Groundwater

Letter to the Editor/ Discussion Editor/Stephen R. Kraemer

Comment on "Drawdown 'Triggers': A Misguided Strategy for Protecting Groundwater-Fed Streams and Springs," by Matthew J. Currell, 2016, v. 54, no. 5: 619–622.

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This is a comment on the technical commentary by Currell (2016). Currell identifies a number of pitfalls that may be encountered when using "drawdown triggers" to protect groundwater-dependent ecosystems (GDEs) from the effects of groundwater pumping. Currell correctly associates sound groundwater management with the concepts of capture and depletion; however, we argue that the title of Currell's commentary is misleading. Rather than being a misguided strategy, we argue that drawdown triggers can be an effective mechanism for protecting GDEs and the pitfalls that Currell identifies can be addressed through groundwater monitoring and modeling. We disagree that triggers specified in terms of groundwater elevation are necessarily superior to triggers expressed in terms of drawdown.

Currell correctly notes that monitoring water levels at groundwater discharge zones such as spring-fed wetlands is a flawed monitoring strategy, because the discharge rate may decrease significantly without appreciable changes in groundwater levels. Instead, groundwater level monitoring points arrayed between the discharge zone and the location of pumping will provide earlier and less ambiguous warning of pumping-induced drawdown. To determine a protective trigger level in a monitoring well located between a pumping well and a GDE, the amount of groundwater elevation change allowable at that monitoring point can be determined by first defining a level of effect that is allowable at the discharge zone and using a groundwater model to determine the amount of upgradient drawdown that corresponds to that allowable effect. A groundwater model can also account for time lags between pumping and declines in discharge, and can be applied to determine, given a specified pumping rate, the trigger level and time at which pumping must cease to not exceed a specified decline in discharge at some subsequent time.

A systematic approach to using drawdown or groundwater level triggers to protect GDEs is as follows:

1. Identify the biological objective(s) for GDEs.
2. Identify the hydrologic condition or threshold that supports the biological objective.
3. Set trigger levels at monitoring locations some distance upgradient from GDEs that maintain the necessary hydrologic condition or threshold identified in Step 2, expressed as either a groundwater elevation or drawdown from a baseline condition.
4. Identify management actions that mitigate negative effects on GDEs if triggers are exceeded. Tiered trigger levels may elicit different management actions at the same monitoring well.
5. Reassess the association between drawdown triggers in Step 3 with hydrologic conditions in Step 2, and modify triggers as necessary.

In principle, drawdown triggers and water level triggers are interchangeable if a baseline water level is known from which drawdown is calculated by difference. We agree with Currell that deconvolution of observed water level declines may be challenging, but generally deconvolution is necessary to tie observed effects, and potential follow-on actions, to specific drivers of groundwater change. Management plans may impose mitigation requirements based simply on groundwater levels without considering the cause of groundwater level declines, or they may take into consideration the portion of decline attributable to the groundwater extractor responsible for implementing mitigation. This is a policy choice driven by sociopolitical factors and project conditions.

Whether using drawdown or groundwater elevation triggers, identifying effective trigger levels is complicated by transient preproject conditions, multiple factors affecting groundwater levels during the project, and uncertainties in ecosystem response to hydrologic change. These uncertainties are best addressed through an

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adaptive management strategy where monitoring data are used to assess, and if necessary recalibrate, trigger levels as the project proceeds and more data become available. An example of such an approach is documented in MHA Environmental Consultants (2008), Daniel B. Stephens & Associates Inc. (2011), and County of Inyo (2011).

Preventing undesirable effects on GDEs from groundwater development projects is a critical concern for groundwater managers, and we thank Currell for highlighting some of the considerations involved in developing management programs based on drawdown or groundwater level triggers.

References

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