**TASK REPORT**

Work performed by:

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**Project objective:**

The objective was to produce a set of modeled GIS-based water rights for irrigation in the Willamette Basin corresponding to the spatial IDU (independent decision unit) geometry of the WW2100 Envision model. The results will be incorporated into the WW2100 model version 2.0.

**Data used**

The data sets used to perform the work consisted of both GIS shapefiles and tabular data downloaded from the water rights databases from the Oregon Water Resources Department’s (OWRD) website and shapefiles downloaded from the WW2100 website:

* POD point file with the points of diversion (from OWRD)
* POU polygon with the water right place of use (from OWRD)
* POD tabular data (from OWRD)
* POU tabular data (from OWRD)
* SWCD shapefile for that POU (from OWRD)
* IDU shapefile (from WW2100)
* Streams shapefile (from WW2100)

**Background information**

The contractor will utilize the water rights databases from the Oregon Water Resources Department (shapefiles and tabular data). Only data identified as Use\_code = IR for irrigation will be used. These irrigation water rights (excluding “supplemental” rights) will be transformed or translated into a set of modeled water rights that are representative of the actual water rights, but not identical to the actual water rights. The aim is to end up with a set of IDUs in the WW2100 model identified as having irrigation water rights. These IDUs will be assigned attributes corresponding to actual irrigation water rights. The correspondence between the modeled set and the actual set of water rights should be very similar in terms of: a) the maximum rate of water that can be legally diverted from an individual stream reach (“max rate”), b) the number of acres of surface water rights in each subbasin, c) the number of acres of groundwater rights in each subbasin, and e) the range and order of water right priority dates. The set of IDUs with irrigation water rights attributes will include 2 types of overlap between the IDU and the water right place of use (POU) polygons: 1) the area and percentage that a POU polygon overlaps with an IDU polygon, and 2) the area and percentage of the IDU that is covered by a POU polygon. In this way the completed set will be flexible and the total acres of land with water rights can be adjusted by modifying the ‘cutoff’ (in terms of percent overlap) for inclusion as “irrigable” in the model.

The OWRD database for these water rights has some errors and omissions, and there will be steps necessary to overcome these shortcomings in the databases. The start date, end date, max rate and duty have all been standardized for irrigation water rights in the Willamette Basin (for 98% of water rights). Therefore we will apply a uniform value for all irrigation water rights. Start date April 1; end date Oct. 31; max rate 1/80 cfs/acre; duty 2.5 af/acre.

There can only be one water right on any piece of land. The OWRD database contains some erroneous cases where the Points of Use (POUs) overlap. These are historical anomalies that have been corrected in terms of the law, but remain in the database. If there are water rights overlapping on the same IDU, the most senior water right should be chosen to be assigned to that IDU. It is not necessary to detect and eliminate the POU overlaps spatially, using a GIS. Instead, POU overlaps should be dealt with after the POU and IDU polygons were intersected by examining the data in Excel.

**Analysis steps**

1. The GIS portion of the project was performed using ArcGIS. All GIS layers were assembled and the OWRD GIS data were projected from the Oregon Statewide Lambert Feet projection to the same projection that the IDU and streams shapefiles of the WW2100 were in: NAD\_1983\_UTM\_ZONE\_10N.
2. The GIS and tabular data were constrained to the Use\_Code of “IR”
3. Unique POU identification numbers (snp\_id numbers) were required for this project. For all datasets (POU and POD GIS data, and POU and POD tabular data), the snp\_ids that were not present in all datasets were eliminated, so that no duplicate entries of the same snp\_id remained. A GIS dissolve function based on the snp\_id eliminated those snp\_ids that were true duplicates, meaning exact copies of the same row, likely a result of double entries.
4. For some water rights, including some large irrigation district water rights, the POUs are not defined as polygons. Instead OWRD indicates the approximate location of these irrigation POUs with ‘diamonds’ or “poly-points” centered on each map section where the POU is located. There were 797 irrigation water rights that were represented with diamonds. These sets of diamonds needed to be transformed into polygons for later intersection with the IDU shapefile, and an area for each diamond was required. Before further analysis, the GIS data was separated into diamonds and non-diamonds.
5. After discussion with Kathy Boles from OWRD, it was decided that the “wris\_acres” field should be used to assign an area to the diamonds. In those cases where there was no value in the wris\_acres field, the area of the diamond was estimated based on the “rate\_cfs” field. Given the standardization of rates (1/80 cfs/acre) and the duty (2.5 af/acre), the size of the corresponding POU could be estimated. I noticed that there was not much difference between the values for max rate and rate cfs, except for a couple of cases.
6. For the diamond POU data, each row in the table represented from 1 to 40 diamonds. The Santiam Water Control District (SWCD) was an exception with 144 diamonds and was handled separately using a shapefile obtained from Dan Bigelow for that area. The Multnomah Drainage District #1 was ignored based on information from William Jaeger. The total estimated area for each row represented by diamonds was divided by the number of diamonds. The GIS data was expanded (i.e explode function), so that each diamond consisted of a separate record in the table, with the appropriate area assigned to each record. The diamond shape was then converted to a square polygon with the appropriate size based on the calculated area. The center of each diamond had been placed by OWRD in the center of the Public Land Survey System (PLSS) quarter-quarter. The center of the square polygon with the estimated area was therefore placed at the same location. Although converting a diamond into a square polygon represents the correct area of that POU, the resulting shape does not represent the true shape of the POU. However, in order to intersect POU and IDU shapefiles, a polygon was required, and the resulting error from the diamond-to-square conversion was deemed acceptable.
7. For the SWCD, a separate shapefile was available. All non-IR codes were deleted, leaving 2294 records in that file. Because this shapefile had different column information than the POU shapefile, manual editing was needed to match up the snp\_ids correctly and format the table, so that this shapefile could be merged with the other POU file.
8. The 3 separate POU shapefiles (POU, SWCD POU, and diamond POU) were merged into one shapefile for further analysis.
9. Next, the POU shapefile was intersected (using the GIS function: Intersect) with the IDU shapefile. This allowed for calculating the area of overlap between the POU and IDU polygons and the percentages of the areas. The following areas and percentages were calculated:
   1. POU total area
   2. IDU total area
   3. Area of POU that overlaps with the IDU
   4. % of area of POU that overlaps with the IDU
   5. % of IDU area associated with the POU
10. The goal was to assign a water right to an IDU polygon based on the amount of overlap between the POU and the IDU. The following rules had to be observed: a) an IDU can have only one water right (one POU), b) a water right (assigned to an IDU) may have more than one POD. In many cases the overlap between the POU and an IDU will be close to 100%. Because there may be several POUs that are covering an IDU either completely or partially, and since there are POUs overlapping in the OWRD database, the intersection of the POU polygons with the IDU polygons may result initially in several POUs associated with an IDU. In those cases, the first rule is to select the POU that has the largest overlap with the IDU (where the IDU is 100% or nearly 100% overlapping with an individual POU). The second rule is that, if there are several (or more than one) POUs that have the same amount of maximum overlap, the POU with the oldest priority date should be chosen. In the end, each agricultural IDU that has some overlap with a POU was assigned attributes of that water right, down to very small overlaps of 1%. As a result, each IDU polygon will be only associated with one POU, but each POU can be located in multiple IDU polygons.
11. The analysis of the overlap, determination of maximum overlap, and selection of oldest priority data in case of a tie was performed in Excel using a combination of rules and/or sorting.
12. For the POD file, it was necessary to attach information from the streams shapefile, so that stream names, tributaries, stream codes, and stream orders could be associated with each POD point. Information from the stream network shapefile from WW2100 Envision was joined to the POD shapefile by finding the nearest stream for each POD point. This approach was chosen, because the source data were not accurate enough for a POD point to exactly cover a stream. The OWRD POD shapefile already contained columns for stream names and tributaries, as well as stream codes, and all these columns were retained in addition to the stream name and codes from the stream shapefile, because in some cases only one or the other file contained information for each field. The stream codes used by OWRD may not be compatible with those in the stream network shapefile, but could be useful to for cross-referencing at a later date.
13. The formatted table with the POU-IDU intersected data was then joined in ArcGIS to the POD shapefile that contained the POD as well as the associated stream name/stream order data. This ensured that only POD points associated with the previously selected POU-IDU maximum overlap sections were selected for the final POD file. Some manual edits were necessary, as some priority dates in the POD file were misspelled, but could be tracked by associating a POU via their snp\_ids.
14. Further formatting included converting the priority dates and the begin and end days of water rights from dates to Julian days. The POD file was sorted from lowest to highest on the YEAR field, and then on the PRIORITYDOY field, and the PODID number was then assigned sequentially.
15. The final POU and POD files were named POU\_final.csv and POD\_final.csv

**Deliverables**

* POU\_final.csv The POU data file in csv format, see column names below
* POD\_final.csv The POD data file in csv format, see column names below
* pod\_ir\_2\_wstreamid\_UTM.shp The GIS shapefile containing the combined information for the POD points and the stream information from the streams.shp shapefile. The “NEAR\_DIST” column contains the distance between the POD point and the nearest stream. The distance is in feet, because the original file was in a statewide Lambert projection. The “COMID” field is the stream’s reachcomid, the “GNIS\_NAME” the stream name, and the “ORDER\_” is the stream order.

**Column names and descriptions for the POD and POU csv files**

**POU\_final.csv**

The POU file has 46,383 records, each consisting of 10 fields. The file is sorted from smallest to largest POU\_INDEX.

POU\_INDEX - sequential from 0 thru 46383, assigned by me when I create the POU .csv file

POUID - For irrigation water rights this is an integer identifier, referenced by the POUID field in the POD file (a single POD record may be associated with multiple IDUs and hence multiple records in the POU file)

IDU\_INDEX - The value in the IDU\_INDEX attribute of the IDU polygon to which this record applies; any given combination of IDU\_INDEX and USECODE should appear not more than once.

SNP\_ID – from OWRD the snap ID number

AREA\_POU– the area in square meters of the overlap between the POU polygon and the IDU polygon

PERCENT\_POU– The area in % of the POU polygon occupied by the overlap area

AREA\_IDU – The area in square meters of the IDU polygon

PERCENT\_IDU – The area in % of the IDU associated with the POU

USECODE – from OWRD (16 = irrigation)

PERMITCODE – from OWRD (2 = surface water, 3= Enlargement, 4 = ground water, 5 = reservoir

**POD\_final.csv**

The POD file has 20,188 records, each consisting of 20 fields. The file is sorted from lowest to highest on the YEAR field, and then within a given year on the PIRORITYDOY field. The PODID number is based on this order.

SNP\_ID = snapID from OWRD data

x - UTM easting of POD location

y - UTM northing of POD location

PODID - unique record identifier, assigned by me when I create the POD .csv file

POUID - For irrigation water rights, and for municipal water rights associated with a rural IDU, this identifies the records in the POU file associated with this POD record; there may be more than one such record in the POU file.

PERMITCODE – from OWRD (2 = surface water, 3= Enlargement, 4 = ground water, 5 = reservoir

PODRATE - from OWRD, max rate of diversion in cfs

USECODE – from OWRD (16 = irrigation)

PRIORITYDOY - Julian day of priority date (Jan 1 = 1; Dec 31 = 365)

YEAR - calendar year of priority date

BEGINDOY - Julian day of first day of the year on which the water right may be exercised

ENDDOY - Julian day of last day of the year on which the water right may be exercised

REACHCOMID - from WW2100 streams layer. For surface water rights, the COMID of the reach from which the water is drawn. Obtained from streams layer

GNIS\_NAME – from WW2100 streams layer, the stream name

STREAMORDER - from WW2100 streams layer, the stream order

SOURCE – from POD shapefile, assumed to be the source of the stream

TRIB\_TO – from POD shapefile, tributary to the stream

STREAMCODE – from POD shapefile, streamcode.

STREAMNAME – from POD shapefile,streamname

LENGTH - for instream water rights, the length of the stream portion to which the water right applies - not currently used