Using enhanced knowledge of climate variability for the benefit of water resource management

Climate 4 Water (C4W); K5/1566

Progress Report Year 2

30 March 2007

Management

A steering committee meeting was held in April 2006 that was useful in guiding and supporting what we are doing and plan to do.

Regular meetings of the University of Cape Town team members have been held throughout the year, with a total of 10 meetings held in this time. These meetings have enabled the team to keep up to date on developments within the project and discuss proposed plans.

Assessment of interviews

Discussion of findings from case study interviews of 2005/06 led to the first deliverable of the year on 30 May 2006: *Assessment of adequacy / inadequacy of current climate prediction tools in relation to water resource management requirements as gathered from the case studies*. This is attached as Appendix 1.

Workshops and Focus Groups

First workshops and later focus groups were held in Overstrand and Cape Town. In the workshops, presentations were given on different weather and climate forecasts that are available. We gained information from water managers on the strengths and weaknesses that they attribute to the different forecasts and established the type of forecasts and climate information water managers use in their work, or would find useful in their work. The focus groups helped water resource managers to consider how forecast and climate change information could be better used for decision making.

Overstrand workshop

The Overstrand workshop was held on 29 May 2006. It was attended by 14 water managers and stakeholders from the Overstrand area as well as 7 members of the C4W team.

Cape Town workshop

The Cape Town workshop was held on 2 August 2006. It was attended by 22 Cape Town water managers as well as 6 members of the C4W team.

Overstrand focus group on water disposal, stormwater and disaster management

One focus group was held in Hermanus on 22 September 2006, covering the three different interest areas outlined above. It was more practical to have a single focus group as the same people in the municipalities dealt with all of these areas. There was no need to hold a water storage group as water storage in the area is controlled by DWAF Western Cape, and there was not enough interest to hold either an agriculture or biodiversity group. The focus group was attended by 4 Overstrand municipal officials whose portfolio included water management, plus 4 members of the C4W team.

Cape Town focus groups

Four separate focus groups were held as follows:

- Water storage 22 November 2006 (attended by 4 people)
- Water supply and disposal 22 November 2006 (4 people)
- Disaster management 29 November 2006 (5 people)

- Nature, biodiversity and agriculture 29 November 2006 (3 people)

Three C4W members attended on 22 November and five on 29 November 2006.

A full summary and discussion of the workshops has been done in the C4W deliverable of 15 November 2006: *Report back on Stage 2 Workshop aims 1, 2 and 3* which is attached as Appendix 2. A summary and discussion of the focus groups was done in the C4W deliverable of 15 February 2007: *Report back on Stage 2 Workshop aim 4* which is attached as Appendix 3.

Toolkit planning

Information gained from interviews done in the previous project year as well as the workshops and focus groups done in the current project year have been discussed at several team member meetings in 2007. Toolkit planning, development and rollout for the upcoming deliverable is the current priority and all meetings have focused on the content, delivery and monitoring planning.

Appendix 1: Assessment of adequacy / inadequacy of current climate prediction tools in relation to water resource management requirements as gathered from the case studies.
C4W deliverable 30 May 2006

How do interviewees use weather and climate information?
Interviews in Cape Town and Overstrand
Water resource managers in the municipal, agricultural, environmental and Department of Water Affairs and Forestry sectors were interviewed in Cape Town and the Overstrand. In Cape Town these were:

- Willie Enright (DWAF Western Cape)
- Bertrand van Zyl (DWAF Western Cape)
- Anton Sparks (Ninham Shand: consultant to DWAF)
- Mike Killick (Planning manager: bulk water and infrastructure, CCT)
- Letlhogonolo Motlhodi (Head: CCT bulk water), Arne Singels (ex Head of CCT bulk water), Rodney Bishop (CCT water engineer, special interest in groundwater)
- Henk Cerfontein (DoA Western Cape)
- Hans King (DoA Western Cape)
- Dean Impson (Cape Nature)

In the Overstrand:

- James van der Linde (ex Water Engineer, Overstrand Head Office)
- Dennis Hendriks (Overstrand Head Office Senior technician: water & sewerage), Dion van Vuuren (Hermanus Operations Manager for Services)
- Dirk Crafford (Gansbaai Operations Manager for services)
- Mike Bartman (Kleinmond Operations Manager for services)
- Bea Whittaker (DWAF consultant. Communications officer on Greater Hermanus Water Conservation Campaign in 2000)
- Rory Pringle (farmer above de Bos Dam)
- Dries Potgieter (Overberg Water)

Use of forecasts in Cape Town
It was found that water managers in Cape Town used weather and climate information far more than those in Overstrand. In general shorter-term forecasts were used more than longer-term forecasts. The water resource managers in Cape Town (with the exception of Dean Impson) all used a variety of forecasts, including:

- 1 – 7 day forecasts from SAWS and/or CSAG
- Fortnight/month forecasts from SAWS and/or CSAG
- 3 month/ seasonal forecasts from SAWS, CSAG, GFCSA, IRI
- Raw data from the SAWS airport weather station, ARC and other sources
- Rain data from various weather stations, especially at dams

The DWAF and some CCT water resource managers we interviewed use a bulletin emailed approximately weekly by Anton Sparks. Sparks has been appointed as a consultant by DWAF in the Western Cape to inform key water decision makers of weather and seasonal climate forecasts and their possible impact on water resources in the CMA and certain parts of the Western Cape. He said that he used raw data and forecasts from SAWS, CSAG, as well as other experts' opinions to make his bulletin, adding his interpretation and advice for water managers.

The weekly bulletin runs to about 20 pages and includes:

- Information on the current situation (including cumulative rainfall figures and dam levels),
- Dam storage forecasts under different demand scenarios (including suggestions for management of water in dams supplying Cape Town)
- 7 day weather forecast for Cape Town and specific towns in the Western Cape
- One month and seasonal forecasts for the country

CCT water managers

CCT bulk water managers used shorter term (daily to fortnightly) forecasts to manage the water in dams. Forecasts informed their decisions on strategic shifting of water – movement of water from one dam to another, as well as which dam(s) to draw on at that time to supply Cape Town. Mike Killick and Arne Singels said that they used the forecasts to inform their own thinking, discussed them with others (especially DWAF), reported on them in water liaison meetings and to politicians, and Killick sent planning decisions to operations. The most important aspect of the forecast was rainfall intensity and thus runoff.

Seasonal forecasts were mainly used in drought management. Longer-term forecasts were seen as less skilful than short-term forecasts. E.g. Killick perceived the skill rate for daily forecasts as 80%, fortnightly as 60%, 3-month as 50%.

Long-term predictions such as climate change scenarios informed their thinking of future resources along the line of diversification.

In the CMA the water is managed as a system and the major dams are linked (Integrated Water Resource Management). Killick said Cape Town is proactive on water resource issues**.** He has a good relationship with DWAF – they operate together and share a vision.

DWAF water managers

DWAF water managers use 1-7 day, monthly and 3-monthly forecasts from CSAG and SAWS as part of their decision-making, but use Anton Sparks' bulletin especially. Willie Enright said he was "sustained by the bulletin" which is also improved by discussions. Through it he can see trends. He has seen scientific models used in longer term forecasting are working.

There are four water management areas the Western Cape: Berg, Doring, Breede and Gouritz. Cape Town's water comes from dams in some of these catchments. The dams used are Steenbras Upper & Lower, Wemmershoek (owned by CCT), Theewaterskloof, Voelvlei, Palmiet (owned by DWAF). Eskom uses Palmiet scheme for hydroelectricity generation, so minimum 1 million m^3 must be held back in Palmiet. A new dam is being built on the Berg River and will come into use in 2007. Willie Enright said farmers in the Breede river area get water from Brandvlei dam, which could become part of the CCT system because the watershed is relatively low.

DWAF make overall decisions about level of restrictions and where Cape Town must take water from. They control many of the dams that are the only source of water for towns throughout South Africa. They also advise farmers and other groups.

Bertrand van Zyl said that he talks regularly with Mike Killick (CCT Bulk water) in winter regarding water plans. He makes decisions on water use planning and disaster management preparation e.g. when floods are expected. He monitors seasonal forecasts, if a dry season is predicted he calls a meeting of the planning committee together to discuss water restrictions and possible emergency measures. The committee includes water managers in CCT, Stellenbosch, Paarl, West Coast municipalities, DWAF, consultants and the irrigation board. It meets every 2 weeks during restrictions, and every 2^{nd} month during quieter periods.

<u>Use of forecasts in the Overstrand</u>

In contrast to Cape Town, water resource managers in the Overstrand made little, if any, use of weather and climate forecasts in their work. The main reason cited was lack of time, however it was evident to the interviewers that lack of awareness of forecasts available and their possible uses was also an issue.

Currently water management is just a small part of the job portfolio of the municipal officials interviewed in Gansbaai and Kleinmond. Their roles are described as "Operations Manager for Services" and include water, sewerage, roads, parks, beaches, cemeteries, refuse and services to informal settlements. In Hermanus the person currently in charge of the water portfolio deals with

water and sewerage for the entire Overstrand area as well as specifically Hermanus. The position of Water Engineer for the Overstrand has not yet been advertised since James van der Linde left in December 2005. The Director of Services resigned at the same time and his position has also not been filled. Time is clearly a big limiting factor for the officials in the Overstrand municipality. This could well be common in many small municipalities in South Africa, where a wide range of services need to be managed by one person.

It was apparent that none of the Overstrand municipal officials were aware of all the forecasts that were available or the usefulness of forecasts in their work. Many of those interviewed were not clear on the meaning of forecast terms such as probability. Thus some training in the area would be useful – this will be initiated as part of the workshop in the Overstrand on 29 May 2006, and continued at focus group meetings with those people who express interest.

A regular newsletter (similar to that of Anton Sparks) giving weather / climate forecasts and pertinent water information could be useful to water resource managers in the Overstrand. Three of those interviewed said that if an interpreted forecast were sent to them it would certainly be used. As time is an issue, they asked that the newsletter be fairly brief.

What are the gaps in forecasts – what tools are needed?
Interviewees were asked what shortcomings they had found in forecasts and to give suggestions or their "wish list" for forecast tools. In Cape Town these included:

Shorter-term forecasts

- Better information on rain intensity.
- A 3 to 4 day rainfall and temperature forecast for sluices.
- Indication of rainfall over 8.5 mm expected
- Studies on rainfall spatial and temporal distribution as well as intensity
- Rainfall response to changes
- Mike Killick requested specific tailored daily forecasts with precipitation intensity
- Dean Impson requested data loggers in rivers: especially Olifants-Dorings and Gouritz

Longer-term forecasts

- Improved long-term forecasts
- Information on the website about the principal drivers behind long-term forecast. This would increase confidence.
- For CSAG 1- and 3-month forecasts would like links to normals, an indication of expectations, and show skill levels.
- For long term scenarios (climate change): air temperature related to water temperature
- Research on changes to vegetation as a result of climate change. This is important for TMG aquifer: need to know the effect on fynbos ecosystem of pumping the aquifer, and what will happen in TMG wetlands?

As mentioned, Overstrand water managers are generally not using forecasts in their work. A regular emailed newsletter giving forecasts and an interpretation for water management is clearly needed. Several people asked for forecasts which are already available, such as a 7-day forecast, temperature conditions, warning of severe events – winds, rain. Other requests included

- Rainfall patterns
- Localised information of daily rainfall statistics,
- Warning of sea storm surges

Regarding longer-term forecasts Dennis Hendriks mentioned forecasts giving predicted amount of rain rather than a percentage of the normal rainfall. He said he needed interpreted weather/climate information.

Conclusion

The choice of case study areas proved an interesting one, as it illustrated very clearly the difference in use of forecast information between water resource managers in a metropolitan area and a small municipality. Climate and water are very closely linked in the Western Cape, yet in Overstrand (an extremely water-stressed area) little use is made of climate forecasts in managing water. The municipal water managers in CCT are in charge of only water, while in the Overstrand operations managers of all services delivered by the small towns include water in their porfolios. Thus it could be said that it is less important to them as it makes up a small part of their job. However it was clear that lack of knowledge of forecasts available and capacity to interpret the forecasts was an important factor. An interpreted forecast emailed to the water managers would be a logical way to solve this issue, coupled with training on use of weather/ climate forecasts in managing water resources.

In short-term forecasts, predictions of rainfall intensity in order to manage runoff to dams and possible disaster management was the most frequently requested information.

Most of the people interviewed felt that longer-term forecasts were less reliable than shorter-term, and several expressed the hope that the skill level would improve.

For long term scenarios, Arne Singels (CCT) summed up the feelings of several water managers when he said (paraphrased) “Scientists can tell me there is climate change but that doesn’t tell me what will happen to my run-off and that is where professors (experts) should comment. And it depends on the type of climate events. So if I take note of climate change it doesn’t necessarily tell me what to do with water management. The WRC should be able to provide that kind of research if we desired that.”

List of acronyms

CCT	City of Cape Town
CMA	Cape Metropolitan Area
CSAG	Climate Systems Analysis Group, University of Cape Town
DoA	Department of Agriculture
DWAF	Department of Water Affairs and Forestry
GFCSA	Global Forecasting Centre for Southern Africa
IRI	International Research Institute for Climate and Society
SAWS	South African Weather Service
TMG	Table Mountain Group (aquifer)

Appendix 2: C4W deliverable 15 February 2007

C4W Deliverable 15 Nov 06: Report back on Stage 2 Workshop aims 1, 2 and 3

Two workshops were held, one in each of the C4W study areas – Overstrand and Cape Town. They were well attended and about half of the time was spent in presentations on weather and climate forecasting and the types of forecasts available, while the other half was spent getting information from delegates on the types of forecasts that they use in their work, or climate information that they would find useful.

Most delegates expressed appreciation in their feedback on the workshop, and it was clear that there was a high level of interest, especially in the Cape Town workshop. This was also made evident by the number of people who expressed interest in coming to focus group meetings, and the fact that we have had an excellent response in arranging Cape Town focus groups for later in November.

In Overstrand fewer people used weather and climate forecasts in their daily work. Although delegates enjoyed the workshop, as reflected in their positive feedback, there was less interest in coming to focus groups in September. In the end only one focus group was organised, for 5 municipal managers.

Overstrand workshop

A workshop was held on 29 May 2006 for water managers in the Overstrand. It was attended by 13 people representing the municipalities, nature conservation, DWAF, agriculture and rate payers associations.

Aim 1: Determine delegates' understanding of climate variability and climate change

Delegates were asked to fill in a questionnaire on arrival which was used to meet the first aim.

Their responses are summarised below:

Do you currently use any weather or climate information in your work?	Yes (9) No (4)
Have you ever accessed any type of climate related forecasts?	Yes (10) No (3)
If yes, which did they include: 2 day, 7 day, 2 week, seasonal	2 day (7) 7 day (1) 2 week (5) seasonal (4)
What variables where you interested in?	Rainfall (11) Temperature (8) Wind speed / direction (1)
How did you access this information?	Radio/ Television (4) Newspaper (2) Internet (9) Email (1) Phone airport (2) Cell (1)
Did you find the forecast easy to understand and use?	Yes (9) Newspaper more difficult (1)
Was there anything lacking that you would have liked to have seen in the forecast?	No (4) Crop info, area specific, translation to English (Overbergagri), greater accuracy, rainfall intensity, more detailed discussion in media, monthly f/c, historical averages (7 year)
Was the timing of the release of the forecast suitable? i.e. was it received in advance time to help in decision making or planning?	Yes (7) Yes but often wrong – causes delays (1) Not always(1)
Did you pass the information on to anyone else?	Yes (7) No (2)
Can climate information help in decision making related to your work?If so please list some decisions that are applicable	Yes (11) Disaster management, water conservation, demand management, fire anticipation, development planning, daily work operations, groundwater recharge & abstraction rates, water pricing, drought / flood planning &

	implementation, water allocation & licences
For those who have not used climate forecasts:	
Would you be interested in receiving climate/ weather forecast information?	Yes (3)
What kind of information would you like to receive in a forecast?	Seasonal rainfall, info to encourage water conservation & assist Kogelberg Reserve
Which variables would you like to have on a forecast?	rainfall
Which forecast timeframes interest you most	1-3 months (1) 3-6 months (2) 6+ months (2)
Would you pass this information on to anyone else?	Yes

Aim 2: to identify the strengths and weaknesses in current forecast tools

A brief presentation was given of four different forecasts available (SAWS 7-day, CSAG 6-day, SAWS seasonal, CSAG seasonal). Delegates then spent time looking at posters of 4 different forecasts and sticking up post-it notes of positive or negative comments on the different type of forecasts.

SAWS daily (7 days) (A)

Strengths
- Easily read
- Clear and easy to understand
- Clear and specific
- Quick and easy to read
- Simple
- Accessible
- User friendly
- Good altogether
- The best poster

Weaknesses
- More information about sea conditions will help
- "Strong" wind – rather give speed range
- Does not quantify rainfall
- No spatial information
- No fire index
- Does not allow for uncertainty
- Compare Overberg Agri format

CSAG daily (6 days, only one 6 hour forecast shown) (B)

Strengths
- Spatially explicit
- Well presented
- Gives very clear forecast
- Best one

Weaknesses
- Not that easy to read and understand
- Don't understand it
- Can't understand terms or how forecasts are x hours old
- Not easy to understand – no keys to interpretation
- Explanation of 'geopotential height'?
- Mm on bottom scale not showing, therefore unclear
- Difficult to interpret for a particular place
- Need more accuracy at local level

SAWS Seasonal (C)

Strengths
- Seasonal forecast very important
- Actually shows that these things are very statistically based
- Very well understood

Weaknesses
- Need more accuracy
- Make it more local / regional
- Not enough regional detail
- Too broad with regard to areas
- Not area-specific enough

- Areas too broad, e.g. coastal vs inland given same colour code
- Transition line about 100km across – what happens here?
- Too busy
- Difficult to comprehend all the detail

CSAG Seasonal (D)

Strengths

- Easy to follow
- Easy to interpret
- Easy to interpret
- Well presented
- Nice colours
- Good detail – nice colours
- Colour coding great
- Good spatial detail
- Better – more user friendly than SAWS
- Gives a seasonal picture, which is very important

Weaknesses

- Very busy
- Need specific area
- Would like more local detail – WCape
- Regions too widely defined
- Too little detail
- Takes too long to read, need some knowledge
- Needs more explanation as to what the key means
- Takes more time to read – need some knowledge
- What is: 700hPa geopotential height; vorticity?
- Need also longer term forecast

<u>Aim 3: to examine the type of climate variability information managers think would be relevant at an annual and longer-term scale</u>

Delegates were asked to think and make notes about the kind of climate information that they would find useful in their work. They were asked to consider the timing, resolutions, variables and format of the information that they would like to receive. (Note that there was no restriction to annual or longer-term scale). Responses were noted on flipcharts.

TYPE OF FORECAST (TIMING) ← when received

- Weekly with pictures, but need concise version
- Weekly rain & wind ← previous Friday
- 7-day forecast updated 3-hourly (Nature Conservation)
- 2 – 3 weeks (to predict water demand)
- Seasonal 1-3, 3-6 month, annual
- 3-months (operational planning) ← rolling
- Agriculture: whole range of info. April to October ← before people plant
- Medium term (18 months) ← autumn
- Long term (3 years) ← updated annually
- 5 years (more climate change) ← at year start feb/mar/apr
- Ten year scenarios re water
- Long-term scenarios

RESOLUTION

- Coverage over larger area
- Specific to Western Cape (long term)
- Southern Cape – mountains & concentrate on ‘vlaktes’
- More specific re topography and rain shadow
- More specific within area
    - Hermanus different to other areas
    - East vs West
- Berg / Breede WMAs
    - Velddrift to Cape Town
    - Every different catchment
    - Recharge area-specific

OTHER VARIABLES

- Short term: precipitation, wind, temperature (short term operations)
- High rainfall / severe events / flood warning (breaching estuaries)
- Wave heights
- UV
- Fire-risk
- More interpretation and reasoning e.g. when fire risks, when to burn
- Real management and conservation recommendations
- Informing water demand and management strategic long term
- Seasonal: + temperature (for restrictions)
- Water restriction and related warnings
- Long term historic data sets for comparison ↔ baseline
- Agriculture: risk & variability mapping (coupled to seasonal forecasts)
- Impacts on local rivers, development control
- Long-term effects on groundwater
- Increased data stations: recommissioning plus adding others

FORMAT & COMMUNICATION:

- Web best
- Not too much small print
- Simple
- In general – needs more community awareness workshops
- Newsletter emailed every Friday
    - Including interpretation
    - for both short term and seasonal
    - Sent via email to people who request it
- Periodic report / summary with some interpretation and explanation (simple)
- Explanation of terms
- Ability to ask questions online
- Website with combination
- Warnings sent by sms or email if you register for them
- Target recreational sports
- Phone in number
- Standard forecast with quick explanation
- Seasonal newsletter and long term

Cape Town Workshop

A workshop was held on 2 August 2006 for Cape Town water managers. There were 22 delegates, including:

- 6 from the City of Cape Town,
- 5 from Dept of Water Affairs and Forestry,
- 5 from Cape Nature,
- 3 from Dept of Agriculture,
- 2 from Ninham Shand
- 1 from Berg River reference group

Aim 1: Determine delegates' understanding of climate variability and climate change
Delegates filled in brief questionnaire determining their understanding of climate variability & climate change. Their responses are summarised below:

Do you currently use any weather or climate information in your work?	Yes (20) No (2)
Have you ever accessed any type of climate related forecasts?	Yes (20) No (2)
If yes, which did they include: 2 day, 7 day, 2 week, seasonal	2-7 day (16) 2 week (7) monthly (8) seasonal (16))
Regardless of any forecast you may have used, which timeframe(s) interest you most?	
What climatic variables are you most interested in?	Rainfall (21) Wind speed / direction Min Temp (5) Max Temperature (8) Ave Temp (3) Relative humidity (1) Rain data (1)
Is there any other variable(s) that should be included in the forecast?	Surface temperature, wind direction and speed, relative humidity, rainfall intensity, longterm variation, flood warning
How did you access / receive the forecast?	Newspaper (4) Radio/ Television (10) Internet (17) Email (10) Cell/sms (3)
Did you pass the information on to anyone else?	Yes (19) No (3)
Would you be interested in receiving updated climate/weather forecast information?	Yes (21) No (1)
Can climate information help in decision making related to your work?If so please list some decisions that are applicable	Yes (22) • Planning, • emergency preparedness, • environmental impact evaluations, • early warning crop estimates – identify risk areas, minimum annual rainfall figures - dam levels & planning, • scheduling prescribed block burns, • fire management, • vegetation monitoring, • planning outdoor work, • agricultural water use planning & management, • management of water resources to avoid unnecessary spillage from Western Cape dams • dam inspections, river bank inspections, • whether to apply water restrictions (2-3 months forecast), • whether to make an environmental flood release (1-5 days forecast of significant flood

	events), • to determine water management charges

Aim 2: To identify the strengths and weaknesses in current forecast tools

A brief presentation was given of four different forecasts available (SAWS 7-day, CSAG 6-day, SAWS seasonal, CSAG seasonal). Delegates then spent time looking at posters of 4 different forecasts and sticking up post-it notes of positive or negative comments on the different type of forecasts.

CSAG daily:	
Good ▫ Rainfall intensity predicted! ▫ Rainfall intensity ▫ Locality of rain shown ▫ Actual rainfall depth predicted ▫ Useful indicator of future rainfall ▫ Very useful to see the movement of the weather pattern. Allows one to anticipate rainfall events etc ▫ Graphs give clear representation of pressure/ rainfall ▫ Gives a trend over time therefore invites interpretation ▫ Nice layout ▫ Most useful model. Graphically well laid out ▫ Looks useful ▫ Good ▫ Never seen but it looks good	***Bad*** ▫ Good level of detail but too specialist for interpretation ▫ Period over which intensity is shown may be misinterpreted as mm/day ▫ Could models results be displayed to give a better indication of when rainfall might commence (for flood reliant forecasting) ▫ Grid undefined appears quite often ▫ Could screen include link button for comment?
SAWS 7 day	
Good ▫ Reliable ▫ Usually correct ▫ Good – like it ▫ Useable ▫ User friendly ▫ Easy to use ▫ It is useful and friendly ▫ Variation during the day ▫ It can guide you through the day ▫ Easy to understand ▫ Easy to read, simple and not a lot of colours ▫ Easy to follow and useful ▫ Used frequently – gives quick answers ▫ Useful as a general tool to get a quick idea ▫ Something hotels, tourism like to display ▫ Level of detail ▫ Information is point specific ▫ Information is stated with a high level of certainty – that can be used in a simple manner for planning (no probability/ estimation effort required by users)	***Bad:*** ▫ Too vague for flood forecasting or water resources management ▫ Too general to be used alone – need other tools to be more confident ▫ No relative humidity ▫ No intensity figure ▫ No indication of intensity ▫ No indication of quantity (mm) expected ▫ Does not predict precipitation depth ▫ Rather use Agric 5 day forecast -- gives mm rainfall ▫ Days since last rain and amount ▫ Terminology confusing ▫ “At first” – morning? Then say so ▫ What is the relevance of moonphase/ moonrise More symbols (visual)
SAWS seasonal	

Good ▫ Gives a good general idea of the spatial weather pattern probability ▫ Normal indicated clearly by separate colours ▫ Good overall indication	***Bad*** ▫ What is normal? 100% or say 80% - 120% of longterm average rain? ▫ Lack of resolution ▫ Resolution ▫ One needs to be careful in interpretation because of lack of resolution ▫ Resolution too coarse for WCape ▫ Too coarse ▫ 3-block system confusing (CSAG is more user friendly) ▫ More areas! ▫ Prefer more categories (3 too little, prefer 4/5) ▫ Range within area below cut-off area line not given ▫ Not specific for Western Cape – based on summer rainfall ▫ Confusing ▫ Not user friendly and is complicated ▫ Needs information defining interpretation ▫ Not easily understandable for lay person ▫ Difficult to fully understand all the data and what they mean in terms of rainfall unless one is a specialist ▫ The written explanation requires a lot of (informed) interpretation (not user friendly) ▫ Information leaves to user with a lot of uncertainty and guestimation to be done by him/herself ▫ Indicate the level of skill (accurate success) of forecasts ▫ Reliability not given ▫ Prefer CSAG but this is simpler ▫ Does not express intervals in given period. What about every 10 days? ▫ Wrong rain AB, wrong rain RB, wrong temp Bd
<u>CSAG seasonal:</u>	
Good ▫ Easy to visualise the climatic variations & probability ▫ Colour coding is clear & gives good indication of precipitation probability ▫ Precipitation probability useful ▫ Includes information about uncertainty ▫ Nice & colourful ▫ Make colour coding for 80-100 and 100-120 shades of same colour (close to normal)	**Bad:** ▫ Not clear to me ▫ Not clear ▫ No clue! ▫ Difficult to understand especially if you are not working with it. ▫ Interpretation too specialised – not user friendly ▫ Objective not clear ▫ Rationale not clear ▫ Description of the shading should be on key and not hidden in text. Users only look at graph. ▫ Need to define hatched area on the chart i.e. <90% confidence ▫ Term “anomaly” may confuse many ▫ Need to understand what “anomaly” means –

	definition is not clear (Does it mean that the average of 10 model runs shows a departure from the averages established by the model in the calibration period 1985-99?) ▫ Rainfall (mm) clearer than anomaly? ▫ Zone for average 90% - 110% ▫ Probability brackets ▫ Combine actual and predicted to obtain cumulative rainfall for winter season ▫ Resolution difficult to interpret for small areas such as WCape mountains ▫ Need fewer "grey areas" – interpretation of grey areas is difficult. 70-90, 50-70, 50< ▫ Blue may still mean no rain if average is zero ▫ Probability brackets should rather be 0-50, 50-75, 75-90, 90-110, 110-125, 125-150, 150-200

Aim 3: To examine the type of climate variability information managers think would be relevant at an annual and longer-term scale

Delegates were asked to write down their answers to four questions:

1a) Which climate information presented today would you/do you make use of?

1b) Please give examples of where you think the information may be useful and of how you use it.

2a) Is there any ideal (but possibly not available) climate information that you would consider helpful/applicable?

2b) How could your management decisions be improved upon or assisted by such climate information?

Useful Climate Information	**Examples of Use**
Rainfall intensity data (historical)	Design of storm water infrastructure Flood prediction
Rainfall intensity data	Planning irrigation schedules Water transfer planning Disaster management Flood prediction
Change in temperature (weeks to month)	Algal bloom management Fire management (7-day forecast) Planning irrigation schedules
Wind conditions	Planning irrigation schedules Fire management
Radar	Intensity prediction Storm management Dam release Rescue
Seasonal forecast	Flood probability (could be used) Agriculture – crop management certain vs uncertain water Grain farming – cash crops (could be used) Game farm water provision Management of artificial recharge of groundwater
Ideal climate information	**How management decisions are improved**
Return period of particular storm	Risk mapping

Rainfall intensity at a smaller time scale	Water transfer planning Disaster management Flood prediction
Temperature change at fine spatial res	Algal bloom management Fire management
Chill unit predictions	Apples and grapes etc
Integration of all the data in one place	
Speed of the frontal system	
Historical demand for water vs temperature Prediction of temperature	
Better accuracy for seasonal forecast	Dam construction and level management Corresponding runoff so decisions for water use can be made
Feedback of accuracy	
Artificial recharge of groundwater	

A more detailed spreadsheet showing delegates' written responses is shown below:

Which climate information presented today would you/ do you make use of?	**Please give examples of where you think the information may be useful and of how you use it.**	**Is there any ideal (but possibly not available) climate information that you would consider helpful/ applicable**	**How could your management decisions be improved upon or assisted by such climate information?**
All 4 are useful, but not equally so, depending on what one is attempting to use the f/cast for The non-graphical SAWS 7-day possibly the least useful for long term water resource planning because the spatial component is obscure	* Day to day planning: SAWS 7 day is useful with a low level of confidence, but better than the media's efforts. CSAG daily is better because one can observe the changes and develop a mental picture of the likely scenarios to plan for. * Long term planning: SAWS seasonal & CSAG are probably equally useful	* accuracy & skill issue is important to emphasize because without this being understood most predictions seem vague & imaginary. Possibly a more easily understood representation of this could be included with each type/ representation of f/cast. * rainfall intensity related to a particular storm but historical and likely and current. Could be used to understand the return periods, risk association. *integration of data sources i.e. rain, wind, temp etc * historical performance of the predictions	The uncertainty of predictions then translated into scenario planning needs to be improved for all sorts of decisions e.g. restrictions, new infrastructure, flood control
* all f/casts, current, medium term & seasonal. * web-based images & data * networking with informants for further exchanges * archived information - for analysis return periods	* locating gauges, weirs, boreholes. To make better decisions and implement on where to position our measuring and abstracting resources * preparing for slow onset and sudden onset emergencies: fire & flood -- disaster management		
* forecasts: CSAG & SAWS (rainfall) monthly & seasonal * actual rainfall of past months: ARC (custom products specifically done for us - rainfall maps; actual data of certain climate stations)	Give picture of actual/ current situation of the climate of past months for agriculture, ground … with actual Agricultural production (specific crops) i.t.o. crop estimation and identify risk areas especially i.t.o. forecasting	More detailed forecasts for the Western Cape, taking mountains into consideration. Shorter forecasting intervals for seasonal forecasts (broken up in smaller periods). Maybe a separate WR forecast (frontal) and SR (?) forecast in the Western Cape to show the different effects on different regions within WCape.	* give a more detailed picture on which agriculture can make accurate decisions ito climate variability vs climate change and if necessary change agricultural practices. * incorporate / interpret wrt crop production maps Above refers to the growing season Apr-Nov for winter

			cereal crops
1) rainfall/ precipitation (unit days) 2) temperature - localised (weeks to a month) 3) rainfall intensity both historical and current 4) wind direction	1) dam/ reservoir levels (supply & demand of potable water) 2) temp levels conducive to algal growth - prediction & timing of interventions 3) flooding 4) control/ monitor veld fires * Catchment/water resource mgt -- longterm capex planning e.g. dams (surface) * Stormwater/underground -- aquifer/ drawdown and recharging cycle * Irrigation -- seasonal & ... farming * Water demand mgt -- water supply vs demand mgt in planning	cannot think of any	in capital budgeting, improve the integrity of assumptions made during the modelling and planning phase
Short term f/cast: forecasting of high intensities for flood preparedness Long term f/cast: water use management (restrictions) from dams Long long term (e.g. CC) for planning of strategies for water supply	* Better dam operation / flood management if high precipitation predication are more accurate * Decisions on when to transfer water over catchments e.g. Palmiet to Steenbras * Decisions on where to increase water supply and where to restrict to get best yield from all dam systems * Decisions on when to release reserve requirements from dams for ecological functioning	* snow predictability * higher resolution of prediction on e.g. mountains (where most runoff is yielded for storage dams) * closer to real time for flood preparedness * predictions of 1 or 2 hour rainfall intensities rather than daily * more radar stations for real time data * historical rainfall & temperature data on maps	Better water management: at present we keep 50% of CCT supply dams for possible next dry years to come – too conservative, but safe due to lack of good predictions
* 7 day f/cast * seasonal and past f/cast verification - information * surface temperature	* 1 week river survey for SASSS and other River Health indices in WCape 4 WMA's * research purposes and added weighting for possible scenarios found from current baseline monitoring -- for Technical Report (fauna, flora & hydrological responses)	* catchment or major river specific past, current & future rainfall averages and extremes * surface temp averages and extremes of major river or catchment areas - past, present & future	* a more resolved management action plan can be drawn for the 4 CMA's of WCape in response to existing cumulative human induced disturbance pressures. * can use this for vegetation temp tolerance ranges & active rehabilitation where relevant
* daily forecast * 5-7 day f/cast, including temp, RH, wind speed, direction,	* scheduling of prescribed blockburns (mild, stable conditions in autumn ideal) * wildfire control - predicting climate	* more accurate seasonal forecasts for summer (extremes) (looking for rain / cool conditions)	predict severity of fire season (risk management)

rainfall probability * seasonal forecast	influences on fire behaviour & planning accordingly * scheduling work programmes in outdoor environment * monitoring local changes: - local weather conditions - water quality & quantity (mountain catchment management) - effect on vegetation - die off	* fire danger index (temp/ RH/ wind/ rainfall etc = FDI) * mountain catchment specific forecasts	
Locality specific forecasts (rainfall mm/day or mm/event) with a simple understandable indicator to show the user the level of confidence he can put in the f/cast	The user needs to make a simple decision, e.g. should water user association (irrigation board) pump water or not -- is the dam going to fill under natural runoff or not		
Use weekly and 3 monthly forecasts mostly. Do not use 14 day forecast due to confidence level	* weekly f/cast used to decide on how much (rate) water to transfer from sources e.g. Palmiet to Steenbras Upper Dam, & to anticipate when transfers are likely * 3 month f/cast used to look at overall risk of water restrictions and to assist managers & politicians in their understanding of the probabilities * should possibly use monthly forecast more	* need to know intensity in different catchments - specifically Steenbras Dam/ Wemmershoek catchment, Voelvlei & Theewaterskloof *How type/direction of system would impact on specific catchments. E.g. if frontal system came from a certain direction more rain could be expected in Steenbras catchment * relationship between rainfall & runoff? If rainfall occurs irregularly, does not generate runoff * how accurately can one predict temperature ahead (say 3 months)	* Environmental flood releases from Berg Water Project need to be predicted, local model may need to be developed * Temperature fluctuations/ predictions could help in determining summer water ….. Predictions * webpage with historic temperature (monthly average & maximum) and rainfall on a monthly basis
Rainfall intensity data (not presented) has been interpreted by various engineers (Midgeley, Pitman etc) to produce rainfall intensity prediction charts. These get used to determine 'design floods' (with various return periods) for different catchments	This data and 'design floods' get used to design infrastructure (road culverts, stormwater pipes, dam spillways, erosion control structures in rivers etc)	Should some means of predicting/ updating rainfall intensity data be available (i.e. predicting how the existing data will shift) the design of infrastructure can be updated	With the threat of climate change, if rainfall intensities change, hydraulic infrastructure (road culverts, dam spill ways, stormwater pipes etc) may possibly no longer perform as designed

7 days: rain, wind speed & direction, humidity, max & min temperature	* In March/April block burn planning & implementing. Rain forecast, wind speed & direction is very important. Humidity will tell what fire would do * Important for wildfire control - use daily f/cast to try to predict what fire would do. * Use 7 day f/cast and longer to planning camping in mountain catchment for alien eradication teams. Need this info to plan our work ahead	* humidity index * extreme - adverse conditions * heat wave/ very cold climatic conditions in high lying areas * berg winds	* fire behaviour and likelihood can be predicted by info supplied * can plan well in advance more … forward or postponed to later or earlier date * can predict dam levels and adapt management decisions
* daily forecast * 7 day f/cast with cloud information (satellite photo) * seasonal forecast (say 3 months) with probability zones	* in planning production activities on the farm * planning harvesting activities * planning irrigation application for optimising quality & yield - wind velocity * It is a absolute make or break in profitable commercial farming	* Wine, grain & fruit farmers need to have a more freely available, specialised and detailed service of weather f/cast. Promote yourself commercially! * More specific detail for certain areas like 10 x 10km areas if possible	
Weather forecast and its time frame of prediction. Rainfall intensity data	* impact if duties are performed in field * design structures to cater for floods * models like dams, bridges * filling dams & rivers	-	-
* CSAG daily forecast - rainfall intensity for flood prediction * SAWS seasonal f/cast * SAWS 7 day f/cast Conditions: temp, wind for fire mgt, temp for … mgt * Radar: for dam release	Help to determine water resource availability, the rate & balance of water in dams. (Steenbras Upper & Lower, Wemmershoek, Voelvlei, Theewaters-kloof). Most importantly our water system should be integrated to obtain optimum use of systems. Temp & rainfall pattern play pivotal role in decisions re water levels in dams etc. <u>Info</u> <u>Use</u> aquifer --> drawdown stormwater --> impact of sediment transport	Daily forecast: helps to guide the management of our dams in order to avoid overflows etc	<u>Inside:</u> plan better and cut costs on system optimisation and efficient utilization of water resources, pre-eminently the dams owned by the city <u>Outside:</u> the lessons learnt over the years could be utilised in other areas like other coastal or inland where the conditions are similar to the WCape system
CSAG daily f/cast (would like to use)	* rainfall f/cast to know when & how to determine water restrictions	CSAG daily f/cast (would like to use)	* to know what to expect, considering that SA is a water

	* during pricing strategy - to determine water management charges for each WMA (would also assist in planning resources needed, including human resources) * to know precipitation, weather & CC in that area - helps in planning to increase or build new storage		scarce area, and what mechanisms to put in place to determine water conservation & demand management * one could also look at demand now and start planning for management of it
a) 3 month seasonal f/cast b) in future 6 hour predictions	a) useful for future water resources management e.g. whether to impose restrictions or not (particularly the Aug/Sept/Oct forecast) b) might be useful for identifying potential significant flood events (e.g. storm rainfall that will produce the annual flood to be released from the Berg River Dam to meet the environmental reserve requirements	a) reliable long range rainfall predictions to enable reliable long range run-offs to be estimated so as to predict runoff and hence make improved management decision b) accurate short term rainfall timing & intensity prediction for accurate flood predictions c) improved understanding of historical a.... rainfall distribution particularly in micro-climatic areas such as the WCape mountains (rain gauges have to be scattered) d) radar may have high potential for short term ... information	
1) SAWS 7day 2) CSAG daily (haven't used yet) 3) CSAG & SAWS seasonal (have not used yet)	1) fire management, to determine conditions for formulation of action plan 2) fire mgt, to complement SAWS 7 day for planning of other catchment mgt activities e.g. monitoring 3) to draw up annual plans of operations e.g. trail maintenance, vegetation monitoring, control burns	Fire Danger Index map (using temp, RH etc)	Fire prevention activities would be more detailed
1) short-term, in particular where rainfall intensity is indicated 2) short- & medium-term rainfall predictions 3) long-term seasonal rainfall predications	1) used to predict floods & inform flood management risks below dams etc 2) monitor stochastic models and available water resources. Inform decision on the imposition of restrictions 3) Inform the need for new water resources & timing of infrastructure etc	Predictions of variation in extreme weather events and the possible effect of climate change on these e.g. an increase of 20% in max flood intensity	Assess the design of flood release mechanisms at dams i.t.o. capacity and associated operation of dams Droughts: water resource mgt wrt * water demand management * conjunctive use of water resources

			* diversification of water resources
1) 5 day agric f/cast / CSAG rainfall f/cast 2) 7 day f/cast 3) 2 week f/cast 4) seasonal monthly f/cast 5) seasonal 3 month f/cast	1) likely rainfall (mm) 3) some idea of following week's rainfall 4) 5) indication of whether the coming month will be above or below average. Possibly need to limit the interpretation to when zones are large and have higher confidence	a) annual forecast / winter forecast * estimate say rainfall for winter * during winter use actual rainfall that has occurred to replace that portion of the f/cast * the winter f/cast can be compared with the average rainfall for entire winter season * present info in mm and in % of normal rainfall b) would like to be able to obtain climate change info for long-term planning	a) the rainfall during winter will help to estimate how the dams will fill over winter and if restrictions will be necessary
* rainfall prediction: 1-3 days, 1-7 days, month, 6 month (probability & location) * real rainfall - cumulative for season, at different stations * temp - *coupled* & evaporation * wind speed & direction * flood warnings (extremes)/ rainfall intensity * cut off low systems - flooding * snow predictions	* operation of WCWSS to optimise storage and minimise spilling - seasonal f/cast * inform bulk water users on current situation and possibility of restrictions to be implemented * flooding - through Prov Disaster Management to warn about it beforehand * Temp & wind speed/direction for: (1) agricultural (2) fire management (3) personal reasons * will help rural teams to make decision on WRM and the development of new water resources * determination of flood lines / risk management	* give information per town / catchment - rainfall prediction - now only per graph * snow depth measurement	
7 day rainfall depths	flood prediction and risk management (particularly response planning)	rainfall intensity forecasts - 24 hour lead time	warning of flood vulnerable communities

Appendix 2
C4W deliverable 15 February 2007

Report back on Stage 2 Workshop aim 4: **Workshop that assesses how climate information might be better used among water resource practitioners**

Previous workshops were held in the Overstrand and Cape Town, with about half of the time spent on presentations on weather and climate forecasting and the types of forecasts available, and the other half spent gathering information from delegates on the types of forecasts that they use in their work, or climate information that they would find useful. Subsequently, focus groups were created according to various specific interests reflected within the larger groups. The focus group meetings were designed as a follow on to the earlier workshops, with the aim of obtaining in-depth information about ways that climate forecasts could better be used in different aspects of water managers' work.
Ultimately, the information from the workshops and focus group meetings will be used to develop an educational toolkit for translating climate information into decisions for water resource managers.

Overstrand
One combined focus group meeting was held with municipal water managers in the Overstrand on 20 September 2006. This focused on water disposal, stormwater and disaster management. This was the main interest area of water managers who had been present at the workshop earlier in the year, and due to the low number of people involved, it was decided to hold just the one focus group. It was also not relevant to focus on water storage as the Overstrand municipality relies on DWAF for access to water – they have no direct decision-making power in how water is stored.
The Overstrand focus group included Operations Managers for Services for the towns of Gansbaai, Kleinmond and Hermanus, as well as the Water Manager for the Overstrand.
The format was as follows:

1. a brief presentation of different forecasts available and how they are used
2. a presentation of the participants' previous responses (from interviews and/or the workshop) on the types of climate info accessed and how they use/can use it
3. discussion on their responses and ways that forecasts could be used
4. a group discussion on uses of medium term forecasts 1 – 6 months
5. a Forecast Risk Assessment exercise

Discussion:

- Weather information is currently mainly used to schedule regular work, such as road maintenance, clearing drains etc.

- Participants expressed the need for warnings of extreme weather. An sms warning was sent to them once by someone from DWAF, but the predicted weather did not happen. They said that they would be more hesitant to react to a similar warning in future.

- Long-term forecasts could be useful for planning tender publication.

- Monthly forecasts would be useful in summer, especially in December until early January over the peak season. Forecasts of rain, or even overcast weather could help in planning water purification. In hot, dry weather restrictions would be necessary as the water purification plant would not be able to cope with demand.

Participants said that they did not value maps as much as a brief summary of the forecast, together with probabilities. Alternatively, a website with a map and an interpretation would be useful. Participants said that seasonal forecasts were difficult to read/interpret - even with the training they had received in our sessions, they struggled to interpret the maps. Thus giving the un-interpreted maps to councillors to back up a request for imposition of restrictions would not be useful.

Cape Town

In Cape Town, four focus group meetings, of a similar format to the Overstrand meeting, were held on 22 and 29 November 2006. These were divided into the following groups:

1. Water storage
2. Urban water supply, water disposal and stormwater
3. Nature, biodiversity and agriculture
4. Disaster Management

1. Water Storage focus group

This was attended by 3 people from the City of Cape Town's bulkwater and groundwater departments and a consultant from Ninham Shand.

Discussion:

- During the climate forecast presentation there were questions about longer-term forecasts. Someone expressed the need for an annually issued forecast for the following 12 months. Decision making on water restrictions is made only once a year therefore shorter forecast is not quite suitable. Another delegate suggested that there should be another category of forecasts (9 months – 1 year), that is, between the existing medium and long term forecasts as most drought periods are 9 months.

- Medium term forecasts can be used for predicting the runoff from the upper Steenbras Dam to the lower Steenbras Dam and decisions about whether to have conjunctive use of dam and aquifer water.

- Climate (rain and temperature) greatly influences water demand in the city during summer months. This influences long-term planning. This was modelled by Ninham Shand during restrictions. One hot dry month isn't really a problem, but several in a row are more of an issue. An early warning system of progressive dry conditions would be useful.

- If climate change brings about a temperature increase in the long term, it would be logical to try to minimise future and existing dam surface areas, however there is little leeway as most of these controls takes place during the design stage.

- If an increase in rainfall pattern is to be expected then constructing new pipelines that could carry larger volume may need to be considered. However this would be an expensive investment, which would require strong confidence in the prediction, which currently they do not have.

- On the question of whether the city had planned for a drier future, it was mentioned that desalination was an option that was being considered as it represented a constant (though expensive) source of water.

2. Urban water supply, water disposal and stormwater focus group

This was attended by 3 people from City of Cape Town's bulkwater and catchment management departments, and a representative of Wildlife and Environment Society of South Africa (WESSA) .

Discussion:

- Significant increase in rainfall increases infiltration, which increases the volume of influx through the treatment plant and may disrupt treatment functioning. Infiltration may also lead to overflow of sewage into the natural systems.

- Effluent going through the treatment plants should not be too diluted as the plant was designed to accommodate a certain range of biological matter content in the water. Therefore over diluted effluent may disrupt functioning of the treatment plant. Conversely water with overly high

content of bio matter would also disrupt treatment plant functioning. Drier conditions, which lead to water restrictions, could induce more concentrated sewage which may disrupt the effective functioning of the treatment plant.

- Short term (monthly) changes in the rainfall pattern would not have significant impact on the water disposal system, but long term change may be significant and they would then construct wider piping systems. However this again require strong confidence in prediction, which is absent at the moment.

- Increases in temperature may enhance the functioning of the treatment as it may increase biological decomposing activities but this may also create stronger odours.

- Climate, rather than population, mainly influences seasonal pattern of disposed water volume.

- If there is a flood warning received from the weather service, little can be done in terms of mitigation, but rather disaster management preparation can be mobilised (e.g. have people on stand-by to unblock drains and to aid victims informal settlements.).

- Seasonal forecasts can be useful in terms of planning for a winter preparedness programme that would allocate human resource to sites that are susceptible to flooding. Drier conditions would have little effect on their design philosophy

- Long term prediction of rainfall intensity would be beneficial to help managers prepare for dam overflows, especially during the end of winter.

3. Nature, biodiversity and agriculture

This focus group was attended by 5 people, representing the Department of Agriculture, UCT freshwater research group, Cape Nature (Fisheries), Wildlife and Environment Society of South Africa (WESSA) and a farmer who is also a member of the Berg River Irrigation Board.

Discussion:

- One of the participants suggested that users traditionally lacked trust in weather/climate info (due to a perceived poor track record) therefore they tended to not to make major decisions based on such info. Users also often lack the necessary knowledge to utilise the info appropriately.

- Another participant agreed, saying that he received climate info and warnings via SMS, however he found the info to be rather inaccurate for his location area most of the time. Therefore he would like to have weather info that is more relevant and detailed for their area.

- The farmer suggested that a database be created, comprising of local weather information contributed by various farmers from different towns (e.g. Wellington) connected via a network (e.g. Cape-Agri) where the collected info could be sent to weather information sources (e.g. CSAG). The collected local observed weather information could be utilised by CSAG to derive a more detailed, large scale forecast or historical data and ultimately to improve details and understanding of the large scale weather information. *(This would make a very interesting future project)*

- In terms of water management, long-term forecasts and climate change projections are useful as:
  - Water resources are affected by the river/stream's biome, which is also affected by long-term climate change rather than short-term changes to which most organisms could adapt.
  - they assist in determining the appropriate amount of water to use
  - they are essential in determining rules for dam operation (e.g. amount of water to release).

- The Berg River project is a high profile project that has an environment monitoring committee, which is likely to integrate climate information into their study.

- In general, plants and animals are quite adaptive to change in the short term (unless very large and very sudden) and long-term changes seems to have a greater impact; therefore climate change projections are very important in terms of determining future distribution of various biomes.

- Climate is an important variable in estuarine activities. One concern is estuaries that are closed in dry conditions, which require mechanical methods to re-open. It is important to know when to re-open the estuary mouth mechanically and what the consequences might be. As most small estuaries that close in dry conditions are situated in the east coast; and climate change projection indicated the increase in summer rainfall over the east coast in the next 50 years, therefore those estuaries may not be closed in winter as per normal in the future. And this may have a serious impact on the natural environment of the estuary.

4. Disaster Management

This focus group was attended by two delegates from the City of Cape Town's Disaster Risk Management and Flood Risk Management departments respectively, and a representative of Cape Nature (river management).
Discussion:

- CCT is interested in seasonal weather forecasts – if the season is going to be wet, informal settlements could be at risk. In winter they are particularly interested in high rainfall intensity because of the likelihood of flooding.

- They are also interested in short term forecasts, just to know what to expect; they would not necessarily mobilise resources as it is often logistically inefficient. It is virtually impossible to predict blockages (i.e. floods) as blockages depend on various factors and not merely rainfall. However short term forecasts would help to predict how long the conditions would persist. Therefore real time monitoring may be more useful to mitigate/prevent floods.

- Long-term forecasts can influence the design of new storm water infrastructures.

- The CCT Disaster Risk Management department is involved in an annual flood risk plan (winter preparation) that uses seasonal forecasts to infer the number of shacks that are susceptible to the potential flood. With this information they can plan preventative measures and inform the finance departments. This type of annual planning seems to have attained better results over the last few years.

- Short term forecasts are potentially useful in a variety of ways, especially the following information:
    - Consecutive days of heavy rain causing flooding
    - Spring time onshore wind that can raise the tide table (e.g. Kommetjie is vulnerable)
    - Unstable slopes – weather forecasts can be used in the design and construction of mitigation/preventative measures.
    - Koeberg's radioactive plumes transmission to public – wind direction can be used to determine plume's travelling route and extent.
    - Major fires – wind, humidity and temperature forecasts can be used to determine the spread of fire and its potential persistence.

- Climate change projections are very important in terms of the City's planning for floods in the future. And if such reliable climate change evidence is documented, then they could start advising politicians with regard to the impacts of changes in development, especially controlling development along the coastline.

Further relevant information from Workshops held in Overstrand on 29 May 06 and in Cape Town on 2 Aug 06

Delegates at the workshops were asked how climate information could be used in their work. Some of the responses from *Overstrand* are summarised below:

- Weekly forecasts can be used to predict water demand and flood warnings can allow preparation. This should ideally be received in a short email giving interpreted forecast for specific area

- Seasonal forecasts are useful for resource management and planning; as well as long-term infrastructure and development planning

- Seasonal forecasts assist the management of lagoons and wetland areas, as well as in fire management

- Long range forecasts of rainfall for wide area surrounding Hermanus, and information on how this could impact on groundwater recharge and levels could be used to decide how groundwater should be managed – and to predict where additional boreholes could be sited

Responses from the Cape Town workshop:

- Forecasts can be used in locating gauges, weirs and boreholes. They help to make better decisions concerning where to position our measuring and abstracting resources

- Good forecasts mean better dam operation / flood management if high precipitation predictions are more accurate. They are used in decisions on when to transfer water over catchments e.g. Palmiet to Steenbras, and decisions on where to increase water supply and where to restrict to get best yield from all dam systems

- Seasonal forecasts are used to look at overall risk of water restrictions and to assist managers and politicians in understanding the probabilities

- Forecasts help to predict temperature levels conducive to algal growth – helps with prediction & timing of interventions

- Forecasts are used in scheduling of prescribed block burns (mild, stable conditions in autumn are ideal). They are also useful in wildfire control – for predicting climate influences on fire behaviour & planning accordingly

Conclusions

The focus group meetings revealed a limited amount of new information to the project. It is apparent that the current forecast information is not sufficiently meeting the expressed needs of water resource managers. This is partly because few of the water managers (especially in the Overstrand) access climate information regularly, while others expressed difficulty in interpreting or understanding seasonal forecasts. It is possible that a different format for these forecasts needs to be explored to make them more accessible to users. Water managers expressed the need for other information to assist with their decision making such as rainfall intensity predictions (frequently mentioned), more specific locations for forecasts (especially in the Overstrand), and also longer forecasts (9 – 12 months) for drought and restrictions planning.

The issues in the Overstrand are different to those of Cape Town. Overstrand municipalities rely on DWAF for most of their water supply. There are some boreholes and one natural spring, but other water for the towns comes from dams controlled by DWAF. Thus water *storage* is not a consideration for the municipality. Most of the people doing the work of 'water engineers' in the towns of the Overstrand are in fact Operations Managers for Service. Their job encompasses everything from road maintenance, stormwater drain clearance, water supply and disposal, to maintenance of parks and beaches. Water is not their main priority and they have limited time to access weather forecasts. Forecasts were used mainly to schedule short term operational activities such as road maintenance rather than in their work as water managers. They all

expressed interest in receiving warnings of extreme weather, preferably by sms or brief email, so that they could prepare for it.

In Cape Town, by contrast, water managers mainly use shorter term climate and weather information to plan and manage water storage and supply. Forecasts help with managing the levels in each dam, decisions on which dam to draw water from, and whether to move water between dams. Seasonal forecasts are used mostly when considering the adoption of water restrictions, the level of restrictions and the implementation timing.

Ninham Shand provides a consultancy service to DWAF and CCT, producing a weekly bulletin with climate and weather information and dam levels. This bulletin is widely used by city officials especially concerning decisions on restrictions.