Delaware River Basin Commission
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Kristen Bowman Kavanagh, P.E.
Executive Director

June 24, 2025

Via email to Marc.Cammarata@phila.gov

Mr. Marc Cammarata
Deputy Commissioner, Planning & Environmental Services
Philadelphia Water Department

Dear Mr. Cammarata,

I write in response to your letter dated December 19, 2024, and attachments, addressing the Delaware River Basin Commission ("DRBC") report *Pathway for Continued Restoration: Improving Dissolved Oxygen in the Delaware River Estuary* ("*Pathway Report*"; DRBC Technical Report No. 2024-6, September 2024). Thank you for your thoughtful review and comment on this important document.

Your letter included as an attachment the February 2024 technical comments of the City of Philadelphia Water Department ("PWD") on EPA's proposed aquatic life use rule for the Delaware Estuary among other items. I note that the letter and PWD's technical comments submitted to the EPA focused in significant part on cost estimates developed by Kleinfelder, Inc. ("Kleinfelder") on behalf of the Commission. These estimates were published in the report *Nitrogen Reduction Cost Estimate Study* (DRBC Technical Report No. 2021-1, January 2021, and addendums dated September 2022 and August 2023) ("Kleinfelder Report"). To ensure that these comments received DRBC's full and appropriate consideration, we reviewed the Kleinfelder Report along with the information you provided, which included the following:

- Mainstream Nutrient Reduction Evaluation at SWWPCP. Hazen and Sawyer. June 2020.
- Southeast Water Pollution Control Plant: Evaluation and Cost Estimate of Nutrient Treatment Practices and Technologies. HDR. April 21, 2021.
- Northeast Water Pollution Control Plant: Evaluation and Cost Estimate of Nutrient Treatment Practices and Technologies. HDR. April 21, 2021.
- Memorandum. Philadelphia Water Department. April 22, 2024 (untitled; highlighting "brief sections in the [full reports by Hazen and Sawyer and HDR] that support PWD's comments on the EPA proposed rulemaking").

Several of your and PWD's comments in our view warrant a written response to address technical assumptions that apparently explain the discrepancies between PWD's and DRBC's cost estimates. I and my staff believe a candid, in-person discussion of these assumptions would help to bridge the gap between our differing perspectives.

We appreciate your invitation to meet on this topic in hopes of supporting better alignment between our organizations on this matter of vital significance to the Estuary and the larger Delaware River Basin.

Sincerely,

Kristen Bowman Kavanagh, P.E.
Executive Director

c: Namsoo Suk, DRBC (namsoo.suk@drbc.gov)
Greg Voigt, EPA Region 3 (voigt.gregory@epa.gov)

ATTACHMENT

Technical comments of Delaware River Basin Commission (DRBC), June 24, 2025, in response to letter of December 19, 2024, from Marc Cammarata of Philadelphia Water Department (PWD) to Kristen Bowman Kavanagh of DRBC

PWD Cover Memorandum, April 22, 2024 ("Memo"), Page 2, Table 1; and Mainstream Nutrient Reduction Evaluation at SWWPCP, Hazen and Sawyer, June 2020 ("Hazen and Sawyer"). Table 1, "Capital Cost Comparison—EPA/Kleinfelder vs. PWD/Hazen and Sawyer/HDR" of the Memo ("Table 1" or "PWD Table 1") presents an incorrect comparison. A copy of Table 1 is attached for reference. The PWD/Hazen and Sawyer value for the Southwest plant "Annual Average Permitting Scenario" in Table 1 ($1,658,813,202) appears to be based on the full Tier 3 "Life Cycle Cost" for "IS 2 – Two-Stage" in Table ES-1 of Hazen and Sawyer.[1] However, the "EPA/Kleinfelder" value presented in Table 1 ($361,200,000) appears to be based on the "Total Present Worth Capital Cost" from the table, *PWD Southwest WPCP Effluent Level: NH3-N=1.5mg/L* ("Kleinfelder Table PWD-SW-1.5") in Appendix D, file page number 120, of the January 2021 DRBC report, *Nitrogen Reduction Cost Estimation Study: Final Summary Report,* prepared by Kleinfelder, Inc. ("Kleinfelder Report"). A copy of Kleinfelder Table PWD-SW-1.5 is also attached for reference. A life cycle cost and a present worth capital cost are not comparable. Importantly, Kleinfelder Table PWD-SW-1.5 includes a "Grand Total Present Worth Cost" ($740,359,000 in 2019 dollars). This, not the "Total Present Worth Capital Cost," is the value that when updated to 2023 dollars would be comparable to Hazen and Sawyer's "full life cycle cost." When the correct Kleinfelder value is used for comparison, the difference between the EPA/Kleinfelder and PWD/Hazen estimates shrinks substantially.

PWD Cover Memorandum dated April 22, 2024 ("Memo"), Page 2, Table 1; and Mainstream Nutrient Reduction Evaluation at SWWPCP, Hazen and Sawyer, June 2020. Overall, the costs from the Kleinfelder Report ($240,800,000 for the Southeast plant and $445,100,000 for the Northeast plant, as updated from 2019 to 2023 in PWD Table 1) appear to be in reasonable agreement with PWD's estimated costs for the two plants in Hazen and Sawyer ($213,275,983 for the SE plant and $485,795,295 for the NE plant, as updated from 2020 to 2023 dollars in PWD Table 1). Only the Southwest plant costs are in poor agreement ($740,359,000 in the Kleinfelder Report in 2019 dollars versus $1,658,813,202 in Hazen and Sawyer, as updated to 2023 dollars in PWD Table 1), and DRBC believes that assumptions inconsistent with EPA's proposed criteria largely account for that difference as described in the following paragraphs.

[1] A footnote to PWD Table 1 states that these cost estimates were developed in 2020 and "have been escalated to October 2023 using Engineering News Record Construction Cost Index (ENRCCI) value 13498." The Tier 3 "Life Cycle Cost" for "IS 2 – Two-Stage" in Table ES-1 of Hazen and Sawyer is $1,620 "in 2020 $M."

- **Memo, page 3, first and second paragraphs.** The Memo states that while biological aerated filtration (BAF) could be implemented at the Southwest plant, it is not the basis for the PWD cost estimate due to "complexity" and operators having "familiarity with the activated sludge process (versus filters) and in terms of additional full-time employees required to operate new facilities." While biological nutrient removal ("BNR"), an activated sludge system, as referenced by PWD is an available alternative technology, BAF is a much more cost-effective technology. According to a web search, the average annual salary for wastewater treatment plant operators in Pennsylvania is $61,459 per year, with a range of $27,065–$107,257. Presuming that operators knowledgeable and experienced in BAF could be hired *at the upper end of that range*, and assuming a factor of 2.5 to account for indirect and fringe costs, an experienced plant operator at the upper end of the range would have a burdened salary of approximately $270,000 per year. If two (2) new plant operators were required to be hired specifically for these advanced treatment options, the total additional annual salary cost of $540,000 would still be less than the annual cost differential cited in Table 1 of the Memo. Also important, while a BAF system may have more mechanical components than BNR, from a process control perspective BAF is simpler than BNR. BAF is predominately automated and can be readily understood through a training program for operations and maintenance personnel provided by the manufacturer or a third party.

- **Memo, Page 3, Table 2.** Memo Table 2 ("PWD Table 2") (copy attached) cites a design flow rate of 540 MGD, referencing Hazen and Sawyer Sections 2.2, 2.5, and 2.6 for that value. However, at the referenced sections, Hazen and Sawyer states that 540 MGD is the "future peak" value but provides no explanation. Figure 2-2 in Hazen and Sawyer, titled "Flow Analysis (2012-2017)," appears to contradict the value of 540 MGD in that the *hourly* flows in Figure 2-2 do not even exceed approximately 460 MGD during the flow analysis period.

- **Memo, Page 3, Table 2.** Memo Table 2 ("PWD Table 2") also suggests that the PWD estimate is based on sizing facilities (to 540 MGD) to capture a flow value that exceeds the highest hourly flow of approximately 460 MGD. As presented in PWD Table 2, PWD's use of 540 MGD as the basis for sizing treatment facilities appears to be much higher than necessary given EPA's proposal.

- **Memo, Page 3, Table 2.** It is important for PWD to provide an explanation for the use of 540 MGD to size its treatment facilities because of potential implications for the socio-economic evaluations. For example, if 540 MGD is based on future projections of a higher number of PWD customers, what is that future projection of customers and what proportion are Philadelphia residents versus suburban residents under municipal contracts for wastewater treatment? If PWD anticipates increasing its number of suburban wastewater customers, this expanded customer base should be the basis of revised socio-economic evaluations.

- **Memo, Page 3 and multiple locations in Hazen and Sawyer.** In several places, documents refer to "DVRPC 2066 projections" but provide no more detailed citation or

information. DRBC performed a scan of documents on the DVRPC website and reached out to DVRPC staff in hopes of obtaining and reviewing these projections. However, DVRPC staff was unable to identify any document corresponding to that reference. Please provide the source for the referenced DVRPC 2066 projections, so that we can be more fully informed in our review.

- **Memo, Page 4, Table 3.** Memo Table 3 ("PWD Table 3") (copy attached) states that the cost estimates in the Kleinfelder Report did not account for additional solids (sludge) handling costs. In fact, Kleinfelder did consider these costs. See Kleinfelder Table PWD-SW-1.5. This table includes a line item for "Additional sludge disposal costs" under "Plant-specific annual O&M Costs."

- **Memo, Page 4, Table 3.** PWD Table 3 states that costly site preparations – specifically, grading and sludge lagoon remediation – were not accounted for in the Kleinfelder Report. Kleinfelder included the following site preparation categories in its evaluation: foundations, excavation, sheeting, dewatering, and land acquisition. See Kleinfelder Report, Section 5.1. For the *generic* pure oxygen plant, Kleinfelder allocated 10% of the total generic plant direct costs to site work in addition to the additional plant-specific costs. In our review of the Hazen and Sawyer (Southwest plant) and HDR (Northeast and Southeast plants) reports, in the sections cited in Memo Table 3, we could find no explanation of the need for sludge lagoon remediation. Please clarify whether this cost is attributable to meeting EPA's proposed dissolved oxygen (DO) criteria or whether it arises from a separate and distinct need or obligation.

- **Hazen and Sawyer, Page 2, last paragraph.** This paragraph states that additional tankage is assumed required as part of the wet weather strategy for the Southwest plant. Any costs that are apart from those strictly necessary to meet the EPA's proposed DO criteria should be excluded from these cost estimates.

- **Hazen and Sawyer, Page 7, first paragraph.** The paragraph states that the DO sag in the estuary is most prevalent during the summer months, so there is the potential that a seasonal ammonia limit may be implemented. In fact, DRBC's technical work makes clear that additional ammonia removal in the winter season would not measurably improve estuary DO concentrations. Under any scenario, DRBC expects that any version of the new criteria could be achieved during winter months with no additional treatment. Since most ammonia removal technologies have some biological component (which is less efficient in colder temperatures), assuming that ammonia would need to be removed during winter months dramatically increases the sizing and energy needed (for treatment during cold temperatures) and, thus, dramatically increases both material and operational costs. We believe that sizing and operations erroneously based on winter treatment significantly overestimates the costs of meeting the proposed criteria and is inconsistent with both the EPA proposal and the technical discussions held in DRBC's Water Quality Advisory Committee meetings that preceded the proposal.

- **Hazen and Sawyer, Sections 2.3 and 2.5.** These sections provide a circular reference for the justification of using 540 MGD as the basis for sizing new treatment. Section 2.3 points to Section 2.5, and Section 2.5 points back to Section 2.3. Yet neither section provides a basis for use of the 540 MGD flow rate, which appears excessive relative to the data and other estimates presented in Hazen and Sawyer and elsewhere.

- **Hazen and Sawyer, Page 2-5, Table 2-2.** Hazen and Sawyer Table 2-2 appears to indicate that biochemical oxygen demand (BOD) increases proportionally with flow. If this is correct, this suggests that the higher flow of 540 MGD is associated with increased wastewater flow (as opposed to stormwater flow, which has a lower BOD than wastewater) and therefore new customers. If the projected peak flow of 540 MGD is based on new customers, the socio-economic evaluations should be updated to include these new customers. If the projected peak flow is not based on new customers, assuming that BOD increases proportionally with flow is likely an overestimate and may be resulting in overestimates of sizing and cost.

- **Hazen and Sawyer, Section 2.6, page 2-6.** The first paragraph states that less than 1.5% of total hourly flows over the five-year period exceeded 225 MGD, which corresponds to 6 days per year of hourly flow above 225 MGD during the five-year period. This finding appears inconsistent with PWD's decision to use a much higher flow rate (540 MGD) as the basis for sizing and cost estimates.

- **Hazen and Sawyer, Page 3-3.** This section states that two additional aeration tanks (ATs) and four additional final settling tanks (FSTs) included in the modeling exercise were assumed as part of the wet weather strategy. These improvements may be important to wet weather operations, but if they are not required to meet the EPA's proposed DO criteria, they should not be included in an estimate of the costs of meeting the criteria.

- **Hazen and Sawyer, Page 3-4 including Table 3-1.** Cost estimates should be recomputed excluding additional winter treatment, because winter treatment is unnecessary and would dramatically increase sizing and capital costs, as well as operations costs. Both the EPA rule proposal and DRBC's technical work preceding that proposal made clear that additional winter treatment did not measurably improve estuary DO concentrations.

PWD Table 1

Table 1. Capital Cost Comparison – EPA/Kleinfelder vs. PWD/Hazen and Sawyer/HDR

PWD WPCP	EPA/Kleinfelder	PWD – Annual Average Permitting Scenario	PWD – Monthly Average Permitting Scenario
Southwest WPCP	$361,200,000	$1,658,813,202	$2,725,193,118
Southeast WPCP	$240,800,000	$213,275,983	$260,670,646
Northeast WPCP	$445,100,000	$485,795,295	$592,433,287
Total	$1,047,100,000	$2,357,884,480	$3,578,297,051
PWD estimated cost difference (additional costs)		+ $1,310,784,480	+ $2,531,197,051

The cost estimates determined by PWD were developed in 2020; they have been escalated to October 2023 using Engineering News Record Construction Cost Index (ENRCCI) value 13498.

Kleinfelder Table PWD-SW-1.5

PWD Southwest WPCP
Effluent Level: NH3-N = 1.5 mg/L

Description	*Amount*
Plant-specific base capital cost[1]:	
Base capital cost per generic plant	$ 339,200,000
subtotal	$ 339,200,000
Plant-Specific Issues Requiring Cost Adjustments	
Design Flow = 212 (Maximum Month)	
Max. Monthly Summer Average Ammonia (May-Oct) = 25.5 mg/L	
subtotal	$ 271,988,000
Plant-specific base captial cost additions[2]:	
Pile Foundations	$ 14,026,320
Rock Excavation	$ -
Sheeting during Construction	$ 4,324,782
Construction Dewatering	$ 1,051,974
Land Acquisition	$ 21,916,125
subtotal	$ 41,319,201
Plant-specific base captial cost deductions[3]:	
None	
subtotal	$ -
Reduced productivity adjustment	$ -
TOTAL PRESENT WORTH CAPITAL COST	*313,307,000*
Plant-specific annual O&M costs:	
Additional personnel costs	$ 440,000
Additional chemical costs	$ 15,153,290
Additional energy costs	$ 4,072,002
Additional sludge disposal costs	$ 283,126
Additional maintenance costs	$ 663,000
TOTAL PLANT-SPECIFIC ANNUAL O&M COSTS	$ 20,611,000
TOTAL PRESENT WORTH O&M COSTS	$ 427,052,000
GRAND TOTAL PRESENT WORTH COST	**$ 740,359,000**

[1]See Generic Plant Capital Cost Estimates Technical Memorandum

[2]For plant specific costs not included in generic plant capital cost estimates

[3]For generic plant costs not required in plant-specific cost estimate

PWD Table 2

Table 2. Flow Rates Chosen to Determine New Infrastructure Size Requirements – PWD vs. Kleinfelder

	PWD	Kleinfelder
Southwest WPCP		
Flow Rate (MGD)	540	212
Description	PWD internal future peak capacity	2016-2018 maximum monthly average flow rate
PWD Report Reference	Section 2.2, Section 2.5, Section 2.6	
Southeast WPCP		
Flow Rate (MGD)	140	110
Description	Projected monthly peak flow rate (based on DVRPC 2066 projections)	Permitted capacity (?) (nominally greater than 2016-2018 maximum monthly average flow rate of 103 MGD)
PWD Report Reference	Section 3.1	
Northeast WPCP		
Flow Rate (MGD)	310	235
Description	2016-2019 observed peaking factors applied to design annual average flow rate	2016-2018 maximum monthly average flow rate
PWD Report Reference	Section 3.2	

PWD Table 3

Table 3. Additional Sources of Differences in Cost Estimates between EPA/Kleinfelder and PWD (with Supporting Report References)

Southwest WPCP	Southeast WPCP	Northeast WPCP	Detailed Comments
NA	Section 3.1, Section 5.1.1, Appendix A	Section 5.1.1	Kleinfelder used Integrated Fixed film Activated Sludge (IFAS) as the technological basis for PWD's Northeast and Southeast wastewater plant cost estimates. IFAS technology is not applicable for Northeast or Southeast.
Section 4.4, Table 4-32	NA	NA	Ammonia removal requires additional solids (sludge) handling; Kleinfelder did not account for these costs in their Engineering Evaluation.
Section 4.3.2.8, Appendix E	Section 3.2	Section 3.3	Costly site preparations – specifically grading and sludge lagoon remediation – were not accounted for in Kleinfelder's Engineering Evaluation.
Section 4.3.2.1 – 4.3.2.3, Figure 4-12	Section 5.2.1, Section 5.3.1, Figure 5.7, Appendix B	Section 5.2.1., Section 5.3.1, Figure 5.9, Appendix C	There are more final settling tanks ("clarifiers") required to preserve biomass in PWD's wastewater plants than what was estimated in Kleinfelder's Engineering Evaluation.