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PIPELINE

MICHIGAN ASSOCIATION OF COUNTY DRAIN COMMISSIONERS
MANAGING MICHIGAN'S WATER RESOURCES SINCE 1899

GRATIOT COUNTY MAINTENANCE REQUESTS

RIBE DRAIN *2021 MACDC INNOVATION & EXCELLENCE AWARD WINNER*

2022 PROJECT SUBMITTALS NOW OPEN!

RIBE DRAIN
2021 MACDC INNOVATION & EXCELLENCE AWARD WINNER

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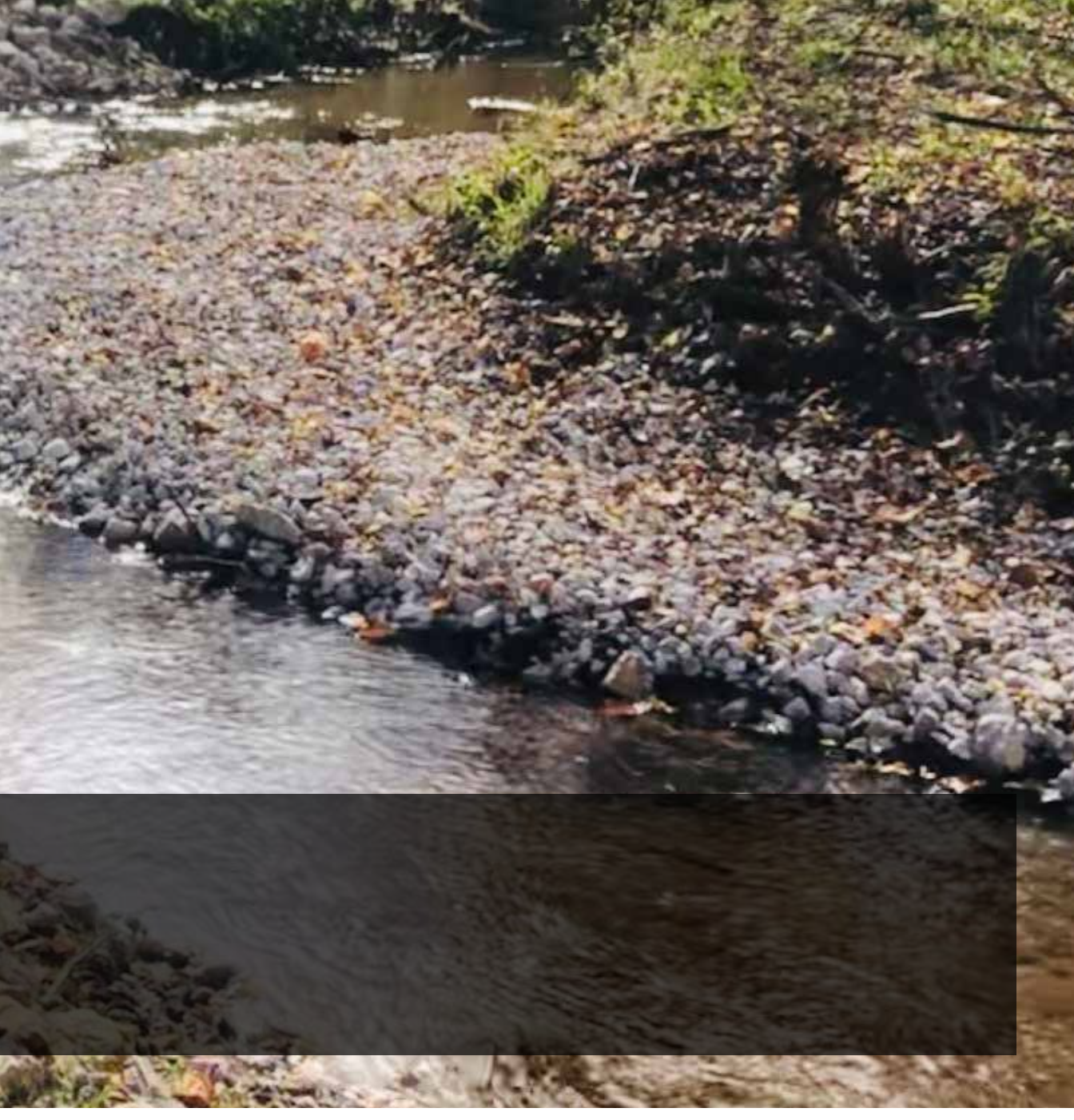
The Ribe Drain Drainage District is an approximately 5700-acre drainage district located in Dalton and Cedar Creek Townships of Muskegon County. The latest petition for the Ribe Drain was filed by residents in the Drainage District who were primarily located on West Lake and were experiencing prolonged high lake levels that were causing structure damage and inundated septic systems.

Upon inspection of the complete watercourse and initial scoping of the project in 2015 the issues to be addressed became apparent.

Due to the lack of routine maintenance on the system since becoming established as a County Drain, stabilization of the existing water course to restore natural stream function and prevent erosion was going to be paramount. The Drain consisted of a significant number of undersized and failing culverts that would need to be replaced, and sized appropriately, to improve stream flow, capacity, and fish passage. The final key element would be to provide an adequate outlet to the chain of lakes in the northern part of the District that would meet the Department of Natural Resources recommended lake level. To



properly solve the lake level issues, the project would have to include improving the channels between the lakes as well to make sure the lakes were properly equalized.

The Ribe Drain is a tributary of the Bear Creek watershed, which discharges to Bear Lake and Muskegon Lake (both Great Lakes Areas of Concern) and is 4.75 miles in length from its outlet to Bear Creek upstream to Twin Lake. The upstream end of the Ribe Drain provides lake level control for Twin, Middle, and West Lakes. A June 1984 MDNR Issued Permit prescribed lake levels to be 678.5 USGS during May 15 - October 15 and 678.0 USGS the remainder of the year.

The issue with the existing lake level control and 1984 design was an extremely flat gradient of 0.06% on the Ribe Drain downstream of the outlet headwall that made it difficult to relieve the lakes and adequately maintain the set levels. As originally configured, the existing design would only operate correctly with a completely free flowing outlet and would still require head pressure to adequately relieve the lakes. Any drain encumbrance (sediment accumulation, log jam, vegetation growth, dead animal, blocked culvert) would impact the lake

levels negatively. Due to the sedimentation and vegetation accumulation, and improperly sized and set culverts downstream, the issues began to compound.

Lake levels in 2015 were surveyed 14 inches above the issued permit for lake levels. The invert (bottom) of the 24-inch pipe is the prescribed lake level and was routinely well above that mark. The water staining on the headwall and wingwalls was an easily identifiable indicator of the long-term issue with high lake levels. The channels between the lakes were considered private watercourses and to our knowledge had never been maintained in a manner to achieve the prescribed lake levels. As such, the lake levels were higher in West Lake and Middle Lake than in Twin Lake where the control structure is located.

Three of the main goals of the project were to:

- Identify the locations of significant land loss from stream relocation due to fallen trees and logjams.
- Design a solution that would work in harmony with the natural landscape of the Drain and adjacent property to provide stabilization and sustainability for the long-term health of the Drain and its ecosystem.
- Provide an outlet that would adequately maintain prescribed lake levels

Upon review of the topographical survey conducted it became very apparent the 1984 design, which extended the Drain north and provided an outlet mechanism for the upstream chain of lakes, had a very small margin for error with regards to maintaining permitted lake levels. To alleviate this issue, we began investigating the feasibility of improving the hydraulics downstream of the outlet control structure by improving gradient on the drain centerline and capacity in the downstream culverts, many of which required replacement due to their deteriorating condition.

Two challenges presented themselves with deepening the system to provide relief to the lakes:

- Permitting from CSX and Genesee & Wyoming Railroad: A new 36-inch storm sewer crossing was required across the railroad tracks approximately 3,000 feet downstream of the lake.
- DTE Energy Natural Gas Pipeline: During preliminary engineering it was discovered that the existing 12-inch pipeline was located only 18 inches below the bottom of the existing drain.

As part of the investigative process of the lake level control structure, drainage calculations were performed (both weir and peak discharge based on normal lake level fluctuations of similar sized lakes) which determined that neither the weir size nor the capacity of the 24-inch outlet pipe were the restrictive elements of proper lake level control. The project team utilized lake level monitoring and rain gauge data to monitor the natural rise and fall of lake levels in West Michigan of similar lake sizes and control structures similar to Twin, Middle and West Lakes to make that determination.

Additionally, the channels between the lakes would have to be improved to provide the necessary equalization of the water levels. West Lake was experiencing considerably higher lake levels than both Middle Lake and Twin Lake. To provide better equalization of water levels among the three lakes the project proposed to deepen the existing channel approximately 18 inches throughout (deeper in some locations due to sedimentation) and provide a rock lined cobblestone channel with impermeable liner to inhibit vegetative growth and maintain appropriate equalization. The area west of Middle Lake Road is part of a much larger wetland complex and the project restricted work to the main channel, while the remaining areas were left undisturbed.

Once we were able to determine that providing additional gradient was possible, we began the final design and permitting process with the Michigan EGLE (formerly DEQ), CSX and Genesee & Wyoming Railroads, and the Muskegon County Road Commission. We also continued discussions with DTE Energy on the coordination of the lowering of their facilities to an appropriate depth below the Drain (the depth and function as a 'primary transmission line' provided significant safety issues to public health, should an issue occur).

THE SOLUTION

The total cost of the project to improve the Drain was $2.9 million. The project was divided into three construction contracts due to the

wide range of work required and to provide a competitive bid environment for each portion. The contract work was divided as follows:

Contract 1 consisted of stream restoration including 3,090 lineal feet of open drain construction, 16,285 lineal feet of open drain cleanout with in-stream structures including rock riffles, vanes, stream meanders, bank tapering and stabilization; and culvert installations for property access at five locations. The Contract was awarded to McCormick Sand, Inc.

Contract 2 consisted of the replacement of three roadway crossings with precast concrete box culvert, including a 10-foot by 5-foot box culvert with tapered end sections, an 8-foot by 4-foot with tapered end sections, and a 43-inch by 68-inch HE RCP culvert. The Contract was awarded to McCormick Sand, Inc.

Contract 3 consisted of a Railroad crossing via bore and jack of 73 lineal feet of 36-inch RCP storm sewer within a 54-inch steel casing pipe across railroad and 77 lineal feet of 36-inch RCP storm sewer within a 54-inch steel casing via open cut with concrete headwall and wing wall end treatments. The Contract was awarded to Jackson-Merkey Contractors, Inc.

DESIGN OVERVIEW & SOLUTION

Stream Restoration

This project included the construction of a significant number and variety of in-stream Best Management Practices and structures that best accommodated the hydraulic and physical conditions of the stream including:

- J-Hook Vanes: 5 Each
- Cross Vanes: 11 Each
- Stream Meanders: 5,750 LF
- Riffle Zones: 1 Each
- Rock Clusters: 18 Each
- 2-Stage Channel: 2,350 LF
- Cobblestone Stilling Basin: 275 LF

The construction of the design techniques transforming this overgrown channel into a healthy meandering stream was an amazing sight to witness. The existing landscape had a natural meandering condition that we strived to enhance and stabilize. Working with the existing meanders to the extent possible, we graded and stabilized the banks, and used coir logs to stabilize the toe of slope of the stream;

each of these were critical elements of design. The design looked to leave existing vegetated and stable meander bars in place but also constructed gravel sedimentation bars where necessary, to stabilize the stream.

The Contractor for the stream restoration work, McCormick Sand, Inc., worked diligently with Eng., Inc. field staff to preserve trees and as much of the natural landscape as possible. Private landowners also contributed to our effort by allowing our team access to sensitive areas of the site.

During the middle of construction, in the spring of 2020, the area received 5.5 inches of rainfall in 24 hours. In a matter of days, this was followed up by a 3.5-inch rainfall event. The infrastructure that had already been constructed, but not yet fully vegetated and stabilized, held up incredibly well. These events acted as a stress test of the improvements; a test they passed.

Culvert Replacements

Another component of this project was the coordination with the Muskegon County Road Commission for the replacement of several aging and inadequate culverts at Pillon Road, Bard Road, and Michillinda Road.

The Pillon Road replacement consisted of a 10-foot by 5-foot precast concrete box culvert, replacing a 120-inch by 86-inch CSP culvert, with precast headwall and end sections and two-stage channel construction on the entry and exit to the culvert.

The Bard Road culvert replacement consisted of a 10-foot by 4-foot precast concrete box culvert, replacing twin 36-inch CSP culverts, with precast concrete headwall and end sections.

The Michillinda Road culvert replacement consisted of a 43-inch by 68-inch HE RCP culvert which replaced an existing 42-inch CSP culvert that was failing and causing roadway damage. The HE RCP culvert had 45-degree bends fabricated due to the 90-degree bend in the stream at this location.

Several other 95-inch by 67-inch CSP arch culverts were replaced for private stream crossings, replacing 60-inch and 66-inch CSP culverts, which are necessary to meet the bank full width of the stream and improve flow conditions. From speaking with residents prior to bidding, we were able to eliminate several aging culverts that were no longer in use and were acting as obstructions in the Drain. In doing so, we were able to restore the natural stream in these locations.

Railroad Crossing

To improve the hydraulics of the system in the upper watershed, and to provide a more reliable outlet and consistent lake level on the upstream chain of lakes, improvements were necessary at the railroad track crossing located approximately 3,000 feet downstream of the lake level control structure. A new 36-inch RCP culvert was proposed at a lower depth, within a 54-inch steel casing utilizing the bore and jack method. The existing 24-inch would be left in place to act as a secondary overflow pipe. We worked with CSX Railroad to obtain a Facility Encroachment Agreement and with Genesee & Wyoming Railroad to obtain a Right of Entry permit.

The construction of the bore and jack was completed by Jackson-Merkey Contractors, Inc., utilizing RT Boring as a subcontractor over an approximately 3-week duration in the Summer of 2020. The precast concrete headwall and wingwalls were formed and reinforced in the field.

The impact on the water lake levels was immediate once the drain improvements and the 36-inch culvert under the railroad tracks was constructed at the lower elevation. Whereas the existing 24-inch culvert would be 50% full of water during previous conditions, the photograph shows the water levels near the lower 36-inch invert located 1.8 feet lower than the 24-inch.

To negate a sudden surge and allow for a slower release of the lake water a temporary check dam was constructed that would allow for a calculated drawdown over a period of weeks, as opposed to days. In doing so, any negative impacts

downstream or stress to the system was avoided.

By the completion of the project, the lake levels were down to their permitted levels. The photo chronology below shows the dramatic difference in lake levels from preconstruction (early summer of 2020) to contract completion (late summer of 2020).

DTE Natural Gas Line Coordination

A major DTE natural gas pipeline runs under the Ribe Drain at Michillinda Road. While completing survey work in late 2017, we learned that the 12-inch pipeline was within 18 inches of the bottom of the drain: a potentially hazardous situation if not addressed. In early 2018, the project team met with representatives of DTE Energy to devise a plan to lower their facility and ensure the two projects coordinated efficiently.

DTE ultimately agreed to lower their gas line at their own expense - approximately 1 million dollars. The cost to relocate was so high due to the proximity of the lowering relative to the railroad right-of-way where the elevation and location of the connection point are fixed. DTE Energy completed the lowering in 2019 ahead of the contract work on the Ribe Drain.

WMSRDC Wetland Creation

In cooperation with the Ribe Drain project, the West Michigan Shoreline Regional Development Commission (WMSRDC) constructed a shallow water wetland with hydraulic connection to the Ribe Drain via placement of a 9-inch high diversion weir/check dam within the existing drain channel. The structure diverts flow through 1100 additional feet of created wetland to filter nutrients and sediments before discharging back to the Ribe Drain through a 24-inch HDPE culvert.

The project was completed and paid for with funding from the Great Lakes Restoration Initiative via Delta Institute.

This project allowed the Delta Institute and a coalition of community organizations to reduce sediment and nutrients in the 19,058-acre Bear Creek and Bear Lake watershed of the Muskegon Lake Area of Concern (AOC). The Bear Creek and Bear Lake Watershed Management Plan had identified the Ribe Drain as a major source of phosphorus contributing to nutrient loading in Bear Creek and eventually to Bear Lake, a part of the Muskegon Lake AOC.

SUMMARY

The Ribe Drain project consisted of many different facets, design elements, partnerships, and permitting agencies coming together to produce a final product that will make a considerable difference to the environment and long-term health of the watershed. This significant improvement was accomplished by implementing many different in-stream best management practices along a 4.75-mile corridor of stream that lacked proper stream function and historical routine maintenance. The result of this project will provide long-lasting impacts to the Bear Creek, Bear Lake, and Muskegon Lake watersheds, which are on a path to be removed from Great Lakes Areas of Concerns due to projects just like this one. This project provided a much more reliable outlet to maintain the permitted lake level elevations on the upstream chain of lakes and all but eliminated the potential for future structure damage and septic system failure. We utilized many different partnerships with this project to reach the monumental goals of stream health, water quality, and long-term stability.