SOCIO-ECOLOGICAL CHARACTERIZATION AND MAPPING OF WILLAMETTE VALLEY, OREGON WET PRAIRIE RECOVERY

Wetgrass Prairie Recovery Using the Assistance of an Ecosystem-wide Conservation and Mitigation Banking Program

University of Washington

Geography 560 – Principles of Mapping

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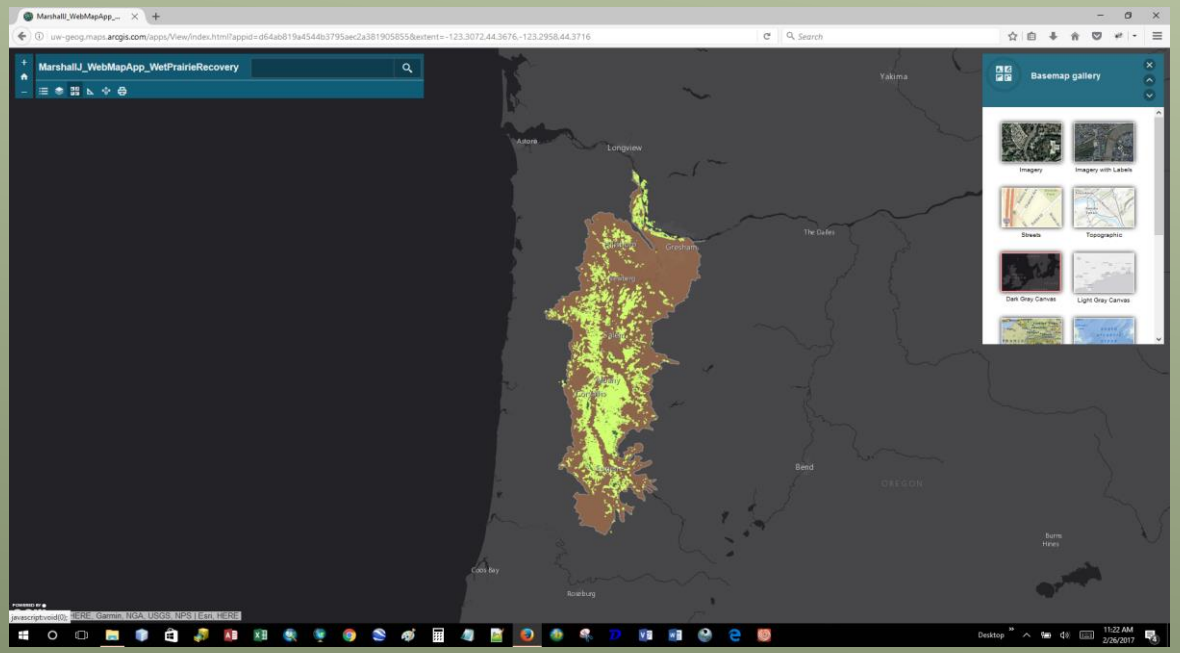
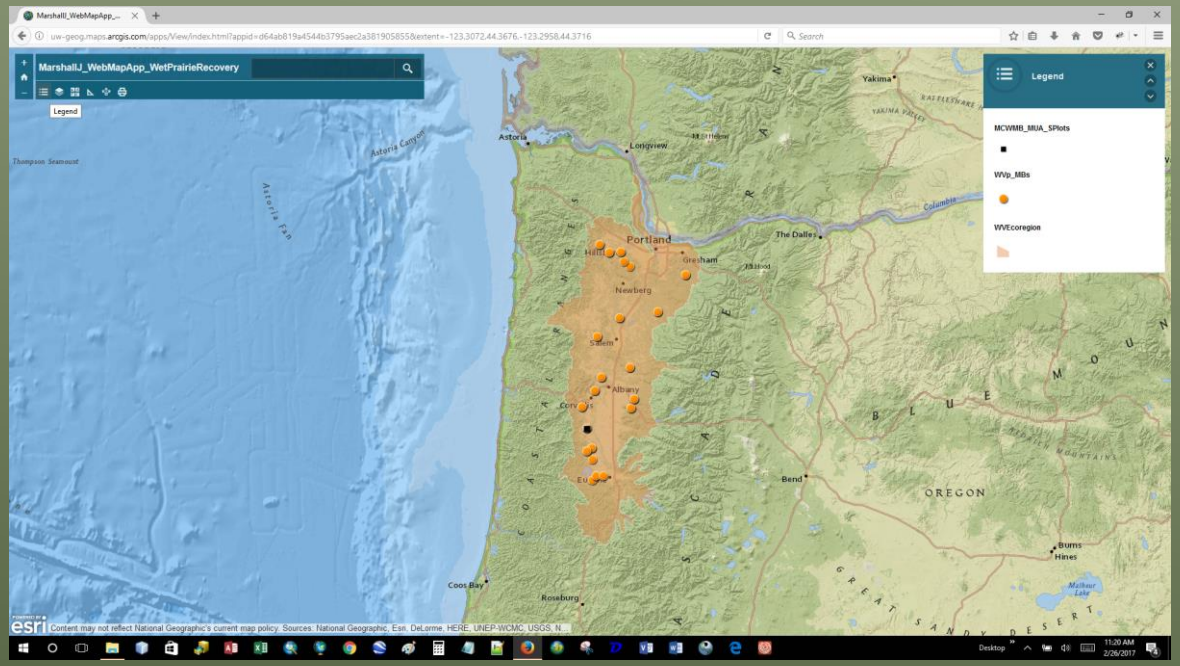




RECOVERING HISTORICALLY LOST WET PRAIRIE

Close to 99% of the pre-European occupation wet grass prairie in the Willamette Valley, Oregon has been converted to pasture and other agricultural uses or urban development.

Displacement of aboriginal peoples and their cultural practices of prairie burning to drive game for hunting and maintaining native prairie food plants, such as camas, has led to an accelerated colonization by woody species and nonnative invasive weeds.

Over a period of about 15 to 20-years, a mitigation and conservation banking program (ORS 196.668 – 196.622) has been steadily growing around the state of Oregon and 22 of those mitigation banks are established in the Willamette Valley Ecoregion. Many of these mitigation banks are targeting the recovery of Willamette Valley wet grass prairie as part of their over-arching management and long-term protection strategy.

A SOCIO-ECOLOGICAL FRAMEWORK FOR WILLAMETTE VALLEY, OREGON WETGRASS PRAIRIE RECOVERY

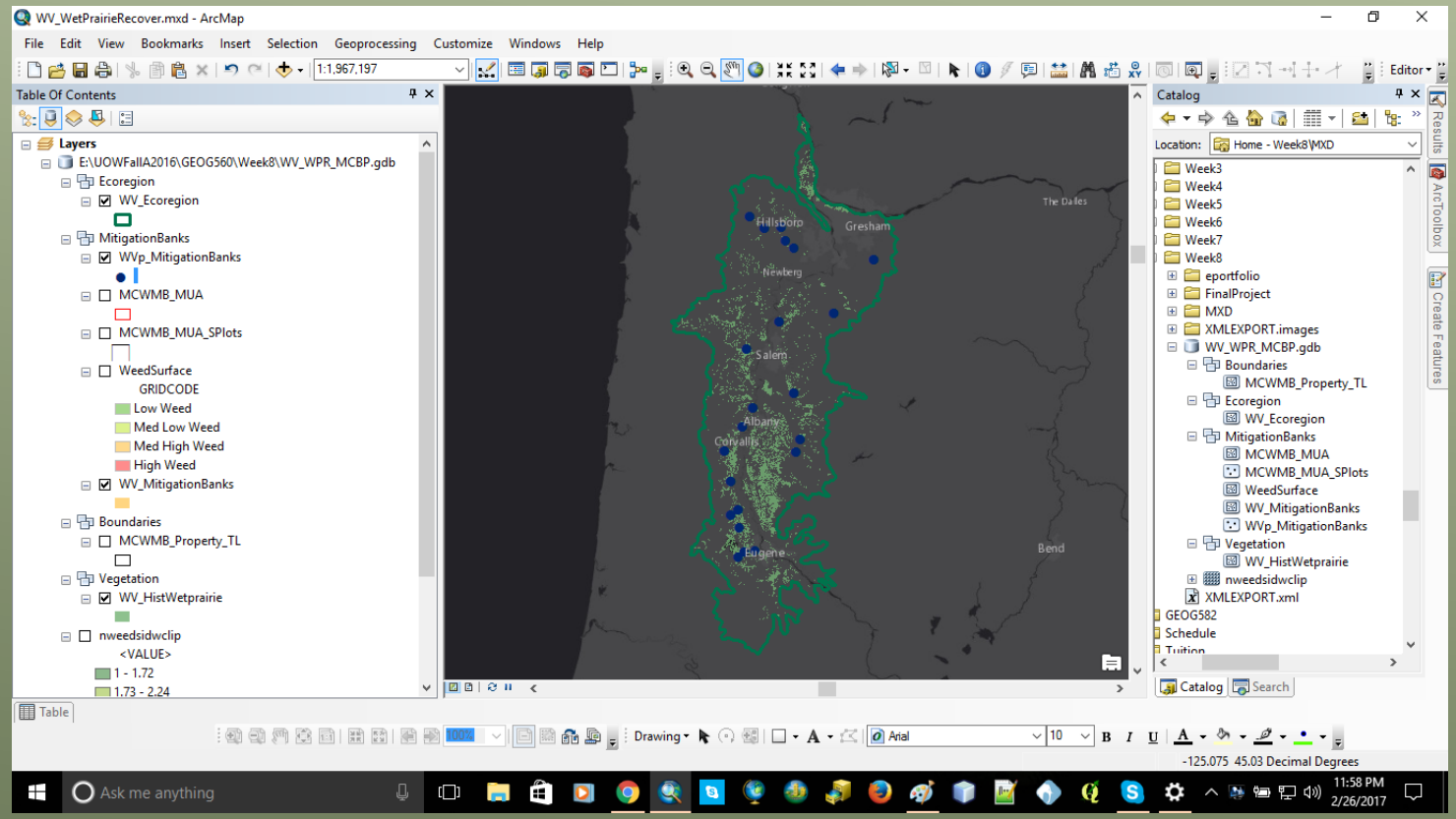
Human Systems/ Scale	Social	Ecological	Economic
Ecoregion: (Willamette Valley, Oregon)	Native American Subsistence/Culture to European Domain	Extreme Habitat Loss and Loss of Species	Subsistence to Farm Based to Industrial to Post-Industrial
Land Parcel (Muddy Creek Wetland Mitigation Bank)	Alternative Lifestyle Regulation Adverse to Regulation Support	Land Restoration Habitat Recovery Species Recovery	Natural Resource Based Economy
Management Unit (Management Unit A)	Science Based Work Modern Social Role Soc./Cult. Shift	Natural Resource Accountability	Natural Resource Units Equate to Income
Sample Plot (Sample Plot 1 – 37)	Interdisciplinary Knowledge Applied /Community Shared	Ecological Performance Based Accountability	Income Tied to Ecological Performance

A socio-ecological characterization and mapping framework is used as the operational construct for meeting the project objective. It recognizes the hierarchical spatial scale as: 1. ecosystem, 2. land parcel, 3. manage-ment unit, and 4. sample plots. The time scale ranges between pre-European settlement to the present. The primary human system/knowledge domains traversed include social, ecological, and economic foci.

Map Data Themes	DataType	Source	OriginalProj	ComProj Static	ComProj Web
Ecoregion Boundary	Polygon	Institute for Natural Resources	NAD_1983_Oregon_ Statewide_Lambert_ Feet_Intl'	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Historic Wetgrass Prairie	Polygon	Oregon Natural Heritage Information Center	NAD_1983_Lambert_ Conformal_Conic	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Willamette Valley Mitigation and Conservation Banks	Point	US Army Corps of Engineers (RIBITS)	WGS 1984	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Willamette Valley Mitigation and Conservation Banks	Polygon	US Army Corps of Engineers (RIBITS)	WGS 1984	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Muddy Creek Wetland Mitigation Bank Tax Lot	Polygon	Benton County, Oregon Assessor's Office	NAD_1983_HARN_ StatePlane_Oregon_ North_FIPS_3601_ Feet_Intl	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Muddy Creek Wetland Mitigation Bank Boundary	Polygon	US Army Corps of Engineers (RIBITS)	WGS 1984	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Muddy Creek Wetland Mitigation Bank Management Unit A	Polygon	Created by Project Author for This Report	NAD_1983_ UTM_Zone_ 10N	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator
Muddy Creek Wetland Mitigation Bank Management Unit A Sample Plots	Points	Arghangelsky 2009	WGS 1984	NAD_1983_ UTM_Zone_ 10N	WGS 1984 Web Mercator

STATIC AND WEB MAP APPLICATION DATA

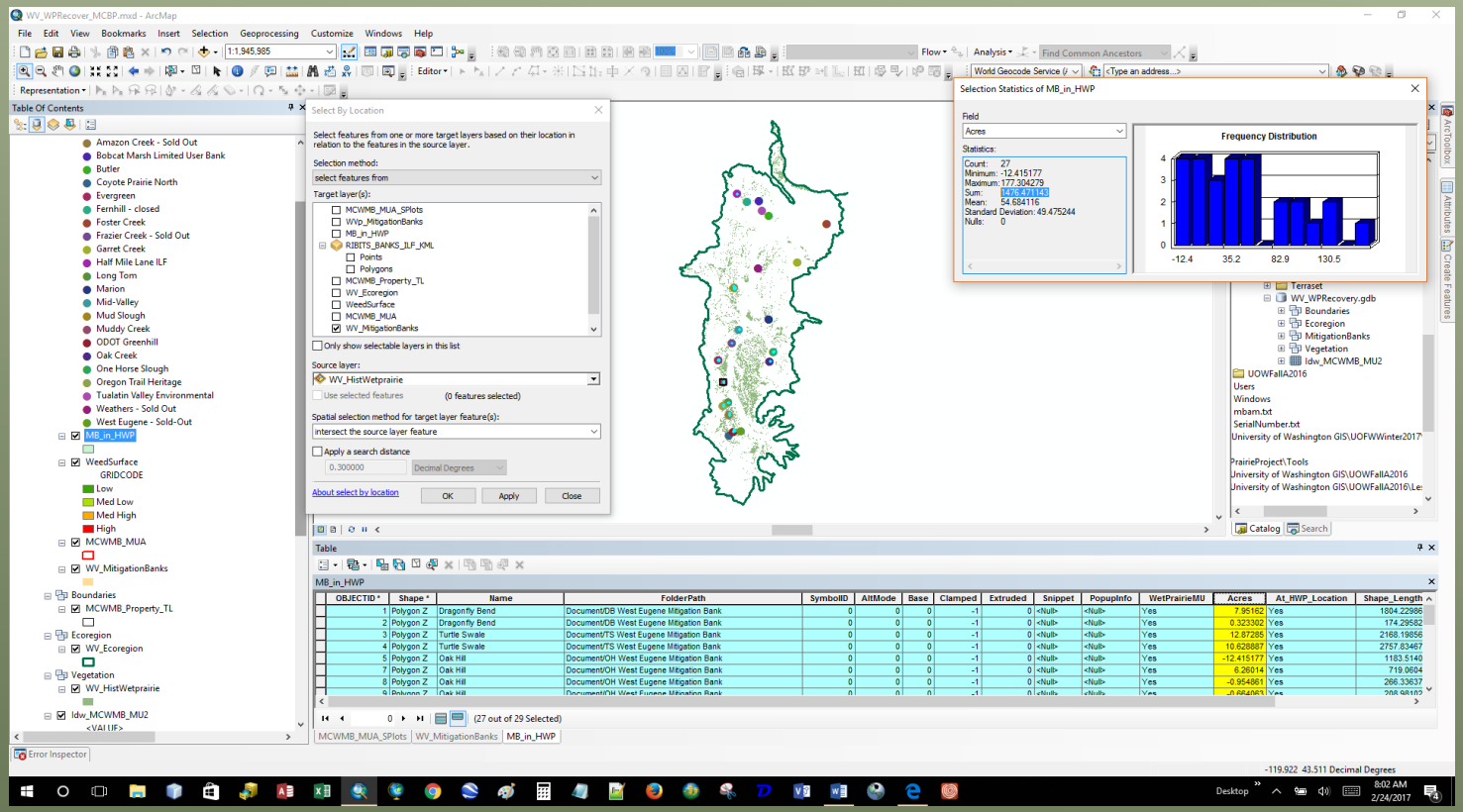
A Geographic Information System (GIS) is selected as a logical technology to create the necessary characterization model and conduct the analyses. The first step toward building the GIS is to inventory and acquire the data required. Eight GIS data layers were identified and acquired.



PREPARING A FILE GEODATABASE TO MANAGE THE DATA

Once data preparation procedures were completed, the datasets were imported into a file geodatabase feature dataset set to convert the different existing projections to a common NAD 1983 UTM Zone 10 projection. Each feature dataset contains one or more layers of a common thematic type. Once the geodatabase was created it was added to an ArcMap project in ArcGIS desktop software.

SQL USED TO ESTIMATE ACRES OF WET PRAIRIE RECOVERY BY MITIGATION BANKS



A SQL query was run to select by location all existing mitigation banks that intersect with historical wet prairie. The selected banks were exported to a separate feature class. A second SQL query was executed to further screen the exported banks by selecting by attribute the mitigation banks that have a wet prairie management unit. The statistics tool was then used to calculate the total acreage of the remaining banks .

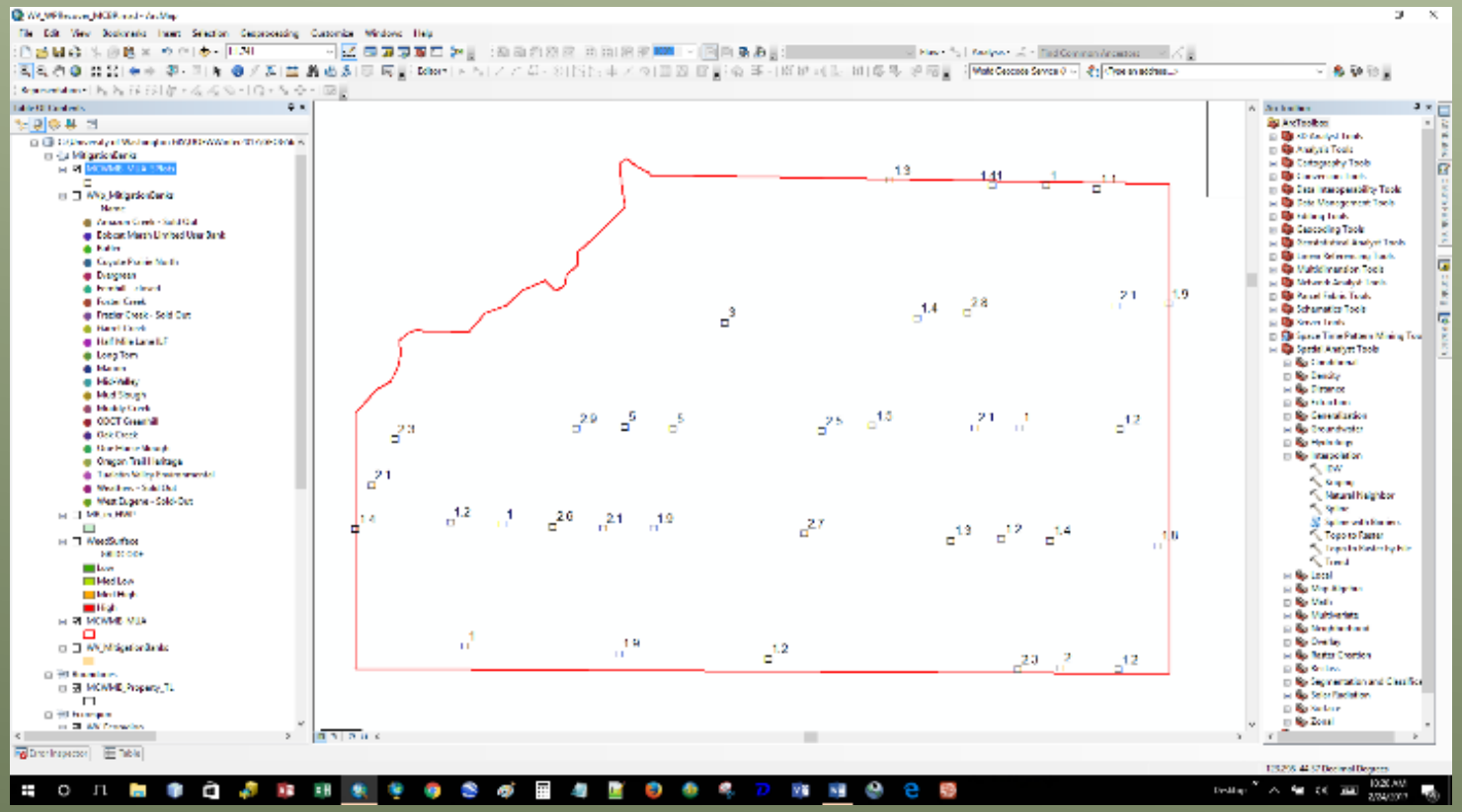
RESULT: 1,476-acres

Species	Percent Cover	Weed Index	Weighted Percent Cover	Weed Index for Sample Plot
Alopecurus geniculatus	63	3	189	375 / 189 = 1.98
Carex unilateralis	3	1	3	
Deschampsia cespitosa	15	1	15	
Juncus tenuis	15	1	15	
Rosa nutkana	15	1	15	
Mentha pulegium	15	5	75	
Eleocharis palustris	63	1	63	
Totals	189		375	

PRAIRIE QUALITY BASED ON WEED INDEX METRIC

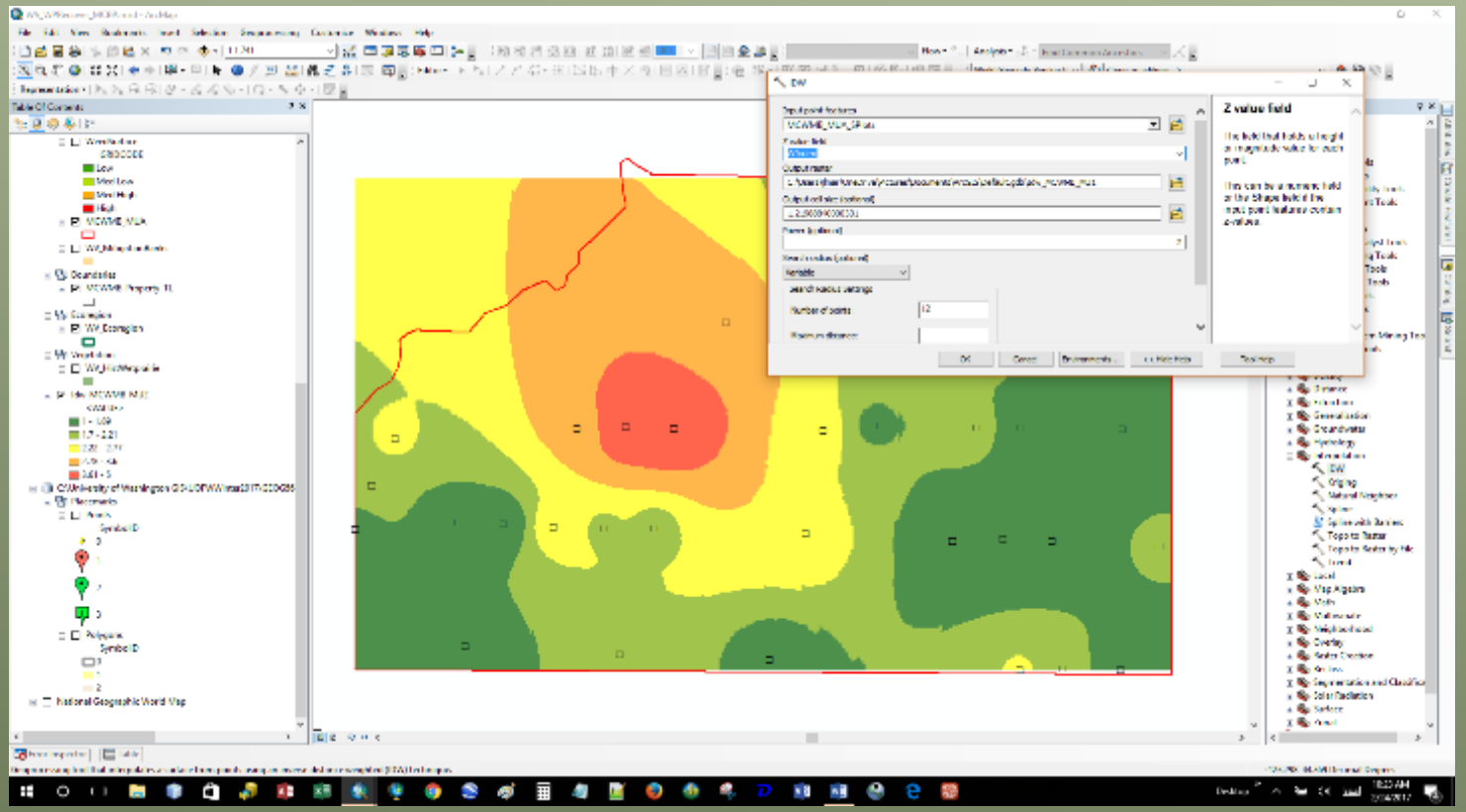
Vegetation sample plot data derived from the 2008 annual monitoring report for this Bank are assigned weed indexes. If a plant is native it receives a weed score of 1, if nonnative but noninvasive it receives a weed score of 3, and if it is nonnative and invasive it receives a weed score of 5. A percent cover weighted average of all the plant species weed scores in each sample plot is used to derive a weed index score for the sample plot.

ADD XY COORDINATES AND ASSIGN SAMPLE PLOT WEED INDEXES

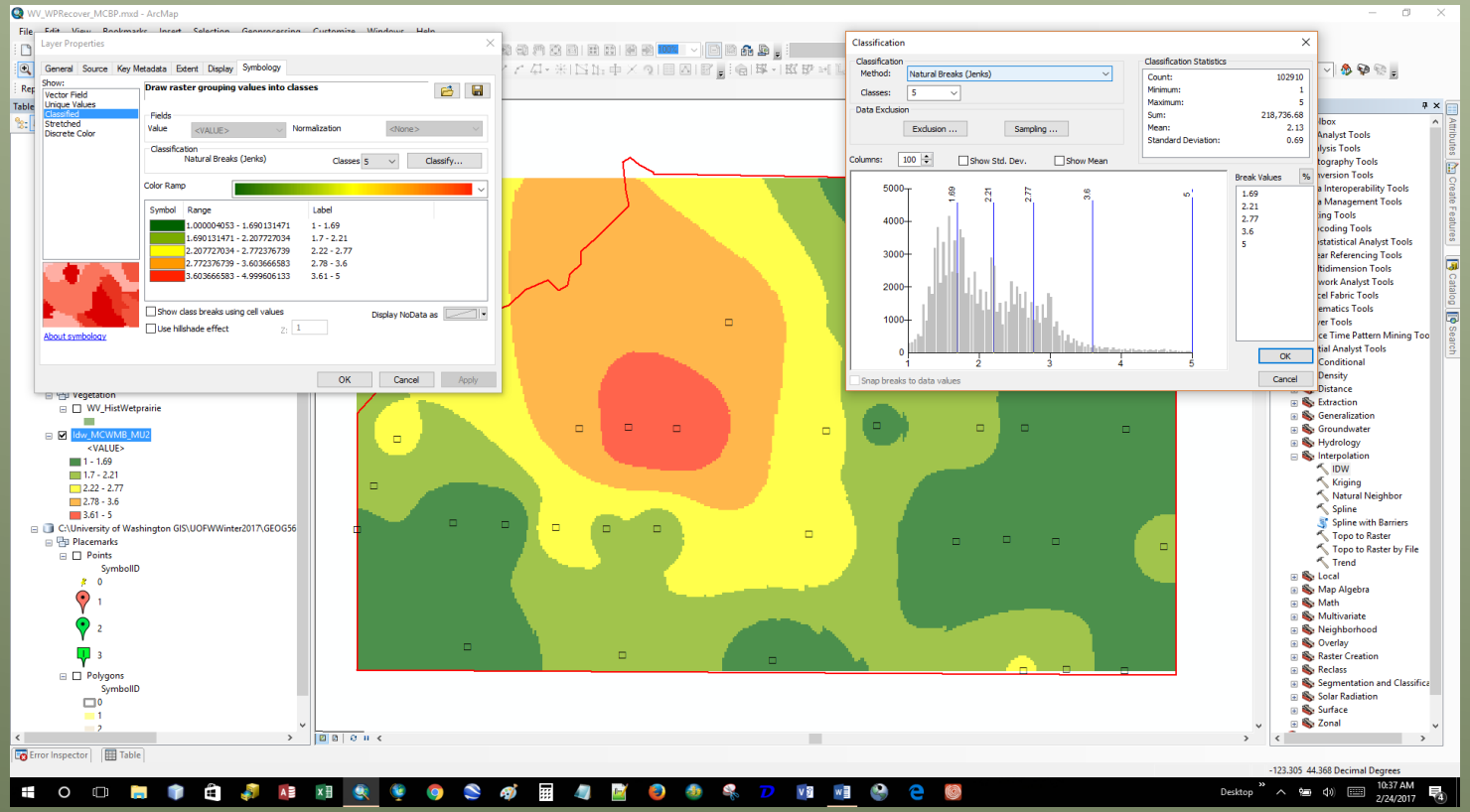


The sample plots were added to ArcMap as XY coordinates, rendered as an event in a WGS 1984 projection, and then exported to a shapefile and imported into the geodatabase Mitigation Bank feature dataset as a feature class projected in NAD 1983 UTM Zone 10. A field called Weed Index (WIndex) was added to the attribute table and each record for a sample plot was populated with a weed index for the sample plot based on the species nativity and percent cover attributes in the sample and using the arithmetic operations in the Table in the previous slide.

INTERPOLATE A WEED SURFACE

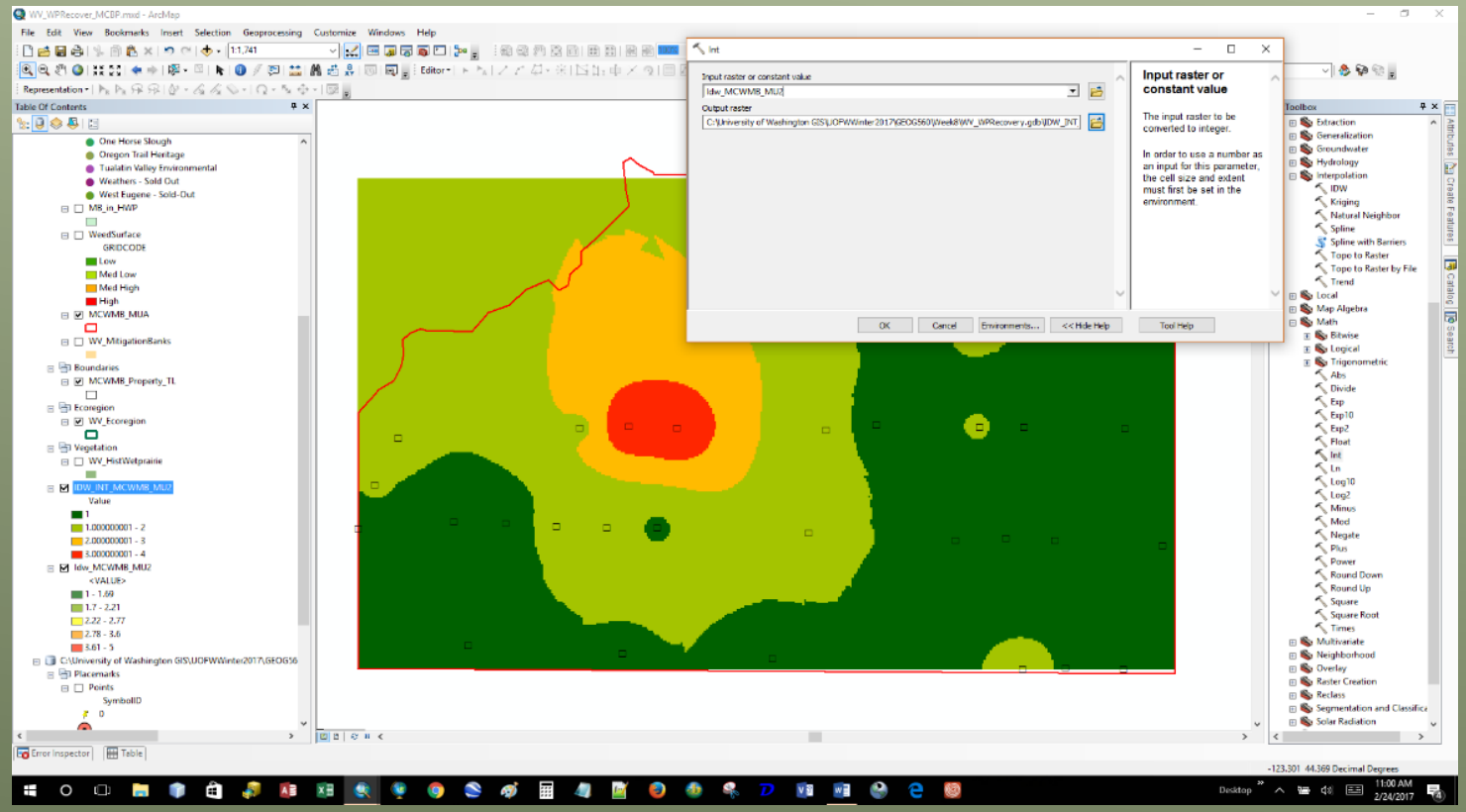


The Spatial Analyst Inverse Distance Weighting (IDW) tool was used to interpolate a raster weed surface.



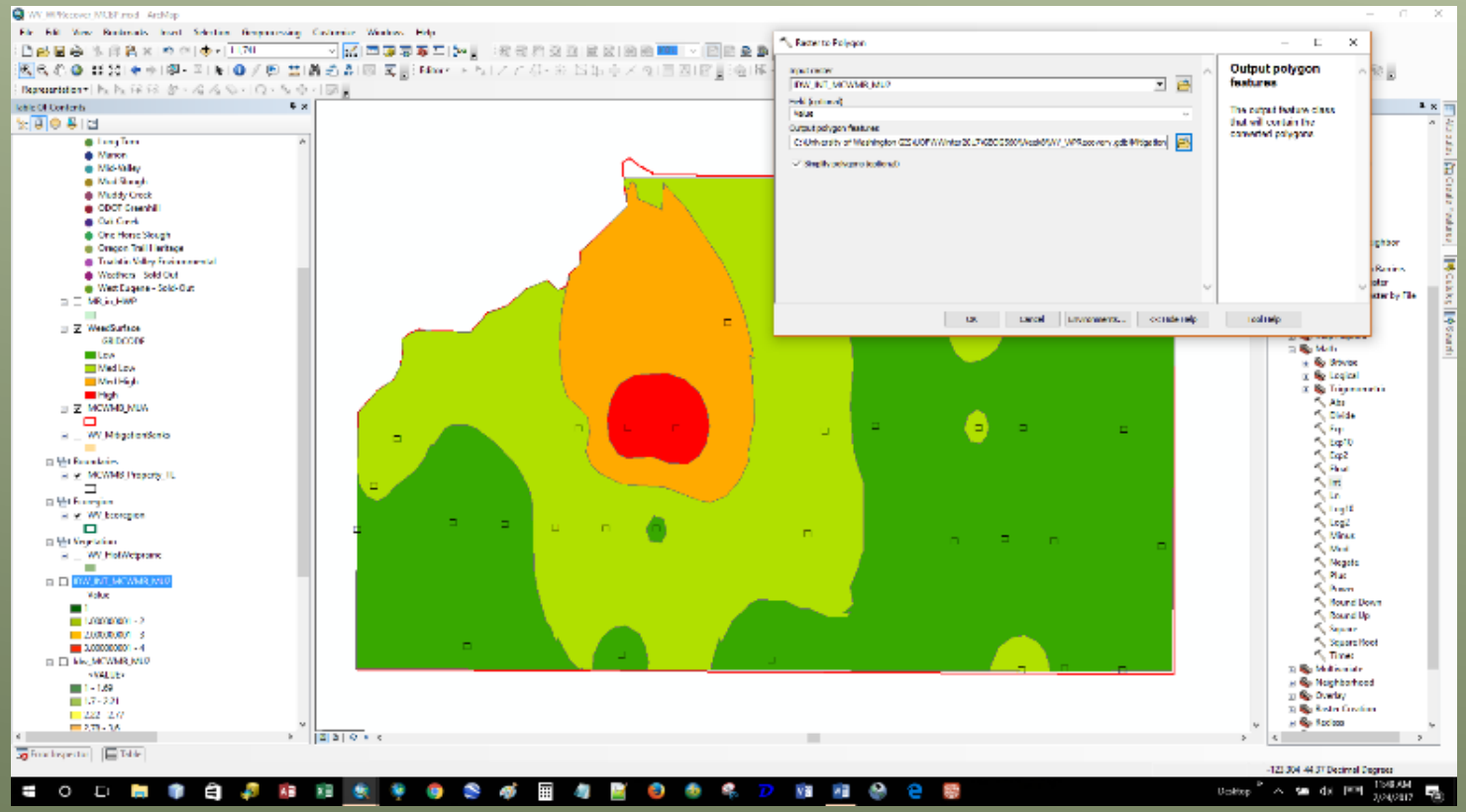
WEED SURFACE CLASSIFICATION

The weed surface was divided into five classes using a natural breaks classification.



CONVERT FROM A CONTINUOUS SURFACE TO A DISCREET SURFACE

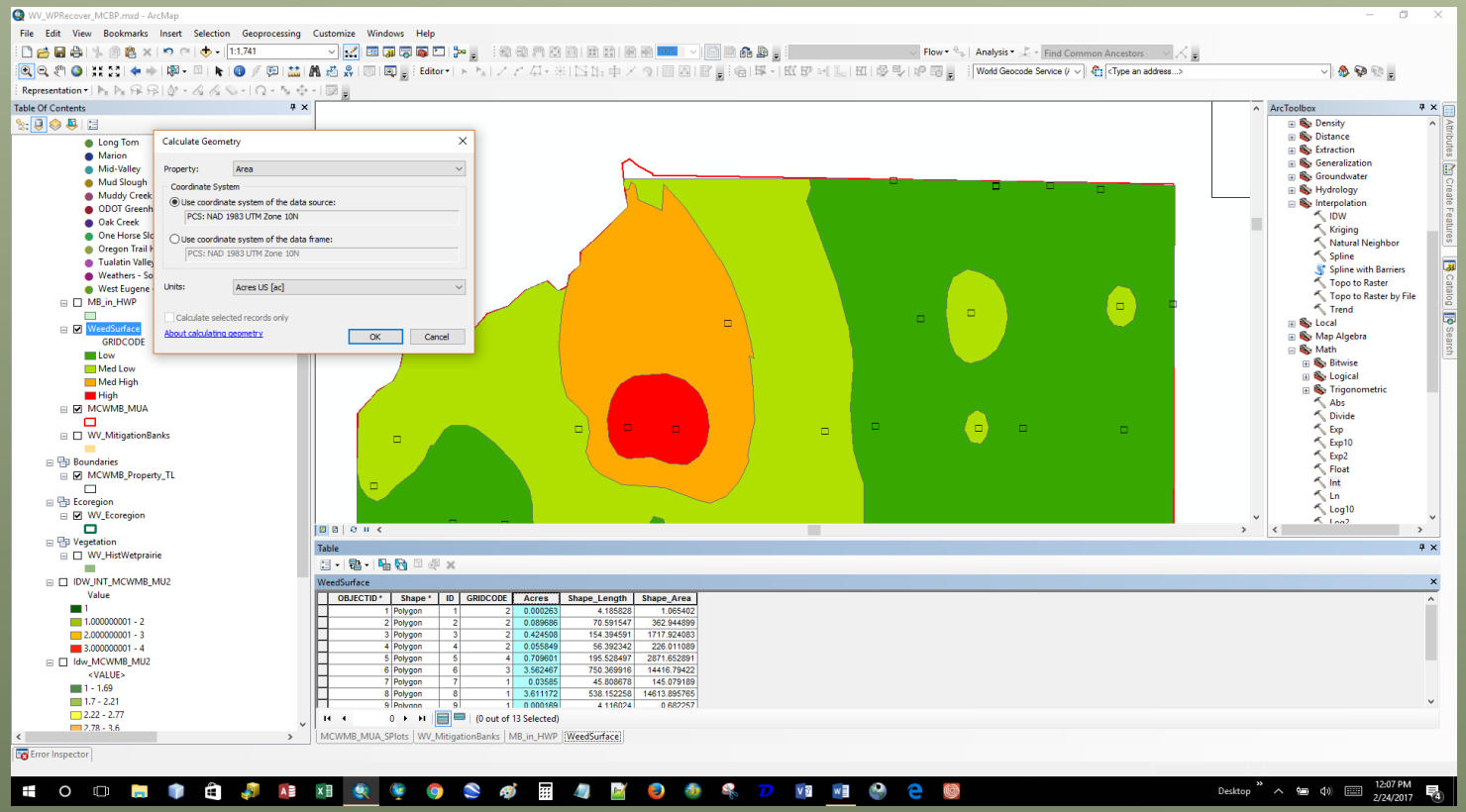
To calculate an acreage measurement for each of the classes, the raster had to be converted into a polygon. However, before this procedure could be executed, a new raster was needed based on the existing raster's cell values but altered from a continuous surface to a discrete surface. Each cell in the new raster needed to be given an integer value. To accomplish this, the int tool in the Math section of Spatial Analyst in ArcToolbox was used to create a new raster with integer cell values modeled from the existing raster's decimal values, but output as integers instead through truncation.



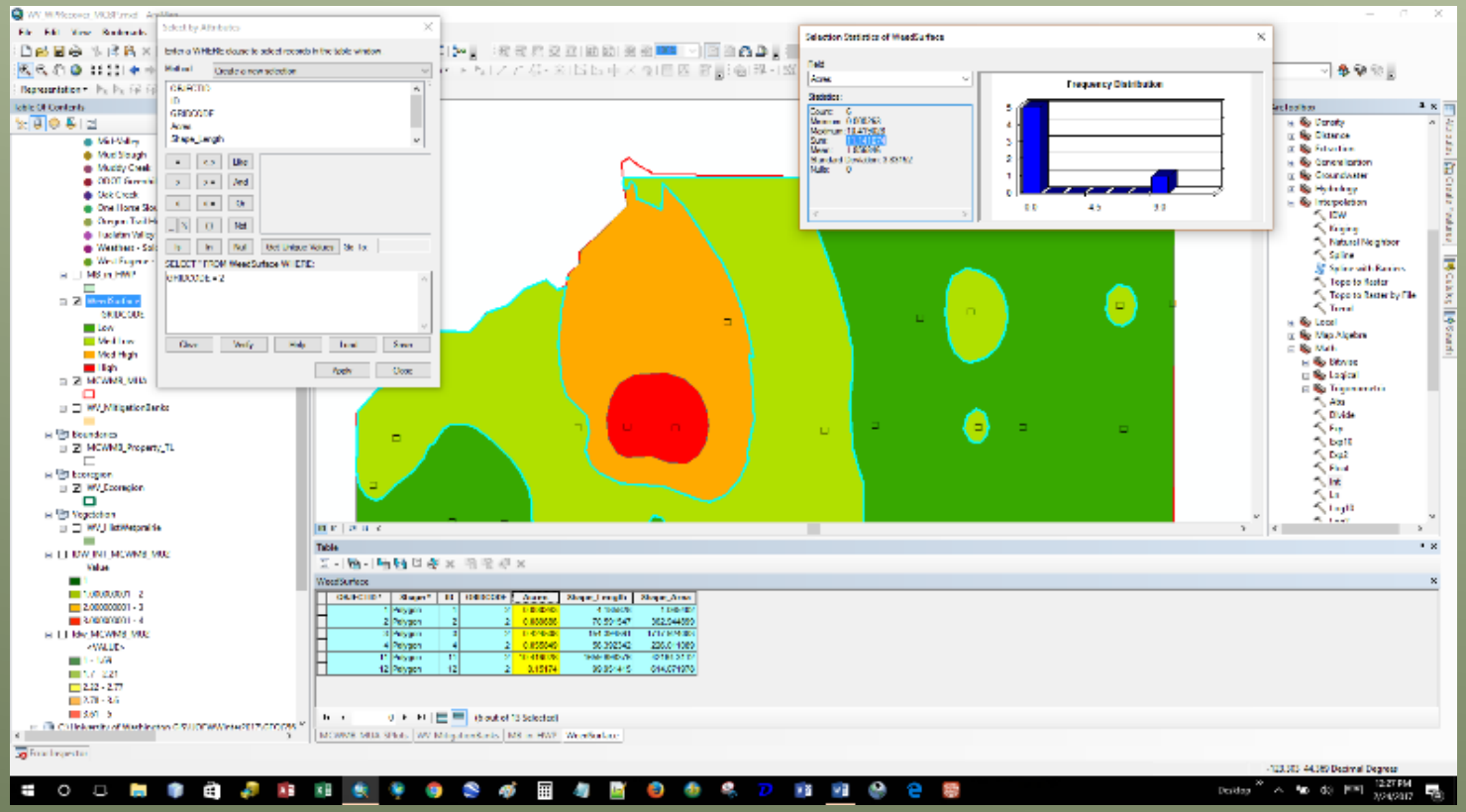
RASTER TO POLYGON

The raster to polygon tool was then run on the discrete surface raster to produce a polygon with areal units with the same areal coverage by weed class as the discrete raster. This polygon was then imported into the geodatabase feature class for mitigation banks to give it the same coordinate system (NAD 1983 UTM Zone 10) as the other data in the geodatabase. This also served to give the polygon a projected coordinate system necessary to use the calculate geometry tool and determine the number of acres covered by the weed surface polygon.

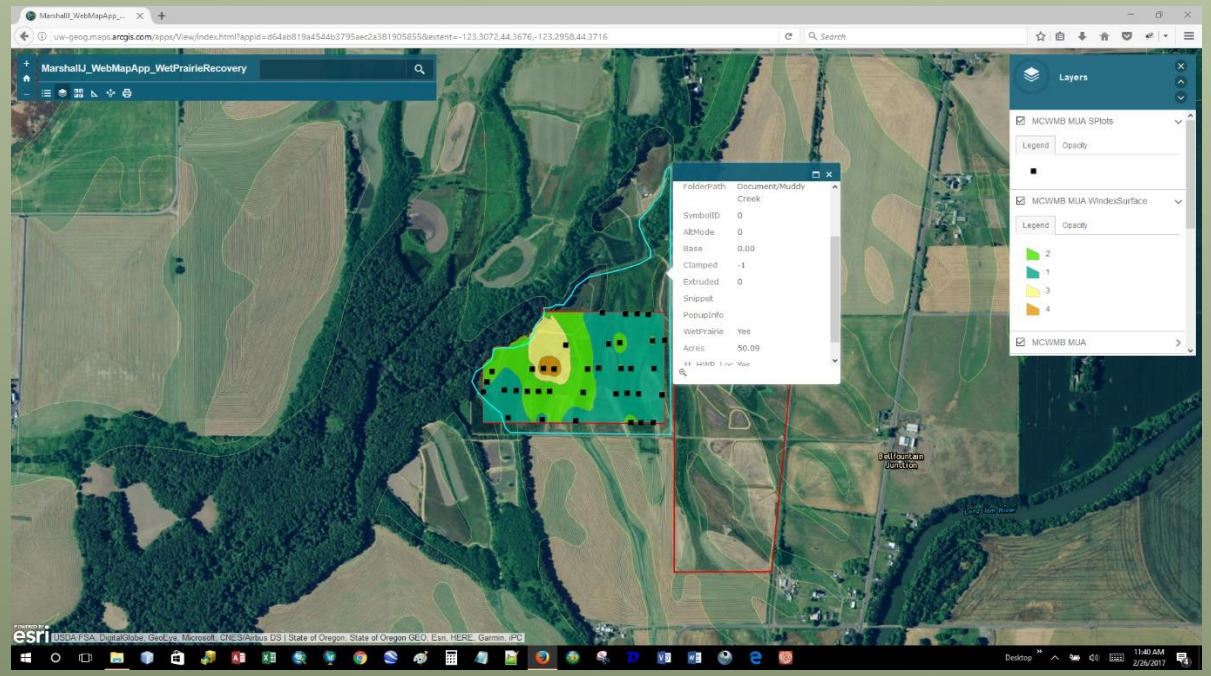
USE OF CALCULATE GEOMETRY TOOL TO DETERMINE WEED SURFACE ACRES COVERED.

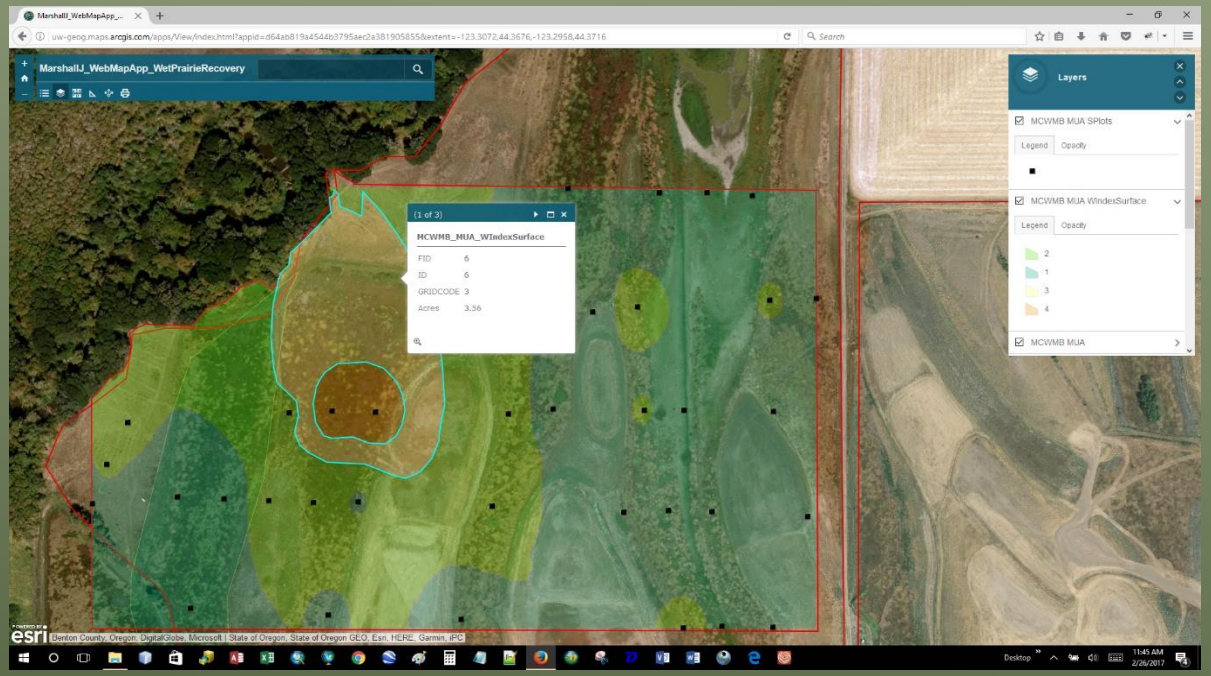


Use the calculate geometry tool to determine the number of acres covered by the weed surface polygon.



SQL QUERY IS USED TO DETERMINE ACREAGE OF EACH WEED CLASS



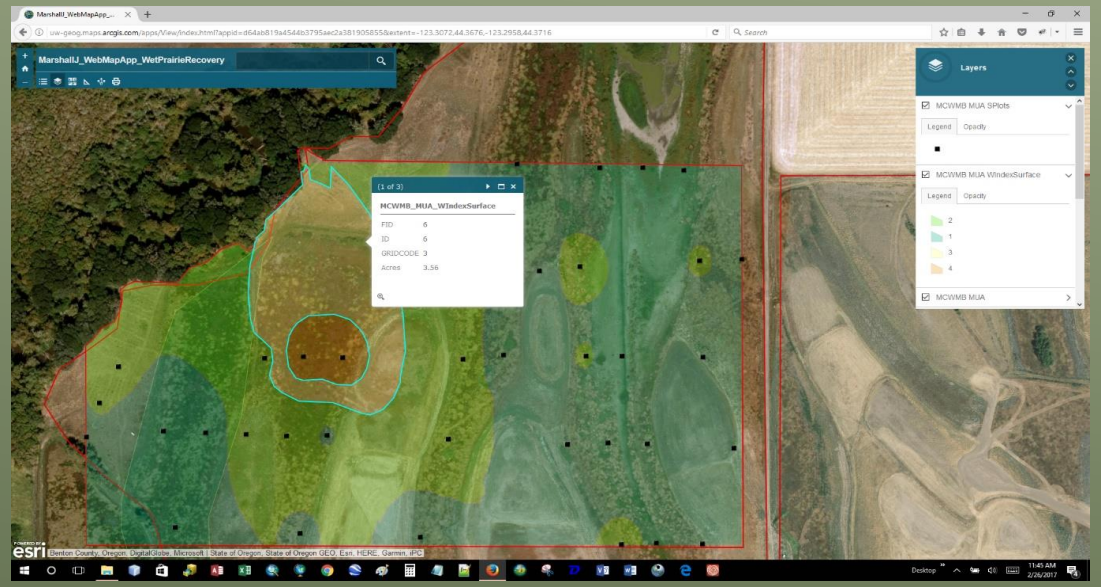


MUDDY CREEK WETLAND MITIGATION BANK WEED SURFACE PERFORMANCE

An ArcGIS On-Line Web Map Application is used to view the weed index surface generated from different scales.

DETERMINE POTENTIAL CREDITS, PENALTY, AVAILABLE CREDIT, AND CREDIT VALUE

Weed Class	WindexRange	Acres	PotCredits	Penalty	AvailCredit	CreditValue
1	1 - 2	18.91	9.455	0	9.455	$709,125.00
2	2 - 3	11.14	5.57	0.25	4.1775	$313,312.50
3	3 - 4	3.56	1.78	0.50	0.89	$66,750.00
4	4 - 5	0.71	0.355	0.75	0.08875	$6,656.25
Total		34.32	17.16		14.61	$1,095,843.75



Looking at the data from the Muddy Creek Wetland Mitigation Bank Management Unit A, it is possible to say that on this tract of land 87% of the land has a weed index of 3 or less which (assuming the performance threshold is correct) is successfully reflected in the output of this projects hypothetical method for assessing the bank's economic viability (85% of its potential credit is available for sale) proportional to it ecological performance.

[1] Potential credit based on an assumption of an acreage divider of 2 (e.g., 10-acres = 5-credits).
[2] Penalty is arbitrarily assigned for purposes of illustration and does not reflect actual penalties for low performance currently levied at mitigation banks.
[3] AvailCredit is derived using this formula: AvailCredit = PotCredits – (PotCredits x Penalty).
[4] CreditValue is derived using this formula: CreditValue = AvailCredit x $75,000.00.

Ecological. Historical losses subsequent to European settlement contribute to present conditions of rare habitat and species.	**It is estimated that up to 99% of the original Willamette Valley wetgrass prairie may have been lost to agricultural conversion and urban development. Several plant and animal species that depend on the prairie for their survival are Federally listed as threatened or endangered.**
Economic. Rare habitat and species become a source of income to landowners incentivizing their protection and restoration.	This helps give an economic incentive for mitigation bank sponsors to manage for high performance of public trust resources.
Social. Newspapers reflect changing societal values and new partnerships.	Wetland mitigation banks seem to strike a mutually beneficial balance between the needs of developers and the concerns of environmentalists.

SOCIO-ECOLOGICAL FRAMEWORK FOR WET PRAIRIE RECOVERY

Within the context of our socio-ecological characterization and mapping framework we have reasonable indication that at the ecosystem level, from pre-European settlement to present-day, there is a substantial trend toward semi-evenly distributed wet prairie acreage recovery. For one land parcel, management unit, and associated vegetation sample plots, we have reasonable indication (presuming the performance threshold is valid) that the prairie quality with respect to weeds is being adequately managed.

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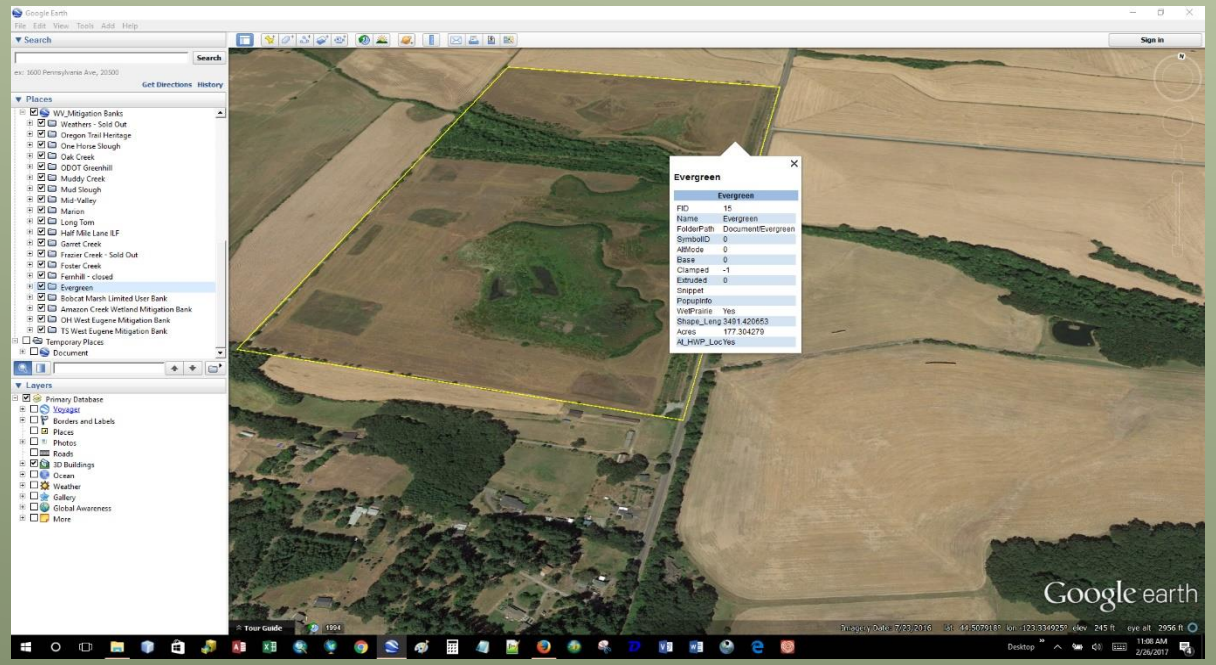
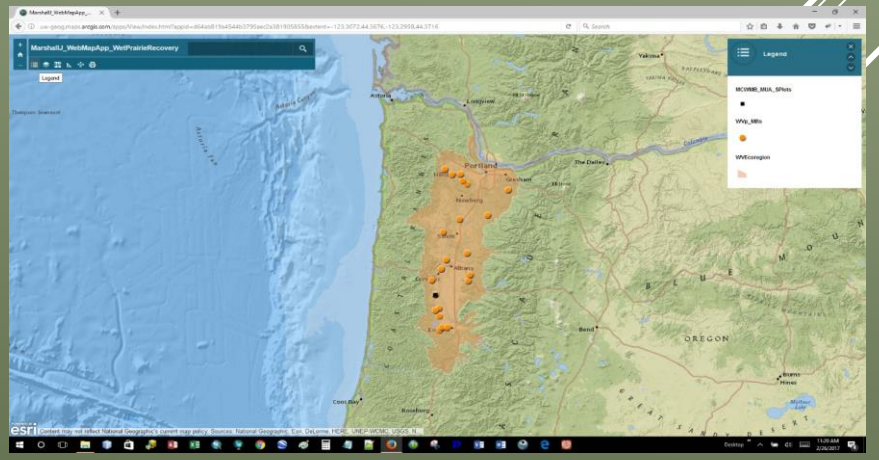
SOCIO-ECOLOGICAL FRAMEWORK FOR WET PRAIRIE RECOVERY

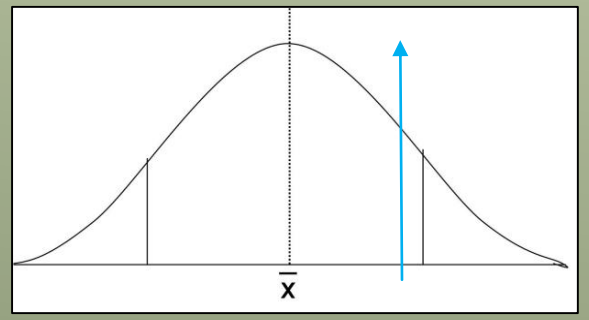
From the socio-ecological perspective this project does provide some insight into spatial and temporal wet prairie loss and recovery across multiple scales, and it does offer room to speculate on the quantitative and qualitative nature of wet prairie across social, ecological, and economic aspects of human interactions with this resource. But mostly to the extent that it leaves more questions unanswered than it offers answers for and the sense that there is a lot of work remaining to be done.



GAPS IN OUR INFORMATION

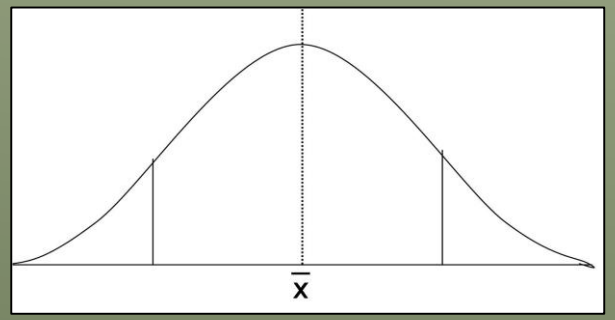
It was determined that over 1,476-acres was dedicated to helping recover wet grass prairie in the Willamette Valley ecoregion. However, since this estimate is based on total bank acreage and most banks have one or more management units that are not dedicated to restoring wet prairie but some other habitat type, it is judged to be an overestimate of the mitigation bank contribution to Willamette Valley wet prairie recovery. Visually we can discern that the recovery actions of these banks tend to be semi-evenly distributed throughout the entire Willamette Valley.





Sample Size
Existing Data
too Small

Missing a Prairie
Recovery Population



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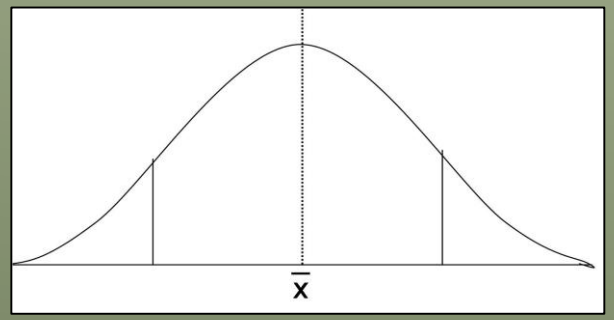


Mitigation Bank
Prairie Recovery

Non-Mitigation Bank
Prairie Recovery

Recovered !

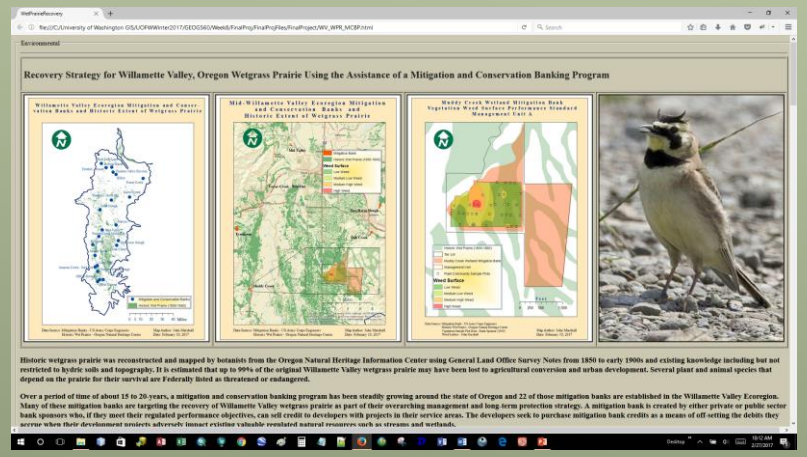
You Are
Here?

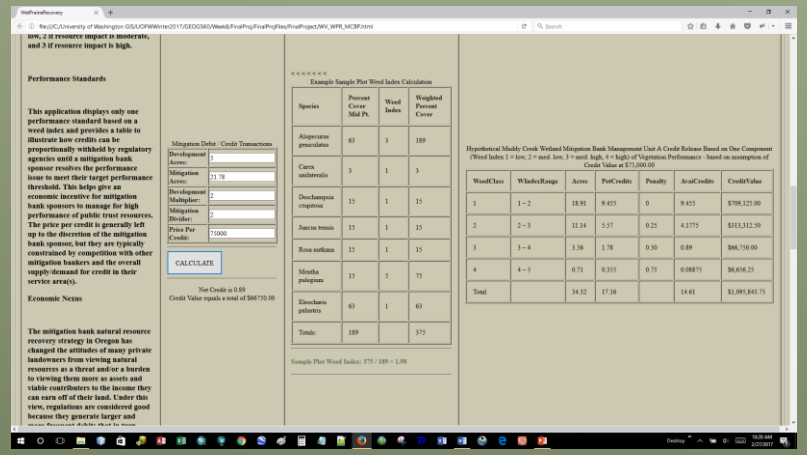
GAPS IN OUR INFORMATION

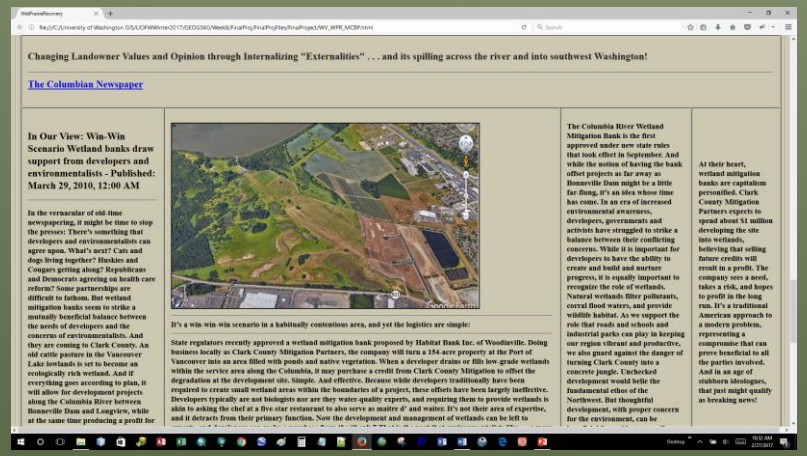
For prairie quality recovery, the sample size (n = 1) is much too small to make any broader inferences from. Another concern is that historically there was also a tremendous historical loss of native upland prairie (inter-digitated with the wet prairie) resulting in its own set of associated imperiled species that this project completely ignores.

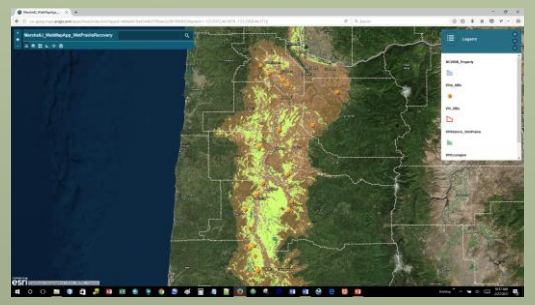
Also, mitigation and conservation banking are not the only projects in the Willamette Valley engaged in wet prairie recovery activities. There are likely as many or more private lands and public lands projects both in the past and on-going that were not considered in this project.

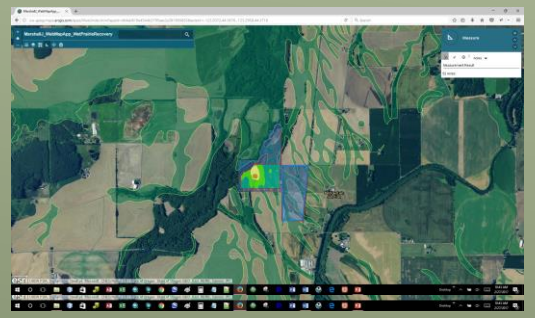
Finally, there is no rationale or path laid out in this project to assess where the benchmark for the state of "successfully recovered" should be placed. Therefore, we cannot discern from the information used in this project where we are in the trajectory toward wet prairie recovery in the Willamette Valley, only that some progress appears to have been made.

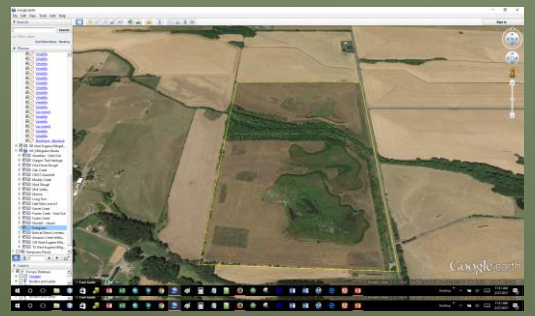












WEB PAGE LAYS FOUNDATION FOR FULL COMPLEMENT OF DATA CONSUMPTION

The entire project (web page, web map, static maps, etc.) comprises a socio-ecological characterization and mapping framework that is used as the operational construct for meeting the project objective. It recognizes the hierarchical spatial scales of ecoregion, mid-range ecoregion, land parcel or site, management unit, and sample plot and a time scale ranging between pre-European settlement to the present. The primary human system/knowledge domains traversed included social, ecological, and economic foci.

Model

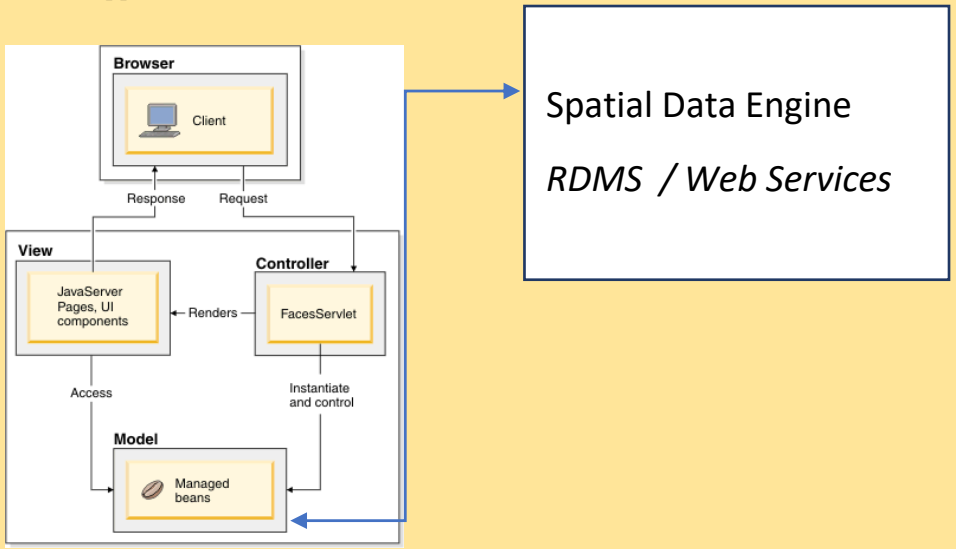
Encapsulates the information (data) and the methods to operate on that information (business logic). Managed beans define the model of a JSF application. These Java™ beans typically interface with reusable business logic components or external systems, such as a mainframe or a **relational database management system**.

View

Presents the Model. JSPs / HTMLs make up the view of a JSF web application. These JSPs / HTMLs interact with JAVA code and use predefined and custom-made GUI components connecting to the Model.

Controller

Processes user events and drives Model and View updates. The Faces Servlet, which handles the request processing lifecycle defined by JSF, drives the application flow.



http://www.ibm.com/support/knowledgecenter/SSRTLW_9.5.0/com.ibm.etools.jsf.doc/topics/cmvc.html

NEXT STEPS

The entire complement of data associated with the ecoregion-wide mitigation and conservation banking program(s), along with nonregulatory wet prairie restoration efforts, needs to be entered onto a relational database management system (RDBMS) operating inside an enterprise spatial database engine that is accessible by a graphical user interface (GUI) in one or more web pages and capable of having supervised data entered and queried (e.g., customized stored procedures) from remote clients such as desktop computers, remote sensors, and hand held mobile devices with GPS functionality.

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