The Potomac Aquifer Recharge Oversight Committee
Meeting Minutes
February 20, 2024

In attendance: Whitney Katchmark (Committee Chair), Mark Bennett (remote), Jay Bernas (remote), Charles Bott (remote), Ryder Bunce, Brian Campbell, Weedon Cloe, Curtis Consolvo (remote), Emma Corbitt, Eva Doty (remote), Jason Early, Robert Edelman, Dan Holloway, Seyyedhadi Khatami (remote), Preston Kirby, Mark Kram (remote), Jamie Mitchell, William Mann (remote), Scott Morris, Mark Nelson (remote), Ivy Ozmon, Harold Post (remote), Doug Powell, Gary Schafran (remote), Mark Widdowson.

Ms. Katchmark (HRPDC) called the meeting to order at 11:00 a.m.

The minutes of the previous meeting were approved as distributed.

Dr. Mark Widdowson (PARML) provided updates on the Enhanced Aquifer Recharge (EAR) EPA research project and the lab's strategic planning process.

The EPA EAR project period began on August 1, 2023. The project aims to take lessons learned at the HRSD SWIFT Research Center (SRC) to form hypotheses for the broader application of EAR. The PARML project will address the four research areas outlined in the EPA grant request for applications. Dr. Widdowson described ongoing injectivity testing investigations as they relate to the effective application of EAR. The project also aims to improve understanding of the degradation and attenuation of biological and abiotic conventional and emerging contaminants. Contaminant fate will be determined using injectivity recovery tests and further evaluated with soil aquifer treatment (SAT) sediment columns experiments. SAT columns will be packed with aquifer sediments collected during drilling of the James River SWIFT managed aquifer recharge (MAR) wells. Sediments will undergo geochemical and microbial characterization at the time of collection during drilling operations and again before SAT experiments. Native groundwater will be used as a control compared to SWIFT water in the SAT column experiments. SAT tests are expected to start in early summer.

Committee members asked many questions. Mr. Brian Campbell (DEQ) asked how sediments will be processed to remove drilling fluids. Dr. Widdowson and Mr. Dan Holloway (HRSD) described the batch washing process. They emphasized that no perfect method exists to retain unchanged subsurface conditions and that bringing underground sediments into an oxygenated environment from the anoxic subsurface environment also contributes to changes. Mr. Campbell asked if sediments would be homogenized before packing the SAT columns. Mr. Widdowson said that there will be some homogenization, but packing will aim to retain the vertical position of the sediment samples collected, targeting the upper strata of the upper Potomac Aquifer. He noted these methods are currently used in California groundwater recharge research projects. Mr. Widdowson also noted the careful column packing process when asked if columns would be packed to avoid changes in sediment matrix structure. Mr. Widdowson explained that the tests aim to mimic groundwater velocities around the recharge wells when asked if the hydrostatic pressure of the aquifer will be mimicked in SAT tests. He stated that mimicking pressures would be challenging to achieve. Mr. Preston Kirby (VDH) asked if microbial characterization has been performed for the existing SRC recharge wells. Ms. Jamie Mitchell (HRSD) shared that previous work revealed that the community was comprised of microbes typically found in soils. Ms.

Katchmark also inquired about the applicability of test methods designed for shallow aquifers to the Potomac Aquifer. Mr. Widdowson noted that these experiments will be conducted to make those comparisons.

Mr. Widdowson reviewed the status of strategic plan development for PARML. The development process guides decisions and scaling up lab operations to fulfill PARML's charges from the General Assembly. Ms. Beate Wright (Wright For You LLC) will facilitate planning meetings that began on January 18. Planning participants include Dr. Widdowson, Dr. Gary Schafran (PARML), Ms. Katchmark, and Mr. Doug Powell (JCSA). At their first meeting, the group discussed the development team charter, promise, vision, principles, and priorities and performed an initial analysis of strengths, weaknesses, opportunities, and threats (SWOT). Mr. Widdowson said the group intends to finalize strategic goals at their next meeting in March. PARML plans to present the draft strategic plan to the committee at the May PAROC meeting and finalize the plan by early June. Ms. Katchmark noted the uncertainty around who should handle inquiries about the PARML process or science. Committee members suggested considering designating a communications officer to take on that responsibility. Mr. Widdowson expressed the need to confirm whether PARML is empowered to respond to inquiries about the lab.

Ms. Katchmark opened a discussion on the five-year review of PARML required by the PAROC authorizing legislation. Evaluation by a panel of experts from the National Water Research Institute (NWRI) is recommended. No one objected to working with NWRI, and HRSD members shared that there is a fee for their review services. Ms. Katchmark said she would contact NWRI to determine the scope, timing, feasibility, and logistical planning for the PARML review after strategic plan development. She proposed completing the evaluation this fiscal year, and the committee agreed. Dr. Charles Bott (HRSD) mentioned that it makes sense to suggest different reviewers than those selected for the initial SWIFT review panel and to request PAROC input for individual expertise to be included. The review panel composition is negotiable. Dr. Bott noted reviews can take six months or longer if the process includes an in-person visit. The scope and charge will inform whether an in-person visit is necessary, so committee members were encouraged to decide on the review scope as soon as possible.

Dr. Charles Bott (HRSD) introduced Dr. Samantha Hogard, who worked with him on pathogen removal research in the SWIFT process at the SRC over the last few years.

Dr. Smantha Hogard (Trussel Tech/ Virginia Tech Ph.D. graduate) shared the SWIFT targets for disinfection driven by the Safe Drinking Water Act's (SDWA) Surface Water Treatment Rule. SWIFT disinfection processes must achieve log reduction values (LRV) of 12/10/10 for viruses, *Cryptosporidium*, and *Giardia* under the requirement. Dr. Hogard reviewed the proportional contribution of various SWIFT treatment processes to the LRV achieved, including flocculation and sedimentation with biologically active filtration (BAF), ozone treatment, ultraviolet disinfection, and SAT. She noted that ozone treatment was evaluated in research only, and full-scale SWIFT operations will not rely on this disinfection technique. To claim LRV credit for this process, a targeted ozone residual concentration must remain after water moves through ozone treatment. This is problematic because the chemical compounds in treated water react with ozone to form disinfection byproducts (DBPs), regulated contaminants under the SDWA. The

ozone research aimed to better understand whether the treatment technique specifications based on modeling by the EPA are as conservative for wastewater treatment as they are for drinking water treatment. The BAF process following ozone treatment removes many DBPs but not bromate. Bromide concentrations are relatively high in the raw wastewater in this region. Dr. Hogard reviewed the process of bromate formation when exposing bromide to ozone and highlighted how the SWIFT ozone treatment process was optimized to limit potential bromate formation.

The three overarching objectives of this research were demonstrating pathogen and surrogate microbe reduction through the SWIFT treatment process, evaluating the balance between ozone disinfection and oxidation versus DBP formation, and evaluating alternative ozone disinfection frameworks for a range of water quality characteristics. *Cryptosporidium*, *Giardia*, and surrogates for Protozoa, and Norovirus, Rotavirus, Adenovirus, and surrogates for enteric viruses were measured using molecular techniques at five sampling points in the SWIFT process, from influent (secondary clarifier effluent) to effluent (SWIFT water) to investigate pathogen reduction. *E. coli* and Coliphage microbes were introduced into the SWIFT pilot-scale process before ozone treatment and measured downstream through the treatment process to investigate pathogen removal efficiencies. The effect of hydrogen peroxide and monochloramine bromate control methods on bromate production and removal of other trace organic contaminants (TrOC) of concern was also evaluated compared to ozone treatment alone. Findings indicated that the EPA model for the inactivation of pathogens does not align with the experimental data collected. Monochloramine was the most effective bromate formation control strategy. However, monochloramine addition inhibited the removal of TrOC compared to the hydrogen peroxide addition and ozone treatment alone. Ozone treatment and hydrogen peroxide treatments enhanced TrOC removal. To evaluate alternative disinfection frameworks, Dr. Hogard investigated the impact of temperature, pH, total organic carbon (TOC) concentrations, and ozone exposure on removing spiked *E. coli* and Coliphage microbes throughout the SWIFT pilot process. Results indicated that ozone treatment successfully removes pathogens even when temperature and pH conditions that promote pathogen growth are present. There were no significant differences in pathogen removal across the range of TOC concentrations tested, though a correction factor for higher TOC water may be necessary. Dr. Hogard summarized the research findings by noting that upstream wastewater treatment, flocculation and sedimentation, BAF, and ozone treatment are robust pathogen removal treatments, that finding a balance between ozone disinfection and oxidation versus DBP formation is possible, and that alternative ozone disinfection monitoring frameworks are necessary for water reuse applications.

Committee members asked what the next steps of this research would entail. Dr. Bott shared that this work concludes the SWIFT pathogen removal research, and HRSD intends to move toward compliance monitoring. The pathogen removal research presented went far beyond the LRV validation objectives outlined by the initial SWIFT NWRI review panel. Dr. William Mann asked if COVID viruses are removed. HRSD confirmed their removal and noted ongoing wastewater surveillance for COVID and flu viruses will continue. The work presented today focused on viruses that are more resilient to water treatment techniques.

Dr. Gary Schafran (PARML) provided updates on the PARML analytical capabilities, aquifer sediment analyses, and sediment analyses on bag filter samples at the SRC. PARML analysts use ion chromatography (IC) to measure inorganic anions, organic acids, bromate, amino acids, and carbohydrates. Dr. Schafran noted that the lowest measurement on analysis calibration curves is excellent for fluoride, chloride, sulfate, bromide, nitrate, and phosphate anions. PARML analysts continue to work on lowering the detection limits for the other compounds measured with IC analyses. The bag filters removing fine particulate material before SWIFT water injection were changed out on January 20, 2024. This process initiated PARML sediment characterization efforts. Dr. Schafran explained that prior analyses of particulate material in SWIFT water showed that iron was dominant. He emphasized that iron is important because it plays a role in geochemical reactions determining the type and level of arsenic released into groundwater from aquifer sediments under changing redox conditions resulting from injection operations. Aquifer sediments collected from drilling injection well NP_MAR_01 were analyzed along with the exhausted filter bag material and sediment trapped in filter bags. Two types of samples were observed for sediments collected at discrete well depths, corresponding to the location of well screens: "sand" samples without visible clays and "visible clay" samples. These samples were analyzed separately, and their analytical results were compared. Dr. Schafran reviewed the sample processing methods from sample preparation through strong acid digestion before inductively coupled plasma mass spectrometry (ICP-MS) analyses. He presented sediment metal content results, then compared arsenic and iron content and the ratio of arsenic to iron in the "sand" and "visible clay" sample types. Filter bags and sediments retained within underwent the same sample processing and analyses. Dr. Schafran presented the bag filter samples' metals, arsenic, and iron results compared to aquifer sediment samples. He summarized findings by saying that iron is the dominant metal, that fine sand material in the bags may be aquifer sediment, and that the arsenic-to-iron ratio determined for bag filters is similar to the ratio measured in aquifer sediment.

Mr. Campbell (DEQ) cautioned that drilling mud - a blend of water, bentonite clay, and emulsified polymers- could coat sediment grains and suggested that sediments should be washed to remove that material before characterization. Dr. Schafran shared that PARML has data comparing washed sediments to unwashed sediments and said their signatures are comparable. PARML plans to analyze a drilling mud sample from HRSD as well.

Mr. Jay Bernas (HRSD) raised questions about PARML's funding source during the roundtable discussion. It was determined that both Old Dominion University and Virginia Tech receive $500,000 yearly to support PARML efforts under the proposed state budget. Members discussed whether PARML funding will be included in future state budgets and who should advocate for maintaining PARML funding every two years.

Ms. Katchmark asked the committee if they wished to hear presentations on land subsidence research at the May meeting. A recent news story identified groundwater withdrawals as a significant contributing factor to the high rates of observed subsidence along the East Coast based on analysis of Interferometric Synthetic Aperture Radar (INSAR) elevation measurements. Mr. Mark Bennett (USGS) emphasized that uncertainties in the study referenced by the press were high, and elevation data collected at regional extensometers do not agree with INSAR data.

Committee members noted several complimentary data to evaluate, including INSAR, extensometer, and survey benchmarking elevation data, and that USGS and DEQ are working in partnership on subsidence research. A presentation from someone researching comparisons of INSAR data to other regional elevation data sources was suggested for a future meeting.

PARML offered to host the May meeting of the PAROC at their facility in Hampton.

There were no public comments.

The meeting adjourned at 1:35 p.m.

Approved: Date:

5/14/2024

Committee Chair

Committee Members:

- Mike Rolband, Director of Virginia DEQ
- Dr. Karen Shelton, Virginia State Health Commissioner
- Dr. William Mann, Governor Appointee
- Doug Powell, Governor Appointee
- Whitney Katchmark, HRPDC
- Dr. Stanley Grant, Director of Occoquan Watershed Monitoring Laboratory
- Dr. Mark Widdowson, Co-Director of the Potomac Aquifer Recharge Monitoring Lab
- Dr. Gary Schafran, Co-Director of the Potomac Aquifer Recharge Monitoring Lab

Non-voting members:

- Mark Bennett, Director of Virginia and West Virginia Water Science Center, USGS
- Leslie Gillespie-Marthaler, Deputy Director Water Division, US EPA Region 3