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ONSITE SEEPS LONG-TERM LOADING CALCULATION PLAN

Chemours Fayetteville Works

Prepared for

The Chemours Company FC, LLC
22828 NC Highway 87
Fayetteville, NC 28306

NORTH CAROLINA LICENSED SEAL 1243 GEOLOGIST E BEAUMONT HODGE

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LIST OF ABBREVIATIONS

CFRW	Cape Fear River Watch
CO Addendum	Addendum to Consent Order Paragraph 12
HFPO-DA	hexafluoropropylene oxide dimer acid
M	measure in mass
MT^{-1}	mass per time
NCDEQ	North Carolina Department of Environmental Quality
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PFAS	per- and polyfluoroalkyl substances
PFMOAA	perfluoro-2-methoxyacetic acid
PMPA	perfluoromethoxypropyl carboxylic acid
T	measured in time
USGS	United States Geological Survey

1 INTRODUCTION AND BACKGROUND

Geosyntec Consultants of NC, PC (Geosyntec) has prepared this Onsite Seeps Long-Term Loading Calculation Plan ("the Plan") on behalf of The Chemours Company FC, LLC (Chemours) pursuant to the requirements of paragraph 2(c)(ii) of the Addendum to Consent Order Paragraph 12 (CO Addendum). The objective of this Plan is to describe the calculation methodology for demonstrating compliance with the Long-Term Seep Remediation Objective described in CO Addendum paragraph 2(c)(i).

At the Chemours Fayetteville Works site (the Site) there are four onsite Seeps A, B, C and D that have been identified that discharge into the Cape Fear River. Per- and polyfluoroalkyl substances (PFAS) from the Site reach the Cape Fear River (Geosyntec, 2020a) from these seeps. Between late 2020 and early 2021, Chemours intends to install interim seep remediation systems, pursuant to CO Addendum paragraph 2(a), to reduce the loadings from these seeps to the river. These seep remediation systems are planned to be in situ flow-through cells. The performance of these interim systems will be evaluated pursuant the *Interim Seep Remediation System Plan* (Geosyntec, 2020b). Performance of the interim seep remedy is not assessed as part of this document.

By March 15, 2023 Chemours must complete the installation and commence operation of a groundwater remedy which will include hydraulically controlling groundwater migrating towards both the onsite seeps and the Cape Fear River. This remedy is anticipated to significantly reduce groundwater seepage downgradient of a potential barrier wall (Figure 1) and may significantly reduce flow to Seeps C and D leading to periods of time where measurable flow may be absent in these seeps. Seeps A and B are expected to still be fed by seepage from the Surficial Aquifer and potentially the Perched Zone water bearing units upgradient of the groundwater remedy. These waters will be captured and treated pursuant to CO Addendum paragraph 2(c)(i).

The remainder of this document describes the sampling program and calculations to be performed to evaluate baseline mass loadings from these seeps and then subsequently outline a calculation methodology to evaluate compliance with the Long-Term Seep Remediation Objective. The remainder of this document is organized as follows:

- Section 2 – Consent Order Addendum Requirements which describes the Long-Term Seep Remediation Objective and the requirements of this Plan;
- Section 3 – Baseline and Compliance Period which describes the different evaluation time periods of this plan;

- Section 4 – Sampling and Measurements which describes sampling and flow measurements conducted to support implementation of this plan;
- Section 5 – Calculations which describe how loadings will be calculated and compliance evaluated;
- Section 6 – Schedule and Reporting which describes how and when loading data will be reported; and
- Section 7 – Potential Adjustments which describes how this Plan may be adjusted in the future based on knowledge gained and/or changing conditions at the Site.

2 CONSENT ORDER ADDENDUM REQUIREMENTS

The Long-Term Seep Remediation Objective requires Chemours to show that the long-term seep remedial actions and the groundwater remedy required pursuant to Paragraph 3 of the CO Addendum achieve the following for Seeps A, B, C and D combined by March 15, 2025 per CO Addendum paragraph 2(c)(i):

- during dry weather[1], reduce total mass loading by at least 99%[2],
- during dry weather and following rain events of 0.5 inches or less [in a 24 hour period], reduce total mass loading by at least 95%[2], and
- for a seep upgradient of the groundwater remedy capture total dry weather flow plus rain events of 0.5 inches or less in a 24-hour period treat PFAS with a removal efficiency of at least 99%[2].

To evaluate compliance with these mass loading reduction requirements, this Plan discretizes the approach into two time periods, the Baseline Period and Annual Compliance Periods. For the seeps, “Baseline Period” measurements will commence with the installation of the interim remediation systems. During the interim seep remediation system implementation, there will be frequent, high-resolution flow measurement data and PFAS sampling specified by this plan.

[1] Dry and wet weather flows are described in Sections 4.2 and 4.3.
[2] Removal efficiency evaluated using indicator compounds hexafluoropropylene oxide dimer acid (HFPO-DA), perfluoromethoxypropyl carboxylic acid (PMPA) and perfluoro-2-methoxyacetic acid (PFMOAA).

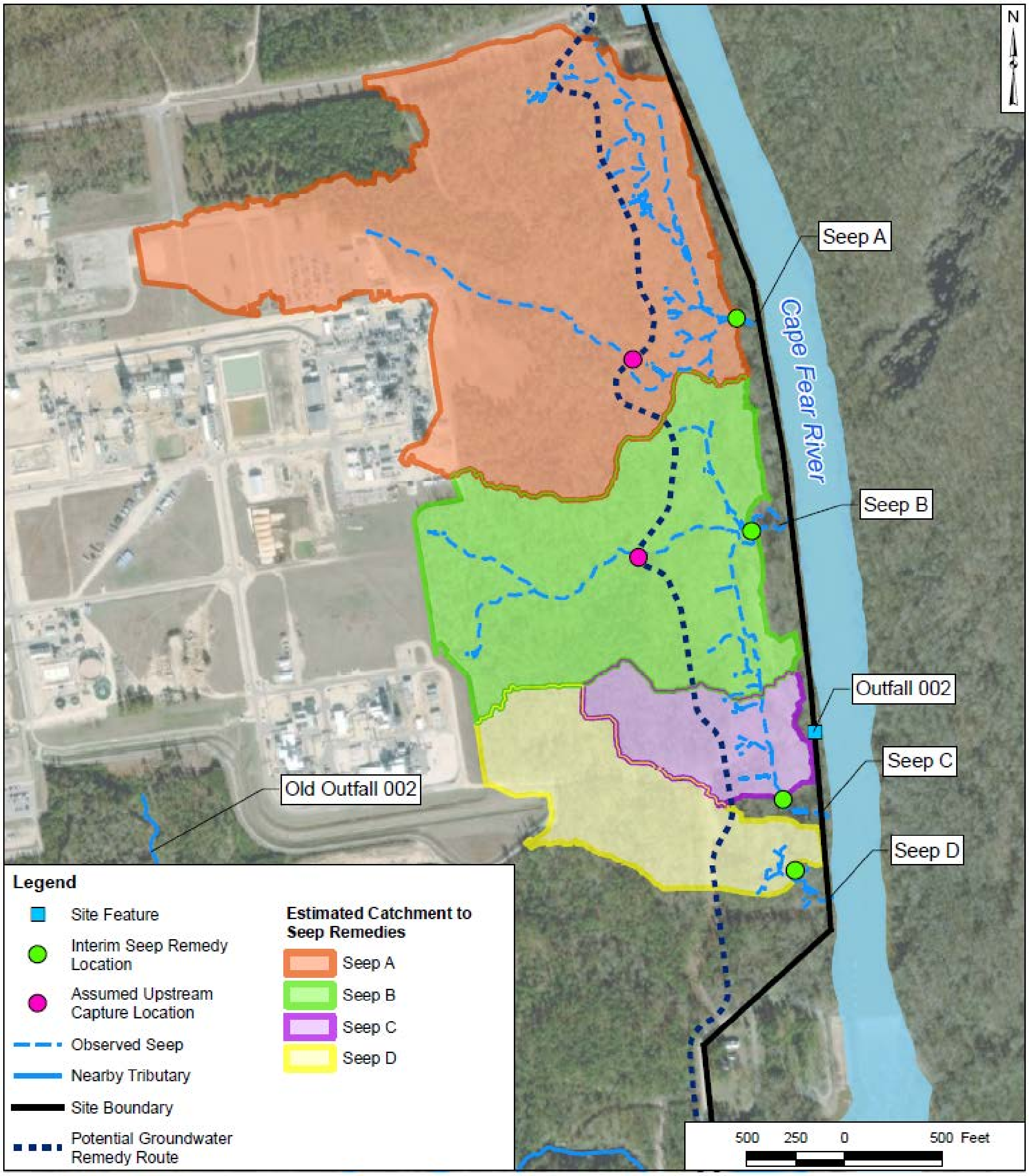

Figure 1: Onsite Seeps

Annual compliance periods will be time periods of 12 consecutive months, where samples are collected to calculate to evaluate reductions against the Baseline loads. The Baseline and Annual Compliance loadings and reductions will be calculated as detailed in the calculations of Section 5. These calculations exclude time periods when the seep remedies or seep measurement locations are inundated by the Cape Fear River. River water levels vary over the course of the year as they are influenced by releases of water upstream and rainfalls in the surrounding areas. River levels may rise to such a level that the seep remediation systems may be flooded, and capture or treatment of seep water is challenged; or in a long-term scenario, seep channels which were dried up may experience temporary flows as the river water recedes.

Sampling of the seeps described in this Plan occurs concurrently with two other sampling programs required by the CO Addendum: the updating of the PFAS loading model pursuant to paragraph 1(b) and the Interim Seep sampling and effectiveness plan pursuant to paragraph 2(a)(iii). Samples collected between these other programs may potentially be used for other programs if the sampling conditions are suitable (e.g. proper duration, weather type, etc.,). For comparison, the sampling programs and their approximate durations and sampling frequencies for each seep are shown below in Table 1.

Table 1: Concurrent Seep Sampling Programs, Sampling Frequencies and Approximate Durations

<table>
<tr><th colspan="2">Year</th><th colspan="4">2021</th><th colspan="4">2022</th><th colspan="4">2023</th><th colspan="4">2024</th></tr>
<tr><th colspan="2">Quarter</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td rowspan="3">CO Addendum Paragraph</td><td>1(b)
Loading Model</td><td colspan="4">Monthly</td><td colspan="12">Quarterly</td></tr>
<tr><td>2(a)(ii)
Interim S & E Plan</td><td colspan="4">2X Monthly</td><td colspan="9">Modified Plan[1]</td><td colspan="3">As Needed [2]</td></tr>
<tr><td>2(c)(ii)
This Plan</td><td colspan="5">Monthly
(Baseline Period)</td><td colspan="4">None</td><td colspan="7">Monthly
(Compliance Period(s))</td></tr>
</table>

1 – pursuant to paragraph 2(a)(iv) the Sampling and Effectiveness plan may be modified after six months of operating all seep interim remedies.

2 – pursuant to paragraph 2(c)(ii) and 2(c)(iii) Chemours must operate the seep interim remedies and implement the sampling and effectiveness plan until the initial demonstration of the Long-Term Seep Remediation Objectives has been achieved.

3 BASELINE AND COMPLIANCE PERIOD

This section describes the Baseline and Annual Compliance Periods. The start and end dates for both these periods will depend on seep and groundwater remedy construction schedules and the dynamics of groundwater seepage at the Site. Table 2 below and the following subsections describe these anticipated dates.

Table 2: Anticipated Baseline and Annual Compliance Period Dates

Onsite Seep	Baseline Period – 1 year per Seep	First Annual Compliance Period	
	Anticipated Start Date[1]	Start Date[2]	End Date[2]
Seep A	Interim Seep Remediation Systems Operational	By Mar. 15, 2024	By Mar. 15, 2025
Seep B			
Seep C			
Seep D			

1 – Baseline Period start dates will be based on CO Addendum Interim Seep Remediation System implementation dates. Dates may vary depending on permitting or construction schedules.
2 – First annual compliance must be attained by March 15, 2025 per CO Addendum; therefore, the start date can be no later than March 15, 2024. Compliance may potentially be achieved earlier.

3.1 Baseline Period Timeline

The Baseline Period for each seep will begin when the seeps interim remediation systems are fully operational. The interim remediation systems per the CO Addendum and the *Interim Seeps Remediation System Plan* (Geosyntec, 2020a) will include flow measurement and sampling of both the influent and effluent of each seep. The Baseline Period for each seep will conclude after twelve consecutive months of Baseline Period sampling at each seep.

3.2 Annual Compliance Period Timeline

CO Addendum paragraph 2(c)(i) requires compliance with the Long-Term Seep Remediation Objective to be demonstrated by March 15, 2025. Therefore, the first annual compliance period at latest will start on March 15, 2024.

4 SAMPLING AND MEASUREMENTS

This section includes information on the sampling and flow measurements that will be collected during the Baseline and Compliance periods. Section 4.1 describes the measurement locations, Section 4.2 describes how dry weather and wet weather flows will be determined, Section 4.3 describes the different combinations of seep flow, river and weather conditions, and Section 4.4. describes the sample collection weather types (dry and wet) and collection frequency. Last, Section 4.4 describes the sampling and measurements to be performed at the long-term upgradient seep capture and treatment locations.

4.1 Measurement Locations

Sampling during the Baseline and Compliance Periods will be performed at the treatment system influent and effluent locations of each seep interim remedy. During the Baseline Period this sampling enables a clear demonstration of loadings before any seep treatment, and during the Compliance Period samples from this location provide a clear comparison to Baseline Period loads. The locations are described below and summarized in Table 3.

Table 3: Sampling Locations

Period	Seep Treatment Status	Sampling Locations	
		Influent	Effluent
Baseline	Flow-Through Cell	✓	--
Compliance	Flow-Through Cell	✓	✓
	System Removed	--	✓

Baseline Period

Baseline Period samples will be collected at the influent of the Flow-Through Cells. The influent samples enable evaluating the seep mass loading before any PFAS removal occurs.

Compliance Period – Flow-Through Cell Interim Remedy

Compliance Period sampling before the removal of the Flow-Through Cells system will be conducted at the influent and effluent of the Flow-Through Cells. The influent and effluent samples are collected for different purposes. The effluent sample will be used to evaluate compliance with the Long-Term Seep Remediation Objective; in other words, during dry weather flows is loading to the River reduced by 99% and during wet weather flows is loading to the River reduced by 95% .

The Flow-Through Cell influent sample during the initial stages of the Compliance Period will be used to evaluate if the Long-Term objectives will continue to be achieved after the Flow-Through Cell systems are removed. In other words if the influent samples, which are taken before any treatment, demonstrate a 99% dry weather flow loading reduction and demonstrate a wet weather flow loading reduction of 95% then the Flow-Through Cell systems can be removed as the Long-Term Seep Remediation Objective will continue to be met after removal.

Compliance Period – Interim Seep Remedies Removed

Compliance period sampling after the removal of the Interim Seep Remediation systems will be performed at the same location as the effluent sampling location prior to removal of the remedies. This location at each Seep enables a direct comparison between Site conditions before and after seep remedy removal.

4.2 Dry Weather Baseflow and Increased Wet Weather Flow

The duration of increased wet weather flows in each of the seeps will be evaluated using flow data collected during the Baseline Period to differentiate between dry weather only baseflows and additional flows due to wet weather events. Onsite seep channels experience both dry weather baseflow which is groundwater fed and increased wet weather flows due to rainfall events. The volume and duration of increased wet weather flows after a rainfall event is expected to be a function of rainfall volume and duration, the size of the drainage basin, the underlying aquifer system and the length of the drainage/stream network.

Wet weather flow and baseflow components can be separated from each other using one of several baseflow separation techniques described in hydrology textbooks (e.g. Bras 1990, Gupta 2008, Dingman 2015, McCuen 2017). Baseflow separation is part of unit hydrology theory, which is a framework used to understand and predict streamflow that will occur in a specific basin following a precipitation event.

During the baseline time period for each seep, flow data will be collected from both the Flow-Through Cell weir and the overflow bypass spillway to develop a higher resolution flow data set alongside the high resolution precipitation data sets from the onsite meteorological station and United States Geological Survey (USGS) rain gauge station at the W.O. Huske Dam. These data will be analyzed to determine how long wet weather flow conditions persist after rainfall events for each seep before dry weather baseflow conditions are re-established. A similar evaluation will be performed to determine how long after river inundation the seep flow rates may be increased directly as a result of the inundation. The results of these analyses will be described in reports to be submitted as described in Section 6.

4.3 Weather and Flow States

There are three categories of seep conditions (river conditions, weather conditions, and presence/absence of seep flow) that lead to seven unique states under which the seeps may exist. These categories are described below, and the resultant seep weather and flow states listed in Table 4.

River Conditions: Inundation – Not Inundated

- River Inundated: a time period where elevated Cape Fear River water levels are affecting the ability to measure flow or collect samples at a given measurement and sampling location, and waters emplaced in soils adjacent to the seeps by elevated river stages are draining from soils into the seeps.
- River Not Inundated: a time period where the Cape Fear River does not affect the ability to measure flow or collect samples at a given measurement and sampling location, nor does the river affect baseflow in the seep.

Weather Conditions: Dry, Wet-Rain 0.5 inches or less, Wet-Rain greater than 0.5 inches

- Dry weather condition;
- Wet weather less than or equal to 0.5 inches rainfall in 24 hours (wet weather sampling conducted for this Plan) condition. The duration of wet weather flows after rain events will be evaluated during the Baseline Period as described above in Section 4.2; and
- Wet Weather greater than 0.5 inches rainfall in 24 hours condition. The duration of wet weather flows after rain events will be evaluated during the Baseline Period as described above in Section 4.2.

Seep Flow Conditions: Flow, No Flow

- Flow: a time period where there is measurable flow in a seep.
- No flow condition: a time period when there is no measurable flow in a seep;

Seep flow conditions will be assessed using flow monitoring devices (e.g. weirs and transducers in interim seep remedy devices). River elevations will be assessed using river elevation data from the USGS river monitoring station at the W.O. Huske Dam (gage 02105500). Weather conditions will be assessed using precipitation data from either the existing USGS weather monitoring station at the W.O. Huske Dam (gage 02105500) or the onsite meteorological station. Snowfall and subsequent snowmelt may require modification to the definitions of wet and dry weather flows. A large snowfall with delayed snowmelt could lead to large volumes of runoff.

Table 4: Seep Weather and Flow States

River Condition	Weather Condition	Flow Condition	Considered in Calculation	Sampled Condition
Inundated	--	--	No	No
Not Inundated	Dry	Flow	Yes	Yes
Not Inundated	Dry	No Flow	Yes	No
Not Inundated	Wet; Rain ≤ 0.5"	Flow	Yes	Yes
Not Inundated	Wet; Rain ≤ 0.5"	No Flow	Yes	No
Not Inundated	Wet; Rain ≥ 0.5"	Flow	No	No
Not Inundated	Wet; Rain ≥ 0.5"	No Flow	No	No

Notes: -- Not Applicable

4.4 Baseline and Compliance Period Sampling Types

Dry and wet weather flow samples will be collected in the Baseline and Compliance Periods. Table 5 below summarizes the sample types to be collected and the subsections below describe the specifics of how each sample type will be collected on a monthly basis.

Table 5: Sampling and Measurement Program

Period	Seep Treatment	Sample Type(s)		Flow
		Dry	Wet	
Baseline	Flow Through Cell	✓	✓	✓
Compliance	Flow-Through Cell	✓	✓	✓
	System Removed	✓	✓	✓

4.4.1 Dry Weather Flow Samples

Dry weather flow samples will be collected on a monthly basis as composite samples with a minimum compositing time period of 24 hours when measurable flow is present in a given seep. Dry weather flow sampling will be initiated when the preceding 72 hours have experienced no more than 0.1 inches of rain in any 24 hour time period, and the weather prediction two days before sampling indicates a 20% or less likelihood precipitation over the targeted 24 hour sampling period. National Oceanic and Atmospheric Administration (NOAA) National Weather Service hourly forecasts will be used to track rainfall predictions at the site[3]. If no data are collected for a given month due to weather conditions or equipment malfunctions, additional sampling will be conducted in subsequent months as needed to generate a data set of at least eight sampling events over the course of the year.

4.4.2 Wet Weather Flow Samples

Wet weather flow samples will be collected on a monthly basis as composite samples with a minimum compositing time period of 4 hours. Wet weather flow samples will also be collected during rainfall events with a minimum nominal rainfall depth of 0.1 inches and up to 0.5 inches when measurable flow is present in a given seep. Wet weather flow sampling will be planned when rainfall is predicted two days before with at least a 70% likelihood of 0.1 inches to 0.6 inches of rainfall depth over a 24 hour period. NOAA National Weather Service hourly forecasts will be used to track rainfall predictions at the site[3].

If no qualifying rain events occur in a month, then a wet weather flow sample will not be collected. Periodic equipment malfunctions (e.g. rain sensor malfunctions) or inconsistent rainfall patterns (e.g. only sudden flash storms) may also result in a potential lack of data for a given month. If no data were collected for a given month due to weather conditions or equipment malfunctions, additional sampling will be conducted in subsequent months with greater rainfalls as needed to generate a data set of at least eight sampling events over the course of the year.

4.5 Upgradient Capture and Treatment Seeps Compliance Sampling

The portion of Seeps A and B flow that originates upgradient of the anticipated barrier wall will be captured and treated by an ex situ system. The captured flow volumes and the overflow volumes (i.e., not captured volumes) for each system will be measured. Precipitation data will be recorded from either the existing USGS weather monitoring station at the W.O. Huske Dam (gage 02105500) or the onsite meteorological station. System influent and effluent samples will be collected pursuant to the National Pollutant Discharge Elimination System (NPDES) permits issued for these systems.

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[3] Hourly weather forecast graphs for Fayetteville Regional Airport, North Carolina can be found here: https://forecast.weather.gov/MapClick.php?lat=34.99&lon=-78.88&lg=english&FcstType=graphical

Table 6: Upgradient Capture Compliance Sampling and Measurement

Period	Seep Treatment	Compliance Monitoring Actions
Compliance Upgradient	Upgradient Capture and Treatment Systems	Measure captured and overflow volumes
		Record precipitation data
		Collect influent and effluent samples per NPDES

5 CALCULATIONS

This section presents the calculations for developing the onsite seeps loading baseline, calculating post-remedy mass loadings and evaluating compliance against the Long-Term Seep Remediation Objectives.

The mass loading quantities used in these calculations are the annual mass discharge [mass per time; MT^{-1}] across all the onsite seeps for dry and wet weather flow conditions over an evaluation period. Mass discharge is the chosen compliance metric rather than an estimate of annual mass load (i.e., total mass) since the time duration of dry versus wet weather flow conditions in any given year are unlikely to be equal and therefore not directly comparable. Some years will be drier, others wetter, and others experience more river inundation events. Therefore, normalizing the mass loads for each weather type by the duration of time for each weather type yields the annual mass discharge, a quantity directly comparable between different monitoring years.

In the remainder of this section, sub-section 5.1 presents the determination of weather-flow state, while sub-section 5.2 describes the calculation of the annual mass discharge calculation. Last, sub-sections 5.3 to 5.5 describe how compliance with the Long-Term Seep Remediation Objectives will be evaluated for dry weather flow, wet weather flow and for the upgradient seep capture and treatment system, respectively.

5.1 Determination of Weather-Flow State

The first step in determining baseline loadings and assessing compliance will be determining the weather and flow conditions for each time increment being considered for each seep. There are seven unique states that any seep can exist under per the weather and flow types described in Section 4.3. Of these seven states, four are considered in calculations. These four states are organized by weather type, Dry and Wet with 0.5 inches or less than rain, and then variations of whether there is or is not flow in the seep(s). The four states are listed below:

- Dry Weather with either:
  - Flow in seep(s)
  - No flow in seep(s)
- Wet Weather, ≤ 0.5 inches rain, with either:
  - Flow in seep(s)
  - No flow in seep(s)

For calculations involving any given seep, flow and seep concentration data will not be considered when that seep is either inundated by the Cape Fear River or when rainfalls exceed 0.5 inches of rain in a 24 hour period and the subsequent wet weather flow durations associated with these rainfall events as described in Section 4.2.

5.2 Annual Mass Discharge Calculation

The annual mass discharge quantities for wet and dry weather during both the baseline and compliance periods are calculated following the same approach. The different forms of the annual mass discharge equation will be used to calculate up to six separate mass discharge quantities described in Table 7. Equation 1 below first calculates for each scenario the annual mass load (e.g. kilograms in that year) from all the seeps for a given weather-time period scenario. The mass load is calculated per seep on a monthly basis by calculating the average measured mass loading rate in a month for the weather and flow condition and applying this rate to all the sum of all time increments in the month (i.e. days in a month) for that weather and flow condition. The sum of all these mass loads is then divided by the sum of time increments (i.e. number of days) the seeps experienced the scenario weather condition during the year (wet or dry) to yield the annual mass discharge value.

Equation 1 also assesses if the seeps have been dried up (i.e. no flow or presence of flow). Periods of no flow are included in determining the annual mass discharge value. A period with no flow conditions from a given seep represents a termination of mass loading from that seep consistent with the Long-Term Seep Remediation Objective.

The monthly samples described in Section 4 will be used to calculate the annual mass discharge quantities following Equation 1 below:

Equation 1: Annual Mass Discharge

$$MD_{scenario} = \frac{M_{Scenario}}{t_{Scenario}}$$

$$MD_{scenario} = \frac{\sum_{s=1}^{S} \sum_{m=1}^{M} f_{s,m,n} \left(\sum_{n=1}^{N} \sum_{i=1}^{I} \frac{c_{s,m,n,i} V_{s,m,n}}{t_{s,m,n}} \times t_{s,m} \right)}{\sum_{m=1}^{M} t_m}$$

where,

$MD_{scenario}$ = is the annual mass discharge for a given scenario (Table 7) from all four seeps based on samples collected at a particular measurement location for a selected weather condition, measured in mass per unit time [MT^{-1}];

$M_{Scenario}$ = is the annual mass load, for a given 12-month period, for a given scenario from all four seeps based on samples collected at a particular measurement location for a selected weather condition, measured in mass [M];

$t_{Scenario}$ = is the duration, during the given annual 12-month period, where the seeps experienced the scenario weather condition (dry or wet, rain 0.5 inches or less), measured in time [T];

s = represents each of seeps being evaluated;

S = represents the total number of seeps being evaluated (e.g., four (4) – Seeps A, B, C and D);

m = represents each of the individual months in a period (Compliance or Baseline) where samples are collected;

M = represents the total number of months in a period (Compliance or Baseline) where samples are collected (e.g., twelve);

n = represents each individual sample collection interval during a month;

N = represents the total number of individual sample collection intervals during a month (e.g., one);

$f_{s,m,n}$ = represents an indicator variable which takes on the value of:

0 if a given seep "s" has no flow in a given month "m" during a given sample collection interval "n" (i.e., no sample is collected for a given interval "n"); or

1 if a given seep "s" has flow in a given month "m" during a given sample collection interval "n" (i.e., a sample is collected for a given interval "n");

i = represents each of the three indicator parameters hexafluoropropylene oxide dimer acid (HFPO-DA), perfluoromethoxypropyl carboxylic acid (PMPA), and perfluoro-2-methoxyacetic acid (PFMOAA);

I = represents the total number of indicator parameters, i.e., three (3) – HFPO-DA, PMPA, and PFMOAA;

$c_{s,m,n,i}$ = is the measured concentration of a given indicator parameter "i" at a given seep "s" in a given month "m" during a given sample collection interval "n";

$V_{s,m,n}$ = is the volume of flow for a given seep "s" in a given month "m" during a given sample collection interval "n";

$t_{s,m,n}$ = is the length of time over which the composite sample was collected at a given seep "s" in a given month "m" during a given sample collection interval "n";

$t_{s,m}$ = is the duration of time of the scenario weather condition (dry or wet) for a given seep "s" in a given month "m"; and

t_m = is the duration of time of the scenario weather condition[4] for a given month "m".

Table 7: Annual Mass Discharge Quantity Scenarios

Mass Discharge Quantity	**Period**	**Weather**	**Sample Location**
MD_{B-dry}^{inf}	Baseline	Dry	Influent
MD_{B-wet}^{inf}	Baseline	Wet	Influent
MD_{C-dry}^{eff}	Compliance	Dry	Effluent
MD_{C-wet}^{eff}	Compliance	Wet	Effluent
MD_{C-dry}^{inf}	Compliance	Dry	Influent
$MD_{C-wet-nf}^{inf}$	Compliance	Wet	Influent

[4] Weather conditions are assumed to be equal across the seeps.

5.3 Compliance Demonstration – Dry Weather Loading Reduction

CO Addendum Paragraph 2(c)(i) requires a 99% total mass loading reduction during dry weather; dry weather flow conditions were described in Sections 4.2 and 4.3. The annual compliance period mass loading reductions percentage during dry weather will be calculated following Equation 2 below:

Equation 2: Annual Dry Weather Mass Loading Reduction Percentage

$$R_{dry} = \left(1 - \frac{MD_{C-dry}^{eff}}{MD_{B-dry}^{inf}}\right) \times 100\%$$

where,

R_{dry} = is the dry weather mass loading reduction;

MD_{C-dry}^{eff} = is the Compliance Period dry weather annual mass discharge to the Cape Fear River as measured at the effluent location; and

MD_{B-dry}^{inf} = is the Baseline Period dry weather annual mass discharge as measured at the influent.

5.3.1 Estimating Compliance After Seep Remedy Removal

Prior to terminating operation of seep interim remedies, the estimated percentage loading reduction that would occur after interim seep remedy termination and removal will be calculated following Equation 3 below. The calculation presented in Equation 3 may be performed on a seep by seep basis depending on the relative performance of the long-term remedy at the various seeps. For evaluating discharges on a seep by seep basis, the relevant annual mass discharge quantities will be calculated on a per seep basis as well by adjusting in Equation 1 the value of "s" and "S" the individual and total number of seeps being evaluated.

Equation 3: Annual Dry Weather Mass Loading Reduction After Remedy Removal

$$R_{dry,wo\ remedy} = \left(1 - \frac{MD_{C-dry}^{inf}}{MD_{B-dry}^{inf}}\right) \times 100\%$$

where,

$R_{dry,wo\ remedy}$ = is the estimated dry weather mass loading reduction with the interim seep remedies removed;

MD_{C-dry}^{inf} = is the Compliance Period dry weather annual mass discharge entering the Interim Remediation System; and

MD_{B-dry}^{inf} = is the Baseline Period dry weather annual mass discharge as measured at the influent.

5.4 Compliance Demonstration – Wet Weather Flow Loading Reduction

CO Addendum Paragraph 2(c)(i) requires a 95% total mass loading reduction during wet weather where rainfall depths are nominally less than 0.5 inches in a 24 hour time period and during the subsequent wet weather flow duration as described in Sections 4.2 and 4.3. The annual compliance period mass loading reductions during wet weather will be calculated following Equation 4 below:

Equation 4: Annual Wet Weather Mass Loading Reduction

$$R_{wet} = \left(1 - \frac{MD_{C-wet}^{eff}}{MD_{B-wet}^{inf}}\right) \times 100\%$$

where,

R_{wet} = is the wet weather mass loading reduction;

MD_{C-wet}^{eff} = is the Compliance Period wet weather annual mass discharge to the Cape Fear River as measured at the effluent location; and

MD_{B-wet}^{inf} = is the Baseline Period wet weather annual mass discharge as measured at the influent.

5.4.1 Estimating Compliance After Seep Remedy Removal

Prior to terminating operation of seep interim remedies, the estimated wet weather percentage loading reduction that would occur after interim seep remedy termination and removal will be calculated following Equation 5 below. The calculation presented in Equation 5 may be performed on a seep by seep basis depending on the relative performance of the long-term remedy at the various seeps. For evaluating discharges on a seep by seep basis, the relevant annual mass discharge quantities will be calculated on a per seep basis as well by adjusting in Equation 1 the value of “s” and “S” the individual and total number of seeps being evaluated.

Equation 5: Annual Wet Weather Mass Loading Reduction After Remedy Removal

$$R_{wet,wo\ remedy} = \left(1 - \frac{MD_{C-wet}^{inf}}{MD_{B-wet}^{inf}}\right) \times 100\%$$

where,

$R_{wet,wo\ remedy}$ = is the estimated wet weather mass loading reduction with the interim seep remedies removed;

MD_{C-wet}^{inf} = is the Compliance Period wet weather annual mass discharge entering the Interim Remediation System; and

MD_{B-wet}^{inf} = is the Baseline Period wet weather annual mass discharge as measured at the influent.

5.5 <u>Compliance Demonstration – Upgradient Seeps Capture and Treatment</u>

CO Addendum Paragraph 2(c)(i) requires that for any seep that daylights upgradient of the Barrier Wall, the total dry weather flow will be captured plus rain events of 0.5 inches or less in a 24-hour period upgradient of the Barrier Wall and during the subsequent wet weather flow duration as described in Section 4.2 and 4.3. Additionally, the CO Addendum requires treating captured water with a PFAS removal efficiency of at least 99% for indicator compounds HFPO-DA, PMPA and PFMOAA. The following sub-section describes the methodology for calculating compliance with these capture and treatment requirements.

5.5.1 Compliance Demonstration – Capture Requirements

Long-Term Seep Remedy Objective compliance with capturing upgradient seep flow volumes during dry weather flow and wet weather flow with rainfalls nominally less than 0.5 inches in 24 hours will be evaluated by first calculating the captured and overflow volumes during the three weather flow conditions described in Sections 4.2 and 4.3. Compliance will be evaluated by inspecting the results of these calculations. If no overflow volume is recorded during dry or wet weather flows with rainfall depths of 0.5 inches or less in 24 hours, then compliance will have been demonstrated.

5.5.2 Compliance Demonstration – Treatment Requirements

Long-Term Seep Remedy Objective compliance with demonstrating PFAS removal efficiency requirements of captured upgradient seep waters will be performed using influent and effluent samples captured at each seep pursuant to NPDES permits for each seep. Compliance will be evaluated on an annual basis. The removal efficiency calculation uses volume weighted concentrations of influent and effluent samples to calculate the percentage of mass removal. Volume weighted concentrations were developed in the event that either the influent and effluent sampling periods have different compositing durations and timings due to differing NPDES permit requirements, potential equipment malfunction, or severe weather events. Weighting by volume provides a representative assessment of mass present in both the influent and effluent over time; samples corresponding to greater flow volumes will have a proportionately higher weight. The calculation will be performed following Equation 6 below:

Equation 6: PFAS Removal Efficiency

$$R_{upgr} = \left(1 - \frac{c_{eff}}{c_{inf}}\right) \times 100\%$$

$$= \left(1 - \frac{\sum_{m=1}^{M} \sum_{i=1}^{\mathrm{i=I}} c_{m,i}^{eff} \times w_m}{\sum_{s=1}^{S} \sum_{n=1}^{N} \sum_{i=1}^{\mathrm{i=I}} c_{s,n,i}^{inf} \times w_{s,n}}\right) \times 100\%$$

$$= \left(1 - \frac{\sum_{m=1}^{M} \sum_{i=1}^{\mathrm{i=I}} c_{\mathrm{m},i}^{eff} \times \frac{V_m}{\sum_{m=1}^{M} V_m}}{\sum_{s=1}^{S} \sum_{n=1}^{N} \sum_{i=1}^{\mathrm{i=I}} c_{s,n,i}^{inf} \times \frac{V_{s,n}}{\sum_{n=1}^{N} V_{s,n}}}\right) \times 100\%$$

where,

R_{upgr} = is the combined PFAS removal efficiency across all captured and treated upgradient seeps.

c_{eff}= is the volume weighted effluent concentration for a given annual compliance period;

c_{inf} = is the volume weighted influent concentration of the seeps combined for a given annual compliance period;

m = represents an individual effluent composite sample time interval during a given annual period[5];

[5] This calculation assumes that the influents from the upgradient seeps are combined into a common treatment system with one effluent location. If this condition is different upon implementation, then this calculation will be adjusted accordingly.

M = is the total number of effluent composite sample time intervals during a given annual period;

n = represents an individual influent composite sample time interval during a given annual period;

N = is the total number of influent composite sample time intervals during a given annual period;

i = represents the each of the three indicator parameters HFPO-DA, PMPA, and PFMOAA;

I = represents the total number of indicator parameters, i.e., three (3) – HFPO-DA, PMPA, and PFMOAA;

$c_{m,i}^{eff}$ = is the measured concentration of a given indicator parameter "i" for a given effluent composite sample[6] "m";

$c_{s,n,i}^{inf}$ = is the measured concentration of a given indicator parameter "i" for a given seep "s", for a given influent composite sample[6] "n";

w_m = is the effluent concentration volumetric weighting factor calculated for and applied individually to each effluent composite sample concentration;

V_m = is the volume of water exiting the treatment system during the effluent composite sample collection period;

$w_{s,n}$ = is the influent concentration volumetric weighting factor for a given seep "s" and a given influent composite sample "n"; and

$V_{s,n}$ = is the volume of water being captured for a given seep "s" and a given influent composite sample "n";

6 SCHEDULE AND REPORTING

The results from this sampling program will be provided to North Carolina Department of Environmental Quality (NCDEQ) and Cape Fear River Watch (CFRW) on a quarterly basis where outputs for the previous quarter are provided within ninety (90) days of the

[6] Non-detect influent and effluent sample results will be assigned a value of zero for the calculation and the values from duplicate samples will be averaged together.

end of the previous quarter pursuant to CO Addendum paragraph 2(c)(v). Information to be reported includes the following:

> *"results of all sampling data, information on extraction, treatment, and flow; an evaluation of the performance of the Barrier Wall, Groundwater Extraction System, and seep remediation system(s) installed pursuant to Subparagraphs 2(a) or 2(b) or compliance with the Long-Term Seep Remediation Objective following removal of a seep remediation system pursuant to Subparagraph 2(c)."*

The first quarterly report is anticipated to be submitted to NCDEQ by March 31, 2021 and will be for the period from October to December 2020. After the initial compliance demonstration conditions have occurred and are then subsequently reported, Chemours will repeat this demonstration for the first five years of the groundwater remedy's operation. Chemours may request NCDEQ to consider semi-annual compliance reporting rather than quarterly reporting after the initial compliance demonstration has been made.

7 POTENTIAL ADJUSTMENTS

The calculation methodologies described in this Plan have been developed based on the present understanding of Site conditions. If conditions or methods change, modifications may need to be made to this Plan. For example, future NPDES permits or Site remedy implementation may require modifications to this Plan. Modifications to the calculation methodologies will be described in submitted reports described in Section 6.

8 REFERENCES

Bras, R. L. Hydrology: An Introduction to Hydrologic Science, 1990.

Dingman, S. L. Physical Hydrology, 3rd ed, 2015.

Geosyntec, 2020a. Cape Fear River PFAS Mass Loading Assessment – Second Quarter 2020 Report. Chemours Fayetteville Works. September 2020.

Geosyntec, 2020b. Interim Seep Remediation System Plan. Chemours Fayetteville Works. August 31, 2020.

Gupta, R.S. Hydrology and Hydraulic Systems, 3rd ed., Waveland Press, 2008.

McCuen, R. H. Hydrologic Analysis and Design, 4th ed., 2017.