

Rapid Assessment Reference Condition Model

The Rapid Assessment is a component of the LANDFIRE project. Reference condition models for the Rapid Assessment were created through a series of expert workshops and a peer-review process in 2004 and 2005. For more information, please visit www.landfire.gov. Please direct questions to helpdesk@landfire.gov.

Potential Natural Vegetation Group (PNVG)

R4NOFP Great Plains Floodplain

General Information

Contributors (additional contributors may be listed under "Model Evolution and Comments")

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Vegetation Type

Woodland

General Model Sources

- Literature
 Local Data
 Expert Estimate

Rapid Assessment Model Zones

- California
 Great Basin
 Great Lakes
 Northeast
 Northern Plains
 N-Cent.Rockies
- Pacific Northwest
 South Central
 Southeast
 S. Appalachians
 Southwest

Dominant Species*

PODE	CEOC
SAIN3	ACNE
SAAM	FRPE
SANI	CODR

LANDFIRE Mapping Zones

30	39
31	40
38	43

Geographic Range

Great Plains river systems from eastern Montana east to North Dakota and south through Kansas and Oklahoma, into western Missouri. Such river systems include the Missouri, Platte, Kansas, and the Arkansas Rivers. The major tributaries to these river systems would be in this PNV, such tributaries include the Yellowstone, Little Missouri, and the Cheyenne Rivers.

Biophysical Site Description

Alluvial surfaces, usually bare, within broad floodplains are present as low elevation shorelines and barforms. The slightly higher fluvial landform adjacent to the channel forms the first terrace for fluvial dependent species. Over time, laterally migrating point bars form bench platforms that may become late seral stage floodplain forests.

Vegetation Description

Broadleaf deciduous forest dominated by cottonwood (primarily *Populus deltoides*, but further west *P. angustifolia* is present), black willow, or peach leaf willow and sandbar willow. Early seral stage phreatophytic vegetation becomes established on low elevation flood deposits, however, long-term survival is possible only on bare, moist sites on slightly higher elevation (1-3m above lower limit of perennial vegetation). Other species found in the floodplain riparian zone include sandbar willow, box elder, hackberry, green ash, typically associated with late seral stages. Understory species in these later seral stages may include dogwood and poison ivy. Loess bluff terraces situated out of the floodplain riparian zone are composed of bur oak, walnut, and sycamore.

Disturbance Description

The development and maintenance of this system is dependent on fluvial geomorphic processes such as channel meandering, sedimentation, erosion, channel avulsion and barform accretion driven by hydrologic variability. This variability incorporates the features of timing, duration, frequency, magnitude, and

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit <http://plants.usda.gov>.

intensity. Regeneration of the dominant species (cottonwood and willow) is dependent on flooding and movement of river channels, which creates bare, moist soil needed for seedling establishment. Oxbow and slough development also influence the floodplain system and create variability in plant community composition. Upper terraces have infrequent flooding and scouring events, while the lower terraces nearest the river flood frequently. Early seral stage development stands are produced on point bars via channel meandering, which occurs most often during moderately frequent high flows. Scouring caused by ice jams during the winter, channel meandering, oxbows and slough development greatly influence this system. Changes in hydrology due to the activities of beaver are also an important ecological process in the Great Plains Floodplain, particularly on the tributaries to the Missouri River. Beaver impoundments kill trees (sometimes over large areas) and may create open water habitat, willow stands, or contribute to channel meandering. This model is based on conditions prior to euro American modification of river systems in North American.

Adjacency or Identification Concerns

Beyond the limits of the high terrace of the riparian floodplain exists the Oak-Hickory Forest in southern portion of Nebraska, Iowa and through Missouri. Along the northern portion of Nebraska, Iowa, and southeast South Dakota, the adjacent PNV is Prairie. Throughout the rest of the Dakotas and eastern Montana the surrounding PNV is Plains Grassland.

Scale Description

Sources of Scale Data Literature Local Data Expert Estimate

Landscape adequate in size to contain natural variation in vegetation and disturbance regime. This PNV occurred in a linear dimension of millions of acres along the Missouri River floodplain, with smaller areas covered in larger tributary rivers and streams. Wetland complexes covered millions of acres, these included oxbow lakes, slough, and marshes. Fire was a disturbance mechanism within portions of floodplain, however, the frequency and intensity is unknown.

Issues/Problems

Assumptions: I developed the VDDT model with the recognition that the Great Plains Floodplain forest (cottonwood-willow-elm community) is a seral community. This seral community is most affected by fluvial geomorphic processes such as flooding, avulsion and deposition, and channel movement. I modeled the floodplain valley up to the last high terrace that rarely floods to reset to an early successional seral stage. The model does include shallow wetlands, sloughs or oxbows. Deep water habitat and the wetted width of the active river were not included in the model. I used three flooding regimes in the model: Option 1 – minor to moderate flooding (5-25 year frequency) Option 2 – major flooding/scouring (30-100 year frequency), and a Wind/Weather/Stress Option - rare, intense flooding (>250 yrs). Flood frequency for a class is based on location on the floodplain, with higher terraces being subject to longer flood cycles (up to 500 years). Fire activity was a minor portion, low intensity, surface, infrequent intervals, small in size and low fuel loads.

Ice jams and ice scouring as well as beaver activity was not modeled. The effects of beaver ponds on forest dynamics in this system are also poorly understood at the landscape level, especially in the presettlement context.

Model Evolution and Comments

One anonymous reviewer provided feedback that has been incorporated into the document. The model is most reflective of the more mesic middle Missouri River region and less so farther west. The PNVG may need to be split to reflect differences from east to west: farther west the uplands start to lose the ability to support trees due to lower precipitation.

Succession Classes**

Succession classes are the equivalent of "Vegetation Fuel Classes" as defined in the Interagency FRCC Guidebook (www.frcc.gov).

Class A 20 %

Early1 All Struct

Description

Created by deposition, stream meander changes, point bar formation, and scouring. Option 1: minor flooding/scouring (<5 year frequency) Pioneer tree and shrub species of cottonwoods and willows. Herbaceous understory of sedges in wet areas. In this early stage, most of the area is bare sand. Age 0-4 years. Most of area is seasonally flooded.

Dominant Species* and Canopy Position

PODE3 Upper
SAIN3 Upper
SAAM2 Upper

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	100 %
Height	Tree Regen <5m	Tree Regen <5m
Tree Size Class	Seedling <4.5ft	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class B 25 %

Early2 Open

Description

Dominated by young canopy of tree saplings and shrubs. The understory is highly variable and consists of bare sand, annuals, or perennial hydrophytes. Species would include indigo bush and various grass, sedges, and rushes. Approximate flooding regime would be 10yrs. Age 5-14 years.

Dominant Species* and Canopy Position

PODE3 Upper
SAIN3 Middle
SAAM2 Middle
SANI Middle

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	15 %	50 %
Height	Tree Regen <5m	Tree Regen <5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class C 25 %

Mid1 Open

Description

This stage develops as the stand starts to mature. This community tends to be partially opened, with scattered cottonwoods and willows. The shrub layer is poorly developed and often consists of widely scattered patches of dogwood. The understory vegetation is highly variable with wild rye, and muhlys. In wetter, more shaded areas Virginia creeper, nettles, and poison ivy would exist. Age is 15-50 yrs.

Dominant Species* and Canopy Position

PODE3 Upper
SAAM2 Mid-Upper
SANI Middle
CODR Middle

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	25 %	75 %
Height	Tree Regen <5m	Tree Short 5-9m
Tree Size Class	Medium 9-21"DBH	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

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Class D 20%

Late1 Closed

Description

This class is a mature, late seral closed canopy cottonwood floodplain forest. Overstory is dominated by cottonwood, box elder, hackberry, and elm. Understory species composed of Virginia creeper, and poison ivy. Age 51-149 years.

Dominant Species* and Canopy Position

PODE3 Upper
CEOC Low-Mid
ACNE2 Low-Mid
FRPE Low-Mid

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	100 %
Height	Tree Medium 10-24m	Tree Tall 25-49m
Tree Size Class	Very Large >33"DBH	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Class E 10%

Late2 Closed

Description

Found along the upper terrace that has been protected from most flood events, except for rare high intensity flooding. Species composition increases towards south and east within the region. Overstory species include hackberry, green ash, sycamore, black walnut, and elm. Understory species include vines and poison ivy.

Dominant Species* and Canopy Position

FRPE Middle
CEOC Middle
ACNE2 Middle
PODE3 Upper

Upper Layer Lifeform

- Herbaceous
- Shrub
- Tree

Fuel Model no data

Structure Data (for upper layer lifeform)

	Min	Max
Cover	75 %	100 %
Height	Tree Short 5-9m	Tree Tall 25-49m
Tree Size Class	Medium 9-21"DBH	

Upper layer lifeform differs from dominant lifeform. Height and cover of dominant lifeform are:

Disturbances

Disturbances Modeled

- Fire
- Insects/Disease
- Wind/Weather/Stress
- Native Grazing
- Competition
- Other: Flooding minor to moderate
- Other Flooding major to rare intense

Historical Fire Size (acres)

Avg: no data
Min: no data
Max: no data

Sources of Fire Regime Data

- Literature
- Local Data
- Expert Estimate

Fire Regime Group: 3

- I: 0-35 year frequency, low and mixed severity
- II: 0-35 year frequency, replacement severity
- III: 35-200 year frequency, low and mixed severity
- IV: 35-200 year frequency, replacement severity
- V: 200+ year frequency, replacement severity

Fire Intervals (FI)

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class. All values are estimates and not precise.

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement					
Mixed	500			0.002	99
Surface					
All Fires	500			0.00202	

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References

Auble, G.T., and M.L. Scott. 1998. Fluvial disturbance patches and cottonwood recruitment along the upper Missouri River, MT. *Wetlands* 18: 546-556.

Boggs, K. and T. Weaver. 1994. Changes in vegetation and nutrient pools during riparian succession. *Wetlands* 14:98-109.

Bovee, K.D. and M.L. Scott. 2002. Implications of flood pulse restoration for populus regeneration of the Upper Missouri River. *River Research and Applications*. 18: 287-298.

Bragg, T.B. and A.K. Tatschl. 1977. Changes in flood-plain vegetation and land use along the Missouri River from 1826 to 1972. *Environmental Management* 1(4):343-348.

Cooper, D.J., D.C. Andersen, and R.A. Chimner. 2003. Multiple pathways for woody plant establishment at local to regional scales. *Journal of Ecology* 91:182-196.

Friedman, J.M., W.R. Osterkamp, and W. M. Lewis, Jr. 1996. Channel narrowing and vegetation development following a Great-Plains flood. *Ecology*. 77: 2167-2181.

Friedman, J.M., W.R. Osterkamp, M.L. Scott, and G.T. Auble. 1998. Downstream effects of dams: regional patterns in the Great Plains. *Wetlands* 18:619-633.

Friedman, J.M. and V.J. Lee. 2002. Extreme floods, channel change and riparian forests along ephemeral streams. *Ecological Monographs* 72:409-425.

Gregory, Stanley V., Frederick J. Swanson, W. Arthur McKee, and Kenneth W. Cummins. 1991. An Ecosystem Perspective of Riparian Zones. *Bioscience*, 41:540-551.

Hughes, F.M.R. 1994. Environmental change, disturbance, and regeneration in semi-arid floodplain forests. Pages 321-345 in A.C. Millington and K. Pye, editors. *Environmental change in drylands: biogeographical and geomorphological perspectives*. John Wiley and Sons, New York.

Johnson, W.C. 1992. Dams and riparian forests: case study from the upper Missouri River. *Rivers* 3(4):229-242.

Johnson, W. C. 1994. Woodland expansion in the Platte River, Nebraska: patterns and causes. *Ecological Monographs* 64: 45-84.

Johnson, W.C. Burgess, R.L and Keammerer, W.R. 1976. Forest overstory vegetation and environment on the Missouri River floodplain in North Dakota. *Ecological Monograph* 46(1):59-84.

Katz, G.L., J.M. Friedman, and S.W. Beatty. 2005. Delayed effects of flood control on a flood-dependent riparian forest. *Ecological Applications* 15(3):1019-1035.

Lytle, D. A. and D.M. Merritt. 2004. Hydrologic regimes and riparian forest: a structured population model for cottonwood. *Ecology* 85(9): 2493-2503.

Noble, M.G. 1979. The origin of *Populus deltoides* and *Salix interior* zones on point bars along the Minnesota River. *American Midland Naturalist* 102:59-67.

Richards, K, J. Brasington, and F. Hughes. 2002. Geomorphic dynamics of floodplain: ecological

implications and a potential modeling strategy *Freshwater Biology*. 47: 559-579.

Richter, BD and HE Richter. 2000. Prescribing flood regimes to sustain riparian ecosystems along meandering rivers. *Conservation Biology* 14:1467-1478.

Scott, M.L., and G.T. Auble. 2002. Conservation and restoration of semi-arid riparian forests: a case study from the upper Missouri River, Montana, USA. Pages 145-190 in *Flood Pulsing and Wetland Restoration in North America*, B. Middleton, (ed.), John Wiley and Sons, Inc.

Scott M.L, G.T. Auble, and J.M. Friedman. Flood Dependency of Cottonwood Establishment Along the Missouri River, Montana, USA 1997. *Ecological Applications*. 7(2): 677-690.

Steinauer, G. and S. Rolfsmeier. Terrestrial Natural Communities of Nebraska (Version III - June 30, 2003). Nebraska Natural Heritage Program. Nebraska Game and Parks Commission. Lincoln, Nebraska.

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System. Available at <http://www.fs.fed.us/database/feis/>

Weaver, J. E. 1960. Flood plain vegetation of the central Missouri valley and contacts of woodland with prairie. *Ecological Monographs* 30 (1): 37-64.