Hydrologic Evaluation

&

Stream Restoration Recommendations

For

Indian Creek

Chicago, Illinois

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Summary of Research Findings

Indian Creek is fed by surface water from Wolf Lake and by groundwater from Wolf Lake, much of it going underneath Highway O and entering the bottom of the short N-S and the long E-W section of Indian Creek
Indian Creek's bankfull flow is about 70 cubic feet per second and a new Indian Creek is designed for 80 cfs including the 12 cfs from the power plant cooling water
Ground water also enters Hyde Lake Wetland
About 25% of the water in Indian Creek leaves it near the SW corner of the Sulfuric Acid Plant and flows underground beneath the seawall to the Calumet River
Several elevations in the bottom of Indian Creek are critically important to the elevation of groundwater in the area. The first two are the wash-around elevation at the Corps of Engineer's dam at Wolf Lake and the exit elevation of the Schroud culverts; both are at an elevation of 1.6 to 1.7 feet. They control the water table and Wolf Lake water level above the Schroud culverts. The second two are the scour-caused central riffle just below the 126th Street Bridge and the waste water pipe inside the old dam at the confluence of Indian Creek with the Calumet River. These points control the elevation of water in the Hyde Lake Wetland and the wetland North of the 126th Street Bridge.

significant natural and social resource. All of the existing functions of this system should be retained and improved on during construction and restoration activities

Summary of Restoration Findings

Dune’s Creek in the Indian Dunes State Park provided stream dimension data that is transferred to a newly designed Indian Creek. The New Indian Creek design is based on providing a channel that will carry a bankfull flow of 80 cfs and have a floodplain that will allow 640 cfs to pass to the Calumet River during the 100-year event. The 50-year event is estimated at 320 cfs. Dunes Creek is in a sand landscape, similar to the bottom of Indian Creek. Stream dimension data from Dunes Creek is transferred to a New Indian Creek using ratios for various design criteria using stream width as the basis of scaling
The peatlands in the Dunes Creek system yield hydrogen ions (acid) that keep Dunes Creek pH in the 7.5 to 8 range. Addition of soil to the floodplain of Indian Creek would also help to lower the pH from the 9.2 to 8 range
The slag banks of the old Indian Creek and the New Indian Creek are very tough and obviate the need for extensive bank revetment work
The is little opportunity to rework the existing over-wide Indian Creek into a normal dimension, pattern, and profile because of the deep, very unstable slop in the bottom
It is recommended to build a New Indian Creek in a new floodplain to the East (North of 126th Street Bridge), to the North (of Hyde Lake Wetland), and to the South (of the long E-W section) on the Schroud Plateau
Some low, bankfull, rock additions along the sides of the existing Indian Creek (to harden the banks) around the ball field would help clear and deepen the existing channel
Channel blocks are used to redirect flow from the old to the New Indian Creek, but low level passages would allow water to circulate into the existing reaches of Indian Creek
If the scour-formed riffle below the 126th Street Bridge is removed, and the mouth of Indian Creek is opened to the Calumet River (at an elevation below the waste pipe of 0.3 feet) at the same time, the water level in Hyde Lake will lower as much as a foot
A series of rock cross vanes is recommended at the Schroud culvert site, one just above the Carondolet Bridge, and a series at the mouth of Indian Creek where it enters the Calumet River. These rock cross vanes allow fish passage at all flow levels and provide grade control for the bottom of the New Indian Creek that will preserve the existing water levels in Wolf Lake, Hyde Lake Wetland, and the wetland North of the 126th Street Bridge
A step/pool series around the Corps of Engineer’s dam at Wolf Lake would also preserve the Wolf Lake water elevation and allow fish passage at average and low water levels
Reshaping of the ditch (to a gentle-sided B channel type) between the Old railroad (paralleling Highway O) and the nitrogen pipeline road will prevent the existing G channel type from accelerated in-channel erosion
Proving soil at least 18 inches deep on the floodplain (floodplain is excavated that much lower to accept it) will provide minimal growth medium for trees, shrubs and herbs

Channel Design for a New Indian Creek

Several aspects of the environment at Indian Creek beg for a departure from the normal approach to new channel design, while most of the 49 considerations for new channel design (Hey and Rosgen 2000) remain an imperative.

Sediment Supply

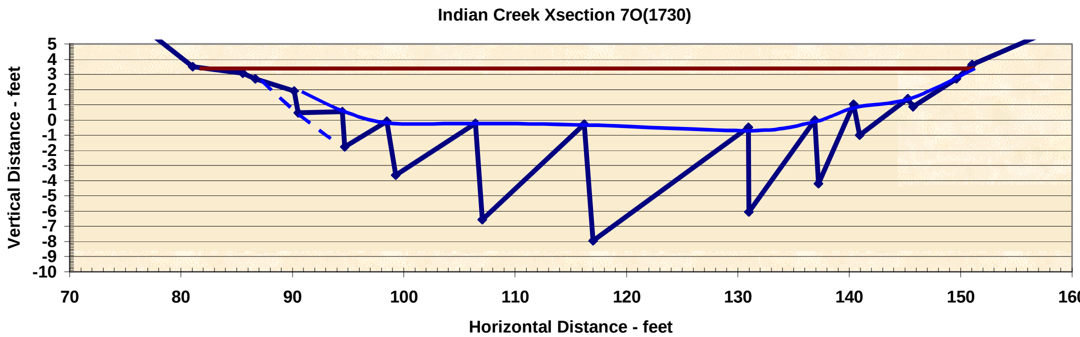
The fact that Indian Creek has little sediment input might imply the channel could not form the normal riffle and pool sequence of a meandering sand bed channel. That is, it may not be able to hold pools, or develop riffles. Though relatively rare in the existing Indian Creek system, the channel has shown that it can maintain pools dug during sand mining at either end of the N-S section paralleling Highway O to the West. Similarly, it has pools from digging above the Schroud culverts, above the Carondolet Bridge, and at the Southwest corner of the Hegewisch ballfield. A very normal pool riffle sequence exists at the end of Indian Creek in the last 400 feet before it enters the Calumet River.

Many examples of pool and riffle sequences in sediment limited situations exist on natural streams below dams constructed a century or more ago. One is in Grand Rapids, MN on the Mississippi River where the river is about 200 feet wide below a series of two dams that transmit virtually no sediment. It also is a sand and gravel bed F5c and C5c channel type and has a normal pool/riffle sequence. Two other examples are below the Stronach Dam on the Little inches below the floodplain elevation and soil added to provide a reasonable environment for trees, shrubs, and grasses. The organic matter in the soil will also provide a hydrogen ion (acid) source to waters percolating into the underlying slag. By comparison, between Dunes Creek and Indian Creek, this may reduce the pH of water entering the channel from 9 to 8.5 or 8.0.

The Wetland Stream System

The bottom elevation in Indian Creek exhibits a longitudinal profile frequently found in wetland streams throughout the northern Lake States. The longitudinal profile of most streams shows a line connecting the tops of the riffles will form a downhill slope consistent with the overall water slope at high flow and the overall slope of the stream bank.

Wetland streams partly depart from this configuration with regard to their bottom profile. Consider a stream flowing downhill through an upland forest area then entering a wide and long or two of the stream cross sections shown earlier in the channel survey section alluded to the presence of a very unstable mixture of fine sand and calcium, magnesium bicarbonate deposits on the channel bottom. These will not support a floating person let alone heavy equipment. The deposits range from 5 to 9 feet deep below the channel bottom and represent the filling-in of a very much over-wide and over-deep trapezoidal channel originally dug primarily for sand mining purposes. Figure 15 illustrates a series of these cross sections taken during the July 11 survey by simply pushing the target pole into the bottom of the stream.



estimate flow at the bankfull elevation in 16 cross sections or a modification of the cross sections to allow for a new floodplain. Bankfull flow was then used to size the channel cross section as influenced by the designed channel sinuosity (thus its length and slope) and new estimates of channel roughness (.035). Bankfull flow was estimated at 80 cfs, somewhat above gauging estimates of bankfull flow (measured just a foot below bankfull and extrapolated). Ratios of discharge at a given recurrence interval (1.5-, 5-, 10-, 25-, and 50-years) to the bankfull discharge were used to estimate the flow for these events. I used ratios from Leopold (1994) for C channel types in the Eastern United States. I doubled of the 50-year flow to estimate the 100-year event (or 8 times the bankfull flow). The 50-year flow estimate is 320 cfs and the 100-year flow estimate is 640 cfs using ratios of an average bankfull flow of 80 cfs (see Table 5).

Table 5. Estimates of bankfull flow on Indian Creek and measured flow (or extrapolation a short distance to other cross-sections) compared to modeled channel flow using the Haestad Methods implementation of the Manning's equation.

Section	Bankfull	100-yr Flood	Bankfull	Estimated flow at the gaging time	Measured flow at the gaging time	Gage	Width at Bankfull

Section 7AB is at the existing 126th Street Bridge. The bridge opening would allow the passage of the 50-year event, but would detain higher flows. Incorporation of a floodplain cross section in addition to a box culvert would allow the passage of the 100-year event. A floodplain profile extending all the way to the Calumet River would ensure unrestricted flood flow.

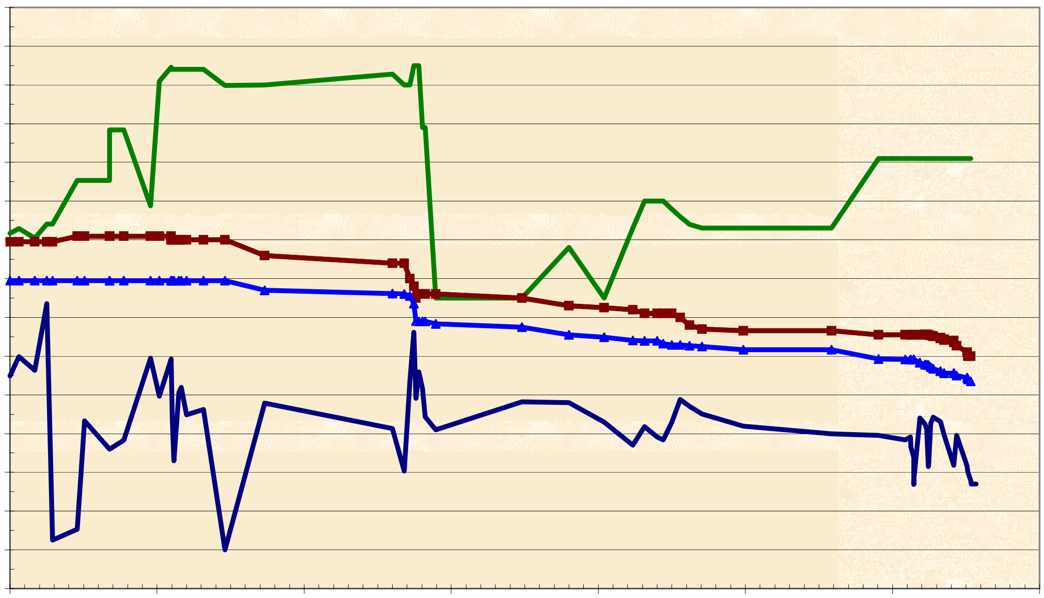
Section 7AI is near the Calumet River where the existing narrow channel with high terraces on each side will also allow the 50-year event to pass, but incorporation of a floodplain with a new outlet to the Calumet River would allow the passage of the 100-year event.

There also needs to be a low-water-level control at the confluence of Indian Creek with the Calumet River to insure the newly constructed wetland floodplain stays wet. The specific ratios and the elevations these flows represent are given in Table 6.

Table 6. Design flow and design flood elevations for various flood events in a new channel designed to carry a bankfull flow of 80 cfs in Indian Creek. Q/Qbkf ratios are taken from Leopold (1994).

C Channel Type		West of the first bend beyond Nitr. Road	West of Carondolet Bridge	North of 126th Street Bridge		Indian Creek Design Discharge
Frequency of flow	**mean d/ mean d bkf**	**Elevation ft**	**Elevation ft**	**Elevation ft**	**Q/ Qbkf**	**cfs**
[100 yr]	[2x50yr]	7.4	6	5	[8.4]	672
50 yr	1.75	5.7	4.4	3.4	4.20	336
25 yr	1.5	5.2	3.8	2.8	3.30	264
10 yr	1.25	4.6	3.2	2.2	2.10	168
5 yr	1.15	4.35	2.95	1.95	1.50	120
1 yr	1	4	2.6	1.6	1.00	80
110 days	0.3	2	0.6	-0.6	0.17	16
37 days	0.15	1.6	0.2	-1.8	0.02	2

Figure 16 (A3) shows the elevations represented by these high flow estimates for the longitudinal Indian Creek section along with the 100-year flood estimate for the HEC-II model presented by SDI.



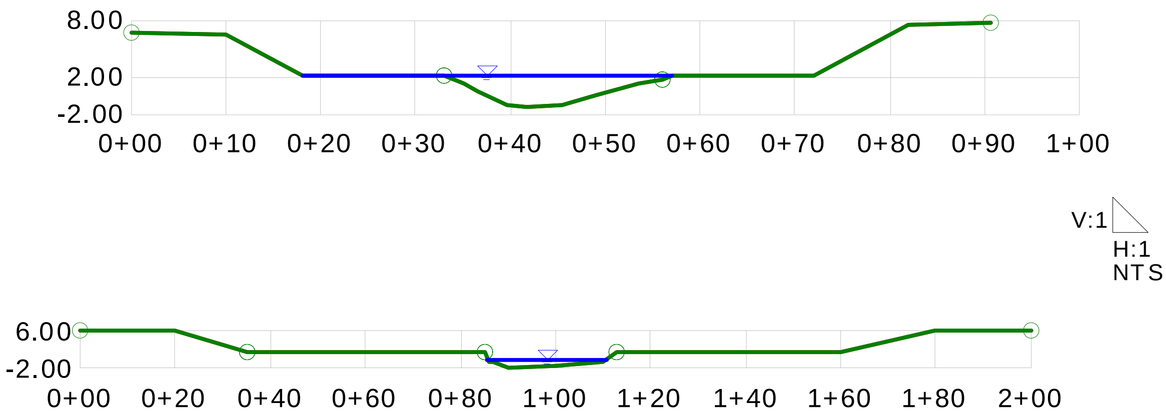
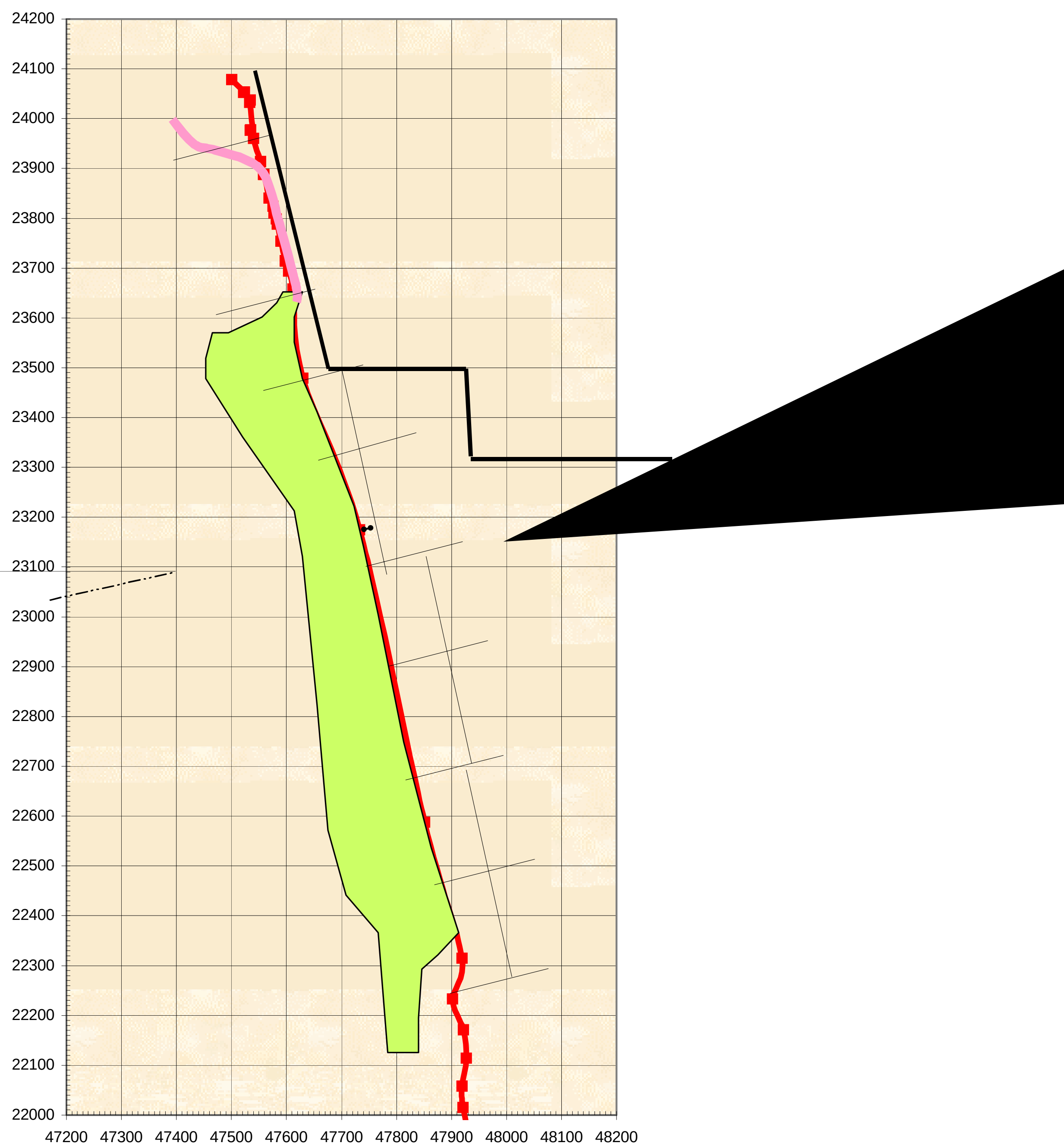


Figure17. Floodplain cross-sections under the new 126th

The riffle cross section is 28 feet wide, and the pool cross section is 28*



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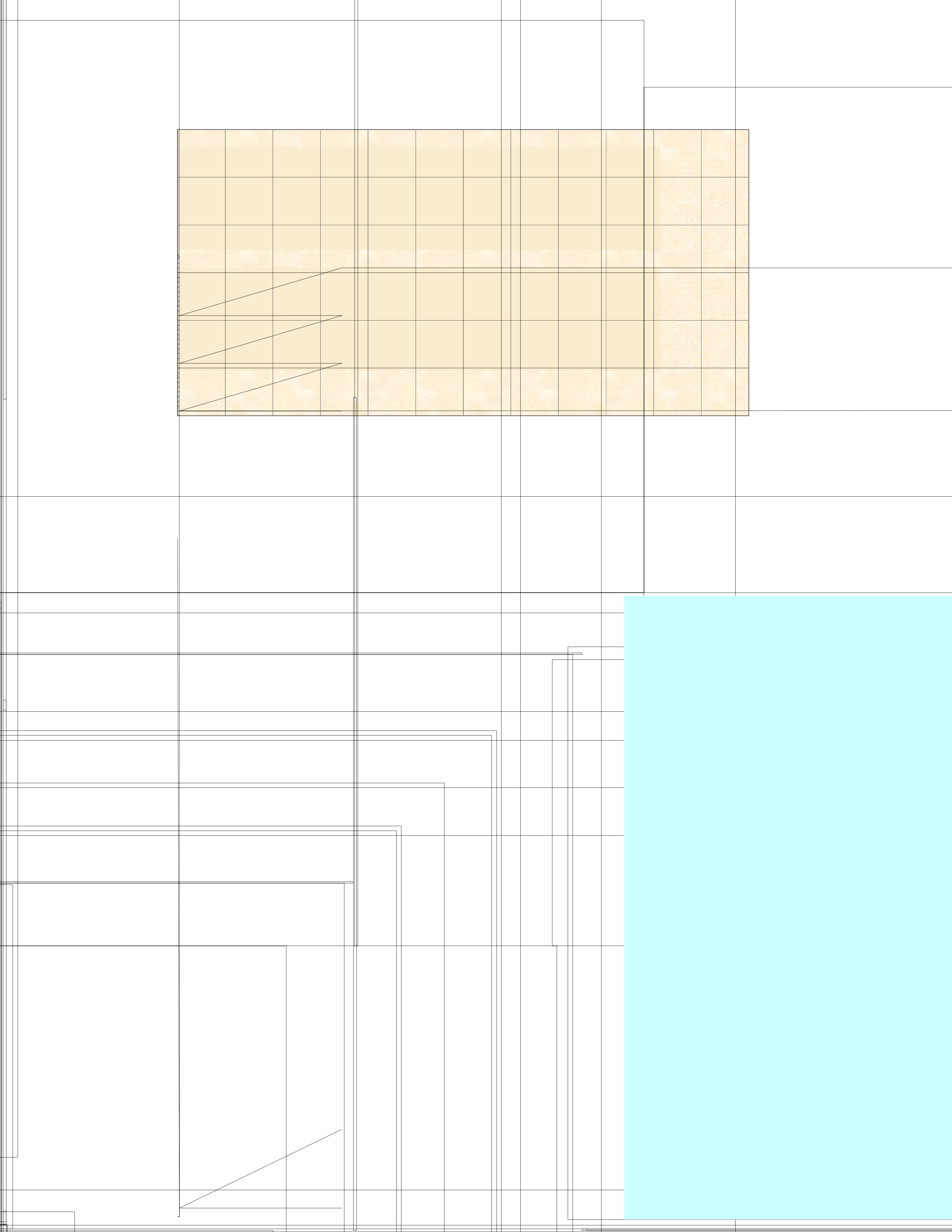


Note the presentation of the figure scales in Figs.19-21 is slightly different. In Fig. 21 the first

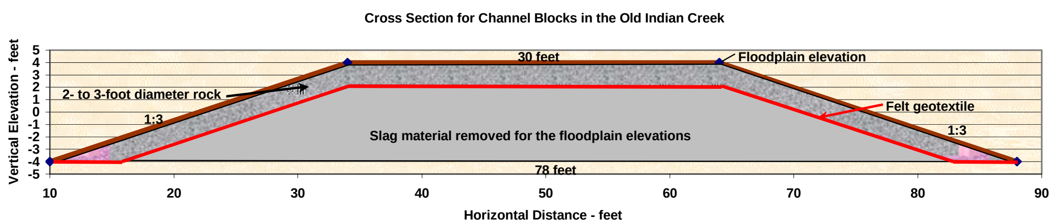
We recommend a range of rock diameters from 15 to 100 mm (1/2 to 4 inches) on the riffle surfaces because we measured slag conglomerate up to 250 mm in diameter at the outlet of Wolf Lake. Some people recommend an underlay of geotextile on the riffle section; however, I do not recommend this because it interferes with burrowing invertebrates, and experience with and without it on a fine sand bed stream (Pokegama Creek south of Grand Rapids, MN; a joint MNDOT, MNDNR, FS stream restoration) indicates it is not needed.

Note the elevation of the top rock cross vane invert is at 1.6 feet. It is the same elevation as the invert of the existing Schroud culvert (inside bottom of the culvert circle). In effect, this design perpetuates a flooded channel that provides deep-water habitat to the fish community between the Schroud culverts and Wolf Lake. Lowering this elevation would yield very low water levels that, in my opinion, would evoke strong opposition from a large number of people who fish the Wm. Powers Conservation Area (lake and stream) and the upper East-West section of the current Indian Creek. Note the uphill stream bottom at the end of the longitudinal section in Fig. 22. This mimics the flooded channel bottoms in natural wetland stream systems.

The multiple rock cross vanes form a step/pool series from the new Indian Creek channel down to the Hyde Lake Wetland that will maintain the current water level regime above and below the vanes and provide for spawning and average flow fish passage. It will also make it very hard to block the flow at this point as some folks wanting to speaflow at thivl7l section in Fig.annen c0..anne130( )]

Figure 23. Elevation detail for the rock cross-vanes at the Schroud road, Chicago Southern railroad site. Gray areas are 3 to 4 inch rock in the plunge pool inside the vanes. Vertical dashed lines are for distance measurement. The diagonal dashed red lines are the rising legs (tails) of the rock cross vanes from their inverts to the bankfull elevation.

Fig. 24, A10 (top) shows a cross-section of the channel block just below the nitrogen pipeline. Figure 24, A11 (bottom) shows a longitudinal section of the channel block just above the Schroud culvert location. Note all of the channel blocks are level across their top except for the one above the Schroud culvert site. At the Schroud culvert site there is a dip in the surface to allow low (and high) water exchange into the old section of Indian Creek and the newly created wetland on its north side. The plan views in Figs. 19-21 show the height of the various channel blocks. There are five channel blocks in all.



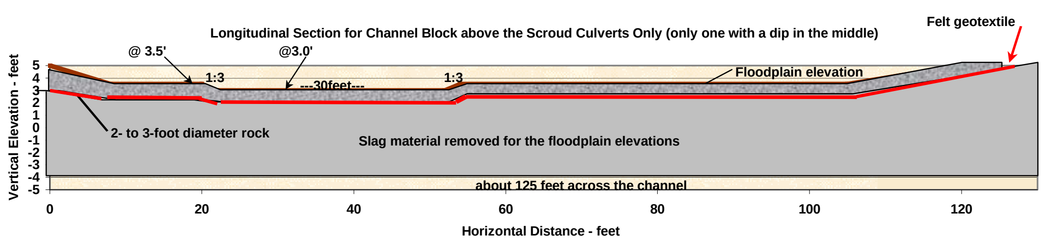


Figure 24. Cross-section (top) and longitudinal section (bottom) for two of the five channel blocks recommended. The top cross section is located just west of Highway O and is straight across at the top at an elevation of 4'. The pool at that location is about a –4' elevation deep. The longitudinal section (bottom) is for the block just above the Schroud culverts and it has a different top (floodplain elevation and a dip to allow low water circulation with the old Indian Creek channel. See plan views for top elevations of other channel blocks.

These channel blocks will overtop during floods (flow above the floodplain) and allow the old part of Indian Creek and the newly constructed wetland to function as a floodplain. Large rock, The rock cross vane at the old trestle site just above the Carondolet Bridge and just below the Hyde Lake Wetland is suggested as a starting point for any construction in the Indian Creek area. The riffle formed by the scour deposit below the 126th Street Bridge controls the water level in Hyde Lake Wetland. The wastewater pipe from the sulfuric acid plant entering the old dam at the confluence with the Calumet River also controls the Hyde Lake Wetland water level.

Removing both of the control points during construction would lower the water level in Hyde Lake Wetland as much as a foot! Alternately, temporary cofferdams at the 0 elevation would maintain the Hyde Lake Wetland water level until permanent rock cross- vanes at the mouth of Indian Creek were completed. However, the cofferdam would be subject to washout when large storms occurred.

Rock cross vane grade controls at the Schroud culvert site, the old trestle site above Carondolet Bridge, and at the confluence with the Calumet River will set the groundwater regime for the entire Indian Creek stream course, Wolf Lake, and surrounding areas. The design elevations selected will maintain the existing deep water above the Schroud culverts, protect the water levels in Hyde Lake Wetland, and allow water