

## **5. PROJECT ALTERNATIVES**

### **5.1 Formulation of Alternatives**

Further screening allowed the team to evaluate each of these measures for feasibility. As indicated above, during the process, certain measures were dropped from further consideration. The remaining measures were combined to formulate project alternatives that would meet project goals.

After several meetings and discussions with the Village of Belleville and the WDNR, the Corps developed a list of final project alternatives for evaluation within the feasibility report. These alternatives include the following:

- Alternative 0: No Action (Figure 5.1)
- Alternative 1: Eastern Diversion with Northern Riffles (Figure 5.2; Plate 2)
- Alternative 2: Eastern Diversion with Southern Riffles (Figure 5.3; Plate 3)
- Alternative 3: Eastern Diversion with Complete Separation (Figure 5.4; Plate 4)
- Alternative 4: Western Diversion with Separation (Figure 5.5; Plate 5)
- Alternative 5: Western Diversion without Separation (Figure 5.6; Plate 6)
- Alternative 6: River Restoration with Pond Creation (Figure 5.7)

The project team, which was comprised of the internal Corps team, the Sponsor, and the WDNR, agreed on the final set of alternatives. The Corps team evaluated these alternatives in detail through habitat and cost analyses. Within each alternative, multiple measures were evaluated. This allowed the team to determine the most cost-effective version of the alternative. Each alternative was assigned a project life of 50 years. This is the standard project life used for environmental restoration projects.

5.2 Description of Alternatives

Table 5.1 - Measure comparison for alternatives.

| Measure                                 | Alternatives |   |   |   |   |   |   |
|---|--------------|---|---|---|---|---|---|
|   | 0            | 1 | 2 | 3 | 4 | 5 | 6 |
| Eastern Diversion (R3)                  |              | X | X | X |   |   |   |
| Western Diversion (R5, R6, R7)          |              |   |   |   | X | X | X |
| Western and Northern Wetlands (W3)      |              | X | X | X | X |   |   |
| Drawdown (D1 and D2)                    |              | X | X |   | X |   |   |
| North Shore Riffle Structures (F1)      |              | X |   |   |   |   |   |
| Southern Riffle Structures (F2)         |              |   | X |   |   |   |   |
| Riffle Structure Western Diversion (F3) |              |   |   |   |   |   | X |
| Riffle Structure across Dam (F4)        |              |   |   |   | X | X |   |
| Rock Ramp Structure (F5)                |              |   |   |   | X | X |   |
| Bypass Channel (F6)                     |              |   |   |   | X | X |   |
| Dam Removal and Riffle Structures (F7)  |              |   |   |   |   |   | X |
| Carp Gate (C1)                          |              | X | X |   | X |   |   |
| Carp Nets (C2)                          |              | X | X | X | X |   |   |
| Drawdown (C3)                           |              | X | X | X | X |   |   |
| Hydraulic Dredging 5 Acres (S1)         |              | X | X | X | X | X |   |
| Hydraulic Dredging 10 Acres (S2)        |              | X | X | X | X | X |   |
| Hydraulic Dredging 15 Acres (S3)        |              | X | X | X | X | X |   |
| Pond Creation (S6)                      |              |   |   |   |   |   | X |

**5.2.1 No Action Alternative.** The No Action Alternative is required for evaluation within all Federal projects. This alternative assumes no project alternatives would be implemented at the project site and is considered to be the future without-project condition. Figure 5.1 shows this feature.



Figure 5.1. Alternative 0, No Action.

**5.2.2 Alternative 1: Eastern Diversion with Northern Riffles.** This alternative would combine river diversion, wetland enhancement, periodic drawdown, and sediment removal, as shown in Figure 5.2 and in Plate 2. The river diversion measure for this alternative is R3. River restoration would include recreating the river channel by excavation along the northern and eastern lake perimeter and reconnecting the river at the existing millrace just upstream of the Highway 69 Bridge. Wetland enhancement measures would be W3. Inflow control structures would be included to assist in management of water levels within the lake and allow large flood events to use the flood storage of the lake. Periodic lake drawdown (D1) would be accomplished by opening the sluice gates of the existing Belleville Dam. Riffle structures would be placed along the northern shore (F1) in the newly excavated river channel to provide for grade control and fish passage. The crest elevation of the most upstream control point or riffle structure must be the same elevation as the crest of the existing dam (857.4 ft NGVD). Reduction in elevation of this upstream control point would result in lower lake elevations, higher demands for dredging, and potentially the complete loss of the lake. For this reason, the elevation of the most upstream control point for each alternative is assumed to be the same as that of the existing dam. Rough fish control would be implemented through a carp gate (C1) adjacent to the water control structure, as well as carp nets (C2) and periodic drawdowns (C3). Sediment removal measures that will be evaluated are S1, S2, and S3.

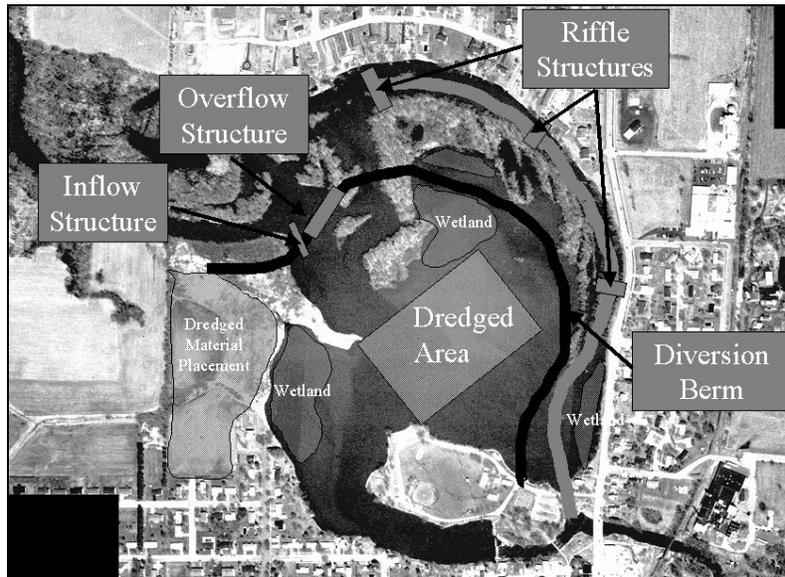


Figure 5.2. Alternative 1, Eastern Diversion with Northern Riffles.

| Alternative 1 | Description  |
|---------------|--|
| 1A            | Eastern Diversion with Northern Riffles – 5 Acres of Dredging  |
| 1B            | Eastern Diversion with Northern Riffles – 10 Acres of Dredging |
| 1C            | Eastern Diversion with Northern Riffles – 15 Acres of Dredging |

**5.2.3 Alternative 2: Eastern Diversion with Southern Riffles.** This alternative would combine sediment removal, river diversion, wetland enhancement and periodic drawdown, as shown in Figure 5.3 and in Plate 3. Sediment removal measures that will be evaluated are S1, S2, and S3. The river diversion measure for this alternative is R3. The wetland enhancement measure is W3. River restoration would include recreating the river channel along the northern and eastern lake perimeter and reconnecting the river at the existing millrace just upstream of the Highway 69 bridge. Inflow control structures would be included to assist in management of water level within the lake and allow large flood events to use the flood storage of the lake. Periodic lake drawdown (D1) would be accomplished by opening the sluice gates of the existing Belleville Dam. Riffle structures would be placed along the eastern shore (F2) in the newly excavated river channel to provide for grade control and fish passage. The crest elevation of the most upstream control point or riffle structure must be the same elevation as the crest of the existing dam (857.4 ft NGVD). Reduction in elevation of this upstream control point would result in lower lake elevations, higher demands for dredging, and potentially the complete loss of the lake. For this reason, the elevation of the most upstream control point for each alternative is assumed to be the same as that of the existing dam. Rough fish control would be implemented through a carp gate (C1) adjacent to the water control structure, as well as carp nets (C2) and periodic drawdowns (C3).



**Figure 5.3. Alternative 2, Eastern Diversion with Southern Riffles.**

| <b>Alternative 2</b> | <b>Description</b>   |
|----------------------|--|
| 2A                   | Eastern Diversion with Southern Riffles – 5 Acres of Dredging  |
| 2B                   | Eastern Diversion with Southern Riffles – 10 Acres of Dredging |
| 2C                   | Eastern Diversion with Southern Riffles – 15 Acres of Dredging |

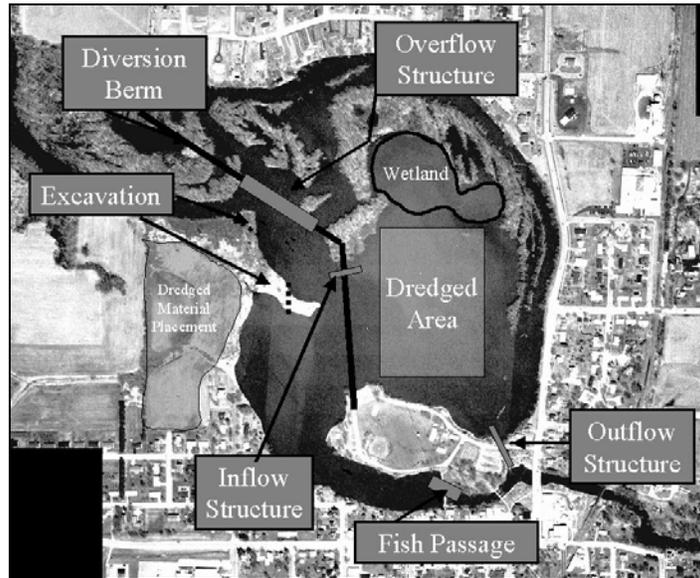
**5.2.4 Alternative 3: Eastern Diversion with Complete Separation.** This alternative would combine sediment removal, river diversion, and wetland enhancement, as shown in Figure 5.4 and in Plate 4. Sediment removal measures that will be evaluated are **S1, S2, and S3**. The river diversion measure for this alternative is a modified version of **R3**. In order to completely separate the river from the lake, the inlet structure would be replaced with a pump station. The wetland enhancement measure is **W3**. River restoration would include recreating the river channel along the northern and eastern lake perimeter and reconnecting the river at the existing millrace just upstream of the Highway 69 Bridge. No water control structures would be installed.



**Figure 5.4. Alternative 3, Eastern Diversion with Complete Separation.**

| <b>Alternative 3</b> | <b>Description</b>  |
|----------------------|---|
| 3A                   | Eastern Diversion with Complete Separation – 5 Acres of Dredging  |
| 3B                   | Eastern Diversion with Complete Separation – 10 Acres of Dredging |
| 3C                   | Eastern Diversion with Complete Separation – 15 Acres of Dredging |

**5.2.5 Alternative 4: Western Diversion with Separation.** This alternative would include sediment removal, river diversion, wetland enhancement, and periodic drawdown, as shown in Figure 5.5 and in Plate 5. Sediment removal measures that will be evaluated are **S1, S2, and S3**. The river diversion measure for this alternative is **R5**. The wetland enhancement measure is **W3**. Inflow and outflow control structures also would be included to assist in management of water level within the lake, as well as providing the opportunity for periodic lake drawdown (**D1**). This alternative would not include channel excavation; however, fish passage would be implemented at the dam to facilitate fish migration. As subcomponents of this alternative, the Corps will evaluate three types of fish passage structures (**F5, F6, F7**). Rough fish control would be implemented through a carp gate (**C1**) adjacent to the water control structure, as well as carp nets (**C2**) and periodic drawdowns (**C3**).



**Figure 5.5. Alternative 4, Western Diversion with Separation.**

| <b>Alternative 4</b> | <b>Description</b>  |
|----------------------|---|
| 4A                   | Western Diversion with Separation – 5 Acres of Dredging – Riffle Structure  |
| 4B                   | Western Diversion with Separation – 10 Acres of Dredging – Riffle Structure |
| 4C                   | Western Diversion with Separation – 15 Acres of Dredging – Riffle Structure |
| 4D                   | Western Diversion with Separation – 5 Acres of Dredging – Rock Ramp         |
| 4E                   | Western Diversion with Separation – 10 Acres of Dredging – Rock Ramp        |
| 4F                   | Western Diversion with Separation – 15 Acres of Dredging – Rock Ramp        |
| 4G                   | Western Diversion with Separation – 5 Acres of Dredging – Bypass Channel    |
| 4H                   | Western Diversion with Separation – 10 Acres of Dredging – Bypass Channel   |
| 4I                   | Western Diversion with Separation – 15 Acres of Dredging – Bypass Channel   |

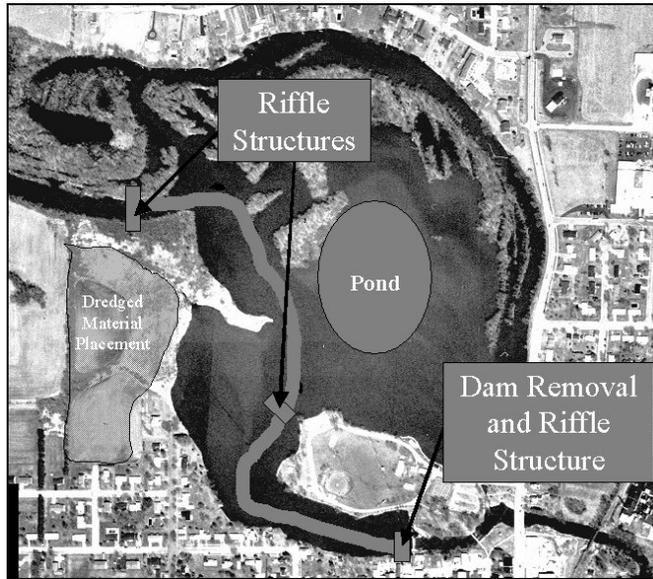
**5.2.6 Alternative 5: Western Diversion without Separation.** This alternative would include sediment removal, river diversion, and wetland enhancement, as shown in Figure 5.6 and in Plate 6. Sediment removal measures that will be evaluated are **S1, S2, and S3**. The river diversion measure for this alternative is **R6**. Wetland enhancement features would not be constructed due to the continued presence of carp. The open lake condition would allow carp to use the lake. This would cause the vegetation in the wetland enhancement areas to be disturbed by carp. Inflow and outflow control structures would not be constructed. Flow diversion structures may be incorporated to divert flows and sediments along the west side of the lake. This alternative would not include channel excavation; however, fish passage would be implemented at the dam to facilitate fish migration. As subcomponents of this alternative, the Corps will evaluate three types of fish passage structures (**F4, F5, F6**). Rough fish exclusion from the lake cannot be implemented with this alternative. This alternative does not separate the river from the lake, but seeks to improve water quality by lowering lake retention times.



**Figure 5.6. Alternative 5, Western Diversion without Separation.**

| <b>Alternative 5</b> | <b>Description</b>   |
|----------------------|--|
| 5A                   | Western Diversion without Separation – 5 Acres of Dredging – Riffle Structure  |
| 5B                   | Western Diversion without Separation – 10 Acres of Dredging – Riffle Structure |
| 5C                   | Western Diversion without Separation – 15 Acres of Dredging – Riffle Structure |
| 5D                   | Western Diversion without Separation – 5 Acres of Dredging – Rock Ramp         |
| 5E                   | Western Diversion without Separation – 10 Acres of Dredging – Rock Ramp        |
| 5F                   | Western Diversion without Separation – 15 Acres of Dredging – Rock Ramp        |
| 5G                   | Western Diversion without Separation – 5 Acres of Dredging – Bypass Channel    |
| 5H                   | Western Diversion without Separation – 10 Acres of Dredging – Bypass Channel   |
| 5I                   | Western Diversion without Separation – 15 Acres of Dredging – Bypass Channel   |

**5.2.7 Alternative 6: River Restoration with Pond Creation.** This alternative would include sediment removal, river diversion, and wetland enhancement, as shown in Figure 5.7. The sediment removal measure is **S6**. The river diversion measure is **R7**. The fish passage measure is **F7**. This is **not** a Sponsor-preferred alternative. Preserving the lake is a key issue for the Sponsor. The Corps and WDNR team members decided to drop Alternative 6 because of the socioeconomic impact it would have on the community and the lack of public support for this type of restoration. This alternative was not evaluated further.



**Figure 5.7. Alternative 6, River Restoration with Pond Creation.**