Impacts to Senior Surface Water Rights in the Little Wood-Silver Creek Drainage: Affects from Junior-Priority Ground Water Pumping in the Wood River Valley South of Bellevue, Idaho and Potential Benefits of Curtailment in the 2021 Irrigation Season

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Background

On May 4, 2021, the Director of the Idaho Department of Water Resources (IDWR) initiated an administrative proceeding concerning water rights in Basin 37 (Wood River Basin). Because a drought is predicted for the 2021 irrigation season and the water supply in Silver Creek and its tributaries may be inadequate to meet the needs of surface water users, the Director initiated the administrative proceeding to determine whether water is available to fill junior groundwater rights within the Wood River Valley south of Bellevue. If the Director concludes water is not available to fill groundwater rights, the Director may order the groundwater rights curtailed for the remainder of the 2021 irrigation season.

Objectives

This report addresses various relevant technical aspects of the Directors "Notice of Basin 37 Administrative Proceeding" (May 4, 2021) by which the Director of the Department has initiated an administrative proceeding to determine "if the surface water rights in the Little Wood-Silver Creek drainage will be ***injured*** in the 2021 irrigation season by pumping from junior-priority ground water rights in the Wood River Valley South of Bellevue" and whether "the water supply in the Little Wood River-Silver creek drainage may be inadequate to meet the needs of surface water users in that area."

Specific objectives of this report include:

- The estimation of hydrologic impacts to surface water rights in the Little Wood-Silver Creek drainage from past groundwater pumping in 2019 and 2020 and ongoing groundwater pumping during the 2021 irrigation season should no curtailment occur.

- The analysis of hydrologic impacts to surface water rights in the Little Wood-Silver Creek drainage under various curtailment scenarios for the 2021 irrigation season.

- The analysis of shortfall predictions for specific senior surface water rights and the implications for timing and volumetric impacts.

Hydrologic Impacts to Little Wood-Silver Creek Drainage Without Curtailment During the 2021 Irrigation Season

At present, efforts are underway by technical experts representing senior water rights holders to convert the existing IDWR 3D numerical MODFLOW model for the Wood River Valley Aquifer System version 1.1 (hereafter referred to as the WRV1.1 Model) to a GMS (Aquaveo) platform. Consequently, estimates of hydrologic impacts in this report are not based on model runs completed by the author. Estimates of hydrologic impacts to surface water rights in the Little Wood-Silver Creek drainage during the 2021 irrigation season, were made based on select data output from the 2019 IDWR curtailment model runs (Sukow 2019) which are available on the IDWR website and summarized in Appendix A. Data output from the 2007 model run from Sukow (2019) was chosen to represent a "dry" year and because it isolated a single year's simulated pumping (approximately 41,000 ac-ft) and its multiple year effects on streamflow making the quantitative estimates of such streamflow effects more straightforward. As a "dry" year, the output data from the 2007 curtailment run (Sukow 2019) is thought to be a reasonable representation of conditions for the 2021 irrigation season.

It should be noted (and is demonstrated by visual examination of figure 1 below) that the hydrologic benefits (i.e., increased reach gains) from a single year of curtailment are manifested over an approximate three-year period. The majority of the hydrologic benefit occurs in the same year as curtailment, with effects diminishing with time over the approximate three-year period. Conversely, the lack of such a curtailment, would logically result in reach gains not occurring in the system and can be viewed as a negative hydrologic impact (i.e., reduced reach gains). When such single-year effects are considered for consecutive years of groundwater extraction, the hydrologic effects overlap and are additive. As a result, for any given year, the actual hydrologic impact logically consists of the impacts from the current year of pumping plus residual impacts from the two antecedent years of pumping.

For this study, reported withdrawals for the entire boundary of the WRV1.1 Model for 2019 (i.e., 37,377 ac-ft), 2020 (i.e., 47,715 ac-ft) and anticipated withdrawals for 2021 (i.e., 47,715 ac-ft) were averaged and that average reduced by 15% to arrive at an average value of "consumptive use". Estimates of actual withdrawals for 2019 and 2020 were provided verbally by Tim Luke (IDWR). The assumed estimate of withdrawals in 2021 (i.e., 47,715 ac-ft) was based on the use in 2020 and is considered conservative given that 2021 is arguably drier than 2020 and will require similar, if not more, water for irrigation. The reduction of the average withdrawals of 15% represents a reasonable overall value for "return flows" (i.e., the fraction of withdrawals that is not consumptively uses but returned to the system). This average value was then further reduced by 30% to remove pumping effects from groundwater pumping north the Glendale road to align with the "Potential Area of Curtailment" as presented in the May 4, 2021 Notice of Basin 37 Administrative Proceeding. The value of 30% is based on the

approximate distribution of groundwater pumpers north/south of the Glendale road reported in a recent staff memo (Sukow 2021).

The resulting estimate of consumptive use was then compared to the 41,000 ac-ft estimate of consumptive use in the 2007 model run (Sukow 2019) to linearly scale the effects for the 2021 irrigation season. The cumulative overlapping effects of three years of groundwater pumping, were then quantified and summed to enable a comprehensive estimate of hydrologic impact for the 2021 irrigation season by month and reach (Table 1). This method resulted in computed hydrologic impacts to surface water rights in the Little Wood-Silver Creek drainage during the 2021 irrigation season of approximately 7,620 ac-ft resulting from groundwater pumping south of Glendale Road if no curtailment were to occur in 2021.

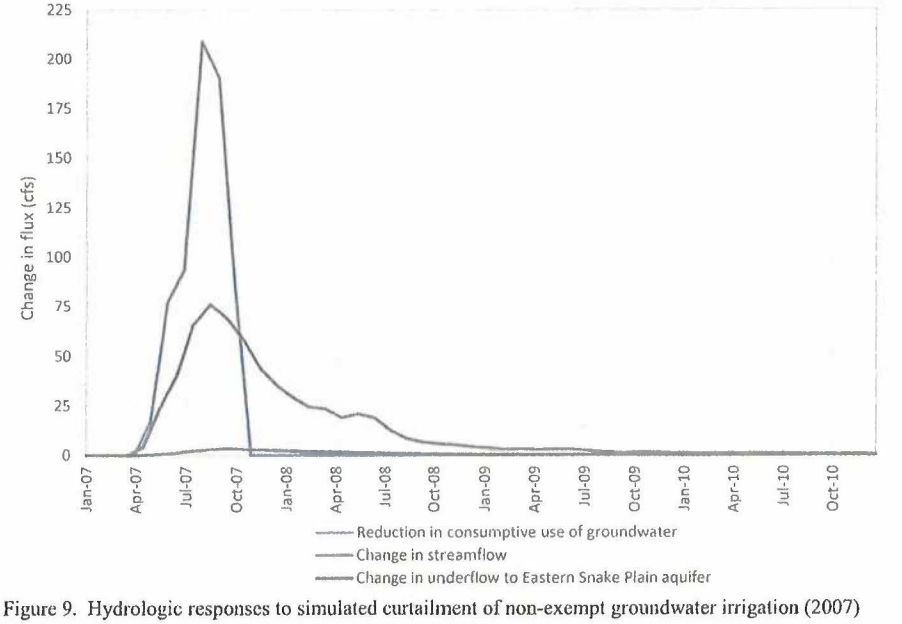

Figure 9. Hydrologic responses to simulated curtailment of non-exempt groundwater irrigation (2007)

Figure 1. – reprinted from Sukow 2019

Table 1 – Estimated 2021[1,3] Cumulative Streamflow System Impacts by Month from Junior Groundwater Pumpers South of Glendale Road

MONTH	TOTAL SILVER CREEK IMPACTS		TOTAL BIG WOOD RIVER IMPACTS		BELOW HEART ROCK RANCH IMPACTS[2]
	(AC-FT)	(CFS)	(AC-FT)	(CFS)	(AC-FT)
Jan	753	12.25	624	10.15	289
Feb	567	**10.20**	469	**8.44**	**206**
Mar	535	8.70	579	9.41	226
Apr	539	**9.06**	509	**8.55**	**229**
May	1,003	16.31	1,002	16.30	254
Jun	1,236	**20.76**	1,283	**21.56**	**244**
Jul	1,954	31.78	1,460	23.74	405
Aug	2,007	**32.65**	1,646	**26.77**	**501**
Sep	1,802	30.29	1,374	23.10	518
Oct	1,551	**25.22**	1,232	**20.03**	**567**
Nov	1,134	19.06	954	16.02	446
Dec	950	**15.45**	796	**12.95**	**366**
Total	**14,031 (AC-FT)**		**11,927 (AC-FT)**		**4,253**
Total Irrigation Season[2]	**8,182 (AC-FT)**		**6,935 (AC-FT)**		**1,999**
Total Non-Irrigation Season	**5,849 (AC-FT)**		**4,992 (AC-FT)**		**2,254**

Notes:

1 - assumes consumptive Use is 85% and 2021 impacts are cumulative effects of 2019, 2020 & 2021 (estimated) pumping withdrawals of 37,377 ac-ft., 47,715 ac-ft., and 47,715 ac-ft. respectively

2 - Irrigation season for Silver Creek and Big Wood River is considered to run from April 20, 2021 – September 30, 2021; below Heart Rock Ranch Impacts include Willow Creek

3 - Temporal and spatial impacts are scaled estimates based on model output data from the 2019 IDWR Curtailment results (Sukow 2019) for 2007 single-year simulation

Analysis of Hydrologic Impacts Under Various Curtailment Scenarios

As noted above, the computed hydrologic impact estimated for the 2021 irrigation year with no curtailment is estimated to be approximately 8,182 ac-ft. If curtailments in the Wood River Valley south of the Glendale road were made, the hydrologic impact would logically be reduced depending upon the magnitude and timing of such curtailments. For convenience in computation and to accommodate direct comparison with a recently completed curtailment study by IDWR (Sukow 2021), a 100% curtailment starting on July1 and August 1 for the 2021 irrigation season. As noted previously, the hydrologic impact in any given month represents the cumulative impact of the current year of pumping plus the residual effects of the two antecedent years of pumping. Analysis of the relative proportions of the two antecedent years of pumping relative to the total hydrologic impact indicated that the ratio of current year pumping to the total three-year pumping impact was approximately 86%, 91% and 92% for the months of July, August and September respectively. Conversely, the relative residual impacts from the two antecedent years of pumping would logically be 14%, 9% and 8% for the months of July, August and September respectively.

Applying these values to Table 1, the reduced impact from 100% curtailment can be estimated. For example, in the case of a July 1, 2021 curtailment, the impact would consist of 1/3 of the April impact (representing an irrigation start date of April 20, 2021), the full impacts for May and June, and partial impacts for July (14%), August (9%) and September (8%) representing residual impacts from the two antecedent years of pumping. In this case the resulting hydrologic impact is approximately 3,001 ac-ft. Similarly, the hydrologic impact from a 100% curtailment starting on August 1, 2021 can be calculated to be approximately 4,649 ac-ft. These hydrologic impact estimates can be compared to estimates recently made by IDWR (Sukow 2021) which estimate increased flow in Silver Creek under 100% curtailment scenarios on these dates as well as approximations of "wet water" deliverable to Station 10 after approximately 25% seepage losses. These values are presented in Table 2. As demonstrated in Table 2, a delay in curtailment increases the hydrologic impact until the "No Curtailment" impact (i.e., 8,182 ac-ft) is reached. Conversely, a delay in curtailment decreases the benefits of estimated reach gains until the "No Curtailment" reach gain is reached (i.e., 0 ac-ft). Based on this analysis, on or about July 5, 2021 the estimated hydrologic impacts will approximately equal the expected reach gains from curtailment. Any curtailment delay beyond July 5, 2021 will necessarily result in hydrologic impacts which cannot be remedied under any curtailment scenario in the 2021 irrigation season. It should be noted that this analysis is only based on volumetric comparisons of hydrologic impacts to expected increases in reach gains under curtailment but does not consider the timing of such impacts. An earlier curtailment date may be necessary which considers the timing of crop irrigation requirements and addresses the likely gap between the timing of cessation of natural flow/supplemental water and the start of any curtailment and its associated reach gains.

Table 2 – Comparison of Impacts and Reach Gains for 2021 Curtailment Scenarios

SCENARIO	IMPACTS (AC-FT)	REACH GAINS (AC-FT)	GAINS MINUS SEEPAGE (AC-FT)
No Curtailment	8,182	0	NA
August 1, 2021 Curtailment	4,649	**1,864**[1]	**1,398**[3]
July 1, 2021 Curtailment	3,001	4,695[2]	3,521[3]

Notes:
1 – predicted reach gains in Silver Creek from 100% curtailment starting August 1,2021 (Sukow 2021)
2 – injury remedied assuming an approximate 73% curtailment starting on July 1, 2021 (Sukow 2021)
3 – computed by multiplying reach gains by 0.75 to account for 25% seepage losses from the area of pumping to Station 10

Depletion and Potential Injury for the 2021 Irrigation Season

The 8,182 ac-ft of hydrologic impacts estimated for the 2021 irrigation season if no curtailment were to occur, represent *depletions* in surface discharge and do not necessarily represent *injury* to senior surface water rights in the Little Wood-Silver Creek drainage during the 2021 irrigation season. In the Director's Notice of Administrative Proceeding (May 2, 2021) the Director indicated that a major purpose for the proceeding was to:

> *"...determine if the surface water rights in the Little Wood River-Silver Creek drainage will be injured in the 2021 irrigation season by pumping from junior-priority ground water rights in the Wood River Valley south of Bellevue."*

This section of the report endeavors to provide technical analysis which may assist the Director in determining whether all, or part, of the depletion documented in this report constitutes injury to senior surface water rights in the Little Wood -Silver Creek drainage during the 2021 irrigation season.

According to the District 37 Water Master (Kevin Lakey) there are approximately 224 water rights within the Little Wood – Silver Creek drainage representing total maximum diversion rights of approximately 671 cfs (Appendix B). As part of Mr. Lakey's work, he is tasked with forecasting the approximate cut-off dates for the water rights within District 37 to allow users to help plan for water shortages and manage the overall District. A summary of Mr. Lakey's forecast was made on May 17, 2021 that included projections for cut-off dates in 2021 for select priority dates (Appendix C) and narrative description of general conditions of the system on that date. On May 25, 2021, Mr. Lakey updated these estimates based on recent precipitation and run-off conditions and provided an updated cut-off forecast for all water rights understood to be within the Little Wood – Silver Creek drainage (Appendix D). In the more expanded cut-off forecast dated May 25, 2021, the number of days of expected irrigation water ranged from 168 for rights with priority dates of March 29, 1877 to a low of 40 days for rights with priority dates of July 1, 1913. Water rights with priority date later than January 1, 1900 were excluded from this analysis to better separate the general set of senior surface water rights from junior groundwater pumpers. This data set was analyzed to estimate the

average number of irrigation days for an average water right within the Little Wood – Silver Creek drainage. This was done by weighting each water right's number of expected days of water by its associated maximum diversion rate and computing a weighted average. Based on the May 25, 2021 updated cut-off forecast, the average number of days of water expected for the average water right was approximately 62.31 days. Given that the start date of irrigation in District 37 for 2021 was April 20, 2021, the resulting average expected cut-off date for senior surface water rights in the Little Wood – Silver Creek drainage is approximately June 21, 2021 if no curtailment is implemented. It should be noted that precipitation events and late season run-off may extend that date.

In the case of a curtailment, additional water would be made available within the system (see table 2). However, depending upon the timing of the curtailment, there still may be a "hiatus" in irrigation that could result in complete crop failure or significant yield reduction. For example, anecdotal reports indicate that it takes only 3 -4 days following the cessation of pumping for increases in discharge to be measurable in the system. If it is assumed that it requires 4 days for measurable water to re-enter the system following any curtailment, additional water would be usable in the system approximately July 5 for a July 1 curtailment and approximately August 5 for an August 1 curtailment. In either case, an irrigation "hiatus" would be experienced by most senior surface water rights of between 14 days (July 1 curtailment) and 45 days (August 1 curtailment).

In addition to potential injury being incurred due to timing, discussed above, potential volumetric injury can be addressed by comparing the volume of depletion and computed volumetric "shortfalls" calculated on individual senior surface water rights in the Little Wood – Silver Creek drainage (Appendix E.1 and Appendix E.2). The shortfall estimates represent most surface water rights in the Little Wood – Silver Creek drainage below Richfield and do not include any water rights above Richfield. Despite only representing a fraction of potentially injured parties, the volume of shortfall estimated as of May 25, 2021 is approximately 3,788 ac-ft. Additional shortfalls for other senior surface water rights in the Little Wood – Silver Creek drainage are anticipated to add to this total, but were not available at the time this report was finalized. These shortfall estimates were categorized into two categories consisting of, (1) those rights WITH some sort of supplemental water and (2) those rights WITHOUT supplemental water. In general, these shortfall estimates are grouped by farm and show the various water rights associated with each farm and their corresponding priority dates and maximum instantaneous diversion rate. For each water right, an estimate of the number of days the right is expected to provide water ("Days Run by Priority") is provided that was reported to have been updated on May 25, 2021. The maximum instantaneous diversion rate was multiplied by 1.9835 to convert from a flow rate of "cfs" to "ac-ft/d" and this value was multiplied by the "Days Run by Priority" to calculate the total water volume (ac-ft) expected to be available for each right in the 2021 irrigation season ("Total Year Acre Feet Diversion"). This expected volume of water for the 2021 irrigation season is then compared to an average volume of water considered "adequate" for each farm ("Avg. Acre Feet Use in Adequate Years"). This average value was computed from four years ("Yearly Acre Feet Use in Adequate Years") of actual diversion volumes for each farm for four years, determined by Mr. Kevin

Lakey, to represent years wherein "adequate" water was available based on his judgement and experience as Watermaster. Actual recorded volumetric data for these four years was averaged to compute the "Avg. Acre Feet Use in Adequate Years". The total water volume expected to be available for each right in the 2021 irrigation season ("Total Year Acre Feet Diversion") was then subtracted from the volume of water considered "adequate" ("Avg. Acre Feet Use in Adequate Years) to compute any shortfall that might exist ("Adequate Year Average Minus Estimate 2021 Diversion (col. R-M).No Injury =0"). A "Total Estimated Injury" is then computed by summing the individual farm injuries and is reported near the bottom right-hand corner of each sheet. The last column in each sheet reports a "Combined Acre Limit".

The "Total Estimated Injury" for each category of shortfall estimates is then totaled. As reported above, this combined volume of shortfall is estimated to be approximately 3,788 ac-ft as of May 25, 2021 for the limited set of water rights available at the time this report was generated. As noted above, additional shortfalls for other senior surface water rights in the Little Wood – Silver Creek drainage are anticipated. It should be noted that although a given water right may not show a "volumetric" shortfall, it should not be concluded that no impact or injury exists. Such water rights can be impacted by an irrigation "hiatus" as noted previously.

That these reported shortfalls constitute "injury" seems apparent given the computed hydrologic impacts or "depletions" under a "no curtailment scenario (i.e., 8,182 ac-ft) exceed the reported shortfall for this limited subset of senior water rights (i.e, 3,788 ac-ft). Put another way, if not for the pumping of junior-priority groundwater rights in the Wood River Valley south of Bellevue, senior surface water rights would have been able to place the entire shortfall to "beneficial use" in finishing their typical crops.

Modeling runs completed for the 2021 irrigation season (Sukow 2021) show that curtailment of groundwater pumping in the 2021 irrigation season would result in increased streamflow in Silver Creek in the 2021 irrigation season. Additionally, these modeling runs show that, even considering seepage losses, the majority of that water would reach senior surface water rights in the Little Wood – Silver Creek drainage and is therefore not futile.

Conclusions

It is estimated, based on analysis of IDWR model output data for 2007 (Sukow 2019), that the hydrologic impacts to surface water rights in the Little Wood-Silver Creek drainage during the 2021 irrigation season are approximately 8,182 ac-ft if no curtailment were to occur in the 2021 irrigation season. These impacts are a result of residual effects of previous groundwater withdrawals from 2019 and 2020 and primarily the effects of ongoing and anticipated withdrawals during the 2021 irrigation season. Hydrologic impacts can affect senior surface water rights in both their timing and volume.

An analysis considering the expected number of days of irrigation water available to senior water rights and the expected dates of reach gains under various curtailment scenarios, indicate that a 100% curtailment is needed on, or about June 17, 2021 to address the timing impacts and expected crop needs given current forecasts of water available to senior water rights.

Volumetric analysis of various curtailment scenarios indicated that, on or about July 5, 2021 the estimated hydrologic impacts pumping will approximately equal the expected reach gains from curtailment. Any curtailment delay beyond July 5, 2021 will necessarily result in volumetric hydrologic impacts which cannot be remedied by curtailment under any curtailment scenario in the 2021 irrigation season.

Additional volumetric analysis of shortfalls identified approximately 3,788 ac-ft of predicted shortfall as of May 25, 2021 for the limited set of water rights available at the time this report was generated. Additional shortfalls for other senior surface water rights in the Little Wood – Silver Creek drainage are anticipated. That the reported shortfalls constitute "injury" seems apparent given that the computed hydrologic impacts or "depletions" under a "no curtailment scenario (i.e., 8,182 ac-ft) exceed the reported shortfall for this limited subset of senior water rights (i.e, 3,788 ac-ft). Put another way, if not for the pumping of junior-priority groundwater rights in the Wood River Valley south of Bellevue, senior surface water rights would have been able to place the entire shortfall (i.e., 3,788 ac-ft) to "beneficial use" in finishing their typical crops.

Based on considering both the timing and volumetric injury analysis, based on current information, a full curtailment of junior water rights should be initiated on, or about, June 17, 2021 to avoid timing injury to senior surface water users. The volumetric injury to senior surface water rights of a curtailment starting on June 17, 2021 would be approximately 1,811 ac-ft. This value is computed consistent with previous calculations, with the exception of applying a 30% to the 13 days in the month of June to represent residual impacts from the two antecedent years of pumping. The reach gains for a 100% curtailment made on June 17,2021 would logically exceed the estimated reach gains for a July 1 curtailment (i.e., 4,695 ac-ft) greatly exceed the estimated volumetric injury of 1,811 ac-ft. However, based on this analysis, such a curtailment is necessary to meet the timing injury induced by junior groundwater pumpers. As such it is theoretically possible to initiate a 100% curtailment on, or about, June 17, 2021 to remedy the timing injury and subsequently reduce the curtailment percentage through the 2021 irrigation season to generally match volumetric estimates of injury. As noted previously, these dates may be significantly affected by future precipitation events and late season run-offs.

Modeling runs completed for the 2021 irrigation season (Sukow 2021) show that curtailment of groundwater pumping in the 2021 irrigation season would result in increased streamflow in Silver Creek in the 2021 irrigation season. Additionally, these modeling runs show that, even considering seepage losses, the majority of that water would reach senior surface water rights in the Little Wood – Silver Creek drainage and is therefore not futile.

References

Sukow 2019; Groundwater-Flow Model for the Wood River Valley Aquifer System, Version 1.1 Simulated Curtailment of Groundwater Use; July 31, 2019; IDWR

Sukow 2021; Staff Memorandum; "Predicted hydrologic responses in Silver Creek and the Little Wood River to curtailment of groundwater use in 2021, Basin 37 Administrative Proceeding, AA-WRA-2021-001", May 17,2021