AQUALINC RESEARCH LIMITED

Water Measurement Programme
- Bay of Plenty Region

Prepared for Environment Bay of Plenty

Report No H07006/1

August 2007

AQUALINC RESEARCH LIMITED

Disclaimer:

This report has been prepared solely for the benefit of Environment Bay of Plenty. No liability is accepted by Aqualinc Research Ltd or any employee or sub-consultant of this Company with respect to its use by any other person.

This disclaimer shall apply notwithstanding that the report may be made available to other persons for an application for permission or approval or to fulfil a legal requirement.

Quality Control			
Client:	Environment Bay of Plenty		
Report reference:	Title: Water Measurement Programme- Bay of Plenty Region		No: H07006/1
Prepared by:	Bob Rout		
Reviewed by:	Greg Barkle	Approved for issue by:	Greg Barkle
Date issued:	August 2007	Project No:	H07006

Document History			
Version: 1	Status: Draft	Author: RSR	Reviewer: CR
Date: 30/07/07	Doc ID: H07006-Draft Report.doc	Typist:	Approver:
Version: 2	Status: Final	Author: RSR	Reviewer: GB
Date: 27/07/07	Doc ID: H07006-Final Report_V3.doc	Typist:	Approver:

Acknowledgements

This report was prepared with the support and in consultation with the following EBOP personnel:

- John McIntosh – Manager Environmental Investigations
- Steve Pickles – Principal Compliance Officer
- Jessica Wiseman – Environmental Consents Officer
- Jolene Francis – Environmental Compliance Officer
- Mark Langridge – Manager Information Services
- Dougall Gordon – Environmental Scientist
- Glenn Ellery – Manager Data Services

TABLE OF CONTENTS

List of Appendices:

List of Tables:

List of Figures:

LIST OF ABBREVIATIONS:

ARC	Auckland Regional Council
EBoP	Environment Bay of Plenty
ECAN	Environment Canterbury
ES	Environment Southland
EW	Environment Waikato
GDC	Gisborne District Council
GWRC	Greater Wellington Regional Council
HBRC	Hawkes Bay Regional Council
HRC	Horizons Regional Council
MDC	Marlborough District Council
MfE	Ministry for the Environment
NCC	Nelson City Council
NES	National Environment Standard
NRC	Northland Regional Council
OBPRPS	Operative Bay of Plenty Regional Policy Statement
ORC	Otago Regional Council
PRWLP	Proposed Regional Water and Land Plan
RMA	Resource Management Act
SOE	State of the Environment
SWPoA	Sustainable Water Programme of Action
TDC	Tasman District Council
TRC	Taranaki Regional Council
WCRC	West Cost Regional Council

LIST OF UNITS:

ha	hectares
l	litre
l/s	litres per second
m	metre

mm	millimetre
m^3	cubic metre
m^3/d	cubic metres per day
m^3/s	cubic metres per second
Mm^3	million of cubic metres

1. INTRODUCTION

This report presents the findings of an initial study into the development of a water measurement programme for Environment Bay of Plenty (EBoP). It provides an overview of; the current status of water measurement identifies future needs and outlines the steps to development of a water measurement programme to meet EBoPs water management responsibilities, both regionally and nationally.

Water resources in New Zealand are coming under increasing pressure to meet rising demand for a range of uses, both consumptive (domestic, industrial and agricultural) and in-stream (ecological, recreational and hydropower). Water allocations for consumptive use on average are rising by close to 10% per year (MfE, 2006a). There is also increasing need to better manage the protection of in-stream environmental values, to ensure the sustainability of the resource for future generations.

The measurement of water use was one of the four national priorities identified in the Sustainable Water Programme of Action (SWPoA). The measurement of actual water use is a key element to improving water resource management in New Zealand. It will improve the ability of regulating authorities to determine resource allocation levels, determine cumulative take rates and volumes and monitor consent compliance. It will also enable the more efficient use, in terms of social and economic factors of allocable resources to meet current and future demand.

A National Environment Standard (NES) for water measurement devices is being developed under the SWPoA. The draft NES sets out the rationale and criteria for adoption of water measurement, along with minimum requirements for accuracy and frequency of recording for discharge types (pipe and open channel). A key element of the NES is the requirement for universal metering of consented water takes, unless otherwise justified. The adoption of the NES will have a significant impact on water users and water resource management authorities in terms of compliance with operational timeline(s), on-going measurement device certification and reporting water use.

EBoP is currently measuring water use on about a third of consented water takes. The water use records are utilised as part of monitoring of consent compliance. However, it is recognised that the current approach could be strengthened in terms of coverage and application, improved processes and access, and the utilization of information on water use. It is also recognised that the NES will have implications for updating and improving monitoring on existing consents, where currently no water use measurements are being captured.

This study is intended to provide guidance to better understanding water measurement issues and needs in the Bay of Plenty Region, and to help develop a programme to meet future needs both within the region and for reporting nationally.

1.1. Study Scope

The overall scope of this study is to assist EBoP in the development of water measurement as part of its water consenting, management and reporting responsibilities. It is an initial study and as such is intended to provide an overview of the current status of water measurement of consented water takes, identify needs in terms of regional and national responsibilities for resource management (consenting, compliance, studies and reporting) and to outline the steps to the development of a programme for water measurement to meet current and future needs of EBoP.

1.2. Approach and Sources of Information

This desktop study has drawn on information from a number of sources, including the following:

- Review of reports, plan and data including the following:
  - MfE reports on water allocations and measuring devices
  - Draft NES for Water Measurement Devices
  - Review of water metering specifications and standards.
  - EBoP Regional Policy Statement.
  - EBoP Proposed Regional Water and Land Plan

- Consultation with EBoP staff on issues of:
  - Consent compliance monitoring
  - Environmental data processing and storage
  - Resource assessment needs and procedures
  - Water resource policy and planning.

Where appropriate, sources of information are fully acknowledged in this report.

1.3. Outline of Report

This report contains the following information:

- Section 2: Current Situation; overview of regional water resource consented allocations and metering, metering elements of the regional policies and plans, and consent compliance monitoring and water use recording.
- Section 3: Needs Assessment; review of regional and national water measurement needs, including water resource assessment, consent compliance and NES for water measurement devices.
- Section 4: What Are Other Regions Doing; a brief outline of current levels of metering in other regions and specific metering activities of interest and relevance.
- Section 5: Proposed Programme for EBoP; outline of the programme objectives, steps and timeline.
- Section 6: Recommendations; study recommendations.

2. WHAT'S THE CURRENT SITUATION?

This section presents an overview of the current status of measurement of consented water takes in the EBoP region. The first subsections outline current levels of consented water allocation, allocation trends and water measurement, while the latter subsections discuss regional policy, planning and consent measurement issues.

2.1. Water Resource Allocations

There are approximately 1,300 water take consents in the EBoP region of which about 1,100 (85%) are for freshwater takes[1] and the balance for geothermal water takes. For the purposes of this study the discussion focuses on freshwater consents, as they are the current focus of water use measurement.

Consented takes account for a combined allocated take rate of 22 cubic metres per second (m^3/s)[2] or the equivalent of about 1.9 million cubic metres per day (Mm^3/d). Figure 2.1 shows the distribution (as percentage) of number of takes and cumulative allocation by water source. It shows that groundwater accounts for more than 60% of takes but less than 30% of the cumulative allocation, while surface water consents are close to 35% of total consents but more than 65% of cumulative allocation.

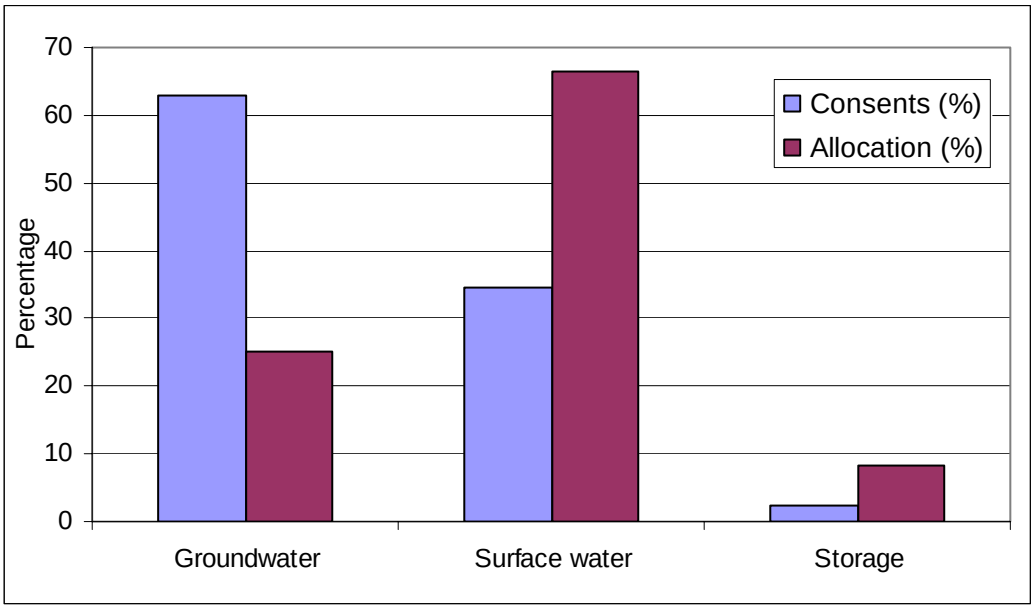

Figure 2.1: Percentage of consented freshwater takes and cumulative allocation by source

Figure 2.2 shows the distribution (percentage) of consented takes and cumulative allocations as a function of the primary use of the water. It shows that irrigation is the dominant use both by number of consents (more than 80%) and allocation (approx. 50%). The irrigated area based on take consents is approximately 20,000 hectares, of

[1] These are the approximate number of water takes for consumptive use i.e. excludes non consumptive uses such as hydropower.

[2] Based on the 2006 MfE water allocation study (MfE, 2006a)

which about 8,000 ha are supplied from groundwater and 12,000 ha from surface water (MfE, 2006a).

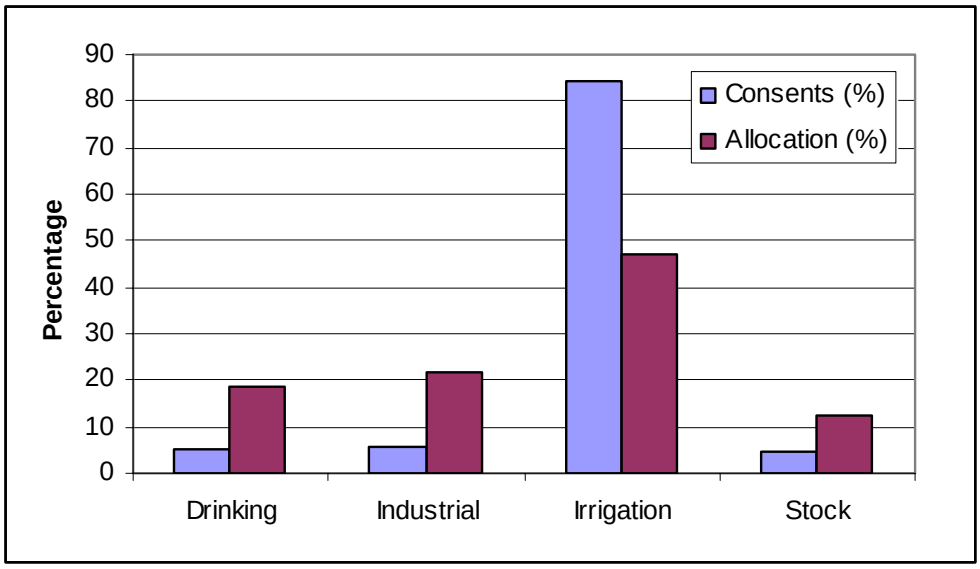

Figure 2.2: Consented freshwater (number and allocation) takes by primary use

Figure 2.3 shows the distribution (percentage) of number of consents and cumulative allocation by daily take category (different volume bands (in m^3/d)). It shows that 70% of takes have an allocation of less than 500 m^3/day but cumulatively account for less than 10% of the total allocation. Conversely, consents with a take rate of more than 10,000 m^3/d, while relatively few (less than 5% of consents) account for nearly 60% of the cumulative allocation.

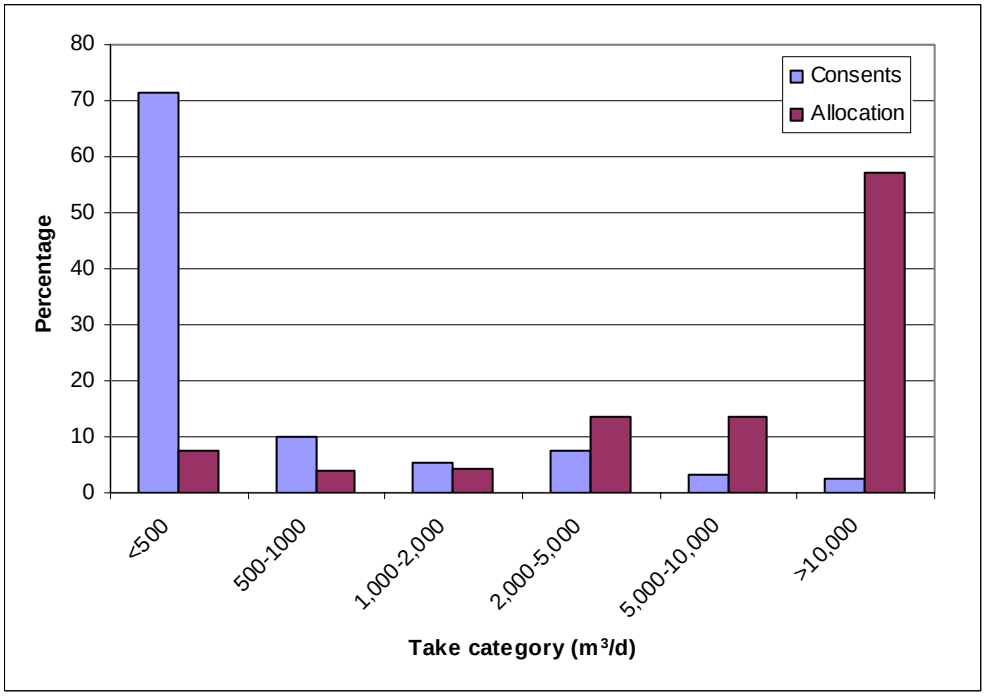

Figure 2.3: Distribution by percentage of consents by daily take rate

2.2. Regional Policy and Plan

Regional policy statements and plan form the legal and administrative platform for the management of water resources (and other resources and the environment).

The Operative Bay of Plenty Regional Policy Statement (OBPRPS) recognises the importance of water to the economic and social well-being of the region (EBOP, 1999a). It identifies a number of water issues, amongst which are the increasing demand for consumptive use and the need for efficient consumptive use. While the OBPRPS acknowledges the need for efficient water use, it does not specifically identify measurement of water use as a component for the promotion of water conservation and efficient use.

The Proposed Regional Water and Land Plan (PRWLP) (EBOP, 2007) sets out the issues, policy and methods related to the management and allocation of fresh water resources in the Bay of Plenty Region. The plan identifies the importance of and need for efficient water use in the interests of protecting environmental and social values, as well as optimising consumptive use. The plan lists a number of methods to encourage efficient water use, though the use of measurement of water is not specifically contained as part of these methods. However, water measurement devices are required by the Plan mainly where water resources are close to full allocable volumes, or there are sensitive values associated with the water resources.

2.3. Consenting

Resource consents are issued for water takes from surface water and groundwater for activities other than reasonable use, and for take rate greater than permitted levels ($15m^3/d$ from surface water and 35 m^3/d from groundwater). The procedures and conditions for consenting have progressively developed over the past 16 years, in part to changing policy and plan rules and in part to greater awareness of the need to protect other consent holders and in-stream values.

The requirement for measurement of water use within the EBoP framework has been progressively expanded as a condition of consented water take. Initially it only applied to large surface water takes; approximately 10 years ago it was applied to all takes greater than 400 m^3/d and about 2 years ago extended to all consented takes (new and renewals). There are currently about 300[3] water meters installed on water take consents which represent about 30% of consented takes (Table 2.1).

Typically, metering conditions include:

- Accuracy of measurement
- Frequency of reading; currently stipulated as daily for all takes
- Frequency of submission of records; annually required
- Units of measurement; cubic metres
- Installation configuration.

[3] Estimates of number of metered takes varies between 280 to 317.

As described by EBOP personnel the consent compliance monitoring includes the following:

- Checking of hardcopy water metering records submitted for verification of daily and weekly take rates.
- Comparing submitted data against consented values for non-compliant takes (if possible).

Table 2.1: Consented and metered takes (as per EBOP consent info.)

Category (m^3/d)	Consented takes (no.)	Metered takes (no.)	% of category metered
< 500	598	70	12
500 – 1,000	98	81	83
1,000 – 2,000	50	49	98
> 2,000	94	82	87
Total	**840**	**282**	34%

Environment Bay of Plenty's policy on compliance monitoring was stated in a 1999 report (EBOP, 1999b). It recommended the five yearly monitoring of irrigation takes.

Current consent compliance monitoring is limited by the format and accuracy of water use records; common problems include:

- Records not submitted
- Missing data in records
- Averaging of daily take values over a period
- Inaccurate data
- Lack of verification of meter accuracy.

2.4. Studies

EBOP as part of its water management responsibilities carries out investigation and studies into water resources. This work contributes to improvement of assessment of water resources and the determination of requirements to sustain aquatic ecosystems, in-stream values (cultural and recreational) and allocable resource for both hydropower and for out-of-stream consumptive use. A variety of methods are adopted in the assessment of water flows and volumes, and water use, including flow monitoring, hydrologic and demand assessment modelling.

Recent, current and proposed studies include the following:

- Water Use and Availability Assessment for the Western Bay of Plenty; the study investigated the sustainability of water resources in the Western Bay of Plenty (Western Bay of Plenty District and Tauranga City Council) to meet future demand. It highlighted the current dependence of limited surface water resources for municipal supplies, and the need to move to the use of groundwater and/or water storage to meet further growth in demand. The study will contribute to a Water Sustainability Strategy for the Western Bay of Plenty.

- Groundwater Study; the regional study (largely) assessed groundwater resources and recommendation for allocable resources.
- Surface Water Assessment; in-line with the PRWLP, in-stream minimum flow requirements (IMFR) will be progressively established for the major rivers and high demand streams in EBoP region. This work will provide a more accurate and defensible assessment of minimum flows and as such contributes to the determination of allocable flows (along with other in-stream values: hydropower, cultural and recreational).

The current metering activities and data are of limited value to the above studies, due to inadequate number of installations and limitation of the water use records, both in terms of format and accuracy of readings.

2.5. Institutional Arrangements

Responsibility for the management of water metering at EBoP currently rests with the Consenting and Compliance sections. Both sections are currently within the Regulation and Resource Management Group which will become the Water Management Group under the proposed reorganisation, as indicated in Figure 2.4 below.

The Consent section activities include setting criteria for metering as a consent condition (currently based on take rate), frequency of reading and submission of records. The Compliance section activities include verification of take and meter compliance, record submission, and meter accuracy. The verification is carried out on a five year cycle, with intermittent periodic checks. The section is also responsible for the storage of the records and the currently limited processing of hardcopy records as part of take compliance.

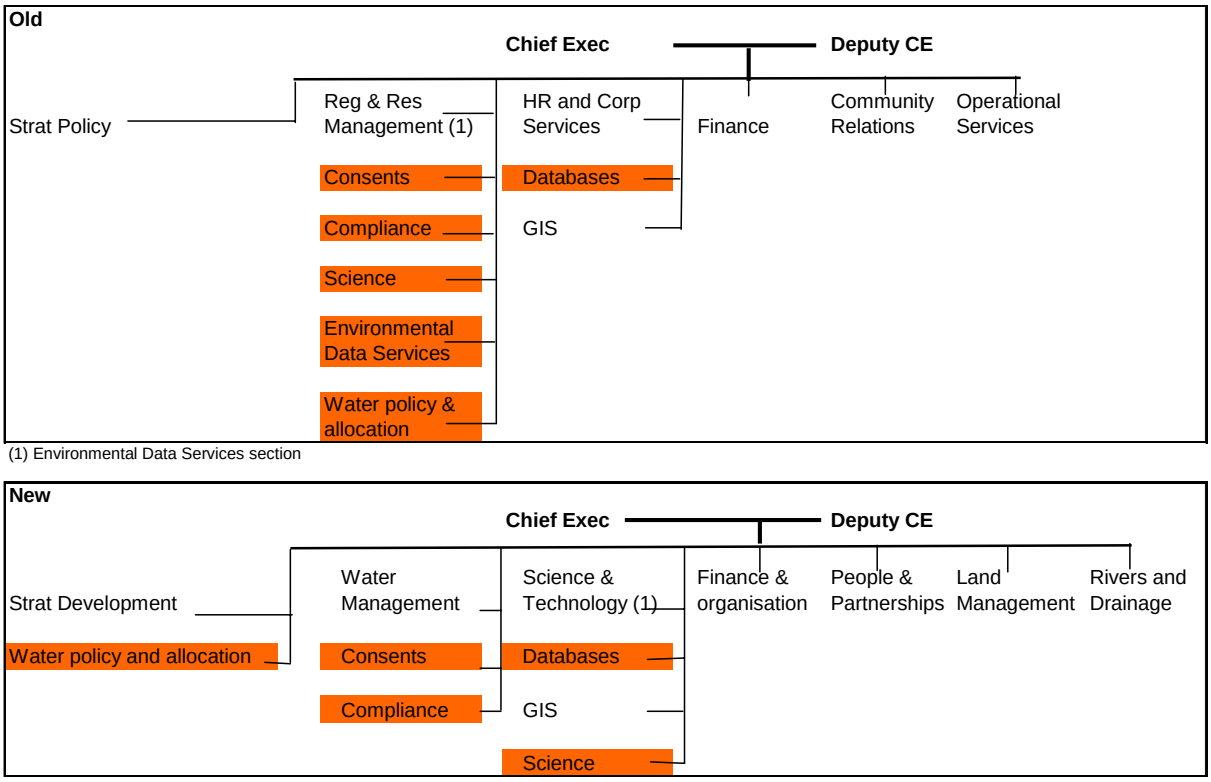

Figure 2.4: EBOP Organogram

3. WHAT ARE FUTURE MEASUREMENT NEEDS?

This section presents an assessment of EBOPs water measurement requirements to meet its water management responsibilities and activities.

For regional councils the need for water measurement can be grouped into two broad categories, regional and national, as listed below.

1. **Regional;** that is the measurement of water use which supports the development policy, plans and management of water resources at a regional scale.

   These include the following responsibilities and activities:

   (a) ***Consent Compliance***; compliance of consent conditions on take rate and volume. The timeliness and accuracy of use records improves the ability to enforce take conditions. While this is currently the primary purpose of water measurement by EBOP, the approach and outcomes could be significantly improved, with improved quality of records, timeliness of submission and record processing and storage.

   (b) ***Allocable Resources***; determination of allocable resources (ground and surface water) with the naturalisation of estimates of water availability. The current approach is based on estimated actual use which is generally a conservative approach which leads to an under estimation of allocable resources. The use of actual water use records would improve the assessment of allocable resource(s).

   (c) ***Allocation Guidelines;*** updating of water allocation guidelines for use categories based on historical use rather than calculated estimates. This is particularly relevant to irrigation takes where actual use is typically 20-30% lower than estimated peak demand.

   (d) ***Low Flow Management;*** management of water resource during periods of low flow by naturalisation of flows and management of takes accordingly. This is the approach currently being developed by Horizons (Section 4), with the simultaneous monitoring of surface water flows and water use, along with systems to alert consent holders of pending restrictions.

   (e) ***Demand Forecasting;*** currently in most regional councils, demand forecasting is largely confined to tracking trends in the number of consents and cumulative allocations. However, there is also a need to determine actual levels of water use to more accurately report on actual water demand levels as opposed to cumulative allocation levels. Recent studies indicate that actual water use is typically 60-70% of consented allocations and in some cases as low as 20% (MfE, 2006a). This information should be of importance to the development of regional policy and plans on water management. Most regional plans have

established allocation levels based on empirical parameters and assumptions which are unproven by actual field measurements.

(f) ***Water Planning;*** currently studies of water resources and demand forecasting, for want of actual history of use, are largely based on calculated water use. This is a weakness in the approach which could be overcome with data on actual water use. Accurate forecasting of demand for water is best based on accurate measurement of current water use as a base for extrapolation out to the required time horizons. This is particularly relevant to studies intended to be used for strategic planning of water resource management and investment in water infrastructure.

(g) ***Water Conservation;*** water use measurement provides a quantitative basis for analysing water use efficiency. Such information can be used to develop and promote regional water conservation policies in the principle water sectors: municipal, industrial and irrigation.

While considerable emphasis is placed on monitoring and assessment of water resources to support resource management, there is a need to complement resource monitoring (assessment) with systematic and accurate determination of actual water use, accompanied by the development of more accurate assessment of water use for permitted activities.

2. **National;** these include regional council responsibilities to meet national environmental and reporting responsibilities, including:
   (a) Enforcement of the proposed National Environment Standard (NES) for water measurement devices as discussed below.

   (b) State of environment reporting on water allocation and use to the Ministry for the Environment.

   (c) National water accounting as periodically prepared by Statistics New Zealand.

The subsections 3.1 and 3.2 further elaborate on the development of the NES and provide an initial analysis of number of meters and records required for a comprehensive water measurement programme for the EBoP region.

3.1. NES for Water Measurement Devices

A NES for Water Measurement Devices is currently under development as part of the SWPoA. The purpose of the SWPoA is to develop a strategic and nationally consistent approach to management of freshwater. The programme aims to achieve three key national outcomes: improve the quality and efficient use of freshwater, improve management of the undesirable effects of land use on water quality, and provide for increasing demands on water resources and encourage efficient water management.

The accurate measurement of actual water use has been identified as a key element to the improvement of freshwater management in New Zealand. The adoption of water measurement standards will improve management through improvement in allocation efficiency (freeing up technically allocated but unused water), assessment of effects of water takes on in-stream values (determination of actual water use as opposed to estimated value), and improved consent compliance.

In December 2006 the Minister for the Environment notified the Proposed NES for Water Measuring Devices under the RMA 1991. Submissions were received on the proposed NES to February 2007[4]. A summary of submissions was published on the MfE website. The next steps are analysis of submissions, final proposal to the minister, minister consulting colleagues, legal draft of the standard and issuing of the regulation. No timeframe has been issued to complete these steps; however, based on progress to date (of both the NES and SWPoA) it appears to be unlikely to be completed in 2007. In all probability the NES is likely to be issued in 2008 at the earliest (assuming it receives ministerial support and approval)[5].

The proposed timeframe for applying the proposed NES is five years (Section 4.7 of the NES Discussion Document). The discussion document states that *"regional councils would need to plan how the requirements of the Standard would be achieved in their region, either by addressing specific catchments or by phasing in the application of the standard by the size and level of take".*

Summary of key elements of the draft NES:
It will apply to all consented water takes under operative and proposed regional plans; it also applies to all catchments and aquifers. However, as presented in the discussion paper, "*it may be appropriate to measure a large proportion of the actual takes and to estimate the reminder[6]"*. However, the paper goes on to say that, "*the estimated proportion must be small enough to avoid compromising the overall water take figure, and there must be confidence in that estimate".*

The key elements of the proposed NES are:

a) Minimum requirements for flow measurement devices:
   - Pipe discharges:
     - Continuous measurement
     - Volumetric measurement in cubic metres
     - Have data storage capability
     - Accuracy standard of +/- 5%
     - Capable of recording daily volume
     - Fit for purpose
     - Tamper-proof and sealed.

b) Installation and maintenance requirements for water measurement devices:

[4] The deadline for submissions was 16th February 2007

[5] The report on submission (MfE, 2007), Section 1.3, page 4 states that '*If approved by the Government, the proposed standard is likely to be introduced later this year (2007)*'. However, this would appear to be an over optimistic prediction at this stage (July, 2007).

[6] Discussion Paper; Section 4.1, page 14

- Installation of a water measurement devices as a water take consent condition
- Installation complies with manufacturer's installation instructions
- Device installed as close as possible to the take point, and upstream to the first outlet
- Accuracy verified independently every 5 years.

c) Data recording and transfer requirements:
   - Consent holder responsible for recording water measurement
   - Consent holder responsible for transfer of data to regional authority at least annually
   - Data recording at a minimum of daily intervals.

Implications of the NES to EBOP

The NES is a significant and substantial development in the measurement of water use in New Zealand which will have implications for regional authorities and water take consent holders. The implications for EBOP is that the NES will speed up the current metering programme with the mandatory adoption of universal metering (more or less) and the associated verification and compliance activities as listed below.

- Mandatory installation of water measurement devices on all new and renewed consented takes to the specified NES conditions of accuracy, units and frequency. Based on current consented takes the number of installation will rise from approx. 300 to 1,200 over the 5 year transition period of the NES.
- Data collection, processing and storage consistent with at least the daily recording frequency, and annual submission.
- Verification of measuring device certification every 5 years (this may include in-situ calibration), rating curves for channel flows and meter calibrations for piped flow.

General comments on the NES

The following is a series of comments on the implications of the NES for both EBOP and consent holders:

- The NES confirms that the consent holder is responsible for meter installation, operation, maintenance, and certification.
- There may be a need for a local contractor to carry out a certification programme given the number of meters ultimately requiring certification (400-500 per year).
- The potential for automation of data capture and transfer should be investigated, on at least the bigger takes, to improve reliability and accuracy of recording and reduce labour requirements and operational costs.
- EBOP should investigate the potential to support and/or subsidize the use of data loggers to reduce its workload in the processing and storage of data (reduce the manual processing of data and reducing QA requirements).
- The NES will significantly increase EBOPs workload for processing, storage and reporting on water use (a 4-5 fold increase).
- EBOP needs to decide on the appropriate level of measurement that meets the intention of "accuracy of measurement of actual use". This is probably best based on assessment of accuracy at the catchment level(s) for minor streams and by reach for larger rivers.
- There's an issue of whether records are required during a period of non-take such as with seasonal takes, or takes with specific seasonal restrictions i.e. specified period of take; this needs to be clarified.

- The timing of submission of annual returns is at the discretion of regional councils[7]; however, the national stock water accounting year begins on 1st July, and this also matches peak seasonal demand for irrigation (the largest water use).
- The NES does not prescribe the type of equipment for measuring, storing or transmitting data. EBOP will need to be more prescriptive to help consent holders be compliant with the required levels of accuracy and to streamline data transfer. There is a danger that unless there is clarification, there will be a multitude of different approaches and equipment, which will be technically and administrative difficult and costly to manage.
- There may be a need to improve audit capabilities to be able to more reliably check compliance with requirements of daily reading (this may include some form of field checks or cross checking with other related parameters such as pump hours and electricity consumption).

As mentioned above, the application of the NES will speed up coverage and formalise the approach and methods adopted for water measurement in the region. While there is a requirement to ensure compliance with the NES, there is also the opportunity to develop water measurement in a way that best meets EBOP water management policy and plans, much along the line of that adopted by the Horizons Regional Council.

3.2. Assessment of Water Measurement Requirements

The following subsections present a summary of water measurement requirements to meet the above needs.

3.2.1. Water Meters Numbers and Data

The figures below present the results of analysis of the requirements (number of meters and records) for a water measurement programme for the Bay of Plenty region. They are based on the development of a programme which would be consistent with the proposed NES and start from the current level of metered consents (2007).

The analysis is based on following assumptions:

- 95% of consented takes are metered (allow for the exclusion of very low take rates),
- compliance with the NES by the year 2013 (5 year transition period) and
- recording of irrigation takes only for the irrigation season.
- It is also based on two potential growth rates in new takes (5% and 8% per annum).

Figure 3.1 shows that the number of meters installed will increase to about 1,600 by 2013 and to 2,000-3,000 by 2020 (5% and 8% growth respectively). While most of the increase in installations (1,300) is over the NES transition period (2007-13) there will also be 80-120 new installations required for new consents per year.

Figure 3.2 shows the estimated number of use records (daily) per year. This is in essence the number of records to be processed and stored by EBoP. Annual records

[7] Discussion paper; Section 4.5, page 18

are currently probably less than 40,000 per year (all in hardcopy). This will increase by about eight fold by 2013 (300,000) and could be over 500,000 by 2020. The implications are that it is unlikely to be feasible to handle and store these numbers of records in hardcopy form. To meet the requirements as outlined in Section 5, of efficiency of handling, quality assurance, and extraction for use the records should predominately be in electronic form, and preferably from source.

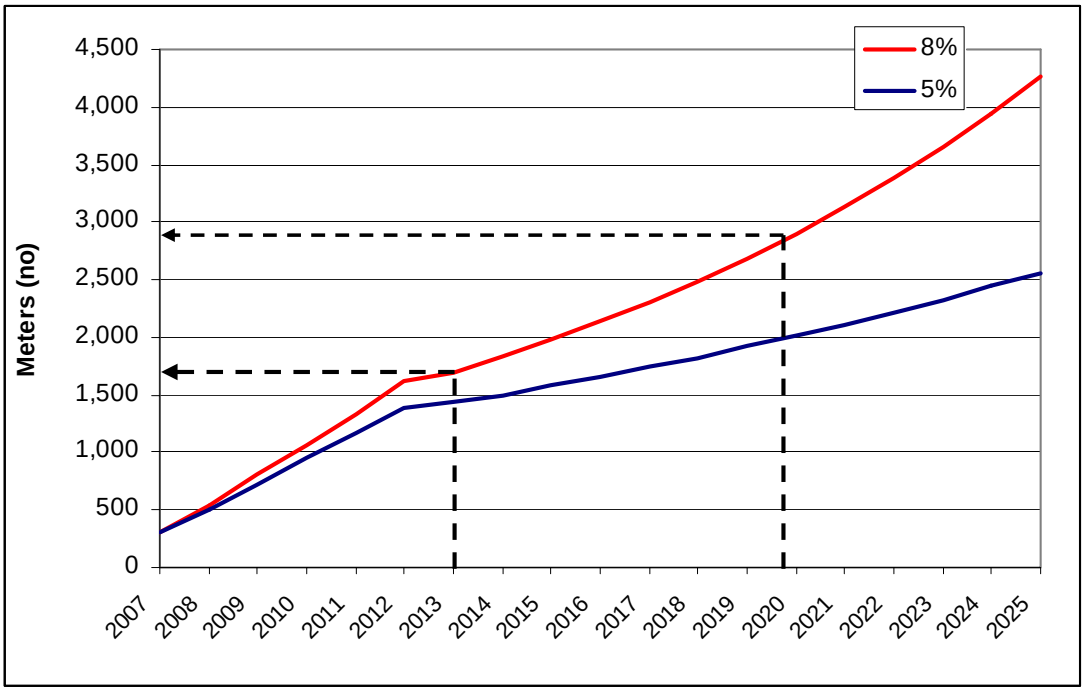

Figure 3.1: Predicted number of meters that will be installed for two levels of growth assumed for fresh water consents.

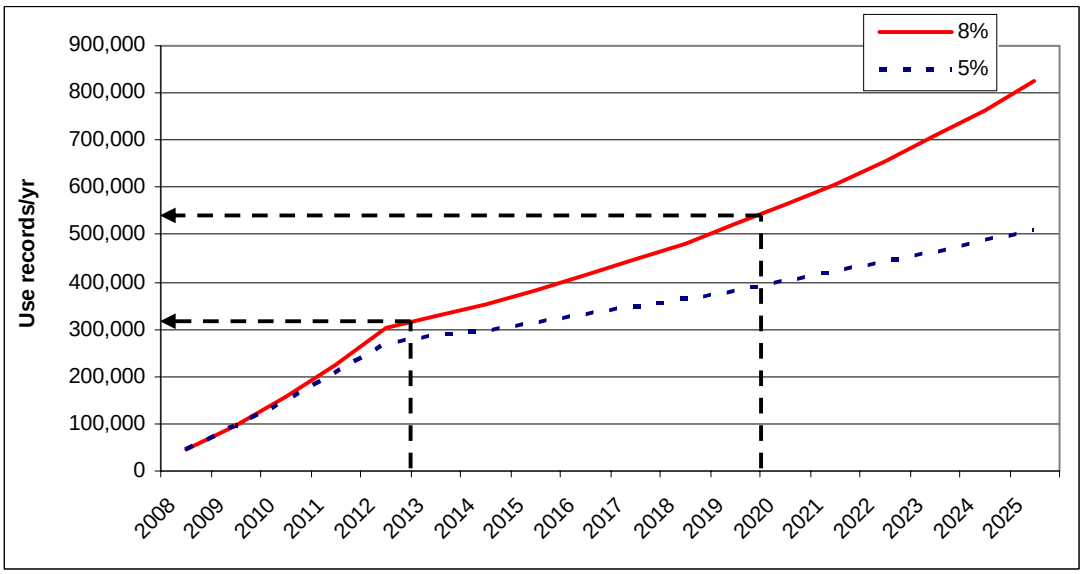

Figure 3.2: Predicted water use records requiring processing for two assumed growth rates.

Figure 3.3 shows the growth cumulative records over time. It shows that the number of records will rapidly rise into the millions within a few years. While this is not a

problem in terms of data storage, it does highlight the need to have an efficient process(s) for the transfer, quality control and storage of records.

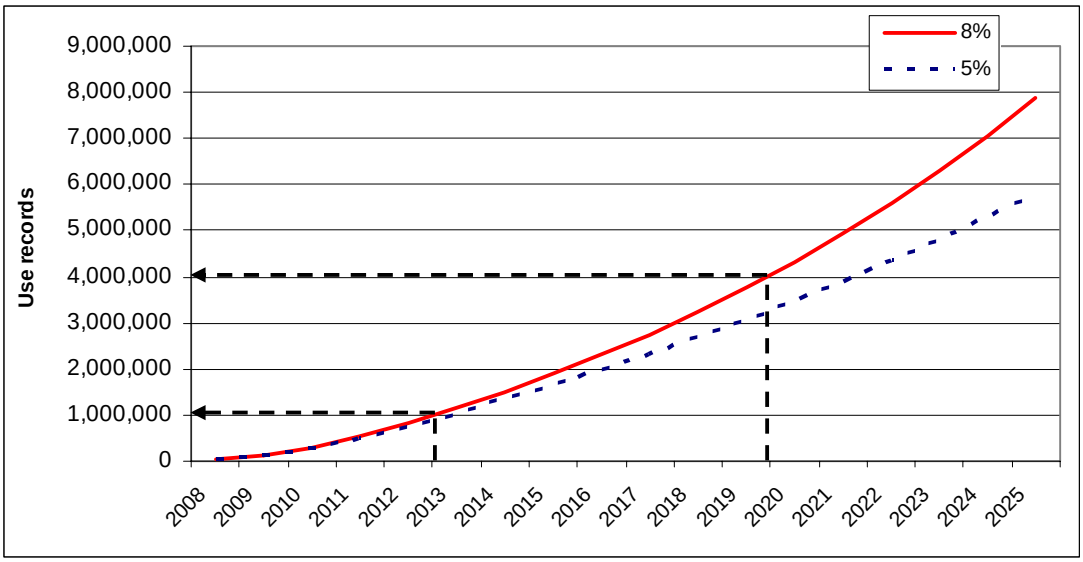

Figure 3.3: Cumulative water use records

3.2.2. Data Requirements and Flow Units

There are a number of methods for measuring water flow. For pumped and piped takes this is generally achieved with the use of a water meter either helical vane or electromagnetic, and for open channel by correlation of depth to flow rate at a gauged channel section. The determination of measurement methods for the range of applications in the region will be one of the key elements in the development of water measurement programme (Section 5). However it is beyond the scope of this report to present the options, specifications, merits and constraints of specific measurement methods.

For helical vane meters (the most common and widely installed meter type) flow is recorded as either cumulative total on a register and/or pulse/count for a given unit volume (typically one pulse per 100 litres or 1 cubic metre). This information along with the take period (day or week) is the primary data on water use, which is converted into unit volume per unit time for the range of applications (as listed below).

Water use applications and units include the following:

a) Compliance monitoring for individual consents:
   - Daily or weekly volume (m^3/d)
   - Annual or seasonal (irrigation takes) volume (m^3/yr)

b) Consent allocations for the zone or reach of interest:
   - Surface water; cumulative peak take rate (l/s)
   - Groundwater; cumulative peak annual rate (m^3/yr)

c) Regional studies:

- Surface water; cumulative average and peak use at daily, weekly and annual durations (m^3/d, m^3/s, m^3/wk and Mm^3/yr)
- Groundwater; cumulative average and peak annual use (Mm^3/y)

d) NES compliance: daily volume per consent (m^3/d)
e) National water accounts for the region: cumulative peak annual volume (Mm^3/yr)

An effective and efficient water measurement programme should be based on recording and transfer method(s) that is cost and time effective for both the consent holder and the council. The approach should also be one that provides feedback to the consent holder to demonstrate the relevance and application of records. For the Bay of Plenty it is likely that a combination of recording and transfer methods would best suit the range of consent holders based on source, use, take rate and convenience.

The range of transfer options includes the following:

- Hardcopy (post or fax)
- Email; emailed spreadsheet of records
- On-line; submission of records on pro-forma template via user account (as per Auckland Regional Council (ARC))
- SMS; text message (as per ARC)
- Logging of data; logging of records and submission of data file by email or downloaded by council (as per Taranaki Regional Council (TRC))
- Telemetry of data; direct telemetry of records from site (as per Hawkes Bay Regional Council)

As outlined in Section 5, the identification and evaluation of recording and transfer methods is a key element in the development of the water measurement programme.

4. WHAT ARE OTHER REGIONS DOING?

Over the past five years there has been considerable interest by regional authorities in the development of water use measurement. There are variations in the approach to measurement of water use between regions. The summary below provides an overview of the current status of water measurement around the country. The latter part of the section provides a summary of the more specific programmes being developed which are relevant to EBoP.

The table below is derived from the MfE report on water measurement (MfE, 2006b). The report shows that nationally approximately 34% of consented water takes are metered, but the level of measurement ranges between regions from 0% up to full coverage.

Table 4.1: Summary of metered consents takes by region

Council	Number of consents (no)	Measured consents (%)
ARC	1,420	95
ECAN	5,872	11
ES	679	66
EW	788	100
GDC	161	100
GWRC	677	35
HBRC	2,517	14
HRC	552	23
MDC	1,191	67
NCC	33	6.
NRC	606	23
ORC	1,968	50.
TDC	1,319	53
TRC	186	27
WCRC	432	0

The summary below summarises specific programmes being developed by regional councils which are relevant to EBoP.

- **Horizons Regional Council**: has the most advanced metering programme, in terms of integrating actual water use into water management. It is progressively expanding a programme for the telemetry of real time water use. Horizons supplies and installs the telemetry units as part of the programme. Consent holders are required to install water meters with pulse out capability.

  Currently there are 106 sites with telemetry and this is to be expanded to cover 80% of the total consented volume from surface water. As part of the programme water use

information is presented on a website, which displays consent allocation (m^3/d), telemetry allocation and actual water use. Groundwater use will also be included in the programme with the telemetry of the large takes initially (3,000-4,000 m3/d).

Information from the programme is used for consent compliance (with automatic reporting of exceedance) and normalisation of flows for determination of allocation limits and restrictions.

Horizons now have considerable experience and expertise through the development of this programme. The programme and its application serves as an example and model of the approach to and application of water use monitoring.

- **Auckland Regional Council:** the council has close to full metering of takes, both surface water and groundwater. Water use is recorded daily for surface water takes and weekly for groundwater takes. Records can be submitted by consent holders in a variety of ways including; hardcopy (postal or fax), emailed record spreadsheets (in Excel, Word or pdf format), on-line submission of records (via user-account on website), text message and direct telemetry (about 12 sites). The submitted information includes date of use, meter reading and consent identifier. The on-line facilities include submission of records and a facility to access history of records and water user for each consent holder.

- **Taranaki Regional Council**: the council has promoted the use of logging of water meters on irrigation takes over the past 3-4 years. The purpose is to improve the quality and reliability of water use records, along with the processing of data. The TRC is promoting the use of dataloggers for recording irrigation water use. To date 16 of the 50 irrigation consents in the region have dataloggers. New water take consents are required to have a pulse transmitting water meter and datalogger.

- **Otago Regional Council:** as a result of high water demand in the Kakanui catchment, a water metering programme was implemented with the installation of water meters and dataloggers on 31 takes.

The current approach to and use of water measurement by EBOP is typical of the majority of regional councils, it being used principally as a consent compliance mechanism. Many of the issues regarding the level of use monitoring and handling of hardcopy records are also similar to other regions. However, as indicated by the above examples, the concept and approach to water use measurement and the use of this information can be considerably enhanced to the advantage of both the water consent holder and the regional council. The Horizons Regional Council approach is an example of what the future approach, with the use of real time monitoring to improve water resource management and efficiency of water use. In specific locations such as in the Kakanui catchment in Otago, metering and use records have been adopted as a management approach to optimising use in high demand catchments.

5. THE PROGRAMME

This section presents an outline of a water measurement programme and the key steps to its development and implementation. It is beyond the scope of this study to go into depth for this process but it provides an overview and framework which is intended to inform and initiate discussion within EBOP on the future of water measurement. It will hopefully stimulate further thinking on how best to prepare for the proposed NES, as well as provide a comprehensive and sustainable contribution to improving water resource management in the EBoP region.

5.1. Programme Outline

For the purpose of this study a water measurement programme is defined as the systematic measurement of water use, data transfer, storage and reporting. While EBOP has in essence a programme operating based on a limited number of consents, the approach being promoted would be a more comprehensive and systematic programme with clearly defined roles and responsibilities.

The programme elements are summarised below.

These are:

(a) Device installation; installation of a water meter (or water depth logger for open channel flows) consistent with EBoP specifications (consistent with at least the NES). The device may also include requirements for logging and automated data transfer.

(b) Water use recording; systematic recording of water use at the frequency and duration consistent with EBoP requirements. The frequency of recording will be a minimum of daily recording (as per NES) but may require more frequent recording to meet specific water management or allocation requirements. A case in point may be the recording of irrigation takes for night irrigation.

(c) Record transfer; the transfer of water use records in a standardised format. While this is currently being done in hardcopy, the approach should be to move towards to the use of electronic format, something which should be investigated in detail with the programme development. The quality and reliability of hardcopy records are generally poor, and records are time consuming to process and bulky to store. The current approach by Horizons Regional Council to move towards the automatic transfer of electronic records is probably the direction that all programmes should ultimately be working towards.

(d) Data processing and storage; the process of record validation, quality control and storage. There are two important aspects to the process, the first is the quality of the records and second the timeliness for data application and reporting. For water meters, water use is recorded at site either on a register or as a pulse per unit volume (stored on a datalogger). The processing and storage of the data needs to take into consideration the intended application and reporting; for compliance monitoring, the determination of daily takes and take rates (on surface water takes).

(e) Data reporting; as outlined in Section 3 there are a number of potential applications for water use records (in addition to consent compliance). The approach should be to establish access to the data which enables queries to be generated to meet specific applications. These range from single consents for consent review and compliance monitoring through to spatial analysis for catchment and management zones (and regionally) for water studies and planning.

(f) Device certification; the periodic verification of device accuracy of performance. Under the NES this will be required at five yearly intervals. As currently stated this requirement is the consent holder responsibility. However, what is not currently known is the process(s) for certification; how will certification be verified and by whom?

Table 5.1 is a summary of the organisational responsibilities for the above programme elements, along with relevant comments. While this lists delegation of responsibilities as per the NES and regional plan, it should be noted that in several regions councils have taken on the responsibilities for data recording, transfer and device certification. The rationale for this approach is to establish water measurement programmes to promote resource management beyond just take compliance.

Table 5.1: Elements and Responsibilities for a Water Measurement Programme

Programme Element	Responsibility	Comment
(a) Device installation	Consent holder	Device standards may be established with guidelines for accuracy and regional consistency
(b) Water use recording	Consent holder	Currently manual recording, however digital recording and telemetry should be investigated (as per Horizons)
(c) Record transfer	Consent holder	Currently hardcopy; however, electronic transfer should be encouraged and developed
(d) Data processing and storage	EBOP – Water Management / Database / Environmental Data Services	Currently Compliance Section; however' this may be better managed by the Water Management Group or Database Section
(e) Use reporting	EBOP – All Groups & Sections	Ideally the data should be available in a format that enables access to all groups.
(f) Device certification	Consent holder	Procedures need to be established for independent verification of meter/measurement performance

5.2. Programme Development

As identified in the preceding sections there is a need for a programme for the development of water measurement at EBoP. The summary below outlines the key steps of the programme development. It lists the key elements within each step as well as a timeline for development and implementation.

As mentioned above the purpose in listing this information is to provide an overview of how and when the programme could be developed. It will hopefully stimulate further thought and discussion on and approach to water measurement at EBoP.

The key steps and elements in the development of the programme are:

Step 1: Assessment of requirements. The first step is the assessment of requirements, this includes:

- Determine the required level of measurement to meet council and NES needs.
- Determine the criteria for implementation of water measurement on existing consented water takes (metered and un-metered); this may be based on classification on criteria of spatial distribution (catchments), use and/or source.
- Determine the required technical specifications for water meters and data transfer.
- Determine the physical, financial and human resource requirements (within EBOP) for handling, processing and storage of water use measurement records.
- Determine staff training requirements to support the programme (this may include one or more of the following: installation compliance, meter certification, data processing and storage).
- Determine the procedures and processes for data quality control, processing and storage.
- Determine the procedures and processes for data querying and reporting.

Step 2: Programme development: formulation of a programme for the implementation of the water measurement programme. The programme development includes the following elements:

- Preparation of guidelines on the water measurement programme and requirements for measurement, recording and submission of records.
- Preparation of the measurement use database system; establishment of the system for the handling and processing of water use records and associated quality control systems. The general ethos of the system should be to establish procedures which enable the efficient handling of the large number of records, and wherever possible standardised transfer in electronic format.
- Preparation of the schedule for sequencing of review of existing water take consents based on the above criteria.
- Preparation of training programme (or alternatively specification of training programmes and identification of training services).
- Cost benefit-analysis of the programme to identify implementation options. The analysis may include comparison(s) of in-house and out-sourcing of some

elements of the programme including data processing and reporting (there may be alternative options worthy of consideration).

- Technological development: identification of potential technological developments in the short to medium term (2-10 years) which may 'significantly' improve the approach to water measurement and data transfer. This may include the imminent development of improved water measurement methods or the likely availability of improved technology at lower cost (such as electromagnetic meters).

Step 3: Programme implementation: the implementation of the programme, including the following elements:

- Stakeholder consultation; publication and dissemination of information on the programme and consent holder responsibilities to comply with the programme.
- Progressive (over a 5 year period) review of existing consented takes (based on scheduled criteria) and notification of requirement to comply with water measurement. It is envisaged that the programme implementation would be phased in over a five year period with approximately 20% of existing consented takes covered per year. The phase-in period would most likely include existing metered consents, as these are unlikely to be compliant with all the technical requirements (such as accuracy, installation configuration and flow recording requirements).
- Compliance monitoring of water meter installation to required technical specification(s).
- Implementation of the data transfer, processing, QA and storage procedures.
- Implementation of data querying and report processes consistent with end-user requirements; consent compliance monitoring, water management and national water use reporting.

Step 4: Programme operation and maintenance: the on-going operation and maintenance includes:

- Compliance monitoring of water meter/measurement certification consistent with the NES (five yearly). Compliance may be coordinated with the current compliance monitoring programme (approximately 250 consented takes per annum).
- Water use reporting; periodic reporting of water use to meet regional and national requirements.
- Stakeholder participation in water management; the availability of reliable water use records may open up opportunities for stakeholder participation in water management at community level.

Figure 5.1 is a preliminary summary programme to the year 2020. The period from 2008 to 2013 covers development and implementation of the programme, and beyond 2013 operation and maintenance. Key points to note are:

- Assessment of requirements is completed by the first quarter of 2008 (to coincide with the likely finalisation of the NES).
- Development of the program (or at least essential elements) is a precursor to the implementation of the requirements under the NES with completion by the end of 2008. In particular, the preparation of guidelines to consent holders, measurement database and the proposed sequencing of consent reviews and compliance.

- Implementation of the programme is schedule for the five year period 2008-2013.
- Operation and maintenance of the programme includes periodic compliance certification.

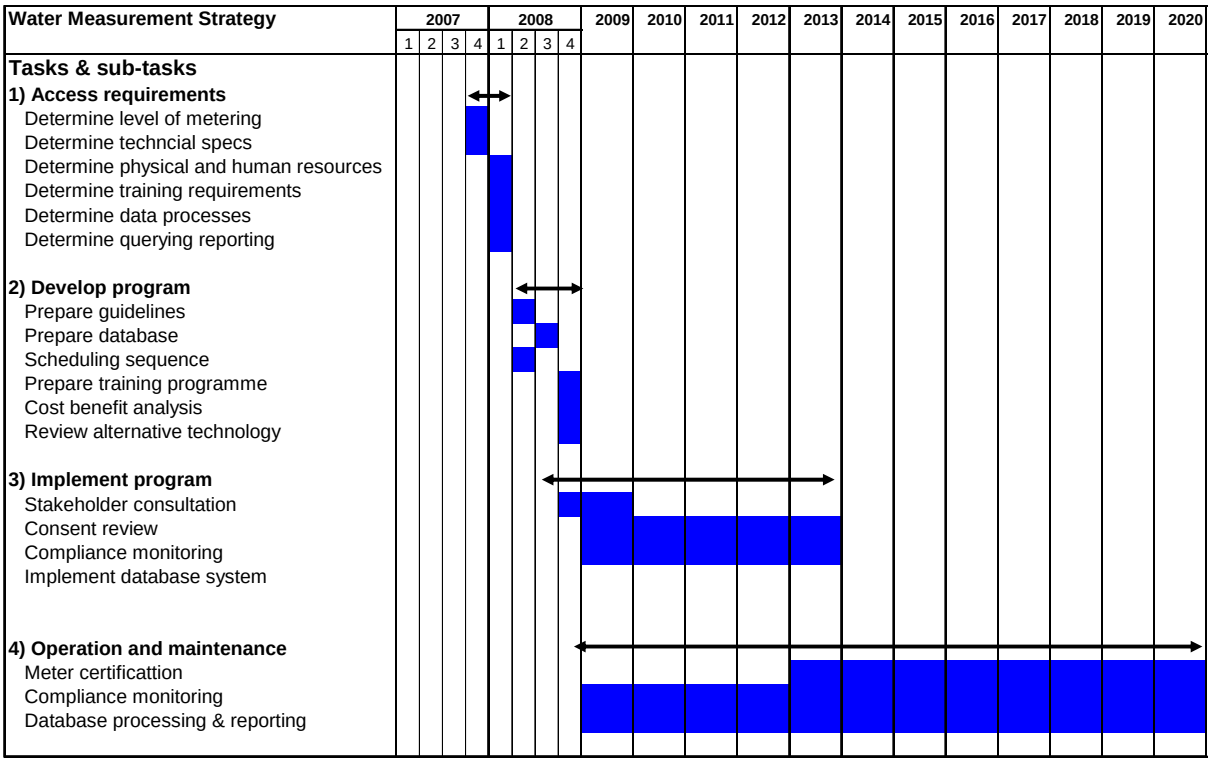

Figure 5.1: Programme timeline

The development and operation of a comprehensive water measurement programme will require considerable resources and investment. It is beyond the scope of this initial study to evaluate these requirements. However, this should be undertaken as part of step one, (assessment of requirements) of the programme.

While much of the work on the programme will be 'in-house', there may be good technical and financial reasons to out-source some elements of the programme. These may include:

- Some elements of the assessment of requirements
- Specialist element of programme development (e.g. cost benefit analysis)
- Data transfer
- Data processing and storage.

As currently proposed under the NES, responsibility for measurement accuracy, certification and data recording rests with the consent holder. In the interest of long term programme management (cost efficiency), it is important that a consistent approach is taken to technical standards for measurement devices as well as data recording and transfer (as promoted by EBOP).

6. RECOMMENDATIONS

As mentioned earlier, this is an initial study which provides a preliminary assessment of the needs and a plan for development of a water use measurement programme for EBoP. It should be regarded as an overview and a starting point to the development of a more detailed approach which can be progressively developed over the next 12 months. There is some urgency, as the pending NES on Water Measurement will create a priority in EBOP (and other regional authorities) for the adoption of universal measurement of consented takes and the associated reporting systems.

The study recommendations are:

1. Prepare a detailed plan for the development of water measurement programme for EBoP to support management of water resources and the NES.

2. Determine criteria for category(s) of water takes metered (identify any potential exclusions). This information will be of assistance in determining the number of meters required to be installed.

3. Initiate consultation with other regional authorities on standard approaches to data handling and processing.

4. Initiate assessment of requirements to determine physical, financial and human resources to support a long term measurement programme.

The overall approach to water use measurement in the Bay of Plenty should be that it an essential part of the development of water resource management. The development of a comprehensive programme stands to benefit all water users by improving knowledge on demand for water and the impact of this demand on the resource. As such, it will contribute to the optimisation of water availability and the use of water to support environmental, social and economic goals in the region.

7. REFERENCES

ARL, 2007. Professional Services Proposal; Developing a water measurement strategy for the Bay of Plenty Region. Aqualinc Research Ltd, Hamilton.

EBOP, 1999a. Operative Bay of Plenty Policy Statement. Environment Bay of Plenty, Whakatane.

EBOP, 1999b. Compliance Report of Surface Water Abstractions in Catchments Under Abstraction Pressure. Prepared by S. Hodges and D Gordon for Environment Bay of Plenty, Whakatane.

EBOP, 2001. Compliance and Impact Monitoring Policy 2001. Environmental Report 2001/02, Environment Bay of Plenty, Whakatane

EBOP, 2007. Proposed Regional Land and Water Plan. Environment Bay of Plenty, Whakatane.

MfE, 2006a. Snapshot – *Water Allocation in New Zealand*. Prepared for the Ministry for the Environment by Aqualinc Research Ltd, Christchurch.

MfE, 2006b. Water Measuring Devices – *Stocktake of existing situation*. Prepared for the Ministry for the Environment by Aqualinc Research Ltd, Christchurch.

MfE, 2006c. Proposed National Environmental Standard for Water Measuring Devices. Discussion Document. Ministry for the Environment, Wellington (downloaded from website www.mfe. Etc).

MfE, 2007. Proposed National Environmental Standard for Water Measuring Devices. Report Submissions. Ministry of the Environment, Wellington

Stats, 2004. Water Physical Stock Accounts for the June years 1995 to 2001, Inaugural Report. Statistics New Zealand, Wellington.

Appendix A: Study Scope

The study scope as listed in the proposal for services (ARL, 2007) is:

The overall objective is to review and outline a programme for the development of water measurement as part of Environment Bay of Plenty's water resource consenting and management responsibilities. The study will provide an evaluation of issues and key elements to the development of a comprehensive water measurement strategy. As listed below one of the key outputs will be identification of the key issues and options requiring future development.

Specific elements of the study will include:

- *Outline of the current water measure activities and organisation (largely based around consent conditions and consent compliance).*
- *Specification of needs to meet in-house requirements (consent and water resource management) NES and national reporting requirements (SOE).*
- *Preliminary plan for development of water measurement to meet technical and management needs such as:*
    - *Consent management (assessing cumulative effects)*
    - *Consent compliance*
    - *Water resource management (determination of water availability and allocable resources)*
    - *NES requirements*
    - *National reporting*
    - *Data transfer storage, QA and reporting*
    - *Meter compliance certification.*
    - *Organisational issues*
    - *Timeline for implementation*
    - *Information gaps and additional needs requirements.*

The study output will be a report presenting the findings, analysis, schedule and discussion. Where relevant the report will also be supported with information and data, such as maps and technical specifications.