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September 22, 2023 Delivery via email

Teton County Idaho
Jade Krueger
Planning Administrator
jkrueger@co.teton.id.us

RE: Response to Review of Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation

Dear Ms. Krueger,

Thank you for your review of the Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation. Your comments have been reiterated below for clarification with responses below the comments.

Harmony Design and Engineering

1. *Compliance Boundaries*: The evaluation considered several potential compliance boundaries, including the subdivision in its entirety, and also each lot individually. The analyses do not examine the effects of certain combinations of adjacent lots aligned with the modeled gradient. An example would be a grouping of Lots 7, 2 and 1 as a unit, and apply the corresponding unit parameters in the spreadsheet model.

   Response – As requested, combinations of adjacent lots aligned with the modeled gradient have been evaluated and included in the updated report. Those lot combinations include:
   - **Lots 1, 2 and 7 (as suggested)**
   - **Lots 4, 3 and 8**
   - **Lots 5, 6, 9, and 10**

2. *Design Flow*: The subdivision proposed 10 lots and 10 homes were included in the evaluation. Each home was assigned the 300 gallon-per-day default parameter value of the model spreadsheet. This equates to a 4-bedroom house. The NP evaluation does not consider a guest house or greater bedroom count, or why the presumed 4-bedrooms per lot is representative of anticipated future development. If guest houses are expected and allowed, or the number of bedrooms anticipated may be greater than 4, there should be discussion of how that would affect the evaluation conclusions.

   Response – Each lot will be allowed to have a home and an accessory dwelling unit. Based on the zoning regulations, 4 bedrooms was used anticipating a 3 bedroom home and the possibility of an accessory dwelling unit.

3. *Hydraulic Conductivity Estimate Above Reference Range*: The hydraulic conductivity used in all model simulations is 100 ft/day. Selection of this hydraulic conductivity value is not well supported. The author describes the 100ft/day value "conservative" for this use, noting that it is on the lower end of typical values for sand and gravel aquifers. The drilling logs cited and provided in the appendix make frequent mention of significant clay, which can greatly retard flow in porous media. There are several logs that have included pumping test data that could be used to infer a more supported hydraulic conductivity value. Evaluating this kind of existing data seems consistent with the Level I Nutrient-Pathogen criteria. Many of these rudimentary tests report production of 1 gallon per minute flow per foot of drawdown. While they lack rigorous description of methods or results, they should at least be compared with the assumed conductivity rate selected. The two best published estimates of conductivity covering this vicinity are from Nicklin (2003) and Cosgrove and Taylor (2007). Both of these assign values close to 25 ft/day for this location.

   Response – Hydraulic conductivity varies widely, even for a homogenous soil type. The hydraulic conductivity was primarily based on the type of soil encountered in the test pits. This is the most accurate information on the local soil on site, in the area of wastewater disposal. The soils in the test pits were described as fine to coarse sands with gravel. There was very little indication of fines, which results in a soil classification of a Poorly Graded Sand (SP) from this information.

   In reviewing general soil literature regarding hydraulic conductivity, it varies over four orders of magnitude. According to online resources, they assign a range from 7 to over 150 feet per day. Per McCarthy (2007) a clean sand/sand and gravel mixtures have a conductivity ranging from 28 to over 2800 feet per day. Per Lindeburg (2008) it lists poorly graded sands as having a conductivity >17 feet per day. According to the Idaho DEQ mass balance spreadsheet, well-sorted sands and glacial outwash have a conductivity of 3 to 300 feet per day, while well sorted gravels have 30 to 3000 feet per day values. So the total range of conductivities for the type of observed soil on site essentially has a range from 3 to 3000 feet per day. Looking at this range, 100 feet per day is more on the conservative side of this range. However, if it's 25, 100, or 1000 feet per day, it is really a case of professional judgement.

   In reviewing the drilling logs within ¼ mile of the proposed subdivision there is a general description of sand and gravel in some wells. The clays, gravels and sands are described in others. It appears that some areas have observed clay and others do not. Also, methods of determining clay in the field varies. I personally have worked on several geotechnical reports where the field logger mentions clay many times. However, after soil samples are analyzed, there is often no significant clay in the soil at all. Silts and really fine sands that clump due to moisture can often be mistaken for clay in field observations. Without proper sieve analysis and Atterburg limits tested, what was observed as a clay in the field may or may not be that in reality. The test pits showed no indication of clay and little to no fines, which is consistent with soil descriptions in well logs for 702556 and 701985. Also, since the test pits displayed a more coarse soil, areas with clay would not slow water flow (or the apparent hydraulic conductivity) down. Water would pool over the clay layers and flow around them, following the path of least resistance. Lenses of clay reduce hydraulic conductivity in pumping tests since it averages out the conductivity ranges in the tested vertical zone.

   Three pump tests were found in the logs within ¼ mile of the project boundaries. The permit numbers for these wells are 702846, 702556 and 702847. Using the attached simplified hydraulic conductivity estimation

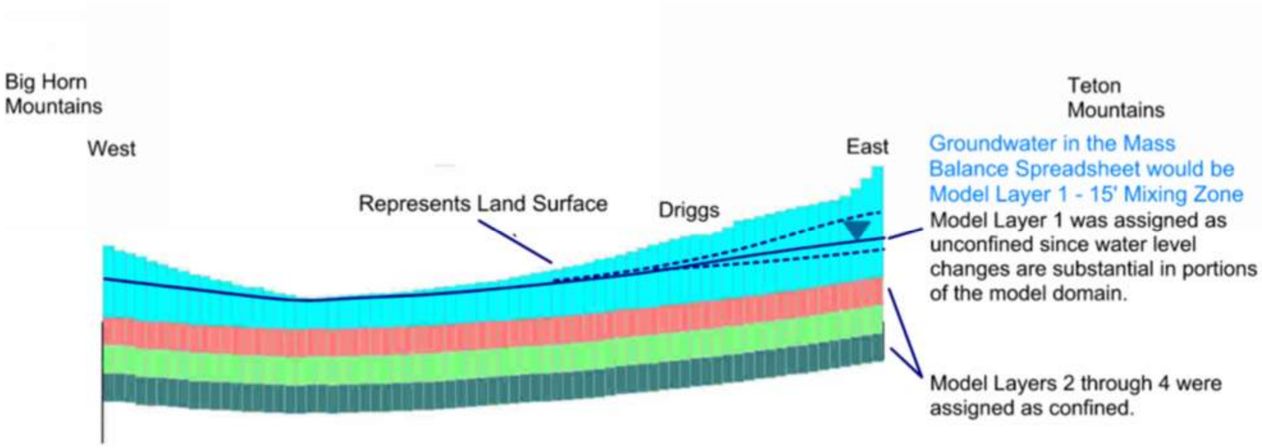
from Montana DEQ resulted in a range of hydraulic conductivities from 12 to 23 feet per day. As stated in the comment, the testing methods and results are not well documented. Also, the depth of pumping in these wells is much deeper than the mixing zone in the Nutrient Pathogen spreadsheet. There appear to be multiple layers in which hydraulic conductivity varies vertically. This is discussed further below in the review of the Nicklin report.

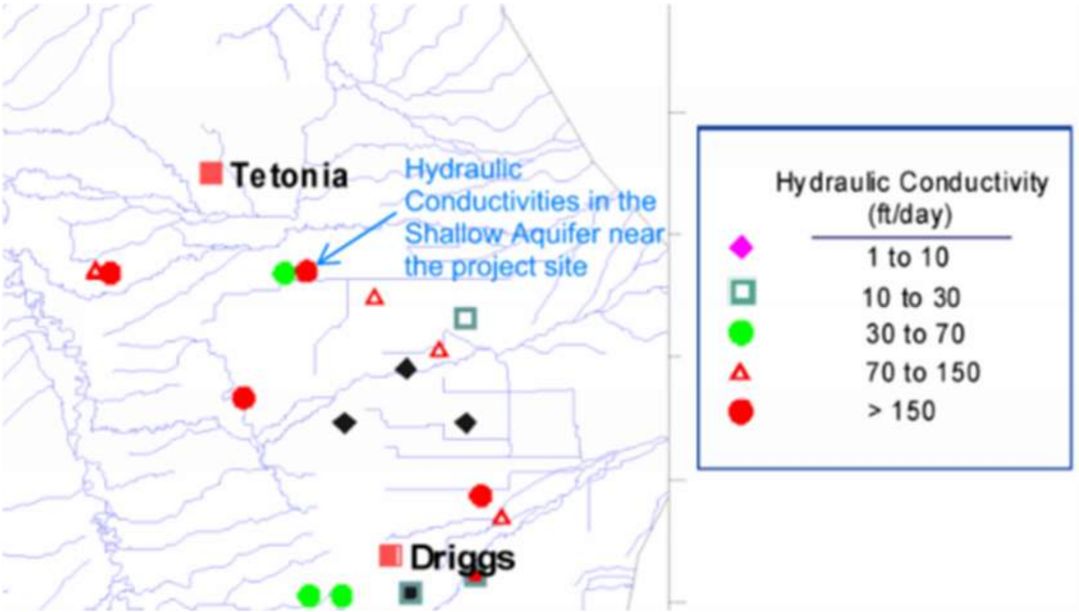
The suggested reports were obtained and reviewed in order to respond to this comment. In the Nicklin (2003) report, final calibrated model parameters shown in Figure 31, range from 14 to 925 ft/day. Figure 19 shows two hydraulic conductivity estimates to the southeast of Tetonia, in the project location. There is one in the range of 30 to 70 feet per day and another adjacent to it that is over 150 feet per day. Figure 30 shows a model range for clean sand hydraulic conductivity from 10 to 1000 feet per day. The 25 ft/day conductivity in the comment pertains to Model layers 2 through 4 in the report. Those layers are the deeper, confined aquifers. The shallow aquifer is of concern for this Nutrient Pathogen Evaluation and consistent with the 15-foot mixing zone in the spreadsheet. The Model Layer 1 conductivity for the project site is right in the transitional area where conductivity was assigned 80 and 150 feet per day.

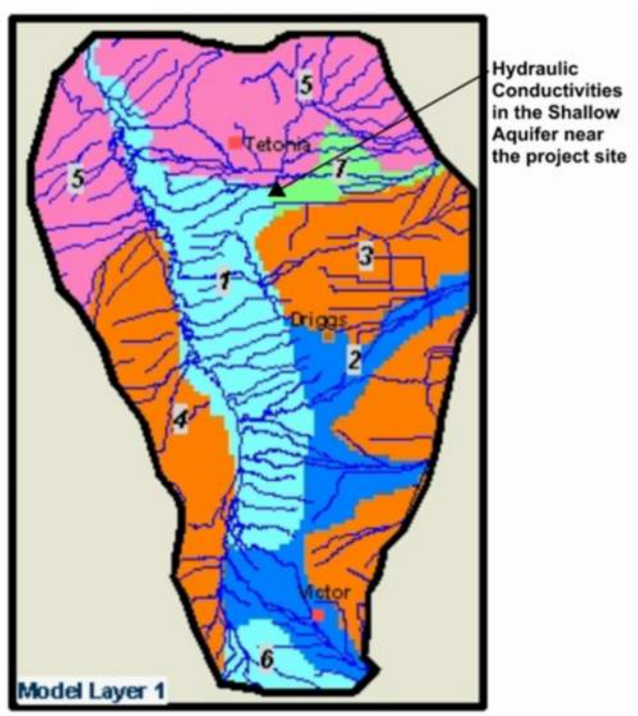
The wells with pumping data with the estimated range of hydraulic conductivities of 7 to 23 feet per day corelate with the Nicklin report and assigned model layer hydraulic conductivities. Those deeper model layers were also associated with confined aquifers. Many of the well logs show a higher stable water level than the initial water level noted in the log.

The Cosgrove and Taylor (2007) report assigned somewhere between 1 and 50 feet per day. This was used from a prior groundwater model. However, it appears that the study recommends a higher recharge rate than what was used in the Irish Acres Subdivision Nutrient Pathogen Evaluation. There is not a lot of background as to what site-specific information was used for this determination.

Hydraulic conductivity is an important parameter, and it can vary greatly. In reviewing the literature, the reasonable range is 3 to 3000 feet per day. Much of the information in the recommended literature and reviewing the pump data appears to be associated with a deeper aquifer zone. The mass-balance spreadsheet only considers the 15-foot mixing zone in its calculations. So, the hydraulic conductivity should be associated with this shallower soil layer. The test pits indicated a soil with a relatively higher conductivity, which is the best on-site data that we have. As a compromise, we have adjusted the hydraulic conductivity in the report to 80 feet per day, consistent with the Model Layer 1 conductivity assigned per the Nicklin report.


Big Horn
Mountains
West
Teton
Mountains
East
Groundwater in the Mass
Balance Spreadsheet would be
Model Layer 1 - 15' Mixing Zone
Represents Land Surface
Driggs
Model Layer 1 was assigned as
unconfined since water level
changes are substantial in portions
of the model domain.
Model Layers 2 through 4 were
assigned as confined.


Tetonia
Hydraulic
Conductivities in the
Shallow Aquifer near
the project site
Driggs
Hydraulic Conductivity
(ft/day)
1 to 10
10 to 30
30 to 70
70 to 150
> 150

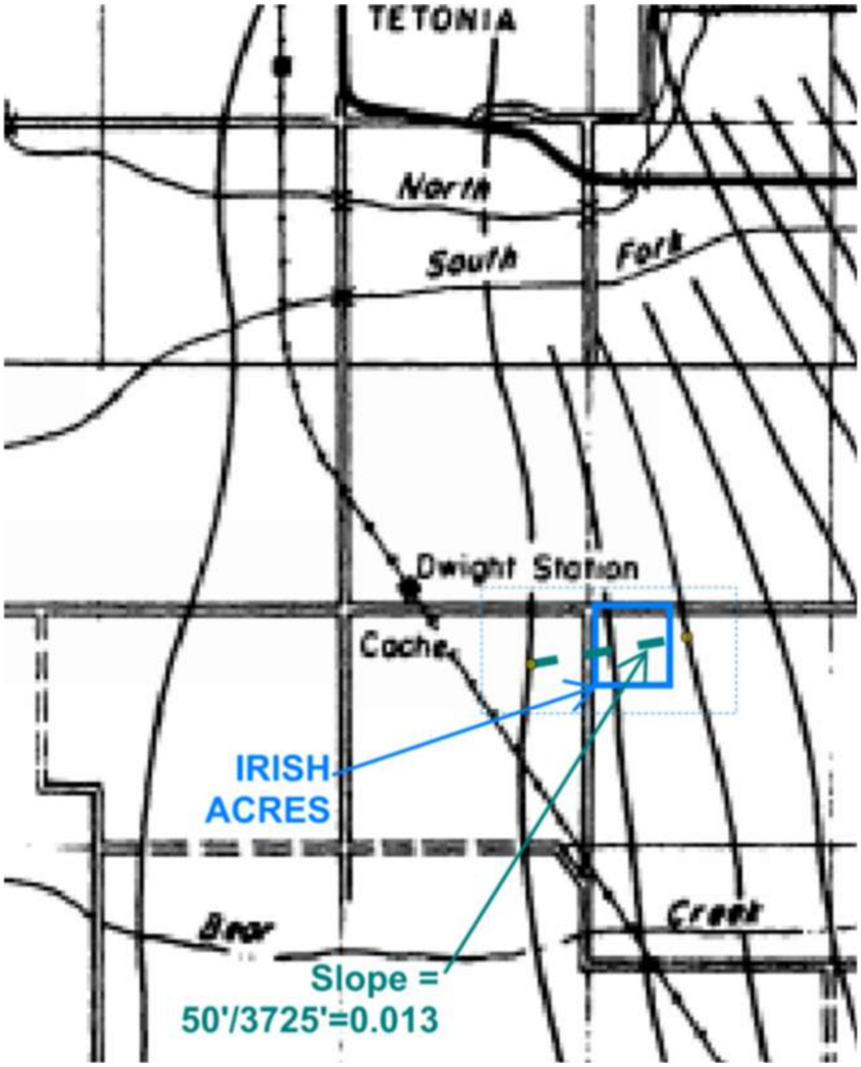


Final Hydraudic Conductivity Zonation

Zone	Hydraulic Conductivity (ft/day)
1	80
2	330
3	25
4	25
5	14
6	130
7	150

4. *Modeled Hydraulic Gradient Inconsistent with References*: The author assumes that the hydraulic gradient reflects the slope of the ground surface: 0.01 ft/ft. This generalized approximation seems a poor substitute for more specific references provided in mapping by Kilburn (1964), Nicklin (2003), and Cosgrove and Taylor (2007), which indicate that 0.006 is a representative value for this location. These maps do generally agree with the author's assertion that the direction of groundwater flow is east to west.

   Response – Nicklin (2003) states in section 4.1.6.3 that the hydraulic gradient assigned in their model ascertaining that the, "general flow direction is consistent with the land slope as typifies many basin aquifers". Figure 22 of the report has the project area mapped with 50 feet of water level contours over 3,725 feet, or a slope of 0.013 ft/ft. This is consistent with the ground slope in the project area. The 0.013 ft/ft gradient as utilized in the updated Nutrient Pathogen Evaluation. Please see the excerpt below.



5. *Phosphorus and Pathogen Impacts to Groundwater and Surface Water Not Addressed*: The report leaves out any meaningful discussion on the impacts of phosphorus and pathogens released in the on-site systems, as DEQ guidance recommends.

   Response – Phosphorus and pathogen impacts have been added to the report.

Idaho Department of Environmental Quality

6. Additional justification for the 100ft/day hydraulic conductivity should be given. The Nicklin model overlay should be consulted and reviewed to verify range of hydraulic conductivity, or a grain size analysis used for characterization of the hydraulic conductivity.

   Response – Please see response to comments #3.

7. The NP evaluation discusses the nutrient impacts to ground water using mass balance spread sheet. The NP evaluation has not addressed the fate transport of pathogens. The NP evaluations needs to be modified to address the fate transport of pathogens.

   Response – Please see response to comment #5.

Please feel free to us with any questions or concerns.

Sincerely,

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Enclosures: Hydraulic Conductivity Estimate Calculations from Pumping Test Data, Updated Nutrient Pathogen Evaluation