7.0 Management Implications

It is expected that the quantification of stream depletion effects, described in these guidelines, will prove most useful in the assessment of resource consent applications and in the development of rules for the management of water resources.

7.1 Resource Consent Applications

As part of the Assessment of Environmental Effects that is required for a resource consent application, consideration should be given to whether stream depletion effects are likely to be an issue of concern. This should be done by assessing the screening criteria that are described in section 3.1 of these guidelines and summarised in the flow chart presented in Appendix E. These are relatively straightforward parameters, which should generally be judged on existing information. However, surveyed elevations of both stream levels and groundwater levels along with the installation of monitoring boreholes and/or test pits may help to improve the assessment.

If it is concluded that stream depletion effects are unlikely to be an issue of concern then no further consideration needs to be given to this matter.

On the other hand, if the indications are that adverse stream depletion effects may occur, then they must be considered further. A suggested starting point is to consider that an adverse effect on the stream could occur and propose appropriate consent conditions that avoid the potential adverse effect. If these conditions are acceptable to all parties, then no further investigation is needed.

However, if the conditions are considered undesirable, then there are a number of progressively more detailed steps that a consent applicant can undertake to improve the understanding of their potential stream depletion effect. These steps are described below. Depending on the level of information provided in the consent application, it is suggested that the points listed below can also be used by Regional Authority Officers to provide guidance in preparing a "Request for Further Information" as specified in Section 92 of the Resource Management Act (1991).

Step 1 The first step to quantifying the stream depletion effects is to assign a numerical value to the parameters described in section 3.2 of these guidelines. The definition of each parameter, its likely range and a data source are listed in the panels of section 3.2. It is unlikely that all parameters will be precisely defined. For those parameters that are not well defined then the range of values that are most likely to apply at a site should be considered. The definition of values must be based on credible sources of information.

Step 2 The known values (or range of likely values) from Step 1 should be used to calculate the value (or range of values) of the stream depletion factor (sdf) and streambed conductance (λ), as described in section 3.3. Using these values, consideration should be given to Figures 21 and 22 to determine

whether the stream depletion effect is likely to be significant and to reconsider the proposed consent conditions.

Step 3 If further quantification is required then the values (or range of values) from Step 1 should be used to calculate the likely stream depletion effect using the techniques described in Sections 4 and 5 of this document. The appropriate calculation method must be consistent with the conceptual hydrogeologic model for the area. If assumptions and simplifications are to be made, they should be clearly stated along with their impact on the resulting calculation.

Step 4 If the accuracy of the result is still considered undesirable then more detailed site specific field investigation will be required. It is to be expected that by the time this point is reached the following parameters should have been well defined:

» *Pumping rate from the well (Q);*

» *Separation distance between the well and the stream (P);*

» *Pumping period (t)*

Assuming this is the case, then more detailed investigations will involve implementing the field methods described in section 6.1. It is recommended that a sensitivity analysis should be carried out on the calculations undertaken in Step 3 to see which of the poorly defined parameters have the biggest influence on the calculated stream depletion effect. Field investigations should be prioritised to focus on those parameters which have the greatest effect on the calculated result. The choice of field investigations is summarised below, based on the consideration of which issues are most sensitive.

Information Required	**Recommended Field Test**
• Improved definition of the interaction between the stream and the aquifer	• Gauging and piezometer survey (section 6.1.1) and/or • A detailed pumping test with several observation bores (section 6.1.2)
• Improved definition of the aquifer Transmissivity (T) and/or Storage Coefficient (S)	• A detailed pumping test with several observation bores (section 6.1.2)
• Improved definition of streambed conductance (λ)	• Gauging and piezometer survey (section 6.1.1) • Infiltration tests (section 6.1.3) in reaches which are dry or have calm, shallow water • Seepage meter surveys (section 6.1.4) in reaches with slow moving deep water • A detailed pumping test with several observation bores (section 6.1.2)

To carry out this field work in a reliable manner requires detailed site observations that may often be beyond the resources of an individual consent applicant. However, the results of the field tests may often have a wider applicability than the assessment of a single consent application. For example, gauging and piezometric surveys and direct infiltration/seepage measurements along a streambed reach could be used in the assessment of all groundwater abstractions within the catchment. Therefore, it may be more feasible for a group of water users, recreational interest groups, Territorial Authority and/or Regional Authority to arrange field investigations that allow an improved assessment of stream depletion effects along a particular stream reach in which all the parties have an interest.

7.2 Water Resource Management Plan Issues

It is beyond the scope of these guidelines to discuss the management options for groundwater abstractions which affect stream flow. However, it is worth pointing out that an effective management approach is dependent upon a knowledge of how the stream depletion effect occurs. Consequently, the assessment tools described in this guideline are an essential first step in determining the effectiveness of any management option.

In particular, the timing and severity of restrictions on groundwater pumping should be based on the degree of hydraulic connection between the pumping well and the stream. As shown in Figures 21 and 22, groundwater pumping restrictions may be quite beneficial to a stream for settings with a low sdf and a high λ. However, restrictions will be relatively ineffective if sdf is high (e.g. > 100 days) and/or if λ is low (< 0.01 m/day), particularly for low – moderate pumping rates.

Management policies must also take into consideration the characteristics of the surface waterway that could be depleted. Stream depletion effects only become a water management issue if the affected surface waterway has important values that are adversely affected by low flows which are contributed to by the stream depletion effect. This situation is typically identified by the stream having a minimum flow and/or a water allocation regime established for surface water users. The magnitude and timing of any stream depletion effects should be compared with the magnitude of the river flow to assess their significance.

This guideline sets out a variety of calculation tools and field investigation techniques which can be used to better understand and quantify the effects of a pumping well on nearby stream flow. These techniques range from simple screening observations to detailed quantitative evaluation. The level of detail that is required in each particular setting should be matched by the likely management implications for any particular groundwater abstraction.

The key parameters which allow the necessary understanding of this effect are the hydrogeologic characteristics of the aquifer and their interaction through the streambed. In the absence of any field data it is conservative (from the stream's perspective) to assume that the streambed has the same hydraulic conductivity as the adjacent aquifer. However, for streams where groundwater pumping effects have the potential to be an important water management issue then the implementation of field measurements (as described in Section 6.1) should be undertaken to aid in the improved management of the water resource. As noted in section 7.1, the resources of several interested groups could be pooled to allow field measurements along a full stream length thereby creating a very worthwhile benefit for improved water management within the catchment.

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