CR 675 Crossings Preliminary Engineering Report

Leelanau CRC & GT Band of Ottawa and Chippewa Indians

Glen Arbor, Michigan

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1.0 PROJECT SCOPE

Gosling Czubak Engineering Sciences (GCES) was engaged by the Leelanau County Road Commission (LCRC) and The Grand Traverse Band of Ottawa and Chippewa Indians (GTB) to complete professional surveying, geotechnical, and preliminary engineering design services at four stream crossings under County Road 675 (CR-675) near Glen Arbor, MI. Three of the crossings are the Crystal River and the other crossing is the Tucker Lake outlet. An overall location map showing each crossing is included as Attachment 1.

The project is being undertaken following a grant being awarded to GTB from the Bureau of Indian Affairs to improve aquatic organism passage and natural stream functions at these four stream crossings. The Crystal River crossings each have multiple culverts while the Tucker Lake outlet channel has a single culvert. Improvement of each crossing with larger structures is needed to restore natural stream functions to each location. The LCRC and GTB are considering timber bridge structures at each location to span the bankfull width at each location to replace the culverts. This report presents the preliminary structure layouts for each site, hydraulic analysis results, and preliminary structure cost estimates for the partners consideration.

2.0 HYDRAULIC ANALYSIS

A hydraulic analysis of each crossing was conducted to examine the backwater effects of replacing the existing culverts at each location with larger structures. The structures initially considered are multi-span timber structures at the three Crystal River crossings and a single span timber structure at the Tucker Lake outlet. The HEC-River Analysis System 5.0.7 (HEC-RAS) developed by the U.S. Army Corps of Engineers was utilized for modeling the natural river with the existing and proposed structures.

It is important to note that the hydraulic analysis of each location has been performed for the purpose of comparing the hydraulic capacities of the existing and proposed structures in the vicinity of each proposed crossing. The analysis has not been performed to determine an accurate water surface profile large distances upstream or downstream of the crossing. However, this analysis has made the best use of surveyed data, existing maps, provided flowrates, and any other available information to determine a

reasonably accurate water surface profile upstream and downstream of the structure for comparison purposes of the conditions modeled.

DISCHARGE FLOWRATES & DRAINAGE AREA

Flood frequency discharges and contributing drainage areas were provided by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The three Crystal River crossings are relatively close to each other with similar discharges and drainage areas. Crossing 1 is the furthest downstream with the highest discharges and drainage area. This data was used to model all three of the Crystal River crossings.

The methodology used by EGLE to calculate flood discharges is a rainfall-runoff methodology. With this methodology, flows within the river are calculated based on a volume of runoff calculated for a given rainfall frequency event. An inherent assumption of the methodology is that the flood discharge volume is significant enough that base flow is negligible in comparison to flood flows. For this reason, a separate base flow determination is not calculated and provided with flood flows typically used for hydraulic analysis of bridges and structures placed in streams and rivers. At the request of project partners, an estimate of "base flow" at 1 cfs per square mile of drainage area for the Crystal River crossings was included in the modeling as an additional conservative analysis measure. Table 1, below, shows the flood frequency discharges and drainage area used for the HEC-RAS models of each Crystal River crossing and the Tucker Lake Outlet crossing.

TABLE 1 – FLOOD FREQUENCY DISCHARGE FLOWRATES

FLOOD FREQUENCY / DRAINAGE AREA	CRYSTAL RIVER CROSSINGS	TUCKER LAKE OUTLET
Q_2 (50%)	35 CFS	1 CFS
Q_{50} (2%)	110 CFS	35 CFS
Q_{100} (1%)	130 CFS	60 CFS
Base Flow	35 CFS (Estimated)	-
Drainage Area	34.5 Square Miles	2.5 Square Miles

MEASURED FLOW DATA

Extensive flow data of the Crystal River has been collected over the years from measurement devices at the Fisher Lake dam. The flows vary with season and weather events. The data provided show the flows are generally in the 60-80 cfs range with peaks of 110 cfs and lows of 25 cfs.

SURVEY DATA

Gosling Czubak Engineering Sciences, Inc. conducted hydraulic surveys of the Crystal River and Tucker Lake Outlet at each crossing location over a period of ten different days from April 27, 2020 to May 29, 2020. Survey data was collected using a combination of Leica GPS and robotic total station equipment. The lengths of longitudinal profiles and number of cross sections surveyed upstream and downstream of each crossing to facilitate the HEC-RAS modeling are listed in Table 2 below. Hydraulic plan, profile, and cross section drawings are included in Appendix 1.

TABLE 2 - SURVEYED AREAS

CROSSING	U/S LENGTH (FT)	NO. U/S X-SECTIONS	D/S LENGTH (FT)	NO. D/S X-SECTIONS
Crystal River #1	1480	3	1330	5
Crystal River #2	1360	4	1480	3
Crystal River #3	1450	6	1450	14
Tucker Lake Outlet	590	2	190	3

The scope of survey work also included locating pools and riffles along the stream profiles and determining bankfull widths at riffles. Table 3 below summarizes the bankfull widths at various locations upstream and downstream of the road crossing centerline noted. The distances between edge of water just upstream of the existing crossings is also noted in the table.

TABLE 3- BANKFULL WIDTHS

CROSSING	U/S LOCATION (FT) / BANKFULL WIDTH (FT)	D/S LOCATION (FT) / BANKFULL WIDTH (FT)	WIDTH BETWEEN EDGE OF WATER (FT) UPSTREAM
Crystal River #1	455 / 62	444 / 69	72
Crystal River #2	435 / 83	539 / 86	65
Crystal River #3	477 / 80	352 / 60	68
Tucker Lake Outlet	259 / 35	216 / 32	24

HYDRAULIC MODEL ASSUMPTIONS, VARIABLES, AND COEFFICIENTS

GRADE LINES AND MANNINGS COEFFICIENTS

The slopes of these river sections were estimated using surveyed data. The estimated slope of the hydraulic grade line used for analysis of Crossings 1 and 2 was .00028 ft/ft. The estimated slope of the hydraulic grade line used for analysis of Crossing 3 was .0008 ft/ft. The estimated slope of the hydraulic grade line used for analysis of Crossing 4 was .0051 ft/ft.

The Manning's roughness coefficients utilized for the channel and floodplains were chosen based on field and photo observations. A coefficient of 0.05 was used for the channel bottom based on a clean, winding channel with some pools and shoals, weeds, stones, and occasional downed trees. The overbanks and floodplains generally consist of dense willow trees, brush, and downed trees. A coefficient of 0.15 was used for these areas.

EXPANSION COEFFICIENTS

Natural Stream / river	0.3
Bridge Sections	0.5

CONTRACTION COEFFICIENTS

Natural Stream / river	0.1
Bridge Sections	0.3

STARTING WATER SURFACE ELEVATION

The starting water surface elevation was determined utilizing an iterative solution of the energy equation.

EXISTING AND PROPOSED STRUCTURES MODELED

The existing culverts modeled at Crossing 1 consist of two 60-inch diameter corrugated metal pipe culverts. The existing culverts modeled at Crossing 2 consist of three culverts including 36-inch diameter, 48-inch diameter, and a 60-inch diameter corrugated metal pipe culverts. The existing culverts modeled at Crossing 3 consist of three 48-inch diameter corrugated metal pipe culverts. The existing culvert modeled at Crossing 4 consists of a single 42-inch diameter corrugated metal pipe culvert.

The proposed structure originally modeled at Crossing 1 consists of two 30-foot timber spans with a total length of 60 feet. The proposed structures modeled at Crossings 2 and 3 originally consisted of three span timber structures with a 30-foot center span and 20-foot end spans with a total overall length of 70 feet. The proposed structure modeled at Crossing 4 consists of a single 18-foot span timber structure.

After initial review and discussion with the project partners, adjustments to the structure configurations at Crossings 1-3 were made for which the hydraulic models were updated and added to this report revision. The updated structure configurations are intended to mimic channel geometry from the adjacent reaches as much as possible through the new structures. Table 4 below identifies the representative cross section used at each crossing and the bankfull width identified at that location. Detailed plots of these cross sections are included in Appendix 1. The updated structure configuration at Crossing 1 consists of a 65-foot single span steel beam superstructure with 60 foot clear between abutments. The updated structure configurations at Crossings 2 and 3 consist of three span timber structures with 38-foot center spans and 21-foot end spans with a total overall length of 80 feet.

The span of Crossing 1 is maximized within existing constraints of M-22 and neighboring drives but does not quite span the bankfull width of the representative cross section. However, the channel

geometry of the cross section within the proposed abutments is mimicked with flatter slopes of the riprap scour protection in front of each abutment.

TABLE 4- REPRESENTATIVE DESIGN CROSS SECTIONS

CROSSING	REPRESENTATIVE CROSS SECTION LOCATION	BANKFULL WIDTH (FT)
Crystal River #1	Sta 20+27	76
Crystal River #2	Sta 12+08	73
Crystal River #3	Sta 16+87	77

2.1 Hydraulic Analysis - Crystal River Crossing 1

The hydraulic analysis for CR 675 crossing 1 over the Crystal River are summarized in the tables below. The relative water surface elevations at the upstream and downstream faces of the structure, velocities in the upstream channel and downstream structure face, and waterway areas through the structure are summarized for the existing and proposed structures at the various flood flows. The change in water surface elevation at the upstream structure faces between the existing and proposed structures at the various flows is also summarized.

The analysis generally shows small changes in water surface elevations between the existing culverts and proposed structure. The existing twin 60” culverts provide a waterway opening of 39.2 square feet while the proposed two span timber structure provides a waterway opening of 340.2 square feet. The clear span bridge structure provides a waterway opening of 335.8 square feet. The analysis predicts the water surface elevations at a 60-foot two span bridge would be reduced by .14 feet (1.7 inches) at the lowest 2-year flow and reduced by .68 feet (8 inches) at the 100-year flow by replacing the twin culverts with the much larger waterway opening provided by a bridge structure. The analysis predicts the water surface elevations at a 65-foot single span bridge would be reduced by .33 feet (4 inches) at the lowest 2-year flow and reduced by .88 feet (10.5 inches) at the 100-year flow

Velocities within the river channel are also shown to be changed in the immediate area of the structure due to the culvert replacements. In general, when a culvert is placed within a stream, the amount of channel area is decreased causing the velocity of the water to be increased. When the culverts are replaced with a more natural channel under the bridge, the velocities will decrease and more closely align with velocities expected in the natural channel up or down stream. The analysis provided by both models predict a reduction in velocity from 1.1 feet per second to .5 feet per second just downstream of the structure for the 2-year flow and a reduction from 2.0 feet per second to .8 feet per second for the 100-year flow.

TABLE 5- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 1 – 60 FT TWO SPAN TIMBER BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	583.72	583.38	0.5	1.1	583.58	583.39	0.5	0.5	160.4	-0.14
50-YR	145	584.98	584.21	0.6	1.9	584.43	584.23	0.8	0.8	203.6	-0.55
100-YR	165	585.30	584.39	0.7	2.0	584.62	584.41	0.8	0.8	213.3	-0.68
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 340.2 SQUARE FEET.											

TABLE 6- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 1 - 65 FT SINGLE SPAN BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	583.72	583.38	0.5	1.1	583.39	583.39	0.5	0.5	154.8	-0.33
50-YR	145	584.98	584.21	0.6	1.9	584.24	584.23	0.8	0.7	200.8	-0.74
100-YR	165	585.30	584.39	0.7	2.0	584.42	584.41	0.9	0.8	211.2	-0.88
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 335.8 SQUARE FEET.											

2.2 Hydraulic Analysis - Crystal River Crossing 2

The hydraulic analysis for CR 675 crossing 2 over the Crystal River are summarized in the tables below. The relative water surface elevations at the upstream and downstream faces of the structure, velocities in the upstream channel and downstream structure face, and waterway areas through the structure are summarized for the existing and proposed structures at the various flood flows. The change in water surface elevation at the upstream structure faces between the existing and proposed structures at the various flows is also summarized.

The analysis generally shows small changes in water surface elevations between the existing culverts and proposed structure. The existing 36", 48", and 60" diameter culverts provide a waterway opening of 39.8 square feet while the proposed 70-foot three span timber structure provides a waterway opening of 439.7 square feet and the proposed 80-foot three span timber structure provides a waterway opening of 513.2 square feet. The analysis predicts the water surface elevations at the 70-foot bridge would be reduced by .13 feet (1.6 inches) at the lowest 2-year flow and reduced by .98 feet (11.8 inches) at the 100-year flow by replacing the three culverts with the much larger waterway opening provided by a bridge structure. The additional waterway opening from an 80-foot bridge compared to a 70-foot bridge does not substantially change the predicted water surface elevations.

The velocity results are similar at this location as they are at crossing 1. The analysis provided by the models for both size structures predict the same reductions in velocity from 1.0 feet per second to .5 feet per second just downstream of the structure for the 2-year flow and a reduction from 1.7 feet per second to .9 feet per second for the 100-year flow.

TABLE 7- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 2- 70 FT THREE SPAN TIMBER BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	585.18	584.98	0.7	1.0	585.05	584.97	0.8	0.5	201.8	-0.13
50-YR	145	586.80	586.04	0.7	1.6	586.10	585.92	0.9	0.8	264.1	-0.70
100-YR	165	587.29	586.31	0.7	1.7	586.33	586.13	1.0	0.9	277.6	-0.96
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 439.7 SQUARE FEET.											

TABLE 8- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 2 – 80 FT THREE SPAN TIMBER BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	585.18	584.98	0.7	1.0	585.04	584.96	0.6	0.5	188.3	-0.14
50-YR	145	586.80	586.04	0.7	1.6	586.08	585.89	0.9	0.8	250.6	-0.72
100-YR	165	587.29	586.31	0.7	1.7	586.30	586.10	0.9	0.9	265.0	-0.99
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 513.2 SQUARE FEET.											

2.3 Hydraulic Analysis - Crystal River Crossing 3

The hydraulic analysis for CR 675 crossing 3 over the Crystal River are summarized in the tables below. The relative water surface elevations at the upstream and downstream faces of the structure, velocities in the upstream channel and downstream structure face, and waterway areas through the structure are summarized for the existing and proposed structures at the various flood flows. The change in water surface elevation at the upstream structure faces between the existing and proposed structures at the various flows is also summarized.

The analysis shows small changes in water surface elevations between the existing culverts and proposed structure. The existing three 48-inch diameter culverts provide a waterway opening of just over 37.7 square feet while the proposed 70-foot three span timber structure provides a waterway opening of 454.7 square feet and the proposed 80-foot three span timber structure provides a waterway opening of 556.0 square feet. The analysis predicts the water surface elevations at the new bridge would be reduced by 1.14 feet at the lowest 2-year flow and reduced by 1.68 feet at the 100-year flow by replacing the three culverts with the much larger waterway opening provided by a bridge structure. The additional waterway opening from an 80-foot bridge compared to a 70-foot bridge does not substantially change the predicted water surface elevations.

It is worth noting that the difference in water surface between the upstream and downstream faces of the existing culverts is quite a bit more noticeable at this crossing location than the others due to the culverts being perched and the sharp river bend on the downstream end. The surveyed difference is noted as 1.1 feet. The difference at the 2-year flow is 2.03 feet and the difference at the 100-year flow is 2.69 feet. After structure replacement, the predicted difference in water surface elevations between the upstream and downstream faces of the bridge is .84 feet (10 inches) at the 2-year flow and .92 feet (11 inches) at the 100-year flow.

Downstream velocities for all conditions are a bit higher at this location compared to crossings 1 and 2 due to a generally smaller channel and bankfull width. The overall reduced velocity results are still similar at this location as they are at crossings 1 and 2. The analysis provided by the models for both size structures predict a reduction in velocity from 2.8 feet per second to 1.3 feet per second just downstream of the structure for the 2-year flow and a reduction from 4.4 feet per second to 2.0 feet per second for the 100-year flow.

TABLE 9- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 3- 70 FT THREE SPAN TIMBER BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	589.25	587.22	0.6	2.8	588.09	587.25	1.1	1.3	131.1	-1.16
50-YR	145	590.42	587.86	0.8	4.2	588.84	587.94	1.4	1.9	166.9	-1.58
100-YR	165	590.70	588.01	0.8	4.4	589.02	588.10	1.4	2.0	177.6	-1.68
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 454.7 SQUARE FEET.											

TABLE 10- SUMMARY OF HYDRAULIC ANALYSIS, CROSSING 3- 80 FT THREE SPAN TIMBER BRIDGE

SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	589.25	587.22	0.6	2.8	588.08	587.25	1.3	1.3	79.2	-1.17
50-YR	145	590.42	587.86	0.8	4.2	588.84	587.94	2.0	1.9	126.8	-1.58
100-YR	165	590.70	588.01	0.8	4.4	589.01	588.10	2.1	2.0	138.2	-1.69
THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED. THE MAXIMUM AREA BELOW LOW CHORD IS 556.0 SQUARE FEET.											

2.4 Hydraulic Analysis - Tucker Lake Outlet Crossing

The hydraulic analysis for CR 675 crossing over the Tucker Lake Outlet is summarized below. The relative water surface elevations, velocities, and waterway areas area summarized for the existing and proposed structures at the various flood flows. The change in water surface elevation between the existing and proposed structures at the various flows is also summarized.

The analysis shows small changes in water surface elevations between the existing culverts and proposed structure. The existing 42-inch diameter culvert provides a waterway opening of just over 9.7 square feet while the propose structure provides a waterway opening of 71.2 square feet. At the highest 100-year flood frequency discharge modeled, the water surface elevation could be expected to be reduced by 2.05 feet by replacing the single culvert with the much larger waterway opening provided by a bridge structure. The analysis provided by the model predicts a reduction in velocity from 2.8 feet per second to 1.3 feet per second just downstream of the structure for the 100-year flow.

With the velocities in the new channel compared to the existing culverts at the flood discharges analyzed being significantly reduced, Significant streambed modification is not anticipated.

TABLE 11- SUMMARY OF HYDRAULIC ANALYSIS, TUCKER LAKE OUTLET CROSSING

SUMMARY OF HYDRAULIC ANALYSIS							
EXISTING				PROPOSED			
FLOOD DATA	DISCHARGE (CFS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY IN D/S CHANNEL (FPS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY IN D/S CHANNEL (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YEAR	1	594.19	0.2	594.01	0.1	6.1	-0.18
50-YEAR	35	596.74	2.2	595.44	0.9	21.7	-1.30
100-YEAR	60	598.00	2.8	595.95	1.3	29.5	-2.05
THE MAXIMUM AREA BELOW LOW CHORD IS 71.2 SQUARE FEET.							

2.5 Stream Morphology

The overall form that a natural stream assumes through its cross section and alignment is a function of many variables with cause and effect relationships that are difficult to establish. The Crystal River may be in equilibrium with respect to the sediment it receives, discharges, or otherwise moves. The velocities within the river at these crossings are generally low and with their reductions from replacing the constricting culverts with larger structures, are not expected to initiate streambed modification. There are many areas of pools and riffles that were surveyed along the river. It is possible that short term adjustments of the stream bed may occur at localized areas of the pools and riffles in response to the culvert replacements and or flood flows the river may experience. A micro-analysis of these areas

within the river was not completed. It is generally expected that the natural channel will assume a geomorphological form in equilibrium with the discharges and sediment load it has historically experienced.

2.6 Effects Outside of Crossing Influence

There has been concern voiced by riparian property owners about the possibility of unacceptably high river levels at the bend in Glen Arbor where the river turns and runs parallel to M-22 as it flows towards Crossing 1 and onto Lake Michigan. A cross section was interpolated and placed in the HEC-RAS model at this location. The water surface elevation at this location is actually lowered when the existing culverts are replaced with the structures at both the 50-year and 100-year discharges plus the base flow estimate. Table 8 below shows summarized the predicted water surface elevations for the various conditions.

TABLE 12- WATER SURFACE ELEVATIONS AT GLEN ARBOR BEND

FLOOD DISCHARGE	W.S.E. W/ EXISTING CULVERT	W.S.E. W/ PROPOSED STRUCTURE
50-Year: 110 +35 CFS	585.44	585.13
100-Year: 130+35 CFS	585.74	585.33

It is also understood that riparian owners and businesses along the river are concerned about water levels and possible effects if they drastically change throughout the system. Tables 9 and 10 below summarize predicted water surface elevations approximately 1000 feet upstream and downstream of each crossing for the high and low flow events.

TABLE 13 – WATER SURFACE COMPARISON ±1000 FT UPSTREAM

	CROSSING 1		CROSSING 2		CROSSING 3	
	Ex. Culverts	Bridge	Ex. Culverts	Bridge	Ex. Culverts	Bridge
2 yr: 70 cfs	583.90	583.78	585.41	585.33	589.41	588.83
100 yr: 165 cfs	585.47	584.85	587.40	586.56	590.91	589.72

TABLE 14 - WATER SURFACE COMPARISON ±1000 FT DOWNSTREAM

	CROSSING 1		CROSSING 2		CROSSING 3	
	Ex. Culverts	Bridge	Ex. Culverts	Bridge	Ex. Culverts	Bridge
2 yr: 70 cfs	583.08	583.08	584.81	584.79	585.34	585.34
100 yr: 165 cfs	584.10	584.10	586.12	585.89	586.62	586.62

The important points to notice for this water surface comparison are that the downstream effects are essentially zero or a very small drop in the predicted water surface elevation at the crossings for both the low and high flows. The low flow condition is generally what the riparian owners and businesses would recognize as a normal condition. At crossings 1 and 2, the water surface reduction at the 2-year flow is .12 feet (1.4 inches) and .08 (1 inch) respectively. For crossing 3, the reduction is .58 feet (7 inches).

Concern was also noted that there is a “short circuit” of sorts in flood flows actually being able to flow through crossings 1 and 2 due to an overland path upstream of crossing 2. Anecdotal secondhand information is noted regarding this condition and the potential for overland flow to occur and reach the part of the river that flows through the highway bridge at M-22. The location of this area from descriptions provided appears to be approximately 1,000 feet upstream of crossing 2. Sufficient data of this area was not collected to include in the modeling. However, the results of the modeling that was completed for the proposed structures and presented elsewhere in the report does not indicate a rise in water surface at the 100 year flood flows that would affect downstream property owners.

3.0 PROPOSED ROAD AND STRUCTURES

The existing road cross section of CR 675 from the M-22 intersection east to the Tucker Lake crossing generally consists of 11-foot lanes with an average of 4.5-foot paved shoulders for a total average paved width of 31 feet. Significant changes to the road cross section are not proposed for the reconstructed areas. The proposed clear width between guardrail at each structure and road approach reconstruction is 34 feet. This results in 12-foot lanes with 5-foot paved shoulders. Two feet of gravel shoulder is also proposed along each side of road outside the limits of each structure.

As previously mentioned, the structures initially considered for each crossing are timber structures as requested by the LCRC and GTB. A preliminary set of plans has been developed showing timber structures at each crossing location. After initial review and discussion with the project partners, adjustments to the structure configurations at Crossings 1-3 were made as previously described in this report revision. Those updated structure configurations are intended to mimic channel geometry from the adjacent reaches as much as possible through the new structures. The updated plans are included with this report as Appendix 2. A universal advantage of the timber structures is that cofferdams and dewatering necessary for concrete construction are generally not necessary. Some measures for stream control to allow for rip rap placement are still necessary though. General discussion of each crossing location and alternative structures considered follows below within this section.

The preliminary cost estimate for each of the original and updated structure configurations at each location is shown in the table below. The detailed estimates for each location are included in Appendix 3. These estimates are inclusive of the anticipated major items of work, including road work, within the limits shown on the preliminary plans. Unit prices for the work are generally based on 2019 average unit prices reported by the Michigan Department of Transportation. Estimates for the supply of the timber structures shown on the plans were provided by supplier Krenn Timber Bridge, Inc. A contingency of 25% is also included in the estimates at this stage of the project.

TABLE 15- PRELIMINARY TIMBER STRUCTURE ESTIMATES

LOCATION	STRUCTURE	ESTIMATED COST
Crystal River Crossing #1	Timber: two 30’ spans, 60’ total	$704,850
Crystal River Crossing #1	Steel: single 65’ span	$831,872
Crystal River Crossing #2	Timber: 20’,30’,20’ spans, 70’ total	$747,350
Crystal River Crossing #2	Timber: 21’,38’,21’ spans, 80’ total	$842,975
Crystal River Crossing #3	Timber: 20’,30’,20’ spans, 70’ total	$809,863
Crystal River Crossing #3	Timber: 21’,38’,21’ spans, 80’ total	$911,144
Tucker Lake Outlet Crossing	Timber: 18’ span	$274,463
Tucker Lake Outlet Crossing	Aluminum Box Culvert: 16-8’ span	$220,213

3.1 Crossing 1 Discussion

The siting of a new structure at Crystal River crossing 1 is geometrically constrained by the riverbanks and skew of the intersection of M-22. The bankfull widths measured approximately 450 feet up and downstream of the road are 62 and 69 feet, respectively. EGLE generally requires new structures to span the bankfull width. With the constraints of the intersection, two 30-foot timber spans with an overall structure length of 60 feet was initially identified as an acceptable fit for this site. The hydraulic analysis shows this structure configuration is adequate for the site even though the bankfull distance is not completely spanned. A field review with EGLE representative Luke Golden was conducted on July 8, 2020. Luke did not note any concerns regarding permitting of this structure as long as the hydraulic analysis showed it was adequate.

The elevations of the existing culvert inverts are the anticipated stream bottom elevation that the new channel through this crossing is excavated to. The vertical distance from the road surface to the stream bottom at the center of the new channel is approximately 8.9 feet. A 50-foot-wide stream bottom can be provided between the toes of slopes where rip rap armament would be placed on the sloping grade from the channel bottom to the abutment faces.

An additional alternative that could be considered at this location is a three-sided precast concrete structure. The practical limits of a three-sided precast concrete structure are about 36 feet per span. Two 30-foot precast spans are considered for this option similar to the two-span timber structure. A concrete pier would need to be constructed within the river as opposed to a timber pile bent. The estimated cost for this option is almost 17% greater than the two-span timber structure at $823,538.

Another alternative that is considered, and preferred by the project partners, at crossing 1 is a clear span steel superstructure. A pre-manufactured galvanized steel beam superstructure supplied by Contech Engineered Solutions could be an effective solution. Correspondence with Contech's bridge consultant indicated that their engineered and manufactured superstructures could span the original 60-foot at crossing 1. It was determined that a 65-foot steel superstructure could be used to maximize the span within the constraints of this crossing. To further maximize the channel flow area through the structure, a representative cross section downstream was identified to mimic the channel geometry from. The

elevations of the scour protection riprap at each abutment will be set just below that representative cross section stream bed elevation where the abutments intercept it.

The estimated cost for the clear span steel bridge option is $831,872. Advantages of this alternative include a 35-year warranty for the galvanized system and no center piers in the river. This structure would require conventional driven steel pile and concrete abutment foundations and wing walls to support the superstructure. The cost presented is based on asphalt surfacing over a metal decking system over the steel beams. A reinforced concrete deck option is also available for this structure. The concrete deck is estimated to be approximately $14,000 more than the asphalt surfacing however, it would allow the beam depth to be reduced. All these elements are included in the estimates for this alternative structure.

3.2 Crossing 2 Discussion

The siting of a timber structure at crossing 2 is more straightforward than crossing 1. The bankfull widths measured up and downstream of the road at the locations noted in Table 3 are 83 and 86 feet, respectively. The surveyed edge of water distance just upstream of the crossing measured 65 feet. A three-span timber structure with an overall length of 70 feet fits well at this crossing site even without fully spanning the bankfull width. The center span is proposed at 30 feet with each end span being 20 feet. The hydraulic analysis of this site shows the structure configuration is quite adequate. Luke Golden also reviewed this site on July 8, 2020 and did not note any concerns regarding permitting of this structure as long as the hydraulic analysis showed it was adequate.

After the initial review and discussion with the project partners, adjustments to the structure configurations at this crossing were made to mimic channel geometry from the adjacent reaches as much as possible through the new structures. The representative cross section used for this location identified a bankfull width of 73 feet. A three-span timber structure with an overall length of 80 feet was selected. The center span was increased maximized at 38 feet to meet the limits of timber and skew of the structure. Each end span is 21 feet. The overall length exceeds the bankfull width.

The existing culvert inverts are slightly above the existing stream bottom just upstream of them at this crossing. It is anticipated that the new channel through this crossing will be excavated to that existing

stream bottom elevation. The vertical distance from the road surface to the anticipated stream bottom at the center of the new channel is approximately 10 feet. The elevations of the scour protection riprap at each abutment will be set just below the representative cross section stream bed elevation where the abutments intercept it. From those pointes, it would slope down to the toe where the anticipated stream bottom will be. A 62-foot-wide stream bottom can be provided between the riprap toes at this location.

The most feasible alternative for this crossing would be the clear span pre-manufactured galvanized steel beam superstructure supplied by Contech Engineered Solutions. Correspondence with Contech's bridge consultant indicated that their engineered and manufactured superstructures could span the 70-foot distance at this crossing. A detailed estimate was not prepared for this crossing, but it is expected to be on the order of 7% greater than the timber structure similar to crossing 1. A multi span precast concrete structure could be configured to this site but would be much costlier and is not recommended for this site.

3.3 Crossing 3 Discussion

Crossing 3 is much like crossing 2 except for the 61-foot-long retaining wall that is needed to support the slope between the road and river where the river parallels the road right after the crossing. The timber pile and lagging retaining wall proposed as part of the timber bridge package for this crossing is a relatively simple and cost-effective solution for this site. The estimated timber materials and installation related only to the wall items is $24,675. A permanent steel sheet pile wall could be used as an alternative to the timber wall. The estimated cost of a 61-foot-long steel sheet piling wall with 20-foot-long sheets at $35/sft is $42,700. The same adjustments to the overall timber bridge configuration were made at this location following the initial review and discussion with the project partners.

The existing culvert inverts are slightly above the existing stream bottom just upstream of them at this crossing. It is anticipated that the new channel through this crossing will be excavated to that existing stream bottom elevation. The vertical distance from the road surface to the stream bottom at the center of the new channel is approximately 9.2 feet. The elevations of the scour protection riprap at each abutment will be set just below the representative cross section stream bed elevation where the abutments intercept it. From those pointes, it would slope down to the toe where the anticipated stream bottom will be. A 64-foot-wide stream bottom can be provided between the riprap toes at this location.

3.4 Crossing 4 Discussion

An alternative that could be considered in lieu of the timber structure at the Tucker Lake Outlet crossing (#4) is an aluminum box culvert structure. This crossing is a rather low flow crossing with a poorly defined channel. The soils present at this site indicate a peat layer between 2.5 to 8 feet below road grade. The peat layer is unsuitable to provide support of a larger culvert structure. A timber structure would be supported by piles extending through the peat to provide foundation support on suitable soils. Utilizing an aluminum box culvert would require removing the peat and any other unsuitable material and replacing with engineered fill to provide suitable bearing for the culvert. The estimated cost for a 16'-6" x 6'-8" aluminum box culvert structure at crossing 4 is $220,213 which is approximately 20% less than the single-span timber structure estimate for this crossing. This estimate includes removing and replacing unsuitable soils.

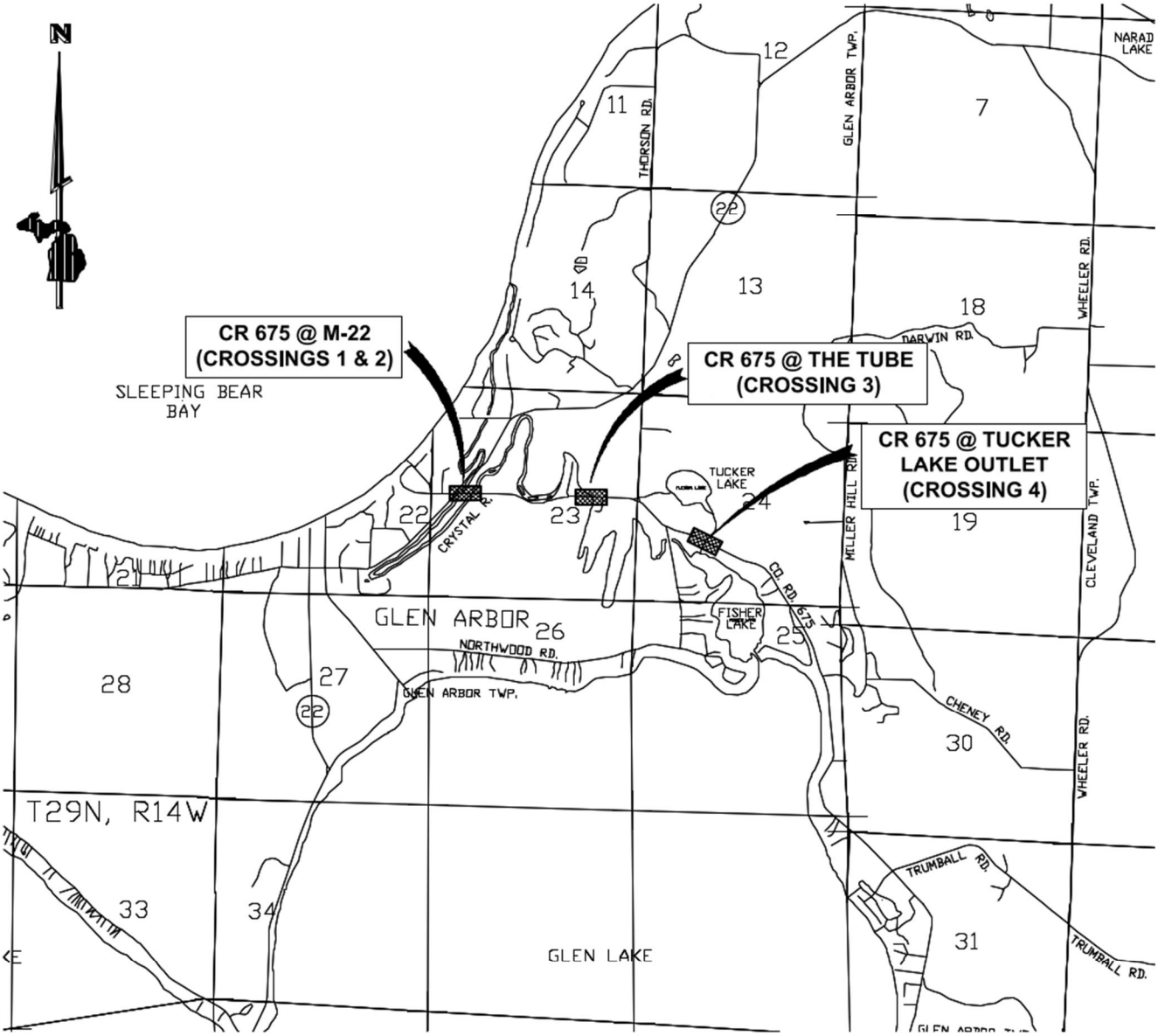
3.5 Construction Schedule

Estimated construction schedules comparing a typical three span timber structure and a clear span steel superstructure are included in Appendix 4. It is estimated that the typical three span timber structure could be completed in 35 working days or 49 calendar days. The clear span steel structure is estimated to take 49 working days or 67 calendar days. The major difference in time being the need to form, pour, and cure concrete substructure and deck elements.

Impact to recreation along the Crystal River is an important factor to consider with this project. The timber structures will provide the least duration of active construction time for these projects. Maintaining recreational traffic through active construction sites should not be allowed. It may be possible to provide portages around the sites with careful planning and permission from adjacent private property owners. Grouping the structures in pairs and constructing one group early in the spring and the second group in the fall may be an option to consider in order to limit the impact to the prime summer recreation season.

Attachment 1

Location Map



LOCATION MAP
NOT TO SCALE

Appendix 1

Hydraulic Plan, Profile, and Section Drawings

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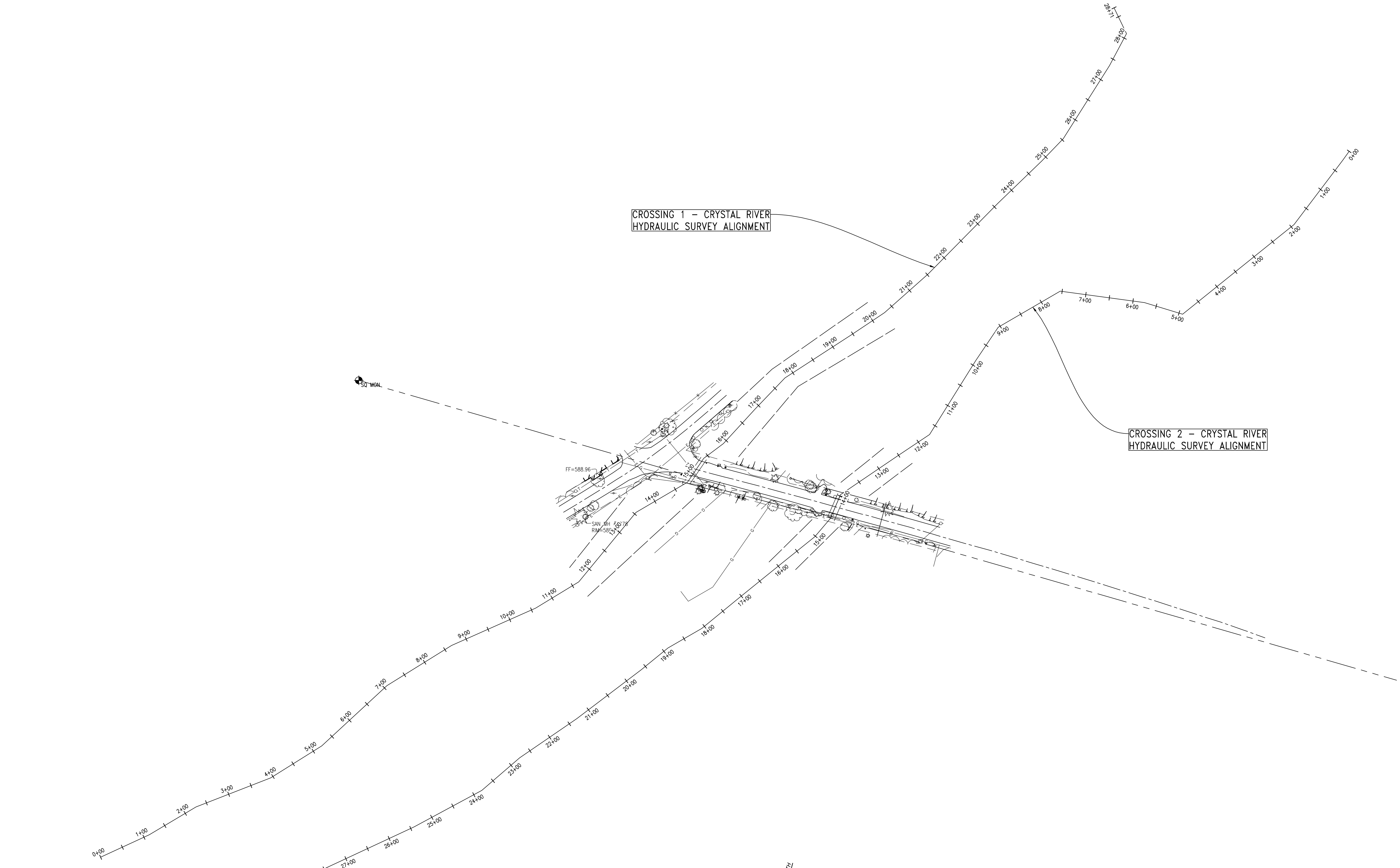

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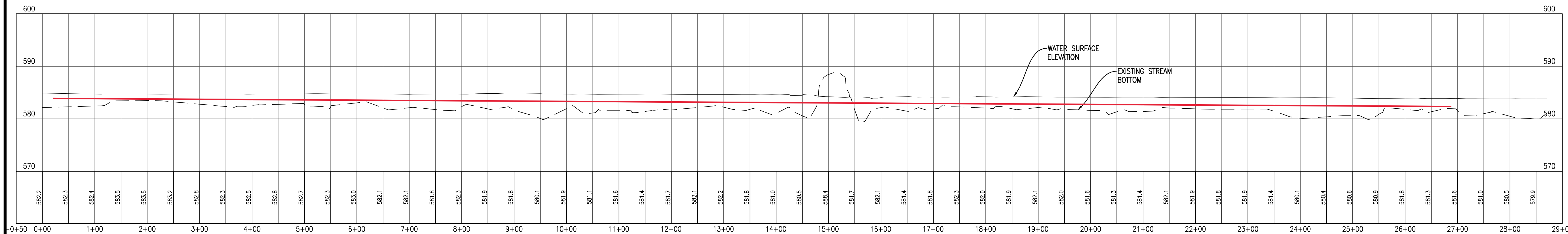

Crystal River Profile - Crossing 1

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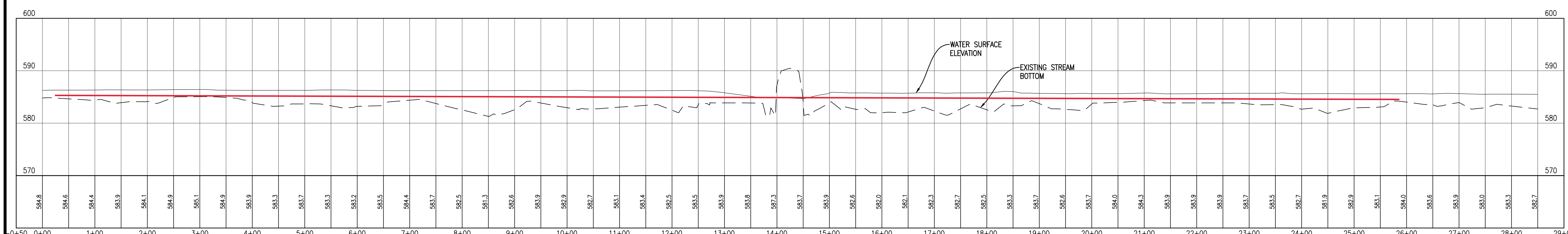

Crystal River Profile - Crossing 2

SCALE HORIZ. 1" = 100'
VERT. 1" = 10'

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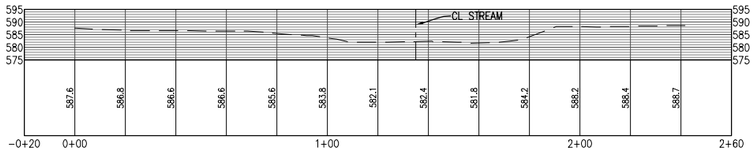

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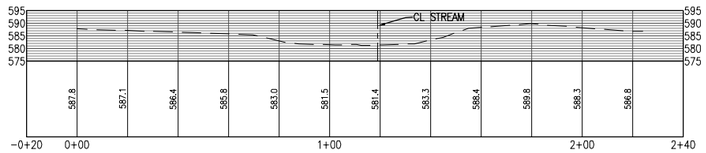

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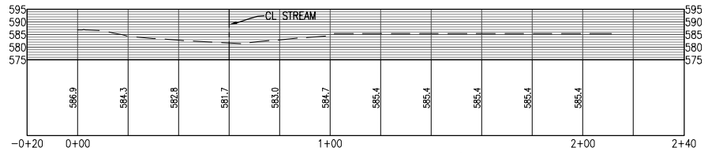

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Crossing 1 Downstream Cross Section 16+34

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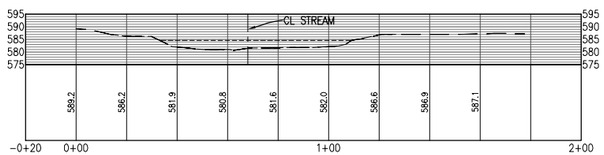

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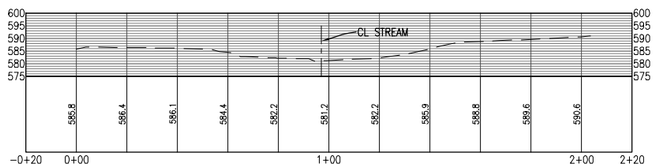

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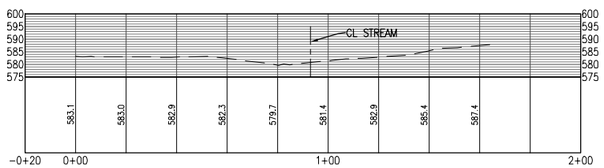

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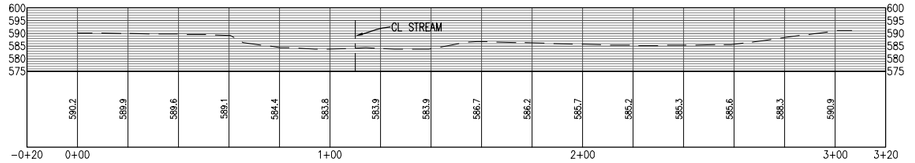

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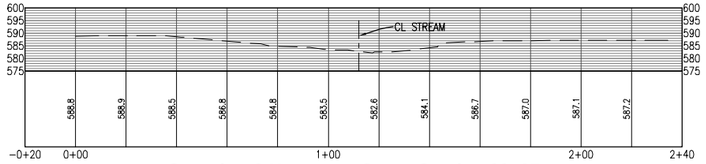

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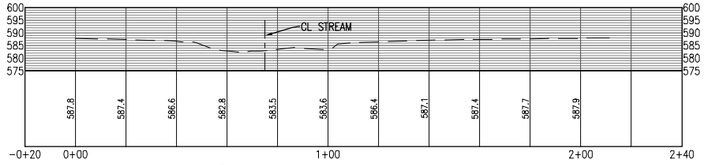

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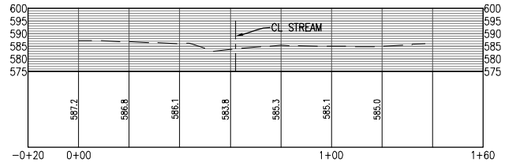

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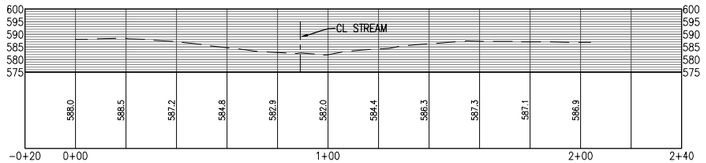

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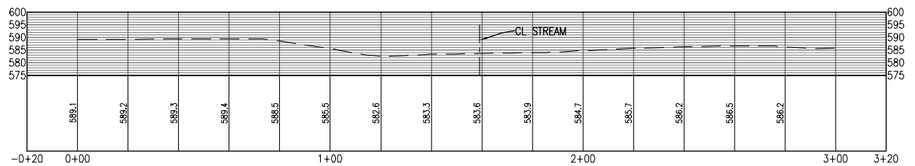

Crossing 2 Downstream Cross Section 26+11

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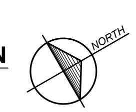

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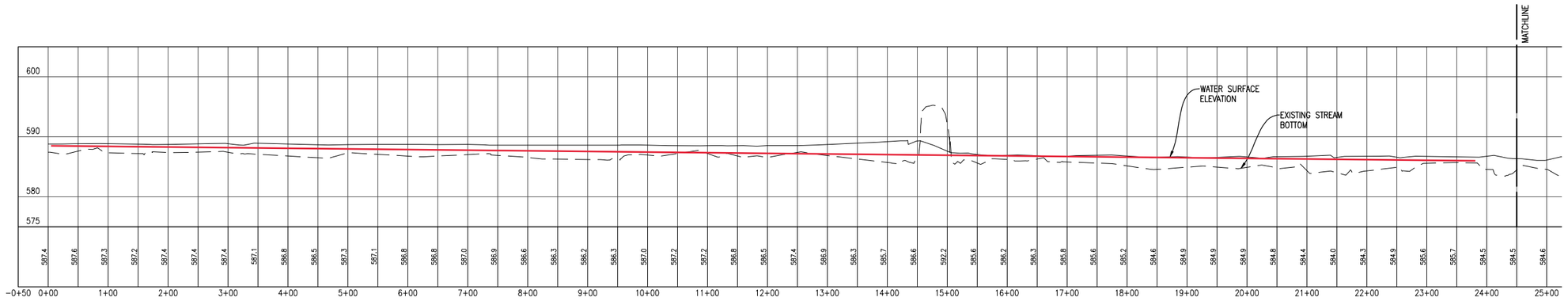

Crystal River Profile - Crossing 3

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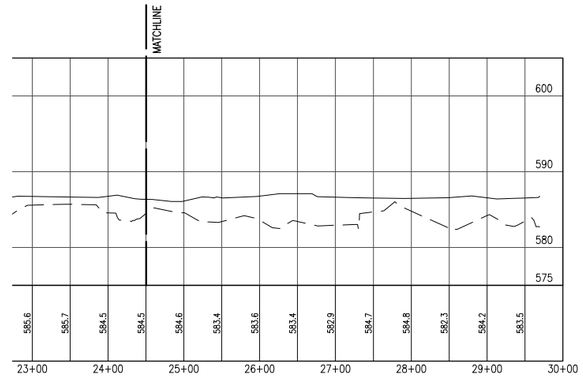

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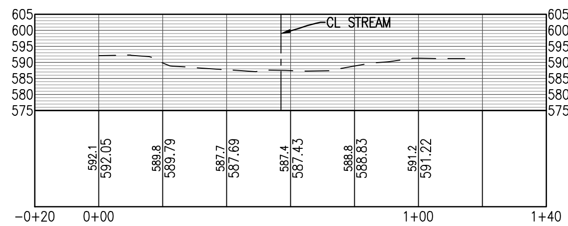

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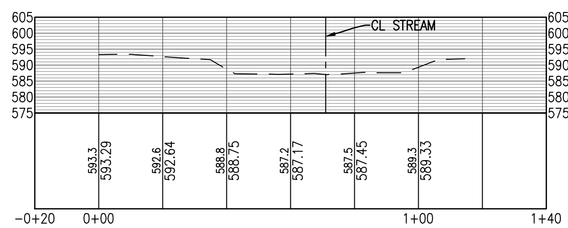

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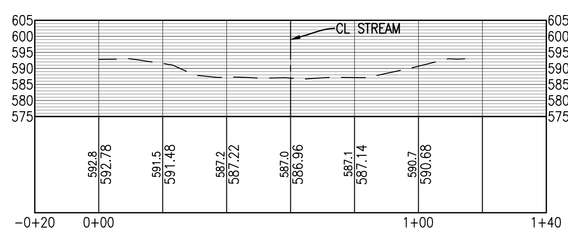

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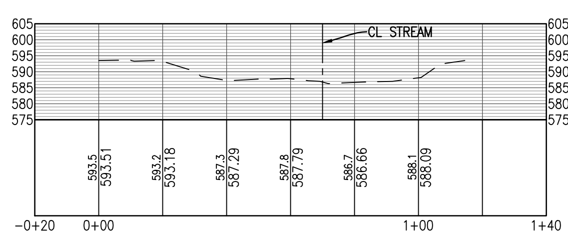

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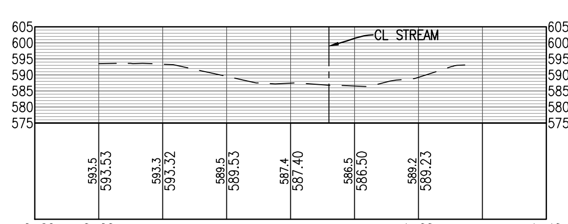

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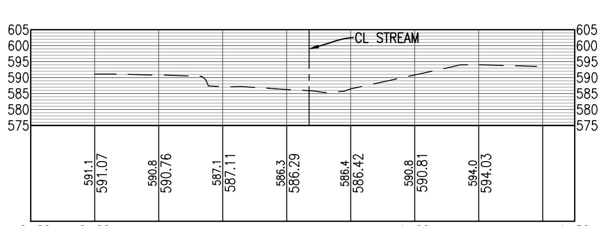

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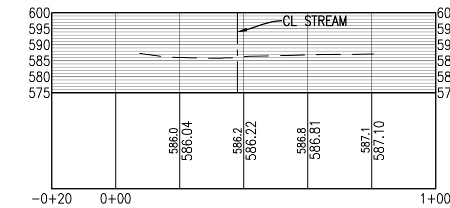

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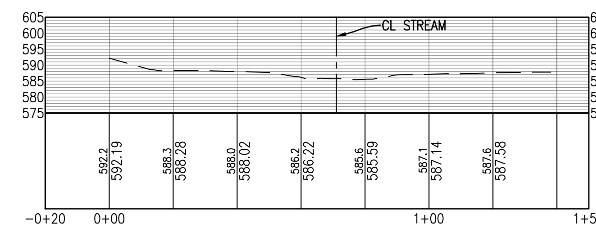

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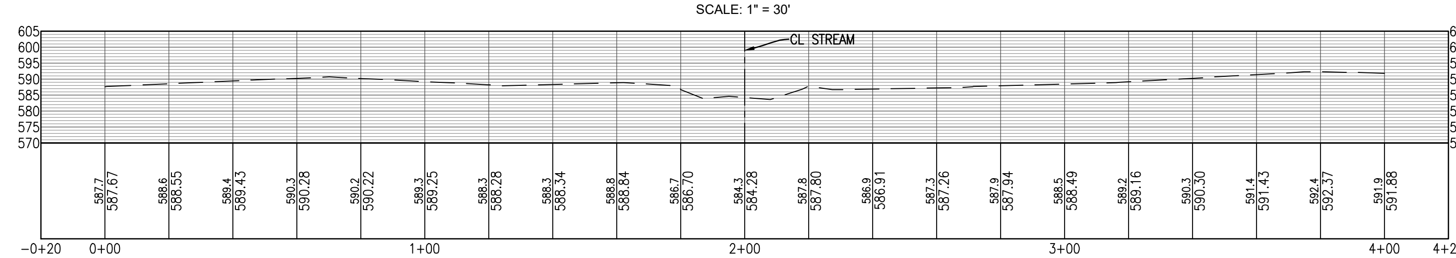
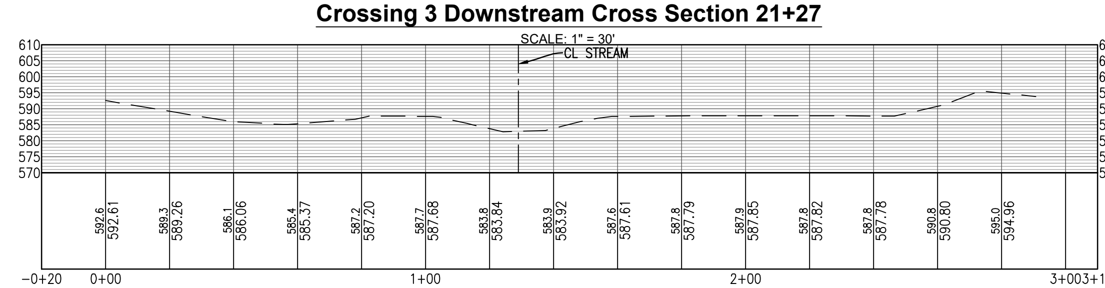


Crossing 3 Downstream Cross Section 21+27
SCALE: 1" = 30'



Crossing 3 Downstream Cross Section 27+15
SCALE: 1" = 30'

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HYDRAULIC SURVEY SECTIONS - CROSSING 3
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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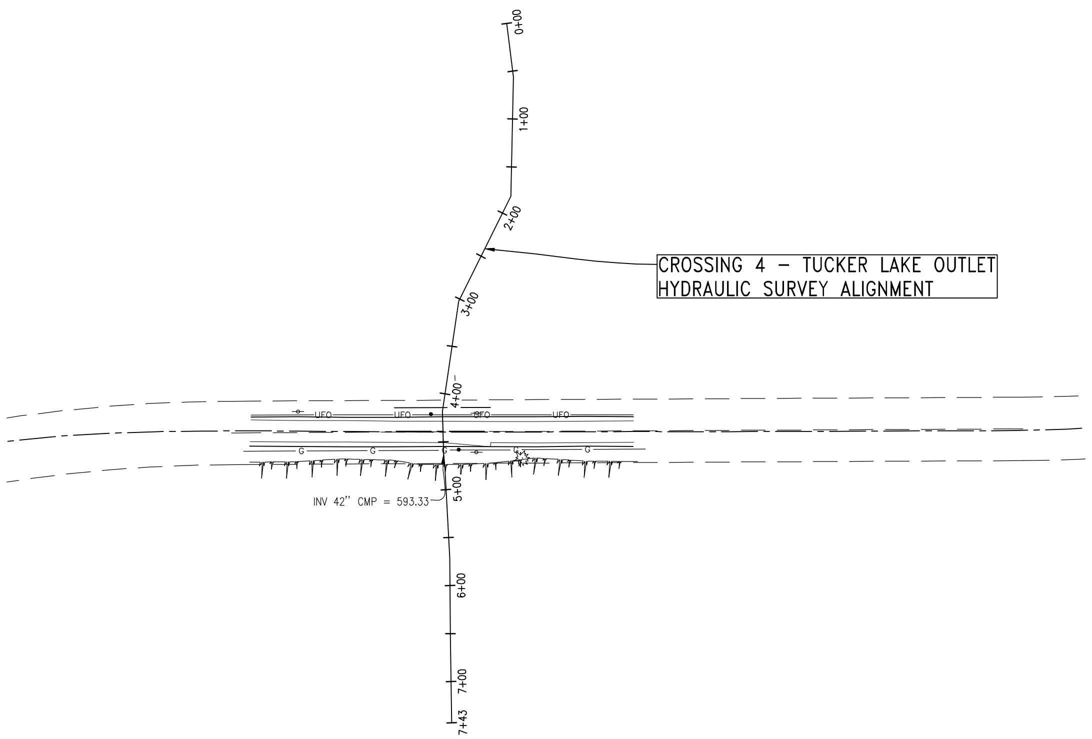
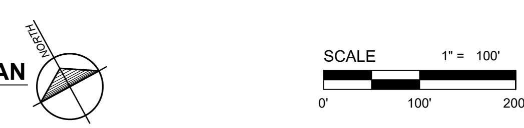
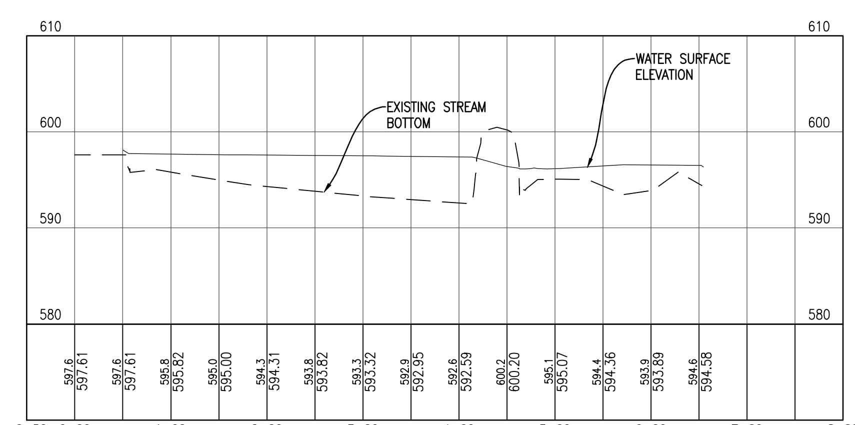


HYDRAULIC SURVEY PLAN

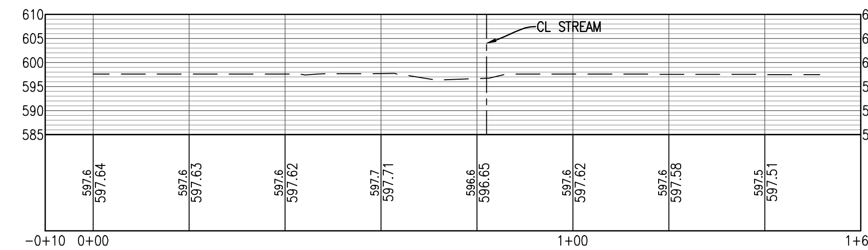
SCALE : 1" = 100'





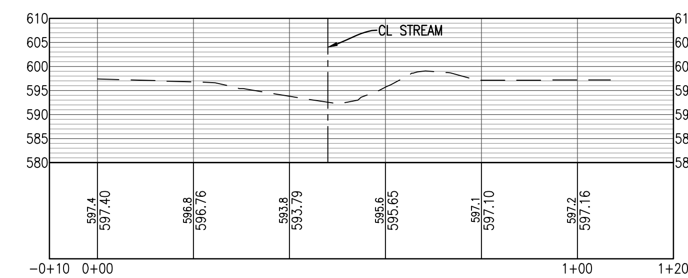
Tucker Creek Profile

SCALE HORIZ. 1" = 100'
VERT. 1" = 10'



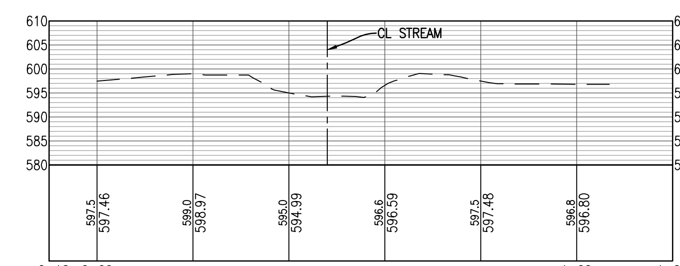
Crossing 4 Upstream Cross Section 02+29

SCALE 1" = 20'



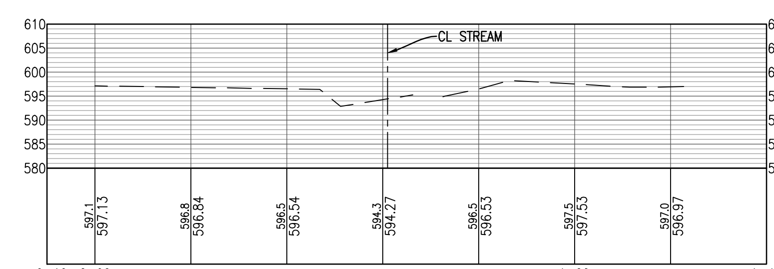
Crossing 4 Upstream Cross Section 05+82

SCALE 1" = 20'



Crossing 4 Downstream Cross Section 06+48

SCALE 1" = 20'



Crossing 4 Downstream Cross Section 08+27

SCALE 1" = 20'

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GENERAL PLAN OF SITE - CROSSING 4
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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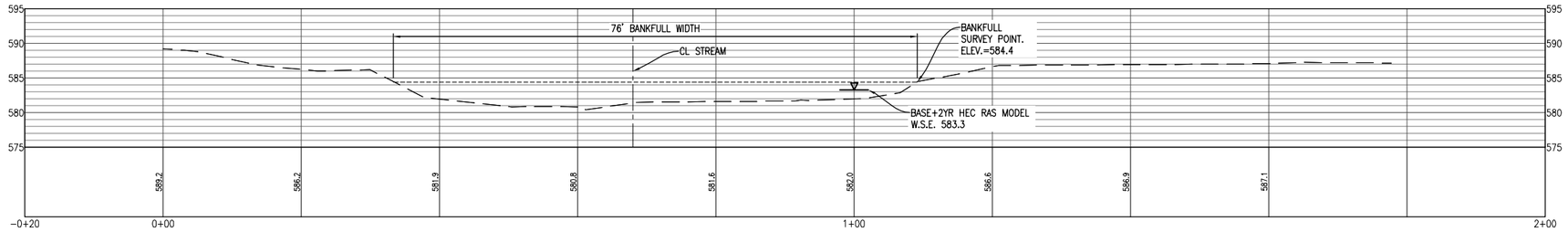
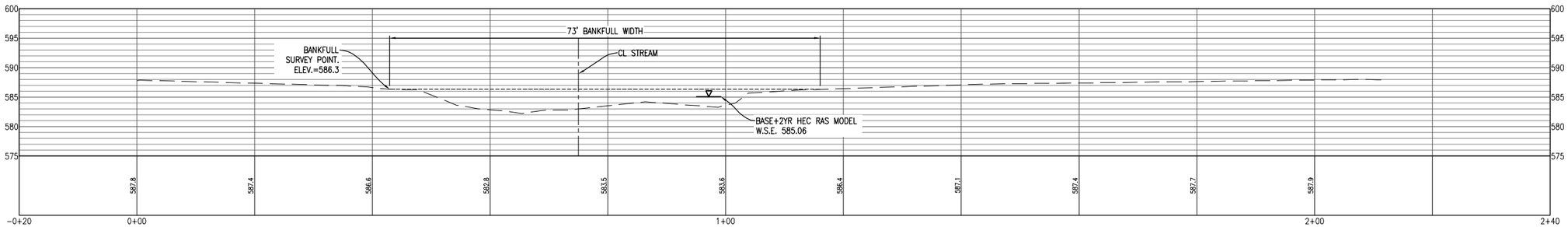


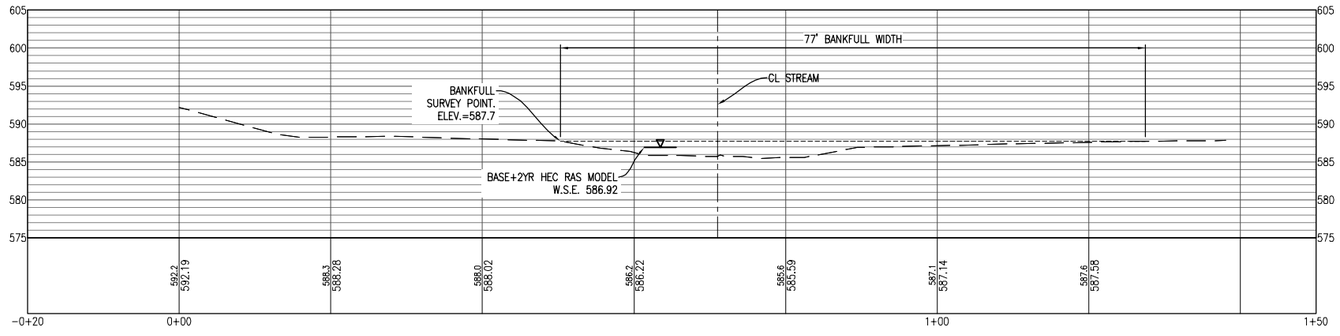
Crossing 1 Representative Design Cross Section Station 20+27

SCALE 1" = 10'



Crossing 2 Representive Design Cross Section Station 12+08

SCALE 1" = 10'



Crossing 3 Representative Design Cross Section Station 16+87

SCALE 1" = 10'

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REPRESENTATIVE SECTIONS - CROSSINGS 1-3
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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Appendix 2

Preliminary Plans

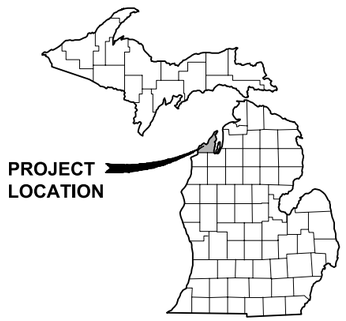
LEELANAU COUNTY ROAD COMMISSION

IN COOPERATION WITH THE

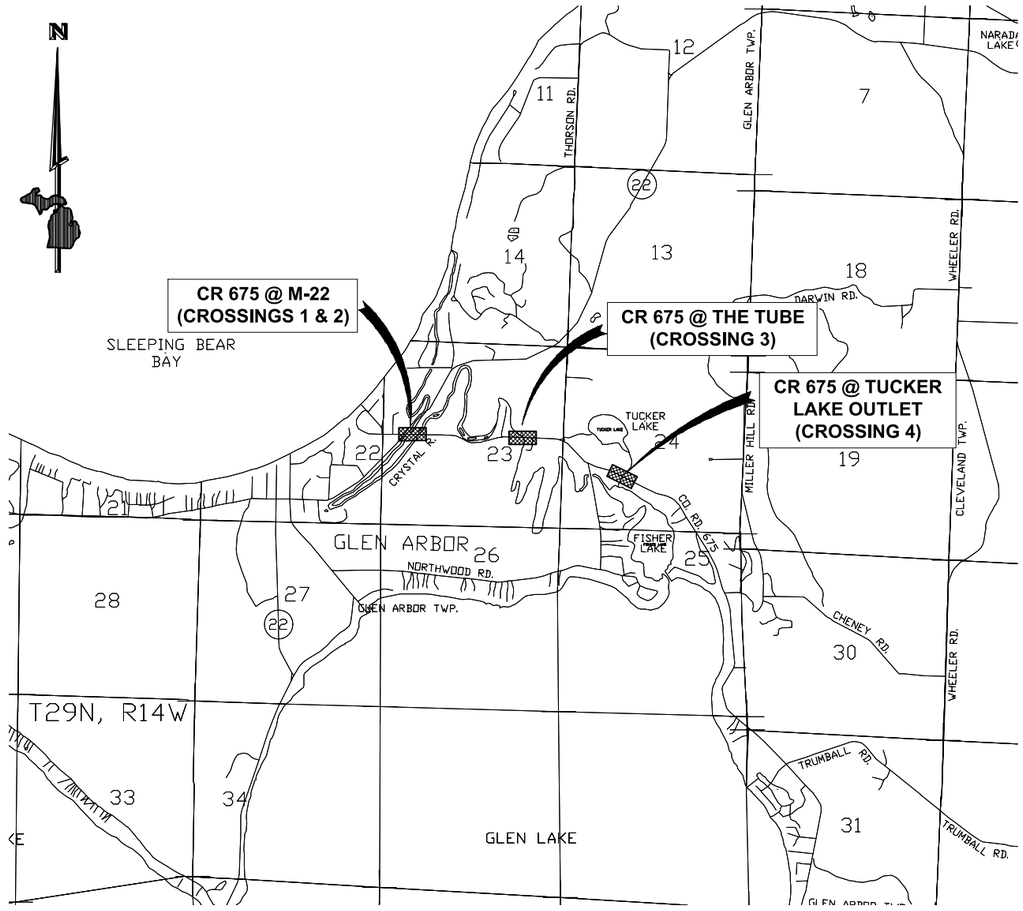
GRAND TRAVERSE BAND OF OTTAWA AND CHIPPEWA INDIANS

PROPOSED PLANS FOR

COUNTY ROAD 675 STREAM CROSSINGS PROJECTS



VICINITY MAP
SCALE



LOCATION MAP
NOT TO SCALE

PRELIMINARY
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CONSTRUCTION

CONTRACT FOR: _____

ROAD COMMISSION APPROVAL

_____ _____
MANAGING DIRECTOR DATE

PREPARED UNDER SUPERVISION OF

MARTIN A. GRAF — 43931
REGISTERED PROFESSIONAL ENGINEER — REGISTRATION NO.

GOSLING CZUBAK ENGINEERING SCIENCES, INC.
ORGANIZATION

1280 BUSINESS PARK DRIVE, TRAVERSE CITY, MICHIGAN 49686
ADDRESS

811
Know what's **below.**
Call before you dig.

ORIGINAL SHEET SIZE IS 22x34 - HALF SCALE SHEET IS 11x17

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CR 675 STREAM CROSSINGS PROJECTS

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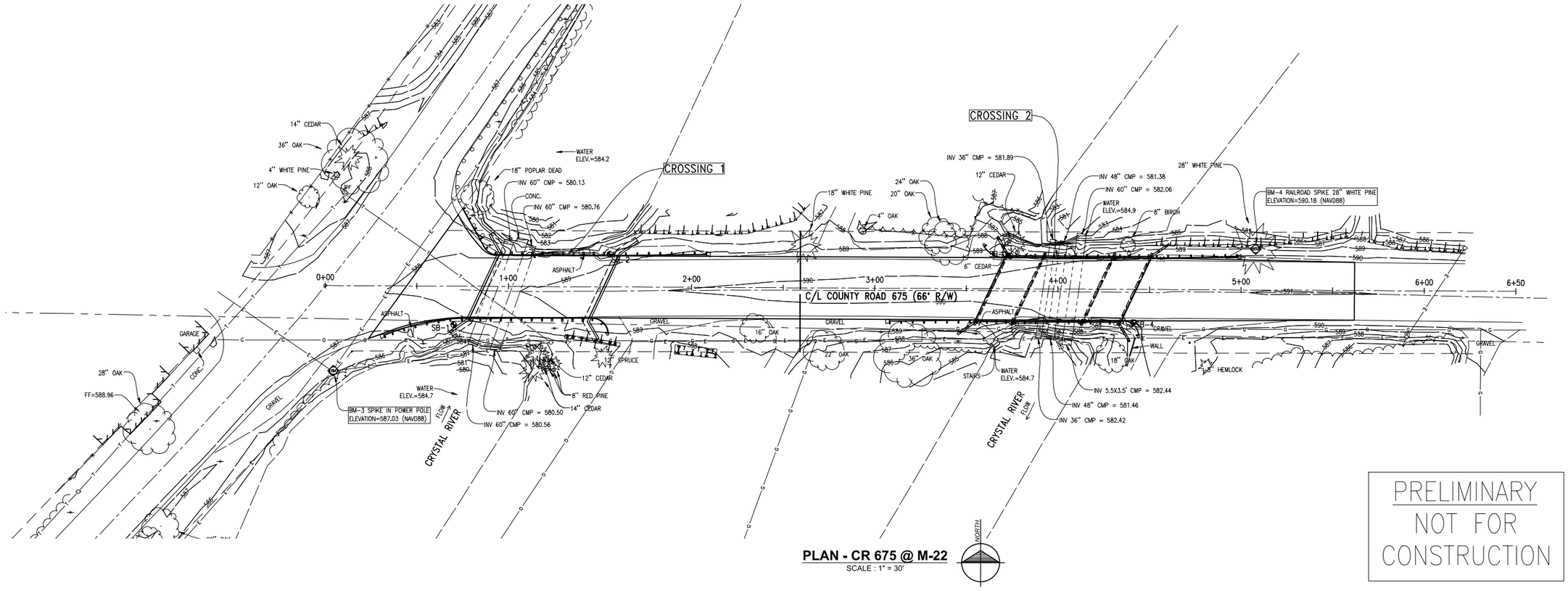

PLAN - CR 675 @ M-22
SCALE : 1" = 30'

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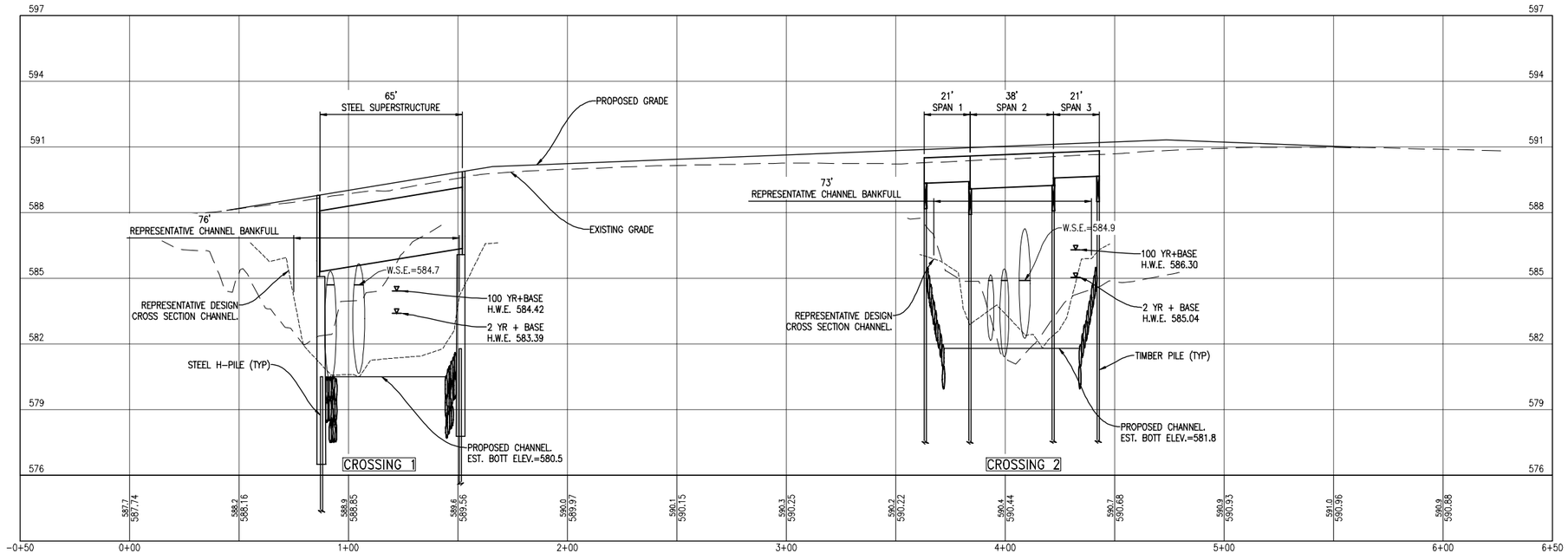

PROFILE - CR 675 @ M-22
SCALE HORIZ. 1" = 30'
VERT. 1" = 3'

SCALE 1" = 30'
0' 30' 60'

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GENERAL PLAN OF SITE - M-22 CROSSINGS 1 & 2
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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Project Number:
2020430002

Sheet:
C1

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-1

GROUND ELEVATION: **DATE:** 6/10/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 30
STATIC WATER LEVEL: ▽ 2.5 **CAVING DEPTH:** ▽ 2.5

SURFACE ELEV.=587.4

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS: Plastic Limit ⊢ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)
		Gravelly SAND (SP) - few cobbles - very loose - dark brown - wet below 3-ft bgs	0	SS1	6	4 2 2		Drove Rock			4
			5	SS2	2	1 2 1					3
		Fine to coarse SAND (SP) - little fine gravel - loose - brown	6	SS3	2	6 3 3					8
		Fine GRAVEL (GP) - little sand - loose - brown	9.5	SS4	10	6 4 3					7
		Fine to coarse SAND (SP) - occasonal gravel seams - medium dense - brown	10.5								
			15	SS5	18	12 10 17					27
			20	SS6	18	22 27 28					55
		Fine to medium SAND (SP) - little silt - trace coarse sand - medium dense - brown	24 25	SS7	18	11 10 17					27
		Boring terminated at 30 ft.	30	SS8	18	30 24 24					48

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-2

GROUND ELEVATION: **DATE:** 6/10/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 30
STATIC WATER LEVEL: ▽ 3 **CAVING DEPTH:** ▽ 3

SURFACE ELEV.=587.7

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS: Plastic Limit ⊢ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)
		TOPSOIL - sandy - black	0	SS1	10	2 1 1					2
		Fine to medium SAND (SP) - little silt - trace organics - very loose - dark brown	1	SS2	14	1 1 1					2
		Fine to coarse SAND (SP) - occasional gravelly sand seams - loose to very dense - brown - wet	3.5	SS3	18	2 2 1					3
			5	SS4	18	5 5 6					11
			10	SS5	18	13 16 28					44
			15	SS6	4	12 22 28					50
			20	SS7	18	8 8 14					22
		Fine to medium SAND (SP) - little silt - trace coarse sand - medium dense - brown	24 25	SS8	0	9 7 11					18
		Boring terminated at 30 ft.	30								

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-3

GROUND ELEVATION: **DATE:** 6/10/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 30
STATIC WATER LEVEL: ▽ 3 **CAVING DEPTH:** ▽ 3.5

SURFACE ELEV.=589.8

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS: Plastic Limit ⊢ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)
		ASPHALT PAVEMENT	0								
		ASPHALT SUB-BASE - Sand and Gravel - dark brown	0.25	SS1	6	5 2 2					4
		Fine to coarse SAND (SP) - occasional fine gravel - very loose - brown	1.5	SS2	8	2 2 3					4
		PEAT - very loose - black - wet	4 5	SS3	12	2 0 2					2
		Fine to coarse SAND (SP) - occasional fine gravel = occasional gravel seams - very lose to medium dense - brown	5.5	SS4	18	3 1 0					1
			10	SS5	18	6 5 10					15
			15	SS6	12	11 13 22					35
			20	SS7	18	10 8 8					14
		Fine to medium SAND (SP) - little silt - trace coarse sand - medium dense - brown	25	SS8	18	10 13 11					24
		Boring terminated at 30 ft.	30								

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-4

GROUND ELEVATION: **DATE:** 6/11/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 30
STATIC WATER LEVEL: ▽ 2.5 **CAVING DEPTH:** ▽ 3

SURFACE ELEV.=590.0

Elevation (feet)	Graphic	Soil Description (See Boring Log Key)	Depth (feet)	Sample Type	Sample No.	Recovery (in)	Blow Counts	Notes	Pocket Penetrometer (tsf)	% < #200	TEST RESULTS: Plastic Limit ⊢ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)
		Gravelly SAND (SP) - loose - dark brown - [FILL]	0	SS1	2	4 3 1		Drove Rock			3
		Fine to coarse SAND (SP) - occasonal gravelly seams - very loose to dense - brown - wet	3.5	SS2	10	1 2 1					3
			5	SS3	8	1 1 1					2
			10	SS4	18	2 1 2					3
			15	SS5	18	15 15 18					33
			20	SS6	2	12 15 24					39
		Fine to medium SAND (SP) - little silt - medium dense - light brown	24 25	SS7	16	6 7 9					16
		Boring terminated at 30 ft.	30	SS8	8	7 9 10					18

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SOIL BORINGS - CROSSINGS 1 & 2
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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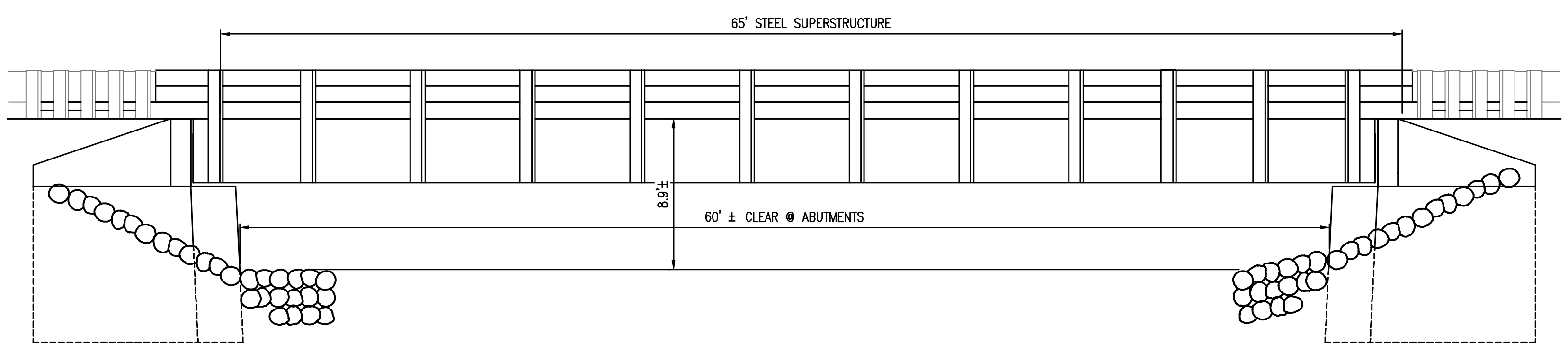
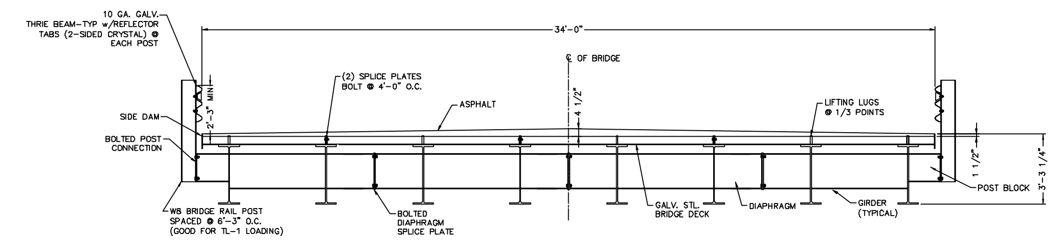
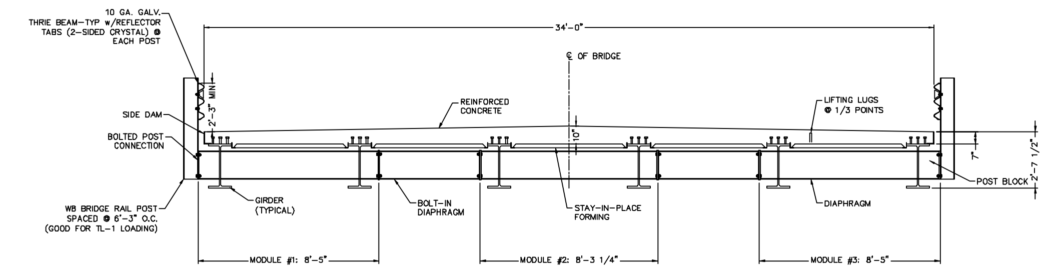


STRUCTURE ELEVATION

NO SCALE



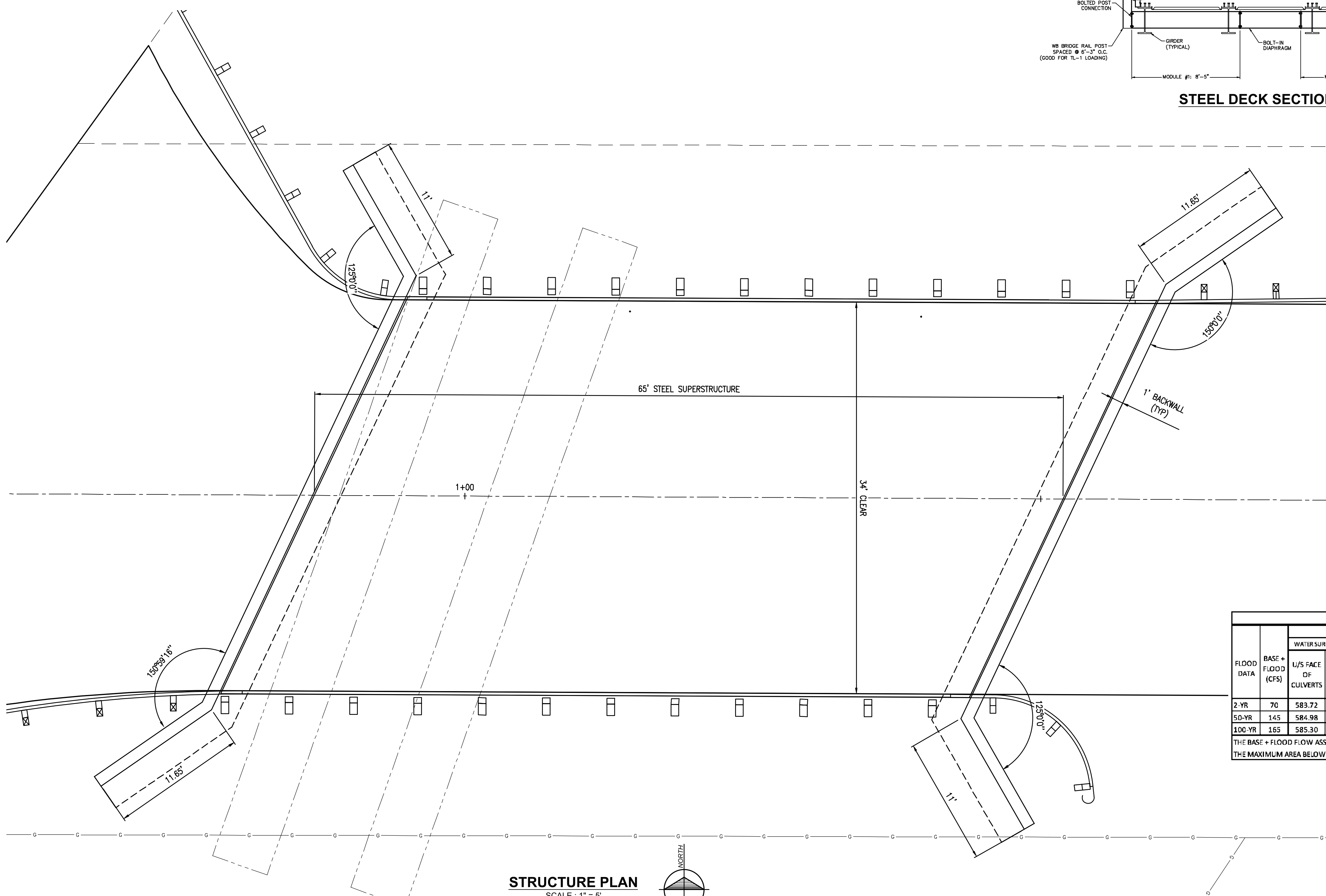
STEEL DECK SECTION - ASPHALT SURFACING OPTION



STEEL DECK SECTION - CONCRETE DECK OPTION

NOTES:

1. THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF THE SPAN LENGTH.



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SUMMARY OF HYDRAULIC ANALYSIS											
		EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
FLOOD DATA	BASE + FLOOD (CFS)	U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (200 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	583.72	583.38	0.5	1.1	583.39	583.39	0.5	0.5	154.8	-0.33
50-YR	145	584.98	584.21	0.6	1.9	584.24	584.23	0.8	0.7	200.8	-0.74
100-YR	165	585.30	584.39	0.7	2.0	584.42	584.41	0.9	0.8	211.2	-0.88

THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED.

THE MAXIMUM AREA BELOW LOW CHORD IS 335.8 SQUARE FEET.

STRUCTURE PLAN

SCALE : 1" = 5'

SCALE 1" = 5'
0' 5' 10'

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GENERAL PLAN OF STRUCTURE - CROSSING 1
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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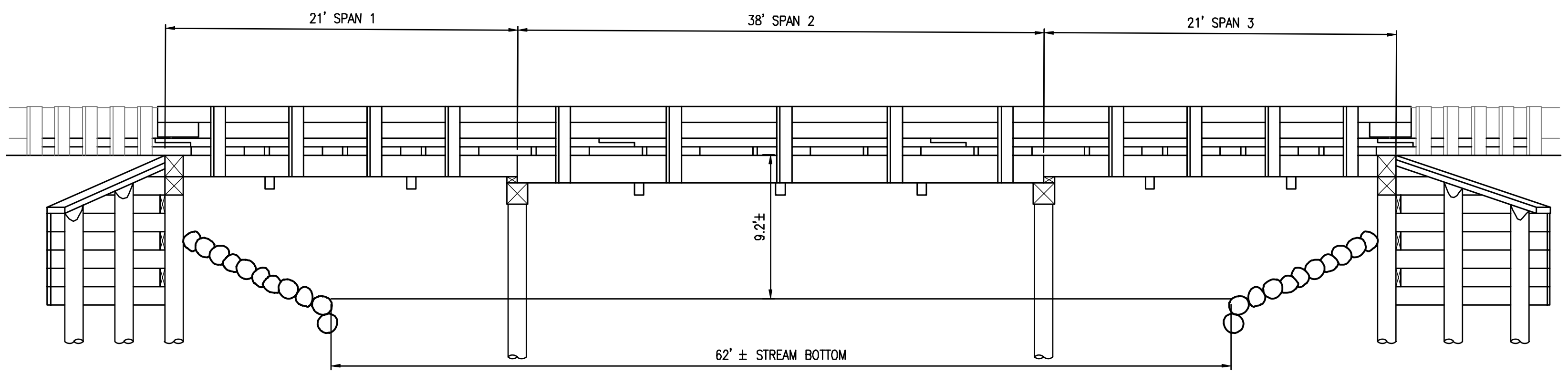
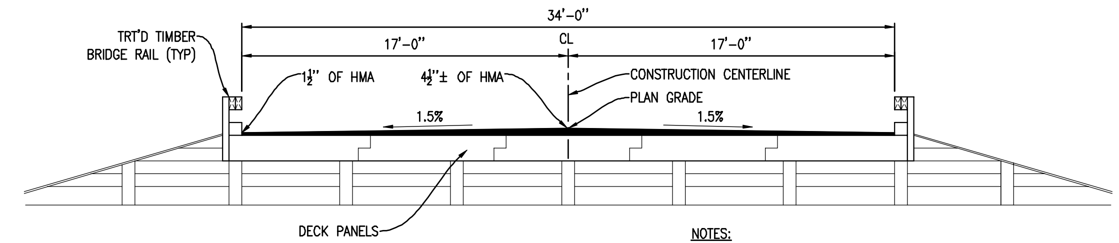


STRUCTURE ELEVATION
NO SCALE

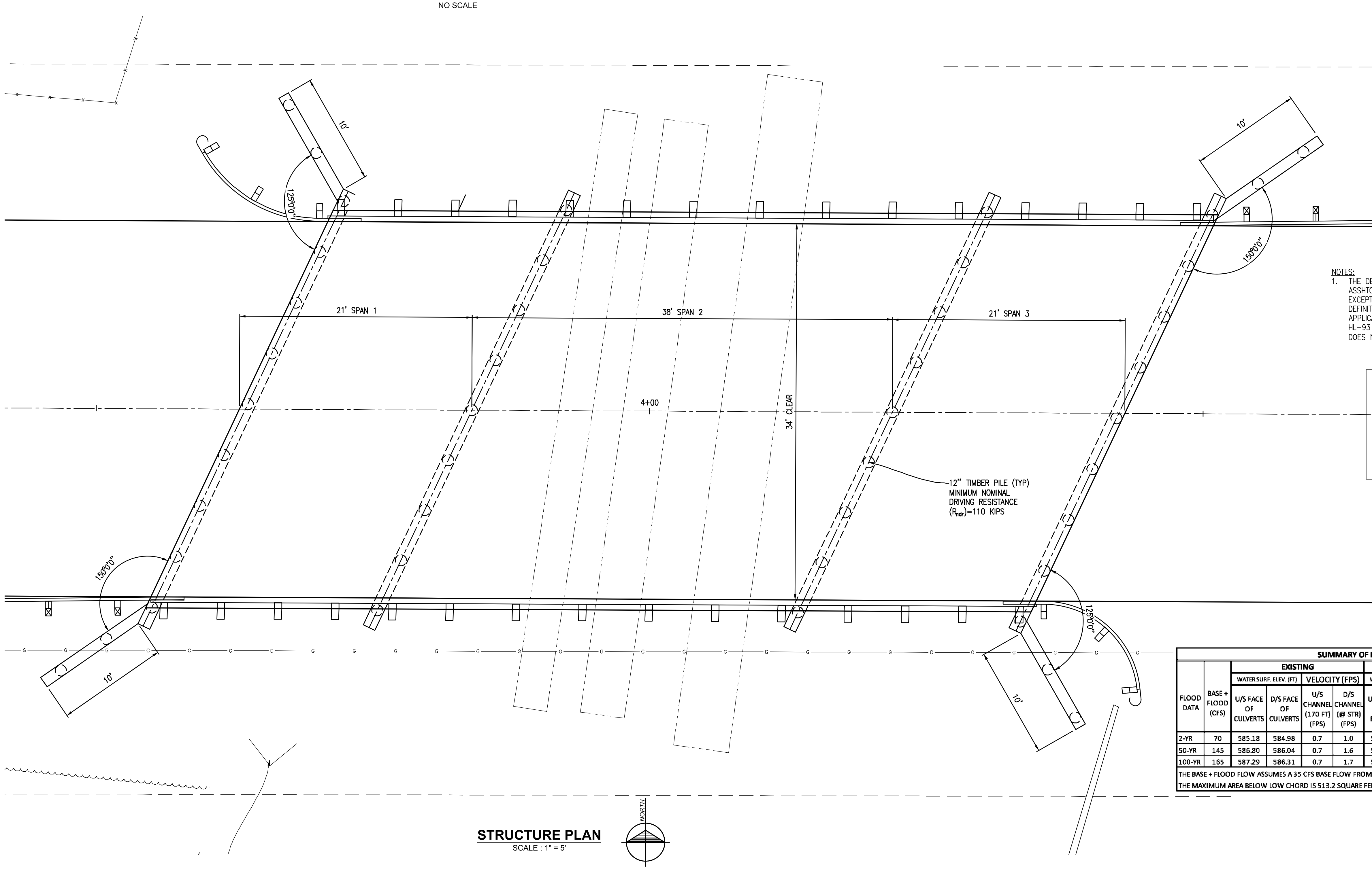


NOTES:
SEE TYPICAL APPROACH SECTION FOR HMA TYPE

CONSTRUCT CROWN ACROSS BRIDGE DECK BY WEDGING BASE LAYER.

TRANSITION FROM 2% APPROACH CROSS-SLOPE TO 1.5% DECK CROSS-SLOPE IN 25' LENGTH OF APPROACH AT EACH END OF BRIDGE.

TYPICAL DECK SECTION



STRUCTURE PLAN
SCALE : 1" = 5'

NOTES:
1. THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT AASHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF THE SPAN LENGTH.

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SUMMARY OF HYDRAULIC ANALYSIS

FLOOD DATA	BASE + FLOOD (CFS)	EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)			
		U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YR	70	585.18	584.98	0.7	1.0	585.04	584.96	0.6	0.5	188.3	-0.14
50-YR	145	586.80	586.04	0.7	1.6	586.08	585.89	0.9	0.8	250.6	-0.72
100-YR	165	587.29	586.31	0.7	1.7	586.30	586.10	0.9	0.9	265.0	-0.99

THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED.
THE MAXIMUM AREA BELOW LOW CHORD IS 513.2 SQUARE FEET.

SCALE 1" = 5'
0' 5' 10'

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1	12-22-2020	CROSSINGS 1, 2, & 3 REVISIONS	RMV

GENERAL PLAN OF STRUCTURE - CROSSING 2
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

Date Issued: ----
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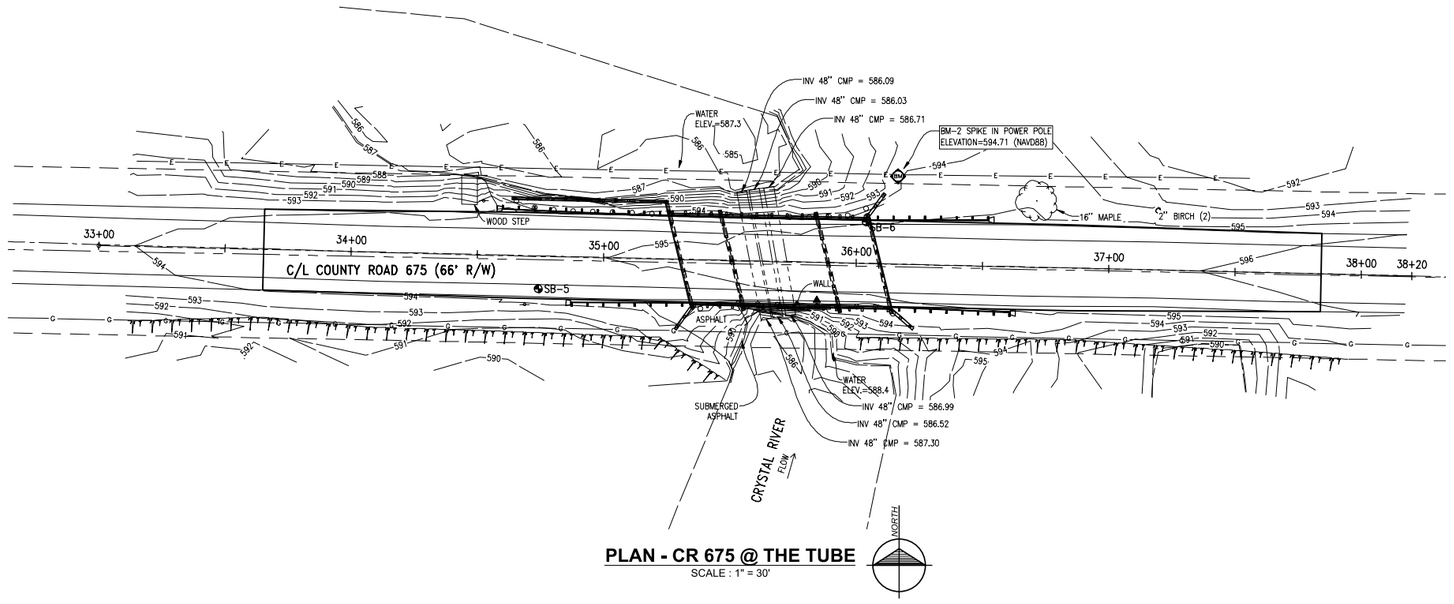
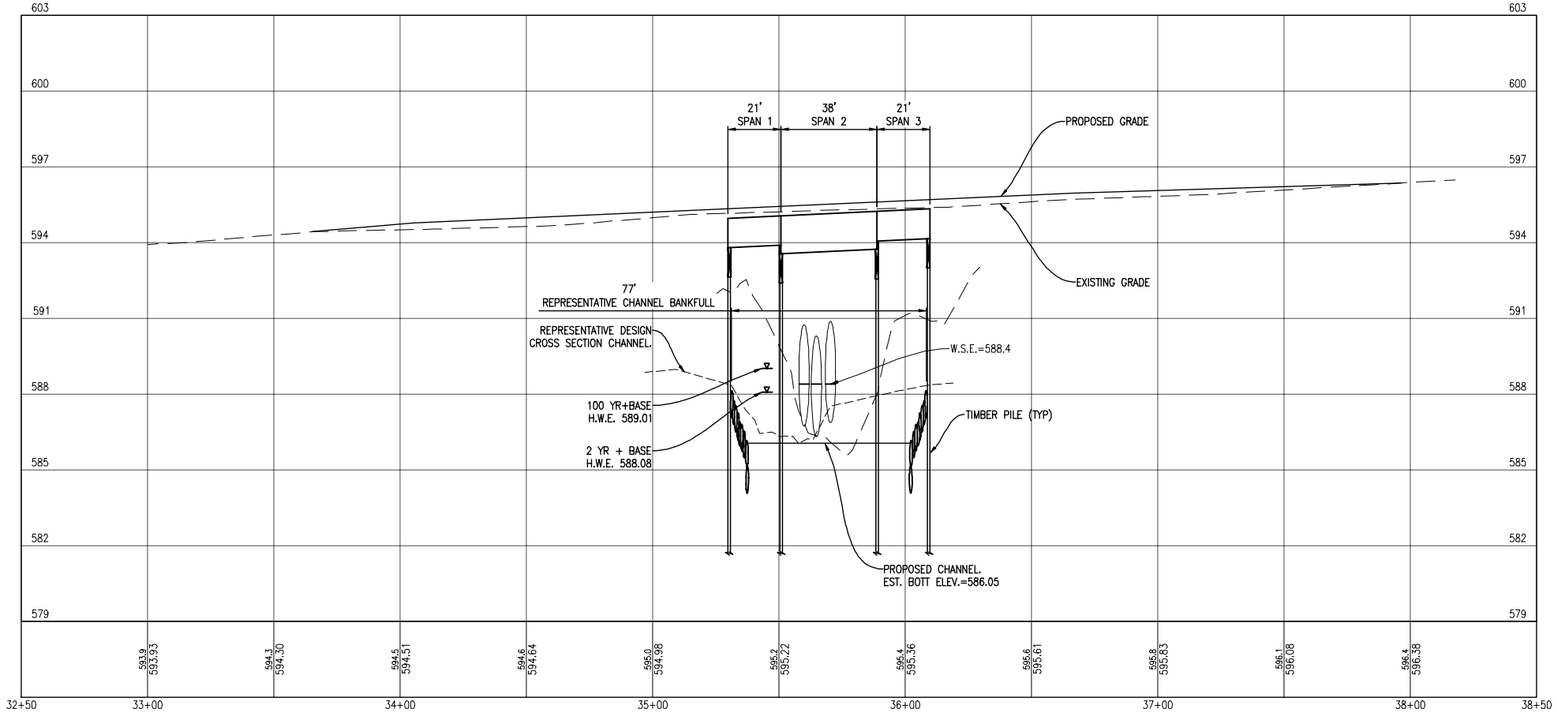


PLAN - CR 675 @ THE TUBE

SCALE : 1" = 30'



PROFILE - CR 675 @ The Tube

SCALE HORIZ. 1" = 30'
VERT. 1" = 3'

SCALE 1" = 30'
0' 30' 60'

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GENERAL PLAN OF SITE - CROSSING 3
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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LOG OF BORING: SB-5

SURFACE ELEV.=594.4

PROJECT: County Road 675 Culvert Replacement		**GROUND ELEVATION:**	**DATE:** 6/11/2020
PROJECT NO.: 2020430002.02		**DRILLING LOCATION:** Glen Arbor, Michigan	
PROJECT LOCATION: Glen Arbor, Michigan		**DRILLING METHOD:** 4.25" (ID) Hollow-Stem Auger	
CLIENT: Leelanau County Road Commission		**BOREHOLE DIAMETER (IN):** +/- 10"	**TOTAL DEPTH (FT):** 30
DRILLING COMPANY: Gosling Czubak	**RIG:** CME-75	**STATIC WATER LEVEL:** 4	**CAVING DEPTH:** 4
DRILLER: M. Allen	**LOGGED BY:** M. Korndorfer		

Columns: Elevation (feet) · Graphic · Soil Description (See Boring Log Key) · Depth (feet) · Sample Type · Sample No. · Recovery (in) · Blow Counts · Notes · Pocket Penetrometer (tsf) · % < #200 · TEST RESULTS (Plastic Limit ├─┤ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value; 10 20 30 40 50)

Depth (ft)	Soil Description
0	Gravelly SAND (SP) - medium dense - dark brown - [FILL]
2.5	Fine to medium SAND (SP) - little gravel - litle silt - medium dense - dark brown - wet below 5-ft bgs
7	Gravelly fine to medium SAND (SP) - trace silt - medium dense - brown
13	Fine to medium SAND (SP) - little gravel - trace silt - very dense - brown
16	Silty fine to medium SAND (SM) - occasional gravel - medium dense - light brown
30	Boring terminated at 30 ft.

Sample No.	Recovery (in)	Blow Counts	N Value
SS1	10	5, 4, 5	9
SS2	10	2, 5, 6	11
SS3	10	7, 5, 7	12
SS4	12	6, 7, 10	17
SS5	10	21, 23, 30	53
SS6	18	4, 13, 14	27
SS7	10	12, 10, 17	27
SS8	18	14, 11, 4	15

LOG OF BORING: SB-6

SURFACE ELEV.=594.9

PROJECT: County Road 675 Culvert Replacement		**GROUND ELEVATION:**	**DATE:** 6/11/2020
PROJECT NO.: 2020430002.02		**DRILLING LOCATION:** Glen Arbor, Michigan	
PROJECT LOCATION: Glen Arbor, Michigan		**DRILLING METHOD:** 4.25" (ID) Hollow-Stem Auger	
CLIENT: Leelanau County Road Commission		**BOREHOLE DIAMETER (IN):** +/- 10"	**TOTAL DEPTH (FT):** 30
DRILLING COMPANY: Gosling Czubak	**RIG:** CME-75	**STATIC WATER LEVEL:** 4.5	**CAVING DEPTH:** 4.5
DRILLER: M. Allen	**LOGGED BY:** M. Korndorfer		

Columns: Elevation (feet) · Graphic · Soil Description (See Boring Log Key) · Depth (feet) · Sample Type · Sample No. · Recovery (in) · Blow Counts · Notes · Pocket Penetrometer (tsf) · % < #200 · TEST RESULTS (Plastic Limit ├─┤ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value; 10 20 30 40 50)

Depth (ft)	Soil Description
0	Gravelly SAND (SP) - loose - dark brown
4	Fine to medium SAND (SP) - trace coarse sand - very loose - brown - wet below 4. 75-ft bgs
5.5	Fine to coarse SAND (SP) - little fine gravel - loose - brown
9	Gravelly SAND (SP) - medium dense - brown
14	Silty fine SAND (SM) - medium dense - light brown
18	Coarse SAND (SP) - little fine gravel - loose - brown
22.5	GRAVEL (GP) - little sand - medium dense - brown
23.5	Gravelly fine to coarse SAND (SP) - medium dense - grayish brown
29	Silty fine SAND (SM) - medium dense - light brown
30	Boring terminated at 30 ft.

Sample No.	Recovery (in)	Blow Counts	Notes	N Value
SS1	0	7, 11, 4	Drove Rock	15
SS2	10	2, 2, 2		4
SS3	18	2, 1, 0		1
SS4	18	1, 1, 6		7
SS5	18	10, 10, 14		24
SS6	4	8, 5, 4		9
SS7	18	24, 12, 14		26
SS8	18	20, 20, 8		28

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SOIL BORINGS - CROSSING 3
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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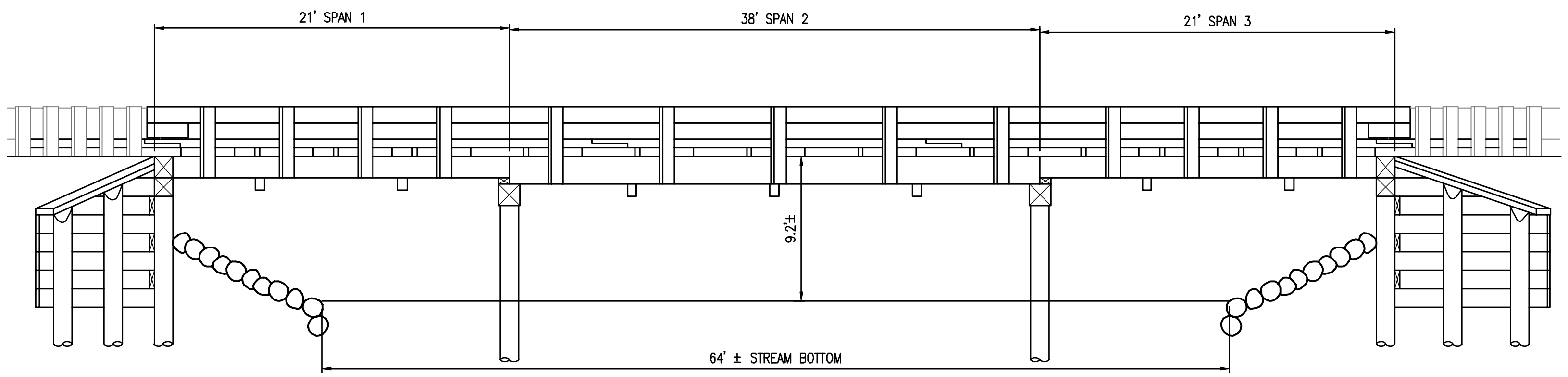
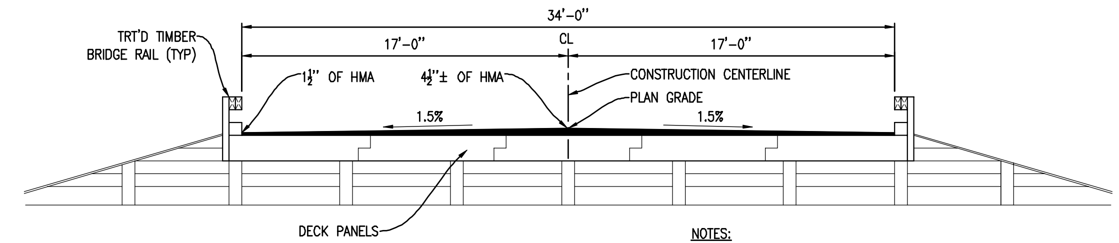


STRUCTURE ELEVATION

NO SCALE

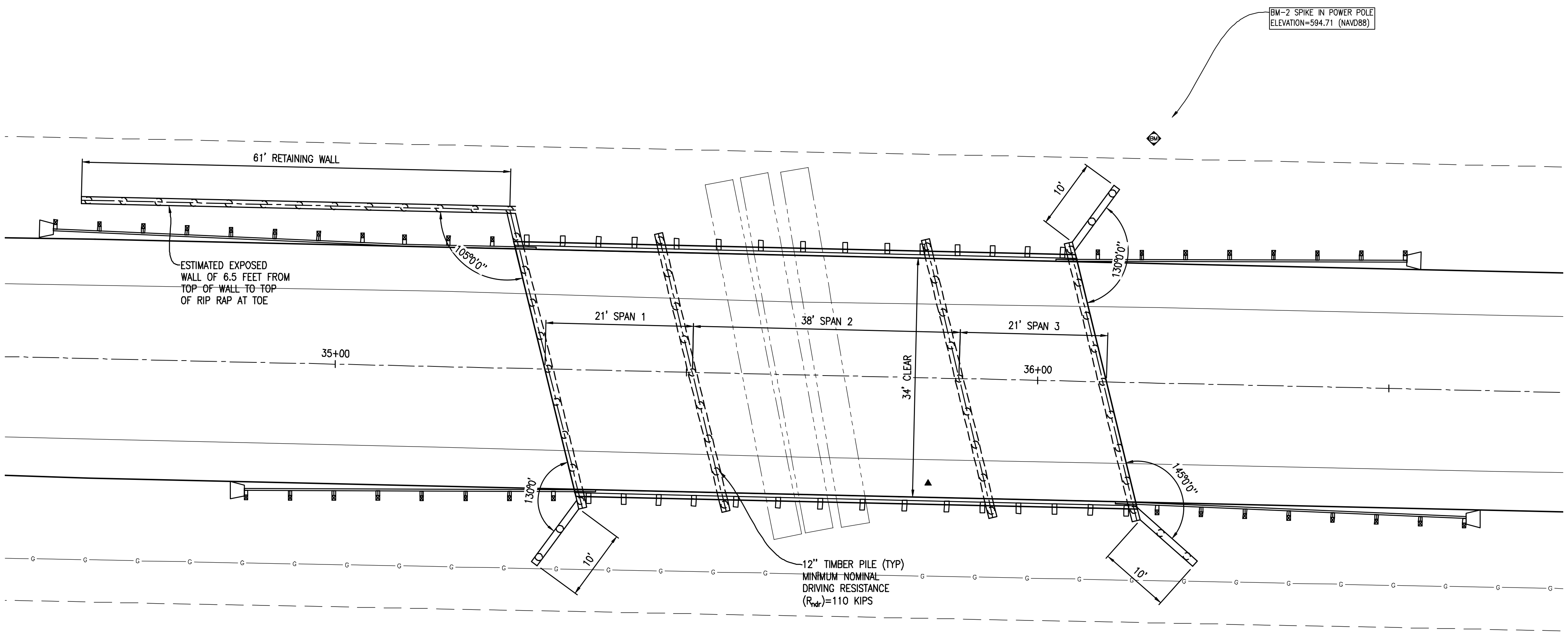


NOTES:
SEE TYPICAL APPROACH SECTION FOR HMA TYPE

CONSTRUCT CROWN ACROSS BRIDGE DECK BY WEDGING BASE LAYER.

TRANSITION FROM 2% APPROACH CROSS-SLOPE TO 1.5% DECK CROSS-SLOPE IN 25' LENGTH OF APPROACH AT EACH END OF BRIDGE.

TYPICAL DECK SECTION



NOTES:
1. THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT ASSHTO LRFD BRIDGE SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF THE SPAN LENGTH.

PRELIMINARY
NOT FOR
CONSTRUCTION

SUMMARY OF HYDRAULIC ANALYSIS

FLOOD DATA	BASE + FLOOD (CFS)	EXISTING				PROPOSED					
		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATER SURF. ELEV. (FT)		VELOCITY (FPS)		WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
		U/S FACE OF CULVERTS	D/S FACE OF CULVERTS	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)	U/S FACE OF BRIDGE	D/S FACE OF BRIDGE	U/S CHANNEL (170 FT) (FPS)	D/S CHANNEL (@ STR) (FPS)		
2-YR	70	589.25	587.22	0.6	2.8	588.08	587.25	1.3	1.3	79.2	-1.17
50-YR	145	590.42	587.86	0.8	4.2	588.84	587.94	2.0	1.9	126.8	-1.58
100-YR	165	590.70	588.01	0.8	4.4	589.01	588.10	2.1	2.0	138.2	-1.69

THE BASE + FLOOD FLOW ASSUMES A 35 CFS BASE FLOW FROM WATERSHED.
THE MAXIMUM AREA BELOW LOW CHORD IS 556.0 SQUARE FEET.

STRUCTURE PLAN

SCALE : 1" = 10'

NORTH

SCALE 1" = 10'
0' 10' 20'

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GENERAL PLAN OF STRUCTURE - CROSSING 3
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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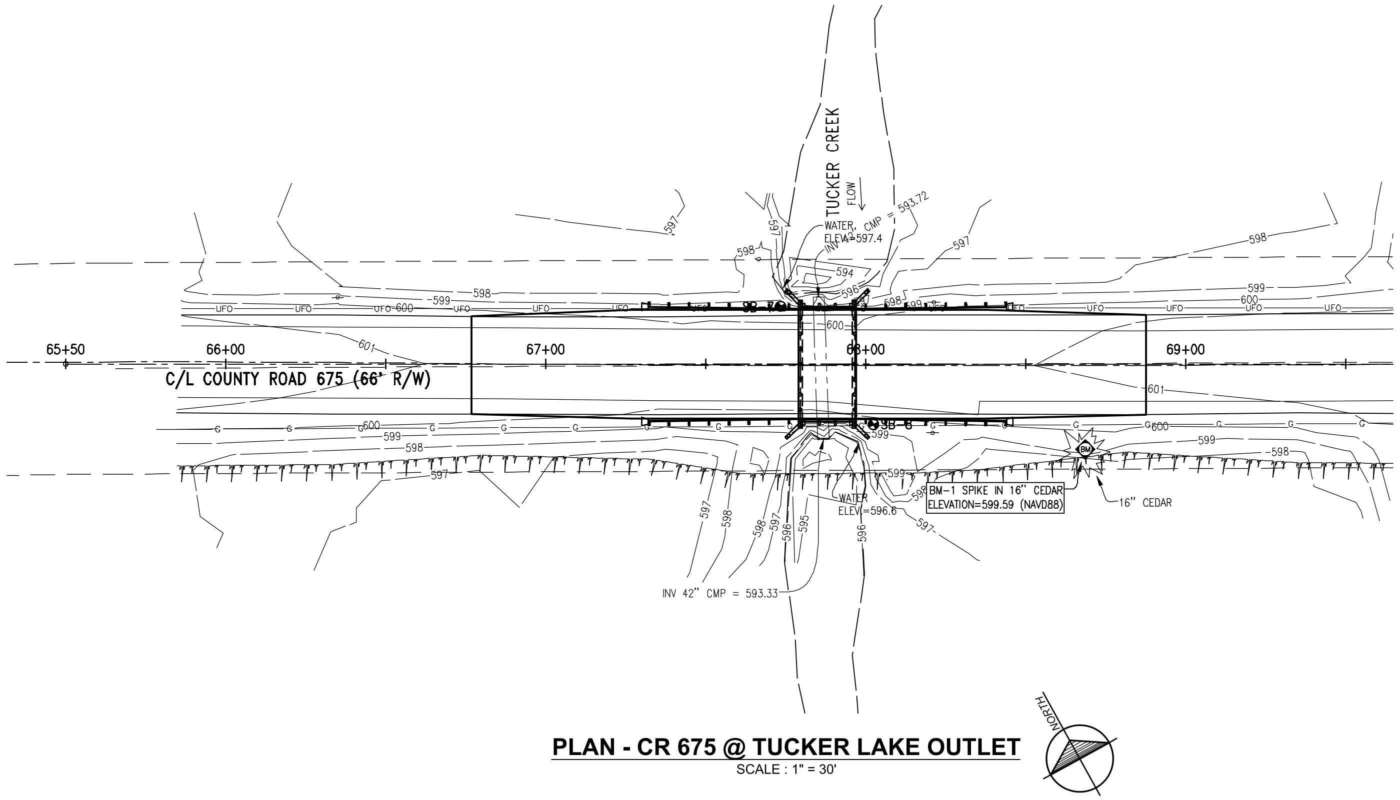
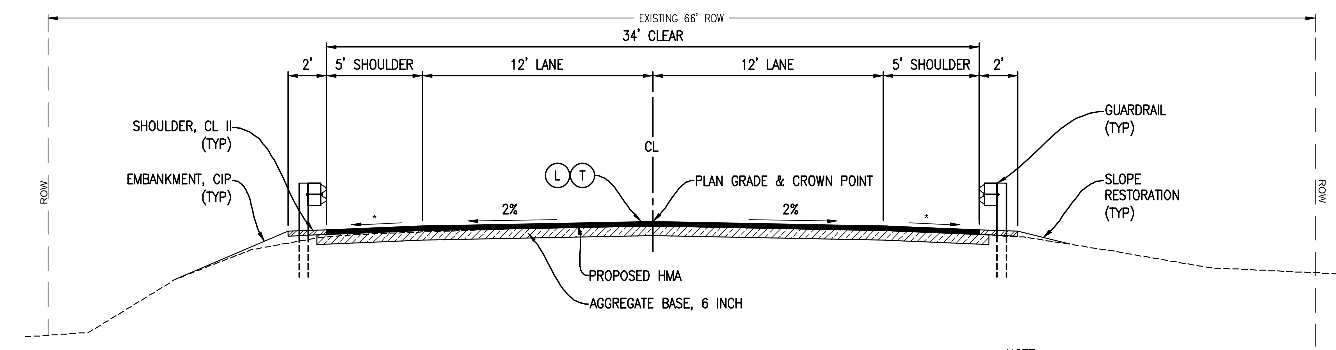


PLAN - CR 675 @ TUCKER LAKE OUTLET

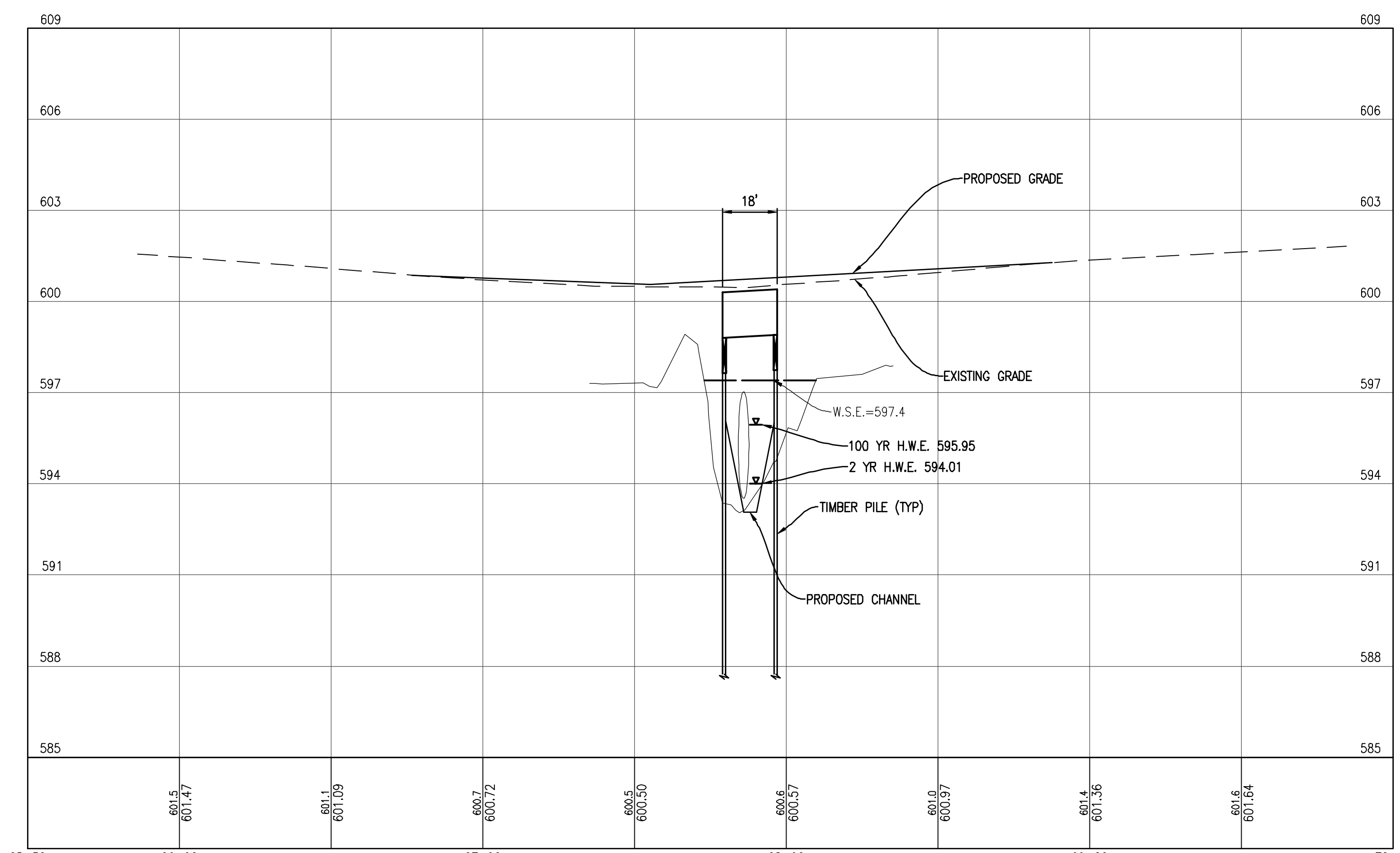
SCALE : 1" = 30'



NOTE:
SLOPE RESTORATION TO INCLUDE: TOPSOIL, SEED, FERTILIZER, MULCH, AND BIODEGRADABLE JUTE NETTING BLANKET.

TYPICAL APPROACH SECTION

(ALL CROSSINGS)



PROFILE - CR 675 @ Tucker Lake Outlet

SCALE HORIZ. 1" = 30'
VERT. 1" = 3'

SCALE 1" = 30'
0' 30' 60'

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GENERAL PLAN OF SITE - CROSSING 4
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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2020430002

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SURFACE
ELEV.=600.0

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-7

GROUND ELEVATION: **DATE:** 6/11/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 35
STATIC WATER LEVEL: 3 **CAVING DEPTH:** 10

TEST RESULTS: Plastic Limit ├─┤ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)

Soil Description (See Boring Log Key)	Depth (feet)
ASPHALT PAVEMENT	0–0.5
SUB-BASE - gravelly sand - medium dense - brown	0.5–2
Silty fine SAND (SP) - medium dense - dark brown	2–2.5
PEAT - very loose - black - wet	2.5–8
Clayey silty fine SAND (SM/SC) - very loose- gray	8–9.5
Silty fine SAND (SM) - loose - light brown	9.5–12
Silty fine to medium SAND (SM) - trace coarse sand - occasional clayey seams - occasional fine gravel seams - loose - ligh brown	12–34
Fine to medium SAND (SP) - little gravel - little silt - dense - light brown	34–35
Boring terminated at 35 ft.	

Sample No.	Recovery (in)	Blow Counts	Notes	SPT N Value
SS1	14	7 7 5		12
SS2	10	4 2 4		6
SS3	0	5 2 2		4
SS4	18	2 0 1		1
SS5	18	6 4 3		7
SS6	18	4 2 5		7
SS7	18	11 4 2		6
SS8	18	11 3 2		5
SS9	18	12 13 25		38

SURFACE
ELEV.=600.2

PROJECT: County Road 675 Culvert Replacement
PROJECT NO.: 2020430002.02
PROJECT LOCATION: Glen Arbor, Michigan
CLIENT: Leelanau County Road Commission
DRILLING COMPANY: Gosling Czubak **RIG:** CME-75
DRILLER: M. Allen **LOGGED BY:** M. Korndorfer

LOG OF BORING: SB-8

GROUND ELEVATION: **DATE:** 6/11/2020
DRILLING LOCATION: Glen Arbor, Michigan
DRILLING METHOD: 4.25" (ID) Hollow-Stem Auger
BOREHOLE DIAMETER (IN): +/- 10" **TOTAL DEPTH (FT):** 30
STATIC WATER LEVEL: 3 **CAVING DEPTH:** 9

TEST RESULTS: Plastic Limit ├─┤ Liquid Limit; Water Content - × %; SPT RESULT - ▲ N Value (10 20 30 40 50)

Soil Description (See Boring Log Key)	Depth (feet)
ASPHALT PAVEMENT	0–0.5
SUB-BASE - gravelly sand - dense - brown	0.5–3
PEAT - loose - black - wet	3–6
Fine to medium SAND (SP) - trace coarse sand - trace fine gravel - medium dense - brown	6–9
Silty fine SAND (SM) - little clay - loose - light brown	9–14
Silty fine SAND (SM) - occasional clayey seams - loose - light brown	14–19
SILT (ML) - little fine sand - medium dense - light brown	19–22
Fine to medium SAND (SP) - trace coarse sand - medium dense - light brown	22–24.5
Silty fine SAND (SM) - medium dense - light brown	24.5–26
Fine to medium SAND (SP) - trace coarse sand - loose - light brown	26–29
Silty fine SAND (SM) - loose - light brown	29–30
Boring terminated at 30 ft.	

Sample No.	Recovery (in)	Blow Counts	Notes	SPT N Value
SS1	0	17 20 17	Drove Rock	37
SS2	16	3 2 2		4
SS3	10	4 12 6		18
SS4	18	3 1 1		2
SS5	18	6 3 6		9
SS6	18	3 3 9		12
SS7	18	11 12 12		24
SS8	18	3 3 3		6

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SOIL BORINGS - CROSSING 4
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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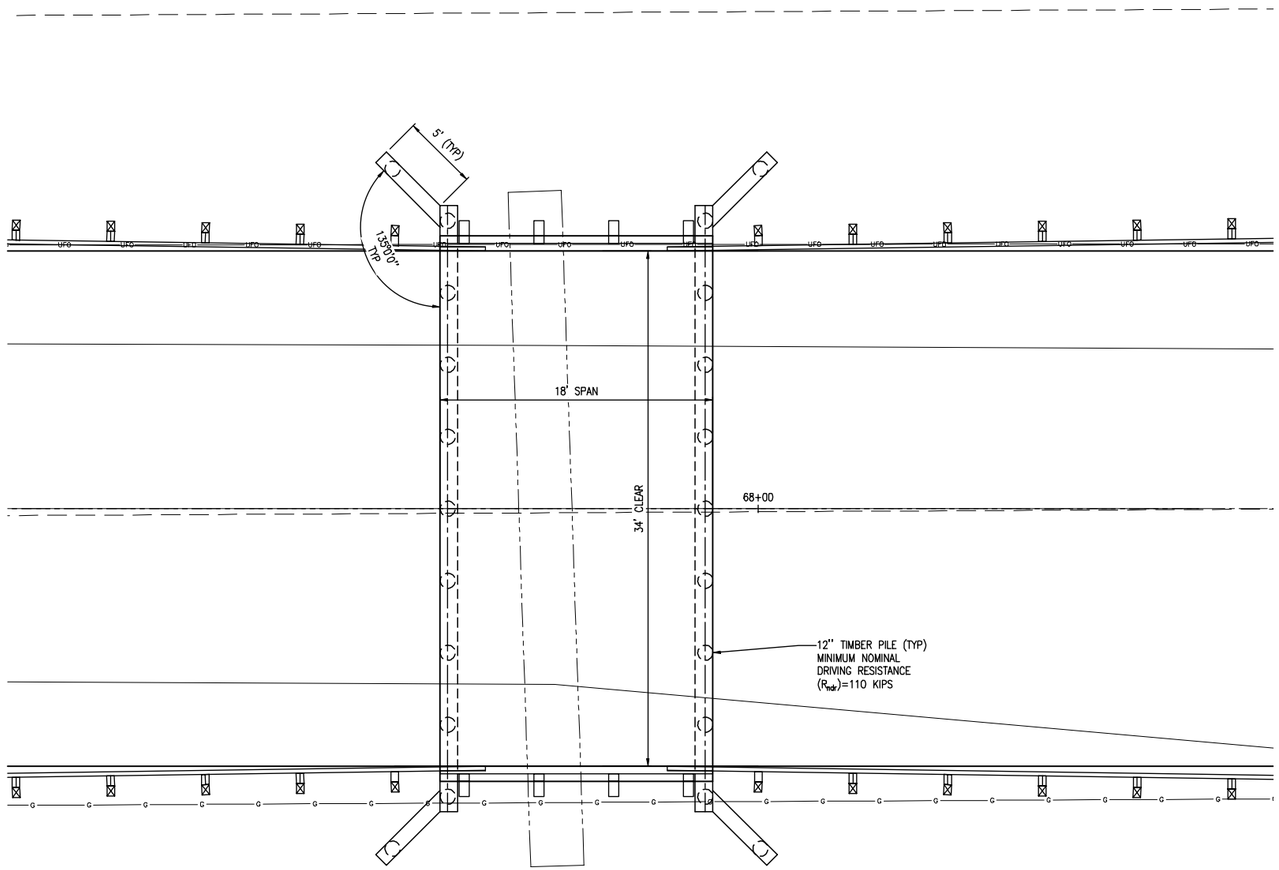
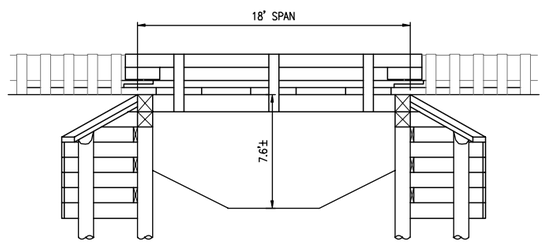


STRUCTURE PLAN
SCALE : 1" = 5'



STRUCTURE ELEVATION
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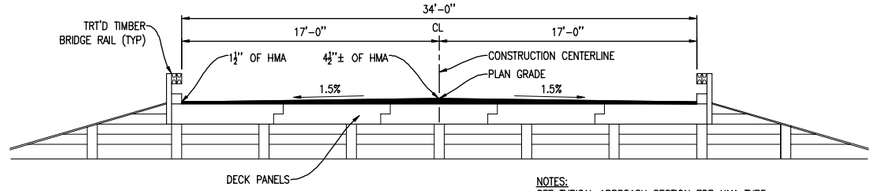

NOTES:
SEE TYPICAL APPROACH SECTION FOR HMA TYPE

CONSTRUCT CROWN ACROSS BRIDGE DECK BY WEDGING BASE LAYER.

TRANSITION FROM 2% APPROACH CROSS-SLOPE TO 1.5% DECK CROSS-SLOPE IN 25' LENGTH OF APPROACH AT EACH END OF BRIDGE.

TYPICAL DECK SECTION

NOTES:
1. THE DESIGN OF THIS STRUCTURE IS BASED ON 1.2 TIMES THE CURRENT ASSHTO LRFD BRIDGE DESIGN SPECIFICATION HL-93 LOADING WITH THE EXCEPTION THAT THE DESIGN TANDEM PORTION OF THE HL-93 LOAD DEFINITION SHALL BE REPLACED BY A SINGLE 60 KIP AXLE LOAD BEFORE APPLICATION OF THIS 1.2 FACTOR. THE RESULTING LOAD IS DESIGNATED HL-93 MOD. LIVE LOAD PLUS DYNAMIC LOAD ALLOWANCE DEFLECTION DOES NOT EXCEED 1/800 OF THE SPAN LENGTH.

SUMMARY OF HYDRAULIC ANALYSIS							
		EXISTING		PROPOSED			
FLOOD DATA	DISCHARGE (CFS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY IN D/S CHANNEL (FPS)	WATER SURFACE ELEV. AT U/S FACE OF STRUCTURE (FT)	VELOCITY IN D/S CHANNEL (FPS)	WATERWAY AREA (SFT) AT D/S FACE	CHANGE IN WS ELEV. U/S OF PROPOSED STRUCTURE (FT)
2-YEAR	1	594.19	0.2	594.01	0.1	6.1	-0.18
50-YEAR	35	596.74	2.2	595.44	0.9	21.7	-1.30
100-YEAR	60	598.00	2.8	595.95	1.3	29.5	-2.05

THE CONTRIBUTING DRAINAGE AREA TO THIS CROSSING IS 2.5 SQUARE MILES.

THE MAXIMUM AREA BELOW LOW CHORD IS 71.2 SQUARE FEET.

THE WATER SURFACE AND/OR ENERGY GRADE ELEVATIONS SHOWN ON THIS HYDRAULIC TABLE AR TO BE USED FOR COMPARISON PURPOSES ONLY AND ARE NOT TO BE USED FOR ESTABLISHING A REGULATORY FLOOD PLAIN.

PRELIMINARY
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SCALE 1" = 5'
0' 5' 10'

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GENERAL PLAN OF STRUCTURE - CROSSING 4
CR 675 STREAM CROSSINGS PROJECTS
LEELANAU COUNTY ROAD COMMISSION

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Appendix 3

Preliminary Cost Estimates

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: August 17, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 1
Opinion of Probable Cost - Timber Structure - 60 ft Span

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$26,000.00	$26,000.00
2		Traffic Control	1	LS	$11,000.00	$11,000.00
3	*2030003*	Culv, Rem, Over 48 inch	2	Ea	$2,000.00	$4,000.00
4	*2040035*	Guardrail, Rem	25	Ft	$2.00	$50.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	775	Cyd	$25.00	$19,375.00
7	*2050016*	Excavation, Earth	375	Cyd	$10.00	$3,750.00
8	*2060002*	Backfill, Structure, CIP	280	Cyd	$30.00	$8,400.00
9	*2060010*	Excavation, Fdn	280	Cyd	$25.00	$7,000.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	700	Syd	$10.00	$7,000.00
12	*3070125*	Shoulder, Cl II, 3 inch	70	Syd	$5.00	$350.00
13	*5010005*	HMA Surface, Rem	850	Syd	$5.00	$4,250.00
14	*5010033*	HMA, LVSP	160	Ton	$100.00	$16,000.00
15		Temporary Stream Control	1	LS	$12,500.00	$12,500.00
16	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
17	*7050010*	Pile, Treated Timber, Furn	1090	Ft	$20.00	$21,800.00
18	*7050011*	Pile, Treated Timber, Driven	1090	Ft	$25.00	$27,250.00
19	*7050015*	Test Pile, Treated Timber	3	Ea	$1,500.00	$4,500.00
20	*7090001*	Structure, Timber, _x_, Furn	1	LS	$340,000.00	$340,000.00
21	*7097051*	Structure, Timber, _x_, Install	1	LS	$17,000.00	$17,000.00
22	*8070000*	Guardrail, Type B	50	Ft	$25.00	$1,250.00
23	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
24	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
25	*8130005*	Riprap, Heavy	70	Syd	$75.00	$5,250.00
26	*8160050*	Slope Restoration	235	Syd	$5.00	$1,175.00
27		Utility Pole relocation	1	LS	$5,000.00	$5,000.00

Subtotal	$563,880.00
Construction Engineering & Contingency (25%)	$140,970.00
Project Total	**$704,850**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: August 17, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 1
Opinion of Probable Cost - 2 Span Precast Concrete

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$31,000.00	$31,000.00
2		Traffic Control	1	LS	$12,000.00	$12,000.00
3	*2030003*	Culv, Rem, Over 48 inch	2	Ea	$2,000.00	$4,000.00
4	*2040035*	Guardrail, Rem	25	Ft	$2.00	$50.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	775	Cyd	$25.00	$19,375.00
7	*2050016*	Excavation, Earth	375	Cyd	$10.00	$3,750.00
8	*2060002*	Backfill, Structure, CIP	280	Cyd	$30.00	$8,400.00
9	*2060010*	Excavation, Fdn	280	Cyd	$25.00	$7,000.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	900	Syd	$10.00	$9,000.00
12	*3070125*	Shoulder, Cl II, 3 inch	100	Syd	$5.00	$500.00
13	*4067001*	Culv, Precast Three-Sided, 30'x6'	84	Ft	$4,000.00	$336,000.00
14	*5010005*	HMA Surface, Rem	850	Syd	$5.00	$4,250.00
15	*5010033*	HMA, LVSP	160	Ton	$100.00	$16,000.00
16	*7040007*	Cofferdams	1	LS	$25,000.00	$25,000.00
17	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
18	*7050030*	Pile, Steel, Furn and Driven, 12 inch	520	Ft	$65.00	$33,800.00
19	*7050031*	Test Pile, Steel, 12 inch	3	Ea	$1,500.00	$4,500.00
20	*7050039*	Pile Point, Steel	26	Ea	$200.00	$5,200.00
21	*7060012*	Conc, Grade S2, Subfooting	12	Cyd	$300.00	$3,600.00
22	*7060092*	Reinforcement, Steel, Epoxy Coated	9000	Lb	$2.25	$20,250.00
23	*7060100*	Substructure Conc	100	Cyd	$800.00	$80,000.00
24	*7100001*	Joint Waterproofing	300	Sft	$5.00	$1,500.00
25	*8070000*	Guardrail, Type B	50	Ft	$25.00	$1,250.00
26	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
27	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
28	*8130005*	Riprap, Heavy	70	Syd	$75.00	$5,250.00
29	*8160050*	Slope Restoration	235	Syd	$5.00	$1,175.00
30		Utility Pole relocation	1	LS	$5,000.00	$5,000.00
					Subtotal	$658,830.00
					Construction Engineering & Contingency (25%)	$164,707.50
					Project Total	**$823,538**

GoslingCzubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: December 22, 2020
Project No.: 2020430002
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 1
Opinion of Probable Cost - Clear Span Steel w/ Conc. Deck

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$32,000.00	$32,000.00
2		Traffic Control	1	LS	$12,000.00	$12,000.00
3	*2030003*	Culv, Rem, Over 48 inch	2	Ea	$2,000.00	$4,000.00
4	*2040035*	Guardrail, Rem	25	Ft	$2.00	$50.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	900	Cyd	$25.00	$22,500.00
7	*2050016*	Excavation, Earth	400	Cyd	$10.00	$4,000.00
8	*2060002*	Backfill, Structure, CIP	500	Cyd	$30.00	$15,000.00
9	*2060010*	Excavation, Fdn	500	Cyd	$25.00	$12,500.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	700	Syd	$10.00	$7,000.00
12	*3070125*	Shoulder, Cl II, 3 inch	70	Syd	$5.00	$350.00
13	*5010005*	HMA Surface, Rem	850	Syd	$5.00	$4,250.00
14	*5010033*	HMA, LVSP	160	Ton	$100.00	$16,000.00
15	*7040007*	Cofferdams	1	LS	$25,000.00	$25,000.00
16	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
17	*7050030*	Pile, Steel, Furn and Driven, 12 inch	440	Ft	$65.00	$28,600.00
18	*7050031*	Test Pile, Steel, 12 inch	2	Ea	$1,500.00	$3,000.00
19	*7050039*	Pile Point, Steel	22	Ea	$200.00	$4,400.00
20	*7060012*	Conc, Grade S2, Subfooting	10	Cyd	$300.00	$3,000.00
21	*7060092*	Reinforcement, Steel, Epoxy Coated	22350	Lb	$2.25	$50,287.50
22	*7060100*	Substructure Conc	175	Cyd	$800.00	$140,000.00
23	*7060110*	Superstructure Conc	20	Cyd	$400.00	$8,000.00
24	*7060111*	Superstructure Conc, Form, Finish, and Cure	1	LS	$8,000.00	$8,000.00
25	*7060112*	Superstructure Conc, Form, Finish, and Cure, N.C.	1	LS	$18,000.00	$18,000.00
26	*7060113*	Superstructure Conc, Night Casting	60	Cyd	$300.00	$18,000.00
27	*7077051*	Prefabricated Bridge Superstructure, Furn	2210	Sft	$85.00	$187,850.00
28	*7077051*	Prefabricated Bridge Superstructure, Erect	1	LS	$18,000.00	$18,000.00
29	*7100001*	Joint Waterproofing	260	Sft	$5.00	$1,300.00
30	*8070000*	Guardrail, Type B	50	Ft	$25.00	$1,250.00
31	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
32	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
33	*8130005*	Riprap, Heavy	70	Syd	$75.00	$5,250.00
34	*8160050*	Slope Restoration	235	Syd	$5.00	$1,175.00
35		Utility Pole relocation	1	LS	$5,000.00	$5,000.00

Subtotal	$676,742.50
Construction Engineering & Contingency (25%)	$169,185.63
Project Total	**$845,929**

GoslingCzubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: December 22, 2020
Project No.: 2020430002
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 1
Opinion of Probable Cost - Clear Span Steel w/ Asphalt Deck

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$31,000.00	$31,000.00
2		Traffic Control	1	LS	$12,000.00	$12,000.00
3	*2030003*	Culv, Rem, Over 48 inch	2	Ea	$2,000.00	$4,000.00
4	*2040035*	Guardrail, Rem	25	Ft	$2.00	$50.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	900	Cyd	$25.00	$22,500.00
7	*2050016*	Excavation, Earth	400	Cyd	$10.00	$4,000.00
8	*2060002*	Backfill, Structure, CIP	500	Cyd	$30.00	$15,000.00
9	*2060010*	Excavation, Fdn	500	Cyd	$25.00	$12,500.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	700	Syd	$10.00	$7,000.00
12	*3070125*	Shoulder, Cl II, 3 inch	70	Syd	$5.00	$350.00
13	*5010005*	HMA Surface, Rem	850	Syd	$5.00	$4,250.00
14	*5010033*	HMA, LVSP	230	Ton	$100.00	$23,000.00
15	*7040007*	Cofferdams	1	LS	$25,000.00	$25,000.00
16	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
17	*7050030*	Pile, Steel, Furn and Driven, 12 inch	440	Ft	$65.00	$28,600.00
18	*7050031*	Test Pile, Steel, 12 inch	2	Ea	$1,500.00	$3,000.00
19	*7050039*	Pile Point, Steel	22	Ea	$200.00	$4,400.00
20	*7060012*	Conc, Grade S2, Subfooting	10	Cyd	$300.00	$3,000.00
21	*7060092*	Reinforcement, Steel, Epoxy Coated	11650	Lb	$2.25	$26,212.50
22	*7060100*	Substructure Conc	165	Cyd	$800.00	$132,000.00
23	*7060110*	Superstructure Conc	20	Cyd	$400.00	$8,000.00
24	*7060111*	Superstructure Conc, Form, Finish, and Cure	1	LS	$8,000.00	$8,000.00
25	*7077051*	Prefabricated Bridge Superstructure, Furn	2210	Sft	$108.00	$238,680.00
26	*7077051*	Prefabricated Bridge Superstructure, Erect	1	LS	$18,000.00	$18,000.00
27	*7100001*	Joint Waterproofing	260	Sft	$5.00	$1,300.00
28	*8070000*	Guardrail, Type B	50	Ft	$25.00	$1,250.00
29	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
30	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
31	*8130005*	Riprap, Heavy	70	Syd	$75.00	$5,250.00
32	*8160050*	Slope Restoration	235	Syd	$5.00	$1,175.00
33		Utility Pole relocation	1	LS	$5,000.00	$5,000.00

Subtotal	$665,497.50
Construction Engineering & Contingency (25%)	$166,374.38
Project Total	**$831,872**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: Dec. 22, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 2
Opinion of Probable Cost - Timber Structure- 70 ft Total Span

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$28,000.00	$28,000.00
2		Traffic Control	1	LS	$11,000.00	$11,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	2	Ea	$1,000.00	$2,000.00
4	*2030003*	Culv, Rem, Over 48 inch	1	Ea	$2,000.00	$2,000.00
5	*2040035*	Guardrail, Rem	150	Ft	$2.00	$300.00
6	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
7	*2050015*	Excavation, Channel	650	Cyd	$25.00	$16,250.00
8	*2050016*	Excavation, Earth	700	Cyd	$10.00	$7,000.00
9	*2060002*	Backfill, Structure, CIP	200	Cyd	$30.00	$6,000.00
10	*2060010*	Excavation, Fdn	200	Cyd	$25.00	$5,000.00
11	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
12	*3020001*	Aggregate Base, 6 inch	900	Syd	$10.00	$9,000.00
13	*3070125*	Shoulder, Cl II, 3 inch	55	Syd	$5.00	$275.00
14	*5010005*	HMA Surface, Rem	1090	Syd	$5.00	$5,450.00
15	*5010033*	HMA, LVSP	200	Ton	$100.00	$20,000.00
16		Temporary Stream Control	1	LS	$12,500.00	$12,500.00
17	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
18	*7050010*	Pile, Treated Timber, Furn	1340	Ft	$20.00	$26,800.00
19	*7050011*	Pile, Treated Timber, Driven	1340	Ft	$25.00	$33,500.00
20	*7050015*	Test Pile, Treated Timber	4	Ea	$1,500.00	$6,000.00
21	*7090001*	Structure, Timber, 34' x 70', Furn	1	LS	$350,000.00	$350,000.00
22	*7097051*	Structure, Timber, 34' x 70', Install	1	LS	$17,500.00	$17,500.00
23	*8070000*	Guardrail, Type B	25	Ft	$25.00	$625.00
24	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
25	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
26	*8130005*	Riprap, Heavy	150	Syd	$75.00	$11,250.00
27	*8160050*	Slope Restoration	290	Syd	$5.00	$1,450.00
28		Utility Pole relocation	1	LS	$5,000.00	$5,000.00

Subtotal	$597,880.00
Construction Engineering & Contingency (25%)	$149,470.00
Project Total	**$747,350**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: Dec. 22, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 2
Opinion of Probable Cost - Timber Structure - 80 ft total span

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$32,000.00	$32,000.00
2		Traffic Control	1	LS	$12,000.00	$12,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	2	Ea	$1,000.00	$2,000.00
4	*2030003*	Culv, Rem, Over 48 inch	1	Ea	$2,000.00	$2,000.00
5	*2040035*	Guardrail, Rem	150	Ft	$2.00	$300.00
6	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
7	*2050015*	Excavation, Channel	650	Cyd	$25.00	$16,250.00
8	*2050016*	Excavation, Earth	800	Cyd	$10.00	$8,000.00
9	*2060002*	Backfill, Structure, CIP	200	Cyd	$30.00	$6,000.00
10	*2060010*	Excavation, Fdn	200	Cyd	$25.00	$5,000.00
11	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
12	*3020001*	Aggregate Base, 6 inch	900	Syd	$10.00	$9,000.00
13	*3070125*	Shoulder, Cl II, 3 inch	55	Syd	$5.00	$275.00
14	*5010005*	HMA Surface, Rem	1090	Syd	$5.00	$5,450.00
15	*5010033*	HMA, LVSP	200	Ton	$100.00	$20,000.00
16		Temporary Stream Control	1	LS	$12,500.00	$12,500.00
17	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
18	*7050010*	Pile, Treated Timber, Furn	1340	Ft	$20.00	$26,800.00
19	*7050011*	Pile, Treated Timber, Driven	1340	Ft	$25.00	$33,500.00
20	*7050015*	Test Pile, Treated Timber	4	Ea	$1,500.00	$6,000.00
21	*7090001*	Structure, Timber,34' x 80', Furn	1	LS	$418,000.00	$418,000.00
22	*7097051*	Structure, Timber, 34' x 80', Install	1	LS	$20,000.00	$20,000.00
23	*8070000*	Guardrail, Type B	25	Ft	$25.00	$625.00
24	*8070042*	Guardrail Approach Terminal, Type 2B	2	Ea	$2,500.00	$5,000.00
25	*8070080*	Guardrail Reflector	6	Ea	$5.00	$30.00
26	*8130005*	Riprap, Heavy	150	Syd	$75.00	$11,250.00
27	*8160050*	Slope Restoration	290	Syd	$5.00	$1,450.00
28		Utility Pole relocation	1	LS	$5,000.00	$5,000.00

Subtotal	$674,380.00
Construction Engineering & Contingency (25%)	$168,595.00
Project Total	**$842,975**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: August 17, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 3
Opinion of Probable Cost - Timber Structure- 70 ft Total Span

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$30,000.00	$30,000.00
2		Traffic Control	1	LS	$12,000.00	$12,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	3	Ea	$1,000.00	$3,000.00
4	*2040035*	Guardrail, Rem	245	Ft	$2.00	$490.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	550	Cyd	$25.00	$13,750.00
7	*2050016*	Excavation, Earth	610	Cyd	$10.00	$6,100.00
8	*2060002*	Backfill, Structure, CIP	275	Cyd	$30.00	$8,250.00
9	*2060010*	Excavation, Fdn	275	Cyd	$25.00	$6,875.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	1335	Syd	$10.00	$13,350.00
12	*3070125*	Shoulder, Cl II, 3 inch	160	Syd	$5.00	$800.00
13	*5010005*	HMA Surface, Rem	1530	Syd	$5.00	$7,650.00
14	*5010033*	HMA, LVSP	280	Ton	$100.00	$28,000.00
15		Temporary Stream Control	1	LS	$16,000.00	$16,000.00
16	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
17	*7050010*	Pile, Treated Timber, Furn	1555	Ft	$20.00	$31,100.00
18	*7050011*	Pile, Treated Timber, Driven	1555	Ft	$25.00	$38,875.00
19	*7050015*	Test Pile, Treated Timber	4	Ea	$1,500.00	$6,000.00
20	*7090001*	Structure, Timber, 34'x70', Furn	1	LS	$350,000.00	$350,000.00
21	*7097051*	Structure, Timber, 34'x70', Install	1	LS	$17,500.00	$17,500.00
		Timber Retaining Wall Lagging	1	LS	$7,500.00	$7,500.00
		Timber Retaining Wall Lagging Install	1	LS	$7,500.00	$7,500.00
22	*8070000*	Guardrail, Type B	20	Ft	$25.00	$500.00
23	*8070042*	Guardrail Approach Terminal, Type 2B	4	Ea	$2,500.00	$10,000.00
24	*8070080*	Guardrail Reflector	10	Ea	$5.00	$50.00
25	*8130005*	Riprap, Heavy	170	Syd	$75.00	$12,750.00
26	*8160050*	Slope Restoration	780	Syd	$5.00	$3,900.00

Subtotal	$647,890.00
Construction Engineering & Contingency (25%)	$161,972.50
Project Total	**$809,863**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: Dec. 22, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over the Crystal River - Crossing 3
Opinion of Probable Cost - Timber Structure- 80 ft Total Span

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$34,000.00	$34,000.00
2		Traffic Control	1	LS	$13,000.00	$13,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	3	Ea	$1,000.00	$3,000.00
4	*2040035*	Guardrail, Rem	245	Ft	$2.00	$490.00
5	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
6	*2050015*	Excavation, Channel	735	Cyd	$25.00	$18,375.00
7	*2050016*	Excavation, Earth	700	Cyd	$10.00	$7,000.00
8	*2060002*	Backfill, Structure, CIP	275	Cyd	$30.00	$8,250.00
9	*2060010*	Excavation, Fdn	275	Cyd	$25.00	$6,875.00
10	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
11	*3020001*	Aggregate Base, 6 inch	1335	Syd	$10.00	$13,350.00
12	*3070125*	Shoulder, Cl II, 3 inch	160	Syd	$5.00	$800.00
13	*5010005*	HMA Surface, Rem	1530	Syd	$5.00	$7,650.00
14	*5010033*	HMA, LVSP	280	Ton	$100.00	$28,000.00
15		Temporary Stream Control	1	LS	$16,000.00	$16,000.00
16	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
17	*7050010*	Pile, Treated Timber, Furn	1555	Ft	$20.00	$31,100.00
18	*7050011*	Pile, Treated Timber, Driven	1555	Ft	$25.00	$38,875.00
19	*7050015*	Test Pile, Treated Timber	4	Ea	$1,500.00	$6,000.00
20	*7090001*	Structure, Timber, 34'x 80', Furn	1	LS	$418,000.00	$418,000.00
21	*7097051*	Structure, Timber, 34'x 80', Install	1	LS	$20,000.00	$20,000.00
		Timber Retaining Wall Lagging	1	LS	$7,500.00	$7,500.00
		Timber Retaining Wall Lagging Install	1	LS	$7,500.00	$7,500.00
22	*8070000*	Guardrail, Type B	20	Ft	$25.00	$500.00
23	*8070042*	Guardrail Approach Terminal, Type 2B	4	Ea	$2,500.00	$10,000.00
24	*8070080*	Guardrail Reflector	10	Ea	$5.00	$50.00
25	*8130005*	Riprap, Heavy	170	Syd	$75.00	$12,750.00
26	*8160050*	Slope Restoration	780	Syd	$5.00	$3,900.00

Subtotal	$728,915.00
Construction Engineering & Contingency (25%)	$182,228.75
Project Total	**$911,144**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: August 17, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over Tucker Lake Outlet - Crossing 4
Opinion of Probable Cost - Timber Structure

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$10,000.00	$10,000.00
2		Traffic Control	1	LS	$4,000.00	$4,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	1	Ea	$2,000.00	$2,000.00
4	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
5	*2050015*	Excavation, Channel	90	Cyd	$25.00	$2,250.00
6	*2050016*	Excavation, Earth	90	Cyd	$10.00	$900.00
7	*2060002*	Backfill, Structure, CIP	100	Cyd	$30.00	$3,000.00
8	*2060010*	Excavation, Fdn	100	Cyd	$25.00	$2,500.00
9	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
10	*3020001*	Aggregate Base, 6 inch	750	Syd	$10.00	$7,500.00
11	*3070125*	Shoulder, Cl II, 3 inch	90	Syd	$5.00	$450.00
12	*5010005*	HMA Surface, Rem	725	Syd	$5.00	$3,625.00
13	*5010033*	HMA, LVSP	130	Ton	$100.00	$13,000.00
14		Temporary Stream Control	1	LS	$10,000.00	$10,000.00
15	*7050002*	Pile Driving Equipment, Furn	1	LS	$15,000.00	$15,000.00
16	*7050010*	Pile, Treated Timber, Furn	550	Ft	$20.00	$11,000.00
17	*7050011*	Pile, Treated Timber, Driven	550	Ft	$25.00	$13,750.00
18	*7050015*	Test Pile, Treated Timber	2	Ea	$1,500.00	$3,000.00
19	*7090001*	Structure, Timber, _x_, Furn	1	LS	$97,000.00	$97,000.00
20	*7097051*	Structure, Timber, _x_, Install	1	LS	$5,000.00	$5,000.00
21	*8070042*	Guardrail Approach Terminal, Type 2B	4	Ea	$2,500.00	$10,000.00
22	*8070080*	Guardrail Reflector	4	Ea	$5.00	$20.00
23	*8130005*	Riprap, Plain	70	Syd	$50.00	$3,500.00
24	*8160050*	Slope Restoration	225	Syd	$5.00	$1,125.00

Subtotal	$219,570.00
Construction Engineering & Contingency (25%)	$54,892.50
Project Total	**$274,463**

Gosling Czubak
engineering sciences, inc.

Project: County Road 675 Stream Crossings

Date: August 17, 2020
Project No.: 2020430002.00
By: RMV

Clients: Leelanau County Road Commission
Grand Traverse Band of Ottawa & Chippewa Indians

County Road 675 over Tucker Lake Outlet - Crossing 4
Opinion of Probable Cost - Aluminum Box Culvert

Item No.	MDOT Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Amount
1	*1000001*	Mobilization	1	LS	$8,000.00	$8,000.00
2		Traffic Control	1	LS	$4,000.00	$4,000.00
3	*2030002*	Culv, Rem, 24 inch to 48 inch	1	Ea	$2,000.00	$2,000.00
4	*2050010*	Embankment, CIP	50	Cyd	$15.00	$750.00
5	*2050016*	Excavation, Earth	250	Cyd	$10.00	$2,500.00
6	*2050017*	Excavation, Peat	300	Cyd	$20.00	$6,000.00
7	*2060002*	Backfill, Structure, CIP	350	Cyd	$30.00	$10,500.00
8	*2080036*	Erosion Control, Silt Fence	100	Ft	$2.00	$200.00
9	*3020001*	Aggregate Base, 6 inch	750	Syd	$10.00	$7,500.00
10	*3070125*	Shoulder, Cl II, 3 inch	90	Syd	$5.00	$450.00
11	*5010005*	HMA Surface, Rem	725	Syd	$5.00	$3,625.00
12	*5010033*	HMA, LVSP	130	Ton	$100.00	$13,000.00
13	*7047007*	Creek Diversion	1	LS	$15,000.00	$15,000.00
14		Dewatering	1	LS	$15,000.00	$15,000.00
15		Aluminum Box Culvert, 16'-6"x6'-8"	1	LS	$60,000.00	$60,000.00
16		Culvert Assembly and Installation	1	LS	$10,000.00	$10,000.00
17		Geogrid	300	Syd	$10.00	$3,000.00
18	*8070042*	Guardrail Approach Terminal, Type 2B	4	Ea	$2,500.00	$10,000.00
19	*8070080*	Guardrail Reflector	4	Ea	$5.00	$20.00
20	*8130005*	Riprap, Plain	70	Syd	$50.00	$3,500.00
21	*8160050*	Slope Restoration	225	Syd	$5.00	$1,125.00

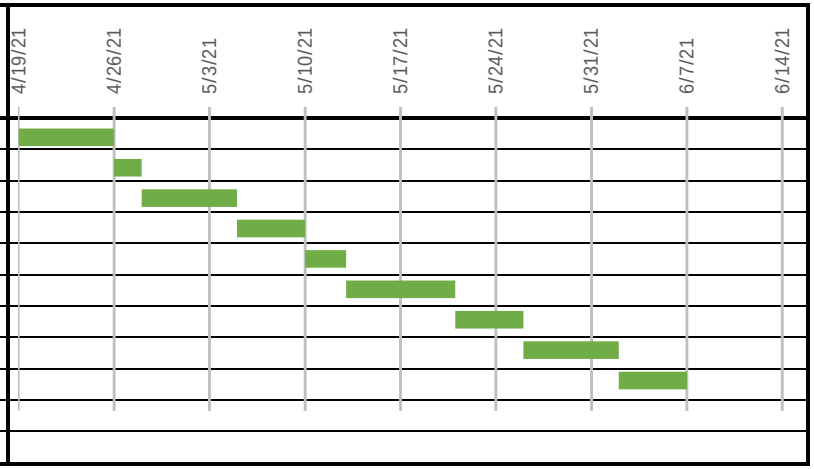
Subtotal	$176,170.00
Construction Engineering & Contingency (25%)	$44,042.50
Project Total	**$220,213**

Appendix 4

Estimated Construction Schedules

Estimated Timber Bridge Construction Schedule - 3 Span

Task #	Description	Start Date	Working Days	End Date
1	Mobilization/Site Prep/Stream Control	4/19/2021	5	4/26/2021
2	Excavation for pile driving	4/26/2021	2	4/28/2021
3	Pile driving (est. 10/day)	4/28/2021	5	5/5/2021
4	Install abutment timbers & pier bracing	5/5/2021	3	5/10/2021
5	Channel excavation & riprap slopes	5/10/2021	3	5/13/2021
6	Set superstructure, stringers, railings	5/13/2021	6	5/21/2021
7	Backfill abutments	5/21/2021	3	5/26/2021
8	Approach roadwork, slope restoration	5/26/2021	5	6/2/2021
9	Paving, guardrail, striping	6/2/2021	3	6/7/2021
	Total Working Days		35	
	Total Days			49



Estimated Steel Bridge Construction Schedule - Single Span Steel

Task #	Description	Start Date	Working Days	End Date
1	Mobilization/Site Prep/Cofferdams	4/19/2021	5	4/26/2021
2	Excavation for pile driving	4/26/2021	2	4/28/2021
3	Pile driving (est. 10/day)	4/28/2021	4	5/4/2021
4	Concrete substructures	5/4/2021	10	5/18/2021
5	Channel excavation & riprap slopes	5/18/2021	3	5/21/2021
6	Superstructure erection	5/21/2021	2	5/25/2021
7	Backfill abutments	5/25/2021	2	5/27/2021
8	Deck Slab reinforcement	5/27/2021	5	6/3/2021
9	Deck Slab pour	6/3/2021	2	6/7/2021
10	Deck Slab cure	6/7/2021	14	6/25/2021
11	Approach roadwork, slope restoration	6/3/2021	5	6/10/2021
12	Paving, guardrail, striping	6/10/2021	3	6/15/2021
	Total Working Days		49	
	Total Days			67