

**Documentation of Shapefiles
for the MODFLOW Stream Package
of the Western Water Use Model
in the Nebraska Panhandle**

by

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Introduction

This report documents shapefiles and other files prepared for the MODFLOW Stream Package of the Western Water Use Model. This model is being constructed as a joint effort among North Platte Natural Resources District (NPNRD), South Platte Natural Resources District (SPNRD), and Nebraska Department of Natural Resources (DNR).

Selection of Streams for the Model

Streams were selected for inclusion in the model by a team consisting of Thad Kuntz (NPNRD and SPNRD), Jesse Bradley (DNR), and Dick Luckey (High Plains Hydrology, LLC). The team consulted with Tom Hayden (DNR, Bridgeport office) in this effort and also made use of DNR Hydrographic Reports. Larger streams were automatically included in the model. Smaller streams were included in the model if their perennial lengths were more than a few miles long, their flows consisted of groundwater during non-runoff periods, and their groundwater components of flow consisted of more than a few cubic feet per second. If a stream was measured by DNR for water rights administration, it was likely to be included in the model.

Streams that were potential candidates for inclusion in the model were visited by one or more team members. These visits were to determine if the stream was perennial, to estimate the amount of groundwater in the stream, and to estimate the start of perennial flow. The visit usually included a recommendation to include or exclude the stream from the model. If there was no recommendation, the stream was visited by another member of the team or at a different time by the person making the original visit.

The streams selected for inclusion in the model are shown on figure 1. Streams included in the model are shown below. The indentations indicate which stream is tributary to which stream and defines the order of the tributary in a subsequent section. The list starts with the North Platte River and its tributaries in a downstream order from the western edge of the model. The South Platte River then follows. Lodgepole Creek is tributary to the South Platte River, although the confluence is south of the area shown on figure 1.

North Platte River	Scottsbluff Drain
Horse Creek	Winters Creek
Kiowa Creek	Dunham Andrews Drain
Owl Creek	Gering Drain
Lane Drain	Melbeta Drain
Sheep Creek	Ninemile Creek
Dry Sheep Creek	Hope Creek
Akers Draw	East Ninemile Creek
Dry Spottedtail Creek	Alliance Drain
Dutch Flats Drain	Moffat Drain
Bald Peak Drain	Bayard Drain
(Wet) Spottedtail Creek	Red Willow Creek
Tub Springs Drain	Wildhorse Drain
Hiersche Drain	Wildhorse Canyon
Sunflower Drain	Indian Creek

North Platte River (continued)	Rush Creek
Upper Dugout Creek	Blue Creek
Pumpkin Creek	Clear Creek
Lawrence Fork	Otter Creek
Greenwood Creek	Lonergan Creek
Silvernail Drain	
Cedar Creek	
Coldwater Creek	South Platte River
Coldwater Creek west tributary	Lodgepole Creek
Coldwater Creek east tributary	

Selection of Stream Cells for the Model

The Western Water Use Model uses MODFLOW to simulate groundwater flow, which requires a regular grid of cells to simulate flow. The model cells are 1320 ft on a side, which results in 40-acre cells. The model consists of 456 rows of east-west cells and 520 columns of north-south cells, for a total of 237,120 cells. There are 174,953 active cells in the model, with the remaining cells outside of the model area. The southwest corner of the southwest most cell in the grid (which is not an active cell) is at 403,920 ft northing and 495,000 easting in Nebraska state plane coordinates (NAD 1983, US foot).

Model cells were selected to represent the streams described in the previous section. These cells were saved in polygon shapefile grid_stream_110127. The stream cells selected represent the general courses of the streams but do not exactly represent the course of the streams. For example, if a stream went through only a corner of a cell, that cell was not likely to be selected as a stream cell. Figure 2 shows stream cells along Kiowa Creek and Horse Creek near the village of Lyman to illustrate the relationship between streams and stream cells. Horse Creek is the east-west feature in the upper part of the figure and Kiowa Creek is the north-south feature near the center. Owl Creek enters Kiowa Creek from the southeast. The feature to the east is Lane Drain.

The colors of the cells represent stream segments, which are part of the streamflow accounting system in MODFLOW. The numbers represent reaches, which are numbered sequentially in a downstream order within a segment. Note that in the yellow segment of Horse Creek, between reaches 16 and 17, the creek goes outside the selected stream cells. A similar situation occurs in the pink segment of Horse Creek between reaches 6 and 7. Note that in the green segment of Kiowa Creek, reach 8 is included as a stream cell, although the length of the stream in this cell is fairly short. This shows that the selection of stream cells is somewhat subject to interpretation.

Estimation of Stream Cell Properties

Several stream properties had to be estimated for each stream cell. These include stream water surface elevation, elevation of streambed top, elevation of streambed bottom, stream slope, stream width, streambed conductance, stream roughness, and streamflow in at the upper end of the segment. How these properties were estimated and how they are used in MODFLOW is discussed below.

Stream water surface elevation is an important property because the model is quite sensitive to some of the model parameters that this elevation was used to estimate. Stream water surface elevation was used to estimate elevation of streambed top, elevation of streambed bottom, and stream slope. Different ways of estimating stream water surface elevation were investigated, with the most satisfactory results obtained when high precision survey points were used where they existed. Where these survey points did not exist, stream water surface elevations were estimated from 1:24,000 scale topographic maps.

High precision survey points were created by Nations Engineering of Ft. Morgan, Colorado, in 2010 along the North Platte River and its tributaries near county roads that crossed these streams (fig. 3). The locations of the 75 points were selected by Thad Kuntz. Sixteen of the points were on the North Platte River and represented all roads crossing the river. The remaining points were on selected tributaries to the river. These points were selected before the selection of streams for the model was completed, so not all tributaries had such points. Future plans call for adding points along additional tributaries and adding points along Lodgepole Creek and the South Platte River.

The points were created using a differential Global Positioning System (GPS). A base station GPS receiver was placed at a benchmark or other point of known location and elevation. A roving station was placed at the edge of the water at a selected site near a county road. The signal from the base station was used to correct the signal received from the GPS satellites by the roving station. In this way, high precision latitude, longitude, and elevation were measured at the point. The high precision elevations were compared to the 30-meter digital elevation model (DEM) and the differences ranged from -18.2 ft (high precision point below DEM) to 7.5 ft. The mean difference was -4.3 ft and the standard deviation was 5.3 ft. The high precision survey points are in shapefile High_Resolution_Stream_Survey_NPNRD_2010.

The high precision survey points were supplemented by additional points estimated from 1:24,000 scale topographic maps. These supplemental points were placed on tributaries that were added to the model after the locations for the high precision points were selected, on Lodgepole Creek, and on the South Platte River. Additional supplemental points were also placed upstream of the high precision points where the tributaries were estimated to become perennial. Additional supplemental points were also added where Horse Creek and the North Platte River crossed the model boundary. Except at the start of perennial flow and at the model boundaries, these supplemental points were placed on the streams where elevation contours crossed the streams. Note that supplemental points were not placed between high precision survey points. This was initially tried but was abandoned when it became clear that these supplemental points degraded rather than enhanced the estimated stream water surface elevations.

The shapefile stream_101110 contains the arcs that define the streams selected for inclusion in the model. These arcs were split at the high precision survey points and at the supplemental points. The arcs were also split where streams intersected. This shapefile contains 261 arcs, including 17 arcs that defined the North Platte River, 6 arcs that defined the South Platte River, and 16 arcs that defined Lodgepole Creek. The supplemental points are represented in this shapefile in the elevation fields; no supplement point shapefile was created.

Field *elev_up* in the shapefile was populated with the upstream water elevation of the arc. Field *elev_dn* was populated with the downstream water elevation of the arc, except for the lowermost arc of each tributary, whose downstream water elevation was unknown at this point in the process.

Stream water surface elevations along the North Platte River, South Platte River, and Lodgepole Creek were then interpolated between high precision points or supplemental points based on the length of the stream between the upstream end of the arc and every vertex on the arc, accounting for the sinuosity of the stream. The exact procedure used is described in Appendix A. Stream water surface elevations at vertices along the stream were saved in shapefile stream_101110_pts. This shapefile contains 211,602 points, including 21,984 points along the North Platte River.

Because the arcs in shapefile stream_101110 were split where streams intersected, shapefile stream_101110_pts contains an interpolated water surface elevation at the mouth of each tributary to the North Platte River. The elevation at the mouth of each tributary was used to populate the field *elev_dn* for the lowermost arc of each tributary.

Stream water surface elevations along first order tributaries (streams directly tributary to the North Platte River – single indent in Selection of Streams for the Model section) were then interpolated between high precision points, supplemental points, and mouths of the tributaries. For example, Horse Creek is a first order tributary of the North Platte River, so stream water surface elevations were interpolated at vertices along Horse Creek and were saved in shapefile stream_101110_pts. This interpolation resulted in elevations at the mouths of second order tributaries (tributaries to first order tributaries). The elevation at the mouth of each second order tributary was used to populate the field *elev_dn* for the lowermost arc of each second order tributary. For example, Kiowa Creek is tributary to Horse Creek and the elevation of Horse Creek at the mouth of Kiowa Creek was used to populate the field *elev_dn* for the lowermost arc of Kiowa Creek. Stream water surface elevations along second order tributaries were then interpolated between high precision points, supplemental points, and mouths of the tributaries. The process was then repeated for third order tributaries (tributaries to second order tributaries). For example, Owl Creek is a third order tributary because it is tributary to Kiowa Creek. The process ended here because no fourth order tributaries were included in the model.

The actual interpolation of stream water surface elevations was done using spreadsheets as described in Appendix A. These spreadsheets are included in the DVD that accompanies this report.

The field *slope* of each stream arc in stream_101110 was calculated using the upstream water surface elevation of the arc, the downstream water surface elevation of the arc, and the total length of the arc. This slope is a dimensionless number representing foot drop per foot of length. The field *ft_mi* represents foot drop per mile of stream length and was generated by multiplying slope by 5280. This field is more intuitive than slope.

The field *width* of each stream arc in stream_101110 was estimated using 2009 aerial photography. Estimated average widths ranged from 2 ft for upper Clear Creek and its tributary Hope Creek to 85 ft for North Platte River in the vicinity of Lisco. The mean width was 9.1 ft and the standard deviation was 12.2 ft. The aerial photography was not of sufficient resolution to

estimate stream width to accuracies better than a few feet and stream width varies from place to place along a single stream arc. Fortunately, the model is not particularly sensitive to stream width.

Shapefiles *stream_101110* and *stream_101110_pts* were used to populate several fields in shapefile *grid_stream_110127*. *Grid_stream_110127* is a polygon shapefile of model cells that represent streams (fig. 2) and contains all the fields needed to create the Stream Package for MODFLOW. The metadata for each of these shapefile is in Appendix B and the metadata describe all the fields in detail.

Fields *row* and *column* in shapefile *grid_stream_110127* came from the original shapefile of the model grid and represent row and column in the grid. Field *layer* represents model layer and was set to 1 for all cells. Fields *segment* and *reach* are used in the MODFLOW streamflow accounting. Segments represent a series of stream cells and are numbered sequentially from 1 through 177. A new segment number must be used below a tributary; elsewhere a new segment number may begin at any stream cell. Segment numbers start with the North Platte River and go in downstream order. Segment numbers then represent North Platte tributaries in downstream order, then South Platte River in downstream order, and finally Lodgepole Creek in downstream order. However, this numbering was not always maintained. For example, Akers Draw was added to the model after the segment numbering was done and it was assigned segment 177. If it had been added earlier, it probably would have been assigned segment number 62. Reaches represent a stream cell within a segment and are numbered from 1 through N in downstream order. Fields *segment* and *reach* were generated manually for the stream cells. Fields *itrib1* and *itrib2* represent segments that are tributary to the current segment and these fields also were generated manually.

Field *stage_elev* of the polygon was populated from the stream water surface elevations in *stream_101110_pts* by using the point closest to the centroid of the polygon. Field *stage* (depth of water in the stream) was estimated to be 5 ft for North Platte River, 3 ft for South Platte River, and 2 ft for all other streams. These estimates are for the deeper parts of the stream based on general personal knowledge. The deeper parts were used because these parts were thought to gain more water than the shallower parts. Field *strm_top* (elevation of top of streambed) was calculated as *stage_elev* minus *stage*. Field *strm_bot* (elevation of bottom of streambed) was calculated as *strm_top* minus 5 ft. The value 5 ft was assumed because in many cases there is not a well defined streambed. Field *strm_bot* controls the elevation of the simulated water table at which stream leakage is limited because a unit downward gradient has been reached. If the simulated water table falls 5 feet below the streambed, a unit gradient probably has been reached. In the study area, stream water surface elevations and groundwater elevations are very close to each other and a unit downward gradient is unlikely to occur over the scale of a model cell.

Field *width* was assigned using the average width of the arcs in *stream_101110* within each model cell. If there were arcs from more than one stream in the model cell, the widths of the lowest order tributary were used. For most stream cells, there was only a single arc in the cell, so the width from *stream_101110* got transferred directly to *grid_stream_110127*. Likewise, field *slope1* was the slope of the lowest order arcs in *stream_101110* within each model cell.

Field *conductance* represents streambed conductance and will likely be changed during model calibration. This field was populated by hand using a previous model of the area (Luckey and Cannia, 2006). Values in the previous model ranged from 0.1 ft/d for tributaries to Pumpkin Creek to 22.5 ft/d for the North Platte River. These values represented conductance per foot of stream in the previous model. For streams that were not present in the previous model, values from nearby similar streams were used. Actual conductance in the model was a calculated value as described below.

Field *roughness* represents Manning's roughness coefficient for the stream. It was set to 0.03 (dimensionless) for all stream cells. This value is typical for streams in the model area. The model is not very sensitive to this value.

Field *strmfl_in* represents streamflow into the stream segment and is meaningful only for reach 1 of a segment. This field was populated manually. At the start of perennial flow, *strmfl_in* was set to 0 because there was no stream inflow. For the North Platte River at the western model boundary, this value was set to 25,920,000 ft³/d (300 ft³/s) because this was the estimated long term baseflow of the river. For the South Platte River at the southern model boundary, this value was set to 6,912,000 ft³/d (80 ft³/s) because this was the estimated long term baseflow of the river. For Horse Creek at two places along the western model boundary, this value was set to 1,036,800 ft³/d (12 ft³/s) because this was the estimated long term baseflow of the creek. For Lodgepole Creek at the western model boundary, this value was set to 172,800 ft³/d (2 ft³/s) because this was the estimated long term baseflow of the creek. These values were extrapolated from estimates at streamflow gages by Luckey and others (2001). For reach 1 of all other segments, this value was set to -1, a flag that indicates inflow to this segment is the sum of the outflows of the immediately upstream segments. For reaches not equal to 1, *strmfl_in* was set to 0.

Field *strmfl_in* represents long term average baseflow estimates for the period after the canals were online for a number of decades but before there was widespread development of groundwater for irrigation. These estimates may not be appropriate for the pre-canal period or after groundwater development. Therefore, these estimates may be changed during model calibration.

Field *rch_len* is the length of the stream arc in the model cell. This value was calculated in ArcMap after splitting stream_101110 at cell boundaries. These arcs are saved in shapefile stream_split_110105.

Field *cond_vistas* (alias for temp_01) is the product of *conductance* and *rch_len*. This is the actual conductance that was used in the model.

Additional Notes

The stream arcs in shapefile stream_101110 are quite sinuous for some streams and this sinuosity causes the arcs to have many vertices. Because stream surface elevation is interpolated at every vertex along the stream, shapefile stream_101110_pts has a large number of points in it. The number of points in the shapefile could be reduced without loss of precision if the arcs in the shapefile were generalized so that they contained fewer vertices.

The number of vertices in the shapefile was not an issue in this process because stream surface elevations at vertices were interpolated one stream at a time using a spreadsheet. The point elevations from each stream were then merged into a shapefile. If elevations of several streams had been interpolated at once, the limits of a spreadsheet could have been exceeded.

The process of interpolating stream surface elevations using spreadsheets was tedious and time consuming. It was also prone to error because the interpolation formula had to be reset at the beginning of each stream arc. If a Geographic Information System (GIS) procedure or script could be found to automate this interpolation, substantial time could have been saved. A search was made for such a procedure early in the process, but none was found.

References Cited

- Luckey, R.R. and Cannia, J.C., 2006, Groundwater flow model of the western model unit of the Nebraska Cooperative Hydrology Study (COHYST) area: Platte River Cooperative Hydrology Study, 63 p.
- Luckey, R.R., Carney, C.P., and Peterson, S.M., 2001, Estimated groundwater discharge to streams from the High Plains aquifer in the Western Model Unit of the Cooperative Hydrology Study area for the period prior to major groundwater irrigation: Platte River Cooperative Hydrology Study, 20 p.

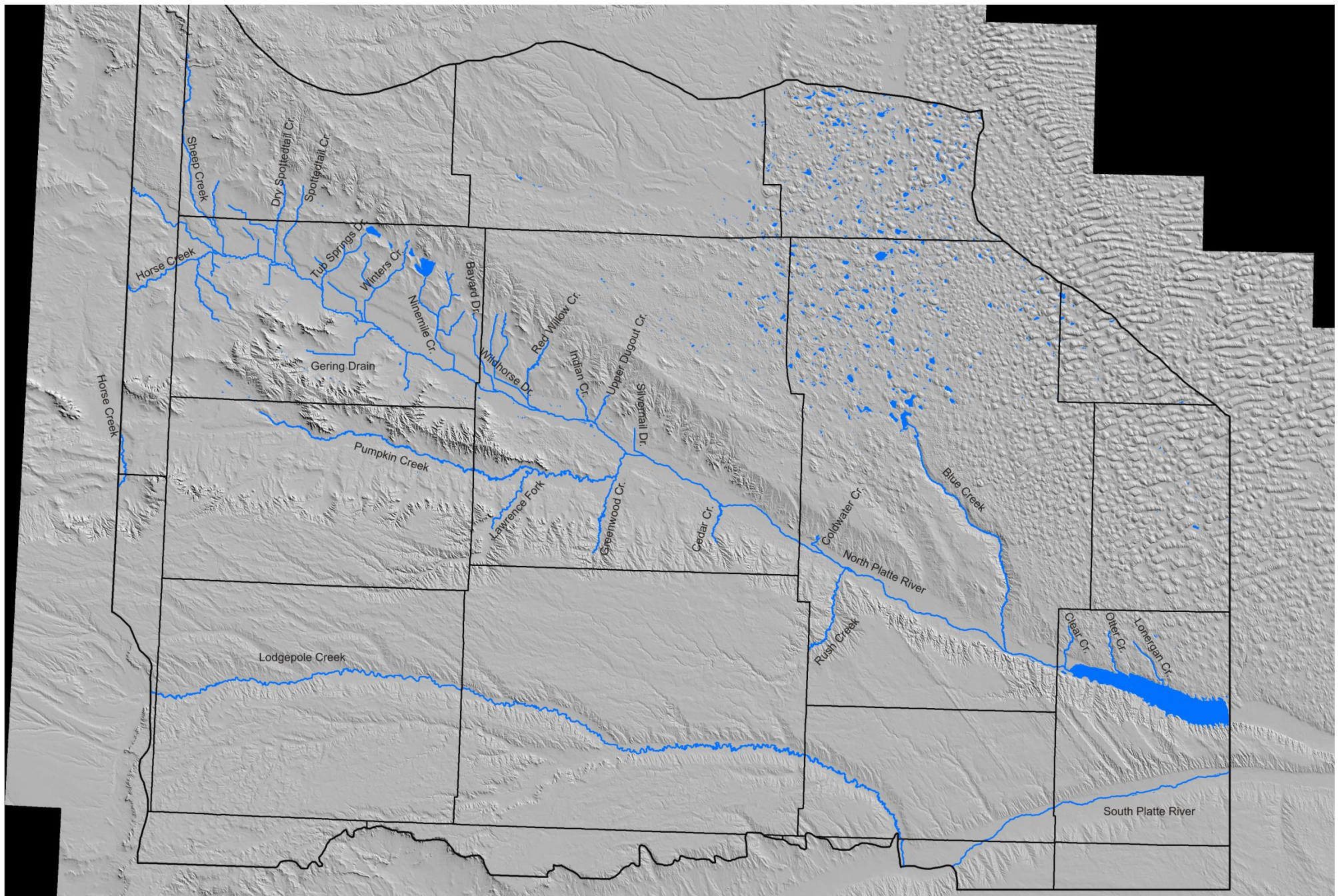


Figure 1. Streams selected for inclusion in the model.

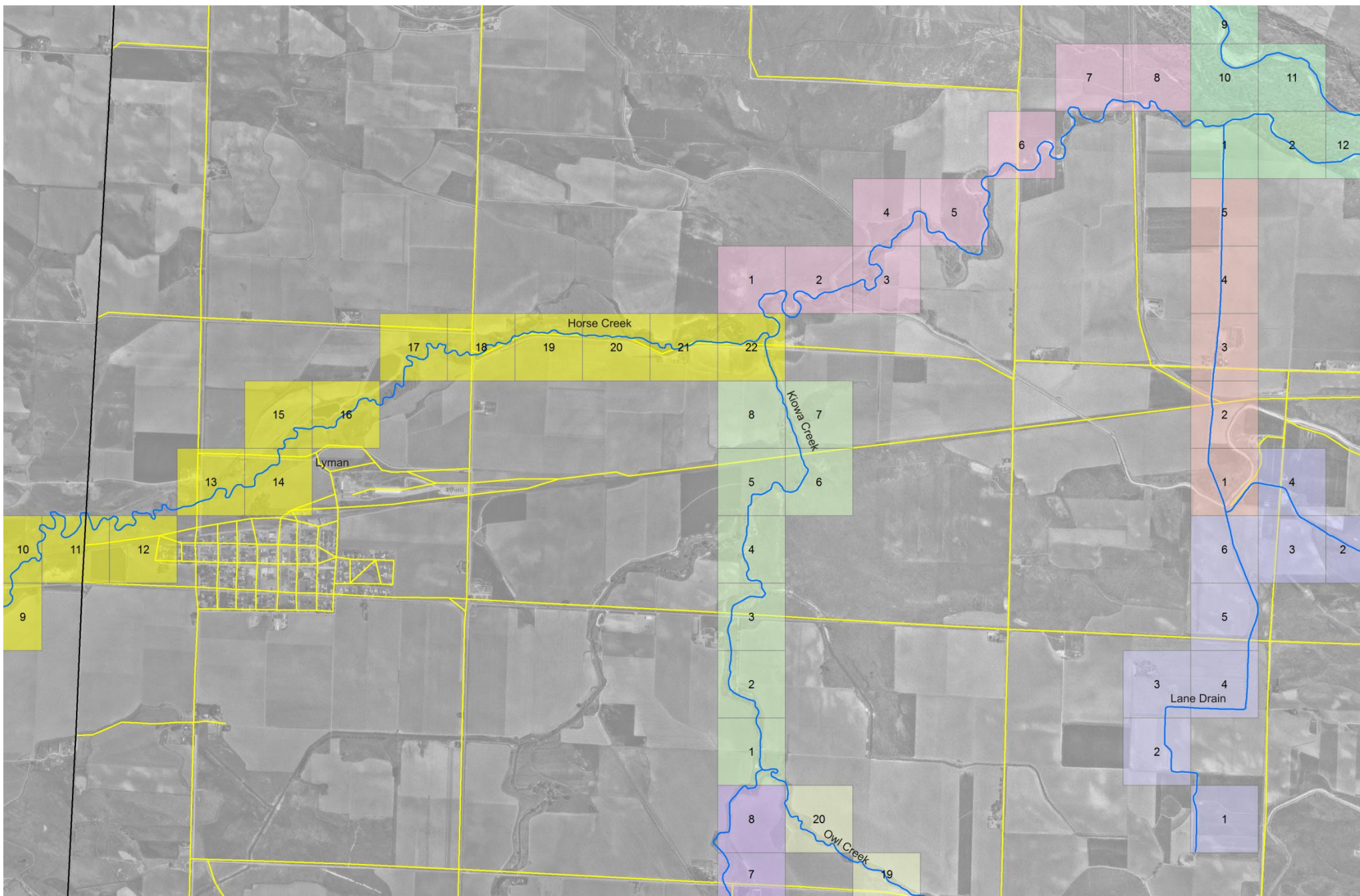


Figure 2. Example of stream cells used in the model. Colors represent stream segments and numbers represent stream reaches.

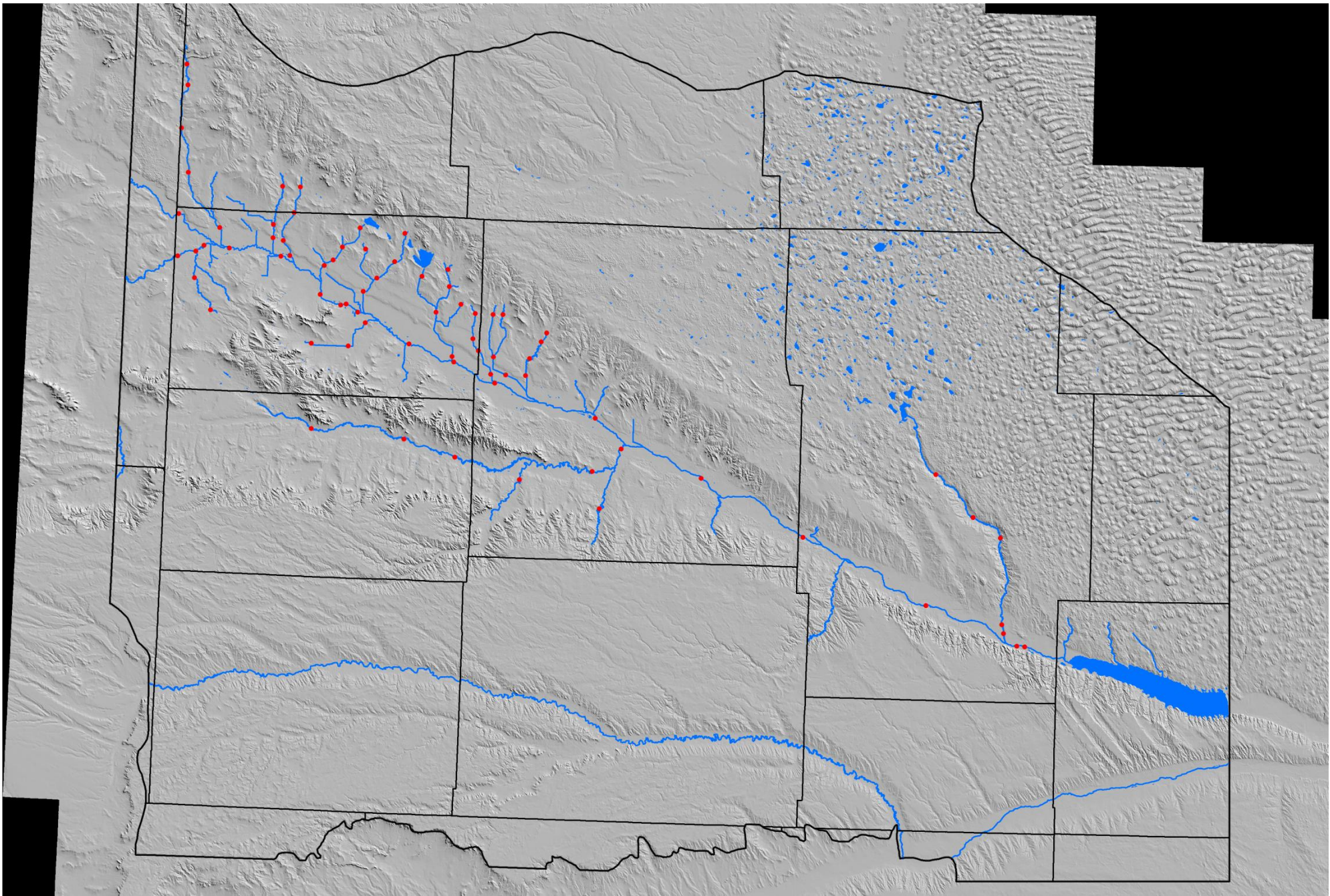


Figure 3. Location of high resolution survey points used to interpolate stream surface elevation.

Appendix A. Procedure Used to Create Files

October 13, 2010

Procedure to create files needed to determine properties for stream cells.

1. Create empty polyline shapefile in ArcCatalog: File --> New --> Shapefile
2. In ArcMap, start editing in workspace where new shapefile was created. Make the Target the new shapefile. Select arcs from existing shapefiles, such as tribs_100430, tribs_proposed_100922, and rivers_100423. Copy the selected arcs to the clipboard. Paste the arcs (this puts them into the new shapefile because it is the Target).
3. Densify vertices on all arcs so that a vertex exists at least every 100 ft. To do this, select one arc and remember its value for FID or Id. Have the attribute table open to do this. In the Editor pull-down menu, select Divide and tell the editor to split the arc every 100 ft. This will generate numerous arcs without any information in the attribute table. Select all of these arcs plus the original arc using the FID or Id. In the Editor pull-down menu, tell the editor to merge the arcs. Repeat this for each arc. Populate the field Id in some meaningful way so the original arcs can be identified.
4. Stop editing so that new fields can be added to the shapefile. Add fields name (text 25), length (double), elev_up (F10.4), elev_dn (F10.4), slope (F10.6), ft_mi (F10.2), elev (F10.4), len_total (double), temp_01 (double), X_end (double), and Y_end to the new shapefile.
5. Start editing again. Break the main stem arc at points of known elevation, including the most upstream and most downstream points. Populate fields elev_up (upstream elevation) and elev_dn (downstream elevation) with known elevations. When main stem is done, calculate geometry (length) for field len_total. Calculate $\text{slope} = (\text{elev_up} - \text{elev_dn}) \div \text{len_total}$ and $\text{ft_mi} = \text{slope} * 5280$. Renumber the Id field so that each arc has a unique value. Stop editing so new shapefile can be created in the workspace.
6. In ArcToolbox, break the arc into numerous short arcs. Use Data Management Tools --> Features --> Split Line At Vertices. For the name, use the original shapefile name plus _arc1. Calculate geometry for field length and verify that the greatest arc length is 100 ft. Calculate geometry for field X_end as X coordinate of end of line. Calculate geometry for field Y_end as Y coordinate of end of line.
7. Use Excel to open the *.dbf of the arc1 shapefile. For the first record, set temp_01 to length. For the subsequent records, set temp_01 to the previous record's temp_01 plus the current record's length. Temp_01 represents the cumulative length of the original arc up to the current point. This works because the split in the previous paragraph starts at the upper end of the arc and proceeds downstream in order. Each time the field Id changes, reset temp_01 to length so the accumulation can start over. Comparing temp_01 to len_total helps find the change in ID.

8. Calculate $elev = elev_up - (elev_up - elev_dn) * (temp_01 / len_total)$ for all records. This is the elevation interpolated from the upstream and downstream elevations based on how far down the current arc is in the original arc. If you are in Excel-2003, you can save the *.dbf. If you are in Excel-2007, you cannot save the *.dbf and will instead have to save it as an *.xls file.
9. If you have to save the arc1 *.dbf as an *.xls, bring the Excel file into ArcMap and use the X_end and Y_end to create a point file. If there are no tributaries to the main stem, the process is over.
10. Use the point file (or the arc1 file if you used Excel-2003) to determine the elevation of the mouth of each level 1 tributary. Put this elevation in the field elev_dn in the original shapefile. Do this for each level 1 tributary. Break each level 1 tributary at known elevation points, including the uppermost point, and populate fields elev_up and elev_dn. Calculate slope and ft_mi as described previously. Split the arcs as described previously. Calculate length, X_end, and Y_end as describe previously. Calculate temp_01 in Excel as described previously. Calculate elev in Excel as described previously. If there are no level 2 tributaries, the process is over. If there are level 2 and higher tributaries, repeat the process as many times as necessary until elev_up and elev_dn is described for each arc.
11. Once all elevations have been computed correctly, create a point shapefile with the stream elevations in it. The point shapefile should have the original shapefile name plus _pts.

The field slope can be used directly to assign slopes to the stream cells. The field elev can be used to assign stream elevation to the stream cells. Use the point nearest the cell centroid to assign the elevation. This process has assured that there will be an elevation at least every 100 ft along the stream arc, and frequently more often.

After using this procedure on many streams, it might be worthwhile to simplify the streams before starting to work on them. Many streams are so sinuous that there are vertices every few feet or tens of feet. This results in many more elevation points than are realistically needed for this procedure.

Appendix B. Metadata for Shapefiles

Shapefile	Page
stream_101110	13
stream_101110_pts	18
stream_split_110105	23
grid_stream_110127	29
High_Resolution_Stream_Survey_NPNRD_2010	35

Metadata for stream_101110

Identification_Information:

Citation:

Citation_Information:

Originator: Richard R. Luckey

Publication_Date: November 10, 2010

Title: stream_101110

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

C:\Data\Nebraska_WWU_Model\model_construction\stream_101110.shp

Description:

Abstract:

This dataset depicts streams that are simulated in the Western Water Use model that is being constructed as a joint effort among North Platte Natural Resources District, South Platte Natural Resources District, and Nebraska Department of Natural Resources.

This dataset was produced using the U.S. Geological Survey National Hydrography Dataset (NHD). After streams were selected for inclusion in the model, they were retrieved from the NHD. Each individual stream or tributary was then merged into a single arc. The resulting arc was then split at points of known elevation: high resolution survey points where available or interpolated values from 1:24,000 maps where not available. The arc was then assigned an upstream and downstream elevation, the length of the arc was computed, the slope of the arc was computed, and other values were then assigned to the arc. Additional vertices were added to the arc so that vertices were no more than 100 ft apart.

Purpose: This dataset was produced to help compute various inputs needed for the Stream Package of the MODFLOW groundwater flow simulation program.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: November 11, 2010

Currentness_Reference: publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -104.207533

East_Bounding_Coordinate: -101.662547

North_Bounding_Coordinate: 42.332197

South_Bounding_Coordinate: 40.905148

Keywords:

Theme:

Theme_Keyword: Western Water Use Model

Theme_Keyword: western model

Place:

Place_Keyword: Nebraska

Place_Keyword: Arthur County

Place_Keyword: Banner County

Place_Keyword: Box Butte County

Place_Keyword: Cheyenne County
Place_Keyword: Deuel County
Place_Keyword: Garden County
Place_Keyword: Grant County
Place_Keyword: Keith County
Place_Keyword: Kimball County
Place_Keyword: Morrill County
Place_Keyword: Scotts Bluff County
Place_Keyword: Sheridan County
Place_Keyword: Sioux County

Access_Constraints: This dataset is in the public domain and may be freely accessed.

Use_Constraints: This dataset is in the public domain and may be freely used. When used, acknowledgement of Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District and High Plains Hydrology, LLC is appreciated.

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Hours_of_Service: 9:00 - 5:00 Mountain time

Data_Set_Credit: This dataset was produced as a joint effort among Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District, and High Plains Hydrology, LLC.

Native_Data_Set_Environment: Microsoft Windows Vista Version 6.1 (Build 7600) ; ESRI ArcCatalog 9.3.1.3500

Data_Quality_Information:

Lineage:

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xmlBFAD.tmp

Process_Date: 20101111

Process_Time: 10105500

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: String

Point_and_Vector_Object_Count: 261

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

- Grid_Coordinate_System:
 - Grid_Coordinate_System_Name: State Plane Coordinate System 1983
 - State_Plane_Coordinate_System:
 - SPCS_Zone_Identifier: 2600
 - Lambert_Conformal_Conic:
 - Standard_Parallel: 40.000000
 - Standard_Parallel: 43.000000
 - Longitude_of_Central_Meridian: -100.000000
 - Latitude_of_Projection_Origin: 39.833333
 - False_Easting: 1640416.666667
 - False_Northing: 0.000000
 - Planar_Coordinate_Information:
 - Planar_Coordinate_Encoding_Method: coordinate pair
 - Coordinate_Representation:
 - Abscissa_Resolution: 0.000000
 - Ordinate_Resolution: 0.000000
 - Planar_Distance_Units: survey feet
 - Geodetic_Model:
 - Horizontal_Datum_Name: North American Datum of 1983
 - Ellipsoid_Name: Geodetic Reference System 80
 - Semi-major_Axis: 6378137.000000
 - Denominator_of_Flattening_Ratio: 298.257222
- Entity_and_Attribute_Information:
 - Detailed_Description:
 - Entity_Type:
 - Entity_Type_Label: stream_101110
 - Attribute:
 - Attribute_Label: FID
 - Attribute_Definition: Internal feature number.
 - Attribute_Definition_Source: ESRI
 - Attribute_Domain_Values:
 - Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
 - Attribute:
 - Attribute_Label: Shape
 - Attribute_Definition: Feature geometry.
 - Attribute_Definition_Source: ESRI
 - Attribute_Domain_Values:
 - Unrepresentable_Domain: Coordinates defining the features.
 - Attribute:
 - Attribute_Label: Id
 - Attribute_Definition: Stream ID number (downstream order)
 - Attribute:
 - Attribute_Label: length
 - Attribute_Definition: Length of stream arc
 - Attribute:
 - Attribute_Label: elev_up
 - Attribute_Definition: Elevation at upstream end of arc
 - Attribute:
 - Attribute_Label: elev_dn
 - Attribute_Definition: Elevation at downstream end of arc
 - Attribute:
 - Attribute_Label: slope

Attribute_Definition: Slope of stream arc (dimensionless)
 Attribute:
 Attribute_Label: ft_mi
 Attribute_Definition: Slope of stream arc, in feet per mile
 Attribute:
 Attribute_Label: width
 Attribute_Definition: Width of stream estimated from aerial
 photography
 Attribute:
 Attribute_Label: name
 Attribute_Definition: Name of stream
 Attribute:
 Attribute_Label: temp_01
 Attribute_Definition: Temporary field used for calculations
 Distribution_Information:
 Resource_Description: Downloadable Data
 Standard_Order_Process:
 Digital_Form:
 Digital_Transfer_Information:
 Transfer_Size: 0.206
 Metadata_Reference_Information:
 Metadata_Date: 20101111
 Metadata_Contact:
 Contact_Information:
 Contact_Person_Primary:
 Contact_Person: Richard R. Luckey
 Contact_Organization: High Plains Hydrology, LLC
 Contact_Position: Senior Hydrologist
 Contact_Address:
 Address_Type: mailing and physical address
 Address: 7956 S. Shawnee St.
 City: Aurora
 State_or_Province: CO
 Postal_Code: 80016
 Country: USA
 Contact_Voice_Telephone: 303-693-0299
 Contact_Facsimile_Telephone: 303-693-0299
 Contact_Electronic_Mail_Address: rrluckey@msn.com
 Hours_of_Service: 9:00 - 5:00 Mountain
 Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
 Metadata
 Metadata_Standard_Version: FGDC-STD-001-1998
 Metadata_Time_Convention: local time
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile

Metadata for stream_101110_pts

Identification_Information:

Citation:

Citation_Information:

Originator: Richard R. Luckey

Publication_Date: November 10, 2010

Title: stream_101110_pts

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

C:\Data\Nebraska_WWU_Model\model_construction\stream_101110_pts.shp

Description:

Abstract:

This dataset depicts elevations along streams that are simulated in the Western Water Use model that is being constructed as a joint effort among North Platte Natural Resources District, South Platte Natural Resources District, and Nebraska Department of Natural Resources.

This dataset was produced using the U.S. Geological Survey National Hydrography Dataset (NHD). After streams were selected for inclusion in the model, they were retrieved from the NHD. Each individual stream or tributary was then merged into a single arc. The resulting arc was then split at points of known elevation: high resolution survey points where available or interpolated values from 1:24,000 maps where not available. The arc was then assigned an upstream and downstream elevation, the length of the arc was computed, the slope of the arc was computed, and other values were then assigned to the arc. Additional vertices were added to the arc so that vertices were no more than 100 ft apart.

The arcs were then split at each vertex to generate a large number of short arcs. The lengths and coordinates of the ends of the short arcs were computed.

An Excel spreadsheet was used to interpolate the elevation at the end of short arcs using the upstream and downstream elevation of the original arc and the cumulative length down the original arc relative to the length of the original arc.

The spreadsheet was used to produce the points in this dataset using the coordinates of the end of the short arcs and the interpolated elevations at the ends of the short arcs.

Purpose: This dataset was produced to help compute various elevations needed for the Stream Package of the MODFLOW groundwater flow simulation program.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: November 11, 2010

Currentness_Reference: publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -104.207511
East_Bounding_Coordinate: -101.662547
North_Bounding_Coordinate: 42.332070
South_Bounding_Coordinate: 40.905149

Keywords:

Theme:

Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.

Theme_Keyword: Western Water Use Model

Theme_Keyword: western model

Place:

Place_Keyword: Nebraska

Place_Keyword: Arthur County

Place_Keyword: Banner County

Place_Keyword: Box Butte County

Place_Keyword: Cheyenne County

Place_Keyword: Deuel County

Place_Keyword: Garden County

Place_Keyword: Grant County

Place_Keyword: Keith County

Place_Keyword: Kimball County

Place_Keyword: Morrill County

Place_Keyword: Scotts Bluff County

Place_Keyword: Sheridan County

Place_Keyword: Sioux County

Access_Constraints: This dataset is in the public domain and may be freely accessed.

Use_Constraints: This dataset is in the public domain and may be freely used. When used, acknowledgement of Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District and High Plains Hydrology, LLC is appreciated.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Richard R. Luckey

Contact_Organization: High Plains Hydrology, LLC

Contact_Position: Senior Hydrologist

Contact_Address:

Address_Type: mailing and physical address

Address: 7956 S. Shawnee St.

City: Aurora

State_or_Province: Colorado

Postal_Code: 80016

Country: United States of America

Contact_Voice_Telephone: 303-693-0299

Contact_Facsimile_Telephone: 303-693-0299

Contact_Electronic_Mail_Address: rrluckey@msn.com

Hours_of_Service: 9:00 - 5:00 Mountain time

Data_Set_Credit: This dataset was produced as a joint effort among Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District, and High Plains Hydrology, LLC.

Native_Data_Set_Environment: Microsoft Windows Vista Version 6.1 (Build 7600) ; ESRI ArcCatalog 9.3.1.3500

Data_Quality_Information:

Lineage:

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xmlBFAD.tmp

Process_Date: 20101111

Process_Time: 10105500

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xml482F.tmp

Process_Date: 20101111

Process_Time: 10494400

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xmlC702.tmp

Process_Date: 20101111

Process_Time: 12534200

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Entity point

Point_and_Vector_Object_Count: 211602

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: State Plane Coordinate System 1983

State_Plane_Coordinate_System:

SPCS_Zone_Identifier: 2600

Lambert_Conformal_Conic:

Standard_Parallel: 40.000000

Standard_Parallel: 43.000000

Longitude_of_Central_Meridian: -100.000000

Latitude_of_Projection_Origin: 39.833333

False_Easting: 1640416.666667

False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: coordinate pair

Coordinate_Representation:

Abscissa_Resolution: 0.000000

Ordinate_Resolution: 0.000000

Planar_Distance_Units: survey feet

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1983

Ellipsoid_Name: Geodetic Reference System 80

Semi-major_Axis: 6378137.000000

Denominator_of_Flattening_Ratio: 298.257222

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: stream_101110_pts

Attribute:

Attribute_Label: FID

Attribute_Definition: Internal feature number.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.

Attribute:
 Attribute_Label: Shape
 Attribute_Definition: Feature geometry.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Coordinates defining the features.

Attribute:
 Attribute_Label: Id
 Attribute_Definition: ID number from original stream arcs used to tell when a new arc is encountered

Attribute:
 Attribute_Label: width
 Attribute_Definition: Width of stream for MODFLOW stream package estimated from aerial photography

Attribute:
 Attribute_Label: length
 Attribute_Definition: Length of stream arc after arc is split at each vertex

Attribute:
 Attribute_Label: elev_up
 Attribute_Definition: Elevation at upstream end of original stream arc

Attribute:
 Attribute_Label: elev_dn
 Attribute_Definition: Elevation at downstream end of original stream arc

Attribute:
 Attribute_Label: slope
 Attribute_Definition: Slope of original stream arc

Attribute:
 Attribute_Label: ft_mi
 Attribute_Definition: Slope of original stream arc, in feet per mile

Attribute:
 Attribute_Label: elev
 Attribute_Definition: Elevation at point, interpolated from elev_up, elev_dn, and length down the original arc relative to total length of the original arc

Attribute:
 Attribute_Label: len_total
 Attribute_Definition: Length of the original arc

Attribute:
 Attribute_Label: name
 Attribute_Definition: Name of stream

Attribute:
 Attribute_Label: X_end
 Attribute_Definition: X coordinate of end of arc after original arc was split at each vertex

Attribute:
 Attribute_Label: Y_end

Attribute_Definition: Y coordinate of end of arc after original arc was split at each vertex
Attribute:
Attribute_Label: temp_01
Attribute_Definition: Temporary field used for calculations
Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.206
Metadata_Reference_Information:
Metadata_Date: 20101111
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Richard R. Luckey
Contact_Organization: High Plains Hydrology, LLC
Contact_Position: Senior Hydrologist
Contact_Address:
Address_Type: mailing and physical address
Address: 7956 S. Shawnee St.
City: Aurora
State_or_Province: CO
Postal_Code: 80016
Country: USA
Contact_Voice_Telephone: 303-693-0299
Contact_Facsimile_Telephone: 303-693-0299
Contact_Electronic_Mail_Address: rrluckey@msn.com
Hours_of_Service: 9:00 - 5:00 Mountain
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile

Metadata for stream_split_110105

Identification_Information:

Citation:

Citation_Information:

Originator: Richard R. Luckey

Publication_Date: January 05, 2011

Title: stream_split_110105

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

C:\Data\Nebraska_WWU_Model\model_construction\stream_split_110105.shp

Description:

Abstract:

This dataset depicts streams that are simulated in the Western Water Use model that is being constructed as a joint effort among North Platte Natural Resources District, South Platte Natural Resources District, and Nebraska Department of Natural Resources.

This dataset was produced using the U.S. Geological Survey National Hydrography Dataset (NHD). After streams were selected for inclusion in the model, they were retrieved from the NHD. Each individual stream or tributary was then merged into a single arc. The resulting arc was then split at points of known elevation: high resolution survey points where available or interpolated values from 1:24,000 maps where not available. The arc was then assigned an upstream and downstream elevation, the length of the arc was computed, the slope of the arc was computed, and other values were then assigned to the arc. Additional vertices were added to the arc so that vertices were no more than 100 ft apart.

Purpose: This dataset was produced to help compute various inputs needed for the Stream Package of the MODFLOW groundwater flow simulation program.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: November 11, 2010

Currentness_Reference: publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -104.205172

East_Bounding_Coordinate: -101.662745

North_Bounding_Coordinate: 42.331900

South_Bounding_Coordinate: 40.907690

Keywords:

Theme:

Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.

Theme_Keyword: Western Water Use Model

Theme_Keyword: western model

Place:

Place_Keyword: Nebraska

Place_Keyword: Arthur County

Place_Keyword: Banner County
Place_Keyword: Box Butte County
Place_Keyword: Cheyenne County
Place_Keyword: Deuel County
Place_Keyword: Garden County
Place_Keyword: Grant County
Place_Keyword: Keith County
Place_Keyword: Kimball County
Place_Keyword: Morrill County
Place_Keyword: Scotts Bluff County
Place_Keyword: Sheridan County
Place_Keyword: Sioux County

Access_Constraints: This dataset is in the public domain and may be freely accessed.

Use_Constraints: This dataset is in the public domain and may be freely used. When used, acknowledgement of Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District and High Plains Hydrology, LLC is appreciated.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Richard R. Luckey

Contact_Organization: High Plains Hydrology, LLC

Contact_Position: Senior Hydrologist

Contact_Address:

Address_Type: mailing and physical address

Address: 7956 S. Shawnee St.

City: Aurora

State_or_Province: Colorado

Postal_Code: 80016

Country: United States of America

Contact_Voice_Telephone: 303-693-0299

Contact_Facsimile_Telephone: 303-693-0299

Contact_Electronic_Mail_Address: rrluckey@msn.com

Hours_of_Service: 9:00 - 5:00 Mountain time

Data_Set_Credit: This dataset was produced as a joint effort among Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District, and High Plains Hydrology, LLC.

Native_Data_Set_Environment: Microsoft Windows Vista Version 6.1 (Build 7600) ; ESRI ArcCatalog 9.3.1.3500

Data_Quality_Information:

Lineage:

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xmlBFAD.tmp

Process_Date: 20101111

Process_Time: 10105500

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xml7448.tmp

Process_Date: 20110202

Process_Time: 15372600

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
 Point_and_Vector_Object_Information:
 SDTS_Terms_Description:
 SDTS_Point_and_Vector_Object_Type: String
 Point_and_Vector_Object_Count: 2654
 Spatial_Reference_Information:
 Horizontal_Coordinate_System_Definition:
 Planar:
 Grid_Coordinate_System:
 Grid_Coordinate_System_Name: State Plane Coordinate System 1983
 State_Plane_Coordinate_System:
 SPCS_Zone_Identifier: 2600
 Lambert_Conformal_Conic:
 Standard_Parallel: 40.000000
 Standard_Parallel: 43.000000
 Longitude_of_Central_Meridian: -100.000000
 Latitude_of_Projection_Origin: 39.833333
 False_Easting: 1640416.666667
 False_Northing: 0.000000
 Planar_Coordinate_Information:
 Planar_Coordinate_Encoding_Method: coordinate pair
 Coordinate_Representation:
 Abscissa_Resolution: 0.000000
 Ordinate_Resolution: 0.000000
 Planar_Distance_Units: survey feet
 Geodetic_Model:
 Horizontal_Datum_Name: North American Datum of 1983
 Ellipsoid_Name: Geodetic Reference System 80
 Semi-major_Axis: 6378137.000000
 Denominator_of_Flattening_Ratio: 298.257222
 Entity_and_Attribute_Information:
 Detailed_Description:
 Entity_Type:
 Entity_Type_Label: stream_split_110105
 Attribute:
 Attribute_Label: FID
 Attribute_Definition: Internal feature number.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
 Attribute:
 Attribute_Label: Shape
 Attribute_Definition: Feature geometry.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Coordinates defining the features.
 Attribute:
 Attribute_Label: Id
 Attribute_Definition: Stream ID number (downstream order)
 Attribute:
 Attribute_Label: length
 Attribute_Definition: Length of stream arc
 Attribute:

Attribute_Label: width
 Attribute_Definition: Width of stream estimated from aerial
 photography
 Attribute:
 Attribute_Label: name
 Attribute_Definition: Name of stream
 Attribute:
 Attribute_Label: row
 Attribute_Definition: Row in model grid
 Attribute:
 Attribute_Label: column
 Attribute_Definition: Column in model grid
 Attribute:
 Attribute_Label: RowCol
 Attribute_Definition: Concatenation of row and column
 Attribute:
 Attribute_Label: segment
 Attribute_Definition: Stream segment number
 Attribute:
 Attribute_Label: reach
 Attribute_Definition: Stream reach number
 Attribute:
 Attribute_Label: strmfl_in
 Attribute_Definition: Inflow to stream segment (-1 is flag to
 compute)
 Attribute:
 Attribute_Label: stage
 Attribute_Definition: Depth of water in steam
 Attribute:
 Attribute_Label: conduct
 Attribute_Definition: Streambed conductance per unit length
 Attribute:
 Attribute_Label: strm_bot
 Attribute_Definition: Elevation of streambed bottom
 Attribute:
 Attribute_Label: strm_top
 Attribute_Definition: Elevation of streambed top
 Attribute:
 Attribute_Label: temp_01
 Attribute_Definition: Temporary field used for calculations
 Attribute:
 Attribute_Label: roughness
 Attribute_Definition: Manning's roughness coefficient
 Attribute:
 Attribute_Label: layer
 Attribute_Definition: Layer in model grid
 Attribute:
 Attribute_Label: itrib_1
 Attribute_Definition: Tributary 1 to segment
 Attribute:
 Attribute_Label: itrib_2
 Attribute_Definition: Tributary 2 to segment
 Attribute:
 Attribute_Label: iupseg

Attribute_Definition: Upstream diversion segment
 Attribute:
 Attribute_Label: stage_elev
 Attribute_Definition: Elevation of water surface in stream
 Attribute:
 Attribute_Label: slope1
 Attribute_Definition: Slope of stream (dimensionless)

Distribution_Information:
 Resource_Description: Downloadable Data
 Standard_Order_Process:
 Digital_Form:
 Digital_Transfer_Information:
 Transfer_Size: 0.206

Metadata_Reference_Information:
 Metadata_Date: 20110202
 Metadata_Contact:
 Contact_Information:
 Contact_Person_Primary:
 Contact_Person: Richard R. Luckey
 Contact_Organization: High Plains Hydrology, LLC
 Contact_Position: Senior Hydrologist
 Contact_Address:
 Address_Type: mailing and physical address
 Address: 7956 S. Shawnee St.
 City: Aurora
 State_or_Province: CO
 Postal_Code: 80016
 Country: USA
 Contact_Voice_Telephone: 303-693-0299
 Contact_Facsimile_Telephone: 303-693-0299
 Contact_Electronic_Mail_Address: rrluckey@msn.com
 Hours_of_Service: 9:00 - 5:00 Mountain

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial

Metadata
 Metadata_Standard_Version: FGDC-STD-001-1998
 Metadata_Time_Convention: local time
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile

 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile

 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile

 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile

Metadata for grid_stream_110127

Identification_Information:

Citation:

Citation_Information:

Originator: Richard R. Luckey

Publication_Date: January 27, 2011

Title: grid_stream_110127

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

C:\Data\Nebraska_WWU_Model\model_construction\grid_stream_110127.shp

Description:

Abstract:

This dataset depicts stream cells that are simulated in the Western Water Use model that is being constructed as a joint effort among North Platte Natural Resources District, South Platte Natural Resources District, and Nebraska Department of Natural Resources.

This dataset was created from the dataset of polygons from the original model grid. Cells were selected depicting the general shapes of the stream; not all cells that streams touched were used. Various fields that are needed by the MODFLOW stream package were added to the dataset. These fields were populated using datasets stream_101110 and stream_101110_pts.

Purpose: This dataset was produced to help compute various inputs needed for the Stream Package of the MODFLOW groundwater flow simulation program.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: January 27, 2011

Currentness_Reference: publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -104.205190

East_Bounding_Coordinate: -101.662745

North_Bounding_Coordinate: 42.332181

South_Bounding_Coordinate: 40.907690

Keywords:

Theme:

Theme_Keyword: Western Water Use Model

Theme_Keyword: western model

Place:

Place_Keyword: Nebraska

Place_Keyword: Arthur County

Place_Keyword: Banner County

Place_Keyword: Box Butte County

Place_Keyword: Cheyenne County

Place_Keyword: Deuel County

Place_Keyword: Garden County

Place_Keyword: Grant County

Place_Keyword: Keith County
Place_Keyword: Kimball County
Place_Keyword: Morrill County
Place_Keyword: Scotts Bluff County
Place_Keyword: Sheridan County
Place_Keyword: Sioux County

Access_Constraints: This dataset is in the public domain and may be freely accessed.

Use_Constraints: This dataset is in the public domain and may be freely used. When used, acknowledgement of Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District and High Plains Hydrology, LLC is appreciated.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Richard R. Luckey

Contact_Organization: High Plains Hydrology, LLC

Contact_Position: Senior Hydrologist

Contact_Address:

Address_Type: mailing and physical address

Address: 7956 S. Shawnee St.

City: Aurora

State_or_Province: Colorado

Postal_Code: 80016

Country: United States of America

Contact_Voice_Telephone: 303-693-0299

Contact_Facsimile_Telephone: 303-693-0299

Contact_Electronic_Mail_Address: rrluckey@msn.com

Hours_of_Service: 9:00 - 5:00 Mountain time

Data_Set_Credit: This dataset was produced as a joint effort among Nebraska Department of Natural Resources, North Platte Natural Resources District, South Platte Natural Resources District, and High Plains Hydrology, LLC.

Native_Data_Set_Environment: Microsoft Windows Vista Version 6.1 (Build 7600) ; ESRI ArcCatalog 9.3.1.3500

Data_Quality_Information:

Lineage:

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xmlBFAD.tmp

Process_Date: 20101111

Process_Time: 10105500

Process_Step:

Process_Description: Metadata imported.

Source_Used_Citation_Abbreviation: C:\Temp\xml482F.tmp

Process_Date: 20101111

Process_Time: 10494400

Process_Step:

Process_Description: Dataset copied.

Source_Used_Citation_Abbreviation:

C:\Data\Nebraska_WWU_Model\model_construction\grid_stream_101110

Process_Date: 20110105

Process_Time: 13083600

Process_Step:

Attribute_Label: row
 Attribute_Definition: Row of model grid
 Attribute:
 Attribute_Label: column
 Attribute_Definition: Column of model grid
 Attribute:
 Attribute_Label: RowCol
 Attribute_Definition: Concatenation of row and column
 Attribute:
 Attribute_Label: width
 Attribute_Definition: Width of stream for MODFLOW stream package
 estimated from aerial photography
 Attribute:
 Attribute_Label: segment
 Attribute_Definition: Segment number for MODFLOW stream package
 Attribute:
 Attribute_Label: reach
 Attribute_Definition: Reach number for MODFLOW stream package
 Attribute:
 Attribute_Label: strmfl_in
 Attribute_Definition: Simulated streamflow into segment. -1
 indicates use streamflow out from upstream segment.
 Attribute:
 Attribute_Label: stage
 Attribute_Definition: Stage of stream relative to strm_top
 Attribute:
 Attribute_Label: conduct
 Attribute_Definition: Streambed conductance for MODFLOW stream
 package. This is conductance per unit length as used in GMS
 Attribute:
 Attribute_Label: strm_bot
 Attribute_Definition: Elevation of bottom of stream bed for MODFLOW
 stream package
 Attribute:
 Attribute_Label: strm_top
 Attribute_Definition: Elevation of top of stream bed for MODFLOW
 stream package
 Attribute:
 Attribute_Label: name
 Attribute_Definition: Name of stream
 Attribute:
 Attribute_Label: roughness
 Attribute_Definition: Manning's roughness coefficient for MODFLOW
 stream package
 Attribute:
 Attribute_Label: layer
 Attribute_Definition: Layer of model grid
 Attribute:
 Attribute_Label: itrib_1
 Attribute_Definition: First tributary segment
 Attribute:
 Attribute_Label: itrib_2
 Attribute_Definition: Second tributary segment
 Attribute:

Attribute_Label: iupseg
 Attribute_Definition: Upstream segment number from which water is diverted
 Attribute:
 Attribute_Label: stage_elev
 Attribute_Definition: Elevation of stream stage (used for calculations)
 Attribute:
 Attribute_Label: slopel
 Attribute_Definition: Slope of stream for MODFLOW stream package
 Attribute:
 Attribute_Label: temp_01
 Attribute_Definition: Temporary field used for calculations. Current value is conductance times rch_len
 Attribute:
 Attribute_Label: rch_len
 Attribute_Definition: Length of stream arc in model cell
 Distribution_Information:
 Resource_Description: Downloadable Data
 Standard_Order_Process:
 Digital_Form:
 Digital_Transfer_Information:
 Transfer_Size: 0.206
 Metadata_Reference_Information:
 Metadata_Date: 20110201
 Metadata_Contact:
 Contact_Information:
 Contact_Person_Primary:
 Contact_Person: Richard R. Luckey
 Contact_Organization: High Plains Hydrology, LLC
 Contact_Position: Senior Hydrologist
 Contact_Address:
 Address_Type: mailing and physical address
 Address: 7956 S. Shawnee St.
 City: Aurora
 State_or_Province: CO
 Postal_Code: 80016
 Country: USA
 Contact_Voice_Telephone: 303-693-0299
 Contact_Facsimile_Telephone: 303-693-0299
 Contact_Electronic_Mail_Address: rrluckey@msn.com
 Hours_of_Service: 9:00 - 5:00 Mountain
 Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
 Metadata_Standard_Version: FGDC-STD-001-1998
 Metadata_Time_Convention: local time
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
 Profile_Name: ESRI Metadata Profile
 Metadata_Extensions:
 Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>

Profile_Name: ESRI Metadata Profile
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile

Metadata for High_Resolution_Stream_Survey_NPNRD_2010

Identification_Information:

Citation:

Citation_Information:

Originator: REQUIRED: The name of an organization or individual that developed the data set.

Publication_Date: REQUIRED: The date when the data set is published or otherwise made available for release.

Title: High_Resolution_Stream_Survey_NPNRD_2010

Geospatial_Data_Presentation_Form: vector digital data

Online_Linkage:

C:\Data\Nebraska_WWU_Model\model_construction\High_Resolution_Stream_Survey_NPNRD_2010.shp

Description:

Abstract: This file was created using several small shape files of the points. The attributes explanation are as follows: Stream = Stream
NameELEV = Surveyed Elevation (Feet)DEM_VALUE = Extracted 10 Meter DEM value (Feet)ELEVDIFF = DEM_VALUE - ELEV (Feet)

Purpose: A high resolution stream and river survey was conducted using a basestation and rover GPS units. The data was collected at the water line at bridge crossing across the district. The North Platte River and selected tributaries were surveyed. The survey was tied to USGS survey markers in and around the general area.

Time_Period_of_Content:

Time_Period_Information:

Single_Date/Time:

Calendar_Date: REQUIRED: The year (and optionally month, or month and day) for which the data set corresponds to the ground.

Currentness_Reference: REQUIRED: The basis on which the time period of content information is determined.

Status:

Progress: REQUIRED: The state of the data set.

Maintenance_and_Update_Frequency: REQUIRED: The frequency with which changes and additions are made to the data set after the initial data set is completed.

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -104.065016

East_Bounding_Coordinate: -102.125408

North_Bounding_Coordinate: 42.291582

South_Bounding_Coordinate: 41.264853

Keywords:

Theme:

Theme_Keyword_Thesaurus: REQUIRED: Reference to a formally registered thesaurus or a similar authoritative source of theme keywords.

Theme_Keyword: REQUIRED: Common-use word or phrase used to describe the subject of the data set.

Access_Constraints: REQUIRED: Restrictions and legal prerequisites for accessing the data set.

Use_Constraints: REQUIRED: Restrictions and legal prerequisites for using the data set after access is granted.

Native_Data_Set_Environment: Microsoft Windows Vista Version 6.1 (Build 7600) ; ESRI ArcCatalog 9.3.1.3500

Spatial_Data_Organization_Information:
 Direct_Spatial_Reference_Method: Vector
 Point_and_Vector_Object_Information:
 SDTS_Terms_Description:
 SDTS_Point_and_Vector_Object_Type: Entity point
 Point_and_Vector_Object_Count: 75
 Spatial_Reference_Information:
 Horizontal_Coordinate_System_Definition:
 Planar:
 Grid_Coordinate_System:
 Grid_Coordinate_System_Name: State Plane Coordinate System 1983
 State_Plane_Coordinate_System:
 SPCS_Zone_Identifier: 2600
 Lambert_Conformal_Conic:
 Standard_Parallel: 40.000000
 Standard_Parallel: 43.000000
 Longitude_of_Central_Meridian: -100.000000
 Latitude_of_Projection-Origin: 39.833333
 False_Easting: 1640416.666667
 False_Northing: 0.000000
 Planar_Coordinate_Information:
 Planar_Coordinate_Encoding_Method: coordinate pair
 Coordinate_Representation:
 Abscissa_Resolution: 0.000000
 Ordinate_Resolution: 0.000000
 Planar_Distance_Units: survey feet
 Geodetic_Model:
 Horizontal_Datum_Name: North American Datum of 1983
 Ellipsoid_Name: Geodetic Reference System 80
 Semi-major_Axis: 6378137.000000
 Denominator_of_Flattening_Ratio: 298.257222
 Entity_and_Attribute_Information:
 Detailed_Description:
 Entity_Type:
 Entity_Type_Label: High_Resolution_Stream_Survey_NPNRD_2010
 Attribute:
 Attribute_Label: FID
 Attribute_Definition: Internal feature number.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
 Attribute:
 Attribute_Label: OBJECTID_1
 Attribute_Definition: Internal feature number.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:
 Unrepresentable_Domain: Sequential unique whole numbers that are automatically generated.
 Attribute:
 Attribute_Label: Shape
 Attribute_Definition: Feature geometry.
 Attribute_Definition_Source: ESRI
 Attribute_Domain_Values:

Unrepresentable_Domain: Coordinates defining the features.

Attribute:
Attribute_Label: OBJECTID

Attribute:
Attribute_Label: FILE

Attribute:
Attribute_Label: NAME

Attribute:
Attribute_Label: ELEV

Attribute:
Attribute_Label: STREAM

Attribute:
Attribute_Label: ELEVDIFF

Attribute:
Attribute_Label: RASTERVALU

Attribute:
Attribute_Label: DEM_VALUE

Distribution_Information:
Resource_Description: Downloadable Data
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.002

Metadata_Reference_Information:
Metadata_Date: 20110202
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: REQUIRED: The organization responsible for the metadata information.
Contact_Person: REQUIRED: The person responsible for the metadata information.
Contact_Address:
Address_Type: REQUIRED: The mailing and/or physical address for the organization or individual.
City: REQUIRED: The city of the address.
State_or_Province: REQUIRED: The state or province of the address.
Postal_Code: REQUIRED: The ZIP or other postal code of the address.
Contact_Voice_Telephone: REQUIRED: The telephone number by which individuals can speak to the organization or individual.

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time
Metadata_Extensions:
Online_Linkage: <http://www.esri.com/metadata/esriprof80.html>
Profile_Name: ESRI Metadata Profile

Appendix C. Files Contained on DVD

Directory of C:\Data\Nebraska_WWU_Model\model_construction\DVD_stream

```
02/08/2011 01:17 PM <DIR> .
02/08/2011 01:17 PM <DIR> ..
10/26/2010 10:36 AM 121,856 Akers_Draw_101026_arc1.xls
02/08/2011 01:08 PM 1,511,246 Backup_of_DVD_label_110208.cdr
10/05/2010 12:53 PM 233,472 Bald_Peak_Drain_101005_arc1.xls
10/06/2010 03:49 PM 522,240 Bayard_Drain_arc1.xls
10/13/2010 12:46 PM 3,703,296 Blue_Creek_101013_arc1.xls
10/13/2010 08:38 AM 910,848 Cedar_Creek_101012_arc1.xls
10/13/2010 01:43 PM 805,888 Clear_Creek_101013_arc1.xls
02/08/2011 12:38 PM 334,848 Coldwater_Creek_101025_arc1.xls
02/08/2011 12:38 PM 342,016 Coldwater_Creek_101025_arc2.xls
10/05/2010 09:39 AM 1,167,360 Dry_Spottedtail_Creek_101005_arc1.xls
10/05/2010 11:13 AM 1,143,296 Dry_Spottedtail_Creek_101005_arc2.xls
02/08/2011 01:16 PM 1,511,349 DVD_label_110208.cdr
02/08/2011 01:17 PM 6,470 files_list.txt
10/06/2010 11:23 AM 372,736 Gering_Drain_arc1.xls
10/26/2010 11:15 AM 4,943,360 grid_stream_101025.xls
11/05/2010 02:37 PM 568,320 grid_stream_101105.xls
01/27/2011 02:04 PM 520,890 grid_stream_110127.dbf
09/08/2010 10:38 AM 534 grid_stream_110127.prj
01/27/2011 02:04 PM 26,532 grid_stream_110127.sbn
01/27/2011 02:04 PM 1,252 grid_stream_110127.sbx
02/07/2011 04:03 PM 361,044 grid_stream_110127.shp
02/02/2011 03:52 PM 17,883 grid_stream_110127.shp.xml
02/07/2011 04:03 PM 21,332 grid_stream_110127.shx
02/02/2011 03:52 PM 10,618 grid_stream_110127.txt
02/02/2011 03:52 PM 4,677 grid_stream_110127.txt.xml
09/13/2010 02:09 PM 12,697 High_Resolution_Stream_Survey_NPNRD_2010.dbf
09/13/2010 01:55 PM 534 High_Resolution_Stream_Survey_NPNRD_2010.prj
01/13/2011 12:32 PM 876 High_Resolution_Stream_Survey_NPNRD_2010.sbn
01/13/2011 12:32 PM 156 High_Resolution_Stream_Survey_NPNRD_2010.sbx
01/13/2011 04:03 PM 2,200 High_Resolution_Stream_Survey_NPNRD_2010.shp
02/02/2011 03:51 PM 12,900 High_Resolution_Stream_Survey_NPNRD_2010.shp.xml
01/13/2011 04:03 PM 700 High_Resolution_Stream_Survey_NPNRD_2010.shx
02/02/2011 03:51 PM 6,401 high_resolution_stream_survey_npnrd_2010.txt
09/30/2010 08:16 AM 37,888 High_Resolution_Stream_Survey_NPNRD_2010.xls
10/27/2010 10:58 AM 2,019,328 Horse_Creek_101027_arc1.xls
10/12/2010 09:25 AM 270,848 Indian_Creek_101012_arc1.xls
11/03/2010 01:49 PM 129,024 Lane_Drain_101103_arc1.xls
11/03/2010 02:19 PM 133,120 Lane_Drain_101103_arc2.xls
11/10/2010 02:41 PM 11,368,960 Lodgepole_Creek_101110_arc1.xls
10/15/2010 11:17 AM 298,496 Lonergan_Creek_101015_arc1.xls
10/06/2010 12:36 PM 241,664 Melbeta_Drain_arc1.xls
10/06/2010 02:11 PM 1,326,592 Ninemile_Creek_arc1.xls
10/06/2010 03:17 PM 1,404,416 Ninemile_Creek_arc2.xls
09/30/2010 01:20 PM 5,263,872 NPR_100930_arc.xls
10/15/2010 10:01 AM 814,592 Otter_Creek_101015_arc1.xls
10/08/2010 03:02 PM 13,925,888 PumpkinCreek_101008_arc1.xls
10/08/2010 03:22 PM 13,963,776 PumpkinCreek_101008_arc2.xls
10/07/2010 12:36 PM 1,937,408 Red_Willow_Creek_arc1.xls
10/13/2010 09:57 AM 2,065,920 Rush_Creek_101013_arc1.xls
10/06/2010 08:56 AM 175,616 scottsbluff_drain_arc1.xls
10/05/2010 08:20 AM 1,933,824 Sheep_Creek_101004_arc2.xls
10/05/2010 07:52 AM 1,915,392 Sheep_Creek_101005_arc1.xls
10/12/2010 12:40 PM 279,040 Silvernail_Drain_101012_arc1.xls
10/05/2010 01:50 PM 847,360 Spottedtail_Creek_101005_arc1.xls
10/15/2010 01:34 PM 745,984 SPR_101015_arc1.xls
11/10/2010 03:46 PM 31,120 stream_101110.dbf
11/03/2010 02:34 PM 534 stream_101110.prj
01/27/2011 01:55 PM 2,876 stream_101110.sbn
01/27/2011 01:55 PM 348 stream_101110.sbx
02/07/2011 04:03 PM 3,407,132 stream_101110.shp
02/02/2011 02:53 PM 13,628 stream_101110.shp.xml
02/07/2011 04:03 PM 2,188 stream_101110.shx
02/02/2011 02:53 PM 8,547 stream_101110.txt
11/11/2010 01:25 PM 8,532 stream_101110_metadata.txt
```

11/22/2010	11:53 AM	94,586,544	stream_101110_pts.dbf
11/10/2010	03:56 PM	534	stream_101110_pts.prj
01/05/2011	01:49 PM	1,975,084	stream_101110_pts.sbn
01/05/2011	01:49 PM	22,812	stream_101110_pts.sbx
01/05/2011	03:51 PM	5,924,956	stream_101110_pts.shp
02/02/2011	02:55 PM	16,475	stream_101110_pts.shp.xml
01/05/2011	03:51 PM	1,692,916	stream_101110_pts.shx
02/02/2011	02:55 PM	10,711	stream_101110_pts.txt
11/11/2010	01:33 PM	10,692	stream_101110_pts_metadata.txt
02/02/2011	04:38 PM	10,737,401	Stream_documentation_110202.docx
02/02/2011	04:39 PM	2,251,284	Stream_documentation_110202.pdf
11/03/2010	12:24 PM	46,592	Stream_Eval_101102.xls
02/02/2011	03:30 PM	621,774	stream_split_110105.dbf
01/05/2011	11:56 AM	534	stream_split_110105.prj
02/02/2011	03:30 PM	24,576	stream_split_110105.RowCol.atx
02/07/2011	02:37 PM	26,516	stream_split_110105.sbn
02/07/2011	02:37 PM	1,236	stream_split_110105.sbx
02/07/2011	04:03 PM	3,185,996	stream_split_110105.shp
02/02/2011	03:54 PM	17,075	stream_split_110105.shp.xml
02/07/2011	04:03 PM	21,332	stream_split_110105.shx
02/02/2011	03:54 PM	10,357	stream_split_110105.txt
02/02/2011	03:53 PM	4,680	stream_split_110105.txt.xml
11/10/2010	02:57 PM	674,816	tub_springs_drain_101110_arc1.xls
11/10/2010	03:29 PM	674,816	tub_springs_drain_101110_arc2.xls
10/12/2010	11:28 AM	286,208	Upper_Dugout_Creek_arc1.xls
10/06/2010	10:17 AM	736,768	Winters_Creek_arc1.xls
10/06/2010	10:39 AM	758,784	Winters_Creek_arc2.xls
	91 File(s)	208,088,739	bytes