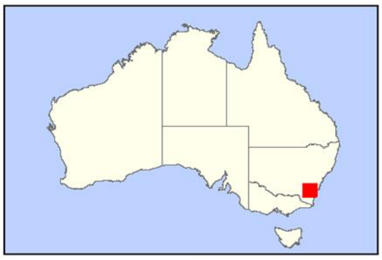


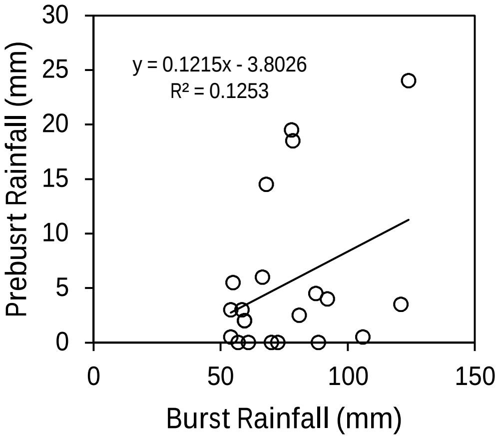


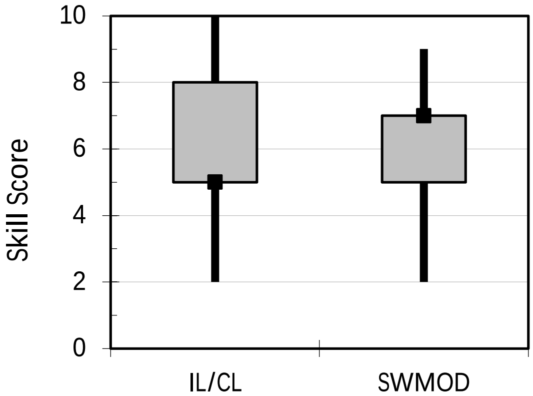


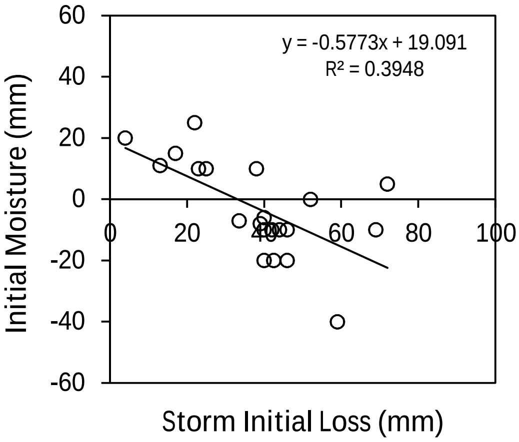


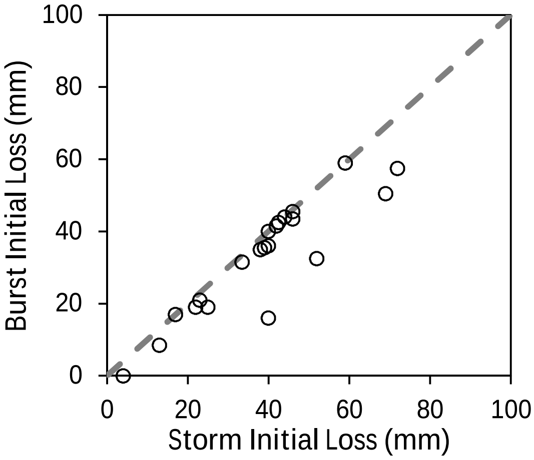
Butmaroo Ck @ Butmaroo (NSW) - 24 hour bursts

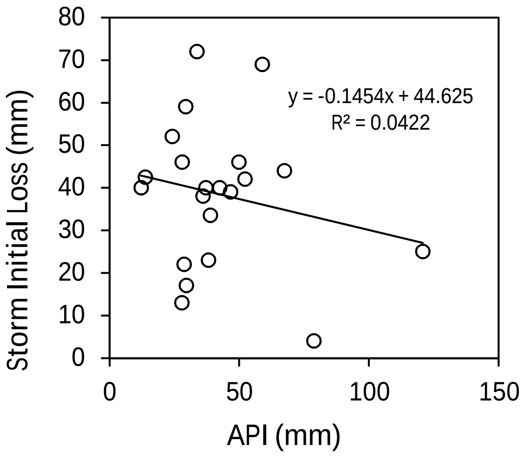


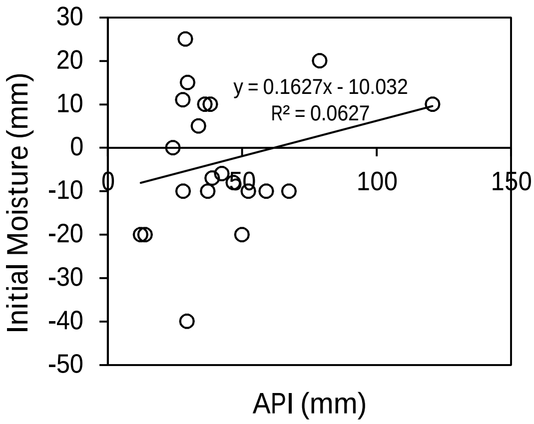




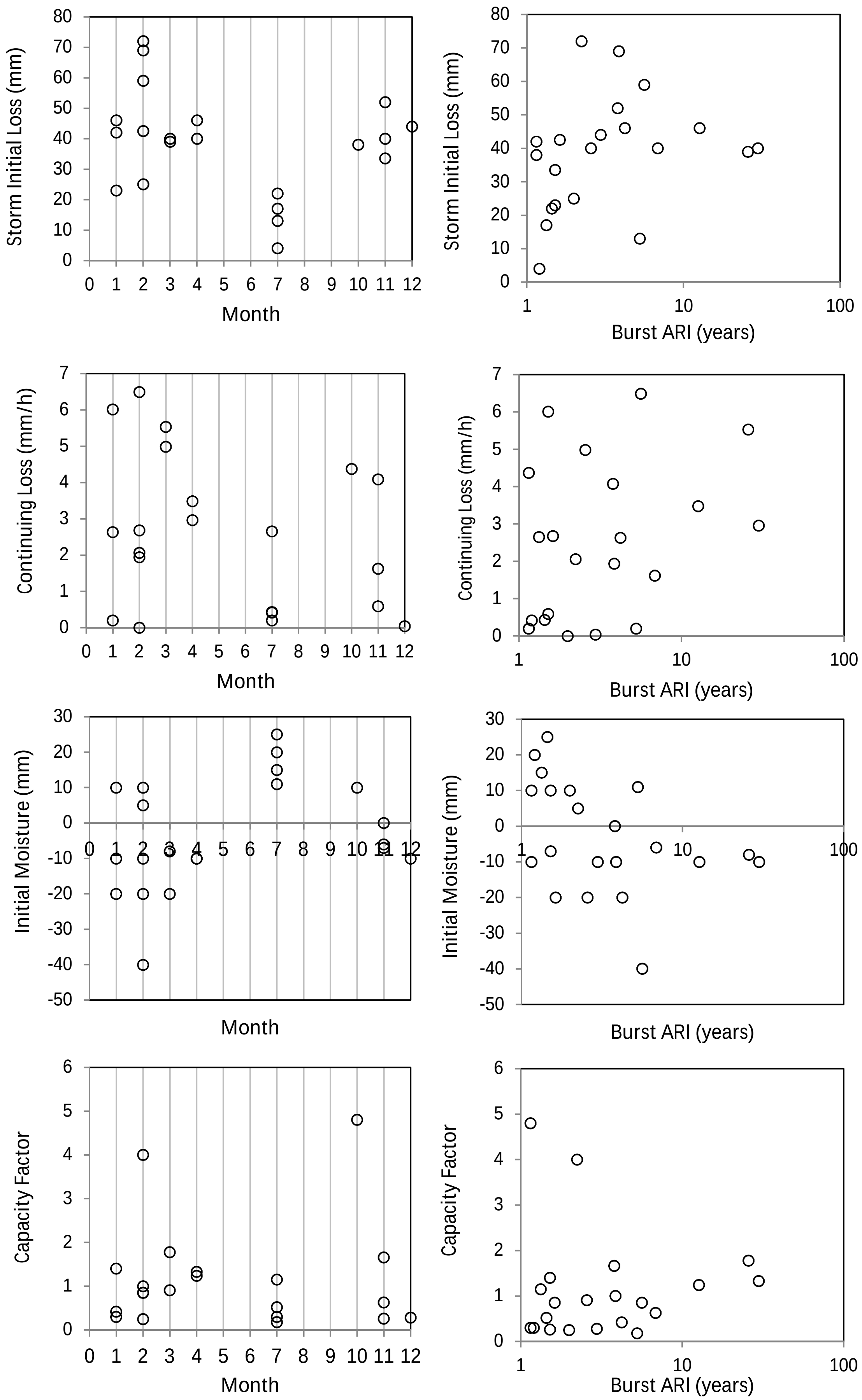




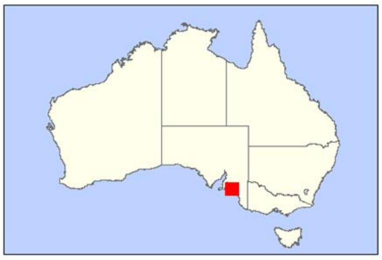


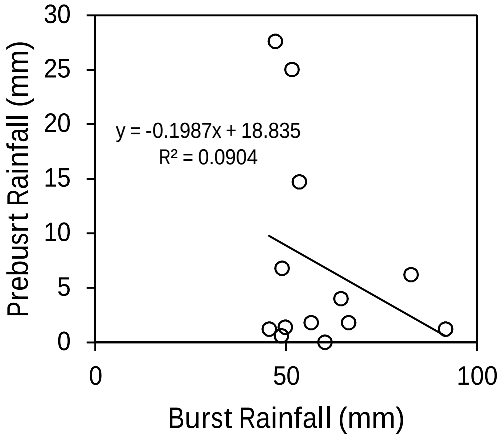


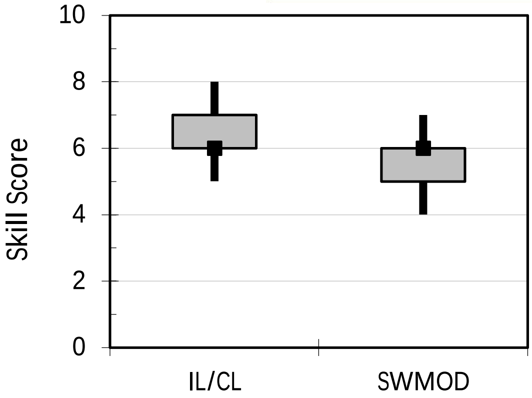
Butmaroo Ck @ Butmaroo (NSW) - 24 hour bursts

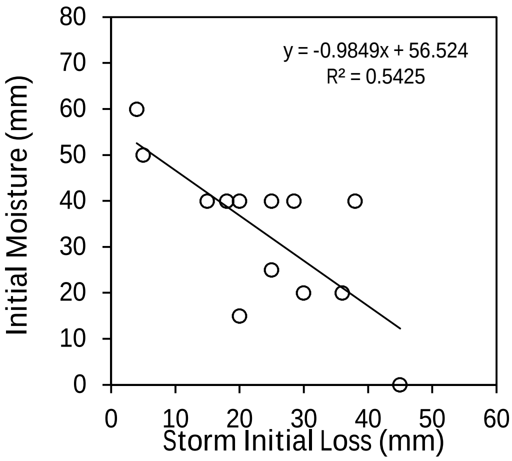


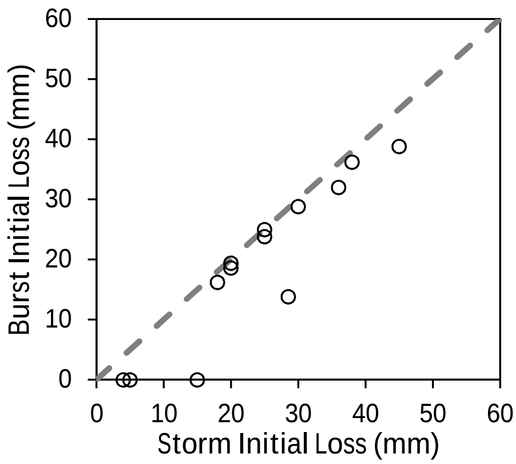
Echunga Ck @ U/S Mt Bold Res. (SA) - 24 hour bursts

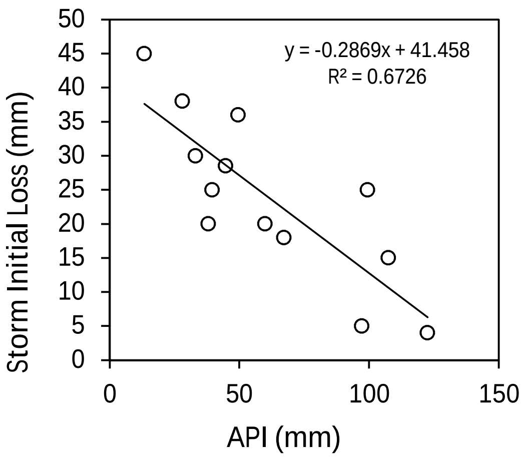


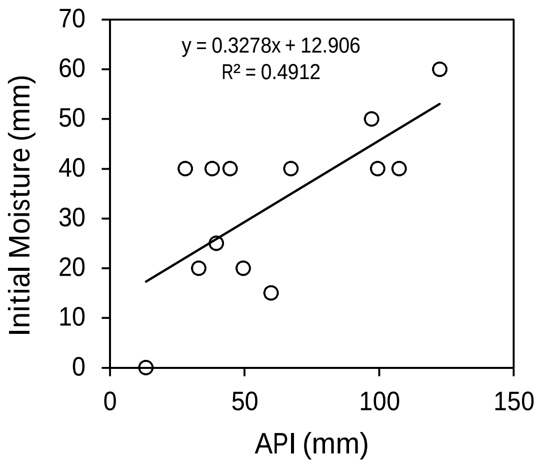




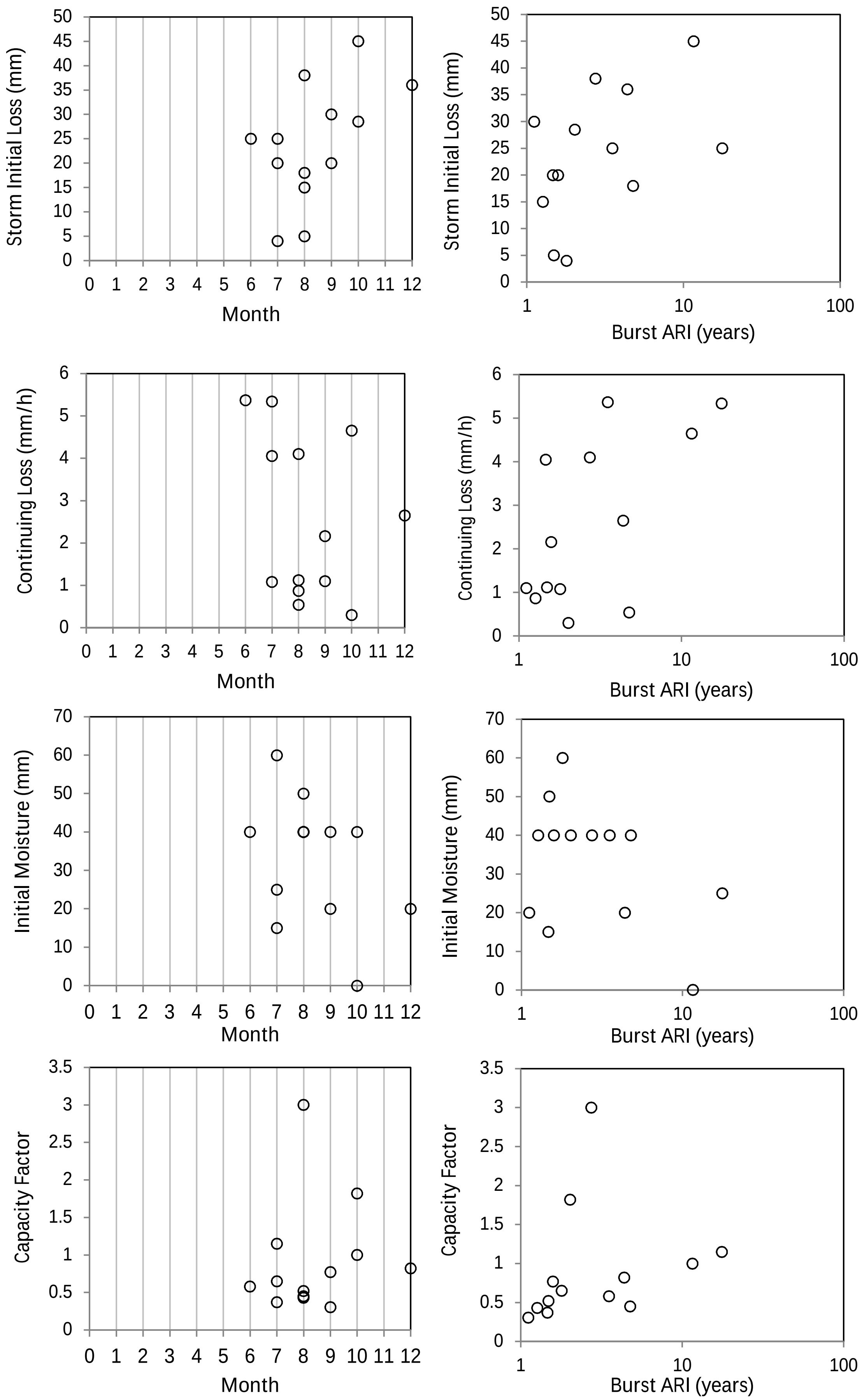




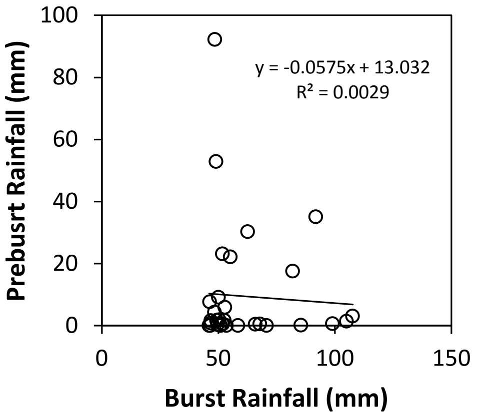


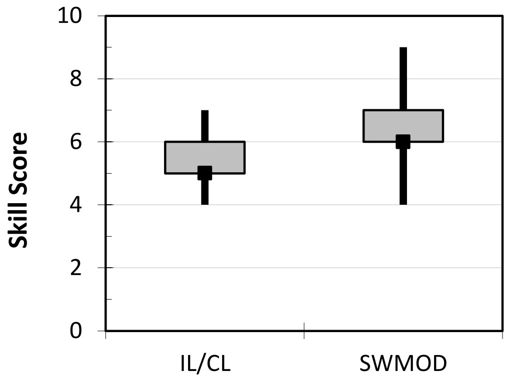


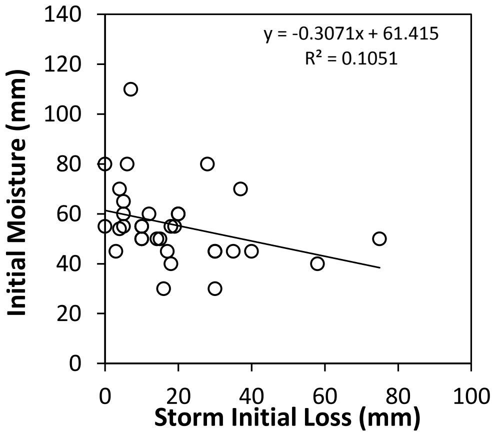
Echunga Ck @ U/S Mt Bold Res. (SA) - 24 hour bursts

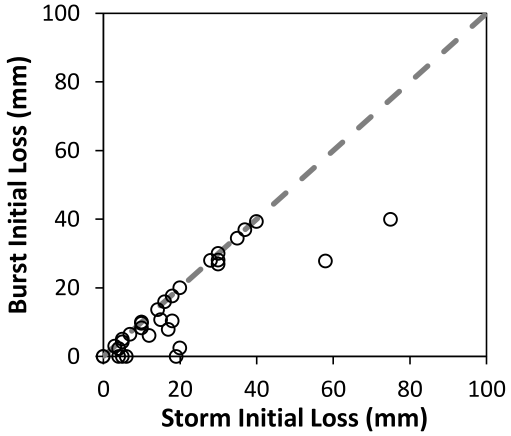


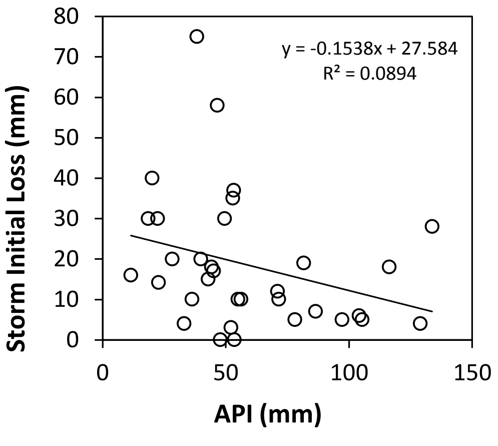
Hindmarsh @ Hindmarsh Vy Res Offtake W (SA) - 24 hour bursts

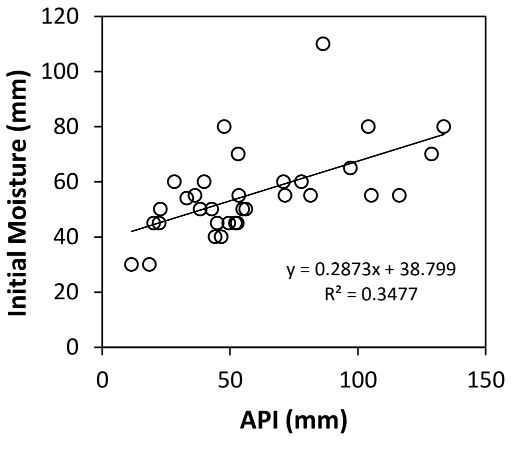




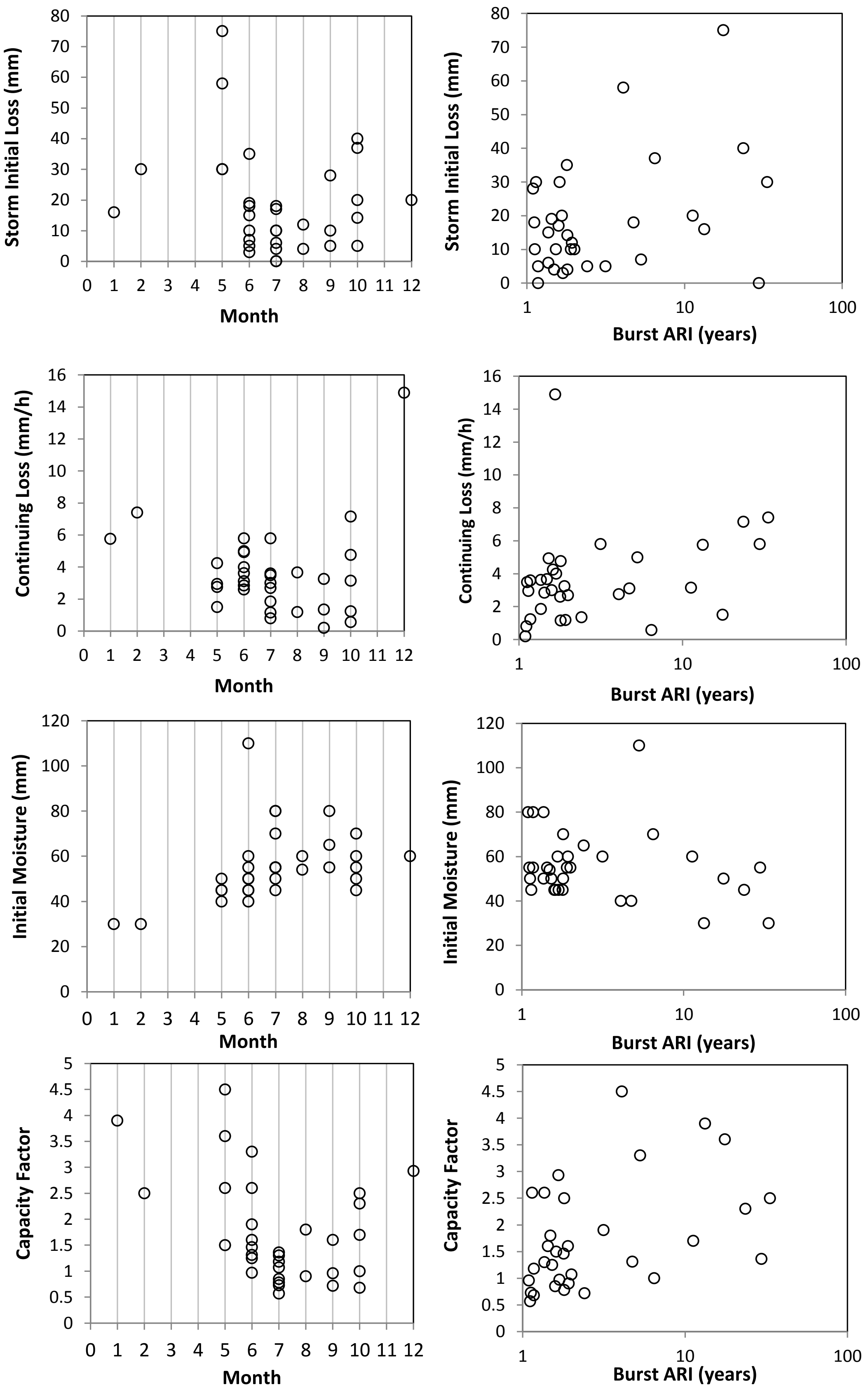




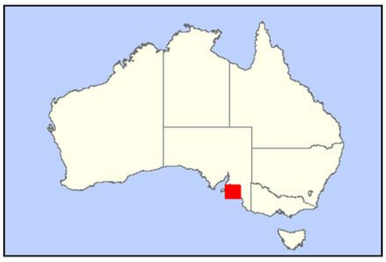


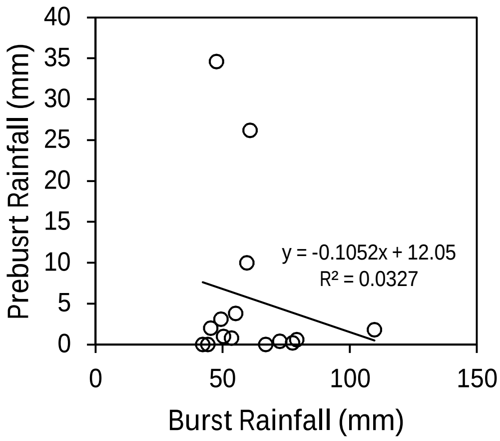


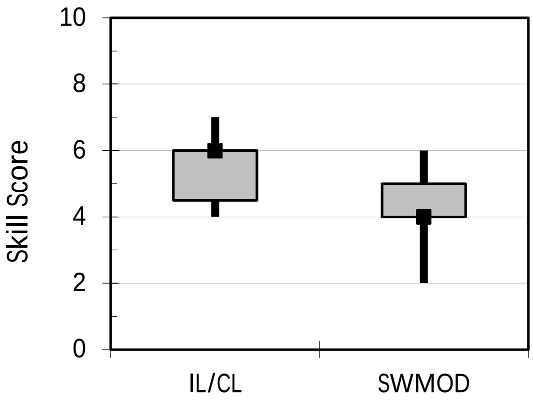
Hindmarsh @ Hindmarsh Vy Res Offtake W (SA) - 24 hour bursts

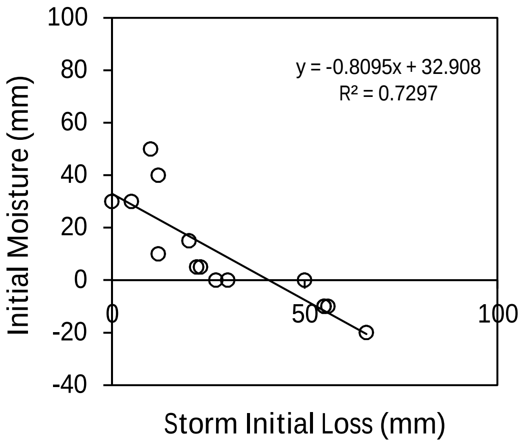


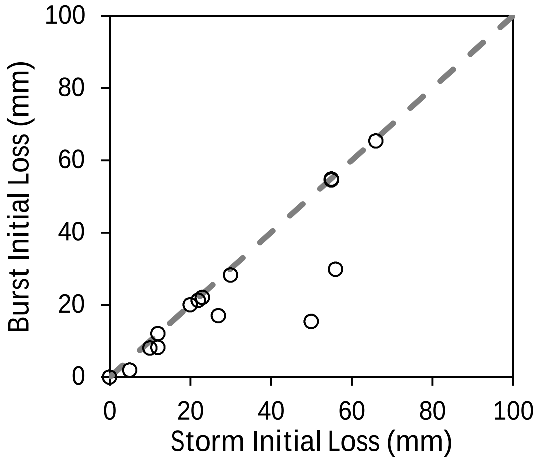
Myponga @ U/S Dam and Rd Br (SA) - 24 hour bursts

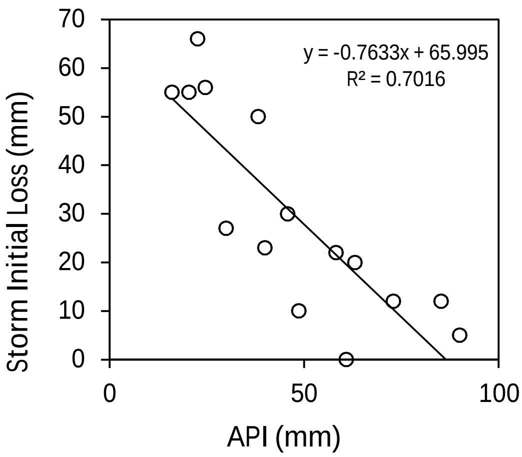


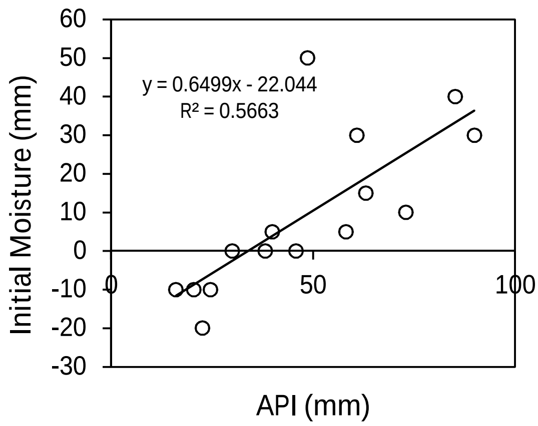




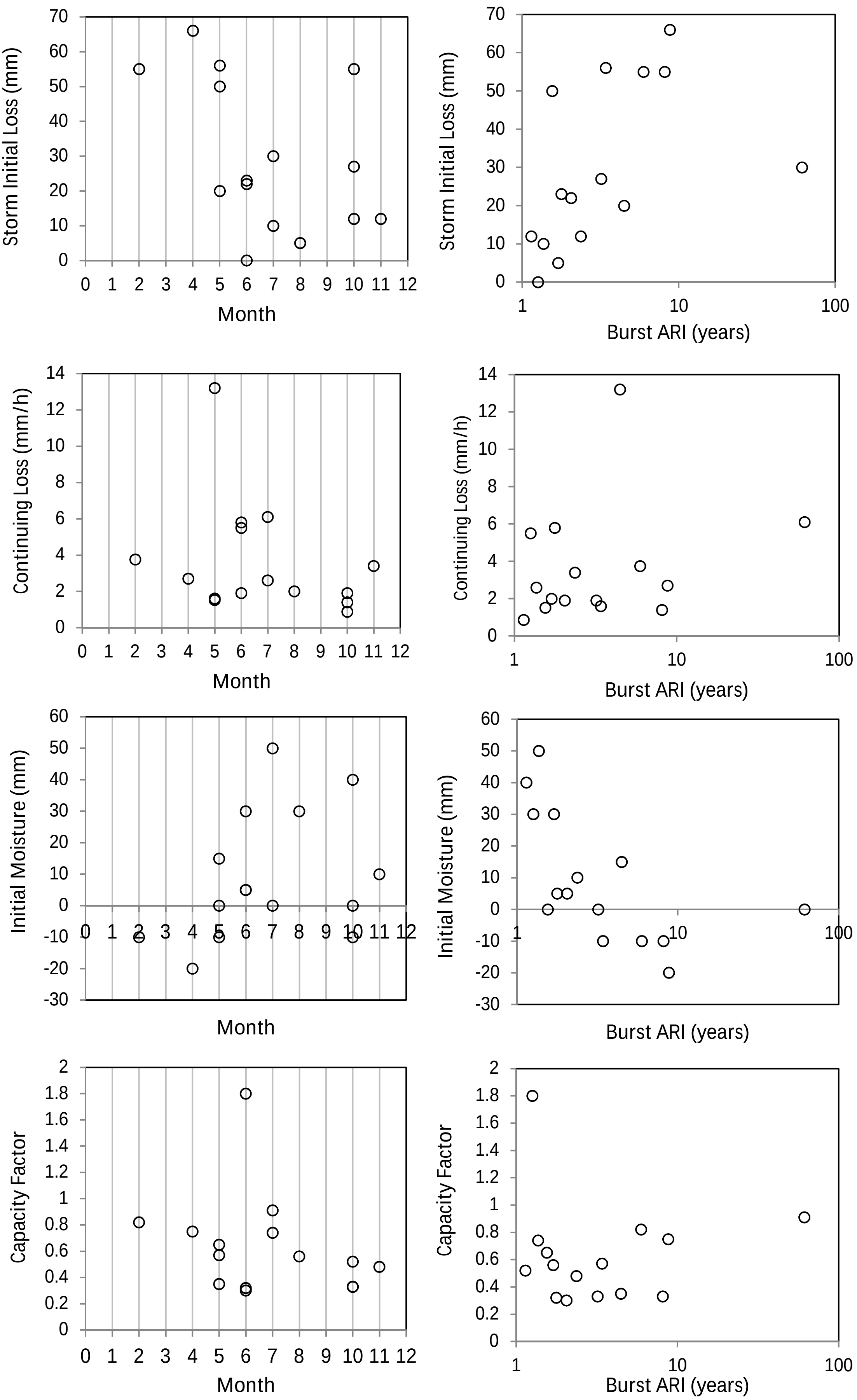




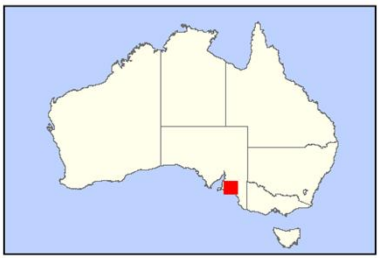


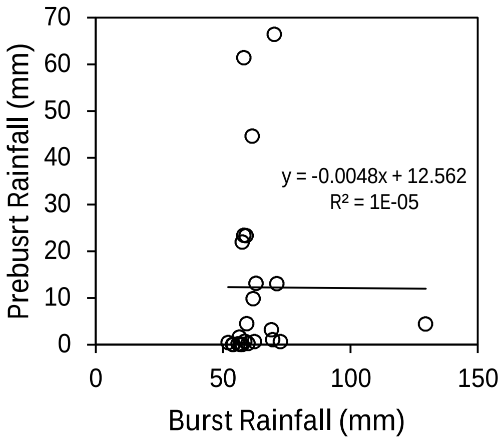


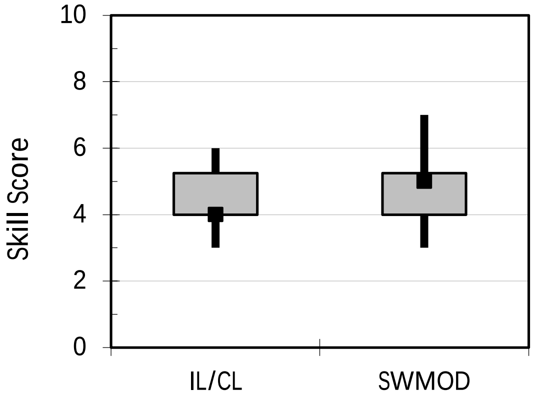
Myponga @ U/S Dam and Rd Br (SA) - 24 hour bursts

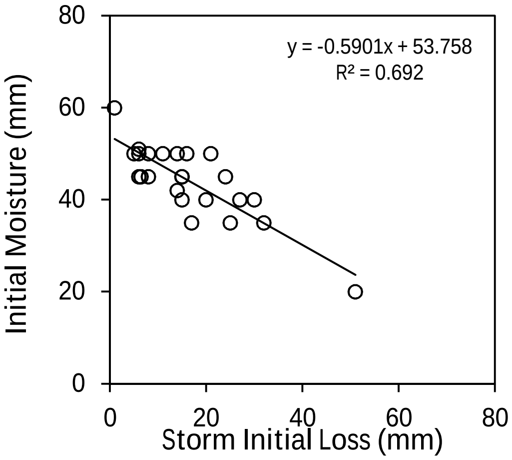


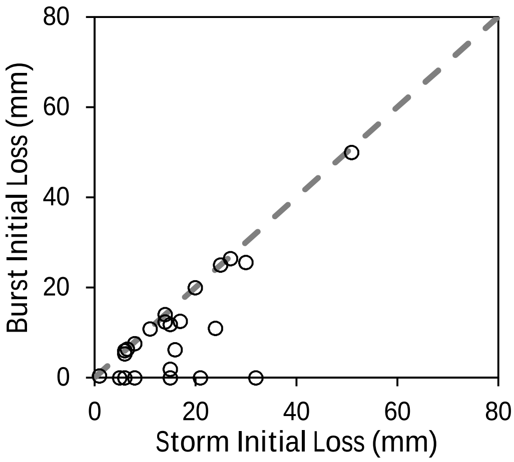
Sixth Ck @ Castambul (SA) - 24 hour bursts

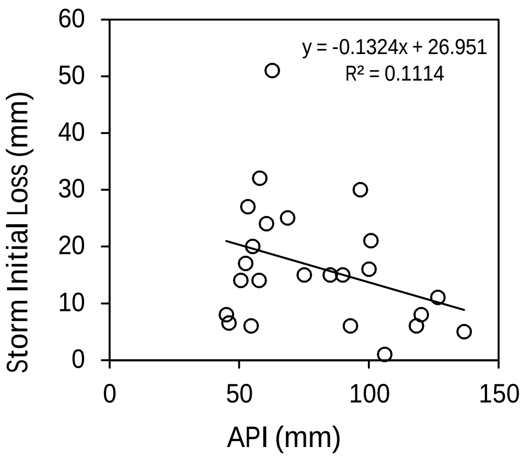


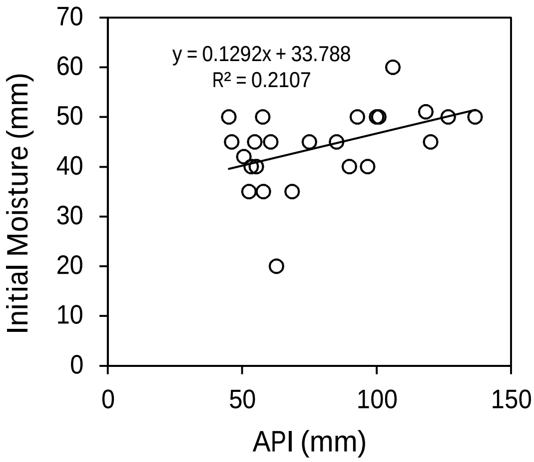




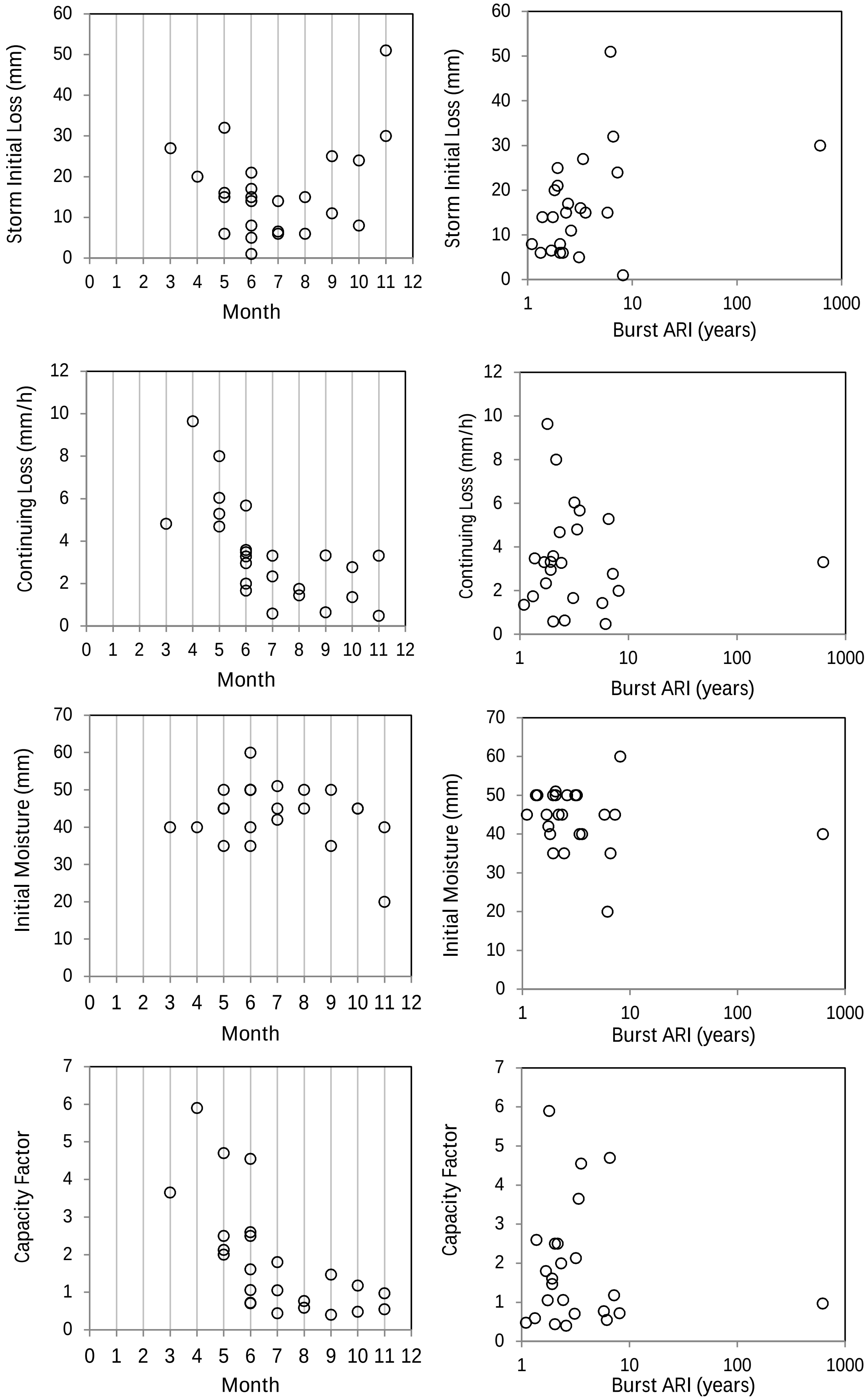




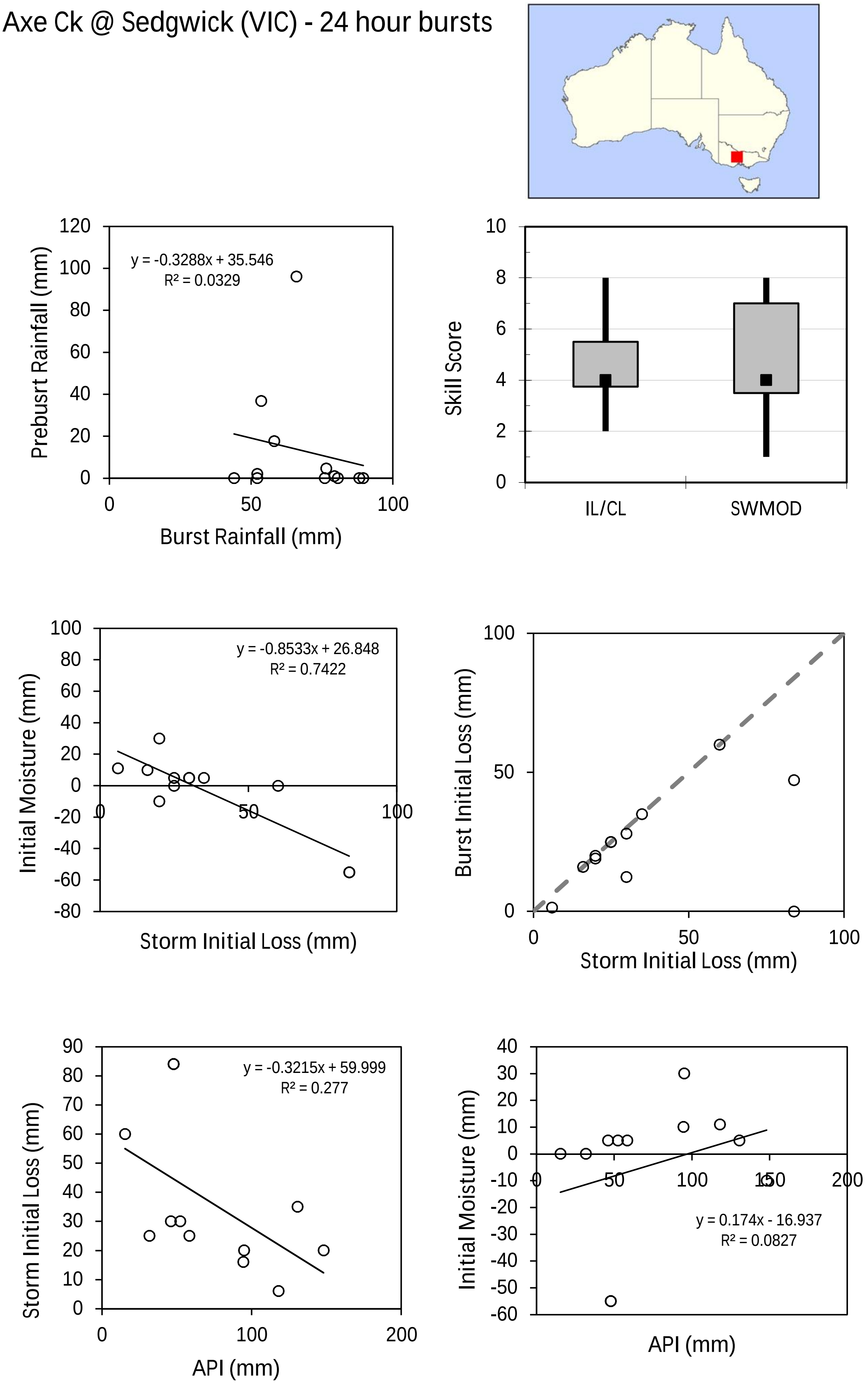




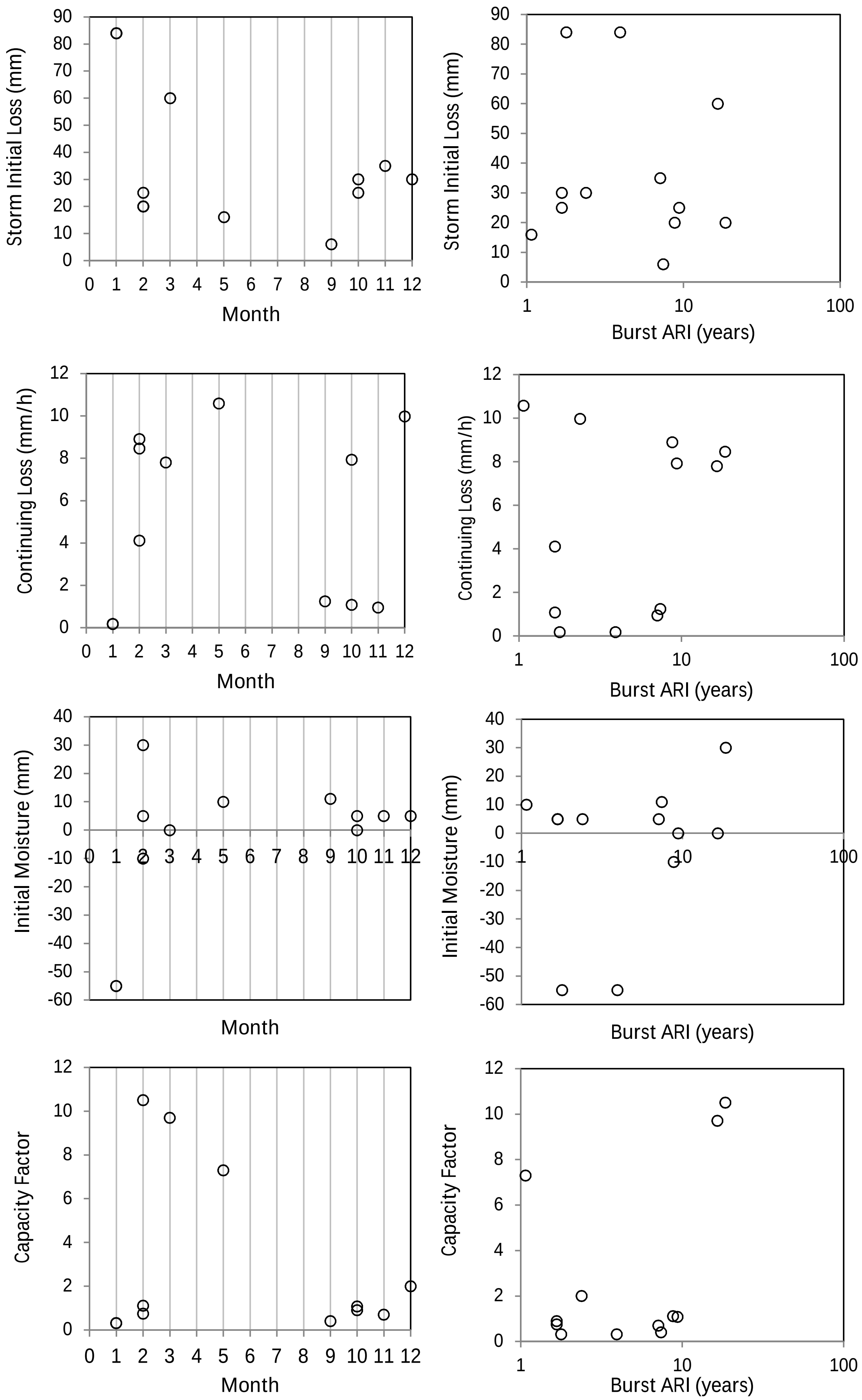
Sixth Ck @ Castambul (SA) - 24 hour bursts



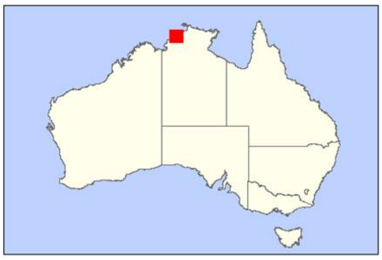
Axe Ck @ Sedgwick (VIC) - 24 hour bursts

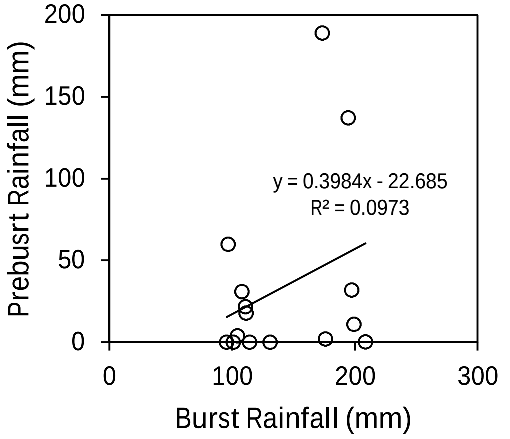


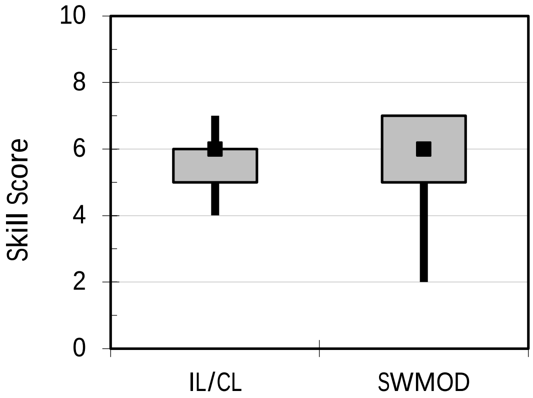
Axe Ck @ Sedgwick (VIC) - 24 hour bursts

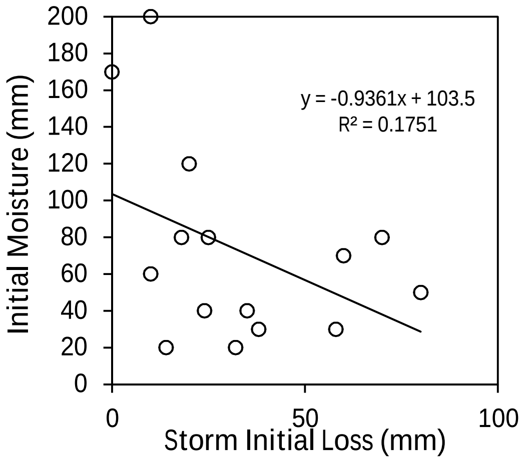


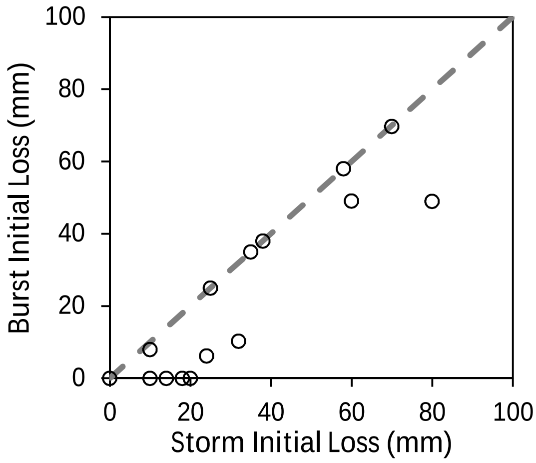
Celia Ck @ U/S Darwin R Dam (NT) - 24 hour bursts

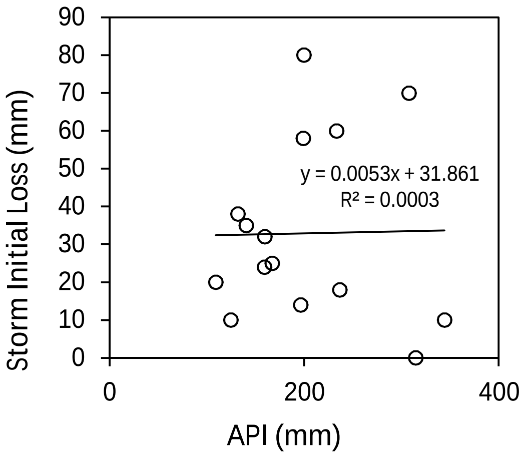


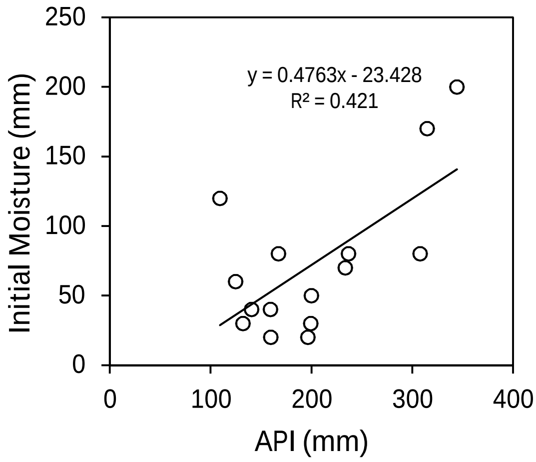




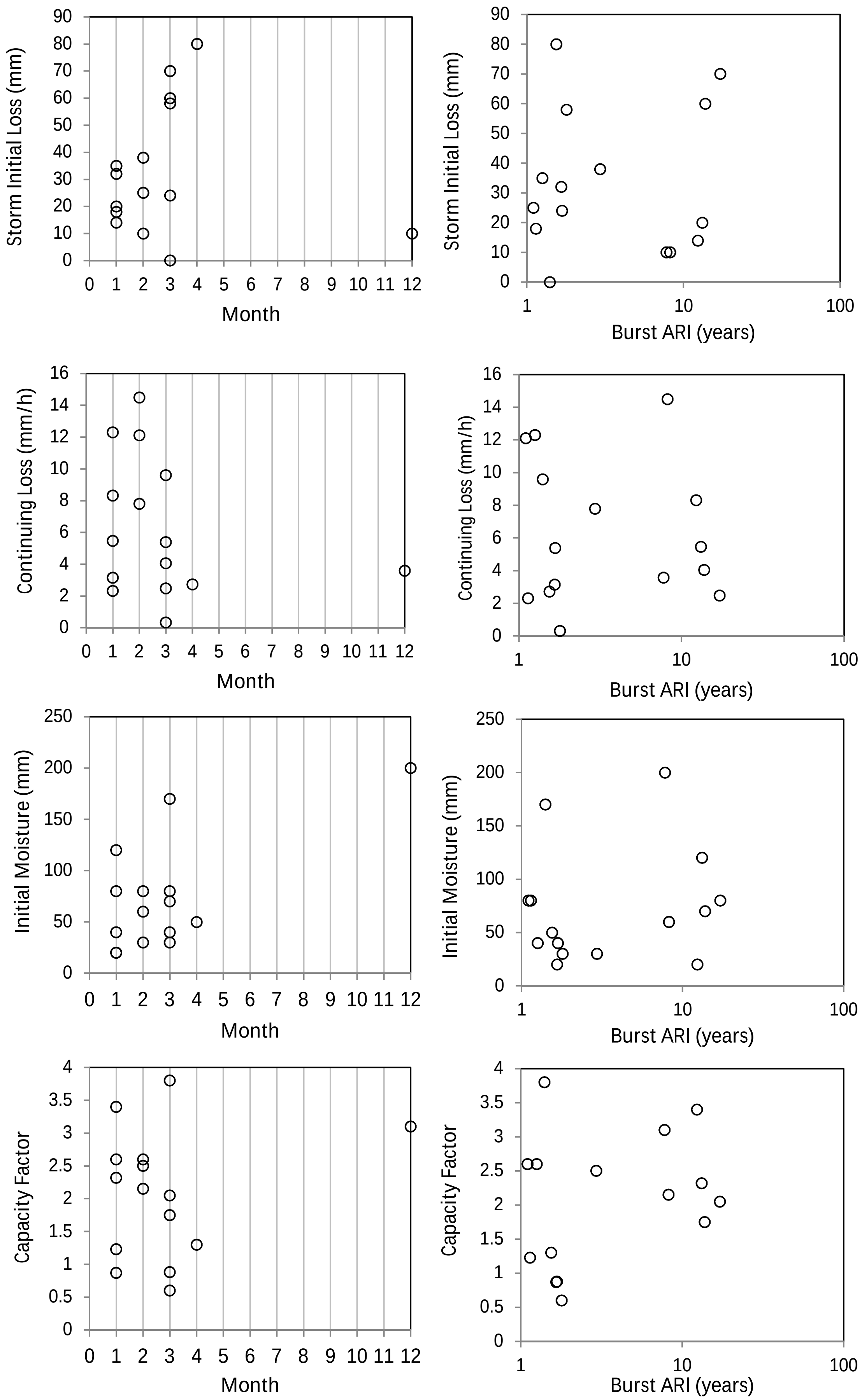




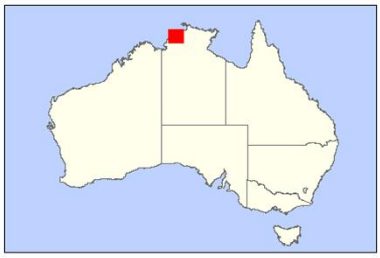


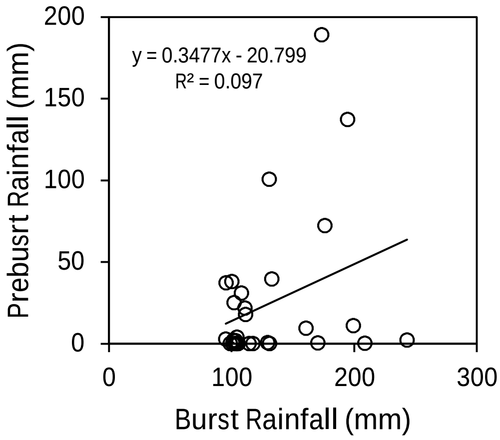


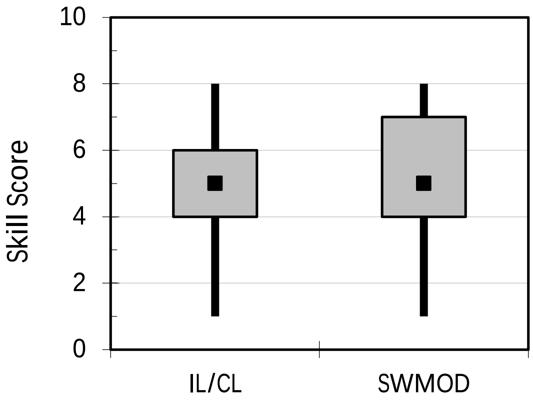
Celia Ck @ U/S Darwin R Dam (NT) - 24 hour bursts

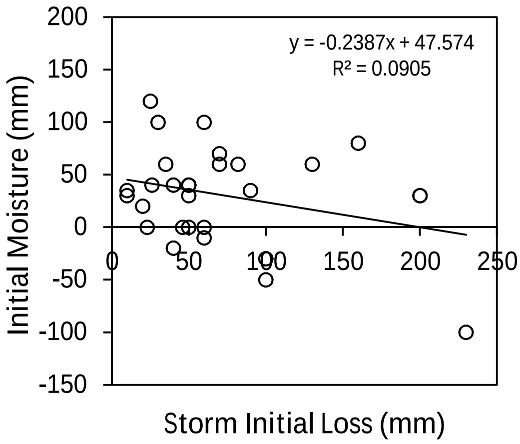


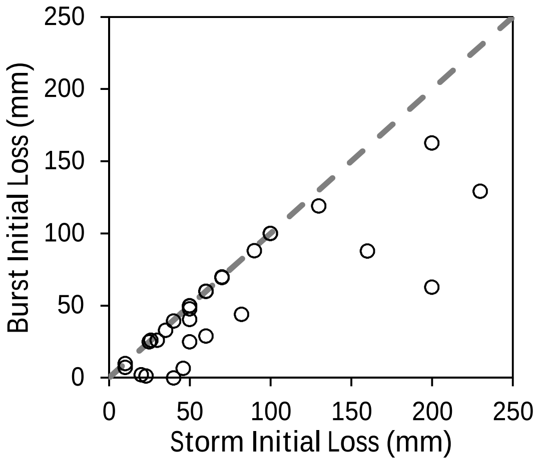
Coomalie Ck @ Stuart HWY (NT) - 24 hour bursts

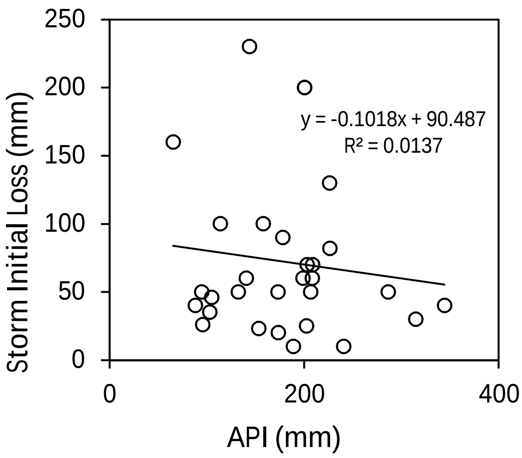


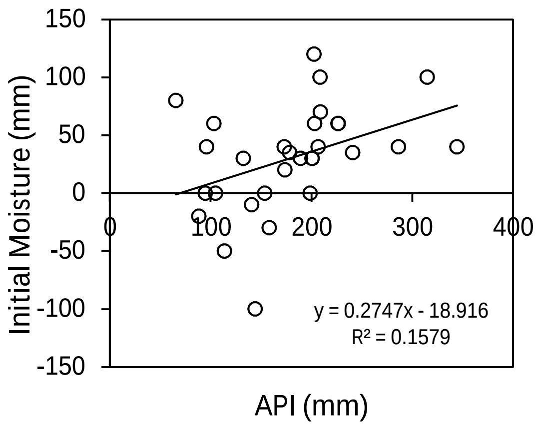




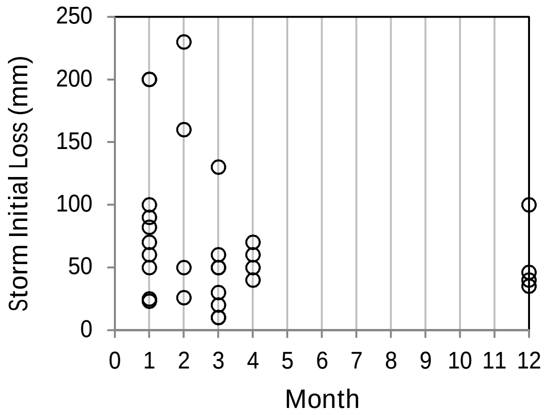


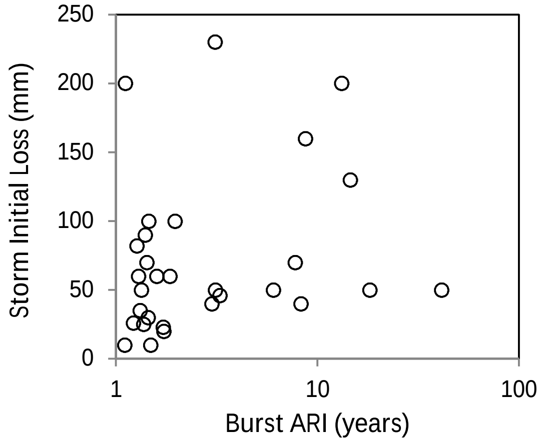


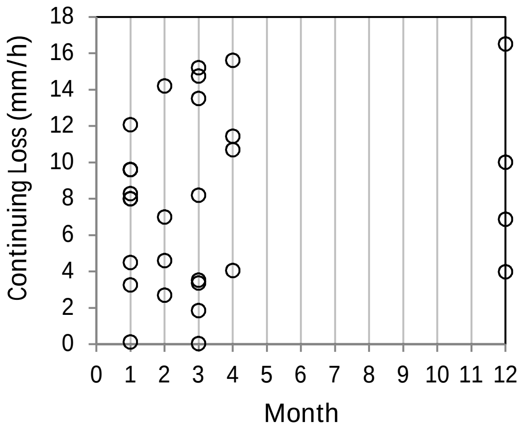


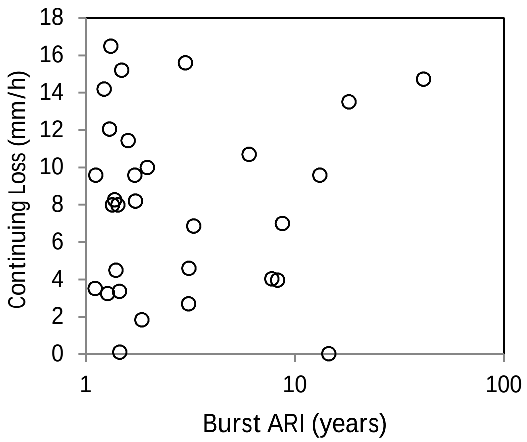


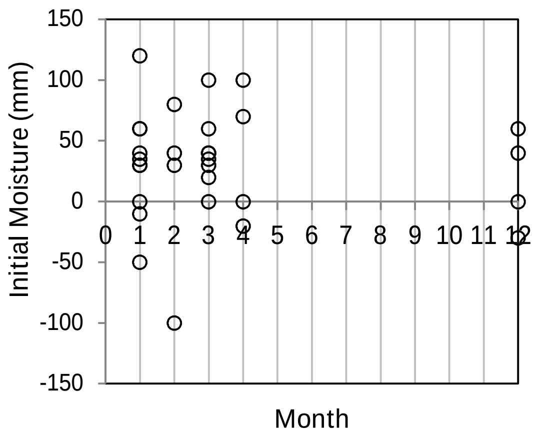
Coomalie Ck @ Stuart HWY (NT) - 24 hour bursts

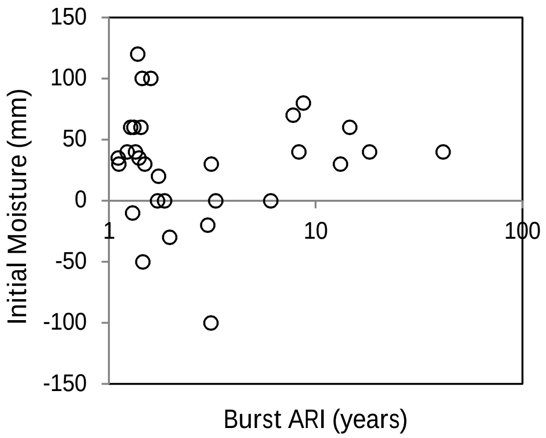


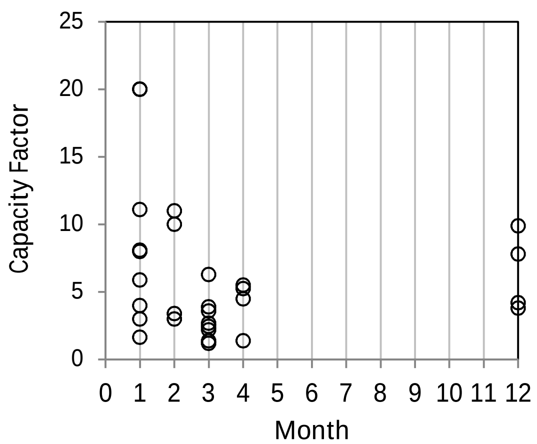


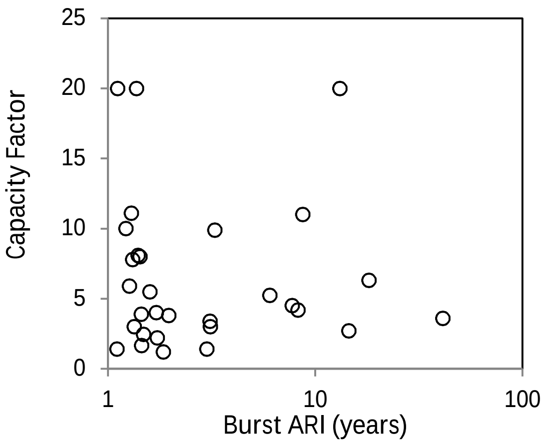




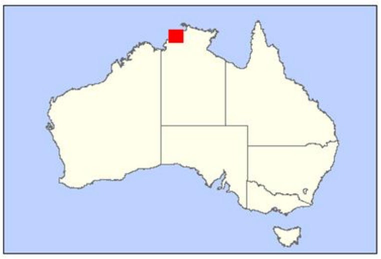


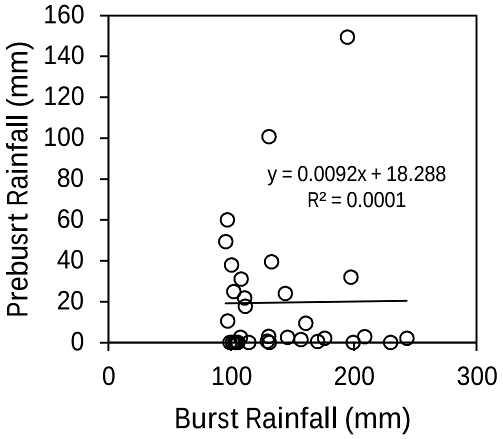


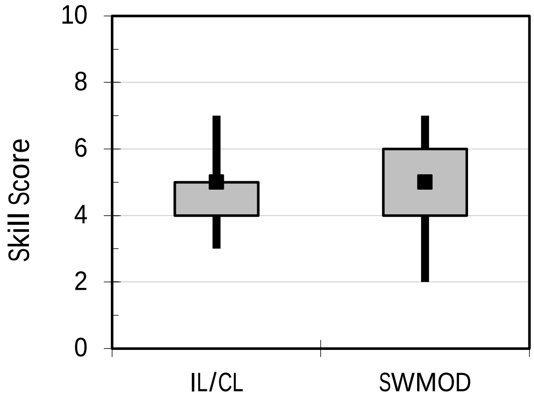


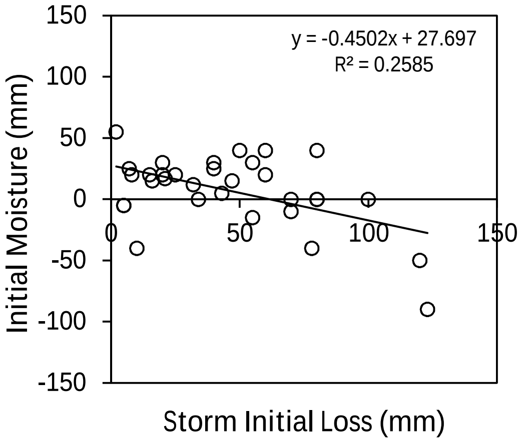


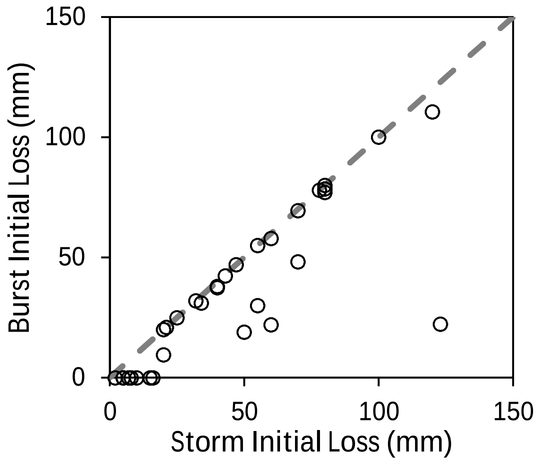
Manton R @ Manton Dam (NT) - 24 hour bursts

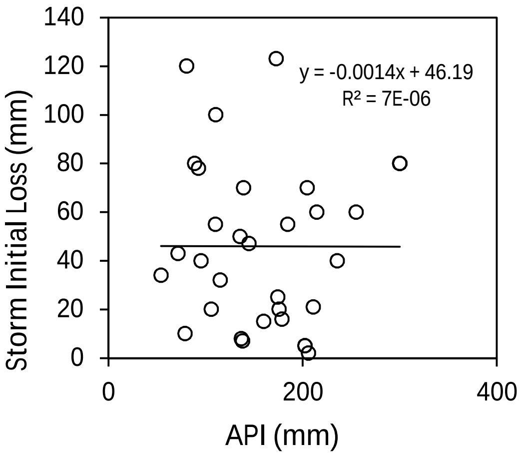


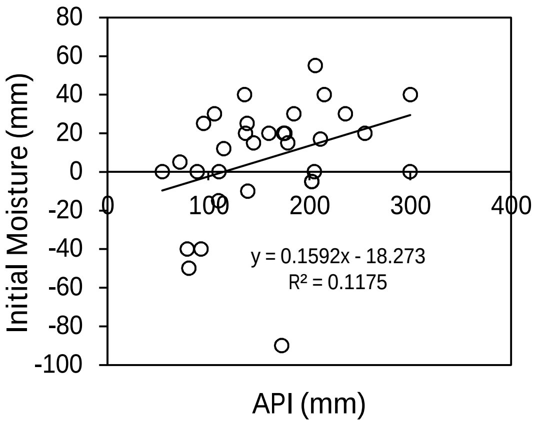




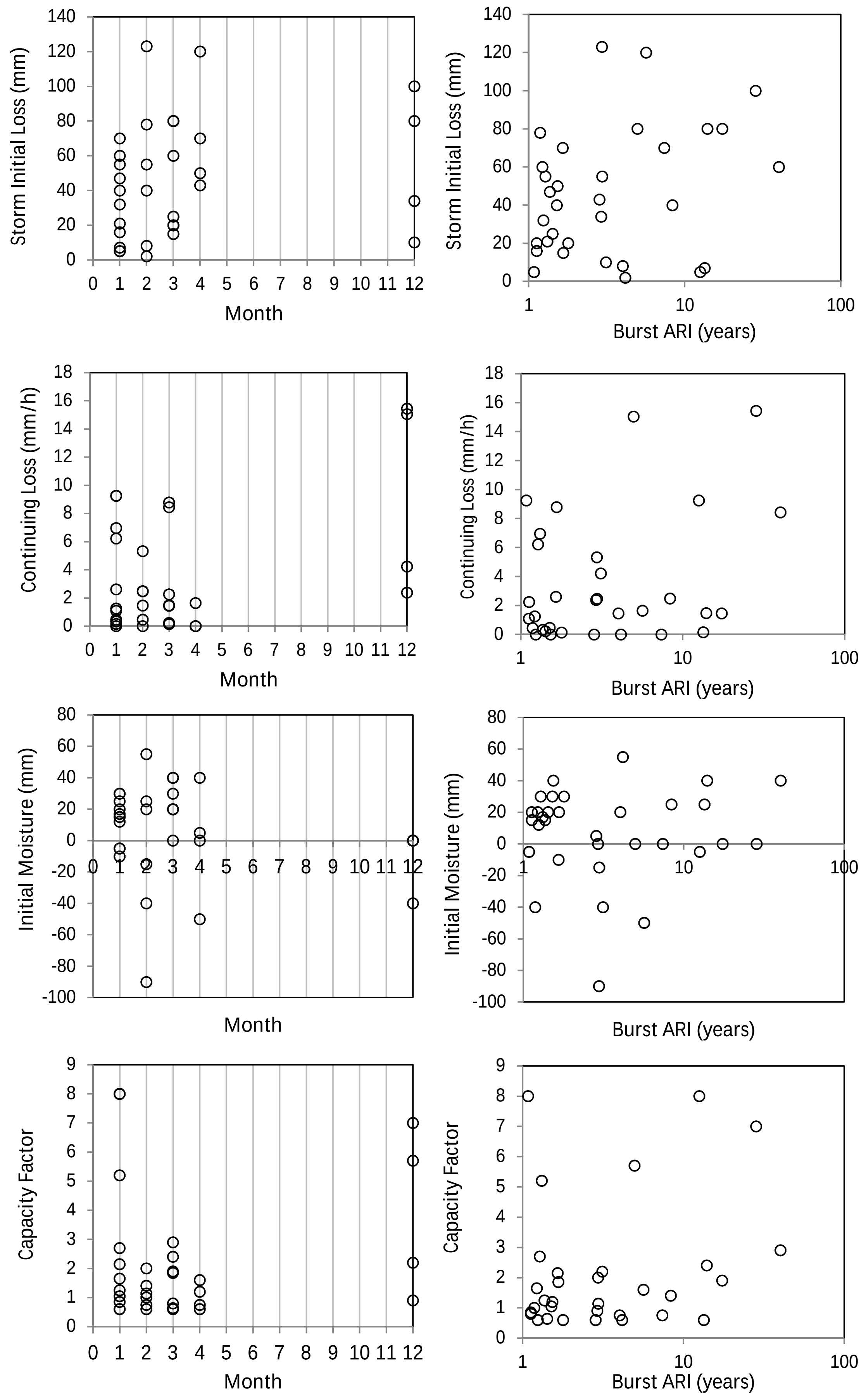




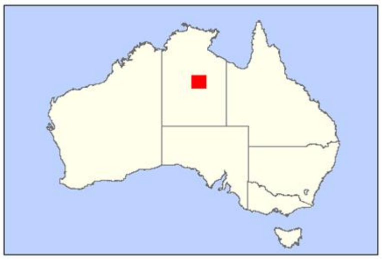


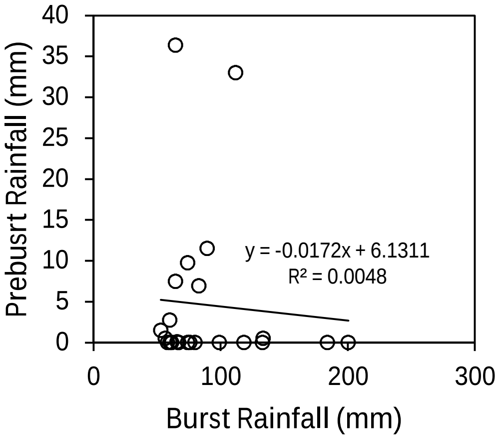


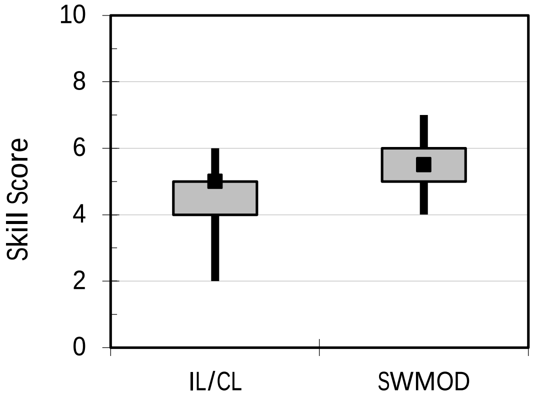
Manton R @ Manton Dam (NT) - 24 hour bursts

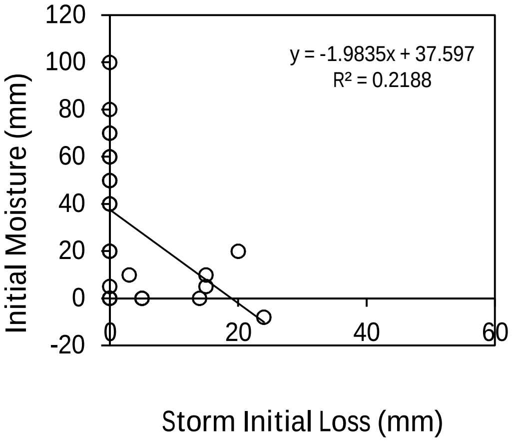


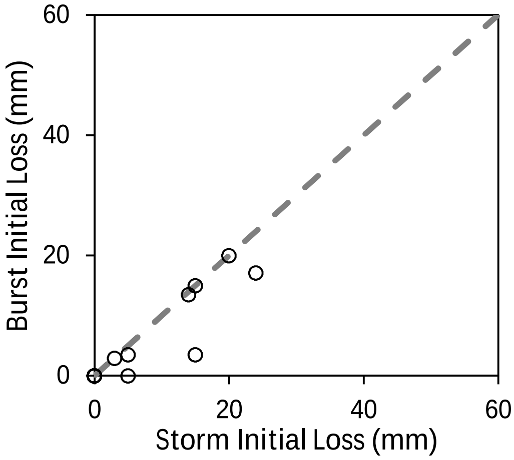
Tennant Ck @ Old Telegraph Stn (NT) - 24 hour bursts

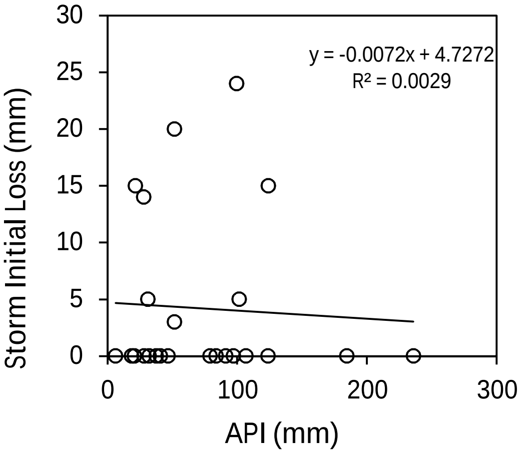


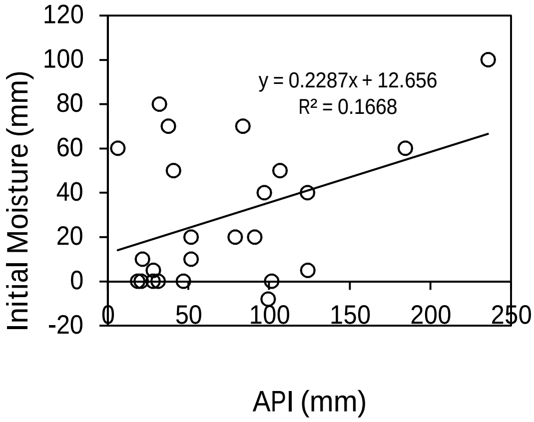




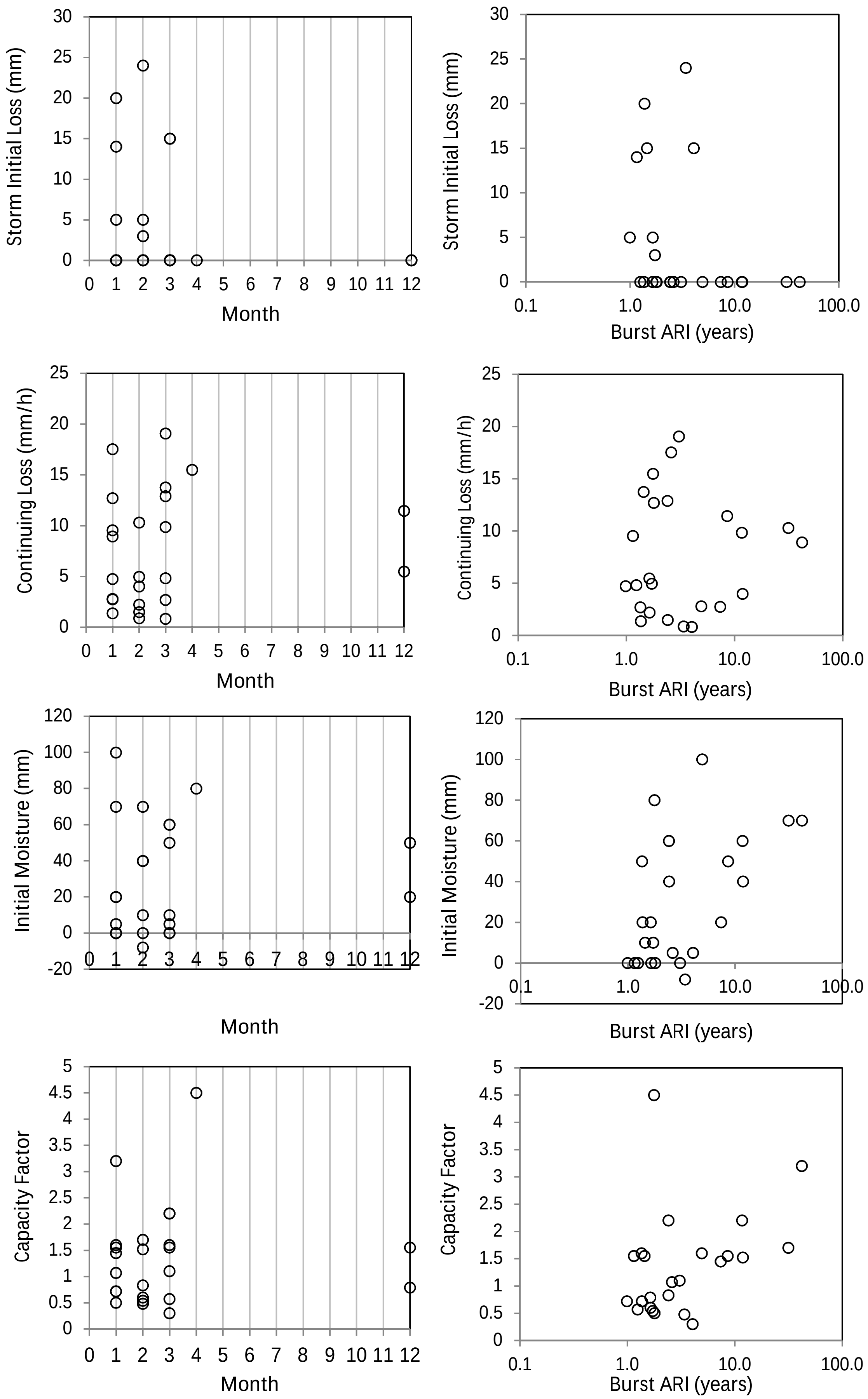




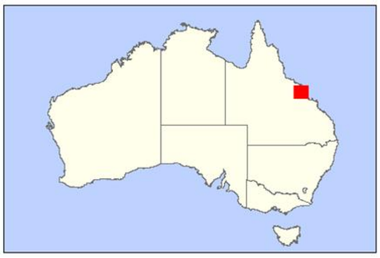


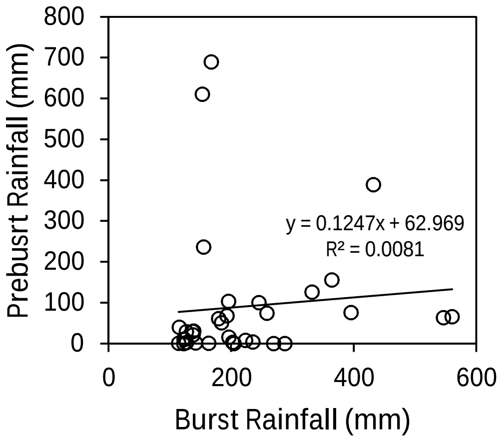


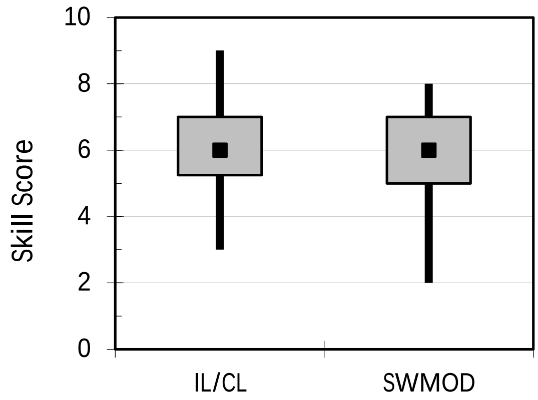
Tennant Ck @ Old Telegraph Stn (NT) - 24 hour bursts

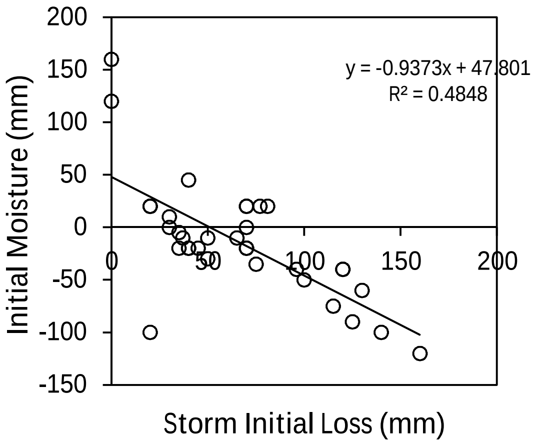


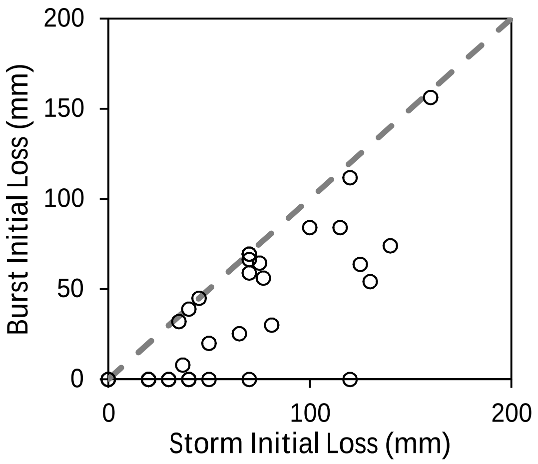
Broken @ Old Racecourse (Qld) - 24 hour bursts

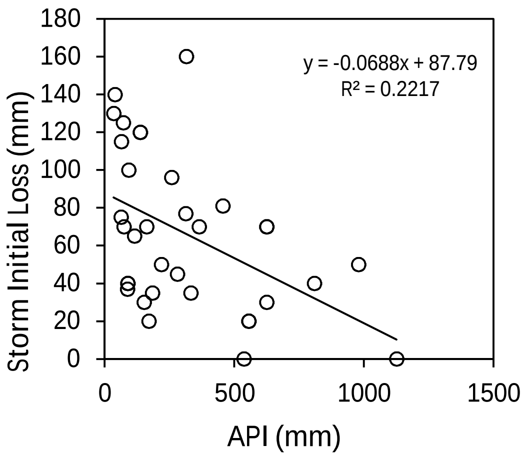


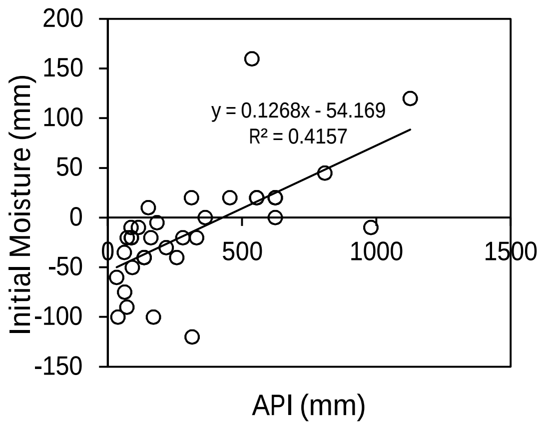




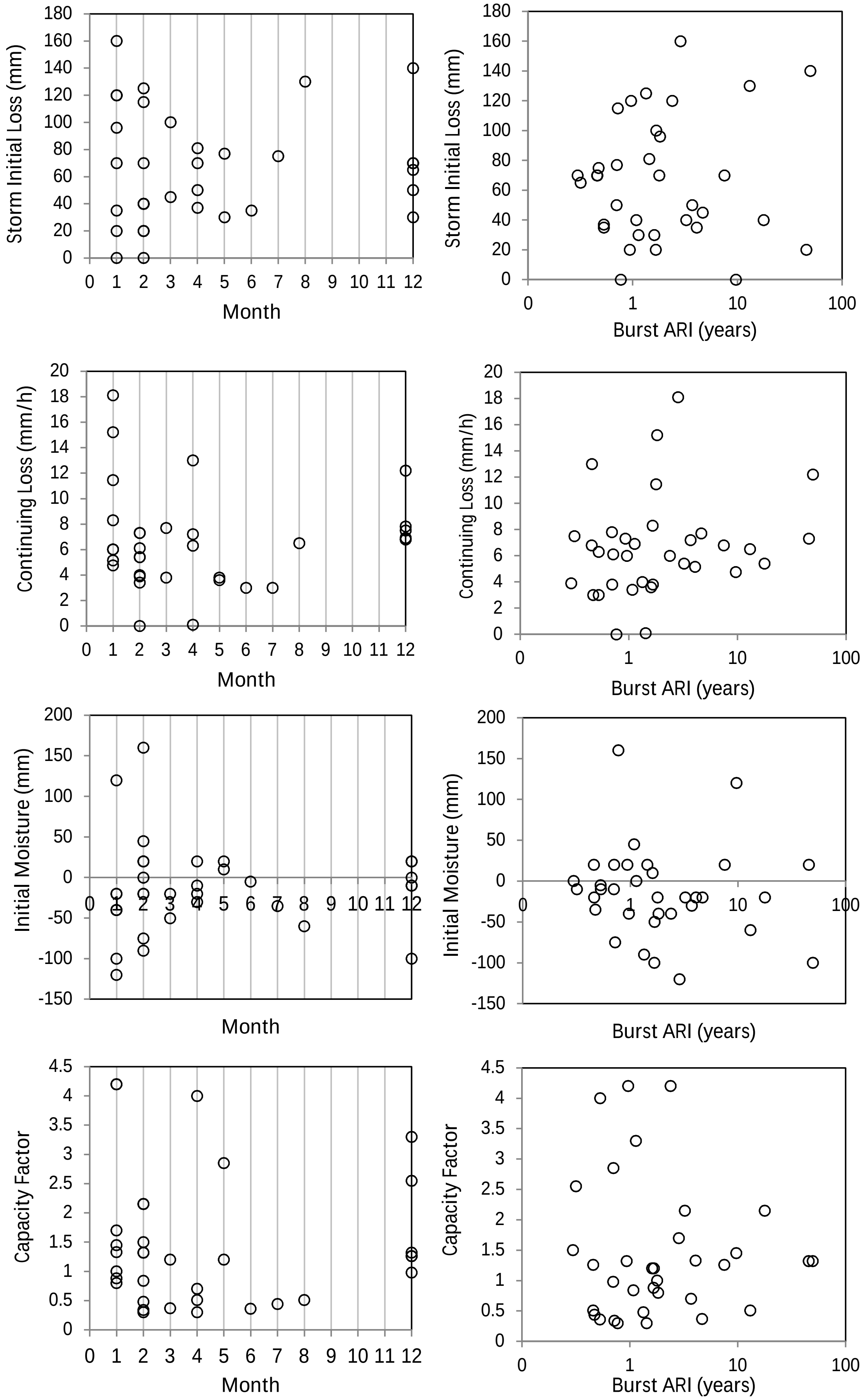




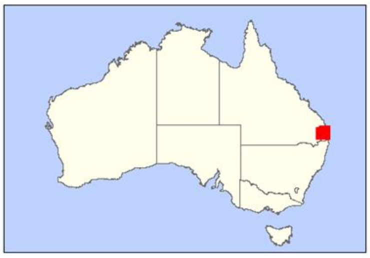


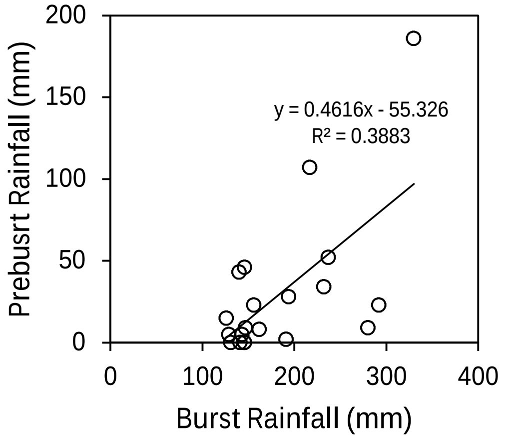


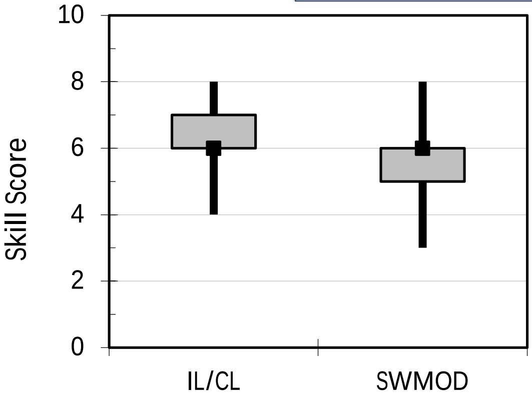
Broken @ Old Racecourse (Qld) - 24 hour bursts

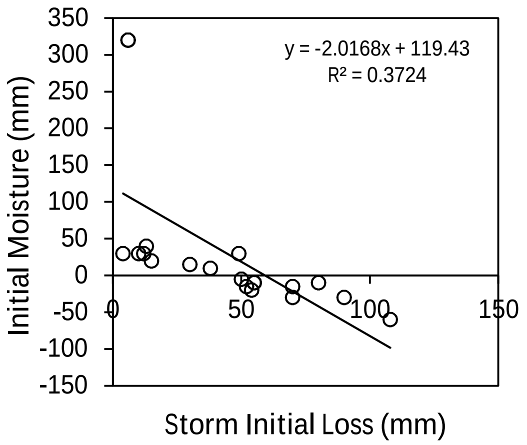


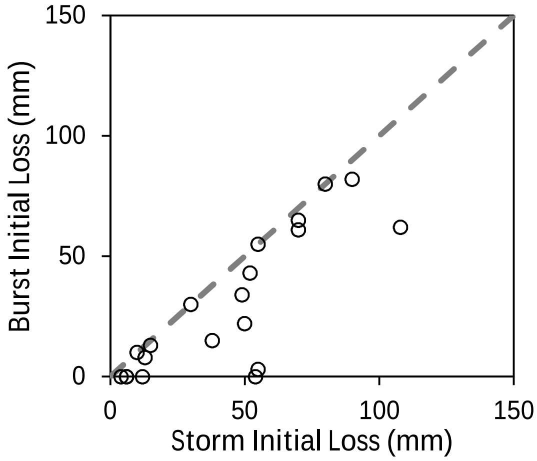
Caboolture @ Upper Caboolture (Qld) - 24 hour bursts

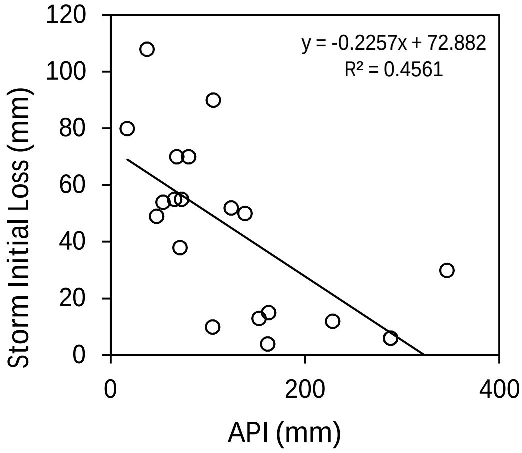


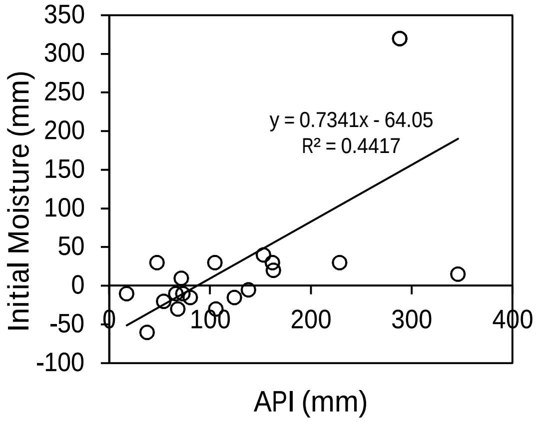




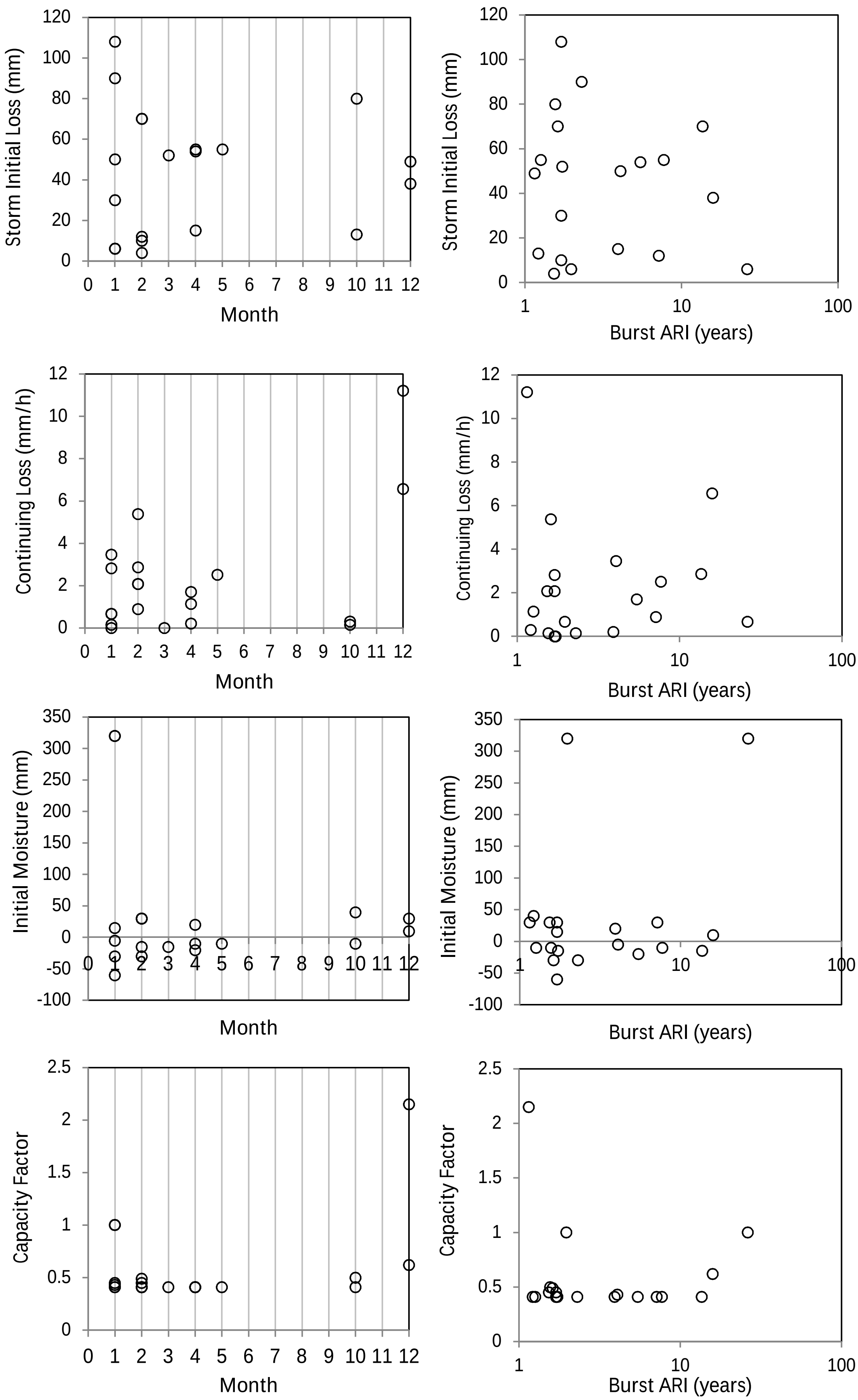




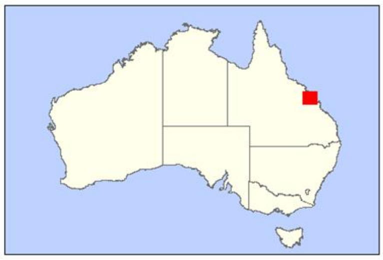


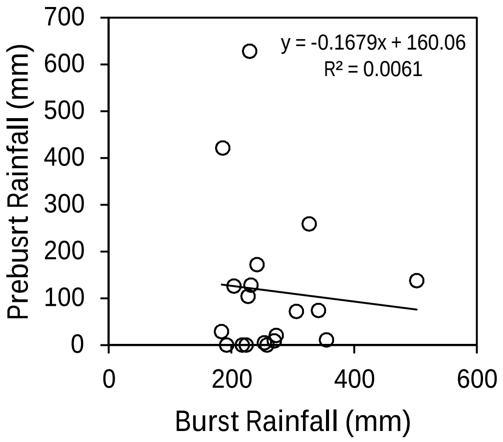


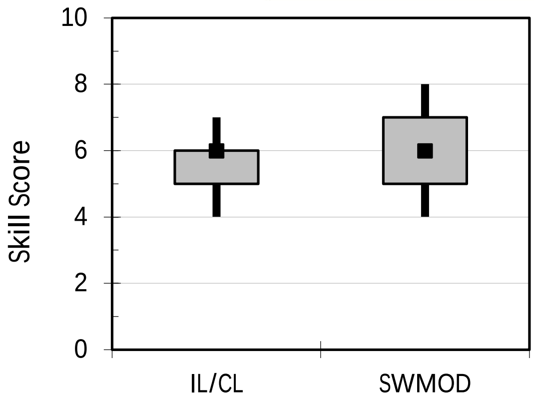
Caboolture @ Upper Caboolture (Qld) - 24 hour bursts

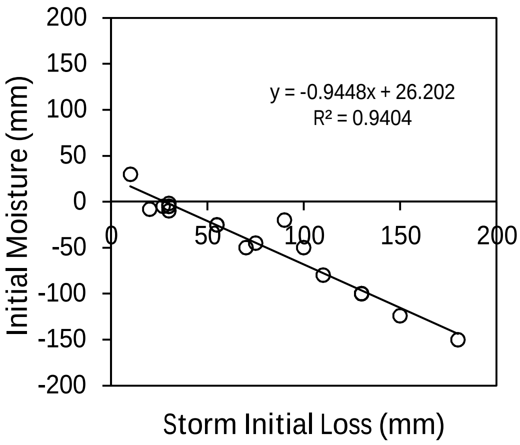


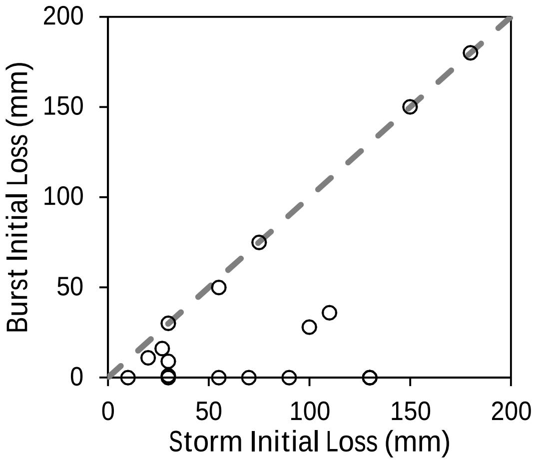
Carmila Ck @ Carmila (Qld) - 24 hour bursts

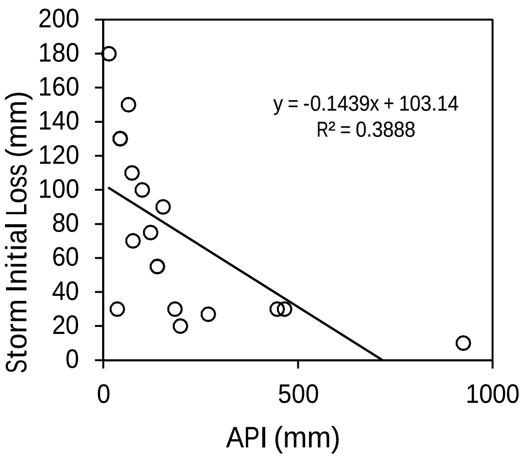


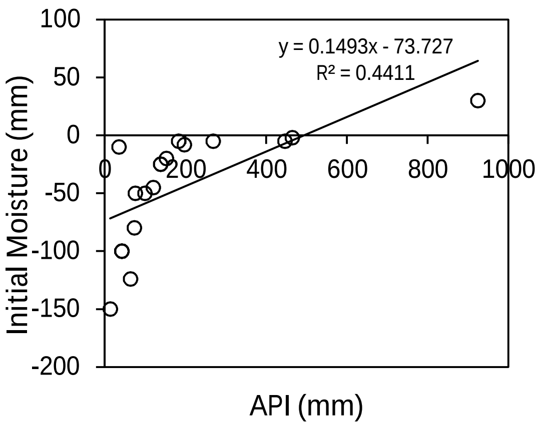




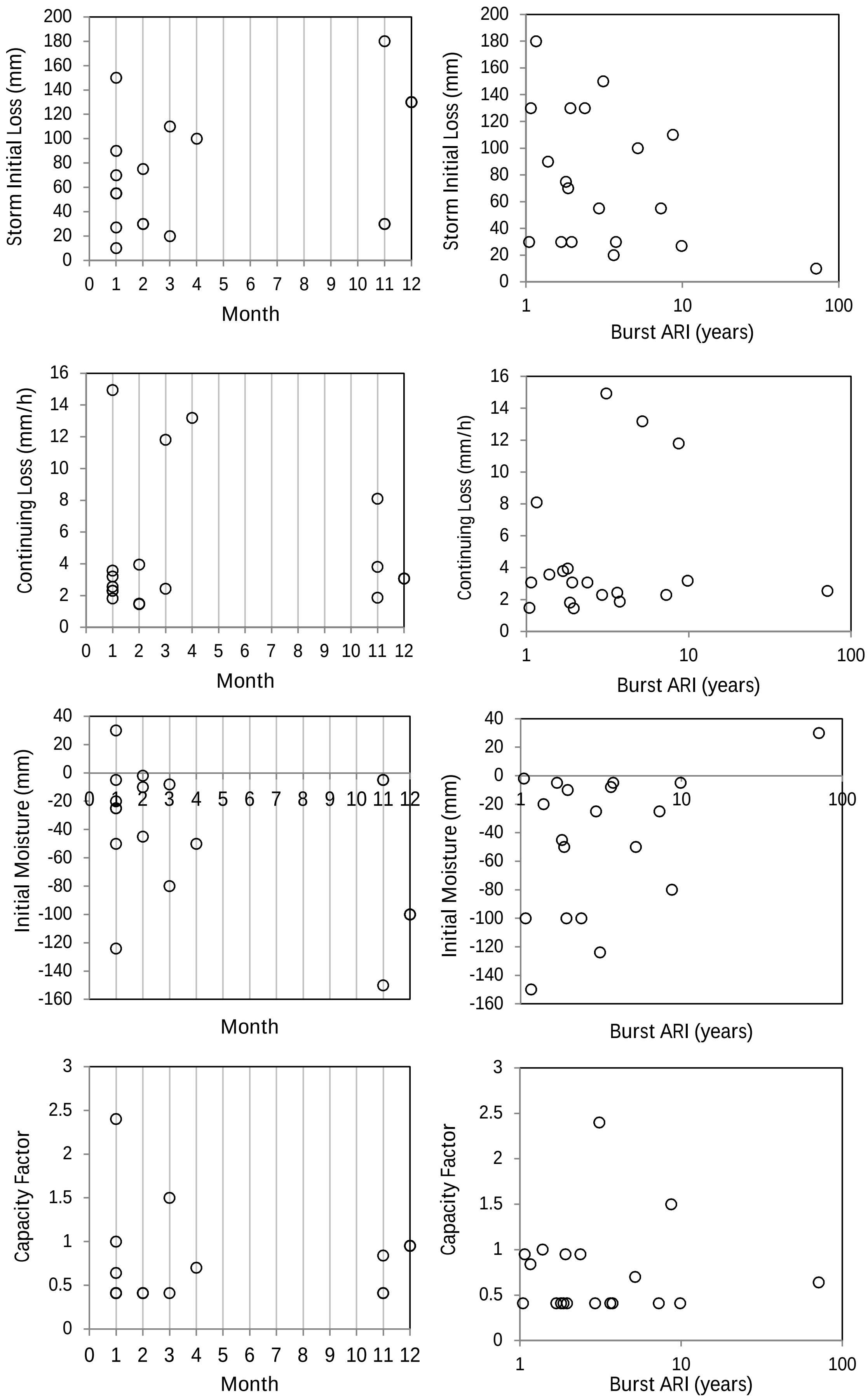




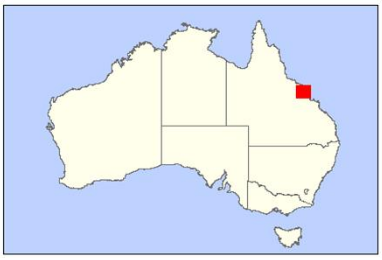


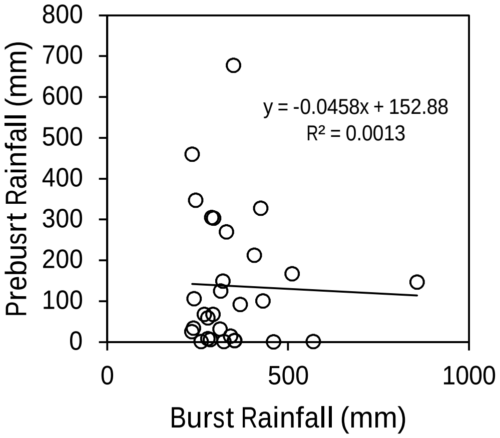


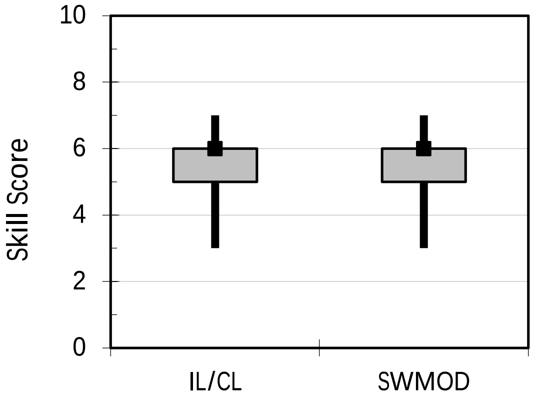
Carmila Ck @ Carmila (Qld) - 24 hour bursts

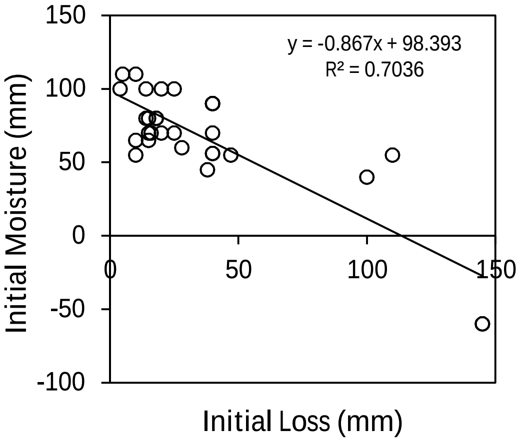


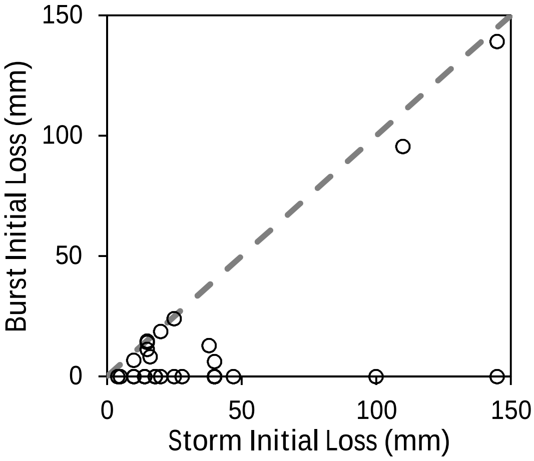
Finch Hatton Ck @ Dam Site (Qld) - 24 hour bursts

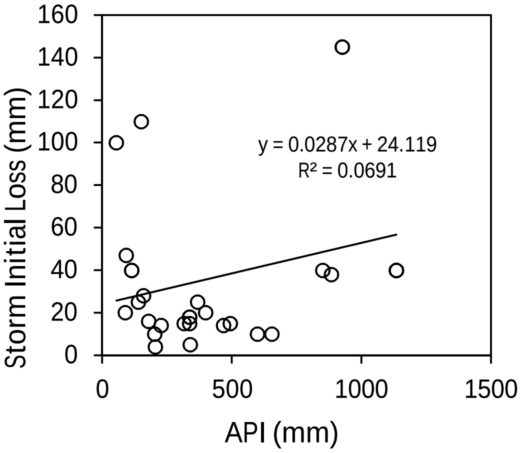


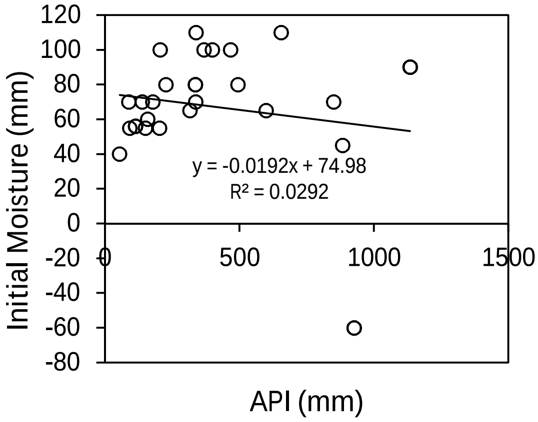




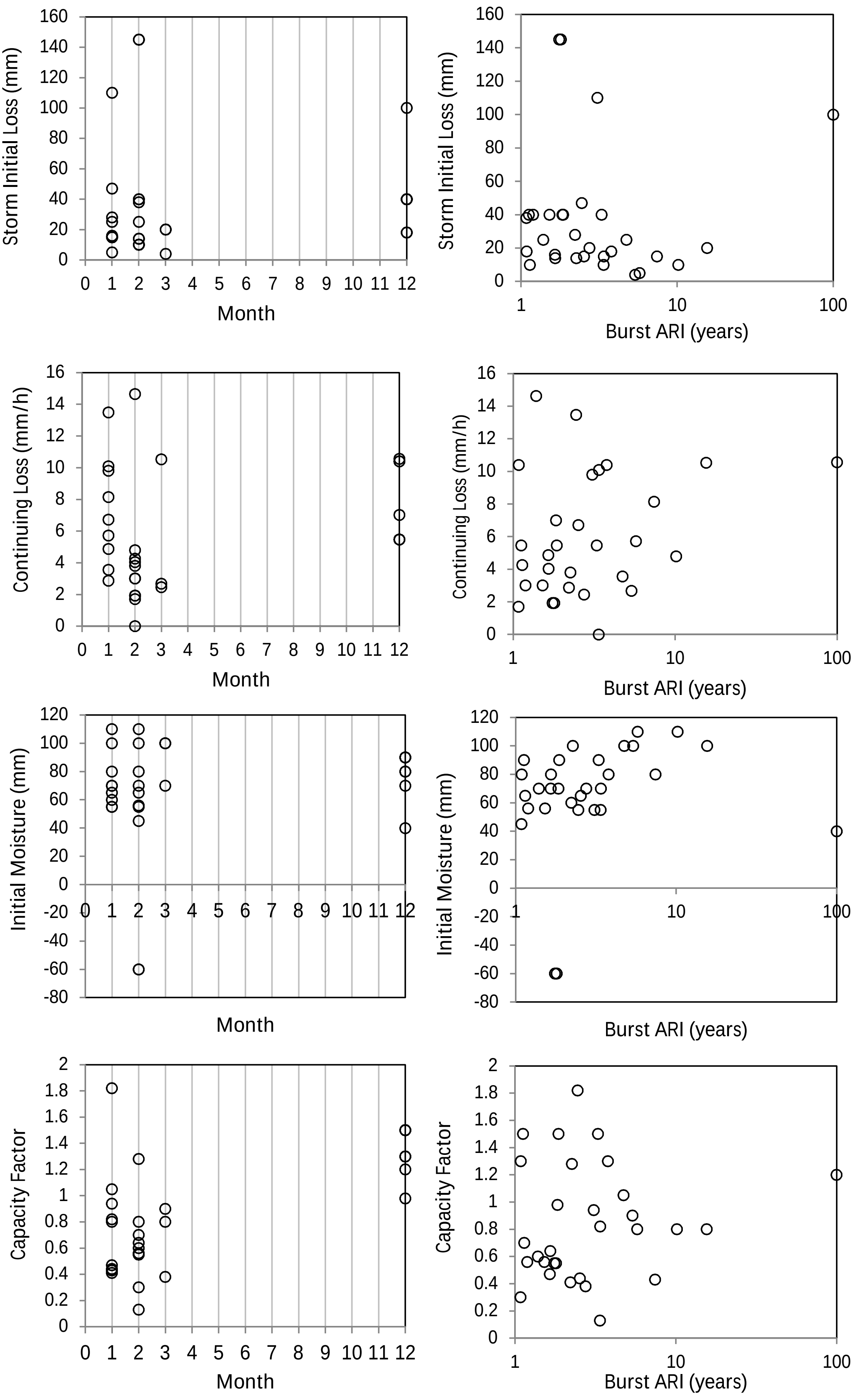




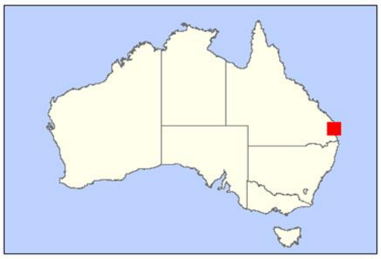


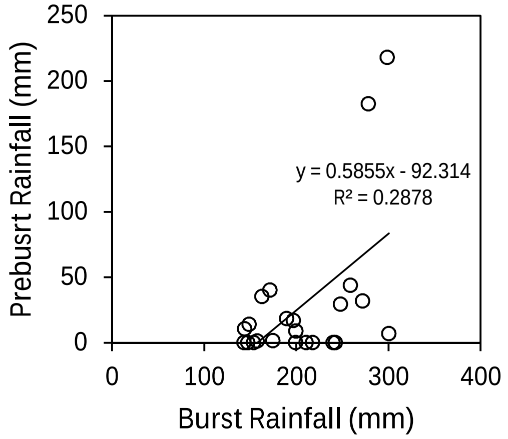


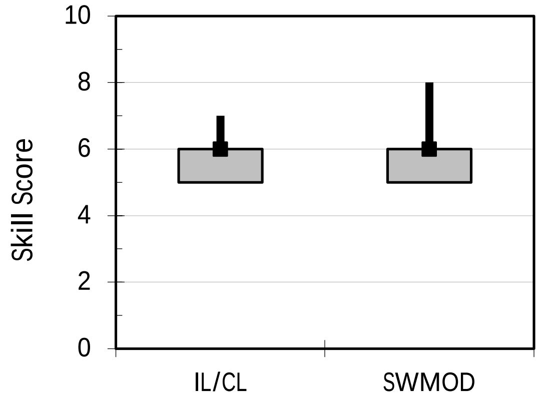
Finch Hatton Ck @ Dam Site (Qld) - 24 hour bursts

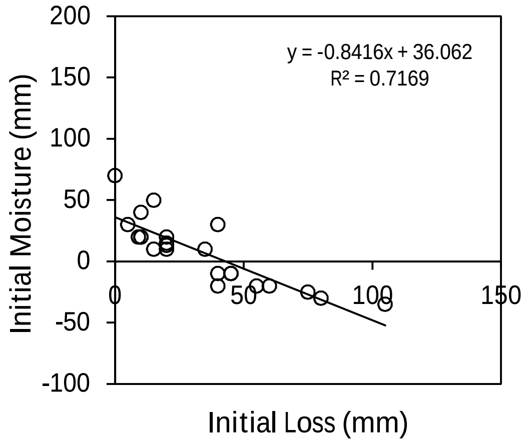


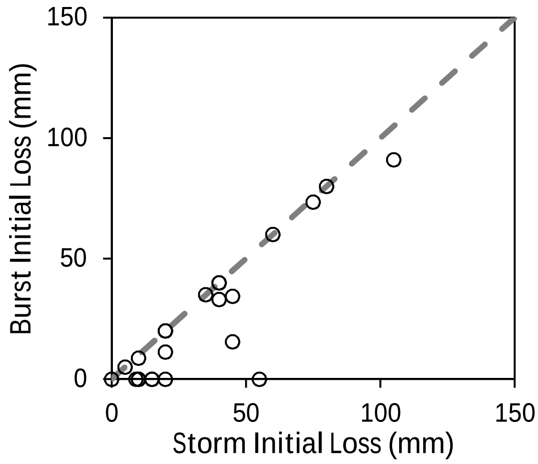
North Maroochy River @ Eumundi (Qld) - 24 hour bursts

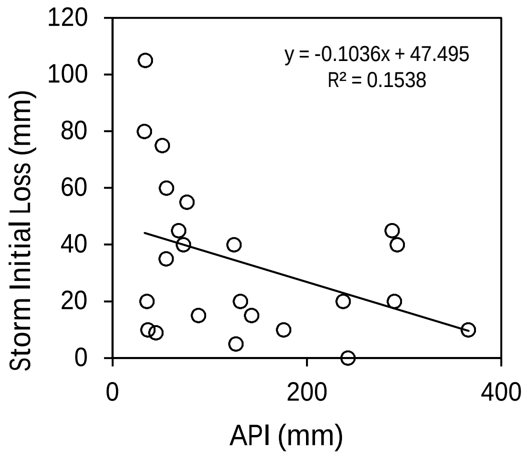


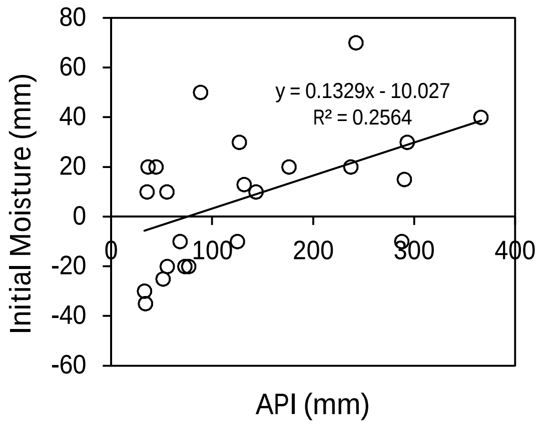




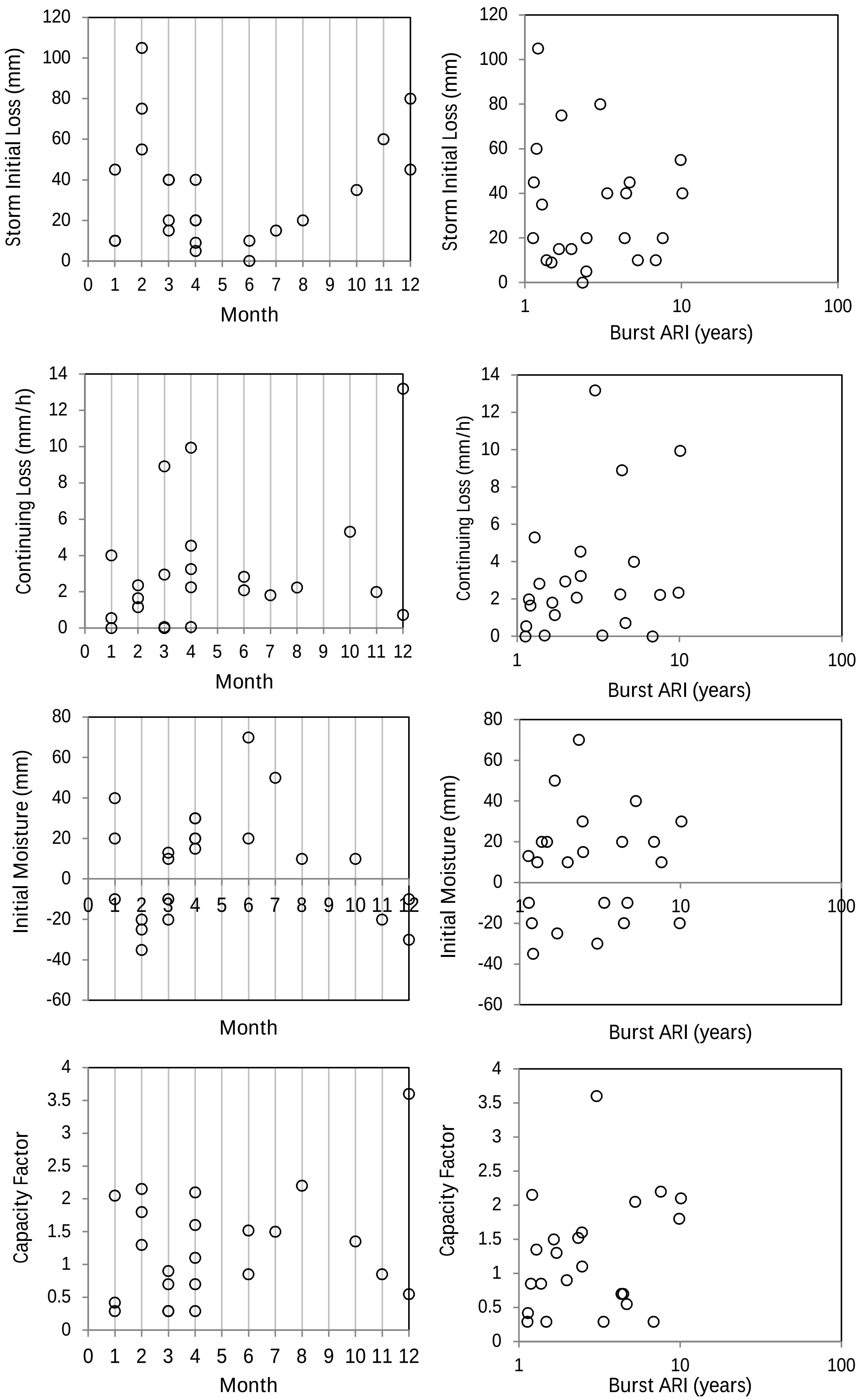




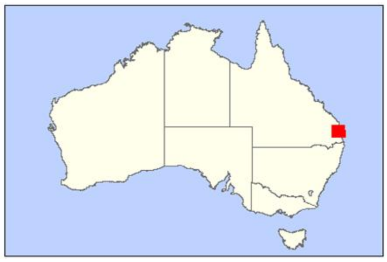


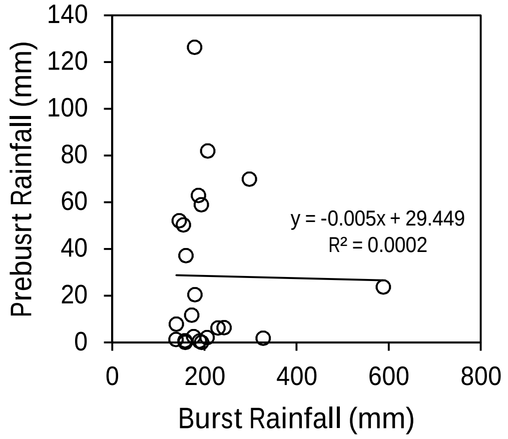


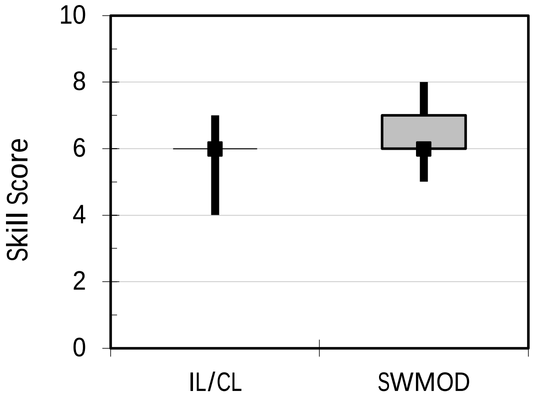
North Maroochy River @ Eumundi (Qld) - 24 hour bursts

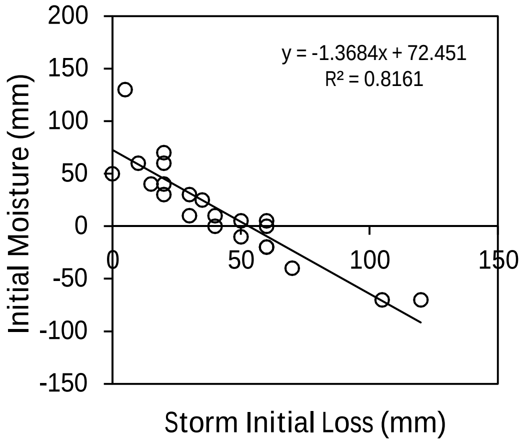


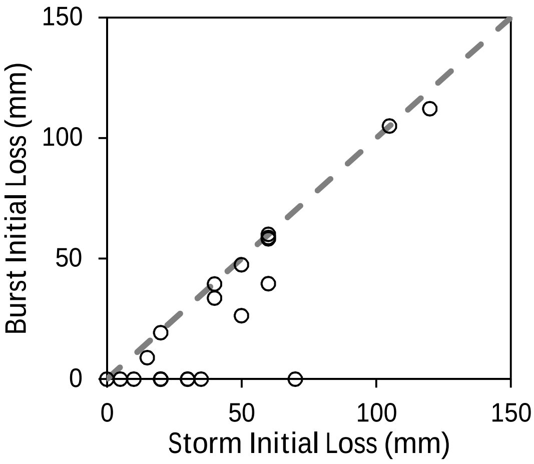
South Maroochy @ Kiamba (QLD) - 24 hour bursts

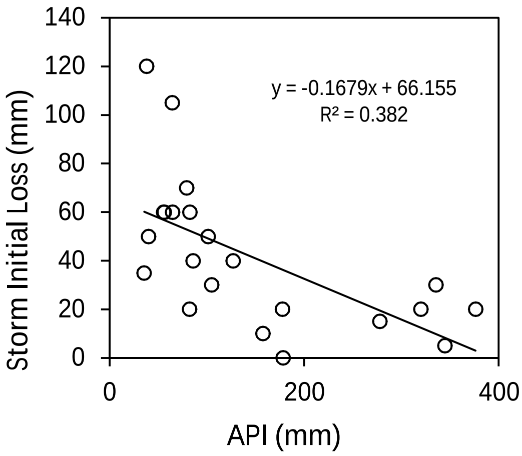


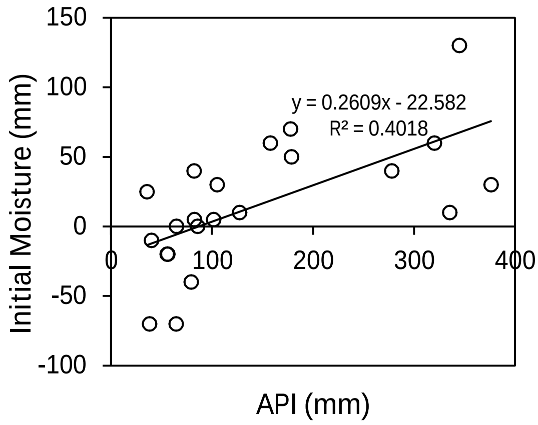




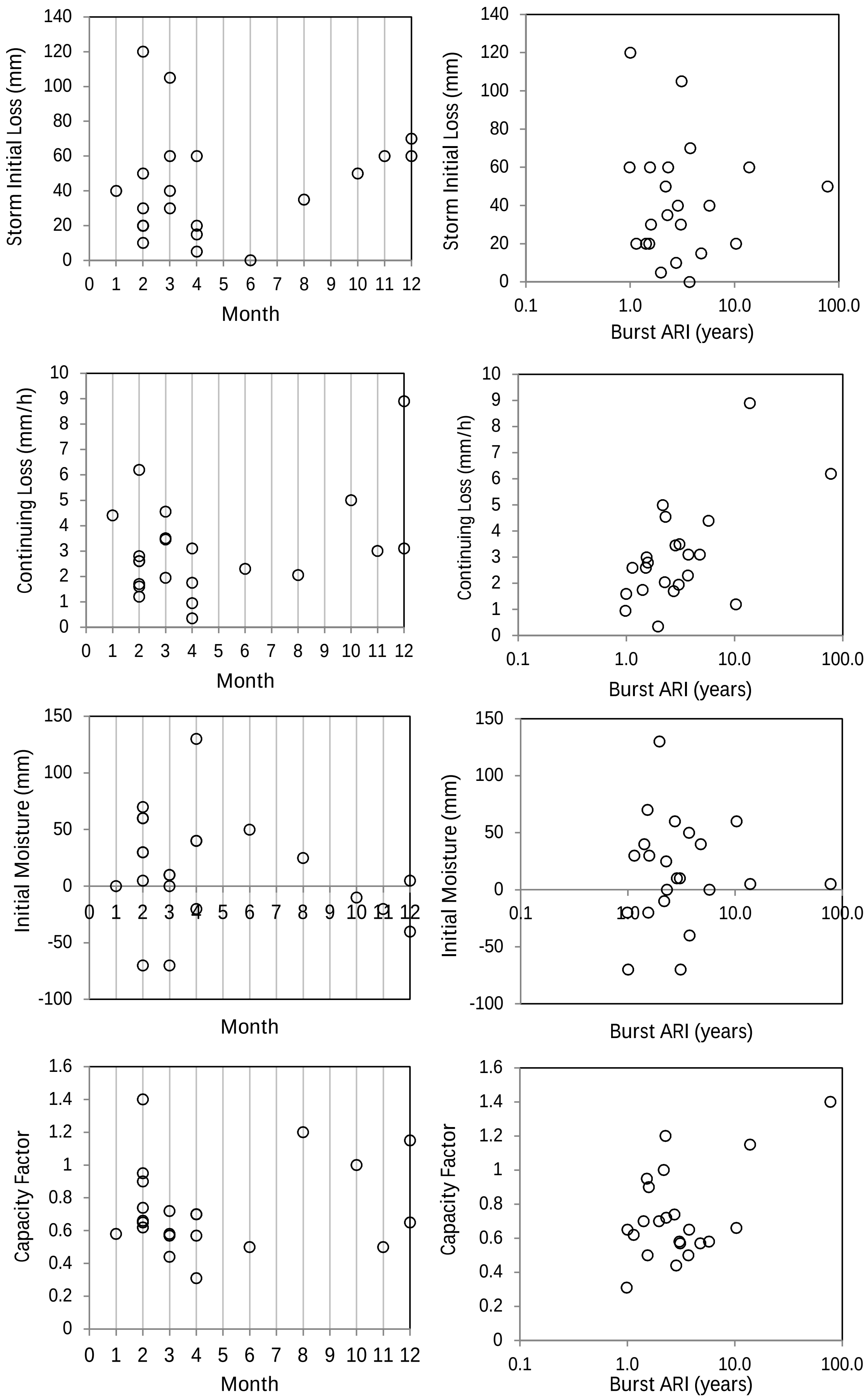




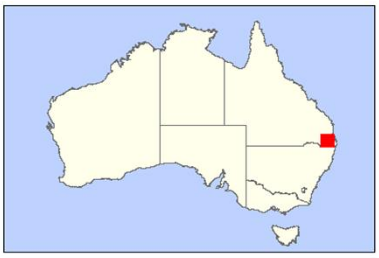


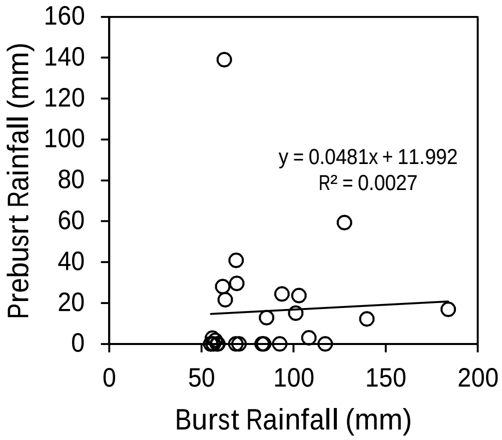


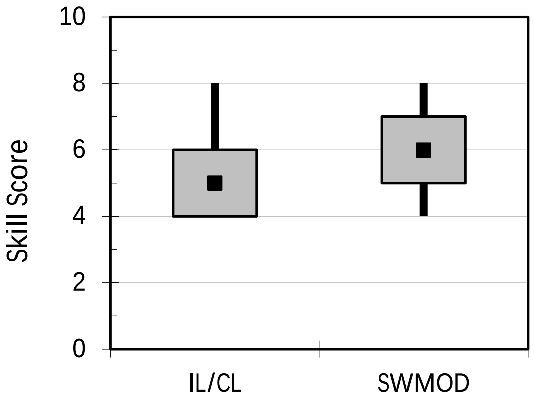
South Maroochy @ Kiamba (QLD) - 24 hour bursts

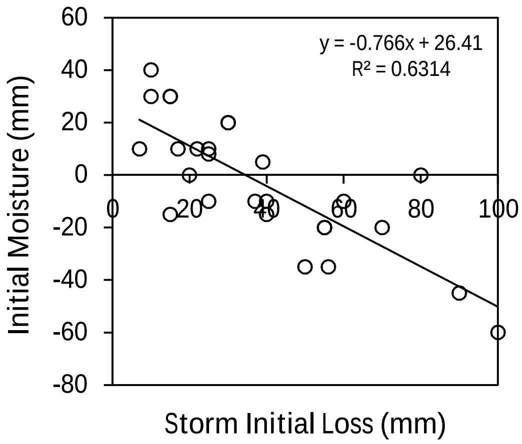


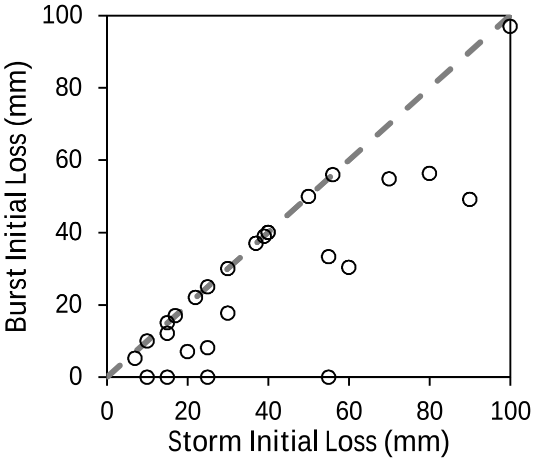
Spring Ck @ Killarney (Qld) - 24 hour bursts

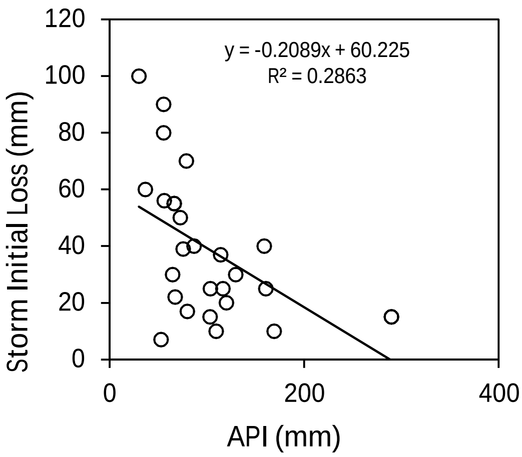


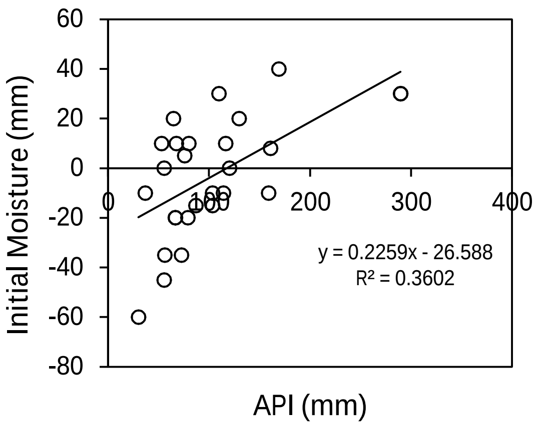




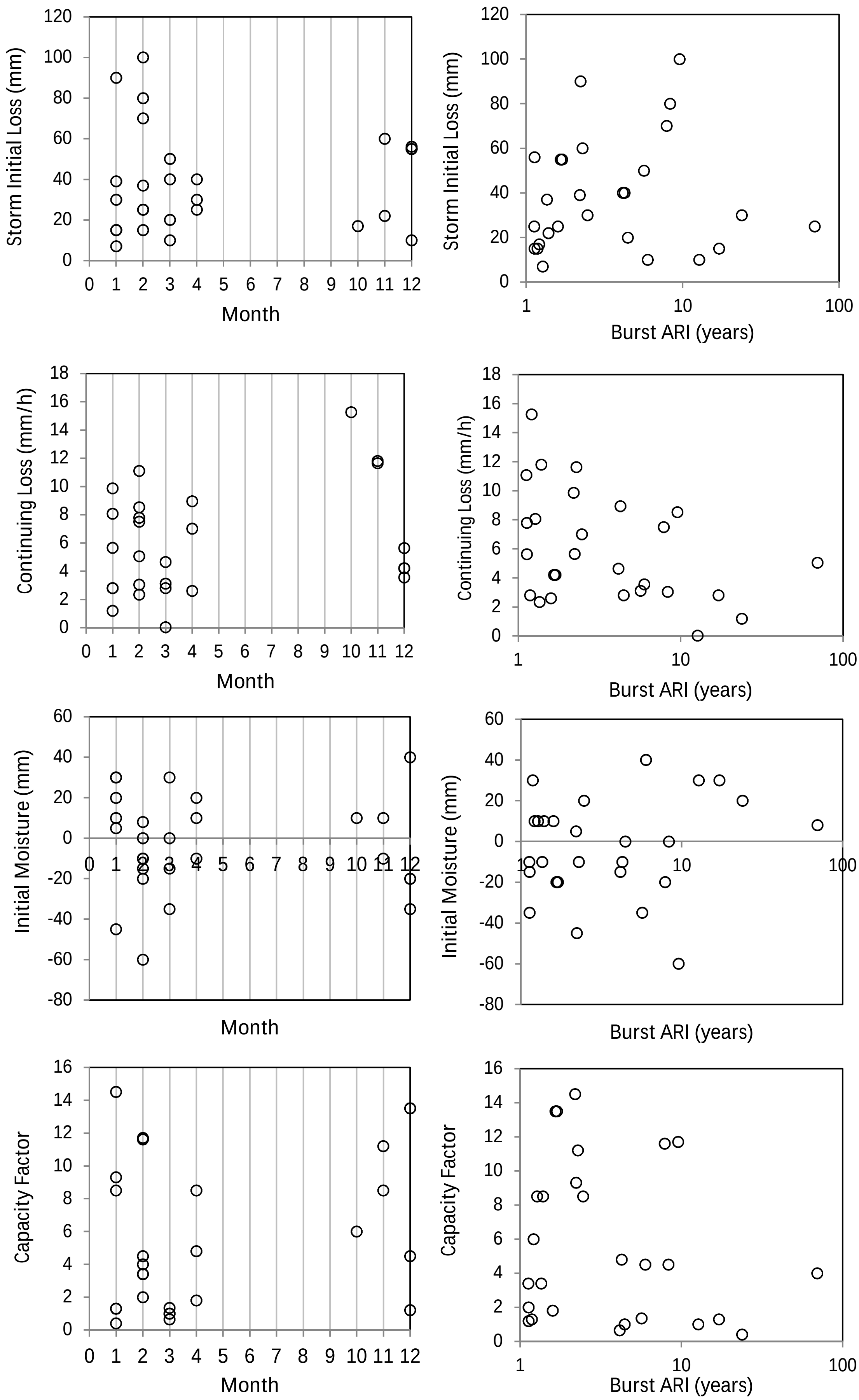




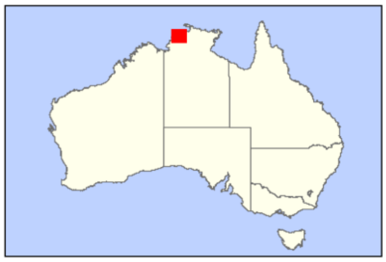


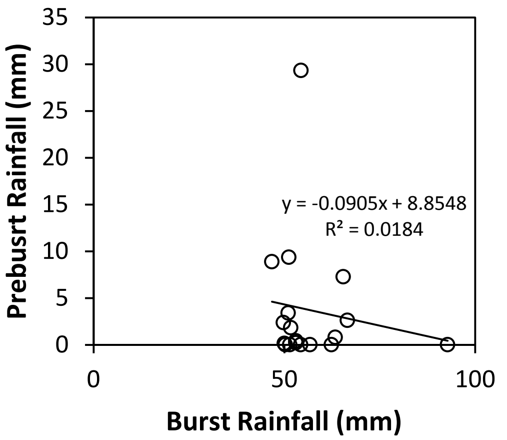


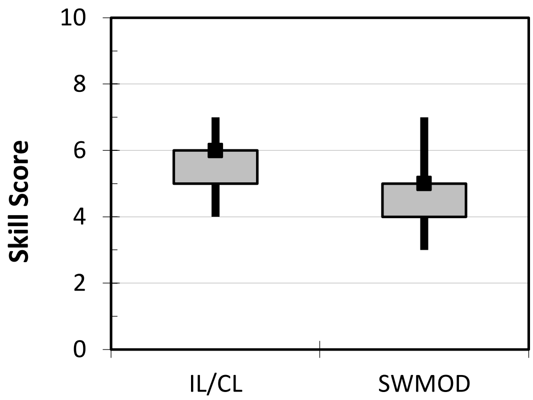
Spring Ck @ Killarney (Qld) - 24 hour bursts

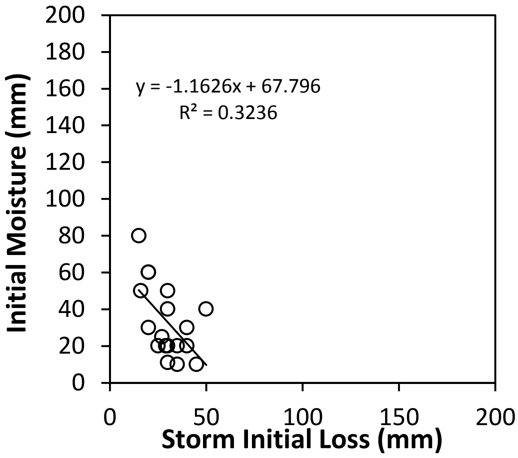


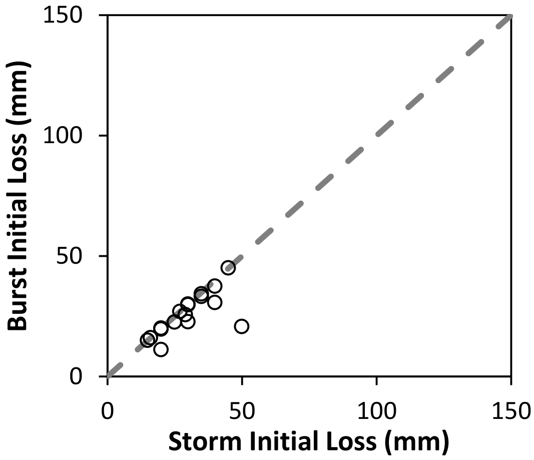
Fletcher Ck @ Frog Hollow (WA) - 3 hour bursts

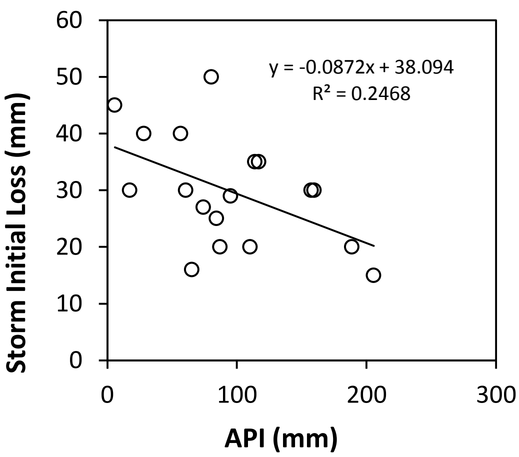


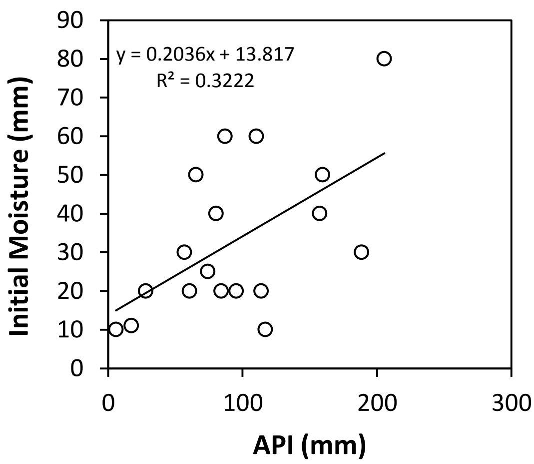




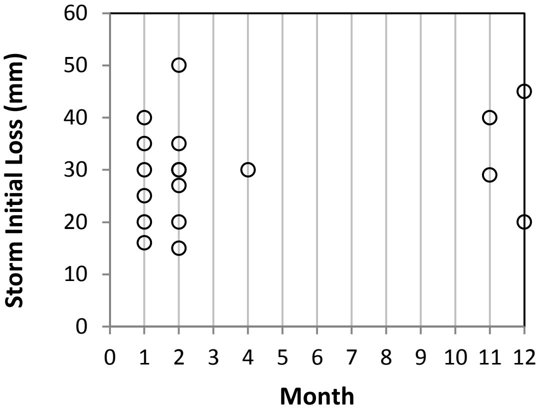


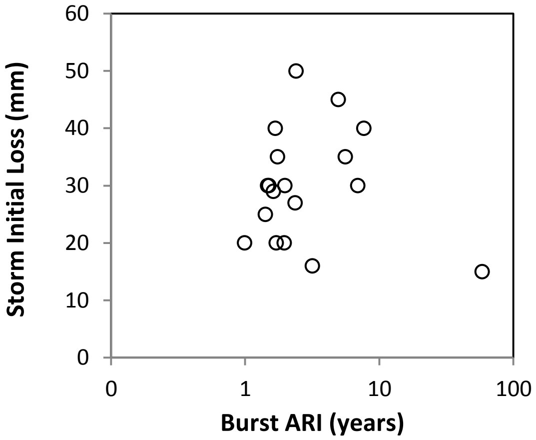


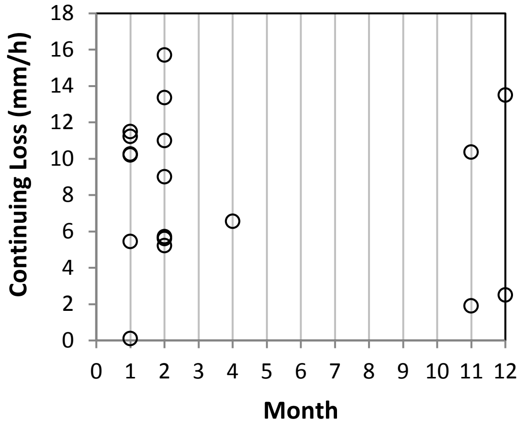


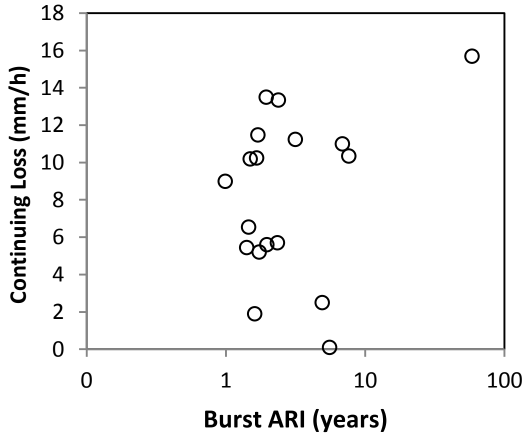


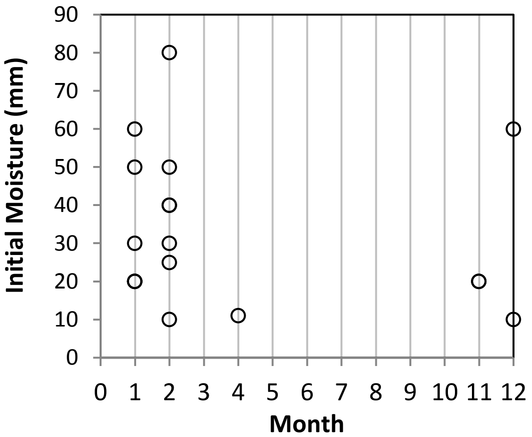
Fletcher Ck @ Frog Hollow (WA) - 3 hour bursts

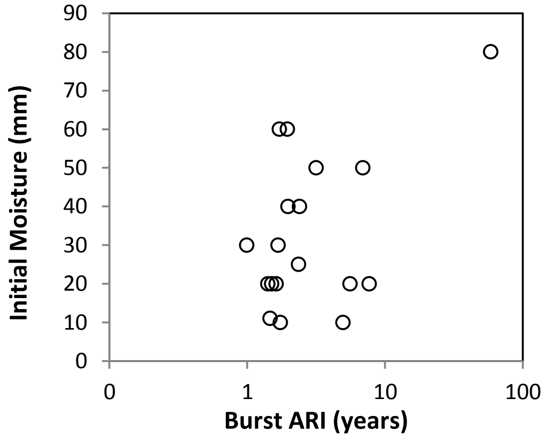


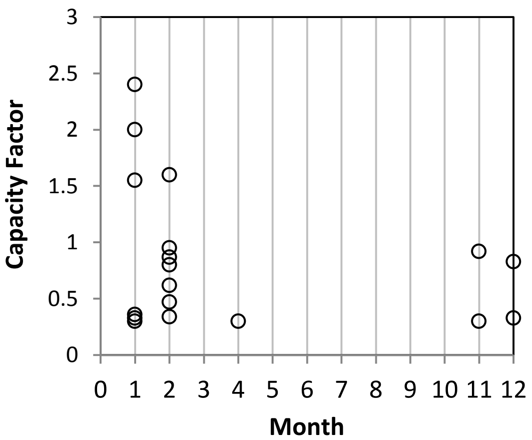


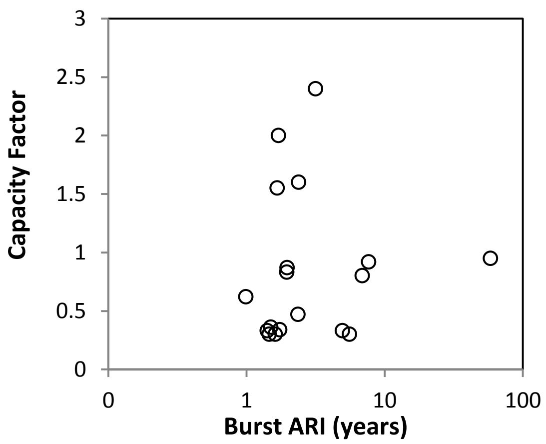




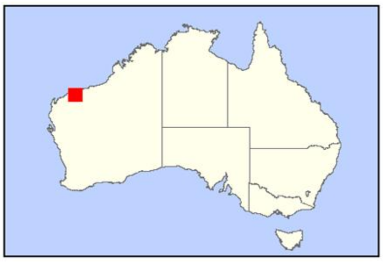


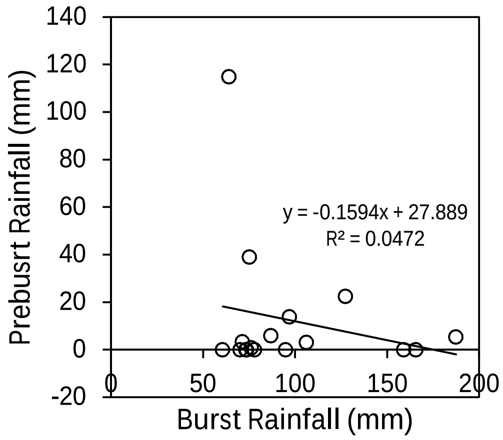


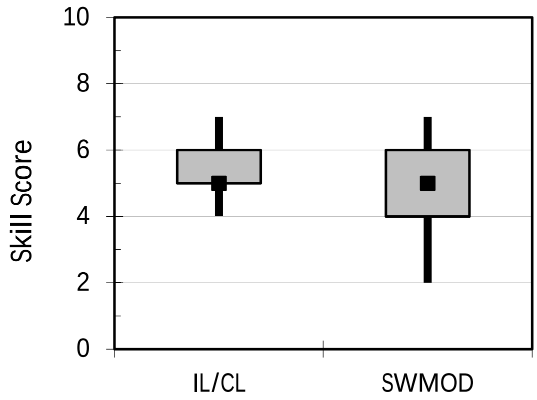


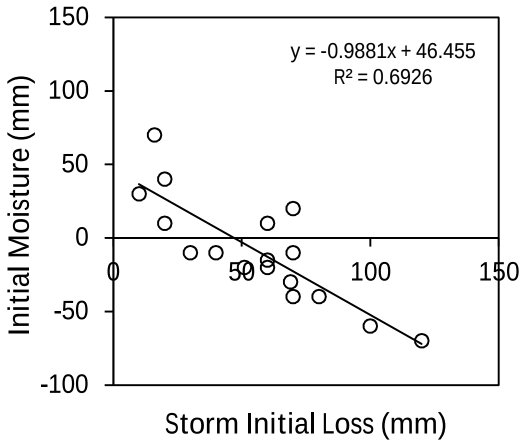


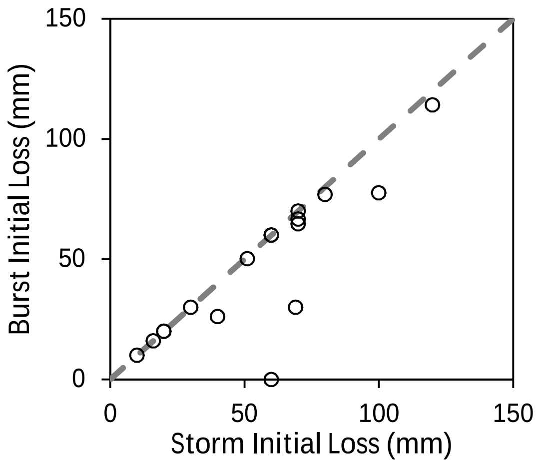
Harding @ Marmurrina Pool U-South (WA) - 24 hour bursts

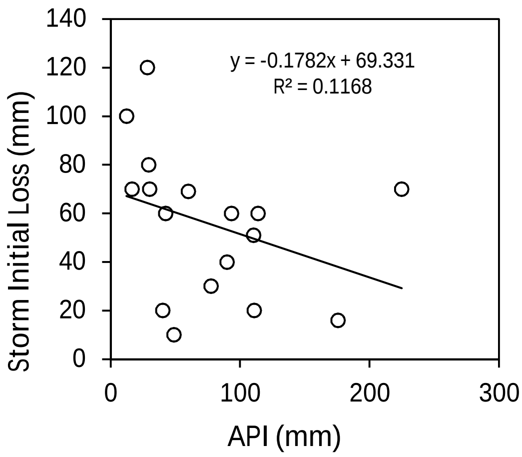


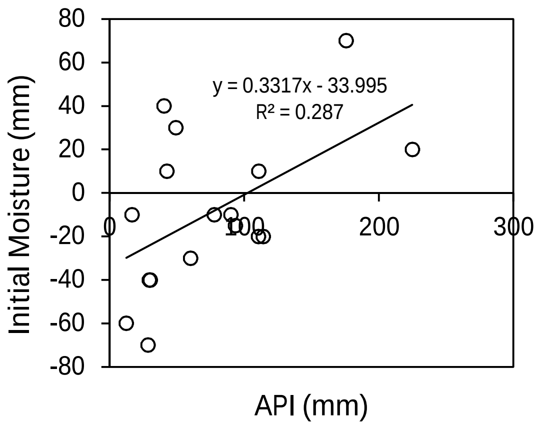




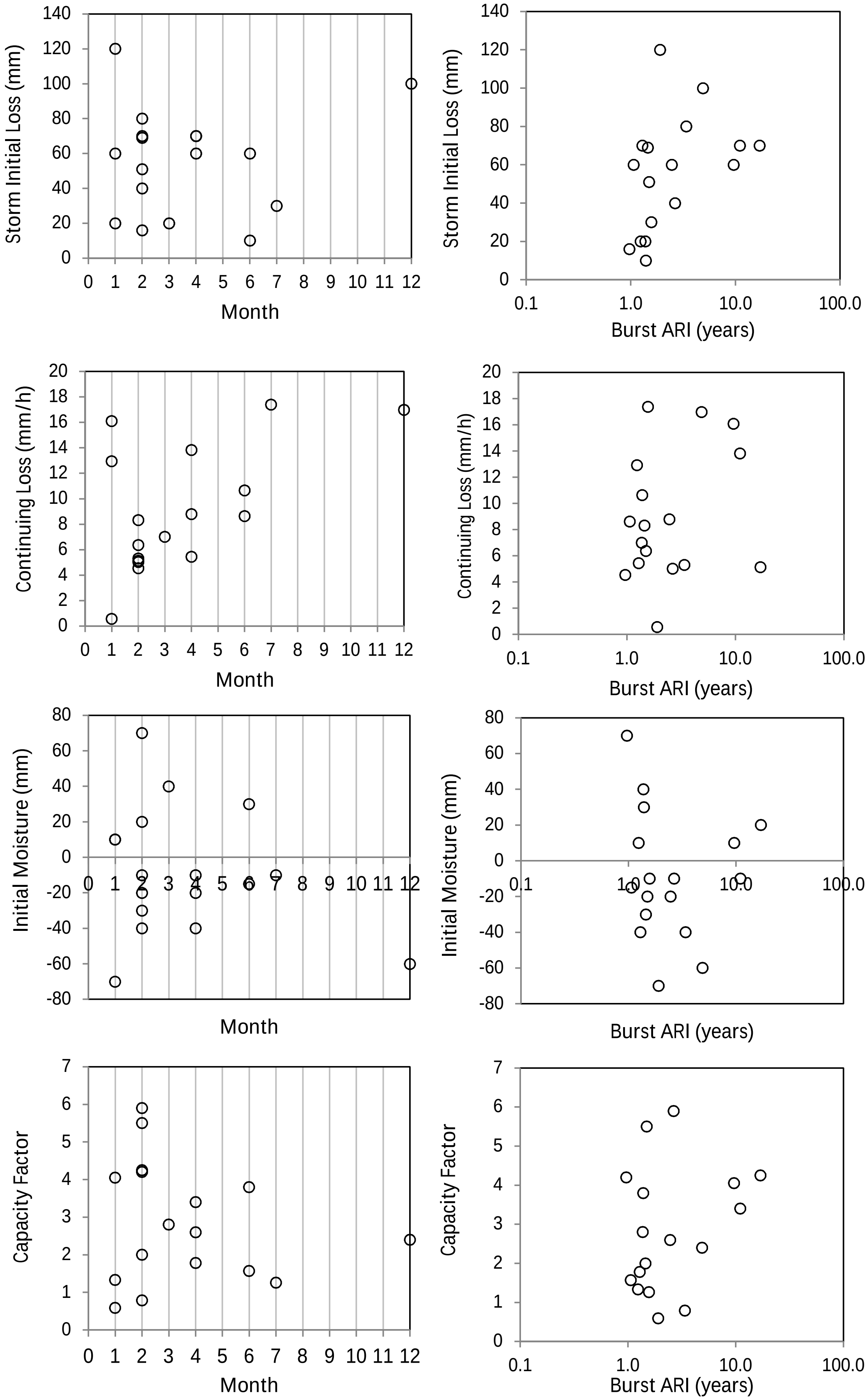




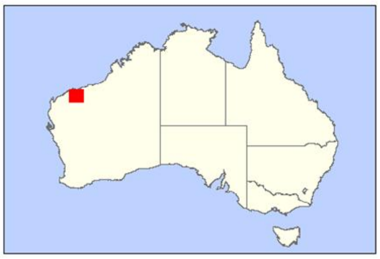


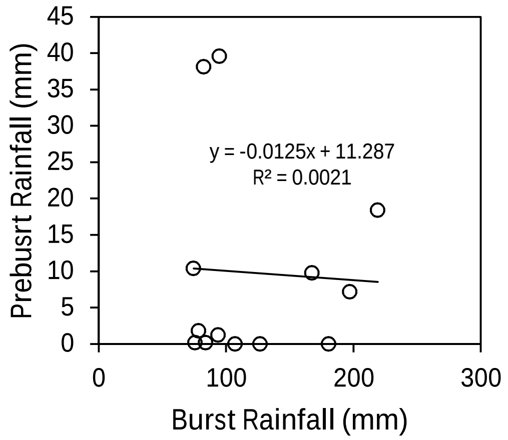


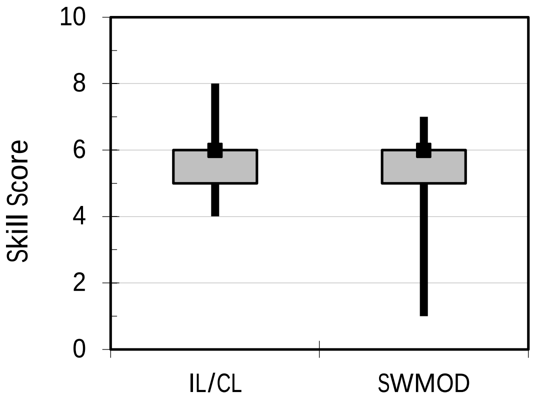
Harding @ Marmurrina Pool U-South (WA) - 24 hour bursts

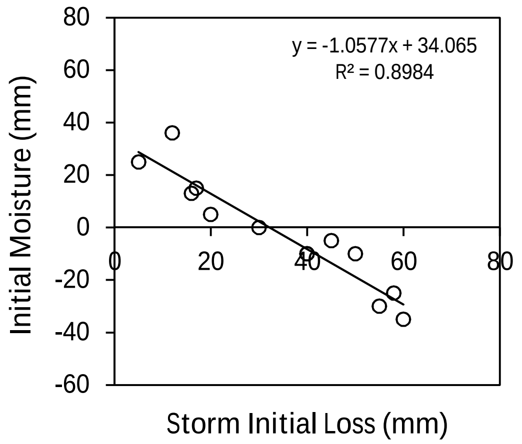


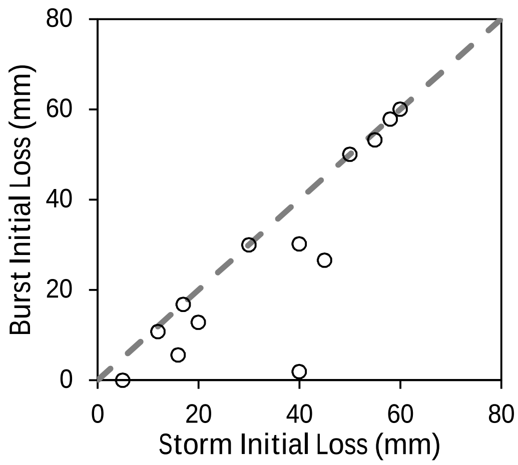
Kanjenjie Ck Trib. @ Fish Pool (WA) - 24 hour bursts

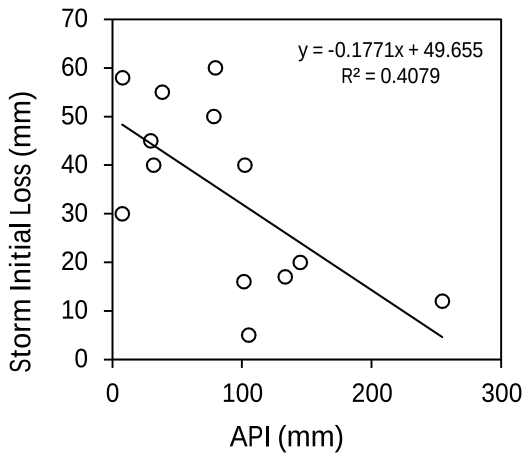


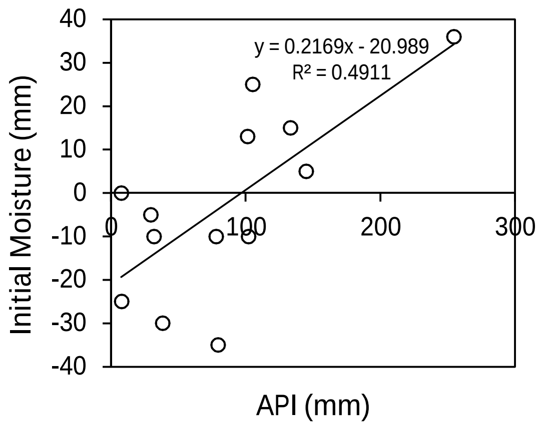




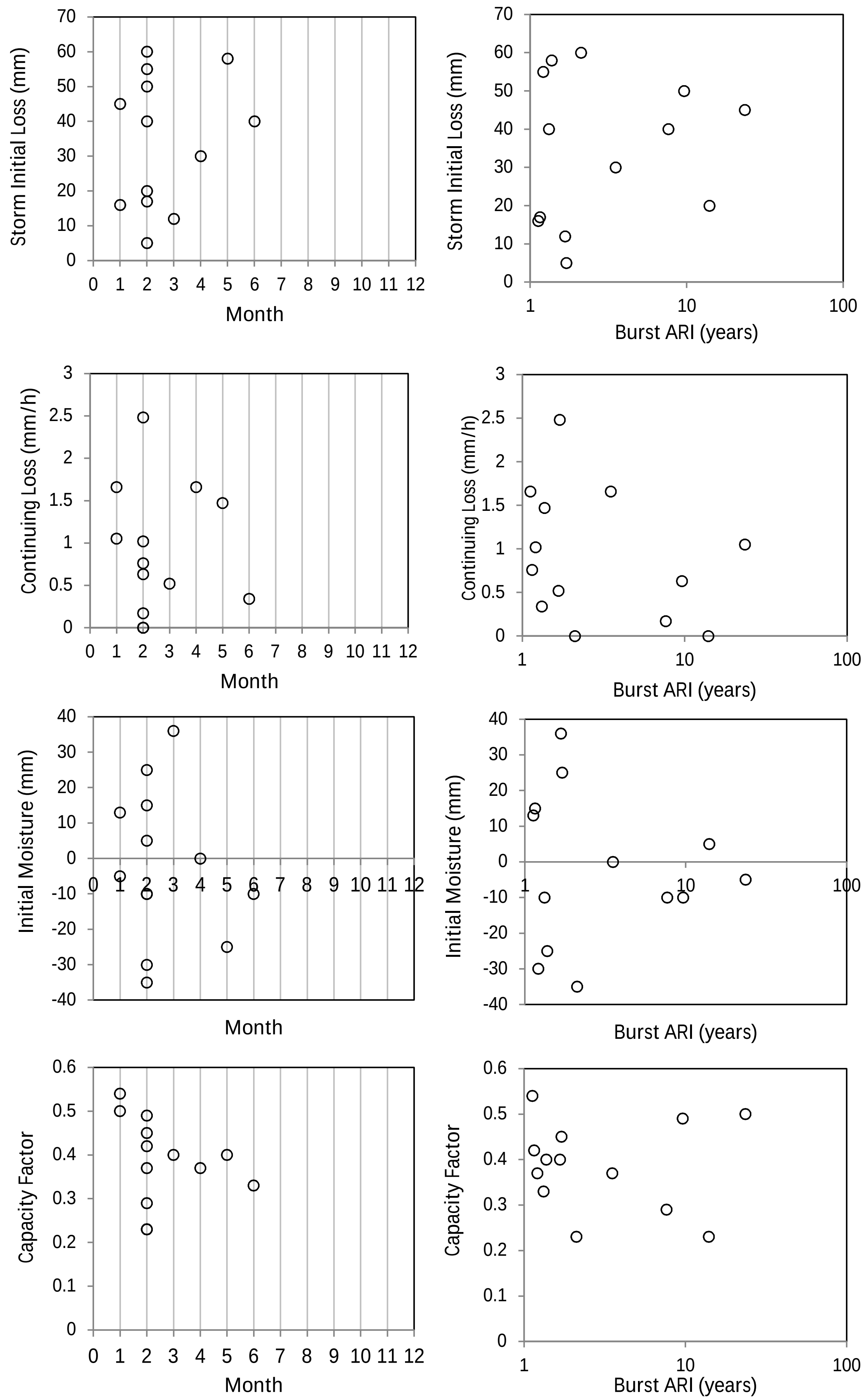




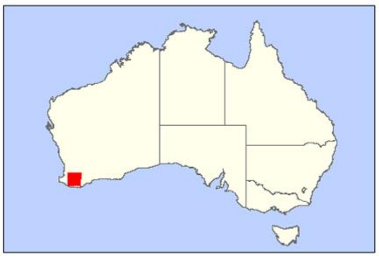


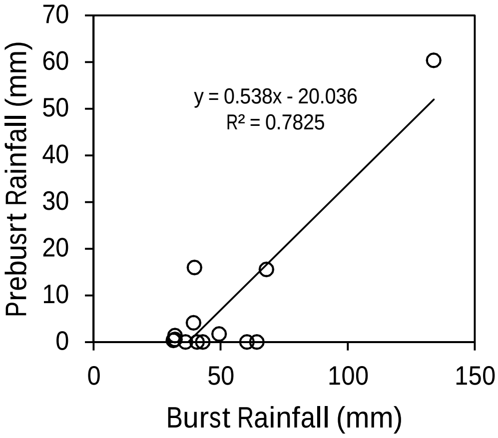


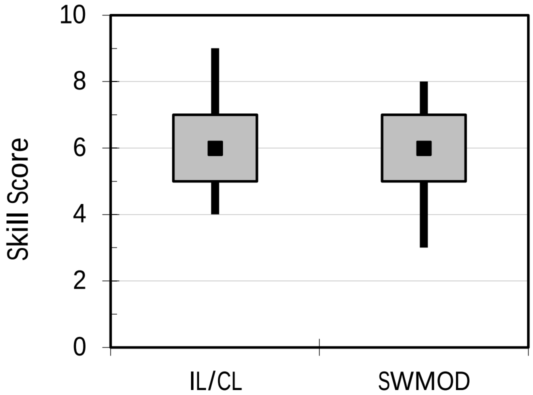
Kanjenjie Ck Trib. @ Fish Pool (WA) - 24 hour bursts

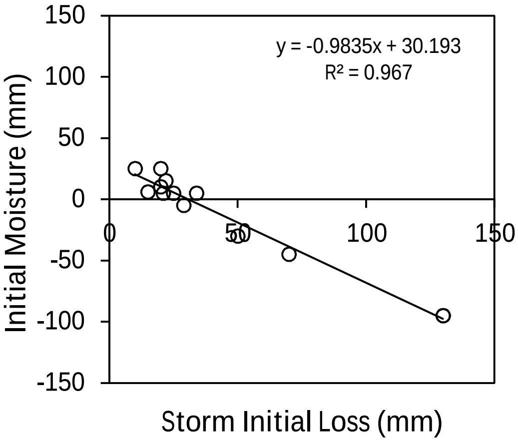


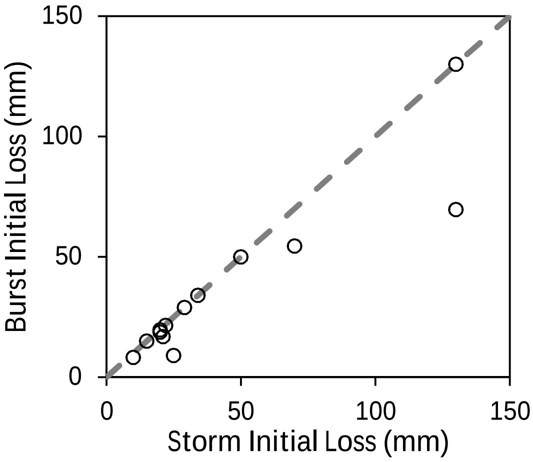
Balgarup @ Mandelup Pool (WA) - 24 hour bursts

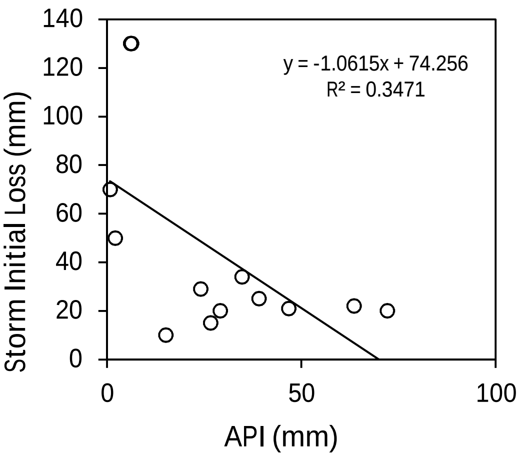


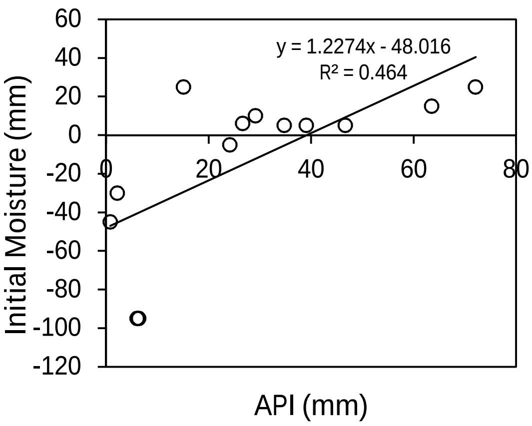




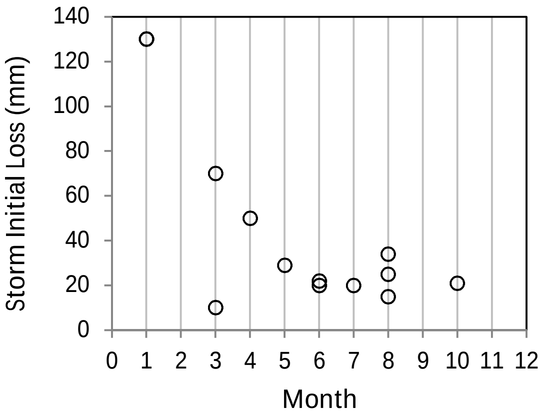


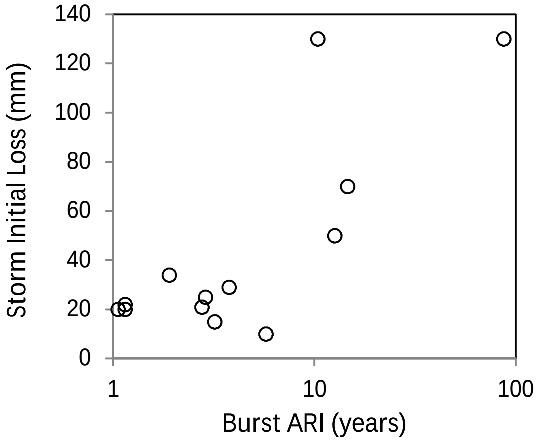


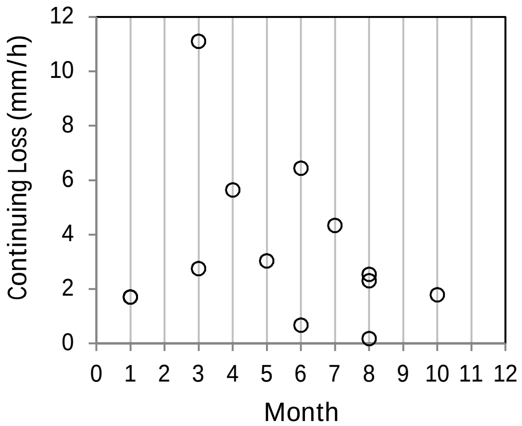


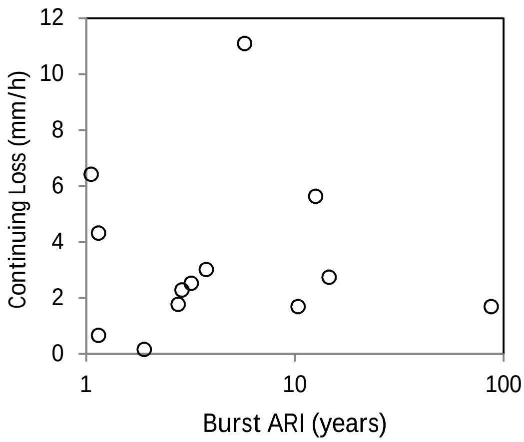


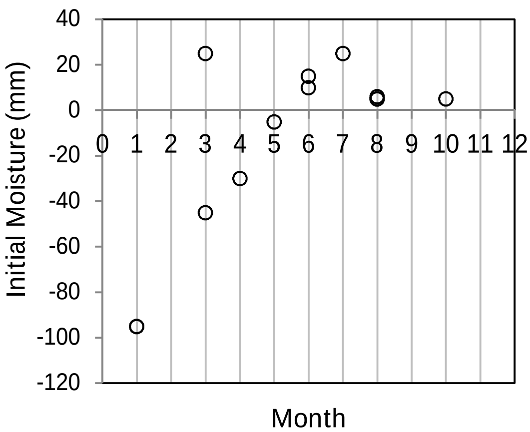
Balgarup @ Mandelup Pool (WA) - 24 hour bursts

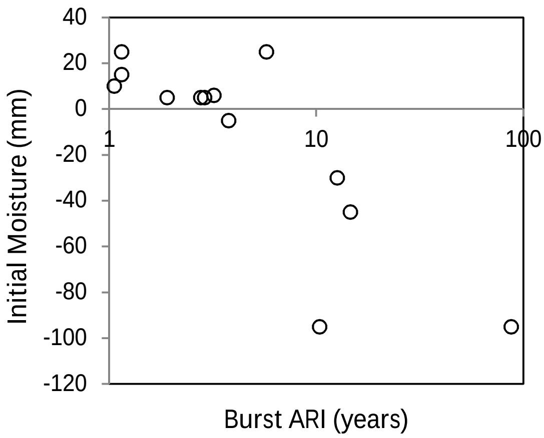


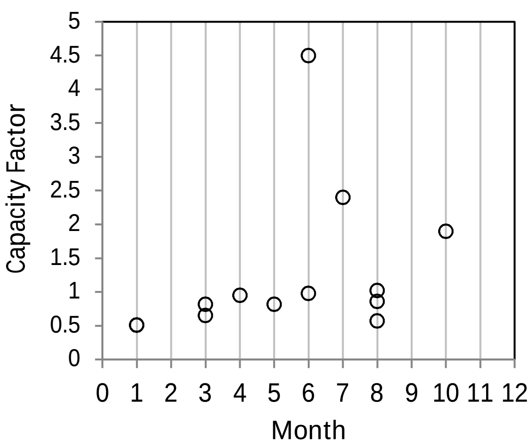


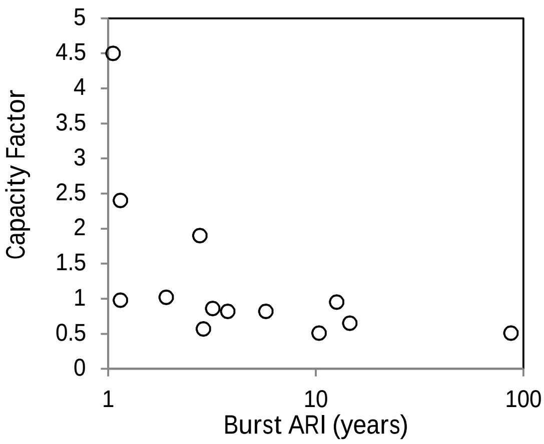




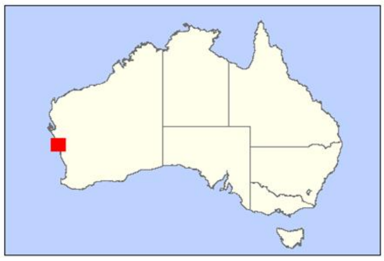


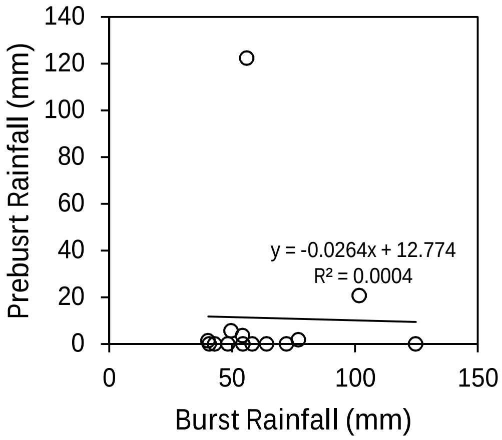


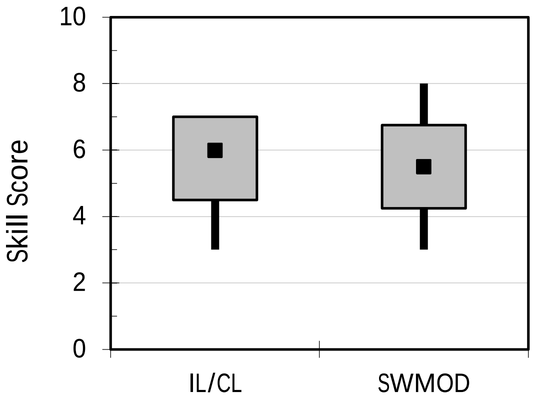


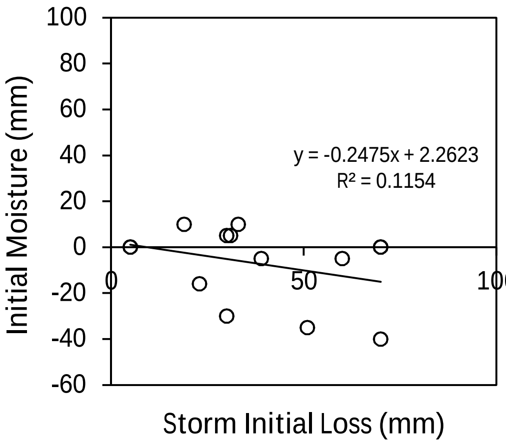


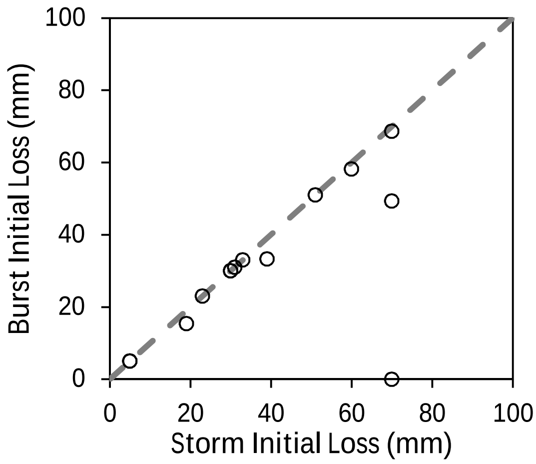
Buller @ Buller (WA) - 24 hour bursts

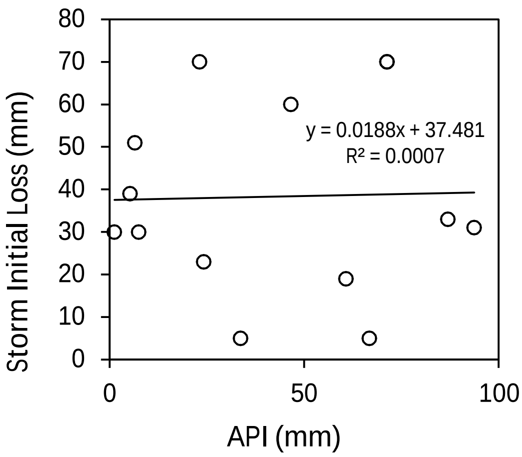


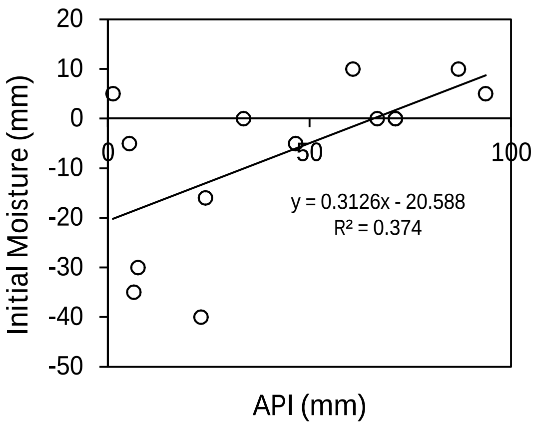




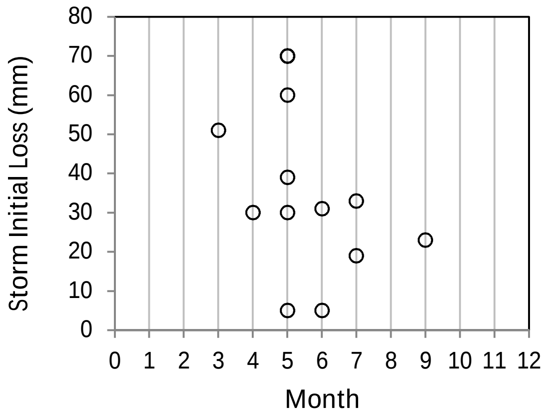


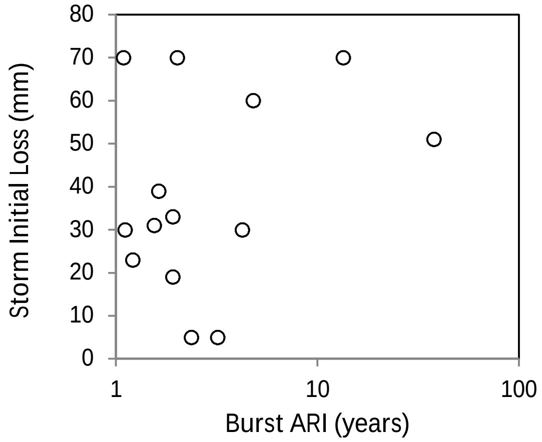


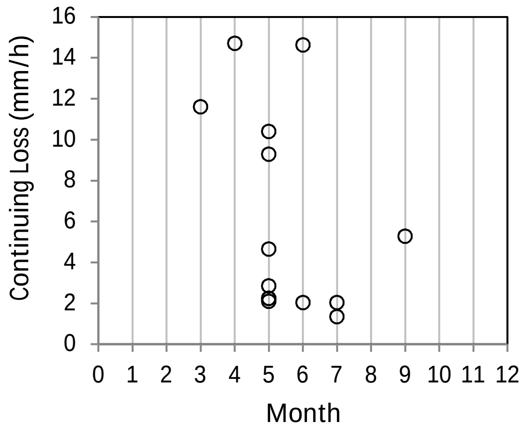


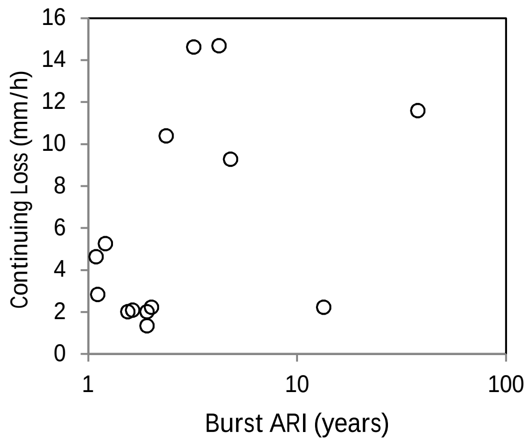


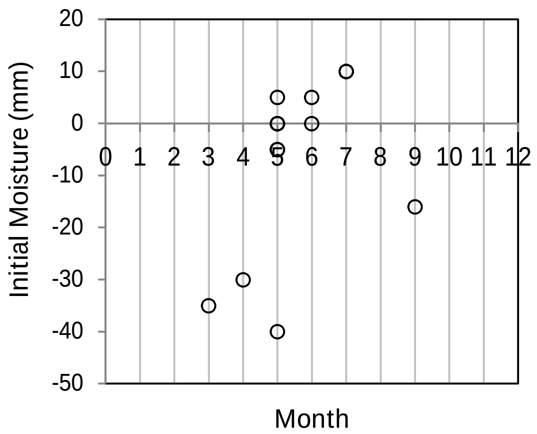
Buller @ Buller (WA) - 24 hour bursts

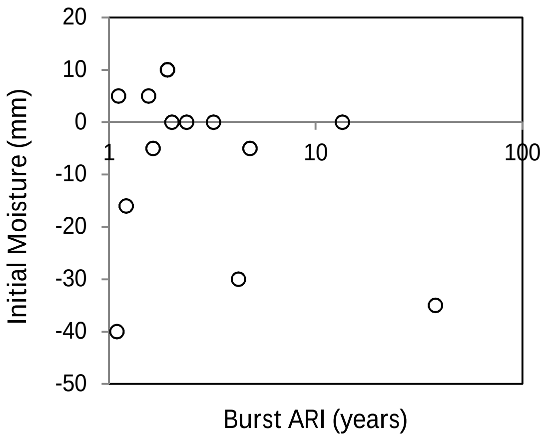


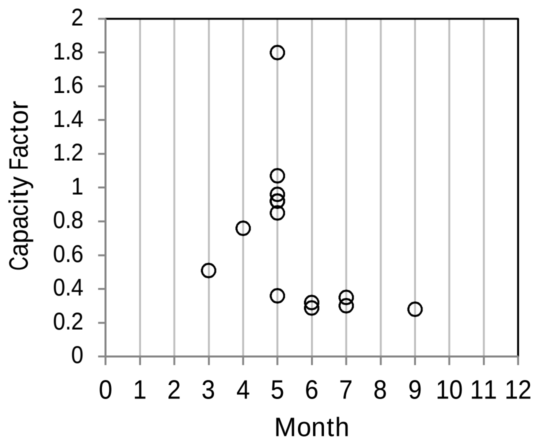


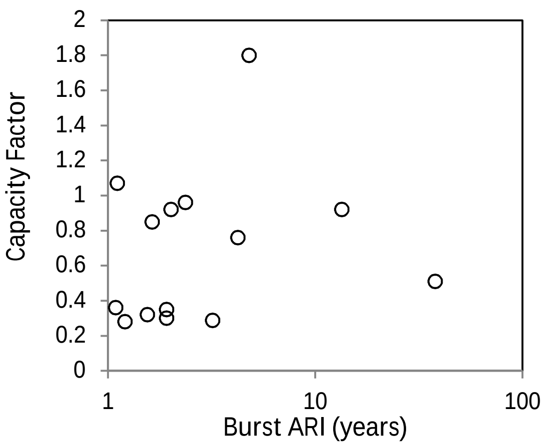




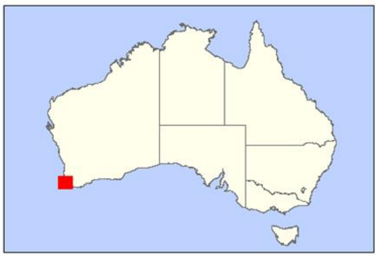


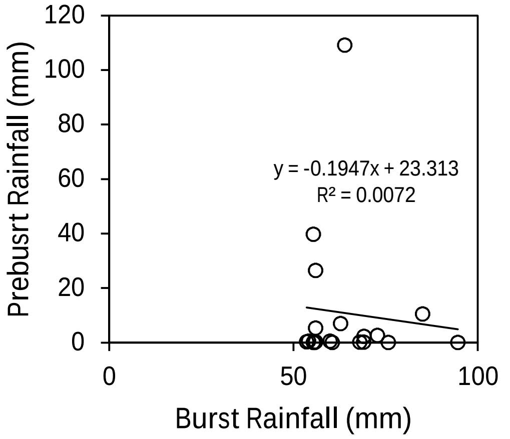


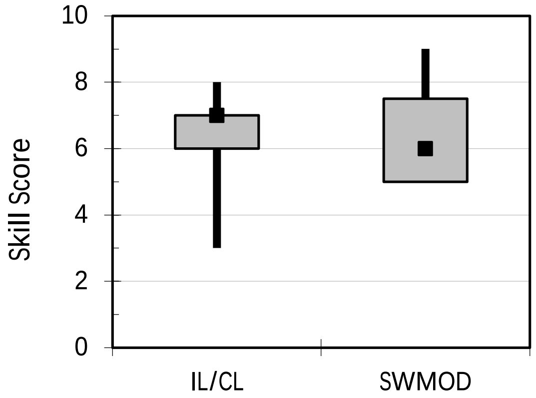


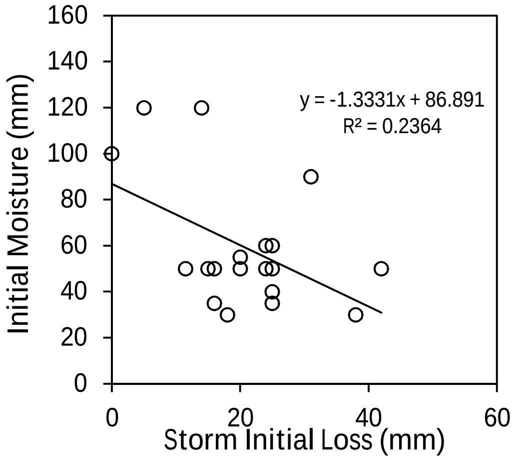


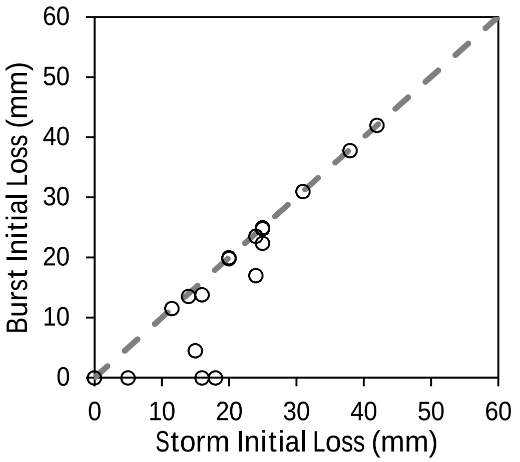
Carey Brook @ Staircase Rd (WA) - 24 hour bursts

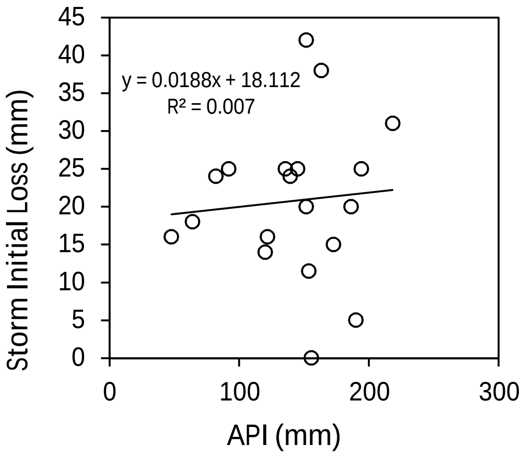


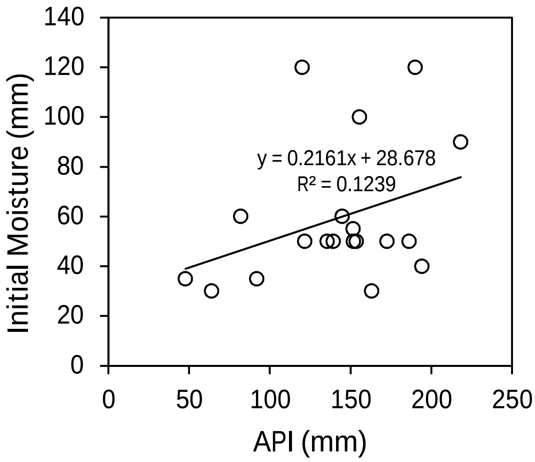




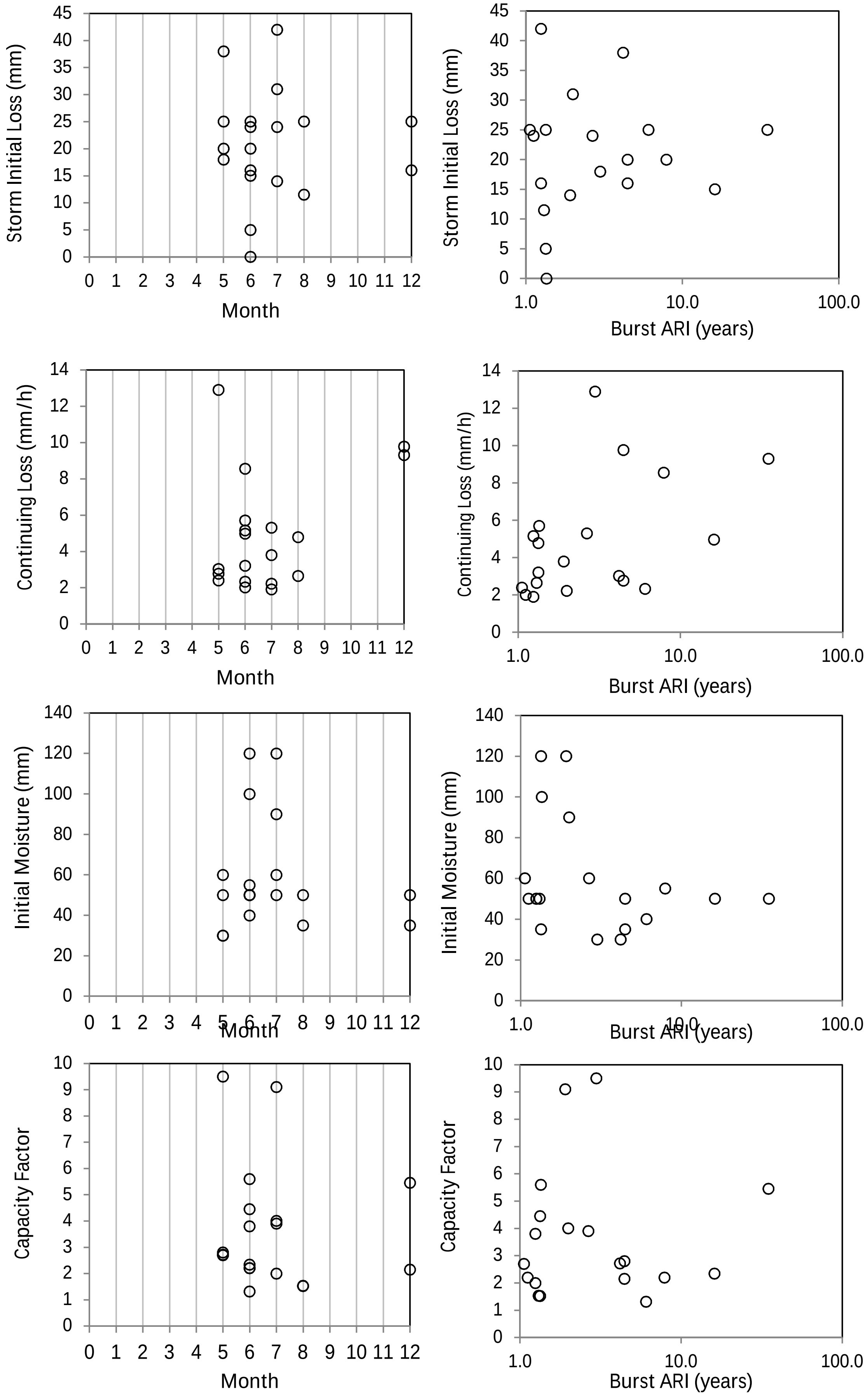




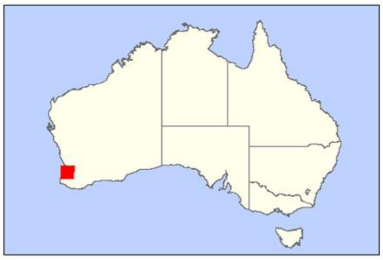


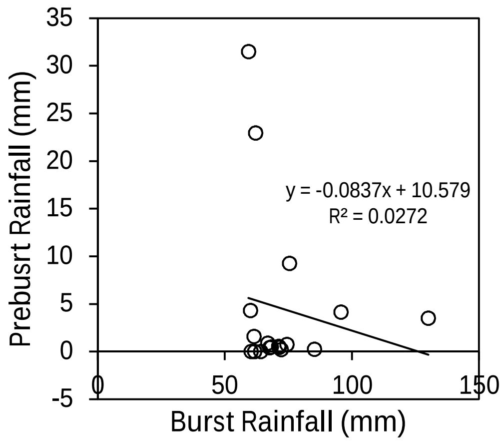


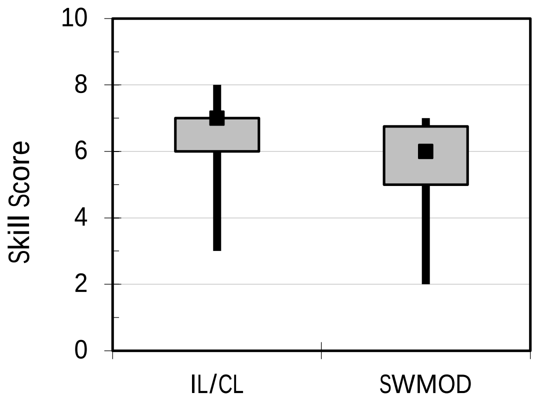
Carey Brook @ Staircase Rd (WA) - 24 hour bursts

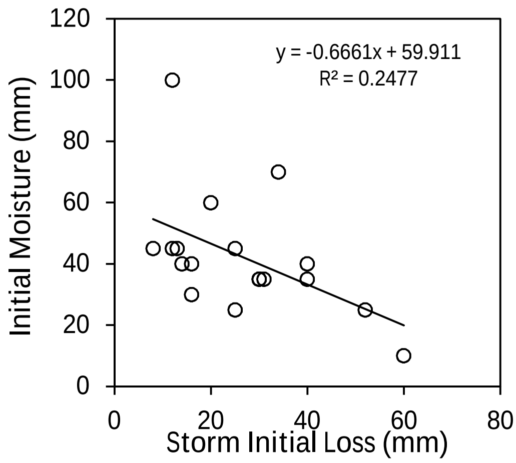


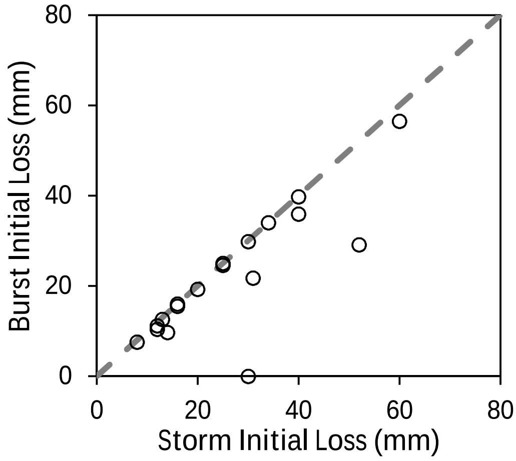
Davis Brook @ Murray Valley Plntn (WA) - 24 hour bursts

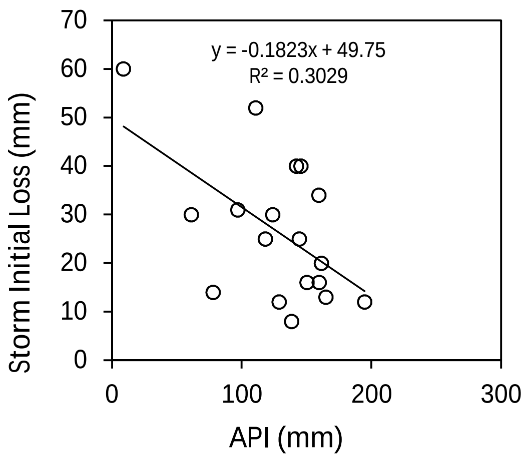


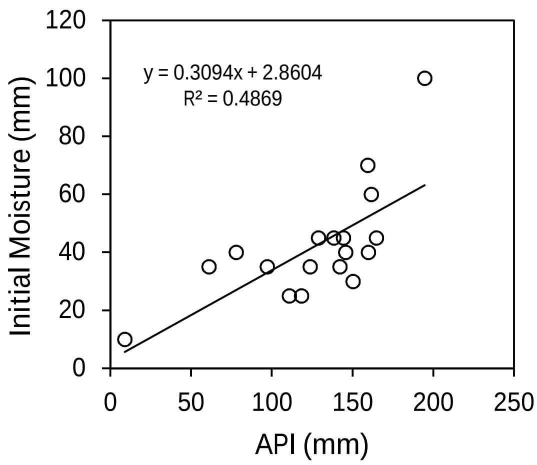




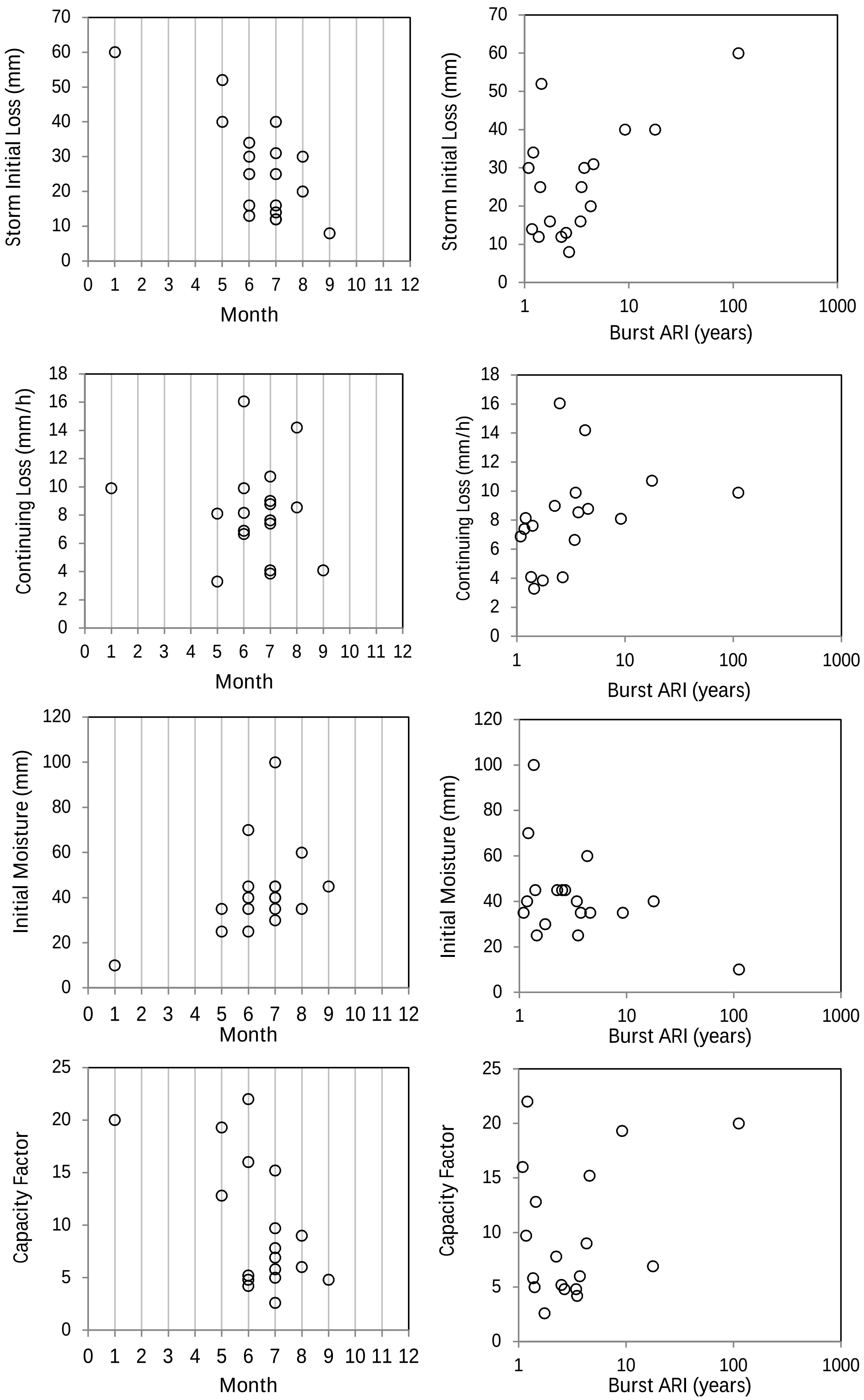




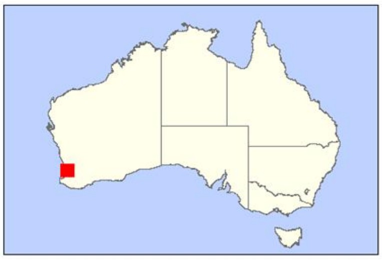


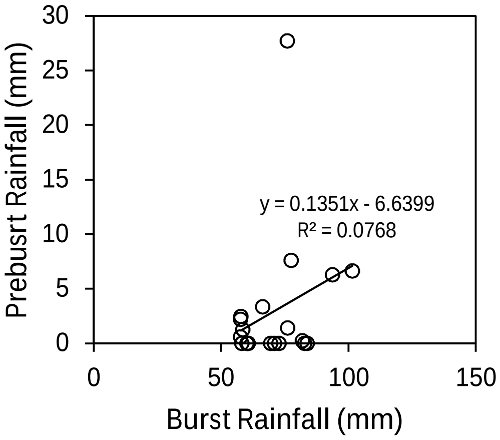


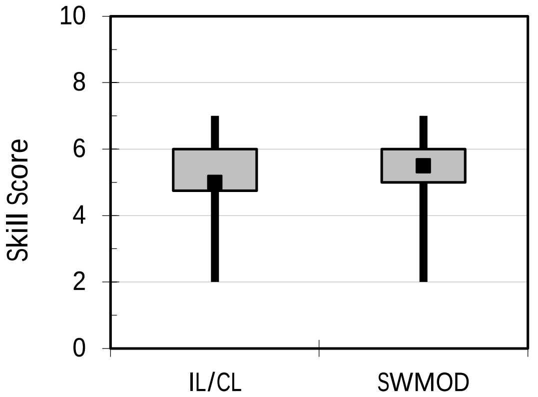
Davis Brook @ Murray Valley Plntn (WA) - 24 hour bursts

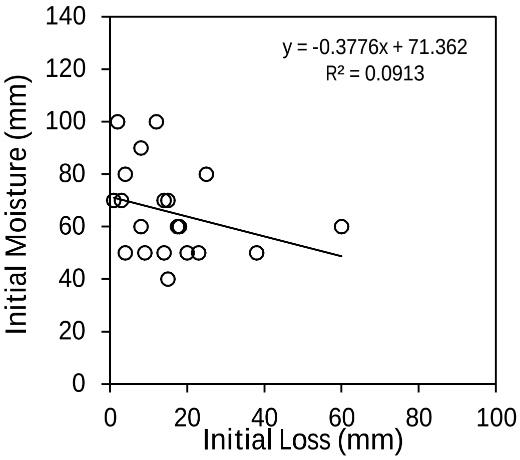


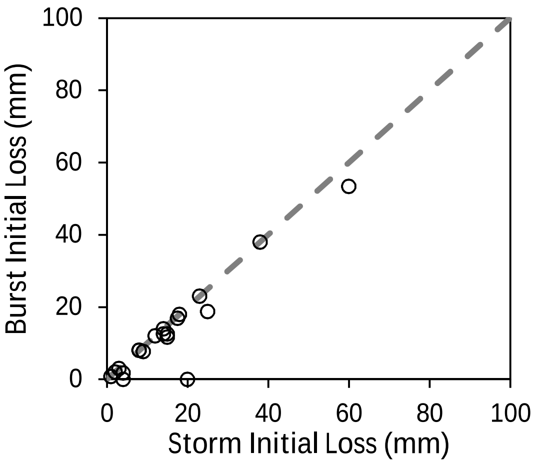
Dirk Brook @ Kentish Farm (WA) - 24 hour bursts

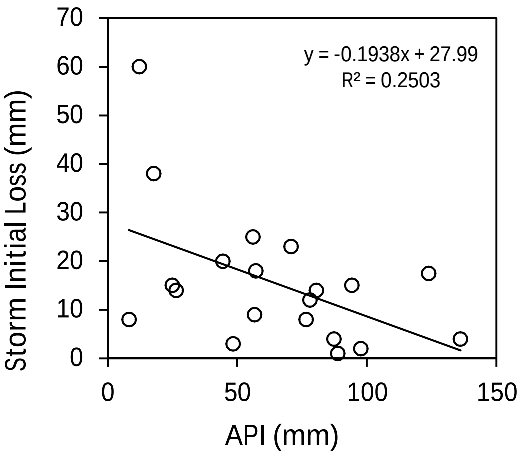


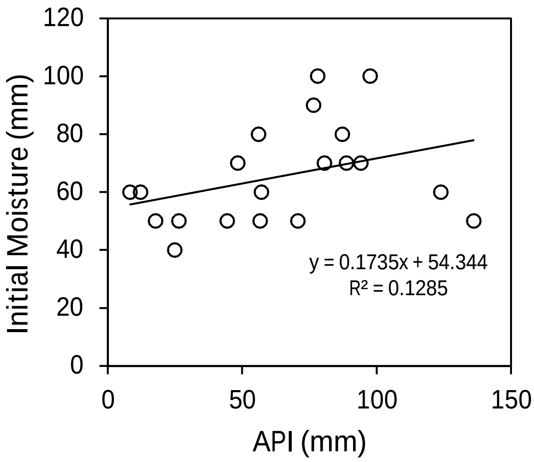




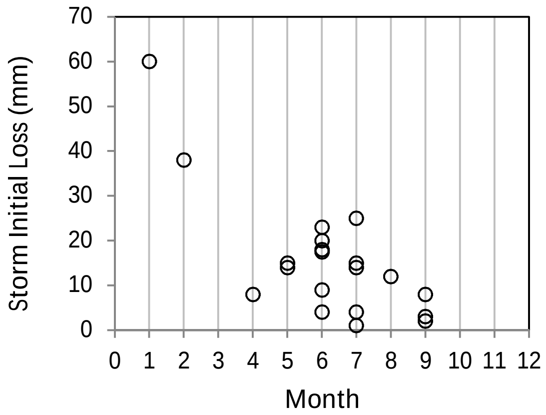


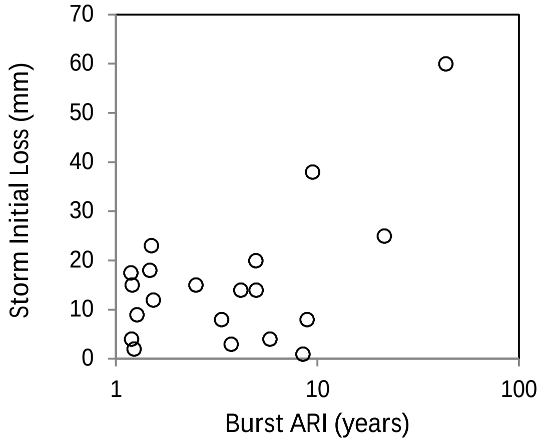


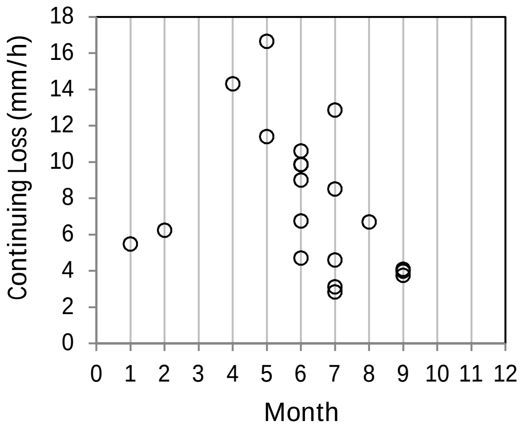


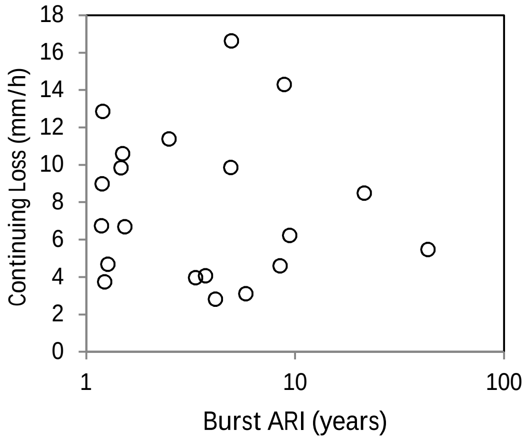


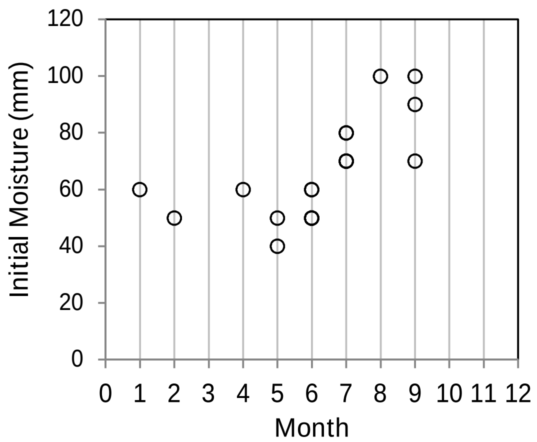
Dirk Brook @ Kentish Farm (WA) - 24 hour bursts

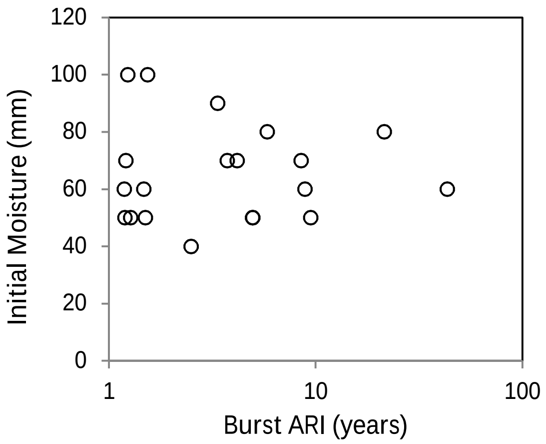


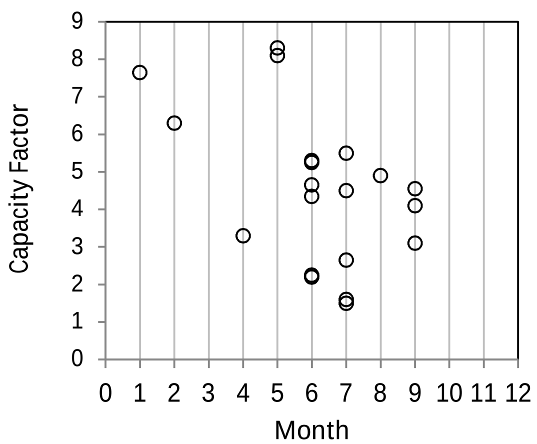


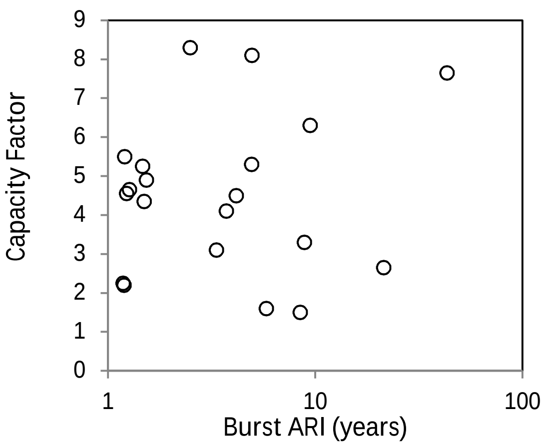




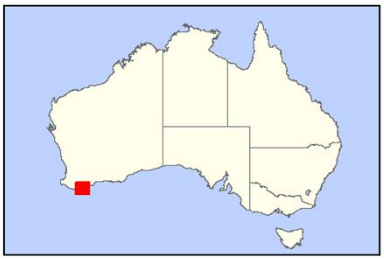


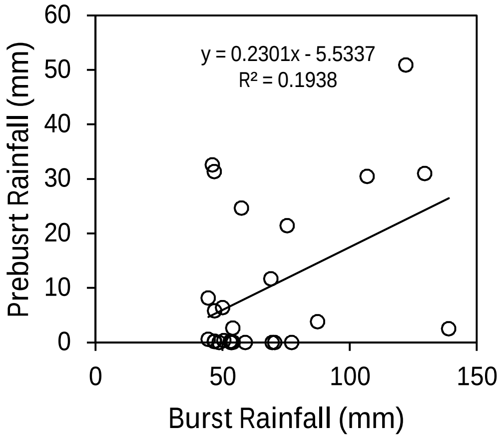


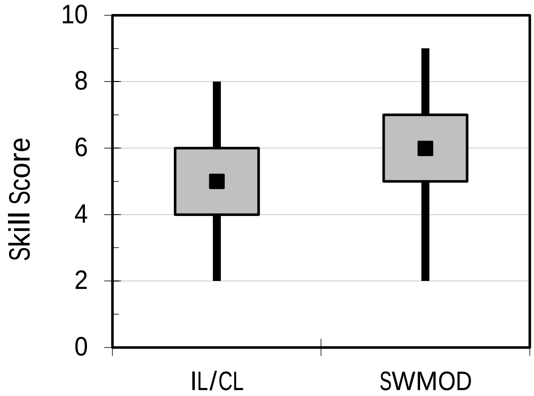


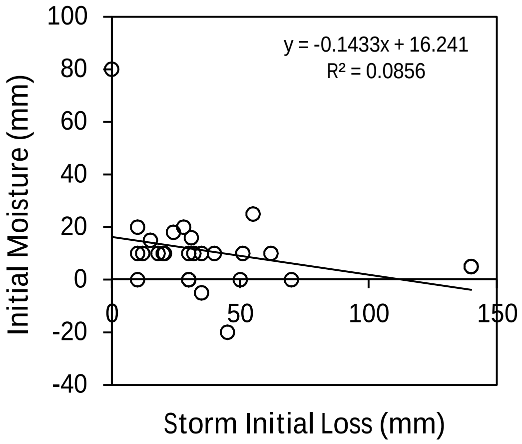


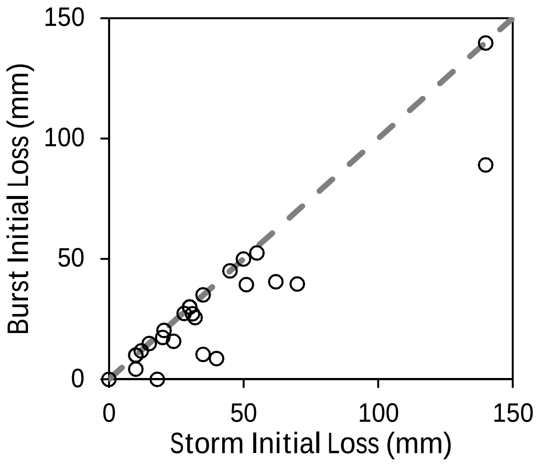
Goodga @ Black Cat (WA) - 24 hour bursts

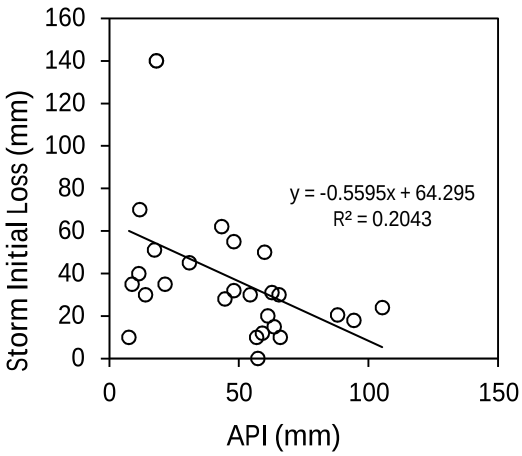


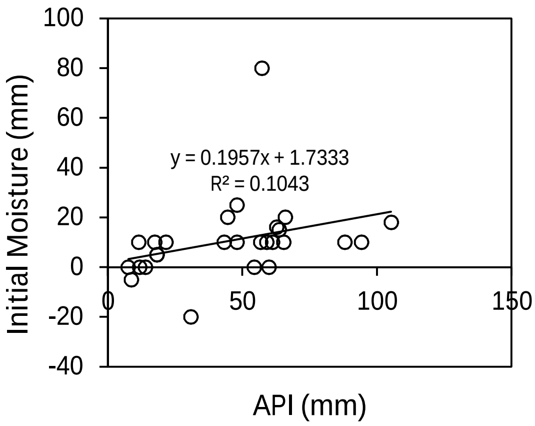




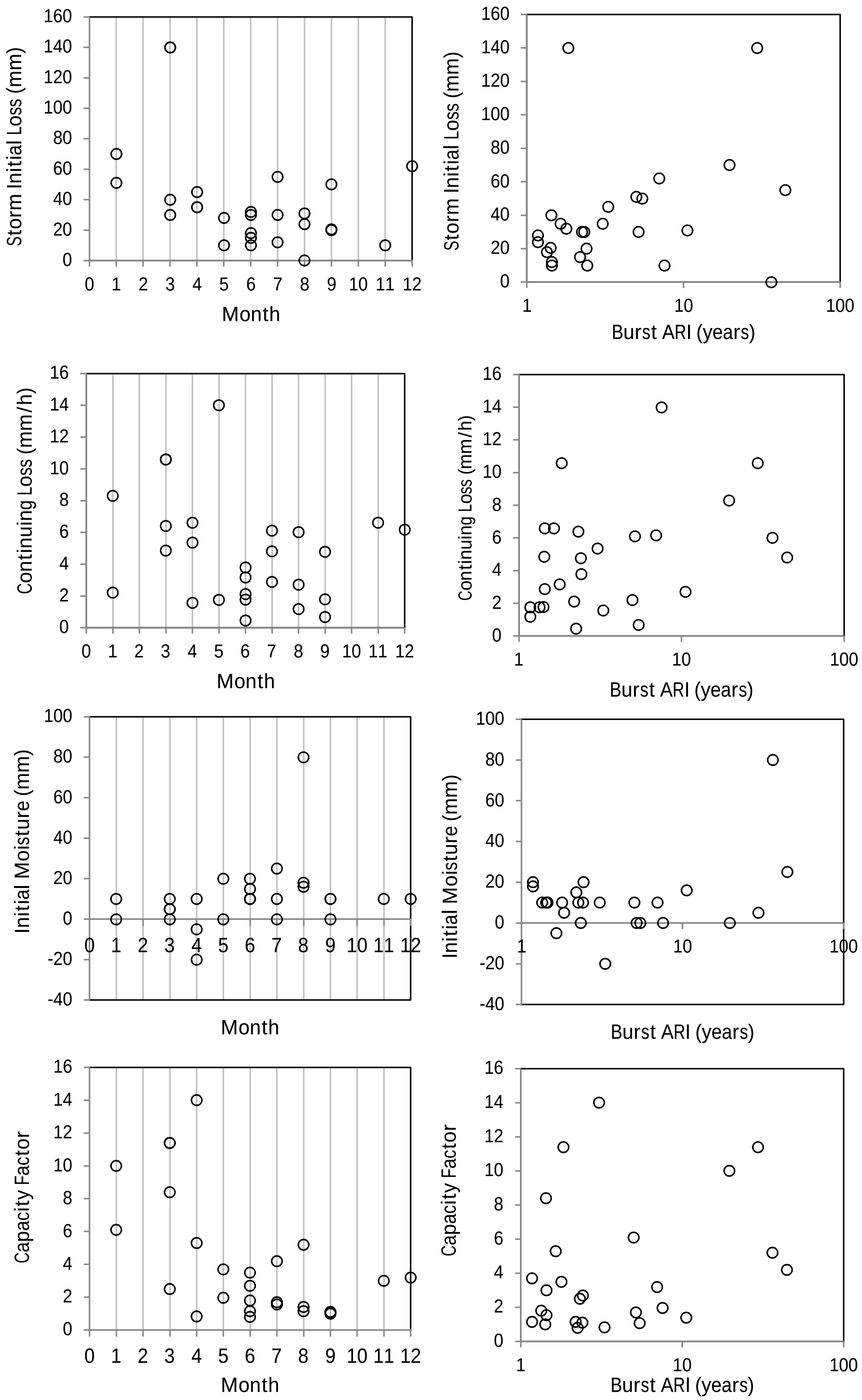




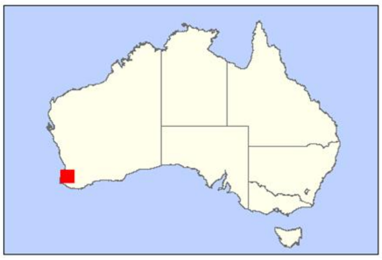


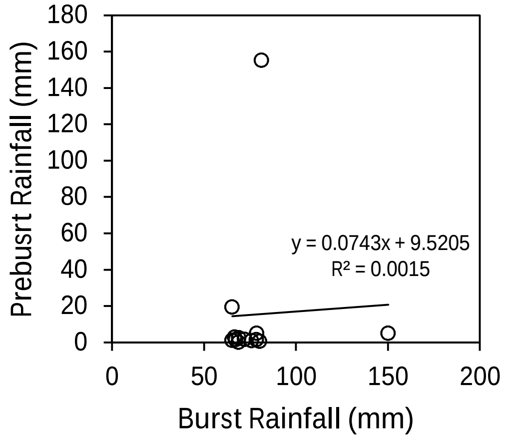


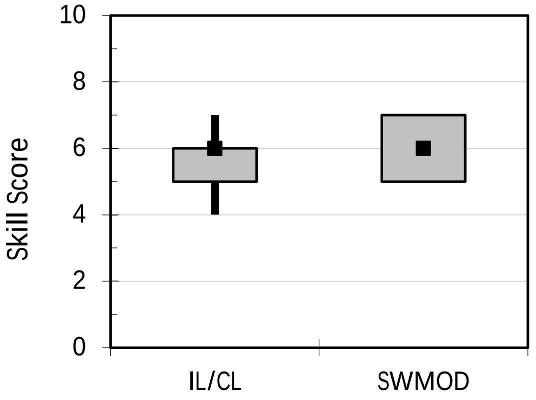
Goodga @ Black Cat (WA) - 24 hour bursts

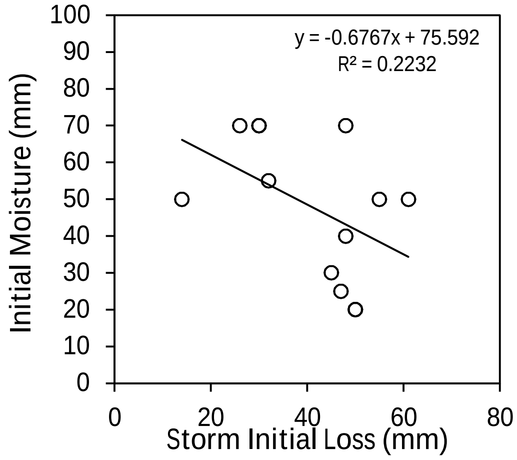


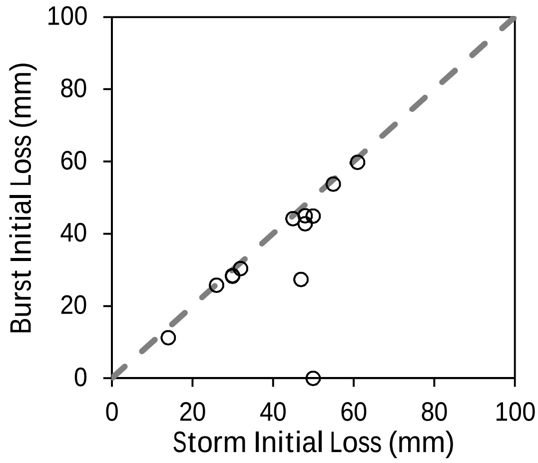
Hamilton @ Worsley (WA) - 24 hour bursts

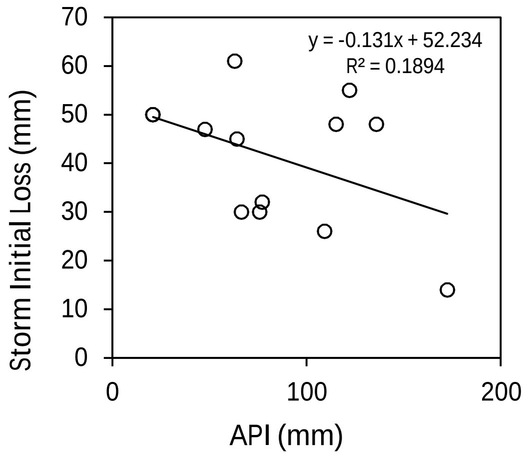


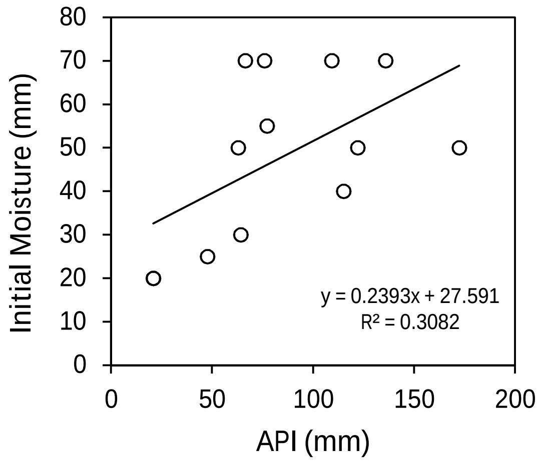




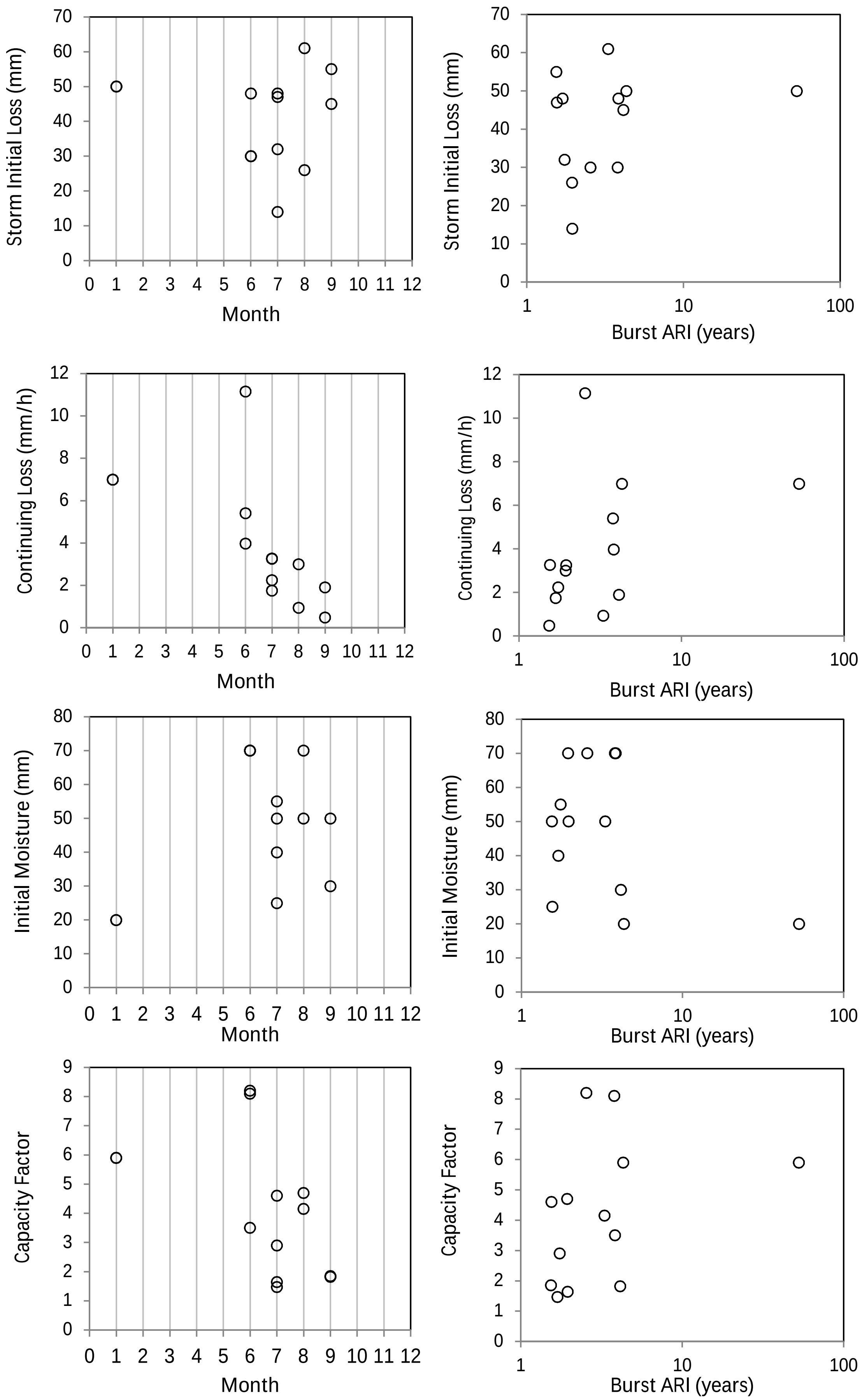




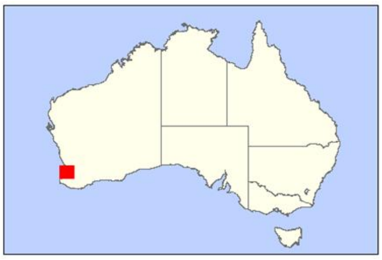


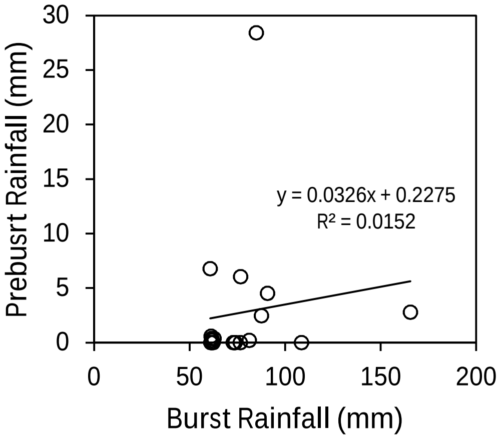


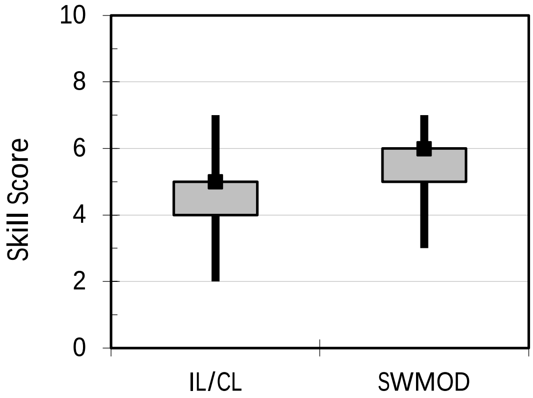
Hamilton @ Worsley (WA) - 24 hour bursts

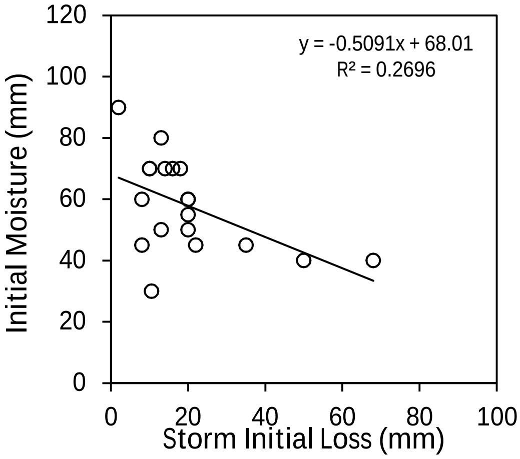


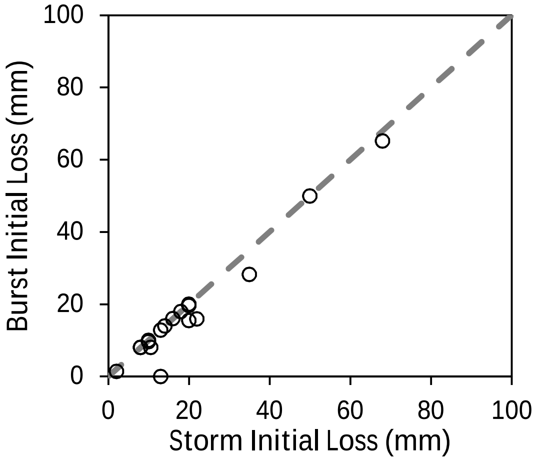
Marrinup Bk @ Brookdale Siding (WA) - 24 hour bursts

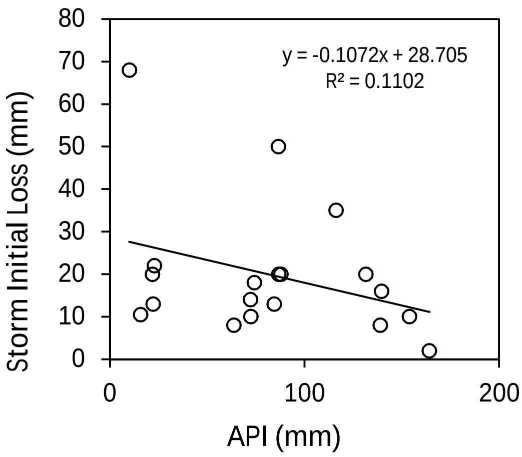


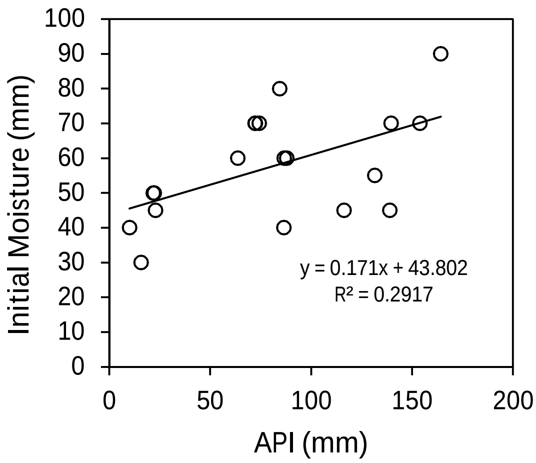




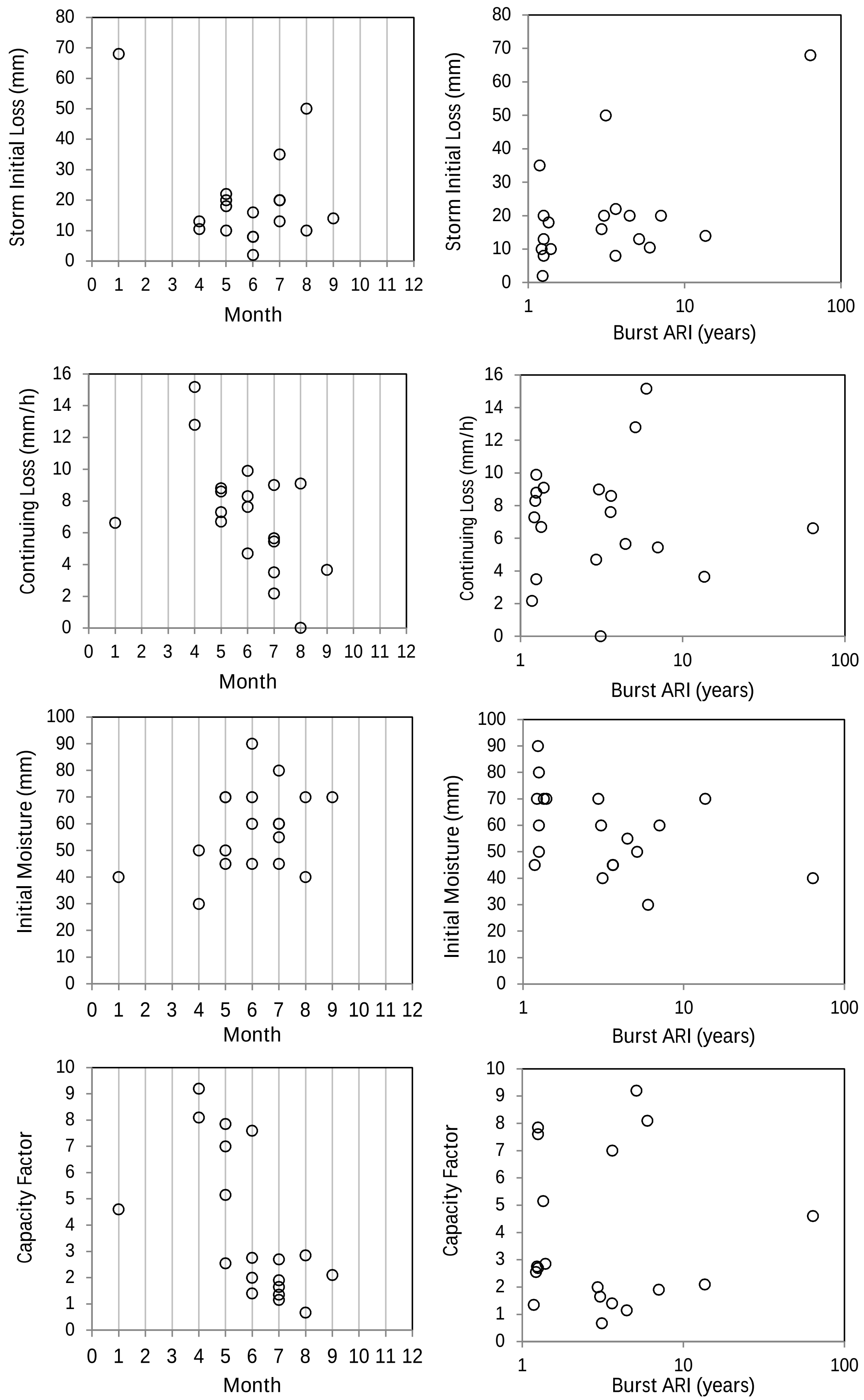




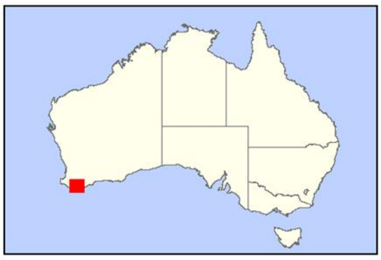


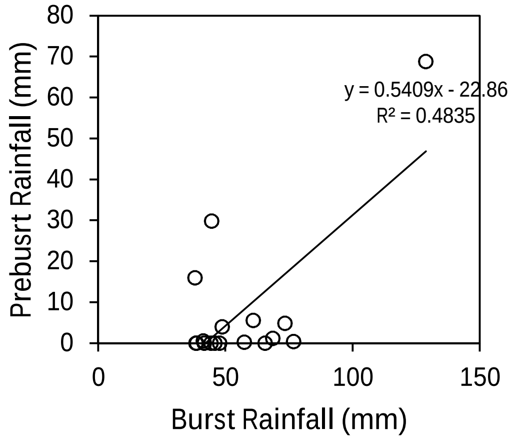


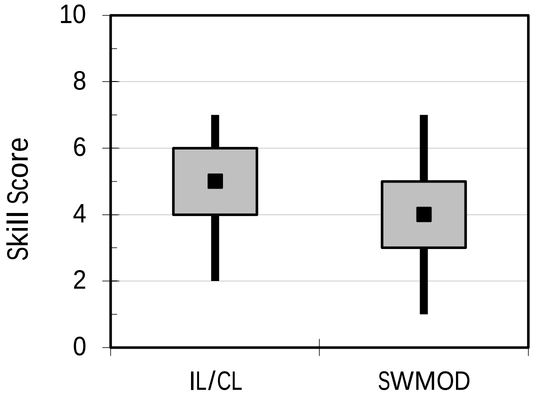
Marrinup Bk @ Brookdale Siding (WA) - 24 hour bursts

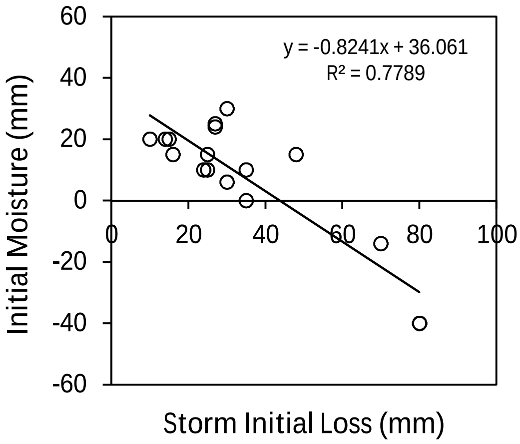


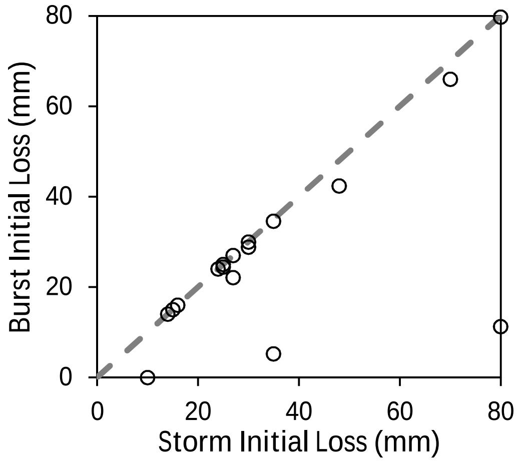
Yates Flat Ck @ Woonanup (WA) - 24 hour bursts

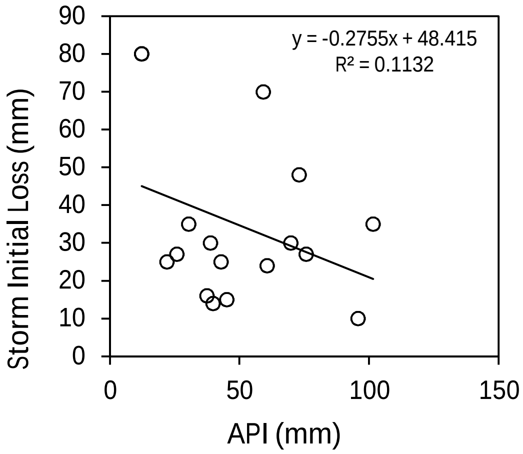


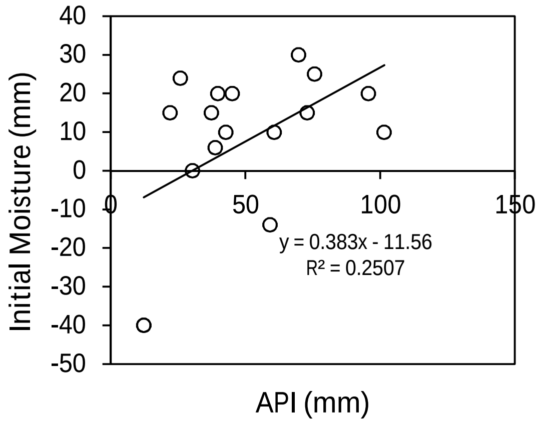




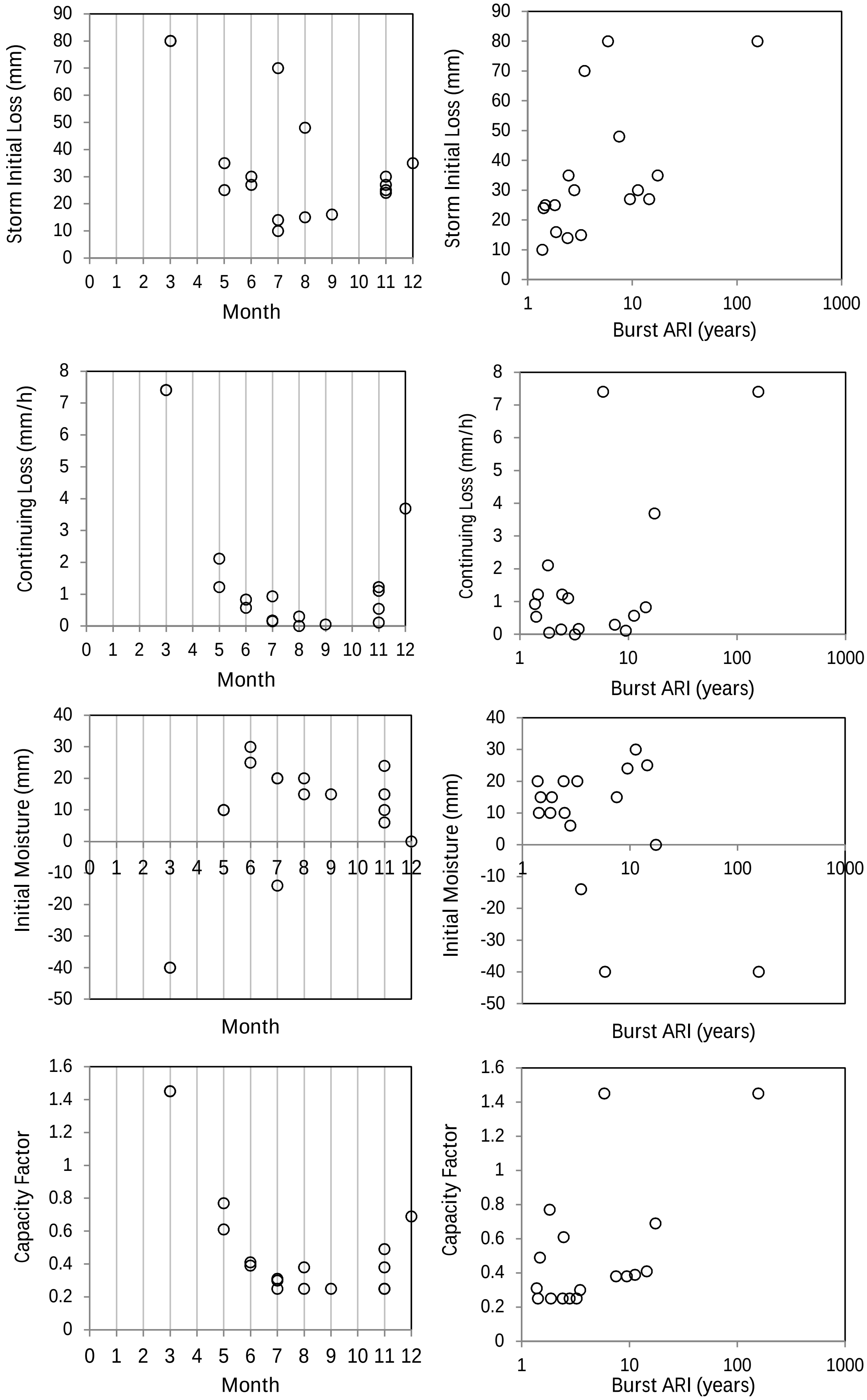






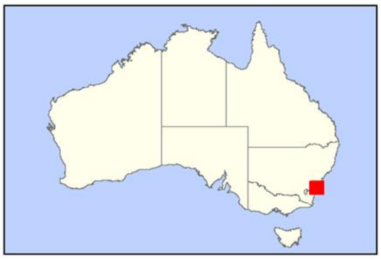


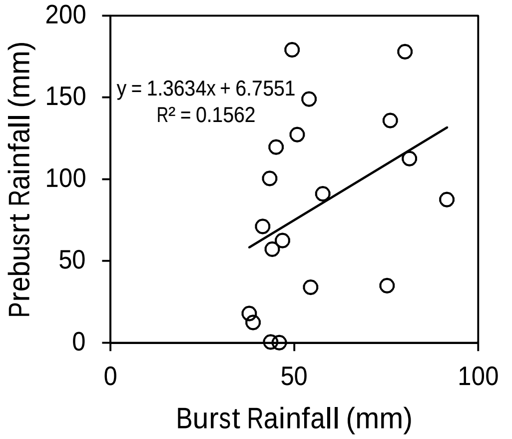
Yates Flat Ck @ Woonanup (WA) - 24 hour bursts

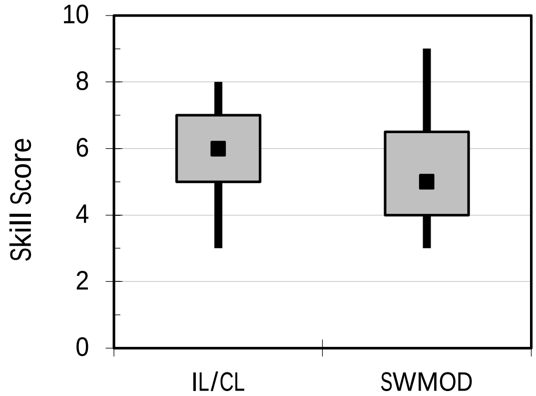


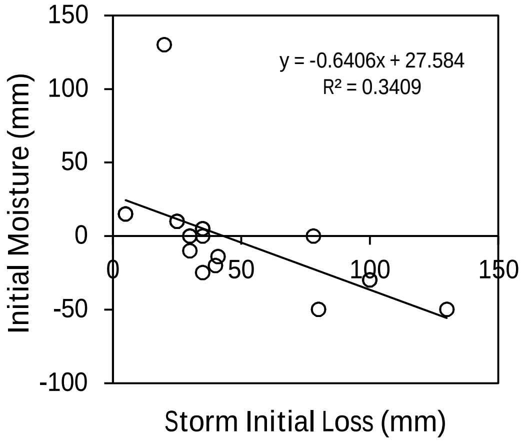
Appendix J Loss summaries for 3h bursts

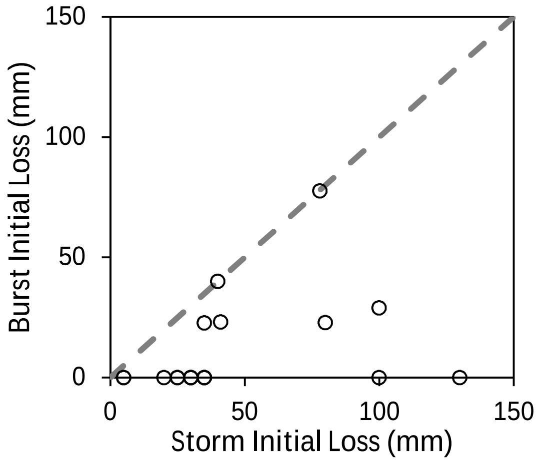
Currambene Ck @ Falls Ck (NSW) - 3 hour bursts

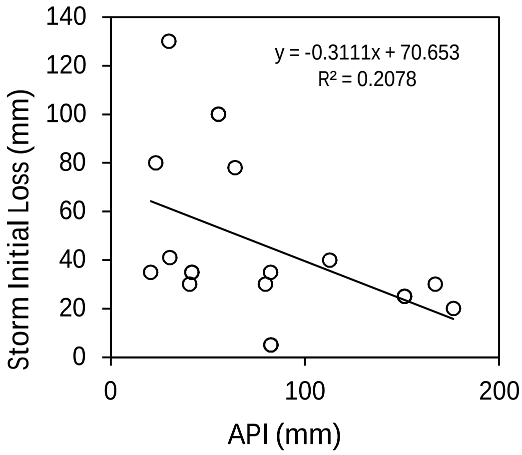


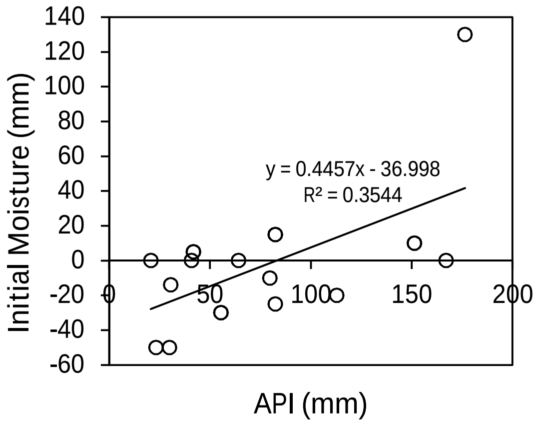




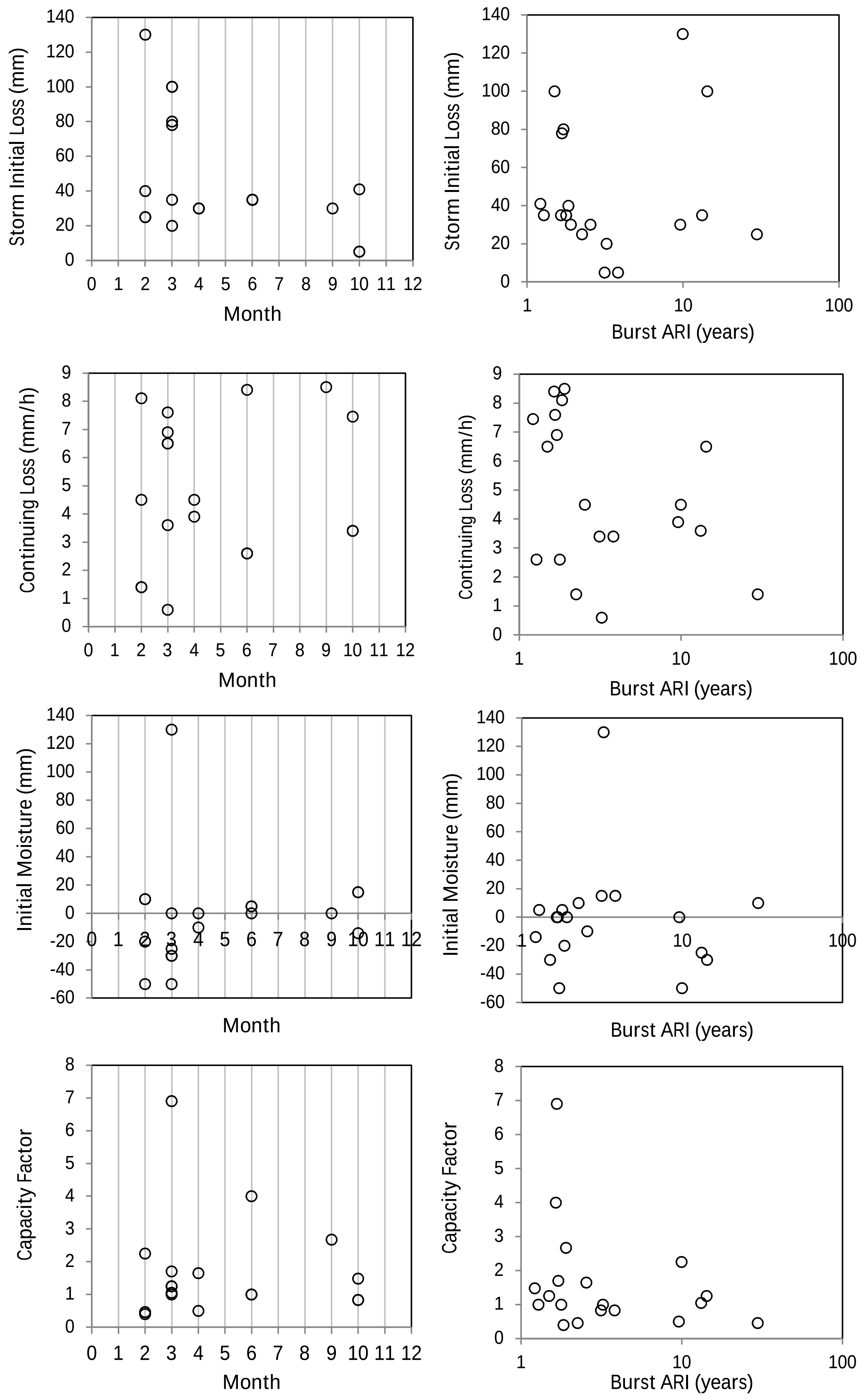




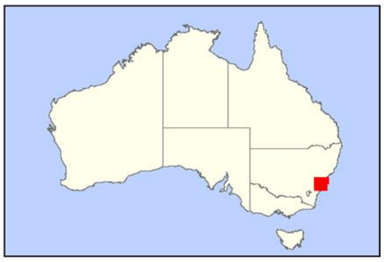


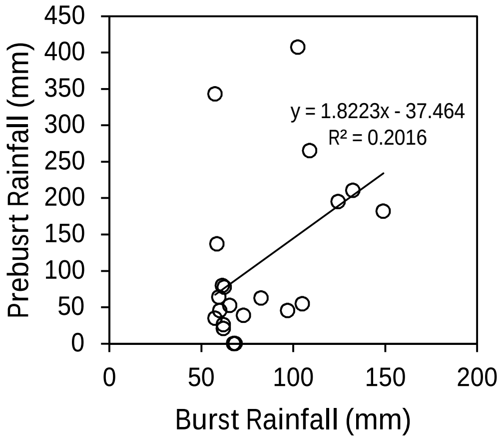


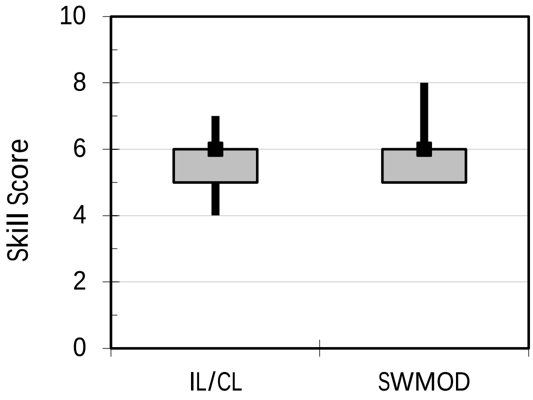
Currambene Ck @ Falls Ck (NSW) - 3 hour bursts

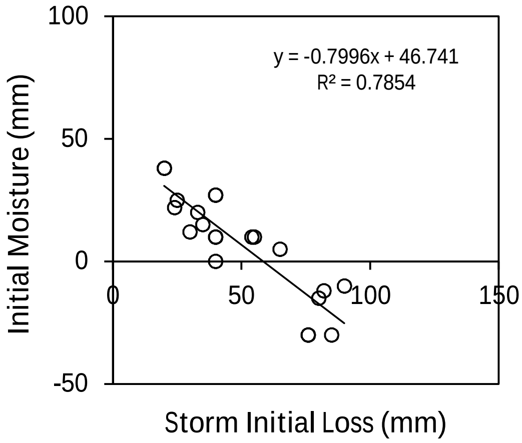


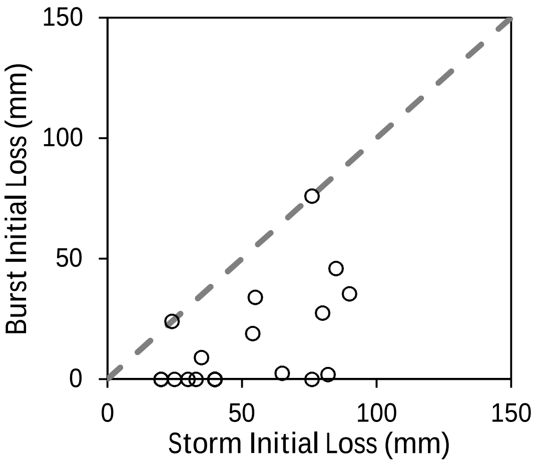
O'Hares Ck @ Wedderburn (NSW) - 3 hour bursts

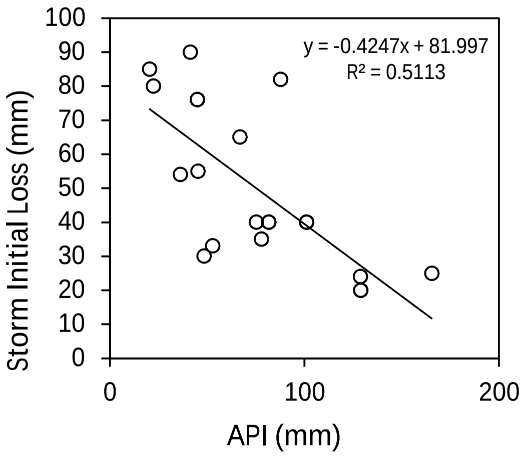


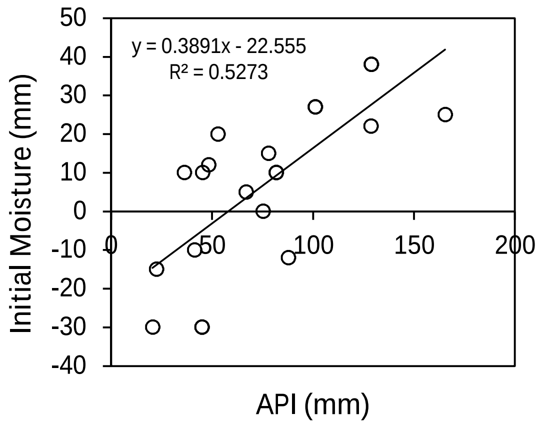




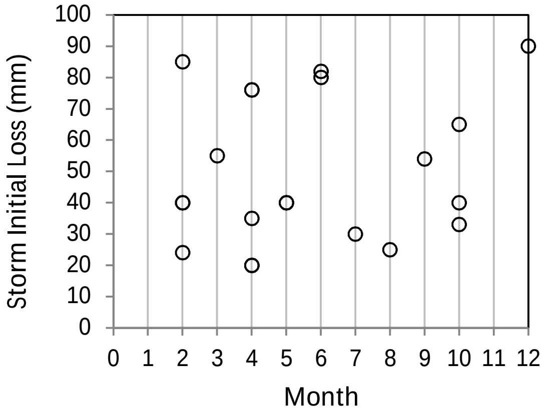


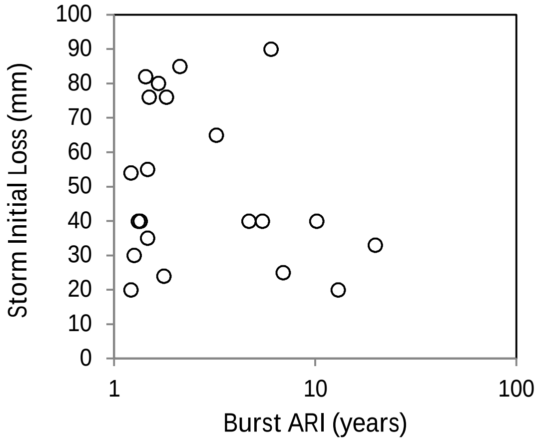


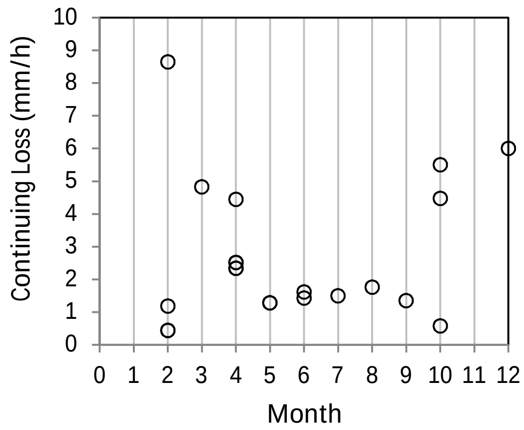


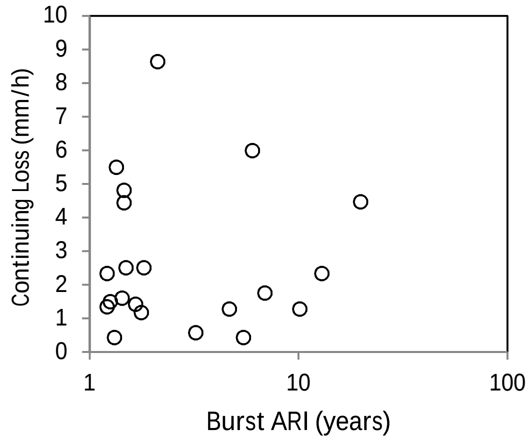


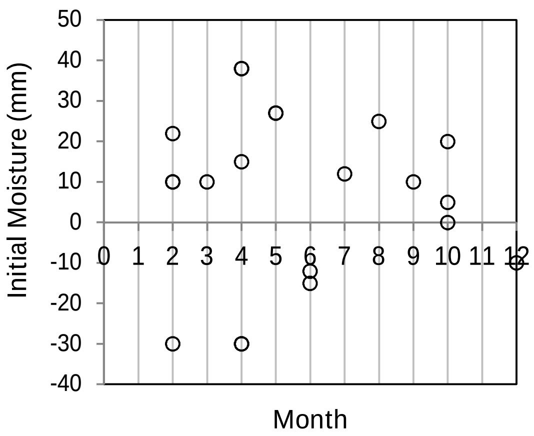
O'Hares Ck @ Wedderburn (NSW) - 3 hour bursts

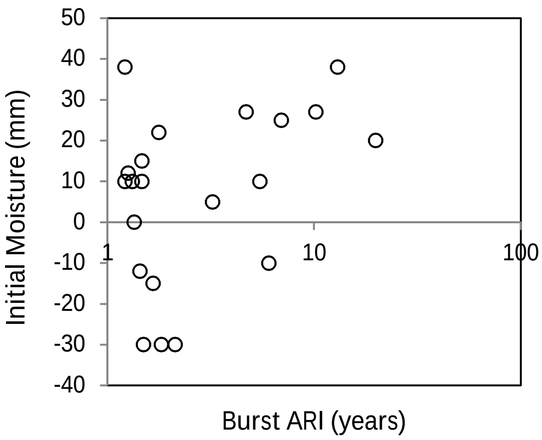


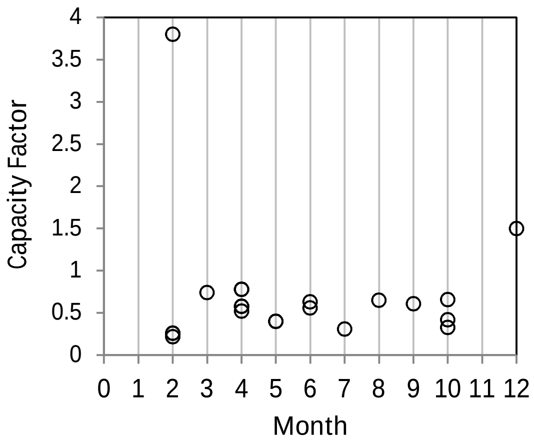


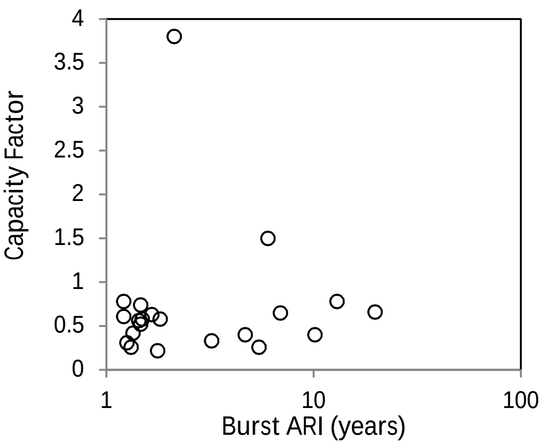




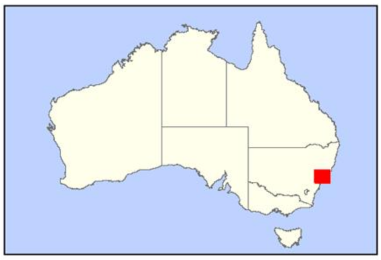


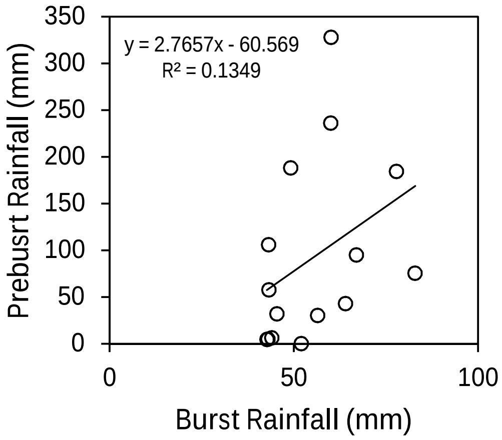


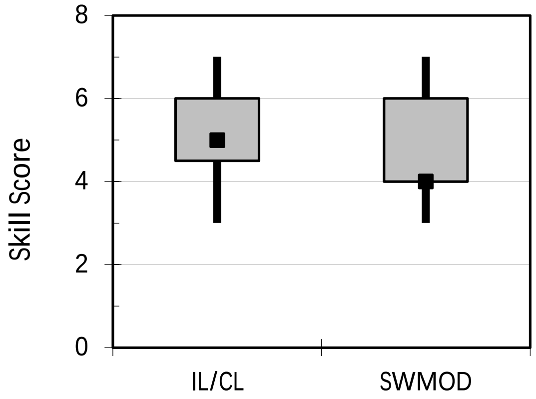


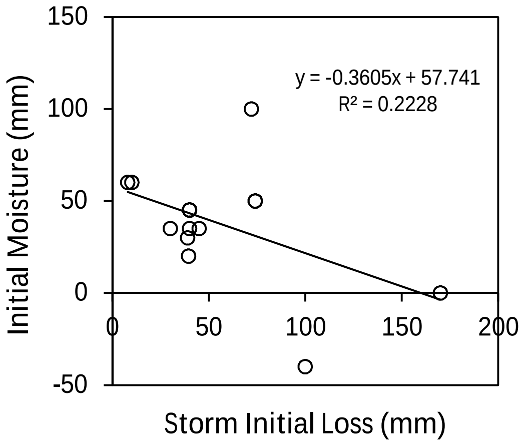


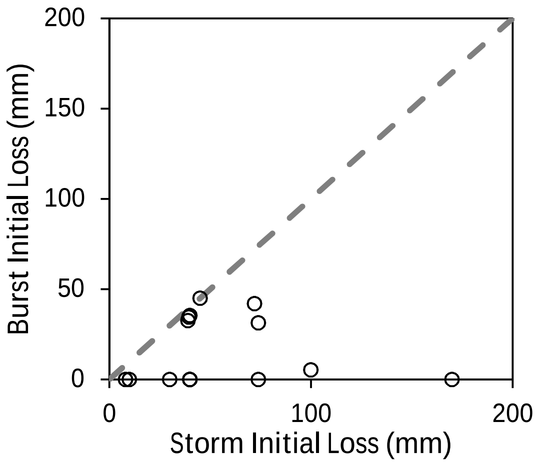
Ourimbah Ck @ U/S Weir (NSW) - 3 hour bursts

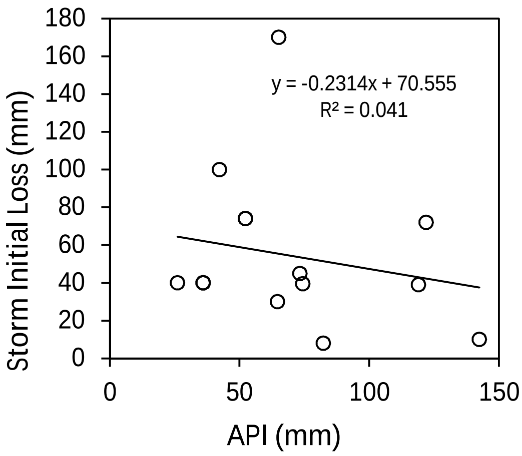


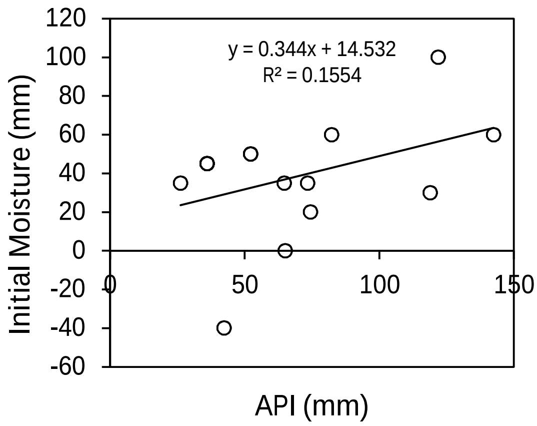




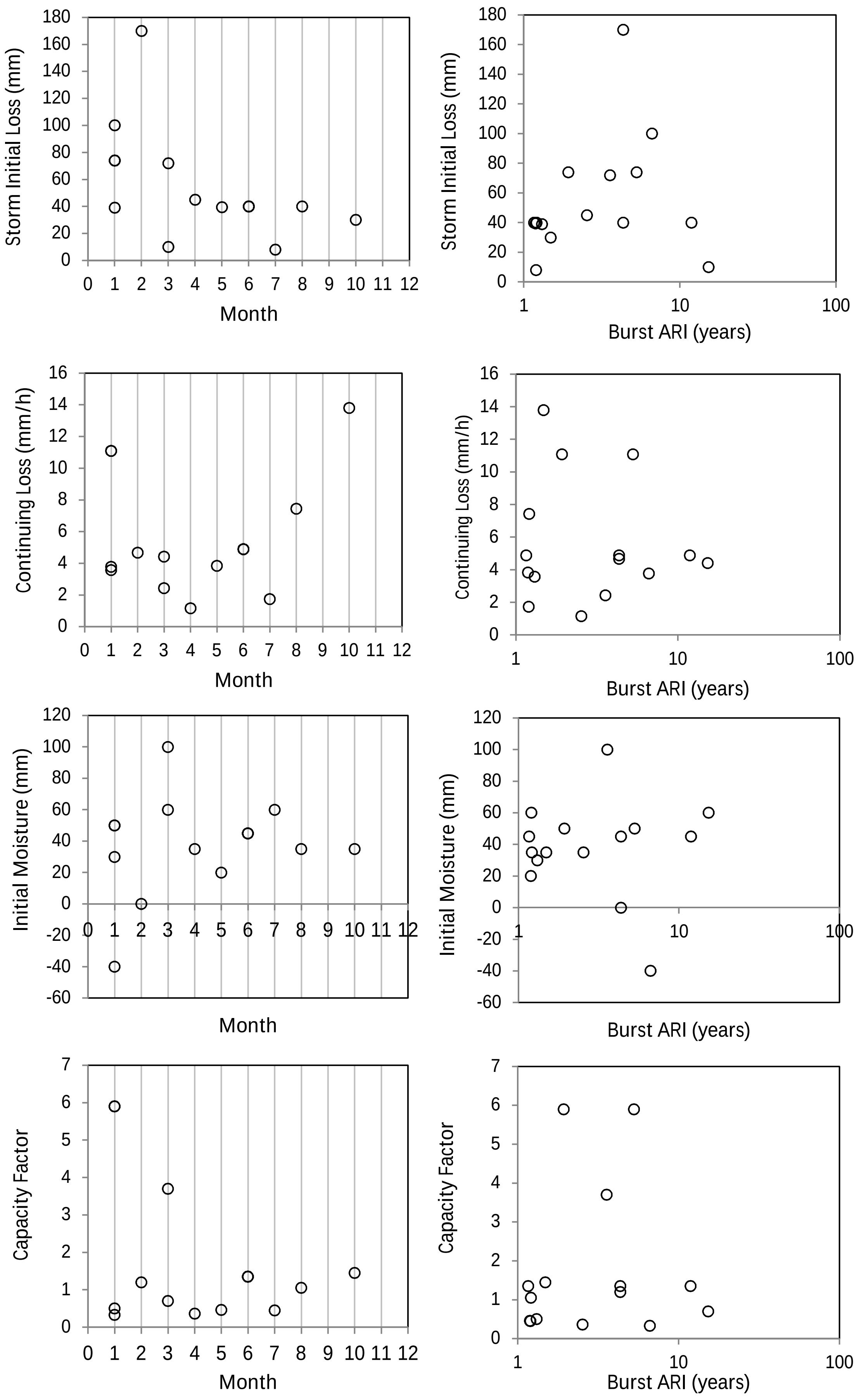




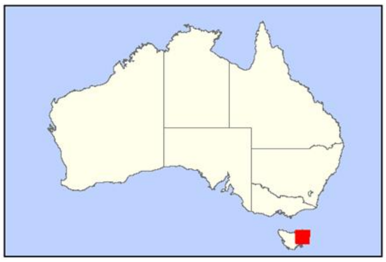


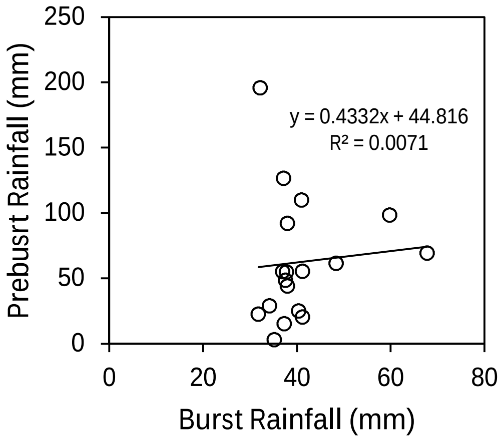


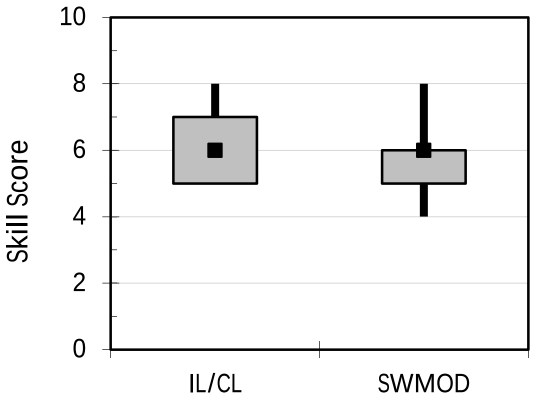
Ourimbah Ck @ U/S Weir (NSW) - 3 hour bursts

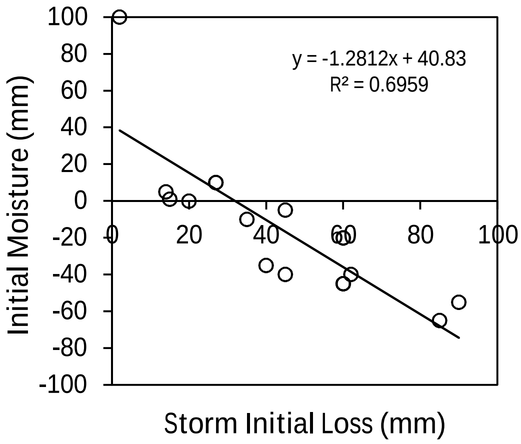


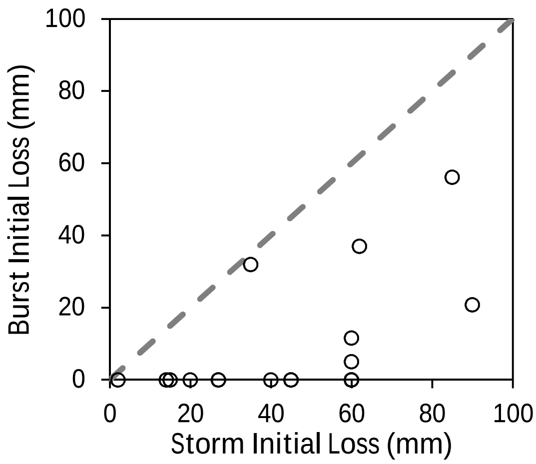
Swan River @ Harding Falls (Tas) - 3 hour bursts

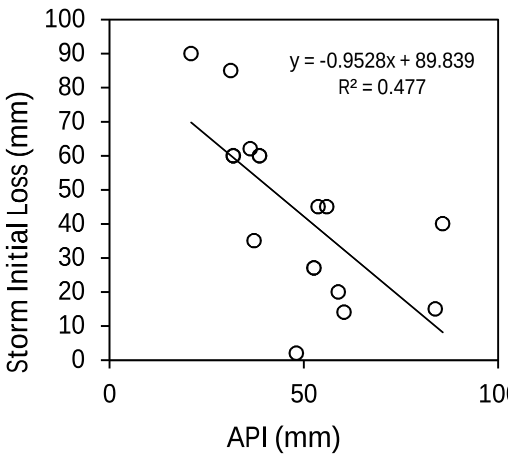


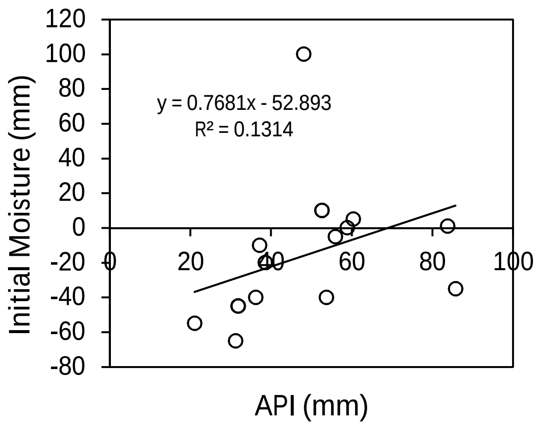




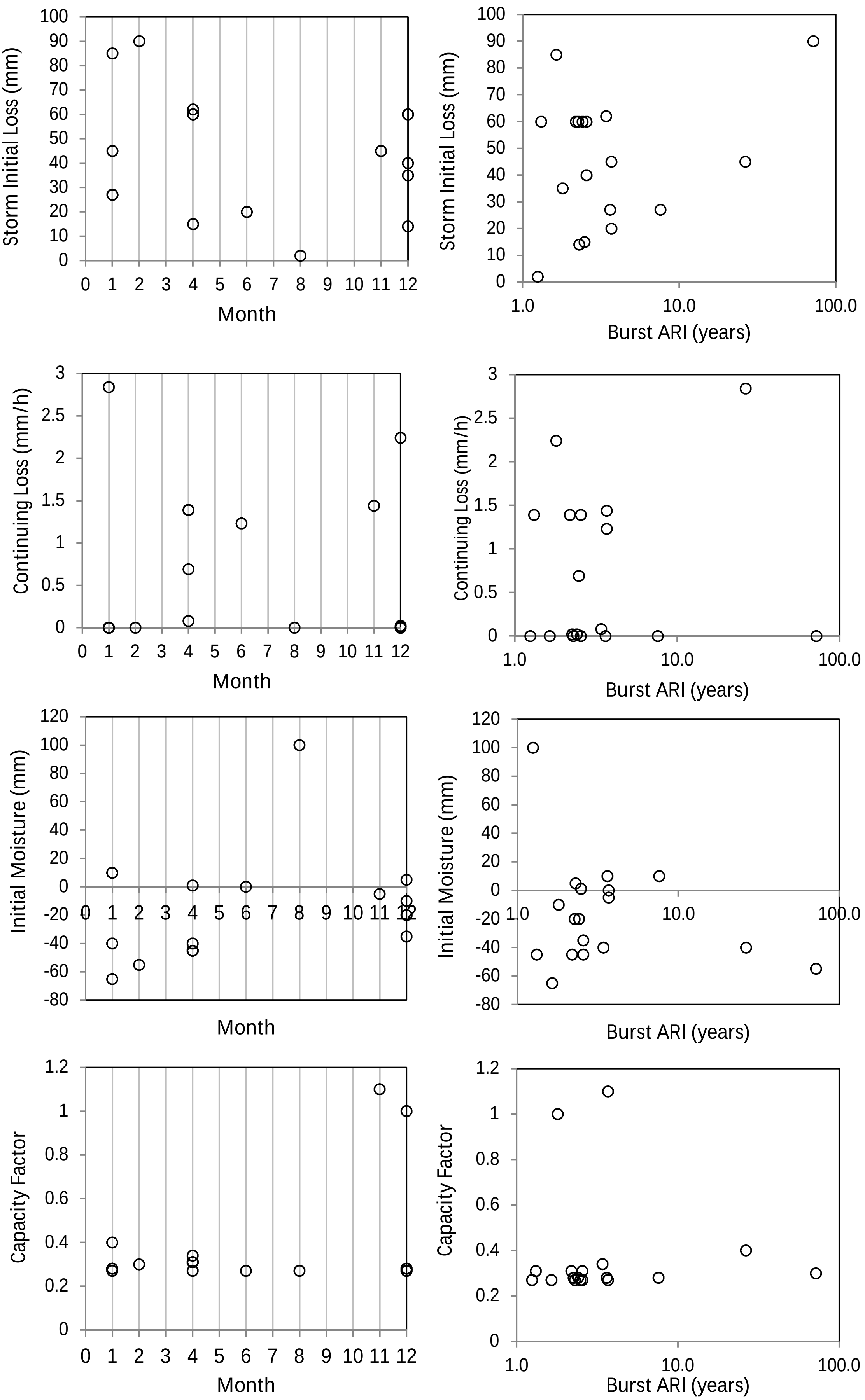




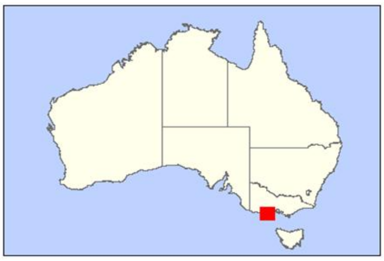


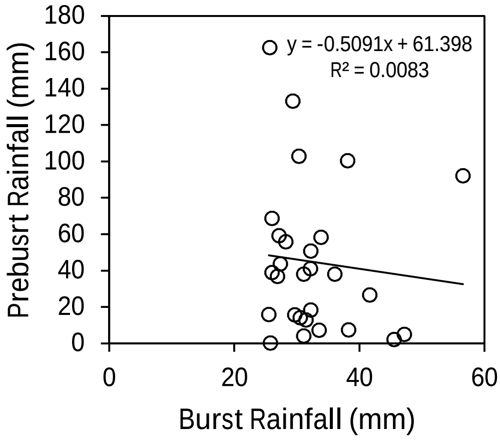


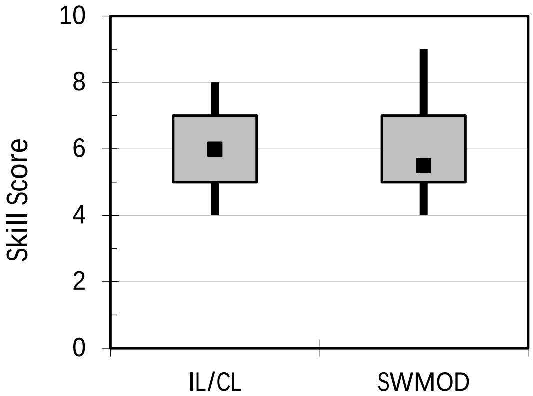
Swan River @ Harding Falls (Tas) - 3 hour bursts

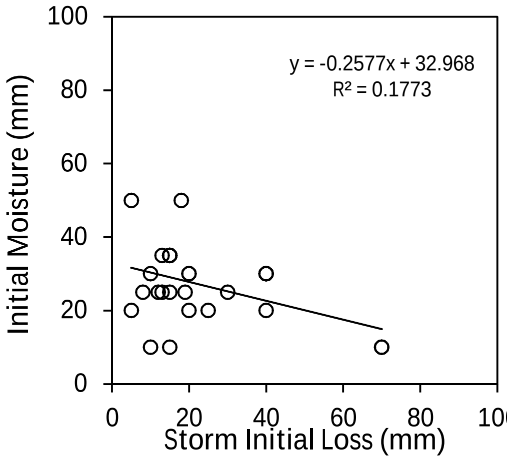


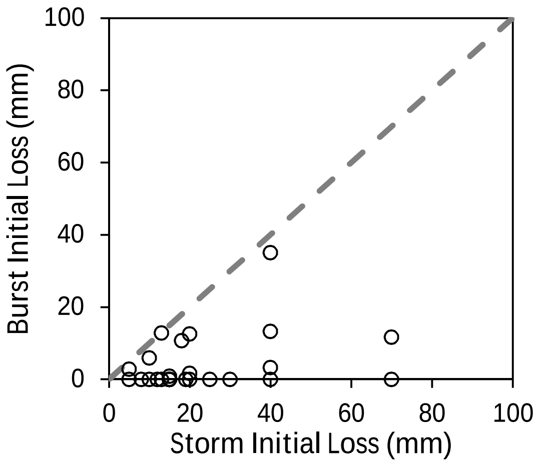
Aire @ Wyelangta (VIC) - 3 hour bursts

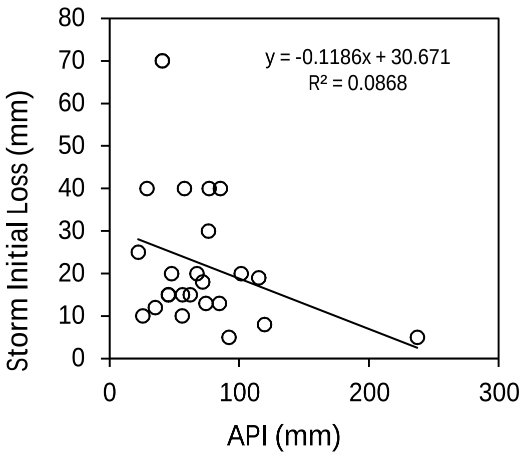


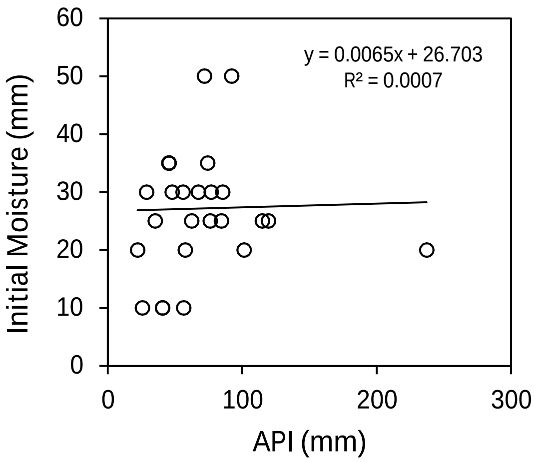




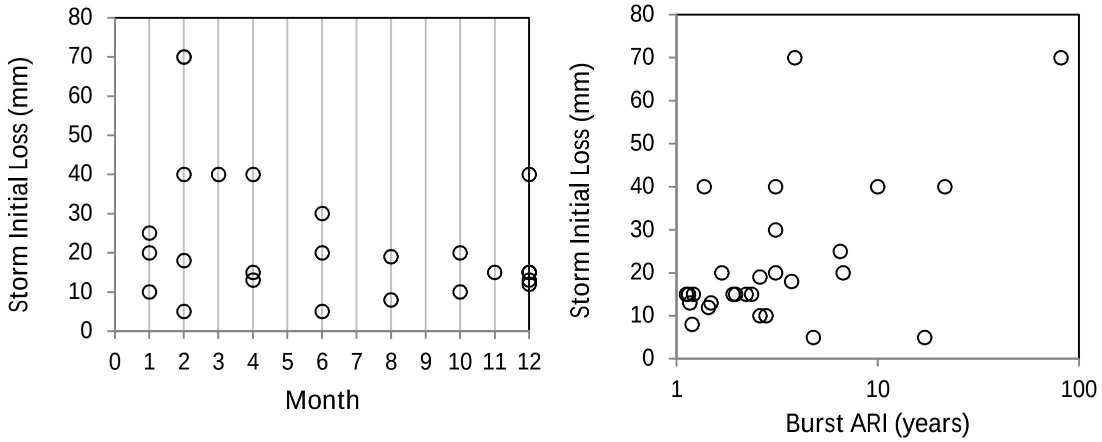


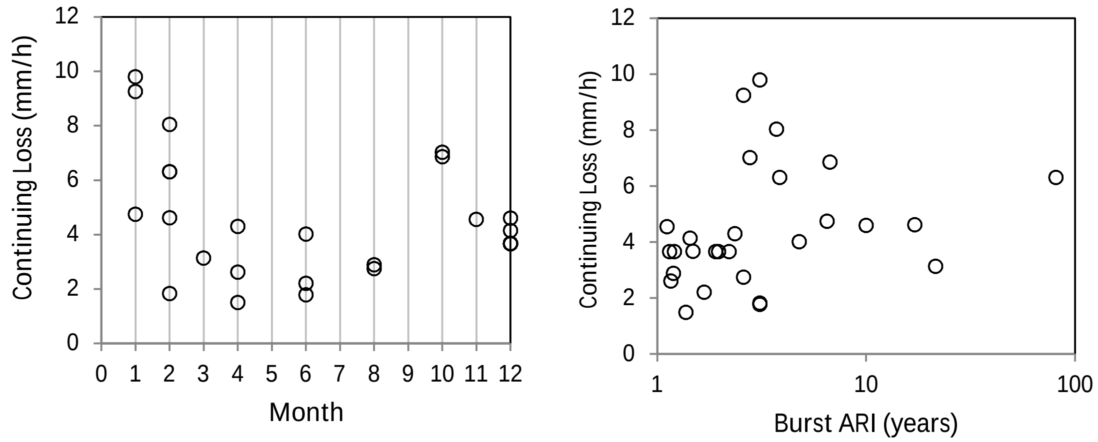


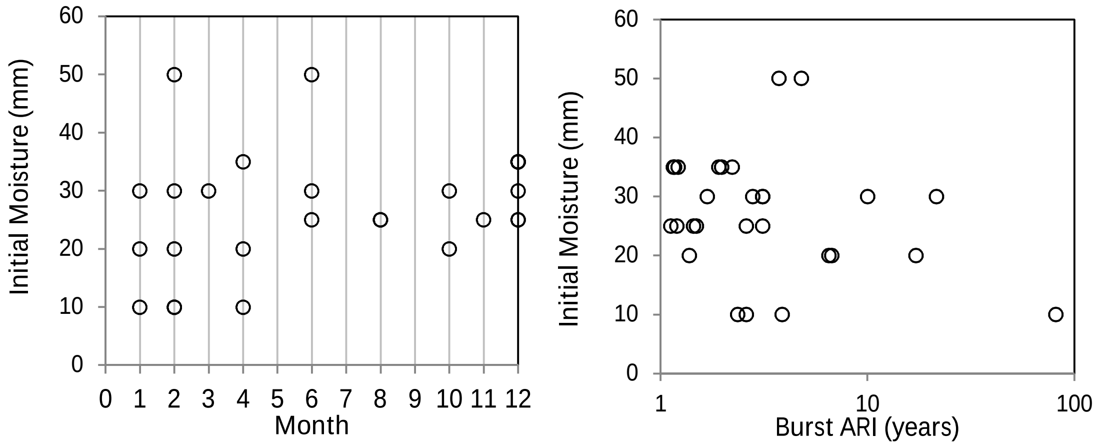


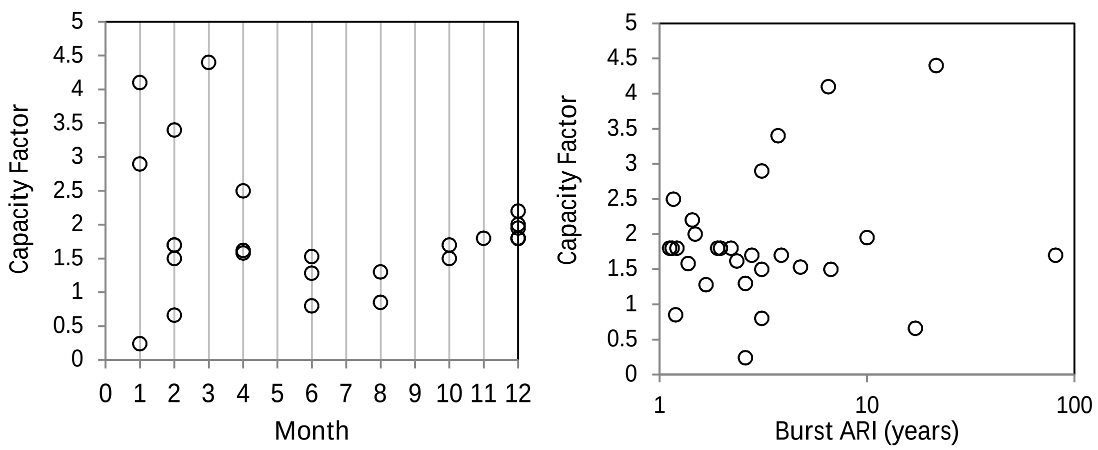


Aire @ Wyelangta (VIC) - 3 hour bursts

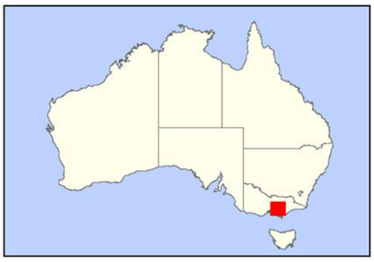


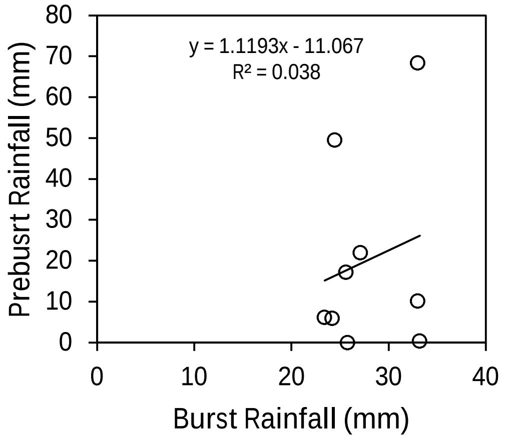


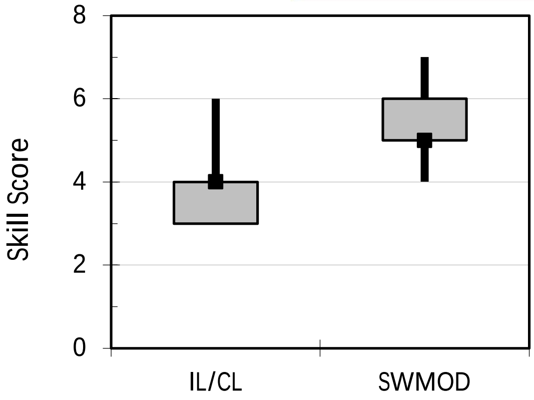


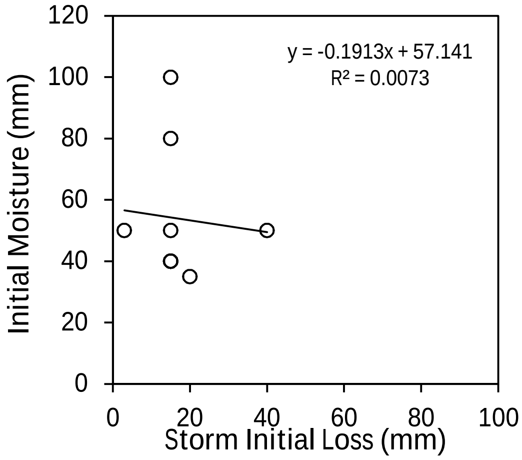


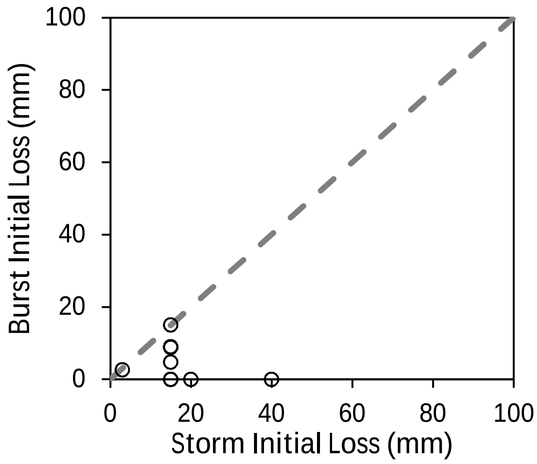
McMahons Ck @ Upstreams Weir (VIC) - 3 hour bursts

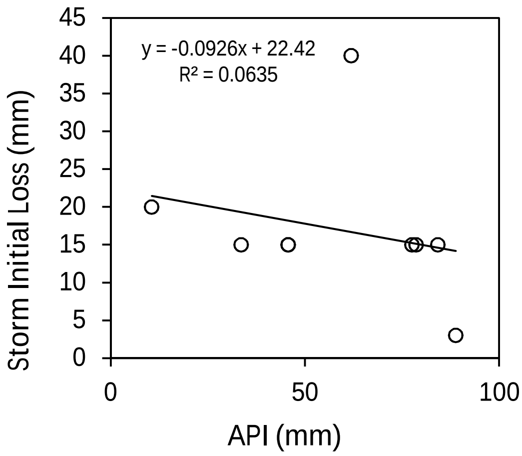


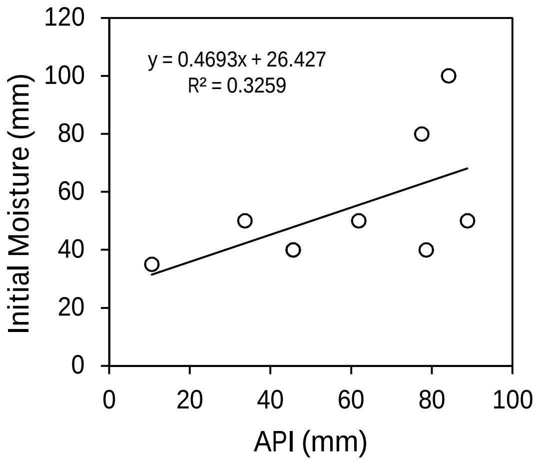




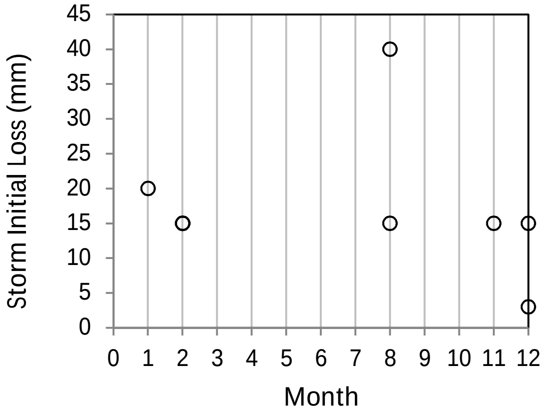


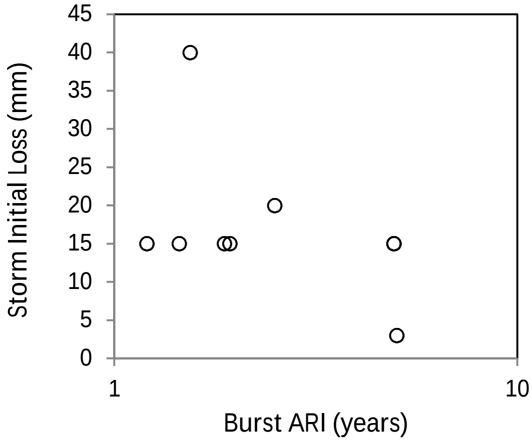


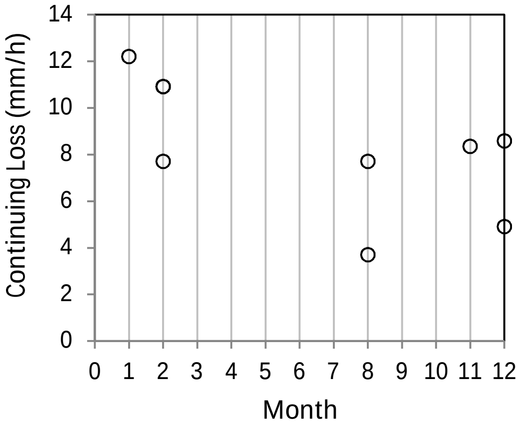


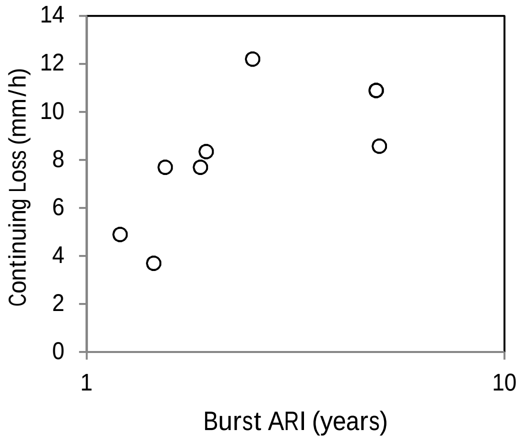


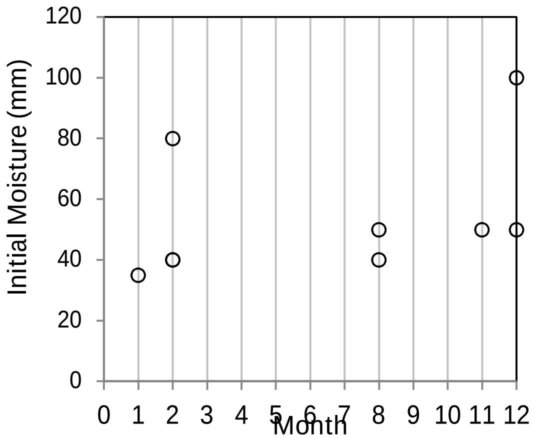
McMahons Ck @ Upstreams Weir (VIC) - 3 hour bursts

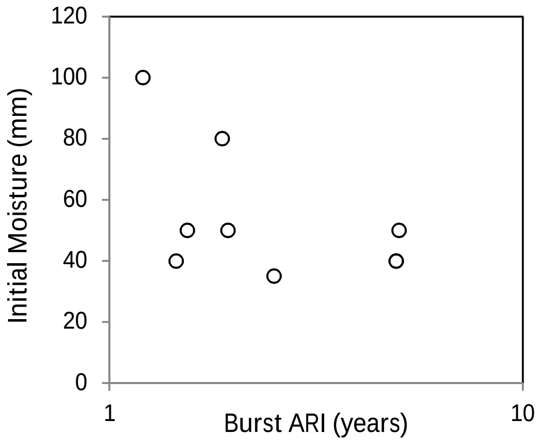


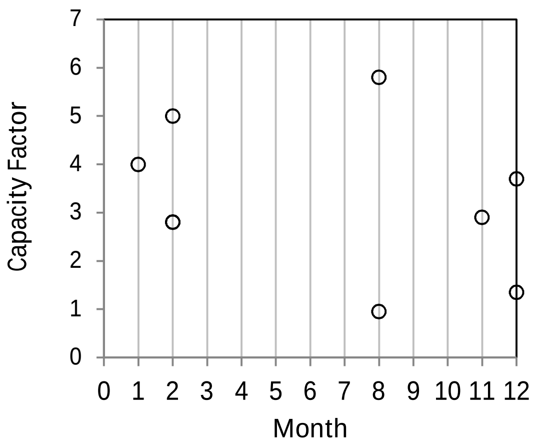


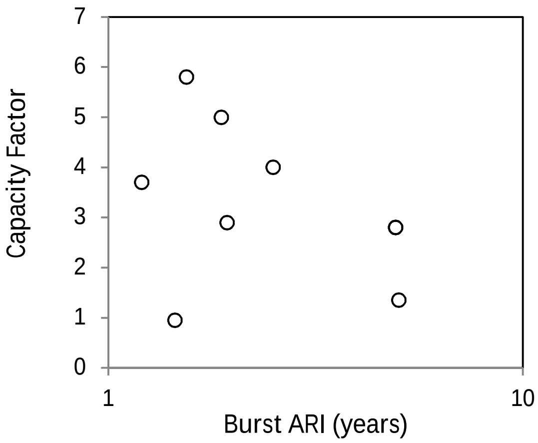




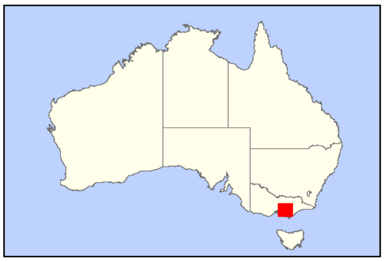


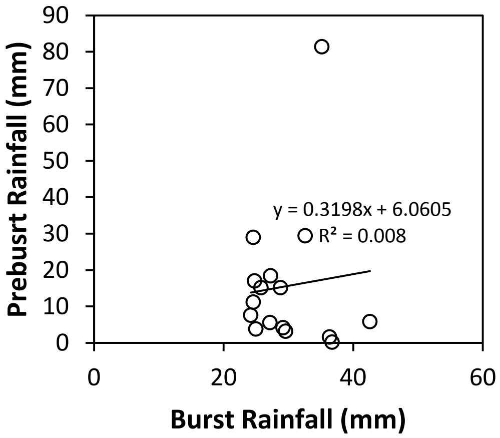


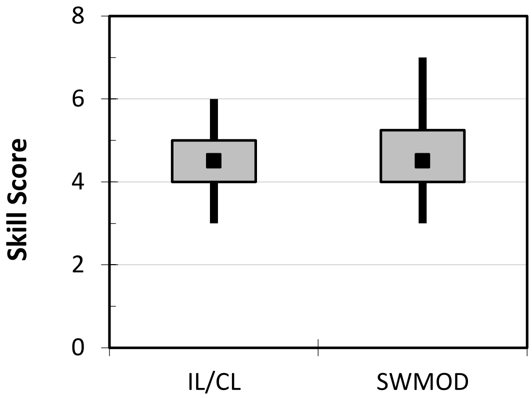


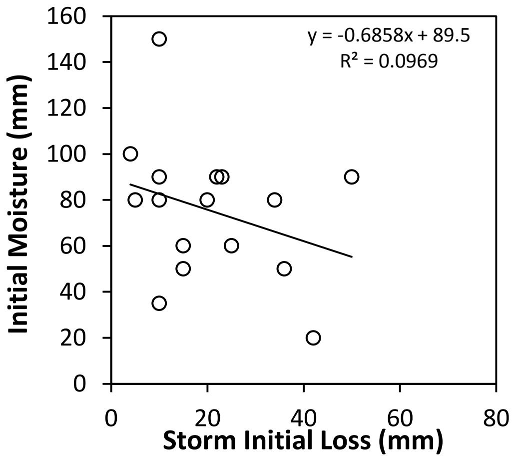


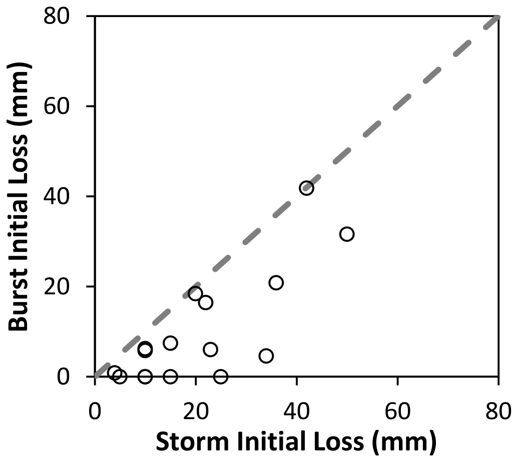
Tarago @ Neerim (VIC) - 3 hour bursts

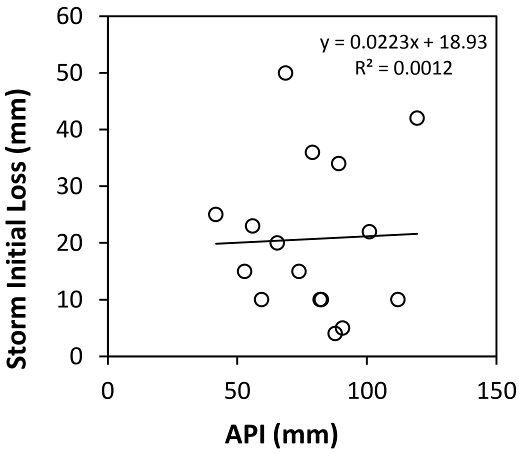


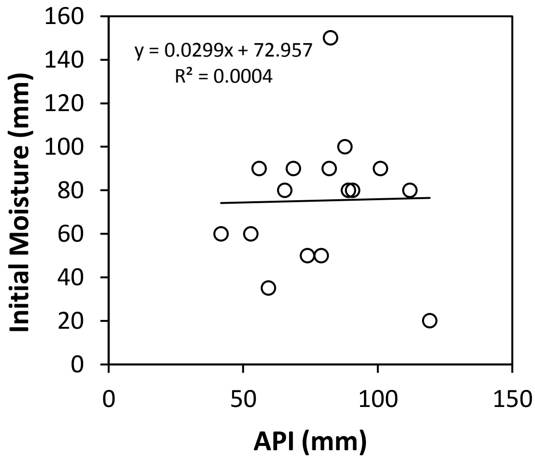




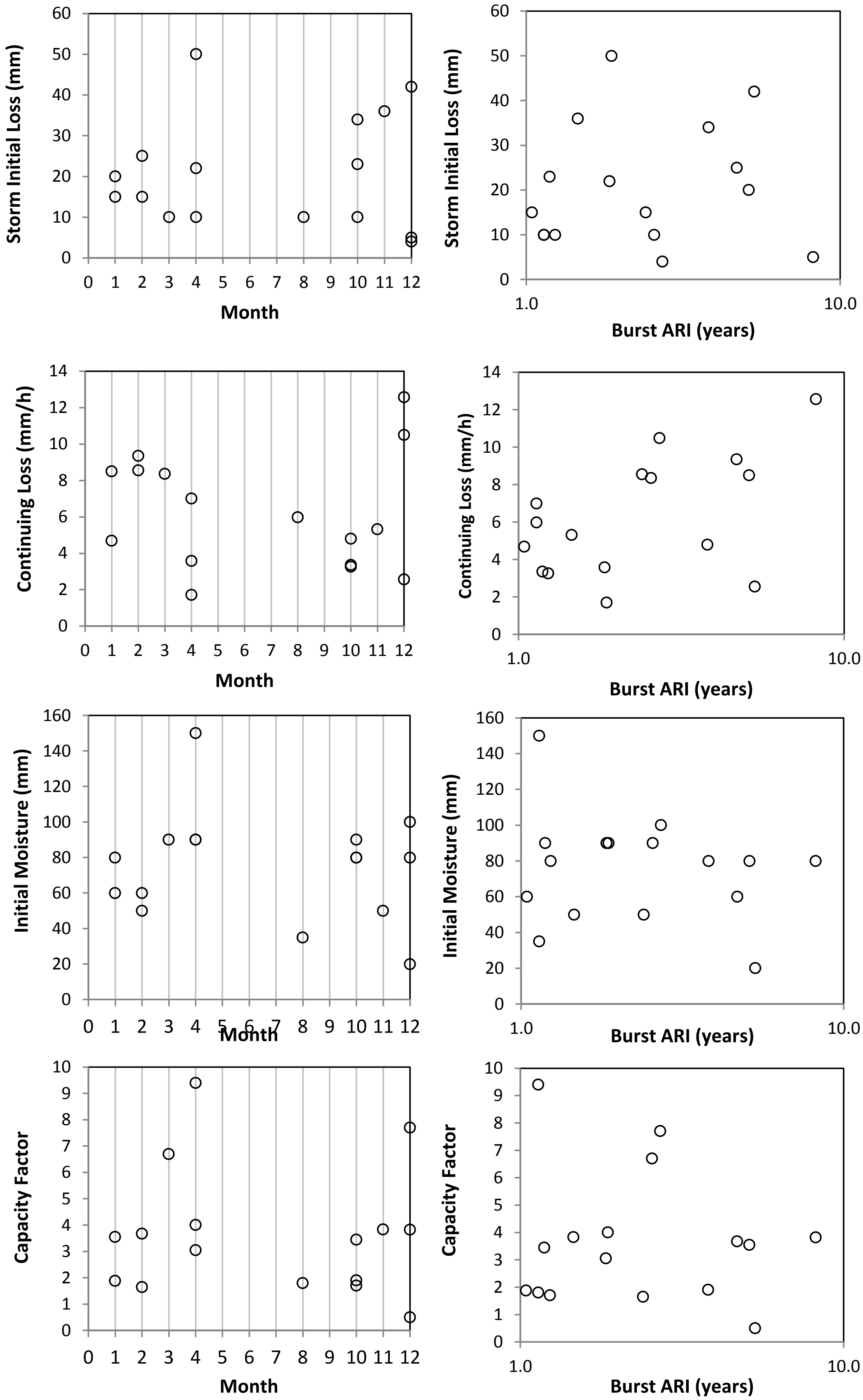




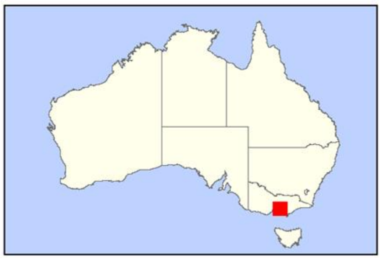


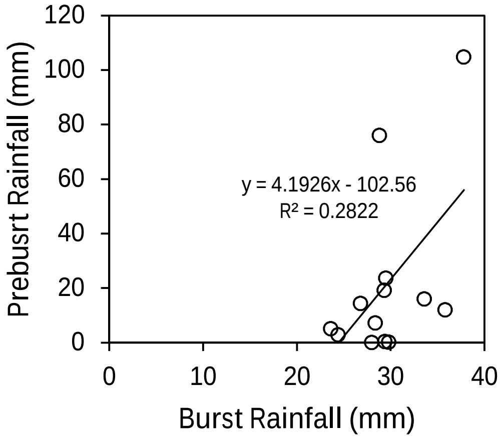


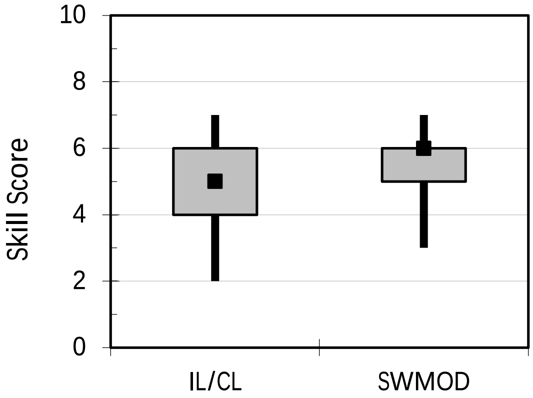
Tarago @ Neerim (VIC) - 3 hour bursts

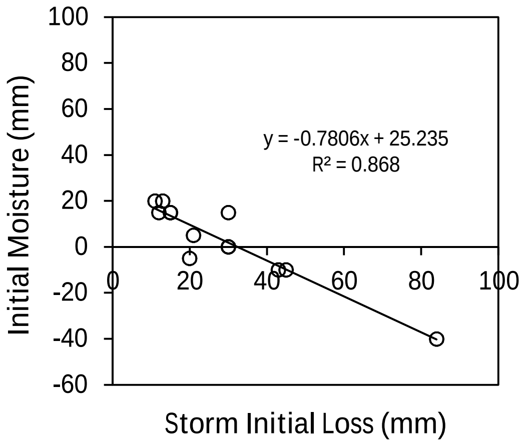


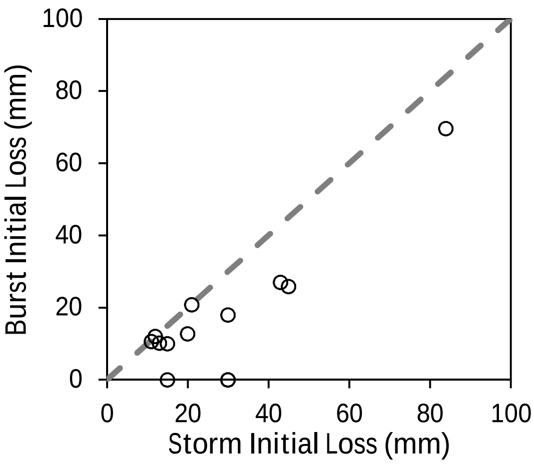
Toomuc Ck @ Pakenham (VIC) - 3 hour bursts

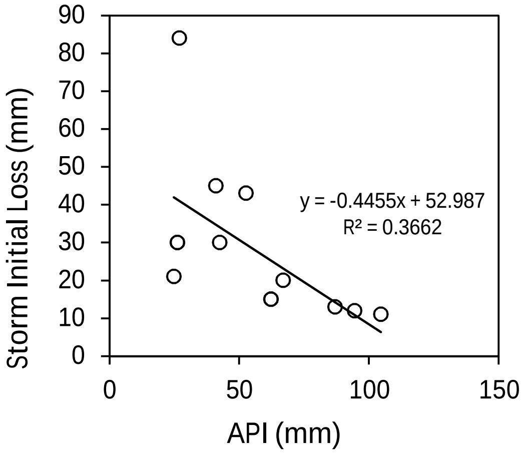


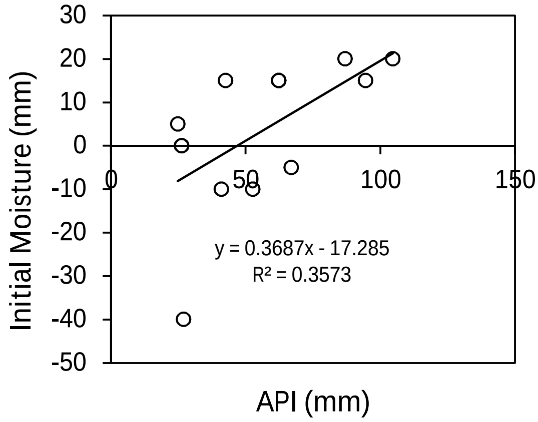




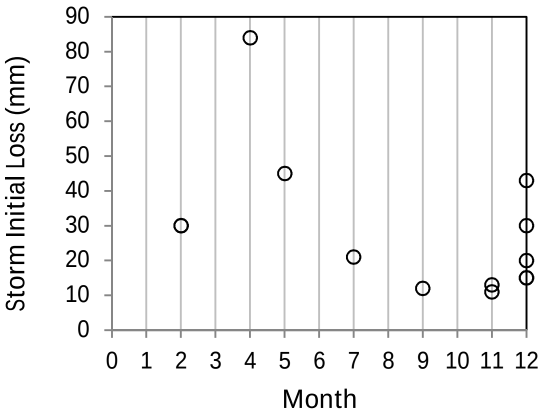


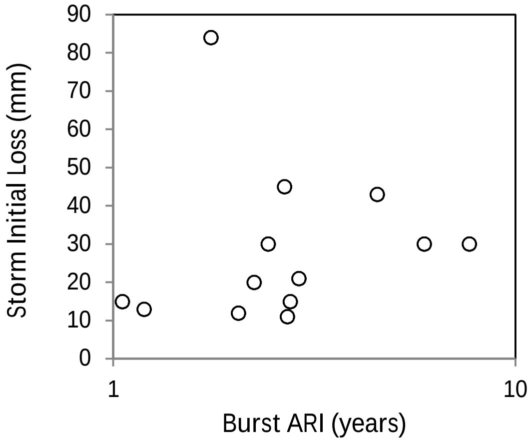


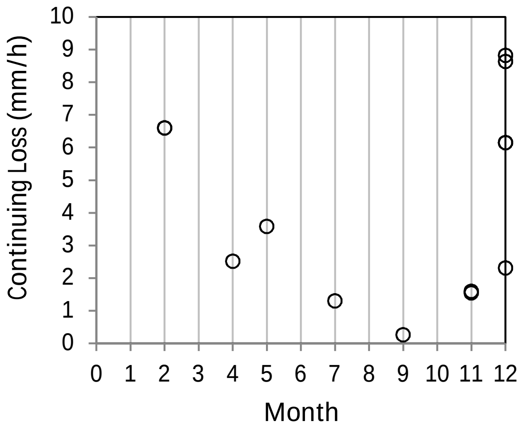


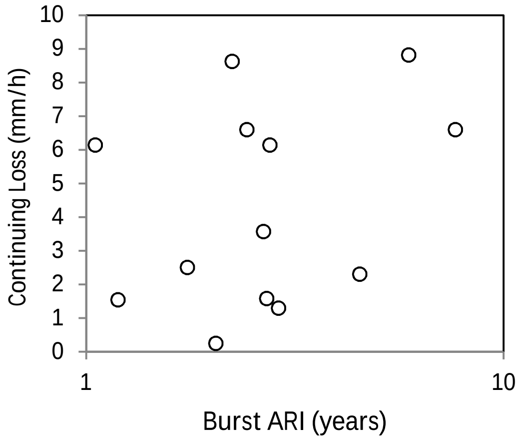


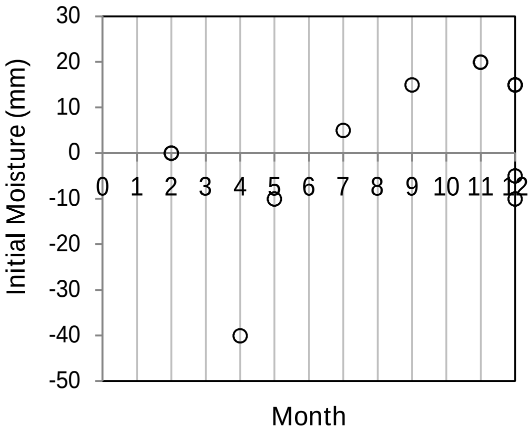
Toomuc Ck @ Pakenham (VIC) - 3 hour bursts

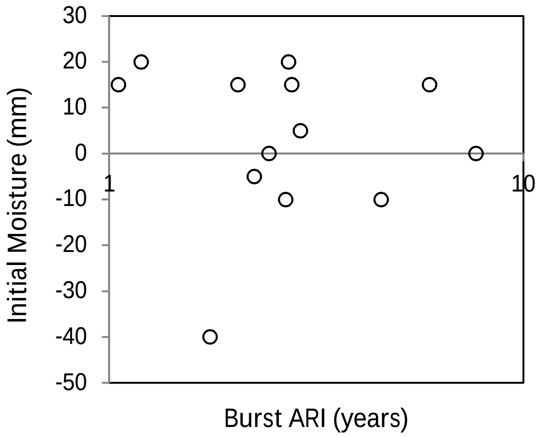


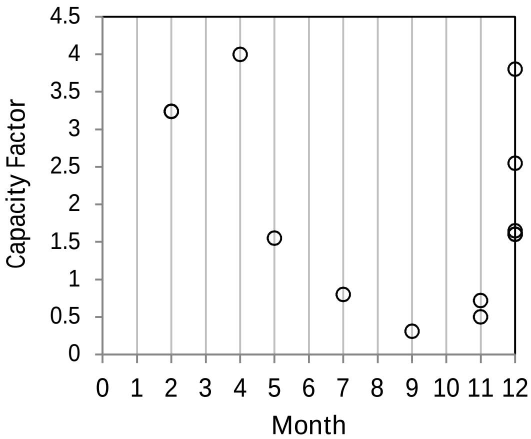


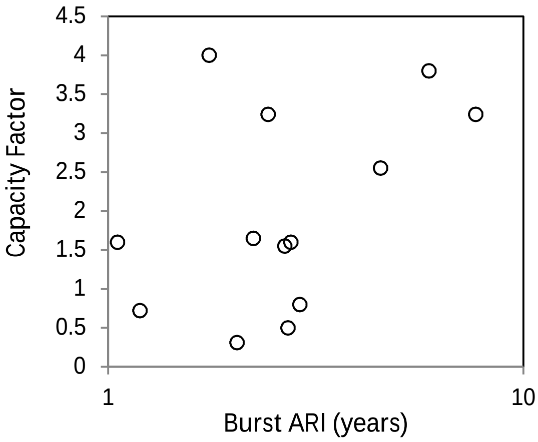




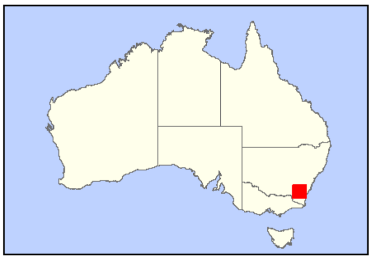


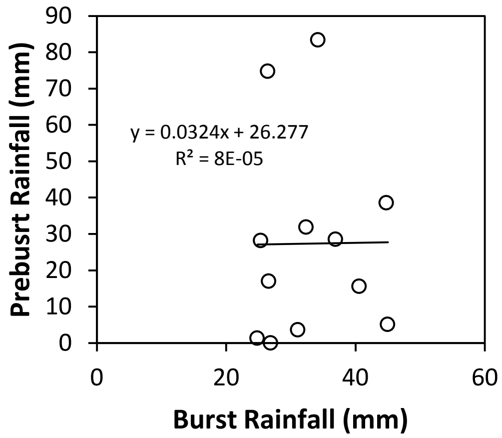


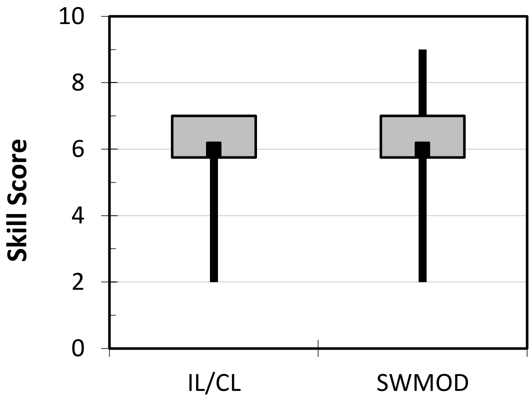


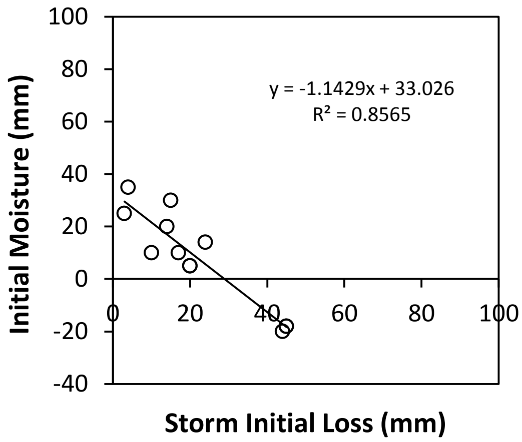


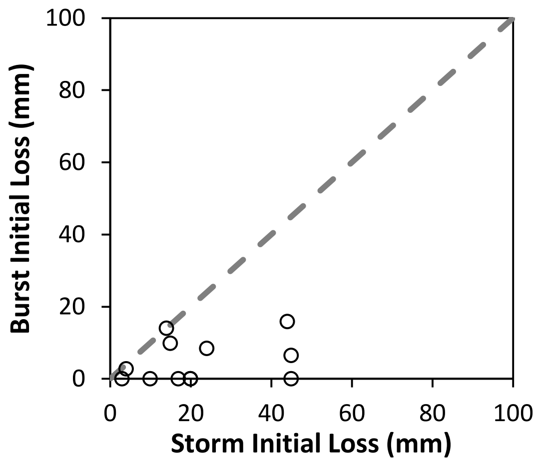
Jerrabomberra Ck @ Four Mile Ck (ACT) - 3 hour bursts

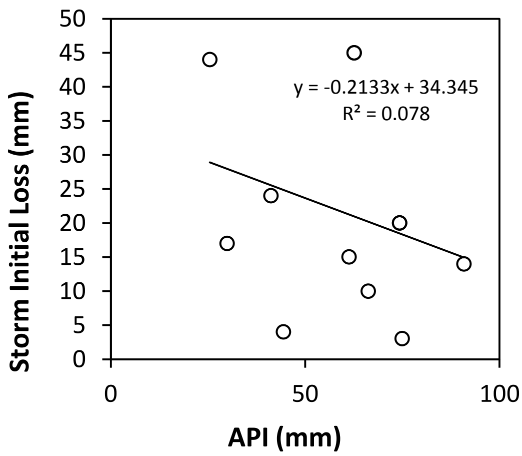


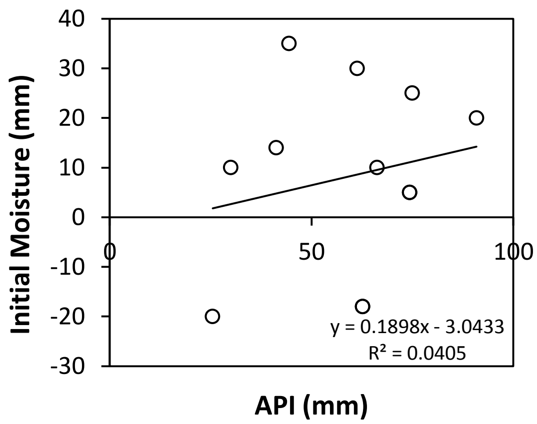




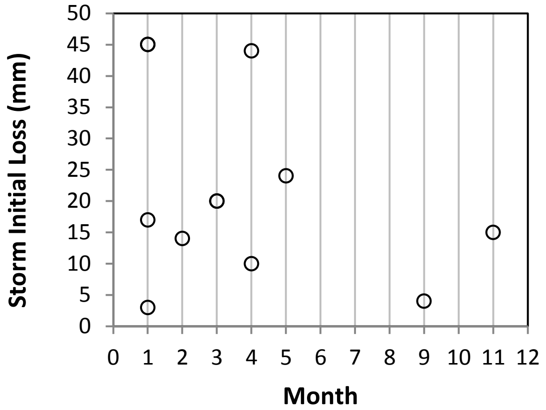


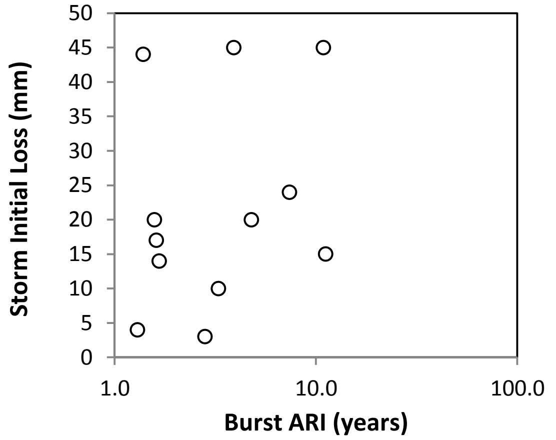


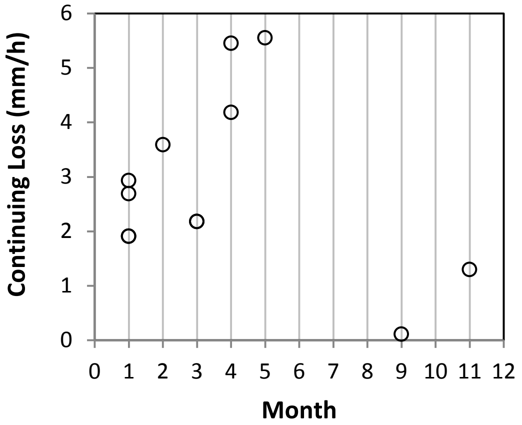


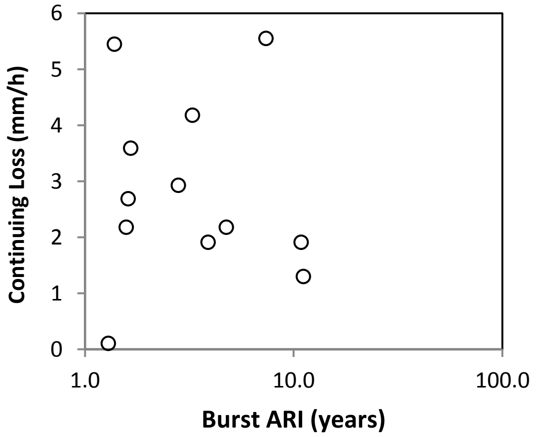


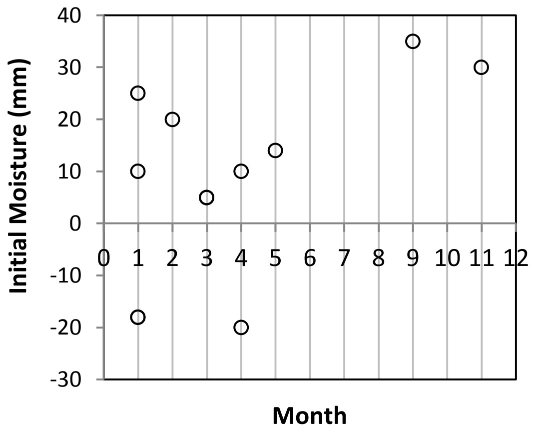
Jerrabomberra Ck @ Four Mile Ck (ACT) - 3 hour bursts

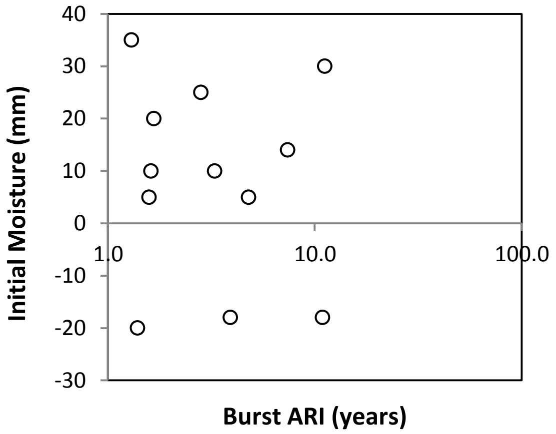


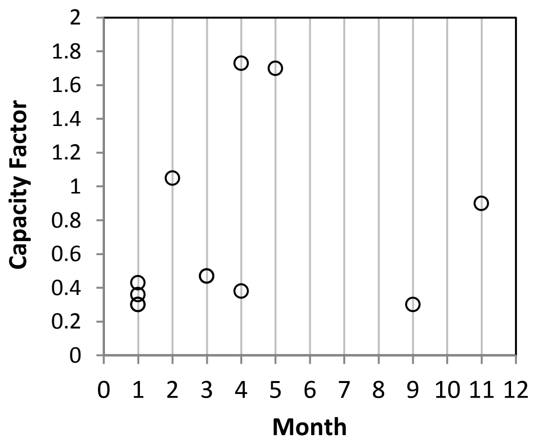


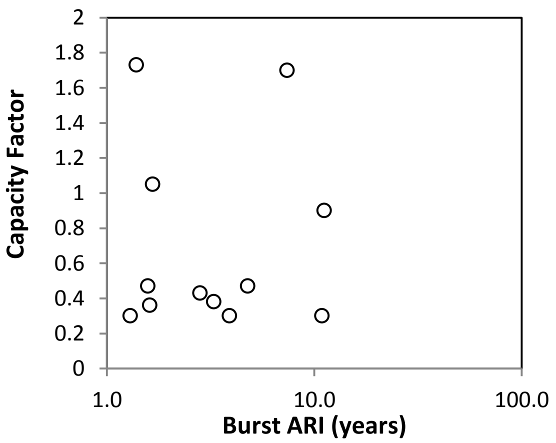




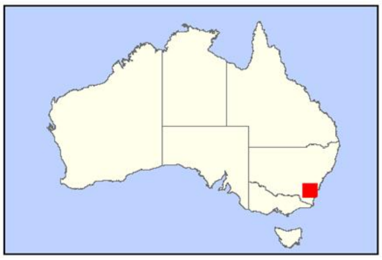


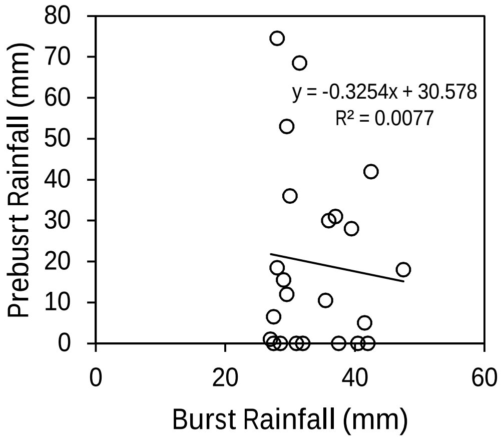


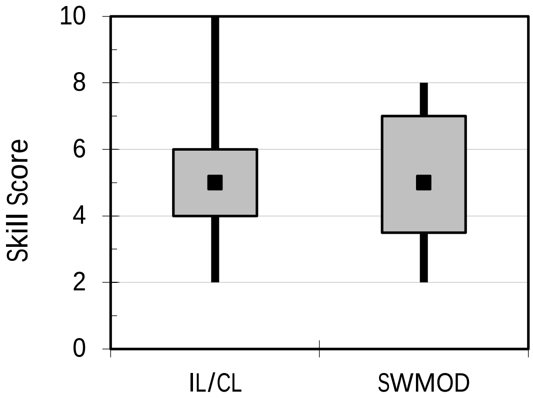


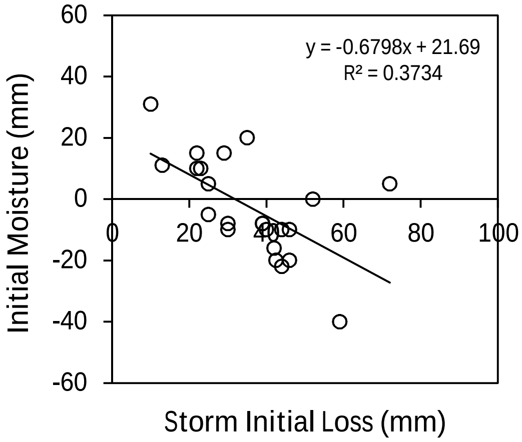


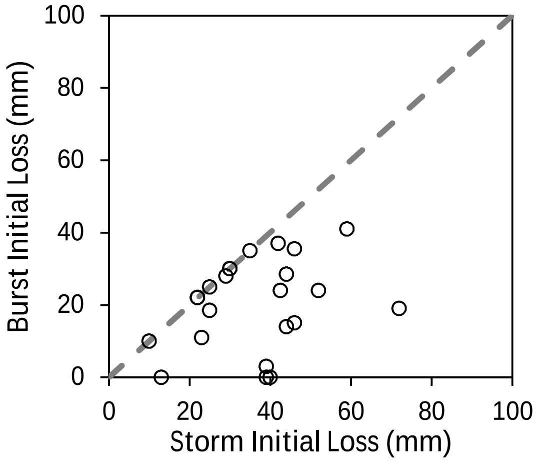
Butmaroo Ck @ Butmaroo (NSW) - 3 hour bursts

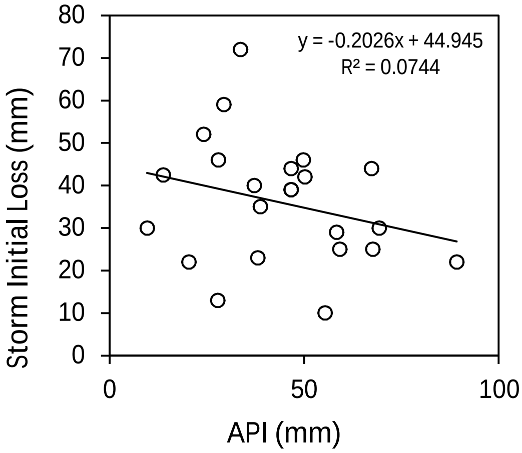


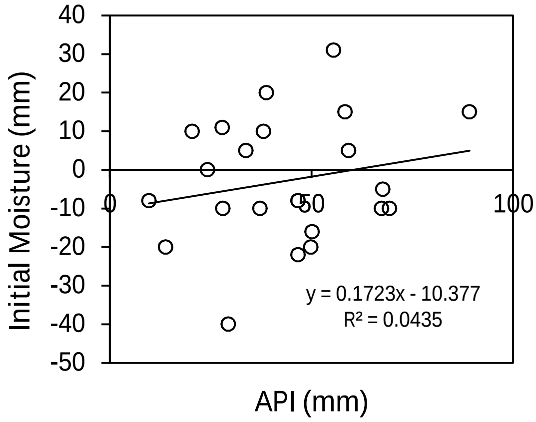




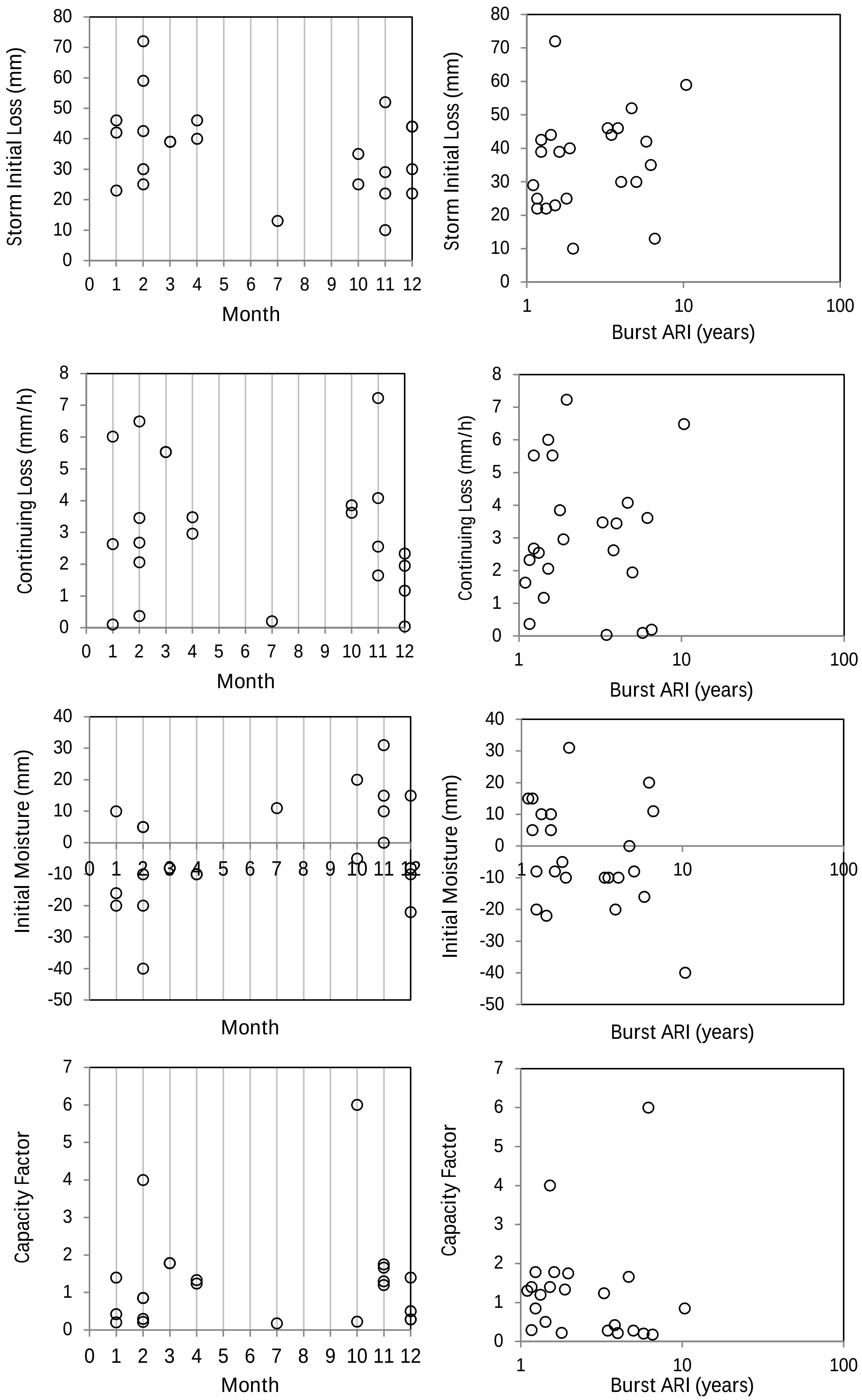




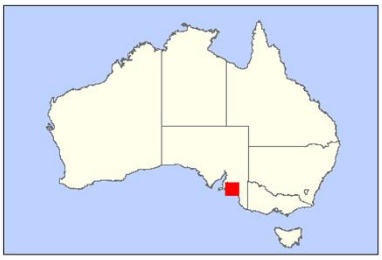


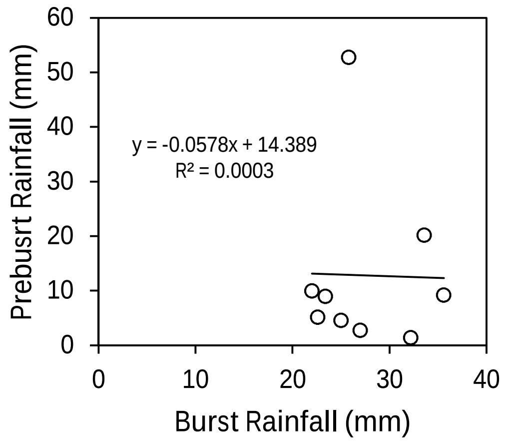


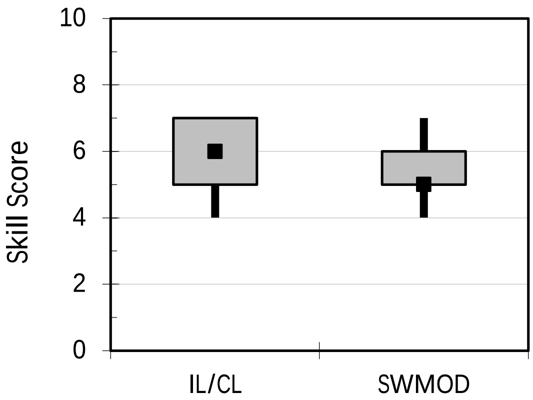
Butmaroo Ck @ Butmaroo (NSW) - 3 hour bursts

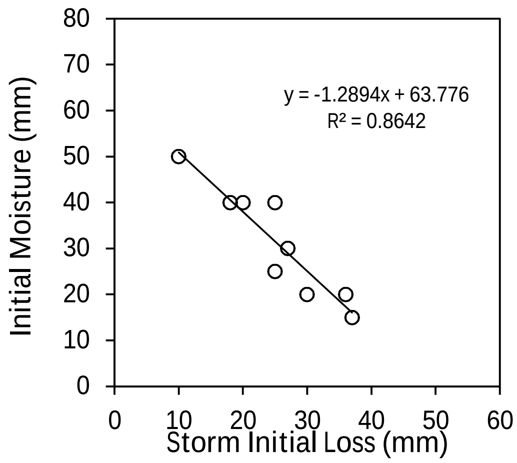


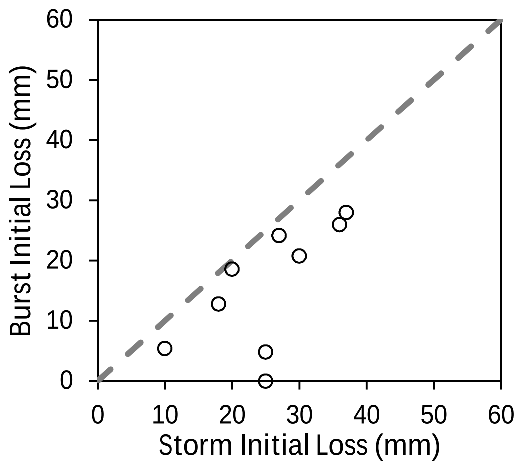
Echunga Ck @ U/S Mt Bold Res. (SA) - 3 hour bursts

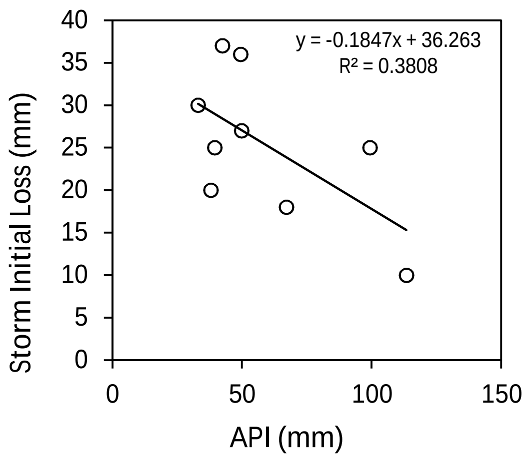


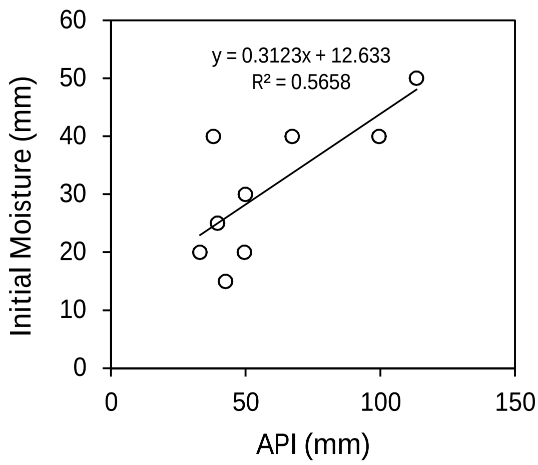




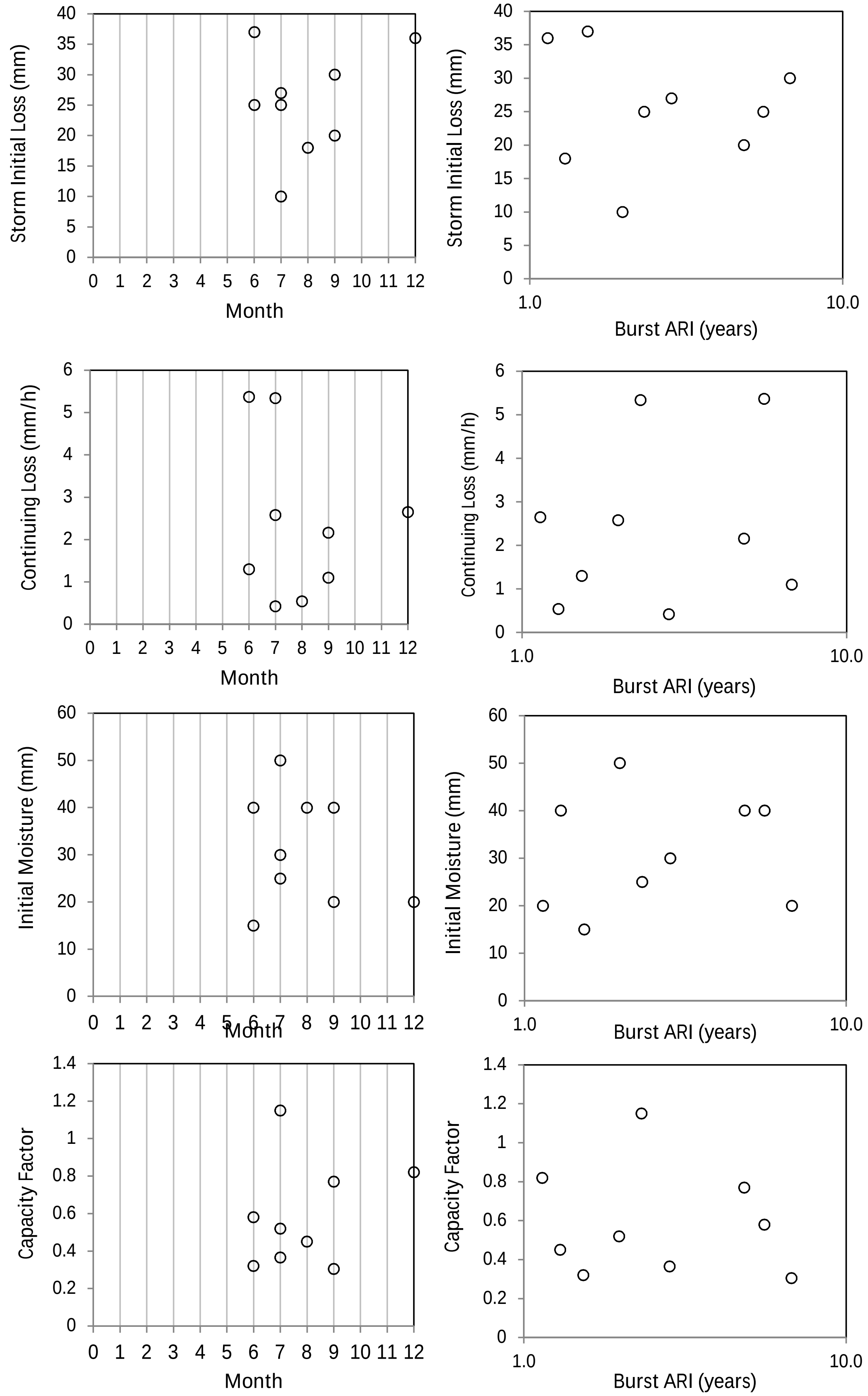




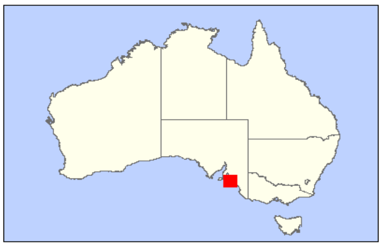


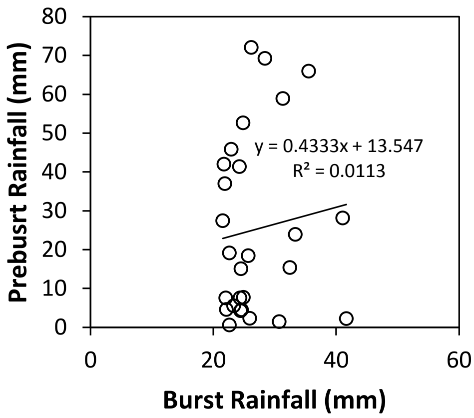


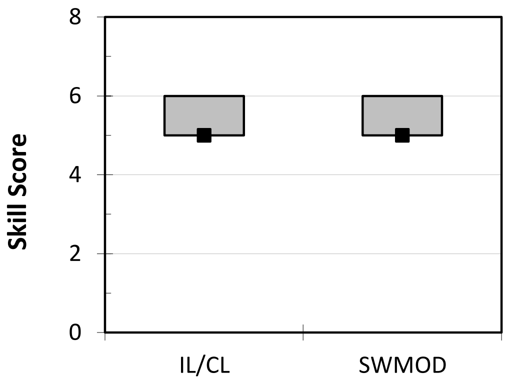
Echunga Ck @ U/S Mt Bold Res. (SA) - 3 hour bursts

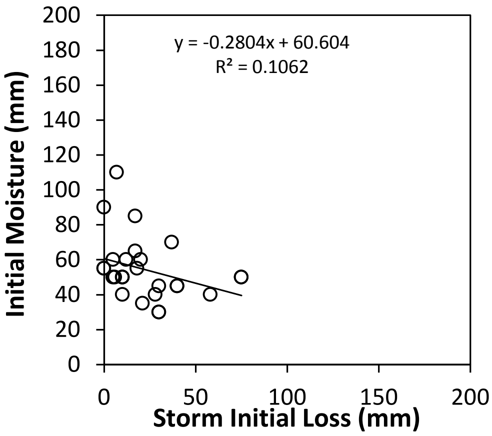


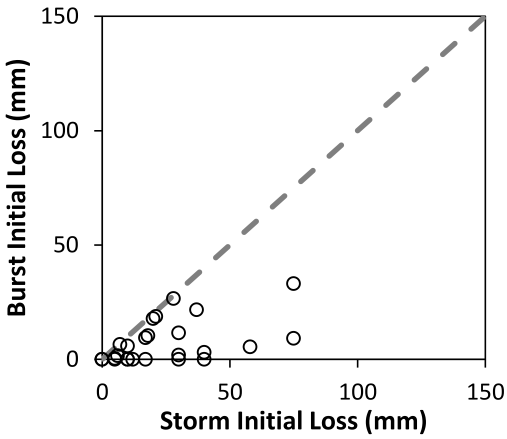
Hindmarsh @ Hindmarsh Vy Res Offtake W (SA) - 3 hour bursts

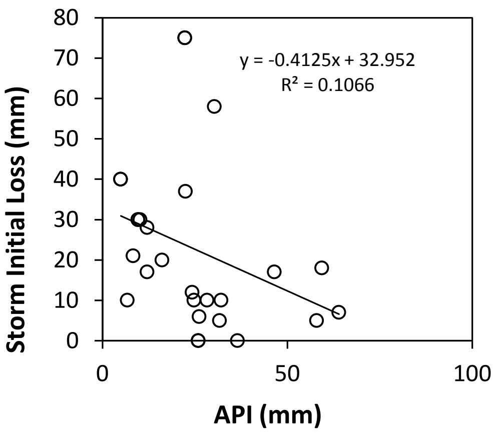


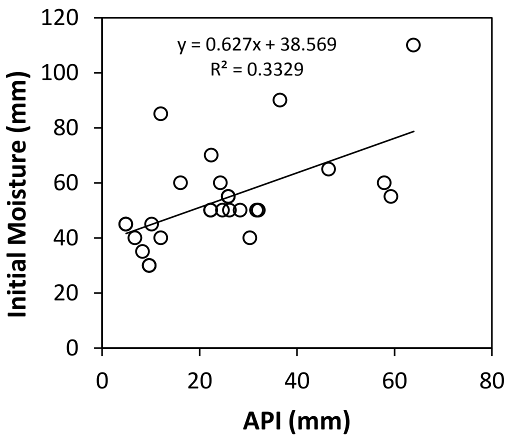




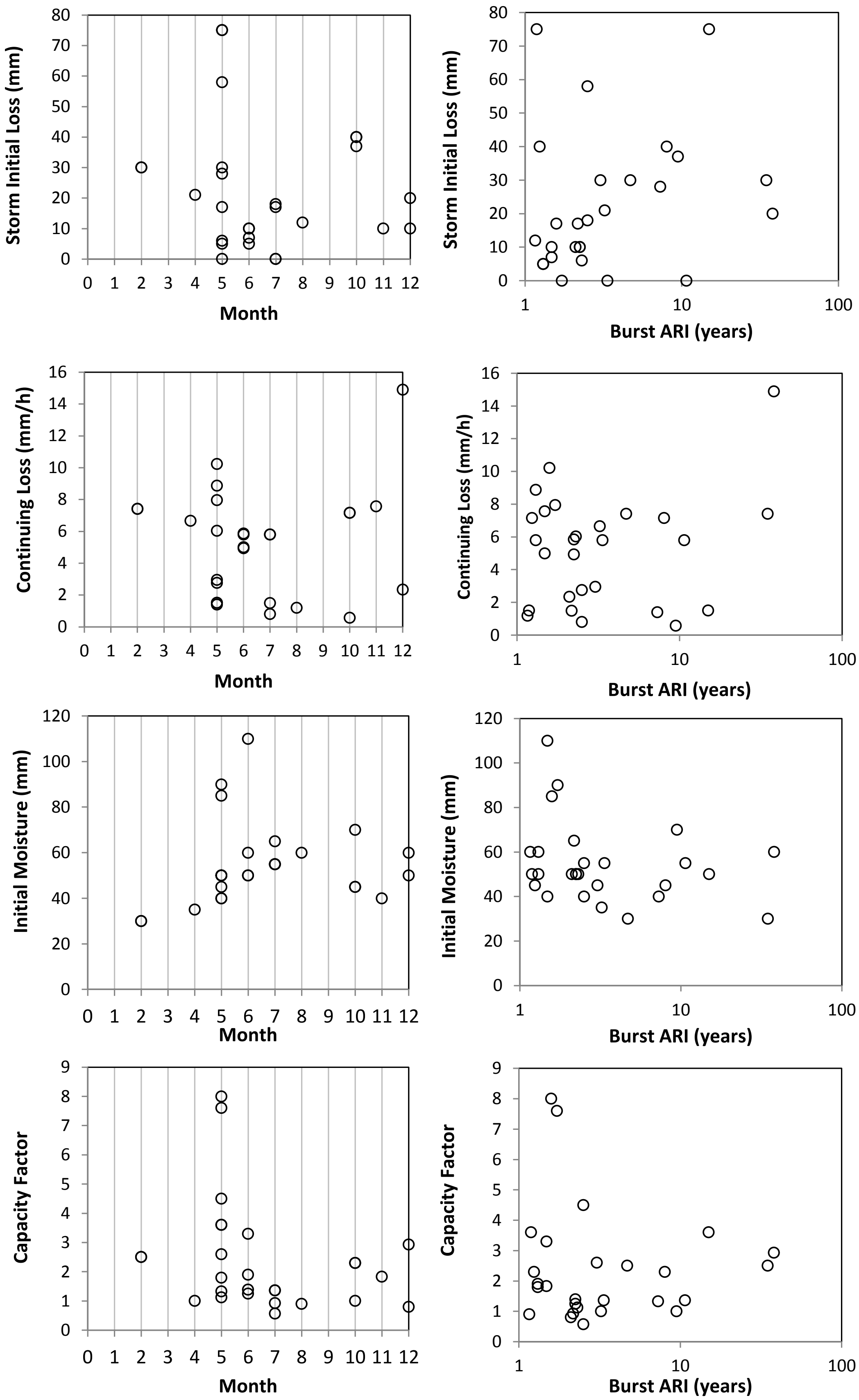




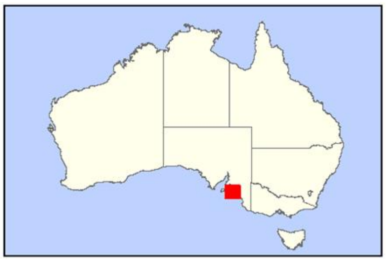


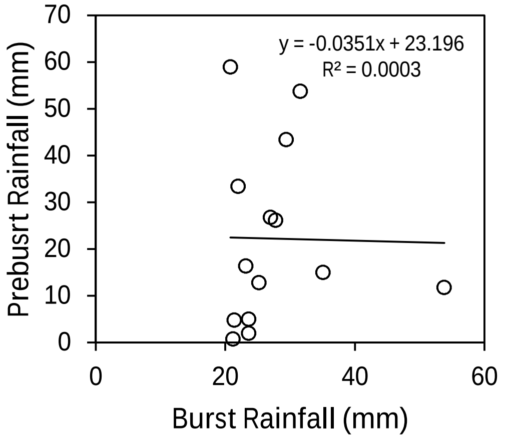


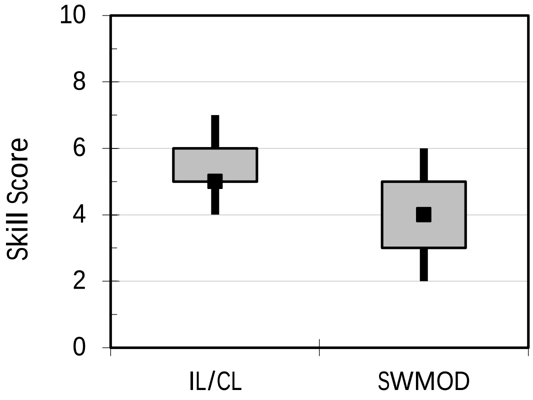
Hindmarsh @ Hindmarsh Vy Res Offtake W (SA) - 3 hour bursts

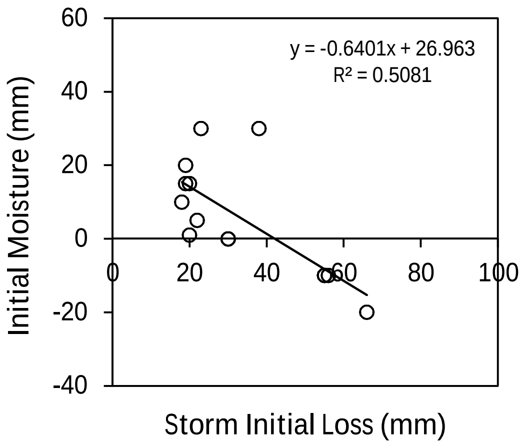


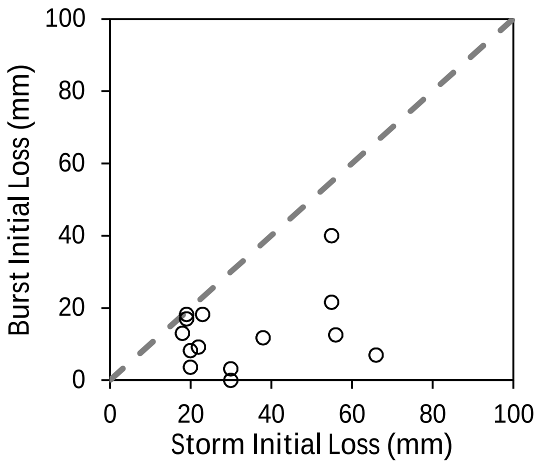
Myponga @ U/S Dam and Rd Br (SA) - 3 hour bursts

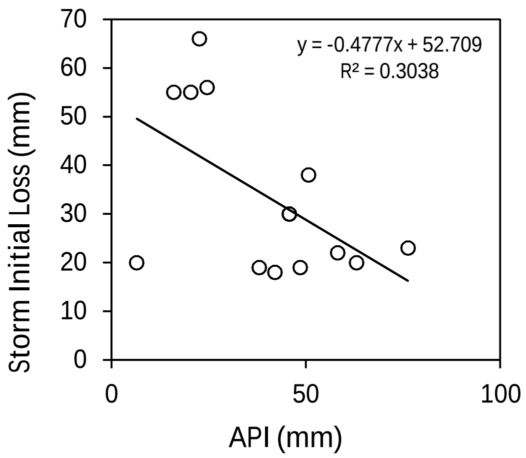


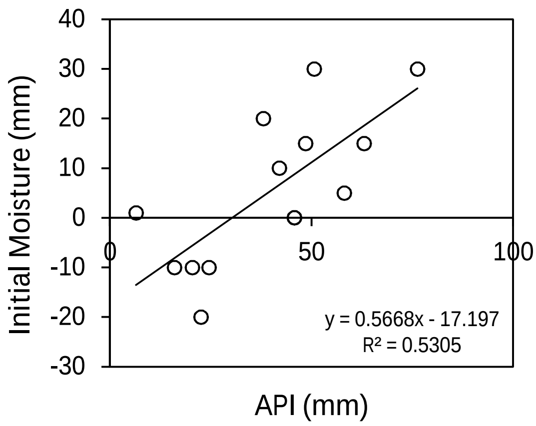




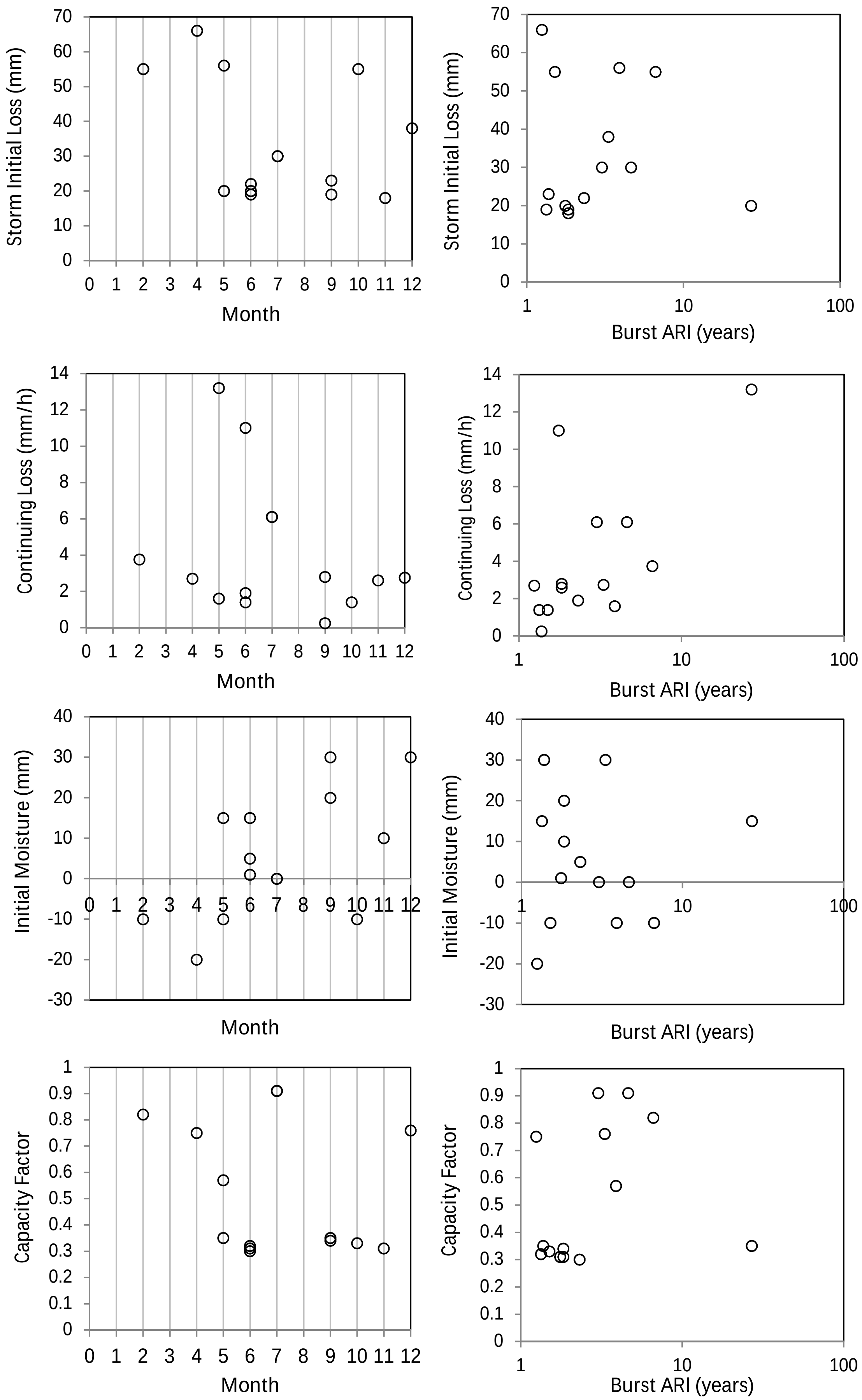




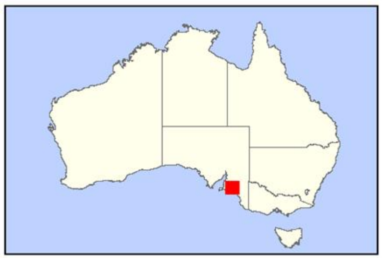


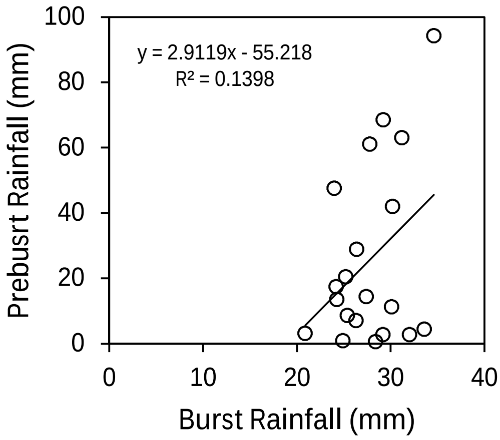


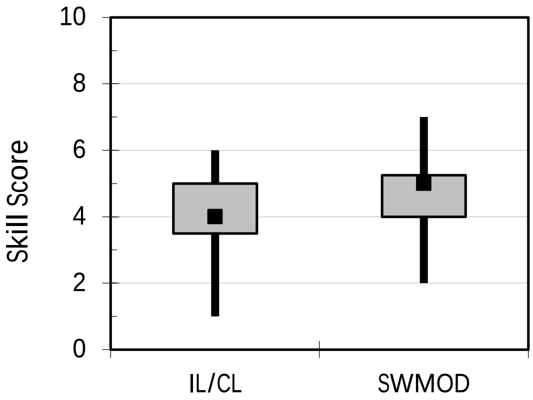
Myponga @ U/S Dam and Rd Br (SA) - 3 hour bursts

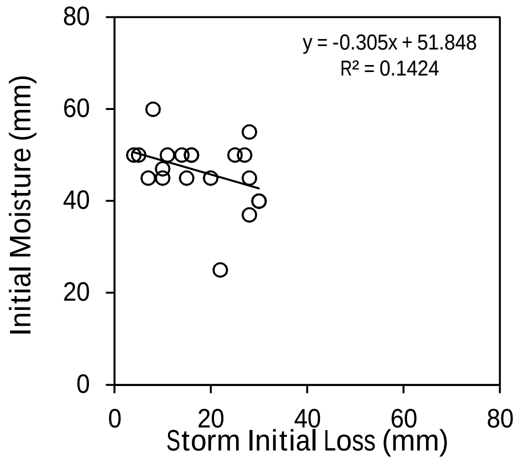


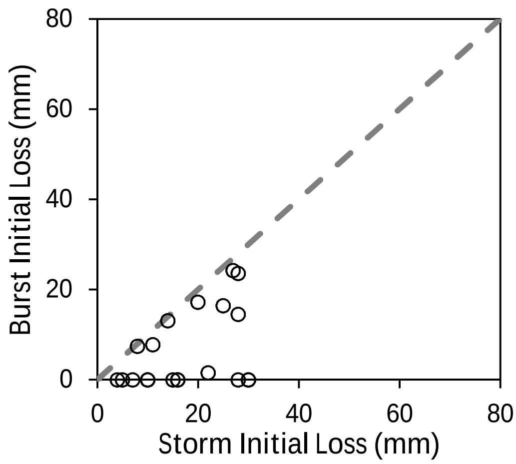
Sixth Ck @ Castambul (SA) - 3 hour bursts

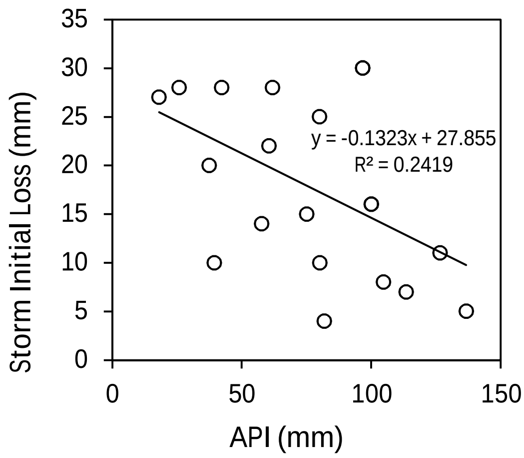


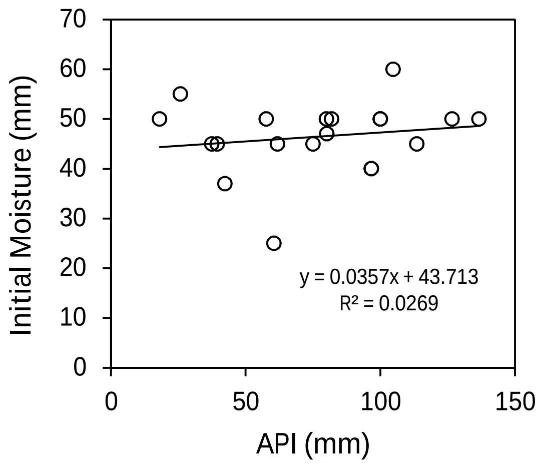




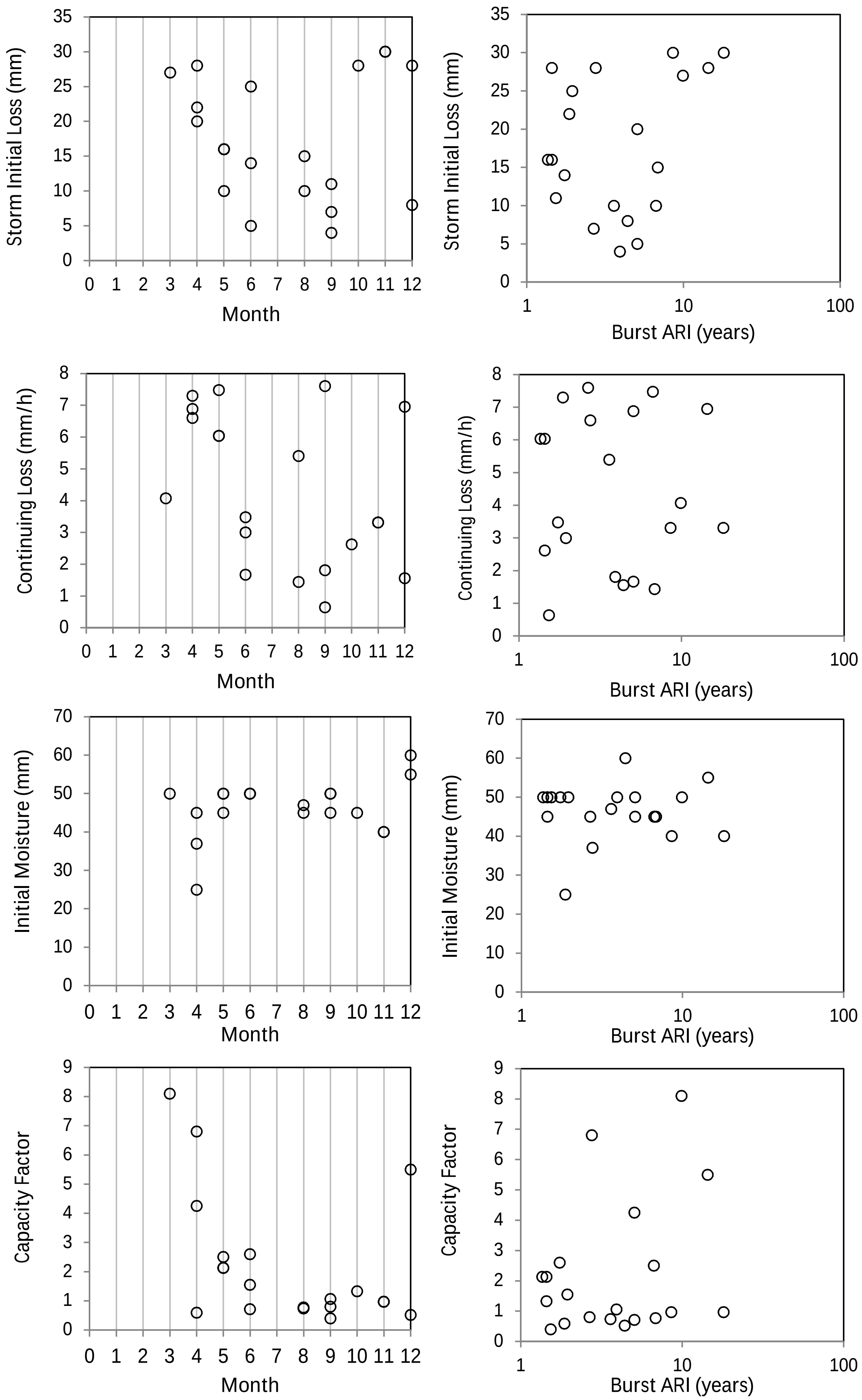




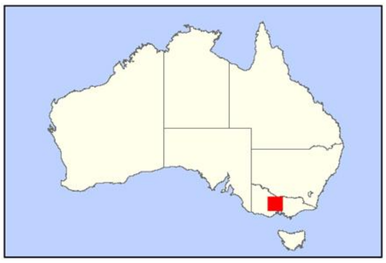


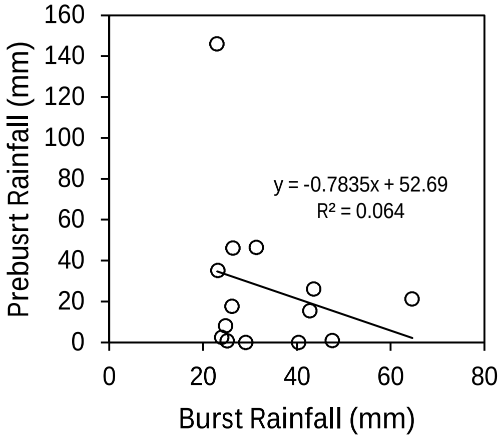


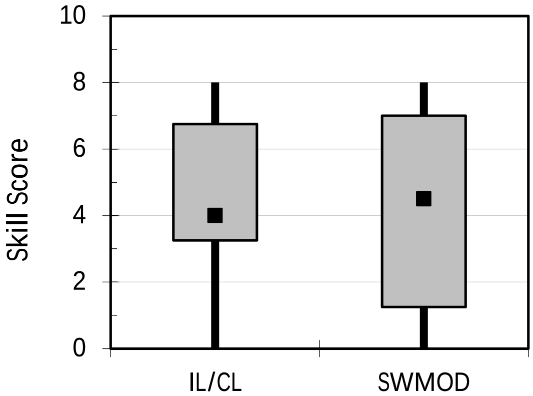
Sixth Ck @ Castambul (SA) - 3 hour bursts

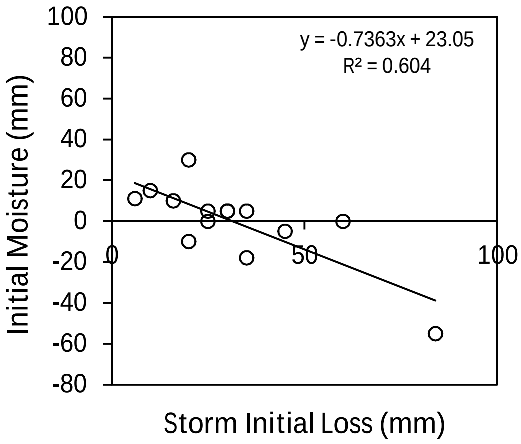


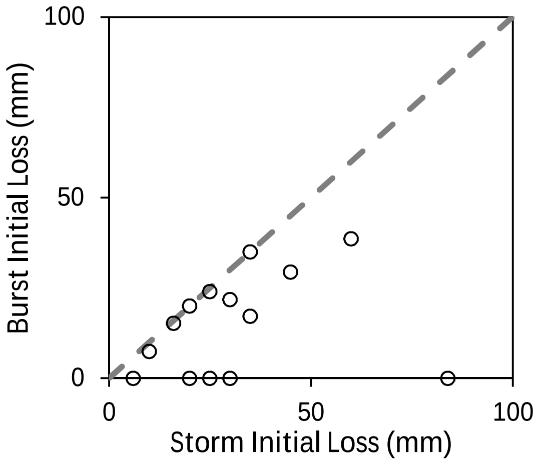
Axe Ck @ Sedgwick (VIC) - 3 hour bursts

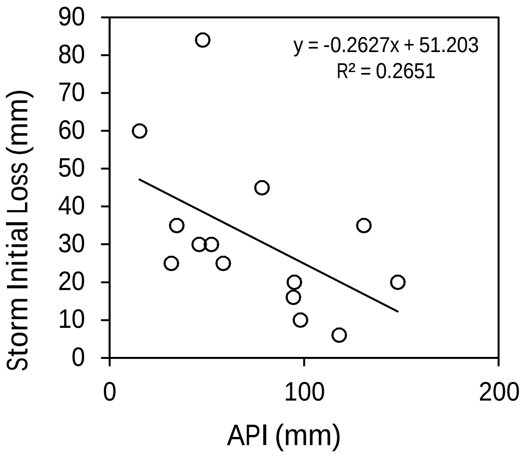


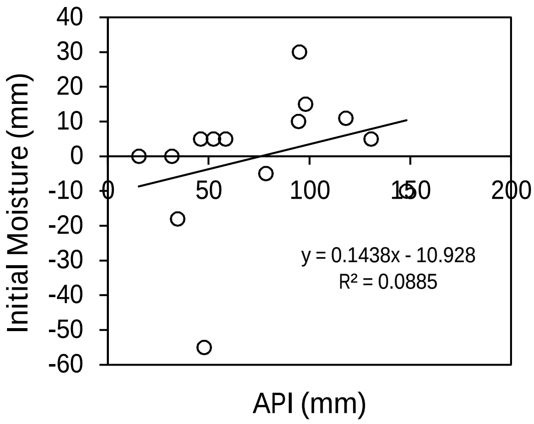




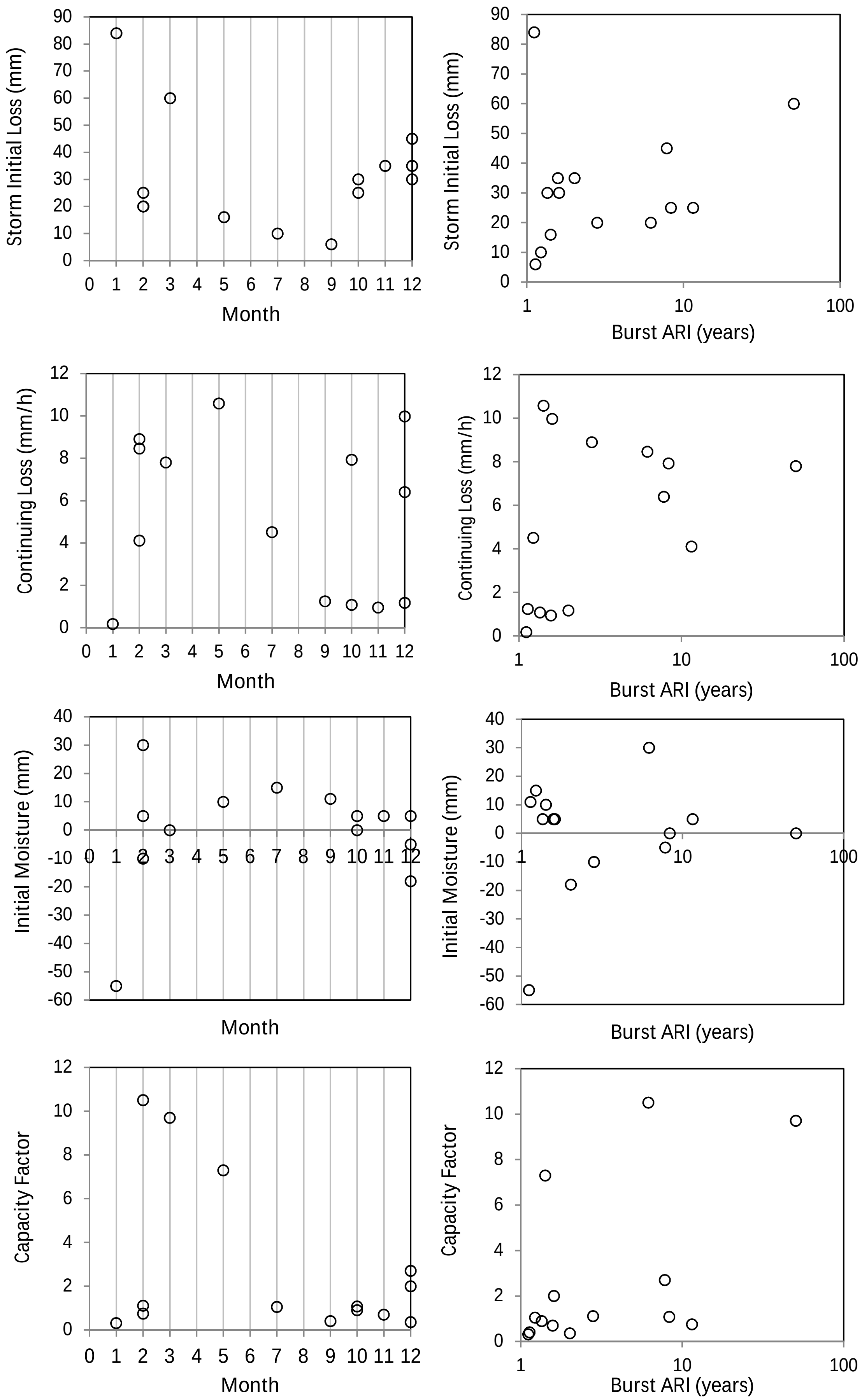




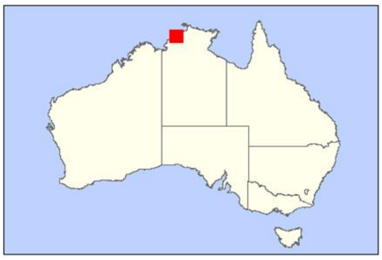


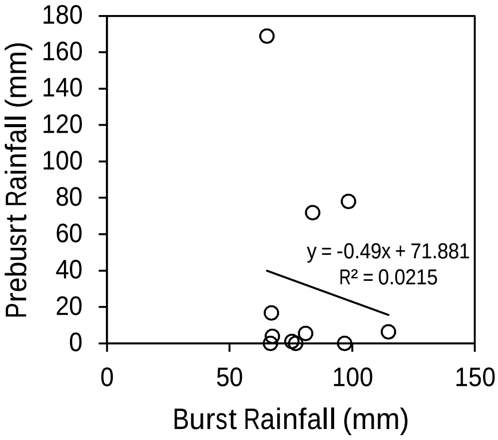


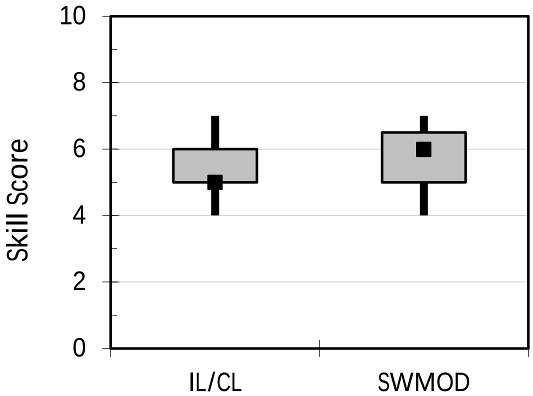
Axe Ck @ Sedgwick (VIC) - 3 hour bursts

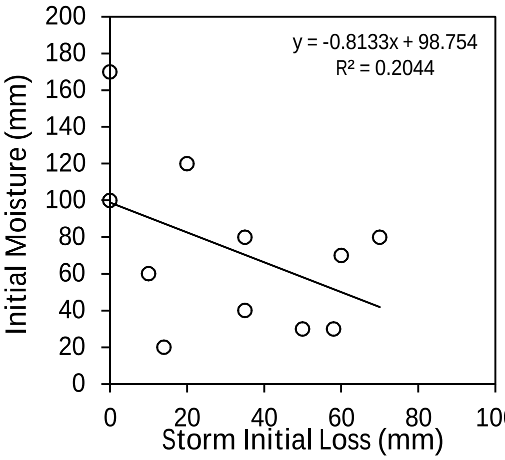


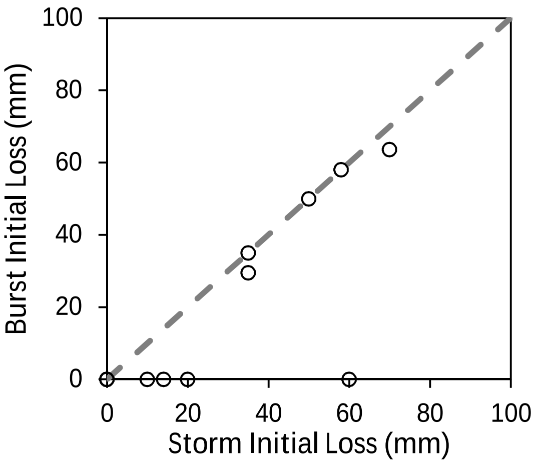
Celia Ck @ U/S Darwin R Dam (NT) - 3 hour bursts

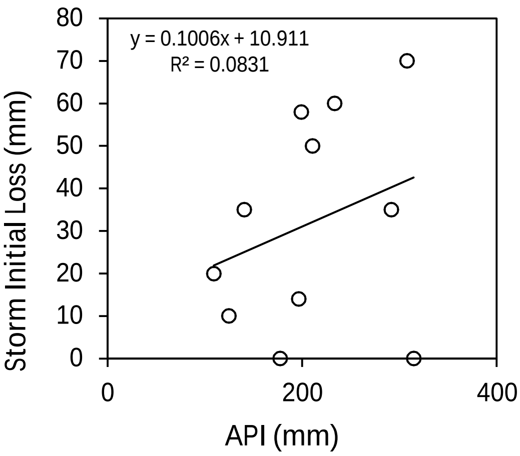


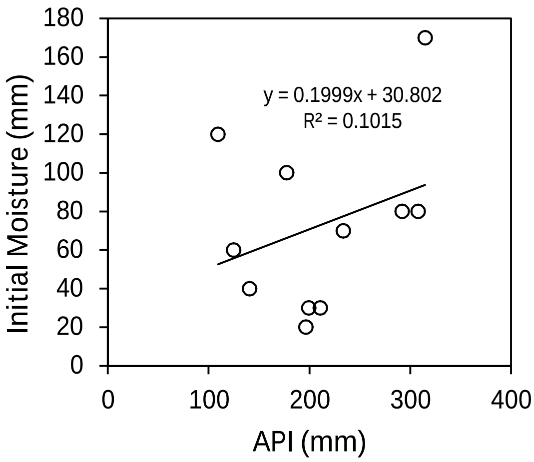




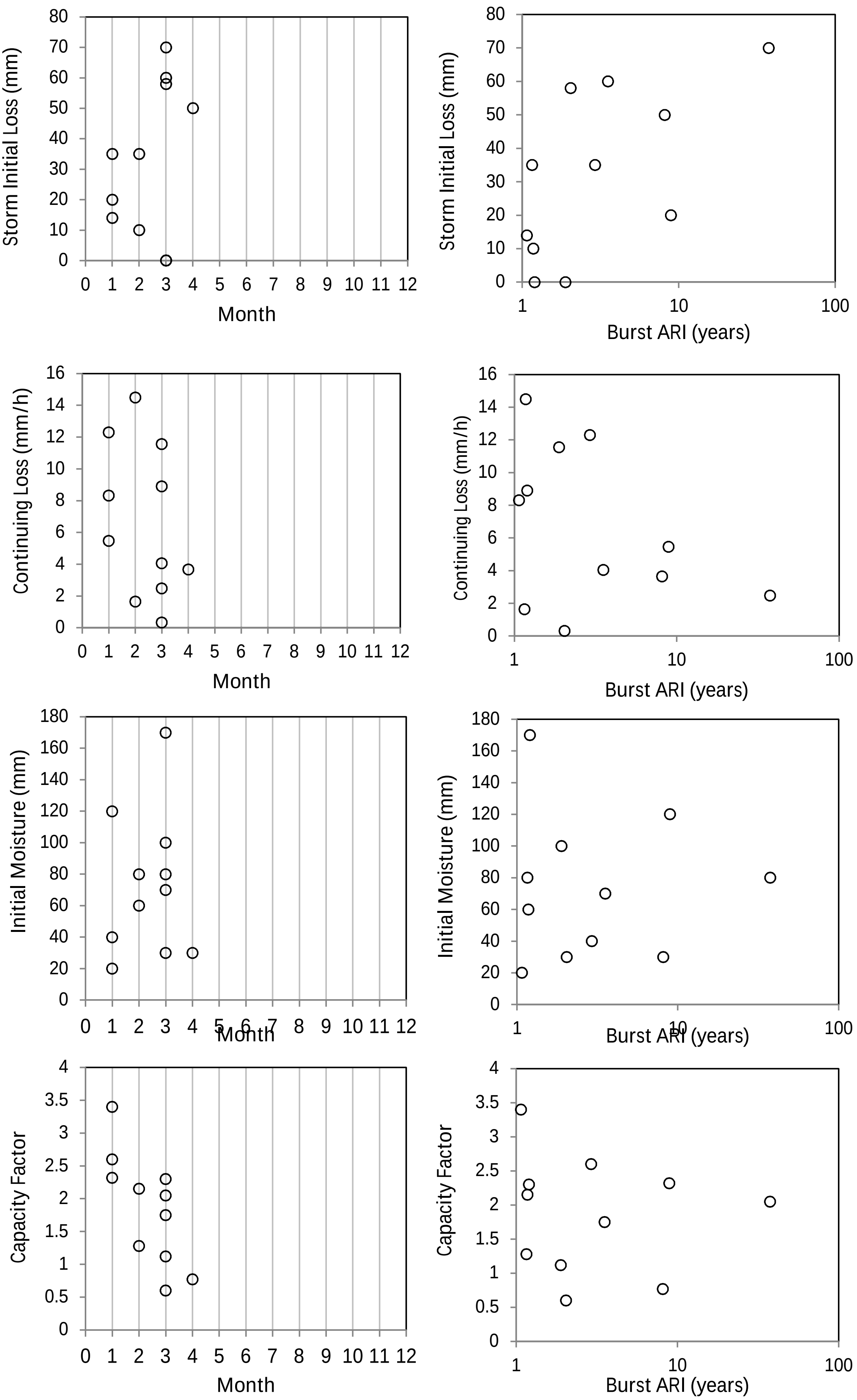




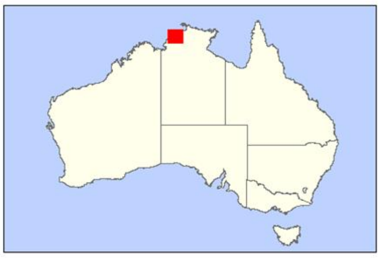


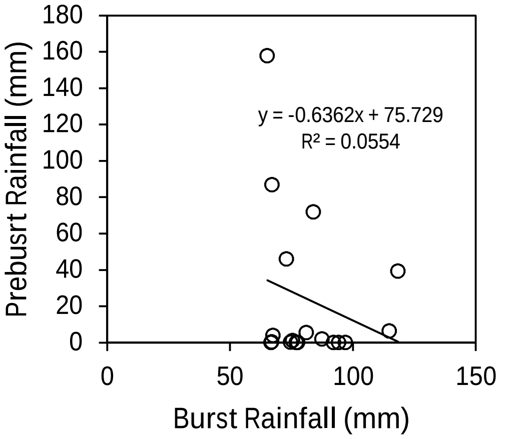


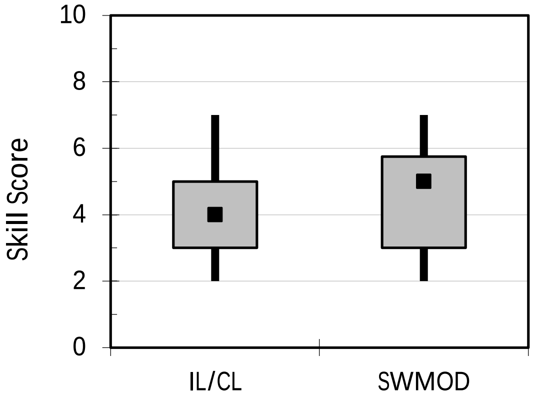
Celia Ck @ U/S Darwin R Dam (NT) - 3 hour bursts

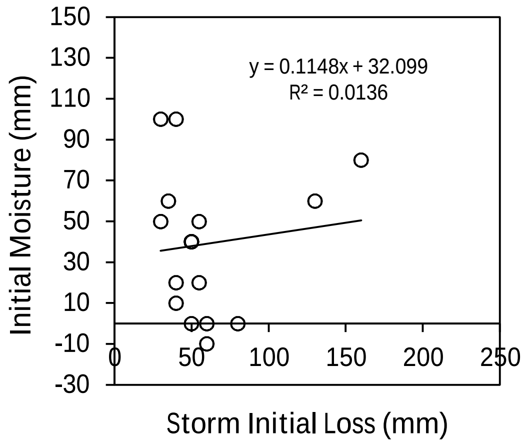


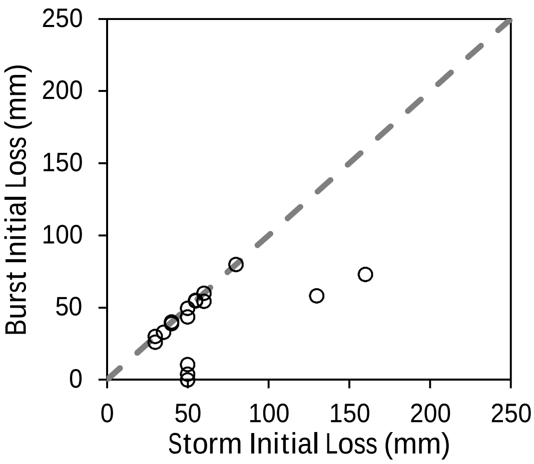
Coomalie Ck @ Stuart HWY (NT) - 3 hour bursts

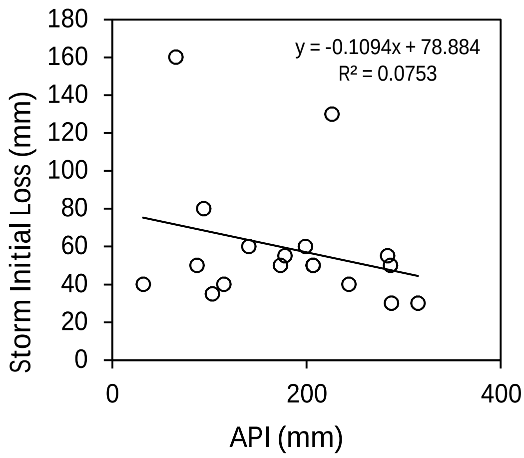


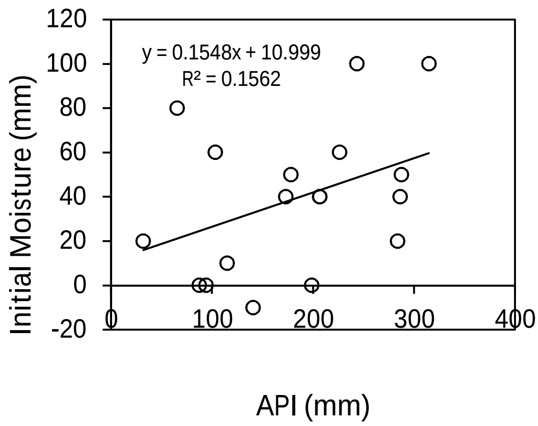




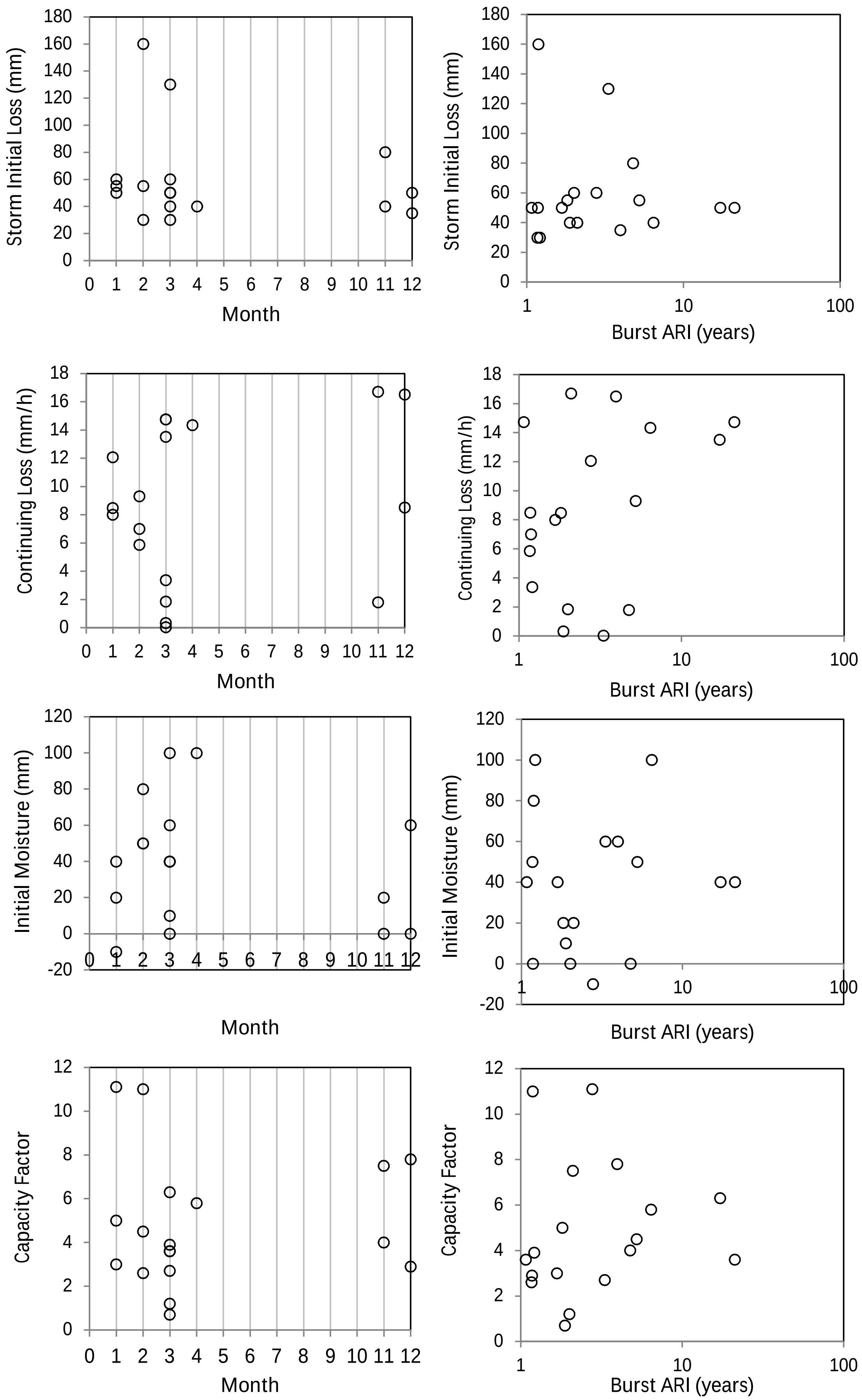




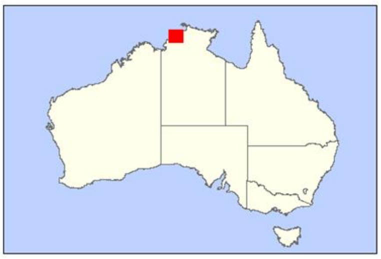


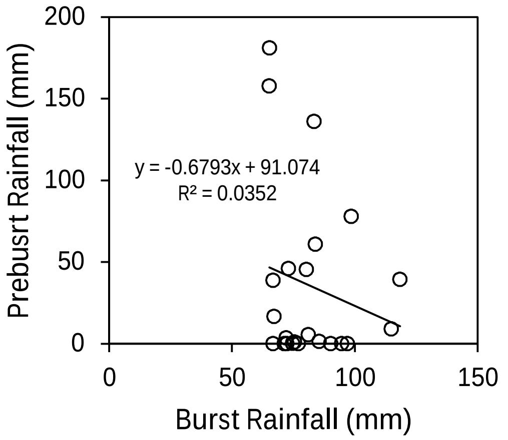


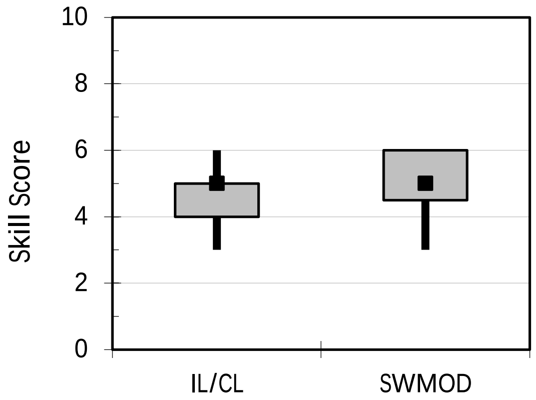
Coomalie Ck @ Stuart HWY (NT) - 3 hour bursts

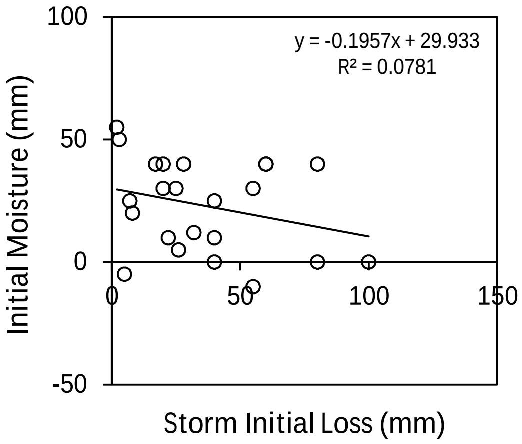


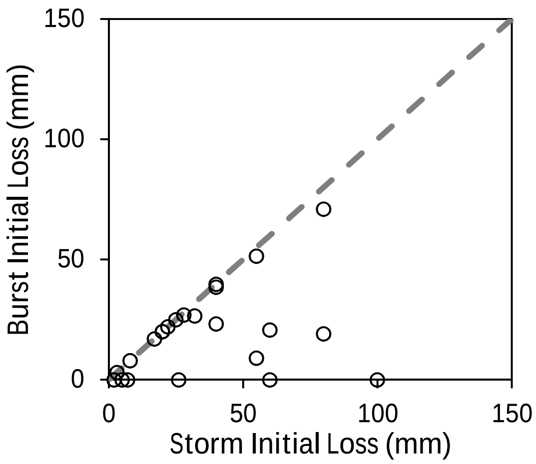
Manton R @ Manton Dam (NT) - 3 hour bursts

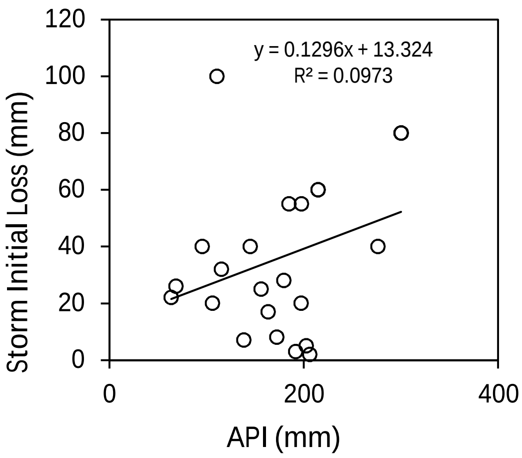


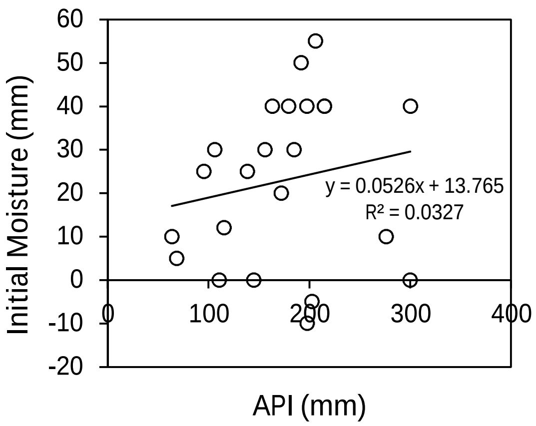




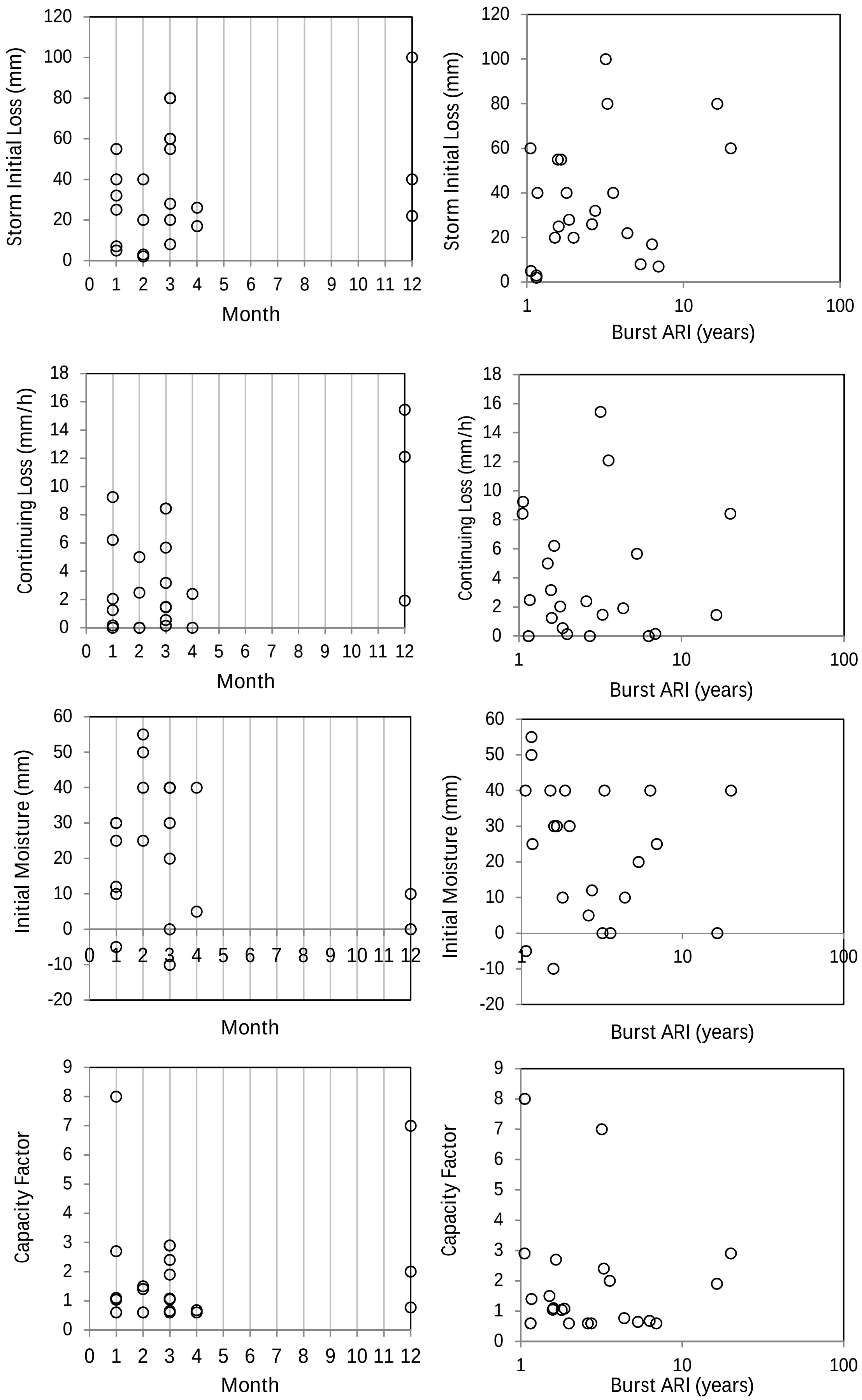




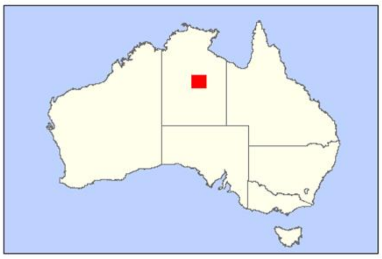


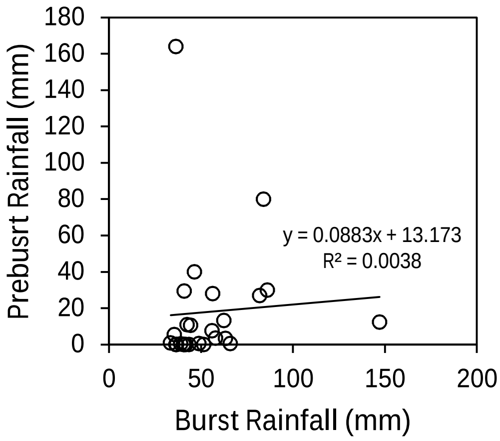


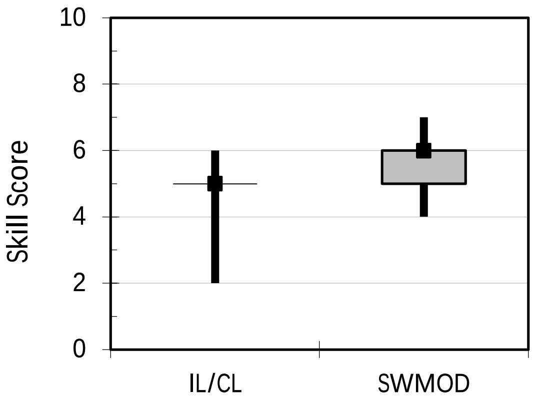
Manton R @ Manton Dam (NT) - 3 hour bursts

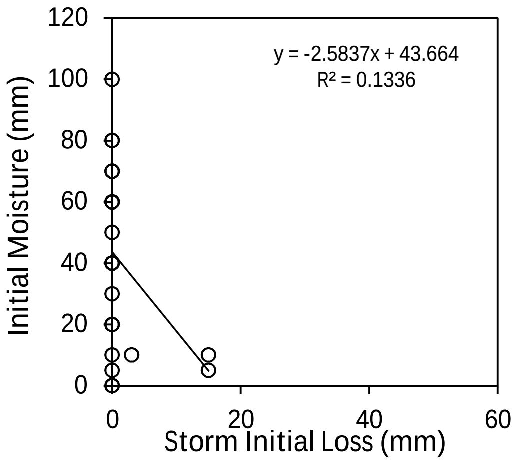


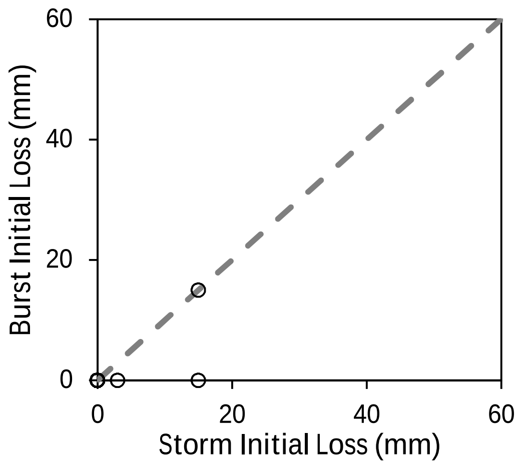
Tennant Ck @ Old Telegraph Stn (NT) - 3 hour bursts

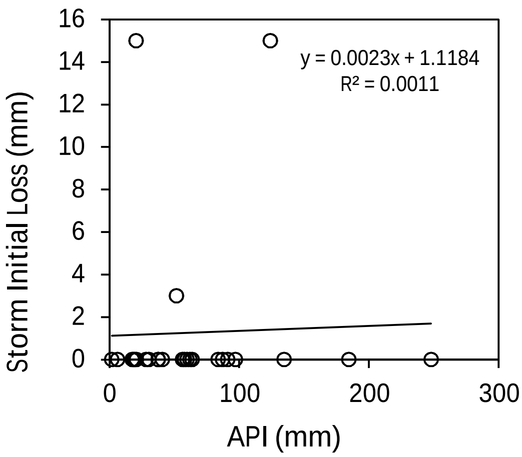


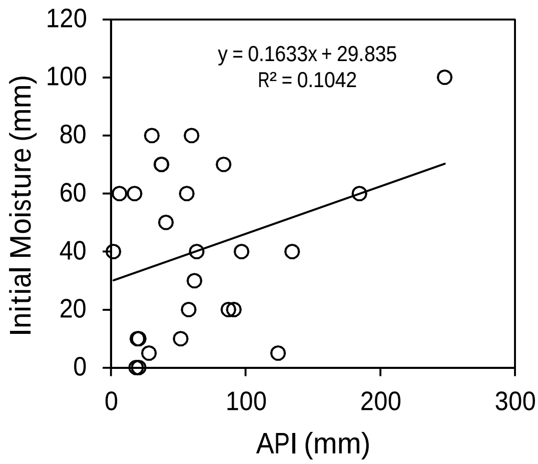




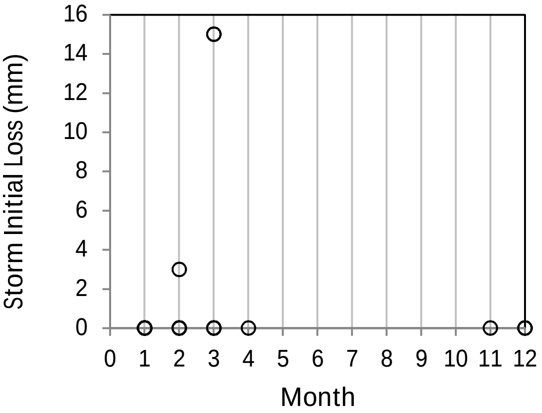


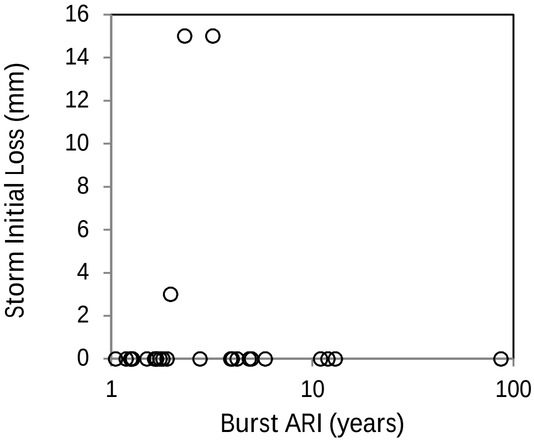


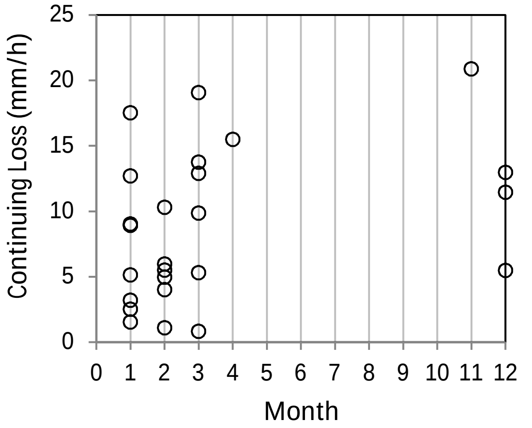


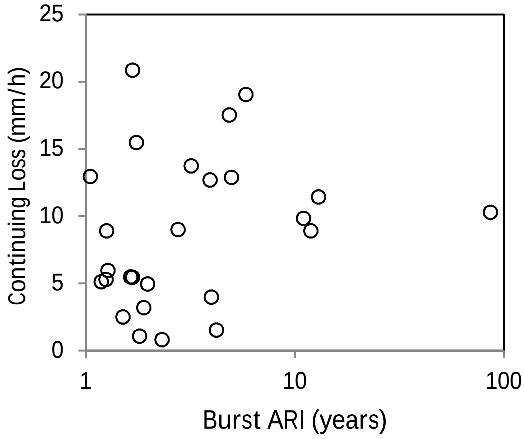


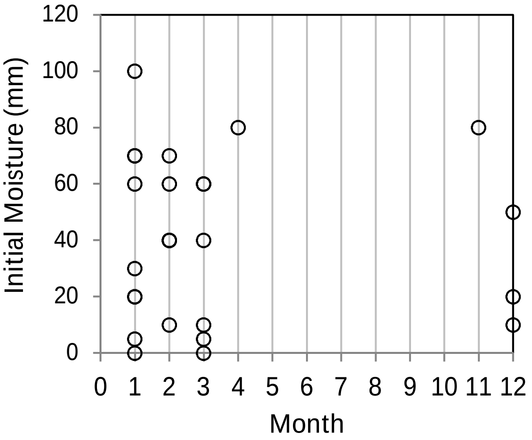
Tennant Ck @ Old Telegraph Stn (NT) - 3 hour bursts

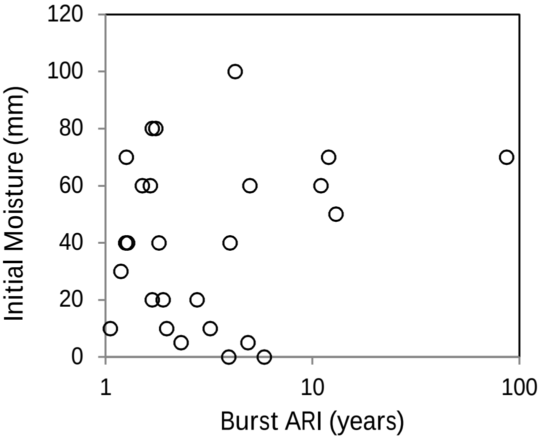


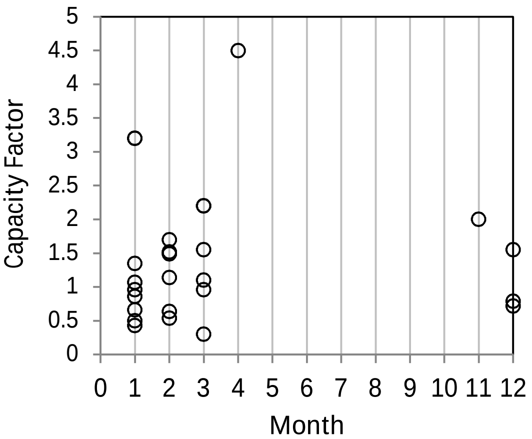


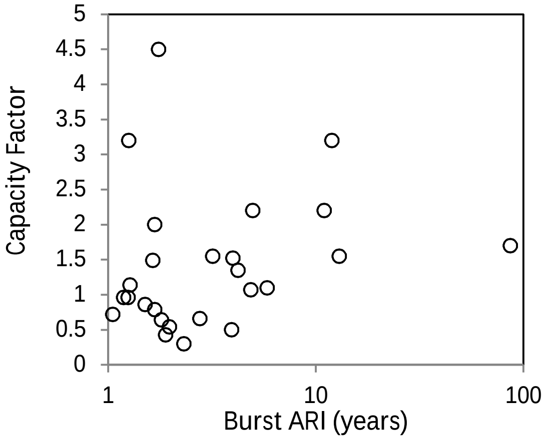




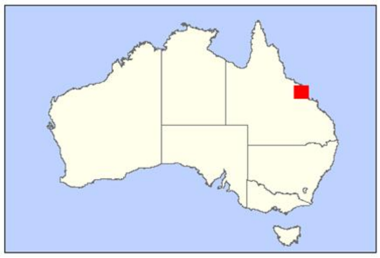


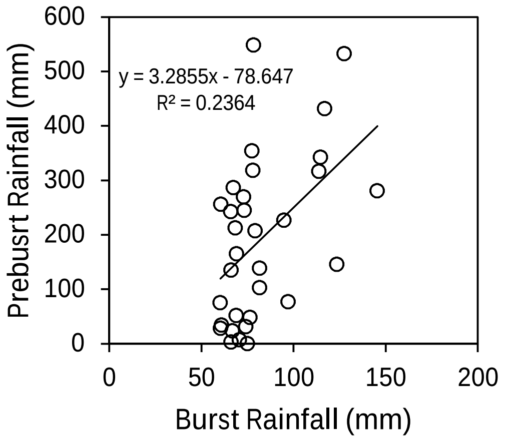


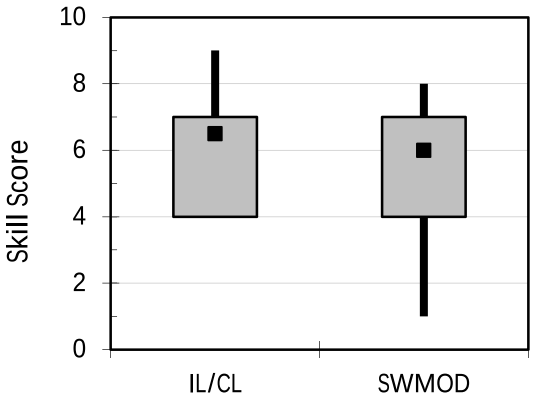


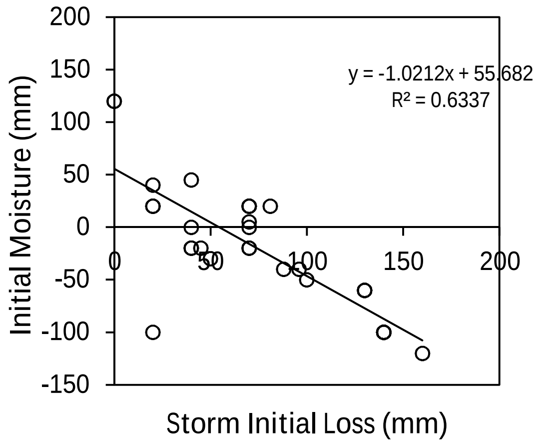


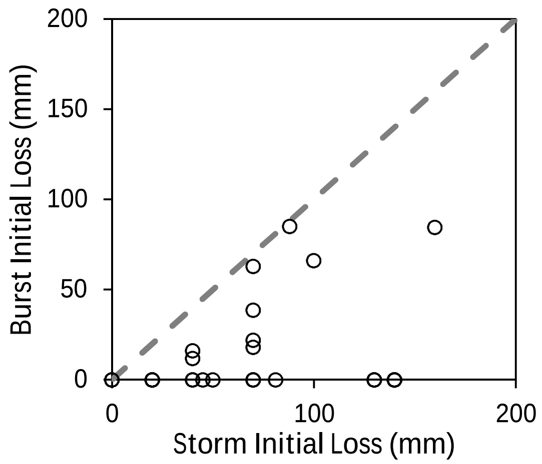
Broken @ Old Racecourse (Qld) - 3 hour bursts

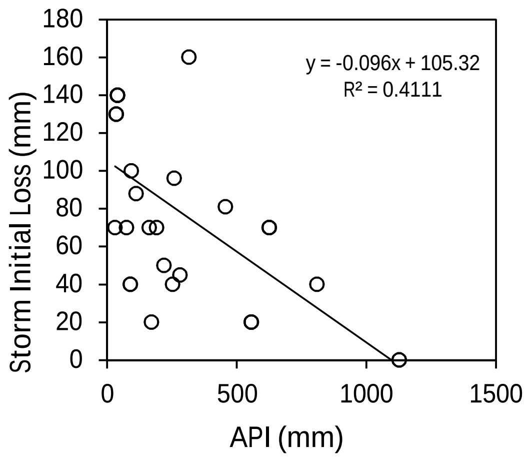


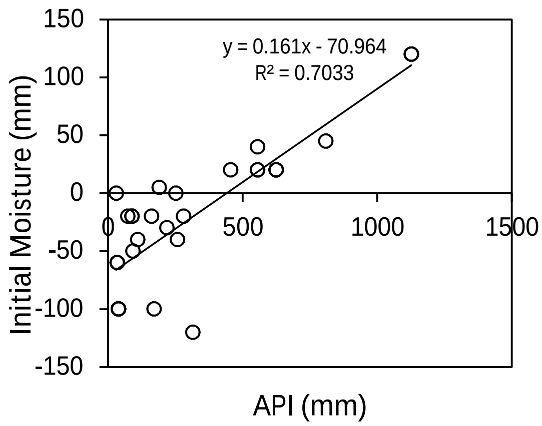




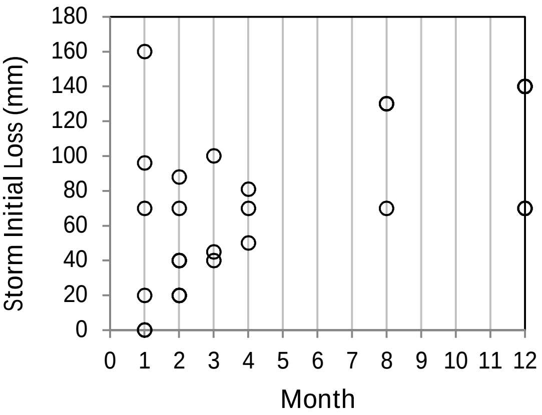


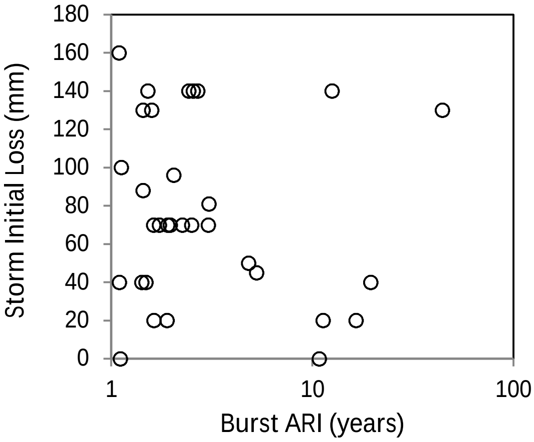


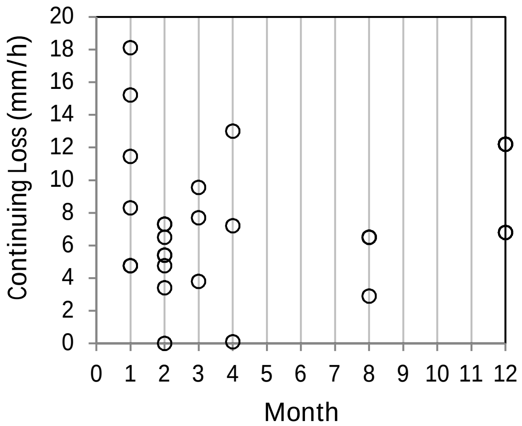


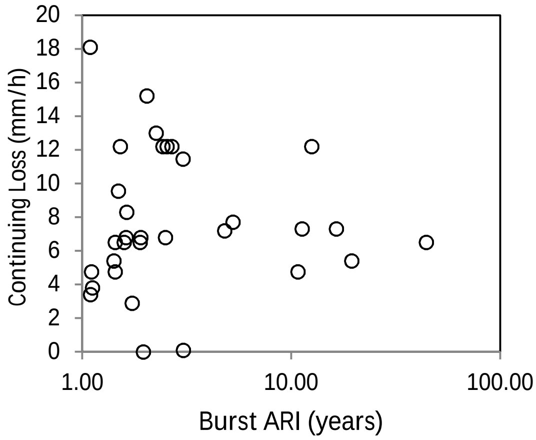


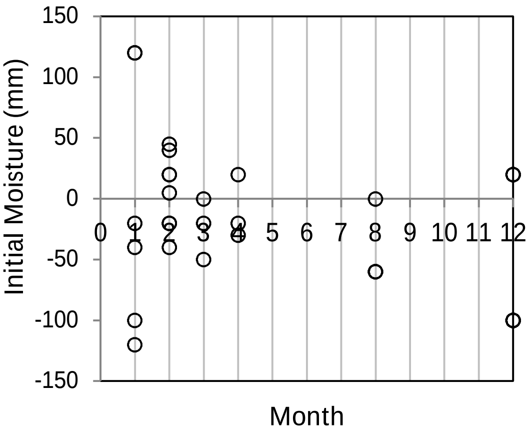
Broken @ Old Racecourse (Qld) - 3 hour bursts

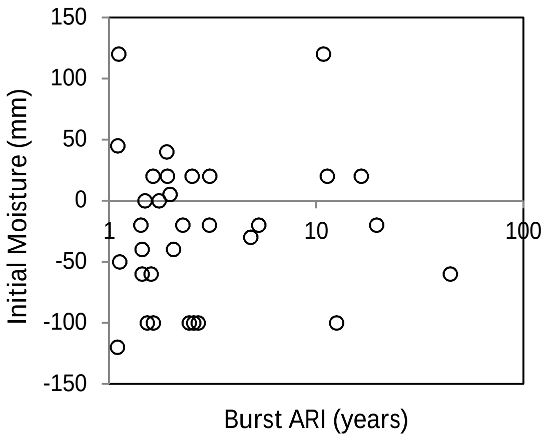


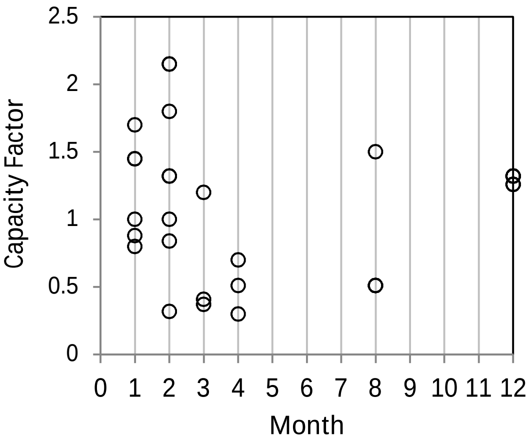


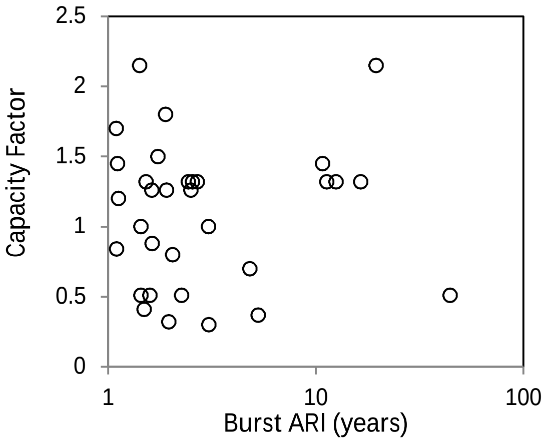




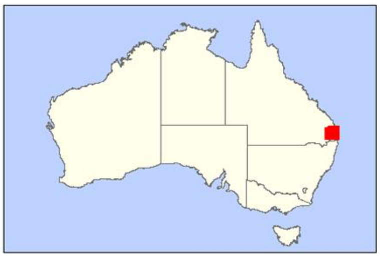


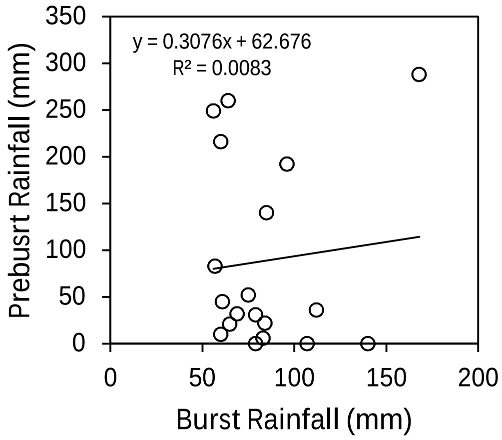


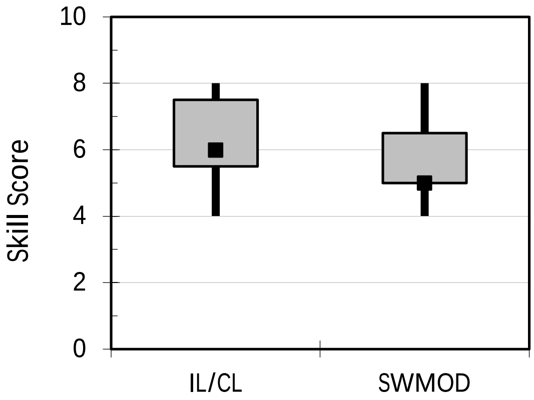


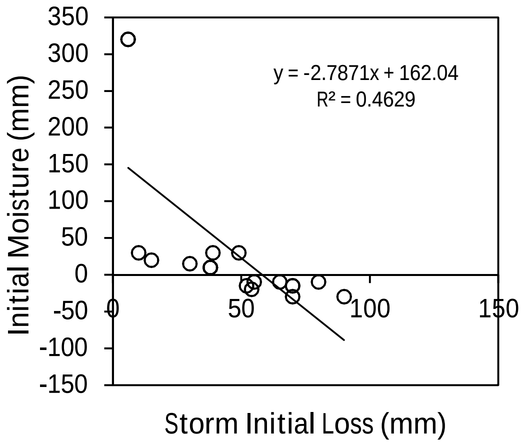


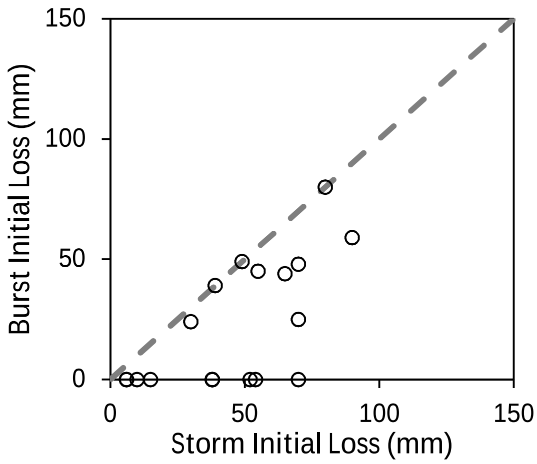
Caboolture @ Upper Caboolture (Qld) - 3 hour bursts

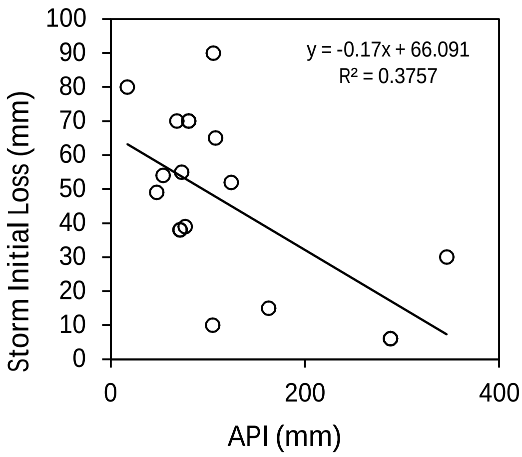


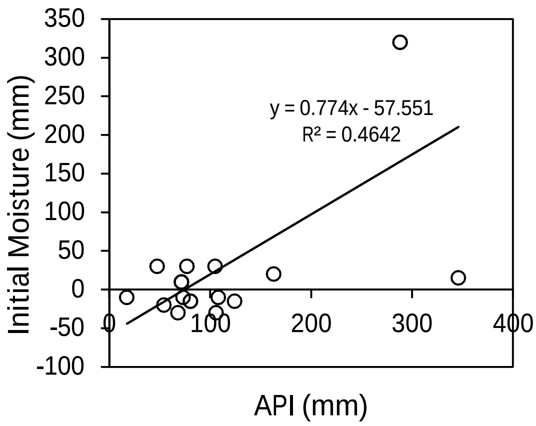




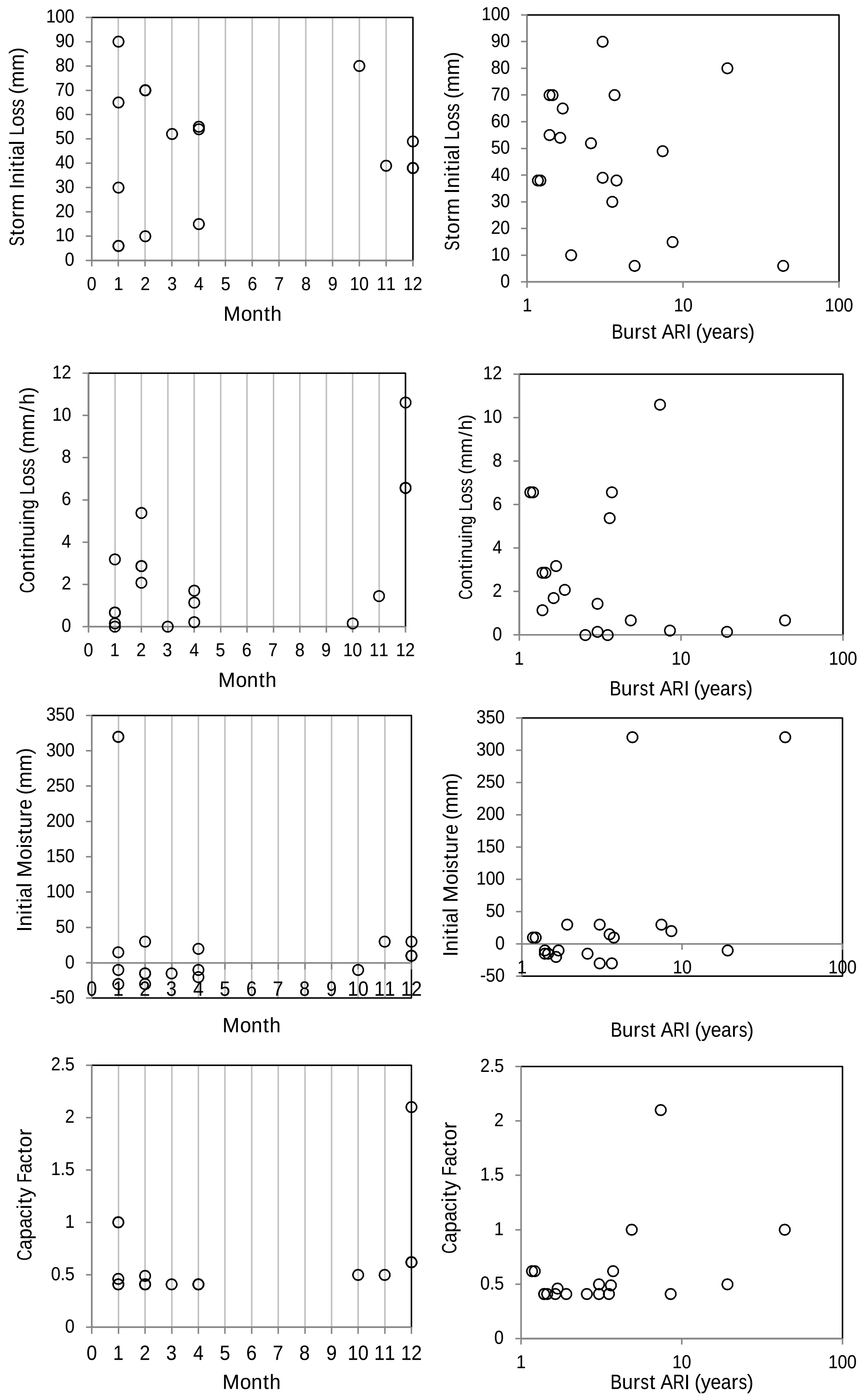




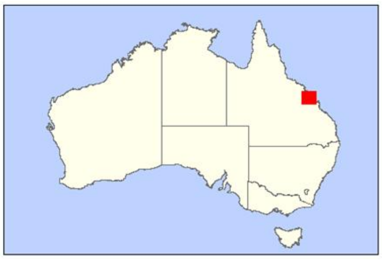


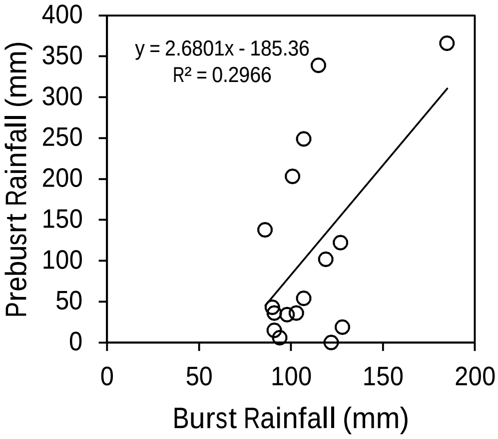


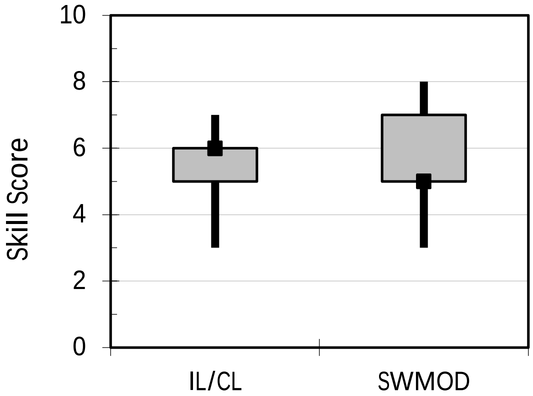
Caboolture @ Upper Caboolture (Qld) - 3 hour bursts

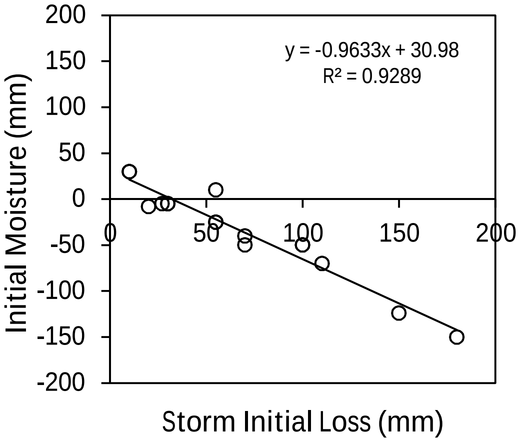


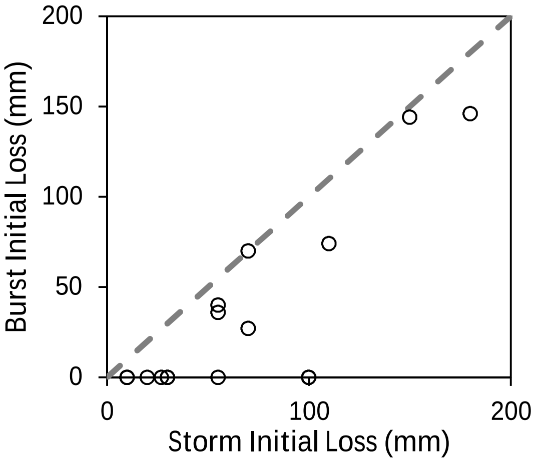
Carmila Ck @ Carmila (Qld) - 3 hour bursts

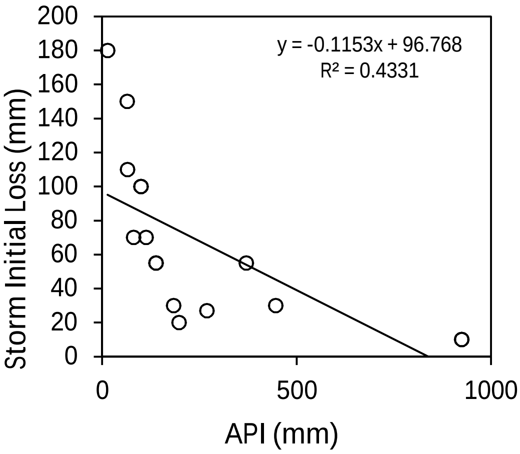


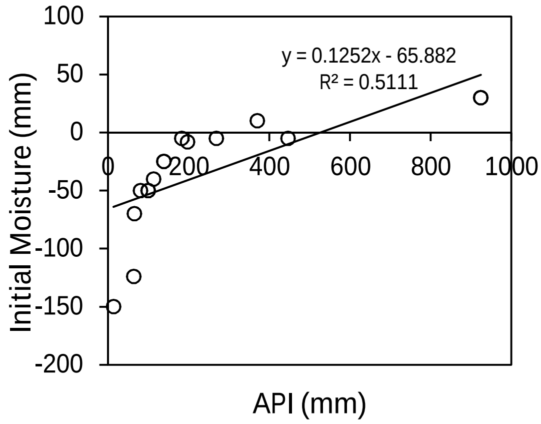




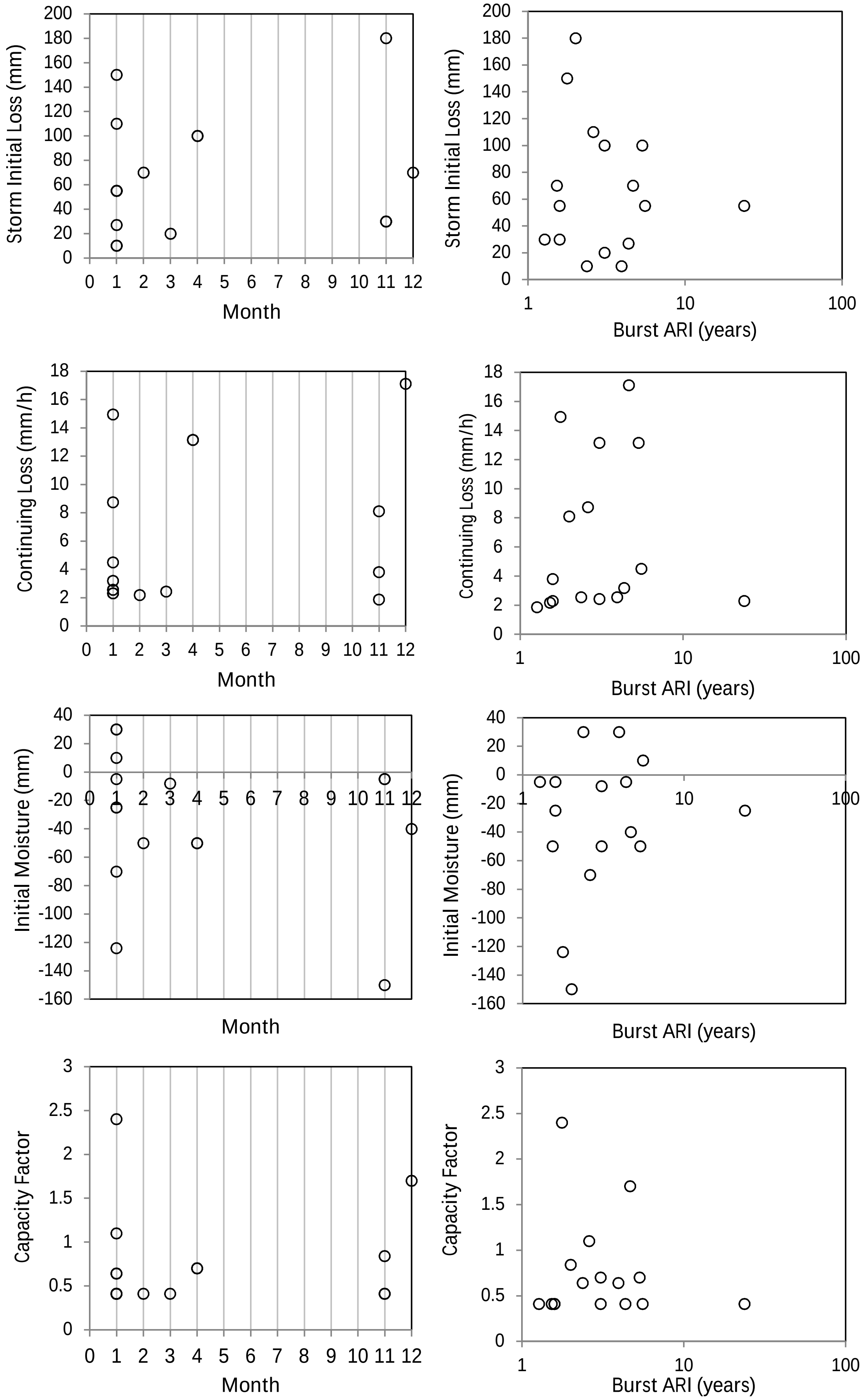




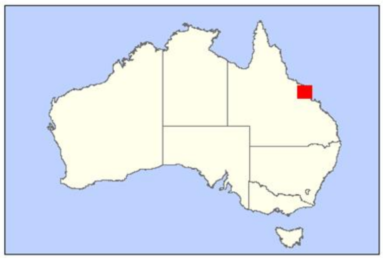


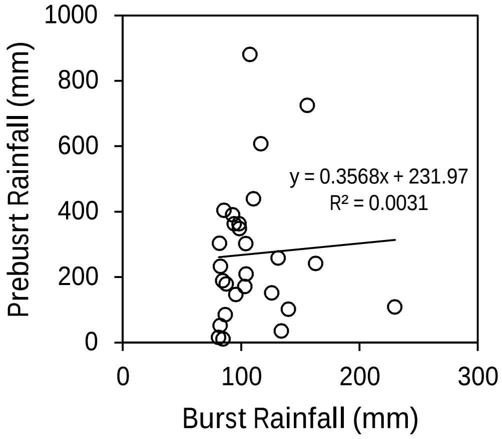


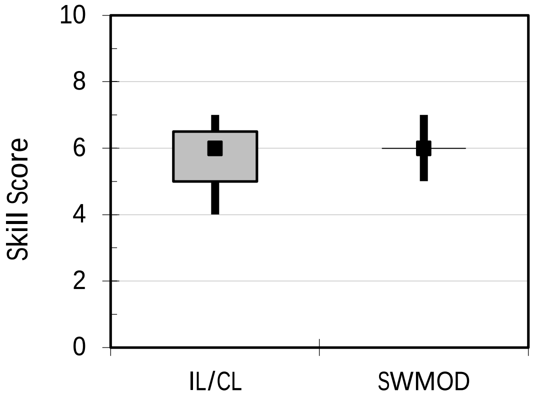
Carmila Ck @ Carmila (Qld) - 3 hour bursts

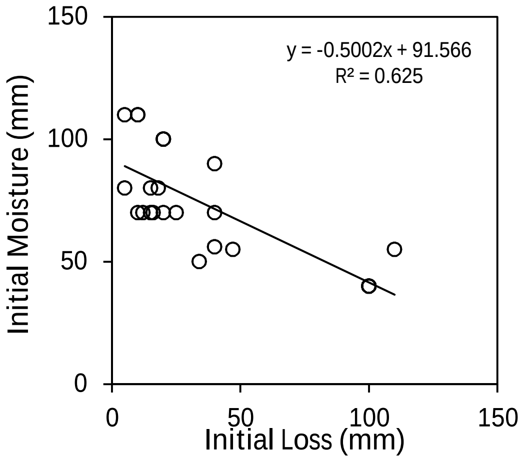


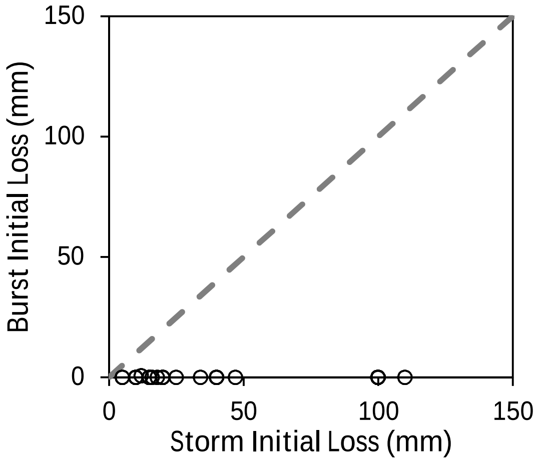
Finch Hatton Ck @ Dam Site (Qld) - 3 hour bursts

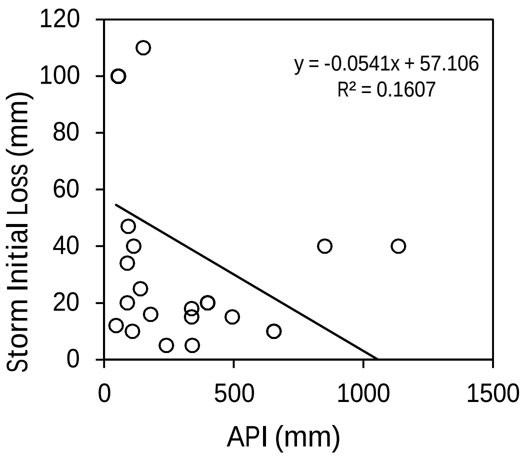


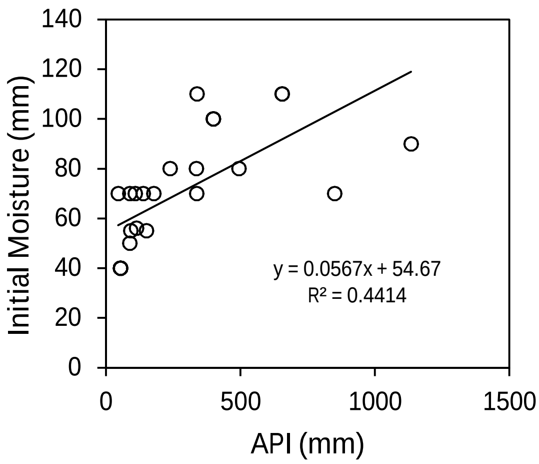




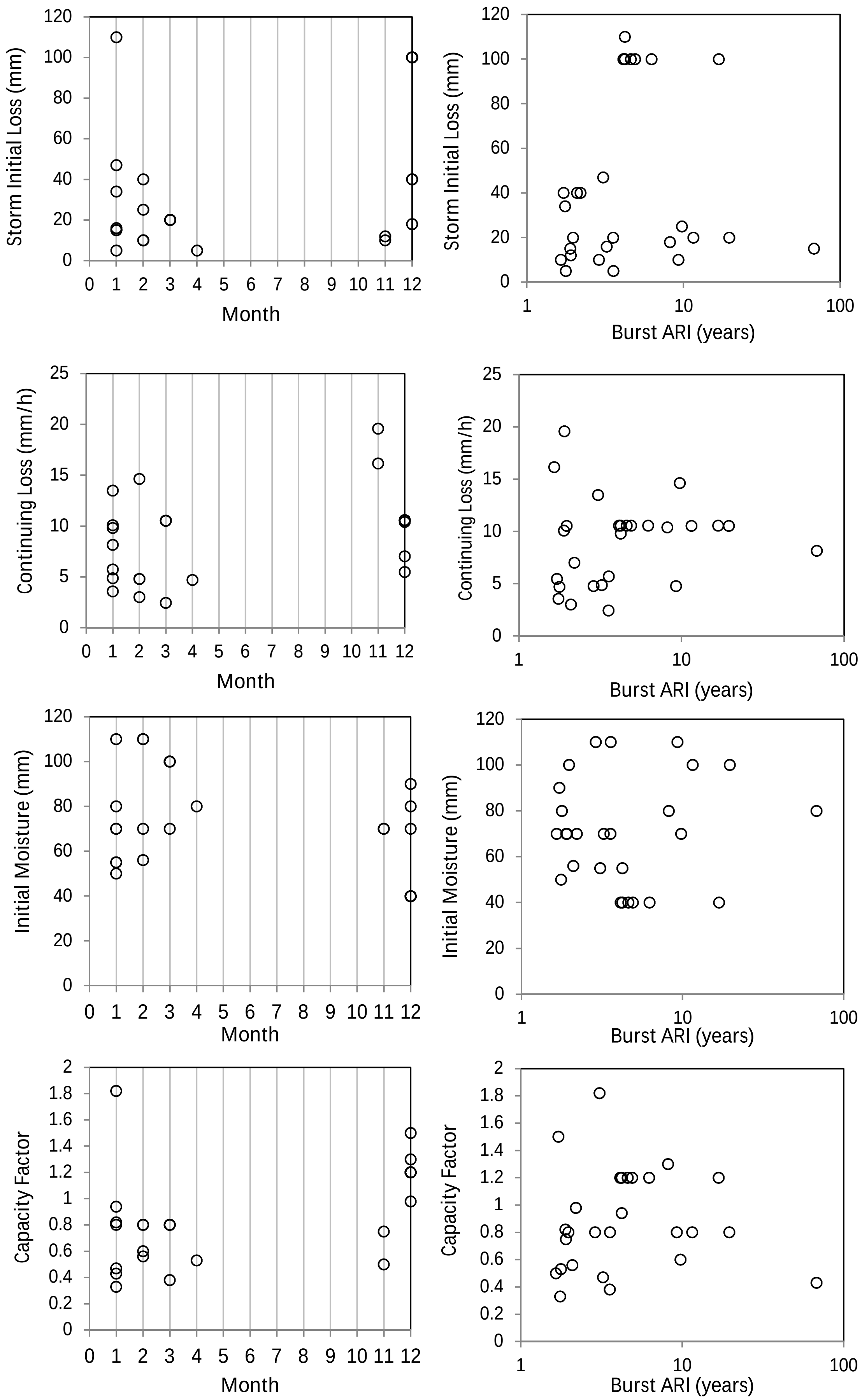




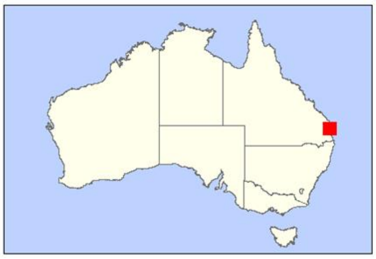


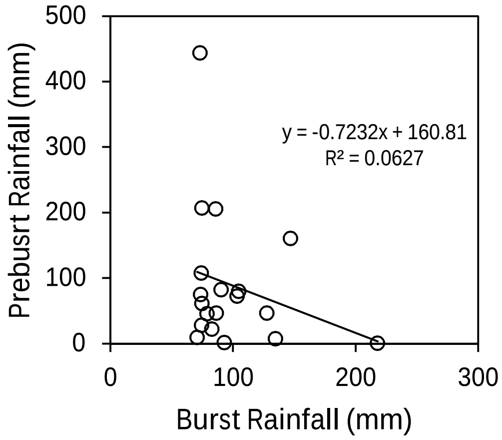


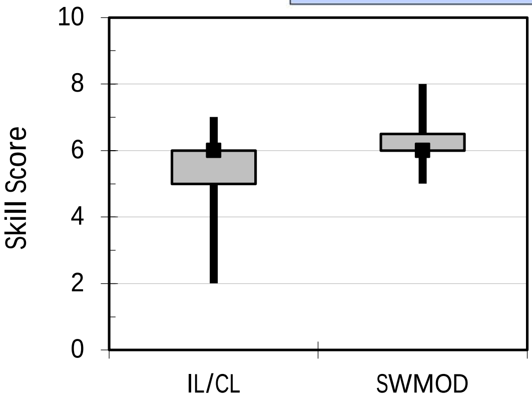
Finch Hatton Ck @ Dam Site (Qld) - 3 hour bursts

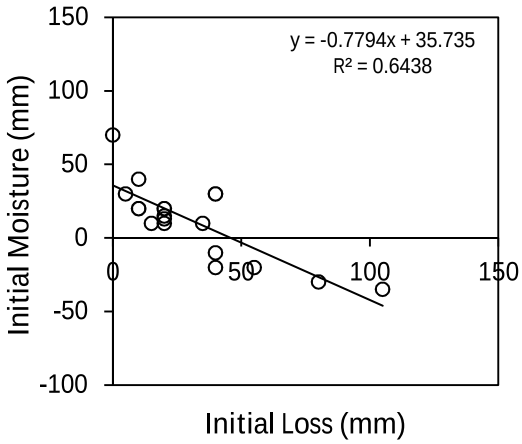


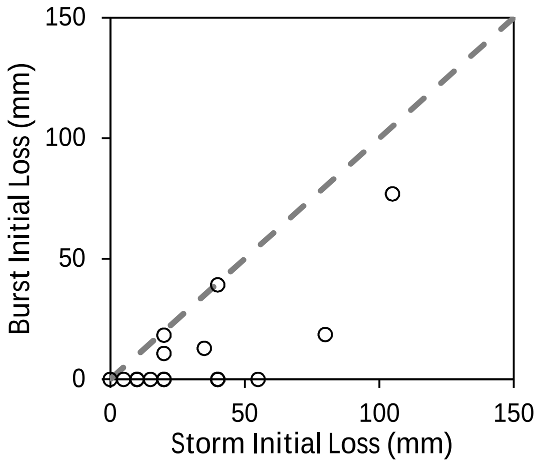
North Maroochy River @ Eumundi (Qld) - 3 hour bursts

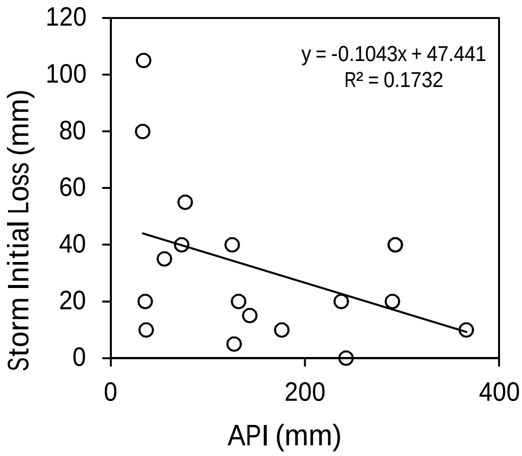


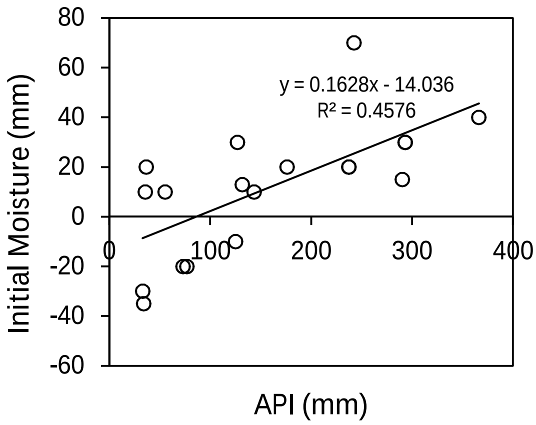




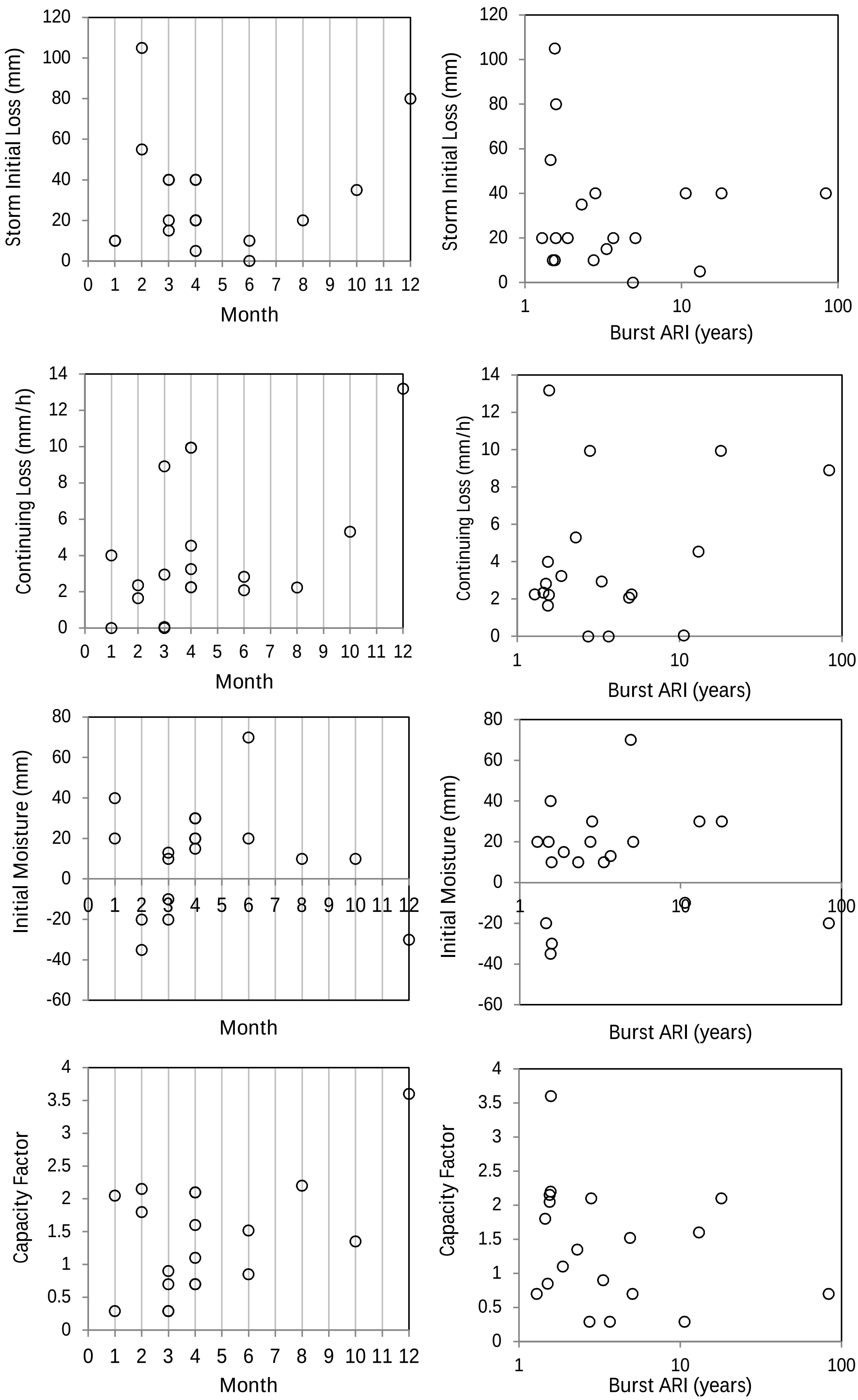




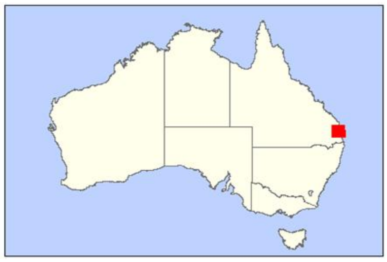


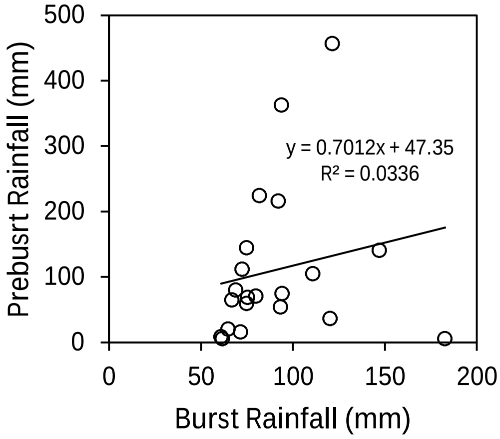


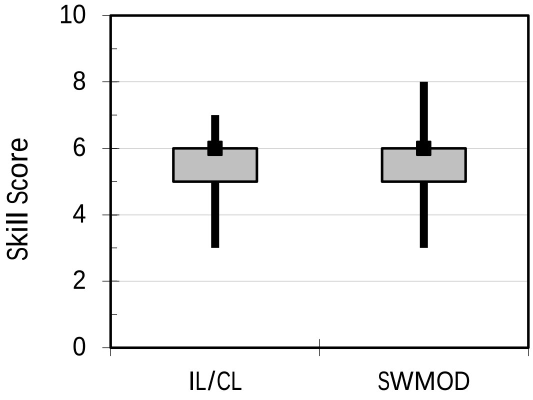
North Maroochy River @ Eumundi (Qld) - 3 hour bursts

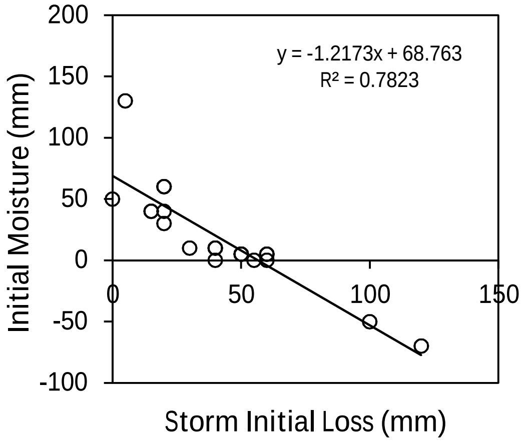


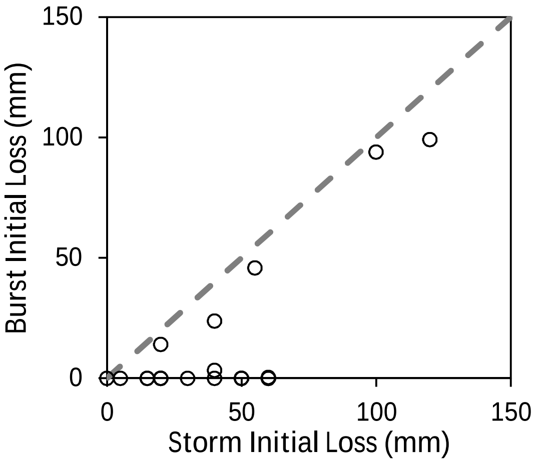
South Maroochy @ Kiamba (QLD) - 3 hour bursts

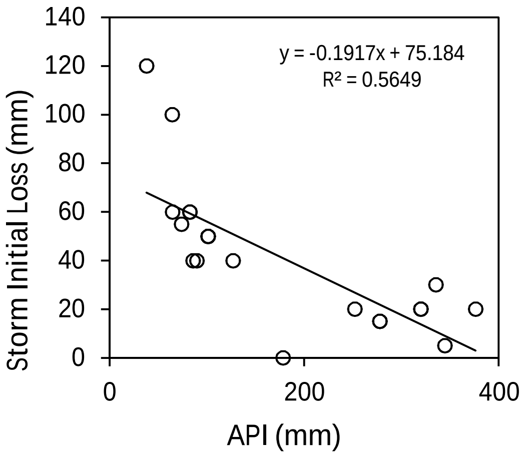


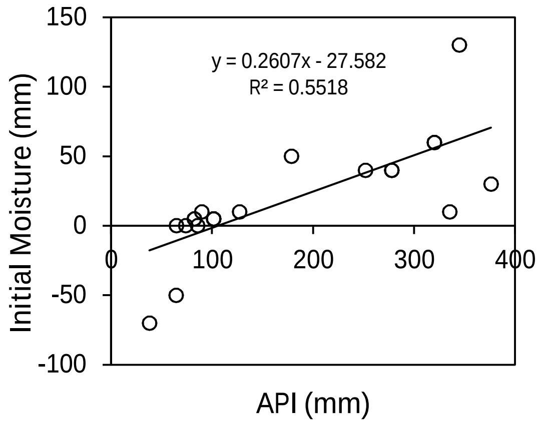




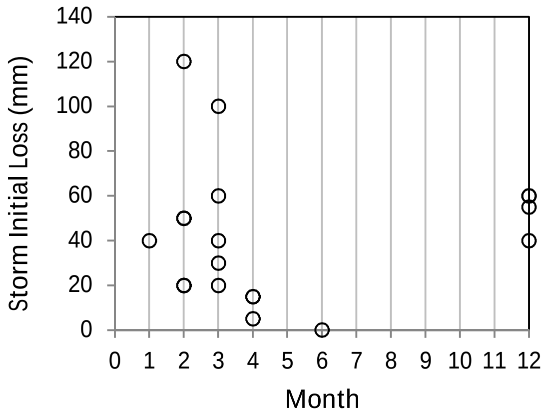


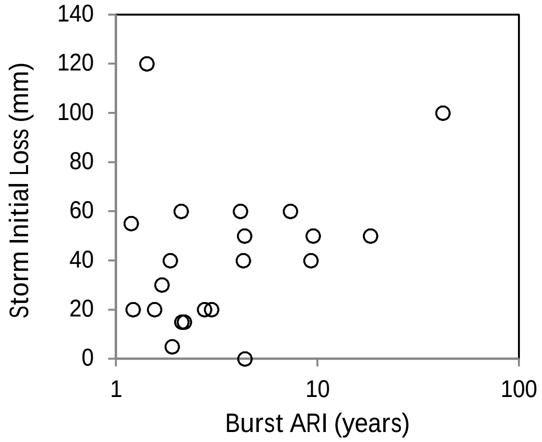


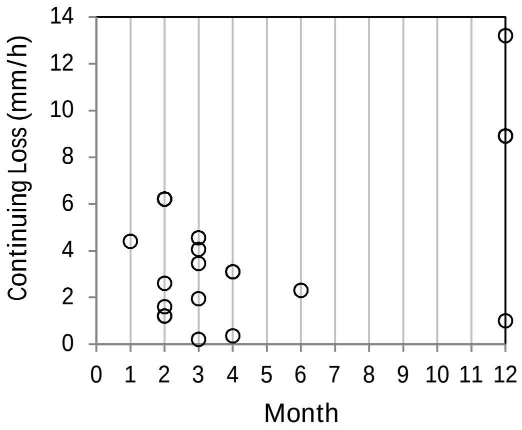


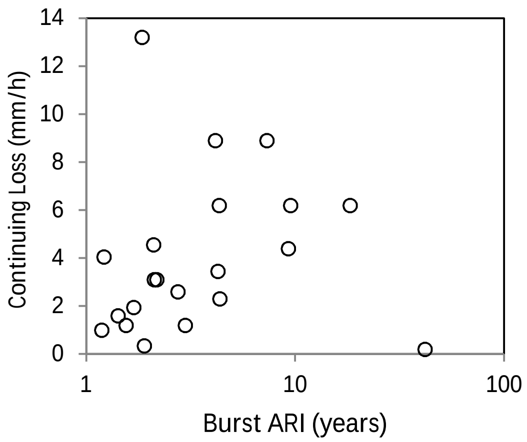


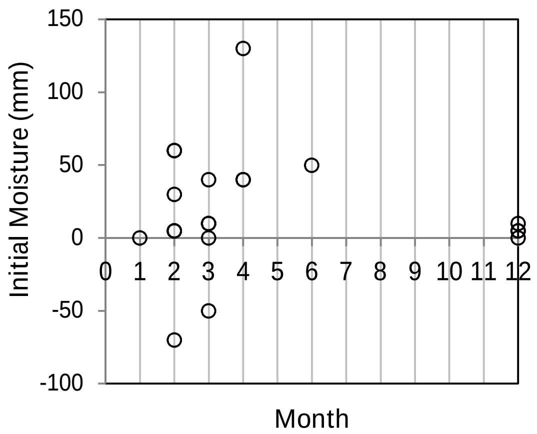
South Maroochy @ Kiamba (QLD) - 3 hour bursts

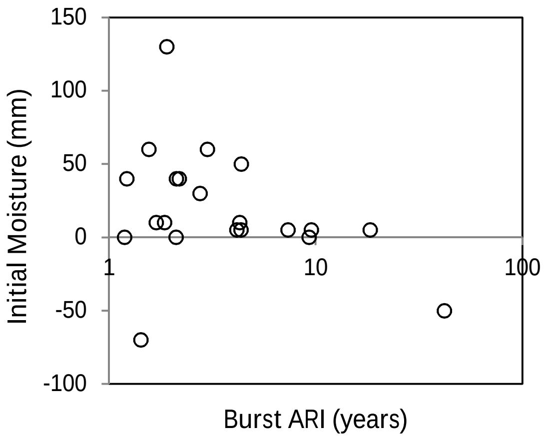


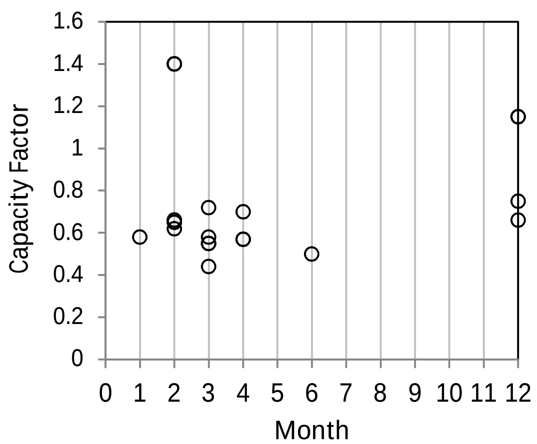


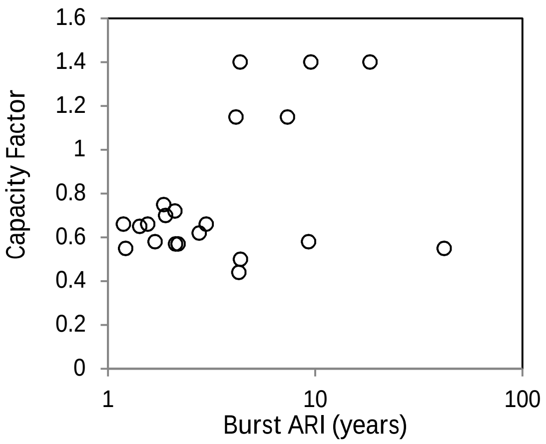




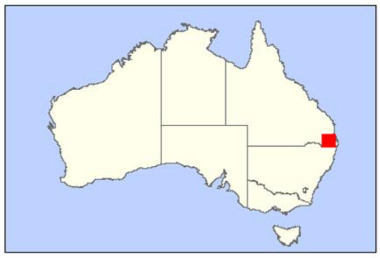


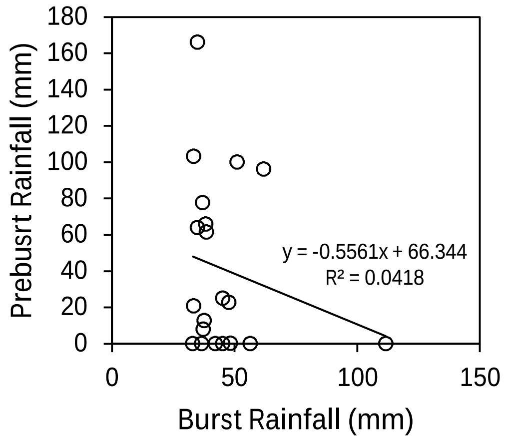


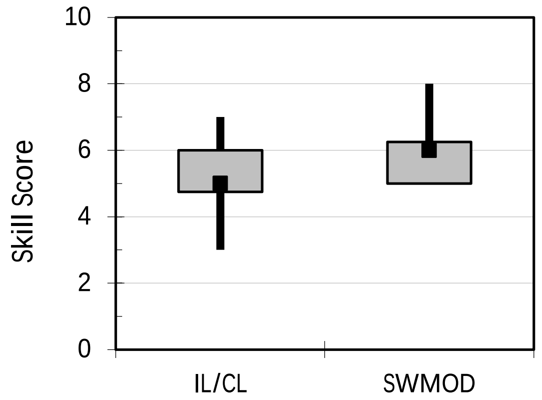


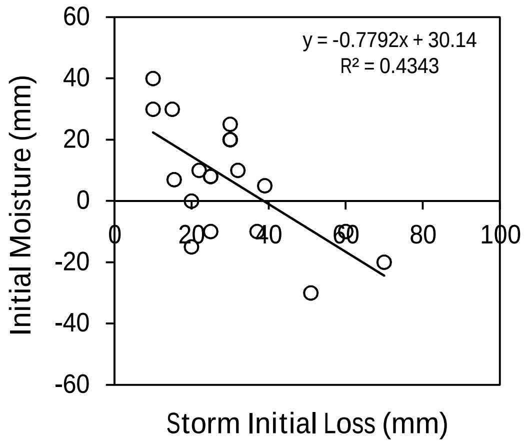


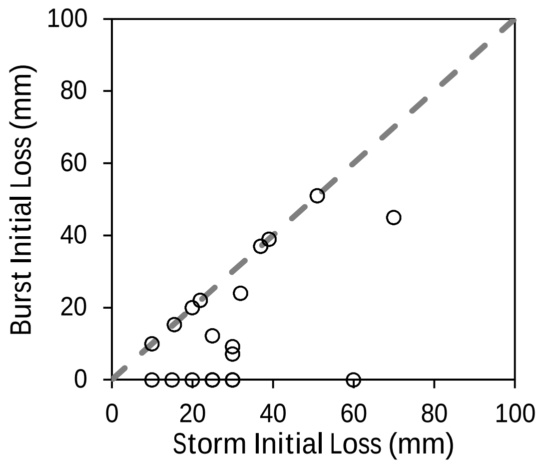
Spring Ck @ Killarney (Qld) - 3 hour bursts

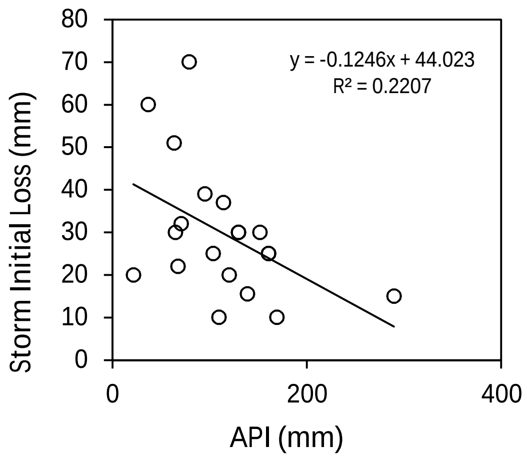


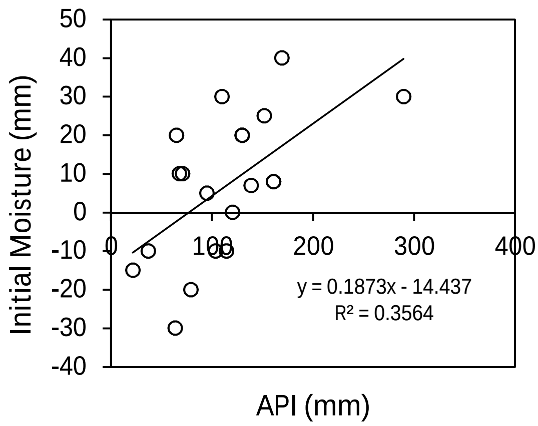




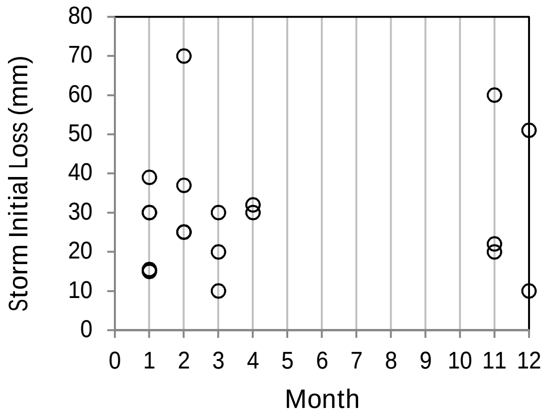


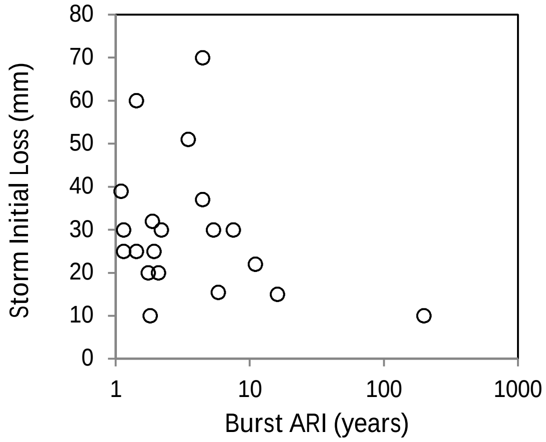


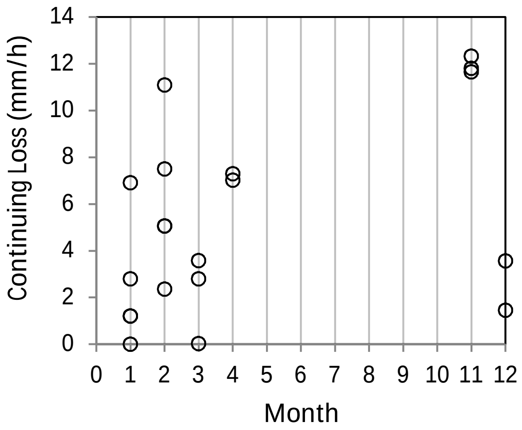


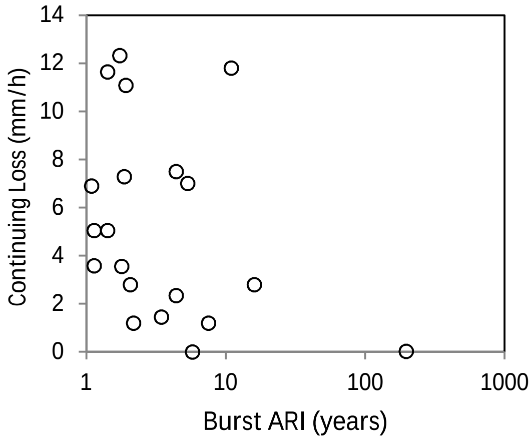


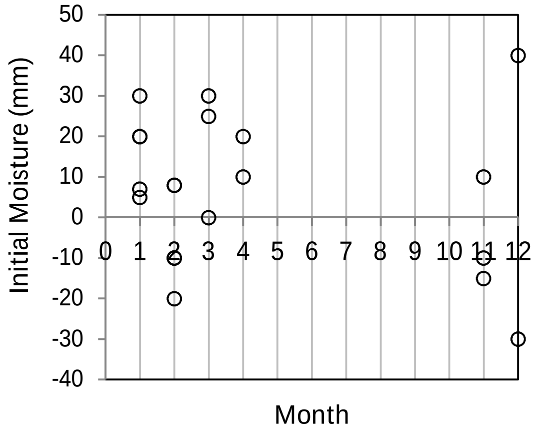
Spring Ck @ Killarney (Qld) - 3 hour bursts

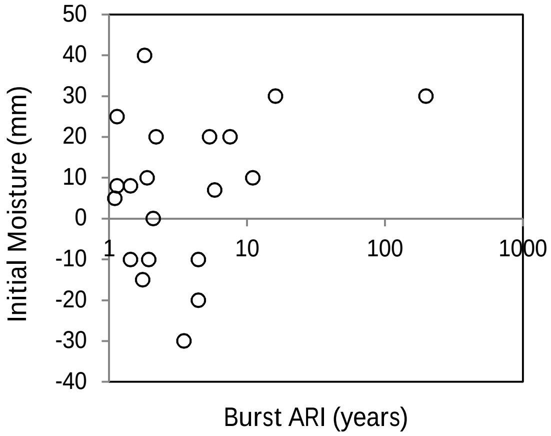


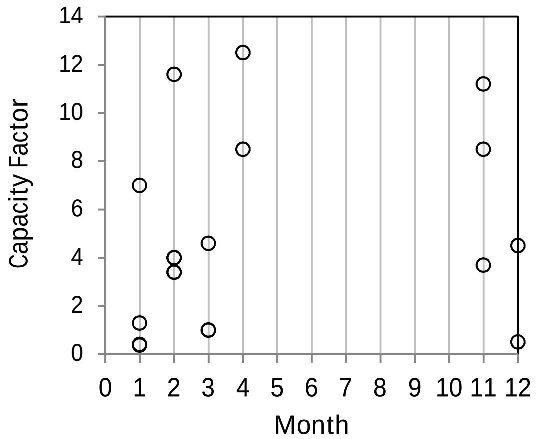


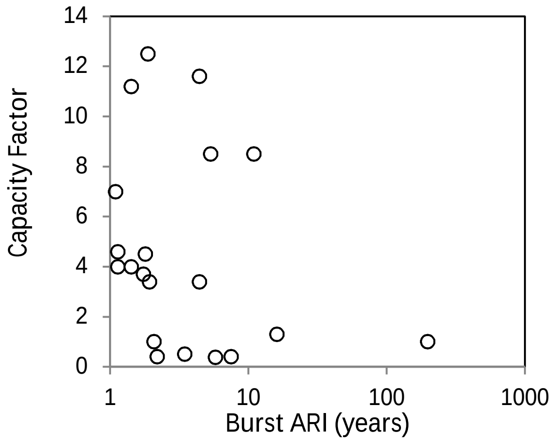




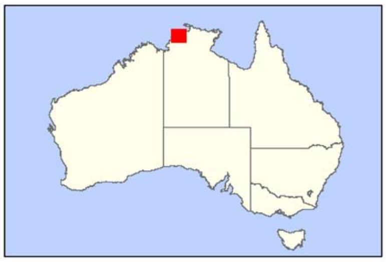


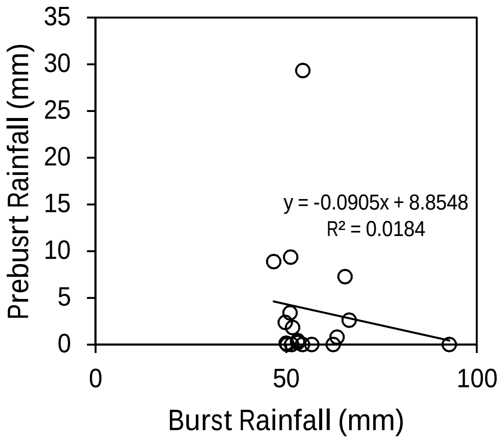


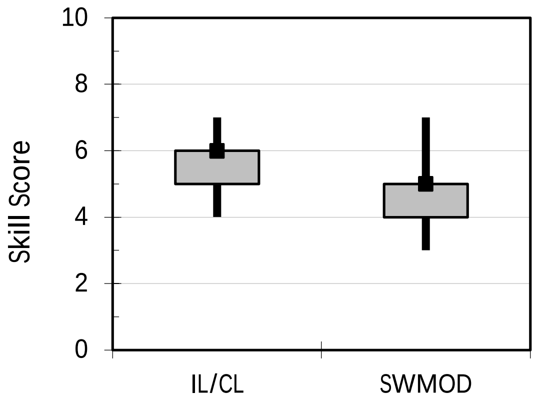


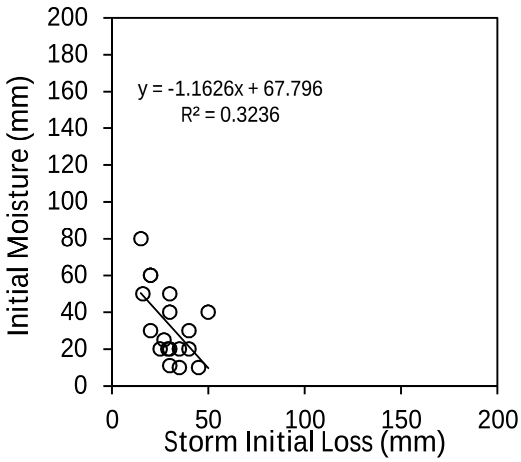


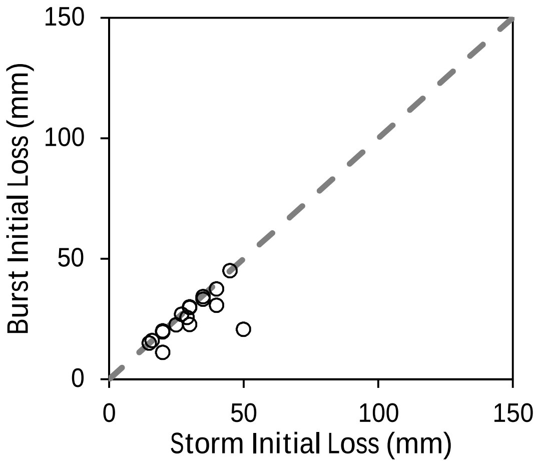
Loss Summary - Fletcher Ck @ Frog Hollow (WA) - 3 hour bursts

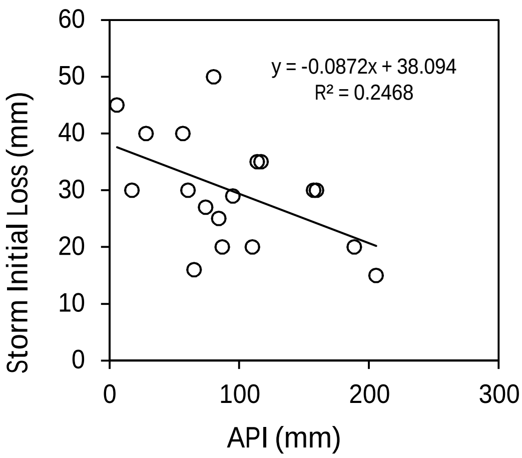


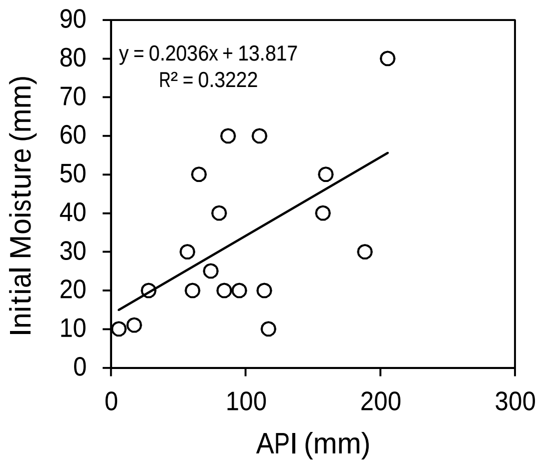




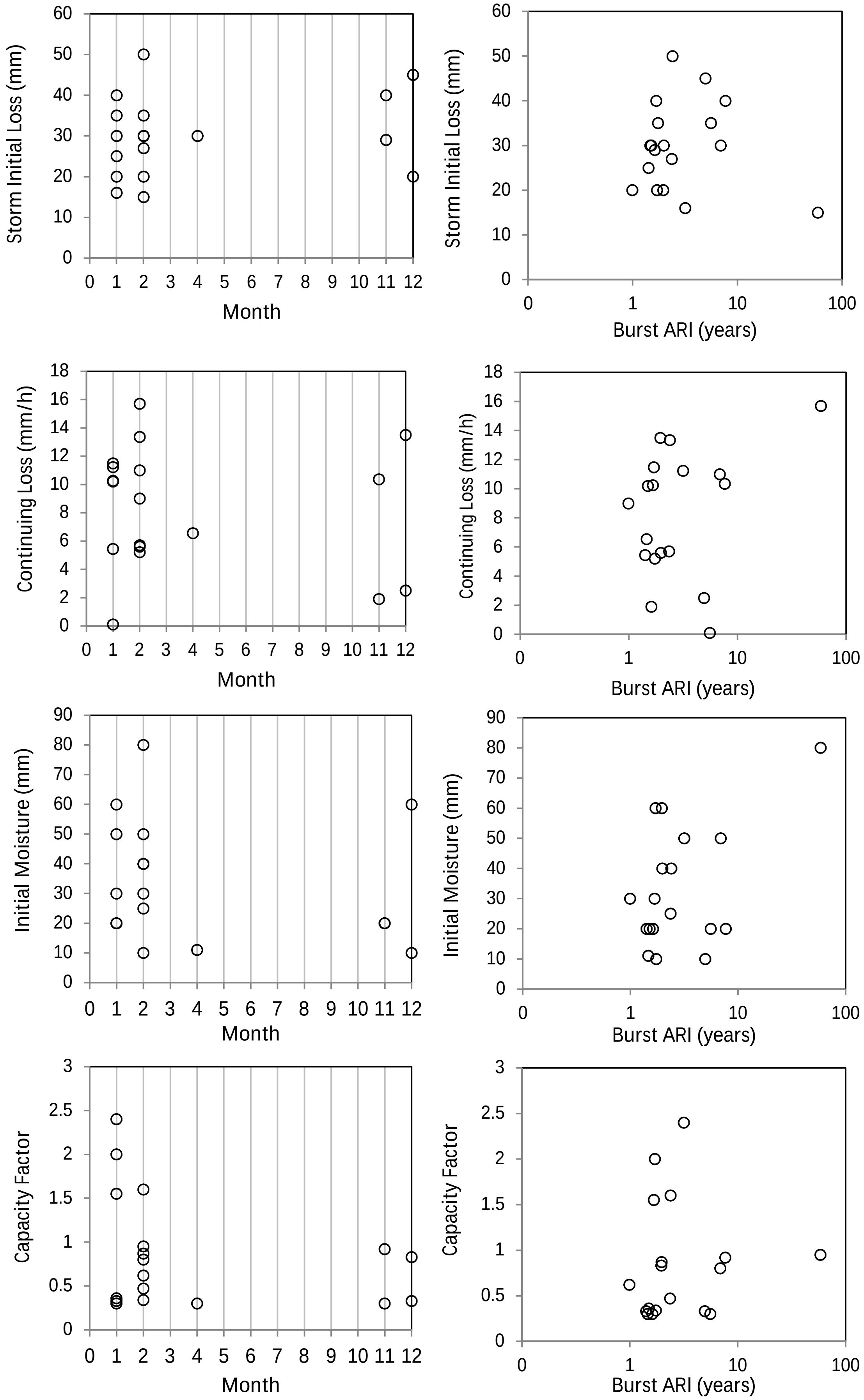




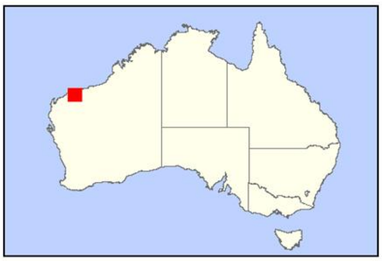


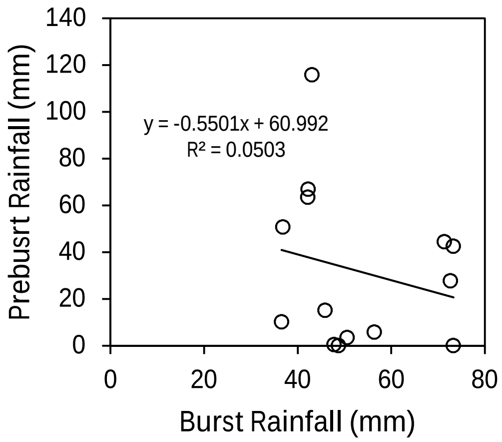


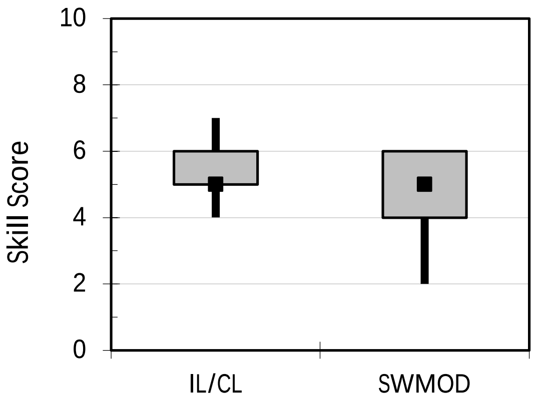
Loss Summary - Fletcher Ck @ Frog Hollow (WA) - 3 hour bursts

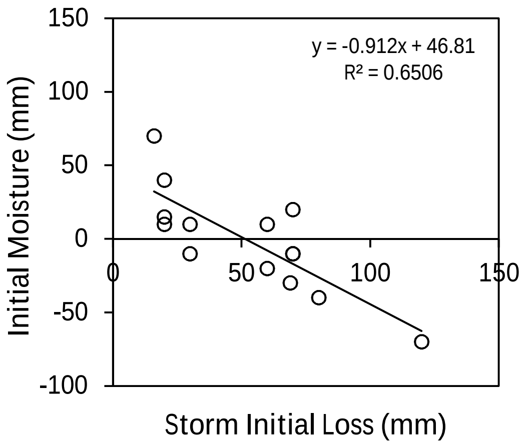


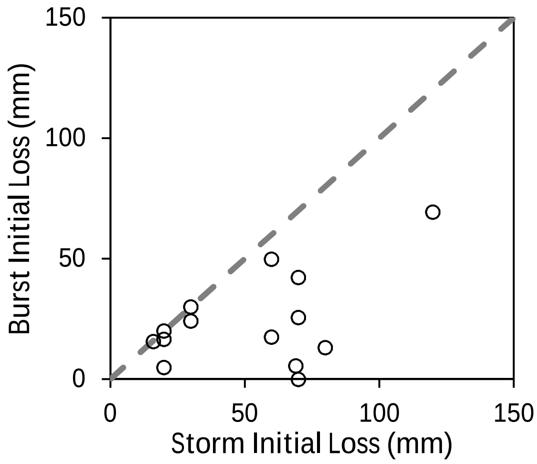
Harding @ Marmurrina Pool U-South (WA) - 3 hour bursts

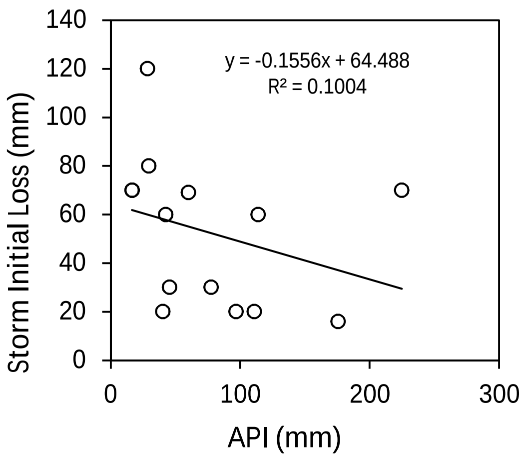


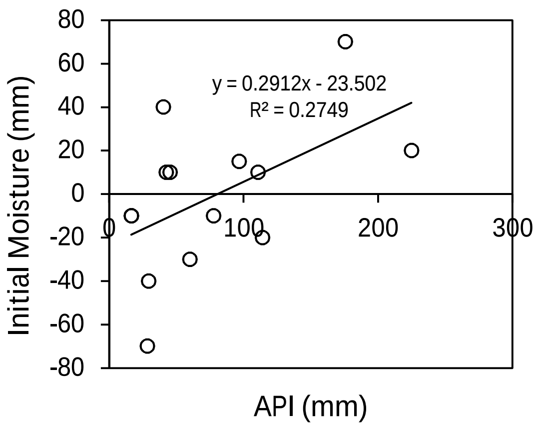




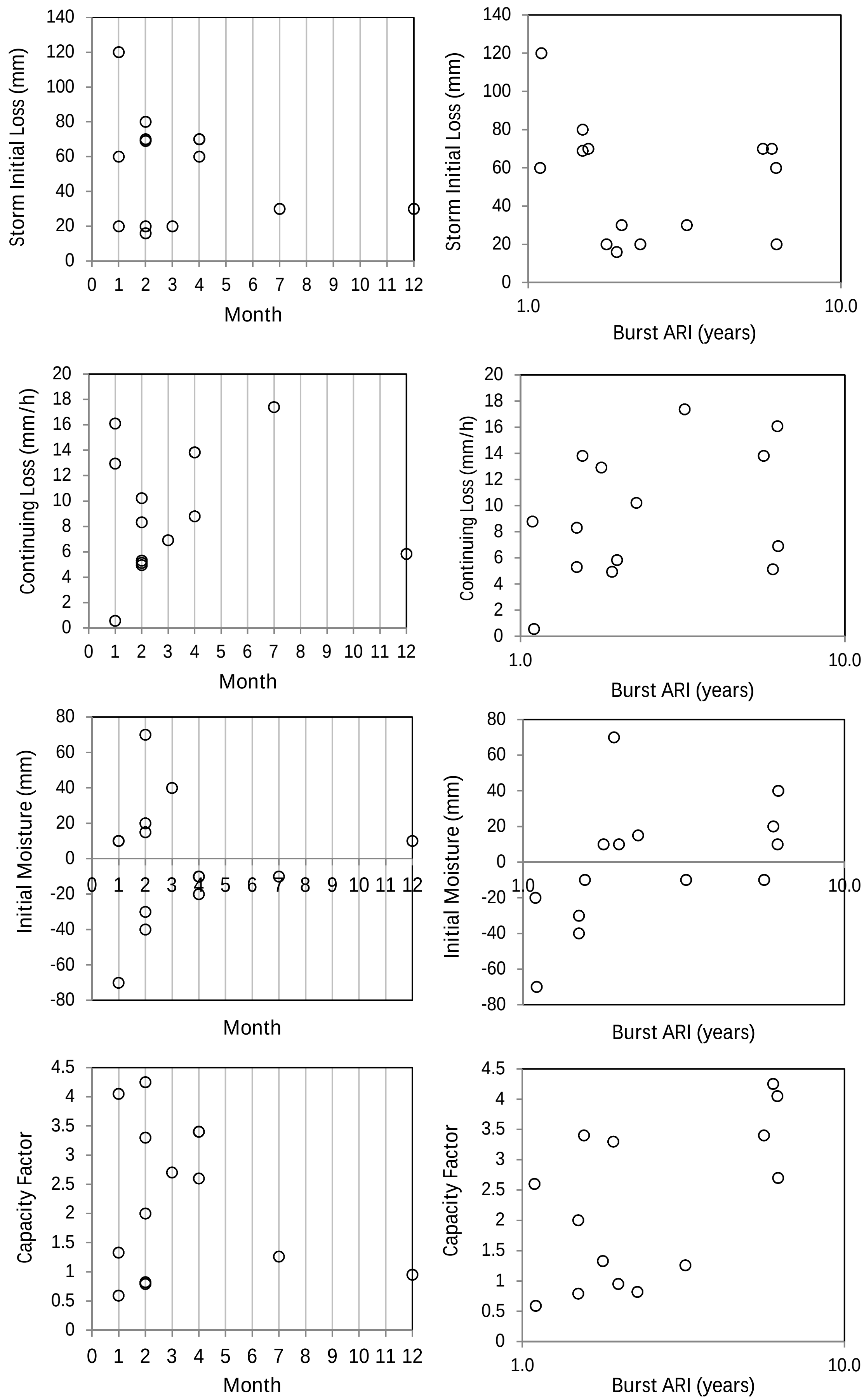




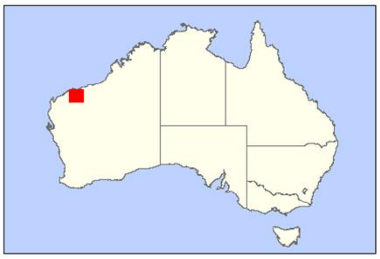


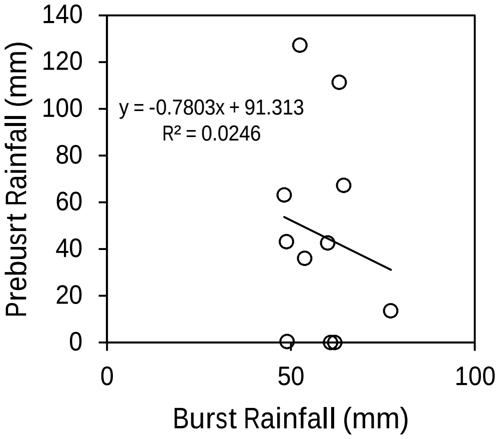


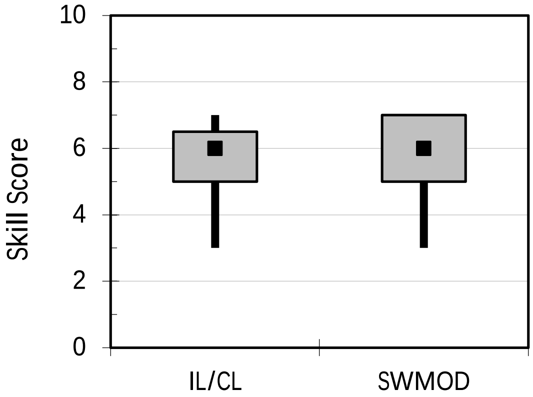
Harding @ Marmurrina Pool U-South (WA) - 3 hour bursts

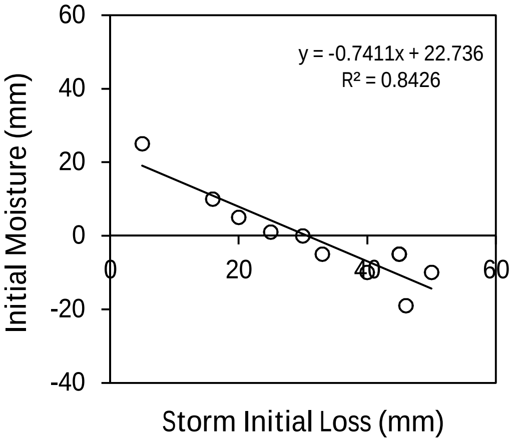


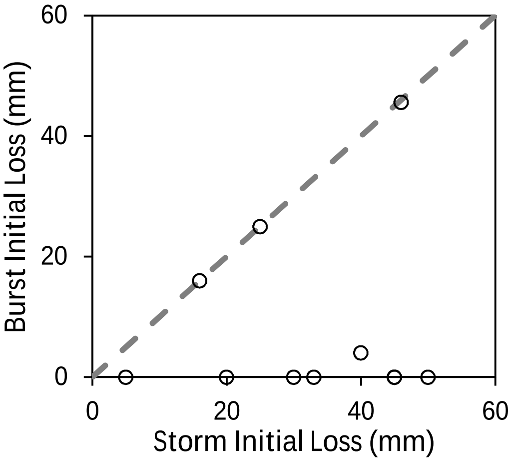
Kanjenjie Ck Trib. @ Fish Pool (WA) - 3 hour bursts

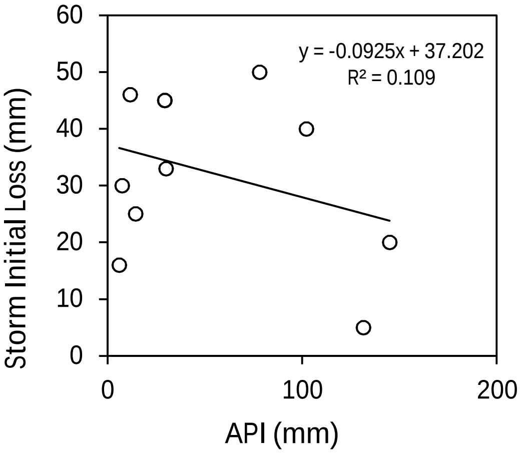


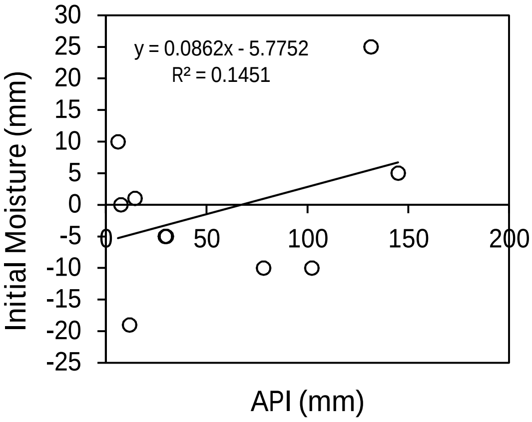




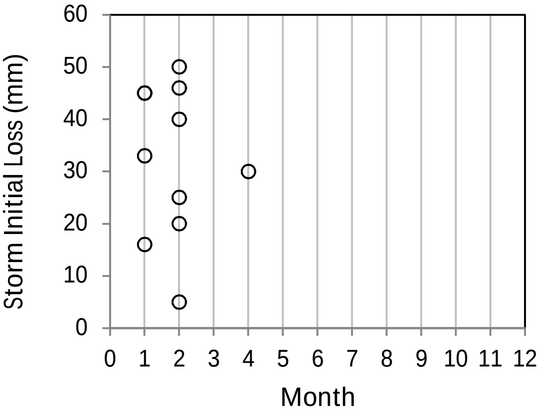


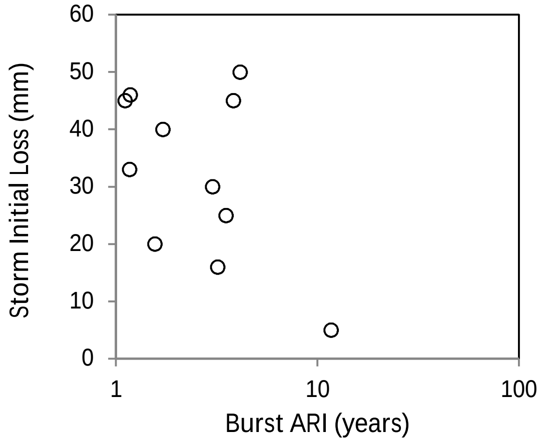


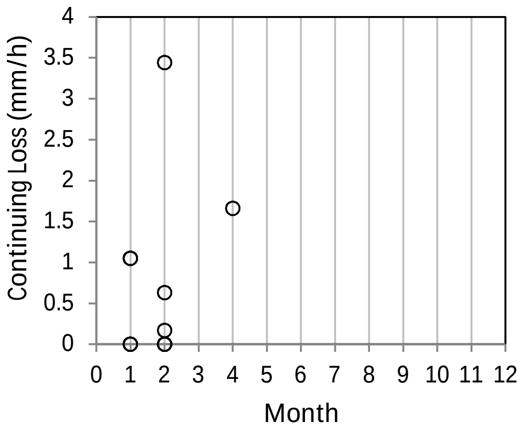


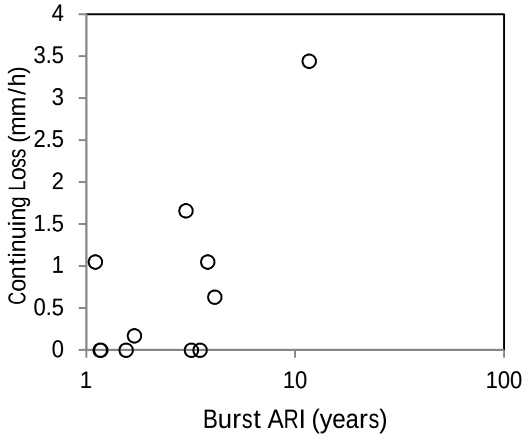


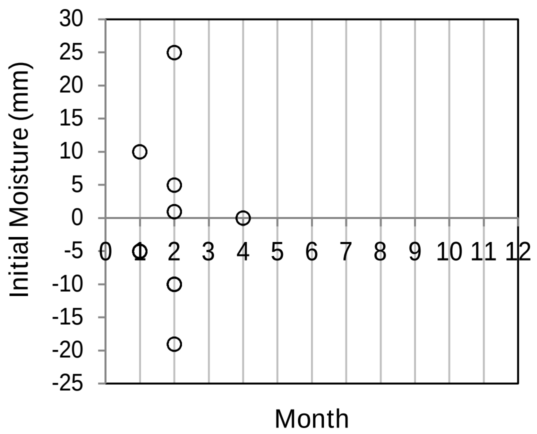
Kanjenjie Ck Trib. @ Fish Pool (WA) - 3 hour bursts

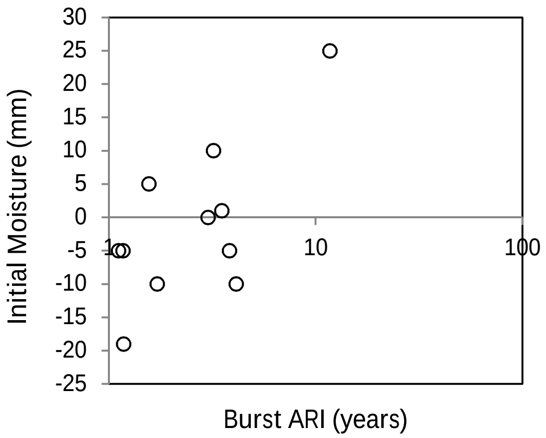


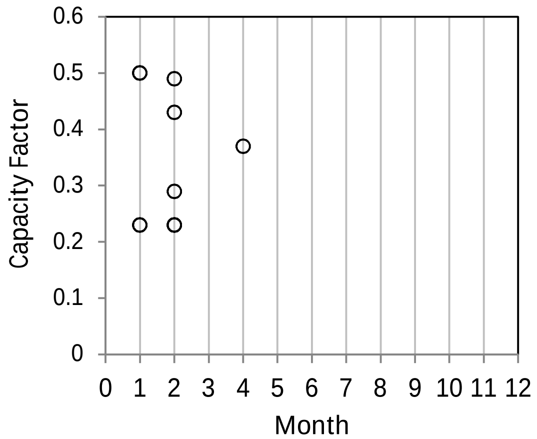


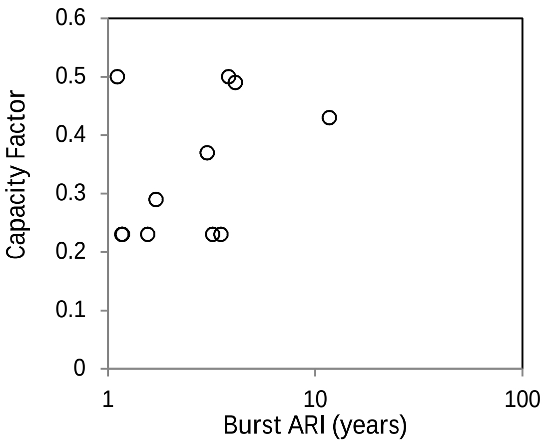




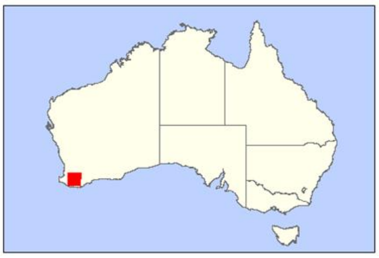


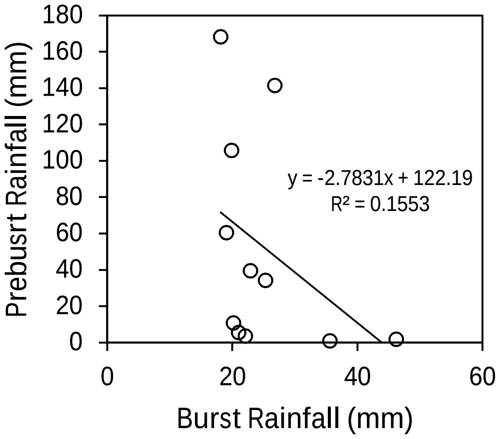


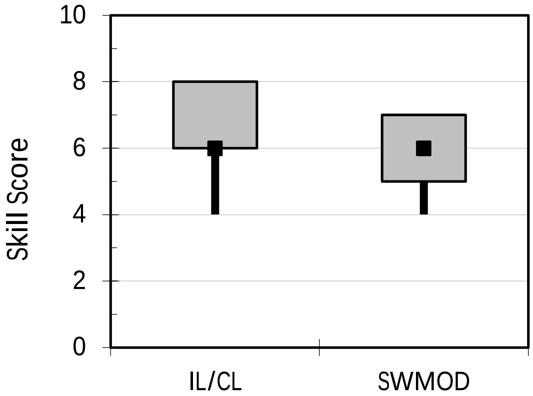


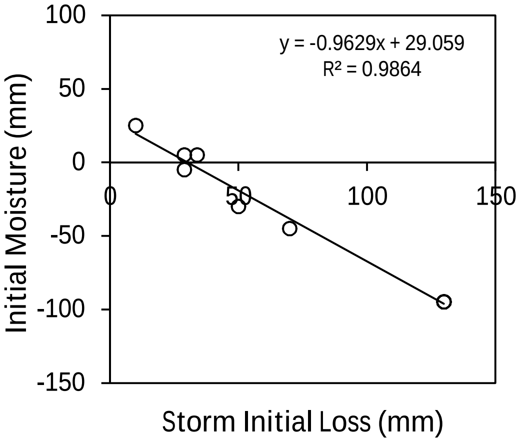


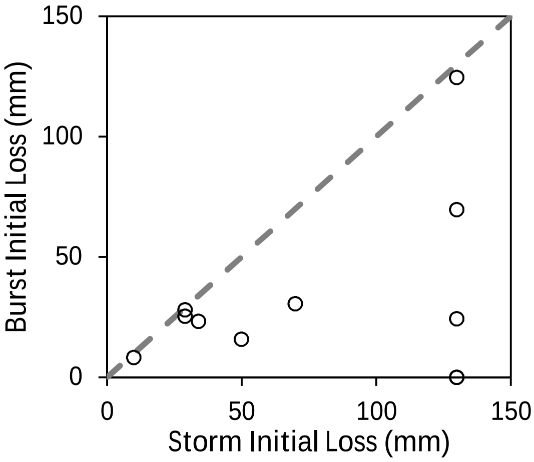
Balgarup @ Mandelup Pool (WA) - 3 hour bursts

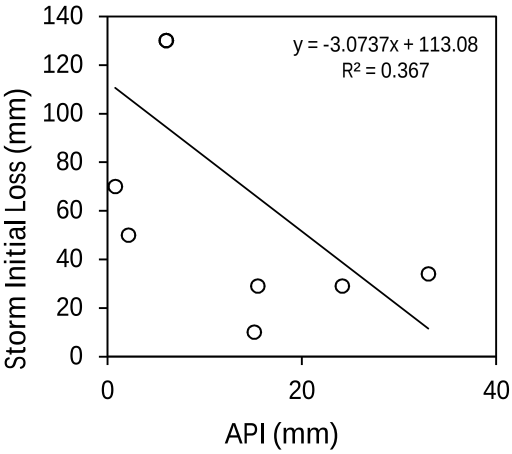


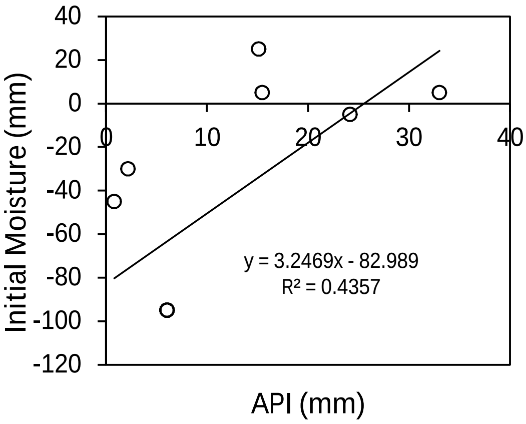




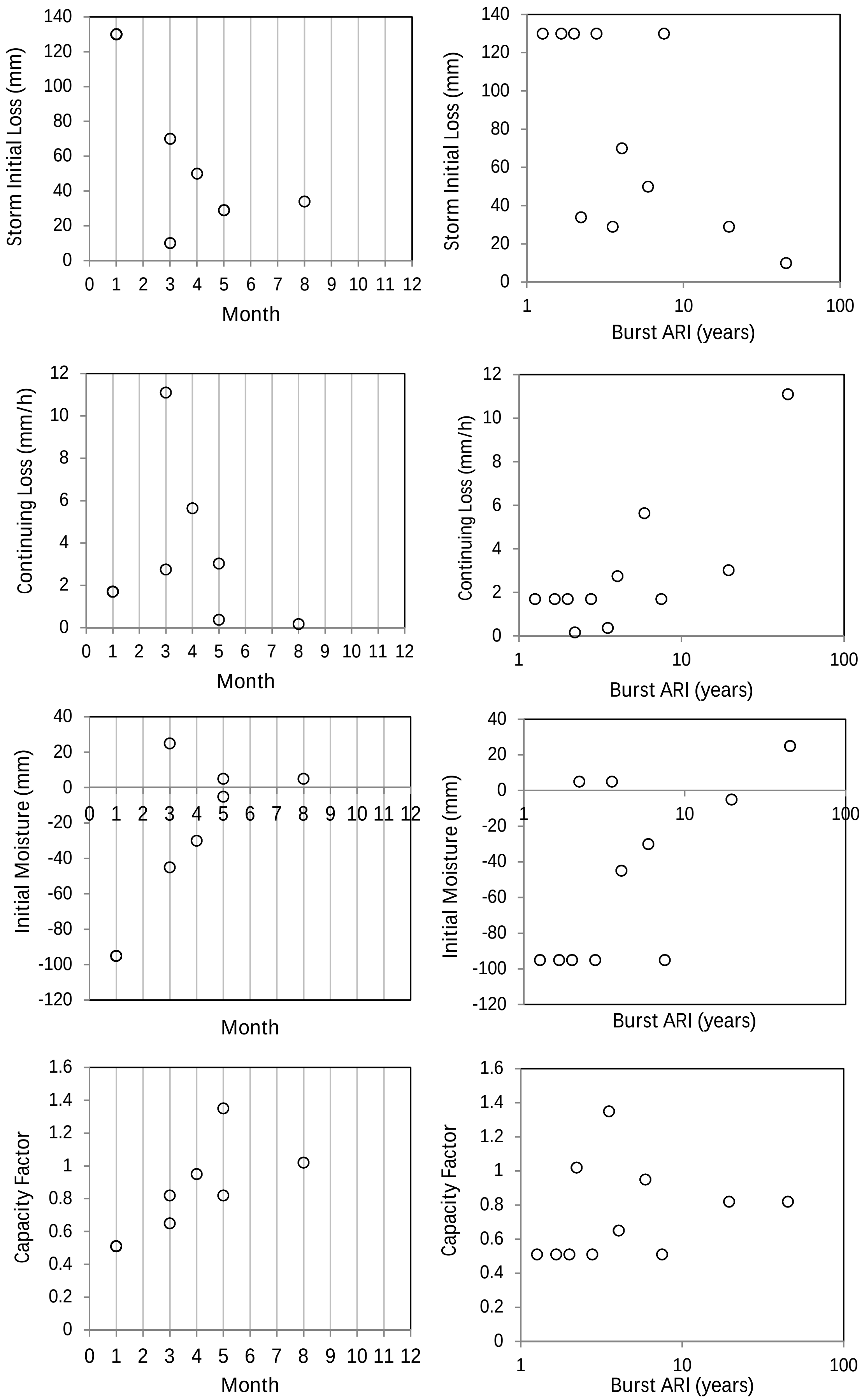




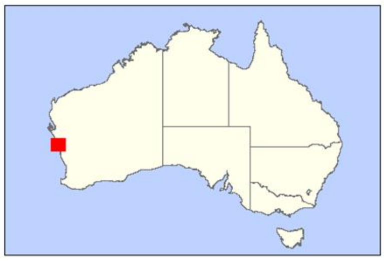


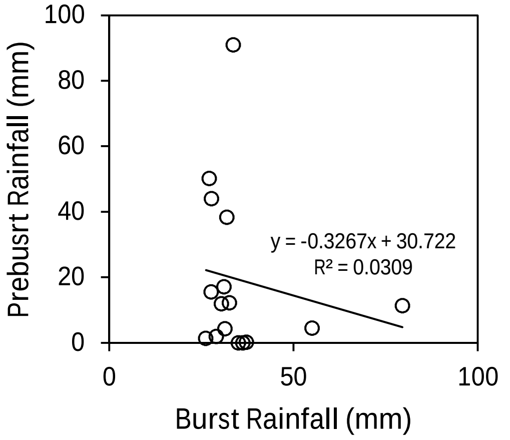


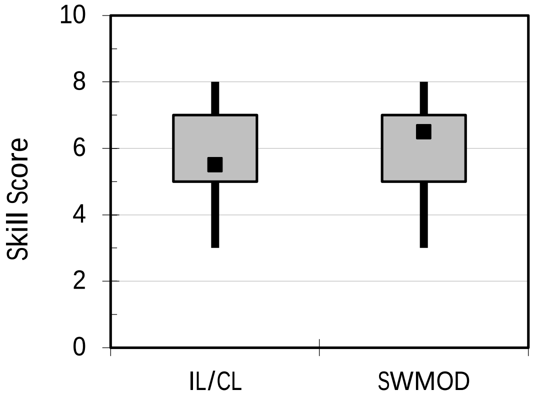
Balgarup @ Mandelup Pool (WA) - 3 hour bursts

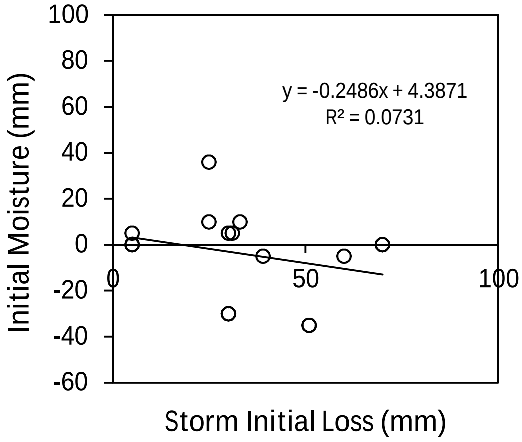


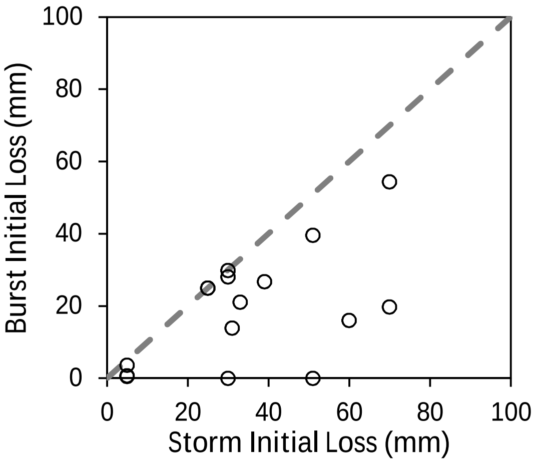
Buller @ Buller (WA) - 3 hour bursts

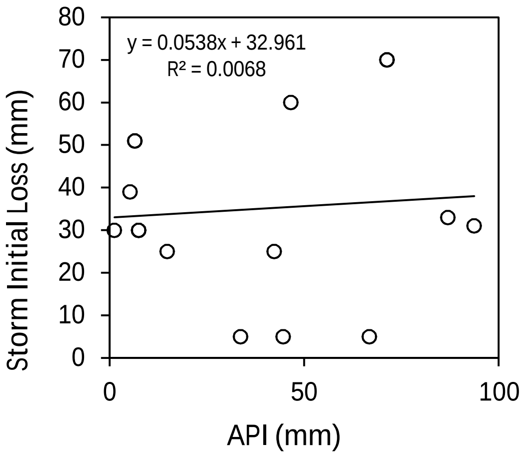


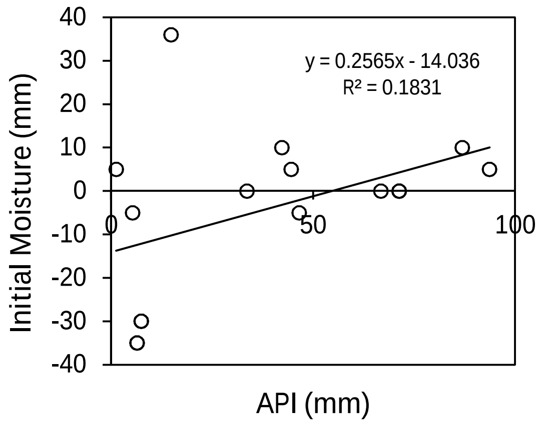




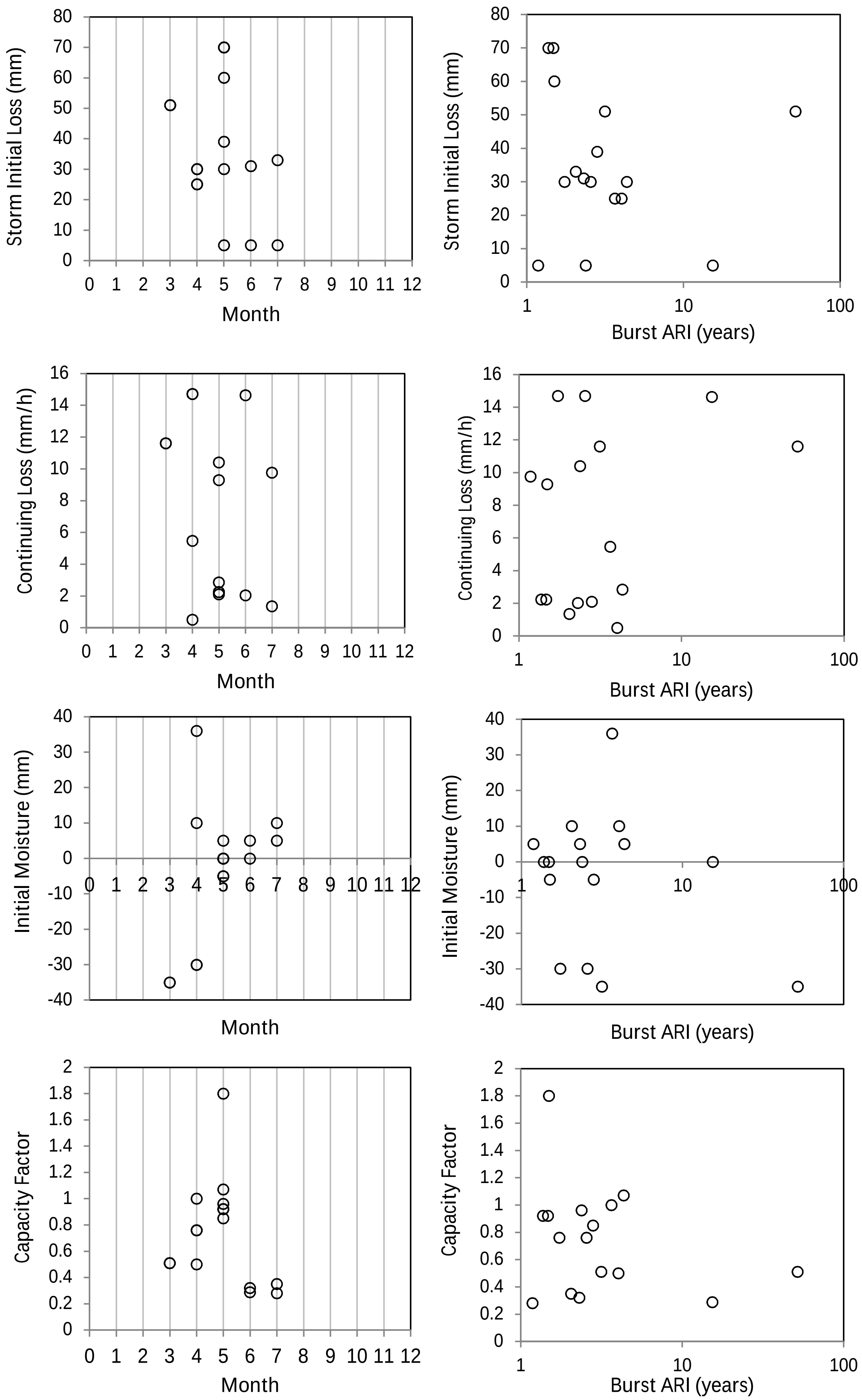




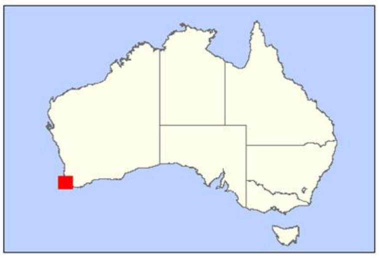


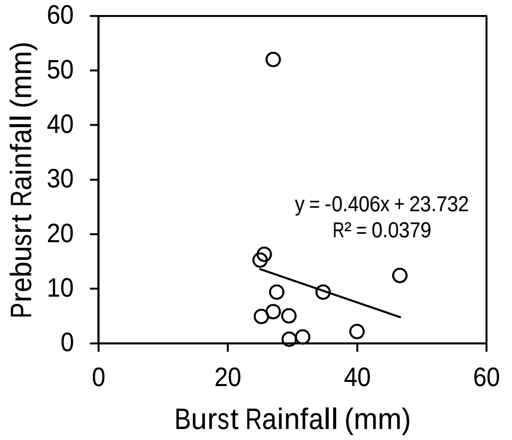


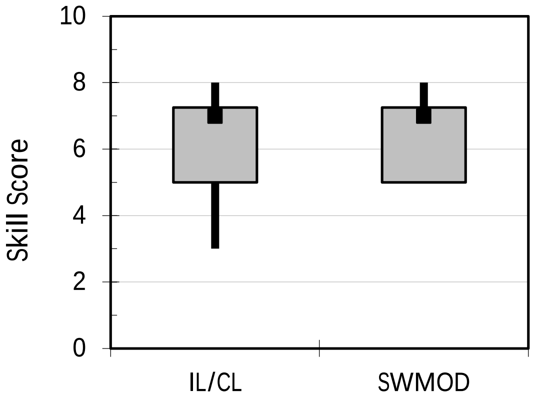
Buller @ Buller (WA) - 3 hour bursts

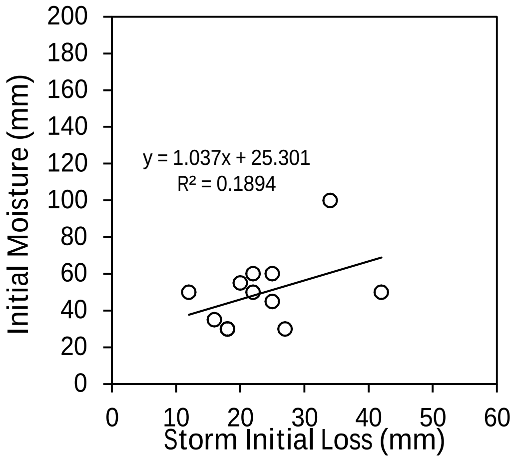


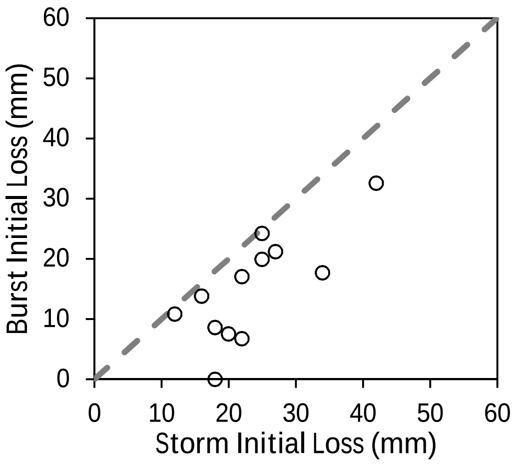
Carey Brook @ Staircase Rd (WA) - 3 hour bursts

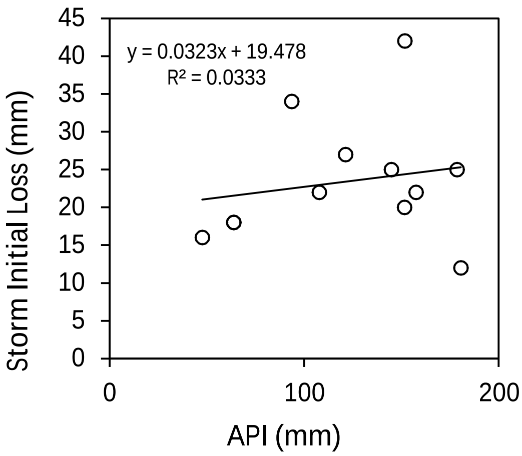


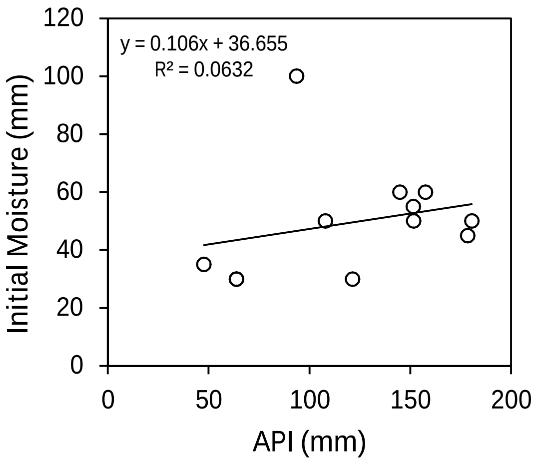




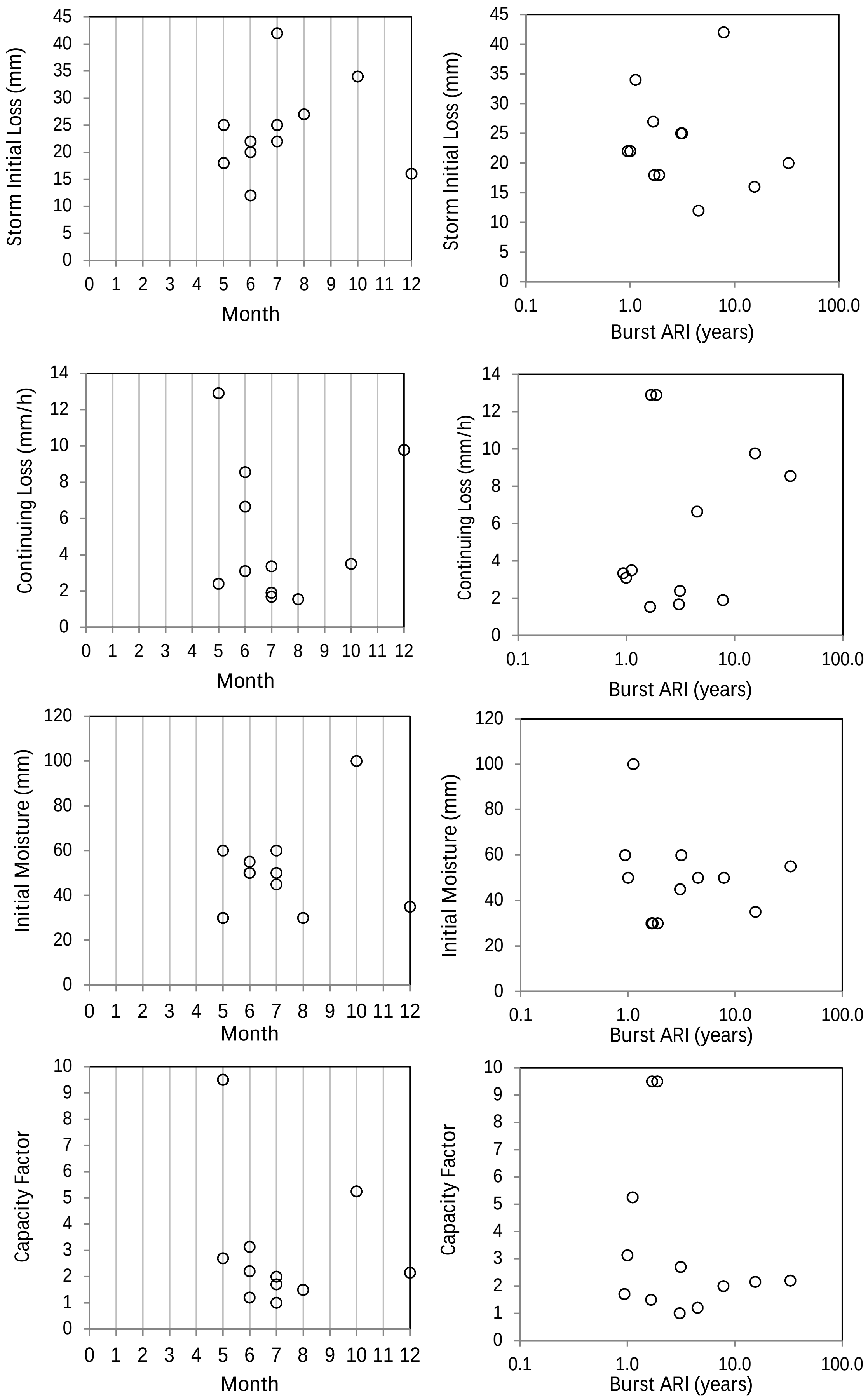




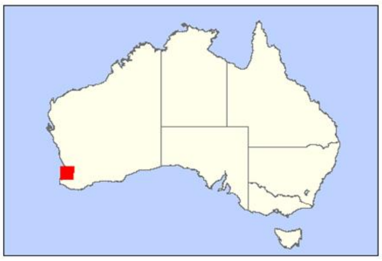


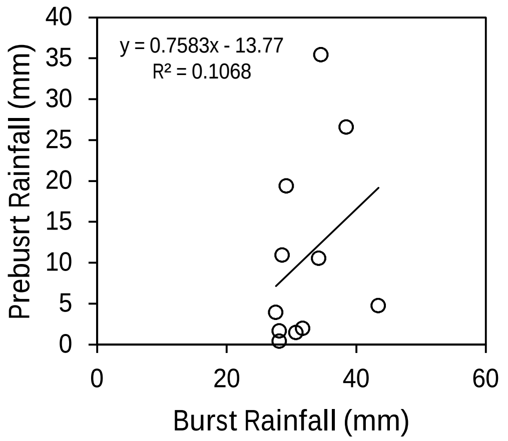


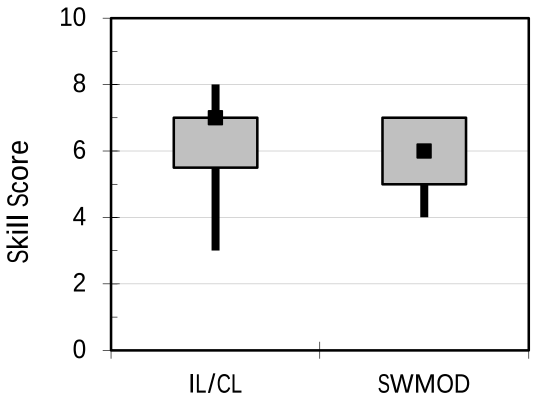
Carey Brook @ Staircase Rd (WA) - 3 hour bursts

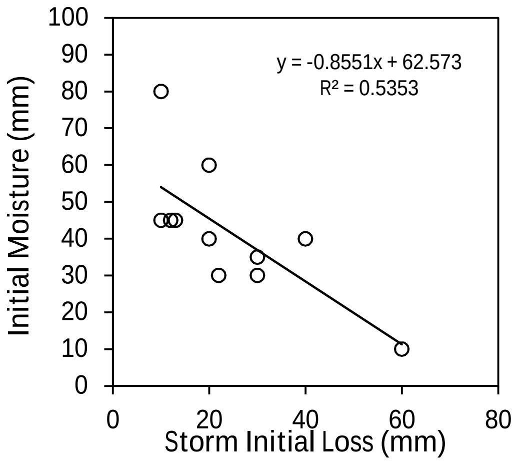


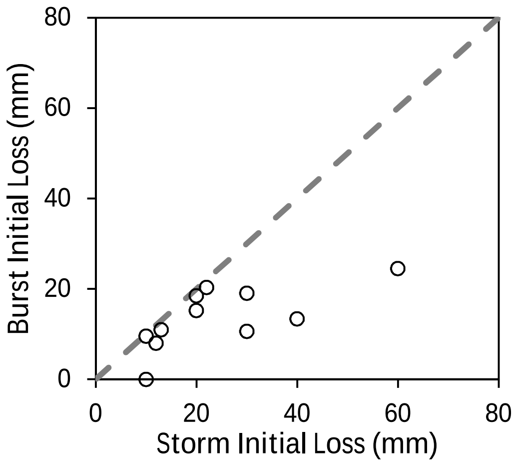
Davis Brook @ Murray Valley Plntn (WA) - 3 hour bursts

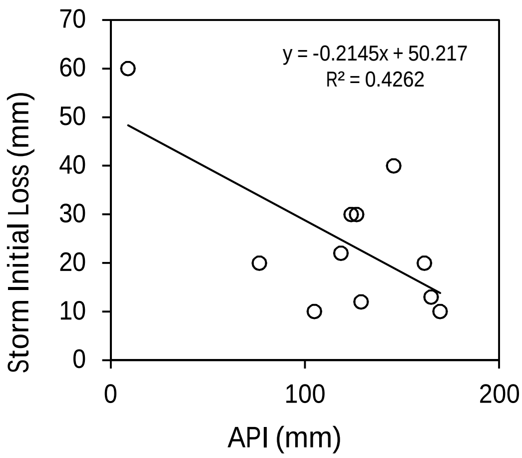


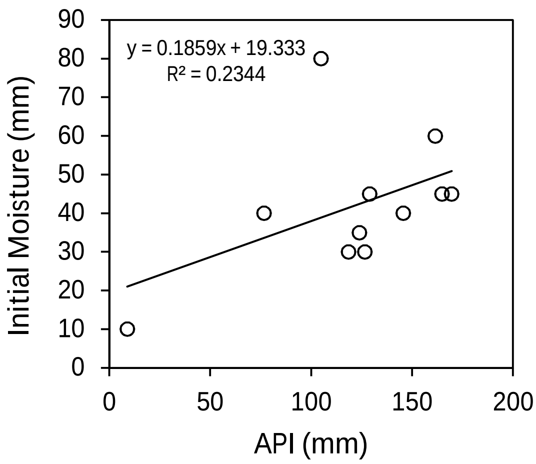




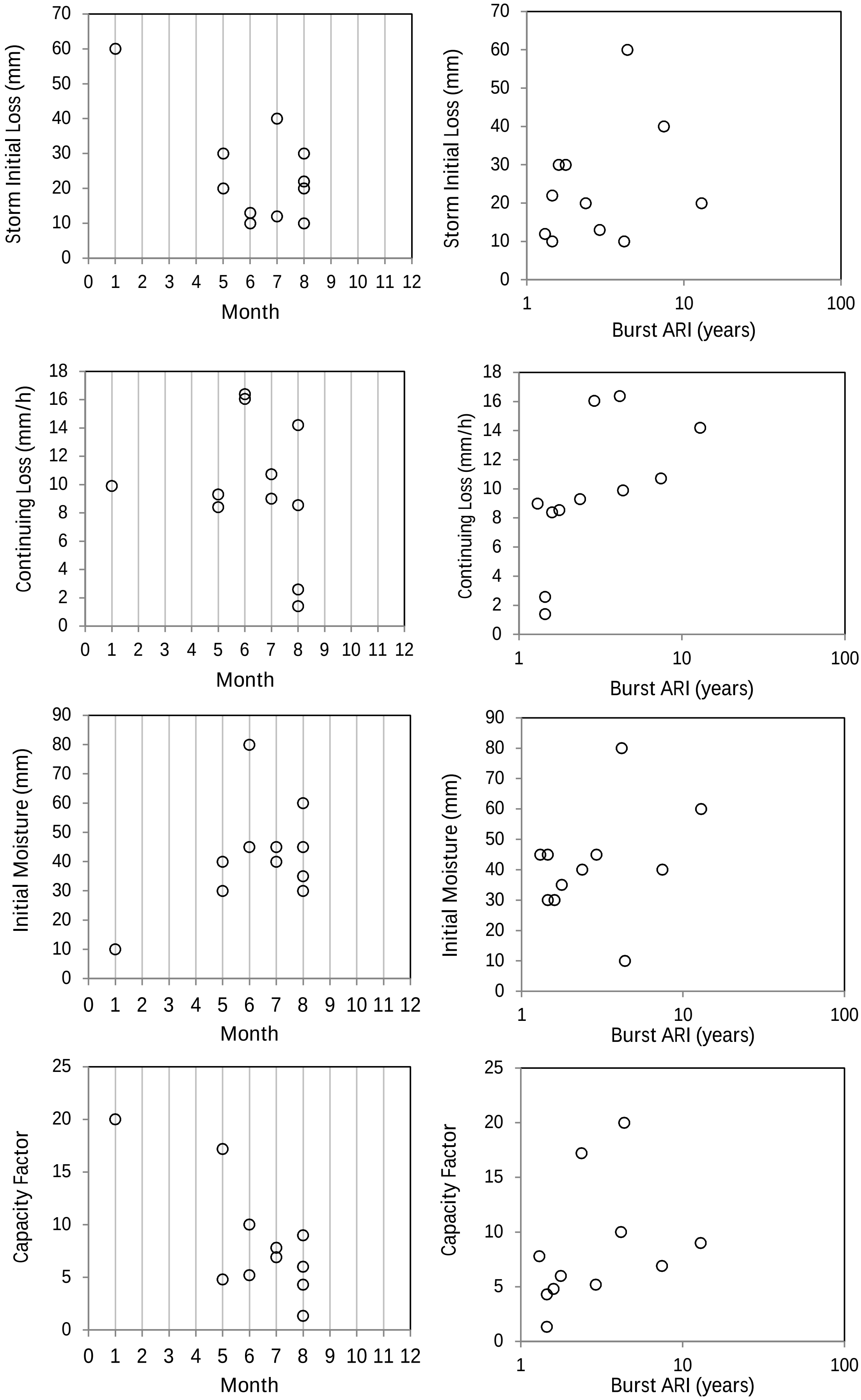




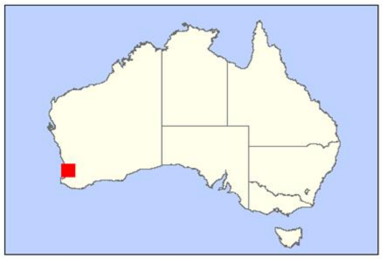


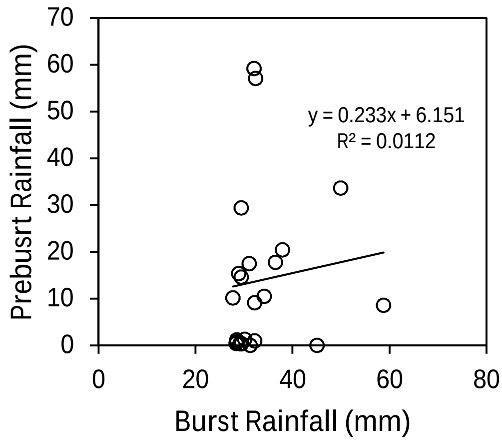


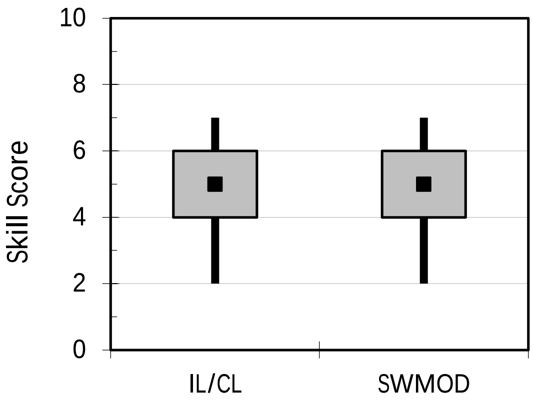
Davis Brook @ Murray Valley Plntn (WA) - 3 hour bursts

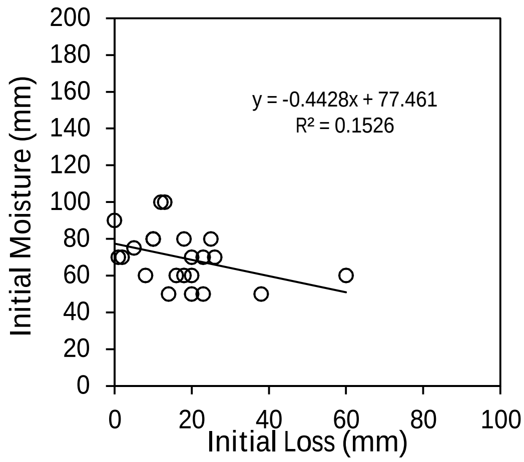


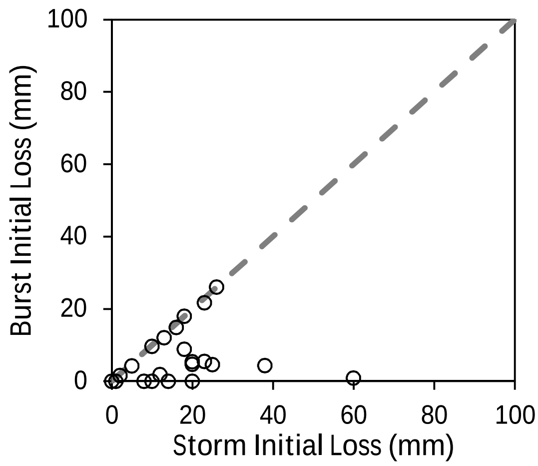
Dirk Brook @ Kentish Farm (WA) - 3 hour bursts

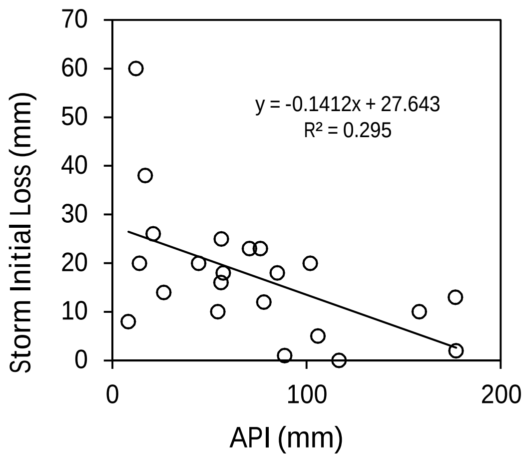


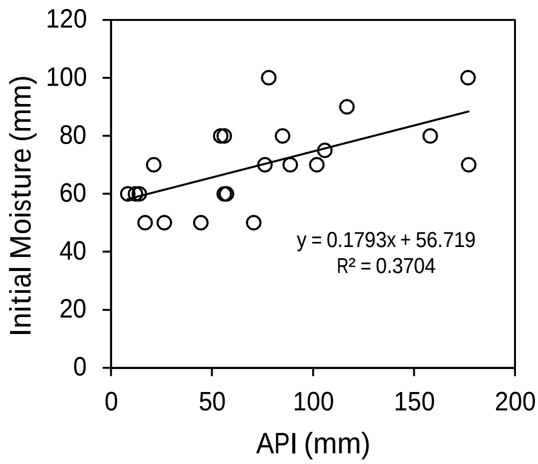




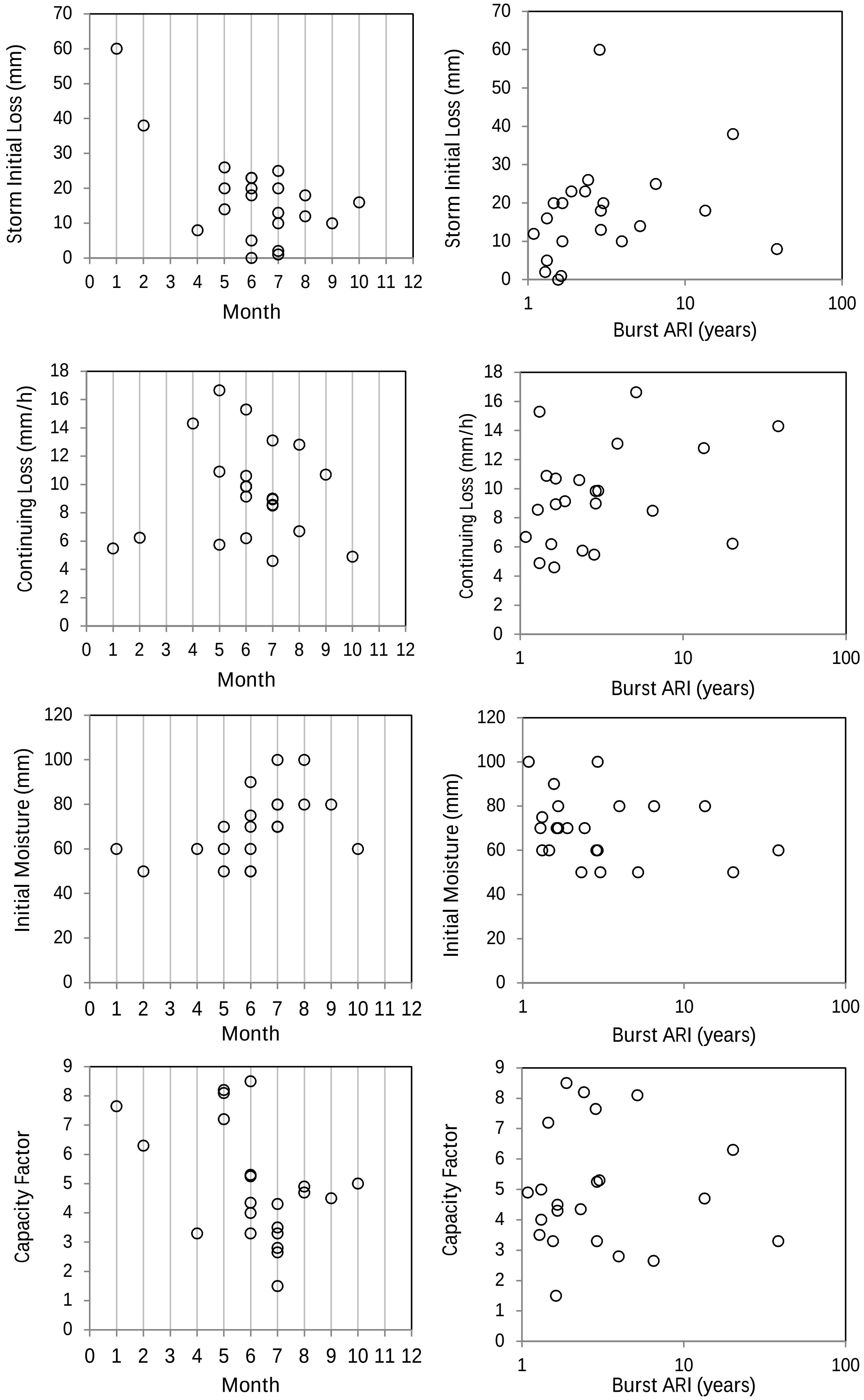




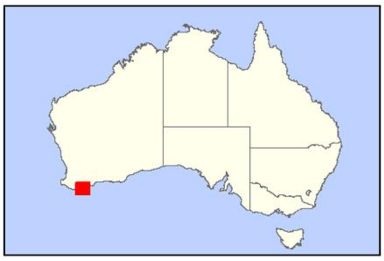


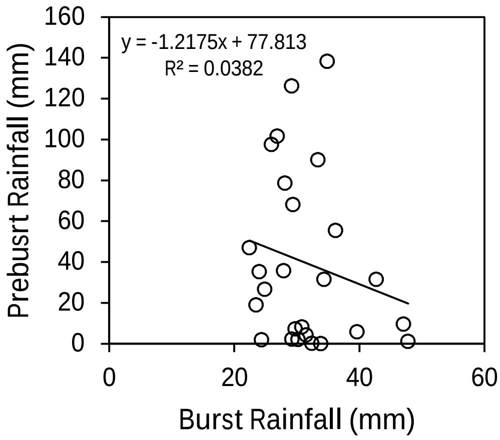


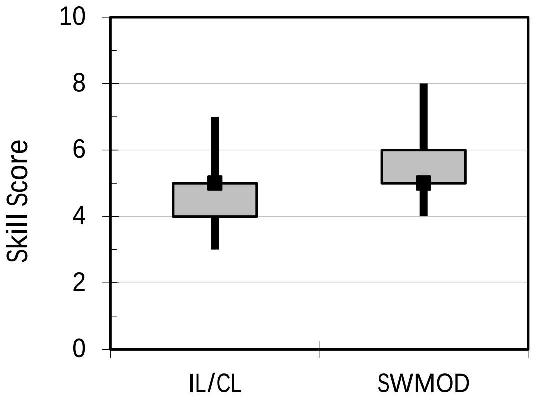
Dirk Brook @ Kentish Farm (WA) - 3 hour bursts

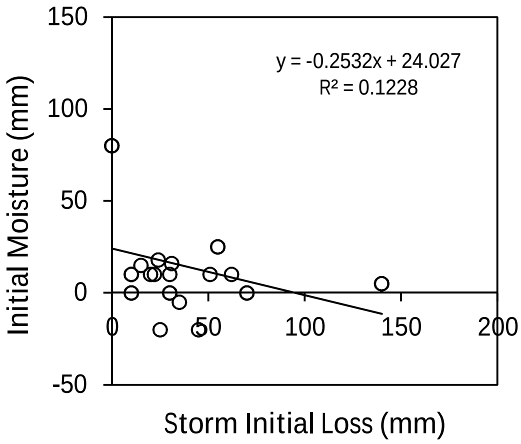


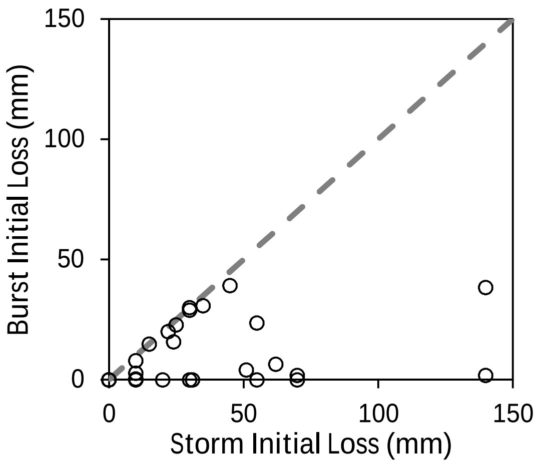
Goodga @ Black Cat (WA) - 3 hour bursts

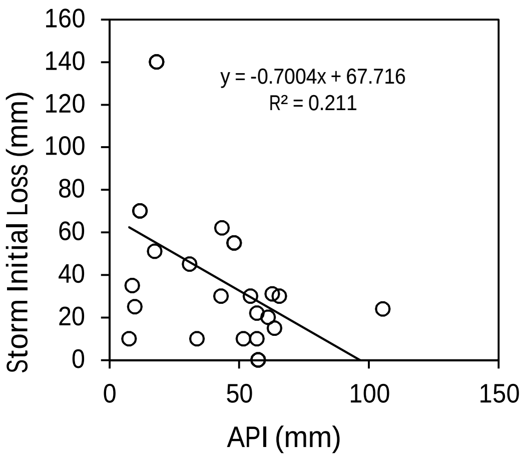


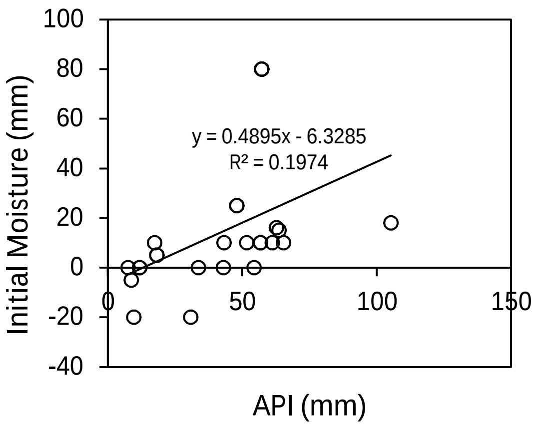




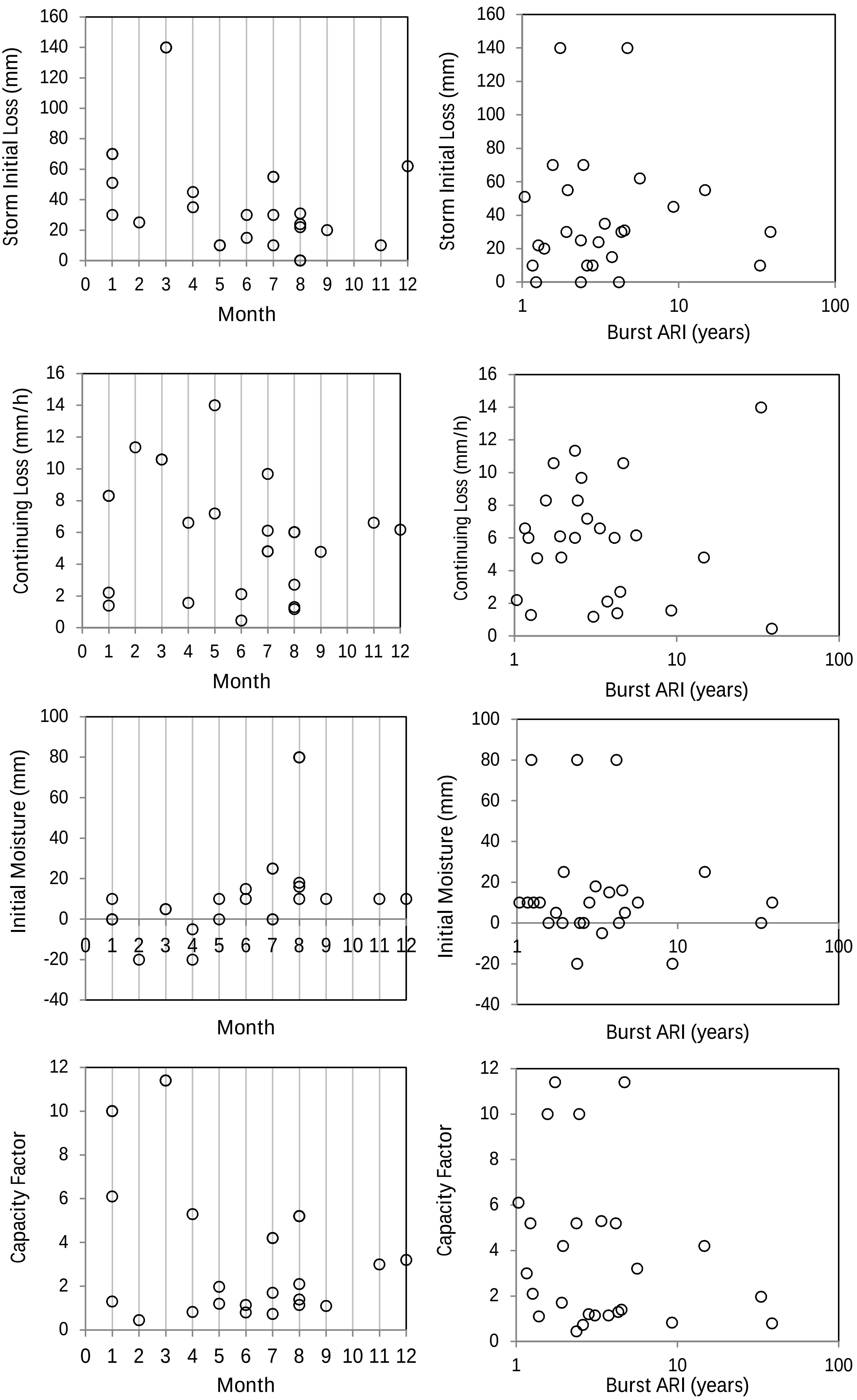




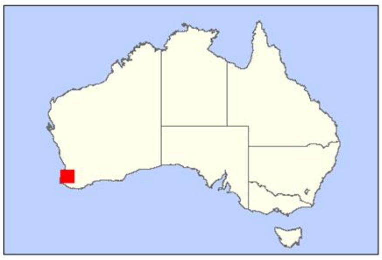


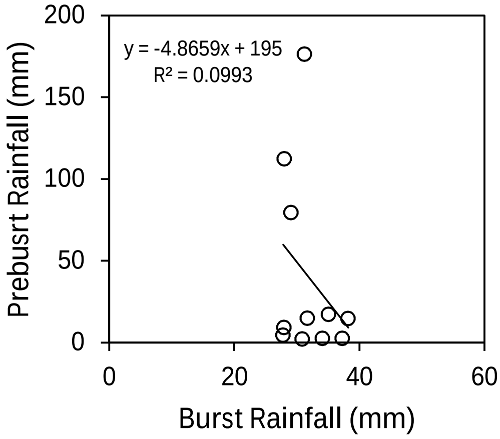


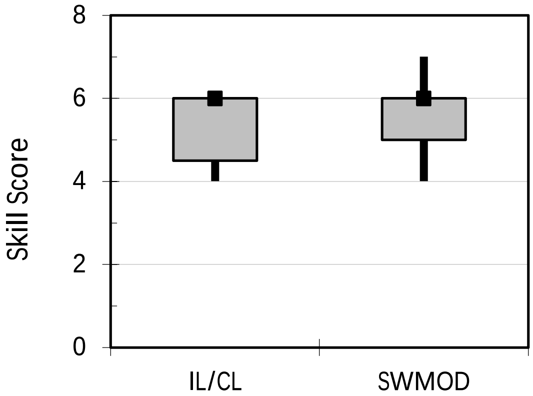
Goodga @ Black Cat (WA) - 3 hour bursts

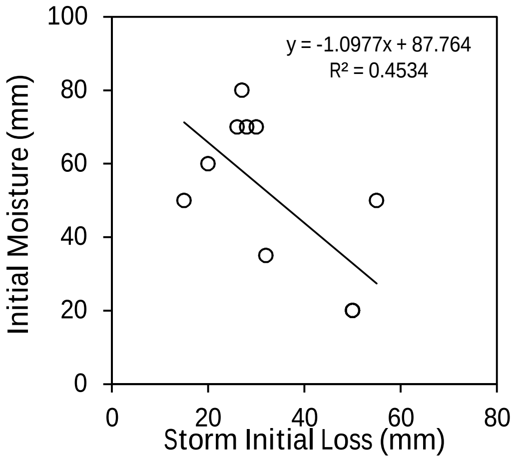


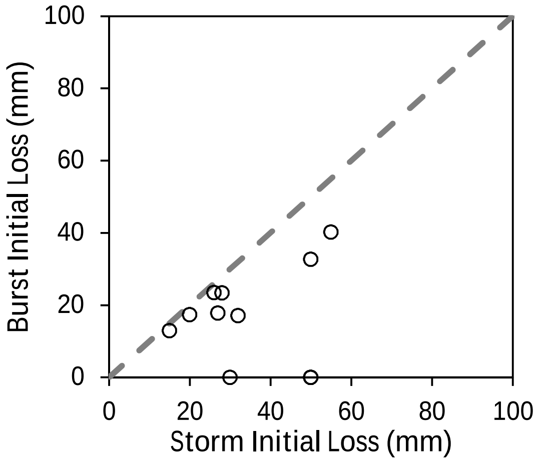
Hamilton @ Worsley (WA) - 3 hour bursts

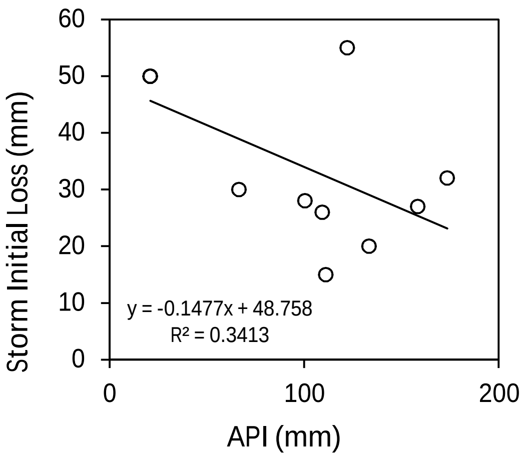


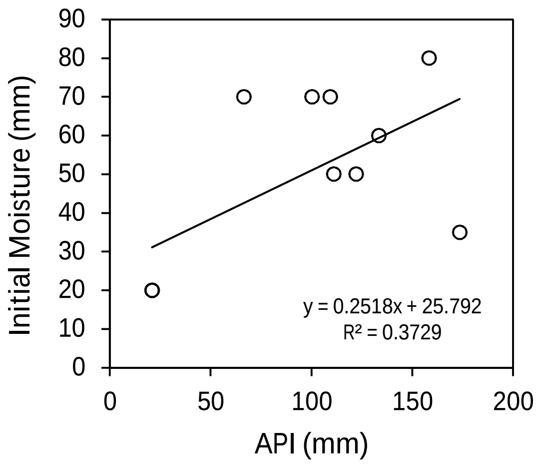




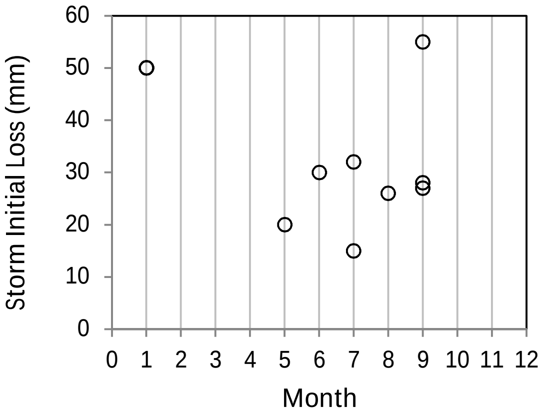


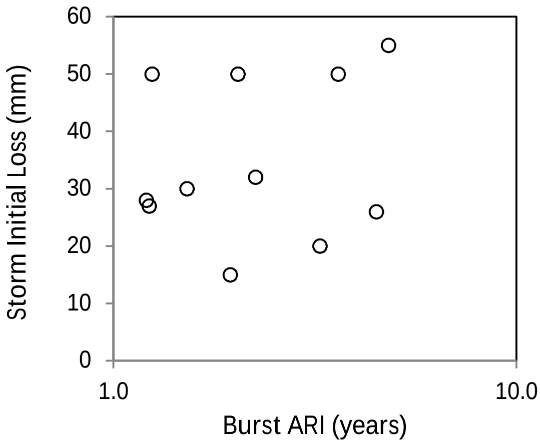


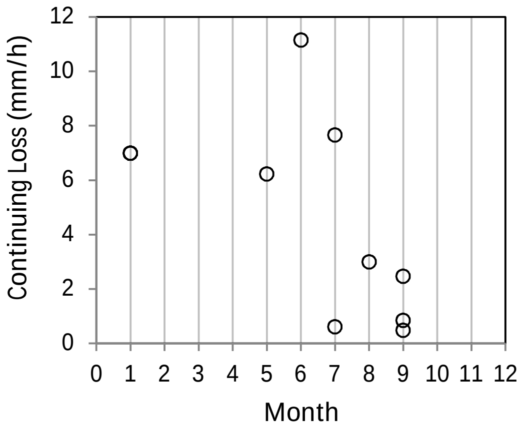


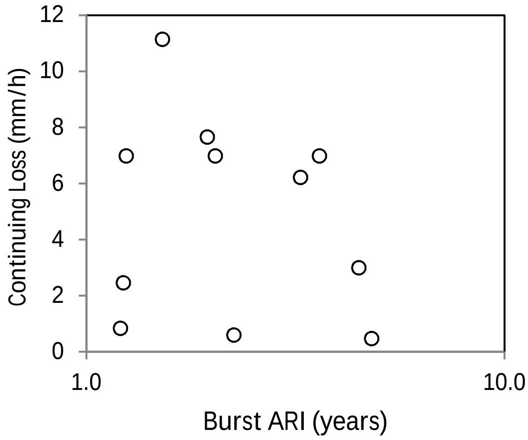


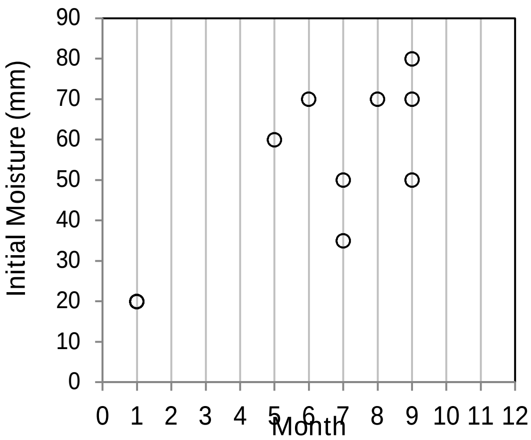
Hamilton @ Worsley (WA) - 3 hour bursts

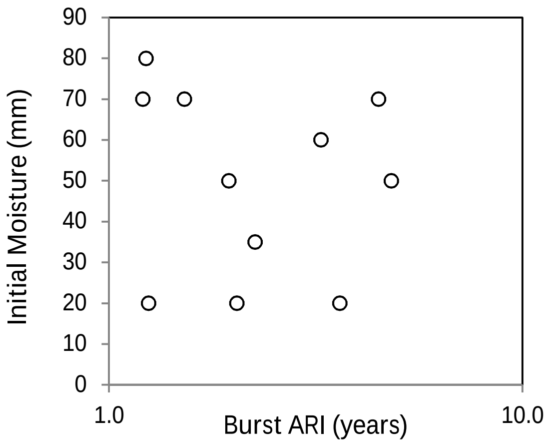


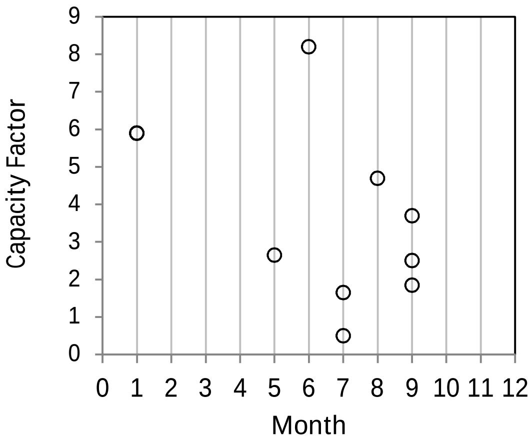


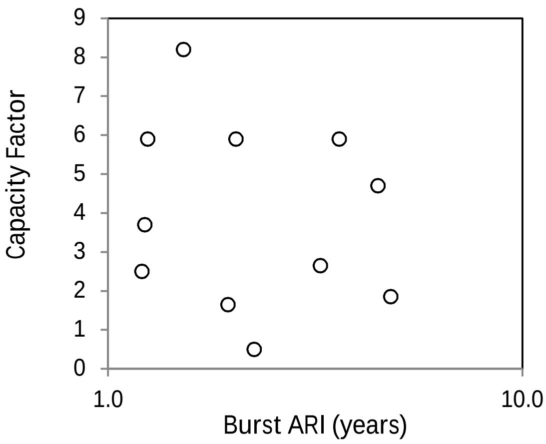




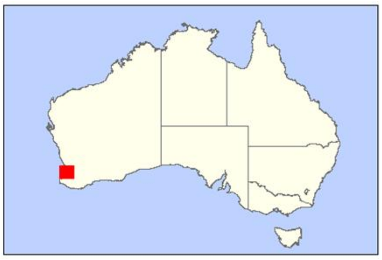


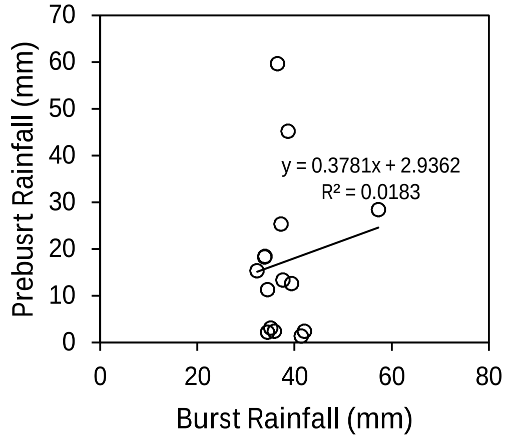


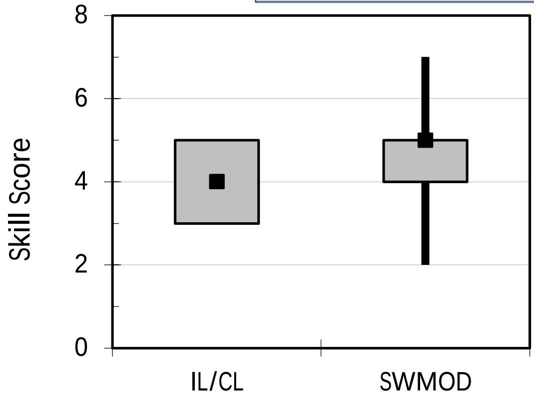


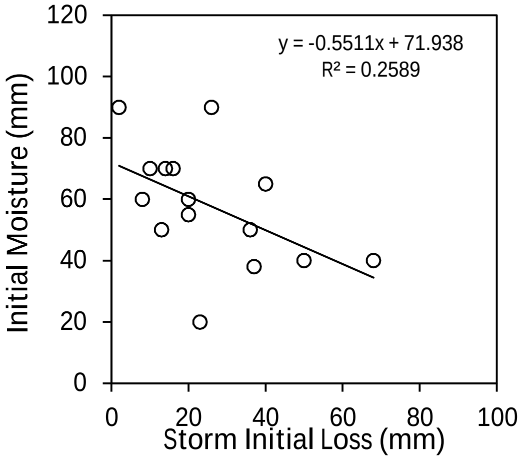


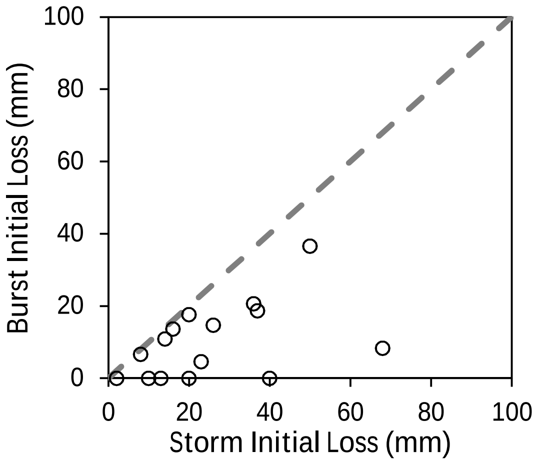
Marrinup Bk @ Brookdale Siding (WA) - 3 hour bursts

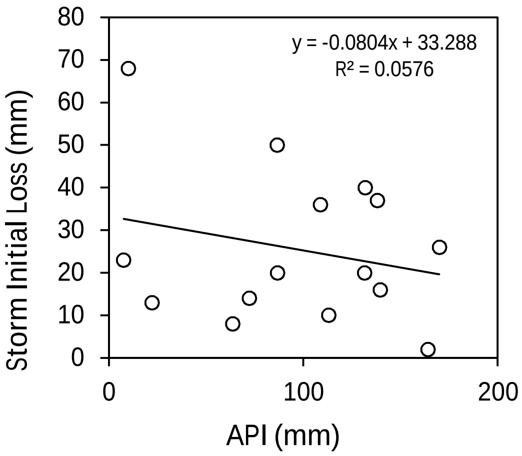


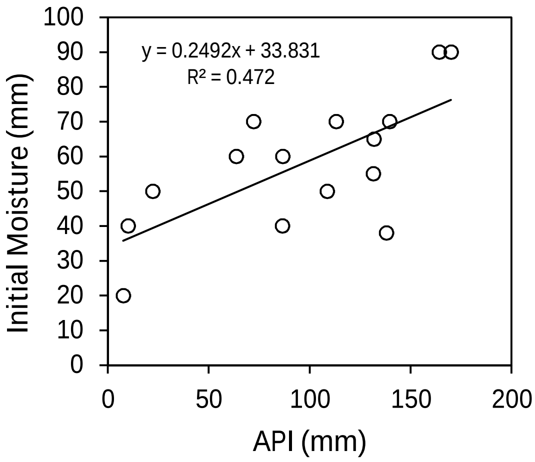




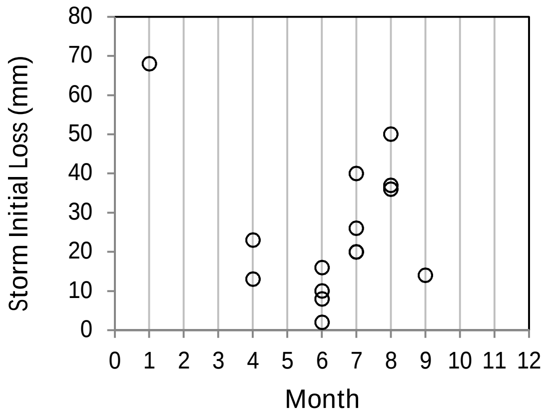


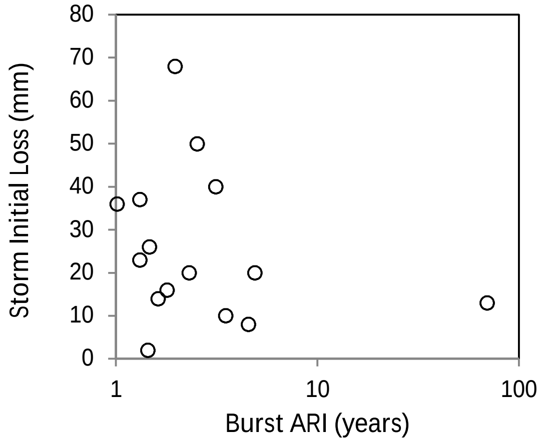


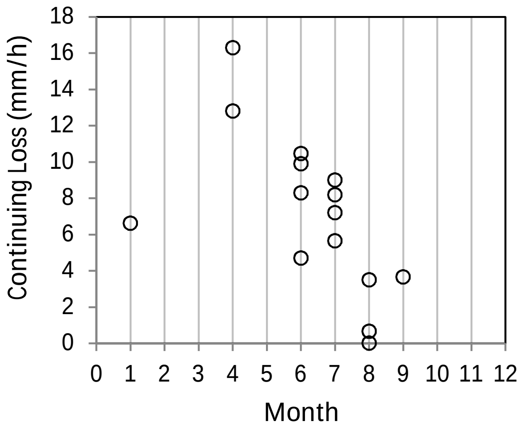


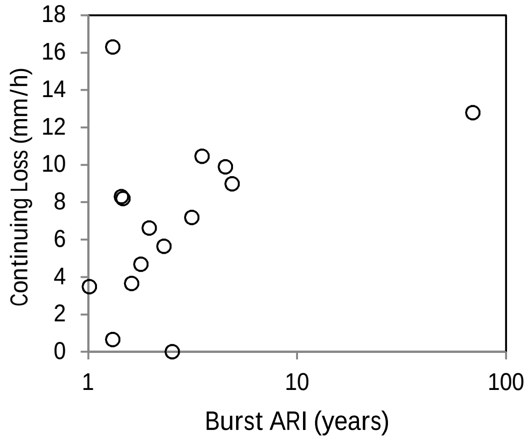


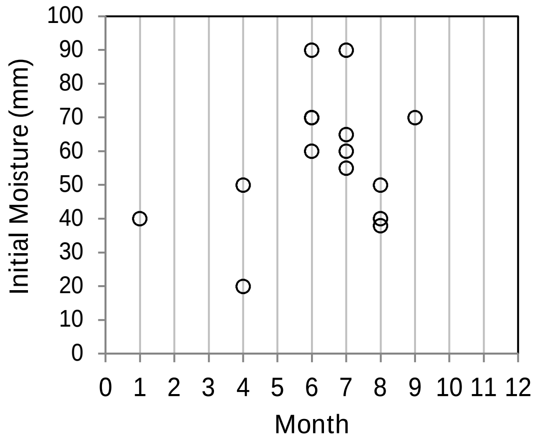
Marrinup Bk @ Brookdale Siding (WA) - 3 hour bursts

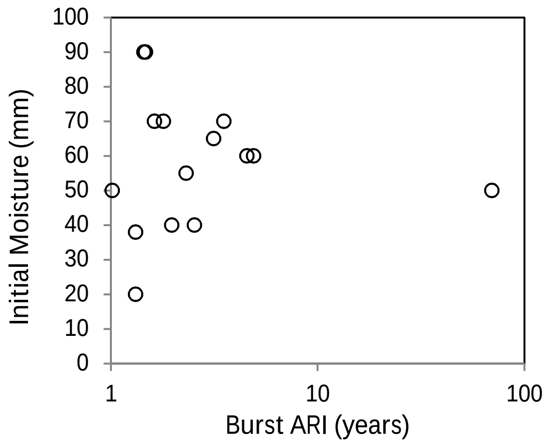


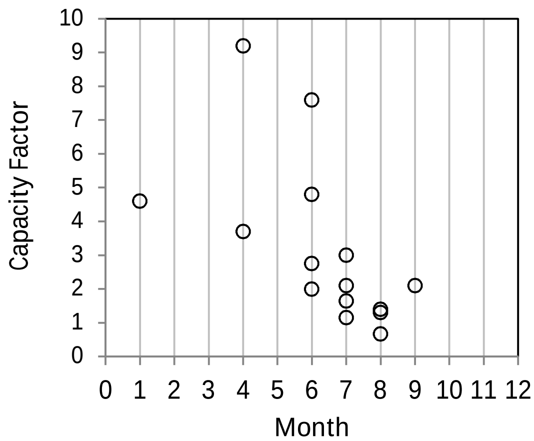


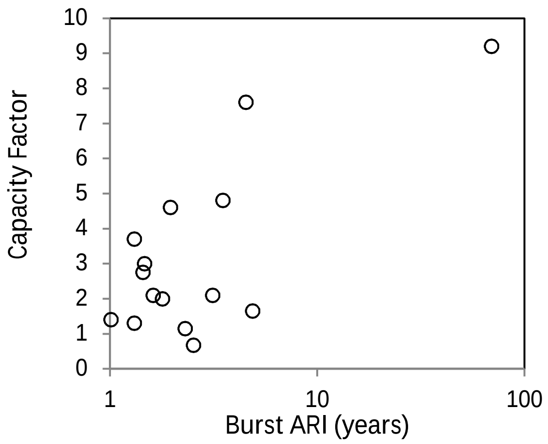




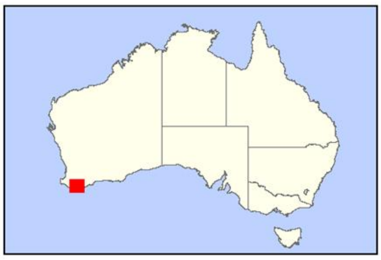


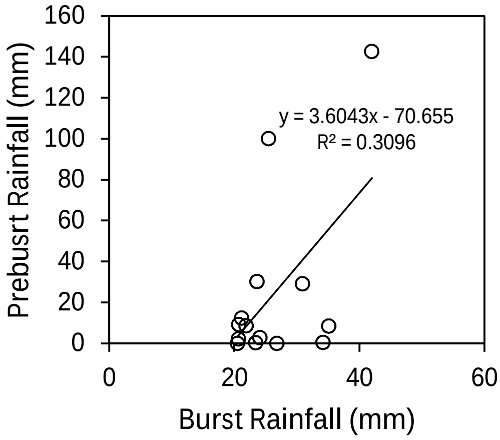


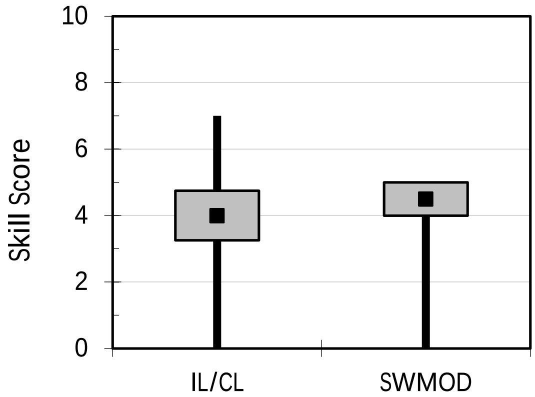


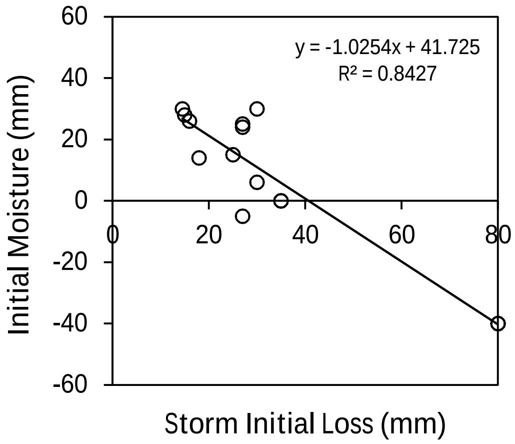


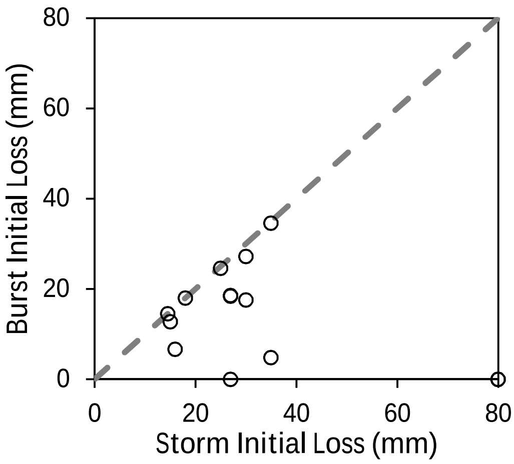
Yates Flat Ck @ Woonanup (WA) - 3 hour bursts

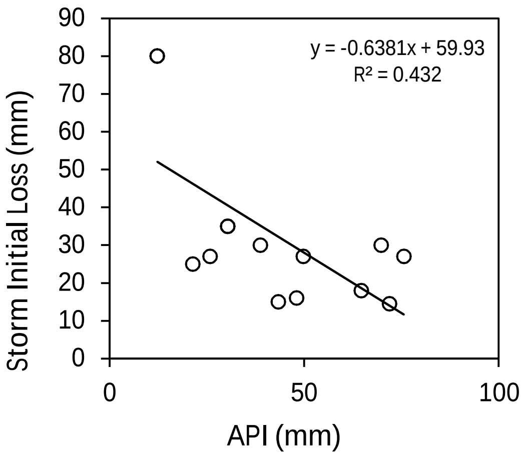


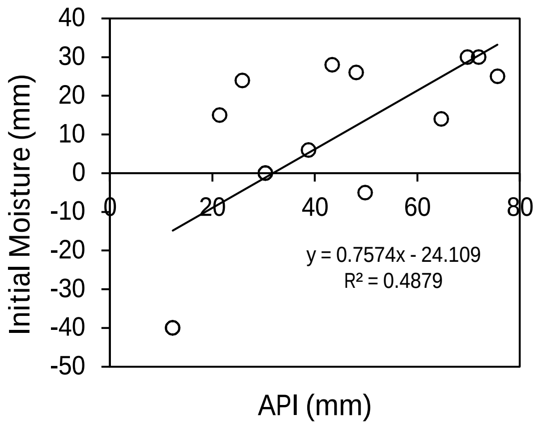




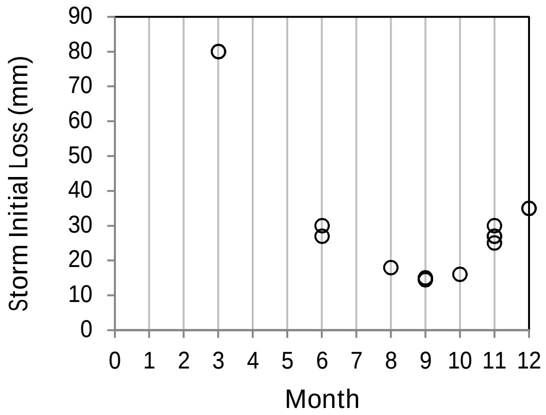


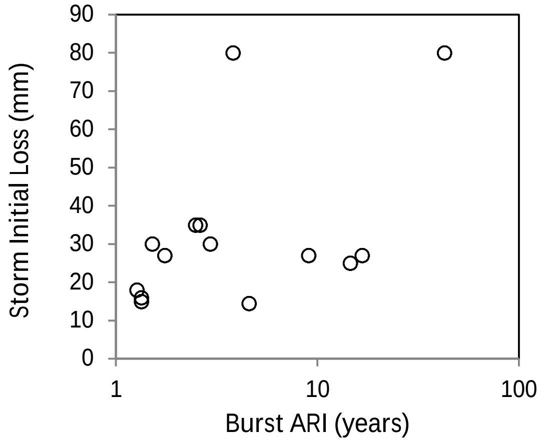


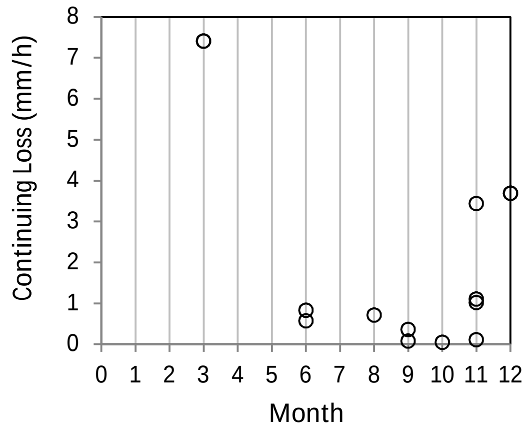


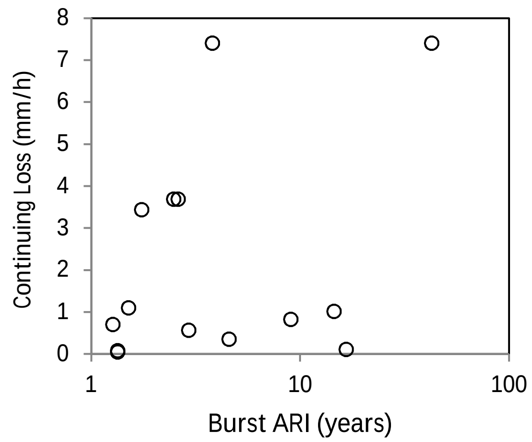


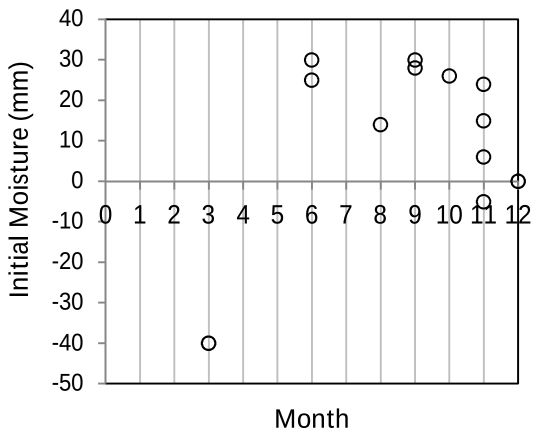
Yates Flat Ck @ Woonanup (WA) - 3 hour bursts

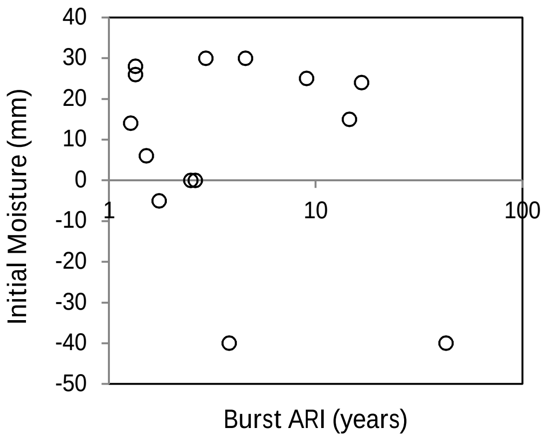


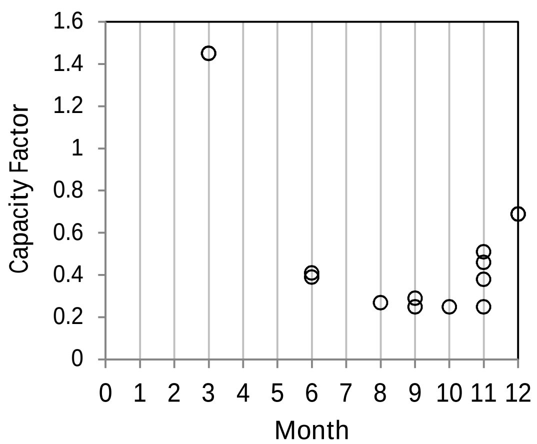


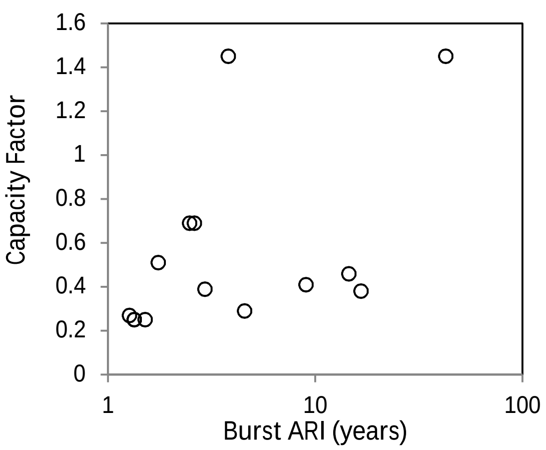






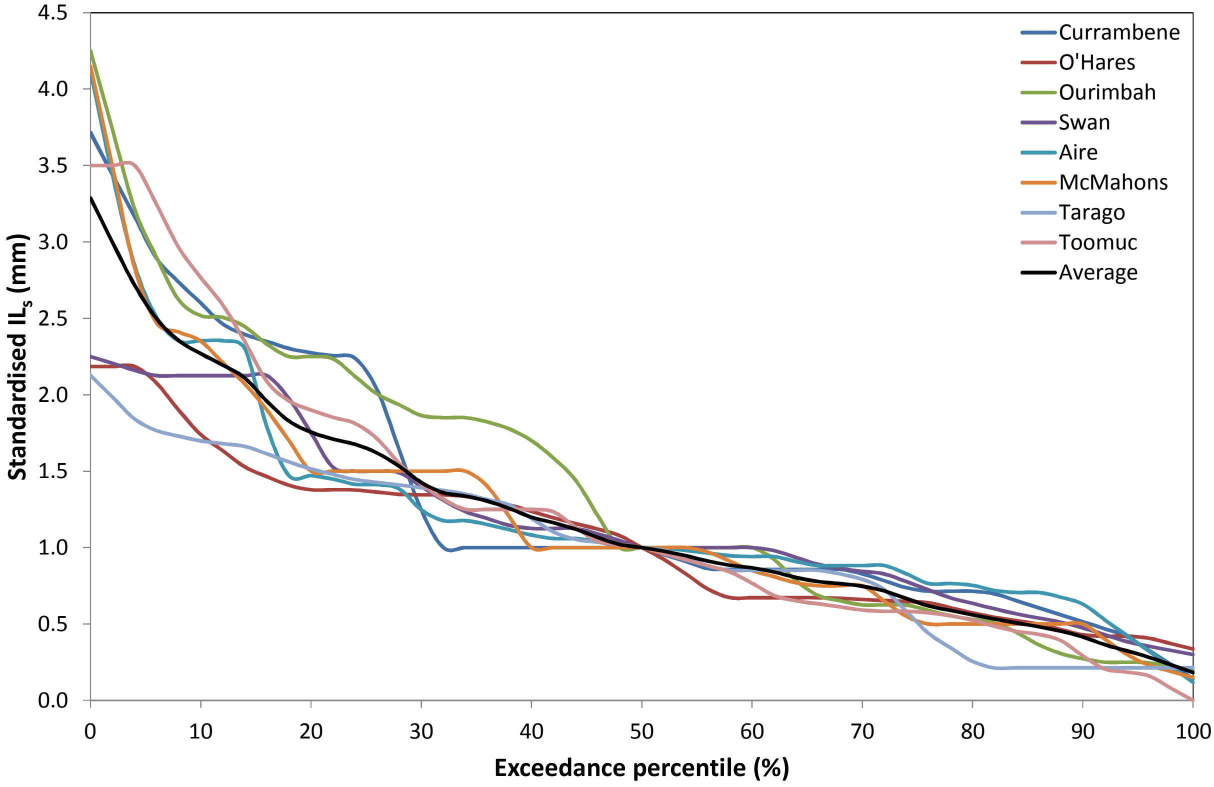


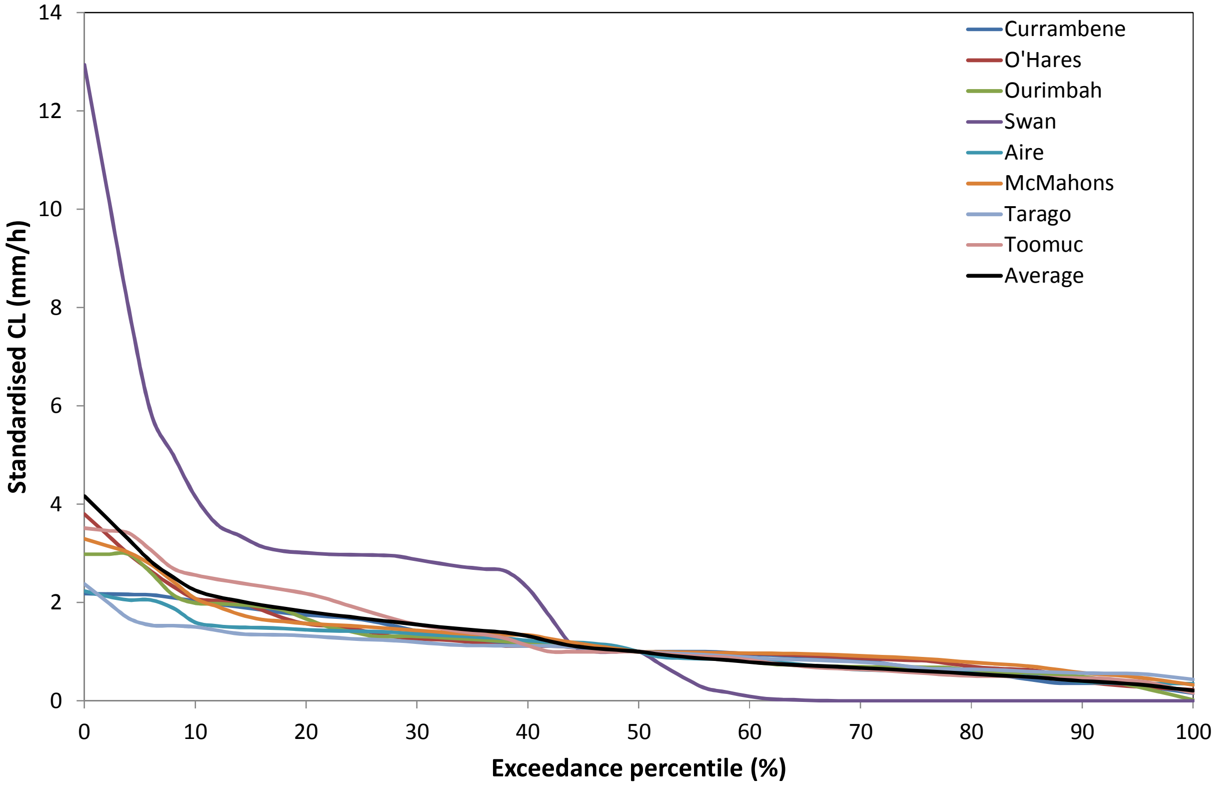




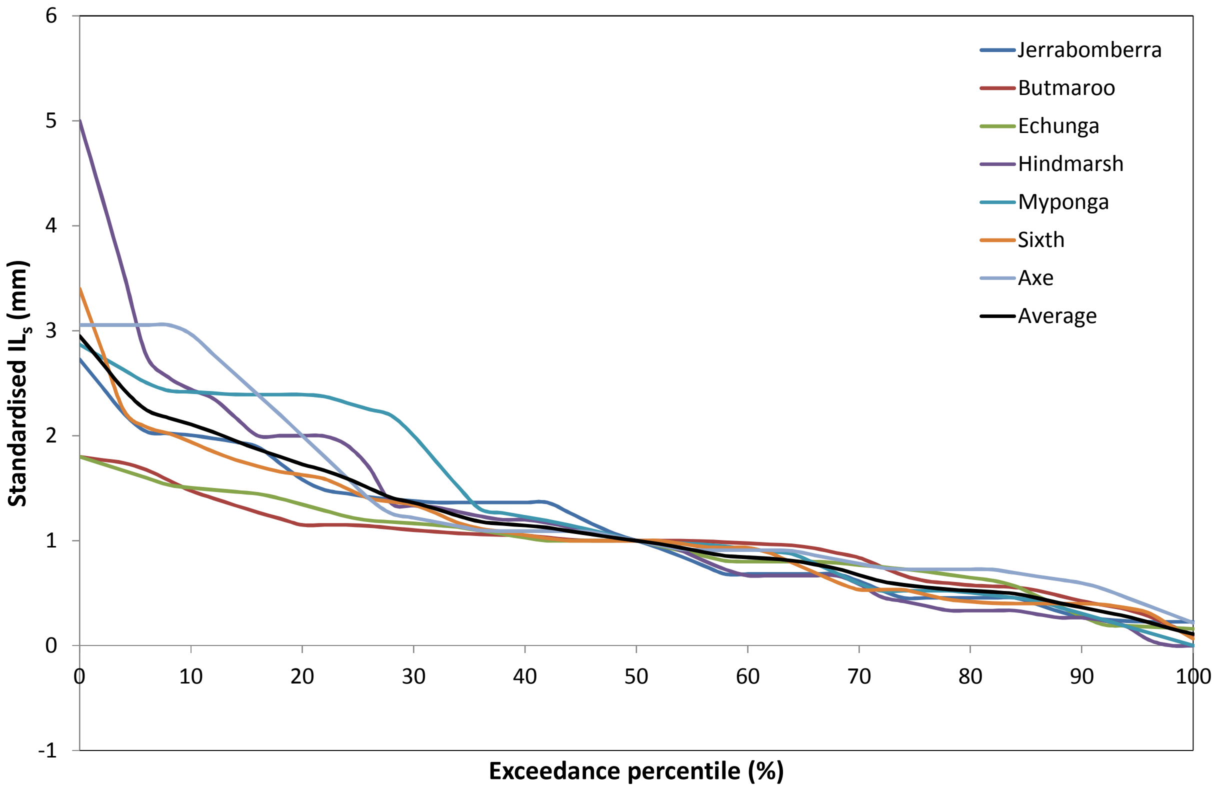
Appendix K Non-parametric loss distributions

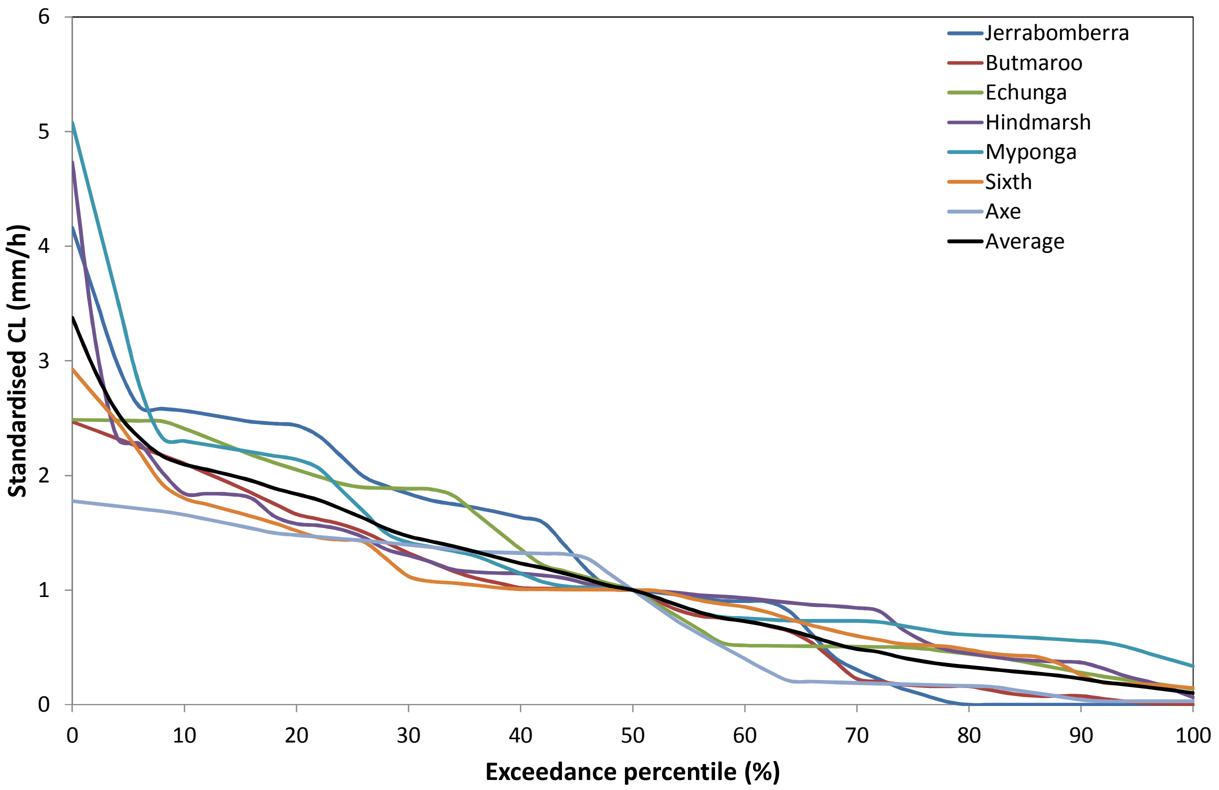
GSAM Coastal



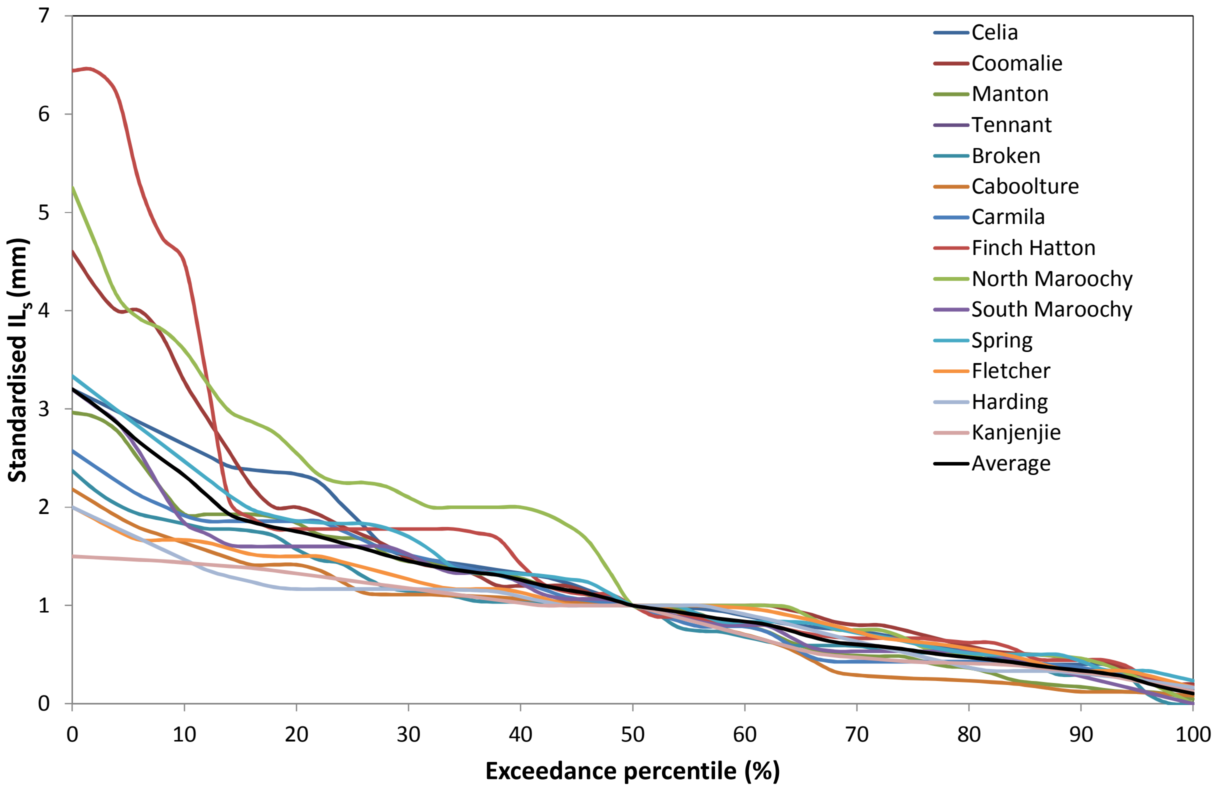


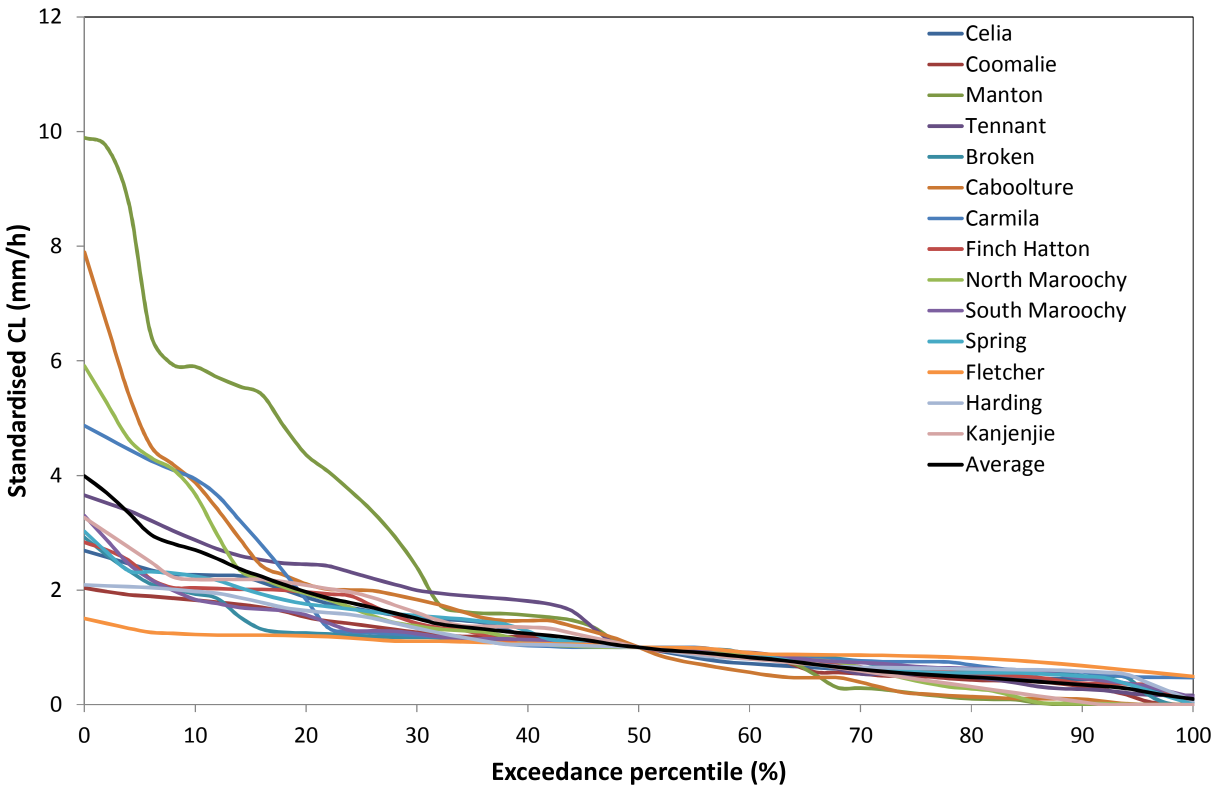
GSAM Inland


6
5
4
3
2
1
0
-1
Standardised IL_s (mm)
0
10
20
30
40
50
60
70
80
90
100
Exceedance percentile (%)
Jerrabomberra
Butmaroo
Echunga
Hindmarsh
Myponga
Sixth
Axe
Average

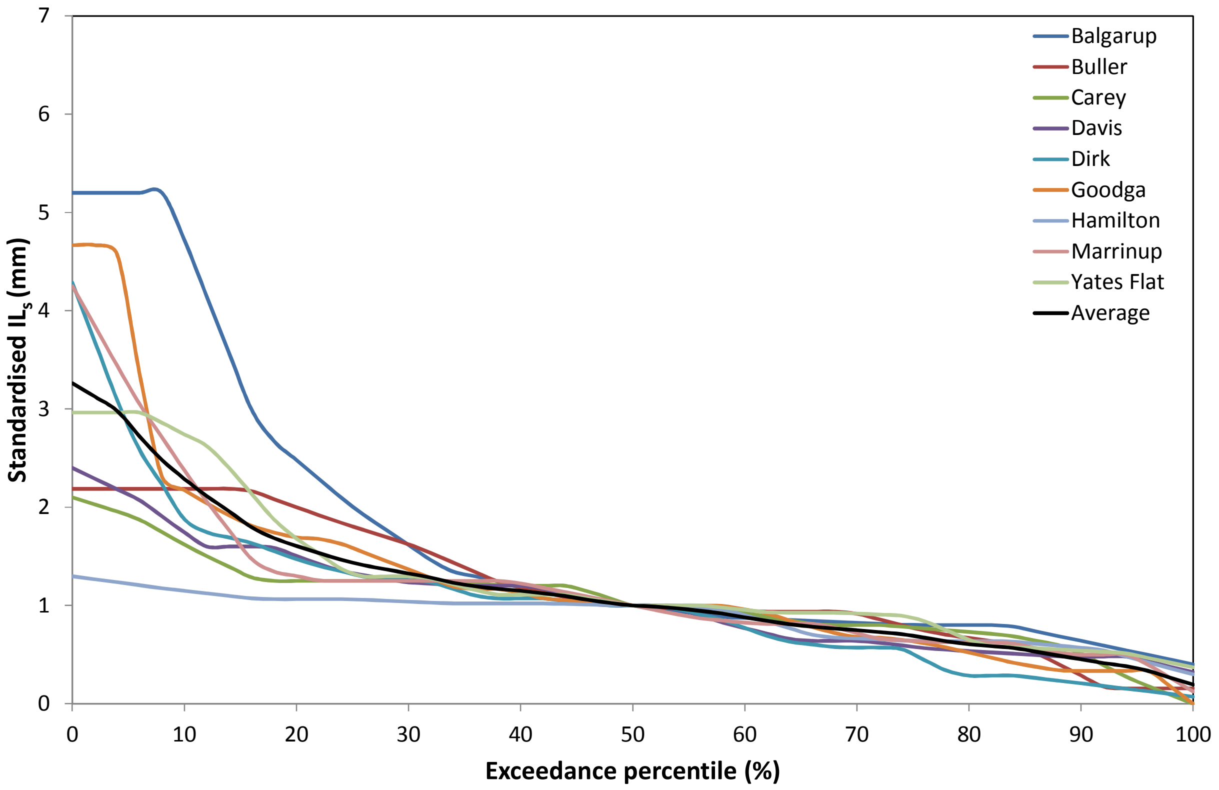

6
5
4
3
2
1
0
Standardised CL (mm/h)
0
10
20
30
40
50
60
70
80
90
100
Exceedance percentile (%)
Jerrabomberra
Butmaroo
Echunga
Hindmarsh
Myponga
Sixth
Axe
Average

GTSMR Coastal

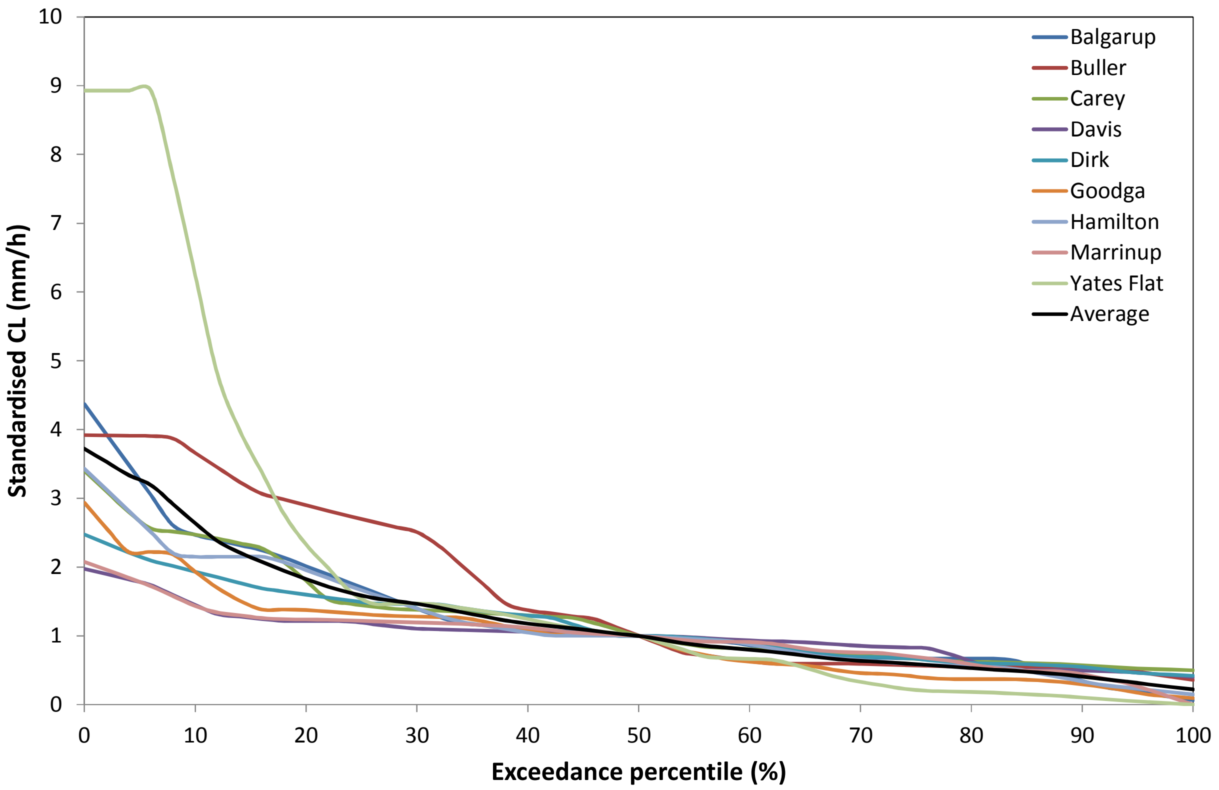




GTSMR SW WA



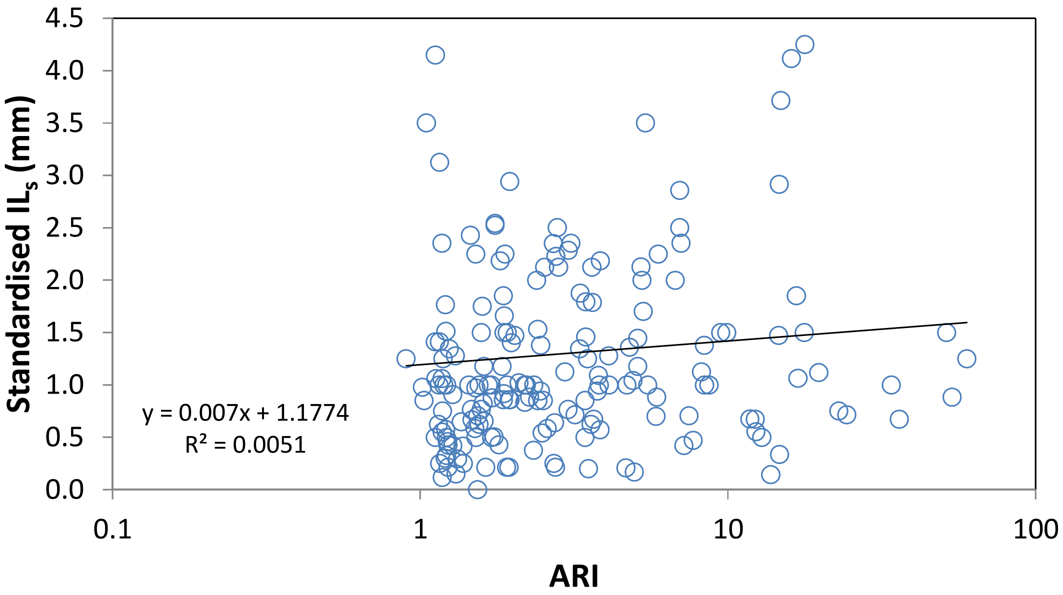
Balgarup
Buller
Carey
Davis
Dirk
Goodga
Hamilton
Marrinup
Yates Flat
Average
Standardised IL_s (mm)
Exceedance percentile (%)

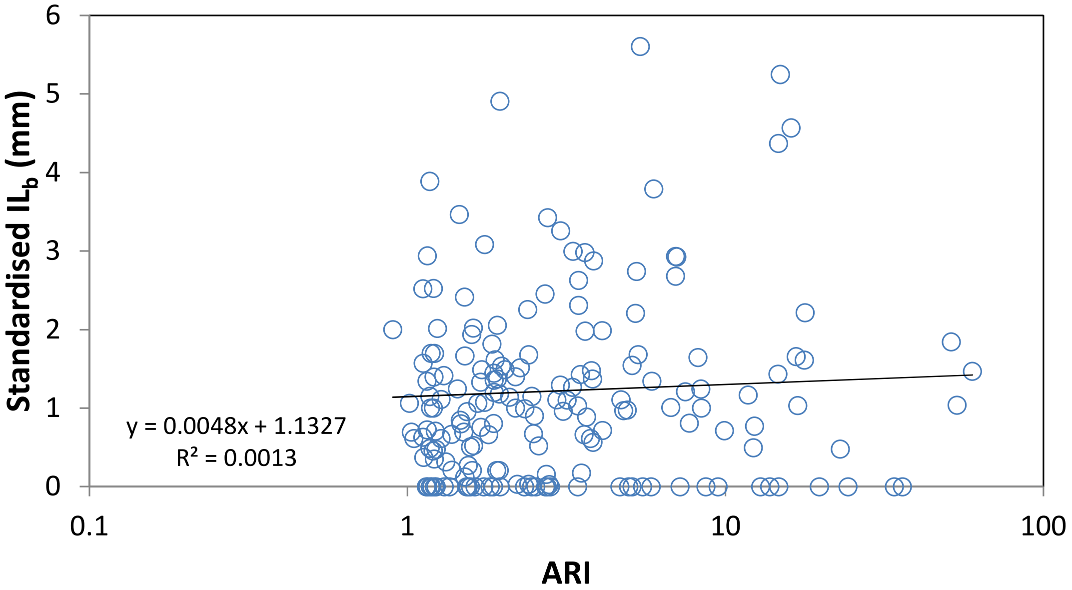


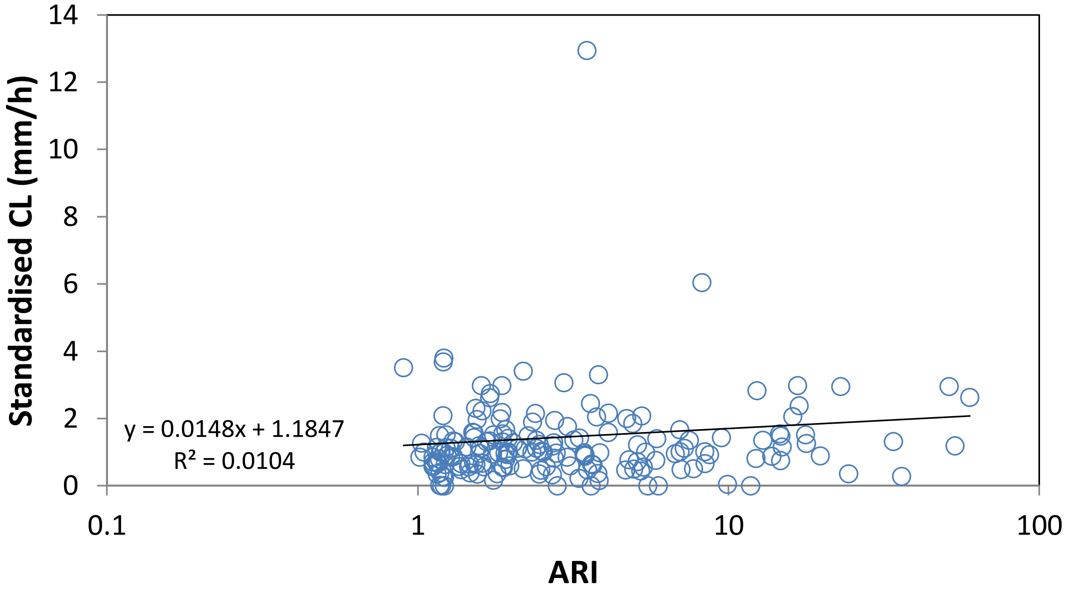
Balgarup
Buller
Carey
Davis
Dirk
Goodga
Hamilton
Marrinup
Yates Flat
Average
Standardised CL (mm/h)
Exceedance percentile (%)

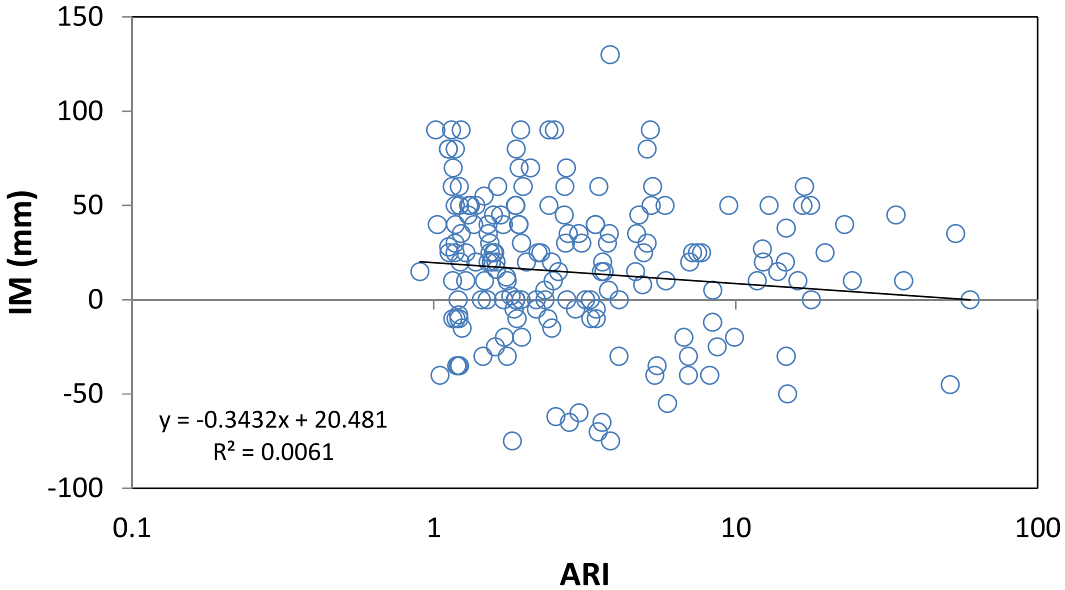
Appendix L Variation of loss values with ARI

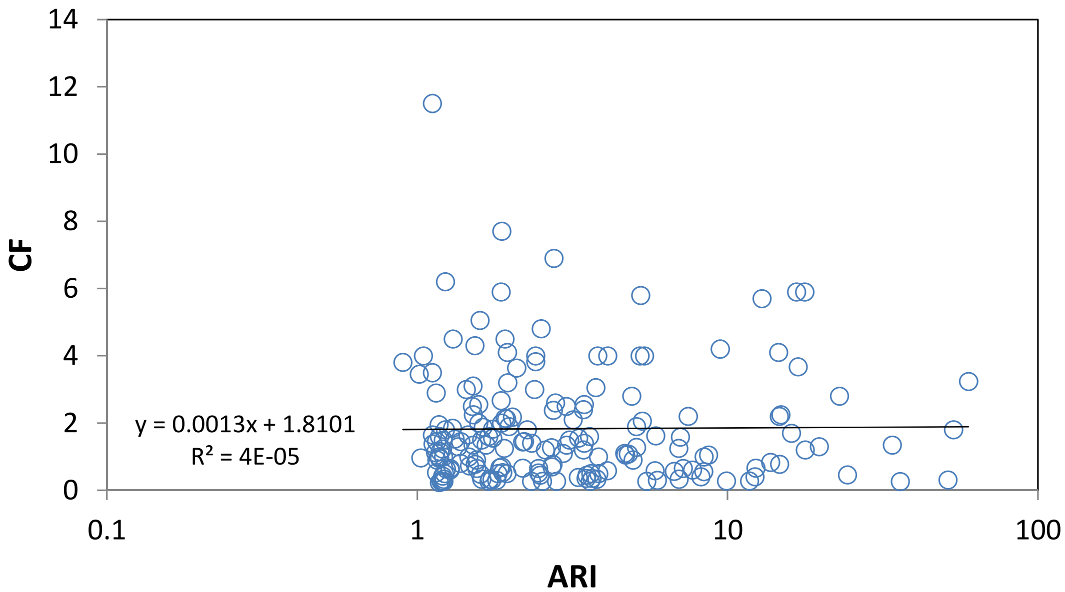
GSAM Coastal



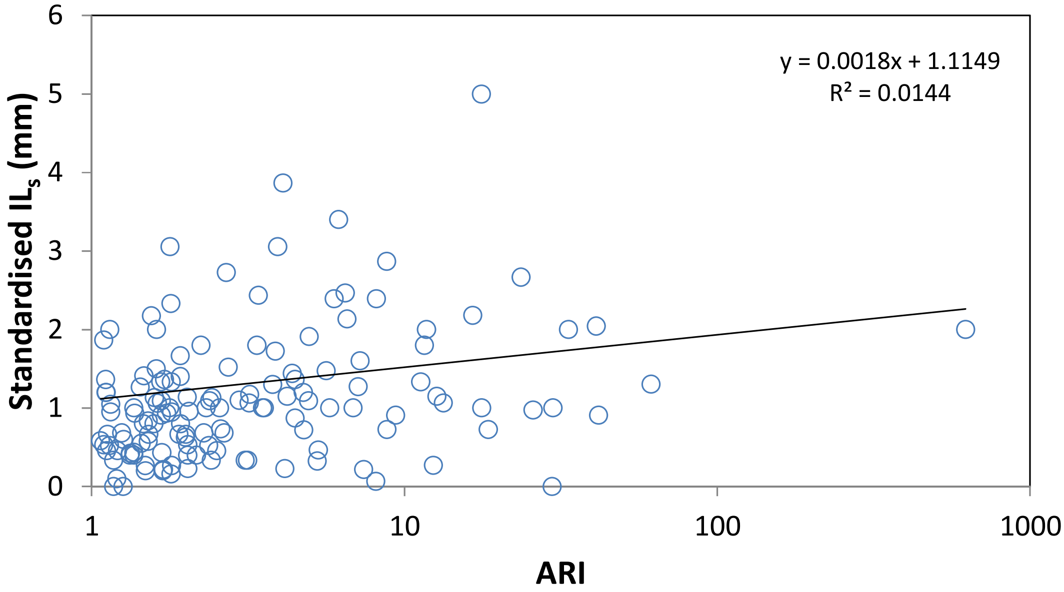



Standardised CL (mm/h)
ARI
y = 0.0148x + 1.1847
R^2 = 0.0104
0
2
4
6
8
10
12
14
0.1
1
10
100


IM (mm)
ARI
y = -0.3432x + 20.481
R^2 = 0.0061
-100
-50
0
50
100
150
0.1
1
10
100

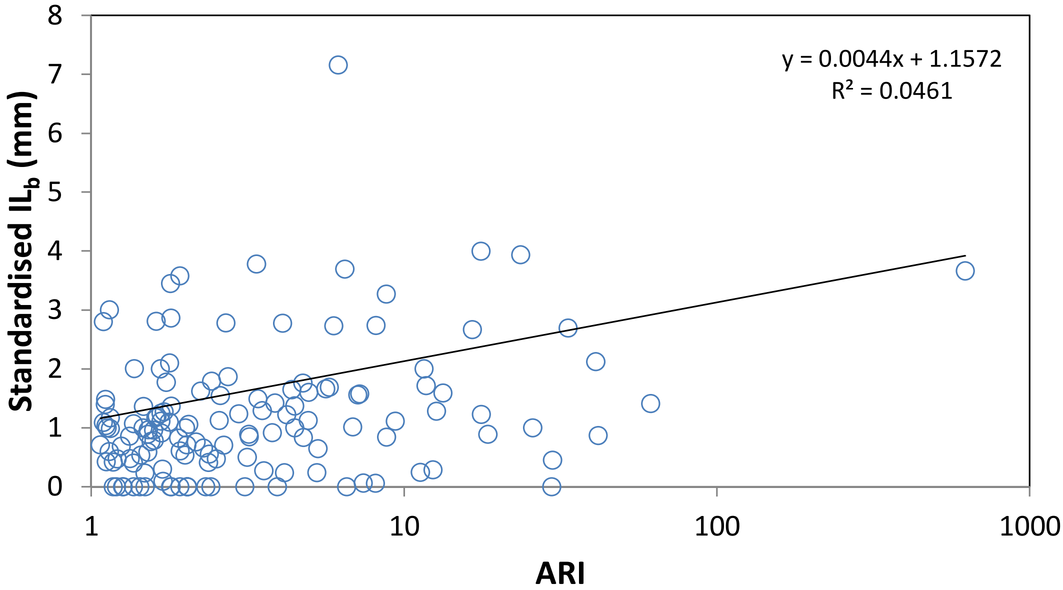

CF
ARI
y = 0.0013x + 1.8101
R^2 = 4E-05
0
2
4
6
8
10
12
14
0.1
1
10
100

GSAM Inland

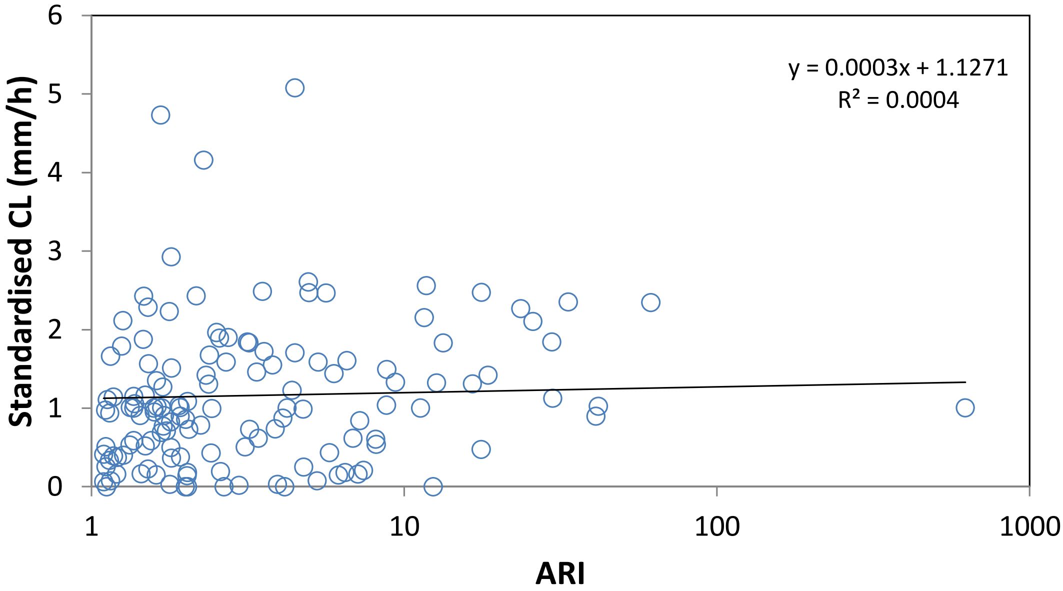


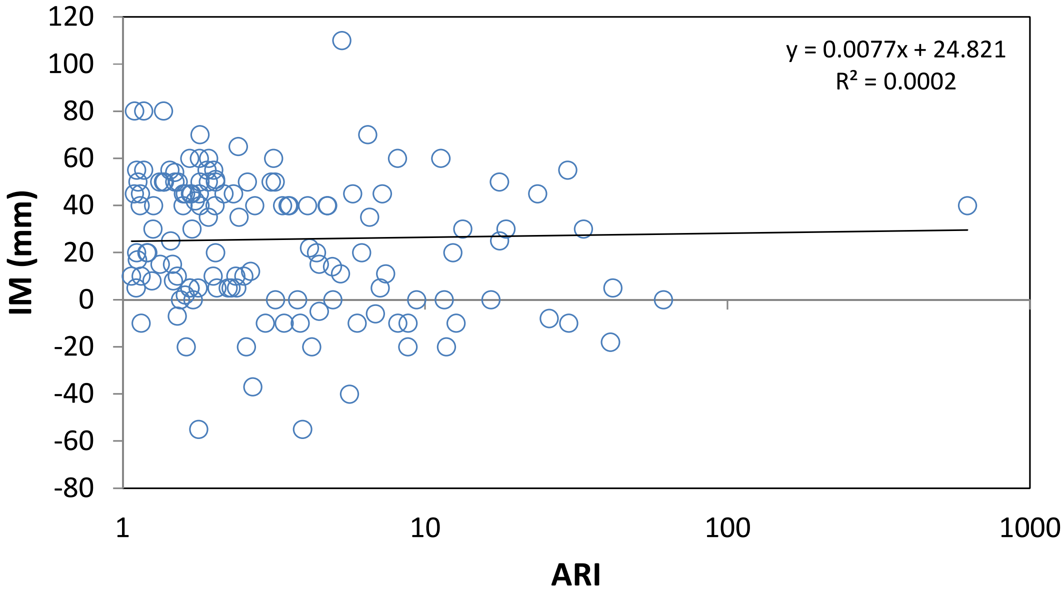
y = 0.0018x + 1.1149
R^2 = 0.0144
Standardised IL_s (mm)
ARI
0
1
2
3
4
5
6
1
10
100
1000

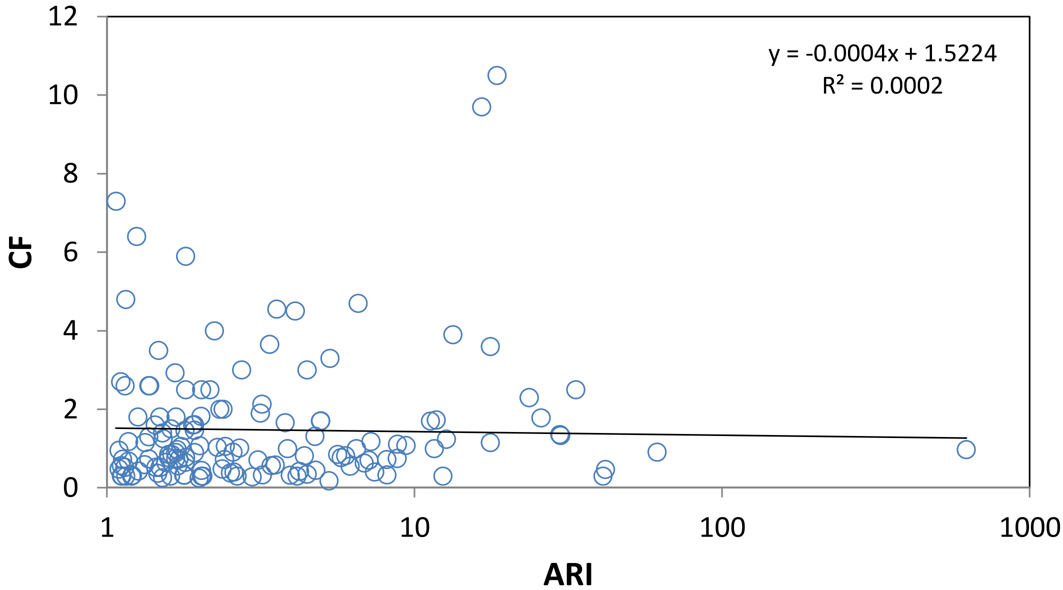
.



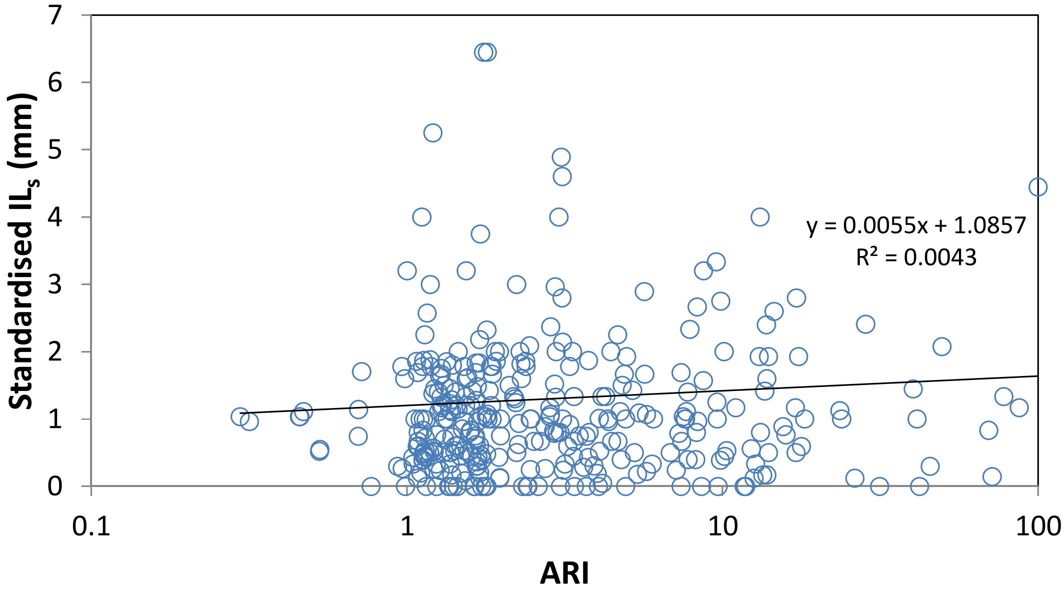
y = 0.0044x + 1.1572
R^2 = 0.0461
Standardised IL_b (mm)
ARI
0
1
2
3
4
5
6
7
8
1
10
100
1000

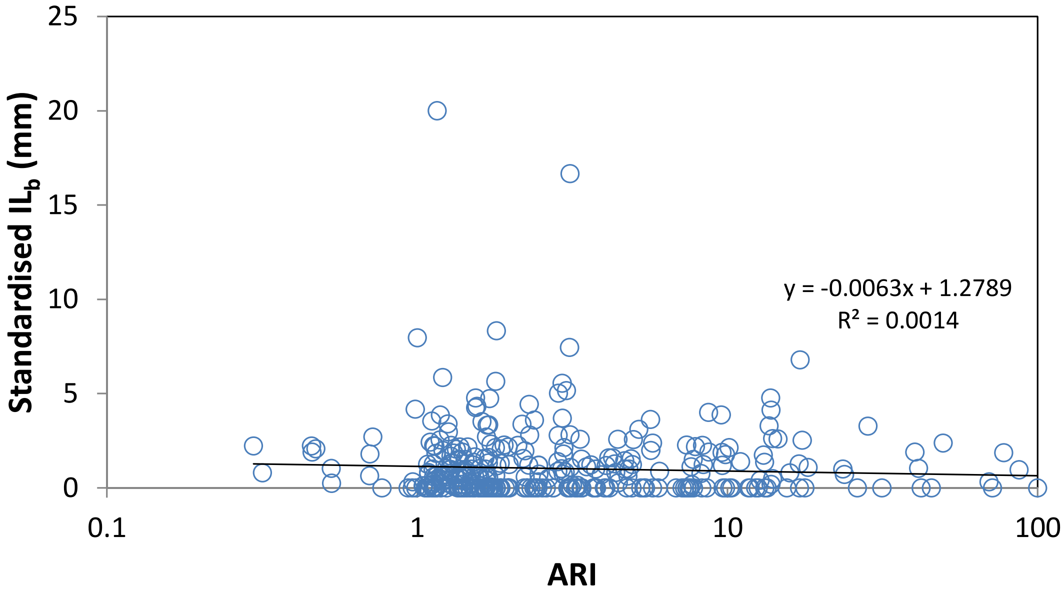

y = 0.0003x + 1.1272
R² = 0.0004
Standardised CL (mm/h)
ARI

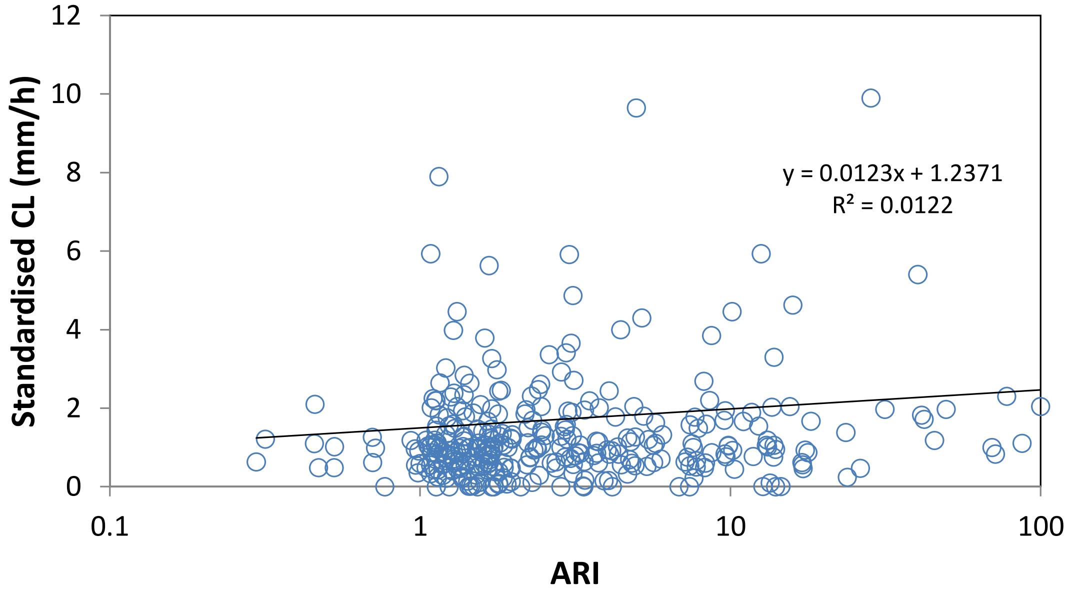

y = 0.0077x + 24.821
R² = 0.0002
IM (mm)
ARI

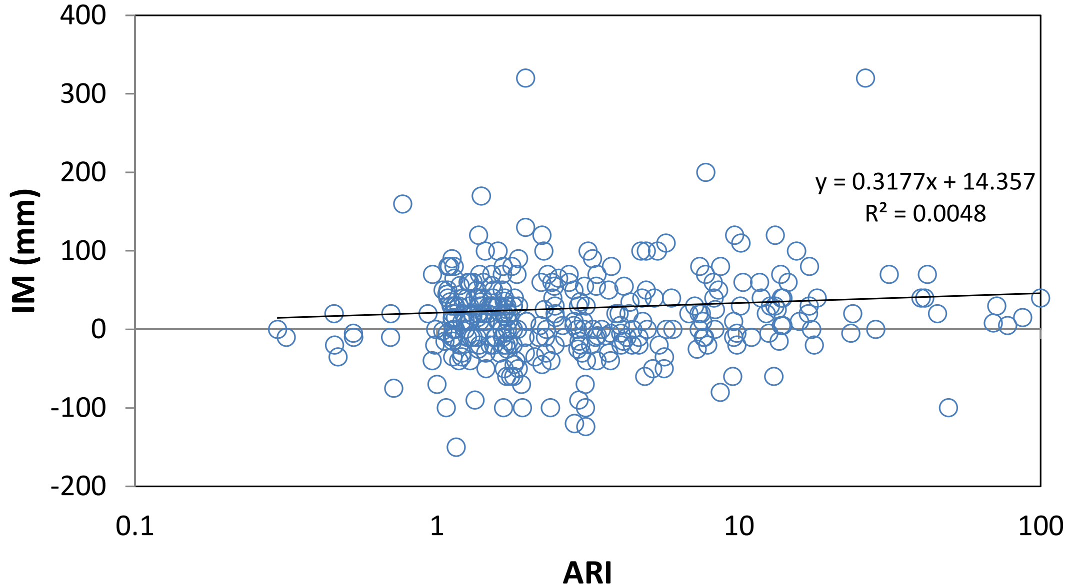

y = -0.0004x + 1.5224
R² = 0.0002
CF
ARI

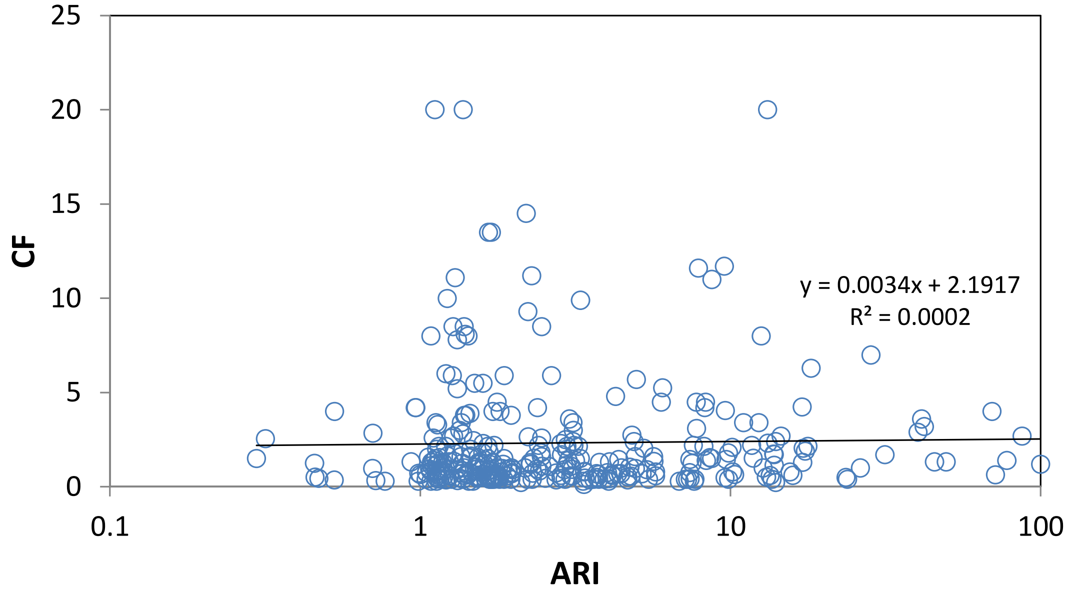
GTSMR Coastal



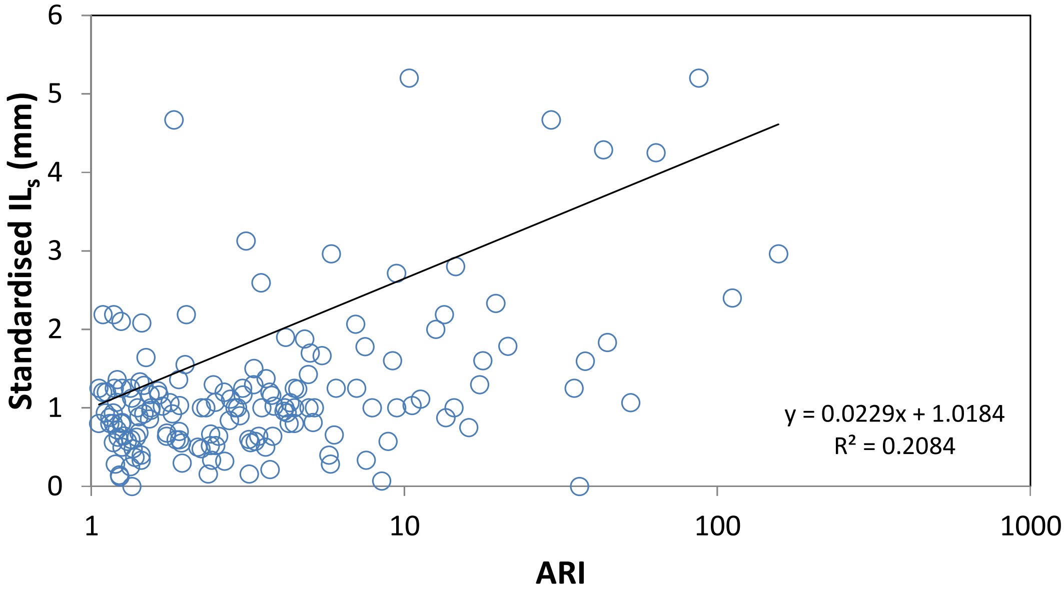


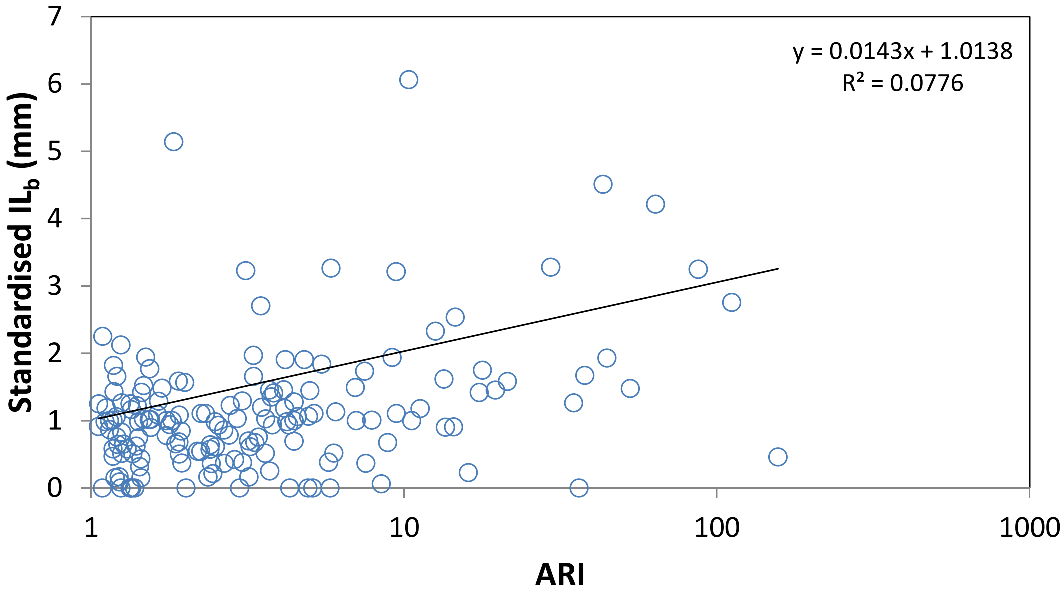

Standardised CL (mm/h)
ARI
y = 0.0123x + 1.2371
R² = 0.0122
0
2
4
6
8
10
12
0.1
1
10
100

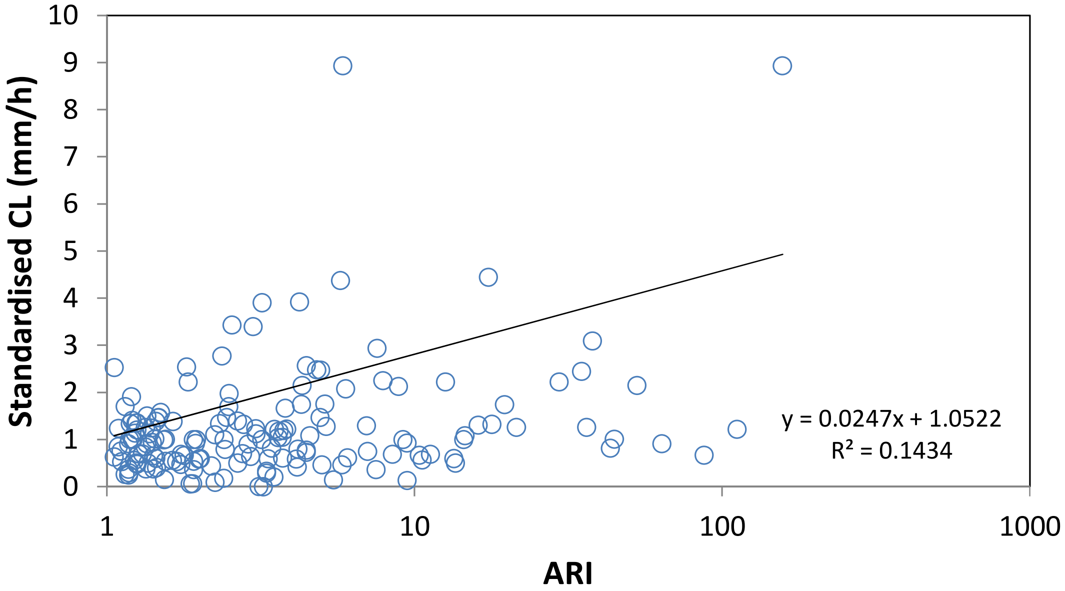

IM (mm)
ARI
y = 0.3177x + 14.357
R² = 0.0048
-200
-100
0
100
200
300
400
0.1
1
10
100

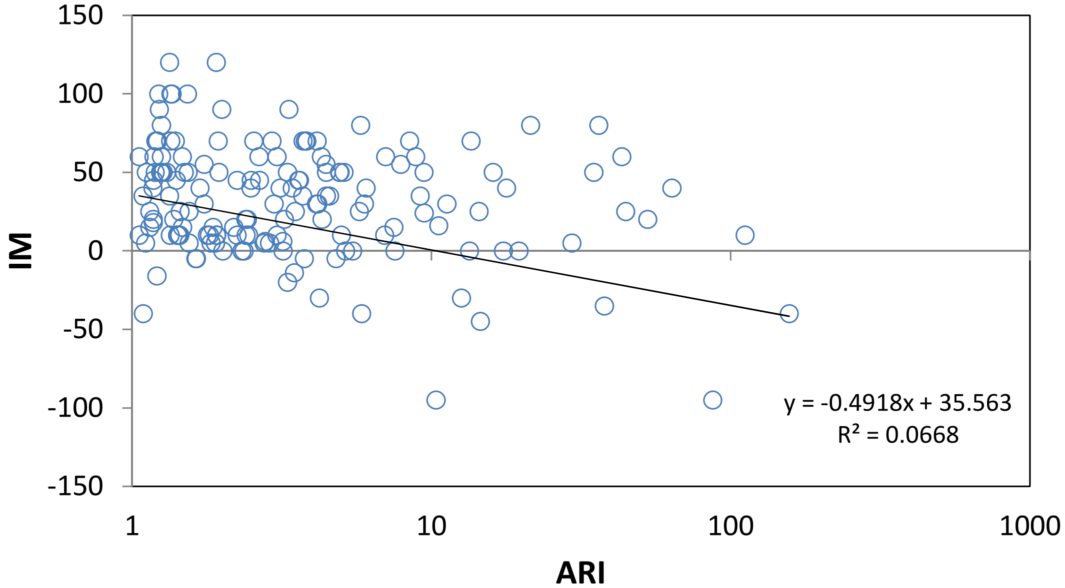

CF
ARI
y = 0.0034x + 2.1917
R² = 0.0002
0
5
10
15
20
25
0.1
1
10
100

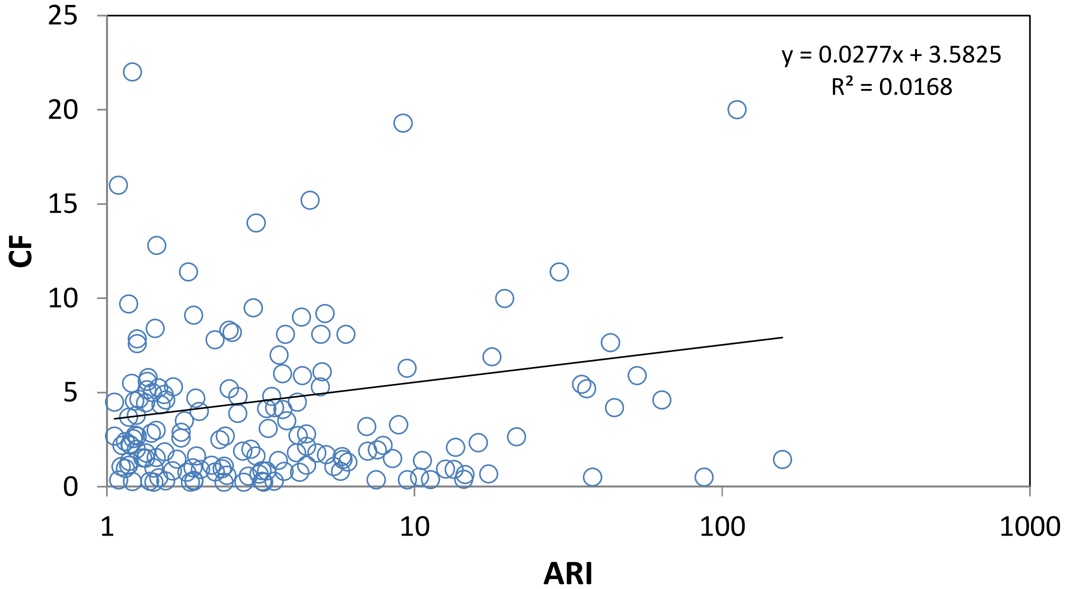
GTSMR SW WA


Standardised IL_s (mm)
ARI
y = 0.0229x + 1.0184
R² = 0.2084
0
1
2
3
4
5
6
1
10
100
1000


Standardised IL_b (mm)
ARI
y = 0.0143x + 1.0138
R² = 0.0776
0
1
2
3
4
5
6
7
1
10
100
1000


Standardised CL (mm/h)
ARI
y = 0.0247x + 1.0522
R² = 0.1434


IM
ARI
y = -0.4918x + 35.563
R² = 0.0668


CF
ARI
y = 0.0277x + 3.5825
R² = 0.0168

Appendix M Prediction equation diagnostics

GSAM Coastal and Inland

Dependent Variable	IL_S
N	15
Multiple R	0.886
Squared Multiple R	0.784
Adjusted Squared Multiple R	0.749
Standard Error of Estimate	6.179

Regression Coefficients B = (X'X)$^{-1}$X'Y

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	16.730	5.608	0.000	.	2.984	0.011
MED_API	-0.291	0.108	-0.377	0.917	-2.692	0.020
DES_RAIN_24HR	0.141	0.021	0.917	0.917	6.555	0.000

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	1,667.563	2	833.781	21.838	0.000
Residual	458.170	12	38.181		

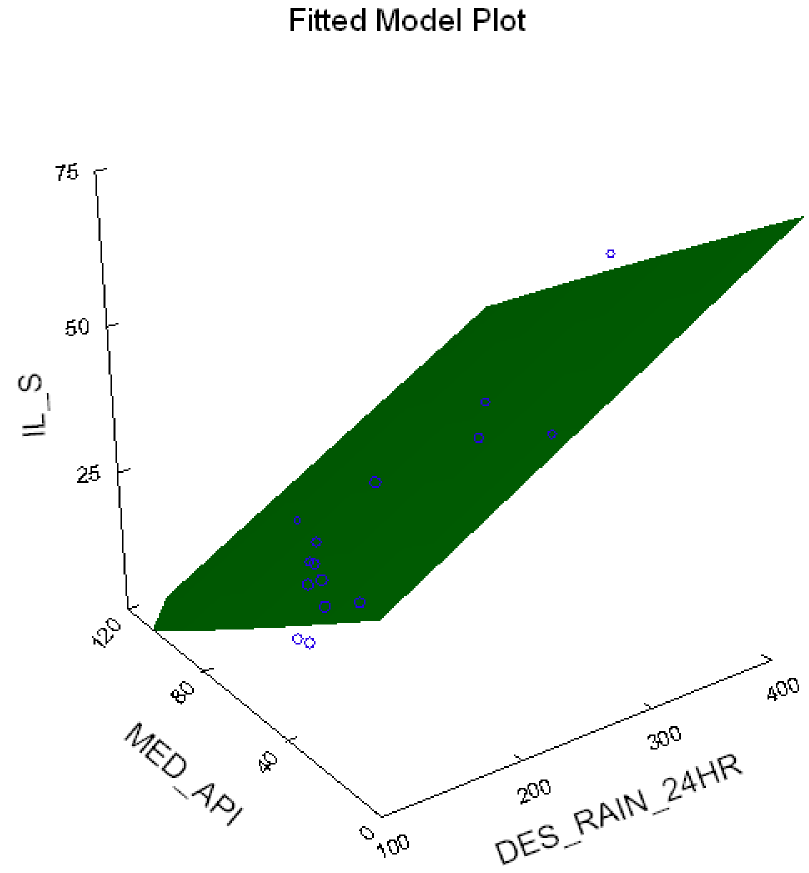
WARNING

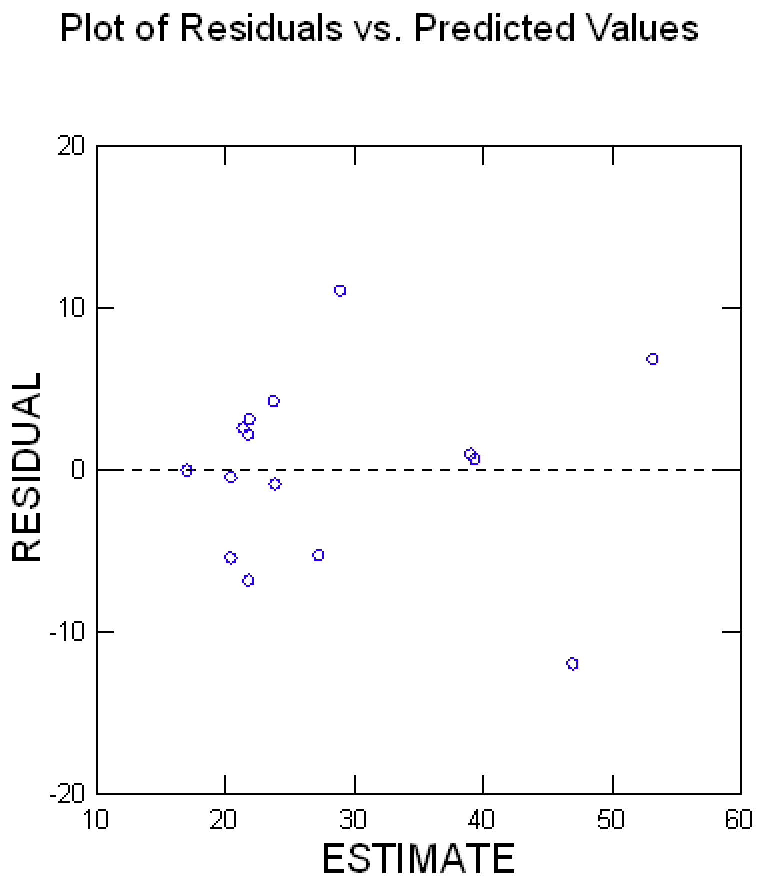
Case 1 is an Outlier (Studentized Residual : -2.902)
Case 5 has large Leverage (Leverage : 0.656)

Durbin-Watson D-Statistic	2.265
First Order Autocorrelation	-0.309

Information Criteria

AIC	101.856
AIC (Corrected)	105.856
Schwarz's BIC	104.688


Fitted Model Plot
IL_S
75
50
25
MED_API
120
80
40
0
DES_RAIN_24HR
100
200
300
400


Plot of Residuals vs. Predicted Values
RESIDUAL
20
10
0
-10
-20
ESTIMATE
10
20
30
40
50
60

Dependent Variable	IM
N	15
Multiple R	0.656
Squared Multiple R	0.430
Adjusted Squared Multiple R	0.387
Standard Error of Estimate	21.413

Regression Coefficients $B = (X'X)^{-1}X'Y$

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	-4.502	9.522	0.000	.	-0.473	0.644
A_KSAT	0.229	0.073	0.656	1.000	3.135	0.008

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	4,505.934	1	4,505.934	9.827	0.008
Residual	5,960.966	13	458.536		

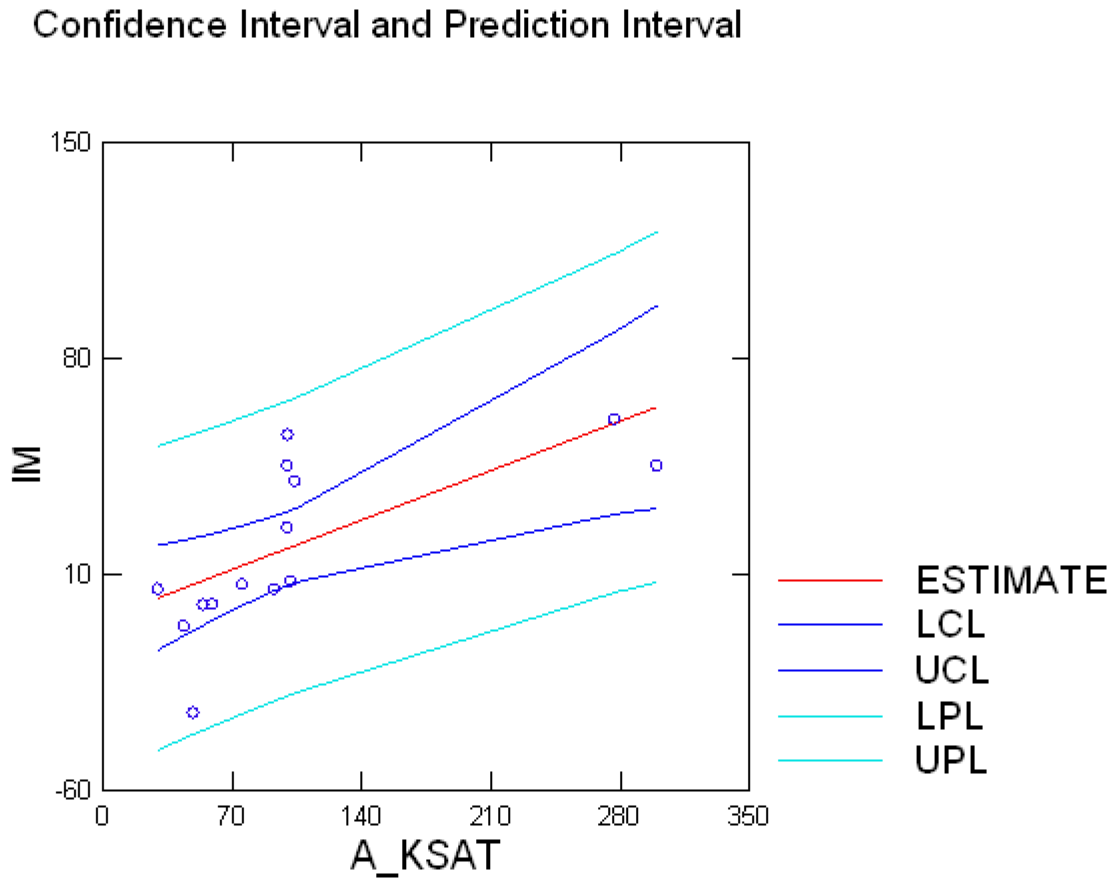
WARNING

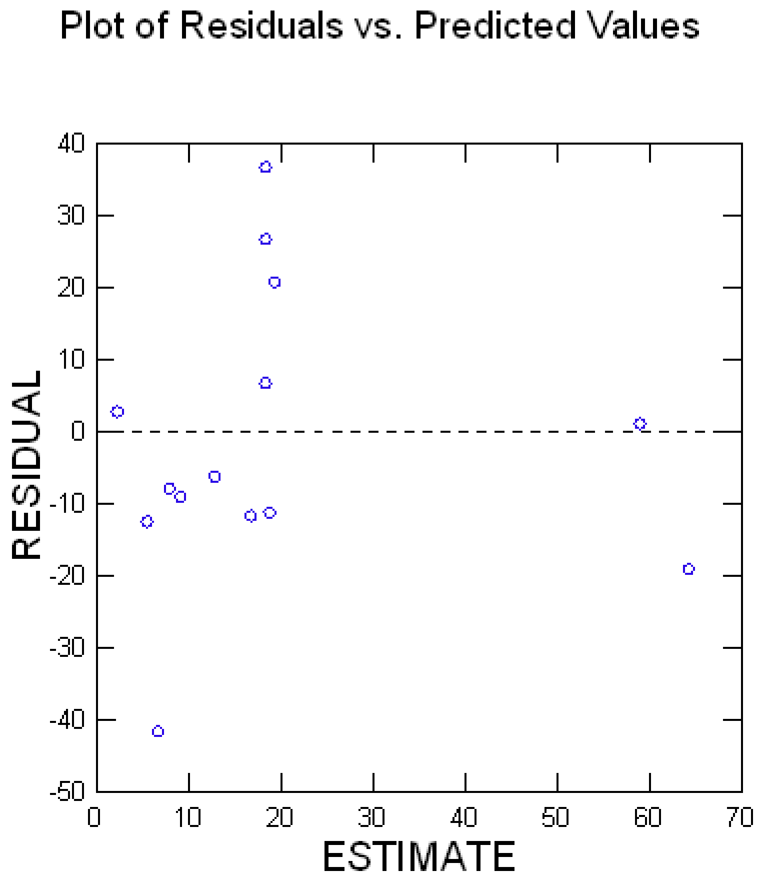
Case 6 has large Leverage (Leverage : 0.506)

Durbin-Watson D-Statistic	2.584
First Order Autocorrelation	-0.300

Information Criteria

AIC	138.342
AIC (Corrected)	140.524
Schwarz's BIC	140.466


Confidence Interval and Prediction Interval
150
80
10
-60
IM
0
70
140
210
280
350
A_KSAT
ESTIMATE
LCL
UCL
LPL
UPL


Plot of Residuals vs. Predicted Values
40
30
20
10
0
-10
-20
-30
-40
-50
RESIDUAL
0
10
20
30
40
50
60
70
ESTIMATE

Dependent Variable	CF
N	15
Multiple R	0.760
Squared Multiple R	0.577
Adjusted Squared Multiple R	0.544
Standard Error of Estimate	0.446

Regression Coefficients $B = (X'X)^{-1}X'Y$

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	0.514	0.198	0.000	.	2.591	0.022
A_KSAT	0.006	0.002	0.760	1.000	4.210	0.001

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	3.524	1	3.524	17.721	0.001
Residual	2.585	13	0.199		

WARNING

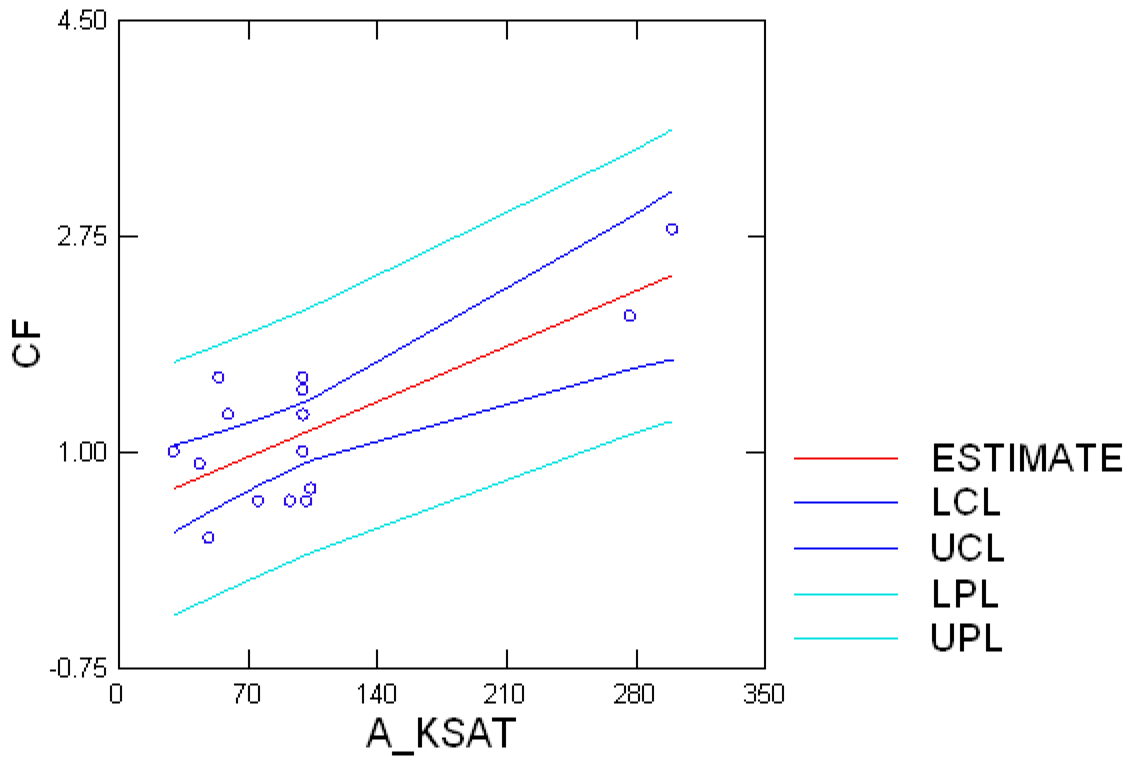
Case 6 has large Leverage (Leverage : 0.506)

Durbin-Watson D-Statistic	2.755
First Order Autocorrelation	-0.426

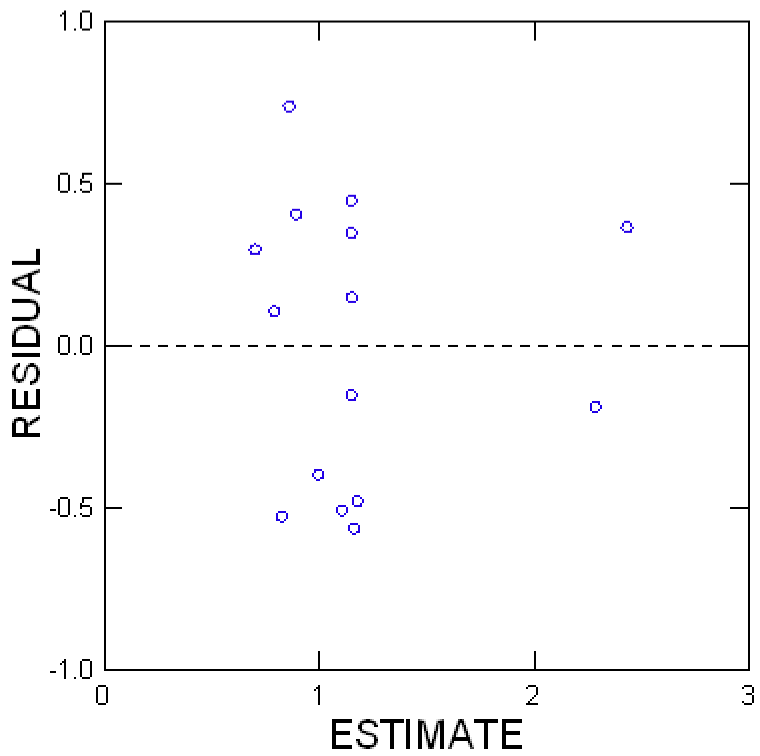
Information Criteria

AIC	22.195
AIC (Corrected)	24.376
Schwarz's BIC	24.319

Confidence Interval and Prediction Interval



Plot of Residuals vs. Predicted Values



GTSMR Coastal

Dependent Variable	IM
N	14
Multiple R	0.812
Squared Multiple R	0.659
Adjusted Squared Multiple R	0.598
Standard Error of Estimate	17.924

Regression Coefficients B = $(X'X)^{-1}X'Y$

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	108.404	24.871	0.000	.	4.359	0.001
ELEVRANGE_SQRTCA	622.208	146.744	1.061	0.495	4.240	0.001
A_FCP	-393.526	91.601	-1.075	0.495	-4.296	0.001

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	6,843.297	2	3,421.649	10.650	0.003
Residual	3,533.935	11	321.267		

WARNING

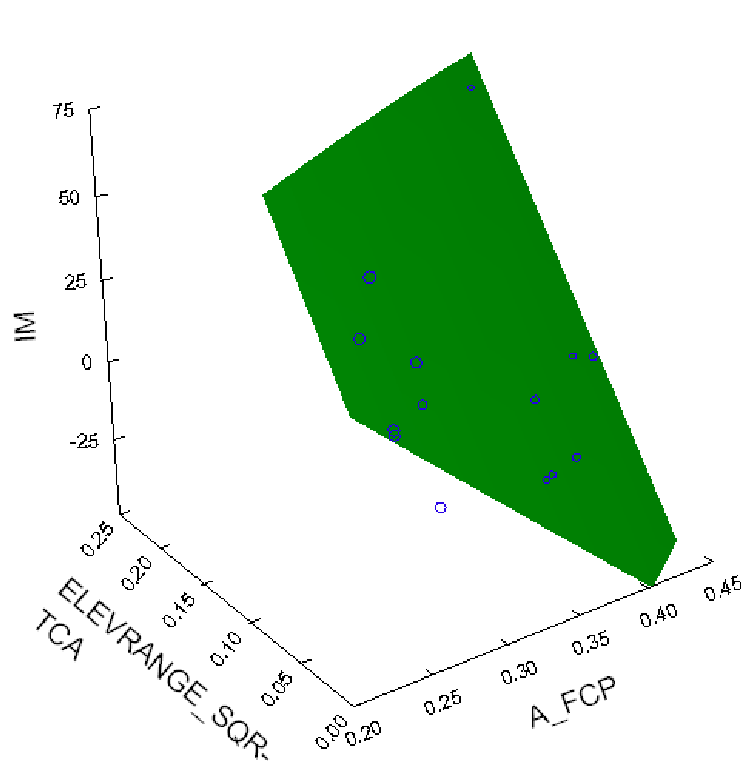
Case 8 has large Leverage (Leverage : 0.834)

Durbin-Watson D-Statistic	2.138
First Order Autocorrelation	-0.228

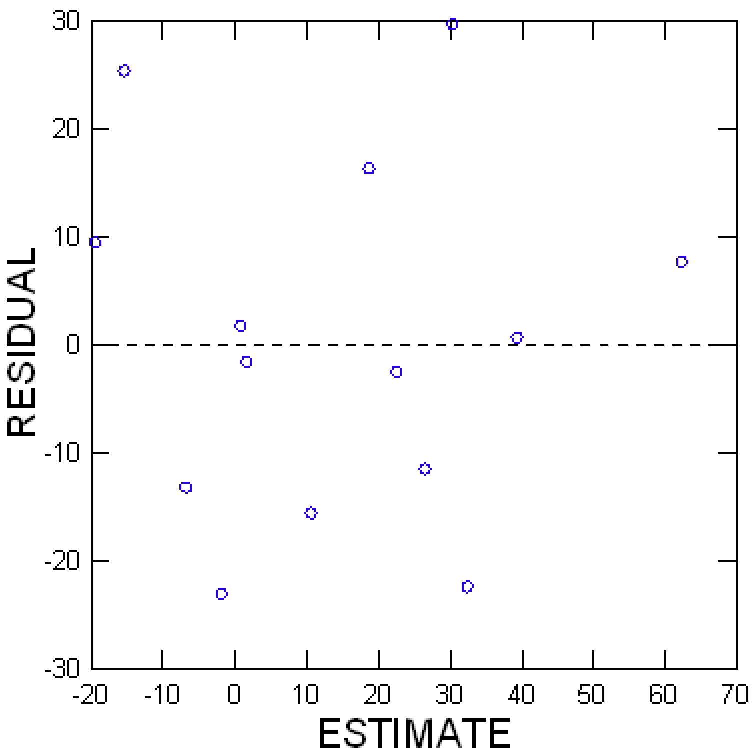
Information Criteria

AIC	125.166
AIC (Corrected)	129.610
Schwarz's BIC	127.722

Fitted Model Plot



Plot of Residuals vs. Predicted Values



GTSMR SW WA

Dependent Variable	CL
N	9
Multiple R	0.738
Squared Multiple R	0.544
Adjusted Squared Multiple R	0.479
Standard Error of Estimate	1.727

Regression Coefficients B = (X'X)$^{-1}$X'Y

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	-10.695	5.314	0.000	.	-2.013	0.084
DES_RAIN_12HR	0.159	0.055	0.738	1.000	2.889	0.023

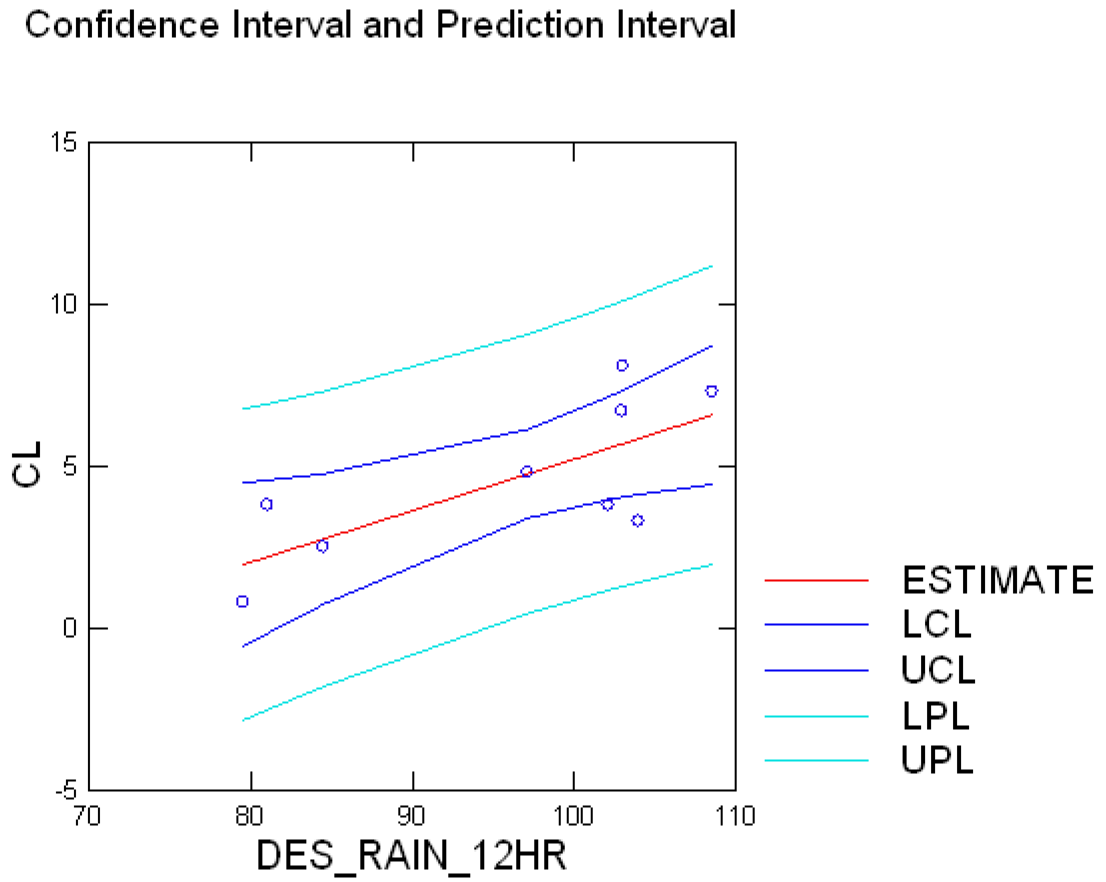
Analysis of Variance

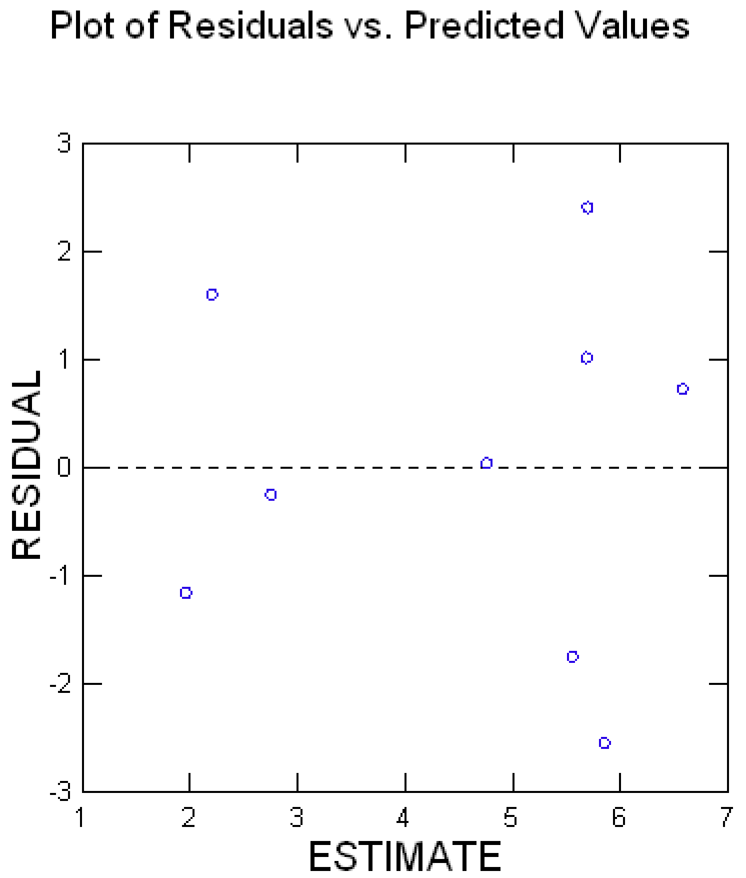
Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	24.912	1	24.912	8.348	0.023
Residual	20.888	7	2.984		

Durbin-Watson D-Statistic	1.819
First Order Autocorrelation	0.056

Information Criteria

AIC	39.119
AIC (Corrected)	43.919
Schwarz's BIC	39.710


Confidence Interval and Prediction Interval
15
10
5
0
-5
CL
70
80
90
100
110
DES_RAIN_12HR
ESTIMATE
LCL
UCL
LPL
UPL


Plot of Residuals vs. Predicted Values
3
2
1
0
-1
-2
-3
RESIDUAL
1
2
3
4
5
6
7
ESTIMATE

Dependent Variable	IM
N	9
Multiple R	0.946
Squared Multiple R	0.894
Adjusted Squared Multiple R	0.879
Standard Error of Estimate	8.527

Regression Coefficients B = $(X'X)^{-1}X'Y$

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	-36.122	9.334	0.000	.	-3.870	0.006
TOP_2PC_API	0.472	0.061	0.946	1.000	7.688	0.000

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	4,296.629	1	4,296.629	59.098	0.000
Residual	508.927	7	72.704		

WARNING

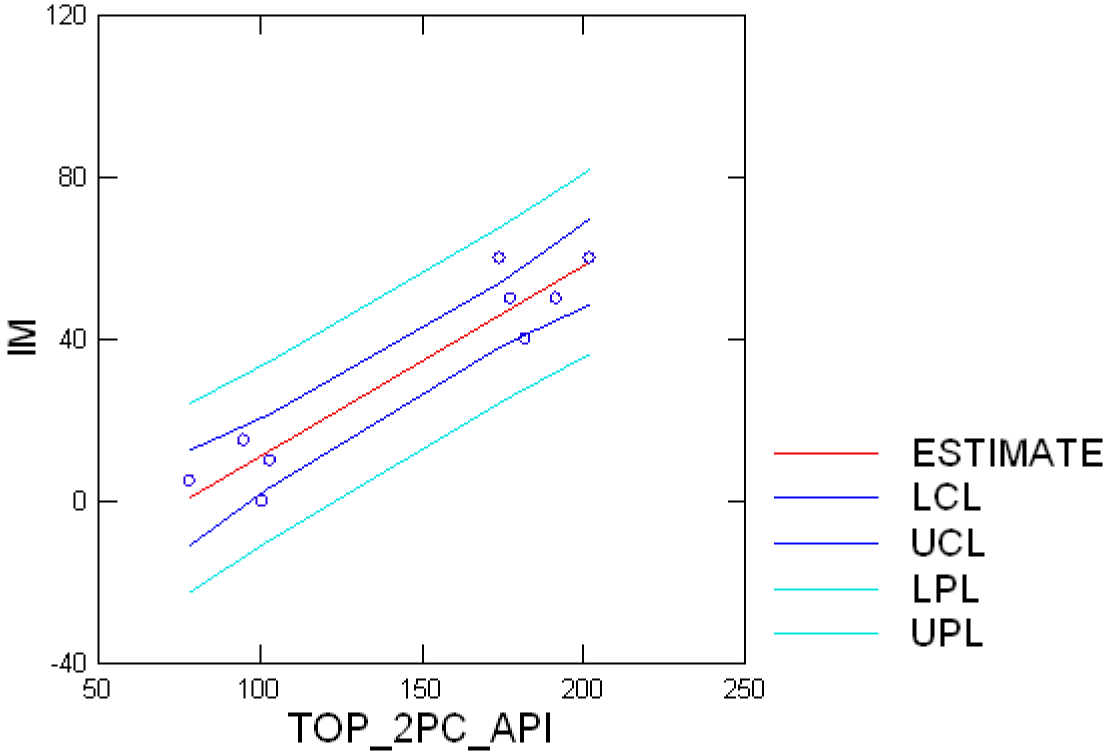
Case 5 is an Outlier (Studentized Residual : 2.254)

Durbin-Watson D-Statistic	2.397
First Order Autocorrelation	-0.254

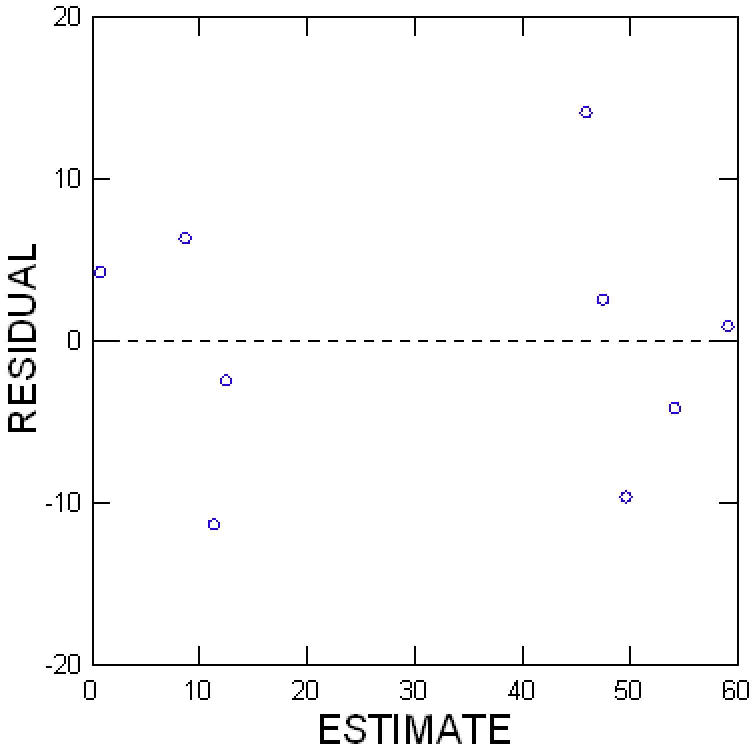
Information Criteria

AIC	67.857
AIC (Corrected)	72.657
Schwarz's BIC	68.448

Confidence Interval and Prediction Interval



Plot of Residuals vs. Predicted Values



Dependent Variable	CF
N	9
Multiple R	0.703
Squared Multiple R	0.494
Adjusted Squared Multiple R	0.421
Standard Error of Estimate	1.705

Regression Coefficients $B = (X'X)^{-1}X'Y$

Effect	Coefficient	Standard Error	Std. Coefficient	Tolerance	t	p-Value
CONSTANT	0.881	0.960	0.000	.	0.918	0.389
B_KSAT	0.012	0.005	0.703	1.000	2.612	0.035

Analysis of Variance

Source	SS	df	Mean Squares	F-Ratio	p-Value
Regression	19.821	1	19.821	6.822	0.035
Residual	20.339	7	2.906		

WARNING

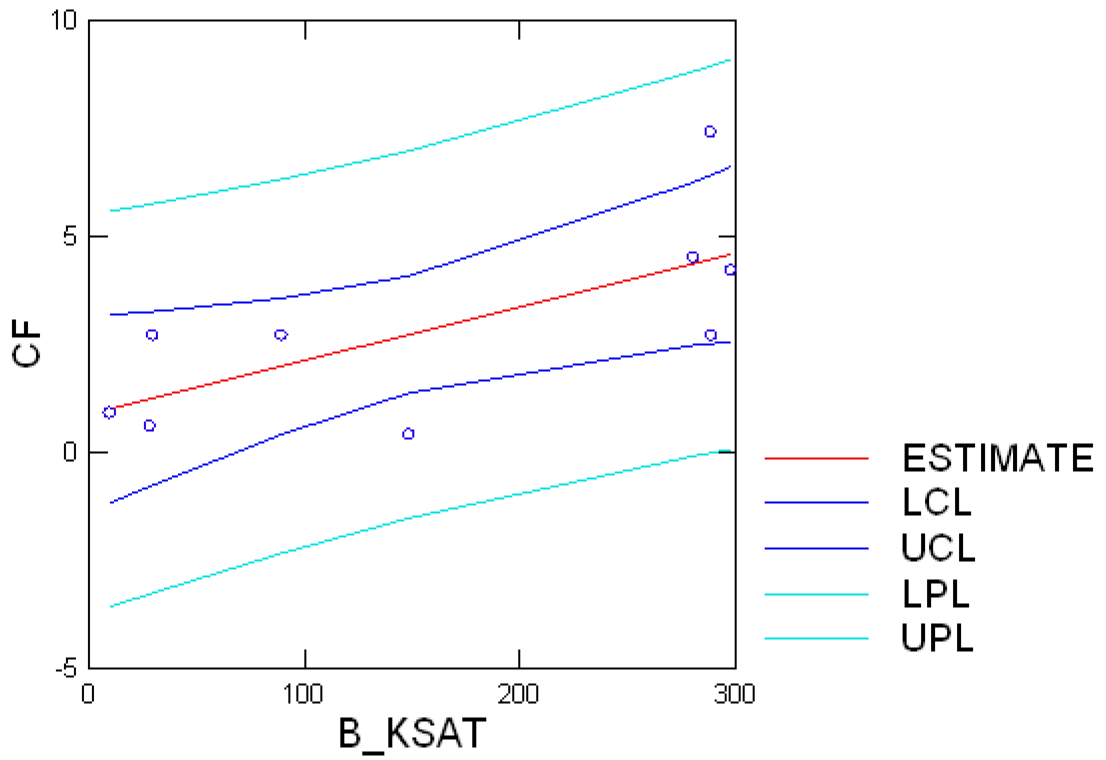
Case 4 is an Outlier (Studentized Residual : 2.726)

Durbin-Watson D-Statistic	0.907
First Order Autocorrelation	0.413

Information Criteria

AIC	38.879
AIC (Corrected)	43.679
Schwarz's BIC	39.470

Confidence Interval and Prediction Interval



Plot of Residuals vs. Predicted Values