Centre for Land and Water

Winter Lectures 2011

Eight informative lunchtime lectures in the Green Shed: Fridays at 12 noon

Lecture 2

Groundwater Resources
beginners guide to hydrology

Tony Davoren

HydroServices
irrigation management & water resource consultants

Winter Lectures 2011

REGISTRATIONS REQUIRED

Phone: 06 650-4532 or Email greenshed@claw.net.nz

Small charge to cover expenses: $25 inc GST per lecture
($150 inc GST for a Series Registration*)

You will receive a light lunch (if you register on time), a lecture and an invitation to stay and discuss the topic in more depth should you wish.

ACKNOWLEDGEMENTS:

The Centre for Land and Water thanks the Winter Lecturers who have generously given their time:

NOTES:

* We may cancel or vary presentations if speakers become unavailable or if registrations fail to meet minimum numbers.
* If a speaker becomes unavailable, we may arrange a suitable replacement to cover the same or a similar topic.
* Holders of a Series registration will be refunded for any cancelled lectures at $20 inc GST per cancellation, up to $150 inc GST total.

UNDERSTANDING GROUNDWATER AND AQUIFER TESTS

On-site, accurate irrigation management to meet your specific crop requirements

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Today

- Key hydro-geologic concepts; aquifers, aquicludes, transmissivity, drawdown etc.
- How do you can make sense of well tests
- The meaning of the aquifer test report
- In a flash, are current take levels sustainable

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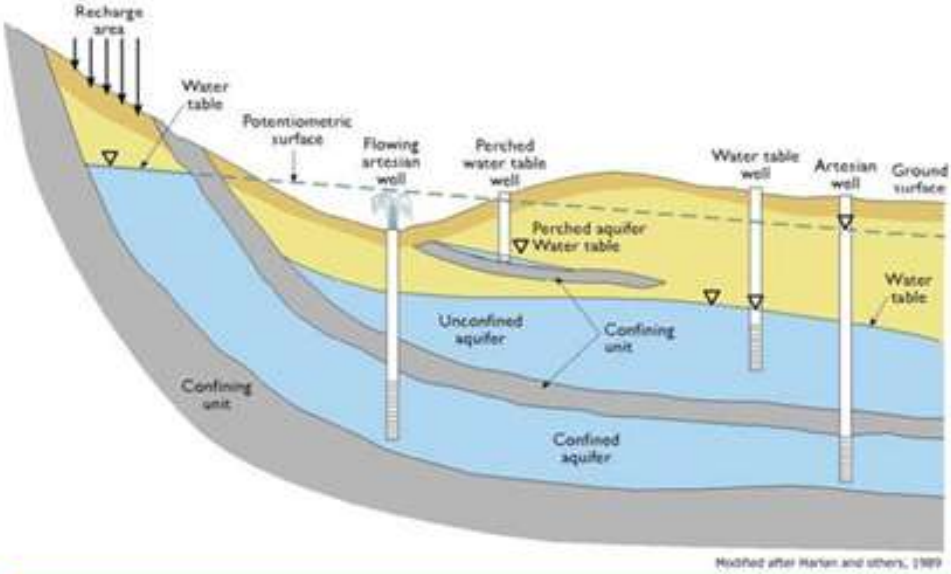
Aquifer Structure



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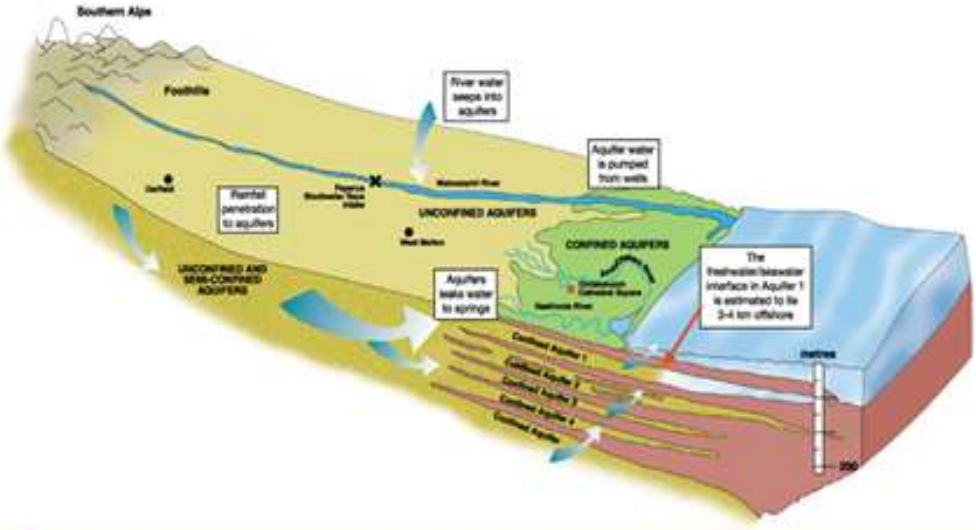
Aquifer Structure



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Aquifers

- An underground geologic unit that is saturated with water
- Has sufficient permeability to yield significant or economic quantities of water
- Multiple aquifers can exist each with unique water producing characteristics

Unconfined Aquifers

- Has a water table at atmospheric pressure
- There is NO overlying impervious layer
- Mostly recharged from surface percolation (precipitation or directly by rivers/streams)
- If natural recharge = abstraction (pumping and environmental flow, system sustainable)

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Confined Aquifers

- Overlain by an impermeable material; e.g. clay
- Water in aquifer is under pressure
- Recharge is restricted to any outcrop location
- NO intermixing with water from other aquifers

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Semi-Confined Aquifers

- Overlain low permeable material; e.g. clay-bound gravels
- Water in aquifer is still under pressure
- Recharge is from the area overlying aquifer
- NZ aquifer systems mostly un- or semi-confined

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Aquicludes

- Saturated layer or formation
- Yields insignificant quantities of water
- PREVENTS flow between adjacent aquifers

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Aquitards

- Saturated layer or formation
- Retards the movement of water between adjacent aquifers
- Stores and transmits water BUT does not yield economic or viable quantities
- The most common layer separating aquifers in NZ

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Common Groundwater Terms

Hydraulic Conductivity
Quantitative measure of porous material to transmit water

Permeability
Quantitative measure of capacity of aquifer material to transmit water = amount of flow/unit X-sectional area under influence of unit gradient (slope)

Piezometer
Observation well/bore used to measure water level of an aquifer

Common Groundwater Terms

Piezometric Contour
Lines of equal groundwater level for an aquifer

Static Water Level
Natural water level in a well/bore (not influenced by pumping)

Drawdown
Decrease in water level resulting from your pumping

Safe Yield
Amount that can be abstracted with no adverse effect on the natural environment

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Common Groundwater Terms

Transmissivity
Rate water is transmitted through a unit width of an aquifer under unit hydraulic gradient (m^2/day)

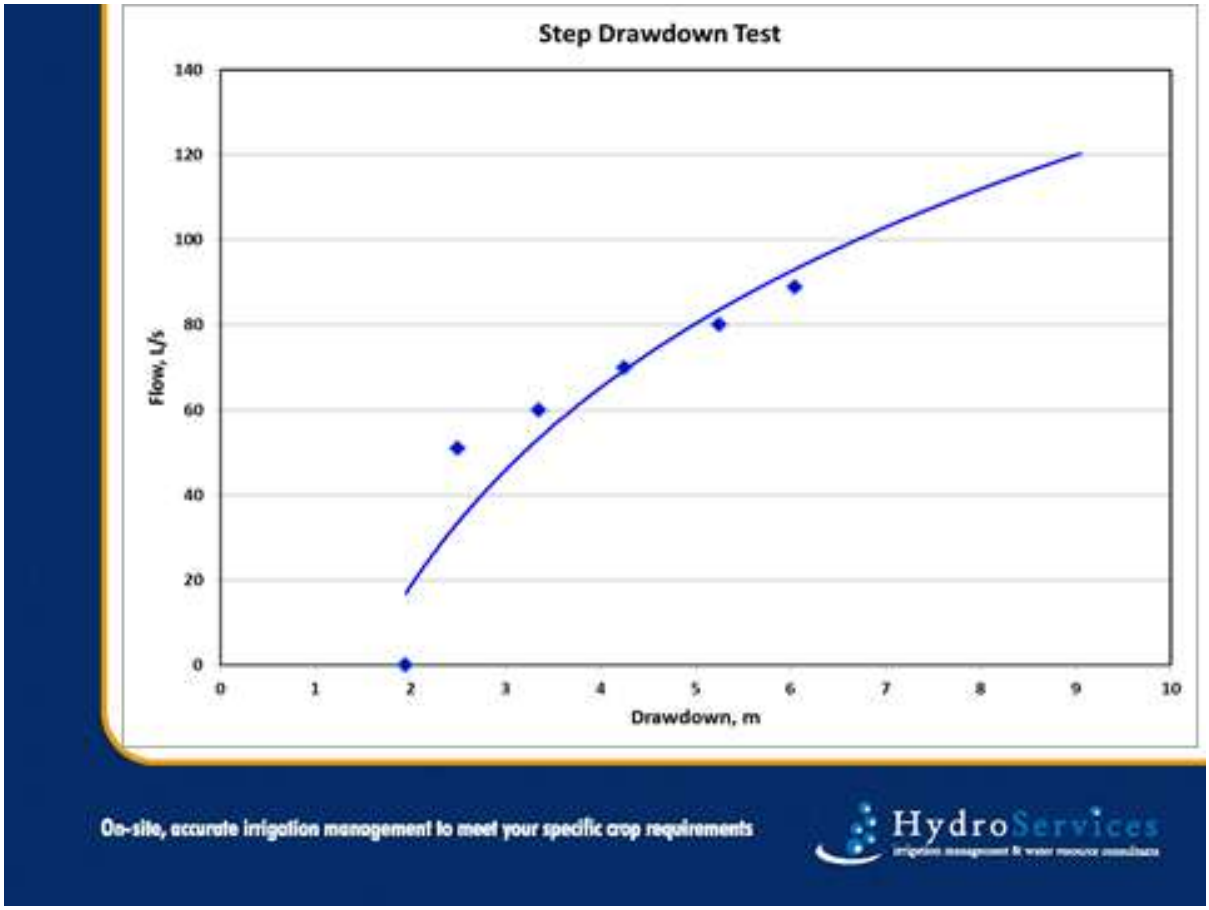
Storage Coefficient or Storativity
Volume of water released from storage per unit decline in hydraulic head in the aquifer, per unit area of the aquifer. It is dimensionless and ranges between 0 and the effective porosity of the aquifer; for confined aquifers it is usually much less than 0.01

Bore Log
Hydro-geological description of the layers or formations

Common Groundwater Terms

Step Discharge Aquifer or Pump Test
Drawdown is measured as water is pumped from the production well/bore as discharge is increased in steps

Why?
- To measure sustainable yield
- Determine aquifer parameter T
- Determine well loss component of the drawdown in the production well


Step Drawdown Test
Flow, L/s
Drawdown, m
0
20
40
60
80
100
120
140
0
1
2
3
4
5
6
7
8
9
10
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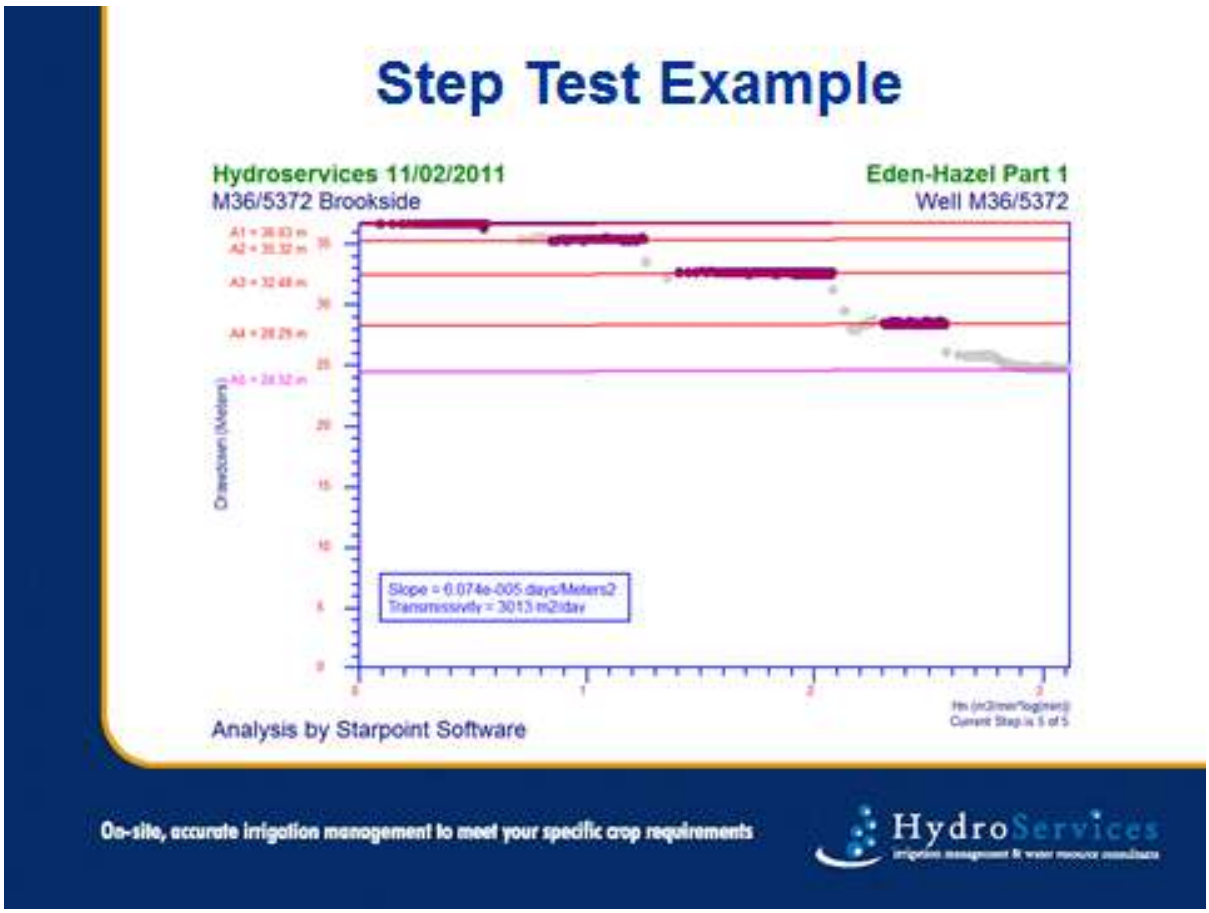
Step Test Example
Hydroservices 11/02/2011
M36/5372 Brookside
Eden-Hazel Part 1
Well M36/5372
Slope = 6.074e-005 days/Meters2
Transmissivity = 3013 m2/day
Analysis by Starpoint Software
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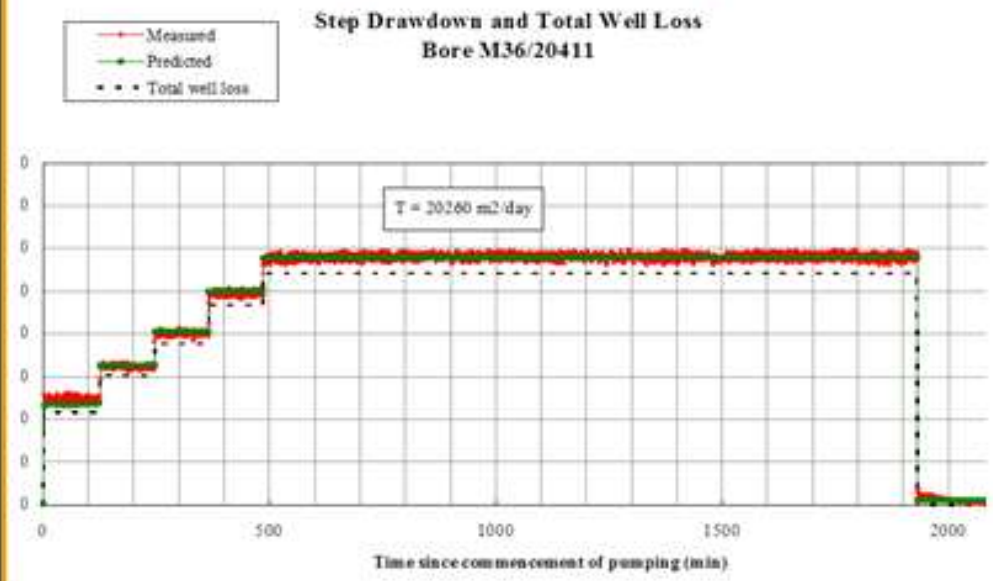
Step Test Example



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Common Groundwater Terms

Constant Discharge Aquifer or Pump Test

Water is pumped from the production well/bore at a constant rate and the drawdown measured in nearby wells/bores (observation wells/bores)

Why?

- To measure *actual* effect on nearby bores
- Determine aquifer parameters (T, S and Leakage)
- Enable the modeling of longer-term effects (drawdown)

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Aquifer Test Plan

		M36/20411	M36/20409	M36/3988	M36/1344	M36/1421	M36/1437	M36/20408
Test purpose		Pump	Observation	Observation	Observation	Observation	Observation	Background
Owner								
Easting		2483636	2483938	2484395	2484390	2482706	2482225	2485122
Northing		5716576	5716024	5716562	5716565	5714642	5715090	5718748
Depth (m)		119	137	51.9	30.15	49.8	71	88.72
Diameter (mm)		300	300	200	200	51	57	250
Casing material		Steel	Steel	Steel	Steel	Steel	Steel	Steel
Primary use		Irrigation	Irrigation	Irrigation	Domestic & stock water	Domestic	Stock water	Irrigation
Radius from pump bore (m)		-	629	759	754	2,146	2,049	2,632
Static water level at start of testing (m mbgl)		1.94	5.83	4.65	4.25	1.08	+0.80	10.82
Screen details	Type	Slotted stainless steel	Slotted stainless steel	Slotted steel	Stainless steel	-	-	Slotted stainless steel
	Diameter (mm)	200	200	200	200	-	-	200
Screen	Top (m mbgl)	86.5	118.98	34.53	28	-	-	83.755
	Bottom (m mbgl)	116.5	137	51.2	30	-	-	88.755

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Aquifer Testing

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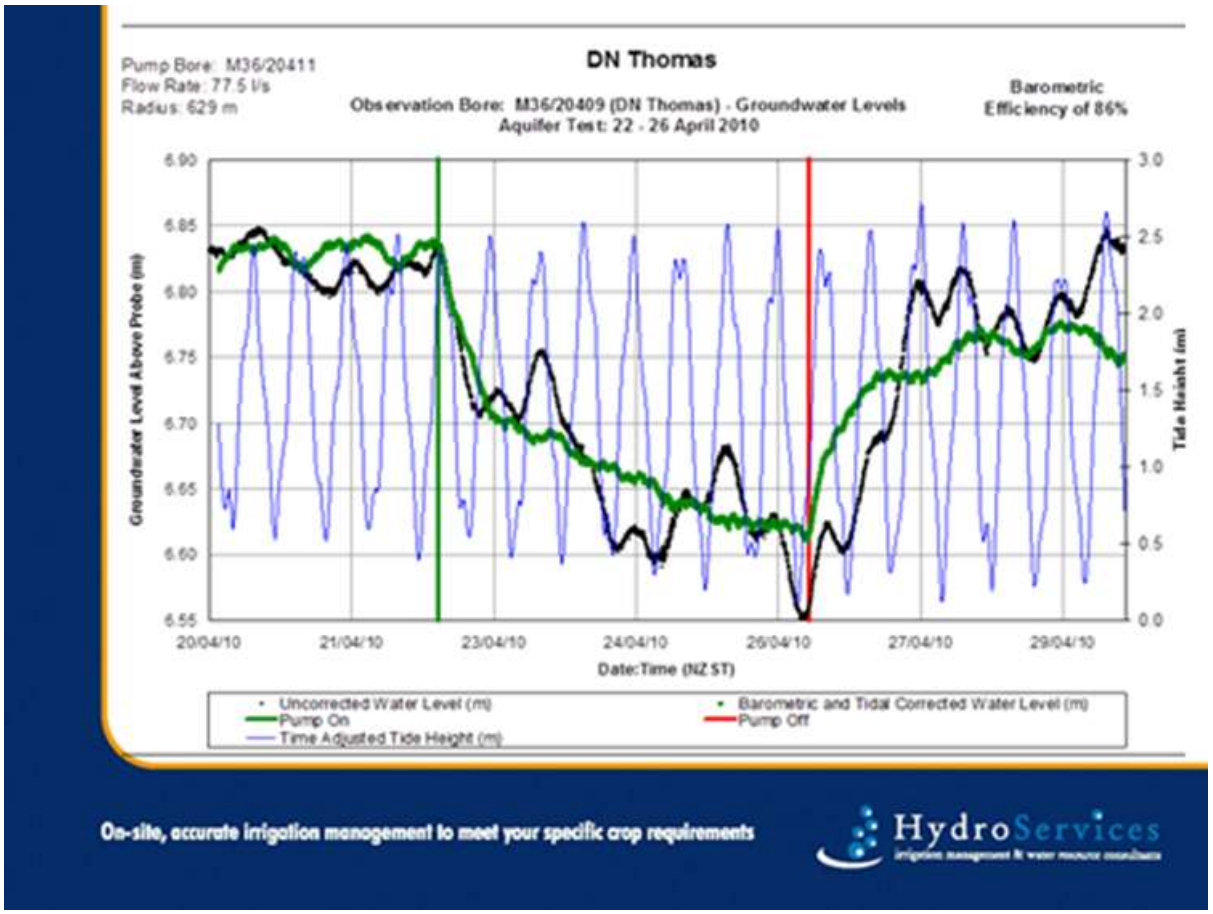
DN Thomas
Pump Bore: M36/20411
Flow Rate: 77.5 l/s
Radius: 629 m
Observation Bore: M36/20409 (DN Thomas) - Groundwater Levels
Aquifer Test: 22 - 26 April 2010
Barometric Efficiency of 86%
Groundwater Level Above Probe (m)
Tide Height (m)
6.90
6.85
6.80
6.75
6.70
6.65
6.60
6.55
3.0
2.5
2.0
1.5
1.0
0.5
0.0
20/04/10
21/04/10
23/04/10
24/04/10
26/04/10
27/04/10
29/04/10
Date:Time (NZ ST)
Uncorrected Water Level (m)
Barometric and Tidal Corrected Water Level (m)
Pump On
Pump Off
Time Adjusted Tide Height (m)
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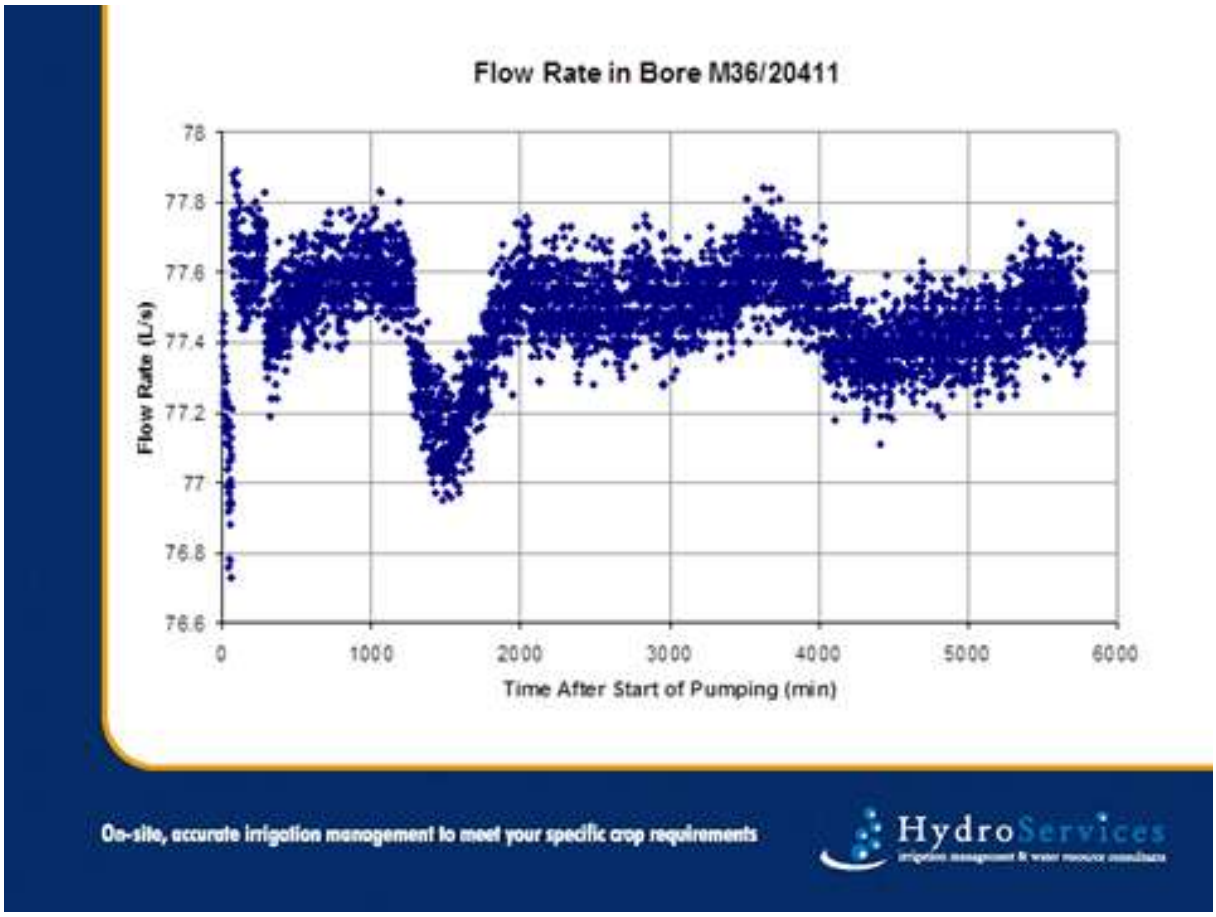
Flow Rate in Bore M36/20411
Flow Rate (L/s)
78
77.8
77.6
77.4
77.2
77
76.8
76.6
0
1000
2000
3000
4000
5000
6000
Time After Start of Pumping (min)
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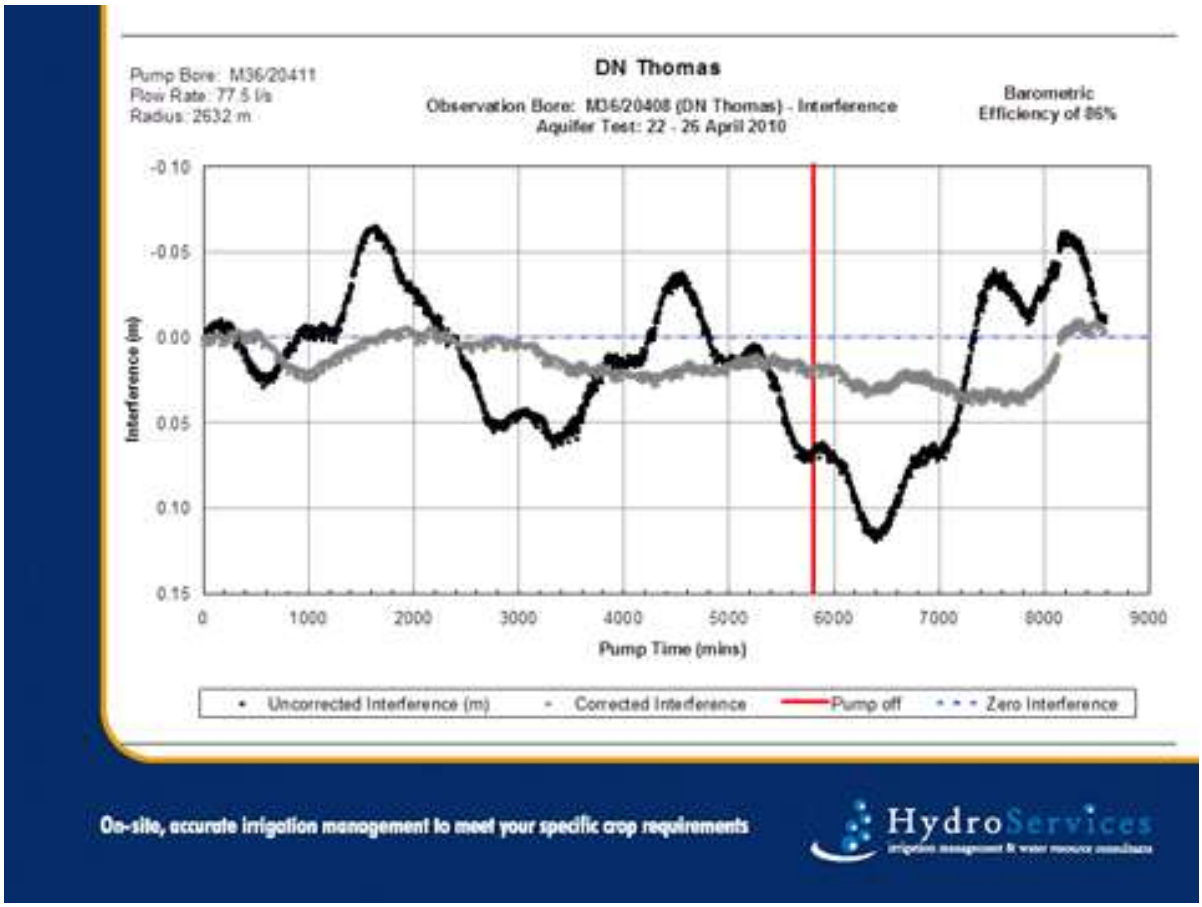
DN Thomas
Pump Bore: M36/20411
Flow Rate: 77.5 l/s
Radius: 2632 m
Observation Bore: M36/20408 (DN Thomas) - Interference
Aquifer Test: 22 - 26 April 2010
Barometric Efficiency of 86%
Interference (m)
-0.10
-0.05
0.00
0.05
0.10
0.15
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Pump Time (mins)
Uncorrected Interference (m)
Corrected Interference
Pump off
Zero Interference
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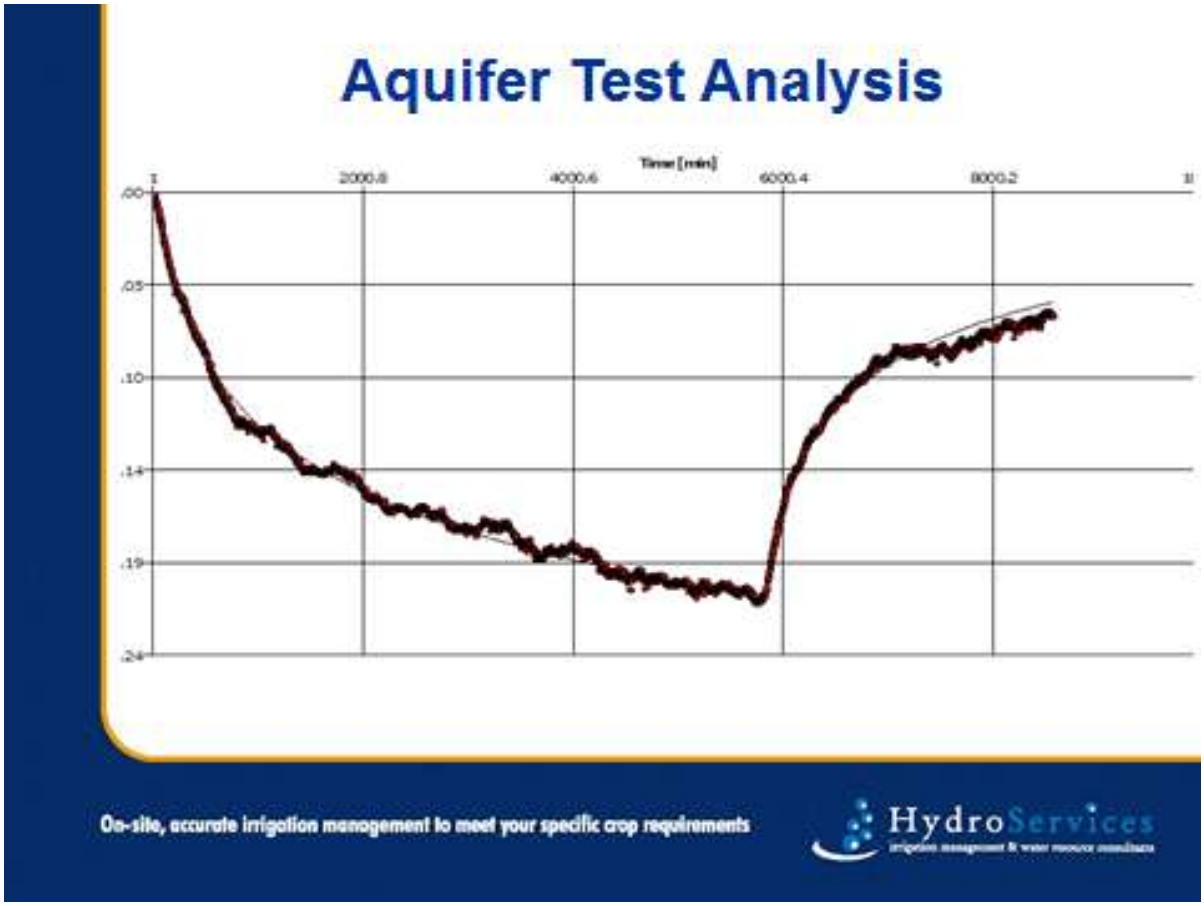
Aquifer Test Analysis
Time [min]
2000.8
4000.6
6000.4
8000.2
.05
.10
.14
.19
.24
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Aquifer Test Analysis

Parameter	Warren & Root	Moench (Match 1)	Moench (Match 2)	Theis	Theis Recovery	Cooper & Jacob
Match made to	All drawdown and recovery	All drawdown and recovery	All drawdown and recovery	All drawdown and recovery	Mid time recovery	Late time drawdown
Transmissivity (m^2/day)	9,860	9,060	10,200	10,100	11,600	10,300
Storativity	0.00445	0.00445	1.86E-06	0.00445	-	0.00407
Sigma	1	1	2,350	-	-	-
Lambda	0.00302	-	-	-	-	-
Gamma	-	0.00136	0.00437	-	-	-
Skin Factor	-	1,000	12.6	-	-	-

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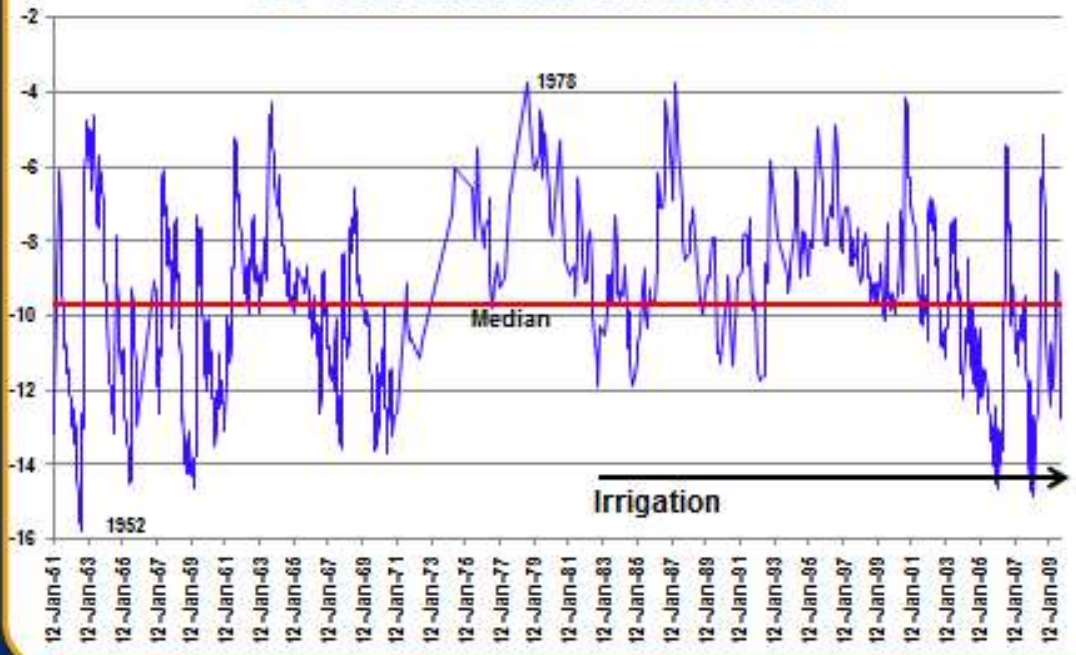
Groundwater Record



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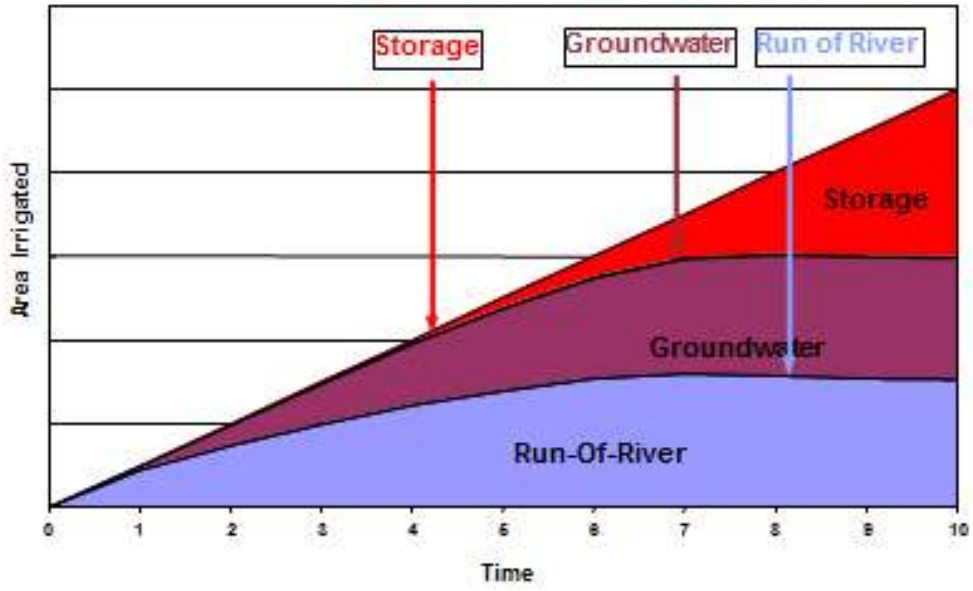
Groundwater Status



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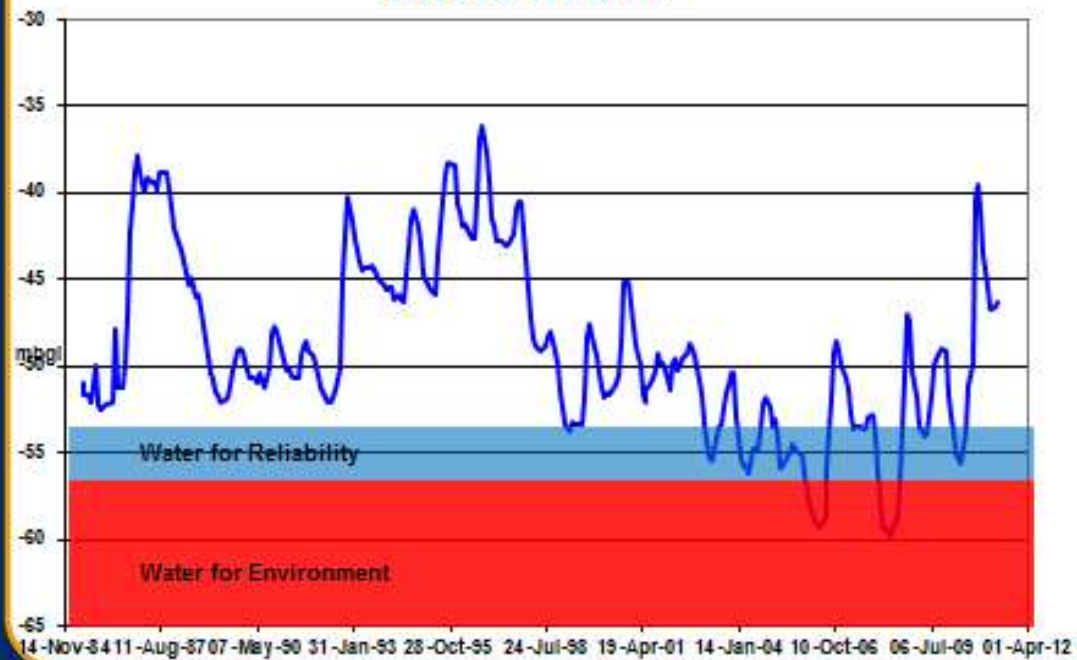
Sustainable?



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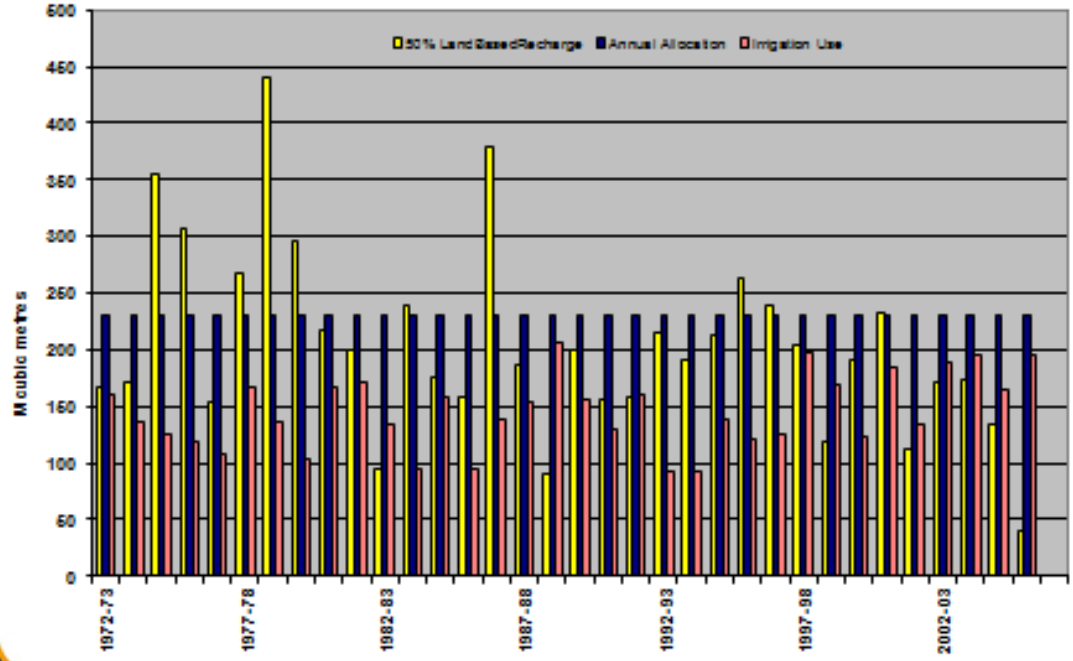
Current Groundwater Management Approach



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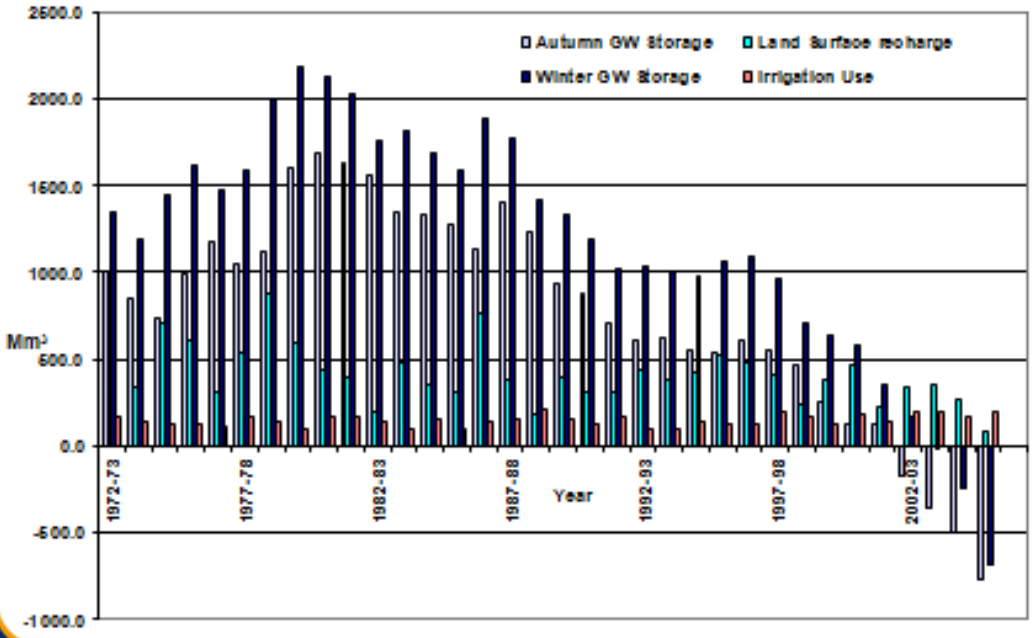
What If It Was Dynamically Managed?



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Groundwater Management

- Have only moderate control of groundwater system
- Irrigation volume is small but has effect
- It is almost entirely dominated & driven by climate
- Proactive (dynamic) management needed
- Management needs to incorporate what we can precisely measure

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Unconfined Groundwater

Having backed myself into a hole

Any Questions??

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Centre for Land and Water

WELCOME

Welcome to the Centre for Land and Water, a venue supporting sustainable agriculture through training, research and consultancy.

The Centre provides professional offices, meeting and seminar facilities and land for research and training.

We currently have rental offices available. Terms by agreement - phone, fax, copy and print facilities available on-site.

The Green Shed seminar venue is available for training, meetings or for general event hire. Contact us: Phone: 06 650-4532 or Email greenshed@claw.net.nz

The Centre is located on a 4 ha site with easy access and plentiful parking. Entry is from Ruahapia Road, accessed from Karamu Road (SH2) at Waipatu or Pakowhai Road at Chesterhope. It is 4 km (8 minutes) from the Hastings CBD, 17 km (20 minutes) from Napier CBD and 18 km (20 minutes) from Hawke's Bay Airport.

COMING SOON

CLAW Short Seminars:

Communications: Preparing a media release

Communications: Writing popular articles

Communications: Writing technical reports and manuals

Communications: Preparing and delivering public presentations

Irrigation: System calibration theory and practice

Irrigation: How much water do I really need?

CLAW Short Courses

NZQA Certified Irrigation Evaluator

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1. Rural New Zealand Biofuels - the future could arrive any time: **July 8th**

Speaker: Rocky Renquist, Plant and Food Research

Rocky is a crop research scientist. Bio-energy can replace ¼ of all energy use by 2050 and reduce the footprint of ag products. Having identified better conversion technologies, Rocky has worked on crops and crop residues to supply fuel plants. His focus is on bio-energy for rural New Zealand.

2. Ground Water Resources – beginners guide to hydrology: **July 15th**

Speaker: Tony Davoren, HydroServices

Tony is a hydrologist with extensive experience in irrigation, soil water, surface and groundwater water resources. He will explain key hydrology concepts so you can make sense of well tests and groundwater science. What does an aquifer report tell me? How do we know if current take levels are sustainable?

3. Bees - what's happening in the hive: **July 22nd**

Speaker: Peter Berry, Berry Beekeeping

Fresh from the National Beekeepers Association Conference, Peter will update us on the latest developments. He is a conservationist, tramper, hunter, fisherman, farm forester, muso and playwright. He is also passionate about bees, with lifelong beekeeping experience.

4. Managing and making sense of data: **July 29th**

Speaker: Mark Rodgers, "Datatamer"/ Hilltop Software

Mark is a data management specialist and developer of Datatamer software which is used by regional councils and irrigation schemes. He will explain how data from water meters, river monitoring, soil moisture and other sensors can be captured, cleaned, stored and made available. What is this data for and how can it help me?

5. Employment Matters - getting it right: **August 5th**

Speaker: Gill Riley, Grow Human Resources

Gill is an HR specialist with experience in management and operational HR across many sectors. She presents a common sense approach to people issues, good employment structures, and ways to de-escalate issues. Her focus is excellence and optimal results through integration of all business operations.

6. Lean Production - taking the waste out of what we do: **August 12th**

Speaker: Glenn Manahi, SBF

Glenn is the director of SBF, a company facilitating businesses into "lean" ways of thinking and doing. Lean is about doing more with less: less time, inventory, space and money; getting the process right the first time. Glenn promises a fun interactive session looking at systems - what works and what doesn't.

7. Social Media - business in the online era for Rural Communities: **August 19th**

Speaker: Matthew Miller, Mogul

Matt has a wealth of experience in digital marketing and web development. He will enlighten us on social media including Facebook and Twitter – what role do they have in keeping rural communities connected with each other, their markets and the rest of the world.

8. Interpreting leaf and petiole test results: **August 26th**

Speakers: Mike White, Analytical Research Laboratories and Andre Lubbe, Ravensdown

Mike and Andre will co-present this session on testing plant material and turning results into fertiliser recommendations. They will use grapes as a case study to explain what your tests tell you about your crop. Mike and Andre are happy to answer questions about other crops that have particular interest to attendees.