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To: "Robert Schlipf" <RSchlipf@waterboards.ca.gov>
Date: 7/21/2008 3:28 PM
Subject: Residence Times

Robert - here is Greg's e-mail re residence times.

Hi Steve,

Sorry for the slow response. I've been gathering numbers to respond to your residence time question. This issue may not be of great importance, but it was one of the few sets of numbers I could try to verify with work we have done. It is not an easy question, because I can not determine the assumptions that they used to calculate the "Depth" and the "Outlet Flow". "Outlet Flow" depends on which discharge structures they are using (weir or culvert and how many weirs or culverts, and how much they are open), what they define as "Summer", and what value the "Depth" represents (is it a staff plate reading and which particular staff plate since some are referenced to elevation and some are not, or is it an actual average depth of the water). Ultimately, the question is: how are these ponds specifically managed for depth and outflow?

For an example, let me discuss pond A3W. If we assume that the actually average water depth is 1.8 feet. For the period 1 June - 31 August, if the outflow is through only one of the three culverts, then we calculate that the Outlet Flow is 21 ft³/s. However, if all three discharge culverts are open, then the calculated Outlet Flow is 62 ft³/s. The Water Board document shows Outlet Flow is 27 ft³/s. So, the value they use is near the low range of the values I calculate for Outlet Flow (and on the long end of the pond residence time), So, the specifics of operations are critical for predicting a residence time. I do have operation information for some of these ponds for 2005 and 2006 (from Eric Mruz), and this suggests that the Outlet Flows are different than the Water Board estimates.

The best I can do right now is present an estimate of Residence Time or range of Residence Times for five of the listed ponds given the POND CALC output. I have made a number of assumptions in these calculations:

- That the water depths in the document tables are actual water depth, not surface elevation
- Water discharges only through fully opened culverts, since weir discharge calculations would require much more information about operations (weir discharge tends to be lower than culvert discharge for a given pond depth)
- Summer is 1 June - 31 August
- Elevation of pond bottoms (from USGS) are accurate
- Pond depth and management are constant throughout the summer
- Pond volumes in the Water Board document are accurate
- High outlet flow is with all culverts opened, low outlet flow is only with a single culvert opened (A2W has 1 culvert; A3W has 3 culverts; A7 has 2 culverts; A14 has 2 culverts; A16 has 1 culvert)

Outlet Flow and Residence time:

A2W: Outlet Flow = 49 ft³/s; Residence Time = 8 days

A3W: Outlet Flow = 21-62 ft³/s; Residence Time = 8-24 days

A7: Outlet Flow = 13-26 ft³/s; Residence Time = 4-9 days
A14: Outlet Flow = 22-44 ft³/s; Residence Time = 4-7 days
A16: Outlet Flow = 24 ft³/s; Residence Time = 9 days

These data suggest that the Water Board estimates of Residence Time are within the high-end of the range of my estimates for ponds A3W, A7, and A14. The Water Board estimates for Residence Time for ponds A2W and A16 are much longer than my estimates.

A simple conclusion would be that it might be better to present Residence Time as a range instead of a single number (and definitely not a number with 4 significant figures!).

Please let me know if you have any question or need additional information.

Cheers,
Greg

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