Lacustrine Fringe HGM Interim (FCI formulas)

Maintain Terrestrial Animal Community:

$$[\{V_{tree} + V_{mid} + V_{herb}/3\} + V_{connect} + V_{typical}]/3$$

Aquatic Biota Potential

$$[\{V_{edge} + 2\,V_{hydro} + [(V_{sub} + V_{VD})1/2]/3.5\} + V_{typical}]/2$$

Maintain Shoreline Integrity:

$$[\{V_{dur} \text{ X } Vfreq\}^{1/2} \text{ X } \{V_{topo} + V_{cwd} + V_{herb}\}/3 + V_{sorpt}/2]\ 1/2$$

Removal & Sequestrian of Elements & Compounds:

$$[[V_{wood} + V_{freq} + V_{dur} + [\{V_{topo} + V_{cwd} + V_{herb}\}/3] + [\{V_{detritus} + V_{redox} + V_{sorpt}\}/3]]/5$$

V_{tree} V_{mid}
V_{herb} $V_{connect}$
$V_{typical}$ V_{edge}
V_{hydro} V_{sub}
V_{VD} V_{dur}
V_{freq} V_{topo}
V_{cwd} V_{sorpt}
V_{wood} $V_{detritus}$
V_{redox}

- The HGM interim model is designed to be used in lacustrine (lakes: which are defined in federal regulations as bodies of open water that are greater than 5-acres in size) fringe setting in Texas and is only to be used for a rapid non-controversial estimate of the potential impacts to lacustrine wetlands and to verify that the proposed mitigation will adequately compensate for the wetland functions that are being impacted.

Variables for HGM (Interim) Lacustrine Fringe

V_{tree}: Percentage of the trees in the WAA that are mast producers

Criteria	Variable Sub Index
At least 60% of the stand is oak, hickory, cypress, maple and/or elm. Black willow, cottonwood, tallow and sycamore do not represent more than 5% of the stand.	**1.00**
At least 40% of the stand is oak, hickory, cypress, maple and/or elm. Black willow, cottonwood, tallow and sycamore do not represent more than 10% of the stand.	**0.80**
More than 20% of the stand is oak, hickory, cypress, maple and/or elm. Black willow, cottonwood, tallow and sycamore do not represent more than 15% of the stand.	**0.50**
Less than 20% of the stand is oak, hickory, cypress, maple and/or elm.	**0.30**
The area is openland (non-forested)	**0.10**

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

Criteria	Variable Sub Index
Midstory coverage of the WAA is more than 50%	**1.00**
Midstory coverage of the WAA is between 31-50 %	**0.75**
Midstory coverage of the WAA is between 11-30%	**0.50**
Midstory coverage of the WAA is less than 10%	**0.25**
The site is openland (non-forested)	**0.10**

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

Criteria	Variable Sub Index
Herbaceous cover in the WAA averages greater than 75%	**1.00**
Herbaceous cover in the WAA averages between 50-75%	**0.75**
Herbaceous cover in the WAA averages between 25-50%	**0.50**
Herbaceous cover in the WAA average is between 1-25%	**0.25**
Herbaceous cover in the WAA is equal to or less than 1% (barren soil or all shrub)	**0.10**

$V_{connect}$: the number of habitat types within a 600' of the parameter 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 Agricultural Field
Open water	Wetland
Mudflat	Lawn

Criteria:	Variable Sub Index
Wetland plus for forest	**1.00**
Wetland plus two or more habitat type (other than forested) OR three or more habitat types	**0.75**
Wetland plus one other habitat types or two other habitat types	**0.50**
One other habitat types other than urban habitat	**0.25**
Surround by urban (homes, lawn, concrete, etc.)	**0.10**

$V_{typical:}$ proportion of the site that is covered by vegetation typical of the regional subclass

Invasive species: Tallow, alligator weeds, common reed, rattlebox, cattail, flat sedge

(Sapium sabiferum, Alternathera philoxeroides, Phragmites drummondii, Sesbania drumondii, Typha sp., Cyperus entranianus)

Total % Cover by typical species	Variable sub-index
10 %	0.1
20 %	0.1
30 %	0.2
40 %	0.4
50 %	0.5
60 %	0.6
70 %	0.7
80 %	0.9
90 %	1.0
100 %	1.0

$V_{edge:}$ the amount of wetlands-water meters/hectare

Site Description	Qualitative	Quantitative	Subindex
Marsh shows deterioration due to subsidence large amounts of open water	Very High	Greater than 800 m/ha	0.8
Well developed tidal drainage network present OR Simple tidal network with isolated ponds & depression in the marsh interior OR Large amount of shallow shoreline in relations to the entire area	High	350—800 m/ha	1.0
Simple tidal drainage network ..isolated ponds and depressions are few & lacking	Moderate	200-350 m/ha	0.7
Marsh lack both tidal creeks & isolated ponds & depressions, shoreline is linear or smooth …Marsh area is large relative to shoreline length.	Low	Less than 200 m/ha	0.4

$V_{hydro:}$ site hydroperiod or degree of hydrological modifications

Site Description	Subindex
Site is open, no hydrologic restrictions	1.0
Moderate hydrologic restriction (i.e low level berms that overtop freq. by waves, or has mutli- breeches or large numerous culverts)	0.6
Severe hydrologic restriction (high elevation berm with in freq over-top, small culverts, single opening or breech)	0.3
Site receives water only during extreme storm events	0.1
Site is cut off from wave or open water exchange	0.0

$V_{sub:}$ The predominate type of substrate within the WAA

Substrate Type	Description	Variable Sub index.
Sandy	Primarily silicate materials	1.0
Gravel &/or Small Rock	Particle size from 5mm to 5cm	1.0
Cobble	Particle size from 5-15cm	0.6
Boulder &/or large Rip-Rap	Greater than 15 cm	0.4
Other	Less than 5mm and not silicate material	0.8

V **VD**: The predominant type of vegetative habitat diversity within the WAA

(note it has to comprise at least 10% of the WAA to be considered as a habitat)

Tree is greater than 18 feet tall from ground surface.
Shrub is 3-18 feet tall from ground surface.
Herb is non-woody and 0-3-foot meters from the ground surface

Vegetative Diversity	Description	Variable Sub index
Trees only	**Tree is greater than 6 meters from ground surface**	**0.2**
Trees & Shrubs	**1 to 6+ meters above the grounds surface**	**0.5**
Trees, shrubs & herbs	**0 to 6+ meters above the grounds surface**	**0.75**
Shrubs & Herbs	**0 to 6 meters above the ground surface**	**1.0**
Herbs or Shrubs only	**0 to 1 or 1to 6 meters above the ground surface**	**0.5**
Barren	**No emergent macrophytic vegetation in the WAA**	**0.0**

V**dur**: The % of the WAA that is flooded and/or ponded due to the hydrology (i.e. flooding overbank flow) of the nearby waterway

Criteria	Variable Sub index
In an average year at 80% of the WAA either floods and/or ponds for at least 14 consecutive days	**1.00**
In an average year at 80% of the WAA either floods and/or ponds for at least 7 consecutive days	**0.75**
In an average year at 50-79% of the WAA either floods and/or ponds for at least 7 consecutive days	**0.50**
In an average year at 25-50% of the WAA either floods and/or ponds for at lease 7 consecutive days	**0.25**
In an average year all or portions of the WAA either floods and/or ponds for at least 1-7 consecutive days	**0.10**
The area is NOT subject to flooding	**0.00**

V**freq**: The frequency that the WAA is flooded and/or ponded by nearby waterway .

Criteria	Variable Sub index
Floods or pond annually 5 out of 5 years (floodway)	**1.00**
Floods or ponds 3 or 4 out of 5 years (elevation data reveals in floodway and mapped w/n 100 yr floodplain)	**0.75**
Floods or ponds 2 out of 5 years (100- year floodplain)	**0.50**
Floods or ponds less than 2 out of 5 years (100-500 yr floodplain grey w/out elevations)	**0.25**
The area is not subject to flooding or ponding (500 yr floodplain)	**0.00**

V**topo**: The roughness associated with the WAA

Criteria	Variable Sub Index
Greater than 30% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	**1.00**
15 - 30% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	**0.70**
Less than 15% of the WAA is represented by dips, hummocks, channel sloughs and/or other topographic features	**0.40**
Smooth, flat, or very gentle undulating with little or no topographic features	**0.10**

V**cwd**: Coarse Woody Debris within the WAA

Criteria	Variable Sub Index
More than 7 pieces of cwd greater than 3" diameter along 100' transect	**1.00**
From 3 -7 pieces of cwd greater than 3" diameter along 100' transect	**0.50**
Less than 3 pieces of cwd greater than 3" diameter along 100' transect	**0.30**
Area is openland (pasture or cropland)	**0.10**

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

Criteria	Variable Sub Index
Herbaceous cover in the WAA averages greater than 75%	1.00
Herbaceous cover in the WAA averages between 50-75%	0.75
Herbaceous cover in the WAA averages between 25-50%	0.50
Herbaceous cover in the WAA average is between 1-25%	0.25
Herbaceous cover in the WAA is equal to or less than 1% (barren soil or all shrub)	0.10

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

Criteria	Variable Sub Index
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)	1.00
WAA is dominated by loamy (silt loams, very fine sandy loams, loam) or non-montmorillonitic clays	0.50
The WAA is dominated by sandy soils (sands, loamy fine sands, loamy sands)	0.10

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

Criteria	Variable Sun Index
Greater than 90% of the WAA is covered with woody vegetation	1.00
67 to 90 % of the WAA is covered with woody vegetation	0.75
34 to 66% of the WAA is covered with woody vegetation	0.50
11 to 33% of the WAA is covered with woody vegetation	0.25
0-10% if the WAA is covered with woody vegetation	0.10

$V_{detritus}$: The amount of the dentritius on the WAA

(A horizon has to have a value of 4 or less)

Criteria	Variable Sub Index
Greater than 85% of the area possesses an O or A horizon	1.00
From 11-84% of the area possesses an O or A horizon	0.50
Less than 10% of the area possesses an O or A horizon	0.30
Site is plowed or primarily covered with rip-rap or revetment mats	0.10

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

Criteria	Variable Sub Index
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)	1.0
Redox features less than 20%	0.1

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

Criteria	Variable Sub Index
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)	1.00
WAA is dominated by loamy (silt loams, very fine sandy loams, loam) or non-montmorillonitic clays	0.50
The WAA is dominated by sandy soils (sands, loamy fine sands, loamy sands) or large concrete blocks	0.10

Lacustrine HGM Interim

The techniques used to determine which functional capacity index (FCI) will be used for each variable rare typically based on standard techniques described in detail in the 1987 Corps Wetland Delineation Manual, the NRCS 3rd Edition to the National Food Security Act Manual (NFSAM), "A Regional Guidebook for Assessing the Functions of Lacustrine Fringe Wetlands Associated with Reservoirs in Oklahoma" and/or the "A Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Northwest Gulf of Mexico Tidal Fringe". These sources will hereafter be referred to as the 87 WDM, NFSAM, and the Lacustrine and/or Tidal Fringe Guidebooks, respectively.

Documentation should be made for each variable as to which method, indicator, plot size was used for each variable. The number of sample plots is related to the variability of the site. Significantly different timber age classes or species types should be sampled separately. One of two sample plots might be sufficiently in a small uniform site, whereas, numerous sample plots would be required for a large diverse site. The following is a general definition and guidance on the methodology for each variable.

$V_{\textbf{tree}}$: Percentage of the trees in the WAA that are mast producers (i.e. nut trees, pecan, hickory oaks, and elms and cypress)

$V_{\textbf{mid: Midstory (Shrubs/saplings/woody vines)}}$: The midstory layer is the layer of botanical specie located between the herbaceous and forest/tree canopy. This would included shrubs, saplings, smaller trees, small trees, and large woody vines. A measure is taken at each plot and/or a visual estimate is performed at each sample location(s).

$V_{\textbf{herb}}$: Herbaceous layers are identified at each data location/plot as is described it in the 87 WDM. It is recommended that 2-5 sub plots be taken at each location to account for vegetative variability.

$V_{\textbf{connect}}$: This variable concentrations on the geo-location of the WAA in relationship to other habitat type within 600 feet from the perimeter of the WAA.

$V_{\textbf{typical}}$: Proportion of the WAA that is covered by vegetation typical of the regional subclass. Invasive species: Tallow tree, weeds, common reed, rattlebox, cattail, flatsedge
(Sapium sabiferum, Alternathera philoxeroides, Phragmites drummondii, Sesbania drumondii, Typha sp., Cypress entranianus)

$V_{\textbf{edge}}$: the amount of wetlands-water meters/hectare

$V_{\textbf{hydro}}$: site hydroperiod or degree of hydrological modifications

$V_{\textbf{sub}}$: The predominate type of substrate within the WAA

$V_{\textbf{VD}}$: The predominant type of vegetative habitat diversity within the WAA
(note it has to comprise at least 10% of the WAA to be considered as a habitat)
Tree is greater than 18 feet tall from ground surface.
Shrub is 3-18 feet tall from ground surface.
Herb is non-woody and 0-3-foot meters from the ground surface

V_{dur}: Indicators as described in the Wetland Hydrology Section of the 87 WDM (paragraphs 46-49) will be utilized to estimate duration of flooding and/or ponding. NOTE: unlike the criteria for hydrology for wetland delineation, growing season is not a factor in the variable

V_{freq}: Indicators as described in the Wetland Hydrology Section of the 87 WDM (paragraphs 46-49) will be utilized to estimate frequency of flooding and/or ponding. Utilization of the county soil survey is a particularly good tool. NOTE: unlike the criteria for hydrology for wetland delineation, growing season is not a factor in the variable.

V_{topo}: This is anestimate/measure of the topographic changes within the WAA. To determine percent for these criteria, visual estimate will be conducted within the WAA. Those areas with significant topographic features will be shown on a reference map, briefly described (i.e. ridge/slough, mounds, undulations, channels/burn, etc.) and measured to determine acreage. Percent of site containing topographic features can then be determined.

V_{cwd}: This variable is measured by the point intercept method along a 100 foot transect within the WAA.

V_{sorpt}: This variable is a general indicator of the potential that the soil/substrate has in regards to it's absorptive properties. This information can be obtained by the use of the county soil survey in conjunction with the field data.

V_{wood}: Percentage of the WAA that is covered by woody vegetation will be determined by the use of recent aerial photography. Field verification is needed to ensure land use changes have not occurred. Size and density of woody vegetation impedes water flow. For example; a few large trees in a pasture would NOT constitute "covered with woody vegetations" nor would 1 year old seedlings. It should also be noted that an area clear cut with stumps, sprouts and shrubs removed would NOT constituted "woody vegetation".

$V_{detritus}$: This variable is a measure of the percentage of areas with detritus at the soil surface. Plowed areas or areas "washed" by high velocity flood water should not be considered as areas having detritus. Determination of an A (with organic) or O horizon should be determined for the entire site by on site field information. For this variable, the A (with organic) must have a Munsell value of 4 or less.

V_{redox}: This variable is an indicator of periodic aerobic and anaerobic process within the top 10-12 inches of the soil surface. Redox features should be document for each sample plot/location and any other soil investigation conducted on the site. At least 50%of the must meet this criteria to be a 1 in the sub index.

Lacustrine Fringe (Interim) HGM Worksheet
Functional Capacity Index (FCI)

Maintain Terrestrial Animal Community:

$[\{V_{tree} + V_{mid} + V_{herb}/3\} + V_{connect} + V_{typical}]/3$

[{___ + ____ + ____/3} + ____ + _____]/3 = FCI

[{___ + ____ + ____/3} + ____ + _____]/3 = FCI

Aquatic Biota Potential:

$[\{V_{edge} + 2\ V_{hydro} + [(V_{sub} + V_{VD})1/2]/3.5\} + V_{typical}]/2$

[{____ + 2 _____ +[(____ + ____)1/2]/3.5} + _____]/2 = FCI

[{____ + 2 _____ +[(____ + ____)1/2]/3.5} + _____]/2 = FCI

Maintain Shoreline Integrity:

$[\{V_{dur}\ X\ Vfreq\}_{1/2}\ X\ \{V_{topo} + V_{cwd} + V_{herb}\}/3 + V_{sorpt}/2]\ 1/2$

[{___ x ____}1/2 x { ____ + _____ + _____}/3 + ____/2]1/2 = FCI

[{___ x ____}1/2 x { ____ + _____ + _____}/3 + ____/2]1/2 = FCI

Removal & Sequestrian of Elements & Compounds:

$[[V_{wood} + V_{freq} + V_{dur} + [\{V_{topo} + V_{cwd} + V_{herb}\}/3] + [\{V_{detritus} + V_{redox} + V_{sorpt}\}/3]]/5$

[[____ + ____ + ____ + [{ ____ + ____ + ____}/3] + [{____ + ____ + ____}/3]]/5 = FCI

[[____ + ____ + ____ + [{ ____ + ____ + ____}/3] + [{____ + ____ + ____}/3]]/5 = FCI

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

WAA #	Pre-project FCUs	Post Project FCUs
Maintain Terr. Animal		
Aquatic Biota		
Maintain Shoreline Intgrity		
Removal of Elements		

Lacustrine Fringe (Interim) HGM Worksheet
Functional Capacity Index (FCI)
Mitigation

Maintain Terrestrial Animal Community:

[{V_{tree} + V_{mid} + V_{herb}/3} + $V_{connect}$ + $V_{typical}$]/3

[{___ + ____ + ____/3} + ____ + _____]/3 = FCI

[{___ + ____ + ____/3} + ____ + _____]/3 = FCI

Aquatic Biota Potential:

[{V_{edge} + 2 V_{hydro} + [(V_{sub} + V_{VD})1/2]/3.5} + $V_{typical}$]/2

[{____ + 2 _____ +[(____ + ____)1/2]/3.5} + _____]/2 = FCI

[{____ + 2 _____ +[(____ + ____)1/2]/3.5} + _____]/2 = FCI

Maintain Shoreline Integrity:

[{V_{dur} X Vfreq}$^{1/2}$ X {V_{topo} + V_{cwd} + V_{herb} }/3+ V_{sorpt}/2] 1/2

[{___ x ____}1/2 x { ____ + _____ + _____}/3 + ____/2]1/2 = FCI

[{___ x ____}1/2 x { ____ + _____ + _____}/3 + ____/2]1/2 = FCI

Removal & Sequestrian of Elements & Compounds:

[[V_{wood} + V_{freq} + V_{dur} + [{V_{topo} + V_{cwd} + V_{herb} }/3] +[{$V_{detritus}$ + V_{redox} + V_{sorpt} }/3]]/5

[[____ + ____ + ____ + [{ ____ + ____ + ____}/3] + [{____ + ____ + ____}/3]]/5 = FCI

[[____ + ____ + ____ + [{ ____ + ____ + ____}/3] + [{____ + ____ + ____}/3]]/5 = FCI

Mitigation

Functional Capacity Units (FCU); FCI x wetland acres per WAA…

WAA #	Pre-project	Post 1 yr	Post 5 yr	Post 10 yr
Terr.Animal				
Aquatic Biota				
Main. Shoreline				
Sequestrian of Elements				

Lacustrine Fringe (Interim) HGM Worksheet
Functional Capacity Unit (FCU)
Impact(s) sheet

Potential Functional Capacity impacts
{i.e. WAA 1 FCU biota loss (bl) + WAA 2 bl + WAA 3 bl + WAA 4 bl = net FCU loss}

Maintain Terrestrial Animal Community:

Aquatic Biota Potential:

Maintain Shoreline Integrity:

Removal & Sequestrian of Elements & Compounds:

*** Net FCU loss is calculated by deducting the post project FCU from the pre-project FCU per function capacity. Different functional capacity index should NEVER be summarized.**

Lacustrine Fringe HGM (Interim) Worksheet

WAA#

V_{tree}	
V_{mid}	
V_{mid}	
V_{herb}	
$V_{connect}$	
$V_{typical}$	
V_{edge}	
V_{hydro}	
V_{sub}	
V_{VD}	
V_{dur}	
V_{freq}	
V_{topo}	
V_{cwd}	
V_{sorpt}	
V_{wood}	
$V_{detritus}$	
V_{redox}	

WAA #

V_{tree}	
V_{mid}	
V_{mid}	
V_{herb}	
$V_{connect}$	
$V_{typical}$	
V_{edge}	
V_{hydro}	
V_{sub}	
V_{VD}	
V_{dur}	
V_{freq}	
V_{topo}	
V_{cwd}	
V_{sorpt}	
V_{wood}	
$V_{detritus}$	
V_{redox}	