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UPRR Crosby-Dayton 2MT
Proposed Compensatory Mitigation Plan

The Applicant has prepared this mitigation plan as required by Code of Federal Regulations (CFR) Title 33, Part 332.4. Since the Applicant proposes to fulfill their compensatory mitigation obligation by securing credits from an approved mitigation bank, this mitigation plan includes the name of the proposed bank to be used, baseline information, and the determination of credits using the interim Hydrogeomorphic Assessment Method (*iHGM*) for wetlands published by the U.S. Army Corps of Engineers (USACE) Galveston District.

PART I: PROJECT INFORMATION

Project Name: Union Pacific Railroad (UPRR) Crosby-Dayton 2MT

Project Location: Lat. 29.937663°N, Long. -95.031615°W to Lat. 30.024041°N, Long. -94.919102°W

Proposed Mitigation Site Locations:

1. Gin City Mitigation Bank (Primary Service Area)
2. Gulf Coastal Plains Mitigation Bank (Primary Service Area)

Watershed(s): Lower Trinity (HUC 12030203); Trinity-San Jacinto (HUC 12040203)

County or Counties: Harris and Liberty Counties

PART II: AVOIDANCE AND MINIMIZATION

Avoidance, minimization, and compensatory mitigation measures will be implemented to the extent practicable in order to ensure that the proposed project will result in minimal adverse effects to the aquatic environment.

1. **Avoidance**

   The Applicant has avoided impacts to waters of the U.S., including wetlands, to the extent practicable through the design of the proposed project. The locations of waters of the U.S. as well as the design requirements to meet the project purpose and need do not allow complete avoidance of impacts. However, waters of the U.S. in the project vicinity will be avoided by the location and layout of the proposed project. Furthermore, the design includes bridges to the extent practicable to avoid permanent impacts to wetlands and streams crossed by the project.

2. **Minimization**

   The design of the proposed project has minimized impacts to waters of the U.S., including wetlands, to the extent practicable, by not impacting all waters of the U.S. within the project area. The design of the proposed project will include drainage structures to minimize downstream impacts by mimicking the existing flows from the site in order to minimize the erosion potential. The project design uses the minimum distances and widths to accommodate the tracks and other features while meeting the requirements for safe construction and operation. The existing bridges will remain in service to the extent practicable or be replaced to minimize impacts to streams, new bridges will be designed to mimic existing flow conditions, and staging areas were placed to minimize impacts to the existing wetlands and streams. Additionally, fill for the proposed

embankment uses a proposed typical slope of 2:1 (horizontal to vertical), compared to a more common 3:1 or 4:1 slope to minimize wetland impacts. Thus the proposed embankment size, side slope, and track centers (i.e., horizontal distance between sets of tracks) provide the narrowest cross-section that still meets the current design criteria for the project to minimize impacts to wetlands. UPRR has modified the original design to minimize impacts to wetlands to the extent practicable through grading changes along ditches and reducing extent of access roads. New ditches would be about 10 feet wide at bottom and about 3 feet below subgrade of proposed track to promote natural stormwater drainage. UPRR has minimized the clearing of the ROW to the minimum necessary for construction in order to minimize impacts to potential waters of the U.S. Wetlands and streams with temporary impacts will be restored to pre-construction elevations and re-vegetated as appropriate. Furthermore, the proposed project will incorporate water quality measures and best management practices during construction to minimize erosion and sedimentation effects to downstream waters of the U.S.

PART III: COMPENSATORY MITIGATION

Since the Applicant proposed to fulfill their compensatory mitigation requirements by the purchase of credits from an approved mitigation bank, as outlined in the Code of Federal Regulations (CFR) Title 33, Part 332.4, only sections on baseline information and determination of credits are included in this Mitigation Plan.

1. Baseline Information

The following section describes the ecological condition of the proposed impact site. The proposed impact site lies in the Atlantic and Gulf Coast Lowland Forest and Crop Land Resource Region and within an area that has been previously impacted by an existing railway and associated right-of-way that traverses industrial and rural properties comprised of residences, warehouses, and manufacturing as well as pasture/hay, herbaceous, and forested communities.

The site contains twelve streams including Adlong Ditch (S-1), Cedar Bayou (S-7), and West Prong Old River (S-10). Intermittent and perennial streams flow generally southeast through the project area and are artificially channelized and maintained to improve their ability to convey storm water. Ephemeral excavated drainages flow parallel to the existing railroad and/or roadways and are the result of excavation for or erosion from the conveyance of storm water from along the railroad to intermittent or perennial channels. Streams within Harris County flow into Cedar Bayou which becomes a TNW south of the project area. Those streams in Liberty County eventually flow to the Trinity River and its surrounding wetlands. No permanent impacts are anticipated to occur to intermittent and perennial streams for expansion of bridge and culvert drainage structures. Excavated ephemeral drainages S-4, S-5, and S-6 which have formed as a result of excavation for or erosion from stormwater runoff associated with the railroad will be filled and shifted for the embankment of the proposed second track resulting in no permanent net loss to aquatic habitat.

Wetlands identified within the project area are located along the existing railroad right-of-way in depressions at the confluence of multiple upland drainage sources. The impact site is dominated by forested uplands and wetlands unless woody vegetation is artificially maintained/controlled and emergent vegetation is dominant. Common vegetation within forested wetlands includes elm

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(*Ulmus* spp.), green ash (*Fraxinus pennsylvanica*), dwarf palmetto (*Sabal minor*), trumpet creeper (*Campsis radicans*), willow oak (*Quercus phellos), sugar-berry (Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), and Chinese tallow tree (*Triadica sebifera)*. Common vegetation within emergent wetlands includes smartweeds (*Persicaria* spp.), flatsedges (*Cyperus* spp.), alligatorweed (*Alternanthera philoxeroides*), spikerushes (*Eleocharis* spp.), and torpedograss (*Panicum repens*). The majority of these wetlands formed in depressional areas that were historically excavated in uplands for stormwater drainage parallel to the existing railroad or roadways in the project area. These depressions pond water for a short duration immediately following precipitation events and are previously disturbed. For the purposes of a Preliminary Jurisdictional Determination for the proposed permitting action, these excavated wetland areas are considered low quality wetlands classified as palustrine forested wetlands in areas not frequently maintained and palustrine emergent wetlands in areas frequently maintained or more recently disturbed.

The species composition as well as the dominant age structure (less than 30 years old) of the vegetation in the wetlands indicates past or current clearing for agriculture, utility, or transportation maintenance. Thus providing low quality aquatic habitat.

iHGM Report

For quality assessment purposes using *iHGM*, wetlands were evaluated based on location within 100-year floodplain, hydroperiod, vegetation type, and vegetation age structure. Soils across the site are consistently dark and clayey with values less than 4 and a chroma less than 3 (see Delineation report in Attachment C of permit application). Wetlands exist almost exclusively within excavated depressions along the rail right-of-way and show little micro-topographic variation. Woody vegetation age structure is typically less than 30-years old and mixed with native and non-native/invasive species. Naturally developed wetlands that fall outside of this typical topography and vegetation structure have been evaluated separately to adequately capture site characteristics (see below).

Wetlands W-4B and W-4I formed naturally outside of excavated drainages. Their vegetation age structure is mature relative to surrounding wetlands within excavated drainages and have lower dominance of non-native species. Based on historic aerials, these wetlands have not been disturbed in over 50-years. They display signs of more regular hydrology such as oxidized rhizospheres, water stained leaves, and saturation throughout the dry season. The characteristics and extent of these features were documented and mapped on-site.

Due to their indistinct hydrology, small size, and disjointed extent, mapping of the remaining excavated wetland features integrated use of LiDAR and on-site GPS to determine extent. Field reconnaissance verified site characteristics and quality including vegetation, topography, soils, and hydrology. These features were determined to exist within previously disturbed, excavated depressions within the railroad right-of-way, and are dominated by early successional scrub forests or emergent vegetation in frequently to occasionally maintained areas. Hydrologic indicators in these areas typically relied on secondary indicators even during wet seasons. Duration of hydrology in these areas is less than two weeks after rain events with long term inundation occurring only during major flooding events.

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2. Determination of Credits:

Wetlands

The proposed project will permanently impact a total of 0.41 acre of palustrine emergent wetlands and 5.07 acres of palustrine forested wetlands while temporarily impacting 0.28 acre of emergent wetland and 0.95 acre of forested wetland.

The determination of credits needed from a mitigation bank to offset the adverse wetland impacts as a result of the proposed project were calculated using two iHGM analyses, the Non-Forested Riverine iHGM and the Forested Riverine iHGM provided from the USACE Galveston District's Website (see attached worksheets in **Attachments A** and **B**).

The functional capacity units (FCU)/credits needed to be purchased were calculated for three different wetland functions including: Temporary Storage and Detention of Storage Water (Physical), Maintenance of Plant and Animal Community (Biological), and Removal and Sequestration of Elements and Compounds (Chemical). FCU's were calculated (see attached worksheets) based on the pre-project functional capacity indices (FCIs) as well as the impacted acreage.

The wetlands were grouped and evaluated based on four characteristics: watershed location, wetland type, location within 100-year floodplain, and natural formation or formation in excavated drainages. The resulting wetland groups within each watershed are emergent wetlands within floodplain, emergent wetlands outside of floodplain, natural forested wetlands within floodplain, excavated forested wetlands within floodplain, natural forested wetlands outside of floodplain, and excavated forested wetlands outside of floodplain.

While both excavated and natural wetlands have similar chemical functions, the naturally formed forested wetlands have a higher overall functional score (FCIs). The naturally formed wetlands have relatively consistent hydrology throughout the year giving them a higher physical score and have mature, native hardwood vegetation. Because of the physical and biological functions of these features, their overall FCI is comparatively higher than the excavated features which dominate throughout the project area and lack frequent hydrology and mature, native vegetation (see attached worksheets in **Attachments A** and **B**).

Temporary Impacts

A total of 0.95 ac of forested wetland and 0.28 ac of emergent wetland will be temporarily impacted by the proposed project. Impacts will consist of clearing of woody vegetation and in some areas construction of temporary access roads.

Existing emergent wetlands throughout the project area are infrequently inundated, low quality (i.e., artificially excavated), and previously disturbed by activities similar to those proposed. Vegetation in these wetlands is typically early successional and/or invasive and will recover quickly after disturbance. Since no adverse impacts to the aquatic environment from the proposed temporary activities in emergent wetlands will persist after these areas are restored following construction, no compensatory mitigation is proposed for temporary impacts to emergent wetlands.

Forested wetlands will have woody vegetation cleared. While no permanent impact to these wetlands' temporary water detention capacity and ability to remove elements is expected, these areas will be remain as emergent or scrub-shrub dominated wetland in the near term following restoration after construction, thus limiting long-term benefits to the biotic environment from the woody vegetation component. The determination of credits needed to offset these adverse temporary impacts was calculated based on the difference between FCU pre-construction and the FCU immediately post-construction of the impacted forested wetlands.

For temporary forested wetland impacts, a total of 0.2 FCU will be needed to mitigate losses for temporary storage and detention of surface water functions. A total of 0.3 FCU will be needed to mitigate losses for the maintenance of plant and animal community functions. A total of 0.3 FCU will be needed to mitigate losses for the removal and sequestration of elements and compounds functions. Therefore, 0.8 palustrine forested wetland credits will be purchased to offset temporary impacts to forested wetlands (see **Attachment B**).

Permanent Impacts
A total of 0.41 acre of emergent wetland and 5.07 acre of forested wetland with be permanently impacted by the proposed project.

For excavated forested wetlands, a total of 2.2 FCU will be needed to mitigate losses for temporary storage and detention of surface water functions. A total of 2.0 FCU will be needed to mitigate losses for the maintenance of plant and animal community functions. A total of 3.1 FCU will be needed to mitigate losses for the removal and sequestration of elements and compounds functions.

For naturally formed forested wetlands, a total of 0.5 FCU will be needed to mitigate losses for temporary storage and detention of surface water functions. A total of 0.5 FCU will be needed to mitigate losses for the maintenance of plant and animal community functions. A total of 0.6 FCU will be needed to mitigate losses for the removal and sequestration of elements and compounds functions.

For excavated emergent wetlands, a total of 0.1 FCU will be needed to mitigate losses for temporary storage and detention of surface water functions. A total of 0.2 FCU will be needed to mitigate losses for the maintenance of plant and animal community functions. A total of 0.2 FCU will be needed to mitigate losses for the removal and sequestration of elements and compounds functions.

Since the permanently and temporarily impacted forested wetlands are within the primary service area of the Gin City Mitigation Bank, a 1:1 service area multiplier will apply. Therefore, the total credit purchases for impacts to forested wetlands (with FCU values rounded up to the nearest tenth) will include 2.9 FCU physical credits; 2.8 FCU biological credits; and 4.0 FCU chemical credits (see **Table 1**).

Since the permanently impacted emergent wetlands are within the primary service area of the Gulf Coastal Plains Mitigation Bank, a 1:1 service area multiplier will apply. Therefore, the total credit

purchases for impacts to emergent wetlands (with FCU values rounded up to the nearest tenth) will include 0.1 FCU physical credits; 0.2 FCU biological credits; and 0.2 FCU chemical credits (see **Table 1**).

Table 1. Summary of total credits for impacts to wetlands within the project area.

Wetland Type	Approximate Temporary Impacts (Acres)	Approximate Permanent Impacts (Acres)	Mitigation Bank	Mitigation Bank Service Area Multiplier	Credits (Total FCUs Rounded Up)
Emergent (PEMx)	--	0.41	Gulf Coastal Plains	1	0.5
Forested (PFO/PFOx)	0.95	5.07	Gin City	1	9.7
Totals	0.95	5.48	-	-	10.2

Streams / Excavated Drainages

The proposed project will permanently impact 0.18 acre of ephemeral excavated drainages and temporarily impact 0.36 acre of perennial stream, intermittent stream, and ephemeral excavated drainages.

Temporary Impacts

A total of 0.16 acre of perennial stream, 0.17 acre of intermittent stream, and 0.03 acre of ephemeral excavated drainage will be temporarily impacted during the construction of the proposed project. Impacts will consist of construction staging and access and will be restored to pre-construction conditions as construction is completed. Since these channels are already highly modified from previous channelization and maintenance by others, no adverse effects will occur from the temporary impacts by the proposed project; and therefore, no compensatory mitigation is proposed.

Permanent Impacts

A total of 0.18 acre of ephemeral excavated drainages will be permanently impacted as a result of the proposed project. These excavated drainages exist as a result of anthropogenic influences within areas that were likely wetlands prior to development. S-4 was excavated in the past to convey storm water drainage from along the railroad between a private driveway and the existing railroad. S-5 and S-6 are moderately stable gullies with distinct headcuts that occur as the topography slopes steeply from uplands down to the floodplain of Cedar Bayou. These drainages exist at the base of the railroad slope and likely eroded from stormwater runoff along the railroad. The banks in all three drainages show signs of moderately active erosion and have some natural stabilization.

The aquatic habitat these features provide will be replaced through the excavation of replacement ditches. Since the permanently impacted drainage features abut forested wetlands that have been adversely impacted by their creation through anthropogenic influences, compensatory mitigation to offset these permanent drainage impacts is proposed using forested wetland credits in

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proportion to the acres of impact and FCI based on highest quality reference wetlands found on-site.

The FCI of forested wetland W-4B has a score of 0.783 for temporary storage of water, 0.800 for biological maintenance, and 0.850 for removal of elements. Based on the 0.18 acre of impacts to the ephemeral drainages the FCUs (rounded to the nearest tenth) for storage of water is 0.1, biological maintenance is 0.2, and removal of elements is 0.2. As proposed, a total of 0.5 FCUs for ephemeral drainage permanent impacts would be compensated with forested wetland credits to offset 0.18 acre of impacts to ephemeral drainages.

Since the permanently impacted ephemeral drainages are within the primary service area of the Gin City Mitigation Bank, a 1:1 service area multiplier will apply. Therefore, the total credit purchases for impacts to ephemeral drainages (with FCU values rounded up to the nearest tenth) will include 0.1 FCU physical credits; 0.2 FCU biological credits; and 0.2 FCU chemical credits (see **Table 2** and **3**).

Table 2. Summary of total purchase credits for permanent impacts to excavated drainages within the project area.

Type	Permanent Impacts (Acres)	Mitigation Bank	Mitigation Bank Service Area Multiplier	Credits (Total FCUs Rounded Up)
Ephemeral Excavated Drainage	0.18	Gin City	1	0.5
Totals	0.18	-	-	0.5

Table 3. Total FCUs calculated using iHGM analysis and the mitigation bank service area multiplier for impacts to potential waters of the U.S. within the project area.

Feature Type	Mitigation Bank Service Area Multiplier	Physical FCU*	Biological FCU*	Chemical FCU*	Total Purchase Credits (FCUs)*
Emergent (PEMx)	1	0.1	0.2	0.2	0.5
Forested (PFO/PFOx)	1	2.9	2.8	4.0	9.7
Ephemeral Excavated Drainage	1	0.1	0.2	0.2	0.5**
Totals	-	3.1	3.2	4.4	10.7

* Includes rounding up to nearest tenth
** Compensatory mitigation credits for ephemeral excavated drainages will be purchased as forested wetland credits from Gin City Mitigation Bank.

Based on the tables above, the Applicant proposed to purchase a total of 10.2 forested wetland credits (FCUs) from the Gin City Mitigation Bank and 0.5 emergent wetland credits (FCUs) from the Gulf Coastal Plains Mitigation Bank to offset adverse impacts to 6.61 acres of wetlands and excavated drainages resulting from the proposed project.

If a mitigation bank proposed above does not have the proposed credits (FCUs by type) available at the time necessary for credit purchase, then the applicant may choose to purchase credits from another approved mitigation bank in accordance with the approved multipliers for the bank. If necessary the applicant will confirm the revised credit purchase with the USACE prior to completion.

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Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

Applicant: UPRR **WAA ID:** W-1B; W-2B; W-2C; W-3D; W-3H **WAA Acreage:** 0.145 (Excavated)

V_{dur}: Percent of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway *In an average year, at least 80% of the WAA either floods and/or ponds for at least 14 consecutive days.*		
	Subindex:	0.750
Comments: *Within 100 yr floodplain, but not annually inundated from waterway or inundated annually for 14 consecutive days but hydrology is not derived from adjacent waterway.*		
V_{freq}: Frequency that the WAA is flooded and/or ponded by the nearby waterway *Floods or ponds less than 2 out of 5 years (100-500-year floodplain [grey without elevations]).*		
	Subindex:	0.500
Comments: *Within 100 yr floodzone*		
V_{topo}: Roughness associated with the WAA *Smooth, flat, or very gently undulating with little or no topographic features.*		
	Subindex:	0.400
Comments: *Wetlands exist in artificial depressions.*		
V_{wood}: Percentage of the WAA that is covered by woody vegetation *0-10% of the WAA is covered with woody vegetation.*		
Proportion of site covered by typical vegetation:	**Subindex:**	0.100
Comments: *Emergent wetland with little woody vegetation based on wetland determination data forms.*		
V_{mid}: The average/mean coverage of the midstory (shrub/sapling) layer in the WAA *Midstory coverage of the WAA is between 1-25%.*		
	Subindex:	0.100
Comments: *Wetlands exist within maintained utility right-of-ways where vegetation is frequently mowed.*		
V_{herb}: The average/mean coverage of the herbaceous layer in the WAA *Herbaceous cover in the WAA averages greater than 75%.*		
	Subindex:	0.750
Comments: *Average cover of herbaceous layer based on wetland determination data forms.*		

Applicant: UPRR **WAA ID:** W-1B; W-2B; W-2C; W-3D; W-3H **WAA Acreage:** 0.145 (Excavated)

$V_{connect}$: Number of habitat types within 600 feet of the perimeter of the WAA

Habitat to be counted has to be at a minimum 5% of the size of the WAA

Habitat Types:

Forested	Shrub/Sapling
Herbaceous/Prairie/Abandoned Ag Field	Active Ag Field
Open Water	Wetland
Mudflat	Lawn

Wetland plus one other habitat type or two other habitat types.

Subindex: 0.250

$V_{detritus}$: The amount of detritus on the WAA (The A-horizon has to have a Munsell value of 4 or less)

Greater than 85% of the area possesses an O or A horizon.

Subindex: 1.000

Comments:

V_{redox}: The amount of the WAA that exhibits redox features as an indication of the chemical exchange

Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material, but conditions are conducive to redoximporhic processes.

Subindex: 1.000

Comments:

Based on wetland determination data forms.

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

V_{sorpt}: The absorptive properties of the soils in the WAA

The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).

Subindex: 1.000

Comments:

Functional Capacity Indices (FCI) and Units (FCU=FCI*WAA Acreage)	Pre-FCI	Pre-FCU
Temporary Storage & Detention of Storage Water [{Vdur * Vfreq} 1/2 * {vtopo + {Vherb + Vmid/2}/2] 1/2	0.50	0.0729
Maintain Plant & Animal Community {Vmid + Vherb + Vconnect}/3	0.37	0.0532
Removal & Sequestrian of Elements & Compounds {[Vwood + Vfreq + Vdur + [{Vtopo + Vherb + Vmid}/3] + [{Vdetritus + Vredox + Vsorpt}/3]]/5	0.55	0.0802

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

Applicant: UPRR **WAA ID:** W-3B; W-3D; W-3H; W-5A; W-5B **WAA Acreage:** 0.199 **(Excavated)**

V_{dur}: Percent of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway		
The area is NOT subject to flooding.		
	Subindex:	0.000
Comments:		

V_{freq}: Frequency that the WAA is flooded and/or ponded by the nearby waterway		
Floods or ponds less than 2 out of 5 years (100-500-year floodplain [grey without elevations]).		
	Subindex:	0.250
Comments:		
Outside 100 yr floodzone		

V_{topo}: Roughness associated with the WAA		
Smooth, flat, or very gently undulating with little or no topographic features.		
	Subindex:	0.400
Comments:		
Wetlands exist in artificial depressions.		

V_{wood}: Percentage of the WAA that is covered by woody vegetation		
0-10% of the WAA is covered with woody vegetation.		
Proportion of site covered by typical vegetation:	**Subindex:**	0.100
Comments:		
Emergent wetland with little woody vegetation based on wetland determination data forms.		

V_{mid}: The average/mean coverage of the midstory (shrub/sapling) layer in the WAA		
Midstory coverage of the WAA is between 1-25%.		
	Subindex:	0.100
Comments:		
Wetlands exist within maintained utility right-of-ways where vegetation is frequently mowed.		

V_{herb}: The average/mean coverage of the herbaceous layer in the WAA		
Herbaceous cover in the WAA averages greater than 75%.		
	Subindex:	0.750
Comments:		
Average cover of herbaceous layer based on wetland determination data forms.		

Applicant: UPRR **WAA ID:** W-3B; W-3D; W-3H; W-5A; W-5B **WAA Acreage:** 0.199 **(Excavated)**

$V_{connect}$: Number of habitat types within 600 feet of the perimeter of the WAA

Habitat to be counted has to be at a minimum 5% of the size of the WAA

Habitat Types:

Forested	Shrub/Sapling
Herbaceous/Prairie/Abandoned Ag Field	Active Ag Field
Open Water	Wetland
Mudflat	Lawn

Wetland plus one other habitat type or two other habitat types.

Subindex: 0.250

$V_{detritus}$: The amount of detritus on the WAA (The A-horizon has to have a Munsell value of 4 or less)

Greater than 85% of the area possesses an O or A horizon.

Subindex: 1.000

Comments:

V_{redox}: The amount of the WAA that exhibits redox features as an indication of the chemical exchange

Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material, but conditions are conducive to redoximporhic processes.

Subindex: 1.000

Comments:

Based on wetland determination data forms.

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

V_{sorpt}: The absorptive properties of the soils in the WAA

The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).

Subindex: 1.000

Comments:

Functional Capacity Indices (FCI) and Units (FCU=FCI*WAA Acreage)	Pre-FCI	Pre-FCU
Temporary Storage & Detention of Storage Water [{Vdur * Vfreq} 1/2 * {vtopo + {Vherb + Vmid/2}/2] 1/2	0.00	0.0000
Maintain Plant & Animal Community {Vmid + Vherb + Vconnect}/3	0.37	0.0731
Removal & Sequestrian of Elements & Compounds [[Vwood + Vfreq + Vdur + [{Vtopo + Vherb + Vmid}/3] + [{Vdetritus + Vredox + Vsorpt}/3]]/5	0.35	0.0705

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Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

Applicant: UPRR **WAA ID:** W-8B **WAA Acreage:** 0.0003 (Excavated)

V_{dur}: Percent of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway

In an average year, at least 80% of the WAA either floods and/or ponds for at least 14 consecutive days.

Subindex:	0.750

Comments:
Within 100 yr floodplain, but not annually inundated from waterway or inundated annually for 14 consecutive days but hydrology is not derived from adjacent waterway.

V_{freq}: Frequency that the WAA is flooded and/or ponded by the nearby waterway

Floods or ponds less than 2 out of 5 years (100-500-year floodplain [grey without elevations]).

Subindex:	0.500

Comments:
Within 100 yr floodzone

V_{topo}: Roughness associated with the WAA

Smooth, flat, or very gently undulating with little or no topographic features.

Subindex:	0.400

Comments:
Wetlands exist in artificial depressions.

V_{wood}: Percentage of the WAA that is covered by woody vegetation

0-10% of the WAA is covered with woody vegetation.

Proportion of site covered by typical vegetation:	**Subindex:**	0.100

Comments:
Emergent wetland with little woody vegetation based on wetland determination data forms.

V_{mid}: The average/mean coverage of the midstory (shrub/sapling) layer in the WAA

Midstory coverage of the WAA is between 1-25%.

Subindex:	0.100

Comments:
Wetlands exist within maintained utility right-of-ways where vegetation is frequently mowed.

V_{herb}: The average/mean coverage of the herbaceous layer in the WAA

Herbaceous cover in the WAA averages greater than 75%.

Subindex:	0.750

Comments:
Average cover of herbaceous layer based on wetland determination data forms.

Applicant: UPRR **WAA ID:** W-8B **WAA Acreage:** 0.0003 (Excavated)

$V_{connect}$: Number of habitat types within 600 feet of the perimeter of the WAA

Habitat to be counted has to be at a minimum 5% of the size of the WAA

Habitat Types:

Forested	Shrub/Sapling
Herbaceous/Prairie/Abandoned Ag Field	Active Ag Field
Open Water	Wetland
Mudflat	Lawn

Wetland plus one other habitat type or two other habitat types.

Subindex: 0.250

$V_{detritus}$: The amount of detritus on the WAA (The A-horizon has to have a Munsell value of 4 or less)

Greater than 85% of the area possesses an O or A horizon.

Subindex: 1.000

Comments:

V_{redox}: The amount of the WAA that exhibits redox features as an indication of the chemical exchange

Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material, but conditions are conducive to redoximporhic processes.

Subindex: 1.000

Comments:

Based on wetland determination data forms.

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

V_{sorpt}: The absorptive properties of the soils in the WAA

The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).

Subindex: 1.000

Comments:

Functional Capacity Indices (FCI) and Units (FCU=FCI*WAA Acreage)	Pre-FCI	Pre-FCU
Temporary Storage & Detention of Storage Water [{Vdur * Vfreq} 1/2 * {vtopo + {Vherb + Vmid/2}/2] 1/2	0.50	0.0002
Maintain Plant & Animal Community {Vmid + Vherb + Vconnect}/3	0.37	0.0001
Removal & Sequestrian of Elements & Compounds [[Vwood + Vfreq + Vdur + [{Vtopo + Vherb + Vmid}/3] + [{Vdetritus + Vredox + Vsorpt}/3]]/5	0.55	0.0002

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

Applicant: UPRR **WAA ID:** W-5D; W-7B; W-7E; W-8B; W-9A **WAA Acreage:** 0.061 (Excavated)

V_{dur}: Percent of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway *The area is NOT subject to flooding.*		
	Subindex:	0.000
Comments: *Outside 100 yr floodplain*		

V_{freq}: Frequency that the WAA is flooded and/or ponded by the nearby waterway *Floods or ponds less than 2 out of 5 years (100-500-year floodplain [grey without elevations]).*		
	Subindex:	0.250
Comments: *Outside 100 yr floodzone*		

V_{topo}: Roughness associated with the WAA *Smooth, flat, or very gently undulating with little or no topographic features.*		
	Subindex:	0.400
Comments: *Wetlands exist in artificial depressions.*		

V_{wood}: Percentage of the WAA that is covered by woody vegetation *0-10% of the WAA is covered with woody vegetation.*		
Proportion of site covered by typical vegetation:	**Subindex:**	0.100
Comments: *Emergent wetland with little woody vegetation based on wetland determination data forms.*		

V_{mid}: The average/mean coverage of the midstory (shrub/sapling) layer in the WAA *Midstory coverage of the WAA is between 1-25%.*		
	Subindex:	0.100
Comments: *Wetlands exist within maintained utility right-of-ways where vegetation is frequently mowed.*		

V_{herb}: The average/mean coverage of the herbaceous layer in the WAA *Herbaceous cover in the WAA averages greater than 75%.*		
	Subindex:	0.750
Comments: *Average cover of herbaceous layer based on wetland determination data forms.*		

Applicant: UPRR **WAA ID:** W-5D; W-7B; W-7E; W-8B; W-9A **WAA Acreage:** 0.061 (Excavated)

$V_{connect}$: Number of habitat types within 600 feet of the perimeter of the WAA

Habitat to be counted has to be at a minimum 5% of the size of the WAA

Habitat Types:

Forested	Shrub/Sapling
Herbaceous/Prairie/Abandoned Ag Field	Active Ag Field
Open Water	Wetland
Mudflat	Lawn

Wetland plus one other habitat type or two other habitat types.

Subindex: 0.250

$V_{detritus}$: The amount of detritus on the WAA (The A-horizon has to have a Munsell value of 4 or less)

Greater than 85% of the area possesses an O or A horizon.

Subindex: 1.000

Comments:

V_{redox}: The amount of the WAA that exhibits redox features as an indication of the chemical exchange

Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material, but conditions are conducive to redoximporhic processes.

Subindex: 1.000

Comments:

Based on wetland determination data forms.

Riverine Herbaceous/Shrub HGM (Interim) Assessment Pre-Impacts

V_{sorpt}: The absorptive properties of the soils in the WAA

The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).

Subindex: 1.000

Comments:

Functional Capacity Indices (FCI) and Units (FCU=FCI*WAA Acreage)	Pre-FCI	Pre-FCU
Temporary Storage & Detention of Storage Water [{Vdur * Vfreq} 1/2 * {vtopo + {Vherb + Vmid/2}/2] 1/2	0.00	0.0000
Maintain Plant & Animal Community {Vmid + Vherb + Vconnect}/3	0.37	0.0224
Removal & Sequestrian of Elements & Compounds [[Vwood + Vfreq + Vdur + [{Vtopo + Vherb + Vmid}/3] + [{Vdetritus + Vredox + Vsorpt}/3]]/5	0.35	0.0216

Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area:

Acreage = 1.427 W-5C; W-6A; W-7A; W-7C; W-8A; W-9A; W-9B (Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.25	Floods or ponds less than 2 out of 5 years (100-year to 500-year floodplain grey without elevations).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.30	Less than 3 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.80	The average basal area of the WAA is between 80-100 square feet per acre.
$V_{density}$	0.60	The WAA averages a tree density of 250-500 trees per acre OR 50-100 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 1.427

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.495
Maintain Plant & Animal Com. (2)	0.433
Removal of Elements (3)	0.713

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.707
alculated FCU (Maintain Plant & Animal)	0.619
Calculated FCU (Removal of Elements)	1.018

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Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area:

Acreage = 0.0003 W-8A (Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.50	From 3-7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.60	The average basal area of the WAA is between 60-80 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 0.0003

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.623
Maintain Plant & Animal Com. (2)	0.483
Removal of Elements (3)	0.777

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.0002
alculated FCU (Maintain Plant & Animal)	0.0001
Calculated FCU (Removal of Elements)	0.0002

JUN 1 1 2019

Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area: W-1C; W-1D; W-2A; W-2D; W-2F; W-2G; W-3E; W-4A; W-4E (Excavated)

Acreage = 0.816

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.50	From 3-7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.60	The average basal area of the WAA is between 60-80 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 0.816

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.623
Maintain Plant & Animal Com. (2)	0.483
Removal of Elements (3)	0.777

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.508
alculated FCU (Maintain Plant & Animal)	0.394
Calculated FCU (Removal of Elements)	0.634

Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area: W-4B (Natural)

Acreage = 0.049

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	1.00	Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	1.00	More than 7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	1.00	Five or more species present.
V_{basal}	1.00	The average basal area of the WAA is greater than 100 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	1.00	Herbaceous cover in the WAA averages between 5-30%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.50	Wetland plus one other habitat type OR two other habitat types.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 0.049

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.783
Maintain Plant & Animal Com. (2)	0.800
Removal of Elements (3)	0.850

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.038
alculated FCU (Maintain Plant & Animal)	0.039
Calculated FCU (Removal of Elements)	0.042

Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area:

Acreage = 2.053 W-1D; W-2G; W-3A; W-3C; W-3E; W-3I; W-4A; W-4E; W-4J (Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.25	Floods or ponds less than 2 out of 5 years (100-year to 500-year floodplain grey without elevations).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.30	Less than 3 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.80	The average basal area of the WAA is between 80-100 square feet per acre.
$V_{density}$	0.60	The WAA averages a tree density of 250-500 trees per acre OR 50-100 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 2.053

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.495
Maintain Plant & Animal Com. (2)	0.433
Removal of Elements (3)	0.713

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	1.017
alculated FCU (Maintain Plant & Animal)	0.890
Calculated FCU (Removal of Elements)	1.464

Permanent Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area: W-4I (Natural)

Acreage = 0.713

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.25	Floods or ponds less than 2 out of 5 years (100-year to 500-year floodplain grey without elevations).
V_{topo}	1.00	Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	1.00	More than 7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.50	More than 20% of stand is oak, hickory, cypress, maple, and/or elm. Black willow, cottonwood, Chinese tallow, and sycamore do not represent more than 15% of the stand.
V_{rich}	0.60	Three tree species present.
V_{basal}	1.00	The average basal area of the WAA is greater than 100 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	0.75	Midstory coverage of the WAA is between 31-50%.
V_{herb}	1.00	Herbaceous cover in the WAA averages between 5-30%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Existing Wetland Assessment Area

Acreage = 0.713

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.658
Maintain Plant & Animal Com. (2)	0.704
Removal of Elements (3)	0.800

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.469
Calculated FCU (Maintain Plant & Animal)	0.502
Calculated FCU (Removal of Elements)	0.570

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Pre-Impact

Acreage = 0.114 W-4I (Natural)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.25	Floods or ponds less than 2 out of 5 years (100-year to 500-year floodplain grey without elevations).
V_{topo}	1.00	Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	1.00	More than 7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.50	More than 20% of stand is oak, hickory, cypress, maple, and/or elm. Black willow, cottonwood, Chinese tallow, and sycamore do not represent more than 15% of the stand.
V_{rich}	0.60	Three tree species present.
V_{basal}	1.00	The average basal area of the WAA is greater than 100 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	0.75	Midstory coverage of the WAA is between 31-50%.
V_{herb}	1.00	Herbaceous cover in the WAA averages between 5-30%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.658
Maintain Plant & Animal Com. (2)	0.704
Removal of Elements (3)	0.800

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.075
Calculated FCU (Maintain Plan & Animal)	0.080
Calculated FCU (Removal of Elements)	0.091

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Post-Impact (Cleared)

Acreage = 0.114

W-4I
(Natural)

Post-Project Year - 1

Variable	Subindex	Comment
V_{dur}	1.00	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.10	The area is openland (pasture or cropland).
V_{wood}	0.10	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.10	The area is openland (pasture or cropland).
V_{rich}	0.10	The area is openland (pasture or cropland).
V_{basal}	0.10	The area is openland (pasture or cropland).
$V_{density}$	0.10	The area is openland (pasture or cropland).
V_{mid}	0.10	The area is openland (pasture or cropland).
V_{herb}	0.10	The area is openland (pasture or cropland).
$V_{detritus}$	0.30	Less than 10% of the area possesses an O or A horizon.
V_{redox}	0.10	Redox features less than 20%.
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.75	Wetland plus two or more habitat types (other than forested) OR three or more habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.376
Maintain Plant & Animal Com. (2)	0.208
Removal of Elements (3)	0.453

Functional Capacity Units (FCU)
Post-Project

Calculated FCU (Temp Storage)	0.043
Calculated FCU (Maintain Plan & Animal)	0.024
Calculated FCU (Removal of Elements)	0.052

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Acreage = 0.025

W-3C; W-3I; W-4J
(Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.25	Floods or ponds less than 2 out of 5 years (100-year to 500-year floodplain grey without elevations).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.30	Less than 3 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.80	The average basal area of the WAA is between 80-100 square feet per acre.
$V_{density}$	0.60	The WAA averages a tree density of 250-500 trees per acre OR 50-100 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.495
Maintain Plant & Animal Com. (2)	0.433
Removal of Elements (3)	0.713

Functional Capacity Units (FCU)
Pre-Project

Calculated FCU (Temp Storage)	0.013
Calculated FCU (Maintain Plan & Animal)	0.011
Calculated FCU (Removal of Elements)	0.018

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Post-Impact (Cleared)

Acreage = 0.025

W-3C; W-3I; W-4J
(Excavated)

Post-Project Year - 1

Variable	Subindex	Comment
V_{dur}	1.00	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.10	The area is openland (pasture or cropland).
V_{wood}	0.10	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.10	The area is openland (pasture or cropland).
V_{rich}	0.10	The area is openland (pasture or cropland).
V_{basal}	0.10	The area is openland (pasture or cropland).
$V_{density}$	0.10	The area is openland (pasture or cropland).
V_{mid}	0.10	The area is openland (pasture or cropland).
V_{herb}	0.10	The area is openland (pasture or cropland).
$V_{delritus}$	0.30	Less than 10% of the area possesses an O or A horizon.
V_{redox}	0.10	Redox features less than 20%.
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.75	Wetland plus two or more habitat types (other than forested) OR three or more habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.376
Maintain Plant & Animal Com. (2)	0.208
Removal of Elements (3)	0.453

Functional Capacity Units (FCU)
Post-Project

Calculated FCU (Temp Storage)	0.010
Calculated FCU (Maintain Plan & Animal)	0.005
Calculated FCU (Removal of Elements)	0.012

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Pre-Impact

Acreage = 0.036

W-4B
(Natural)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	1.00	Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	1.00	More than 7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	1.00	Five or more species present.
V_{basal}	1.00	The average basal area of the WAA is greater than 100 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	1.00	Herbaceous cover in the WAA averages between 5-30%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.50	Wetland plus one other habitat type OR two other habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.783
Maintain Plant & Animal Com. (2)	0.800
Removal of Elements (3)	0.850

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.028
Calculated FCU (Maintain Plan & Animal)	0.028
Calculated FCU (Removal of Elements)	0.030

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Post-Impact (Cleared)

Acreage = 0.036

W-4B
(Natural)

Post-Project Year - 1

Variable	Subindex	Comment
V_{dur}	1.00	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.10	The area is openland (pasture or cropland).
V_{wood}	0.10	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.10	The area is openland (pasture or cropland).
V_{rich}	0.10	The area is openland (pasture or cropland).
V_{basal}	0.10	The area is openland (pasture or cropland).
$V_{density}$	0.10	The area is openland (pasture or cropland).
V_{mid}	0.10	The area is openland (pasture or cropland).
V_{herb}	0.10	The area is openland (pasture or cropland).
$V_{detritus}$	0.30	Less than 10% of the area possesses an O or A horizon.
V_{redox}	0.10	Redox features less than 20%.
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.75	Wetland plus two or more habitat types (other than forested) OR three or more habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.376
Maintain Plant & Animal Com. (2)	0.208
Removal of Elements (3)	0.453

Functional Capacity Units (FCU)
Post-Project

Calculated FCU (Temp Storage)	0.013
Calculated FCU (Maintain Plan & Animal)	0.007
Calculated FCU (Removal of Elements)	0.016

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Pre-Impact

Acreage = 0.100 W-1C; W-1D; W-1E; W-3E; W-4E; W-4F (Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 7 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.50	From 3-7 pieces of cwd greater than 3" in diameter along a 100-foot transect.
V_{wood}	1.00	Greater than 90% of the WAA is covered with woody vegetation.
V_{tree}	0.30	Less than 20% of stand is oak, hickory, cypress, maple, and/or elm.
V_{rich}	0.40	One-two tree species present.
V_{basal}	0.60	The average basal area of the WAA is between 60-80 square feet per acre.
$V_{density}$	1.00	The WAA averages a tree density of 100-250 trees per acre.
V_{mid}	1.00	Midstory coverage of the WAA is more than 50%.
V_{herb}	0.30	Herbaceous cover in the WAA is less than 5% OR greater than 50%.
$V_{detritus}$	1.00	Greater than 85% of the area possesses an O or A horizon.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	One other habitat type other than urban habitat.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.623
Maintain Plant & Animal Com. (2)	0.483
Removal of Elements (3)	0.777

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.062
Calculated FCU (Maintain Plan & Animal)	0.048
Calculated FCU (Removal of Elements)	0.078

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Post-Impact (Cleared)

Acreage = 0.100

W-1C; W-1D; W-1E; W-3E; W-4E; W-4F (Excavated)

Post-Project Year - 1

Variable	Subindex	Comment
V_{dur}	1.00	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.10	The area is openland (pasture or cropland).
V_{wood}	0.10	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.10	The area is openland (pasture or cropland).
V_{rich}	0.10	The area is openland (pasture or cropland).
V_{basal}	0.10	The area is openland (pasture or cropland).
$V_{density}$	0.10	The area is openland (pasture or cropland).
V_{mid}	0.10	The area is openland (pasture or cropland).
V_{herb}	0.10	The area is openland (pasture or cropland).
$V_{detritus}$	0.30	Less than 10% of the area possesses an O or A horizon.
V_{redox}	0.10	Redox features less than 20%.
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.75	Wetland plus two or more habitat types (other than forested) OR three or more habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.376
Maintain Plant & Animal Com. (2)	0.208
Removal of Elements (3)	0.453

Functional Capacity Units (FCU)

Post-Project

Calculated FCU (Temp Storage)	0.038
Calculated FCU (Maintain Plan & Animal)	0.021
Calculated FCU (Removal of Elements)	0.045

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Pre-Impact

Acreage = 0.665 W-5C; W-6A; W-7A; W-7C; W-7F; W-8A; W-8C; W-9B (Excavated)

Pre-Project Year - 0

Variable	Subindex	Comment
V_{dur}	0.75	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.25	Floods or ponds annually 5 out of 5 years (floodway).
V_{topo}	0.40	Smooth, flat, or very gently undulating with little or no topographic features.
V_{cwd}	0.30	The area is openland (pasture or cropland).
V_{wood}	1.00	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.30	The area is openland (pasture or cropland).
V_{rich}	0.40	The area is openland (pasture or cropland).
V_{basal}	0.80	The area is openland (pasture or cropland).
$V_{density}$	0.60	The area is openland (pasture or cropland).
V_{mid}	1.00	The area is openland (pasture or cropland).
V_{herb}	0.30	The area is openland (pasture or cropland).
$V_{detritus}$	1.00	The site is plowed.
V_{redox}	1.00	Redox concentrations represent at least 20% of the pedon within the top 4 inches of the soil surface, or feature masked due to parent material but conditions are conducive to redoximorphic processes (many mottles).
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.25	Wetland plus one other habitat type OR two other habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.495
Maintain Plant & Animal Com. (2)	0.433
Removal of Elements (3)	0.713

Functional Capacity Units (FCU)

Pre-Project

Calculated FCU (Temp Storage)	0.329
Calculated FCU (Maintain Plan & Animal)	0.288
Calculated FCU (Removal of Elements)	0.474

Temporary Impacts

Interim Riverine Forested Hydrogeomorphic Analysis Worksheet

Post-Impact (Cleared)

Acreage = 0.665 W-5C; W-6A; W-7A; W-7C; W-7F; W-8A; W-8C; W-9B (Excavated)

Post-Project Year - 1

Variable	Subindex	Comment
V_{dur}	1.00	In an average year, at least 80% of the WAA floods and/or ponds for at least 14 consecutive days.
V_{freq}	0.50	Floods or ponds 2 out of 5 years (100-year floodplain).
V_{topo}	0.40	Less than 15% of the WAA is represented by dips, hummocks, channel sloughs, and/or other topographic features.
V_{cwd}	0.10	The area is openland (pasture or cropland).
V_{wood}	0.10	0-10% of the WAA is covered with woody vegetation.
V_{tree}	0.10	The area is openland (pasture or cropland).
V_{rich}	0.10	The area is openland (pasture or cropland).
V_{basal}	0.10	The area is openland (pasture or cropland).
$V_{density}$	0.10	The area is openland (pasture or cropland).
V_{mid}	0.10	The area is openland (pasture or cropland).
V_{herb}	0.10	The area is openland (pasture or cropland).
$V_{detritus}$	0.30	Less than 10% of the area possesses an O or A horizon.
V_{redox}	0.10	Redox features less than 20%.
V_{sorpt}	1.00	The WAA is dominated by montmorillonitic clayey soils (clay, clay loams, silty clay loams) or soils with high organic (2/1, 2/2, or 3/1).
$V_{connect}$	0.75	Wetland plus two or more habitat types (other than forested) OR three or more habitat types.

Functional Capacity Index (FCI)

Temp. Storage of Water (1)	0.376
Maintain Plant & Animal Com. (2)	0.208
Removal of Elements (3)	0.453

Functional Capacity Units (FCU)

Post-Project

Calculated FCU (Temp Storage)	0.250
Calculated FCU (Maintain Plan & Animal)	0.139
Calculated FCU (Removal of Elements)	0.301