9 February 2010 Ref : CO6C/18965

MEMORANDUM

FROM : **CARL HANSON**

TO : **ANGELA DEAN**
CC :

SUBJECT: **CENTRAL PLAINS WATER, CONSENT CONDITIONS RE GROUNDWATER QUALITY MONITORING**

The following is a note to refine and justify my recommendations for monitoring the effects of the Central Plains Water irrigation scheme on nitrate concentrations in groundwater. My original recommendation was in an email that I sent to you on 21 January 2010.

OVERALL STRATEGY

As we've discussed, my intention was to recommend a scheme-based monitoring programme, rather than a farm-based scheme. I recommended that purpose-built monitoring wells be installed immediately down-gradient of individual farms not because I wanted to monitor the effects at individual farms, but because I wanted to ensure that we know the source of the groundwater being sampled from the wells.

My objective was to develop two sets of data: one representing groundwater affected by the scheme, and the other representing groundwater not affected by the scheme. By comparing the two sets of results, we would be able to see whether there are systematic differences between them, and we may even be able to quantify the differences, at least in a broad sense.

The only places where we know with certainty that groundwater will be affected by the scheme will be at the water table immediately down-gradient of scheme farms. Similarly, the only places where we know with certainty that groundwater will not be affected by the scheme will be at the water table immediately down-gradient of non-scheme farms.

At any other locations, the source of the groundwater is uncertain. Once a well screen is more than a few metres beneath the water table, we can no longer be certain of how much the water reflects leaching from the farm, and how much it represents mixing with groundwater from up-gradient of the farm. Similarly, the farther the well is from the down-gradient end of the property, the greater the possibility that the water in the well is derived from adjacent farms.

Therefore, the best place to be certain that groundwater reflects the effects of any farm, irrigated or not, is at the water table beneath the down-gradient boundary of the farm.

PURPOSE-BUILT MONITORING WELLS

In order to monitoring groundwater quality at the water table at the down-gradient boundaries of specific farms, it will be necessary to install purpose-built monitoring wells. Other water supply wells, including any existing wells within the CPW scheme area, are screened well below the water table to ensure that the wells do not run dry when water levels are low. Also, it is highly unlikely that existing wells will be located in the precise locations that we need.

Specific wells will need to be installed to ensure that the wells are located where we need them, and screened at the water table.

In addition, the wells at each monitoring location will need to be clusters of wells rather than individual wells. Well screens should be no more than 3 metres long. If screens are longer, there is too much uncertainty about the depth interval that most of the water in the well is coming from, and the target water at the water table is excessively diluted by deeper groundwater.

However, the level of the water table at any location can fluctuate by several metres over the course of a year. This means that a 3 m well screen might intercept the water table for part of the year, but at times the screen may be considerably below the water table, and at other times the screen may be completely above the water table, such that the well is dry.

The only way to have 3 m well screens and ensure that the water table is always within a screen interval is to have a cluster of wells, with screens places at different depths over the range of water table fluctuation. In such a well cluster, there will always be one of the well screens that is intercepting the water table at the time of sampling, and that is the well that should be sampled.

NUMBER OF MONITORING SITES

In my original email, I recommended that wells be installed at a minimum of twenty farms, with at least two wells per farm. On further consideration, I could accept fewer wells. To begin with, it would be sufficient to have only one well down-gradient of each farm. Two wells would give us a better picture of groundwater quality at each farm, but for monitoring the effects of the overall scheme, one well per farm would be sufficient.

I originally recommended monitoring groundwater down-gradient of at least twenty scheme farms, and I did not specify a number of non-scheme farms. On further consideration, I think it might be sufficient to monitor down-gradient of ten scheme farms and ten non-scheme farms. I am not completely comfortable with this concession, because there will be a large amount of variation between the different farms within the scheme. There will be a variety of farm types – dairy vs. crop vs. sheep vs. beef – and also variations in land management practices within each farm type. I consider ten farms from each category (scheme and non-scheme) as the minimum required to account for this variability.

Monitoring groundwater at ten farms from each category should enable us to make at least a broad statement as to whether the scheme was causing higher nitrate concentrations than we would have seen without the scheme, and we may even be able to put some brackets around how much higher nitrate concentrations were beneath scheme farms than beneath non-scheme areas. However, if we monitored groundwater at twenty farms from each category, this would provide much more reliable information for quantifying the effects of the scheme.

CONSENT CONDITION WORDING

On Friday (5 February, 4:31pm), you sent me (and others) an email with draft wording for consent conditions regarding “Groundwater and Lowland Drainage”. The following are some comments on that draft.

First, there was a paragraph 6c, that began “The Groundwater and Drainage Plan shall include:”. Sub-paragraph (ii) set out the location and depth of monitoring bores as follows:

> *(ii) The location and depth of specific monitoring bores for assessing effects of the scheme activities on groundwater: specifically groundwater levels, groundwater quality, surface water flow and surface water quality. There shall be at least x monitoring bores within and down-gradient of the scheme area, with at least three bores evenly distributed across the up-gradient areas irrigated by the scheme. The monitoring bores:*

A shall have a screen no longer than 3 metres; and

B shall be screened at the shallowest water table

C may include any bore this is operated by the Canterbury Regional Council for sampling purposes

D shall be replaced by a deeper monitoring bore if a monitoring bore is dry for two subsequent monitoring runs.

I suggest the following changes, in an attempt to meet the requirements I set out earlier in this note:

(ii) The location and depth of specific monitoring bores for assessing effects of the scheme activities on groundwater: specifically groundwater levels, groundwater quality, surface water flow and surface water quality.

A There shall be at least twenty monitoring bore clusters within the scheme area. At least ten clusters will be located at the down-gradient boundaries of ten different farms that are irrigated by the scheme. At least ten other clusters will be located at the down-gradient boundaries of farms not irrigated by the scheme. The farms selected shall represent a variety of farm types.

B Individual monitoring bores within each cluster shall have a screens no longer than 3 metres.

C Each monitoring bore cluster shall include a sufficient number of individual bores to cover the range of water table variation at the site, ensuring that at the water table will be intercepted by at least one bore screen at all times.

D The diameters of individual bores will be sufficient to allow the bores to be purged and sampled according to the sampling procedure specified in paragraph xx.

E If one of the scheme farms associated with a monitoring cluster drops out of the scheme, a new cluster shall be established immediately down-gradient of another scheme farm. Similarly, if one of the non-scheme farms associated with a monitoring cluster joins the scheme, a new cluster shall be established immediately down-gradient of another non-scheme farm.

Second, regarding paragraph 6(e), which contains requirements for groundwater quality monitoring, as follows:

(e) Groundwater quality monitoring

(i) For two years prior to, and three years after the use of water under CRCXXXXXX commences, groundwater quality samples shall be taken from the bores identified in the Groundwater and Drainage Plan in March, June, September and December each year.

(ii) Three years after the use of water under CRCXXXXXX commences, the frequency of groundwater quality sampling shall reduce to twice per year, where each sample shall be taken during August-September and April-May each year.

(iii) Water quality sampling shall be undertaken in accordance with xx guidelines.

(iv) As a minimum, the water quality analyses shall include E. coli, pH, electric conductivity, alkalinity, chloride, ammonia-N, nitrate-Nitrogen, total-N, dissolved reactive phosphorus and sulphate.

(v) *If any bore within the area shown on the attached Plan CRCXXXXXX exceeds a nitrate-nitrogen concentration of 11.3 grams per cubic metre and the bore supplies domestic water to a dwelling that has infants under the age of six months old at the time of the exceedence, then the consent holder shall supply an alternative drinking water supply to those dwellings until it can be demonstrated that the concentration of nitrate-nitrogen in the subject bore is below 11.3 grams per cubic metre, unless the concentration of nitrate-nitrogen in the subject bore exceeded 11.3 grams per cubic metre prior to the use of water by the consent holder.*

I support the requirement in sub-paragraph (i) to monitor groundwater quality for two years prior to the commencement of the scheme operation, but I understand that it may be difficult to identify scheme farms and non-scheme farms this early. If it is not possible, I recommend that the monitoring not be required to start until the scheme is operative.

Regarding sub-paragraphs (i) and (ii), I am not completely comfortable with decreasing the sampling frequency from quarterly to twice per year after three years. Such a reduction may be acceptable after a period of monitoring, depending on what the monitoring shows, but I would prefer no to guarantee it for at least ten years.

Regarding sub-paragraph (v), I suggest some minor wording changes in the last sentence, as follows (my additions in ***bold***): … *unless* ***it can be demonstrated that*** *the concentration of nitrate-nitrogen in the subject bore exceeded 11.3 grams per cubic metre* ***on at least one occasion*** *prior to the use of water by the consent holder*.

Finally, regarding paragraph 11, Response to Groundwater Complaints. My only comment here is that it seems that it could take a long time for a complainant to get a response from the consent holder. If a family needs an alternative water supply, whether because there is a bottle-fed baby at risk from high nitrate or because the family blames a bacteria detection on the scheme, they are likely to need the replacement supply quite soon. Is there a way to speed the process up for at least a temporary alternate supply?