WAIMEA WATER AUGMENTATION PROJECT

FUTURE WATER DEMAND BY WATER ZONE

July 2006

1.0 BACKGROUND

The project area includes irrigable land in 9 broad zones, plus part of the Wai-iti. The current water allocation sees all the available water designated to users throughout this region, with water restrictions expected at about the 35% level, in a 1:10 year return period.

The augmentation system is to utilize stored water (in the Waimea River upper catchment reaches) to be released into the existing river system, and flow down and out of the Wairoa Gorge, and to recharge most of the Waimea Plains water resources in a natural manner. Comments on whether this "natural recharge" is likely to be adequate for some of the zones is made, and if thought to be inadequate, then those areas are identified, and the restrictions/limits mentioned, so that any shortfall could be addressed.

Water allocation is dependant mostly on soil type and crops grown. These areas have generally been based on earlier studies, but in some cases altered slightly using the author's general local knowledge. These water demands can then be looked at alongside weather data and river flows, so that storage volumes can be determined.

All data is based on allocating the future demand figures between the 9/10 zones making up the irrigable land in the project area.

2.0 DETAILED FUTURE WATER DEMAND.

2.1 THE ZONES INVOLVED.

Table 1 shows the approximate irrigable areas associated with each of the water zones.

Note that the original area was assessed at 6,582 ha, and reduced to 5,306 ha when urban areas, road reserves and river reserves were excluded.

Table 1

Irrigation Areas & Volumes by Water Zones

Zone	Area Ha	Current Allocation Limits l/s	Future Allocations l/s
Upper Catchments	minimal	3	5
Reservoir	580	826	288
Waimea West	385	178	191
Hope & Eastern Hills	2,170	97	1,256
Golden Hills	300	113	149
Delta	1,246	1000	556
Upper Confined		147	
Lower Confined		230	
Redwood	625		258
TOTALS	**5,306**	2,594	2703
Wai-iti Aldourie Rd to Wakefield	300 ha extra allowed for in this Design [Could supply some water into this area. Up to 1180 ha irrigable. Current allocation sufficient for 181 ha.]	[105]	174 [105]
TOTALS	**6,486 ha**	**2,699 l/s**	**2,982 l/s**

Note. In Table 1, the current allocation limits show where the water is drawn from to carry out the irrigation. The future allocation figures are based on which zone the land needing to be irrigated actually lies. The allocation has been based on the predominant soil type making up that zone (see Table 2). Also I have allowed for an additional 300 ha worth of water to service some of the lower Wai-iti zone, in addition to the current allocation already allowed for this zone. I have not allowed for all the irrigable area in this zone to be serviced, (and have ignored any additional water coming from the new Wai-iti Dam, as this water could be used in land not yet irrigated in this valley). There is the possibility that some duplication from land watered from this dam and the 300 ha I have allowed for in the Wai-iti could occur.

2.2 SOIL TYPES & WATER ALLOCATIONS

Table 2 shows the areas of each soil type within the Waimea Plains, and after allowing for the allocation per hectare, the total volumes of water needed by month (ignoring rainfall). This will allow the calculation of the water deficit, given various rainfalls at different times of the year. To do this, I have had to assume a certain cropping mix, as pasture needs maximum irrigation for all irrigation months, whereas most horticultural crops start with low requirements in the spring (as the leaves grow), and water requirements are taken as halving after crop harvesting. Note that the areas (ha) do not include either urban areas or road and river reserves.

Table 2

Irrigable Areas by Soil Type

Soil Type	Area Ha		Allocation Limits[*1] m^3/ha/week	Peak Allocation Limit m^3/week	Comments
	Total	Irrigable			
Mapua sandy loam	258	200	190	38,000	Foothills around the Redwood Valley
Dovedale gravelly loam	525	520	250	130,000	Mostly found in the Redwood Valley area.
Richmond clay loam, silt loam & Wakatu silt loam	643	610	270	165,000	Towards the Estuary and the foothills along Patons Road.
Waimea silt loam & sandy loam	2,137	2,130	300	639,000	Alongside the Waimea River
Ranzau Soils	1,649	1,640	350	574,000	Waimea Plains
Totals	**5,212**	**5,100**		**1,546,000= 2,556 l/s**	
Motupiko loams (Wai-iti)	1180	480	350	278	Wai-iti Valley (Brightwater to Wakefield)
Totals	**6,392**	**5,580**		**2834**	

[*1] These limits are taken from the TRMP, Chapter 31, Fig 31.1D

The current total water allocation limit in the Waimea Plains is 2,699 l/s. If we deduct the 105 l/s allocated to the Wai-iti, and allow for 220 l/s reserved for increased future urban demands (arrived at during our 7th Feb 2005 meeting), then the allocation remaining for the project area is 2,374 l/s (2699-220-105= 2,374), or a shortfall on the above estimated figure of 182 l/s (2,556-2,374 = 182). These figures however, assume the TDC allocation of 2,699 l/s is the correct allocation for a 1:10 year drought. More recent indications suggest that this allocation may be restricted as often as once every 2 or 3 years. Note also, that the above requirements are "peak" weekly figures for the year, and do not allow for the lesser requirement of row crops, which do not cover 100% of the ground. Water requirements in this situation will be less than those used above.

The peak l/s/week figures rises to 2,834 if we include the current allocation for the Wai-iti, and for a further allocation to irrigate another 300 ha in this area.

2.3 WATER ALLOCATION BY MONTH

As mentioned above, horticultural crops generally lose their leaves over winter and as they grow new leaves through spring it takes them a while to build up to their full irrigation requirement. From soil moisture measurements taken over the last 15 years, we can estimate that for the main two crops (Apples and Kiwifruit), the irrigation demand during

the height of the season, on the most common soil types found on the plains, will equate fairly closely with ET losses.

ET losses over the irrigation season follow a parabolic curve, with figures shown in Table 3 being relatively common from one year to the next, although they can change significantly week-by-week.

Table 3

Average Weekly ET Figures for Waimea Plains

Week	Ave. Daily ET Mm	Weekly ET mm	Weekly ET as Proportion of Peak ET	Accumulated ET mm
1 (1st Week Sept)	1.4	9.8	0.29	9.8
2	1.6	11.2	0.33	21
3	1.8	12.6	0.37	33.6
4	2.1	14.7	0.43	48.3
5 (Oct)	2.3	16.1	0.47	64.4
6	2.6	18.2	0.53	82.6
7	2.9	20.3	0.59	102.9
8	3.1	21.7	0.63	124.6
9	3.4	23.8	0.69	148.4
10 (Nov)	3.6	25.2	0.73	173.6
11	3.9	27.3	0.8	200.9
12	4.1	28.7	0.84	229.6
13	4.2	29.4	0.86	259
14 (Dec)	4.4	30.8	0.9	289.8
15	4.5	31.5	0.92	321.3
16	4.6	32.2	0.94	353.5
17	4.7	32.9	0.96	386.4
18 (Jan)	4.8	33.6	0.98	420
19	4.9	34.3	1	454.3
20	4.9	34.3	1	488.6
21	4.8	33.6	0.98	522.2
22	4.6	32.2	0.94	554.4
23 (Feb)	4.3	30.1	0.88	584.5
24	4.0	28	0.82	612.5
25	3.7	25.9	0.76	638.4
26	3.4	23.8	0.69	662.2
27 (Mar)	3.2	22.4	0.65	684.6
28	2.9	20.3	0.59	704.9
29	2.6	18.2	0.53	723.1
30	2.3	16.1	0.47	739.2
31 (April)	2.0	14	0.41	753.2
32	1.7	11.9	0.35	765.1
33	1.4	9.8	0.29	774.9
34	1.1	7.7	0.22	782.6

Note that these figures will be sufficient to supply all the irrigation requirements for a horticultural crop that is being irrigated via an under tree/vine mini-sprinkler type system, that is designed to irrigate herbicide strips under the crops, and not the inter-row grass strips (although these inevitably receive some water). I am a little reluctant to further reduce the crops' overall water requirements to allow for the proportion of ground they cover, as some crops cover all the ground (eg. pasture, kiwifruit on pergolas). Also, most crops have grass in the inter-row area, which is usually irrigated, therefore the area runs close to 100% crop cover. Since we are dealing with such large areas, this could amount to maybe only 10% water saving for horticultural row-crops only.

Row crops tend to cover about 70% of the available ground surface. Kiwifruit grown on pergolas cover 100% of the planted area, but unplanted headlands and access tracks will surround these areas.

The peak irrigation allowance of 350 m^3/week on Ranzau and Motupiko soil types is very close to the ET figures shown above, for weeks 18 to 21 (in Jan).

The fourth column in Table 3 (showing the proportion of the peak week ET), or the Weekly ET's will give a good idea of water requirements for those weeks before and after the "peak weeks". The other factor we still need to allow for is sometimes called "crop factor". This is where the crops' leaves are still growing to try and intercept all the available light falling within the plants' canopy spread. This will further reduce the water requirements early in the season. Table 4 gives a limited idea of the effect of this on some crops.

Table 4

Crop Factors for Main Crops On Waimea Plains

Crop	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Pasture					1.0				
Apples	0.4	0.5	0.7	0.9	1.0	1.0	0.95	0.4	0.4
Kiwifruit	0.4	0.6	0.9	1.0	1.1	1.1	1.1	0.7	0.4
Berries	0.4	0.6	0.9	1.0	1.0	0.5	0.4	0.4	0.4
Grapes	0.3	0.4	0.4	0.5	0.5	0.5	0.4	0.2	0

This table assumes 1.0 as being the water requirement for the particular soil type in its peak week (e.g. 350 m^3/week for pasture on Ranzau soils for mid-January).

Once we decide on the proportion of each crop that we will be dealing with on the plains, we can get an idea of how much irrigation water we may need for each period, and whether the rainfall was adequate or whether we need to add water via irrigation.

For Example. What are the monthly per ha requirements for apples on a Ranzau soil type for the irrigation season (assuming no rainfall)?

See Table 5.

Crop = Apples

Peak Weekly Irrign. Requirement (Ranzau) = 350 m^3/week

Table 5

Monthly Water Requirements For Apples
on the Ranzau Soils
on theWaimea Plains
m^3/ha/month

Crop	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May
Apples	207	443	830	1270	1488	1078	810	186	112

Example Calc: Ave ET for Sept. = 1.725mm/day x 30 days = 51.75 mm x 0.4 crop Factor = 20.7 mm or 207 m^3 for the month. Depending on when and how much rain fell as to how much of the water requirement is needed from irrigation.

When overlaying the weather data, you need to be aware that, for example, the Ranzau silt loams only hold a total of about 35 mm of moisture within the plants' root zone. Since we would normally want to irrigate when about 40% of this moisture was depleted, then by the time we have a 15 mm deficit, the irrigation system needs to be turned on. In the hotter months this can be only 3 days after a rainfall event that may have been sufficient to bring the soil back to field capacity.

2.4 CROPPING AREAS

The last information needed to calculate the water requirements for the project area is to decide on the planted area for each of the main crops. Since there will be some crops grown in the area that we have not even thought of yet, I think we should consider a range of crop types, and then apportion the area between these "general" categories. Table 6 covers these crops. (I have used the Tasman Regional Water Study figures, Stage 2, Appendix A, Table on Likely Land Use for 2051 as the basis for these figures.)

Table 6

Irrigation Areas by Crop Type
Waimea Plains

Crop Type	Reservoir & Hope & Eastern Hills ha	Golden Hills, Waimea West & Delta. ha	Redwood ha	Wai-iti ha	Totals ha
Pasture	350	621	265	220	1,456
Apples/Pears	1,500	750	265	80	2,595
Kiwifruit	100	60	0	0	160
Grapes/Olives	600	300	65	80	1,045
Other Crops (Berries, Hemp, Hops, Vegetables, etc.)	200	200	30	100	530
Totals	**2,750**	**1931**	**625**	**480**	**5,786**
			5,306	**5,786**	

3.0 GENERAL DISCUSSION

The above tables should give sufficient data on which to calculate the likely water demands for the next 40 odd years. When expanding these numbers to cover the different land area available, it is worth remembering that the scenario used above was the "Likely Land Use Scenario", which only has about two thirds of the area under pasture that the "Extreme Land Use Scenario" uses. This will result in a significantly lower water volume requirement for storage than would be the case with the high pasture scenario.

Lastly, most areas will be able to continue to draw their augmented water from the same place as they get their present supplies. For some areas however, additional water transport will be needed for the supplies to be available where they are needed. Briefly:

- Hope aquifers and Eastern Hills area; Half this area is covered by the Waimea East Community scheme, and much of the remainder by either the unconfined gravels alongside the Waimea River, or from the UCA & LCA. Some smaller more isolated blocks around the edges of this zone may have difficulty accessing the Augmented Supply.

- Golden Hills, Waimea West & Delta; This zone should have water access from the unconfined gravels. As you approach the western limits of this zone, the additional water may be hard to retrieve. This might involve some bores being located nearer the river, and the water pumped to the application areas.

- Redwood. This area has a limited supply coming in from the west (surface water). To get additional Augmented Water would involve bore/s in the Delta area pumping water via a pipeline into the zone (e.g. as happens now for the Redwood Valley Irrigation Scheme).

- Wai-iti Zone; Once again this area will lie mostly "up-stream" of the Augmented supply. Water may be needed to be pumped up the Wai-iti Valley to supply the 300 ha allowed for under this system.

The numbers in the above tables do not always add up to the same totals, as their origins differ. However, I think they are close enough to be sufficiently accurate. Accuracy is obviously not great, as when you consider all the assumptions made, many and varied results will occur. When the weather variability is added, then another whole risk scenario is added to the mix.

4.0 WATER REQUIREMENTS IN A DROUGHT YEAR (1982-83)

To test the likely irrigation use for a drought year, an irrigation water balance sheet was drawn up using the Meteorological Data from the (July to June) 1982-83 year. This was done for three crop groups and for three soil types with a range of soil moisture holding capacities.

Crops

Pasture
Apples, KF,
Grapes and Olives

Soil Types:

38 mm soil moisture-holding capacity
78 mm " " " "
130 mm " " " "

A sample for one crop type (pasture) and one soil type (38 mm soil moisture holding capacity), was selected for only part of the 82 – 83 summer, and has been attached as Appendix 1. This is to illustrate how we arrived at the water requirements that were needed by the crops for the various "cells" making up the project area.

The "cells" shown on the attached map, are the same "cells" as used in Timothy Hong's analysis, and illustrate: -

The irrigation area concerned

The boundaries of the area that denotes soil type changes, and thereby those "cells" that fall within each of my range of seasonal irrigation requirement levels. (X_1)

Those cells where irrigation water needed for additional "outside" areas will be likely to be drawn from. (X_2)

Those particular cell/s where existing & additional "Urban/Commercial" water will be needed. (X_3)

As a result of the analysis from the whole of the 82-83 years' data, I arrived at the following irrigation water requirements by soil type and crop group: -

Table 7

Irrigation Water Requirements by Soil Type & Crop for 1982/83 Year				
	Soil Type (by Soil Moisture Holding Capacity in mm)			
	38mm	**78mm**	**130mm**	
Crop				
	Seasonal Irrigation Requirement (mm)			
Pasture	570	570	500	
Apples, KF et al	570	570	500	
Grapes/Olives	200	180	140	
	Crop Mix (%)			
Pasture	15	40	30	
Apples, KF et al	63	50	55	
Grapes/Olives	22	10	15	
"Average" Cell Seasonal Water Requirement mm	489	531	446	
	Approximate Areas (ha)			
Total (ha)	2,450	765	4,430	7,645 (1510 Cells)
Not Irrigated (20%)	490	153	886	1,529
Irrigated (80%)	1,960	612	3544	6,116
Soil Types Involved				
	Ranzau	Dovedale	Waimea	
	Wantwood	Motupiko	Mapua	
	Heslington	Braeburn	Richmond	
			Wakatu	

John Bealing
AGFIRST
11/07/2006

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Appendix 1

Waimea Water Augmentation Project

P38n.dsm

Pasture, 38 mm soil moisture holding capacity, Nelson rainfall

Allocation Peak 35 mm/Week

Allowed Water Deficit =+5mm

Totals 82/83 year = 880 664 515

Date	SMD Start (mm)	ET (mm)	Rainfall (mm)	Effect. Rain (mm)	SMD (Interim)	Irrign Trig Pt (mm)	Irrign Appl.d (mm)	SMD (End) (mm)
11/12/82	0	4.5	7.5	7.5	-3	25	0	-3
12/12/82	-3	4.5	0	0	1.5	25	0	1.5
13/12/82	1.5	4.5	0	0	6	25	4.5	1.5
14/12/82	1.5	4.5	0	0	6	25	4.5	1.5
15/12/82	1.5	4.6	0	0	6.1	25	4.6	1.5
16/12/82	1.5	4.6	0	0	6.1	25	4.6	1.5
17/12/82	1.5	4.6	0	0	6.1	25	4.6	1.5
18/12/82	1.5	4.6	0	0	6.1	25	4.6	1.5
19/12/82	1.5	4.6	0.7	0	6.1	25	4.6	1.5
20/12/82	1.5	4.6	11.7	11.7	-5.6	25	0	-5.6
21/12/82	-5.6	4.6	2.8	0	-1	25	0	-1
22/12/82	-1	4.7	0	0	3.7	25	4.7	-1
23/12/82	-1	4.7	0	0	3.7	25	4.7	-1
24/12/82	-1	4.7	0	0	3.7	25	4.7	-1
25/12/82	-1	4.7	6.5	6.5	-2.8	25	0	-2.8
26/12/82	-2.8	4.7	0		1.9	25	0	1.9
27/12/82	1.9	4.7	0.1	0	6.6	25	4.7	1.9
28/12/82	1.9	4.7	0	0	6.6	25	4.7	1.9
29/12/82	1.9	4.8	0	0	6.7	25	4.8	1.9
30/12/82	1.9	4.8	0	0	6.7	25	4.8	1.9
31/12/82	1.9	4.8	0.4	0	6.7	25	4.8	1.9
01/01/83	1.9	4.8	0	0	6.7	25	4.8	1.9
02/01/83	1.9	4.8	0	0	6.7	25	4.8	1.9
03/01/83	1.9	4.8	0	0	6.7	25	4.8	1.9
04/01/83	1.9	4.8	23.5	23.5	-16.8	25	0	-5
05/01/83	-5	4.9	0	0	-0.1	25	0	-0.1
06/01/83	-0.1	4.9	0.6	0	4.8	25	0	4.8
07/01/83	4.8	4.9	0.7	0	9.7	25	0	9.7
08/01/83	9.7	4.9	0	0	14.6	25	0	14.6
09/01/83	14.6	4.9	0	0	19.5	25	0	19.5
10/01/83	19.5	4.9	0	0	24.4	25	0	24.4
11/01/83	24.4	4.9	0	0	29.3	25	0	29.3
12/01/83	29.3	4.9	36.3	36.3	-2.1	25	0	-2.1
13/01/83	-2.1	4.9	0.4	0	2.8	25	0	2.8
14/01/83	2.8	4.9	0	0	7.7	25	0	7.7
15/01/83	7.7	4.9	4.3	0	12.6	25	0	12.6
16/01/83	12.6	4.9	0	0	17.5	25	0	17.5
17/01/83	17.5	4.9	0	0	22.4	25	0	22.4
18/01/83	22.4	4.9	4	0	27.3	25	4.9	22.4
19/01/83	22.4	4.8	0	0	27.2	25	4.8	22.4
20/01/83	22.4	4.8	0	0	27.2	25	4.8	22.4
21/01/83	22.4	4.8	0	0	27.2	25	4.8	22.4

153 Tasman Street
Nelson
New Zealand
Ph/Fax: (03) 546 6007
Email: bealing@agfirst.co.nz

Sally Marx & David Leong
Tonkin & Taylor Ltd
P O Box 2083
WELLINGTON

11 July 2006

Dear Sally and David

WAIMEA WATER AUGMENTATION PROJECT

Please find attached my compiled report for inclusion as an Appendix to your main report. I trust that I have included all that you were hoping would appear. Give me a ring if there are any obvious "holes".

Yours sincerely

John Bealing
Engineering Consultant
Agfirst.