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Memo

To:	**Adriana Webb, Engineering Division Manager** **Robyn Flakne, Natural Resources Manager**
	Village of Glenview
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From:	**Paul Siegfried, P.E., CFM, CPESC**
Date:	**January 29, 2021** **Project No.: 190005.12**
Subject:	**Pine Stream Park Streambank Stabilization, Bio-Swale, and Rain Garden Design Memorandum**

Project Background and Location

Under existing conditions, stormwater flowing to the Pine Street cul-de-sac and the open lots to the east of the cul-de-sac is collected by an existing storm sewer system. This system discharges to the West Fork of the North Branch of the Chicago River through 24-inch and 15-inch diameter outfall pipes. The existing channel banks are steeply eroded in many areas within the project limits, which extend approximately 750 feet downstream from Lake Avenue within publicly owned property. This property includes Sleepy Hollow Park and several parcels owned and maintained by the Village that are located south of East Lake Avenue, east and south of Pine Street, and west of Hollow Road. Publicly owned properties within the project limits are highlighted in **Figure 1**.

The Village's Pine Street Park Streambank Stabilization, Bio-Swale, and Rain Garden project proposes the following improvements:

- 750 linear feet of stone toe streambank stabilization along the west bank of the channel (within publicly owned property), with native vegetation at the top of slope and overbank areas;
- A rock riffle and pool structure;
- 200 linear feet of bio-swales to treat stormwater discharges from the Pine Street cul-de-sac and adjacent areas; and
- 0.21 acres of rain garden located downstream of the bio-swales.

Streambank Stabilization

The proposed streambank stabilization treatments include stone armoring from the toe of the slope up to the break in the channel bank, within the portion of the channel experiencing the highest flow velocities. The proposed top of stone elevation is located between the normal flow depth and the 10-year flood profile as shown in the FEMA Flood Insurance Study (FIS). These frequent storms typically

are responsible for most erosion and channel evolution. Native vegetation will be utilized in the upper bank and overbank areas above the stone treatment, where a combination of gentler slopes and slower water velocities are anticipated. A typical cross section showing proposed streambank stabilization treatments is presented in **Figure 2**.

Stone gradations were selected based on calculations of flow velocities and shear stresses for storms up to and including the 100-year event, utilizing site specific survey data and FEMA FIS data, including regulatory flow rates and flood profiles. Flow rates from upstream pumps are considered to have negligible impact as maximum pumping capacities are small relative to flows during flooding events; and therefore would have negligible impacts on maximum flow depths and velocities. The proposed plans include bid options for both angular and round stone. Angular stone is generally considered more effective for bank stabilization because of its interlocking properties and lower risk of failure. However, round stone can also be utilized if larger stone sizes are specified. Vegetation will be utilized above the stone treatment at a maximum 3H:1V slope.

The existing channel banks are steeply eroded in many areas and, while bank slopes vary, they are steeper than 2H:1V in many locations. This project proposes a gentler maximum slope of 2H:1V to provide stability for the stone armoring, requiring some cutback from the existing toe of slope into the bank in many locations. Excavation will be required in all locations to avoid placing materials above existing grade. This design approach will maintain or increase the channel conveyance capacity, and will not direct water toward the opposite bank. As such, the project will not increase flood heights or worsen erosion on the east channel bank.

Baxter & Woodman considered several options in addition to the proposed design of rock armoring and vegetation at the top of bank. These included:

- Vegetated slopes – A maximum slope of 3H:1V is needed, especially in these highly erosive conditions. This approach would result in removal of more trees along the channel bank than the current plan. Vegetation alone may not provide adequate stabilization within the banks, where flow velocities and shear stresses are greatest.
- Mats/grids – Turf Reinforcement Mat is very thick, making it difficult to establish consistent vegetative cover. This often results in spotty vegetation and exposed mat. Honeycomb grid promotes better establishment of vegetation. However, with the steep slopes and flow conditions at this project site, soil can erode out of the honeycomb openings leading to failure.
- Tree revetments – Installation would require cutting back deep into bank, resulting in the loss of many more large trees than the current design.
- Coir logs - A maximum slope of 3H:1V is preferred, and would result in removal of more trees along the channel than the current design. Logs deteriorate over time, and a steeper installation would eventually result in a steep slope relying solely on vegetation for stabilization.

Stone armoring was determined to be the most appropriate bank treatment after considering site-specific flow conditions, the steeply eroded banks, and the Village's goal of preserving as many existing trees as possible.

Rock Riffle

The project includes a rock riffle that will be constructed near the southern project limits, where public property extends across the entire width of the channel. Rock riffles oxygenate the water,

which is beneficial for aquatic life. Additionally, they stabilize the channel bottom and reduce low flow velocities by forming a pool upstream of the riffle structure. The proposed riffle is designed with round stone placed up to an elevation just below the normal flow depth of the channel, with a gradual slope back to the natural channel bottom. This will force low flow water to flow over the rocks, breaking the water surface and adding oxygen to the water. As the rock riffle is design below the normal water surface elevation, it will not have any adverse impacts to the base flood elevation.

Bio-Swales

Storm water collected at the south low point of the Pine St. cul-de-sac will be directed to a proposed bio-swale by replacement of the existing curb inlet grate with a closed lid and a curb cut. East of the Pine St. cul-de-sac, three (3) inlet grates in low areas where stormwater collects will be replaced with closed lids, and minor grading will direct flow to a second bio-swale. The proposed bio-swales will include six (6) inches of engineered soils and deep-rooted, native vegetation that will absorb water, provide filtration, and remove pollutants from stormwater runoff. Underlying soils will limit infiltration capacity.

Rain Gardens

Two rain gardens will be located at the downstream ends of the bio-swales, and will overflow to the West Fork of the North Branch of the Chicago River. The proposed rain gardens will include six (6) inches of engineered soils and deep-rooted, native vegetation that will absorb water, provide filtration, and remove pollutants from stormwater runoff. Underlying soils will limit infiltration capacity. Both rain gardens are designed without an outlet pipe, and water will overflow to the downstream channel when depths exceed 0.8 feet. Vegetation for rain garden bottoms was selected based on anticipated ponding depths.

Tree Removal and Replacement

Rain gardens and bio-swales were designed to preserve as many trees as possible. However, associated grading will result in removal of three (3) non-landmark trees ranging from 4 inches to 8 inches in diameter. Existing landmark trees along the streambank stabilization improvements will be preserved, where possible, by grading around them. Removal of any additional trees that are determined to be at risk during construction must be approved by a Village arborist. Requirements of the Village's Tree Preservation Ordinance will be adhered to. The project includes planting of 30 new trees, for which a Village arborist will select species and locations.

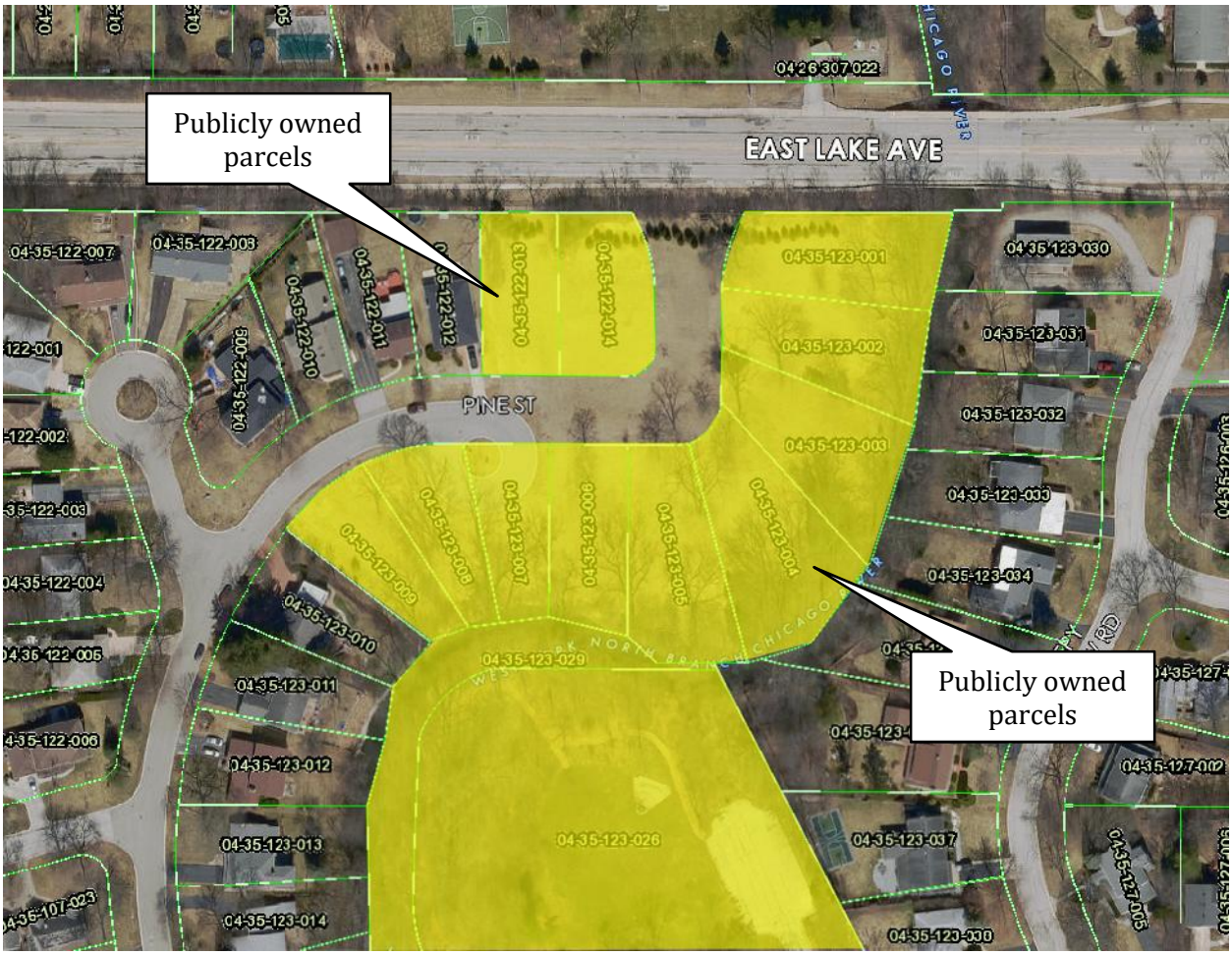

Figure 1. Publicly owned parcels within the project limits (Source: CookViewer Cook County Map Application)

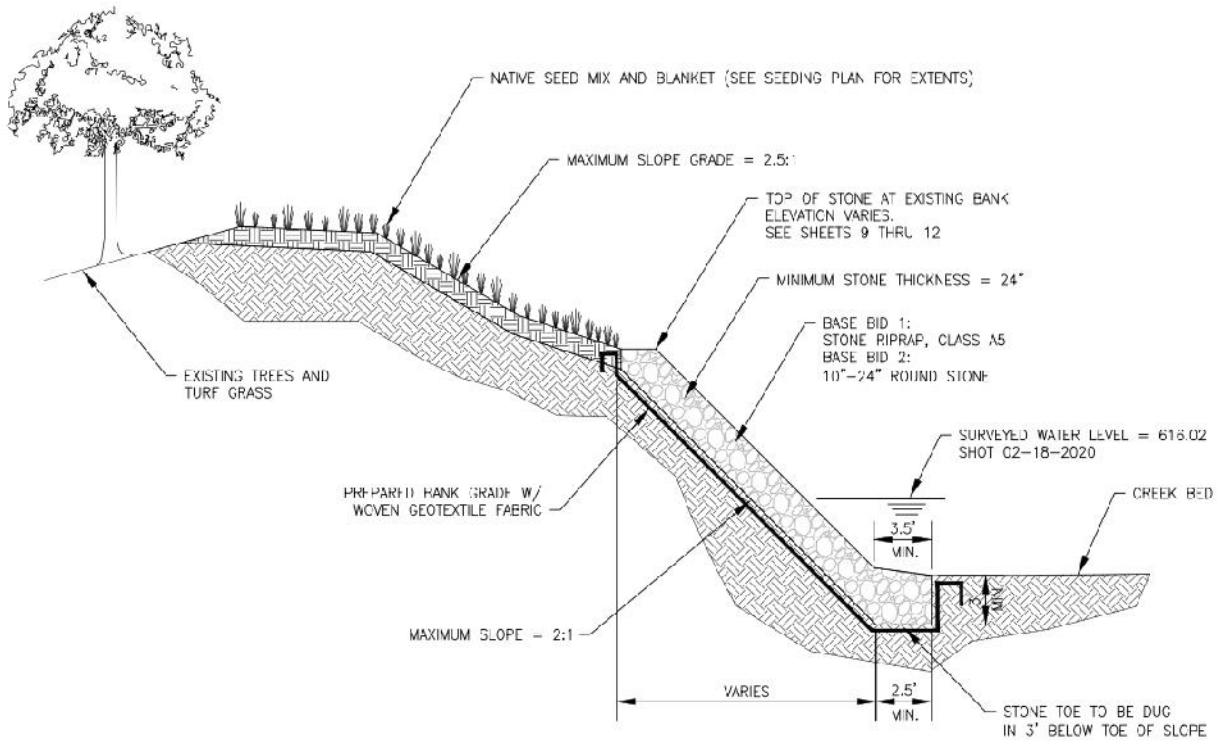

Figure 2. Typical cross section of proposed streambank stabilization

Site Photos – 2/3/2020

West bank looking north toward E. Lake Ave.

West bank looking northeast toward rear yards of Sleep Hollow Road properties

View from west bank south of E. Lake Ave., facing south

View from east bank at curve south of E. Lake Ave., looking northwest toward opposite bank