SPC Geoscience Division
Private Mail Bag
Suva
Fiji
Telephone: +679 338 1377
Fax: +679 337 0040

SPC CPS
SECRETARIAT OF THE PACIFIC COMMUNITY
SECRÉTARIAT GÉNÉRAL DE LA COMMUNAUTÉ DU PACIFIQUE

SPC Headquarters
BP D5
98848 Noumea Cedex
New Caledonia
Telephone: +687 26 20 00
Fax: +687 26 38 18

MISSION REPORT

Staff Member(s)	Amandine Bosserelle and Peter Sinclair
Countries visited	Kiribati (Tarawa)
Programme	Water and Sanitation Programme – Water Resource Assessment and Monitoring Team (CAIA project)
Period	26 to 29 October 2015
	South Tarawa Drought Committee Meeting - October 2015
Activities Description	The second South Tarawa Drought Committee meeting for 2015 was held at the Utererei Hotel in South Tarawa, Kiribati between the 27th and the 28th of October. The meeting objectives were to present and discuss key findings from Bonriki groundwater abstraction flow meter testing field investigations and the numerical groundwater modelling undertaken by the EU funded Climate and Abstraction Impacts in Atoll environments project, CAIA. The South Tarawa Drought Committee, consisting of members from NDMO, MPWU, KMS, PUB, and MOHMS, is the relevant government body to consider findings that may affect the operations and overall sustainability of the Bonriki freshwater lens. The flow meter testing conducted as part of the CAIA project's field investigations in June 2015 for the Bonriki and Buota water reserves was reported back to the committee. Existing fixed flow meters installed near the main transmission lines and galleries were tested against portable ultrasonic flow meters to determine: • the actual abstraction data at all galleries and transmission pipes flow meters, and • the variability and reliability of flow estimates given by existing meters. An over-estimated flow of 18% and 9% were measured at the Bonriki and Buota main transmission lines flow meters, respectively. Incorrect flow meter installation and turbulent-induced errors associated with the gallery pump-house pipe works are possible causes of the variability margin. Replacement of flow meters, replacement of pumps, and the design and implementation of correct flow meter installation to minimise turbulence are amongst the key remedial measures to ensure the accurate estimation of abstraction data for the modelling and sustainable management of the water reserves. The groundwater numerical modelling study and predictive scenarios are

	being finalized and the key findings were discussed during the meeting: • Impact assessment of different abstraction rates from 900 to 1,800 kL/d under different rainfall scenarios on the salinity of the water provided to South Tarawa residents. • Impact assessment of clearing of existing vegetation and replacing with grass on the salinity and the volumes of the water available for network distribution. • Identification of infiltration galleries which are contributing most to the increased salinity during dry periods with consideration to optimization of abstraction and determination of pumping rates under different rainfall scenarios to minimise impact to the freshwater lens.
Why is the activity important?	• The Bonriki Water Reserve is the main source of freshwater for the 52,000 residents of South Tarawa. The resource is under risk of salinization from over abstraction. The numerical model results are useful to improve the sustainability and consider impacts of possible climate and operational scenarios. • Disseminating the preliminary results of the CAIA project to MPWU, PUB and key agencies is important as they can use the results to define priorities on the government activities and directions, and operational activities. • Discussions with stakeholders were essential to define the output requirements from the modelling aspect of the study. • The measurement of abstraction of groundwater from the Bonriki Water Reserve is reliant on the installed flow meters. Identifying the errors associated with the existing flow meter setup and recommendations to correct the identified problems is important to ensure accurate readings are obtained which will help with the overall management of the groundwater system.
Who benefits/stands to benefit from activity?	• MPWU, PUB, and the Government of Kiribati with better understanding of Bonriki's groundwater model, and how the modelling and field work results can be used to improve the operation, management and planning of the Bonriki Water Reserve. • SPC – Presentation of results to the stakeholders and opportunity to inform about the CAIA project and links to other projects. • Researchers and practitioners in the field of atoll hydrology and groundwater management with improved understanding of the issues facing a highly developed and relied upon atoll groundwater system.
Problems encountered	N/A
Follow Up	• Follow up with the ministry on the action items identified in the attached minutes. • Follow up with recommendations from meeting regarding any additional work with regards to flow meters installation, improving the presentation and use of the model results and its application into the planning and operational management of the Bonriki Water Reserve's galleries field.

<table>
<tr><th>ANNEX I - Activity Name – Title / Task Profile Number</th><th>ACTION</th></tr>
<tr><td>Monday 26th October 2015
Travel from Suva to Tarawa
Preparation of Drought Committee Meeting presentations</td><td></td></tr>
<tr><td>Tuesday 27th October 2015
Drought Committee Meeting – day 1 (See ANNEX III – Meeting Minutes)</td><td></td></tr>
<tr><td>Wednesday 27th October 2015
Drought Committee Meeting – day 2 (See ANNEX III – Meeting Minutes)</td><td></td></tr>
<tr><td>Thursday 27th October 2015
Visit of the Bonriki Water Reserve, observations of monitoring network and installations at the PUB Water Treatment Plant and newly inaugurated Solar Water Protection in Kiribati, 500kWp Solar Power Plant.
Calibration demonstration of the newly replaced (probe only) TPS EC meter at the treatment plant to PUB staff and checking salinity of the trunk main October readings.



Travel from Tarawa to Suva</td>
<td>Peter to email MPWU about status of BN4 monitoring bore covered by UAE solar project clearing

(Completed Fri 30/10/2015)

Probe requires repair at TPS, Peter to arrange for repair when in Australia. Completed 12/11/2015. Probe to be sent to Fiji</td></tr>
</table>

ANNEX II – Meeting Agenda

CLIMATE AND ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

DROUGHT COMMITTEE MEETING OCTOBER 2015

Dates: 27th and 28th of October 2015 - Venue: Utirerei Board Room, Ambo, Tarawa

27th October 2015

Time	**Agenda**
0930 - 1000	Review of previous minutes and identified actions
1000 - 1045	Bonriki abstraction update on June 2015 field investigations
1045 – 1115	Morning Tea
1115 - 1230	Review of new scenarios undertaken and presentation of results
1230 - 1330	Lunch at the Utirerei
1330 – 1500	Discussion on model results and potential implications on sustainable yield for Bonriki Water Reserve
1500 – 1530	Afternoon Tea
1530 - 1630	Review of Drought Plan for South Tarawa Dec 2013 V5. Monitoring of indicators and governance for altering abstraction rates and volumes

28th October 2015

Time	**Agenda**
0930 - 1030	Sustainable Yield –concept review and discussion of interim 12 year 2016-2028 sustainable yield – Bonriki Water Reserve
1030 – 1100	Morning Tea
1100 - 1230	Operation of Bonriki Water Reserve Monitoring: gallery salinity and freshwater lens thickness, Abstraction optimisation insights
1230 - 1330	Lunch at the Utirerei
1330 - 1430	Considerations for South Tarawa Drought Plan review - indicies and assignment of abstraction
1430 - 1500	Next steps / closing remarks
1500 – 1530	Afternoon Tea

NOTE: *Draft agenda, subject to minor changes

ANNEX III – Meeting Minutes

CLIMATE AND ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

DROUGHT COMMITTEE MEETING

27th-28th October 2015

Minutes

The second 2015 Drought Committee meeting for Kiribati was held at the Utererei Hotel in South Tarawa between the 27th and the 28th of October. The meeting objectives were to discuss the key findings of CAIA project with in particular the preliminary results from the modelling predictive simulations that could be used by the Drought Committee to strength the existing Drought Response Action Plan that is administered by the Drought Committee. The meeting also discussed the key findings from the field investigations from June 2015 related to the abstraction verification work in the Bonriki Water Reserve and the possible links between CAIA and other projects such as the New Zealand Water Security project.

Present:

Name	Agency	Email
Riteta Iorome	MPWU	ioromekuaravete@mpwu.gov.ki
Itienang Timona	PUB	itienangtimona@gmail.com
Mauna Eria	MET (KMS)	meanruti@gmail.com
Marella Rebgetz	KAP III	m.rebgetz@gmail.com
Aritu Iotia	Health	aritu2012@gmail.com
Benjamin Tokataake	MPWU	secret@mpwu.gov.ki
Maiango Enota	MPWU	maiangoe@mpwu.gov.ki
Tearinaki Tanielu	DFAT - Australia High Commission	tearinaki.tanielu@dfat.gov.au
Peter Sinclair	SPC	peters2@spc.int
Amandine Bosserelle	SPC	amandineb@spc.int

Meeting Chair:

The meeting chair was shared between the following persons, due to commitments with other ongoing meetings.

Benjamin Tokataake
MPWU
Meeting Chair during the morning session on Tuesday 27th Oct

Meeting Chair (Continue):

Riteta Iorome
MPWU
Meeting Chair during the afternoon sessions on Tuesday 27th Oct

Maiango Enota
MPWU
Meeting Chair during the sessions on Wednesday 28th Oct

DAY 1 – Tuesday 27TH OCTOBER 2015

Time	Agenda/ Activity	Actions
1015 - 1050	1. Registration of the attending members • Introduction by the chair Benjamin Tokataake to the meeting • Summary of the PICOF meeting (Suva, Fiji, October 2015) and review of regional statement by Mauna/Riteta/Peter. • Mauna indicated that Butaritari was experiencing a reduced rainfall anomaly suggesting drought warning should be in place based on analysis of 3 month indicie approach. However impact on the ground did not at this stage warrant water conservation measures due to the high rainfall generally experienced • Review of last meeting action plan and activities by Peter	
1030 - 1120	2. Bonriki abstraction update • Presentation by Peter on the findings from the comparison of the fixed flow meters and the ultrasonic flow meter readings: o Purpose, method and approach undertaken by PUB, KAPIII and SPC staff. o Meters at the Bonriki and Buota main transmission lines are overestimating abstraction by 18% and 9%, respectively. o Incorrect installation resulting in turbulence is causing the over reading errors in the meters. Even new meters demonstrate incorrect readings. o Replacement of older flow meters, meters on main transmission lines are a matter of urgency. o Redesign flow meter setup for galleries and at the main transmission lines to ensure that meters are installed correctly. • Draft report available for discussion provided to PUB and MPWU • Some recent salinity measurements seem low (below 400 µS/cm) and SPC staff will collect data for EC and abstraction readings from PUB during this trip.	It was agreed that the water quality instrument from PUB will be checked and calibrated on the next day if available. Draft report shared with PUB, MPWU and KAPII– comments to be provided- report to be finalised
1150 - 1300	3. CAIA scenarios results and key findings • The preliminary results and key findings of CAIA project scenarios were presented by Amandine: o Impact to the freshwater lens and the salinity at the trunk main under different abstraction rates and	Amandine to provide an informative summary of recommendations

	climate scenarios to help identify a safe yield for an agreed climate condition o Identification of galleries which contribute to increased gallery salinity: 1, 10 and 19 are critical followed by galleries number 5, 15, 17 and 22 o Identification of rainfall indicie for recovery on the freshwater lens o Impact of vegetation cover • The review of the predictive scenarios under the current landuse show that: o A safe yield of 1,600 kL/d was successfully modelled with 21 galleries out of 22, number 18 is permanently decommissioned, for a 30 year projection of salinity at the trunk main not exceeding 1,500 µS/cm including during a 3 year drought event. o A worst case scenario demonstrates that a rate of 1,180 kL/d can be abstracted with salinities below 1,500 µS/cm at the trunk main with a 3 year drought happening within the first 5 years of projected historical rainfall • Review of the predictive scenarios using a significant change in the landuse (clearing all trees and replacing them by grass), this will increase the net recharge by 20% to 25% and therefore increase the abstraction yield by 11% to 1,840 kL/d not exceeding 1,500 µS/cm, including during a 3 year drought event. Those results are coherent with previous estimates. • Amandine presented that coconut trees can use up to 150L/tree/day and had estimated 1,520 trees from satellite imagery and landuse analysis suggesting that savings of up to 228 kL/d could be saved, which accords with the model results. • Some concern was raised by the group over the removal of pandanus trees due to their medicinal value. Removal of coconut trees would be considered Ok but not pandanus. Impact of pandanus on the recharge and available abstraction should be considered.	based on model predictive scenarios findings
1300 - 1400	Lunch	
1400 - 1600	4. Discussion Session: • Discussion around the conceptualization of sustainable yield for Bonriki with consideration to o future demands, economic costs of alternative water, social and economic costs of vegetation removal, acceptable limits of salinity and impacts to the freshwater lens thickness both short and long term. • Results provided indicated that 1600 kL/d can be sustained if a 3 year drought was to occur 12 years from 2015. The group discussed this risk option and felt that it would be appropriate to maintain the current sustainable yield of	

	1660 kL/d day BUT to have a process for varying the allowable abstraction based on triggers if extended drought came sooner and started to impact on water quality. Further that consideration be given to the triggers resulting in the reduction of abstraction that would be required and the timing of the reduced abstraction to minimize the potential impact on the lens and keep the salinity of the water abstracted below the 1,500 µS/cm threshold. • Discussion on using the model to develop a relationship between the monitoring bore salinity at specific locations and the thickness of the freshwater lens. • Amandine recommended that based on modelling results that only 21 galleries can operate out of the 22 used for the assessment. Further that the current research will provide a recommendation on the individual pumping rate to set the new pumps with a total yield of 1,600 KL/d fixed for the next 12 years. • PUB, Itienang was interested in using the model to provide advice on optimizing the abstraction whilst minimizing the impact to the freshwater lens. In particular identify which galleries will need to be switched off or abstraction rates to maintain salinity levels leaving the treatment plant. • Discussion around the identification of the triggers for surveillance of the freshwater thickness, salinities at the trunk main at the water treatment plant and rainfall observations. KMS indicated that they can provide a rainfall outlook bulletin, based on SCOPIC outlook for different time period, 3, 6 and 12 months, up to 36 months, (albeit reduced confidence). Need for identifying critical monitoring bores which would provide insight to the expected freshwater lens thickness below galleries. • Amandine presented graphs which demonstrated that the model predicts that the impact to the freshwater lens and the increase in salinity for the water leaving the treatment plant is rapid. This suggests that the 3, 6, and 12 month rainfall outlooks will be important in determining triggers to reduce abstraction if the salinity increases during dry periods is to be avoided. • To be further discussed on meeting day 2.	

DAY 2 – Wednesday 28TH OCTOBER 2015

Time	Agenda	Action
1030 - 1100	1. Introduction by the chair Maiango Enota to the meeting 2. Summary and review of previous day agenda and discussions by Peter Reviewed the model results for different abstraction under different rainfall conditions: • Extended dry period will result in a rapid rise in salinity at galleries and in the trunk main. • Good following rainfall will see an even more rapid response in reducing the salinity, at the top of the freshwater lens, to background levels.	

	• The shorter the period between stresses e.g. droughts, the quicker the abstracted water will reach a higher salinity. Thinning of freshwater lens reduces its resilience to provide the same quality of water for the same abstracted volume. • The concept of an abstraction range was considered based on the anticipated rainfall and antecedent conditions. This range could vary from 900-1,800 kL/d based on model results. • Agreed that the SY would be restricted to 1,600 kL/d for a period of 12 years and that the focus should be on providing guidance on when and by how much abstraction may need to be varied in individual galleries to reduce the impact to the freshwater lens and maintain the salinity leaving the treatment plant to an acceptable level.	
1100 - 1200	3. Sustainable Yield (SY) concept for Bonriki • Agreed that assigning a fixed SY involves a certain amount of risk, as the model identifies that fixed abstraction may range from 900-1,800 kL/d over a 12 year period, depending on rainfall climate experienced, to avoid breaching salinity thresholds, and a thinning trend in freshwater lens thickness. • Discussion over the current reform for PUB which will focus on reversing the revenue losses from water supply part of PUB. This will involve increasing the water demand with improved water service and supply, and resulting increased charge for service, which will have potential impact on the Bonriki Water Reserve. Consideration to alternate water sources is required to meet the predicted increases in demand whereby the model clearly identifies that the Bonriki freshwater lens is unable to increase abstraction long term. Discussion around the proposal to introduce a desalination plant to provide the water demands of Bairiki and Betio populations which will reduce the demand on the Bonriki Water Reserve and thereby increase its potential to meet the demands of a smaller population.. • Discussion on the potential improvement in the operation of the Bonriki Water Reserve. Whereby with variable pumps provided from DFAT and MFAT funding the abstraction rate can be adjusted based on the performance of the gallery. Pumps are still waiting to be installed. • The current drought plan has no explicit guidance related to varying abstraction at the Bonriki Water Reserve, the committee would like to see some guidance provided from the modelling on the types of responses and what water conservation and water restriction may be required, including altering the abstraction at individual galleries using new adjustable pumps to meet the needs of the community and the resource • Possible triggers: o Measured salinities, daily readings at the treatment plant o Communication and responsibility plan between	

<table>
<tr><td></td><td>agencies and KMS for outlook when salinity reaches 1000 µS/cm at the treatment plant</td><td></td></tr>
<tr><td>1200
-
1230</td><td>4. Status of South Tarawa Drought plan
• 2013 update – Draft status under CoSPPAC project
• Major changes include:
o Name change from South Tarawa Drought Response Action Plan to Drought Plan for South Tarawa
o Averaging the percentiles for 3,4,5 years is considered incorrect, plan recommends 4 and 5 year percentiles for Bonriki
o 7-day average salinity of the mixed water from the Buota and Bonriki galleries exceeds a critical salinity value (currently set at 1,200 µS/cm)
o Annex C removed – identifying responses and responsibilities applicable in each alert</td><td></td></tr>
<tr><td>1230
-
1330</td><td>Lunch</td><td></td></tr>
<tr><td>1330
-
1500</td><td>5. Operation of Bonriki Water Reserve
• Amandine, based on model runs, proposed an assignment of variable abstraction with 9 galleries at 90 m^3/d, 7 galleries at 70 m^3/d and 5 galleries at 60 m^3/d
• During drought, identification of the galleries susceptible to increase salinity at the water treatment plant, number 1, 10 and 19, then galleries number 5, 15, 17 and 22.</td><td rowspan="2">Outputs from CAIA (recommendations for the Drought Plan for South Tarawa update)

• Agreement on abstraction yield for the next 12 years and distributions over the galleries field.
• Recommendations on an approach to vary abstraction and guidance on how this could be achieved
• Guidance from modelling results from specific scenarios
• Additional figures on ranking of 6, 18 and 36 month rainfall totals for reporting on indices and triggers
• Email CAIA website with a copy of the presentations</td></tr>
<tr><td>1500
-
1530</td><td>6. Considerations for South Tarawa Drought Plan review - indicies and assignment of abstraction
• KMS system for identifying and track rainfall percentiles using selected indicie durations for triggering alert levels:
o 40 percentiles: Watch
o 25 percentiles: Warning
o 10 percentiles: Drought Declaration
• The analysis of rainfall ranking and the modelled salinity at the trunk main demonstrate that alert levels 1 and 2 could be given using the 12 or 24 months charts and that alert level 3 could be given using the 30 or 48 months charts. The 30 months rankings could also be used for the recovery and dropping the alert. This assessment was discussed briefly during the sessions and needs to be further explored in combination with the freshwater lens thickness and salinities at the trunk and galleries prior to a recommendation for the draft Drought Plan.
• Consideration that a salinity of 1,000 µS/cm at the trunk main, in combination with a review of other rainfall outlooks and monitoring bores may be a useful trigger for a level three alert.

7. Meeting closing remarks from the chair Maiango and Peter</td></tr>
</table>

ANNEX III – Drought Committee meeting presentations – attached pdf files

Climate and Abstraction Impacts on Atoll Environments

Presenter: Peter Sinclair and Amandine Bosserelle

Tuesday 27 October 2015

CAIA
CLIMATE & ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

EUROPEAN UNION

ACP S&T PROGRAMME

SPC Secretariat of the Pacific Community

USP THE UNIVERSITY OF THE SOUTH PACIFIC

Flinders UNIVERSITY

Introduction

- Objectives
  - Review the progress from the previous meeting in May 2015
  - Discuss model results and potential implications for existing sustainable yield and operation of Bonriki
  - Considerations for drought management plan
  - Future steps

Previous agreed activities

Activity Number	Activity	Responsibility	Due date
8.2	Proposed modelling scenarios	Drought committee /SPC/ TWG	May 2015
8.5	Calibration of fixed flow meters	PUB/SPC	June 2015
8.2	Calibration of groundwater model	SPC/Flinders University	June/July 2015
8.2	Review of modelling scenarios/review of key inputs for DRAP with TWG	TWG	July 2015
8.2	Modelling of scenarios	SPC/ Flinders	August /Sept 2015
8.3 and 8.4	Recommendations for improvements in the tools and trigger parameters for inclusion in updated DRAP	SPC/Drought Committee	October 2015

Bonriki abstraction update

Groundwater abstraction validation exercise Flow meter testing, Buota & Bonriki Water Reserves, Tarawa, Republic of Kiribati (June 2015 field investigations)

Aminisitai Loco

Draft Report August, 2015

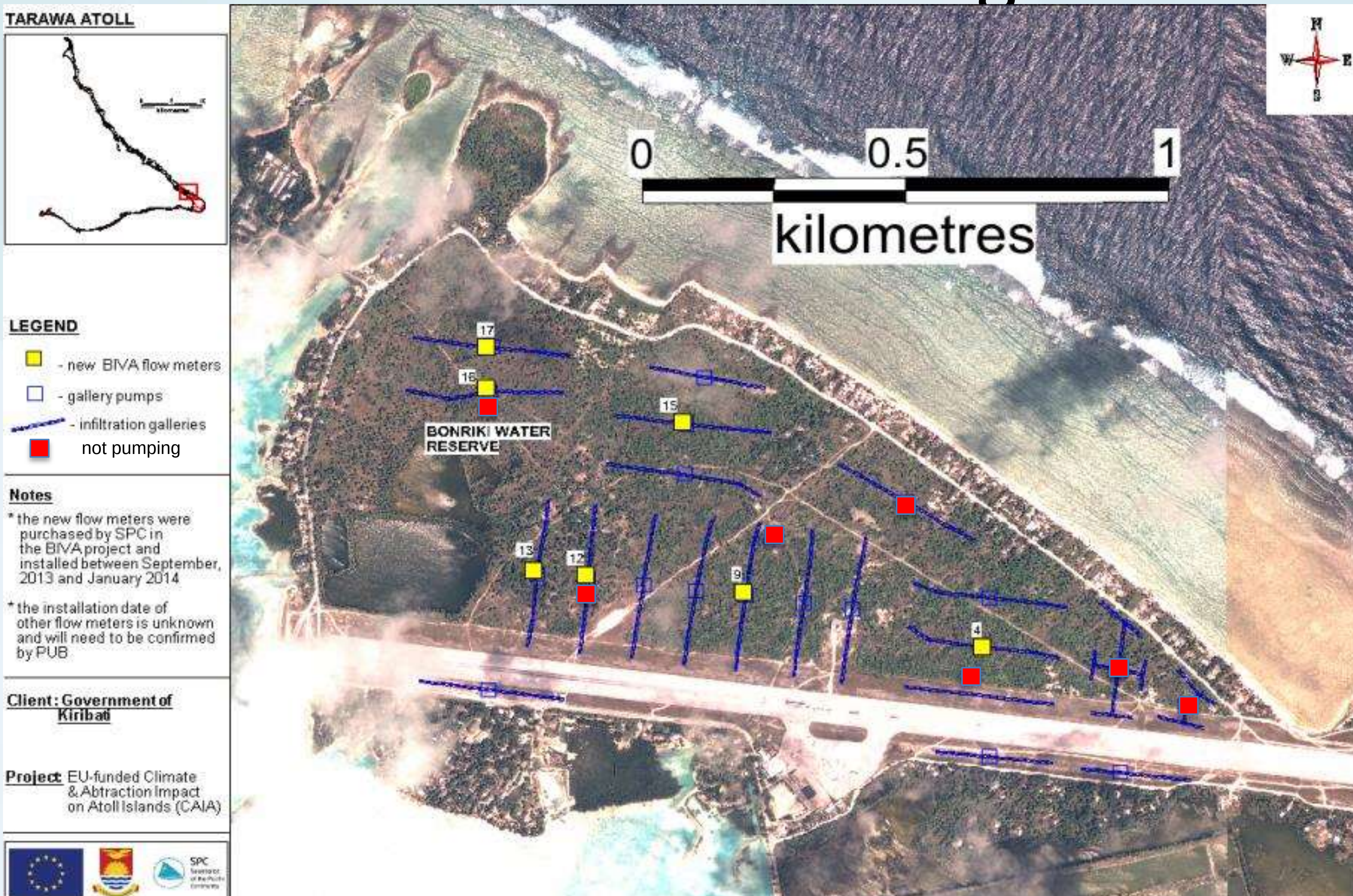
Purpose

- Reduce the uncertainty associated with the current fixed flow metered recorded abstraction rates.

Approach

- SPC to engage with PUB and KAPIII to design and undertake field testing on the fixed flow meters using ultrasonic flow meters UFM,
- Previous testing Oct 2014 and Dec 2014 suggest that the fixed flow meters are over reading y on average 16%
- Abstraction is a critical parameter to improving the confidence of the numerical model

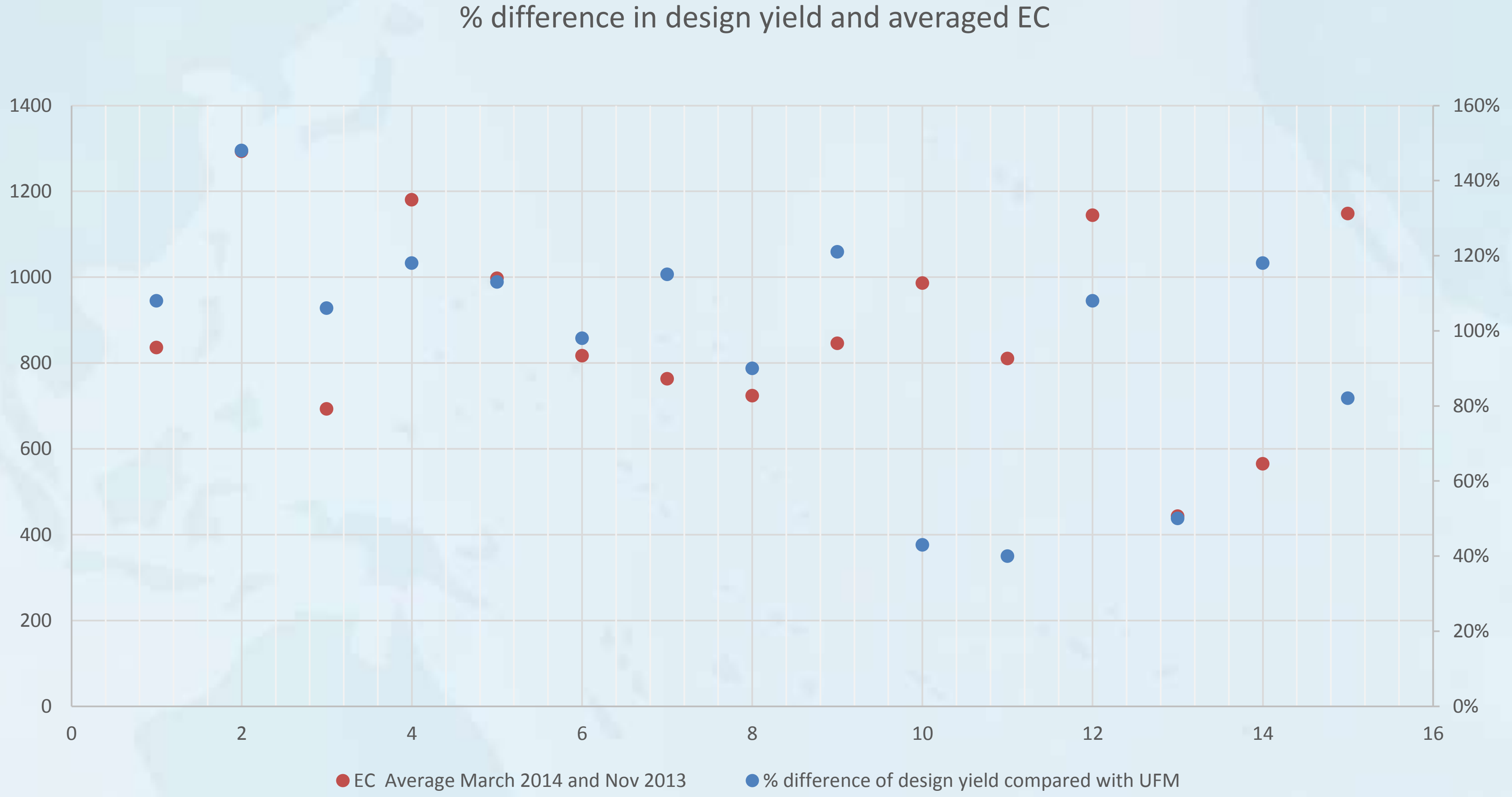
Fixed flow meter testing sites



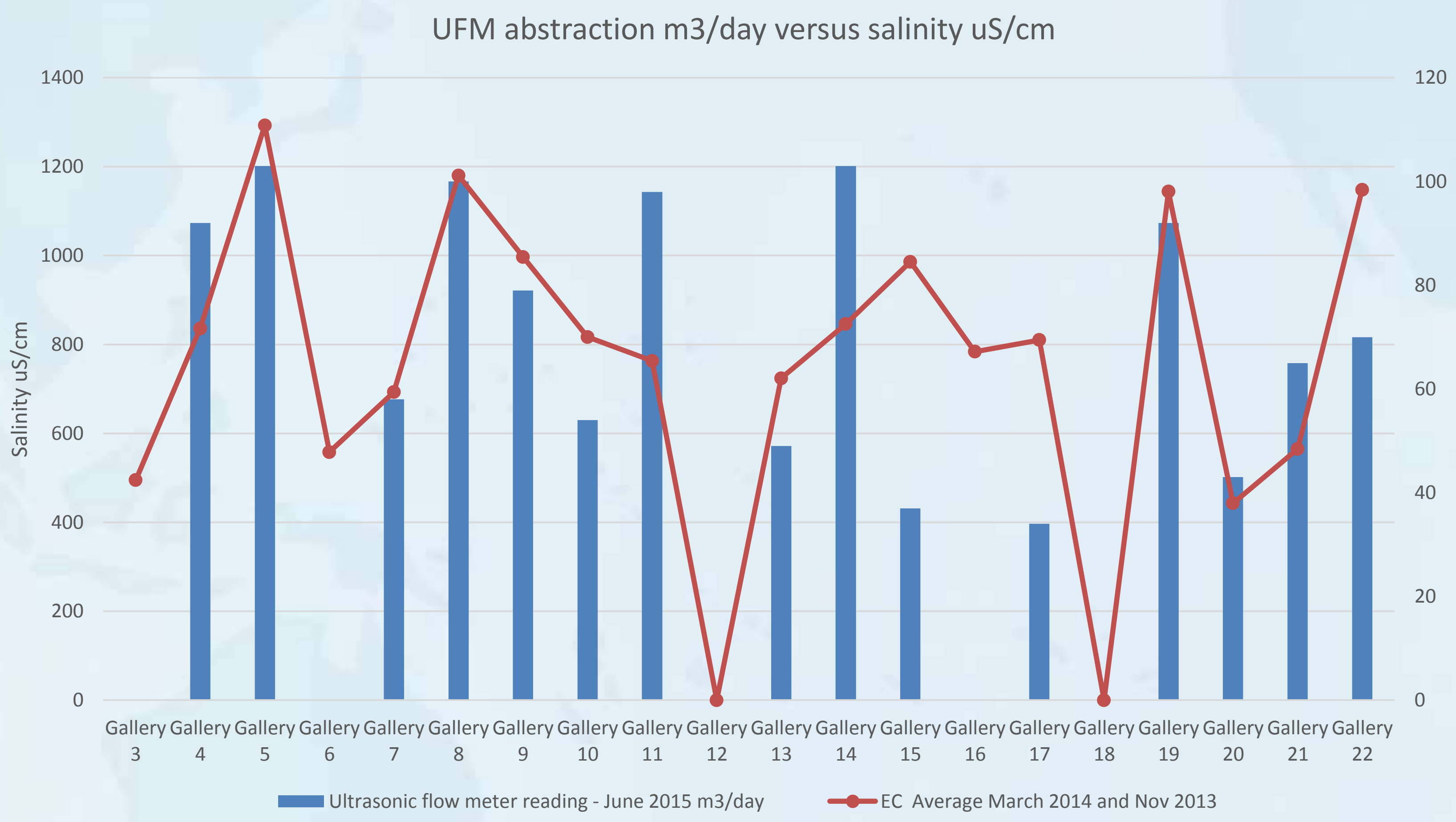
Assessment of gallery meters

Meter	Tested gallery design yield (Falkland, 2003) m^3/day	Fixed flow meter reading - June 2015 m^3/day (new meter*)	Ultrasonic flow meter reading - June 2015 m^3/day	% difference of FFM compared with UFM	% difference of design yield compared with UFM	EC Average March 2014 and Nov 2013
Bonriki WTP	2000	1570	1284	18%	64%	
Buota main	340	254	232	9%	68%	
Gallery 1	85			No pump	NA	
Gallery 2	85			No pump	NA	
Gallery 3	85			NA retesting	NA	495
Gallery 4	85	103*	92	10%	108%	836
Gallery 5	70	127	103	19%	148%	1,293
Gallery 6	55			NA	NA	558
Gallery 7	55	86	58	32%	106%	693
Gallery 8	85	128	100	22%	118%	1,180
Gallery 9	70	99*	79	20%	113%	997
Gallery 10	55	61	54	12%	98%	817
Gallery 11	85	125	98	22%	115%	763
Gallery 12	55			not pumping	NA	
Gallery 13	55	53*	49	6%	90%	724
Gallery 14	85	135	103	24%	121%	846
Gallery 15	85	41*	37	12%	43%	986
Gallery 16	85			NA (slow pumping)	NA	784
Gallery 17	85	39*	34	12%	40%	810
Gallery 18	85			No pump	NA	
Gallery 19	85	98	92	7%	108%	1,144
Gallery 20	85	67	43	37%	50%	443
Gallery 21	55	112	65	42%	118%	565
Gallery 22	85	110	70	36%	82%	1,148

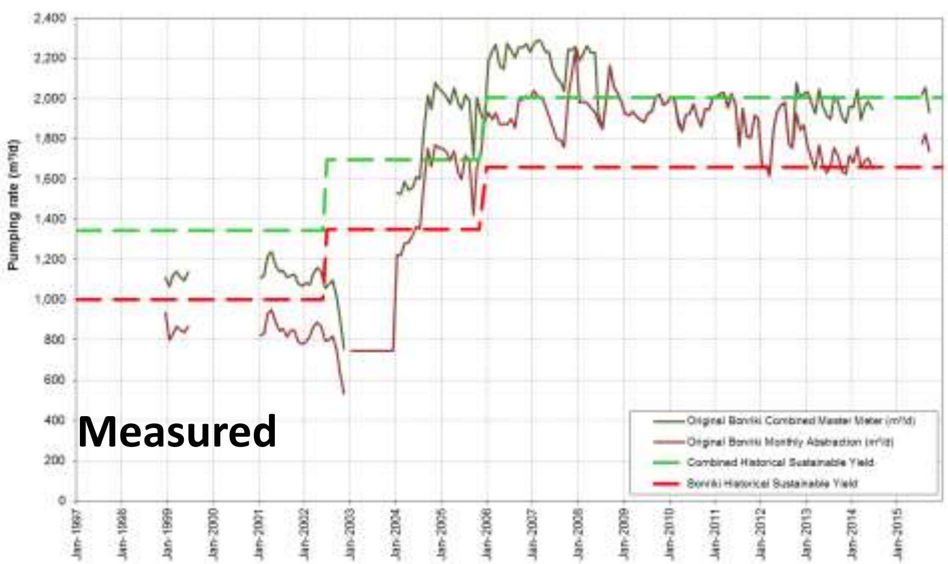
Comparison of EC and abstraction versus design yield

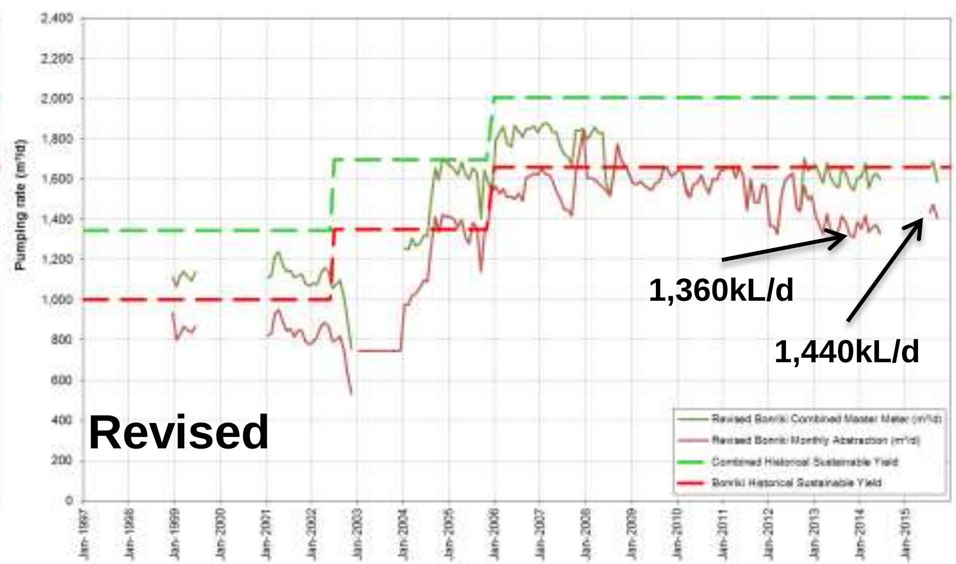


Comparison of EC and abstraction versus design yield



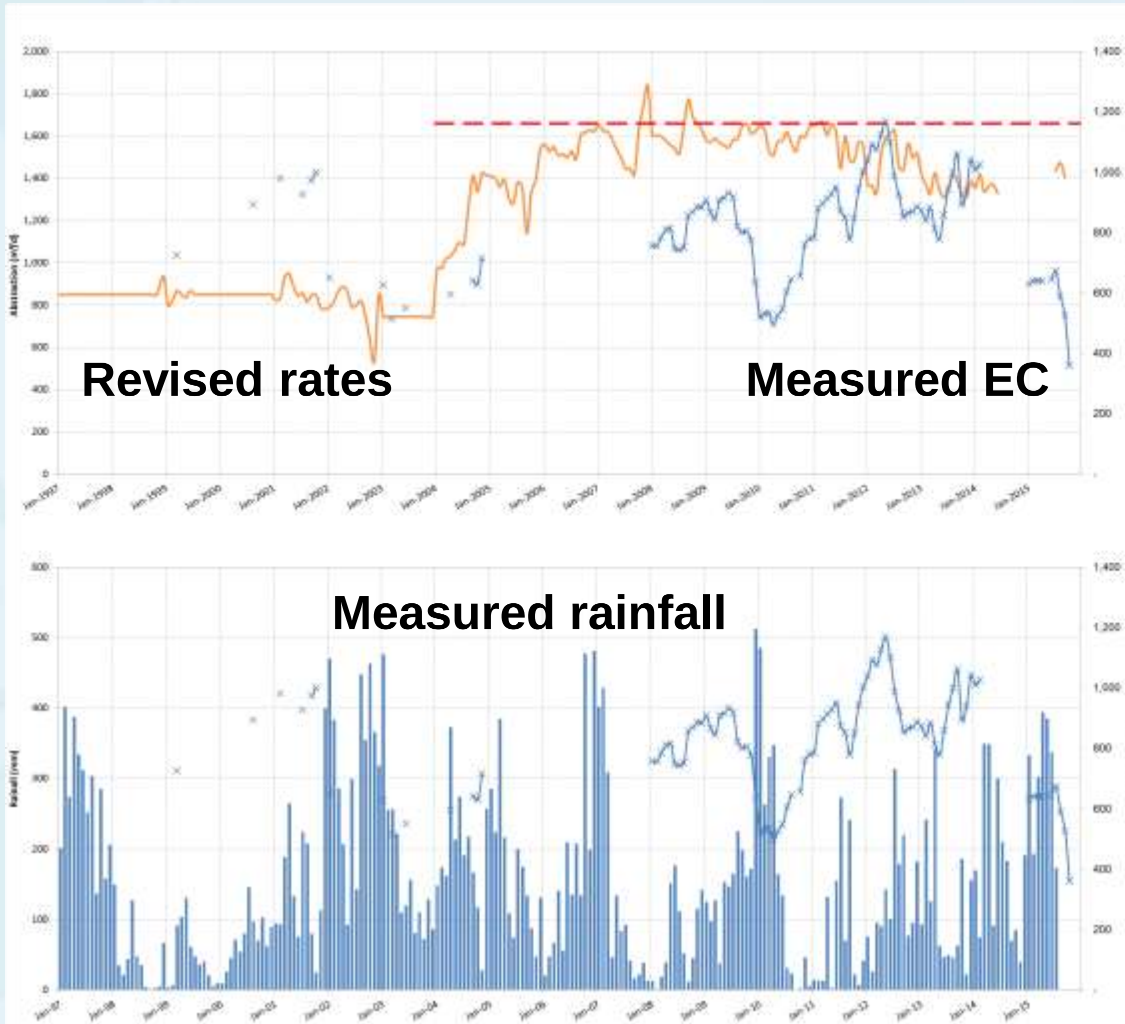
Measured versus revised groundwater abstraction rates





Bonriki abstraction update

Measured EC and rainfall versus revised groundwater abstraction rates – Bonriki Only



Fixed flow meter testing findings

- Meters at the Bonriki and Buota main transmission lines are overestimating abstraction by 18% and 9 %, respectively.
- Fifteen (15) of the twenty-two (22) gallery flow meters at Bonriki, operating in June 2015 were tested with UFM. All fixed meters registered over reading of 6 – 42% above the actual flow, with more than 85% of meters registering more than 10% error.

- Incorrect installation resulting in turbulence is causing the over reading errors in the meters. Even new meters demonstrate incorrect readings

- Overall system running at 64% of designed abstraction in June 2015.
- 9 galleries abstracting greater than design rate, up to 148%, on average 17% more than design rate
- 6 galleries abstracting less than design rate, up to 40%, and on average 58% of design rate

Fixed flow meter testing recommendations

- Redesign flow meter setup for galleries and at the main transmission lines to ensure that meters are installed correctly. All galleries and main transmission lines will require new setup of flow meters
- Replacement of older flow meters, meters on main transmission lines, are a matter of urgency

- Pumping from each gallery should be reviewed with regard to actual abstraction, designed abstraction and the salinity at the gallery. Consider adjusting abstraction to design rate if salinity permits.

- As the 6 galleries become operational, additional testing should be carried out to determine abstraction rates.

Review of new scenarios

Presenter: Peter Sinclair and Amandine Bosserelle

Tuesday 27 October 2015

CAIA

CLIMATE & ABSTRACTION IMPACTS
ON ATOLL ENVIRONMENTS

EUROPEAN UNION

ACP S&T PROGRAMME

SPC
Secretariat
of the Pacific
Community

USP
THE UNIVERSITY OF THE
SOUTH PACIFIC

Flinders
UNIVERSITY

Review of new scenarios

- The **impact of vegetation cover** on recharge and the groundwater storage over time to provide technical advice for future planning

- The **impact to the freshwater lens** and the **salinity at the trunk main under different abstraction rates and climate scenarios** to help identify a sustainable yield for an agreed climate condition

- The **identification of galleries which contribute to increased gallery salinity** under different abstraction rates and identification of an optimal abstraction rate for each gallery under different climate conditions for the proposed sustainable yield

- Identifying an improved **indicie for rainfall to determine impact and recovery on the freshwater lens in Bonriki** using the rainfall decile methodology

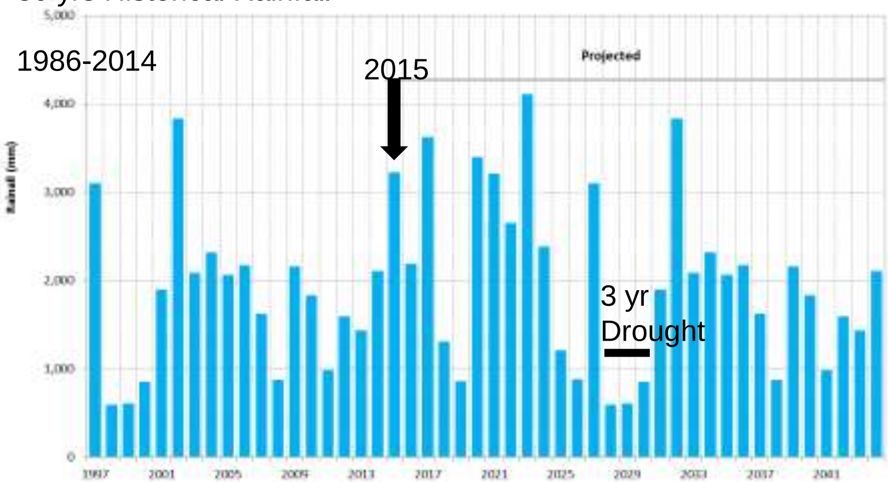
Review of new scenarios

Model input parameters		Simulation 1					Simulation 2		Simulation 3		Simulation 4		Simulation 5	
		Base Case - 3 year drought - Climate and Abstraction Scenarios					Base Case - 6 year drought - Climate and Abstraction Scenarios		Base Case - 3 year drought - Vegetation and Abstraction Scenarios		Worst Case - 3 year drought - Climate and Abstraction Scenarios		Worst Case - 5 year drought - Climate and Abstraction Scenarios	
		1A	1B	1C	1D	1E	2A	2B	3A	3B	4A	4B	5A	5B
Climate	Historical (30 yrs with a 3 year drought)	√	√	√	√	√			√	√				
	Historical (30 yrs with a 6 year drought)						√	√						
	Historical (20 yrs repeat with a 3 year drought)										√	√		
	Historical (20 yrs repeat with a 5 year drought)												√	√
Vegetation	Current landuse – (10 to 20% trees)	√	√	√	√	√	√	√			√	√	√	√
	Cleared (grasses only – no trees)								√	√				
Abstraction	Current abstraction distribution and projected design rate (1,660m³/d 21 galleries)	√					√		√		√		√	
	1,800m³/d projected design rate (21 galleries)			√										
	No Abstraction after December 2015		√											
	Uniform abstraction distribution (~79m³/d per galleries - 21)					√								
	Optimised abstraction distribution (based on iterations – 3 different initial rates)				√			√		√		√		√

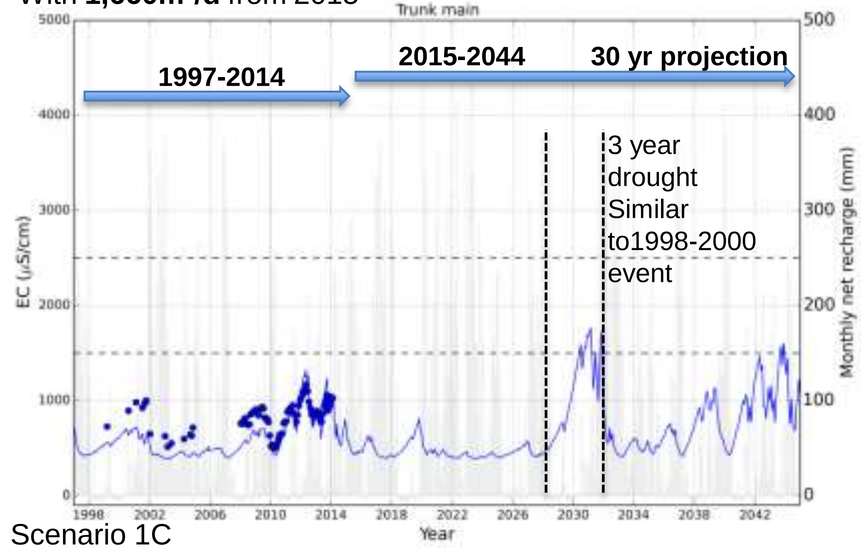
Simulation 1

Base Case - 3 year drought - Climate and Abstraction Scenarios

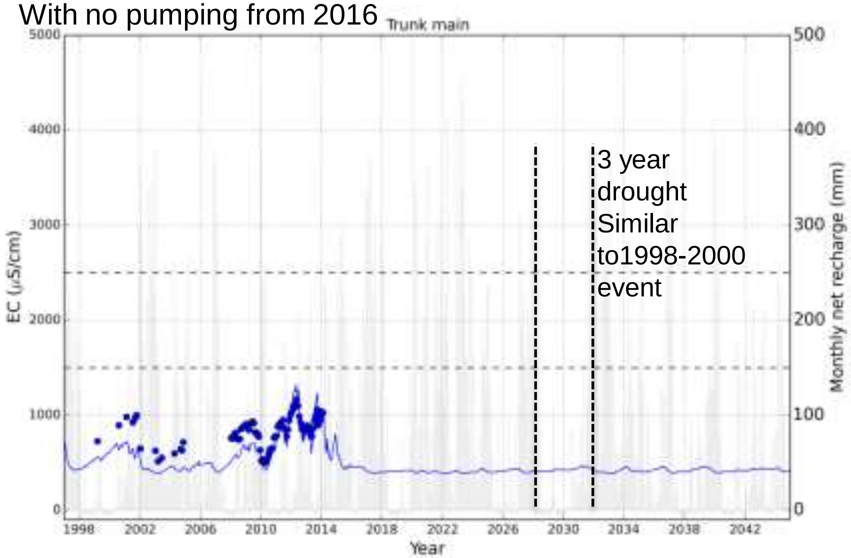
30 yrs Historical Rainfall



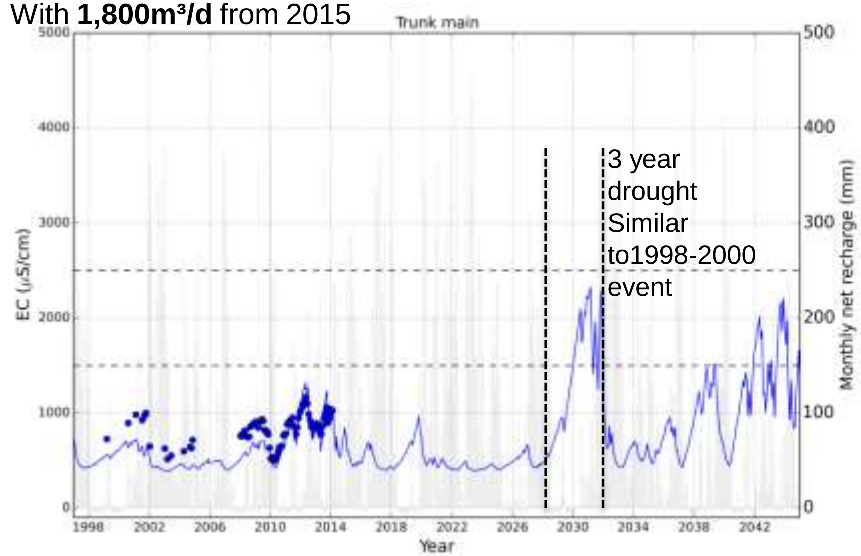
Scenario 1A
30 yr Projected Rainfall – 3 yr Drought
With **1,660m³/d** from 2015



Scenario 1B
30 yr Projected Rainfall – 3 yr Drought
With no pumping from 2016



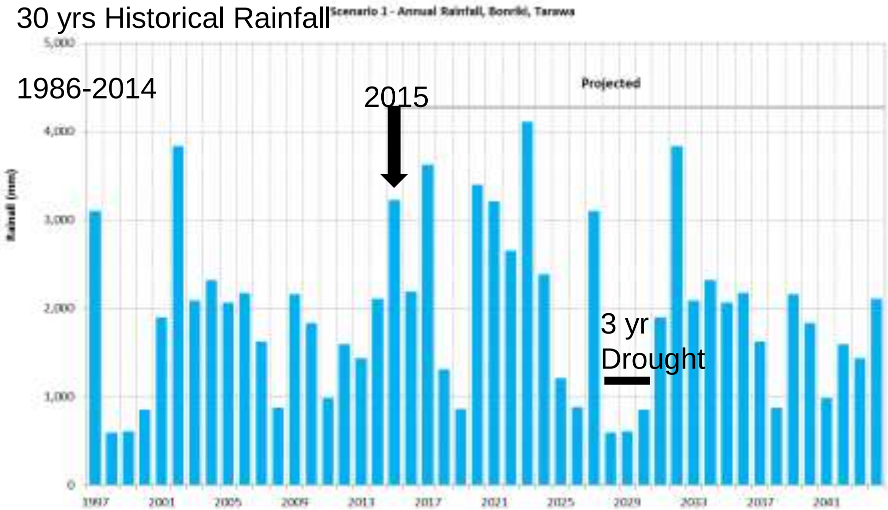
Scenario 1C
30 yr Projected Rainfall – 3 yr Drought
With **1,800m³/d** from 2015



CAIA

Simulation 1

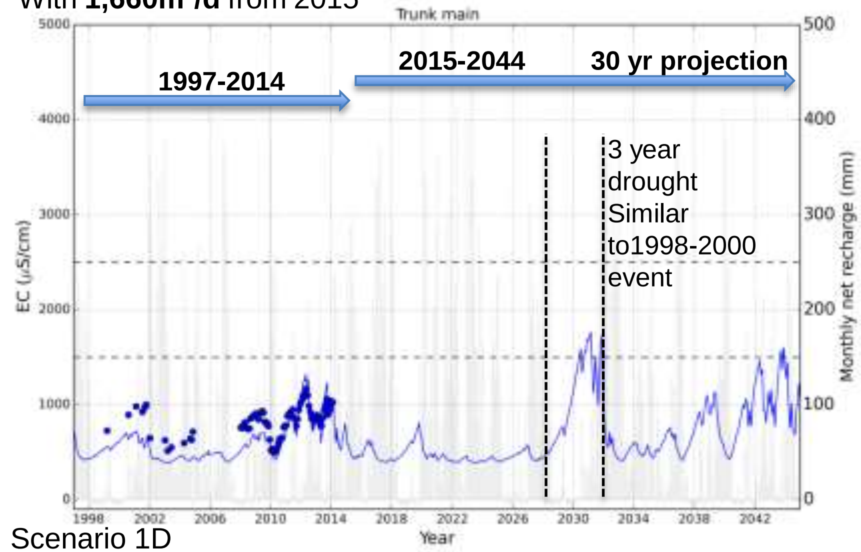
Base Case - 3 year drought - Climate and Abstraction Scenarios



Scenario 1A

30 yr Projected Rainfall – 3 yr Drought

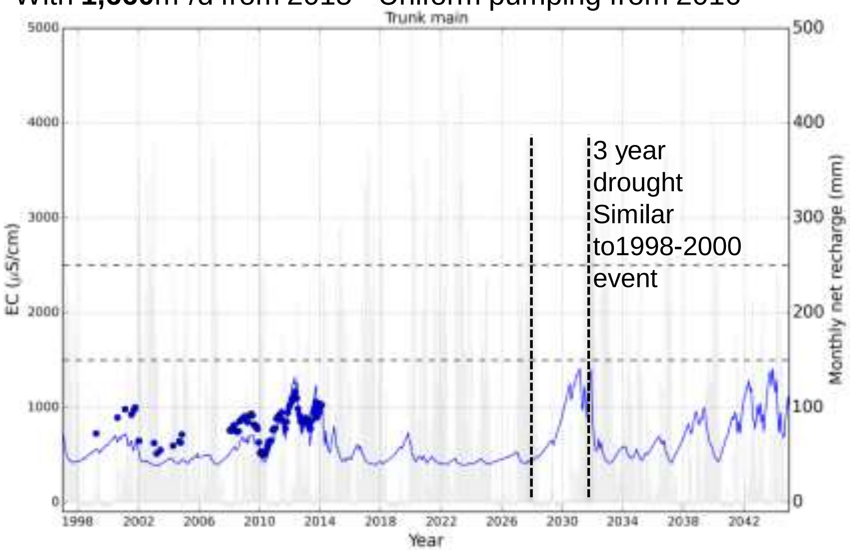
With **1,660m³/d** from 2015



Scenario 1E

30 yr Projected Rainfall – 3 yr Drought

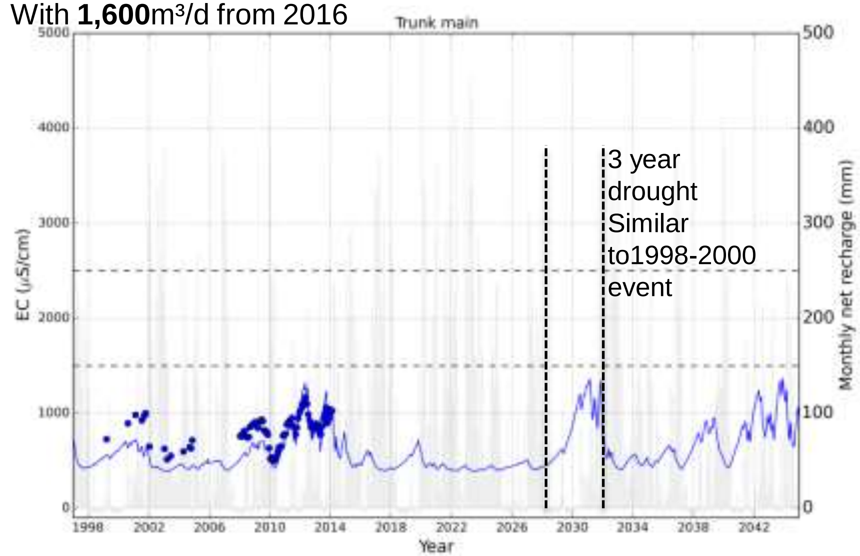
With **1,660**m³/d from 2015 - Uniform pumping from 2016



Scenario 1D

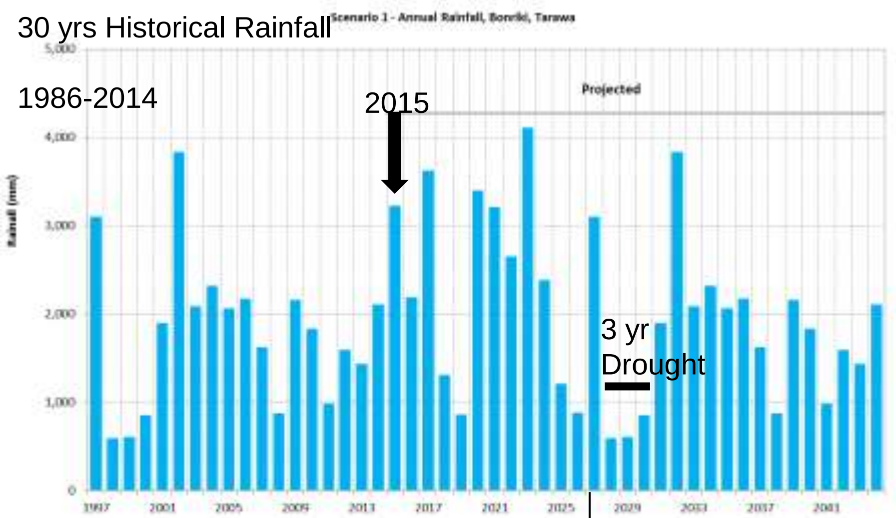
30 yr Projected Rainfall – 3 yr Drought

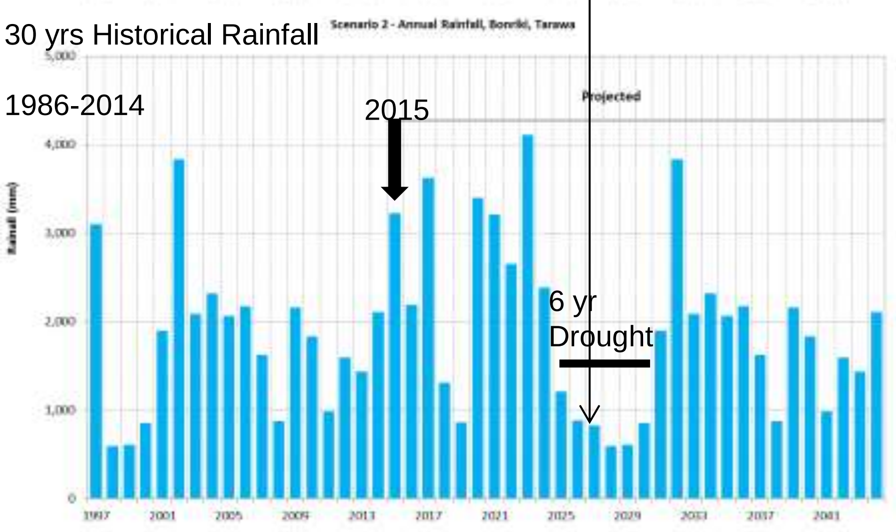
With **1,600**m³/d from 2016



Simulation 2

Base Case - 6 year drought - Climate and Abstraction Scenarios

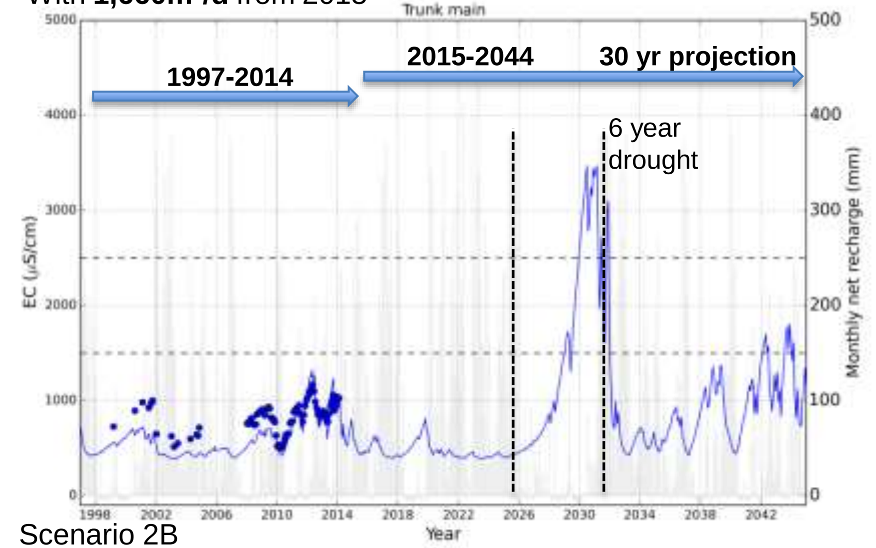




Scenario 2A

30 yr Projected Rainfall – 6 yr Drought

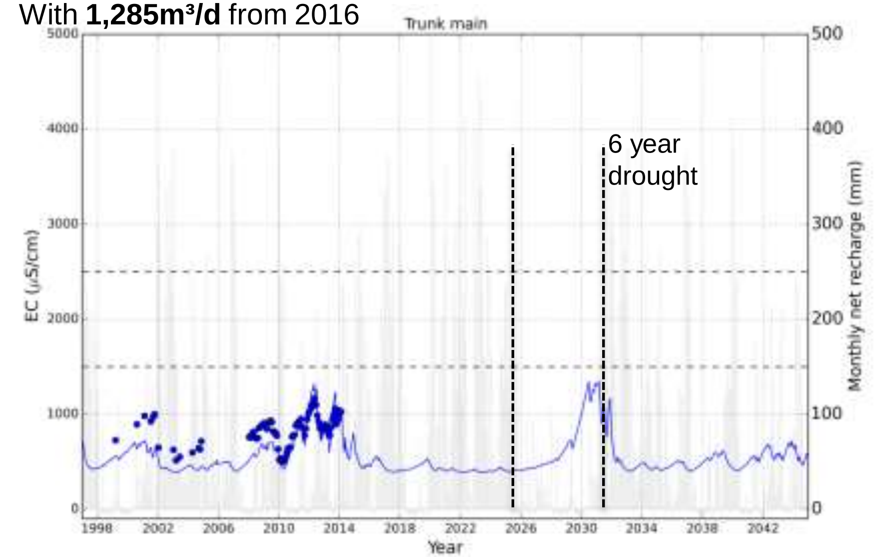
With **1,660m³/d** from 2015



Scenario 2B

30 yr Projected Rainfall – 6 yr Drought

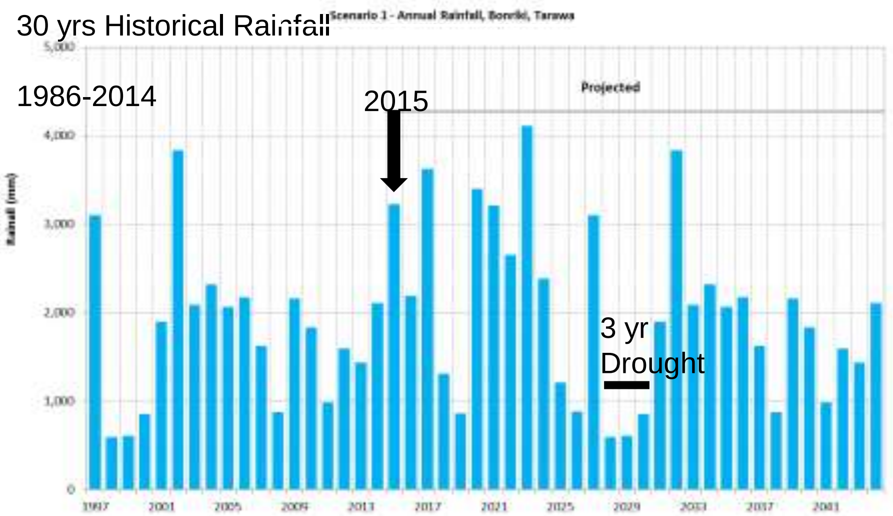
With **1,285m³/d** from 2016



Simulation 3

Base Case - 3 year drought - Vegetation and Abstraction Scenarios

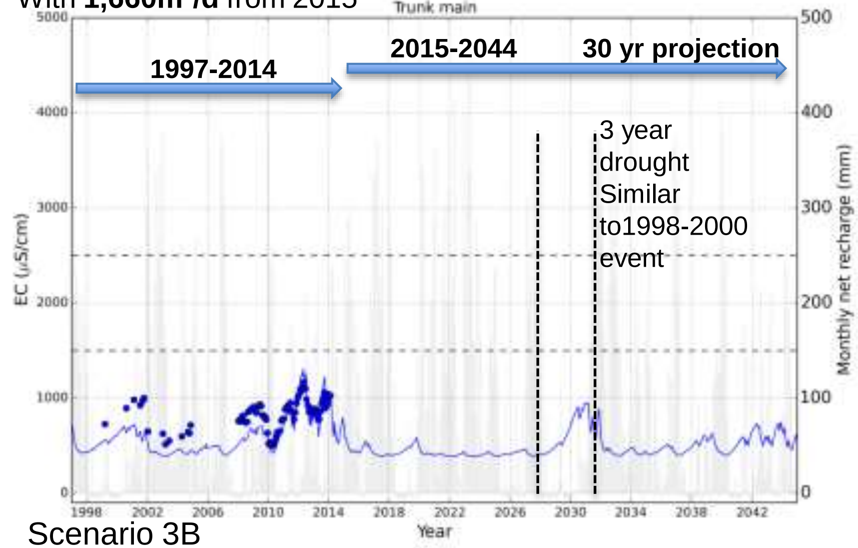
30 yrs Historical Rainfall



Scenario 3A

30 yr Projected Rainfall – 3 yr Drought

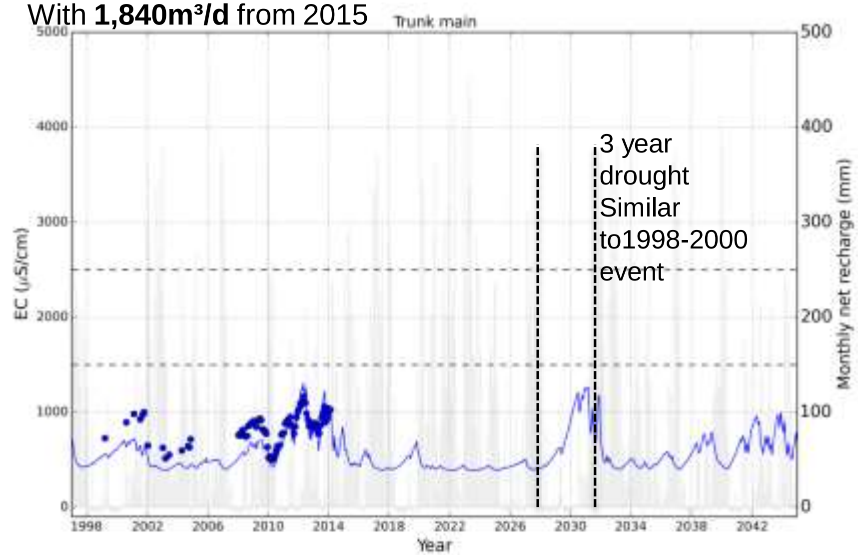
With **1,660m³/d** from 2015



Scenario 3B

30 yr Projected Rainfall – 3 yr Drought

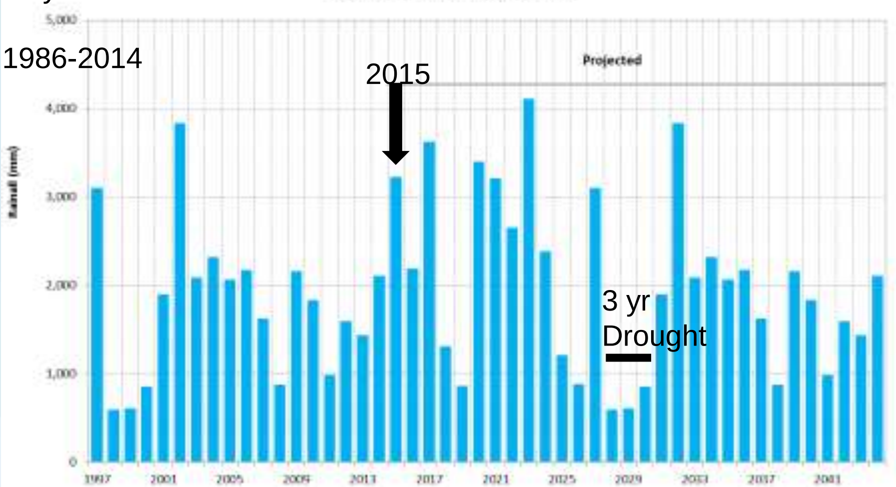
With **1,840m³/d** from 2015



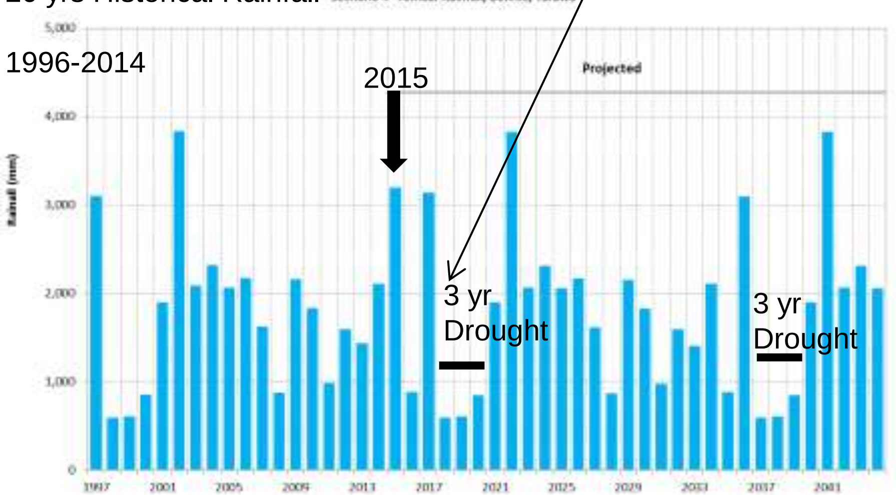
Simulation 4

Worst Case - 3 year drought - Climate and Abstraction Scenarios

30 yrs Historical Rainfall



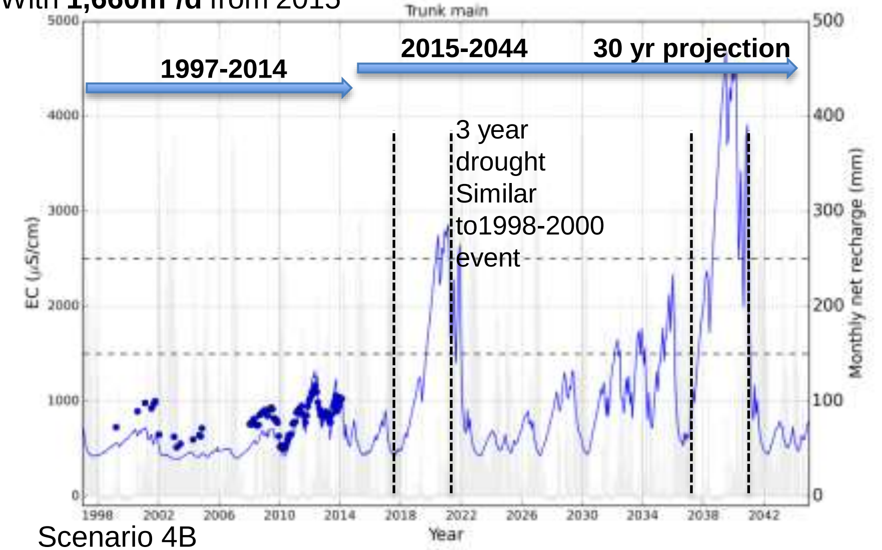
20 yrs Historical Rainfall



Scenario 4A

20 yr Projected Rainfall – 3 yr Drought

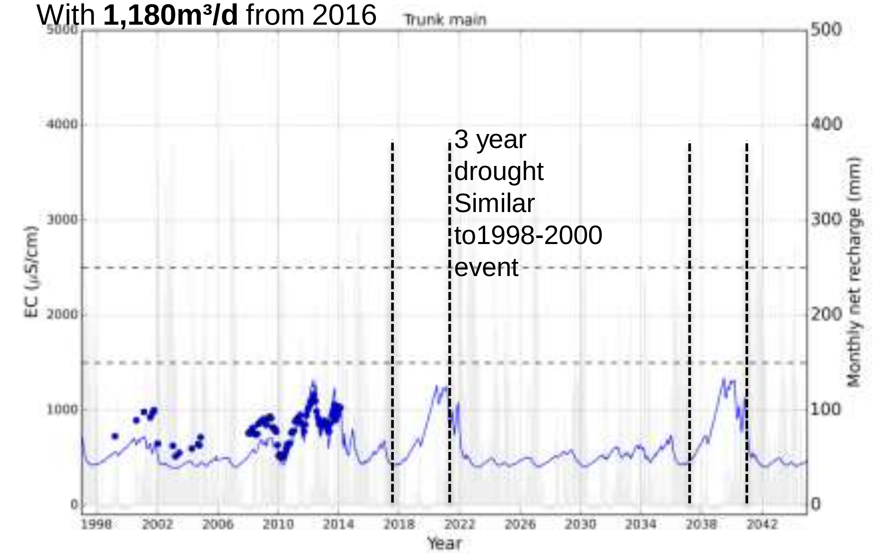
With **1,660m³/d** from 2015



Scenario 4B

20 yr Projected Rainfall – 3 yr Drought

With **1,180m³/d** from 2016

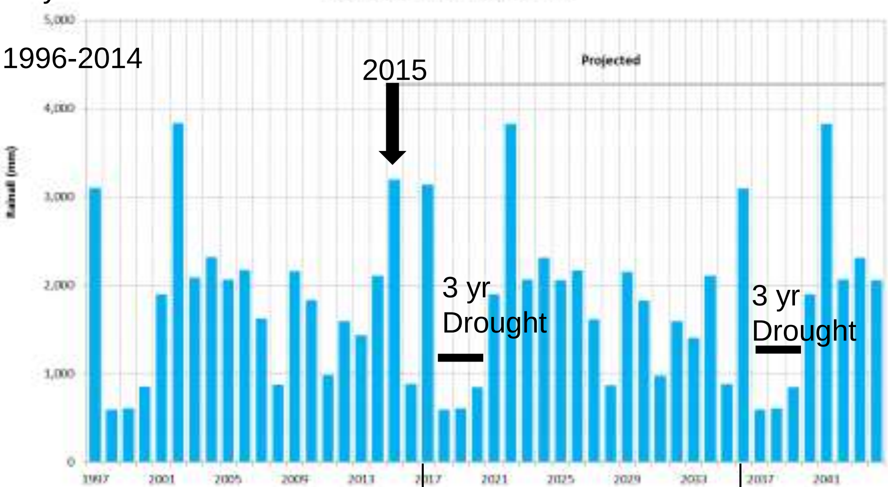


CAIA

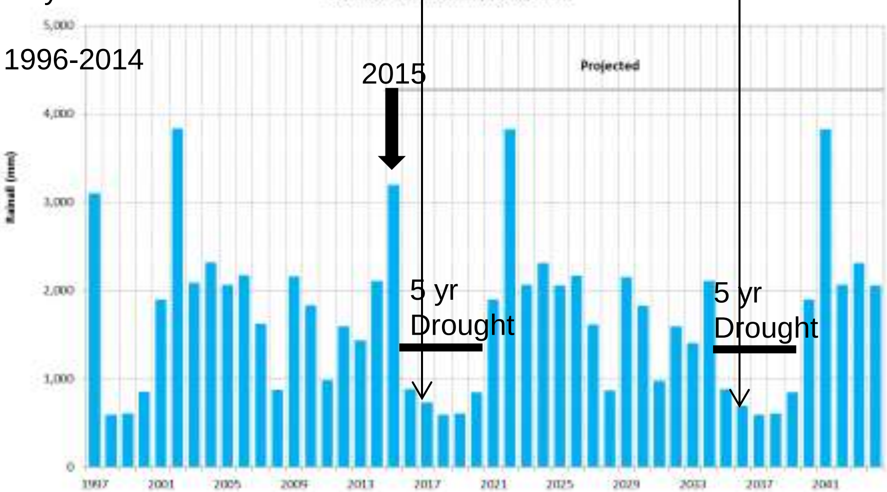
Simulation 5

Worst Case - 5 year drought - Climate and Abstraction Scenarios

20 yrs Historical Rainfall



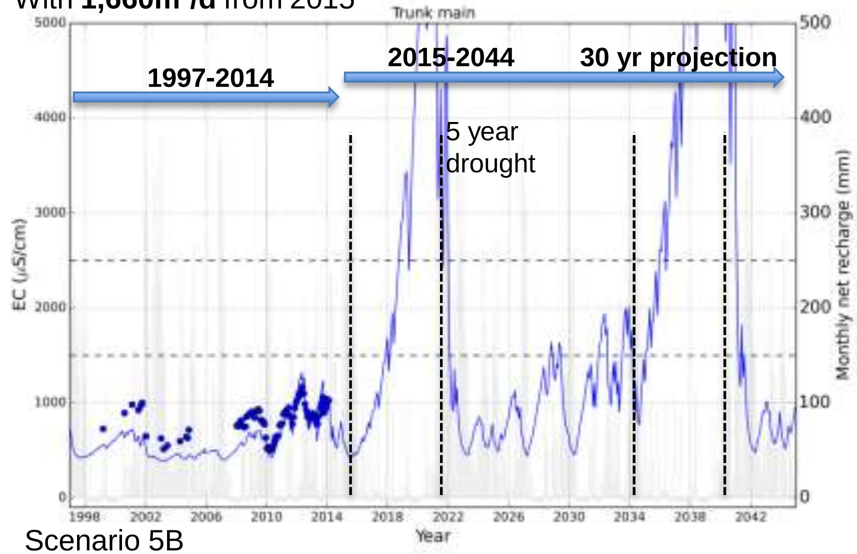
20 yrs Historical Rainfall



Scenario 5A

20 yr Projected Rainfall – 5 yr Drought

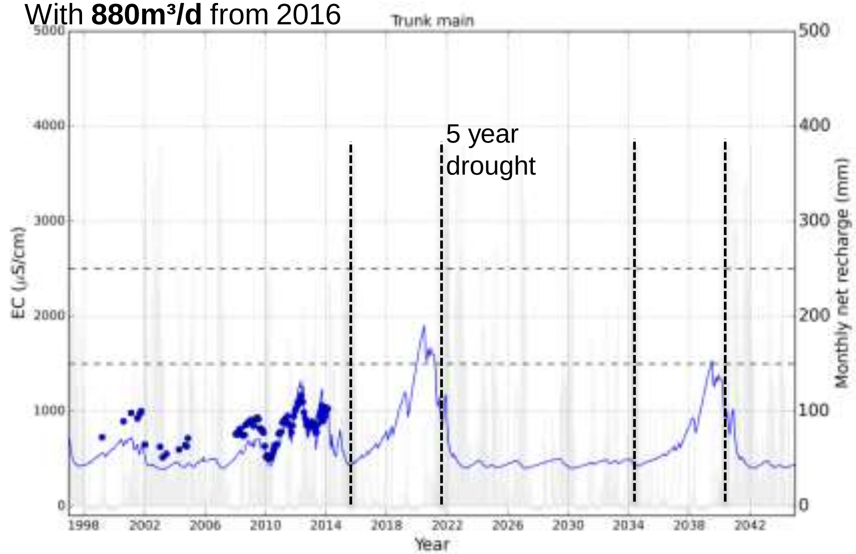
With **1,660m³/d** from 2015



Scenario 5B

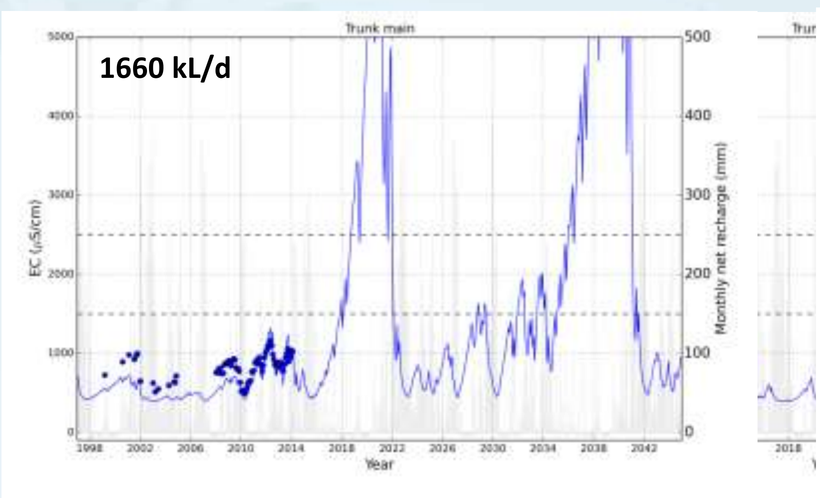
20 yr Projected Rainfall – 5 yr Drought

With **880m³/d** from 2016



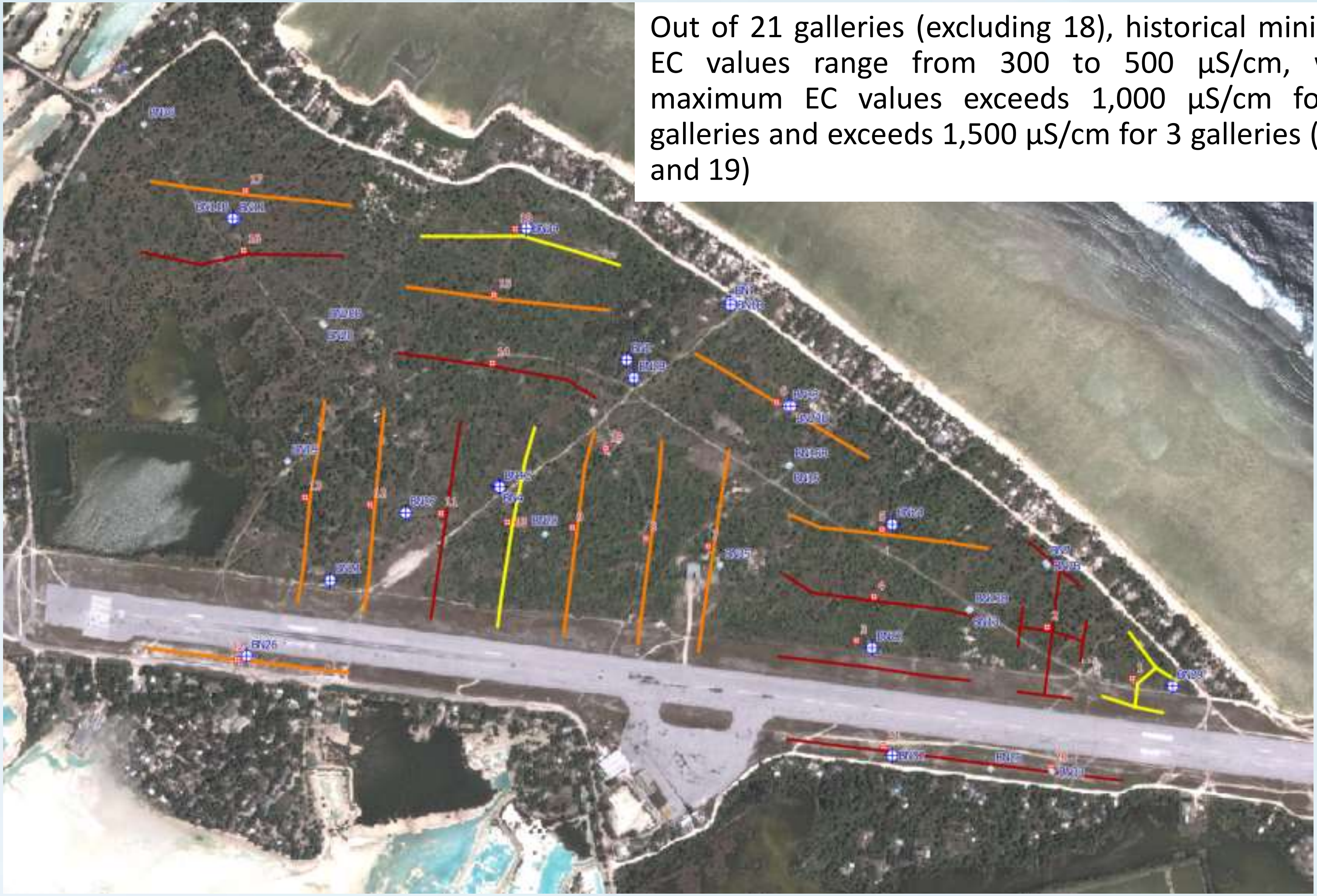
Review of new scenarios

Model input parameters		Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
		Base Case - 3 year drought - Climate and Abstraction Scenarios	Base Case - 6 year drought - Climate and Abstraction Scenarios	Base Case - 3 year drought - Vegetation and Abstraction Scenarios	Worst Case - 3 year drought - Climate and Abstraction Scenarios	Worst Case - 5 year drought - Climate and Abstraction Scenarios
Results	Predicted safe abstraction yield and predicted EC at the trunk main remains below 1,500 µS/cm (adopted sustainability criterion) for: • Historical variations in rainfall and drought • Landuse conditions	1660 kL/d (exceeds 1500µS/cm for second half of drought) 1600 kL/d (remains < 1500µS/cm) projected 12 years of historical rainfall followed by a 3 year drought under current landuse conditions	1660 kL/d (exceeds 2500µS/cm for second half of drought) 1285 kL/d (remains < 1500µS/cm) projected 9 years of historical rainfall followed by a 6 year drought under current landuse conditions	1840 kL/d (remains < 1500µS/cm) projected 12 years of historical rainfall followed by a 3 year drought Projected landuse conditions (no trees)	1660 kL/d (exceeds 2500µS/cm for second half of drought) 1180 kL/d (remains < 1500µS/cm) 3 year drought within the first 5 years of projected historical rainfall under current landuse conditions	1660 kL/d (exceeds 5000µS/cm for second half of drought) 880 kL/d (just reaches 1500µS/cm) 5 year drought within the first 5 years of projected historical rainfall under current landuse conditions



Review of new scenarios

Identification of galleries which contribute to increased gallery salinity



Out of 21 galleries (excluding 18), historical minimum EC values range from 300 to 500 µS/cm, while maximum EC values exceeds 1,000 µS/cm for 13 galleries and exceeds 1,500 µS/cm for 3 galleries (1, 10 and 19)

Review of new scenarios

Modelled Abstraction Yield

Bonriki Pump Station (PS)	Design yield (m^3/d) – *Falkland* (2003)	Measured flow rate - Mean 2013 (m^3/d)	Percentage discrepancy (Fixed flow meter vs UFM)	Revised flow rate - Mean 2013 (m^3/d) – Bonriki Only Mean 1,363 m^3/d	% Diff Revised/Design	1660m^3/d	Uniform 1660m^3/d	**Base Case 1600m^3/d 3 yr drought**	**Base Case 1285m^3/d 6 yr drought**	**Worst Case 1180m^3/d 3 yr drought**	**Worst Case 970m^3/d 5 yr drought**
PS1	85	not working	No Pump (2015)			90	79	**70**	55	50	40
PS2	85	116	No Pump (2015)			90	79	**90**	75	70	60
PS3	85	153	FM not working	144	41%	90	79	**90**	75	70	60
PS4	85	91	0.105	81	-5%	90	79	**90**	75	70	60
PS5	70	102	0.186	83	16%	74	79	**90**	75	70	60
PS6	55	not working	FM not working			57	79	**60**	45	40	30
PS7	55	81	0.321	55	0%	57	79	**70**	55	50	40
PS8	85	113	0.217	88	3%	90	79	**90**	75	70	60
PS9	70	104	0.201	83	16%	74	79	**90**	75	70	60
PS10	55	62	0.12	54	-2%	57	79	**60**	45	40	30
PS11	85	128	0.216	101	16%	90	79	**90**	75	70	60
PS12	55	67	FM not working	58	5%	57	79	**60**	45	40	30
PS13	55	48	0.065	45	-22%	57	79	**60**	45	40	30
PS14	85	114	0.236	87	2%	90	79	**90**	75	70	60
PS15	85	118	0.122	104	18%	90	79	**90**	75	70	60
PS16	85	68	FM not working	59	-44%	90	79	**70**	55	50	40
PS17	85	40	0.118	36	-136%	90	79	**60**	45	40	30
~~PS18~~	~~85~~	~~80~~	~~No Pump (2015)~~	~~71~~	~~-20%~~	~~0~~	~~0~~	~~**0**~~	~~0~~	~~0~~	~~0~~
PS19	85	69	0.069	64	-33%	90	79	**70**	55	50	40
PS20	85	69	0.37	43	-98%	90	79	**70**	55	50	40
PS21	55	107	0.421	62	11%	57	79	**70**	55	50	40
PS22	85	109	0.36	69	-23%	90	79	**70**	55	50	40

Climate and Abstraction Impacts on Atoll Environments

Presenter: Peter Sinclair and Amandine Bosserelle

Wednesday 28 October 2015

CLIMATE & ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

EUROPEAN UNION

ACP S&T PROGRAMME

SPC Secretariat of the Pacific Community

USP THE UNIVERSITY OF THE SOUTH PACIFIC

Flinders UNIVERSITY

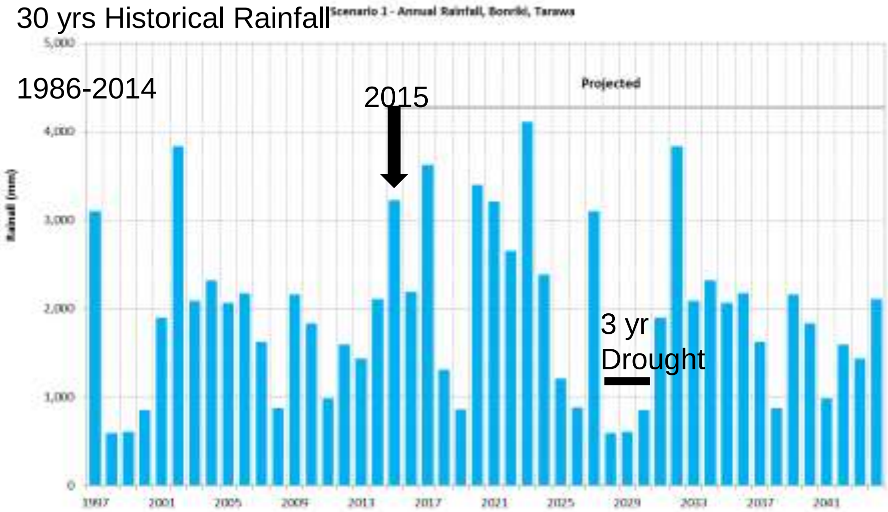
Recap

- Reviewed the model results for different abstraction under different rainfall conditions
- Common to all includes the following
  - Extended dry period will result in a rapid rise in salinity at galleries and in the trunk main
  - Good following rainfall will see an even more rapid response in reducing the salinity, at the top of the freshwater lens, to background levels
  - The shorter the period between stresses eg droughts, the quicker the abstracted water will reach a higher salinity. Thinning of freshwater lens reduces its resilience to provide the same quality of water for the same abstracted volume

Simulation 1

Base Case - 3 year drought - Climate and Abstraction Scenarios

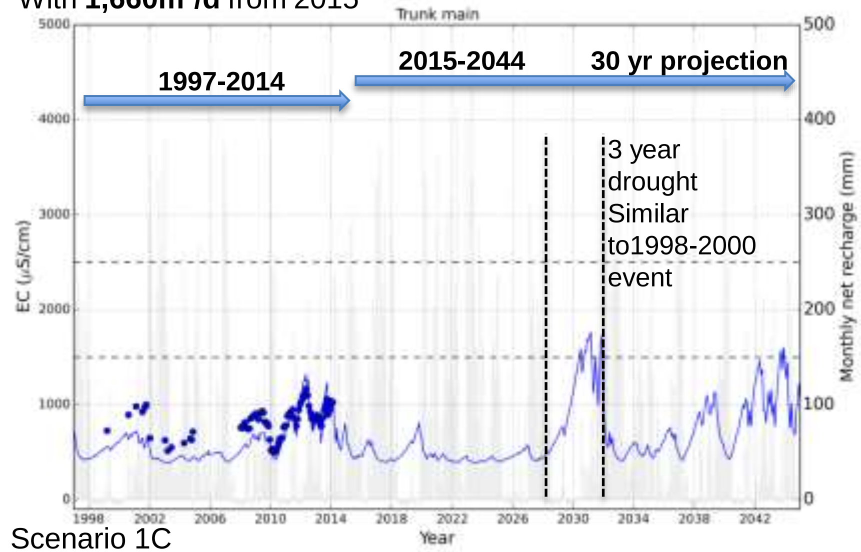
30 yrs Historical Rainfall



Scenario 1A

30 yr Projected Rainfall – 3 yr Drought

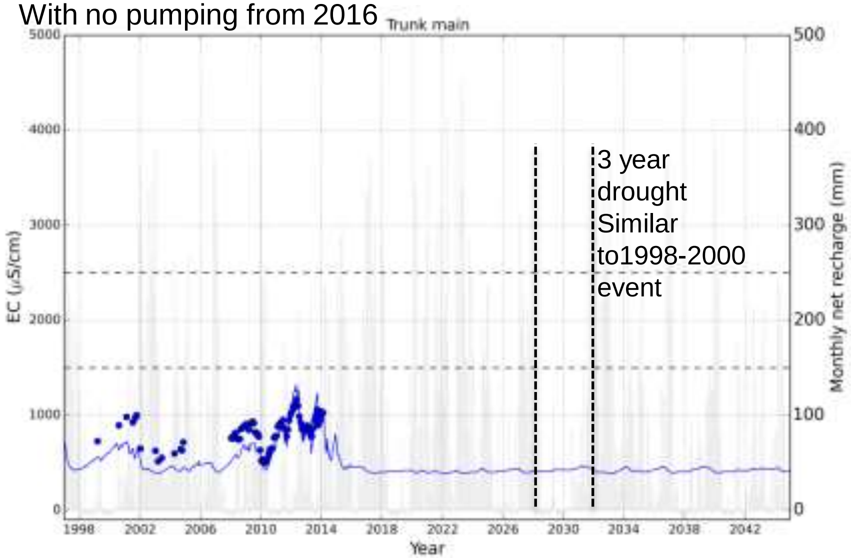
With **1,660m³/d** from 2015



Scenario 1B

30 yr Projected Rainfall – 3 yr Drought

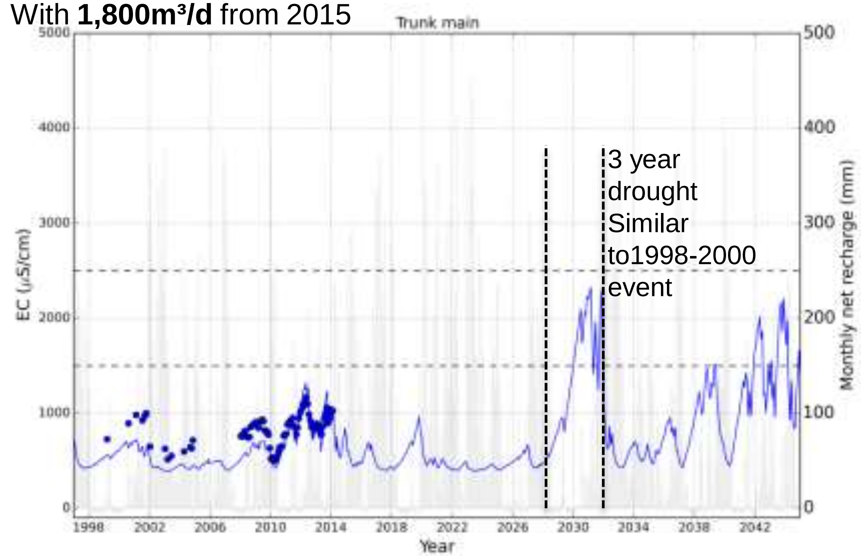
With no pumping from 2016



Scenario 1C

30 yr Projected Rainfall – 3 yr Drought

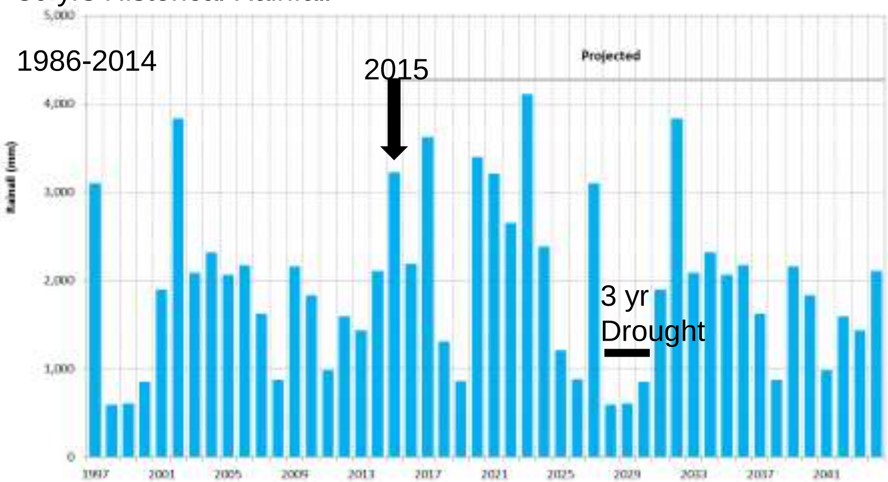
With **1,800m³/d** from 2015



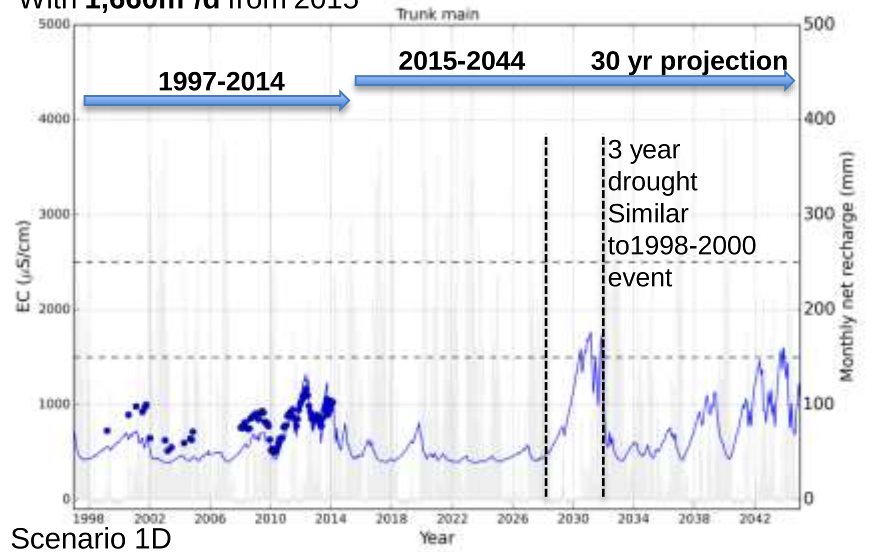
Simulation 1

Base Case - 3 year drought - Climate and Abstraction Scenarios

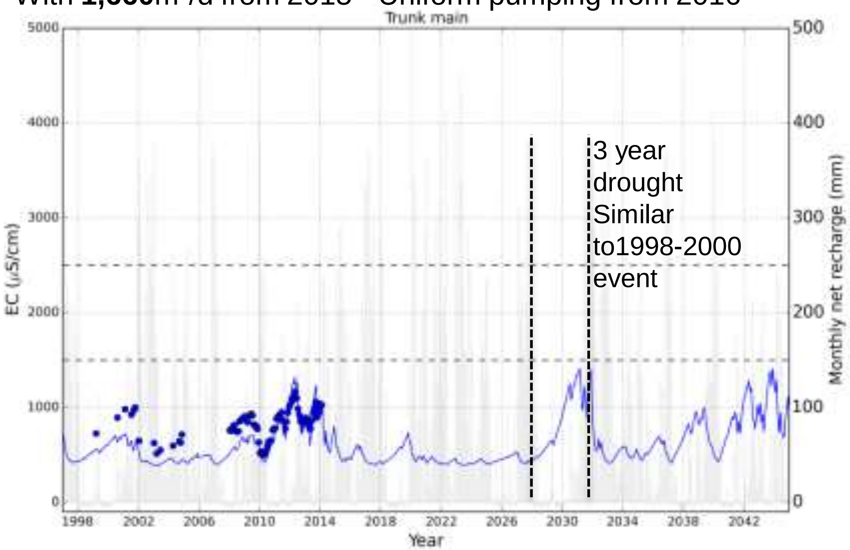
30 yrs Historical Rainfall



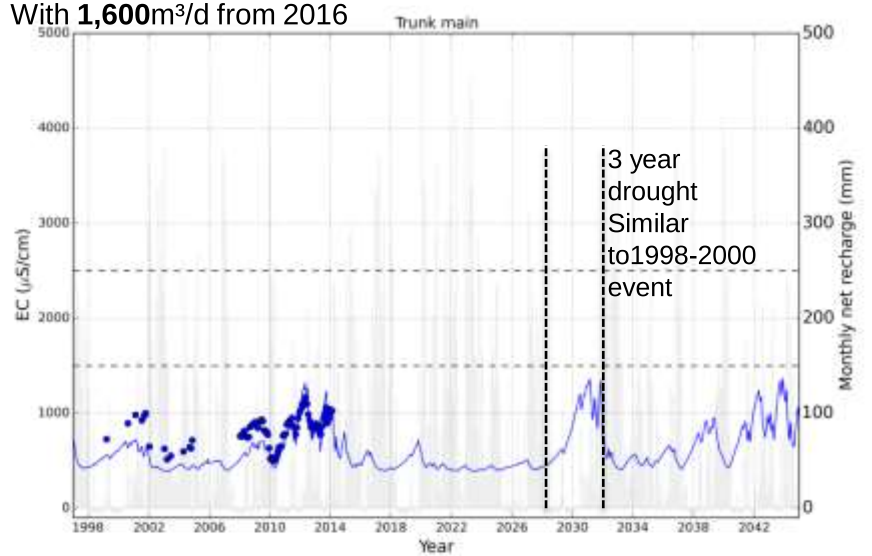
Scenario 1A
30 yr Projected Rainfall – 3 yr Drought
With **1,660m³/d** from 2015



Scenario 1E
30 yr Projected Rainfall – 3 yr Drought
With **1,660**m³/d from 2015 - Uniform pumping from 2016

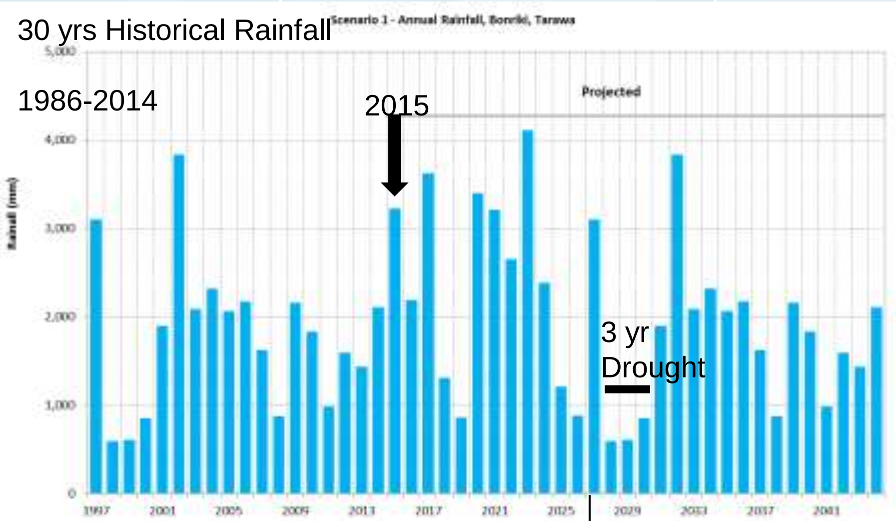


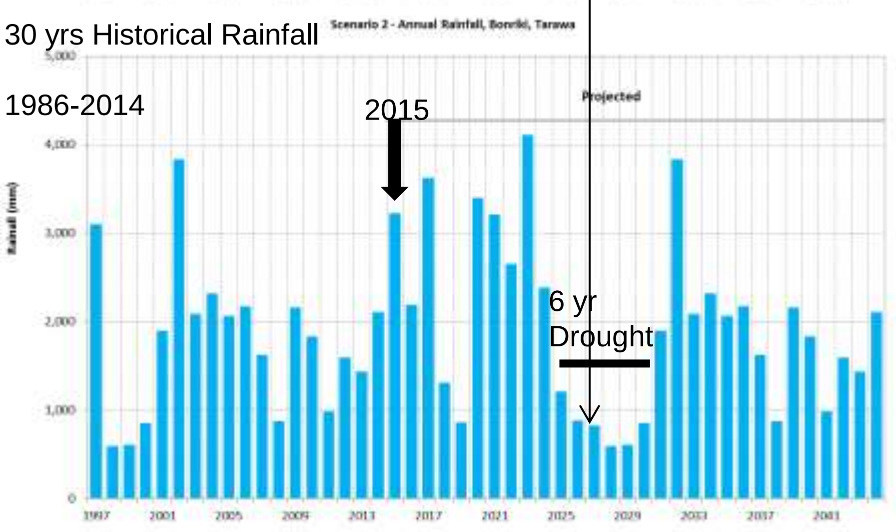
Scenario 1D
30 yr Projected Rainfall – 3 yr Drought
With **1,600**m³/d from 2016



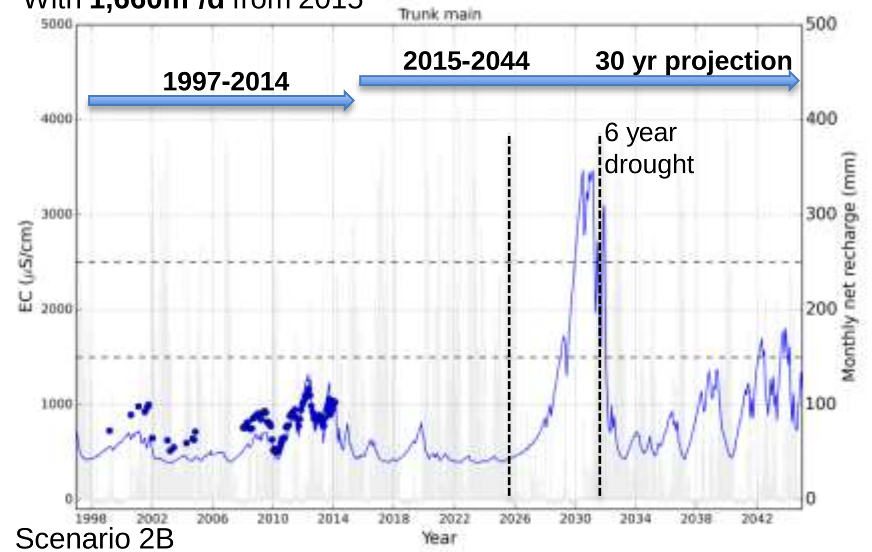
Simulation 2

Base Case - 6 year drought - Climate and Abstraction Scenarios

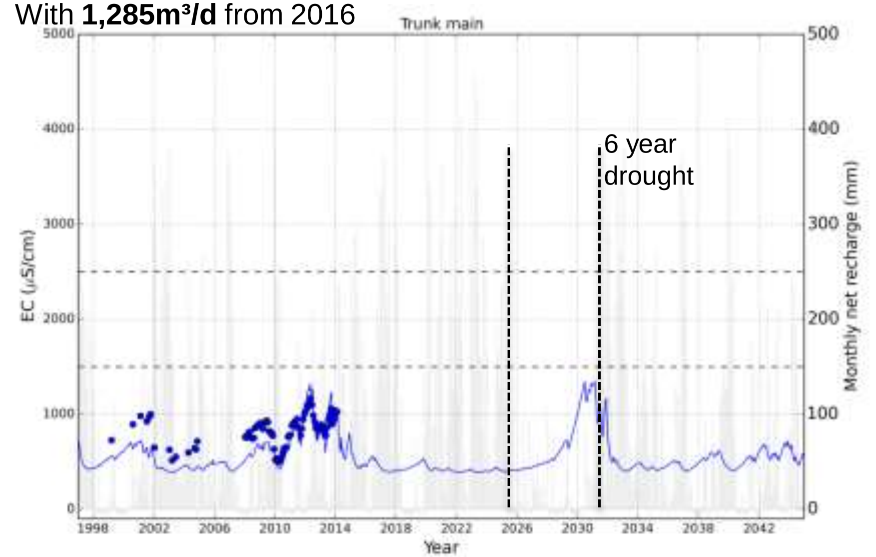




Scenario 2A
30 yr Projected Rainfall – 6 yr Drought
With **1,660m³/d** from 2015

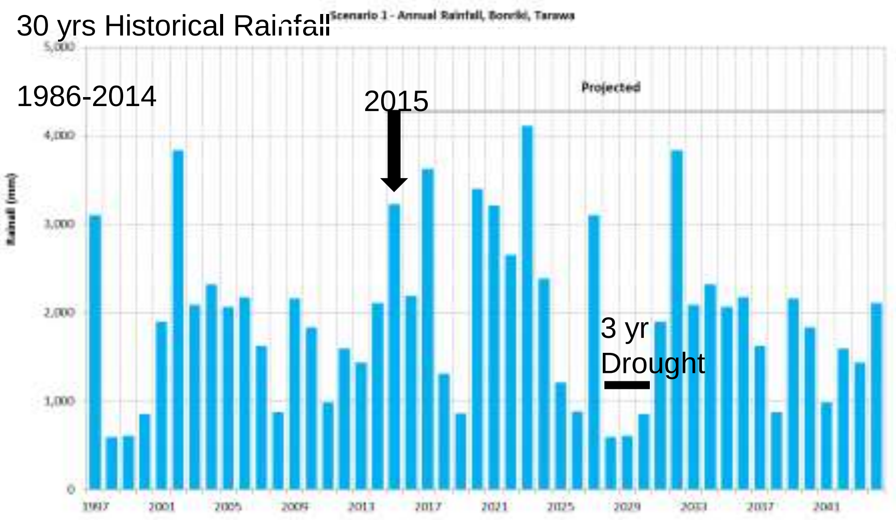


Scenario 2B
30 yr Projected Rainfall – 6 yr Drought
With **1,285m³/d** from 2016



Simulation 3

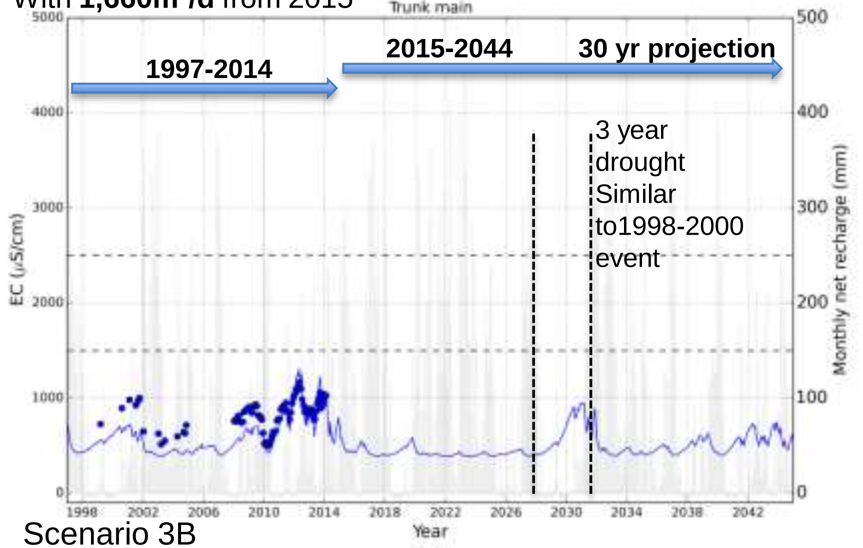
Base Case - 3 year drought - Vegetation and Abstraction Scenarios



Scenario 3A

30 yr Projected Rainfall – 3 yr Drought

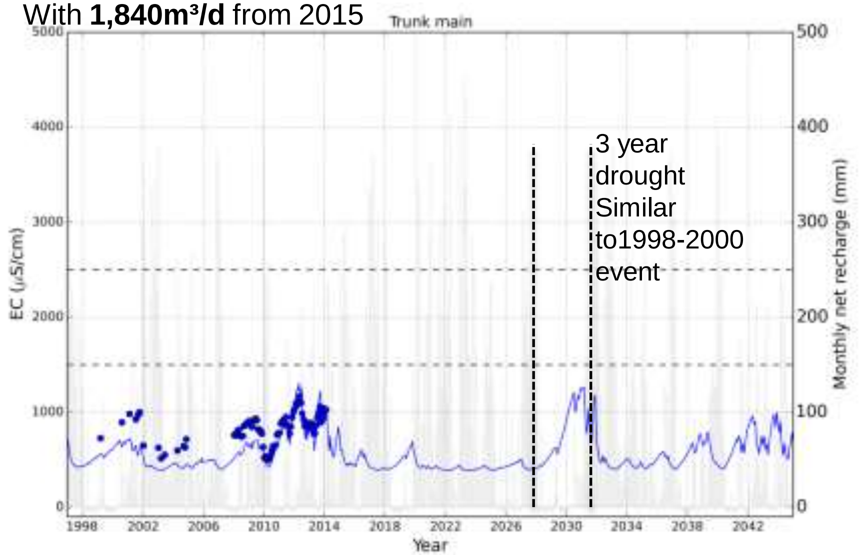
With **1,660m³/d** from 2015



Scenario 3B

30 yr Projected Rainfall – 3 yr Drought

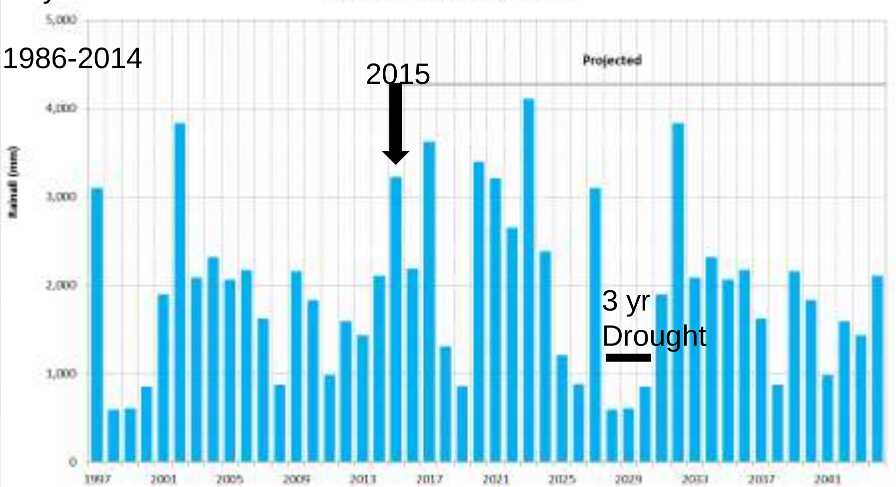
With **1,840m³/d** from 2015



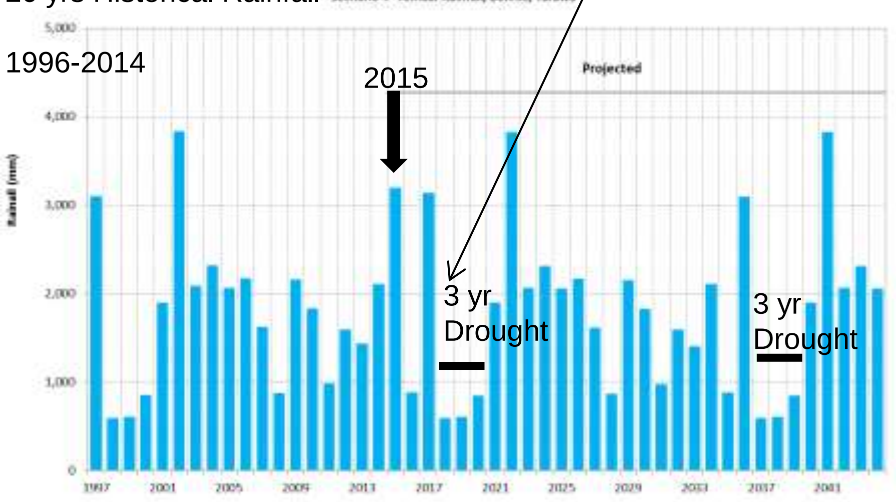
Simulation 4

Worst Case - 3 year drought - Climate and Abstraction Scenarios

30 yrs Historical Rainfall



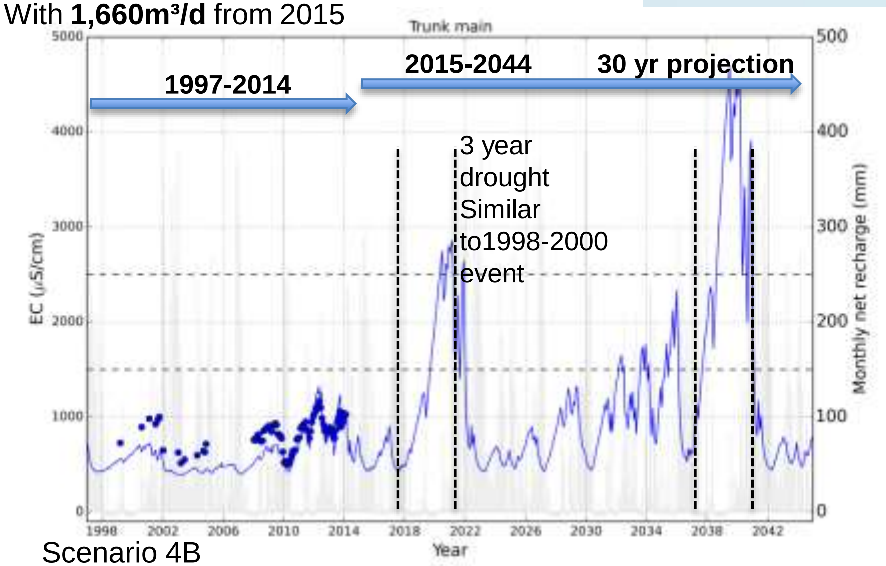
20 yrs Historical Rainfall



Scenario 4A

20 yr Projected Rainfall – 3 yr Drought

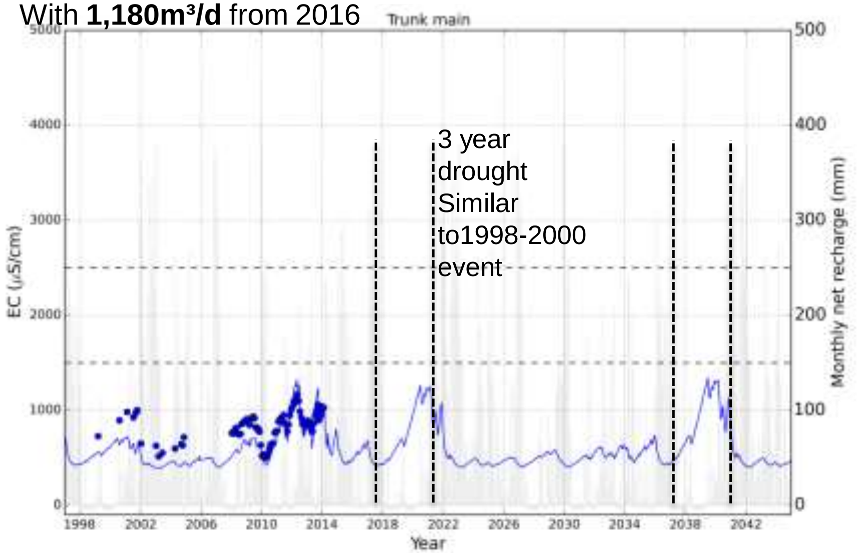
With **1,660m³/d** from 2015



Scenario 4B

20 yr Projected Rainfall – 3 yr Drought

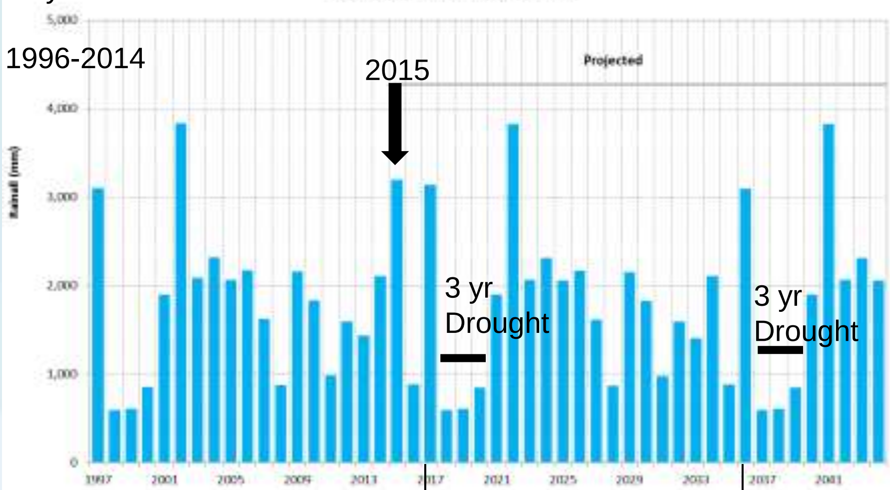
With **1,180m³/d** from 2016



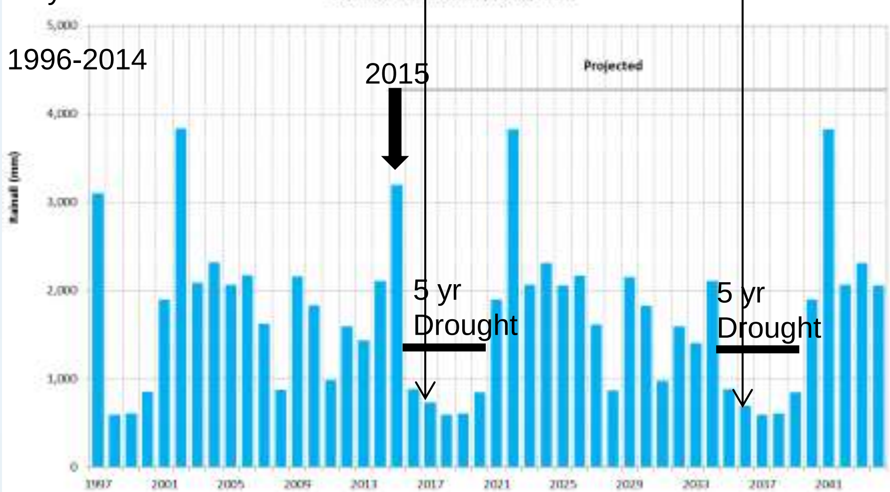
Simulation 5

Worst Case - 5 year drought - Climate and Abstraction Scenarios

20 yrs Historical Rainfall



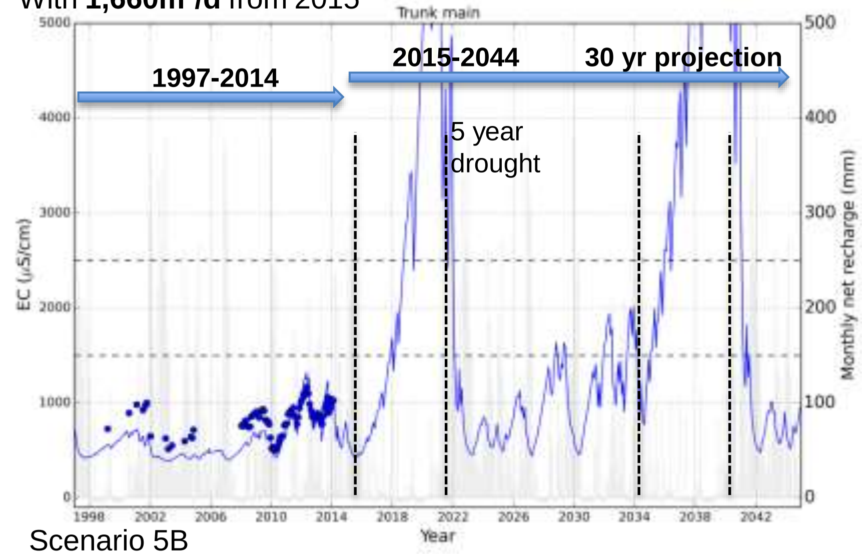
20 yrs Historical Rainfall



Scenario 5A

20 yr Projected Rainfall – 5 yr Drought

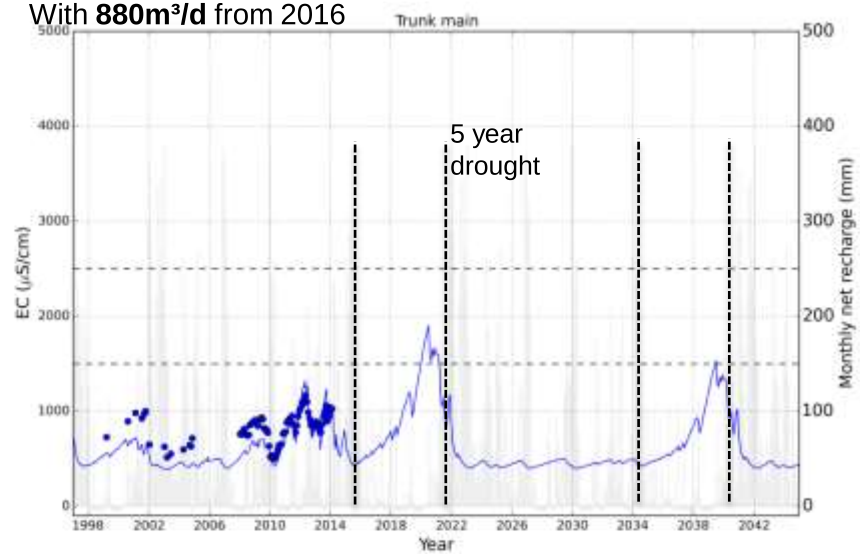
With **1,660m³/d** from 2015



Scenario 5B

20 yr Projected Rainfall – 5 yr Drought

With **880m³/d** from 2016



Recap

- Modelling is useful to indicate the impact of abstraction over a 30 year period, different abstraction impacts can be reviewed, providing insight into the effect of assigning a sustainable yield
- Recognise that the concept of sustainable yield is dependent on the anticipated rainfall and antecedent conditions
- Model suggests that abstraction range from 880-1840m^3/day depending on rainfall volume and timing, and landuse, without breaching 1,500µS/cm

Recap

- Model indicates that the clearing of trees and replacing vegetation with grass could provide up to 11% increase in available abstraction
- All galleries are not the same in providing the same quality of water for the volume abstracted.
  - Gallery 18 should not be used.
  - Marginal galleries include 1,5, 10,15,17,19,22 - would be one of the first to be considered to have reduced pumping

Sustainable Yield concept for Bonriki

- Assign a volume of water which can be abstracted over a defined period to meet expected demands without resulting in unwanted impacts
- Time frame: SY would be in place for 12 years, and then reviewed
- Constraints – salinity should not breach 1,500µS/cm under predicted conditions
- Available abstraction – ability to vary the abstraction by a fixed amount to accommodate variations in demand and climate which can impact on the acceptable limits of salinity

Recap

- SY is defined by considering
  - Acceptable risks, (rainfall scenarios)
  - Acceptable limits of salinity (how much can these vary over short periods)
  - Demands from population pressure, and costs of alternatives
- Consider focussing on our ability to vary abstraction based on the impact to the freshwater lens. Build guidance and confidence around how to vary abstraction above or below a defined sustainable yield long term (12 years)

Information sources and possible triggers

- Climate
  - Forecasts from meteorology, 3,6,12 months outlooks for rainfall, SCOPIC indicies and percentiles which relate back to either increasing salinity or changing freshwater lens thickness (monthly)
- Salinity
  - Salinity as measured at the trunk main (daily)? and at the individual galleries (monthly)
- Freshwater lens thickness
  - Relationship between freshwater thinning under the galleries but measured at the monitoring bores
  - Rate of change of thinning or thickening of FWL (quarterly)
  - Identify most critical monitoring bores

Sustainable yield for Bonriki water reserve

- Discussion
  - Does the modelling provide sufficient evidence to alter the current 1660m^3/day SY from 2003 to 1600m^3/day
  - Is more information needed? If so what?
  - What pressures would apply to result in considering the SY to be altered?
  - Options for increasing SY
    - Vegatation clearing
    - Additional galleries

Status of South Tarawa Drought plan

Advice from Mike Foon NDMO –OB on the status of the DRAP 30/7/2015

- The DRAP was originally tabled at Cabinet and then the Secretaries meeting.
- DRAP is a functional plan under National Disaster response Management Plan NDRMP, and therefore under NDRMP does not require Cabinet approval. It is **approved at the NDC level and can be altered as required**.
- The **Secretaries meeting is acting as the National Disaster Committee, NDC during peace times** and can table DRM items for approval. (NDC and Secretaries Meeting membership is the same)
- The recommendation to get MPWU to chair Drought Committee during peace times (non critical periods) is from OB. Rationale is that OB wants sectors to take lead in respective hazards related to their sectors instead of OB having to chair so many committees

Drought Plan South Tarawa update

- Draft updated under CoSPPAC project 2013, to be accepted by NDC.
- Major changes include
  - Name change from South Tarawa Drought Response Action Plan to Drought Plan for South Tarawa
  - Averaging the percentiles for 3,4,5 years is considered incorrect, recommend 4 and 5 year percentiles for Bonriki
  - 7-day average salinity of the mixed water from the Buota and Bonriki galleries exceeds a critical salinity value (currently set at 1,200 µS/cm)
  - Annex C removed – identifying responses and responsibilities applicable in each alert

Current information sources in drought plan

- KMS
  - Use SCOPIC to identify and track rainfall percentiles for selected indicie durations, 3,6, 12 months and 4,5 years
  - 10 and 40 percentiles for triggering alert levels
- WEU
  - 3 monthly monitoring of monitoring bores for salinity to determine freshwater thickness, increase frequency of monitoring bores may be required at times
- PUB
  - Volume of water abstracted, galleries and overall trunk main
  - Salinity of individual galleries and salinity of the mixed water to South Tarawa

Drought Plan

- South Tarawa Drought plan currently provides limited guidance on the response actions for each alert level,
- Drought plan does not explicitly provide for varying abstraction at the Bonriki water reserve
- Drought plan considers triggers for alert levels and declaration of drought identifying information which could be used to inform community of status of climate outlook and water resources
- What would you like to see?

Operation of Bonriki Water Reserve – Monitoring and Abstraction Optimisation Insights

Presenter: Peter Sinclair and Amandine Bosserelle

Tuesday 27 October 2015

CAIA
CLIMATE & ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

EUROPEAN UNION

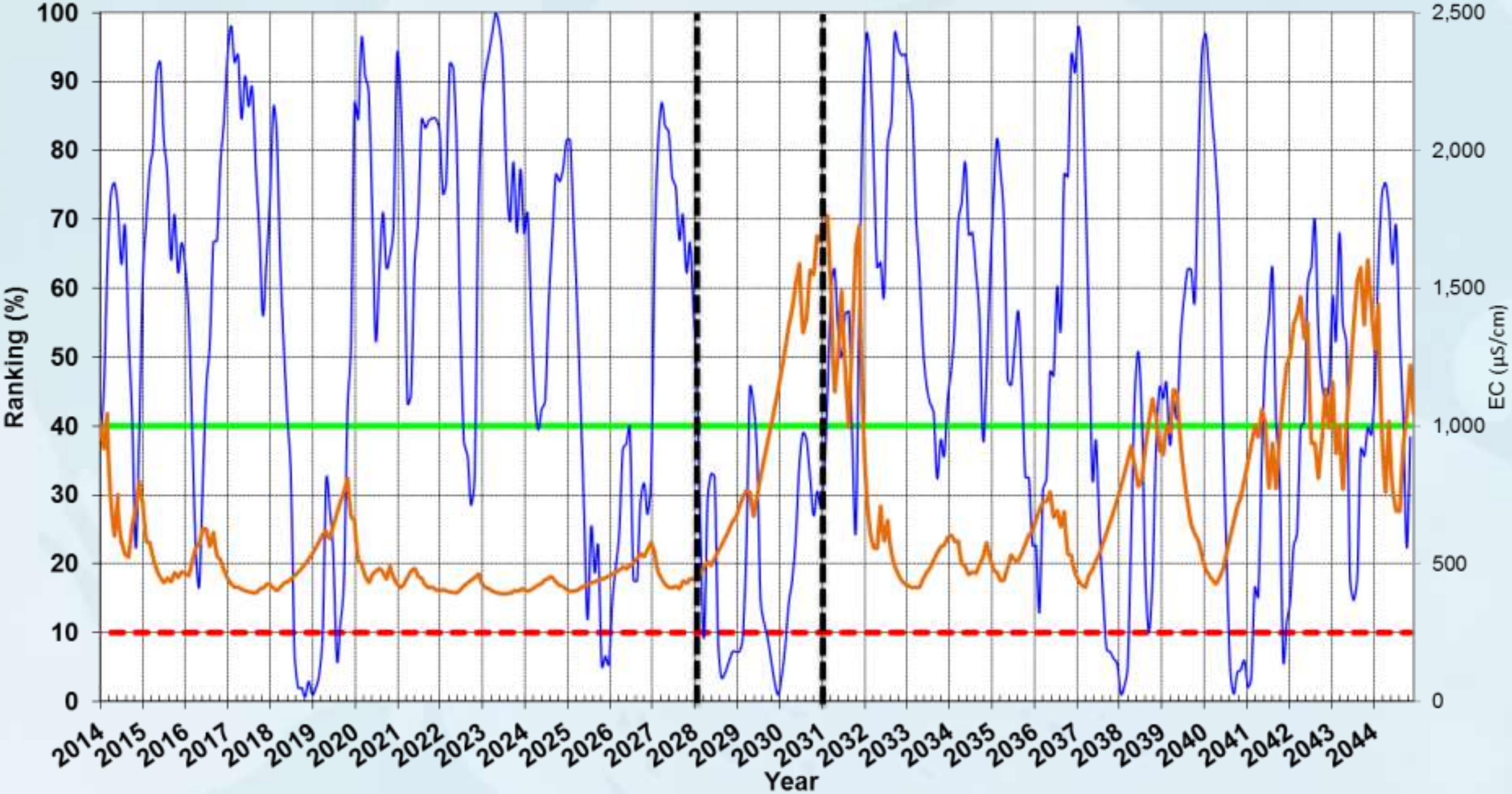
ACP S&T PROGRAMME

SPC Secretariat of the Pacific Community

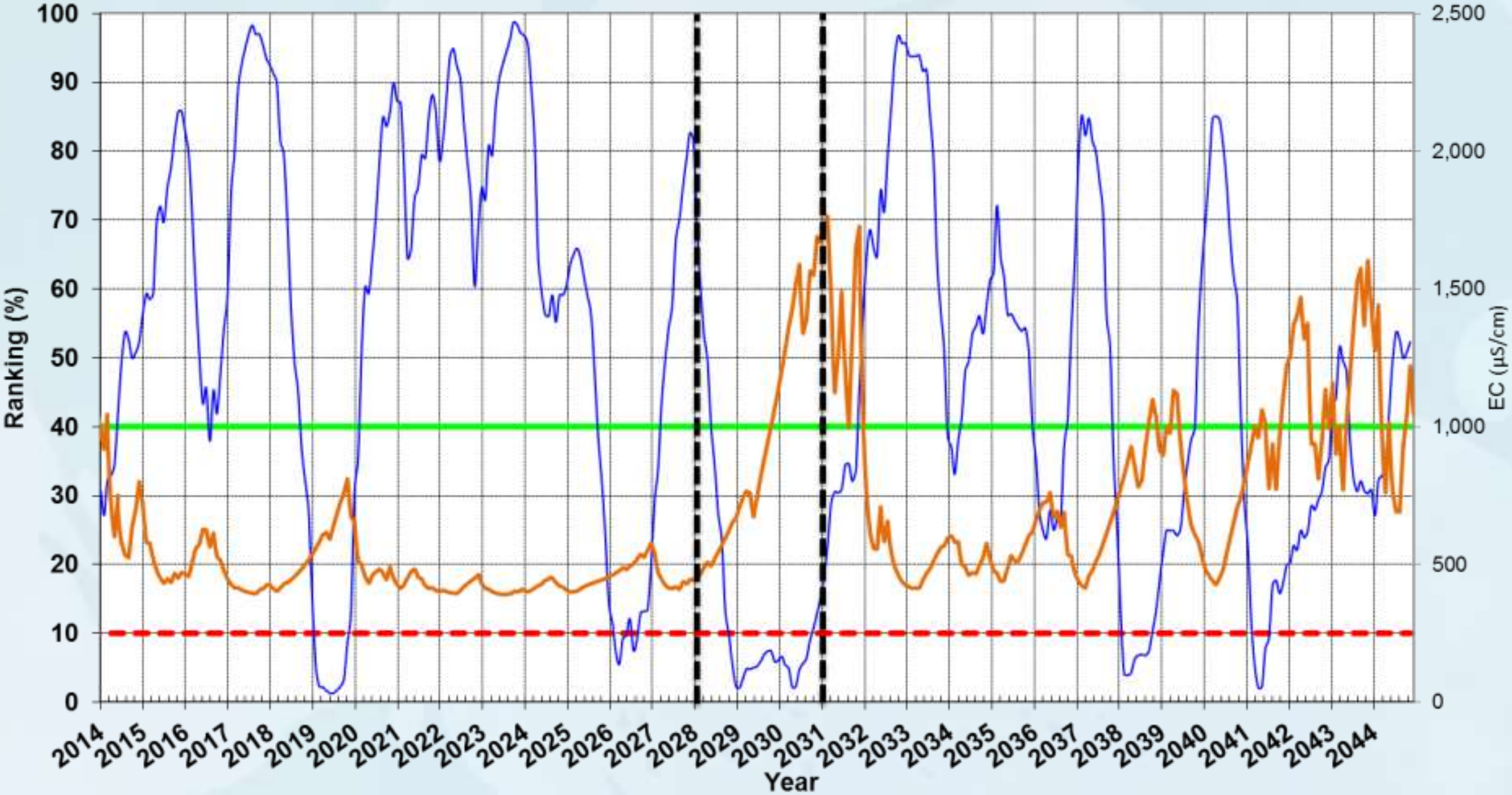
USP THE UNIVERSITY OF THE SOUTH PACIFIC

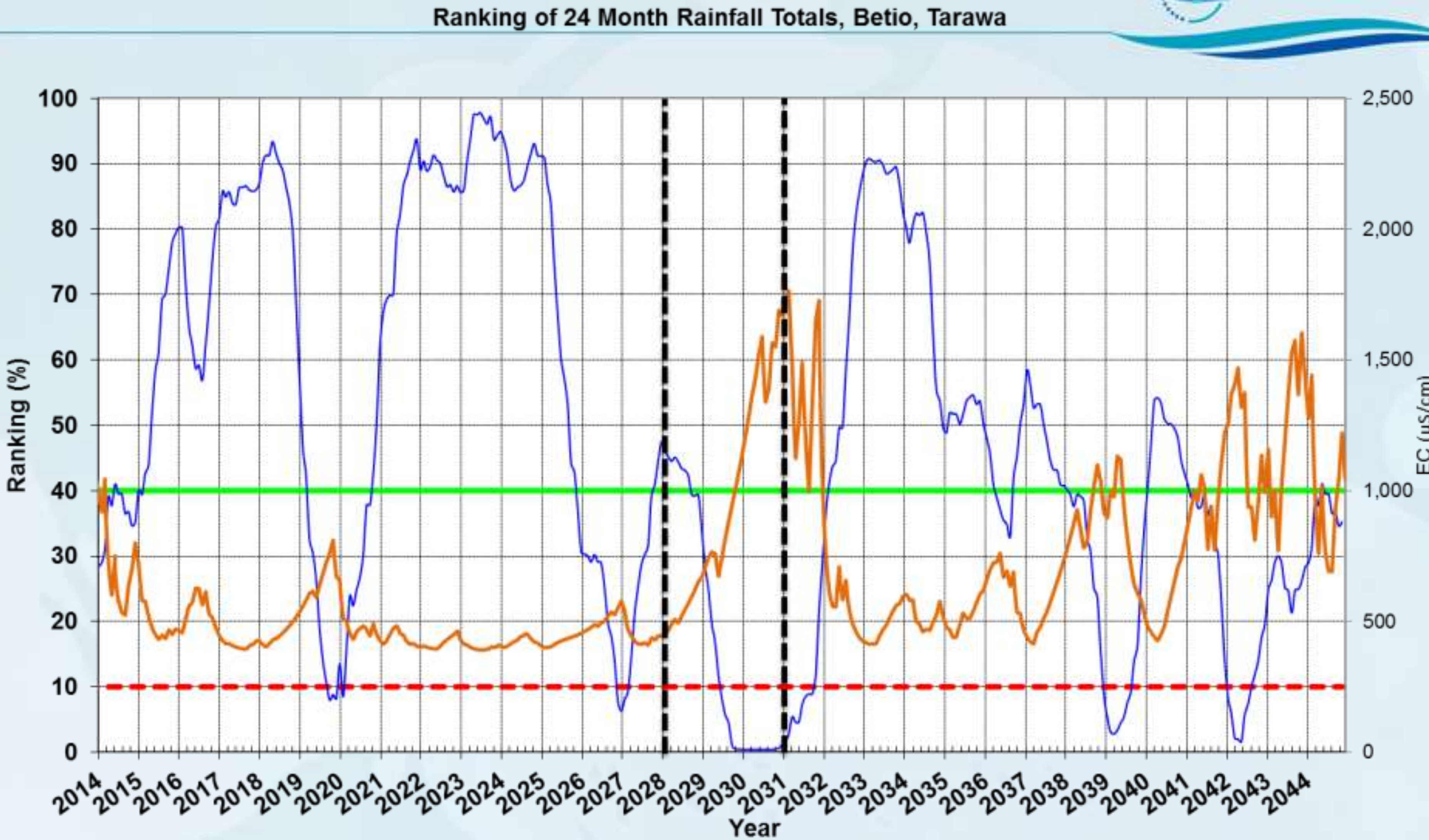
Flinders UNIVERSITY

Ranking of 3 Month Rainfall Totals, Betio, Tarawa

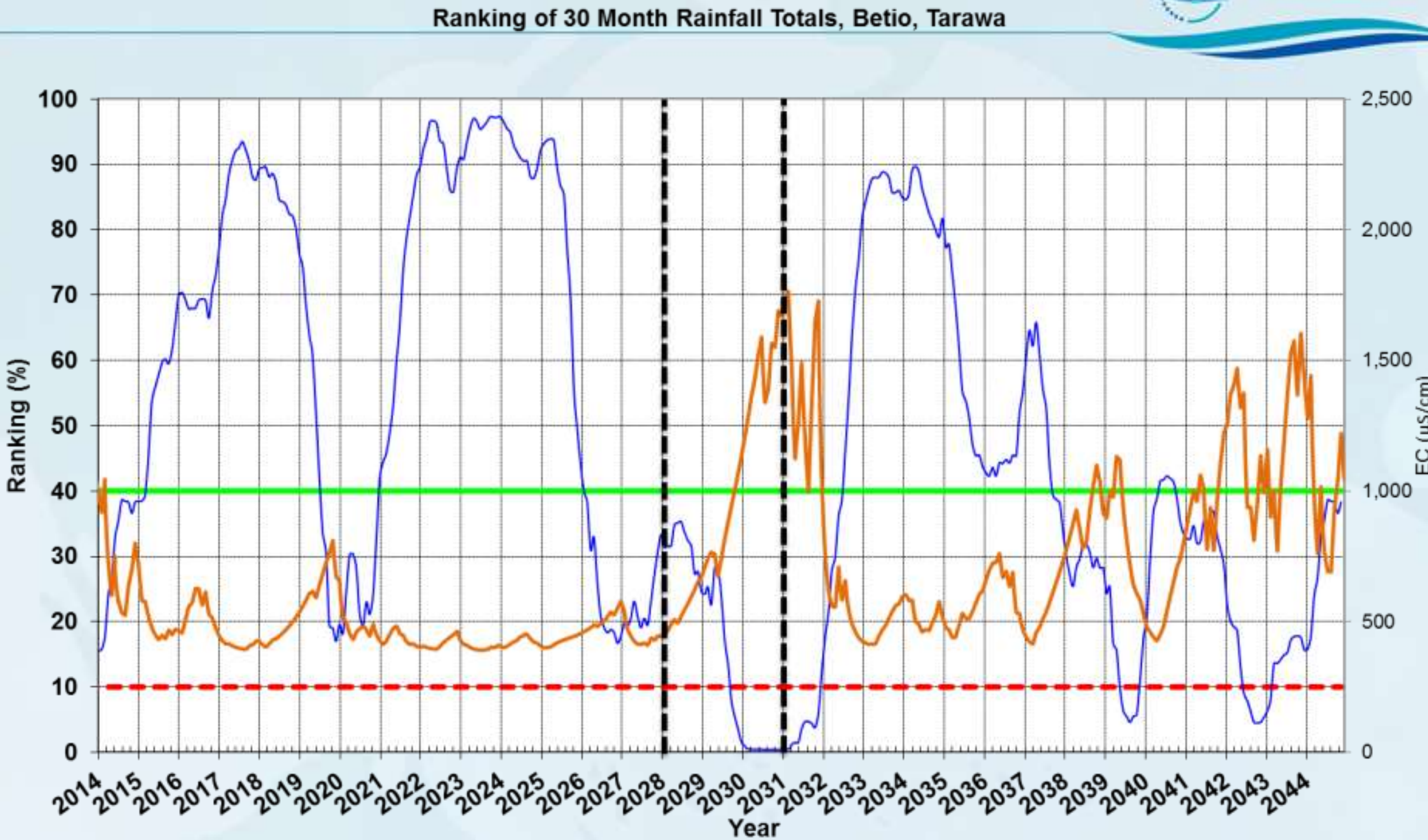


Ranking of 12 Month Rainfall Totals, Betio, Tarawa



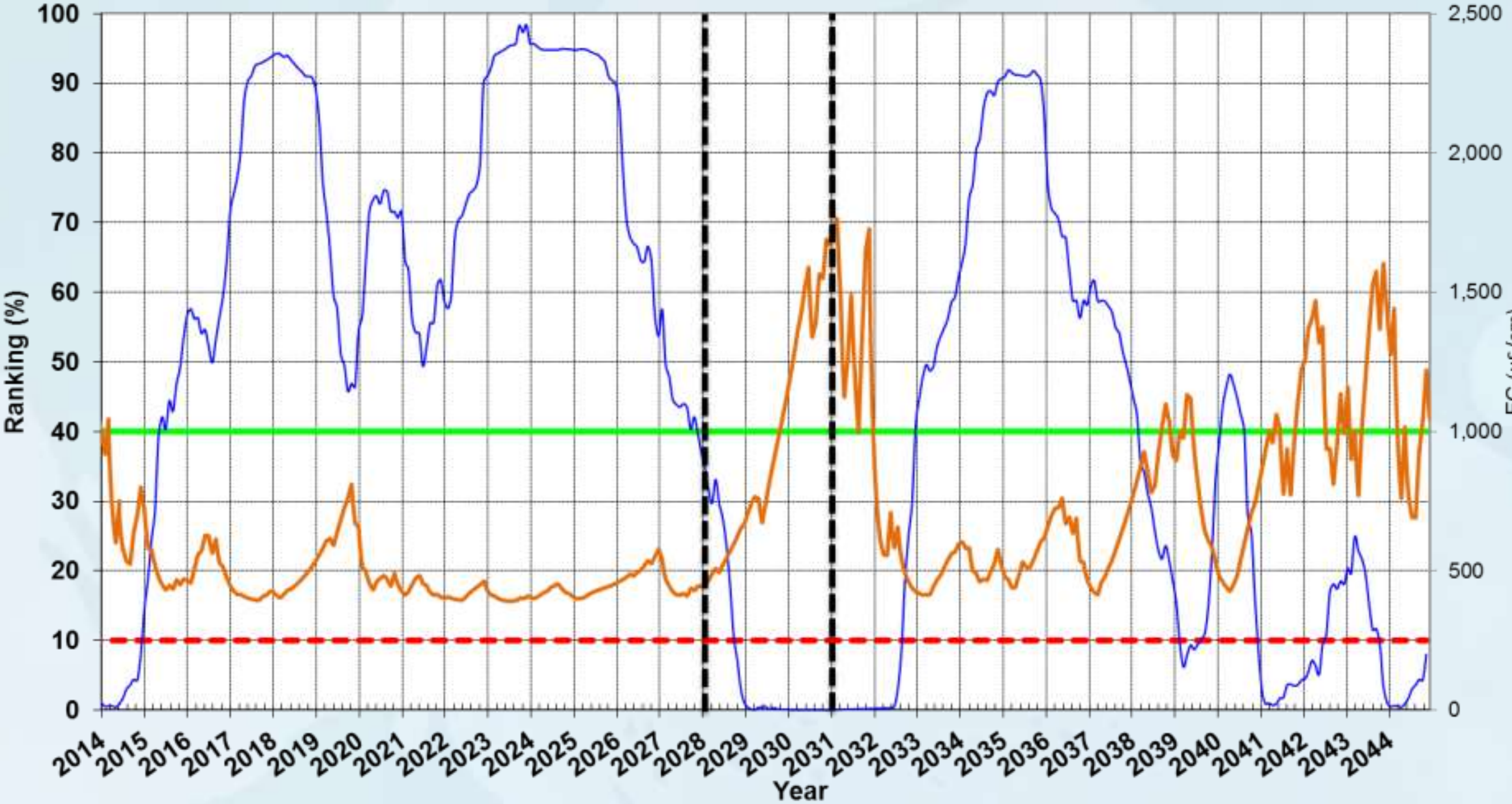


Ranking of 24 Month Rainfall Totals, Betio, Tarawa
Ranking (%)
EC (µS/cm)
Year
100
90
80
70
60
50
40
30
20
10
0
2,500
2,000
1,500
1,000
500
0
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044

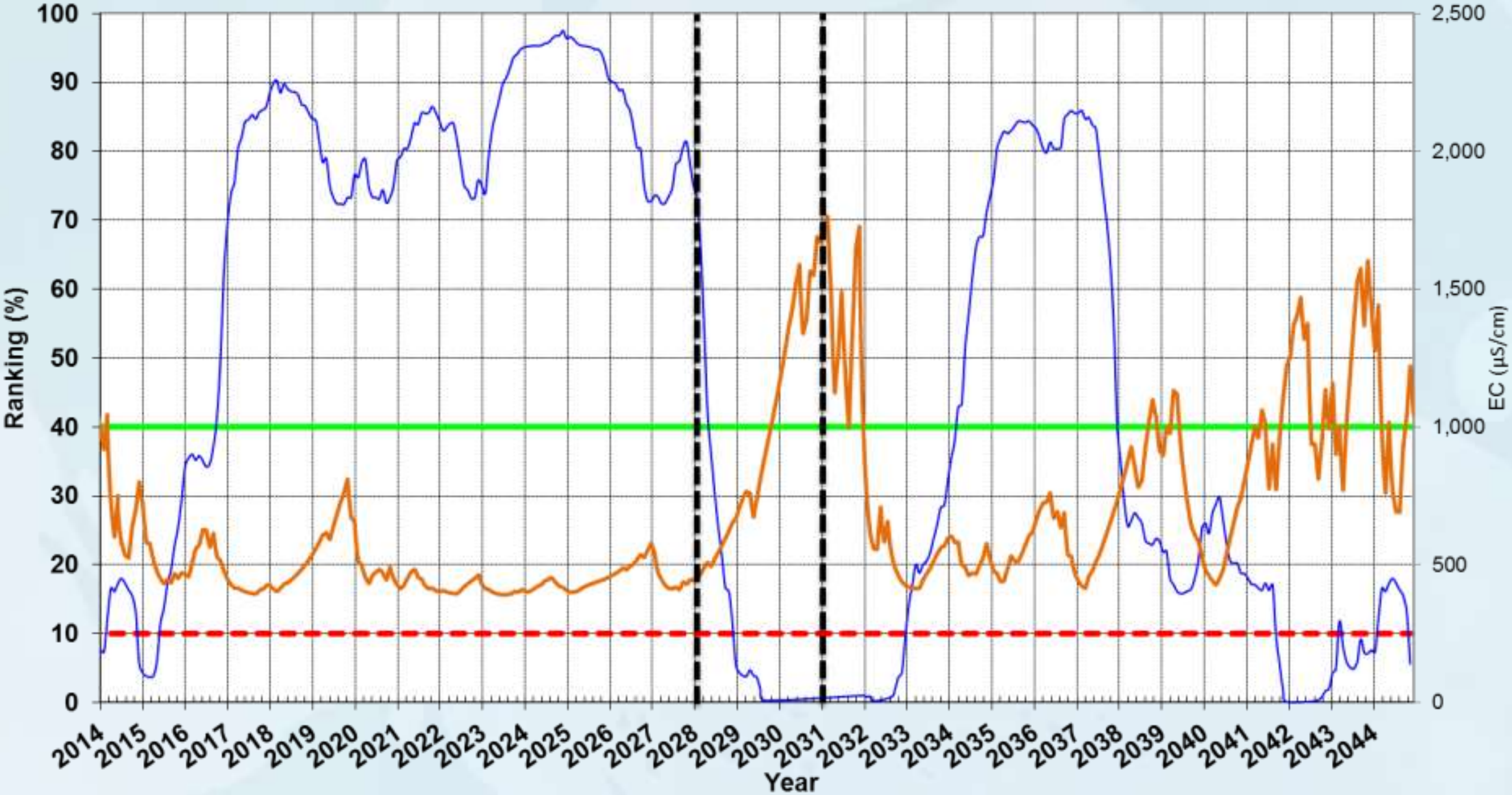


Ranking of 30 Month Rainfall Totals, Betio, Tarawa
Ranking (%)
EC (µS/cm)
Year
100
90
80
70
60
50
40
30
20
10
0
2,500
2,000
1,500
1,000
500
0
2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044

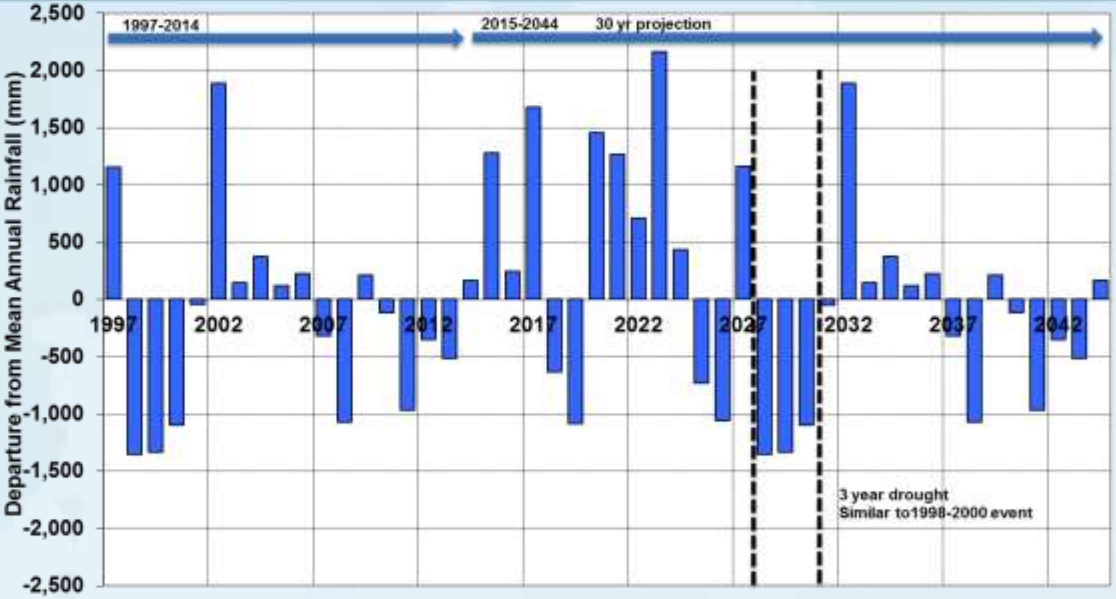
Ranking of 48 Month Rainfall Totals, Betio, Tarawa



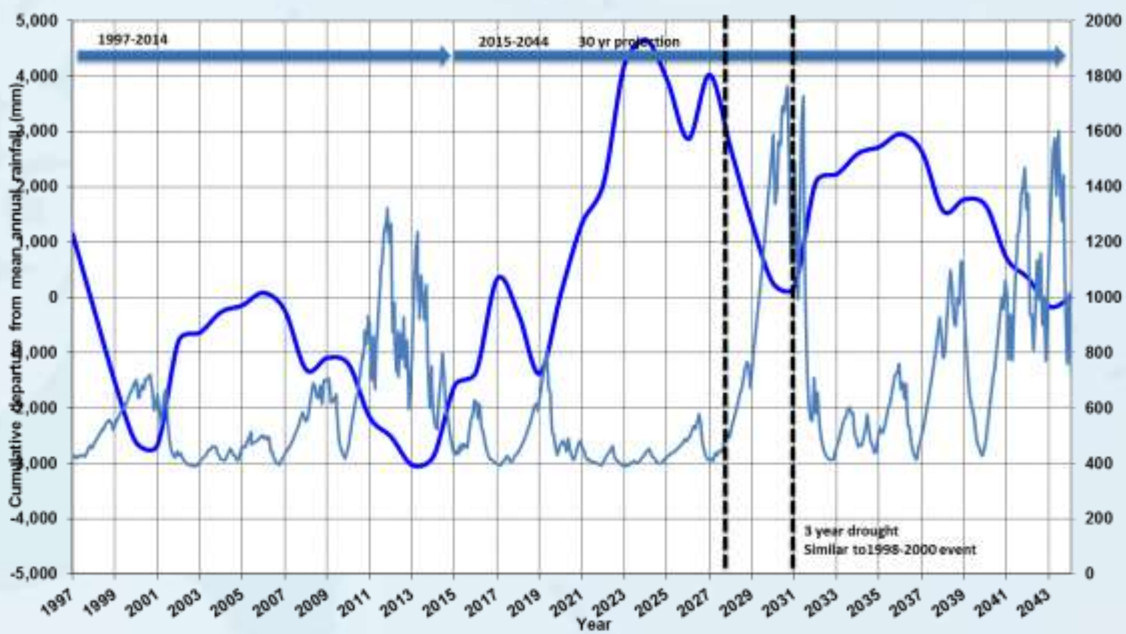
Ranking of 60 Month Rainfall Totals, Betio, Tarawa



Projected Departure from Mean Annual Rainfall, Bonriki, Tarawa



Cumulative departure from mean annual rainfall, Betio, Tarawa



Review of new scenarios

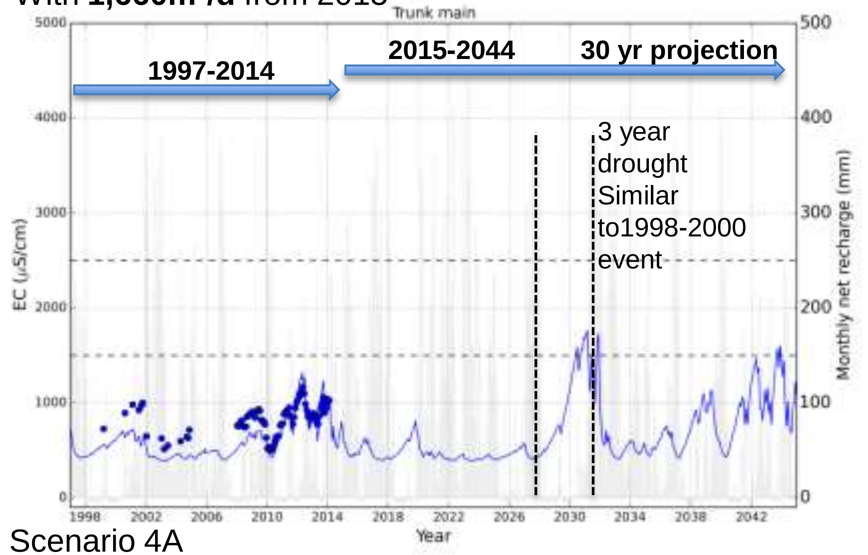
Model input parameters		Simulation 1	Simulation 2	Simulation 3	Simulation 4	Simulation 5
		Base Case - 3 year drought - Climate and Abstraction Scenarios	Base Case - 6 year drought - Climate and Abstraction Scenarios	Base Case - 3 year drought - Vegetation and Abstraction Scenarios	Worst Case - 3 year drought - Climate and Abstraction Scenarios	Worst Case - 5 year drought - Climate and Abstraction Scenarios
Results	Predicted abstraction yield safe for the following conditions: • variation in rainfall and drought • landuse conditions	1600 to 1660 kL/d 1800kL/d (exceeds 1500µS/cm at the end of the 1st drought year) projected 12 years of historical rainfall followed by a 3 year drought under current landuse conditions	1660 kL/d (exceeds 2500µS/cm for second half of drought) 1285 kL/d (remains < 1500µS/cm) projected 9 years of historical rainfall followed by a 6 year drought under current landuse conditions	1840 kL/d (remains < 1500µS/cm) projected 12 years of historical rainfall followed by a 3 year drought Projected landuse conditions (no trees)	1660 kL/d (exceeds 2500µS/cm for second half of drought) 1180 kL/d (remains < 1500µS/cm) 3 year drought within the first 5 years of projected historical rainfall under current landuse conditions	1660 kL/d (exceeds 5000µS/cm for second half of drought) 880 kL/d (just reaches 1500µS/cm) 5 year drought within the first 5 years of projected historical rainfall under current landuse conditions
Adopted sustainability criterion	• **Predicted EC at the trunk main remains below 1,500 µS/cm** • **The freshwater lens thickness below the reference galleries remains greater than 5m** • **Changes in freshwater lens thickness compare to simulated natural conditions doesn't exceed XX% at reference points (central monitoring locations where the lens is the thickest)**	• XX • XX • XX				

	1660m³/d 9 yrs historical climate + 3 yr drought	**1660m³/d Early 3 yr drought + 9 yrs historical climate**
Time from 1st month of drought to exceed 1000µS/cm	22 months	11 months
Time from 1st month of drought to exceed 1500µS/cm	29 months (7 months after exceeding 1000µS/cm)	18 months (7 months after exceeding 1000µS/cm)
Time from 1st month of drought to exceed 2500µS/cm	-	28 months (10 months after exceeding 1000µS/cm)

Scenario 1A

30 yr Projected Rainfall – 3 yr Drought

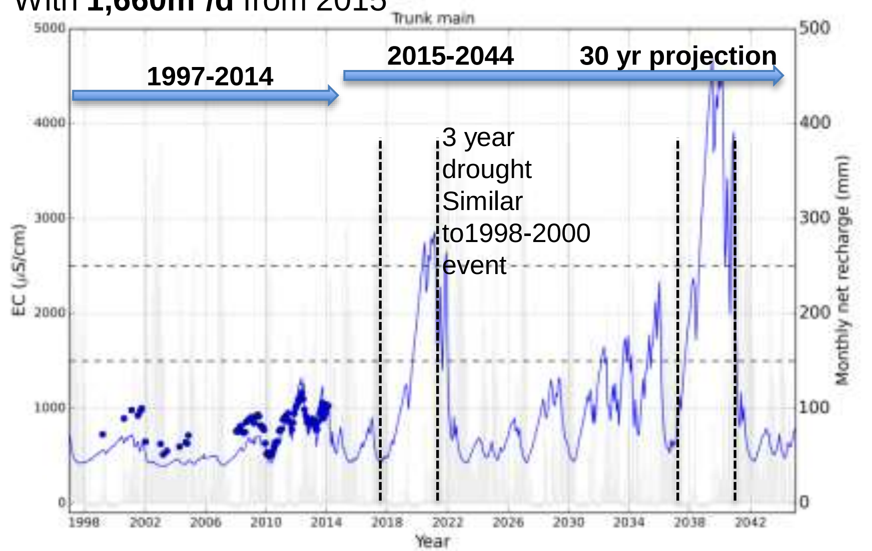
With **1,660m³/d** from 2015



Scenario 4A

20 yr Projected Rainfall – 3 yr Drought

With **1,660m³/d** from 2015



Galleries Recommended Yield

Bonriki Pump Station (PS)	**Base Case 1600m³/d 3 yr drought**
PS1	**70**
PS2	**90**
PS3	**90**
PS4	**90**
PS5	**90**
PS6	**60**
PS7	**70**
PS8	**90**
PS9	**90**
PS10	**60**
PS11	**90**
PS12	**60**
PS13	**60**
PS14	**90**
PS15	**90**
PS16	**70**
PS17	**60**
~~PS18~~	**~~0~~**
PS19	**70**
PS20	**70**
PS21	**70**
PS22	**70**

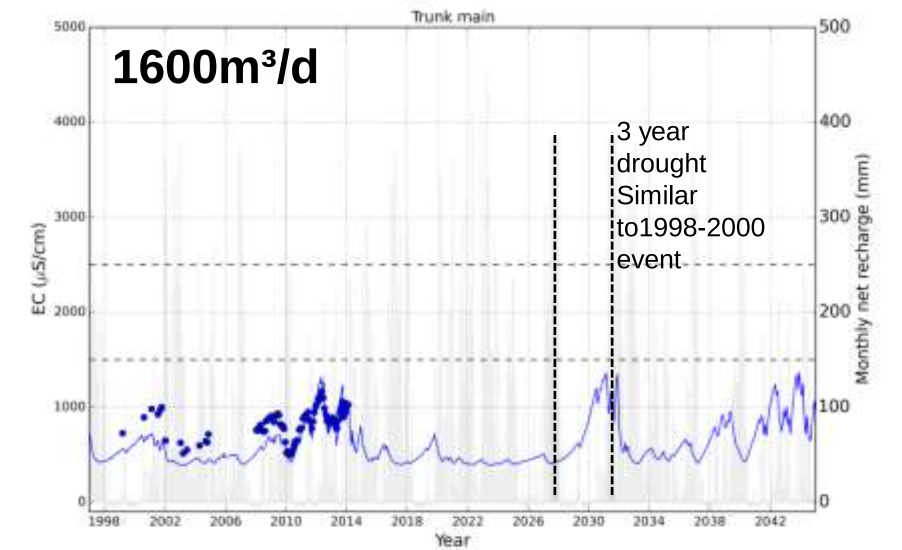
Identification of galleries which contribute to increased gallery salinity

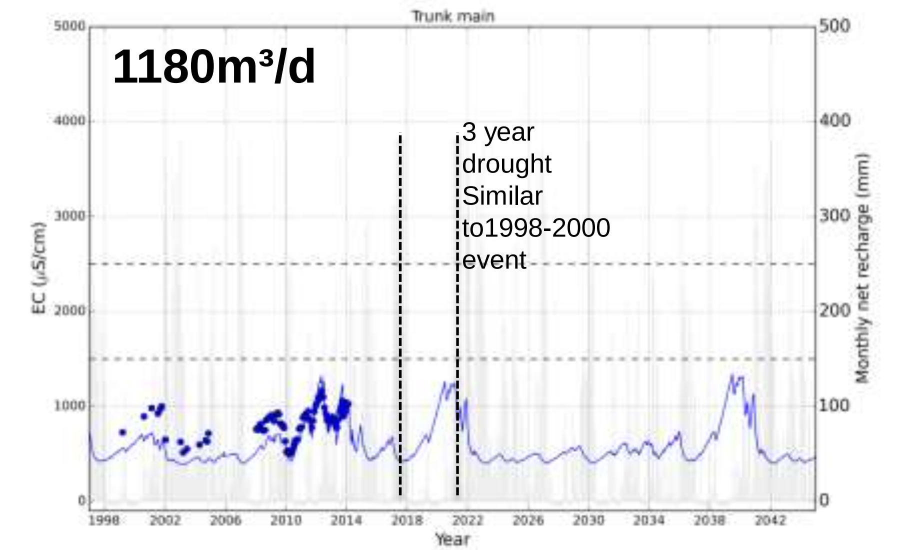
9 galleries at 90 m³/d
7 galleries at 70 m³/d
5 galleries at 60 m³/d

Out of 21 galleries (excluding 18), historical minimum EC values range from 300 to 500 µS/cm, while maximum EC values exceeds 1,000 µS/cm for 13 galleries and exceeds 1,500 µS/cm for 3 galleries (1, 10 and 19)

Galleries Recommended Yield

Bonriki Pump Station (PS)	**Base Case 1600m³/d 3 yr drought**				**Early Drought Case 1180m³/d 3 yr drought**
PS1	**70**				50
PS2	**90**	**90**	**90**	**90**	70
PS3	**90**	**90**	**90**	**90**	70
PS4	**90**	**90**	**90**	**90**	70
PS5	**90**	**90**	***70***		70
PS6	**60**	**60**	**60**	**60**	40
PS7	**70**	**70**	**70**	**70**	50
PS8	**90**	**90**	**90**	**90**	70
PS9	**90**	**90**	**90**	**90**	70
PS10	**60**				40
PS11	**90**	**90**	**90**	**90**	70
PS12	**60**	**60**	**60**	**60**	40
PS13	**60**	**60**	**60**	**60**	40
PS14	**90**	**90**	**90**	**90**	70
PS15	**90**	**90**	***70***		70
PS16	**70**	**70**	**70**	**70**	50
PS17	**60**	**60**	***40***		40
~~PS18~~					
PS19	**70**				50
PS20	**70**	**70**	**70**	**70**	50
PS21	**70**	**70**	**70**	**70**	50
PS22	**70**	**70**	***50***		50
Total Bonriki	**1600**	**1400**	**1320**	**1090**	**1180**





Climate and Abstraction Impacts on Atoll Environments

Presenter: Peter Sinclair and Amandine Bosserelle

Wednesday 28 October 2015

CAIA

CLIMATE & ABSTRACTION IMPACTS ON ATOLL ENVIRONMENTS

EUROPEAN UNION

ACP S&T PROGRAMME

SPC Secretariat of the Pacific Community

USP THE UNIVERSITY OF THE SOUTH PACIFIC

Flinders UNIVERSITY

Considerations for South Tarawa Drought Plan

Indicies and assignment of abstraction

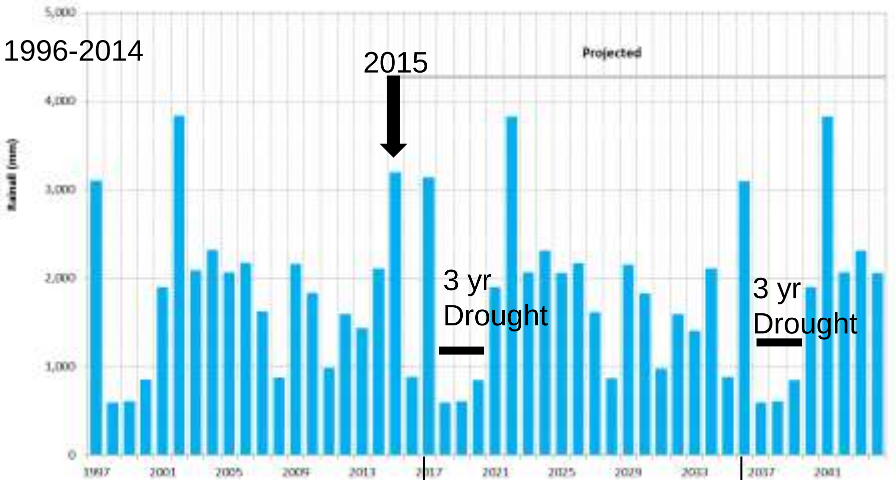
- Current draft recommends
  - Alert level 1 <40 percentile rainfall for 3months duration – (reflect rainfall tanks)
  - Alert level 2 < 40 percentile rainfall for 5 year duration and/or impact to lens from salinity measurements at galleries of monitoring boreholes
  - Alert level 3 <10 percentile rainfall for 5 year duration and or salinity at trunk main exceeds critical value 1,200uS/cm over 7 day average

- 5 year duration based on calculated residence time for Bonriki water source

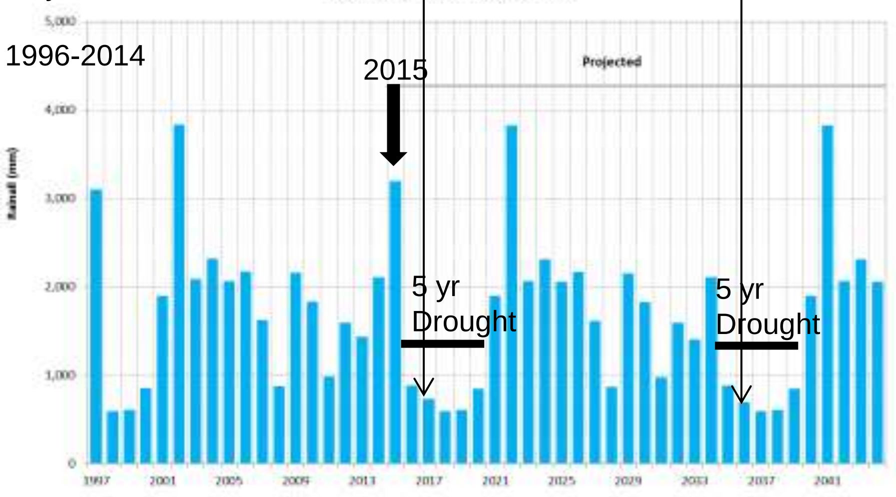
Simulation 5

Worst Case - 5 year drought - Climate and Abstraction Scenarios

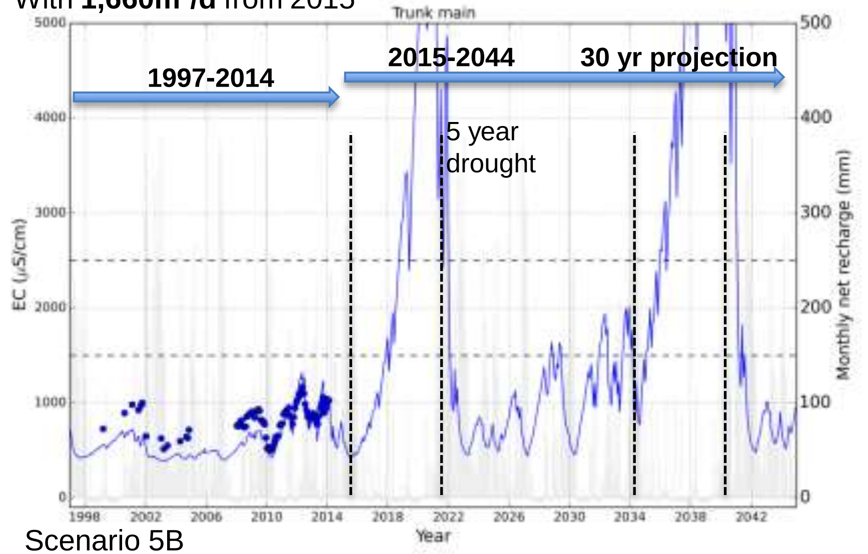
20 yrs Historical Rainfall



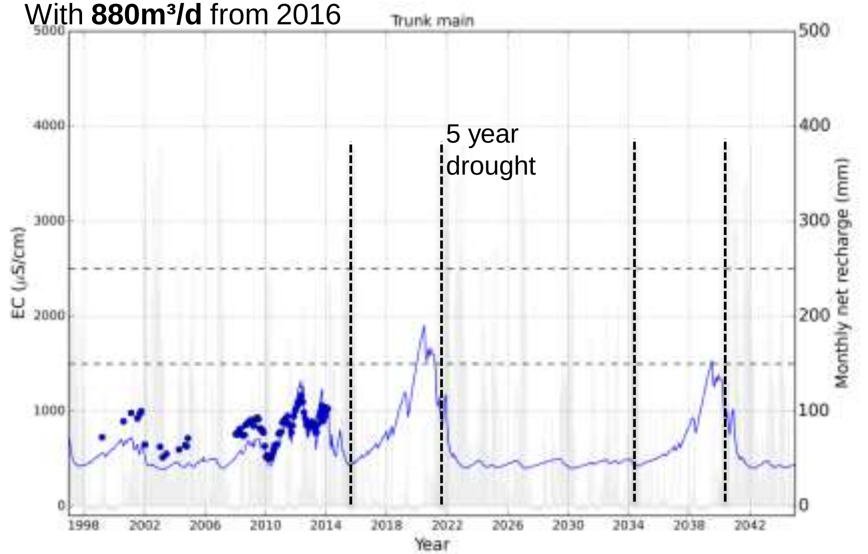
20 yrs Historical Rainfall



Scenario 5A
20 yr Projected Rainfall – 5 yr Drought
With **1,660m³/d** from 2015



Scenario 5B
20 yr Projected Rainfall – 5 yr Drought
With **880m³/d** from 2016



Indicies

- Deterioration of salinity in gallery is a slower response than the recovery in salinity of gallery after rainfall,
- consider different indicies to better reflect the onground situation- avoid maintaining restrictions during wet periods, recognising that thickening of the water lens will take additional time

Assignment of abstraction

- Being able to assign abstraction for a defined period to respond to a change in salinity, rainfall, and freshwater lens status
- Consideration of rules that provide guidance
  - How much to vary from the sustainable yield in a given year, or a given day?
  - When it can vary, and for how long?
  - Mechanism to vary – best to be incorporated in to a drought plan or separate policy, if seperate who would implement?

Next steps

- Additional information
  - What expectations from govt for this work, where can it be best utilised
- Outputs from CAIA
  - Agreement on sustainable yield
  - Recommendations on an approach to vary abstraction and guidance on how this could be achieved
  - Guidance from modelling results from specific scenarios

Next steps

- Linkages to other projects
  - CoSPPAC,
  - NZ water security
  - Others?