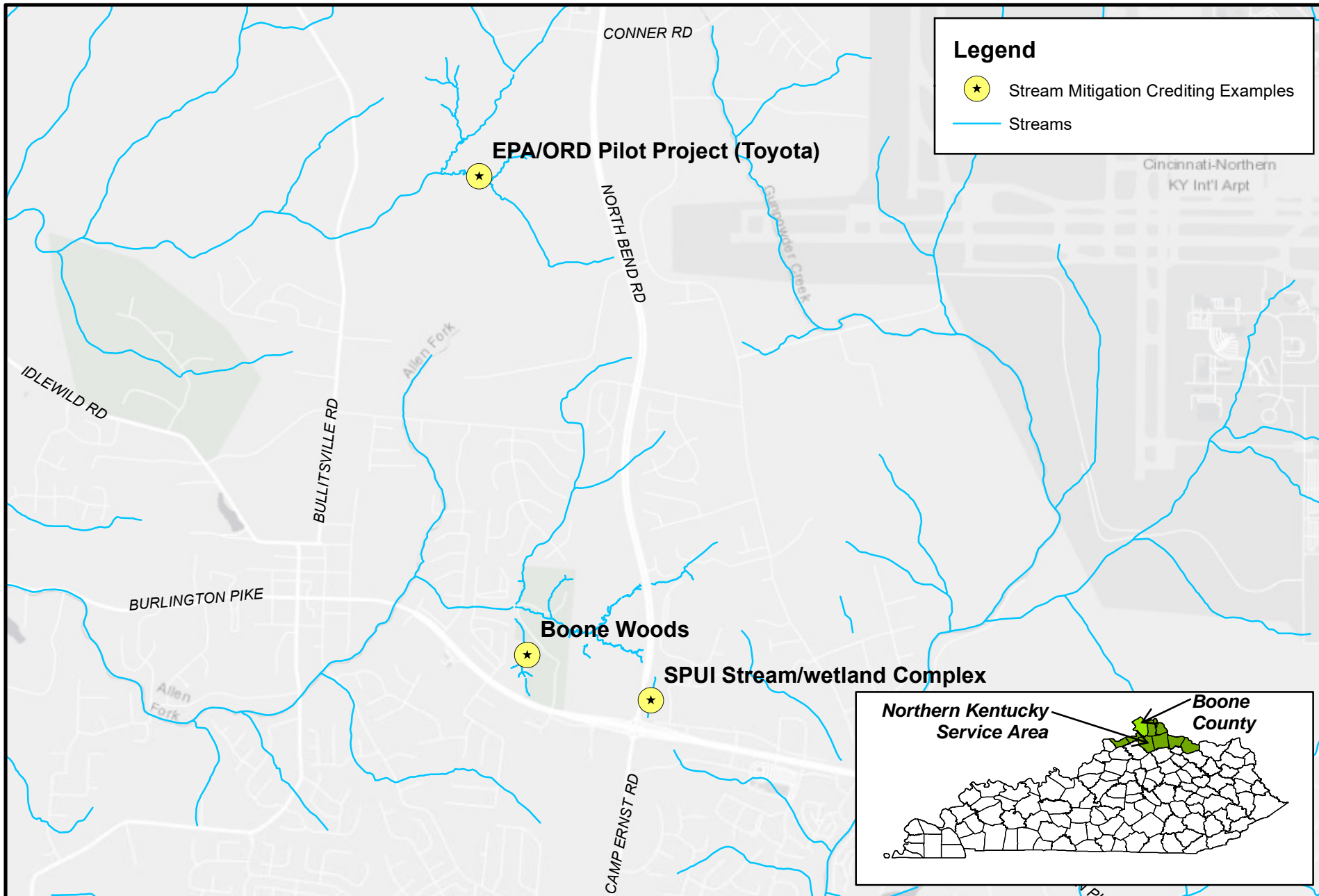



APPENDIX A

Project Location Maps

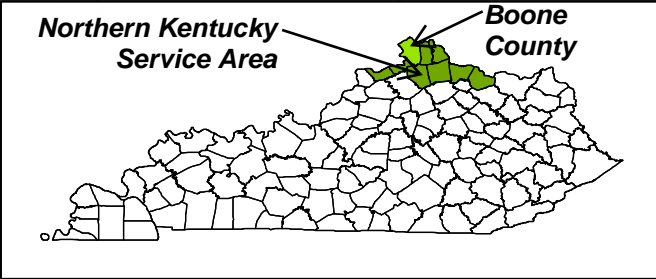
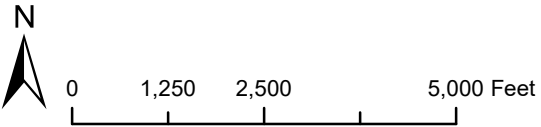


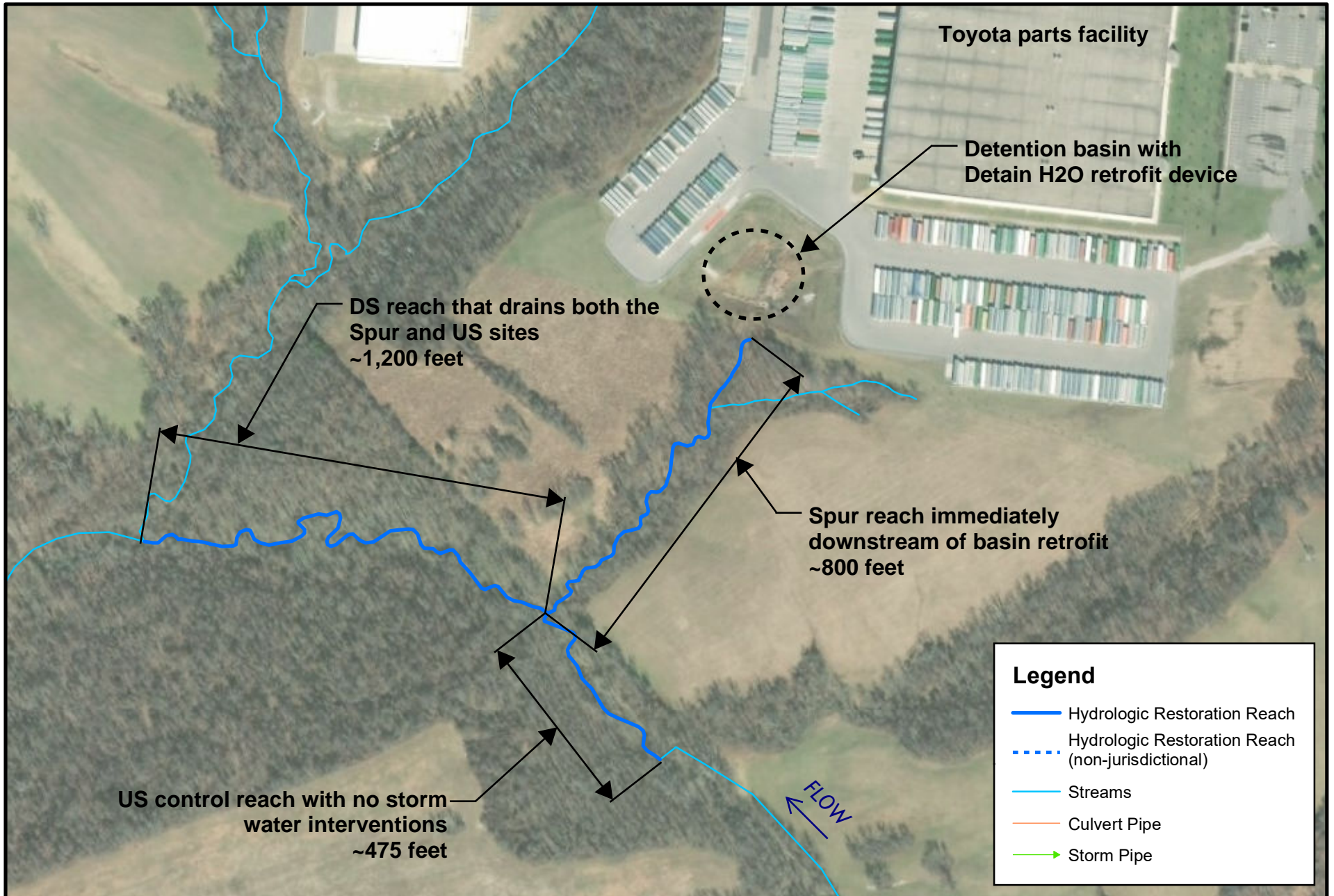
Legend

-  Stream Mitigation Crediting Examples
-  Streams

LOCATION MAP

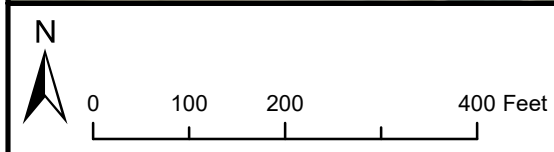
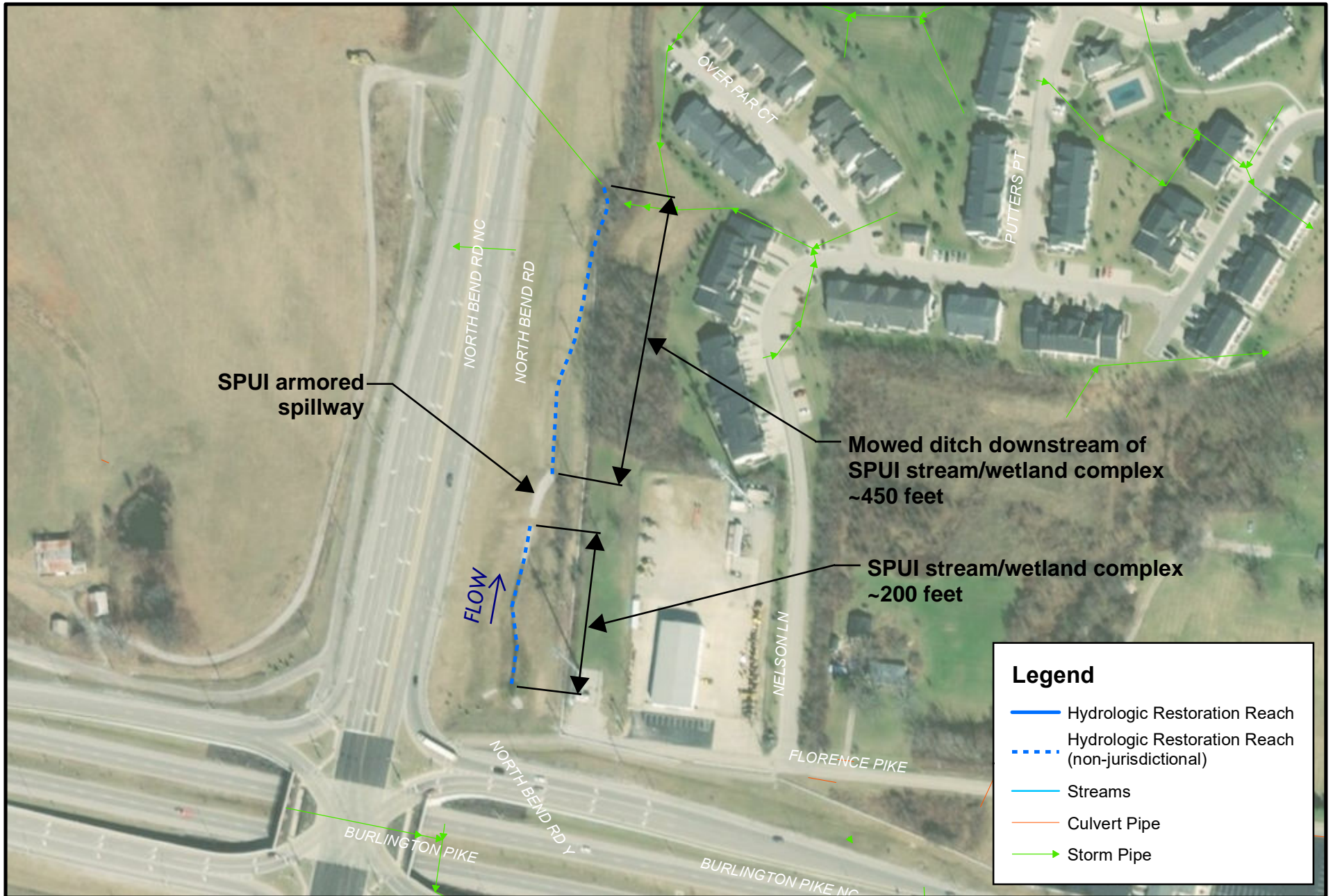
STREAM MITIGATION CREDITING EXAMPLES
 MITIGATION ALTERNATIVE METHODOLOGY DEVELOPMENT
 SANITATION DISTRICT NO. 1 OF NORTHERN KENTUCKY

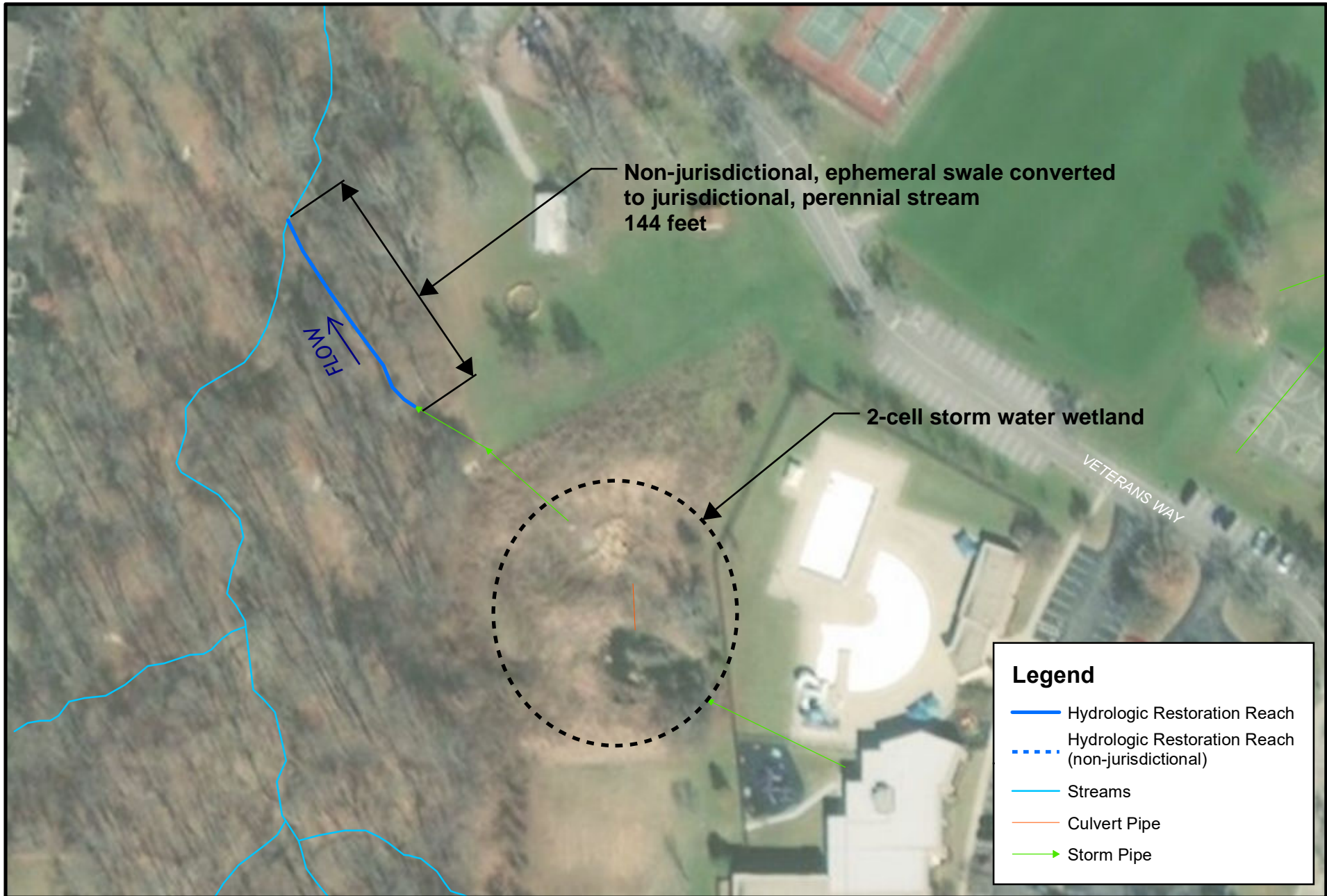




EPA/ORD PILOT PROJECT (TOYOTA)
STREAM MITIGATION CREDITING EXAMPLES
 MITIGATION ALTERNATIVE METHODOLOGY DEVELOPMENT
 SANITATION DISTRICT NO. 1 OF NORTHERN KENTUCKY



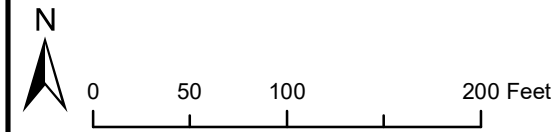




BOONE WOODS

STREAM MITIGATION CREDITING EXAMPLES

*MITIGATION ALTERNATIVE METHODOLOGY DEVELOPMENT
SANITATION DISTRICT NO. 1 OF NORTHERN KENTUCKY*



APPENDIX B

EPA/ORD Pilot Project (Toyota) Rapid Bioassessment Protocol Field Sheets

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|--------------------------------|-----------------------|--|---------------------|---|
| STREAM NAME: Spur | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDTN (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 12/21/2013 | | REASON FOR SURVEY: Pre-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 3 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|--|----|----|----|----|--|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | |
| SCORE (LB): 4 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 7 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | |
| SCORE (LB): 5 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 6 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | |
| SCORE (LB): 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 113 | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|--------------------------------|-----------------------|--|---------------------|--|
| STREAM NAME: Spur | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDT (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 7/8/2019 | | REASON FOR SURVEY: Post-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 7 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|--|----|----|----|----|--|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | |
| SCORE (LB): 8 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 8 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | |
| SCORE (LB): 8 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 8 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | |
| SCORE (LB): 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 143 | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|---|-----------------------|--|---------------------|---|
| STREAM NAME: Upstream (US) reach | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDT (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 8/26/2013 | | REASON FOR SURVEY: Pre-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 18 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------|----|----|----|--|----|----|----|----|--|----|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | | |
| SCORE: | 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | | |
| SCORE: | 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | | |
| SCORE (LB): | 8 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 7 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | | |
| SCORE (LB): | 8 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 7 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | | |
| SCORE (LB): | 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 151 | | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|---|-----------------------|--|---------------------|--|
| STREAM NAME: Upstream (US) reach | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDTN (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 7/8/2019 | | REASON FOR SURVEY: Post-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 16 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------|----|----|----|--|----|----|----|----|--|----|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | | |
| SCORE: | 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | | |
| SCORE: | 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | | |
| SCORE (LB): | 7 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 4 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | | |
| SCORE (LB): | 7 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 5 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | | |
| SCORE (LB): | 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 137 | | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|---|-----------------------|--|---------------------|---|
| STREAM NAME: Downstream (DS) reach | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDT (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 4/29/2013 | | REASON FOR SURVEY: Pre-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 11 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 11 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 9 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------|----|----|----|--|----|----|----|----|--|----|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | | |
| SCORE: | 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | | |
| SCORE: | 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | | |
| SCORE (LB): | 3 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 2 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | | |
| SCORE (LB): | 3 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 3 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | | |
| SCORE (LB): | 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 109 | | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 1

| | | | | |
|---|-----------------------|--|---------------------|--|
| STREAM NAME: Downstream (DS) reach | | LOCATION: Woolper Creek Watershed, near Toyota parts facility | | |
| STREAM WDTN (FT): | DEPTH (FT): | PERENNIAL | INTERMITTENT | EPHEMERAL |
| STATION #: N/A | RIVERMILE: N/A | COUNTY: Boone | | STATE: KY |
| LAT | | LONG | | |
| CLIENT: | | PROJECT NO. EPA/ORD Pilot Project (i.e. Toyota retrofit) | | |
| INVESTIGATORS/CREW: RJH | | | | |
| FORM COMPLETED BY: NLK | | DATE: 7/8/2019 | | REASON FOR SURVEY: Post-retrofit habitat assessment |
| | | TIME: | | |

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | |
|--|---|----|----|----|----|---|----|----|----|----|---|---|---|---|---|--|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | | | | | 40-70% mix of stable habitat; well suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | | | | | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | | | | | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | | | | | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | | | | | Gravel, cobble, and boulder particles are 50- 75% surrounded by fine Sediment. | | | | | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. | | | | | |
| SCORE: 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slowdeep, slow-shallow, fastdeep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.). | | | | | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | | | | | Only 2 of the 4 habitat regimes present (if fastshallow or slow-shallow are missing, score low). | | | | | Dominated by 1 velocity/depth regime (usually slow-deep). | | | | | |
| SCORE: 10 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | | | | | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | | | | | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | | | | | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. | | | | | |
| SCORE: 17 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | | | | | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | | | | | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | | | | | Very little water in channel and mostly present as standing pools. | | | | | |
| SCORE: 12 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

Parameters to be evaluated in sampling reach

HABITAT ASSESSMENT FIELD DATA SHEET - HIGH GRADIENT STREAMS, PAGE 2

| Habitat Parameter | Condition Category | | | | | | | | | | | | | | | | | | | | | |
|--|---|------------|----|----|----|--|----|----|----|----|--|----|---|---|---|---|---|---|---|---|---|---|
| | Optimal | | | | | Suboptimal | | | | | Marginal | | | | | Poor | | | | | | |
| 6. Channel Alteration | Channelization or dredging absent or minimal; stream with normal pattern. | | | | | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (>20 yr.) may be present, but recent channelization is not present. | | | | | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | | | | | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. In stream habitat greatly altered or removed entirely. | | | | | | |
| SCORE: | 15 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 7. Frequency of Riffles (or bends) | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction. | | | | | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | | | | | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | | | | | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ration of > 25. | | | | | | |
| SCORE: | 14 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 8. Bank Stability (score each bank) Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | | | | | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | | | | | Moderately unstable; 30- 60% of bank in reach has areas of erosion; high erosion potential during floods. | | | | | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. | | | | | | |
| SCORE (LB): | 7 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 8 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 9. Vegetative Protection (score each bank) | More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or non- woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | | | | | 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well- represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | | | | | 50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | | | | | Less than 50% of the stream bank surfaces covered by vegetation; disruption of stream bank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. | | | | | | |
| SCORE (LB): | 7 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 8 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| 10. Riparian Vegetative Zone Width (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | | | | | Width of riparian zone 12- 18 meters; human activities have impacted zone only minimally. | | | | | Width of riparian zone 6- 12 meters; human activities have impacted zone a great deal. | | | | | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. | | | | | | |
| SCORE (LB): | 9 | Left Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| SCORE (RB): | 9 | Right Bank | | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | | | | | | | |
| TOTAL SCORE: | 146 | | | | | | | | | | | | | | | | | | | | | |

Parameters to be evaluated in sampling reach