Appendix D - CATCHMENT YIELD

D.1 Long-Term Runoff Estimation – KII Method

Long-term runoff from a catchment can be estimated using the KII method developed by the US Department of Agriculture (USDA, 1971). The information provided here is generally taken from the Farm Water Supplies Design Manual Volume 1 (Horton and Jobling, 1992).

The KII method predicts runoff from daily rainfalls. Using historical rainfall data for and extended period, (say 30 years) the long-term runoff from a catchment can be estimated. The KII method relies on assigning the catchment a "KII index" that is based on soil type, vegetation, condition and land use. This is done using Table D-1, Table D-2 and Table D-3.

The hydrologic condition referred to in Table D-3 is the general condition of the catchment. "Poor Condition" refers to an overstocked, sparsely grassed, or sheet eroded catchment, which would yield more runoff than a "Good Catchment", that is appropriately stocked and well grassed.

TABLE D-1 - CLASSIFYING SOIL TYPE ACCORDING TO NATIVE VEGETATION

Soil description	Examples of Associated Timber	Soil Classification
Sandy Surface – Clay Sub-soil (including ridges)	Stunted Eucalypt Oak Forest	C tending towards D where top soils are shallow
Hard Setting	Ironbark, Box, Belah	C
Friable – Black and Brown	Soft wood scrub	B
Seasonal Cracking Melon holes	Brigalow Belah	B Deep melon holes tending towards A
Friable – Red	Well grown Eucalypt forest, and tall "rain-forest" scrub where rainfall is high and soil is deep	B can tend towards A. Where base flow is intercepted revert to Class C.
Sandy – Deep	Cypress Pine	A

TABLE D-2 - GENERAL CLASSIFICATION OF SOIL TYPES FOR KII

Soil Group	Description of Soil Characteristics.
A	Soil having very low runoff potential. For example, deep sands with very little silt or clay.
B	Light soils and/or well structured soils having above-average infiltration when thoroughly wetted. For example, light sandy loams, silty loams.
C	Medium soils and shallow soils having below-average infiltration when thoroughly wetted. For example, clay loams.
D	Soils having high runoff potential. For example, heavy soils, particularly clays of high swelling capacity, and very shallow soils underlain by dense clay horizons.

TABLE D-3 - CATCHMENT INDEX KII

Land Use or Cover	Farming Treatment	Hydrologic Condition	Soil Group			
			A	B	C	D
Native Pasture or Grassland	-	Poor	68	79	86	89
		Fair	50	69	79	84
		Good	39	61	74	80
Timbered Areas	-	Poor	46	68	78	84
		Fair	36	60	70	76
		Good	26	52	62	69
Improved Permanent Pasture	-	Good	30	58	71	78
Rotation Pastures	Straight Row	Poor	66	77	85	89
		Good	58	72	81	85
	Contoured	Poor	64	75	83	85
		Good	55	69	78	83
Crops (Small, Grain)	Straight Row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
Fallow	Straight Row	-	77	86	91	94
Contoured Native Pasture	-	Poor	47	67	81	88
		Fair	25	59	75	83
		Good	6	35	70	79
Homestead Areas	-	-	59	74	82	86
Roads (Dirt, Hard surfaced)	-	-	72 74	82 84	87 90	89 92

Once the KII index is defined then KI and KIII indices can be defined. Using these indices with the rules and equations of the USDA model, the runoff for each day over the study period can be estimated. The details of this process are not relevant here. Done manually the process is laborious. Computer programs such as FSA Irrigation's "Whole Farm Irrigation Simulation", CSIRO's "DamEa$y" and DNR's "Rustic" have been written to carry this out automatically.

Using this method the runoff that could be expected in 50% of years (median) and 75% of years has been calculated for sites around Queensland. These results are shown in Table D-4 and Table D-5 for various KII values. These results, taken from Horton and Jobling (1992), have been calculated from 30 years of daily rainfall data prior to 1976.

TABLE D-4 - SUMMARY OF RUNOFFS (MM) EQUALLED OR EXCEEDED IN 50% OF YEARS

Rainfall Station	Value of KII		
	65	75	85
Bundaberg	96	171	293
Childers	72	136	242
Gin Gin	50	129	242
Maryborough	38	126	227

Notes: Calculated by U.S.D.A model from 30 years of daily rainfall records. Values shown are the runoffs, which in the long term should be equalled or exceeded in 2 out of 4 years, i.e. 50% of the time.

TABLE D-5 - SUMMARY OF RUNOFFS (MM) EQUALLED OR EXCEEDED IN 75% OF YEARS

Rainfall Station	Value of KII		
	65	75	85
Bundaberg	32	75	143
Childers	25	47	107
Gin Gin	15	41	97
Maryborough	23	61	124

Notes: Calculated by U.S.D.A model from 30 years of daily rainfall records. Values shown are the runoffs, which in the long term should be equalled or exceeded in 3 out of 4 years, i.e 75% of the time.

D.2 Long Term Catchment Yield

Once the long-term runoff is estimated for a catchment then the long term catchment yield can be calculated as shown below:

Long term yield (ML / yr) = Catchment Area (ha) x Long term runoff (mm / yr) x 0.01

The long term runoff is usually expressed as a probability. For example 50% of years (median) or 75% of years.

Using this equation and the long term runoff estimates given in the previous section the catchment yield per hectare can be calculated as shown in Table D-6 and Table D-7.

TABLE D-6 - SUMMARY OF CATCHMENT YIELD (ML/HA/YR) EQUALLED OR EXCEEDED IN 50% OF YEARS

Rainfall Station	Value of KII		
	65	75	85
Bundaberg	1.0	1.7	2.9
Childers	0.7	1.4	2.4
Gin Gin	0.5	1.3	2.4
Maryborough	0.4	1.3	2.3

Notes: Calculated by U.S.D.A model from 30 years of daily rainfall records. Values shown are the runoffs, which in the long term should be equalled or exceeded in 2 out of 4 years, i.e 50% of the time.

TABLE D-7 - SUMMARY OF CATCHMENT YIELD (ML/HA/YR) EQUALLED OR EXCEEDED IN 75% OF YEARS

Rainfall Station	Value of KII		
	65	75	85
Bundaberg	0.3	0.8	1.4
Childers	0.3	0.5	1.1
Gin Gin	0.2	0.4	1.0
Maryborough	0.2	0.6	1.2

Notes: Calculated by U.S.D.A model from 30 years of daily rainfall records. Values shown are the runoffs, which in the long term should be equalled or exceeded in 3 out of 4 years, i.e. 75% of the time.

D.3 References

Horton, AJ, and Jobling, GA. 1992. *Farm Water Supplies Design Manual Volume 1 - Farm Storages.* Water Resources Commission. Brisbane, Queensland.

United States Department of Agriculture Soil Conservation Services. 1971. *SCS National Engineering Handbook Section 4 - Hydrology*.