Oregon

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MEMORANDUM

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PREPARED FOR: AR LL-1964 application file and Umatilla County

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SUBJECT: Artificial groundwater recharge application LL-1964 is incomplete

DATE: 4/15/2024

Expires: 1/1/2025

Background

Application LL-1964 proposes to divert 18,000 acre-feet per year from the Columbia River for artificial groundwater recharge (AR) on the former Umatilla Military Chemical Depot (UMCD). This memo outlines application deficiencies and unresolved issues related to artificial groundwater recharge rules (OAR 690-350-0120). Additional, separate comments were provided by other state and federal agencies.

Summary of Application Deficiencies

CERCLA Liability. The proposed recharge project is in the same aquifer and near groundwater contamination plumes regulated under the Federal Environmental Protection Agency's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) program. Liability associated with the CERCLA program needs to be resolved for this project to proceed. Detailed comments are available in EPA and OMD agency comments.

Land Ownership. The proposed project is located on the CDA property which is part of the former UMCD property. Recently (3/26/2024, East Oregonian), the CDA revoked land ownership from Umatilla County. Please provide an update regarding current land ownership of the AR site.

Hydrogeologic Feasibility Report. There are issues in the hydrogeologic description that should be remedied to defensibly show how the proposed AR project would impact the aquifer.

Monitoring Plan. The plan lacks certain water quality and water quantity monitoring elements.

Numerical Groundwater Model. The model calibration to water level data is not acceptable, exceeding 15%. Therefore, the results of predictive exercises are not protective of the public interest.

Deficiencies with detailed comments

690-350-0120(3)(a) Minimum Perennial Stream Flow or instream water right required. WRD defers to ODFW comments.

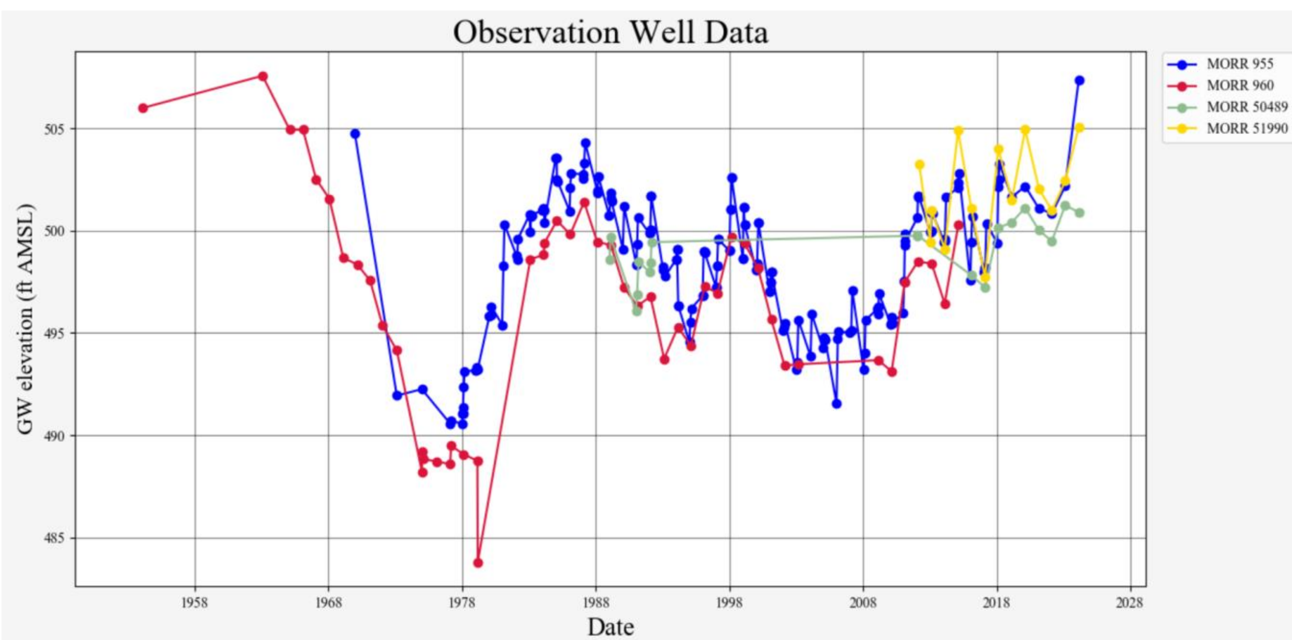
690-350-0120(3)(b) Water Quality Permit. WRD defers to DEQ to determine what is needed. DEQ required PFAS analysis in pre-application meeting. However, there is no PFAS assessment in this application. See DEQ, OMD and EPA comments for other water-quality related comments.

690-350-0120(3)(c) Purpose of Recharge. Section 1.3 provides a list of broad ideas: drought and climate resiliency, building environmental wealth, long-term recovery of the Ordnance Gravel. There is no specific purpose described for this project.

690-350-0120(3)(d) Annual Storage. Application is for 18,000 AF/year but numerical model is for 5,000 AF/yr.

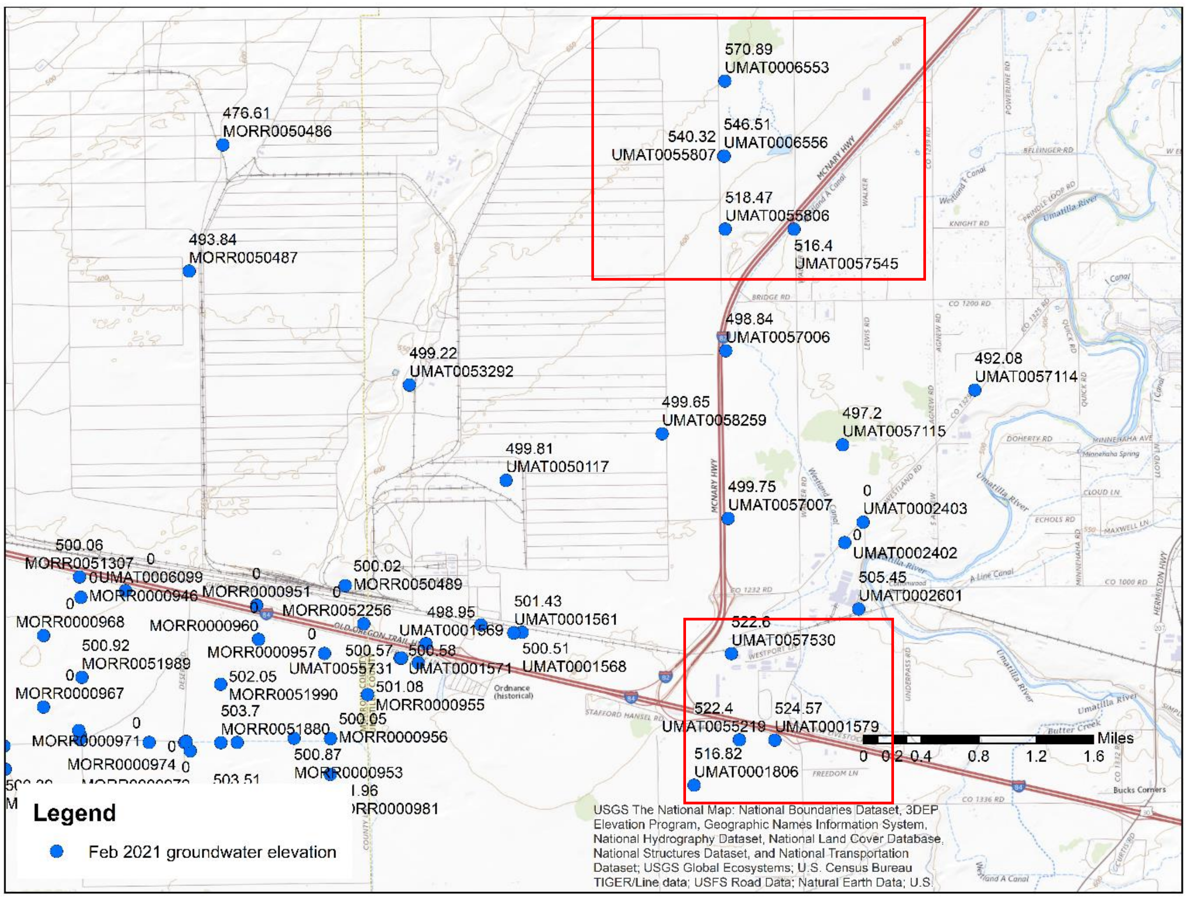
690-350-0120(3)(f) Hydrogeologic Feasibility: **Assessment of current conditions**

1) Assessment of current conditions hinges on water level data from MORR 960, which is identified as representative of the Ordnance Gravel Critical Groundwater Area (CGWA). However, this well does not have a complete record, and has a history of oil sitting on the water column. Therefore, the etape measurements are measuring the depth to the oil/water interface, and this level is depressed compared to a nearby wells without oil on the water column, such as MORR 955, MORR 51989 and MORR 50489. Monitoring at MORR 960 has been intentionally discontinued and replaced in OWRD's well network in recent years by these non-oily wells. Representative wells in the saturated coarse-grained sediments tell a story of water level recovery to historic levels, and a flattening out of the hydrograph despite year over year artificial groundwater recharge by CLWID that exceeds recovery. This lack of continuing water level increase suggests that significant increased storage capacity may not exist in the Ordnance CGWA.



2) Sections 3.2.1 and 3.2.2: Geology and Hydrogeology.
No distinction is made between saturated catastrophic flood deposits' coarse and fine-grained facies. Well yield within the Ordnance Gravel CGWA exhibits order of magnitude differences based on location and predominant grain size of the saturated zone. Additionally, water levels indicate these facies changes affect groundwater flow direction.

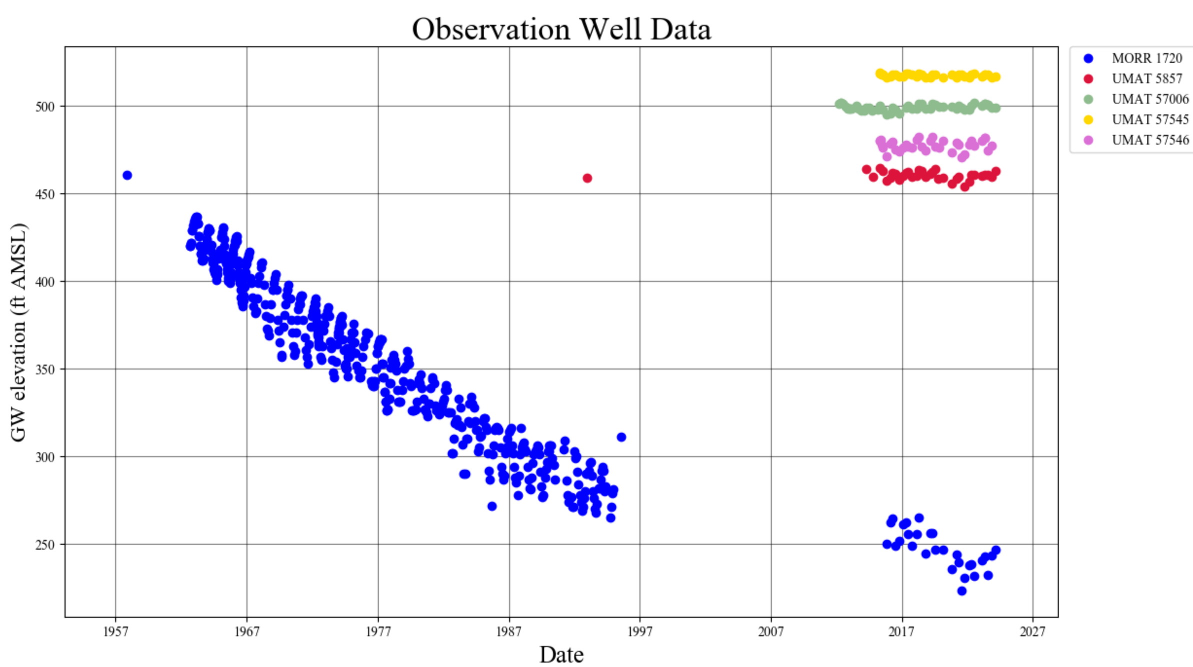
Fig 5 and Fig 6. What season does this figure depict? The contours are extended into areas where data is available but was omitted. Therefore, they fail to reflect the actual water table. For example, the wells in red boxes below are primarily located in saturated fine-grained sediments and reflect water table high points in the subject area. Omission of wells and water level data from fine-grained sediments in the catastrophic flood deposits in Figure 6, page 40 results in modeled water level elevations that deviate from measured levels by approximately 40-80 feet NE of the proposed AR site and 10-20 feet SE of the Depot.



How was Alkali Canyon identified? It is difficult to differentiate from fine-grained catastrophic flood deposits using well log descriptions.

Fig 4a and 4b. What data support the Alkali Canyon depiction on cross section A-A'? Given that Alkali Canyon was emplaced before the Missoula floods and their resulting erosional features into basalt, what geologic process would place Alkali Canyon on top of a younger erosional feature? Mechanisms aside, the hydraulic significance of erosional windows in this area is that there is a potential pathway for water to move from sediments into the Rattlesnake Ridge interbed, which lies between Elephant Mountain and Pomona.

This leads to the discussion on p. 11 of the application, where the conclusion is drawn that there is no hydraulic connection between flood deposits and underlying basalt, even where erosional windows juxtapose Elephant Mountain and Pomona Members of the CRBG against catastrophic flood deposits. While there is a difference in head between the saturated coarse-grained flood deposits and nearby wells that access basalt, this head difference indicates a downward gradient across a permeability contrast, not an absolute lack of hydraulic connection. The first basalt aquifers in this area typically exhibit stability and seasonal fluctuations like the sedimentary aquifer system, while deeper basalt wells completed into the Umatilla Member show distinctly different trends and elevations. The hydrograph below shows UMAT 57545 and UMAT 57006, completed into the flood deposits, UMAT 57546 and MORR 5857, completed into the Rattlesnake Ridge interbed between Elephant Mountain and Pomona Members, and MORR 1720, completed into the Umatilla Member. While MORR 1720 has a water level 200 feet below the others, the head difference between the upper units is on the order of 20 feet. For this reason, it is very unlikely recharge activities will affect the aquifer accessed by MORR 1720. There is more uncertainty about interactions between the remaining 3 units, and the project should identify a plan to monitor water level impacts across these three units: catastrophic flood deposits, the basal Elephant Mountain/Rattlesnake Ridge interbed aquifer and the basalt Pomona/ Selah interbed aquifer. WRD defers to the water quality agencies to determine what water quality monitoring may be required.



Attachment E. Deep Soil and GW Investigation (p. 468 of application)

The project installed monitoring wells and conducted a 48-hour aquifer test. The maximum pumping rate was 100 gallons per minute (gpm). In a high K environment, a higher pumping rate is necessary to produce measurable drawdown. Attachment C.1 shows total drawdown from pumping is reported as 0.009', while an etape can detect +/- 0.01' in perfectly calibrated condition. The total change in water level during this test is less than measurement error, which does not adequately characterize aquifer parameters. The hydraulic conductivity reported from this test is 5,330-7,020 ft/day. This is higher than but in the same order of magnitude as other tests in the coarse-grained catastrophic flood deposits. These values were used in aquifer recharge mounding analysis (p. 473-479). Because the hydraulic conductivity used is on the high end of other reported values, mounding estimates are likely low.

690-350-0120(3)(f) Hydrogeologic Feasibility: Anticipated changes due to proposed recharge

Section 4.2 This section concludes there are no nearby wells to impact. There is no mention of potential impact to the adjacent pump and treat system or mobilization of contaminants. This is incomplete analysis. The groundwater model was created to address this topic, and the application should reference its results. This review acknowledges that the model, in its current state, is not acceptable to reviewing agencies. This presents the need for a step-wise approach to revising the application: improve model inputs and calibration, then use its predictive results to address the application requirement.

690-350-0120(3)(g) Project Description Report: operation and monitoring plans.

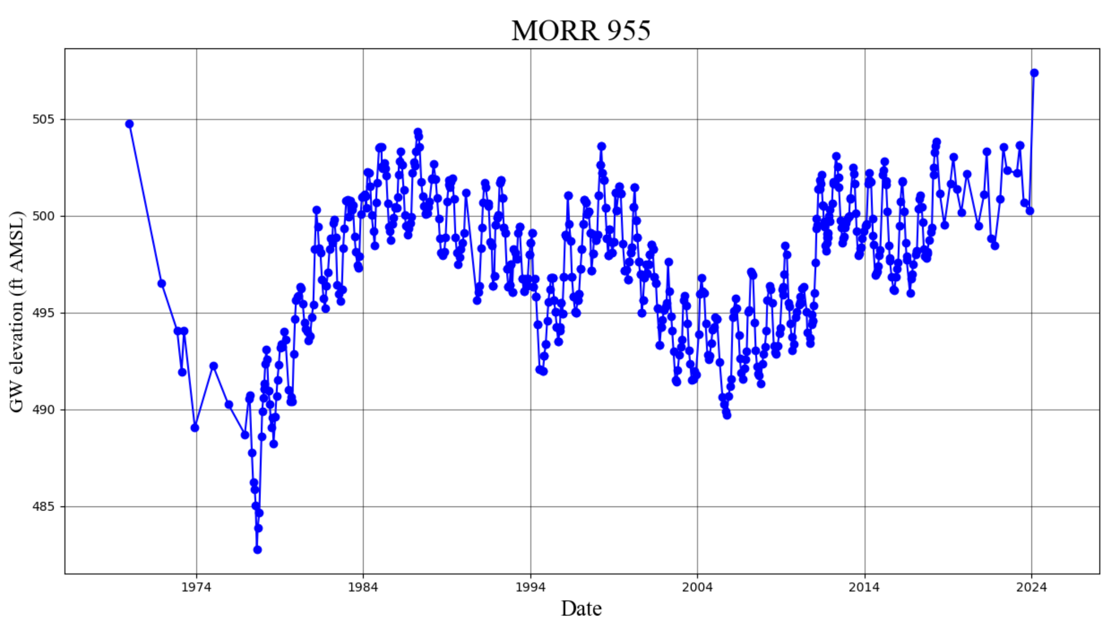
1) Mentioned in this section: a second AR LL may be incoming from Umatilla River to recharge at the same location. Is that contemplated as additive to the volume planned for in this Columbia River application?
2) There is a mention of secondary groundwater permits here with no previous mention in the application. Without knowing what (if any) recovery of stored water is contemplated, it is not possible to assess if the water level monitoring plan will be sufficient. From the perspective of impact to nearby wells, the plan should include at least one well between the recharge site and the landfill.

690-350-0120(3)(h) Additional Information. The reviewing agencies required a calibrated numerical groundwater model be built and used predictively to estimate impacts to the groundwater contamination plumes and the pump and treat systems operating to control them.

<u>GW model report comments:</u>

1) p. 2 "This new model would supplement previous modeling evaluations that showed the aquifer recharge project would not impact the pump and treat system". Please share the previous modeling evaluations.

2) There are two model layers: “Ordnance gravel aquifer “ and Alkali Canyon. How was Alkali Canyon formation identified? How was K value for Alkali Canyon estimated?
3) The model assumes no hydraulic connection between sediments and basalts. The available data do not support this as a blanket statement. See comments in hydrogeology section above.
4) Were catastrophic flood deposits delineated into coarse and fine-grained saturated facies with appropriate aquifer parameters ahead of model calibration? The figure illustrating modeled hydraulic conductivity values has no landmarks to reference.
5) Omission of water level data from fine-grained sediments in the catastrophic flood deposits within the model area results in modeled water level elevations that deviate from measured levels by approximately 40-80 feet NE of the proposed AR site and 10-20 feet SE of the Depot. See map above. This is not acceptable as a basis to model predictively.
6) Section 2: Justify the selection of modeling code MODFLOW-USG. Main benefit of using MODFLOW-USG over traditional MODFLOW is its capability to provide a higher level of flexibility in grid geometry and refinement. However, this model used uniform grid cells (800 ft X 800 ft) and failed to take an advantage of MODFLOW-USG capabilities. Building nested grids with refined grid cells in the Umatilla Depot area would improve model resolution and could provide greater detail and more accuracy around the area of interest.
7) Section 2.2: The model simulates only 5-year period from 2017 to 2022. Water levels in the Depot area for the simulated period appear to be in steady state. However, historical data show variations in groundwater levels in different stress periods (see the water level plot for MORR 955). A model developed for a period of reasonable stable groundwater levels cannot predict the impact of future changes in groundwater conditions and may result in greater uncertainty in model predictions.



8) Section 2.2: Was a single value of hydraulic conductivity used for the entire Ordinance Gravel Aquifer? Was it assumed that the system is homogenous with uniform hydraulic conductivity? If not, what interpolation scheme was implemented to interpolate hydraulic conductivity data? Were parameter zones for hydraulic conductivity identified before model calibration? The adjusted hydraulic conductivity values during calibration process, appear to be too high for some zones. For an example, adjusted

hydraulic conductivity value is nearly double than measured value for Ordnance Gravel in a zone. Unexpectedly high or low values could be a result of force matching observed and simulated heads. Accuracy of the adjusted hydraulic conductivity values should be further tested conducting model calibration between observed and simulated stream flows.

9) Section 2.4:
    - Calibration target wells are concentrated in a small area and are not well distributed throughout the model domain. In this case, refine grid cells in and around depot area could improve the model calibration. A better approach would be to create a small scale, refined sub-model for the area of interest.
    - Model calibration to the transient data set from longer period (e.g. MORR 955) would increase model accuracy and should reduce uncertainty for model predictions.
10) Section 2.5: Simulation of future scenario with 18,00 AF per year (maximum proposed rate) should be modeled to assess the potential impact of future project expansion on hydraulic capture of the contaminant plume.
11) Section 3: As modeling result suggest, the Ordnance Gravel aquifer recharge program likely results in more flow of water between the recharge basin and the extraction wells and may quicken the contaminant cleanup process. However, at the same time, recharge project will create a groundwater mound resulting in steep head gradients, which may cause flushing of residual contamination from the vadose zone to the groundwater system. On the other hand, increased groundwater flow could enhance dispersion process and may result in spreading of contaminant plume. A thorough evaluation of groundwater flow and contaminant transport before and after artificial recharge should be conducted to better understand these processes.