



February 5, 2021

Mr. Robert Haines, PE  
City of La Crosse  
400 La Crosse Street  
La Crosse, WI 54601

**Re: Hydrologic and Hydraulic Analysis of Surface and Ground Water Impacts on the Forest Hills Golf Course, CBC Quote No. 21-056-12W**

Dear Bob,

Per your request, please find a proposal to complete a hydrologic and hydraulic analysis of the surface and ground water impacts upon the Forest Hills Golf Course. Our analysis will result in remediation recommendations that will impact the drainage, maintenance and use of the golf course. This proposal is based upon our teleconference call on January 25, 2021 and subsequent emails on January 26, 2021.

**Introduction**

In recent years, the Forest Hills Golf Course, located in the City of La Crosse Wisconsin, has been impacted by sediment deposition from extensive gully erosion and drainage problems that hamper maintenance and use of the facility. The erosion and sediment deposition has been caused by on-going gully erosion downstream of Bliss Road. The drainage problem occurs along the valley bottom and is caused by surface water exacerbated by ground water seepage and a shallow water table. CBC Engineers and Associates completed a "Slope and Gully Stabilization Plan for the Hixon Forest and Bliss Road – Phase 1" for the City in April of 2020. This report identified alternative runoff storage and conveyance options for managing runoff and erosion and sediment deposition created by on-going gully erosion downstream of Bliss Road. However, the evaluation did not examine the drainage issues at the golf course or consider the combined impact of groundwater and surface water because this analysis was beyond the scope of the initial report. The effect of the surface water and infiltration will impact the ground water conditions associated with the golf course.

The City has subsequently discussed improvement priorities with the golf course operators, and drainage enhancement is the top priority. Drainage issues appear to have worsened since the course was expanded eastward into Hixon Forest to compensate for the addition of a second railroad line along the west side of the golf course. The golf course operator has attempted ad hoc, trial-and-error drainage enhancements, but their efforts appear to have been inadequate, due to lacking a comprehensive understanding of the surface and ground water hydrology and hydraulics and associated constraining factors. Specifically, the operators have installed various pond and drainage infrastructure to reduce wet areas that cannot be maintained and hamper the usage of the course. The impoundments in particular may be exacerbating standing water in some areas of the course. Efforts to mitigate the gully erosion and sediment deposition problems may also have the potential to exacerbate the drainage issues.

The City has requested CBC Engineers and Associates (CBC) and its subconsultant, The OS Group, LLC (OSG), to prepare a proposal to complete a comprehensive hydrologic and hydraulic analysis of the surface and ground water that affects Forest Hills Golf Course and to make recommendations for mitigation. Based upon CBC's understanding of the project and the desired outcome, CBC offers the following scope of services.

### **Field Survey and Data Collection**

To determine the extent of the surface and ground water issues, CBC/OSG staff will meet with the golf course operators and City staff to identify specifically where the chronic problems occur on the course. Following that initial meeting, a field survey of the existing surface water conveyance features will be conducted. Data collection will include, but may not be limited to, the identification and surveying the dimensions and elevations, outlet controls, and depths of:

- Ponds, impoundments, and retention/detention/infiltration structures
- Standing water and seeps
- Conveyance pipes and drain tiles, including inverts and materials, where ascertainable
- Conveyance swales, ditches and tranches, including topography and surface cover and condition
- Sediment storage facilities (check dams) topography and outlet control device elevations and materials

The limits of the field survey will be within the grounds of the Forest Hills Golf course. The operators of the course will be requested to assist in locating conveyance systems in the field as needed.

The City storm sewer system information, in the vicinity of the golf course, will be obtain from the City Engineer.

### **Surface Water Hydrology and Hydraulics**

The Forest Hills golf course is located in Miller Coulee within an approximately 860-acre watershed that is comprised of natural woodlands and steep hills and valleys. The east portion is bound on the north, east and west by Hixon Forest recreational area. The course is transected near its western boundary by the BNSF railroad line. It is adjoined on the west by a residential neighborhood. Based upon the NRCS Soil Survey the subject property is comprised of silty loam and sands. Figure 1 presents the approximate limits of the watershed. The watershed ultimately drains to the northwest to the La Cross River Marsh via Miller Creek, an intermittent stream, which before the development ran along the center of Miller Coulee.

Figure 1 – Miller Coulee Watershed



CBC will complete a hydrologic analysis of the entire watershed. The Bliss Road hydrologic analysis summarized in the “Slope and Gully Stabilization Plan for the Hixon Forest and Bliss Road – Phase 1” will be integrated into the hydrologic analysis. CBC will use the HydroCad computer software to compute the existing condition 2, 10, 50 and 100-year stormwater runoff events.

Upon completion of the Hydrologic analysis, a hydraulic analysis of the existing stormwater facilities associated with the golf course will be completed. The existing systems will be evaluated based upon the 2, 10, 50 and 100-year storm events. CBC staff will rely upon information provided by the operators of the golf course, the field survey data collected, existing topography available from the County, and if needed, City storm sewer as-built records. The facilities will be analyzed using a variety of software packages that may include HydroCad, Hec Ras and EPA SWMM to understand both subsurface and overland flow conditions that occur during the various stormwater runoff events.

### **Ground Water Hydrology**

To define the limiting conditions posed by ground water conditions, OSG will lead the study of relevant ground water conditions. CBC will coordinate all on-site investigative activities to be performed during this surface water investigation. An OSG environmental geologist will be on site during drilling activities to log soils and direct the drilling contractors on the construction of the monitoring well(s).

A total of five (5) soil borings will be drilled to depths a ranging from 10 to 25 feet to characterize subsurface conditions, including soils and depths of saturation. Three (3) of the borings will be finished as two-inch diameter monitoring wells for measuring depth to water and the water table potentiometric surface, over multiple observations, such as post storm events. Figure 2 presents the preliminary locations of the proposed soil borings and monitoring wells with the final locations to be jointly determined with the input from the golf course operators and the City. Clear access to the subject property is the responsibility of the client. Due to the size and weight of subsurface exploration equipment and vehicles, some damage to areas accessed by the equipment may occur. CBC/OSG shall not be responsible for such damage or its repair.

Figure 2 – Proposed Soil Borings and Monitoring Wells



CBC or the drilling subcontractor will notify Diggers Hotline for the location of underground utilities. Private utility location will be coordinated with golf course operations. It may be necessary to contact a private utility locating firm to clear any/all utilities not located by Diggers Hotline or the owner. This will be quoted under separated cover if necessary.

The soil borings will be conducted by Geoprobe and monitoring wells by Hollow Stem Auger (HSA). Both Geoprobe and HAS will be mounted on a single unit, which will be selected based on balancing capability and minimizing disturbance of surface and vegetation.

Monitoring wells will be constructed in conformance with Chapter NR 141, Wisconsin Administrative Code. The monitoring well(s) will be finished with five- (5) or ten- (10) foot, depending on depth to water observed in the field, PVC 0.010 slotted well screen, with a PVC riser to surface grade with a well cap, secured within a flush-mounted well vault. Top-of-casing elevations and horizontal coordinates for all monitoring wells will be surveyed.

The monitoring wells will be developed, utilizing a portable submersible pump, per NR 141 and WDNR guidance. The main purpose of developing new monitoring wells is to remove the residual materials remaining in the wells after installation has been completed and to establish hydraulic between the aquifer the monitoring well. The monitoring wells will be developed until discharged water is free of visible sediment or five well volumes, whichever occurs first.

### **Monitoring Well Measurement**

Depth to water in all monitoring well(s) will be measured by an OSG geologist with a 100-foot electronic water level probe consisting of a polyethylene tape with a ½ inch diameter stainless steel probe and an audible buzzer.

The depth-to-water data will be converted to water table elevation. That data, coupled with surveyed observations of standing water, seeps and impoundments, will be used to develop a water table potentiometric contour map and inferred groundwater flow direction. Additionally, CBC staff will enter the information into the SURFER software program that will compute the groundwater flow rate and verify flow direction. Understanding how the groundwater impacts and imposes limitations on drainage will be critical in understanding the predominant and critical surface water and groundwater factors affecting runoff and drainage, and thus the maintenance and use of the course.

### **Alternative Improvement Evaluation and Recommendations**

Based upon the results of the ground water mapping and the hydraulic analysis of the surface water storm water management facilities, the following and other alternative improvements will be evaluated:

- Increased surface and subsurface conveyance capacity
- Improved pond storage capacity, outlets and discharge flow routes
- Improved surface drainage via green infrastructure considerations

The alternatives considered will be evaluated based upon impacts to the conveyance and storage of surface water, impacts of surface water runoff upon ground water, mitigation impacts on course maintenance and water removal, and the cost to construct and maintain the improvements. Improvement recommendations will be presented based upon cost effectiveness and the ability to achieve the desired results of surface and ground water control, course drainage and reduced maintenance costs.

### **Summary Report**

CBC will prepare a summary report that will document the process, analysis and results of the hydrologic and hydraulic analysis, ground water monitoring and modeling, alternative analysis, and recommendations. The narrative will be supported by the appropriate figures, maps, and tables.

### **Deliverables**

The summary report will be delivered to the City in digital format and hard copy. A maximum of 10 paper copies will be prepared and submitted to the City. A digital copy of the summary report will be submitted to the City in .pdf format.

**Timeline**

CBC understands that time is of the essence and therefore would propose a tentative initial timeline that is presented in Table 1 and is based upon receiving a notice to proceed in mid-February 2021.

Table 1

Task	February	March	April	May	June
Field Survey					
Compile City and Golf Course Data					
Ground Water Monitoring Wells - 5 Soil borings/ 3 MWs					
GW Monitoring- data collection, modeling					
Hydrologic analysis					
Hydraulic Analysis					
Alternative evaluation					
Recommendations					
Summary Report					
Administration, coordination and meetings					

**Compensation**

CBC will complete the scope of services based upon our current hourly rates and an engineering fee budget of **\$53,000** and reimbursable expenses to not exceed **\$1,000.00**. The project will be administered and invoiced under the Bliss Road Design Services Agreement, that was executed by the City on September 30, 2019, as a new design phase of the project.

CBC is prepared to begin work on this project immediately upon your acceptance of this proposal and authorization to proceed. Please direct all questions to Todd Weik via telephone at 262-219-2938 or via email at [toddweik@cbceng.com](mailto:toddweik@cbceng.com).

Sincerely,  
 CBC Engineers and Associates



Todd B. Weik, PLA, CPESCS  
 Manager LID Design Services

c: Mitchell Hardert, Chief Engineer  
 John Storlie, The OS Group, LLC