Environmental Defense Fund

Please accept these comments from EDF on the produced water management provisions of the proposed regulations. Two attachments.

March 30, 2018

Delaware River Basin Commission
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via http://dockets.drbc.commentinput.com

RE: Special Regulations Part 440 – Hydraulic Fracturing in Shale and Other Formations

To Whom It May Concern:

Environmental Defense Fund (EDF) respectfully submits these written comments in response to the Delaware River Basin Commission's (DRBC's or Commission's) proposed special regulations on hydraulic fracturing, specifically the provisions related to produced water management. EDF is a nonprofit organization representing over two million members and activists around the world and over 75,000 members in the Delaware River Basin Commission states, many of whom care deeply about the environmental impacts associated with oil and gas development, public health, and clean water resources.

EDF supports the authority of local and regional governing entities to adopt controls or provisions that guard against impacts to the health and welfare of the people and environments they are charged with protecting. Recognizing that a majority of local surface and groundwater impacts associated with oil and gas development arise from surface activities, including the management and disposal of wastes like produced water, EDF's comments are limited to the DRBC's proposed provisions on produced water management. EDF commends the Commission for its proposal of advanced limitations and monitoring requirements for surface water discharges of treated produced water. However, given what is known – and unknown – about the chemical and toxicological character of produced water, EDF believes there are opportunities for the Commission to include additional requirements that would further its mission to "preserve and protect the quality and quantity of the Basin's water resources" in line with the Comprehensive Plan.

EDF agrees with the Commission that "the disposal of produced water poses a significant risk to the water resources of the Basin if the wastewater is not properly managed," and further agrees that "this waste stream is unlike other industrial and domestic waste streams" and "poses significant risks to human health and the environment if improperly handled." Numerous studies, reports, academic publications, and the like from recent years affirm these statements.[1]

EDF has developed scientific, technical, and regulatory expertise on produced water management through numerous avenues including internal data and policy development, direct support of ongoing academic research, and participation in multi-stakeholder thought-leadership groups on this subject. Relevant to the DRBC region, EDF is a member of the Center for Responsible Shale Development (CRSD), an alliance of energy producers and environmental organizations in the Appalachian Basin. With CRSD, EDF worked alongside other NGOs and major operators in the region to develop a Performance Standard on the discharge of oil and gas wastewater. EDF believes CRSD's Performance Standard One and its accompanying technical guidance on testing and monitoring programs [see Attachment][2] set an appropriately high bar for produced water discharge specific to the Appalachian Basin. EDF encourages the DRBC to review these documents and, where appropriate, incorporate relevant provisions or ideas into the DRBC final rule.

General Comments on Produced Water

The Commission's Rulemaking Notice and Proposed Regulations make clear that the DRBC has committed to substantive research and analysis toward better understanding produced water, its constituents, and associated risks in order to draft a protective permitting system. It is important to note, however, that neither the science nor regulatory guidelines are settled on the chemical and toxicological characterization of produced water that might flow into a treatment facility as influent or out as effluent, or the appropriate corresponding permit conditions.

Produced water can include water from the producing reservoir itself, water and chemicals utilized in hydraulic fracturing or added during operations over the life of a well, as well as

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[1] *See, e.g.,* Andrii, Butkovskyi et al., *Organic Pollutants in Shale Gas Flowback and Produced Waters: Identification, Potential Ecological Impact, and Implications for Treatment Strategies,* 51(9) ENVTL. SCI. & TECH 4740-4754 (2017); D. DiGuilio & SBC Shonkoff, *Is Reuse of Produced Water Safe? First, Let's Find Out What's in It.* EM MAGAZINE (Aug. 2017); Emily A. Chittick et al., *An Analysis of Chemicals and Other Constituents Found in Produced Water from Hydraulically Fractured Wells in California and the Challenges for Wastewater Management*, 204(1) J. ENVTL. MGMT. 502-509 (2017); José M. Estrada & Rao Bhamidimarri, *A Review of the Issues and Treatment Options for Wastewater from Shale Gas Extraction by Hydraulic Fracturing* 182 FUEL 292-303 (2016); Kathrin Hoelzer et al., *Indications of Transformation Products from Hydraulic Fracturing Additives in Shale-Gas Wastewater,* 50(15) ENVTL. SCI. & TECH 8036-8048 (2016); Matthew S. Landis et al., *The Impact of Commercially Treated Oil and Gas Produced Water Discharges on Bromide Concentrations and Modeled Brominated Trihalomethane Disinfection byproducts at Two Downstream Municipal Drinking Water Plants in the Upper Allegheny River, Pennsylvania, USA,* 542 SCI. TOTAL ENV'T 505-520 (2015); Paul Ziemkiewicz et al., *Practical Measures for Reducing the Risk of Environmental contamination in Shale Energy Production,* 16 ENVTL. SCI.: PROCESSES & IMPACTS 1692-1699 (2014); Tamzin A. Blewett et al., *Sublethal and Reproductive Effectives of Acute and Chronic Exposure to Flowback and Produced Water from Hydraulic Fracturing on the Water Flea* Daphnia Magna, 51(5) ENVTL. SCI. & TECH 3032-3039 (2017); William D. Burgos et al., *Watershed-Scale Impacts from Surface Water Disposal of Oil and Gas Wastewater in Western Pennsylvania*, 51(15) ENVTL. SCI. & TECH 8851-8860 (2017); *and* William Orem et al., *Organic Geochemistry and Toxicology of a Stream Impacted by Unconventional Oil and Gas Wastewater Disposal Operations*, 80 APPLIED GEOCHEMISTRY 155-167 (2017).

[2] Center for Responsible Shale Development Performance Standards, *available at* http://www.responsibleshaledevelopment.org/wp-content/uploads/2018/01/Performance-Standards-v.1.5.pdf. Performance Standard 1 Technical Guidance - Effluent Monitoring Programs, *available at* http://www.responsibleshaledevelopment.org/wp-content/uploads/2018/03/CRSD-Effluent-Monitoring-Program-P.S.1.V.2..pdf. Performance Standard 1 Technical Guidance – Whole Effluent Toxicity (WET) Testing Program, *available at* http://www.responsibleshaledevelopment.org/wp-content/uploads/2016/09/CSSD-Whole-Effluent-Toxicity-WET-Testing-Program-V.1.pdf.

transformational products or byproducts caused by subsurface interactions. The quality of produced water can vary greatly from well to well, and over the life of a producing well due to both geology and operational practices, like choice of completion or maintenance chemicals. According to FracFocus.org, about 350 constituents were used in hydraulic fracturing in the state of Pennsylvania between 2013 and 2017. While hydraulic fracturing chemicals are only a portion of the constituents that may be present in produced water, they are still relevant for assessing treatment technology efficacies and regulating discharges.

A recent compilation of identified produced water constituents was published by the Environmental Protection Agency (EPA) in its hydraulic fracturing and drinking water study.[3] In its final report, the EPA listed a total of 599 constituents.[4] Of these:

- Seventy-seven were also identified as being used in hydraulic fracturing fluids[5]
- Concentration data was available for only 175 identified pollutants,[6] and
- Key toxicity data was available for only about 20% of the 599 (either a chronic oral reference value or oral slope factor from at least one of selected federal, state, and international sources).[7]

Based on EDF review, a limited number of the 599 constituents overlap with existing regulatory structures that may be relevant to the development of treatment and discharge standards:

- Priority Pollutant List[8]: 63
- Toxics Release Inventory Listed Chemicals[9]: 96
- Resource Conservation and Recovery Act - Hazardous[10]: 69
- National Primary Drinking Water Regulations[11]: 32
- Contaminant Candidate List 4[12]: 20
- Centralized Wastewater Treatment Effluent Limitation Guidelines[13]: 25, and
- EPA-approved analytical methods exist for only about 30%.[14]

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[3] U.S. ENVIRONMENTAL PROTECTION AGENCY, EPA-600-R-16-236FA, HYDRAULIC FRACTURING FOR OIL AND GAS: IMPACTS FROM THE HYDRAULIC FRACTURING WATER CYCLE ON DRINKING WATER RESOURCES IN THE UNITED STATES (2016) [hereinafter EPA HF STUDY].

[4] *Id.* at app. H, tbl. H-4. USEPA itself acknowledged that "it is not likely that the data sources were able to capture all of the chemicals present. Chemicals and their metabolites may go undetected in produced water because they were not targeted in the analytical protocols, they were below the limit of detection, or because no standard analytical method exists." (*Id.* at 9-11). In fact, literature published since the EPA report suggests this number is actually much higher. *See, e.g.,* Hoelzer et al. (*supra* n.1) and Jenna Luek et al., *Halogenated Organic Compounds Identified in Hydraulic Fracturing Wastewaters Using Ultrahigh Resolution Mass Spectrometry*, 51(10) ENVTL. SCI. & TECH 5377-5385 (2017) (publishing results of high-resolution, non-targeted analyses of transformation products from additives and halogenated organic compounds, respectfully, identified in produced water).

[5] EPA HF STUDY at 9-11.

[6] *Id.*

[7] *Id.* at 9-17.

[8] 40 C.F.R. pt.423, appx. A.

[9] USEPA,*TRI-Listed Chemicals*, https://www.epa.gov/toxics-release-inventory-tri-program/tri-listed-chemicals (2012 List of Lists).

[10] 40 C.F.R. pt.261, appx. VIII.

[11] USEPA, *National Primary Drinking Water Regulations,* https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations.

[12] USEPA, *Contaminant Candidate List and Regulatory Determination,* https://www.epa.gov/ccl/chemical-contaminants-ccl-4.

[13] 40 C.F.R. pt.437.

[14] Based on EDF review of approved methods and cross-walk with EPA lists.

In summary, we know enough about produced water to know that it has a number of chemicals of potential concern, many of which are not currently part of discharge-relevant regulatory guidelines. For example, EPA itself has emphasized that the Agency did not evaluate certain pollutants that are likely to be present in produced water when developing the CWT effluent guideline.[15] Further, we know that there are a number of constituents potentially present in produced water that have yet to be identified, do not have analytical methods approved for regulatory purposes, or have methods that only work without salt-related matrix interferences that are prevalent in highly saline, raw produced water.[16] These knowledge gaps pose significant limitations to the development of permitting and other regulatory requirements for produced water that aim to identify the scope of effluent limitations necessary to protect human health and the environment and prevent the release of "toxic pollutants in toxic amounts."[17] As such, permitting regimes for the treatment and discharge of produced water should carefully monitor and regularly incorporate advancements in science and technology in an effort to continuously work toward more informed, protective standards.

The Center for Responsible Shale Development Performance Standard

CRSD Standard One, published in 2015, addresses the discharge of treated shale wastewater through Centralized Wastewater Treatment (CWT) facilities. In development of the Standard and technical guidance documents, CRSD members,[18] evaluated produced water literature, regulatory standards, permits, and technologies to establish a consensus standard and programs for testing and monitoring specific to the Appalachian Basin region. The standard and technical guidance on monitoring programs are included with these comments as an Attachment.

CRSD Standard One provisions relevant to the goals of the proposed DRBC regulations include, but are not limited to, the following (as paraphrased):

- CWT's should be designed and permitted specifically to receive and treat oil and gas produced water;
- CWT's should utilize best available technology, including at a minimum a combination of distillation and biological treatment;
- CWT's should follow acceptance procedures to ensure that influent is compatible, treatable, and consistent with the waste stream the facility is permitted to accept and discharge;
- Initial confirmatory testing of effluent from multiple sampling events, covering 300+ constituents via available, EPA-approved analytical methods in addition to Whole Effluent Toxicity testing; and
- Ongoing monitoring following confirmatory testing procedures, or modified, facility-specific monitoring programs developed by CRSD based on test results and/or new data.

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[15] Attachment to Memorandum from James Hanlon, Director of EPA's Office of Wastewater Management to EPA Regions on Natural Gas Drilling in the Marcellus Shale under the NPDES Program – Frequently Asked Questions at 12 (March 16, 2011), *available at* https://www3.epa.gov/npdes/pubs/hydrofracturing_faq.pdf.
[16] Karl Oetjen et al., *Emerging Analytical Methods for the Characterization and Quantification of Organic Contaminants in Flowback and Produced Water,* 15 Trends Envtl. Analytical Chem. 12-23 (2017).
[17] Clean Water Act, 33 U.S.C. §1251(a)(3).
[18] Environmental Defense Fund, Pennsylvania Environmental Council, Clean Air Task Force, Chevron, CNX, EQT, and Shell.

CRSD Standard One was successfully implemented while allowing operators to continue utilizing CWT's for discharges of treated produced water in line with advanced performance standards. Additional EDF recommendations on how portions of this standard could be utilized to strengthen the DRBC regulations are included below.

Technical Comments on Proposed Standards for Produced Water Discharges

In general, the DRBC has established a commendable draft set of standards for produced water discharges. This set of regulations, to EDF's knowledge, would likely be above and beyond existing surface discharge regulatory standards that currently exist at the state or federal level. However, EDF urges the Commission to consider the following comments on potential improvements:

<u>18 CFR pt. 440.2 (Definitions)</u>

- *Centralized waste treatment (CWT) facility* – In addition to a general ability to treat industrial wastes, CWT's should be designed and permitted specifically to receive and treat produced water. The treatment of constituents of concern in produced water more often than not require specific secondary or tertiary treatment technologies capable of addressing both high salts and other total dissolved solids (TDS), inorganics (including heavy metals), radionuclides, and a wide range of organics. EDF agrees with the DRBC that "this waste stream is unlike other industrial and domestic waste streams," and it follows that not all industrial treatment facilities will inherently have the capacity to manage this unique waste stream. As such, only facilities that are intentionally designed and explicitly permitted to handle the content and variability of produced water should be considered. *(See* CRSD Performance Standard 1.2.a).

- *Pollutants of Concern:* While EDF recognizes the potential practicality of limiting the number of constituents repeatedly analyzed and/or monitored in a permitting scheme (taking into account cost, time, method availability, etc.), it is important to acknowledge that there are numerous "pollutants of concern" associated with produced water in the Basin that may not be represented in the cited EPA tables and, in fact, may not yet be identified. Since the time of the publication of the technical development document cited by DRBC (June 2016) to inform the current "pollutant of concern" list, EPA itself has expanded its list of constituents potentially present in produced water from 134[19] to 599;[20] studies since this time have expanded lists even further while acknowledging significant remaining unknowns.[21] In addition, as noted by EPA itself, little is known about the potential hazards associated with the chemicals that have been identified[22] – limiting the ability to adequately narrow a broad list of potential constituents to a definitive list of "pollutants of concern." Therefore, EDF

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[19] USEPA, ASSESSMENT OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING FOR OIL AND GAS ON DRINKING WATER RESOURCES (External Review Draft) at app.A, tbl. T-4 (June 2015), *available at* https://cfpub.epa.gov/ncea/hfstudy/recordisplay.cfm?deid=244651.
[20] EPA HF STUDY at app. H, tbl. H-4.
[21] *See supra* n.1.
[22] EPA HF STUDY at Ch.9 (Identification and Hazard Evaluation of Chemicals across the Hydraulic Fracturing Water Cycle) (Including a discussion of "notable uncertainties in the chemical and toxicological data" at 9-82).

would recommend that the Commission consider whether another name for its chosen list of analytes – such as "current pollutants of concern" would more appropriately label the purpose of the suite of tests while recognizing that data gaps currently limit the establishment of a comprehensive "pollutants of concern" list. As indicated below, EDF also recommends that the DRBC consider regular updates of this list based on new data or advancements in analytical methods.

pt.440.5 (f) Treatability Studies

EDF strongly supports the DRBC's proposal to require treatability studies to ensure that pollutant loads are thoroughly characterized and the applied level of treatment effectively reduces or eliminates identified pollutants of concern. EDF respectfully submits the following comments:

- DRBC should clarify whether initial characterization analyses such as those required in 440.5(f)(1) and (2) are required for "each proposed source of the produced water" or "CWT wastewater" or both. The introductory language in part (f) simply says "or." Requiring a characterization of expected influent (produced water) is as important in understanding treatment efficacy as is analysis of resulting effluents. As such, EDF recommends the inclusion of influent analysis in treatability studies as it is vital to support identification of constituents important for monitoring in effluent, particularly where efficacies of treatment technologies are under assessment.
- 440.5(f)(1) – analysis, characterization, and quantification of pollutants of concern
    - As discussed in the above comments on the definitions section, DRBC's pollutants of concern list may be too limited to gather a thorough analysis that will provide adequate information for a treatability study. EDF recommends that the DRBC, at a minimum, consider CRSD's Initial Confirmatory Testing [see Appendix A, Technical Guidance on Effluent Monitoring Program, Attachment A: Analytical Parameters and Analytical Methods] for its treatability study requirements. This would expand the scope of analytes assessed from 72 (DRBC current "pollutants of concern" list) to over 300 (CRSD Effluent Monitoring Program).
    - The DRBC should also regularly revisit, review, and update its list of "pollutants of concern" to reflect advancements in analytical chemistry, toxicity assessment, and method development.
- 440.5(f)(1) – Whole Effluent Toxicity
    - EDF strongly supports the DRBC's requirement for Whole Effluent Toxicity. Recognizing the unknown fraction of produced water that may not be analyzed in treatability studies or effluent limitations, the WET procedures allow for a backstop to identify potential toxicological risks. The inclusion of WET testing is supported by the CRSD Technical Guidance on Whole Effluent Toxicity testing. [Attachment].

440.5(g) – Additional effluent requirements

- 440.5(g)(1) – Total Dissolved Solids (TDS)
    - EDF strongly supports the DRBC's TDS effluent limitation set at the lesser of background concentrations or 500 mg/L. This is a protective standard that not only reduces the potential for salt loading in receiving bodies, but also calls for advanced

treatment technologies capable of significantly reducing TDS, such as distillation. (CRSD Performance Standard 1.2.c). The 500 mg/L TDS level is also supported by Pennsylvania's General Permit for the processing and beneficial use of oil and gas waste.[23]

- 440.5(g)(2) – Drinking Water/Public Water Supply
    - DRBC's effluent requirements incorporating primary and secondary drinking water standards where receiving waters contain such designated uses is a necessary minimum to protect water quality and human health. However, drinking water standards were not written to address the constituents of potential concern in produced water. For example, of EPA's list of 599 chemicals that have been detected to-date in produced waters, only 32 are included in the National Primary Drinking Water Standards.[24] Further, published studies out of EPA's Office of Research and Development have shown a connection between treated produced water discharges and the development of disinfection byproducts at drinking water plants.[25] EDF recommends that the Commission limit to the extent feasible discharges of treated water to waters designated for "public water supplies" or "drinking water" given the current status of knowledge on this particular industrial waste stream.
- 440.5(g)(5) – Additional monitoring and reporting required by Commission
    - EDF strongly supports the DRBC's explicitly retained authority to expand the scope of monitoring and reporting requirements in support of the development of additional numeric limits that may be needed. As indicated throughout these comments, much remains unknown about the character and quality of produced water and research is advancing such that new pollutants of concern or improved test methods may be identified in the near future. Furthermore, on a more practical level, produced water influent quality can be highly variable, and necessary requirements for any given permit may require modification based on a change in accepted produced water influent even with current knowledge and methods. Therefore, provisions that allow for the amendment of limits, reporting, and other potential requirements based on new information are necessary and appropriate.
    - The need for further research and assessment in establishing the most appropriate regulatory limitations for various alternatives for produced water disposal, like surface discharge, is widely recognized and supported. For example, EPA itself is conducting a study[26] of the CWT Effluent Limitation Guidelines and their application to oil and gas wastewater or produced water. In addition, groups like the Groundwater Protection Council[27] are also devoting time and resources toward

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[23] Pennsylvania General Permit WMGR123 for Processing and Beneficial Use of Oil and Gas Liquid Waste (March 2012), *available at* http://files.dep.state.pa.us/Waste/Bureau%20of%20Waste%20Management/WasteMgtPortalFiles/SolidWaste/Residual_Waste/GP/WMGR123.pdf.

[24] *See supra* n.11.

[25] Matthew S. Landis et al., *The Impact of Commercially Treated Oil and Gas Produced Water Discharges on Bromide Concentrations and Modeled Brominated Trihalomethane Disinfection byproducts at Two Downstream Municipal Drinking Water Plans in the Upper Allegheny River, Pennsylvania, USA,* 542 SCI. TOTAL ENV'T 505-520 (2015).

[26] USEPA, *Centralized Waste Treatment Effluent Guidelines*, https://www.epa.gov/eg/centralized-waste-treatment-effluent-guidelines.

[27] Groundwater Protection Council: Produced Water as a Resource, Identifying Opportunities & Challenges, *available at* https://gallery.mailchimp.com/e4d95ec7676fac6a01f324ddd/files/b7e67fe3-3d3f-42fa-984254362d0b36eb/Produced_Water_Final_Fact_Sheet.pdf.

identifying the research needs and knowledge gaps that need to be filled to help regulators address similar questions within state programs.

- EDF supports the Commission's stated authority to continue learning even as it begins to allow these practices to occur. In addition to ongoing assessment of a "pollutants of concern" list for regular effluent monitoring, EDF strongly encourages the Commission to consider utilizing this authority by requiring reporting on a broader suite of analytes on a regular basis (quarterly, bi-annually, or at a minimum annually) such as that required by the CRSD Effluent Monitoring and WET Programs [See Attachment].

Other Considerations: Long-Term Monitoring

In addition to treatability studies and effluent monitoring, EDF respectfully recommends the Commission consider long-term environmental monitoring to better understand potential downstream impacts of permitted releases. Studies have shown, for example, that sediment downstream of CWT discharges in Pennsylvania can contain elevated levels of pollutants of concern like NORM relative to background (upstream) concentration.[28] Understanding the individual and collective impacts of releases to the environment beyond monitoring of specific permitted discharges could help establish a more streamlined and sustainable program to protect the Basin, now and in the future.

In conclusion, EDF commends the Commission for its thoughtful consideration of the appropriate limitations for produced water discharges in the Basin. EDF urges the Commission to adopt our suggestions and add additional protections to the drafted regulations, and would like to thank the DRBC for the opportunity to submit these comments.

Respectfully submitted,

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Attachment: CRSD Standard One and associated Monitoring and Whole Effluent Toxicity Programs

[28] N. Lauer, N.R. Warner, and A. Vengosh, *Sources of Radium Accumulation in Stream Sediments near Disposal Sites in Pennsylvania: Implications for Disposal of Conventional Oil and Gas Wastewater*, 52(3) ENVTL. SCI. & TECH. 955-962 (2018).

WATER PERFORMANCE STANDARDS

The goal of the water standards is that there be zero contamination of fresh groundwater[1] and surface waters.

PERFORMANCE STANDARD 1

1. Operators shall maintain zero direct or indirect intentional discharges of shale wastewater (including drilling, flowback and produced waters) to surface water except as provided by this Standard.

2. In order to facilitate comprehensive wastewater management programs that consider environmental, safety, health, and economic factors, Operators may send shale wastewater to a Centralized Waste Treatment facility (CWT) for treatment and discharge if the Operator demonstrates the following conditions are satisfied at the CWT:
    a. The CWT has, and is in substantial compliance with, a NPDES discharge permit to treat and directly discharge shale wastewater;
    b. The CWT meets or exceeds a CRSD shale wastewater effluent performance standard to be based on current best available technology designed to prevent the discharge of toxic pollutants in toxic amounts;
    c. The CWT must use best available technology for all fluids discharged. Best available technology requires a combination of distillation and biological treatment, with the addition of reverse osmosis if CRSD determines based on further analysis that it provides protection necessary to ensure effluent quality. CRSD may authorize the use of different technologies or combinations of technologies that provide equivalent or superior treatment;
    d. The CWT adheres to acceptance procedures designed to assure that the wastewater delivered by the Operator is compatible with the other wastes being treated at the facility, treatable by the treatment system, and consistent with the specific waste stream the facility was permitted to treat and discharge;
    e. The CWT does not indirectly discharge wastewater from a CRSD Operator through a POTW.

3. An uncertified Operator must meet the following obligations prior to certification to this Standard and a certified Operator must meet the obligations prior to the use of a new CWT for discharge:
    a. Operator shall review, compile, analyze, and deliver to CRSD, publicly available information pertaining to the CWTs performance and permit compliance to demonstrate that the CWT satisfies Part 2(a).

[1] "Fresh groundwater" is "water in that portion of the generally recognized hydrologic cycle which occupies the pore spaces and fractures of saturated subsurface materials."

b. In order to help assure the permit writer has all information necessary to consider establishing limits on all pollutants in the expected influent, the permitting agency shall be provided the current CRSD list of chemicals believed to occur in the region's wastewater.

c. In order to confirm the CWT is operating as intended, the Operator shall demonstrate to CRSD that testing at the CWT satisfies the Initial Confirmatory Testing Program or a facility-specific Protocol approved by CRSD.

d. In order to evaluate the potential for CWT effluent toxicity, Operator shall complete WET Testing pursuant to the WET Testing Program or an alternative facility-specific Protocol approved by CRSD.

4. For so long as the Operator delivers shale wastewater to a CWT:
   a. Operator shall conduct effluent monitoring as specified in the CRSD Ongoing Monitoring Program or facility-specific Protocol approved for that CWT by CRSD.
   b. Every six months, Operator shall review, compile, analyze and deliver to CRSD publically available information about the CWT's performance and permit compliance.
   c. Unless CRSD determines that ongoing WET testing is not necessary, Operator shall complete WET testing at a frequency to be determined in the WET Testing Program or facility-specific Protocol.

5. Operators may not initiate, and will immediately cease, deliveries to a CWT:
   a. If the CRSD Board determines that discharges from the CWT may increase the risk of harm to human health or the environment. This determination may take into account data and reports submitted to CRSD under this standard, deterioration in effluent quality, research to be sponsored by CRSD or by other parties, and/or any other data or available research.
   b. That exhibits substantial non-compliance with its NPDES permit.

   Deliveries shall not be resumed until the Operator demonstrates to the satisfaction of CRSD that appropriate corrective measures have been made.

6. Operator reporting under this standard shall be as follows:
   a. Data from all testing and any additional information gathering required under this standard, shall be analyzed, compiled, and submitted to CRSD by the Operator.
   b. Where an operator discovers a potential non-compliance with an existing NPDES discharge permit as part of the monitoring and auditing requirements required under this Standard, the Operator shall immediately report such findings to the CWT, the permitting agency, and CRSD.

Note: This standard does not apply to nor prohibit disposal of wastewater by deep well injection.

Adopted: August 19, 2013; Amended: December 9, 2014

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Technical Guidance
Effluent Monitoring Programs
Wastewater Discharge Standard No. 1

Background

This document provides supporting guidance for implementing the Initial Confirmatory Testing and Ongoing Monitoring Programs required in sections 3.c and 4.a respectively of Standard No. 1. The framework for both programs is presented in the following sections. Final Ongoing Monitoring Protocols specific to conditions and circumstances of the CWT being monitored will be developed by the technical subcommittee and provided to the Standards Committee for approval. In all instances of testing and monitoring, samples will be analyzed by a laboratory that is accredited by the National Environmental Accreditation Program (NELAP).

Initial Confirmatory Testing Program

As noted in the standard, confirmatory sampling of the effluent must be completed at any CWT used for discharge. Representative effluent samples will be collected at the monitoring point specified in the CWT's NPDES permit.

Prior to initiation of sampling activities, a sampling and analysis plan (SAP) shall be developed by the Operator for review and approval by CSSD. The SAP shall detail sample collection and handling procedures including applicable QA/QC samples (field duplicates, trip blanks, and equipment rinsate blanks) and analytical lab(s) selected to perform analysis (if multiple labs are proposed, analyses performed by each lab shall be specified).

Unless modified by CSSD in a facility-specific Protocol, the list of parameters included as part of the initial confirmatory sampling and associated analytical methods are identified in Attachment A. Attachment A may be revised as additional science and knowledge is developed relative to shale wastewater constituents and available and approved analytical methods.

Unless modified by CSSD in a facility-specific Protocol, a minimum of five sampling events will be conducted over an appropriate period (the default period shall be 10 days unless an alternative period is approved by CSSD in the SAP) in order to ensure that discharges sampled are representative of treated effluent typically discharged by the facility being tested. The type of samples collected (grab vs. 24-hour composite) for each sampling event will be based on the monitoring requirements specified in the NPDES permit.

Full laboratory data reports and a summary table of all analytical results will be provided to CSSD following conclusion of the sampling event. Additionally, a summary report will be provided demonstrating that all work was performed in accordance with the applicable testing Program or Protocol and identifying any changes to the field or laboratory protocols that may have resulted in a deviation from expected results, in particularly any QA/QC issues.

Ongoing Monitoring Program

Unless established otherwise in a facility-specific Protocol, all monitoring tests conducted under this subsection will occur on a semi-annual basis, beginning six months after results are finalized for the Initial Confirmatory Testing Program.

Until modified by CSSD, ongoing monitoring will follow the same sampling and analysis procedures as specified in the Initial Confirmatory Testing Program. This includes the list of parameters and associated analytical methods included in Attachment A.

Full laboratory data reports and a summary table of all analytical results will be provided to CSSD following conclusion of the sampling event. Additionally, a summary report will be provided demonstrating that all work was performed in accordance with the applicable testing Program or Protocol and identifying any changes to the field or laboratory protocols that may have resulted in a deviation from expected results, in particular any QA/QC issues.

Technical Guidance
Effluent Monitoring Program
Wastewater Discharge Standard No. 1

Attachment A
Analytical Parameters and Analytical Methods

Analysis	Method
TOC	EPA 415.1
Aldehydes	SW-846 8315
VOCs	SW-846 8260B with 20 non-interpretive TICs
SVOCs	SW-846 8270C with 25 non-interpretive TICs
Pentanoic and Hexanoic Acids	8270C-TLS (Library Search)
Organic Acids	SW-846 8015B (mod)
Alcohols	SW-846 8015B (mod)
Glycols	LC/MS/MS 8321AMOD
TPH C8-C40	SW-846 8015B (TPH)
30 ICP Metals	SW-846 6010B
Anions - Sulfate, Chloride, Fluoride, Bromide	EPA 300
Ammonia	EPA 350.2
TDS	SM 2540D
Ra 226 and Ra 228, dissolved, insoluble	EPA 903.1 and 904
Acrylamide	EPA 603
MBAS	Method SM 5540 C-2000
Mercury	Cold Vapor Method EPA 245.7
Nonylphenol	WS-MS-0010
Nitrite	SW-846 9056/A
Nitrate	SW-846 9056/A
Hexavalent Chromium	SM 3500-Cr B-2009
Total Strontium	EPA 200.7
Thallium	EPA 200.8

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CSSD Whole Effluent Toxicity (WET) Test Program
(Including a Modification for Low Ionic Content Effluents)

Standard WET Testing Program

Background

WET testing is used to identify effluent toxicity which may be caused by the aggregate and/or synergistic toxic effects of a mixture of pollutants and other water quality parameters. WET testing is required by CSSD Standard 1 in order to evaluate the potential for CWT effluent toxicity. WET testing is also required as a part of ongoing effluent quality monitoring for facilities operating under the standard unless CSSD determines ongoing WET testing is not necessary in a particular case. WET testing will be conducted every six months, beginning six months after results are finalized for the initial WET test, unless CSSD determines another timeline is appropriate.

Specifications

Acute and chronic toxicity tests will be completed using the water flea (Ceriodaphnia dubia) and fathead minnow (Pimephales promelas). An additional chronic test will be completed using the alga Raphidocelis subcapitata (formerly known as Selenastrum capricornutum and Pseudokirchneriella subcapitata). All testing will be conducted in accordance with the following EPA methods [EPA 2002a,b]:

- 2002.0 Ceriodaphnia dubia, acute
- 2000.0 Fathead Minnow, Pimephales promelas, acute
- 1002.0 Daphnia, Ceriodaphnia dubia, survival and reproduction
- 1000.0 Fathead minnow, Pimephales promelas, larval survival and growth.
- 1003.0 Green alga, Selenastrum capricornutum (renamed to Raphidocelis subcapitata and also may be referred to as Pseudokirchneriella subcapitata), growth.

Tests will be conducted at five effluent concentrations using a dilution factor of 0.5 (see, for example, EPA 2002b, p. 204). Testing will be conducted under laboratory specific quality control standard operating procedures (SOPs) which are in conformance with NELAC and US EPA guidelines, where applicable.

Modification for Low Ionic Content Effluents

Background

Some wastewater treatment processes, such as distillation and reverse osmosis, may create effluents that are toxic due to the absence of salts or ions required to support aquatic life (ionic imbalance toxicity [SETAC 2004]). Low ionic content effluents that are expected to fail the **Standard WET Testing Program** may be evaluated for toxicity using this modification. The ionic imbalance toxicity is addressed by adding simple salts to effluent samples prior to testing for whole effluent toxicity. This modification is intended to capture any additional toxicity that might be present due to effluent pollutants.

Modifying Effluents for Ionic Imbalance Toxicity

Prior to preparing test solutions, effluent samples will be modified by the addition of physiologically required ions as specified in the EPA moderately hard synthetic freshwater recipe [EPA 2002a, p. 32]. Otherwise, all other requirements outlined in this Standard WET Testing Program remain the same..

Reporting Requirements

The laboratory should provide the Operator with proof of proper accreditation. The laboratory will provide a final report specifying sampling and testing methods, test conditions, amended effluent and test solution properties, materials, results, statistical determination of organism survival and reproduction rates at the established effluent concentrations, any unforeseen laboratory protocol deviations, any results that indicate a potential effluent toxicity, and conclusions and recommendations based on results. . In the event results or laboratory conclusions indicate a potential effluent toxicity, the appropriate EPA guidance documents will be followed, unless CSSD establishes otherwise, and CSSD will assist as needed with detailing the proper procedures for ongoing analysis.

References

EPA 2002a, "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms," Method Manual EPA-821-R-02-012, Fifth edition, U.S. Environmental Protection Agency, Office of Water, Washington, DC , available at: http://water.epa.gov/scitech/methods/cwa/wet/upload/2007_07_10_methods_wet_disk2_atx.pdf.

EPA 2002b, "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms," Method Manual EPA-821-R-02-013, U.S. Environmental Protection Agency, Office of Water, Washington, DC, Fourth edition, available at: http://water.epa.gov/scitech/methods/cwa/wet/upload/2007_07_10_methods_wet_disk3_ctf.pdf.

SETAC 2004, "Whole Effluent Toxicity Testing: Ion Imbalance," Technical Information Sheet, Society of Environmental Toxicology and Chemistry, Pensacola, FL, available at: https://www.setac.org/resource/resmgr/publications_and_resources/tip-ion.pdf.