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Subject: **DRWW Nutrient Assessment Reduction Plan (NARP) Development Services**

Dear Al:

Thank you for the opportunity to provide consulting services to develop the Nutrient Assessment Reduction Plan (NARP) Workplan for the Des Plaines River Watershed Workgroup (DRWW). Based on our understanding of the project, Geosyntec Consultants, Inc. (Geosyntec) has developed this scope of work to address the objectives detailed in the DRWW's Request for Proposal (RFP) and our proposed approach from our January 13, 2021 submittal.

Project Understanding

The DRWW is a diverse coalition of stakeholders formed to address the water quality impairments in the Des Plaines River and its tributaries. Participants in the group include POTWs, MS4s, Forest Preserve Districts, and environmental groups. The workgroup has developed and implemented a comprehensive monitoring program for collecting chemical, physical, and biological data to accurately identify the quality of stream and river ecosystems as well as stressors associated with non-attainment of water quality standards and designated uses. This data has been utilized by the DRWW members to meet their monitoring requirements for POTW and MS4 NPDES permits. The data will be used to assess the environmental stressors contributing to biological impairments using the Integrated Prioritization System (IPS), a tool developed by Midwest Biodiversity Institute.

There are eight major POTWs in the Upper Des Plaines River watershed. These POTWs anticipate getting special conditions in their NPDES permits to develop a NARP by December 31, 2023. These conditions are a result of discharging to stream segments listed as impaired for DO and TP or at risk of eutrophication. Additionally, Illinois' general permit for MS4s requires that the permittee's discharges, alone or in combination with other sources, do not cause or contribute to violations of water quality standards. The MS4 permits further require that their stormwater programs be reviewed in accordance with TMDLs or

other approved watershed management plans (i.e., NARPs). Illinois EPA also recognizes that other measures (such as dam removal, stream restoration, riparian buffers, or constructed wetlands) may be needed to eliminate impairments. Illinois EPA has therefore encouraged POTWs to develop NARPs on a watershed-wide basis with input from key stakeholders such as MS4s. As a result, the DRWW is undertaking the development of the NARP for the Upper Des Plaines River watershed. The NARP needs to identify phosphorus reductions (from both point and non-point sources) and other measures to eliminate the phosphorus-related water quality impairments in the watershed. The NARP must be completed by December 31, 2023.

Geosyntec developed the DRWW NARP workplan working with the DRWW to identify the scope, schedule, and cost to develop the NARP. The following objectives were defined for the workplan:

- Establish watershed-specific water quality targets
- Determine phosphorus reductions needed to achieve site-specific water quality targets or if targets are infeasible
- Identify mechanisms to facilitate cost-effective NARP implementation

Scope of Work

Geosyntec has teamed with Kieser & Associates, LLC (K&A) and The Conservation Fund (The Fund) to develop the DRWW NARP. The Geosyntec Team proposes the following scope of work to develop the DRWW NARP. The methodology and results of each phase will be documented in the NARP report, for submittal to the Illinois EPA to meet the NARP NPDES special conditions and DRWW's objectives.

Phase 1: Conduct Data Analysis

Objective

The objective is to analyze the recent data collected by DRWW and other entities in the watershed to supplement the findings from the data analysis conducted for development of the NARP workplan.

Approach

The Geosyntec Team will combine the recent data with the data sets we already analyzed as part of the preliminary NARP workplan development. The Geosyntec Team can perform this phase cost effectively by leveraging our experience from the preliminary NARP workplan development. The datasets that will be analyzed include:

- Instream water quality monitoring data collected by DRWW in 2019 and 2020
- Continuous Sonde data collected by North Shore Water Reclamation District in 2020
- POTW effluent flow and water quality data for 2019 and 2020

Activities

- Review the recent field data to help ensure the data makes sense, does not contain erroneous values, is consistent with the system understanding that already exists, and is appropriate for supporting the modeling or for comparison to model results. Any issues will be brought to the DRWW's attention along with suggestions for resolution.
- Conduct a **kickoff meeting** for information transfer, establishing communication logistics, defining DRWW
- members' collective and individual interests and concerns.
- Prepare longitudinal plots of DO, nutrients and chlorophyll-a (sestonic and benthic algae) along the mainstem Des Plaines River to develop an understanding of the relationships between sestonic algae, benthic algae, dissolved oxygen, and phosphorus and to confirm the growing season.
- Analyze long-term rainfall and flow data to identify time periods of critical low flows in the Des Plaines River.
- Develop a presentation summarizing the data analysis results.
- Conduct a **meeting** to present the results of data analysis.
- Document the data analysis results within a chapter of the NARP report.

Assumptions

- DRWW's data will be provided in an electronic format, meets the appropriate quality assurance/quality control (QA/QC) guidelines, and is of sufficient quality for use in the project.
- The meeting will be attended virtually by two Geosyntec personnel.

Deliverables

- Presentation slides and summary presenting the data review
- Report chapter in the NARP document summarizing the data analysis

Phase 2: Develop Modeling Tools

Objective

This objective is to develop the modeling tools to support the development of the DRWW NARP including identifying phosphorus load reductions and other measures to eliminate impairments in the Des Plaines River (NARP Objective 2) and developing site-specific water quality targets under Phase 3.

Approach

The Geosyntec Team will develop and utilize a linked watershed and instream model to simulate the impact of nutrients on instream water quality in Des Plaines River. The linked model will be developed using the platforms specified in the Request for Proposals - SWAT for the watershed platform and QUAL2kw for the instream model. The Geosyntec Team has successfully developed watershed and instream models for several clients in the Great Lakes Region such as FRSG and CMAP, and others across the nation.

The watershed model will be developed using the following input datasets, at a minimum:

- Elevation: LiDAR Data for Lake County
- Soil Survey: United States Department of Agriculture Web Soil Survey
- Land Use: 2015 Chicago Metropolitan Agency for Planning land use data
- Rainfall: Lake County

The SWAT model has been developed primarily as an agricultural assessment tool, which may present select challenges for accurately calibrating to urban watersheds. For this project, calibration efforts will focus heavily on model values pertaining to urban land-use areas. Care will be taken to ensure the model can adequately represent the hydrograph timing that results from the flashy nature of stormwater runoff in urban areas. Specifically, curve number values will be examined and adjusted as needed to ensure surface runoff is representative. Soil values in the model will be adjusted to ensure that subsurface flow is not over-represented.

The watershed model will include the specific lakes of interest identified in the NARP workplan, which may have a substantial impact on stream water quality. The watershed model will be used to develop the timeseries of flow and load estimates for nutrients and sediments from non-point sources. The watershed model will be calibrated to match the flow and water quality data in the Des Plaines River tributaries.

The instream model of the Des Plaines River and relevant tributaries will be developed using the QUAL2kw modeling platform. The QUAL2kw model is a time variable one-dimensional model that is capable of simulating nutrient dynamics and their impact on phytoplankton and DO in the Des Plaines River. The data sets that will be utilized for instream model include, at minimum:

- Cross-section data: Lake County
- Upstream Flow: U.S. Geological Survey measured flow at gage 05527800 Des Plaines River at Russell, IL
- Upstream water quality: DRWW discrete and continuous Sonde measured data

The instream model will include the hydraulics and water quality to simulate hydraulics (flow, velocity and depth) and water quality (nutrients, chlorophyll-a, benthic algae, dissolved oxygen, and temperature). The instream model will also include the mainstem Des Plaines River and the tributaries which receive discharges from POTWs. These include:

- Hasting Creek downstream of Hasting Lake (receives effluent from Lindenhurst Sanitary District Sewage Treatment Plant or STP)
- Rasmussen Lake (downstream of Lindenhurst Sanitary District STP)
- North Mill Creek downstream of Rasmussen Lake (downstream of Lindenhurst Sanitary District STP)
- Mill Creek downstream of confluence with North Mill Creek (receives effluent discharge from Mill Creek Water Reclamation Facility)

The instream model will be calibrated to datasets defined in NARP workplan and additional data analyzed under Phase 1 to help ensure the model is representative of existing conditions. The Geosyntec Team has already developed an initial segmentation for the mainstem Des Plaines River as part of our RFP response dated January 13, 2021. This initial segmentation will be refined during the project based on input from the DRWW.

Based on the approach described above, the following is a description of sub-phases to accomplish the objectives of this phase.

Sub-Phase 2A: SWAT Model Development

Activities

- Acquire and review the necessary data and studies for the SWAT model development from DRWW, MS4s, Lake County, and other publicly available sources (including previously published SWAT model runs for the Des Plaines watershed).
- Review MS4 studies to discern implemented stormwater policies which might affect runoff contributions (e.g., on-site stormwater retention).
- Process datsets such as landuse and elevation data for SWAT model setup.
- Delineate the DRWW watershed into subwatersheds using the 2018 Lake County topography data.
- Conduct QA/QC of the SWAT model input files (peer and senior reviews).
- Develop a SWAT model for the watershed.
- Calibrate the hydrology for the SWAT model to match available flow data.
- Validate hydrology for the SWAT model for a different timeframe.
- Conduct preliminary water quality calibration for the SWAT model to match available instream water quality loading data in the tributaries.
- Conduct a sensitivity analysis to identify which SWAT model input parameters are the largest sources of potential uncertainty in the model results to understand implications on watershed implementation scenarios.
- Develop a presentation describing the watershed model development, and calibration/validation results.
- Conduct a meeting to present the results of the initial watershed model development, and calibration/validation results.
- Update the model based on the feedback received from DRWW.
- Document the watershed model development and calibration in a portion of a report chapter.

Assumptions

- One virtual meeting will be conducted to present the initial watershed model development, and calibration/validation. Three Geosyntec Team members will participate.
- The SWAT model will accurately simulate the flow and concentrations for the tributaries with the adjustments to account for the urbanized nature of the watershed.
- Calibration of the SWAT model to lake water quality is not required.

Deliverables

- A calibrated SWAT model for the Upper Des Plaines River watershed.
- Presentation slides and meeting presenting the watershed model development and calibration/validation.
- A report chapter summarizing the SWAT model development and calibration process.

Sub Phase 2B: QUAL2kw Model Development

Activities

- Process SWAT model output for incorporating into the QUAL2kw model.
- Process other datasets to develop QUAL2kw model inputs including cross-section data, point source flow and water quality data.
- Conduct QA/QC of the instream model input files (peer and senior reviews).
- Refine the preliminary segmentation for the mainstem Des Plaines River and develop segementation for included tributary segments.
- Conduct QA/QC of the insteam model output files (peer and senior reviews).
- Calibrate the instream model to field collected, instream data.
- Validate the instream model for a different timeframe.
- Conduct a sensitivity analysis to identify which QUAL2kw model input parameters are the largest sources of potential uncertainty in the model results.
- Develop a presentation documenting the final calibration of the SWAT model and development of the instream model.
- Conduct a **meeting** with the DRWW to present the final calibration of the SWAT model and development of the instream model.
- Develop a presentation documenting the calibration of the instream model.
- Conduct a **meeting** with the DRWW to present the calibration of the instream model.

Assumptions

- Two virtual meetings will be conducted to present the final SWAT calibration and QUAL2kw model development and calibration. Three Geosyntec Team members will participate.
- The QUAL2kw model will not be calibrated to Rasmussen Lake water quality.
- The criteria by which the model calibration will be judged will be agreed upon between Geosyntec and DRWW.

Deliverables

- A calibrated QUAL2kw model for the Des Plaines River mainstem.
- Presentation slides and meeting presenting the final SWAT model calibration and instream model development.
- Presentation slides and meeting presenting the final calibration of the QUAL2kw model.
- A report chapter describing the instream model development.

Phase 3: Watershed Management Scenarios

Objective

The objective is to explore and identify point and non-point source phosphorus reductions and other measures to eliminate the phosphorus-related impairments and achieve site-specific water quality targets (NARP Objective 2).

Approach

The Geosyntec Team will work with the DRWW to develop a list of recommended measures to address the phosphorus-related impairments. The recommended measures will be evaluated using the modeling tools developed under Phase 2. The scenarios used in the model simulations to evaluate the recommended measures will include baseline conditions, point source load reductions, non-point source load reductions, other measures, and combinations of potential watershed management scenarios. The Geosyntec Team will work with the DRWW staff to streamline these scenarios based on model sensitivity to provide the cost-effective benefit to the DRWW NARP.

After analyzing the combinations of potential watershed management actions, the model results will be evaluated to identify the potential site-specific nutrient targets. This will include consideration of magnitude, duration, and frequency which is necessary for specifying water quality criteria. The Team will also note whether there are information gaps that should be addressed before the targets can be used as water quality criteria. One potential outcome is that there are no combinations of feasible and cost-effective measures to eliminate all of the phosphorus related impairments. In this case, the Geosyntec Team will help the DRWW understand how to indicate that a Use Attainability Analysis (UAA) should be conducted in the future. The outcome of the UAA would be to establish the highest attainable use and numeric nutrient criteria to protect that use. The Geosyntec Team will also utilize the models developed in Phase 3 to help inform the IPS tool to better identify projects for improving the biological health of the streams. The IPS tool requires inputs, which are based on monitoring data and additional information. The models developed under Phase 3 will be leveraged to provide inputs for the flow regime (flow flashiness of stream) and water quality to supplement the monitoring data. Geosyntec's experience on local watershed-based planning in northeastern Illinois will be valuable here. This phase will utilize the QUAL2Kw model pre- and post-processing tools already developed by Geosyntec for efficiency and provide model results that can be used with the IPS tool.

Activities

- Develop a list of recommended watershed management measures to eliminate the phosphorus-related impairments.
- Conduct a meeting with DRWW to discuss the proposed suite of measures and refine the list of measures based on DRWW input.
- Identify a critical time period for baseline conditions.
- Develop a baseline model for the identified critical time period.
- Customize the model pre-processor tool for the baseline model and catalog files to efficiently develop and assess alternative scenarios.

- Generate the necessary input files using the model pre-processor for the development of the model scenarios.
- Conduct QA/QC of the model scenario input files.
- Simulate and post-process the model scenario results.
- Evaluate potential site-specific water quality targets and the potential need for a UAA.
- Determine the phosphorus reductions from point and non-point sources and other measures needed to eliminate the phosphorus-related water quality impairments.
- Process the model scenario results to be incorporated into the IPS tool.
- Develop a technical presentation describing the model scenario results.
- Provide recommendations for combining scenarios or running any additional model scenarios.
- Develop recommended site-specific nutrient targets (if feasible).
- Conduct a **meeting** with the DRWW to present the model scenario results, recommendations, and conclusions.

Assumptions

- A total of six watershed management scenarios for eliminating phosphorus related impairments will be evaluated.
- DRWW will make the final determination of the selected scenario or scenarios that are ultimately chosen to meet the NARP conditions.
- A single virtual meeting will be conducted to present the findings. Three Geosyntec Team members will participate.
- Development of a UAA is outside of this scope of work.

Deliverables

- Presentation slides summarizing the results of this phase
- Report chapter documenting the methodology and results of this phase

Phase 4: Implementation Plan and Schedule

Objective

The objective of this phase is to identify delivery mechanisms for cost-effective implementation measures identified in Phase 3 (NARP Objective 3).

Approach

The Geosyntec Team will identify specific implementation projects based on the results of Phase 3 which will individually and cumulatively help achieve the desired water quality changes in the Des Plaines River. The Team will work with the DRWW to develop a project timeline that serves the best interests of the DRWW members and stakeholders while addressing the requirements of the NPDES permits. The Geosyntec Team will leverage the Lake County Green Infrastructure Model and Strategy[1] and partnership

[1] The Conservation Fund. Green Infrastructure Model and Strategy for Lake County, Illinois

opportunities with area stakeholders to identify potential green infrastructure opportunities in the Des Plaines River watershed.

A draft implementation plan and schedule will be developed for the recommended implementation projects These projects will be developed considering the budget allocations in the Capital Improvement Program (CIP) for Lake County and other DRWW members. The implementation plan will provide a comparative cost analysis to examine relative costs, benefits, and feasibility of various alternatives. If non-point source treatment suggests reduced compliance costs, the implementation plan and schedule will also include the feasibility of a WQT program in the watershed. The plan will also identify other potential financing vehicles to support eliminating the phosphorus-related impairments. Depending on the recommended implementation strategies, potential additional sources of funding will be identified to leverage local resources include national and local philanthropic foundations investing in green infrastructure solutions; corporate ESG (Environmental, Social and Governance) commitments around carbon, water quality, and habitat; mitigation opportunities; and federal programs such as the USDA's Regional Conservation Partnership Program or Conservation Collaboration Grant program; US EPA's Gulf of Mexico Division Farmer to Farmer grant program; and FEMA's Building Resilient Infrastructure and Communities (BRIC) program. We will also conduct a comprehensive inventory of aligned stakeholder activity within the watershed along with associated funding sources and identify opportunities to develop innovative partnerships to reduce compliance costs and/or generate additional voluntary action.

The plan will also identify other measures that that support eliminating the phosphorus-related impairments. Stakeholders with the potential to implement these other projects (e.g. habitat enhancement or other) will be identified and interviews will be conducted to discuss potential implementation of projects.

The Geosyntec Team will work with the DRWW to develop a long-term schedule for facilitating the NARP implementation plan. The draft implementation plan and schedule will then be compiled in a draft NARP report and combined with the results from the phases above.

Activities

- Develop a list of implementation projects to be undertaken by the DRWW members to address the phosphorus-related impairments, including a reasonable timeline and planning-level cost estimates.
- Integrate this list of projects with any significant Lake County and other DRWW members projects, developments, or other undertakings to ensure optimal investment of resources and capital.
- Compile the list of prioritized projects into a workable implementation schedule agreeable to the DRWW.
- Develop cost estimates and means to implement the projects with assistance from the DRWW.
- Identify the list of stakeholders the DRWW can work with to implement the other measures to address the phosphorus-related impairments.
- Document the implementation plan and schedule in a report chapter of the NARP.
- Develop a long-term adaptive management plan to document the benefits of implemented projects, track the impact of proposed projects, and adjust the NARP as needed.
- Conduct a meeting with the DRWW to discuss the draft implementation schedule.

- Refine the draft implementation plan and schedule based on input from the DRWW members.
- Conduct a series of meetings with stakeholders to discuss the Draft NARP.
- Revise the Draft NARP based on input from various stakeholders and DRWW.
- Conduct an in-person meeting to discuss the Revised NARP and obtain feedback.
- Finalize the Phase 1 NARP.

Outcomes & Deliverables

- Draft NARP
- Revised NARP
- Final Phase 1 NARP

Assumptions

- The draft Phase 1 NARP will undergo two rounds of review before being finalized.
- DRWW will provide one set of consolidated review comments on each draft report.
- A total of two (2) in-person meetings with the DRWW are budgeted under this phase.

Key Personnel

The key personnel proposed for development of the DRWW NARP are shown in Figure 1 below. As indicated in our January 13, 2021 RFP Response, Rishab Mahajan, PE, CFM, CPSWQ will serve as Project Manager. Adrienne Nemura will serve as Project Director.

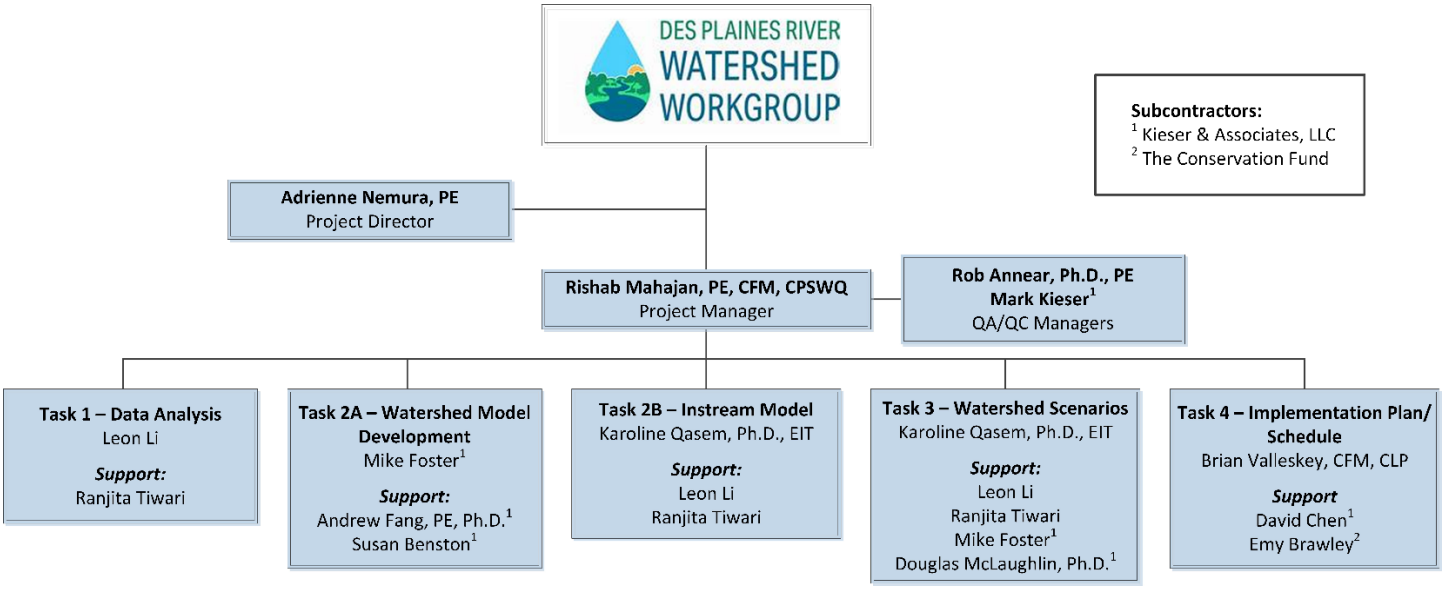


Figure 1: Proposed Project Team and Key Personnel

Schedule and Key Phases

It is assumed that the project will start around March 1, 2021. The proposed schedule is shown in Figure 2. Meetings are shown as circles and milestones shown as stars. The schedule includes time for review by the DRWW staff on various interim deliverables in the project. Phase 1 will occur within a month of the project kickoff meeting. The development of watershed model and instream models under Phase 2 will occur from April 2021 to July 2022. Phase 3 will be undertaken from August 2022 to December 2022. Phase 4 will occur from January 2023 to September 2023, culminating in the final NARP document which will be submitted to Illinois EPA.

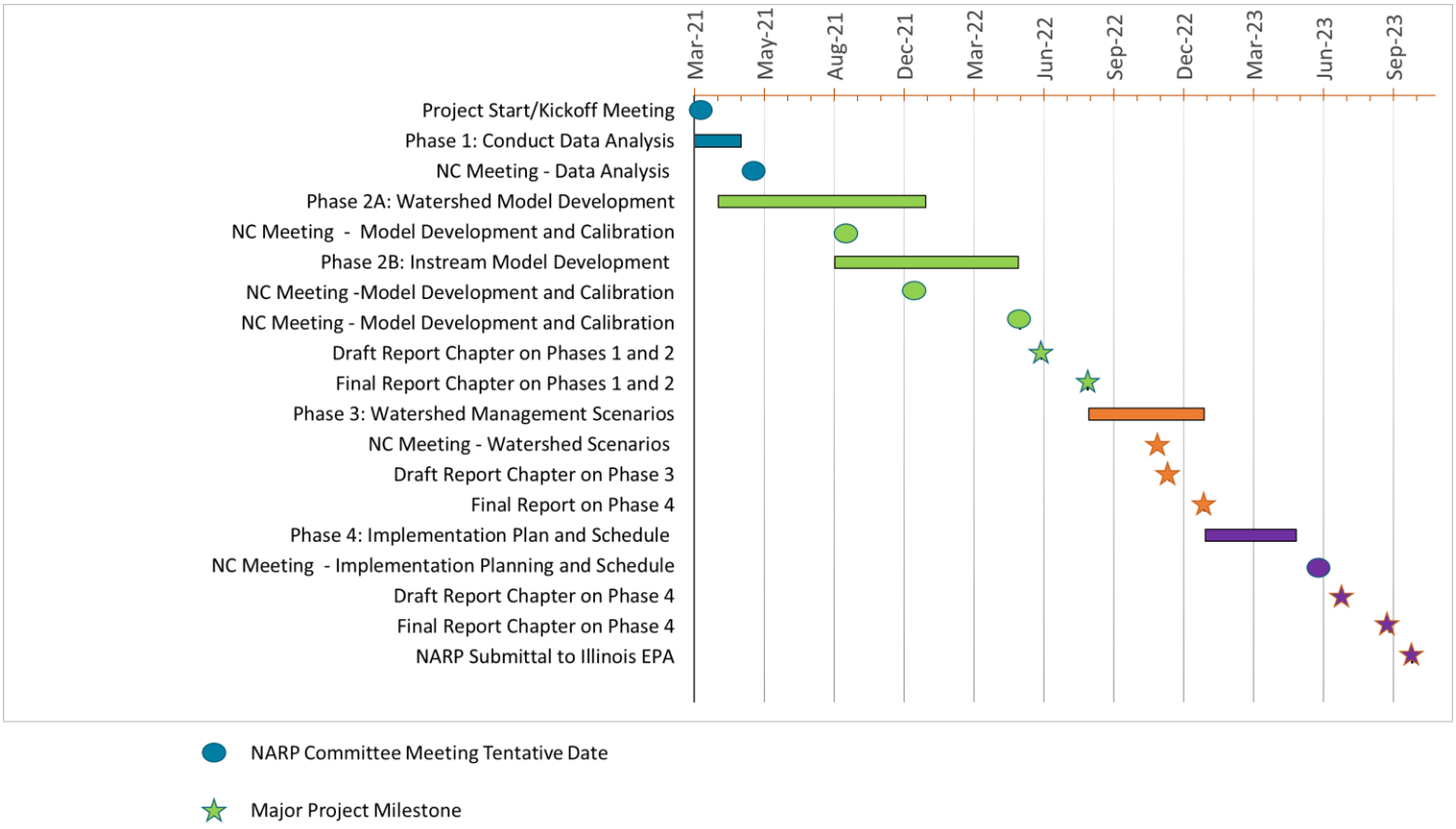


Figure 2: Proposed Schedule for the Des Plaines River Watershed Workgroup NARP

Compensation

Compensation for the work described above will be on a time and materials basis at the project level. Geosyntec's proposed rate schedule is presented below. Our cost estimate for the services described in this proposal is **$310,000** as shown in Table 1. This estimate will not be exceeded without written approval from the DRWW We will invoice monthly based on services provided.

Table 1: Cost Estimate for Developing the DRWW NARP

Phase*	Description	2021	2022	2023	Total Budget
1	Conduct Data Analysis	$9,400			$9,400
2	Develop Modeling Tools	$90,300	$83,500		$173,800
3	Watershed Management Scenarios		$27,900	$23,000	$50,900
4	Implementation Plan and Schedule			$75,900	$75,900
Total Proposed Budget		**$99,700**	**$111,400**	**$98,900**	**$310,000**

* Implementation of each phase is subject to appropriation of sufficient funds by the DRWW Executive Board by each year.

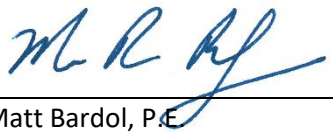
Closure

By its signature below and/or authorizing Geosyntec to proceed in accordance with this Proposal, the Des Plaines River Watershed Workgroup accepts and agrees to the Services, Schedule and Compensation described above and in the attached terms and conditions (Attachment 1).

3/18/21

Al Giertych
President
Des Plaines River Watershed Workgroup

Date



3/18/21

Matt Bardol, P.E.
Senior Principal
Geosyntec Consultants, Inc.

Date

ATTACHMENTS (1)