Enhanced Snake Plain Aquifer Model

Version 2

Uncertainty Analysis

Idaho Department of Water Resources
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DRAFT

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Abstract

The Enhanced Snake Plain Aquifer Model Version 2 (ESPAM2.0) was, developed by the Idaho Department of Water Resources (IDWR), with oversight from the Eastern Snake Hydrologic Modeling Committee (ESHMC). The ESHMC considered an uncertainty analysis the third highest priority in developing ESPAM2.0. The process of deciding how to evaluate predictive uncertainty was more complicated than deciding that evaluating predictive uncertainty was necessary. The ESHMC eventually chose a limited analysis that involved imposing a stress at the centroid within each of the eight water districts on the Eastern Snake Plain, and determining the impact of parameter uncertainty on key predictions using a procedure proposed by Doherty (2010). This technique locates the maximum and minimum values for the selected prediction by adjusting model parameters while still keeping the model calibrated. The technique identifies how well the calibration dataset constrains the selected predictions but not the probability of any one prediction being true.

The results of this analysis indicate that about 82% (14/17) of the analyses had low predictive uncertainty, about 18% (3/17) of the uncertainty analyses identified predictions with uncertainty greater than 0.10. Interestingly all the predictions with high uncertainty evaluated the impact of water districts northeast of American Falls Reservoir on the Near-Blackfoot-to-Minidoka reach of the Snake River; however, not all water districts northeast of American Falls Reservoir registered high uncertainty for their impact on the Near-Blackfoot-to-Minidoka reach. The Snake River reach gains have significant noise, and the IDWR suspects this noise contributes to the observed uncertainty since the model cannot match the noise. The IDWR proposes including filtered and unfiltered Snake River gains to try and reduce the uncertainty identified in this analysis.

Introduction

The Eastern Snake Plain Aquifer (ESPA) extends from Ashton, Idaho in the northeast to King Hill, Idaho in the southwest (Figure 1). The Enhanced Snake Plain Aquifer Model Version 2.0 (ESPAM2.0) was developed by the Idaho Department of Water Resources (IDWR) with oversight from the Eastern Snake Hydrologic Modeling Committee (ESHMC) to incorporate new data and model enhancements to improve the previous model (ESPAM1.1). Details of the model are provided in the Final Report (TBD).

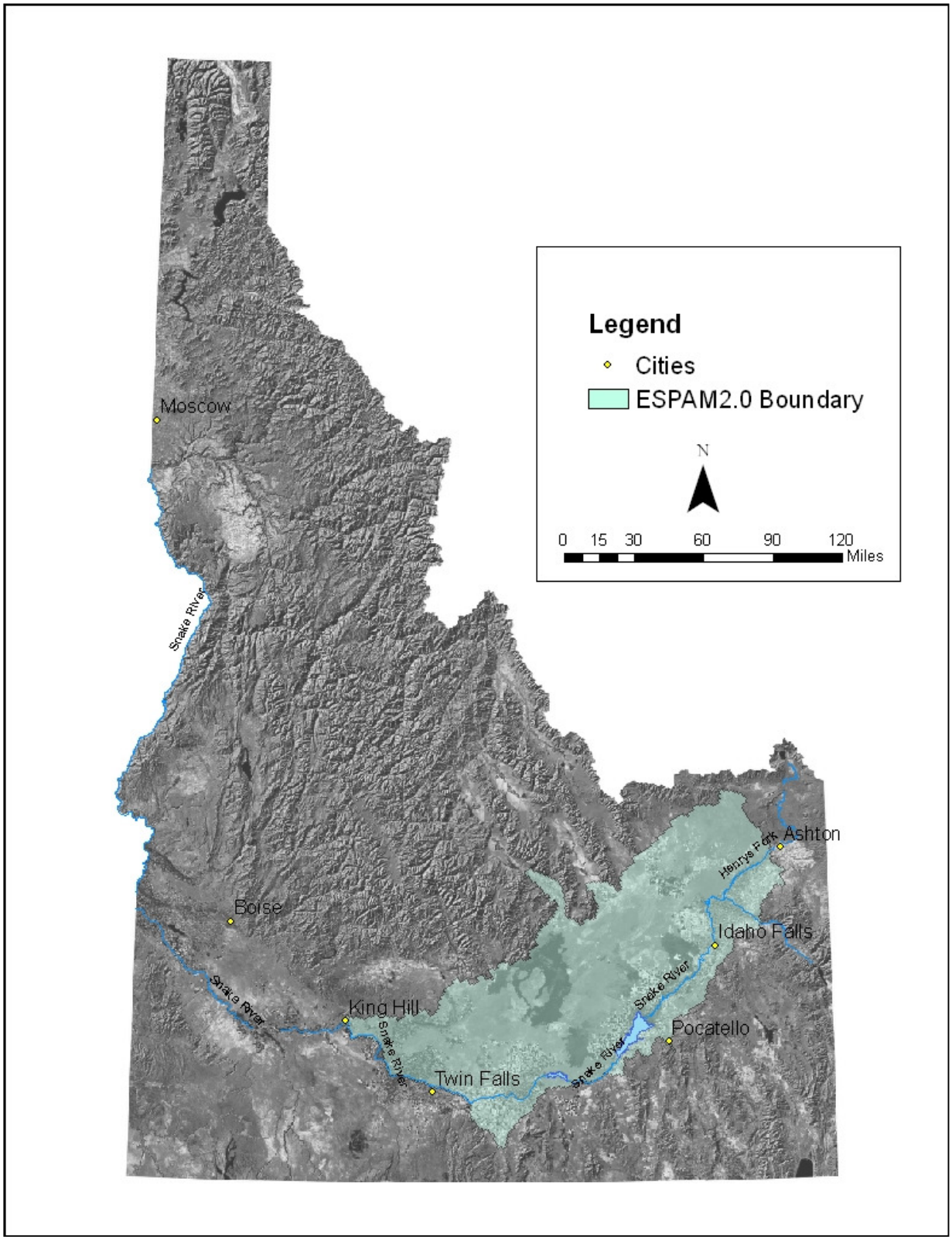

Figure 1. Location of Eastern Snake Plain Aquifer.

In 2007, the ESHMC identified goals for development and calibration of ESPAM2.0 and the committee members independently ranked the components that they considered most important. Completing an uncertainty analysis was ranked as the third highest priority for ESPAM2.0. In the November 2009 ESHMC meeting, the committee chose to evaluate predictive uncertainty using PEST (Doherty, 2010) following the procedure outlined by Doherty (2003). In the February 2010 ESHMC meeting this decision was modified to use the nonlinear analysis proposed by Doherty (2010). During the March 2011 ESHMC meeting, the committee unanimously agreed to proceed with a predictive uncertainty analysis immediately after calibration of ESPAM2.0. In the June 2011 ESHMC meeting, the committee chose to reduce the scope of the analysis because an exhaustive uncertainty analysis for a complex model like the ESPAM2.0 would be time-prohibitive. The committee chose a limited predictive uncertainty analysis that involved imposing a stress at the centroid within each of eight water districts on the ESPA, and determining uncertainty for the impact of the stress on two springs and two river reaches. The eight water districts chosen were: Water District 100, 110, 120, 130, 140, 33, 34, and the Rexburg Bench, hereafter referred to as Water District 99, or WD099. The chosen springs were Blue Lake and Clear Lakes and the chosen river reaches were near-Blackfoot-to-Minidoka and Ashton-to-Rexburg (Figure 2).

The uncertainty analysis commenced in August 2011 and continued until August 2012. The final calibration run (E120116A008) was completed in March 2012, so several of the uncertainty analyses were conducted using a preliminary calibration run. The ESHMC concluded that one of the preliminary runs should be rerun with E120116A008 to assess the changes due to different calibration runs. While the uncertainty analysis was in progress, the ESHMC decided to further limit the scope and only analyze uncertainty at one spring, Clear Lakes, and one river reach, near-Blackfoot-to-Minidoka.

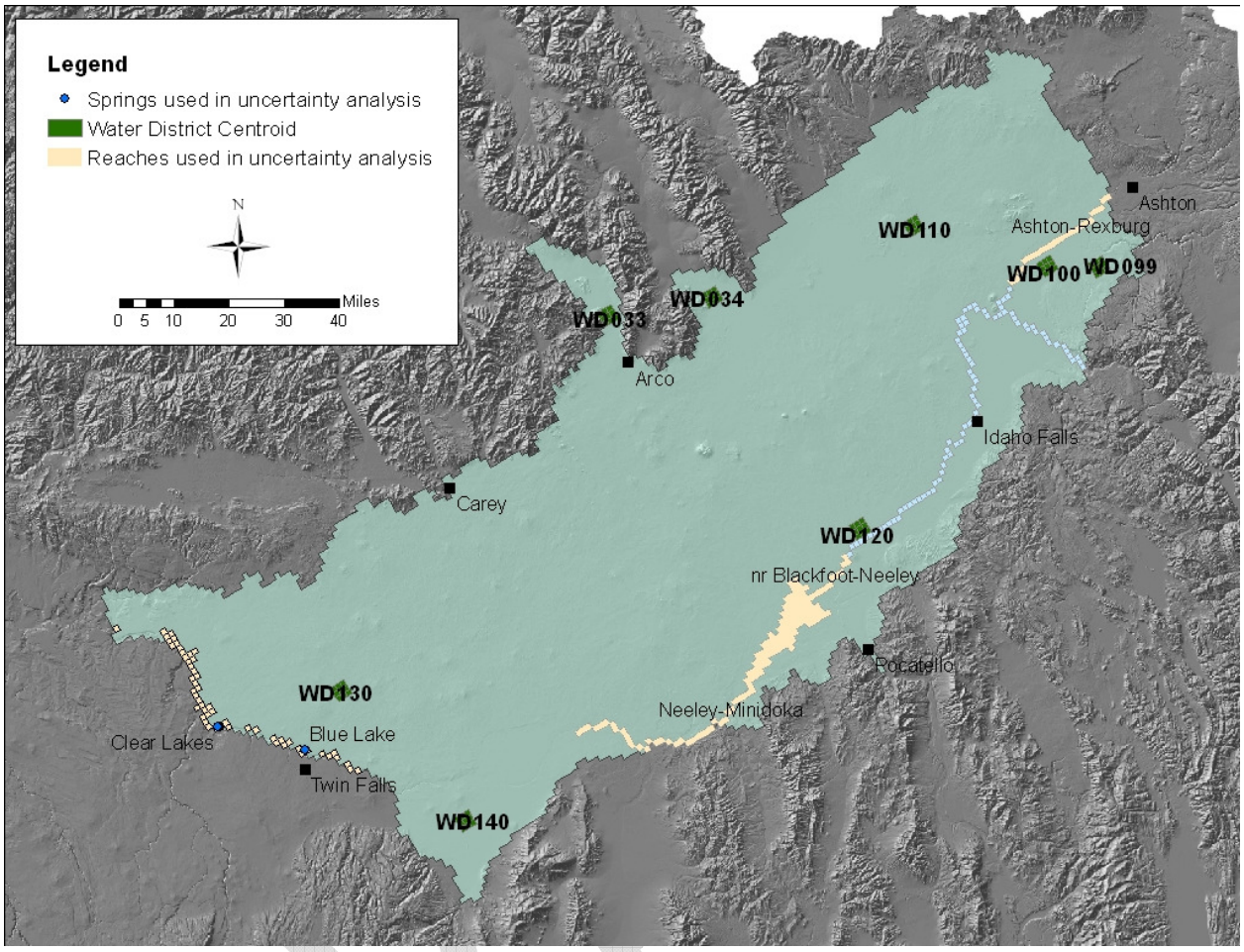

Figure 2. Water District centroids and springs and river reaches.

Methodology

Models are calibrated by adjusting parameters to reduce the discrepancy between model outputs and field observations. The discrepancies are encapsulated in an "objective function"; defined as the weighted sum of squared differences between field observations and model outputs. Generally, the topology of the objective function in parameter space is shaped like a long, narrow valley of nearly equal objective function values, with the objective function minimum placed somewhere in the bottom of the valley. The parameter distribution that describes this long narrow valley calibrates the model. Thus the model calibration is not unique. Normally, as in the case of ESPAM2.0, a single set of parameters is chosen as "The Model" (i.e. E120116A008) and used to make predictions. Given this long narrow valley in the objective function, an obvious question is, "what would have been the prediction if another set of parameters lying along the valley bottom were chosen?" An effective way to investigate the variability of a model prediction while maintaining goodness of fit between model outputs and field observations is with the constrained maximization/minimization technique (Doherty, 2010). This technique keeps the model calibrated while identifying the critical values along the parameter-space valley where the selected prediction is either maximized or minimized.

The following is the procedure used to identify how correlations in adjustable parameters can impact the selected predictions.

1) Identify the centroid of the irrigated lands within the water district.
2) Prepare the model files necessary to run the prediction, including a stress file constructed using the 3x3 cell centriod identified in step one (1).
3) Make a copy of the PEST control file. The PEST control file contains all of the adjustable parameters and their bounds, and all the field observations. Since the entire PEST control file is copied, every parameter adjustable in a calibration run will also be adjustable in the predictive uncertainty analysis, and every field observation used as a calibration target will also be used as a target in the predictive uncertainty analysis. The following adjustments (items 4 – 12) were made to the PEST control file.
4) Replace the word 'regularization' with the word 'prediction' on the third line.
5) Increase the number of observations by one (1) because the prediction will be a new observation.
6) Increase the number of observation groups by one (1) because there will now be an observation group 'predict'.
7) Increase the number of instruction files by one (1) because PEST will now be required to monitor the prediction.
8) Add 'predict' to the list of observation groups.
9) Add an observation representing the prediction to the observation section. Any weight and target observation value can be provided because PEST ignores the weight and target observation value for any observation in the 'predict' group when it is run in predictive analysis mode.
10) Change the model command line to reflect the name of the batch file used to run the model and the prediction.
11) Add the name of the new instruction file; the output file it will read to the list of files used to read model output.
12) Add a 'predictive analysis' section to the control file. This will include NPREDMAXMIN, PD0, PD1, and PD2. NPREDMAXMIN instructs PEST to either maximize (+1) or minimize (-1) the prediction of interest. PD0 is a value of the objective function (phi) which is considered calibrated. Because the shape of the PD0 envelope can be complex, it is extremely hard for PEST to identify a parameter set that lies exactly on the boundary. Therefore, PD0 must be greater than phi for the calibrated model, but only slightly greater. The value supplied for PD1 (which must be slightly greater than PD0) is a value PEST will consider "close enough". If the sum-of-the-squared residuals is above PD2, PEST tries to minimize the objective function until the objective function is below PD2, at which point PEST begins searching for either the maximum or minimum value for the prediction at PD0.

Thus, during a predictive uncertainty analysis run PEST will: A) run MKMOD, B) run MODFLOW, C) compare model output with field observations in the same manner as in a calibration run, D) compare the sum-of-the-squared residuals (phi) from this run with PD0, E) make a model run in superposition mode containing only the 3x3 stress file constructed during steps 1 and 2, F) collect the predicted impact at the target spring or river reach, and G) compare this prediction with the previous maximum (or minimum) prediction and save the value if it is a new maximum (or minimum) and if phi for this run is less than PD1.

Doherty (2010) recommends that phi from the calibrated model <PD0 < PD1 < PD2 and that PD0 should only be slightly larger than phi for the calibrated model (1or 2% larger). Doherty (2010) further states that PD1 should only be slightly larger than PD0 (1 or 2% larger), and PD2 should be generally 1.5 to 2 times PD0. Table 1 shows the phi, PD0, PD1, and PD2 values used in this scenario with calibration run E120116A008. In this scenario PD0 is 1.5 % larger than phi, PD1 is 1.5 % larger than PD0, and PD2 is 1.5 times larger than PD0. Functionally, assigning PD0 and PD1 values a little larger than the calibrated phi allows PEST enough latitude to explore parameter space and locate correlated parameters that might impact the selected prediction.

Table 1. Phi, PD0, PD1, and PD2 values used for predictive uncertainty analysis with calibration run E120115A008.

phi	PD0	PD1	PD2
26517	26915	27312	39776

This approach investigates the magnitude of the impact that correlations between all adjustable model parameters can have on the selected predictions. It does not provide an estimate of the probability of any prediction, nor can it assess the impact of non-adjustable parameters. This approach does not directly address the impact of measurement error; however, confidence in field observations may be reflected in the assigned measurement weights.

Results

As shown in Table 2, 17 analyses have been completed to evaluate the maximum and minimum impact of the eight water districts on Clear Lakes and the near-Blackfoot-to-Minidoka reach of the Snake River as well as one analysis to determine the maximum and minimum impact of Water District 130 on the Ashton-to-Rexburg reach. The column in Table 2 titled “Calibrated Impact” represents the fraction of the total impact realized in the target reach at steady state.

The column in Table 2 titled “Range” represents the difference between the Maximized Impact and Minimized Impact. Impact differences are used in this table rather than percent change because the more practical metric is the fraction of the total impact, not the percent change. For example, the Calibrated Impact for the centroid of WD120 on Clear Lakes is 0.005, the Maximized Impact is 0.009, and the Minimized Impact is 0.004. The Maximized Percent Change is 80% ((0.009-0.005)/0.005) and the Minimized Percent Change is -20% ((0.004-0.005)/0.005), and the Range in percentage is 100% (80% - (-20%)). In this example, 100% uncertainty sounds bad; however, this analysis indicates that the model cannot remain calibrated and increase the impact at Clear Lakes by more than 0.009. Unless something is wrong with the hydrogeologic conceptualization upon which ESPAM2.0 is based, the impact for the centroid of WD120 upon Clear Lakes will remain small. In this example, 100% uncertainty does not accurately reflect the fact that we are certain that at least 99% of the impact is not realized at Clear Lakes. It is only after the impact differences (Range) becomes large, say 0.10 or greater, that the uncertainty becomes a practical issue.

The majority of the analyses resulted in a relatively tight predictive uncertainty range. Three analyses resulted in a range of 0.1 or greater: Water District 34 to near-Blackfoot-to-Minidoka, Water District 99 to near-Blackfoot-to-Minidoka, and Water District 120 to near-Blackfoot-to-Minidoka (Figure 2). All of these Water District centroids are north of American Falls Reservoir, and all of these analyses involve the near-Blackfoot-to-Minidoka reach. Appendix A contains a map showing the Water District centroid and spring or river reach in which the impact is observed for each of the 18 analyses. Each map is followed by pie charts illustrating how the steady state impact was apportioned between the river reaches and springs: 1) for the calibrated model and for the minimum prediction, and 2) for the calibrated model and for the maximum prediction. Bar charts illustrating fractional change in the adjustable parameters for each prediction are also included. Appendix B contains a list of the adjustable parameters. The fractional change was computed by:

$$(prediction - calibration) \,/\, calibration$$

Where: *prediction* is the parameter value used in the maximum/minimum prediction model and *calibration* is the parameter value used in the calibrated model. Appendix C contains a color ramp that can be used to relate the colors in the pie charts to individual springs and river reaches.

Table 2. Constrained maximized/minimized uncertainty analyses conducted with ESPAM2.0. Calibrated Impact represents the fraction of the total impact at the centroid that was realized in the target reach.

Centroid	Reach	Calibrated Impact	Maximized Impact	Minimized Impact	Range	Model Version
WD110	Clear Lakes	0.002	0.002	0.002	0.000	E110712A001
WD110	nr Blackfoot-Minidoka	0.263	0.267	0.261	0.006	E120116A008
WD120	Clear Lakes	0.005	0.009	0.004	0.005	E110712A001
WD120	nr Blackfoot-Minidoka	0.665	0.913	0.550	0.363	E120116A008
WD130	Clear Lakes	0.071	0.074	0.069	0.004	E110712A001
WD130	nr Blackfoot-Minidoka	0.216	0.217	0.149	0.067	E120116A008
WD130	Ashton-Rexburg	0.009	0.010	0.009	0.000	E120116A008
WD34	Clear Lakes	0.027	0.034	0.004	0.030	E110712A001
WD34	nr Blackfoot-Minidoka	0.682	0.862	0.324	0.537	E120116A008
WD140	nr Blackfoot-Minidoka	0.349	0.351	0.347	0.003	E120116A008
WD140	Clear Lakes	0.045	0.046	0.044	0.002	E120116A008
WD33	Clear Lakes	0.006	0.006	0.005	0.001	E120116A008
WD33	nr Blackfoot-Minidoka	0.612	0.615	0.606	0.009	E120116A008
WD100	nr Blackfoot-Minidoka	0.198	0.198	0.198	0.000	E120116A008
WD100	Clear Lakes	0.001	0.001	0.001	0.000	E120116A008
WD99	Clear Lakes	0.001	0.001	0.001	0.001	E120116A008
WD99	nr Blackfoot-Minidoka	0.164	0.297	0.030	0.267	E120116A008

Summary and Conclusions

Perhaps the most important observation is that all of the analyses with ranges between the minimized and maximized impact higher than 0.10 involve the near-Blackfoot-to-Minidoka reach. The reach gain field observations contain significant noise (erroneous data) as shown in Figure 3. The noisy data may be allowing PEST some latitude because the model output will never successfully match the noise. This suggests that the reach-gain calibration targets need to be improved. A Butterworth filter (Butterworth, 1930) is available with PEST and could be applied to remove the noise from the observation data. Even though model output will not contain noise, model output will need to be processed with the same filter prior to comparison with the filtered observed data. IDWR recommends that the reach gain targets should include both filtered and unfiltered reach gains for calibration of future versions of ESPAM.

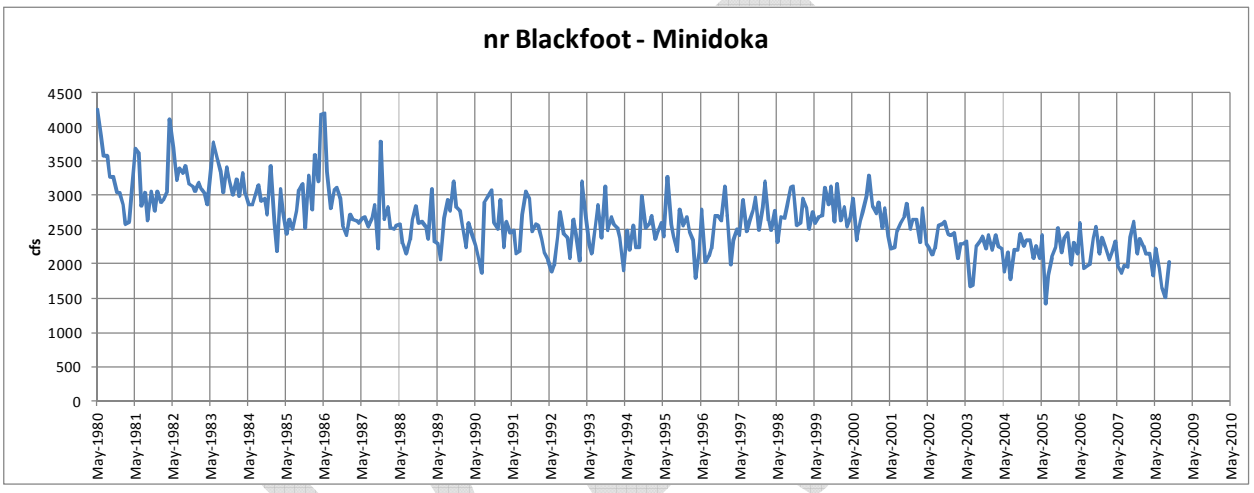

Figure 3. Observed reach gains between the near Blackfoot and Minidoka gages.

None of the analyses involving Clear Lakes resulted in significant uncertainty. Perhaps this is because the total impact at Clear Lakes is necessarily small, so the net change cannot be large, or perhaps this is because there is less noise in the spring discharge observations.

None of the analyses involving either Water District 130 or Water District 140 resulted in significant uncertainty. A possible explanation for this is that most of the impact is dispersed amongst the springs and cannot be shifted elsewhere while allowing the model to remain calibrated.

The impact from Water District 100 and Water District 110 showed very little uncertainty. Perhaps this is because the model will not calibrate unless a significant portion of the impact from these districts is absorbed by the Ashton-to-Rexburg reach leaving very little latitude with the remaining impact.

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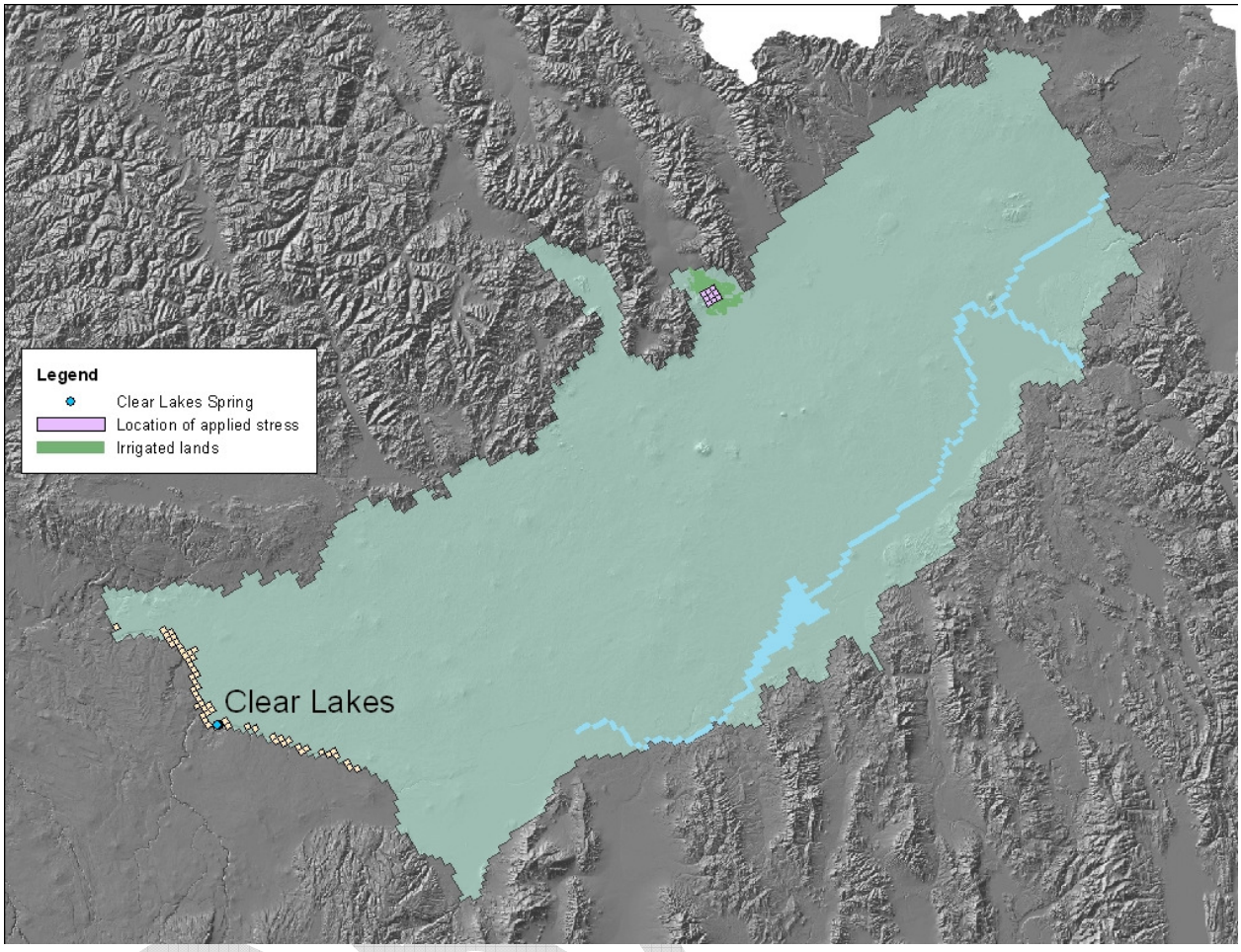
Appendix A

Maps, pie diagrams, and bar charts

Impact of Water District 33 on Clear Lakes using calibration run E120116A008.



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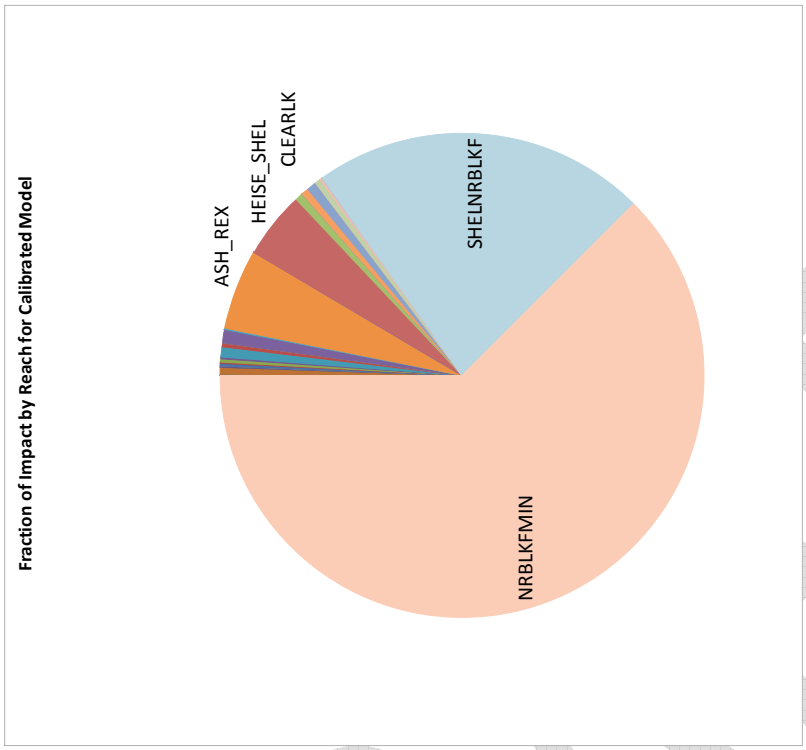

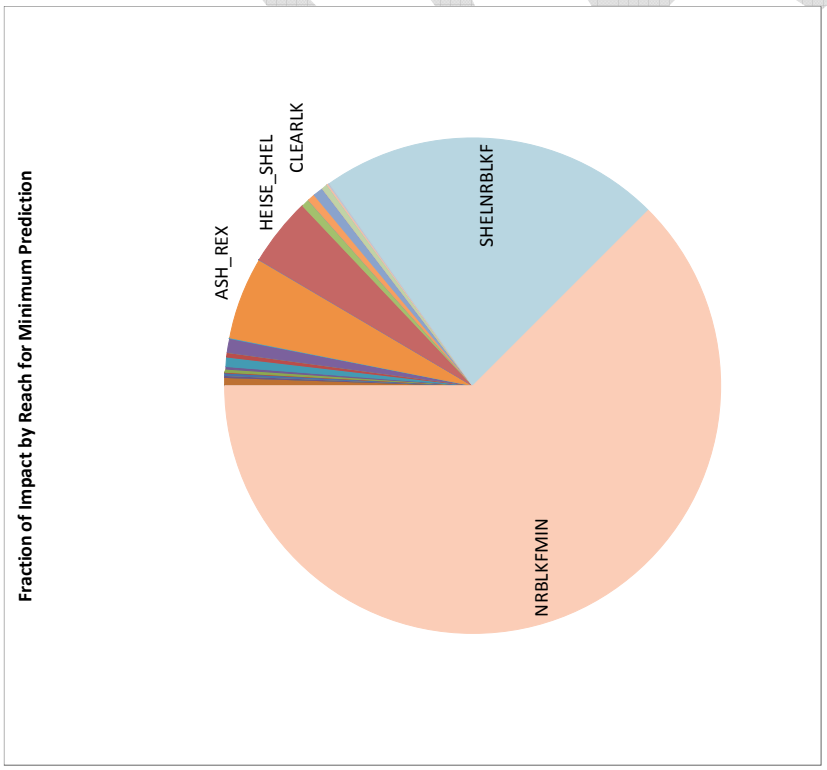

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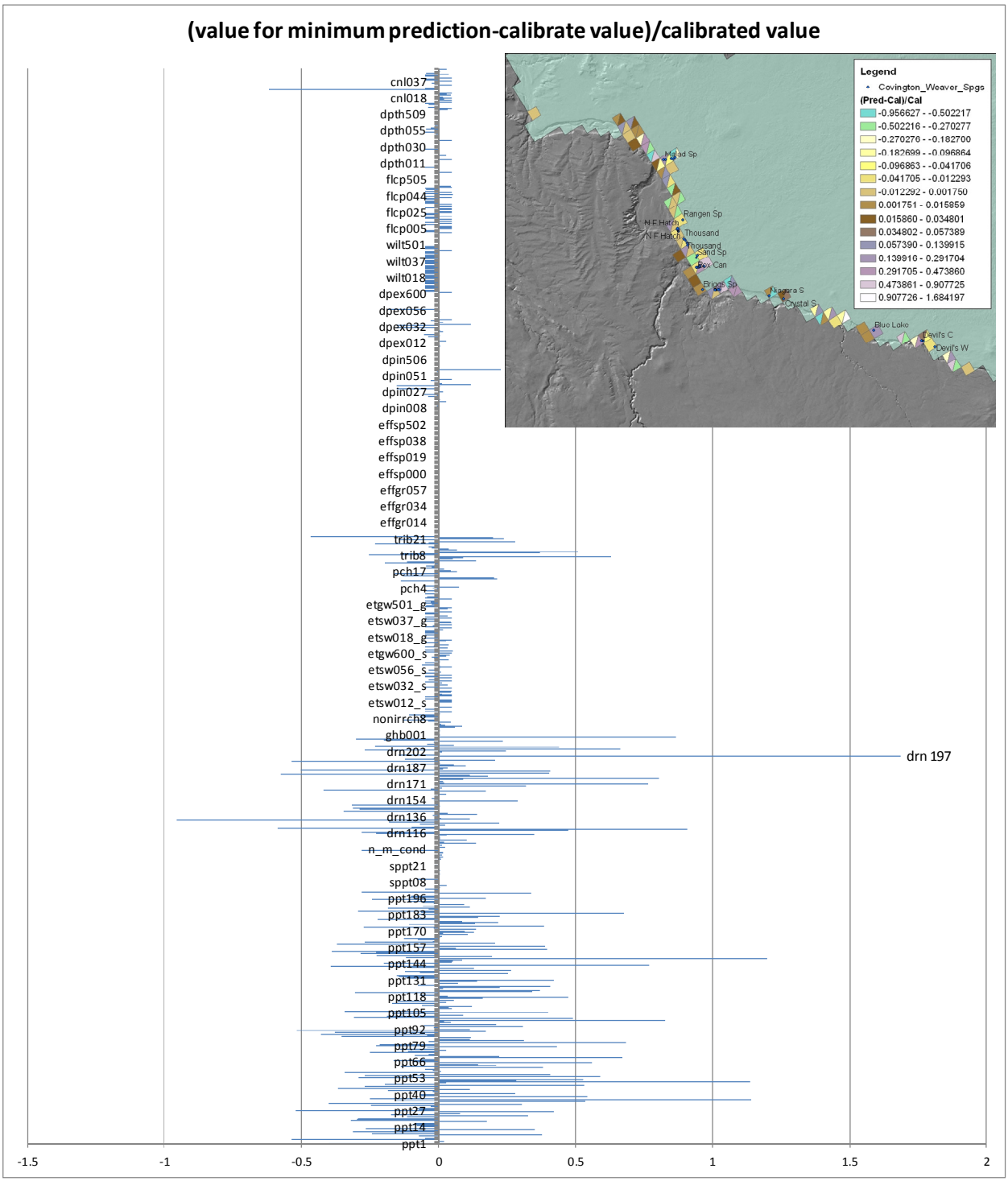

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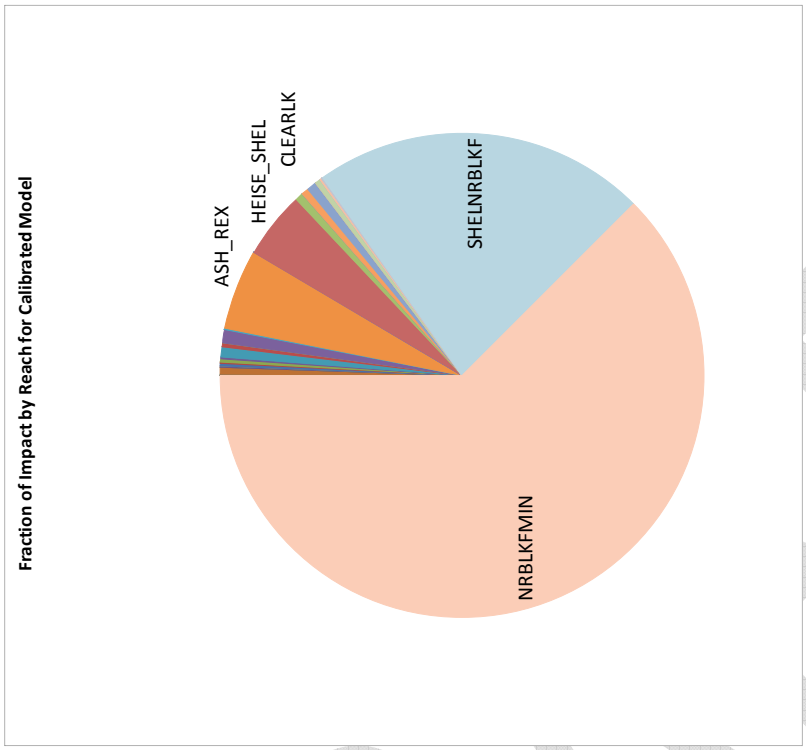

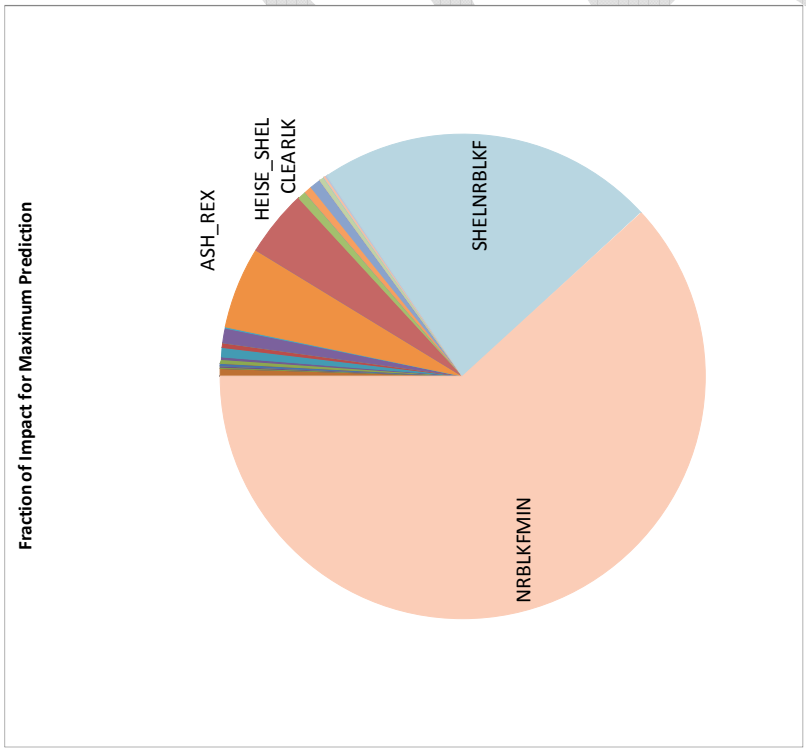

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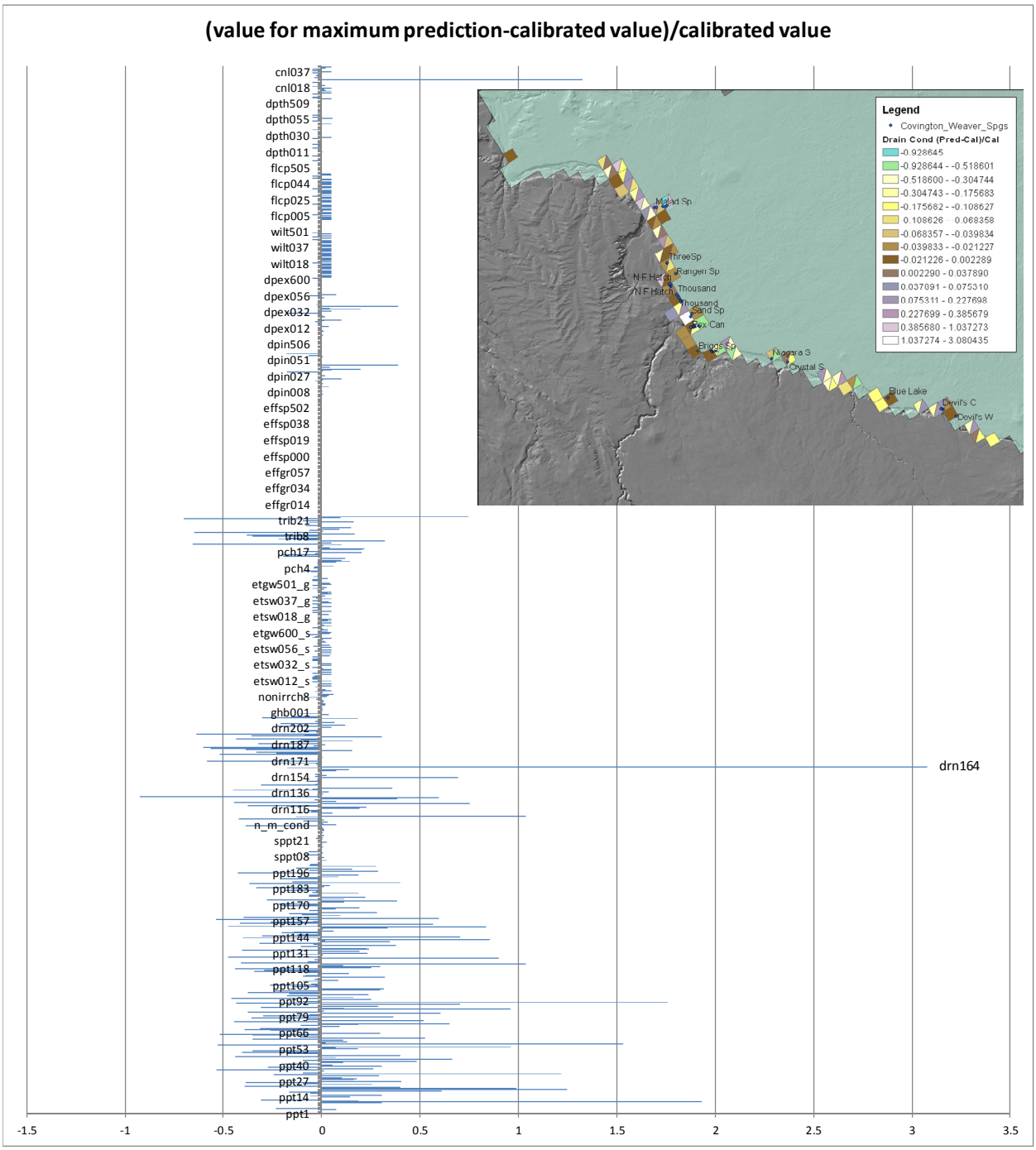
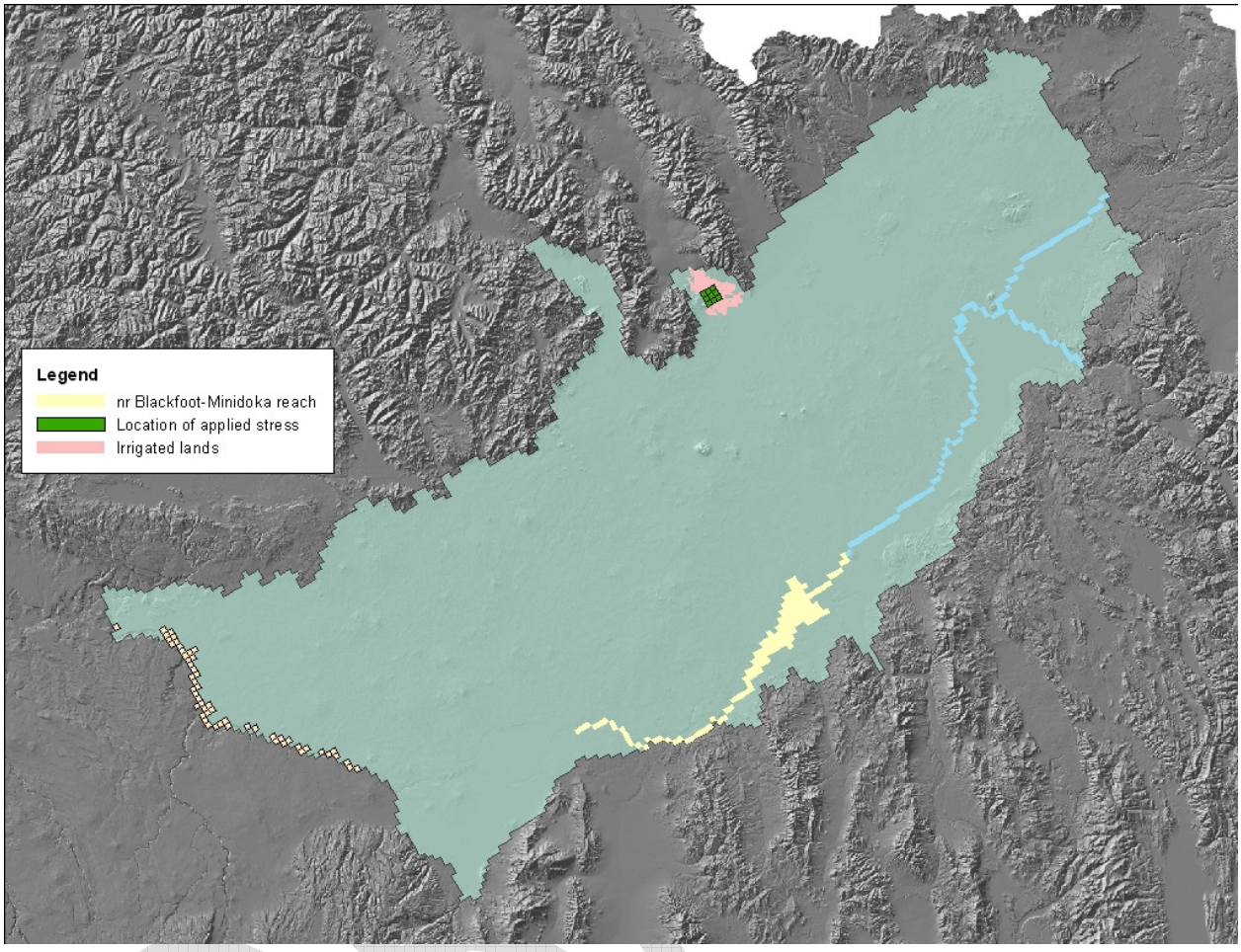


Impact of Water District 33 on nr Blackfoot-Minidoka using calibration run E120116A008



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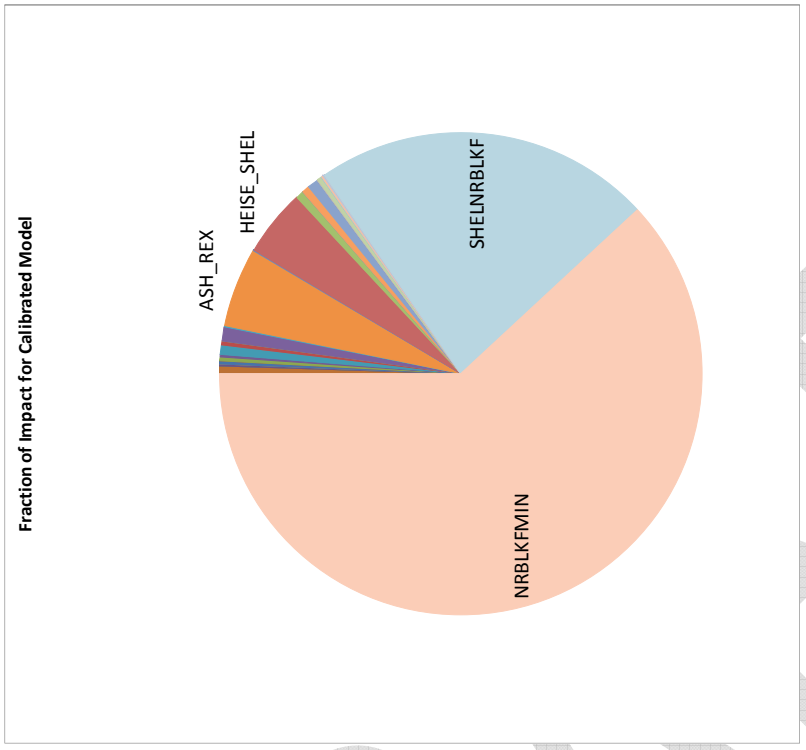

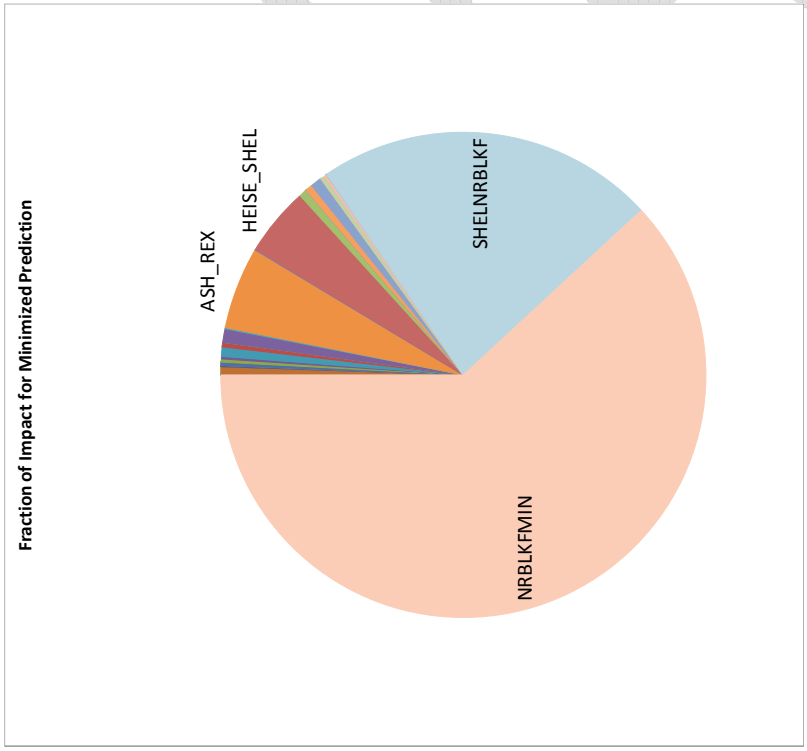

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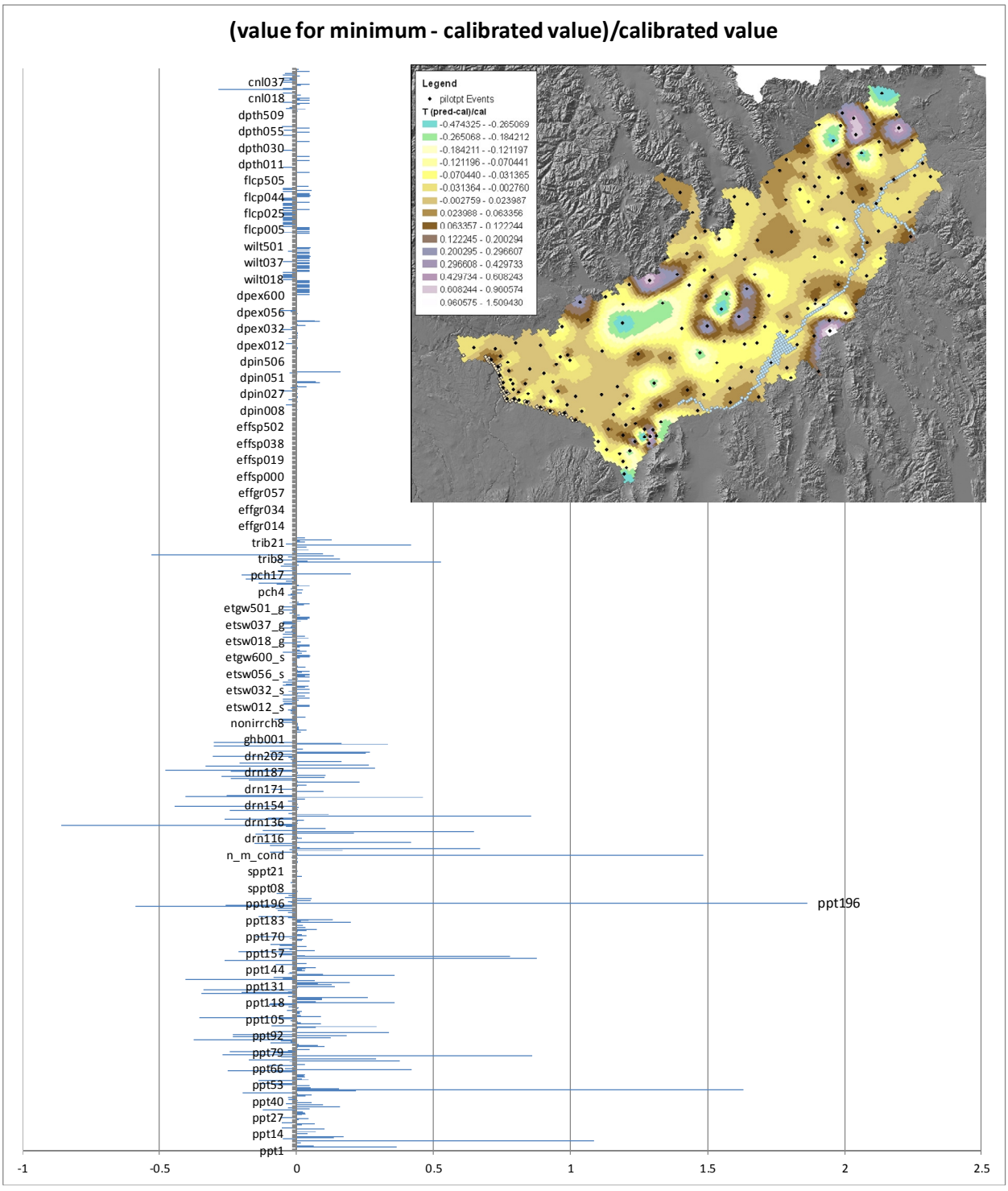

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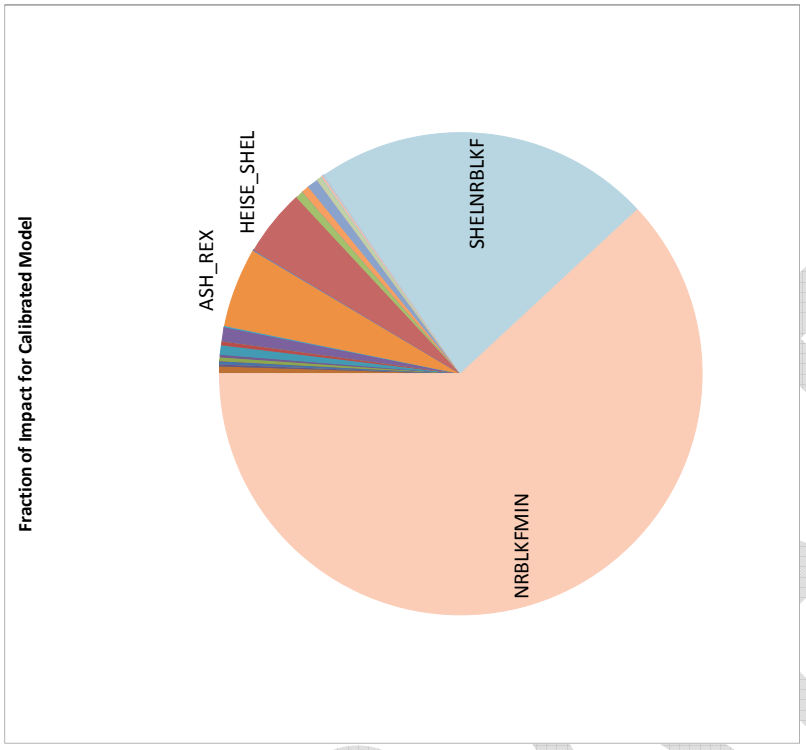

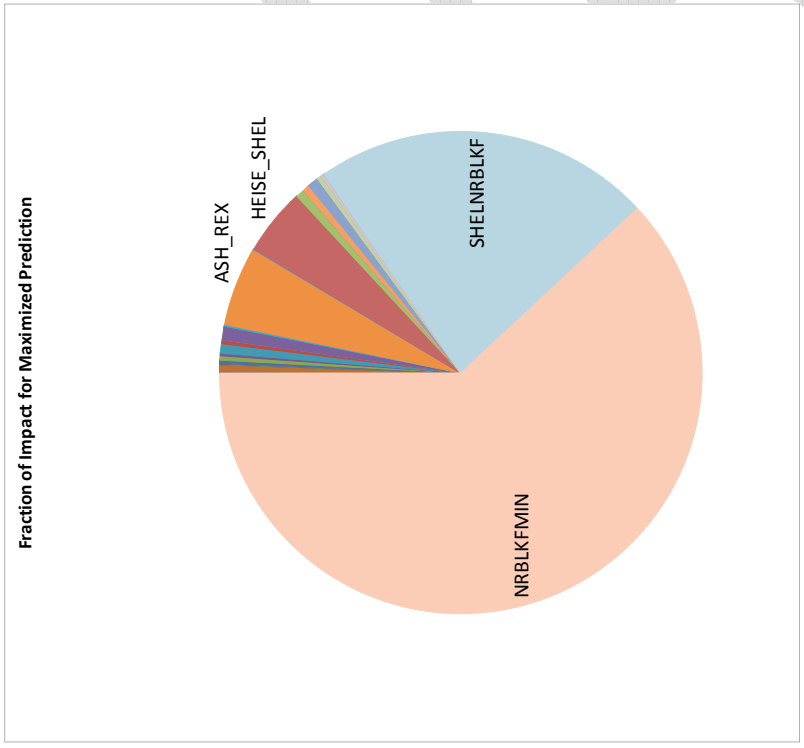

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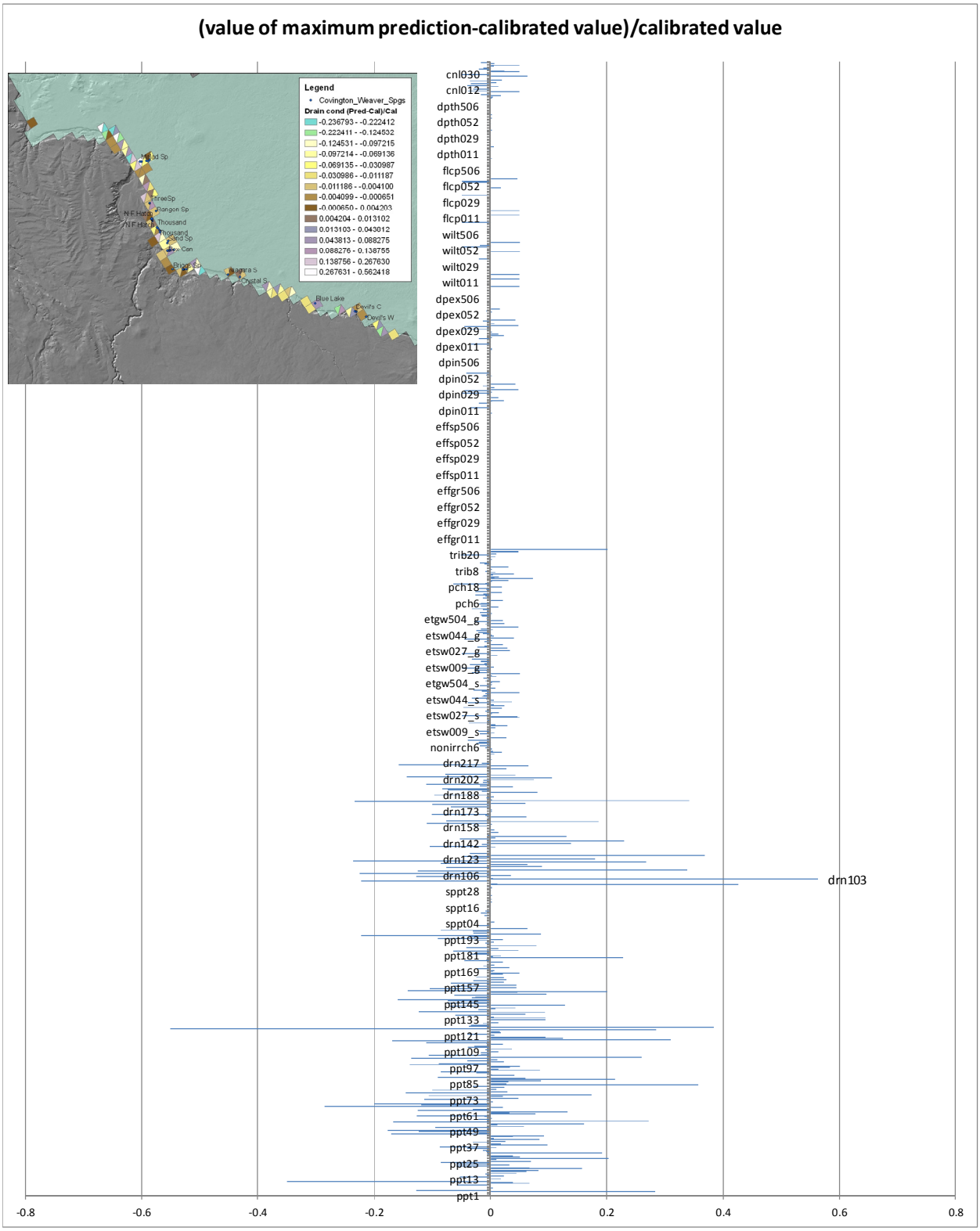
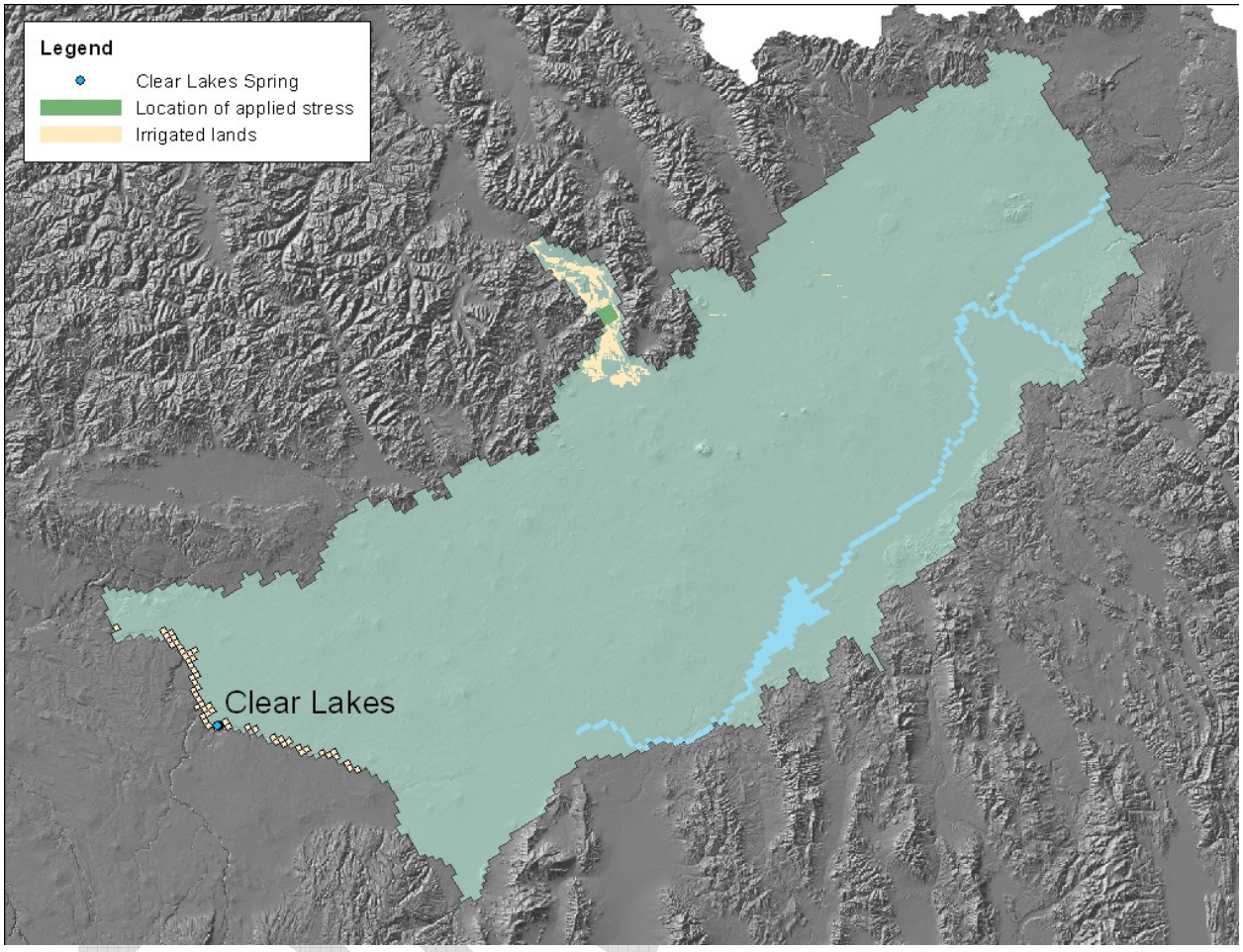


Impact of Water District 34 on Clear Lakes using calibration run E110712A001



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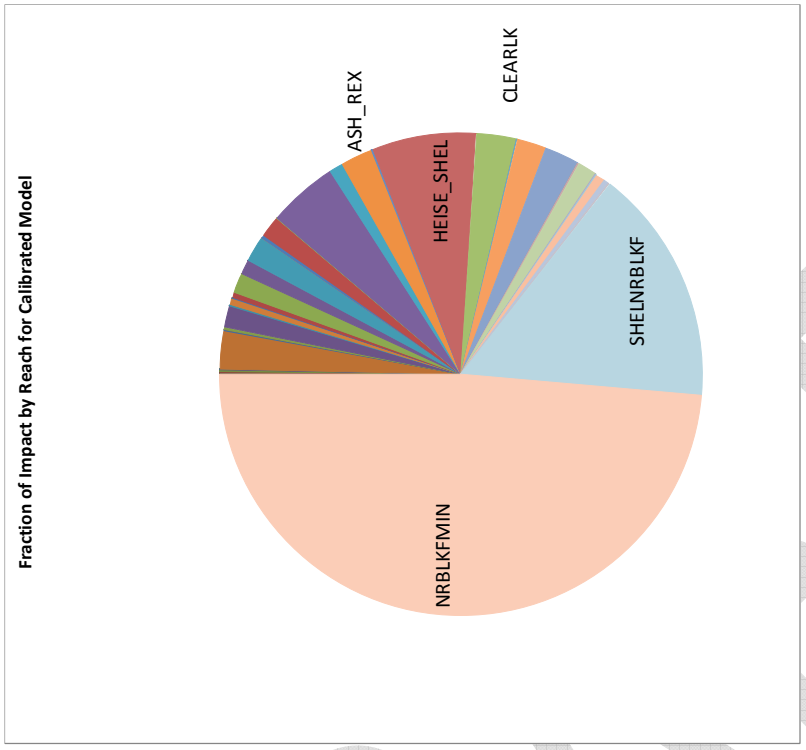
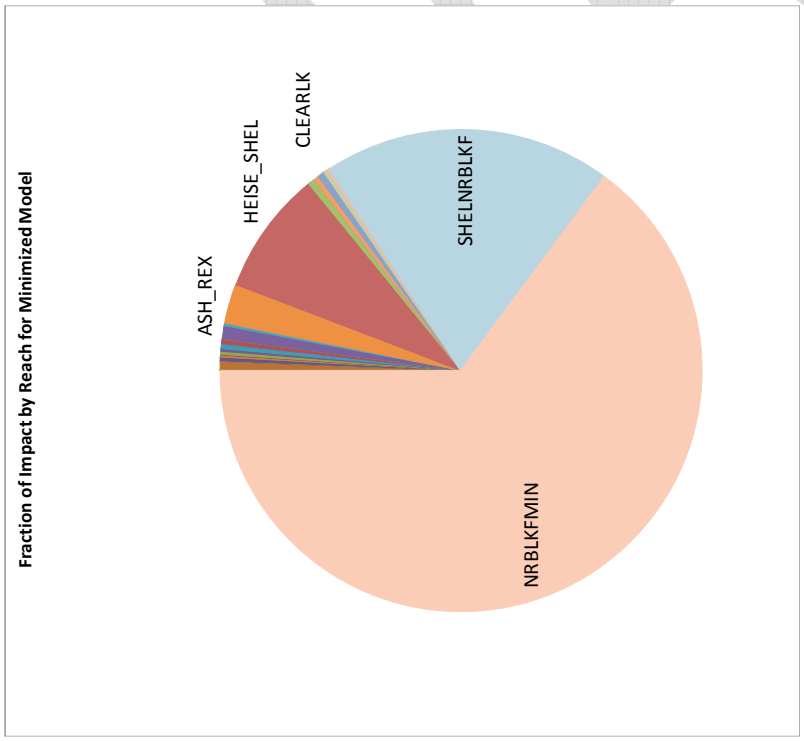
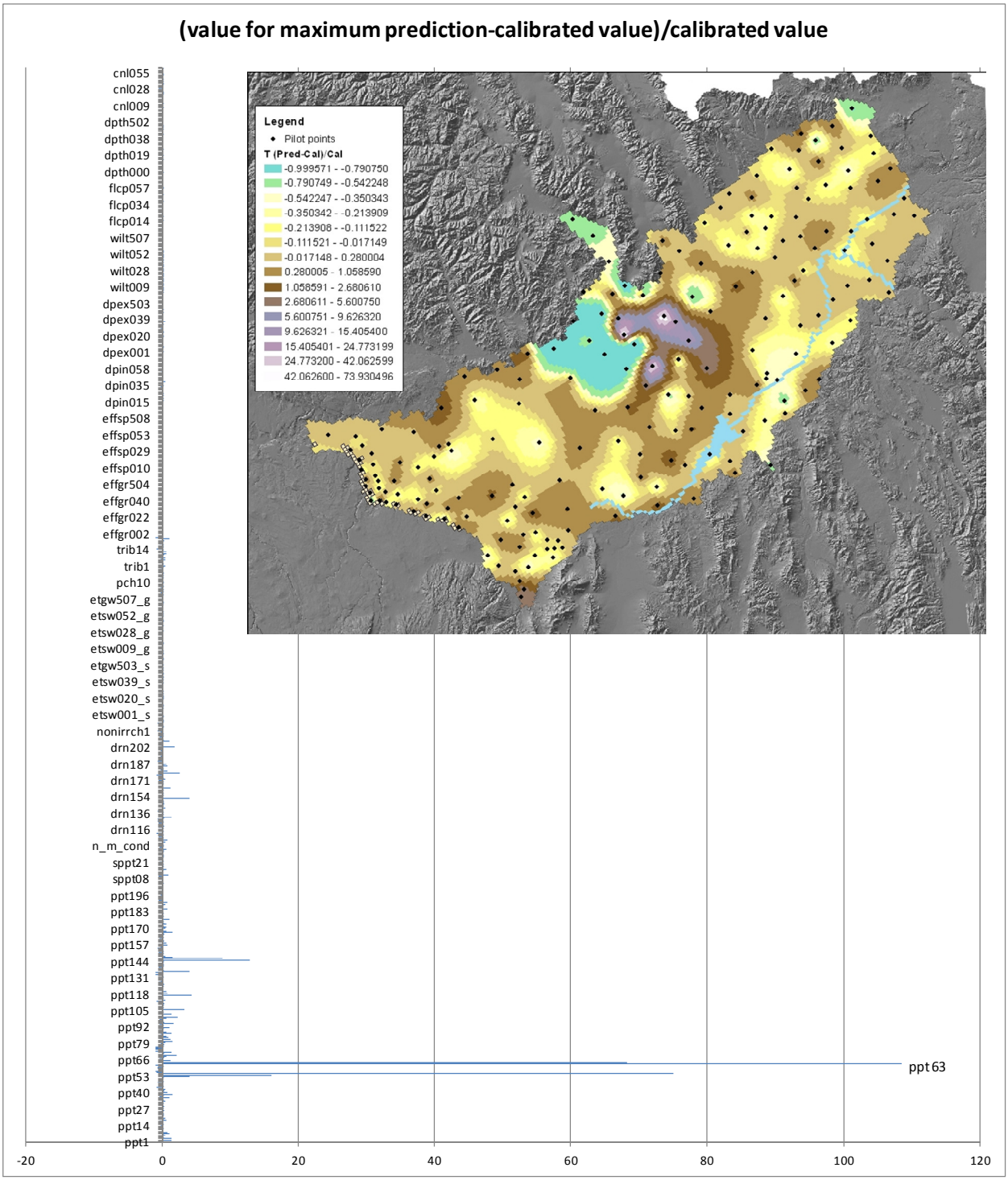




Impact of Water District 34 on Clear Lakes using calibration run E110712A001



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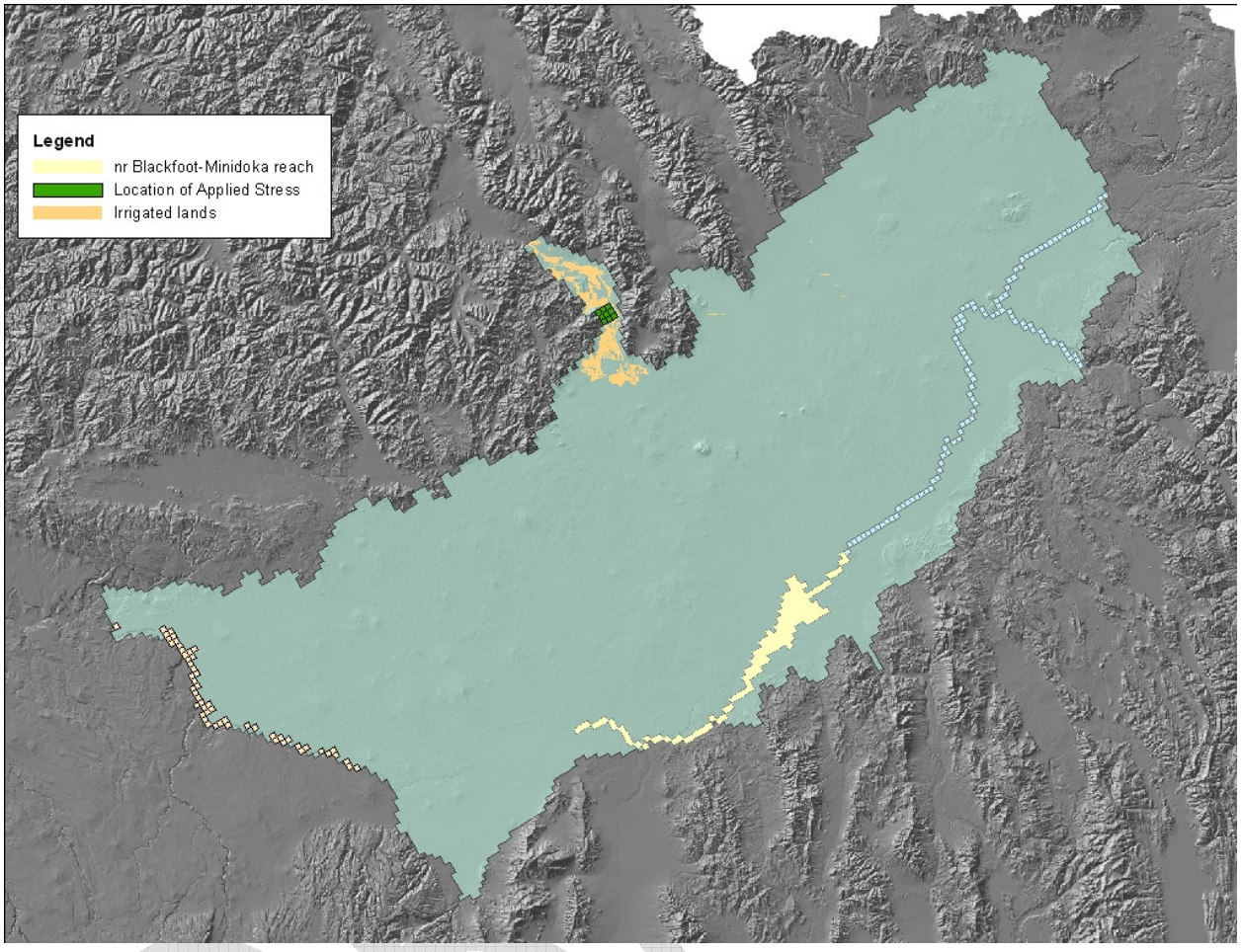

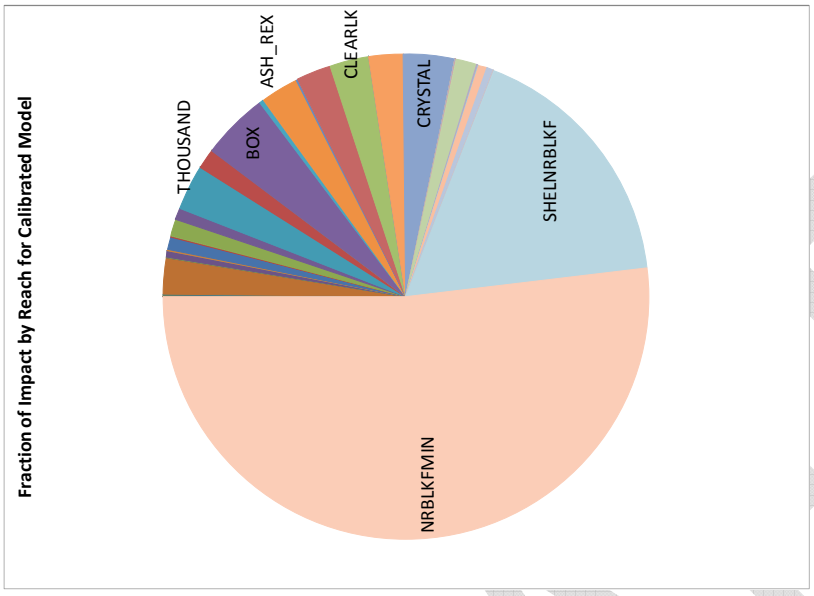
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CRYSTAL
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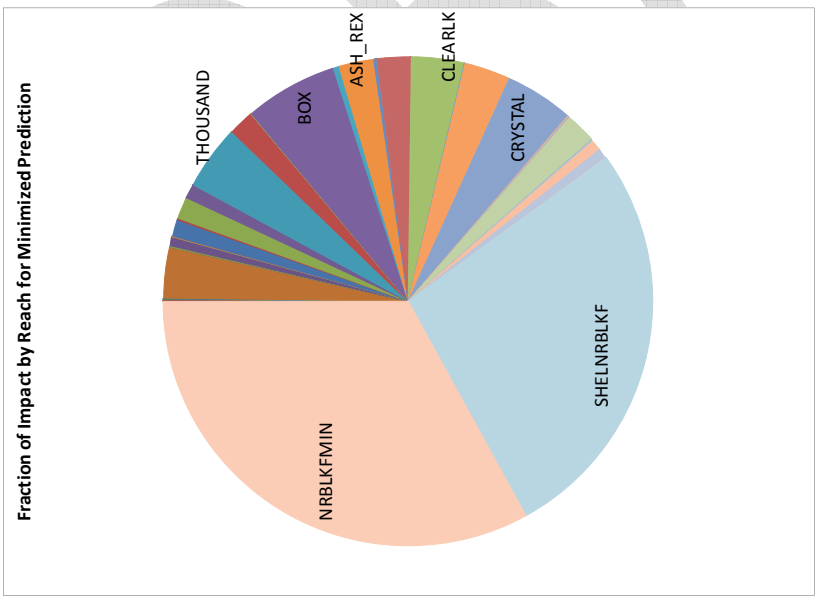
Fraction of Impact by Reach for Minimized Prediction
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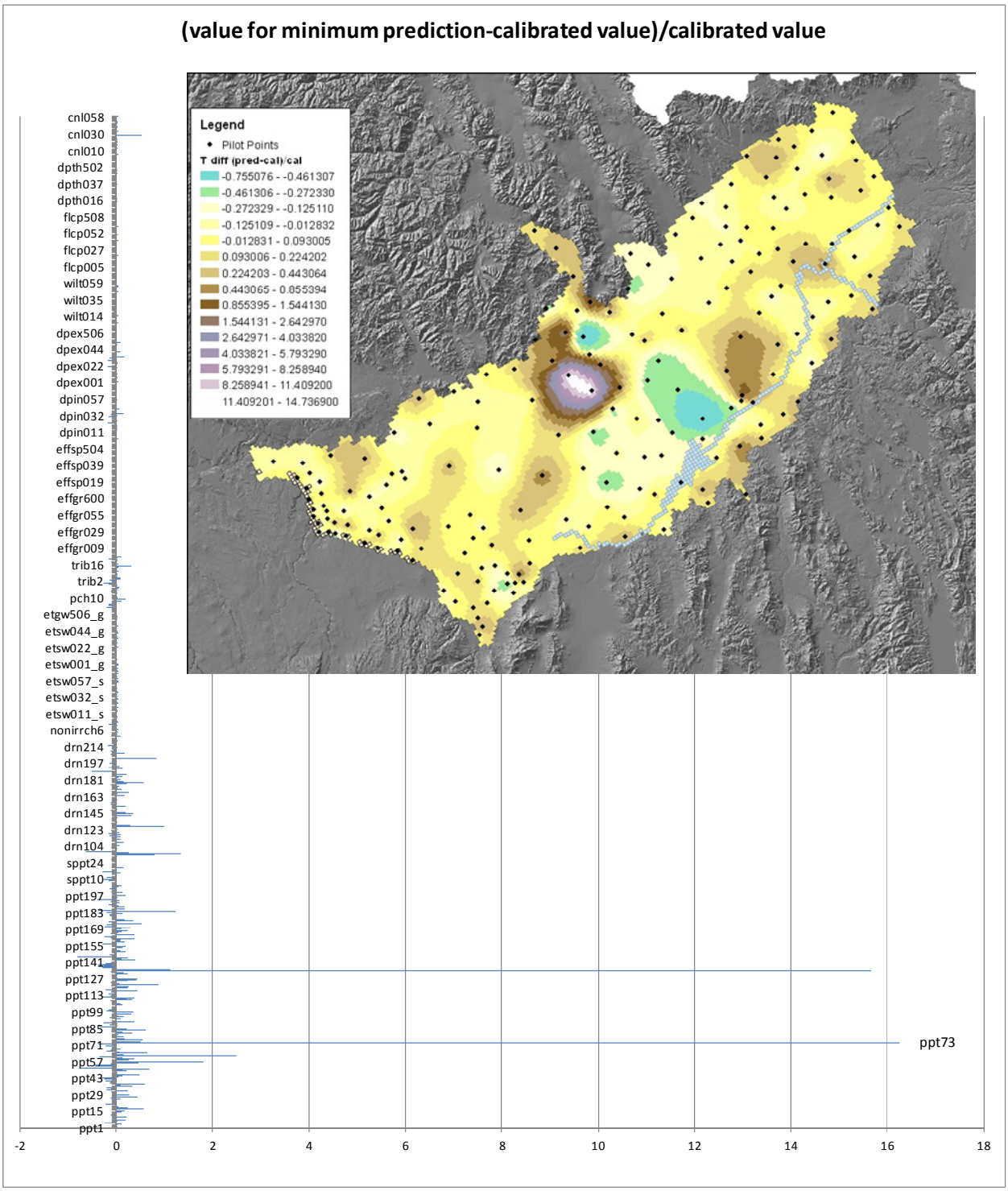
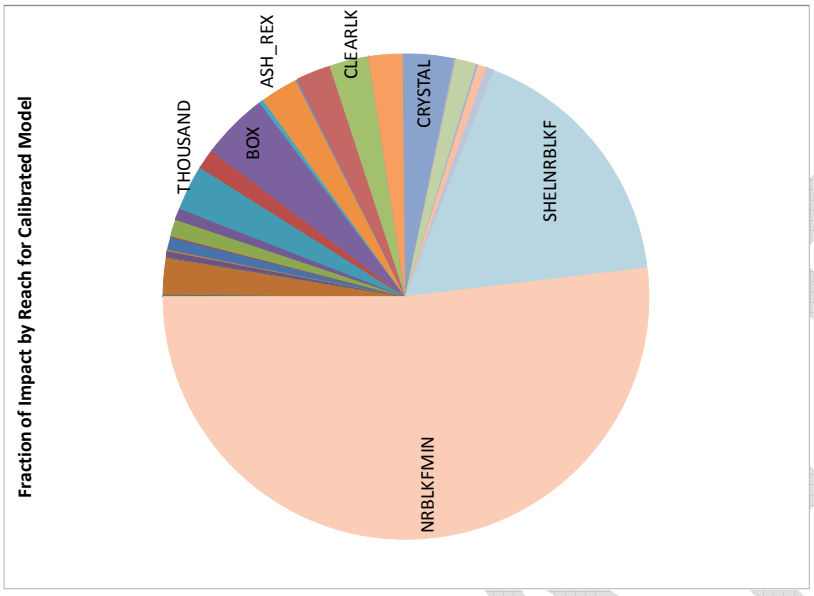
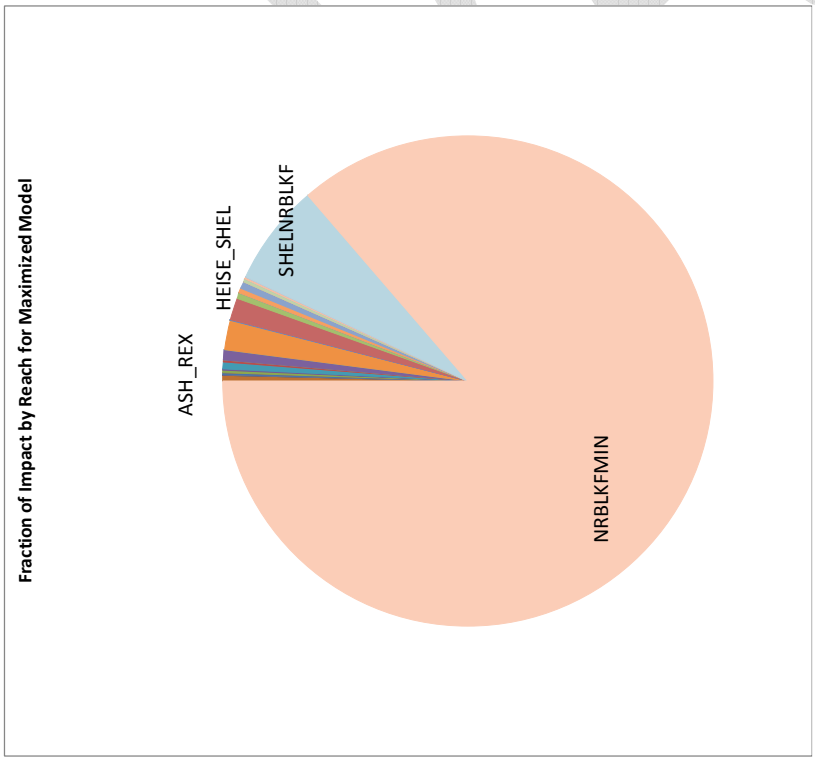
CRYSTAL
SHELNRBLKF
NRBLKFMIN

Impact of Water District 34 on nr Blackfoot-Minidoka using calibration run E120116A008

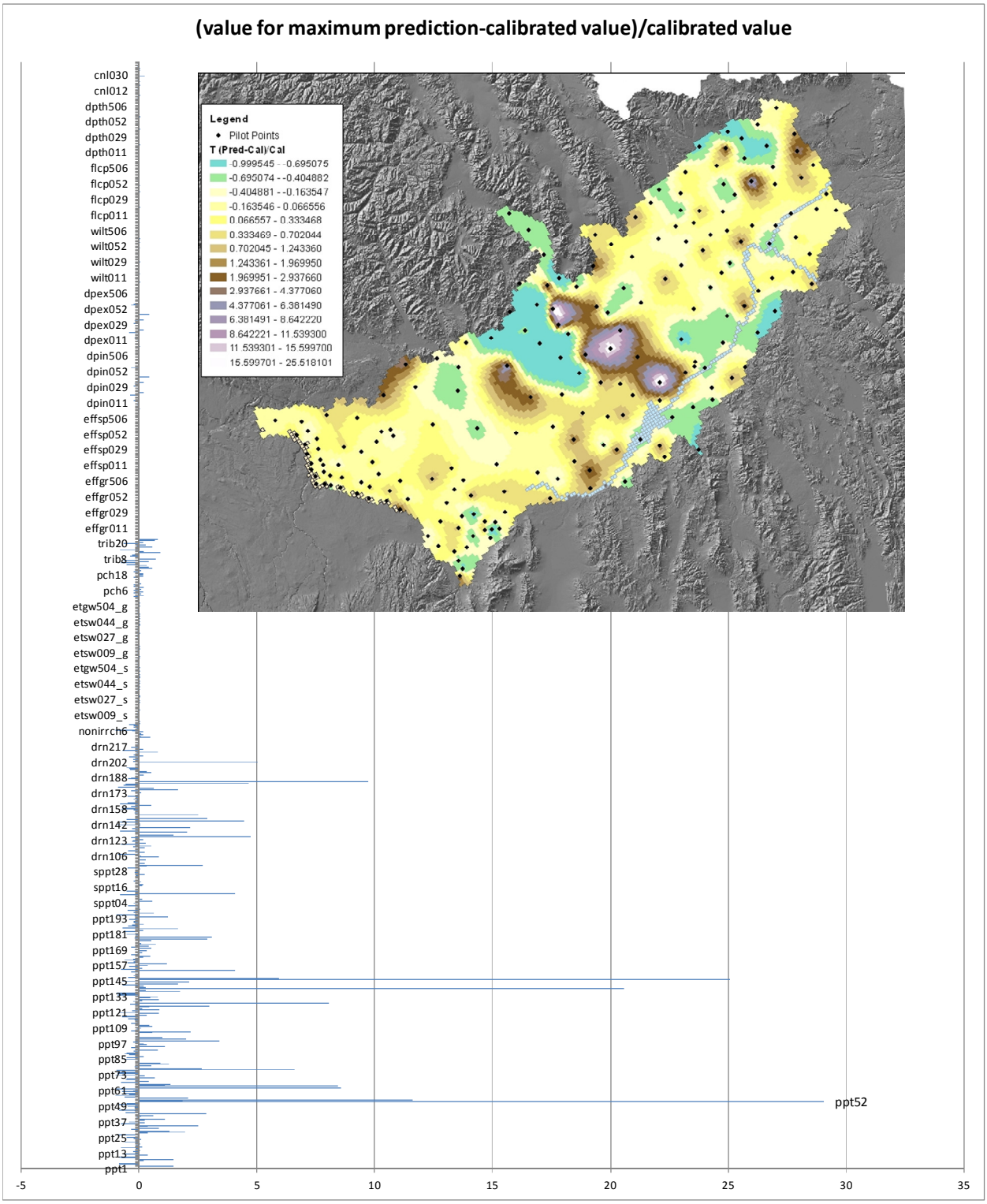


Impact of Water District 34 on nr Blackfoot-Minidoka using calibration run E120116A008

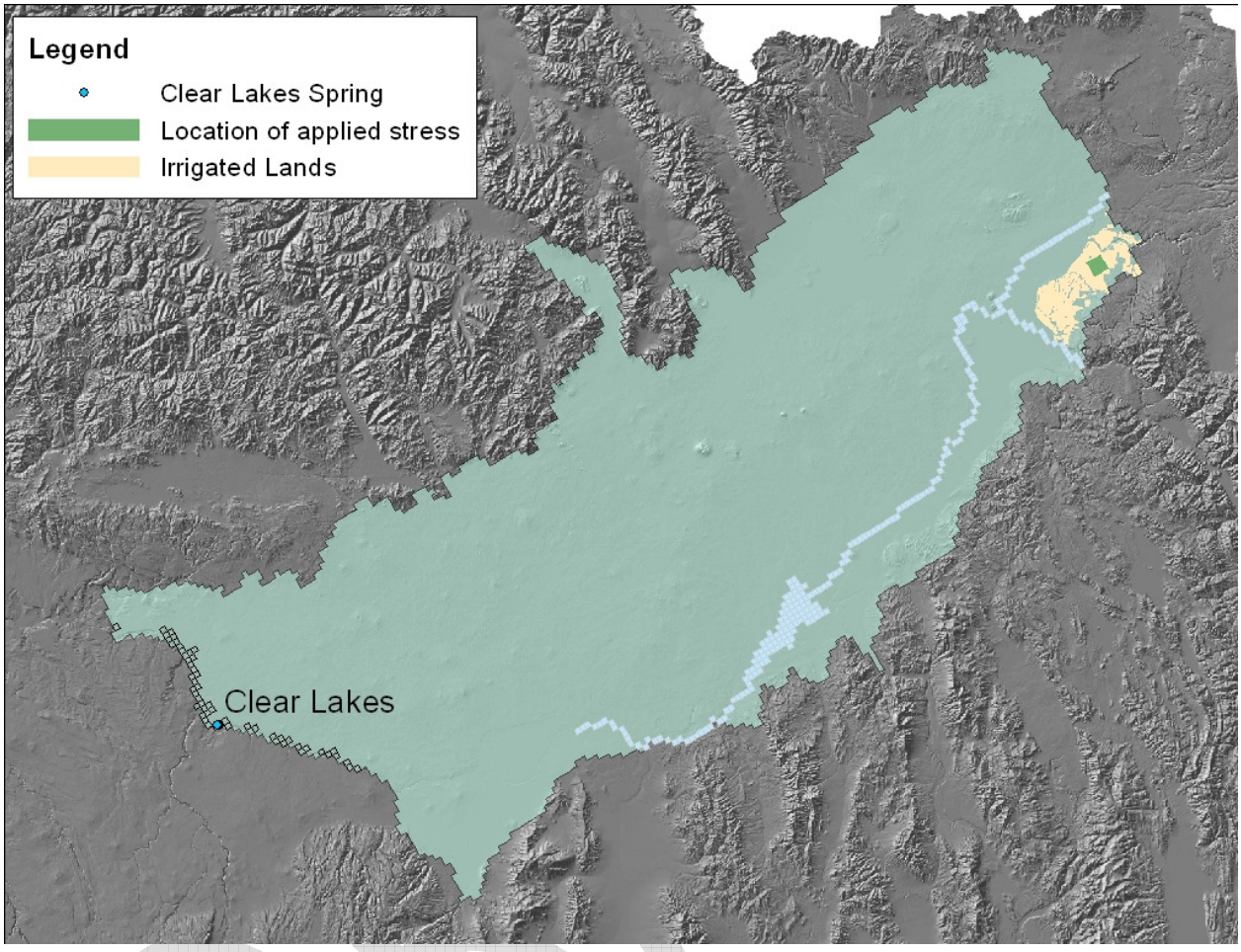




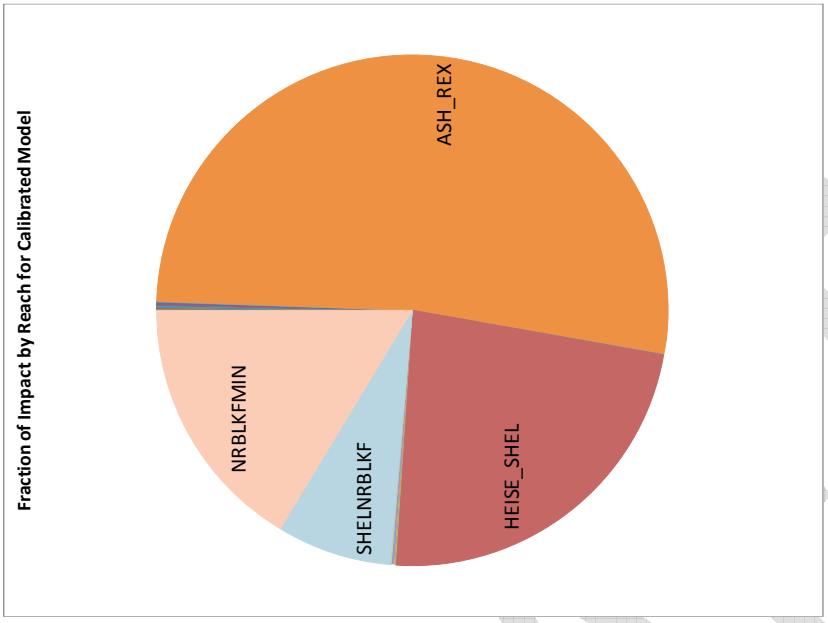
Impact of Water District 34 on nr Blackfoot-Minidoka using calibration run E120116A008

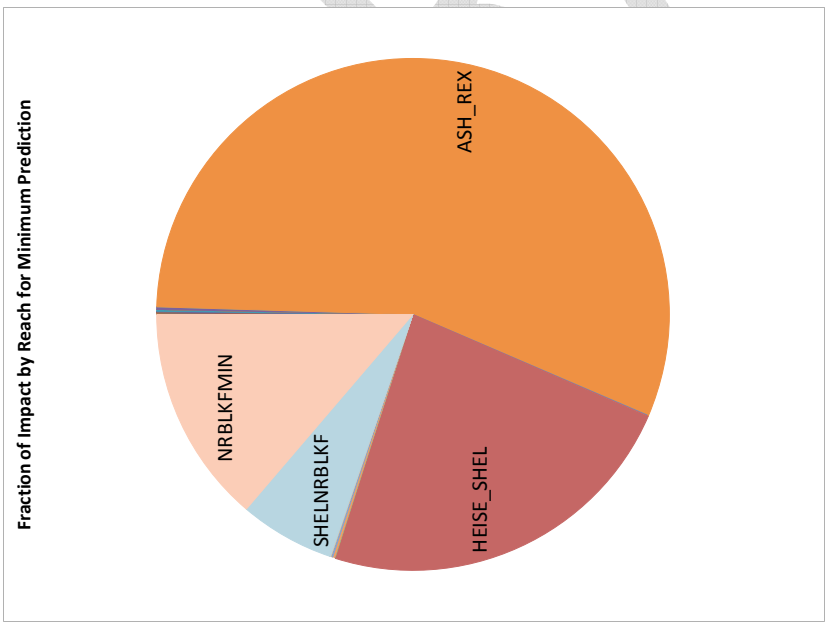


Impact of Water District 99 (Rexburg Bench) on near Clear Lakes using calibration run E120116A008.

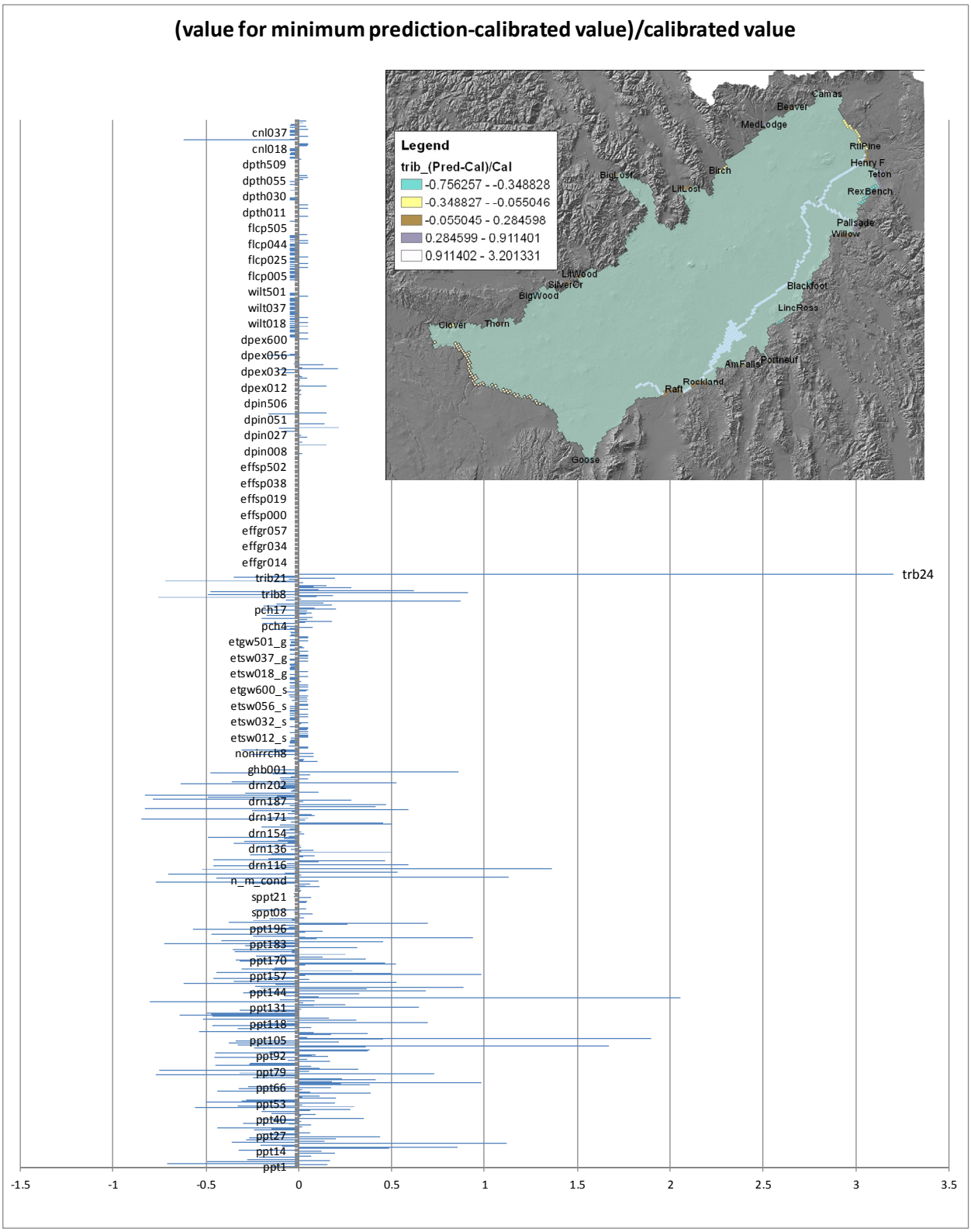


Impact of Water District 99 (Rexburg Bench) on near Clear Lakes using calibration run E120116A008

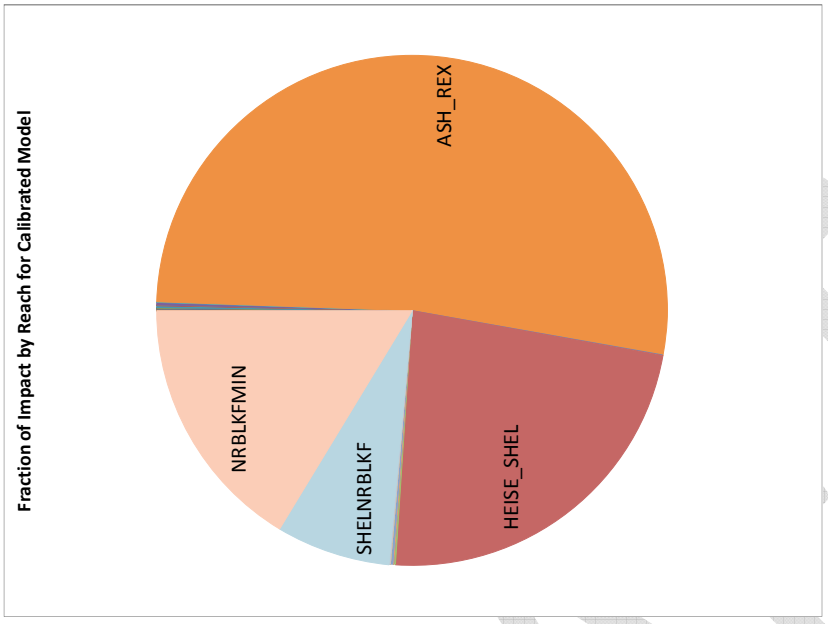


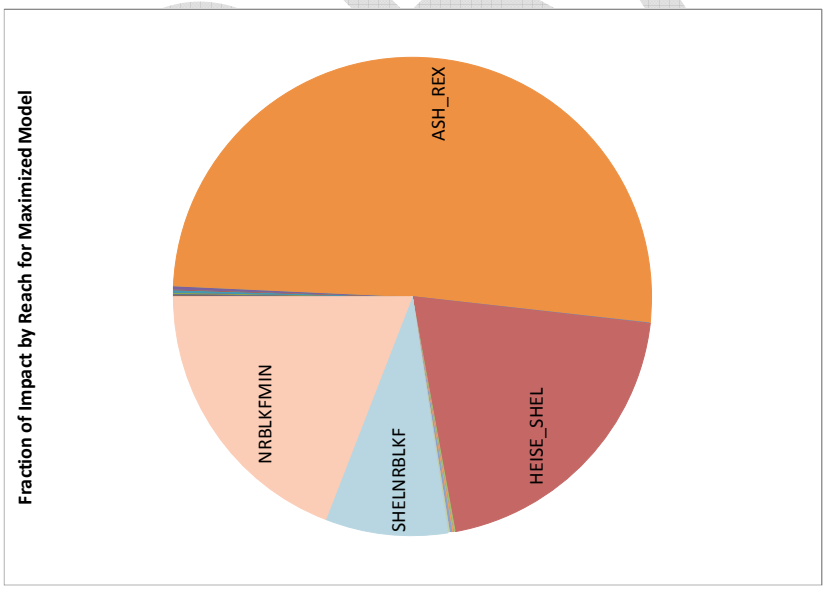


Impact of Water District 99 (Rexburg Bench) on near Clear Lakes using calibration run E120116A008

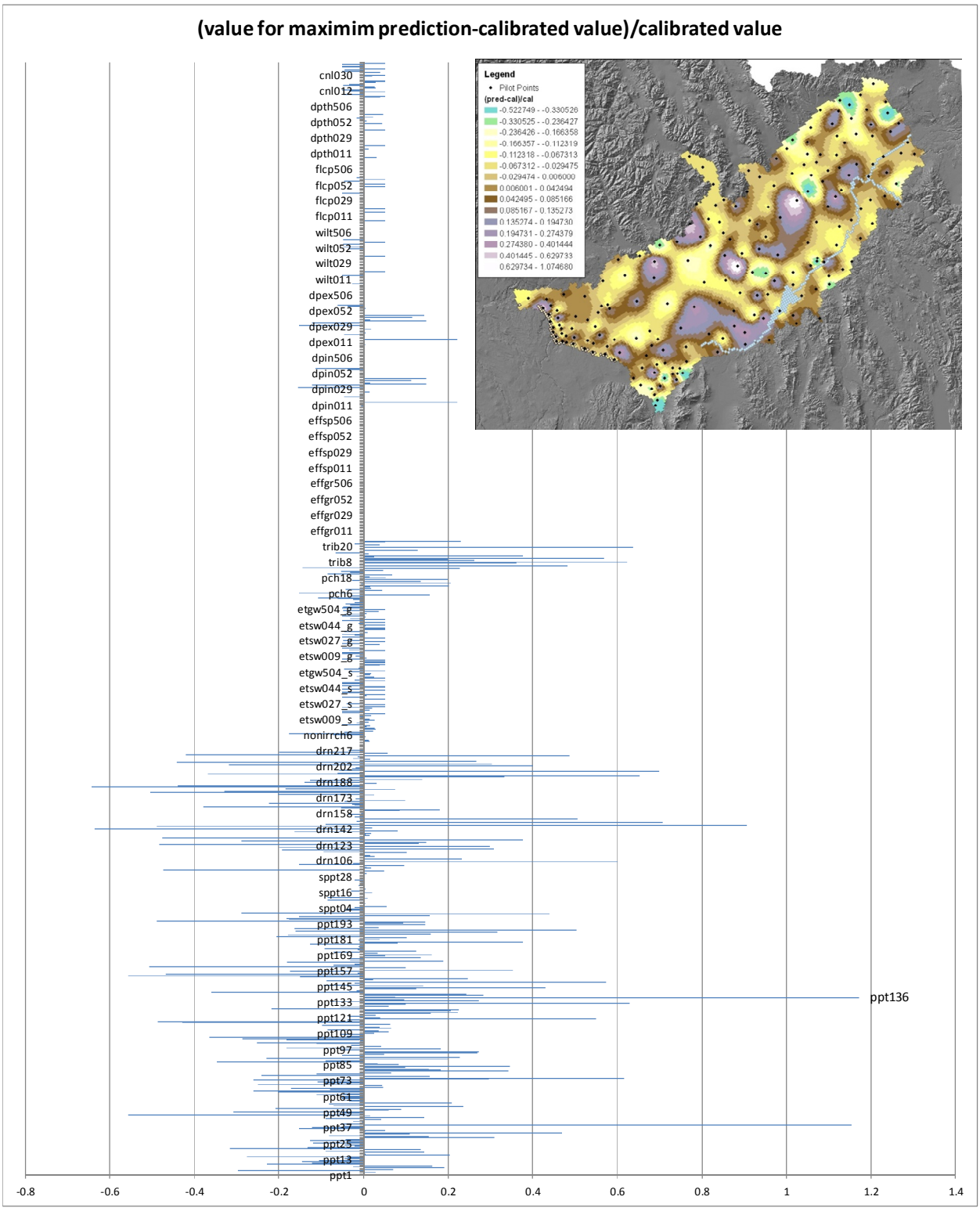


Impact of Water District 99 (Rexburg Bench) on near Clear Lakes using calibration run E120116A008

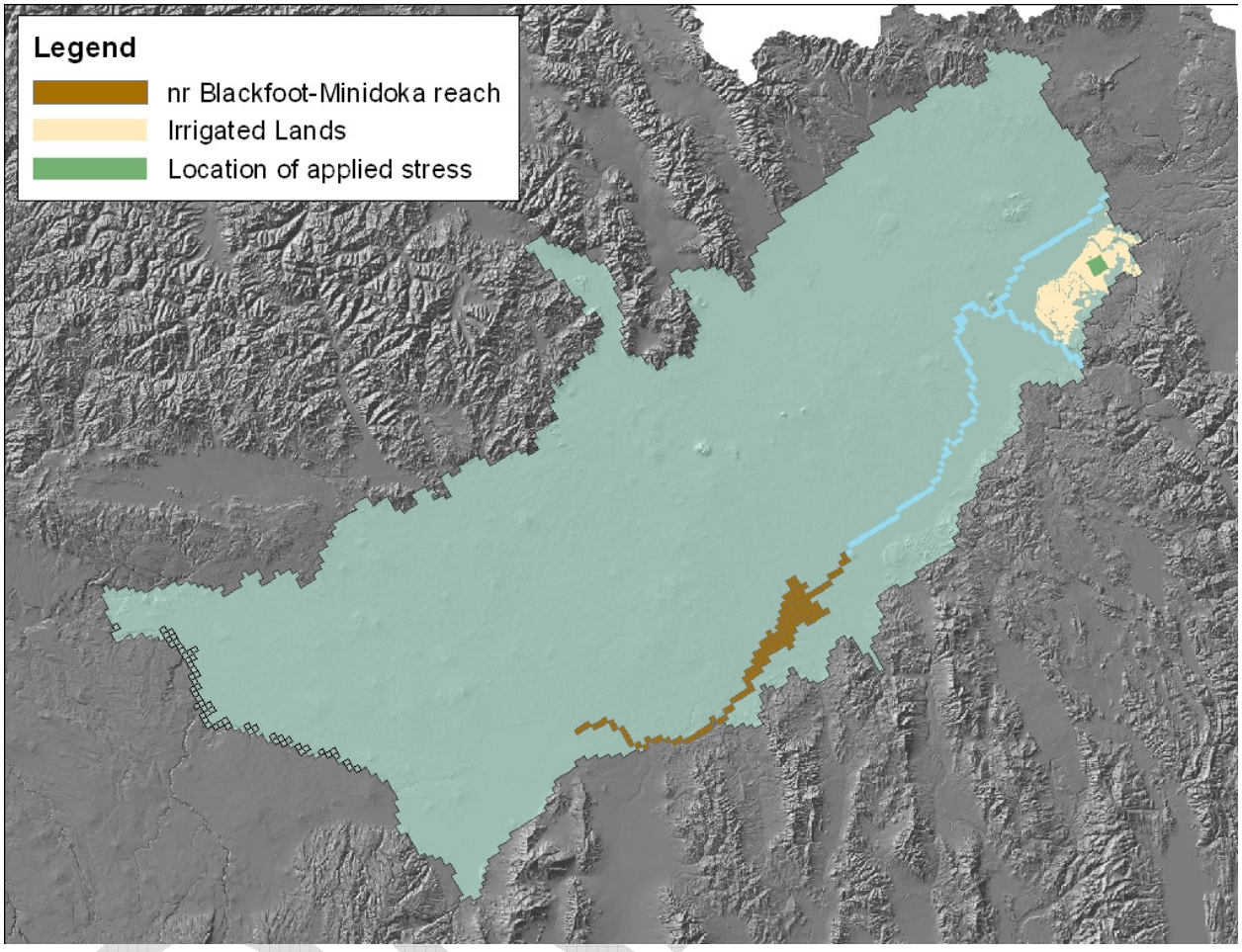




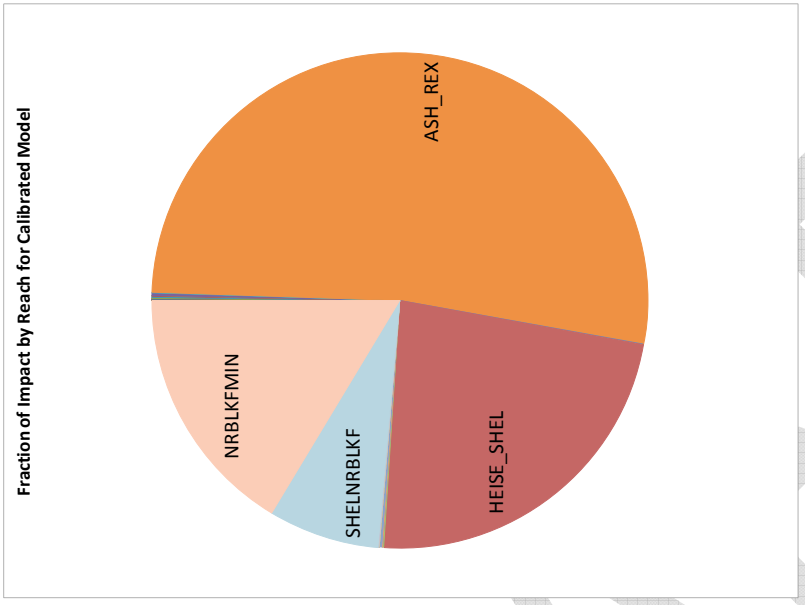
Impact of Water District 99 (Rexburg Bench) on near Clear Lakes using calibration run E120116A008

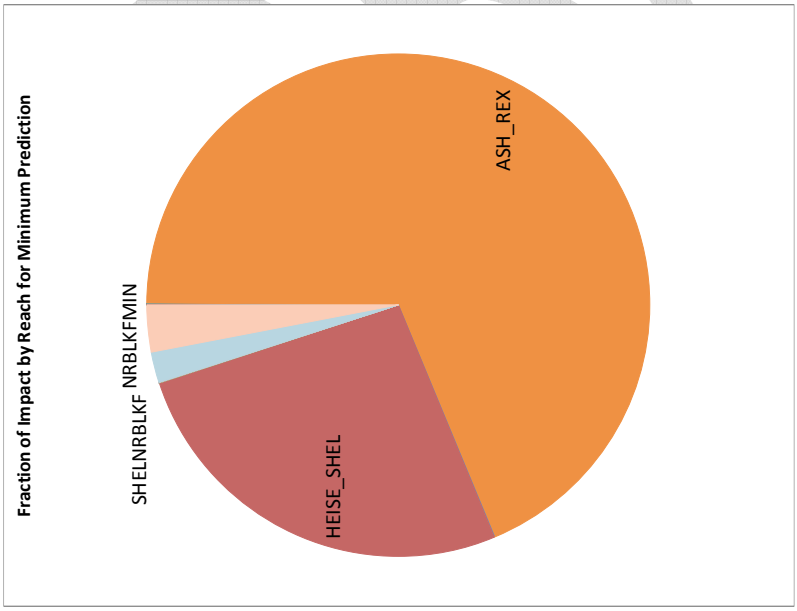


Impact of Water District 99 (Rexburg Bench) on near Blackfoot-Minidoka using calibration run E120116A008.

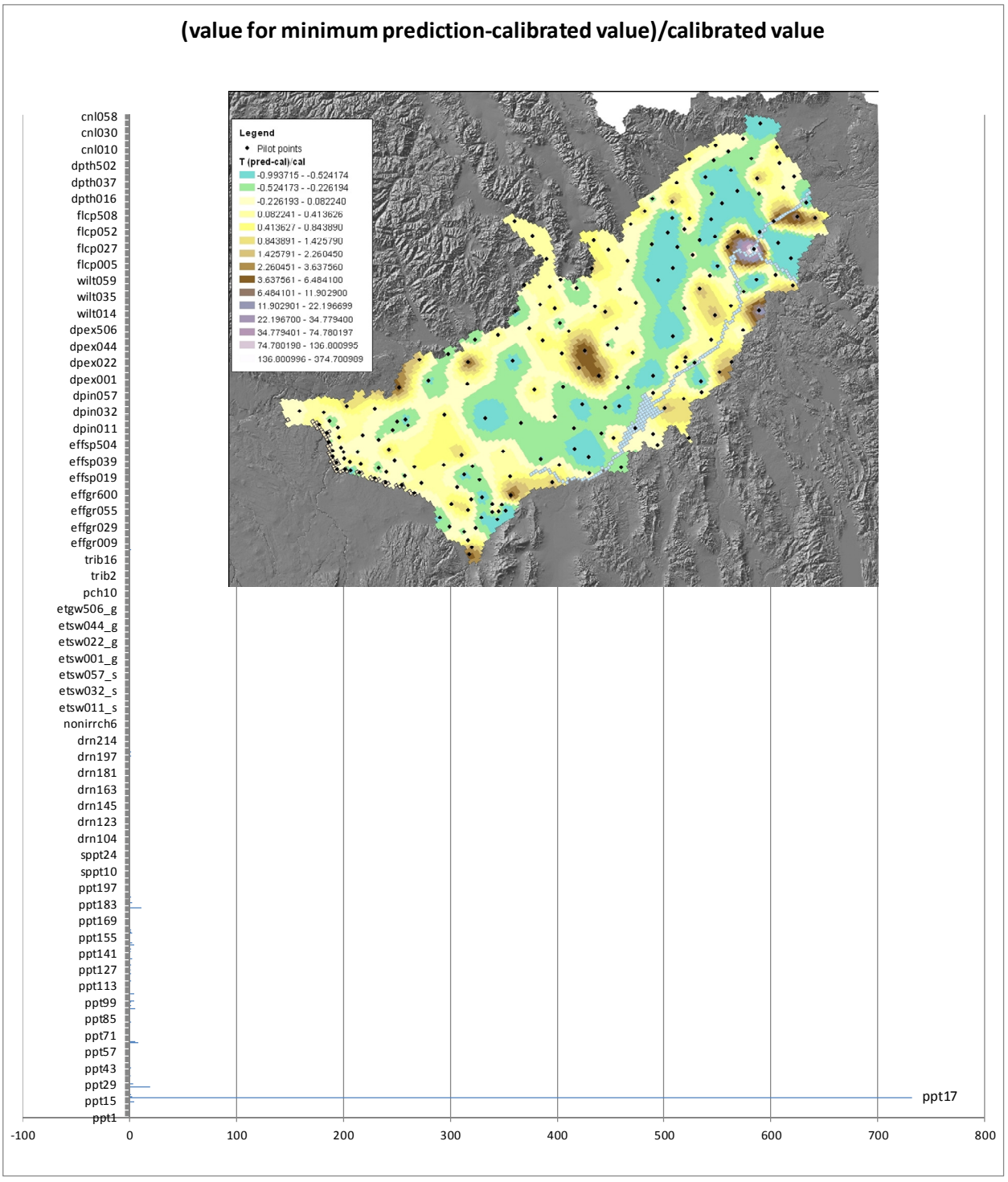


Impact of Water District 99 (Rexburg Bench) on near Blackfoot-Minidoka using calibration run E120116A008

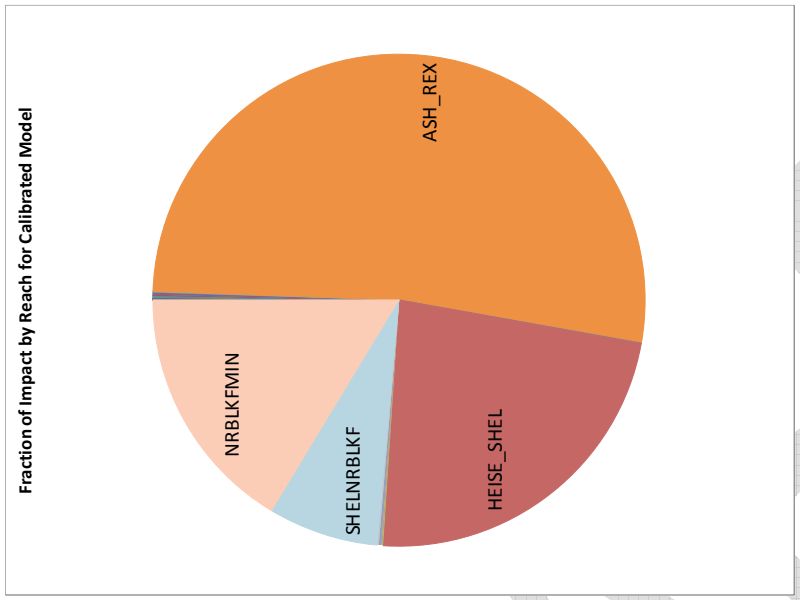


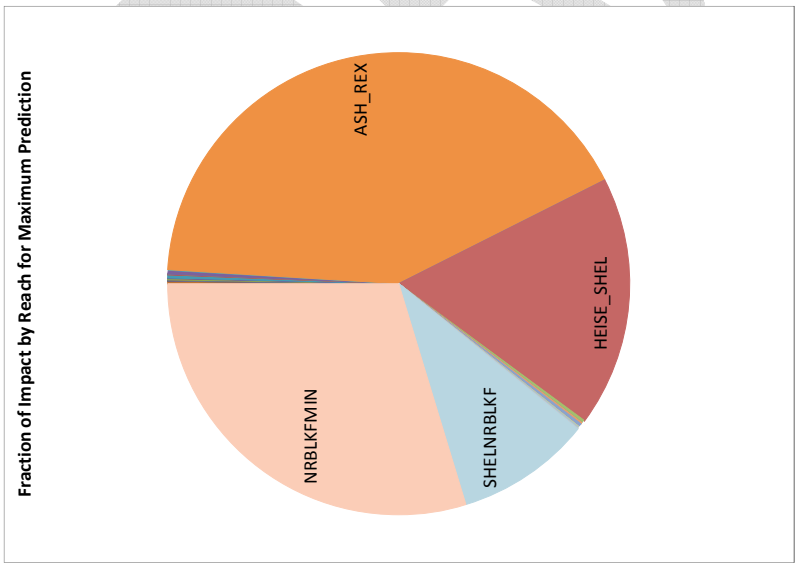


Impact of Water District 99 (Rexburg Bench) on near Blackfoot-Minidoka using calibration run E120116A008

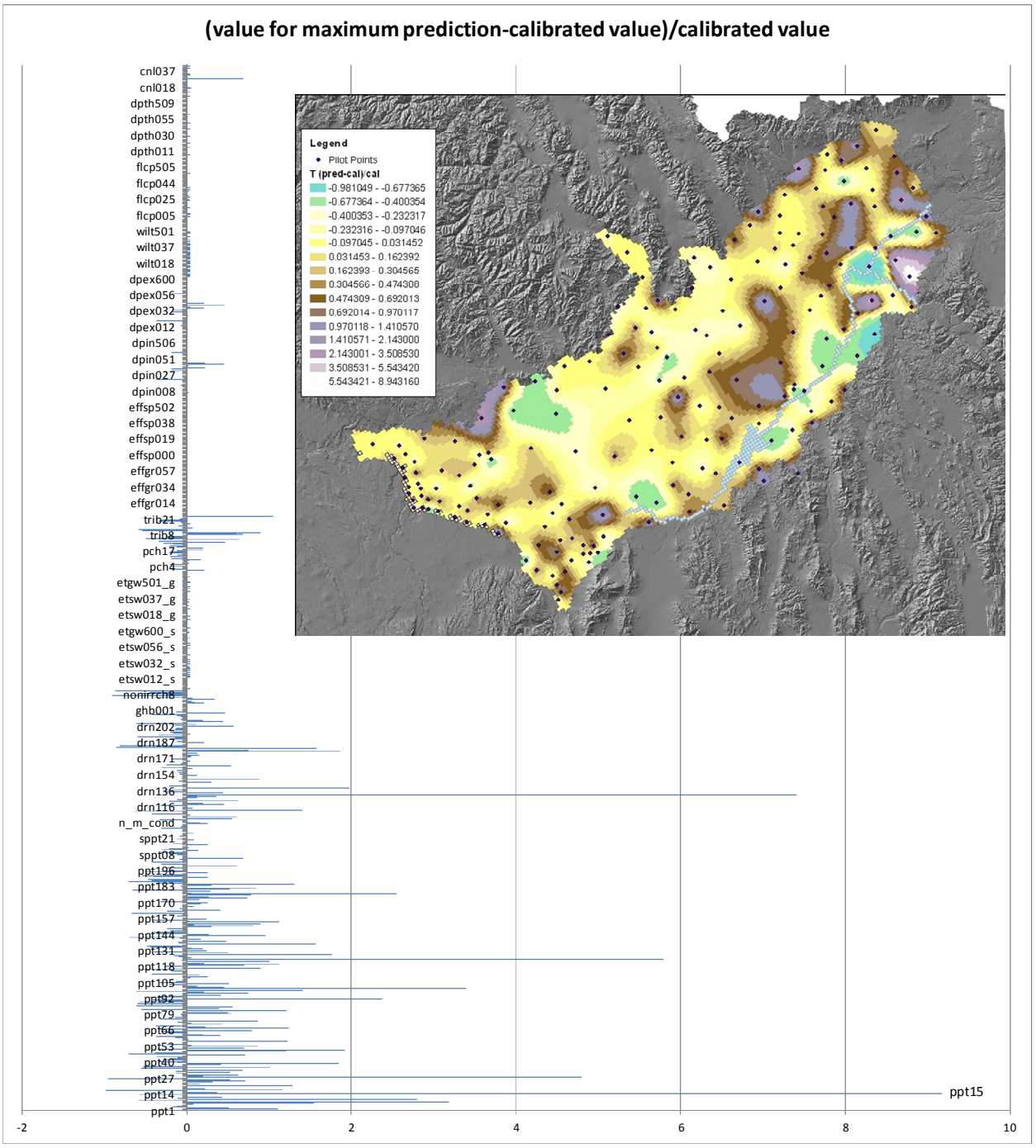


Impact of Water District 99 (Rexburg Bench) on near Blackfoot-Minidoka using calibration run E120116A008.

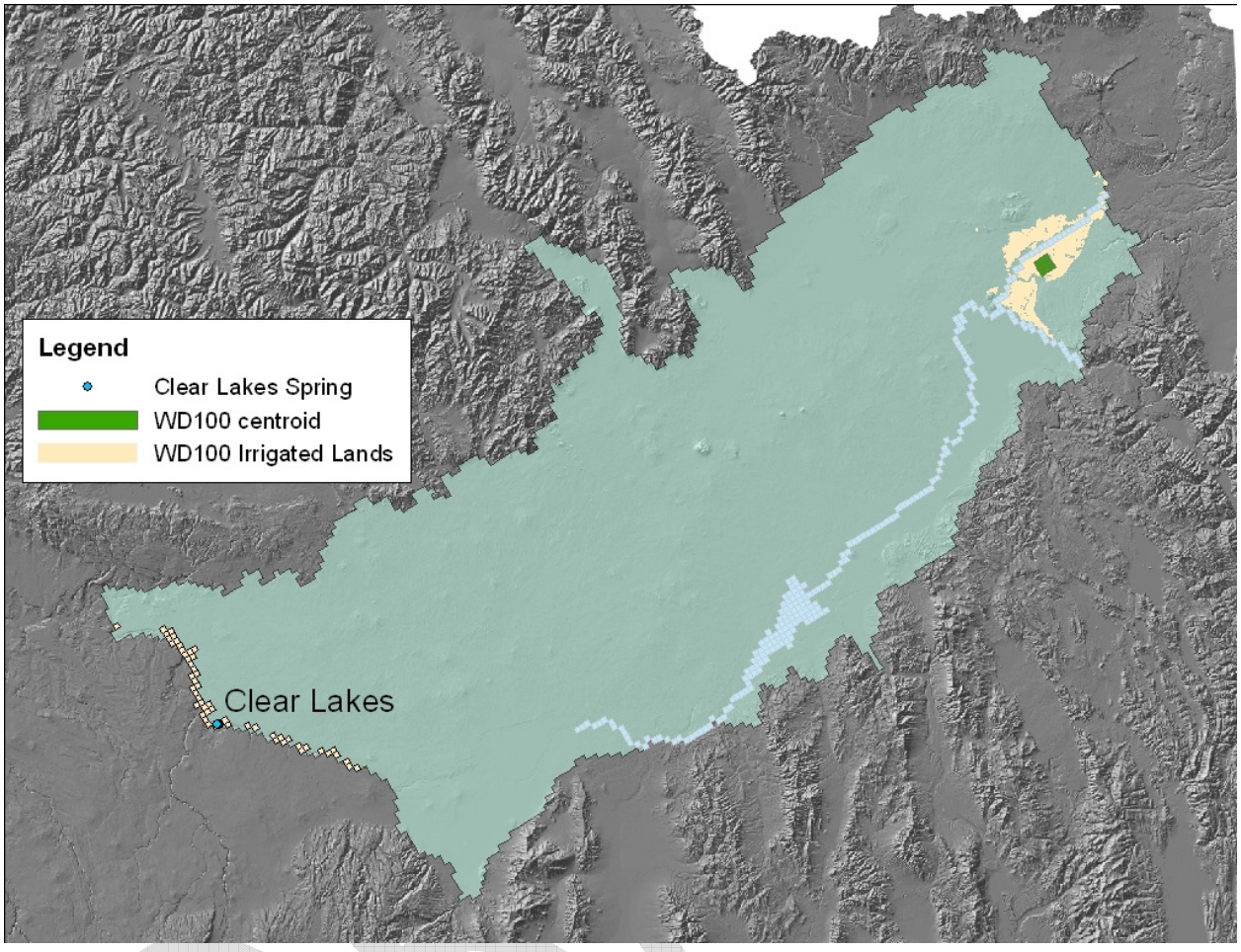




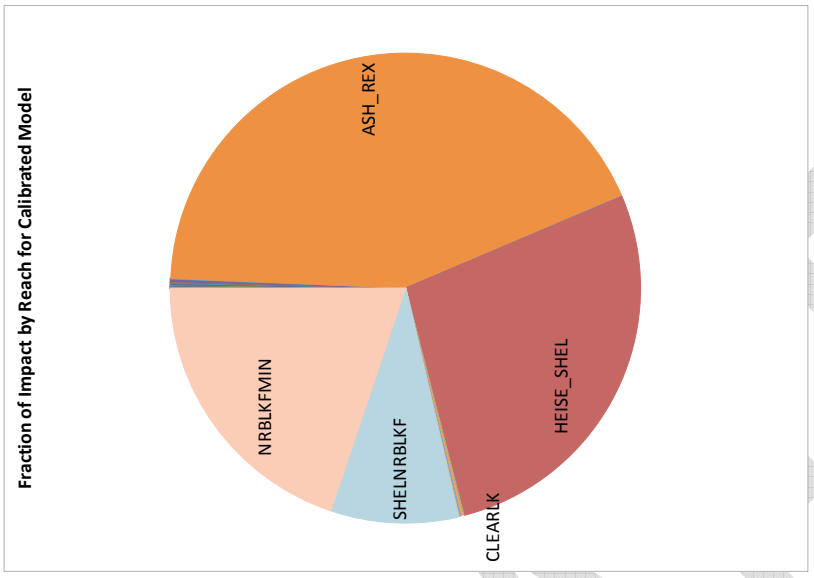
Impact of Water District 99 (Rexburg Bench) on near Blackfoot-Minidoka using calibration run E120116A008

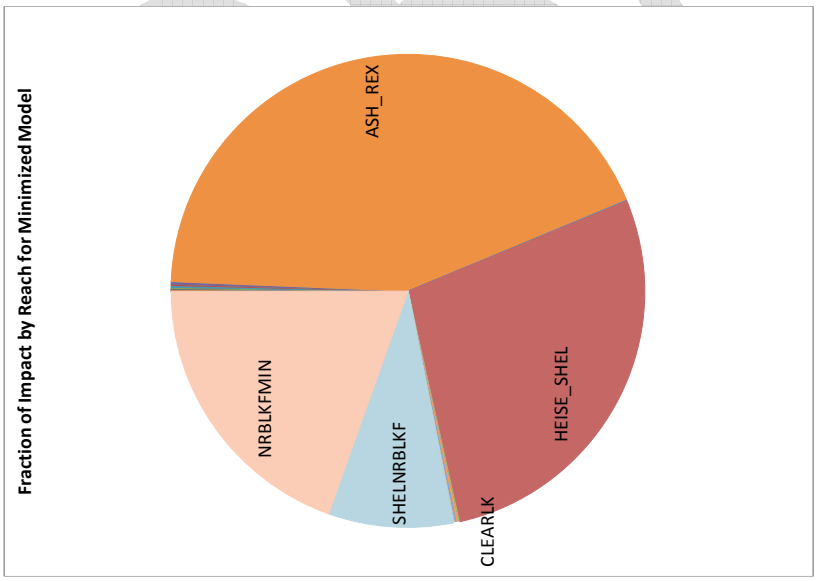


Impact of Water District 100 on Clear Lakes Spring using calibration run E120116A008.

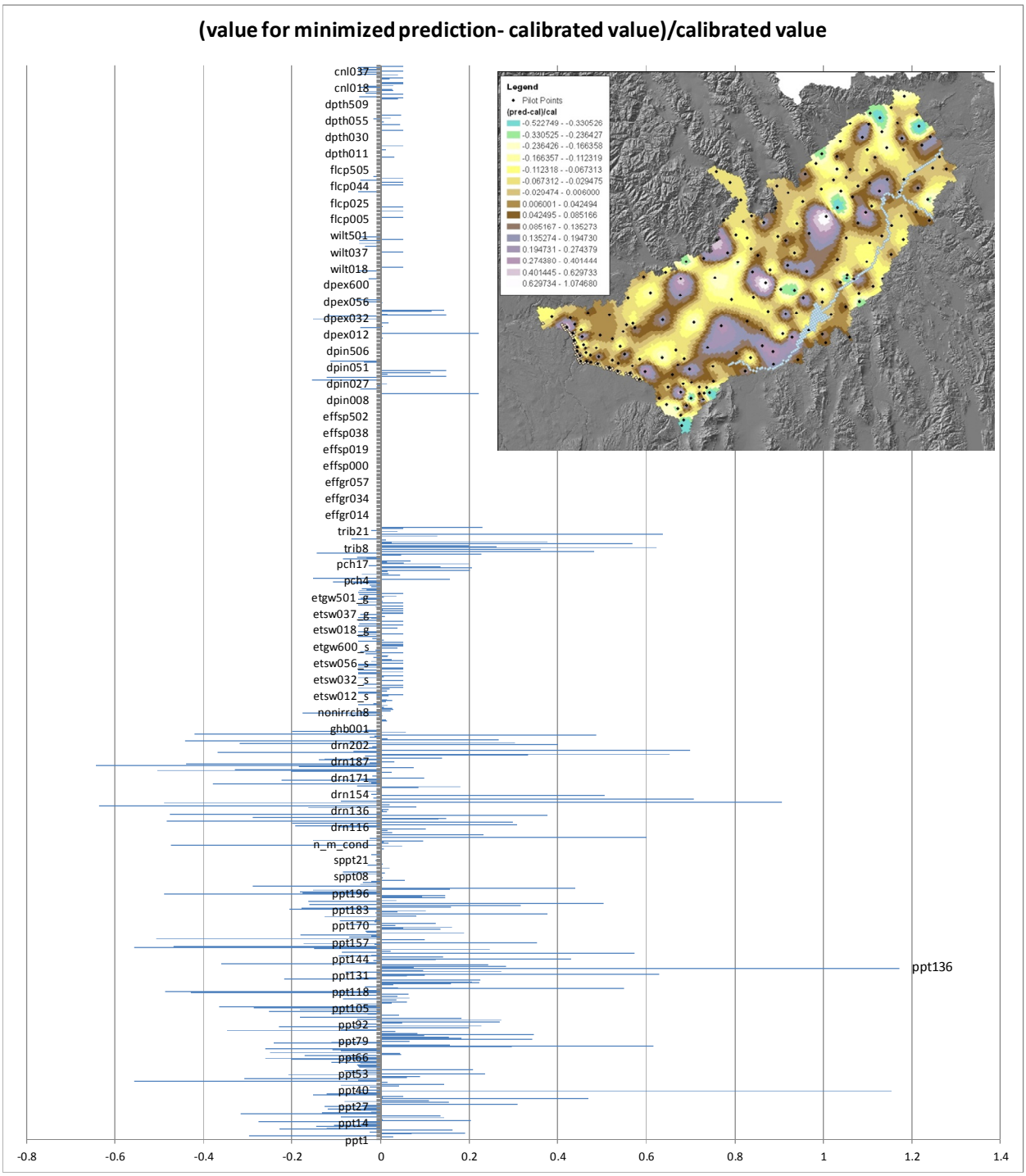


Impact of Water District 100 on Clear Lakes Spring using calibration run E120116A008

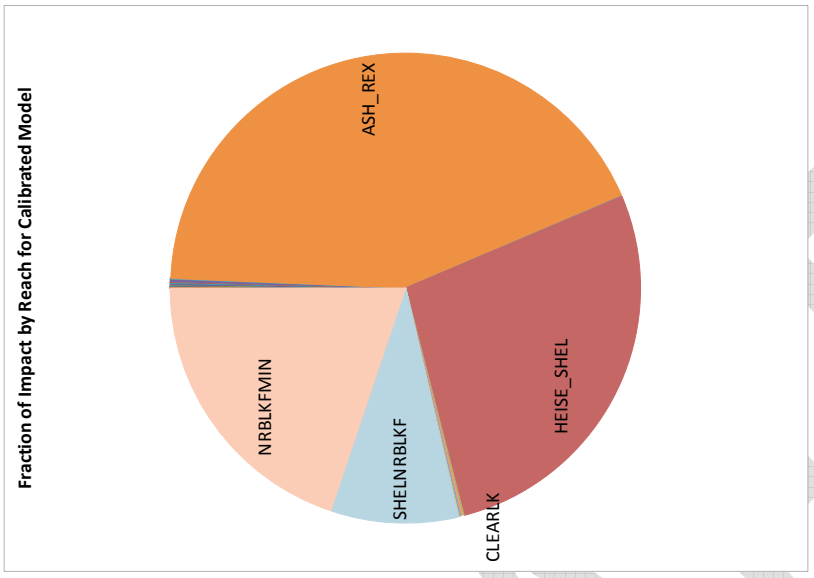


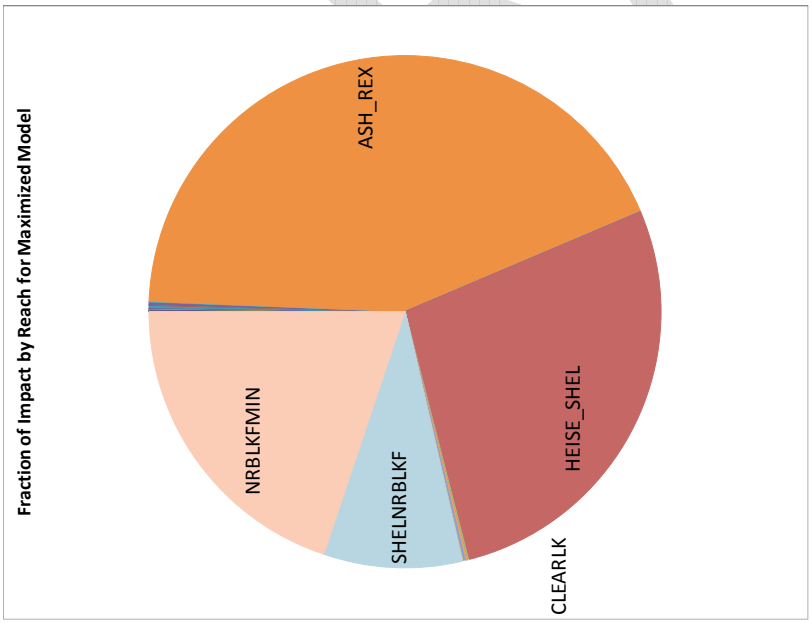


Impact of Water District 100 on Clear Lakes Spring using calibration run E120116A008

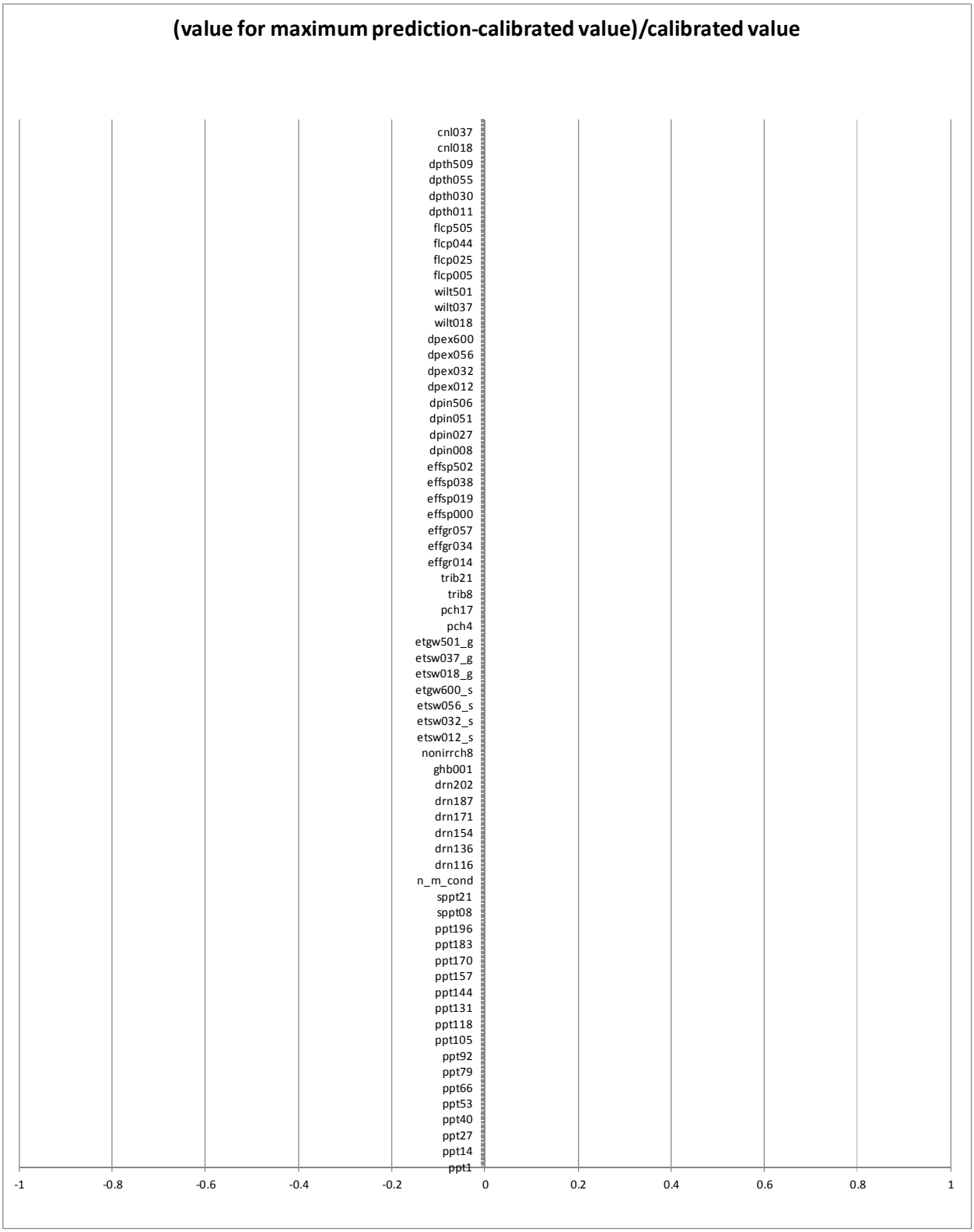


Impact of Water District 100 on Clear Lakes Spring using calibration run E120116A008

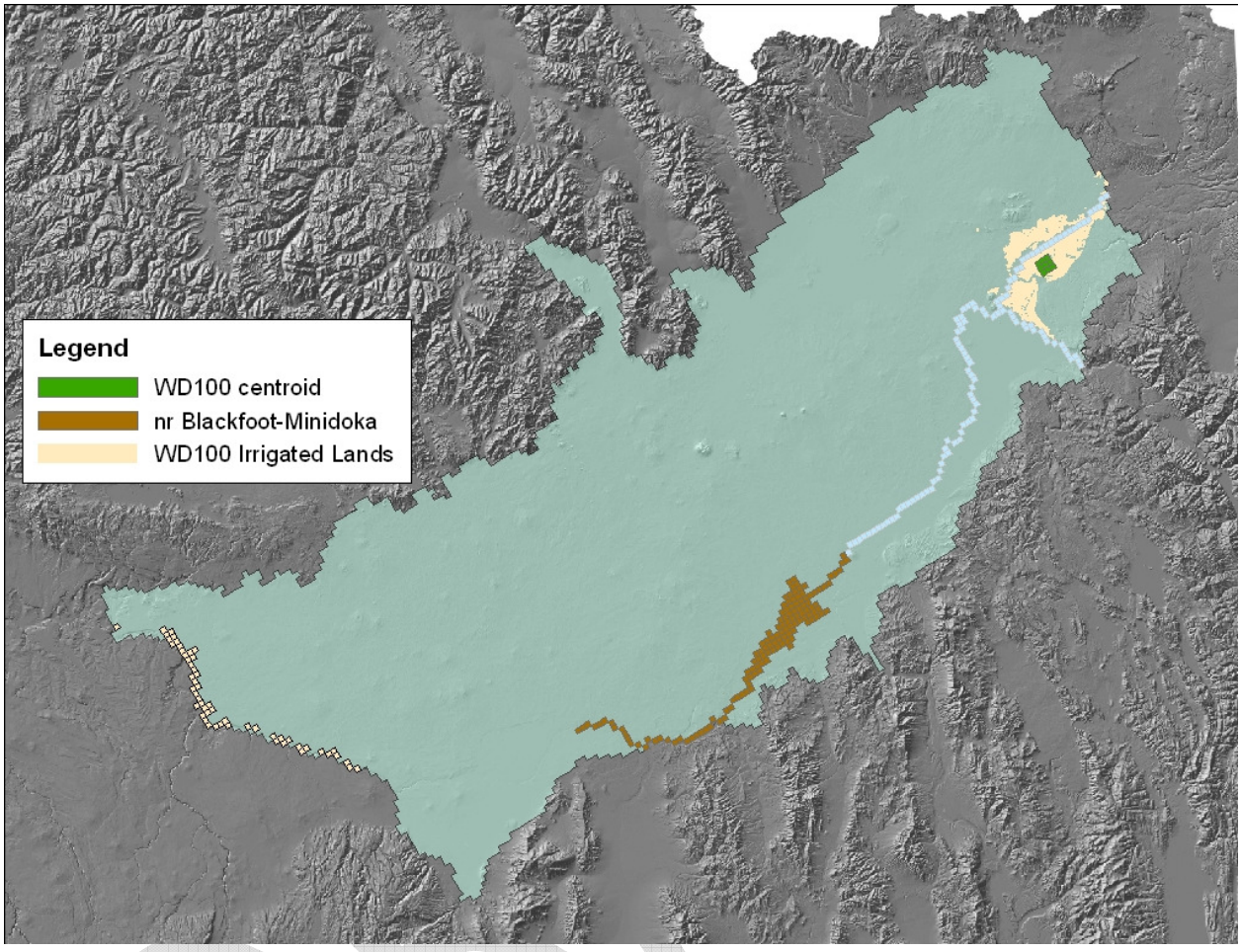




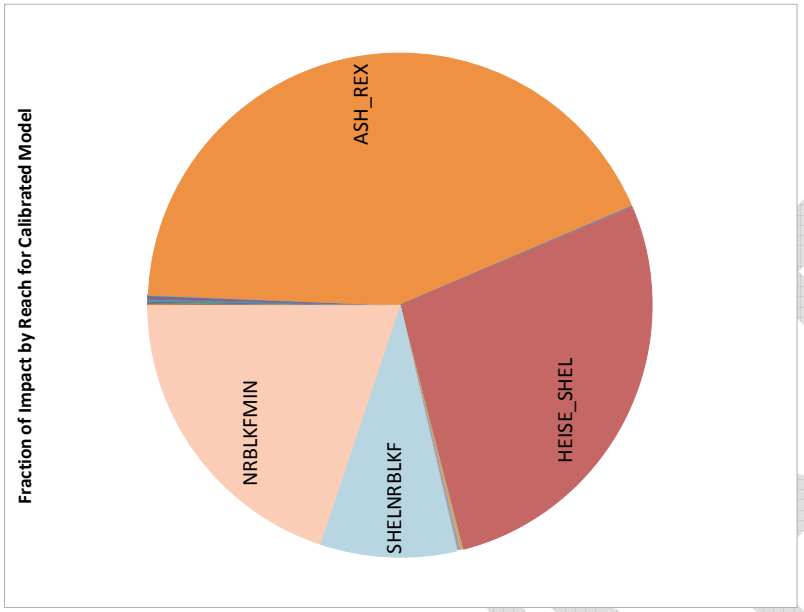
Impact of Water District 100 on Clear Lakes Spring using calibration run E120116A008

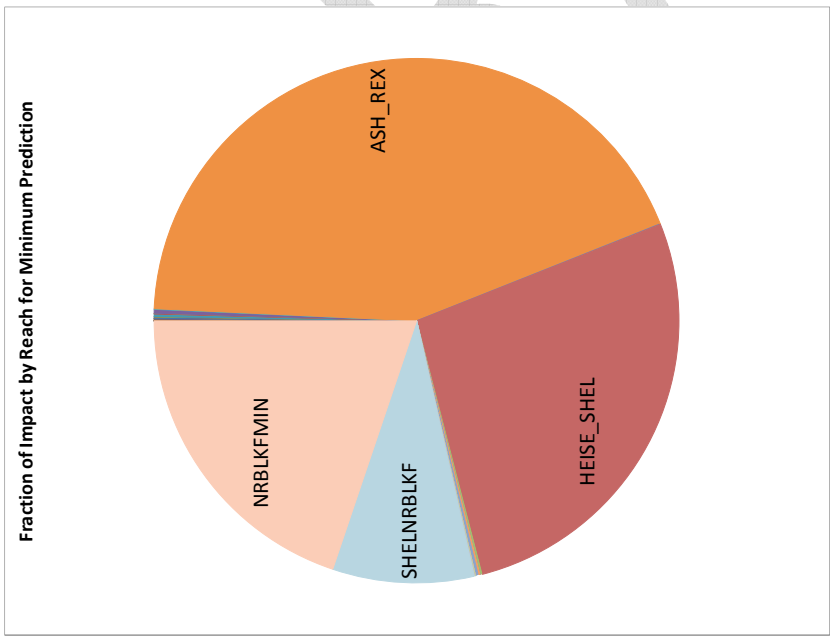


Impact of Water District 100 on near Blackfoot-Minidoka using calibration run E120116A008.

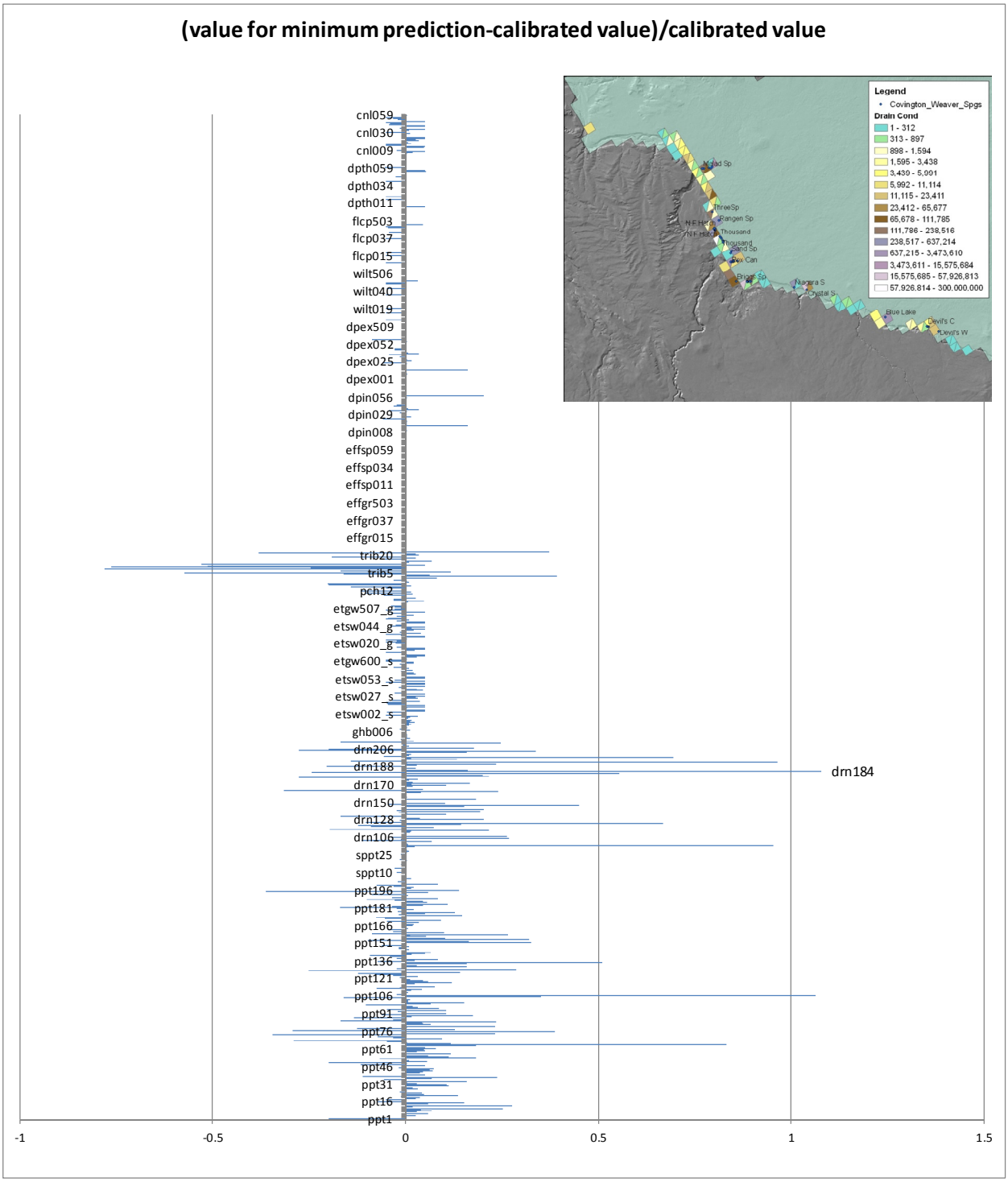


Impact of Water District 100 on near Blackfoot-Minidoka using calibration run E120116A008.

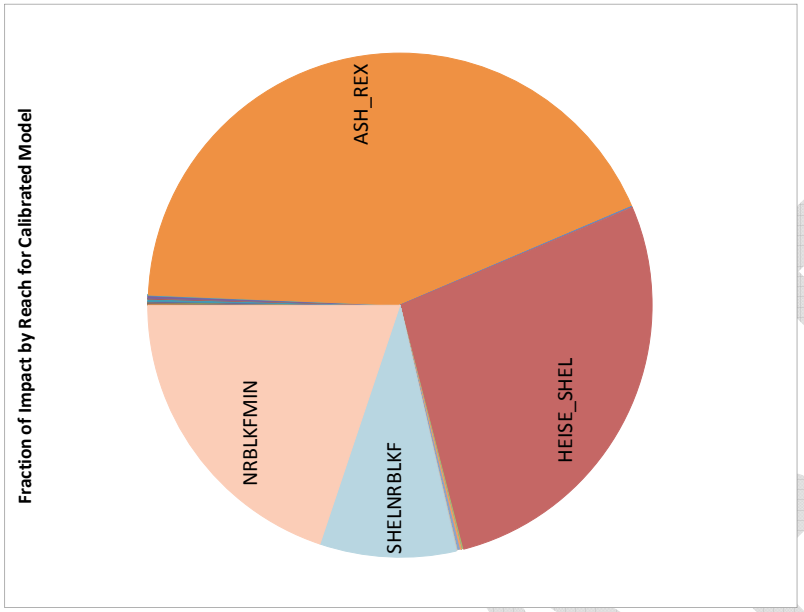


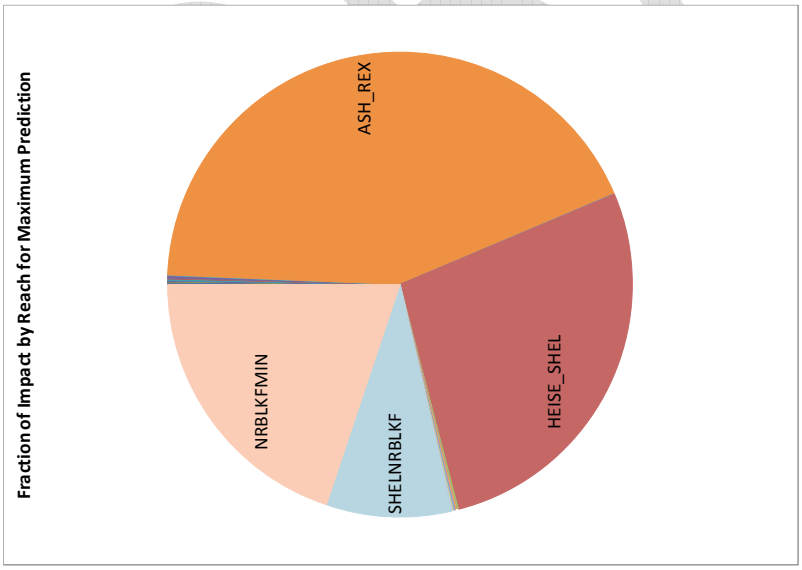


Impact of Water District 100 on near Blackfoot-Minidoka using calibration run E120116A008.

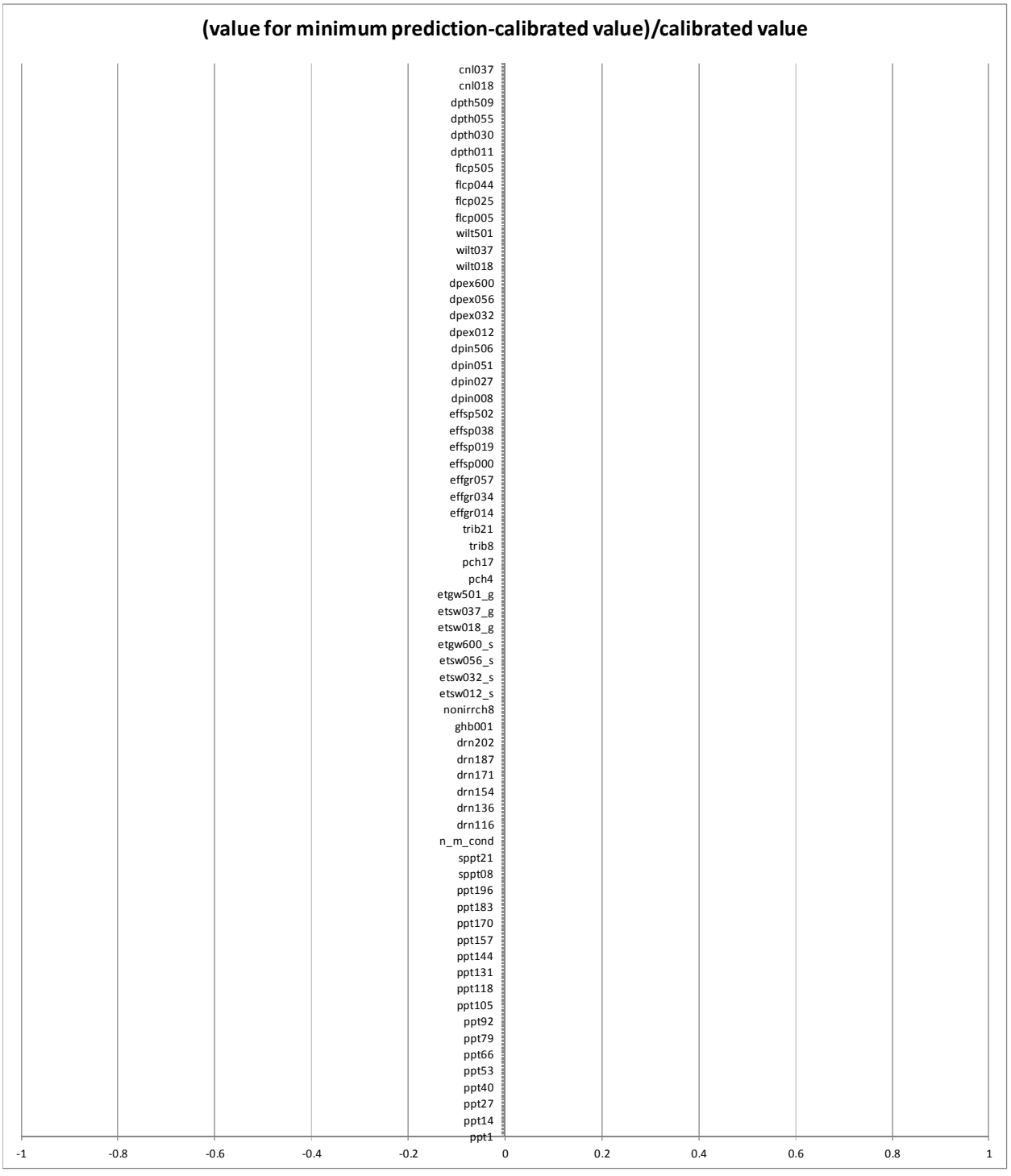


Impact of Water District 100 on near Blackfoot-Minidoka using calibration run E120116A008.

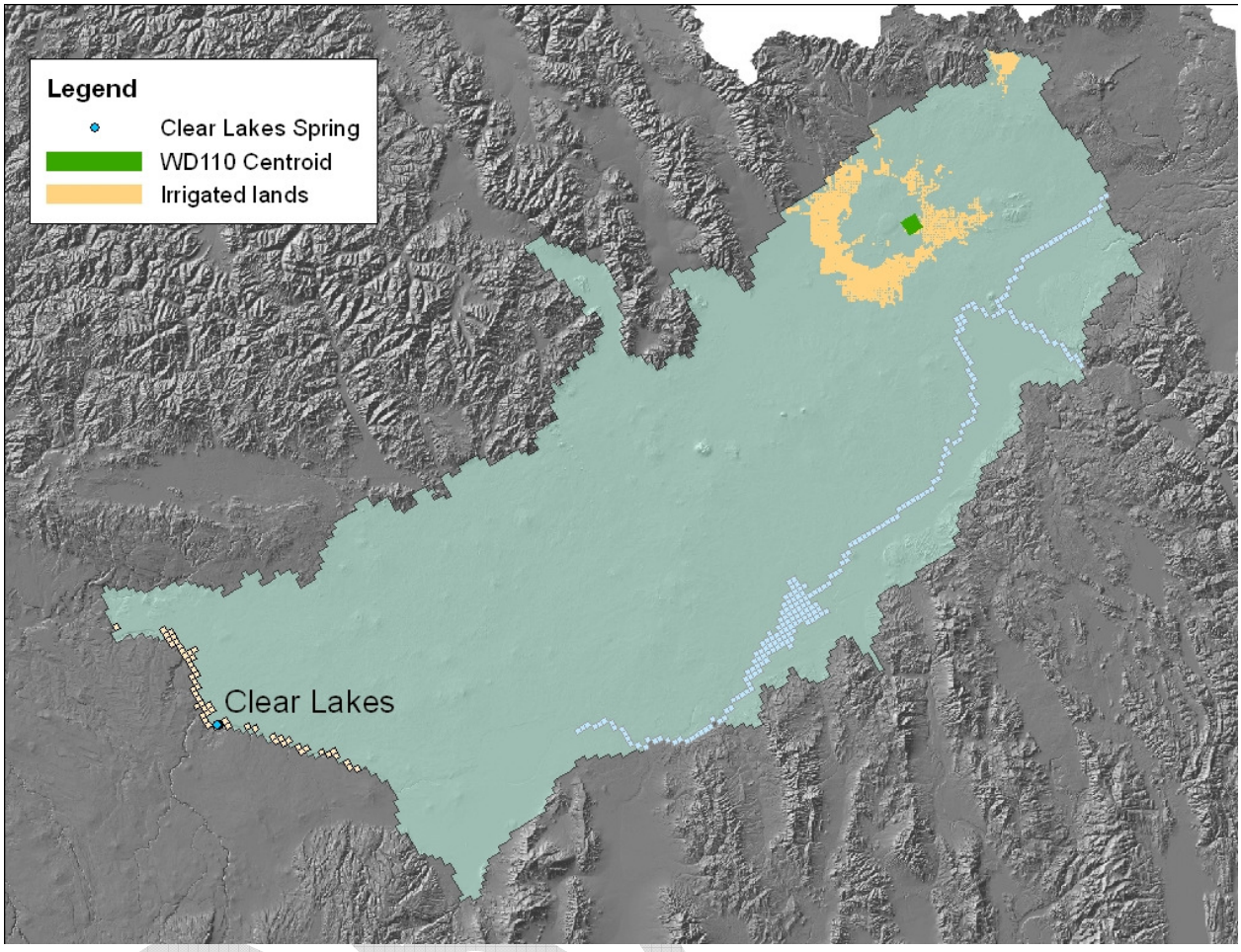




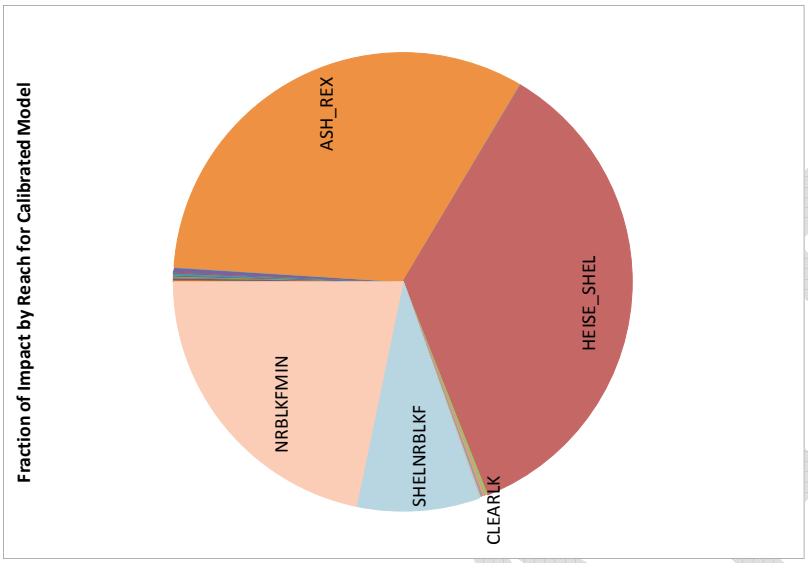
Impact of Water District 100 on near Blackfoot-Minidoka using calibration run E120116A008.

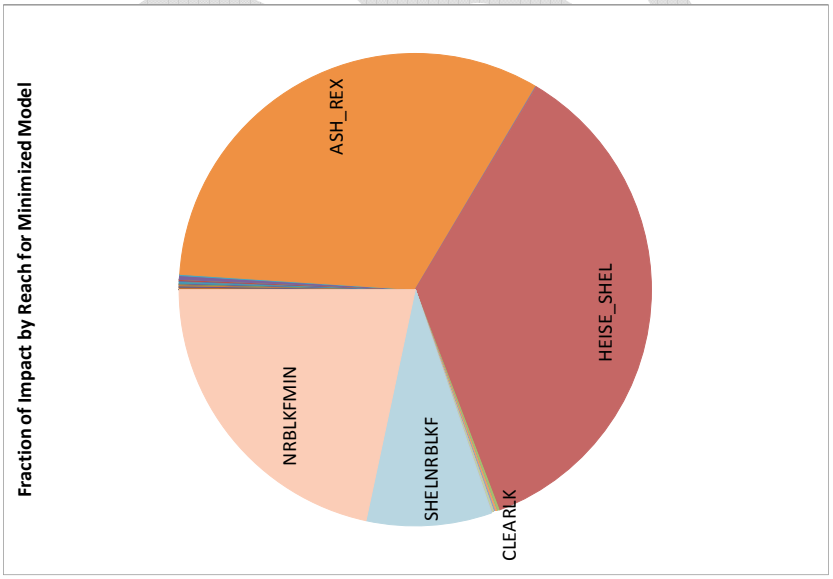


Impact of Water District 110 on Clear Lakes Spring using calibration run E110712A001.

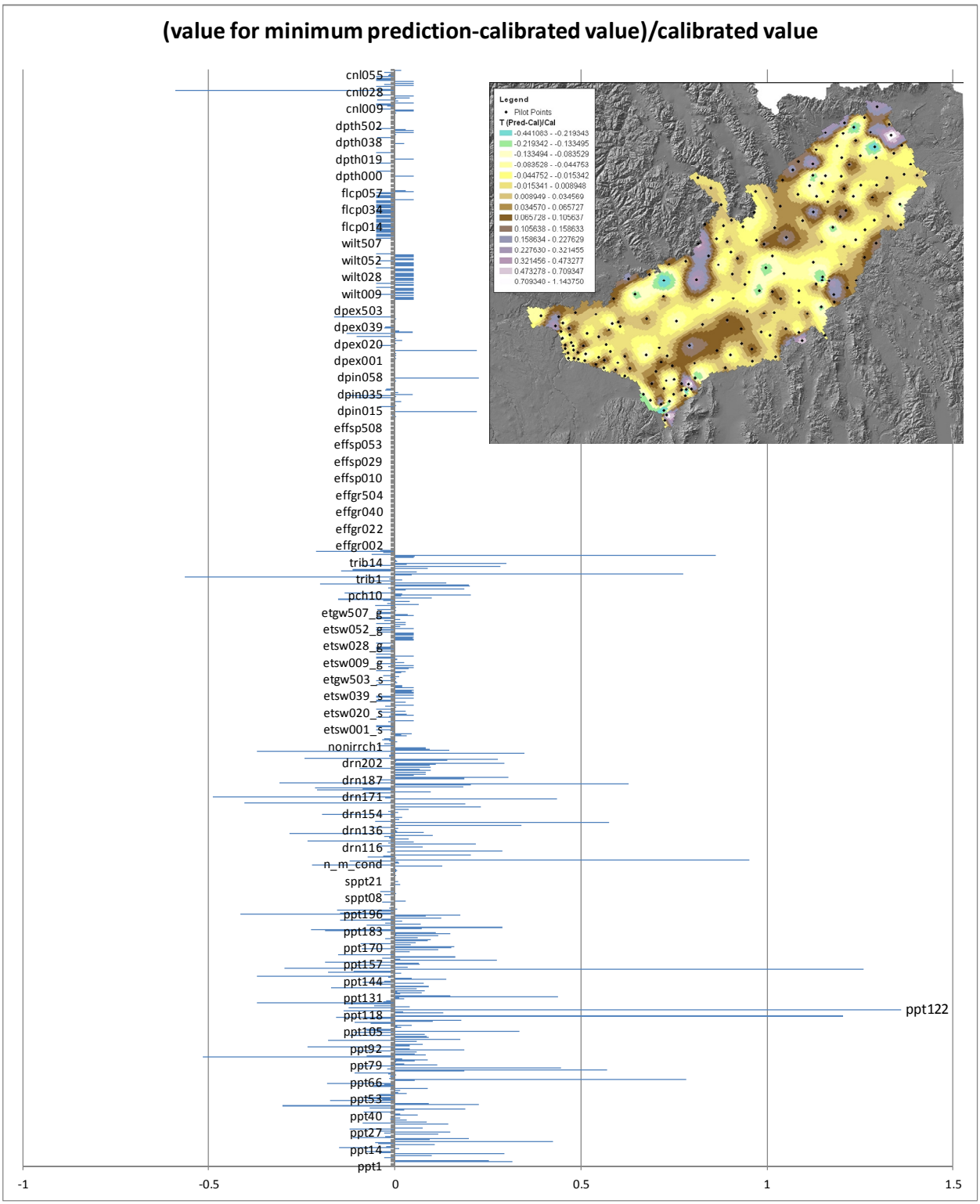


Impact of Water District 110 on Clear Lakes Spring using calibration run E110712A001.

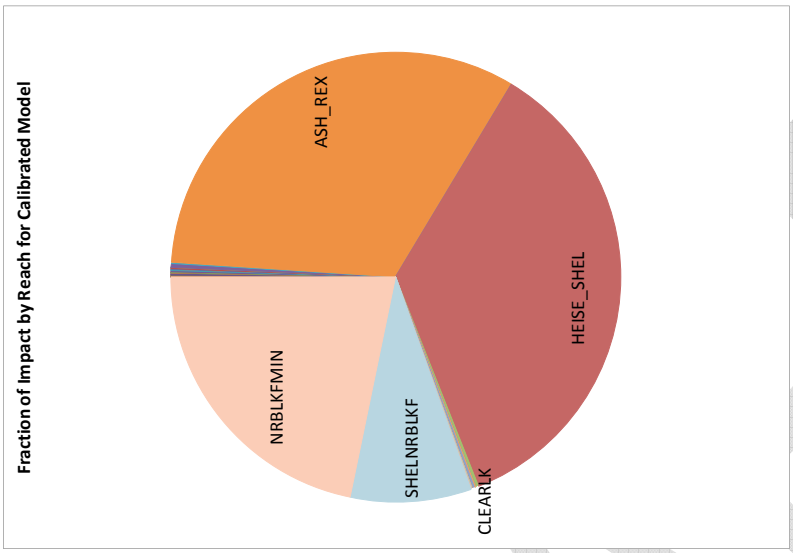


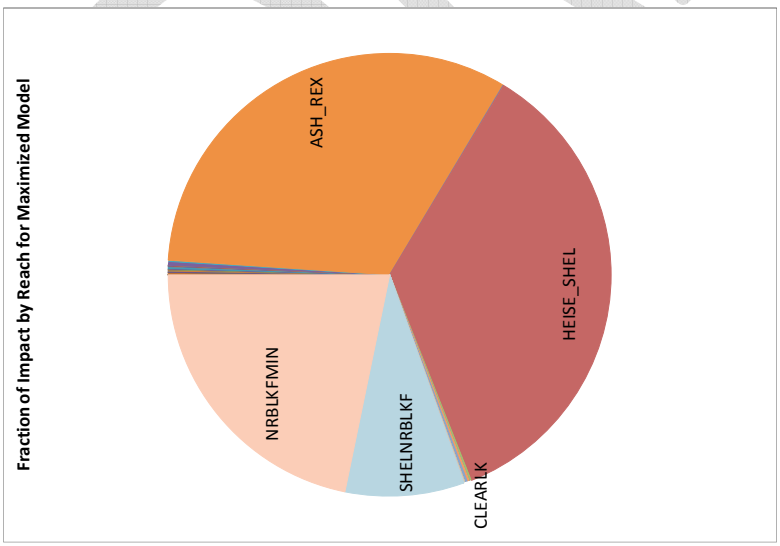


Impact of Water District 110 on Clear Lakes Spring using calibration run E110712A001.

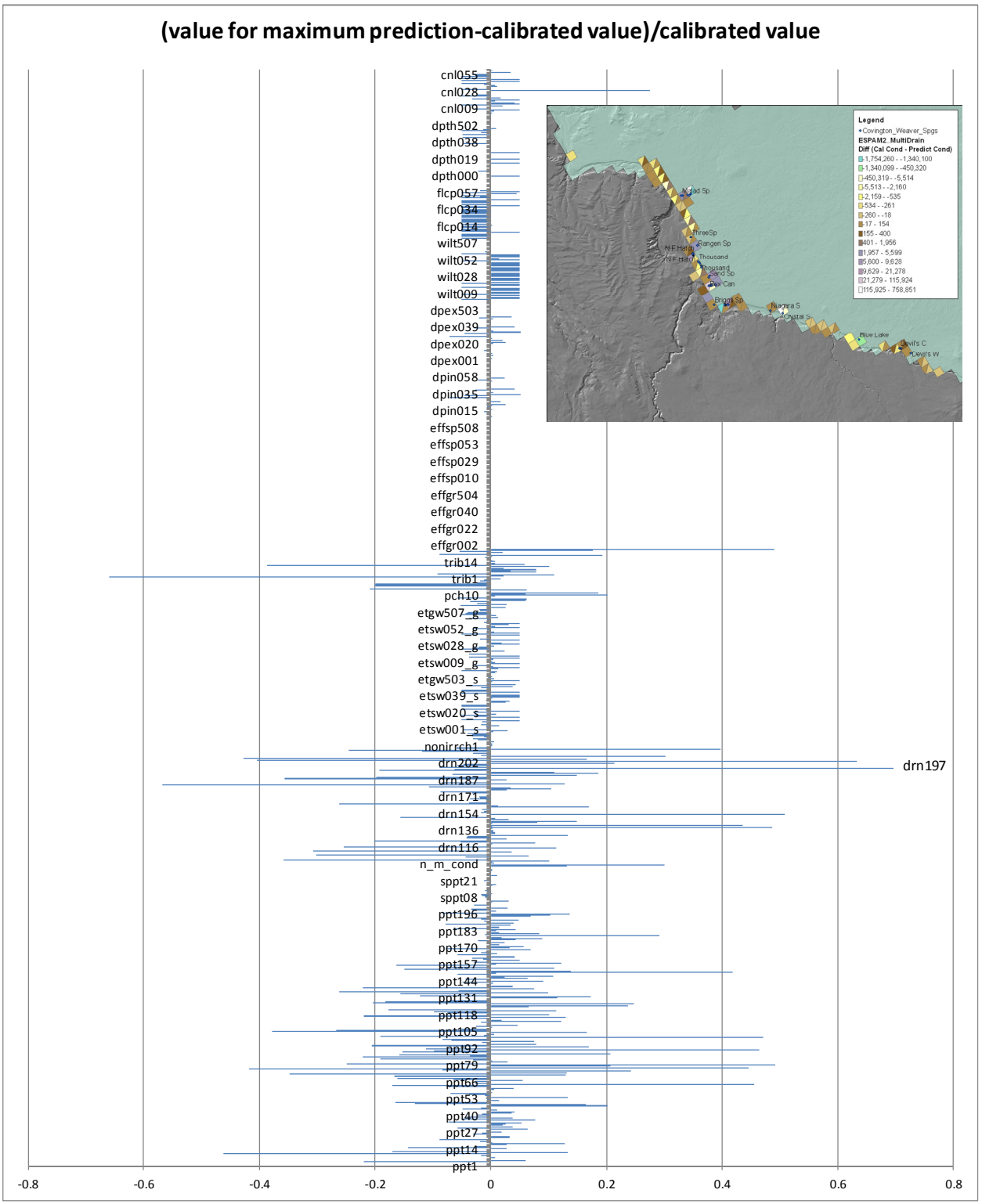


Impact of Water District 110 on Clear Lakes Spring using calibration run E110712A001.

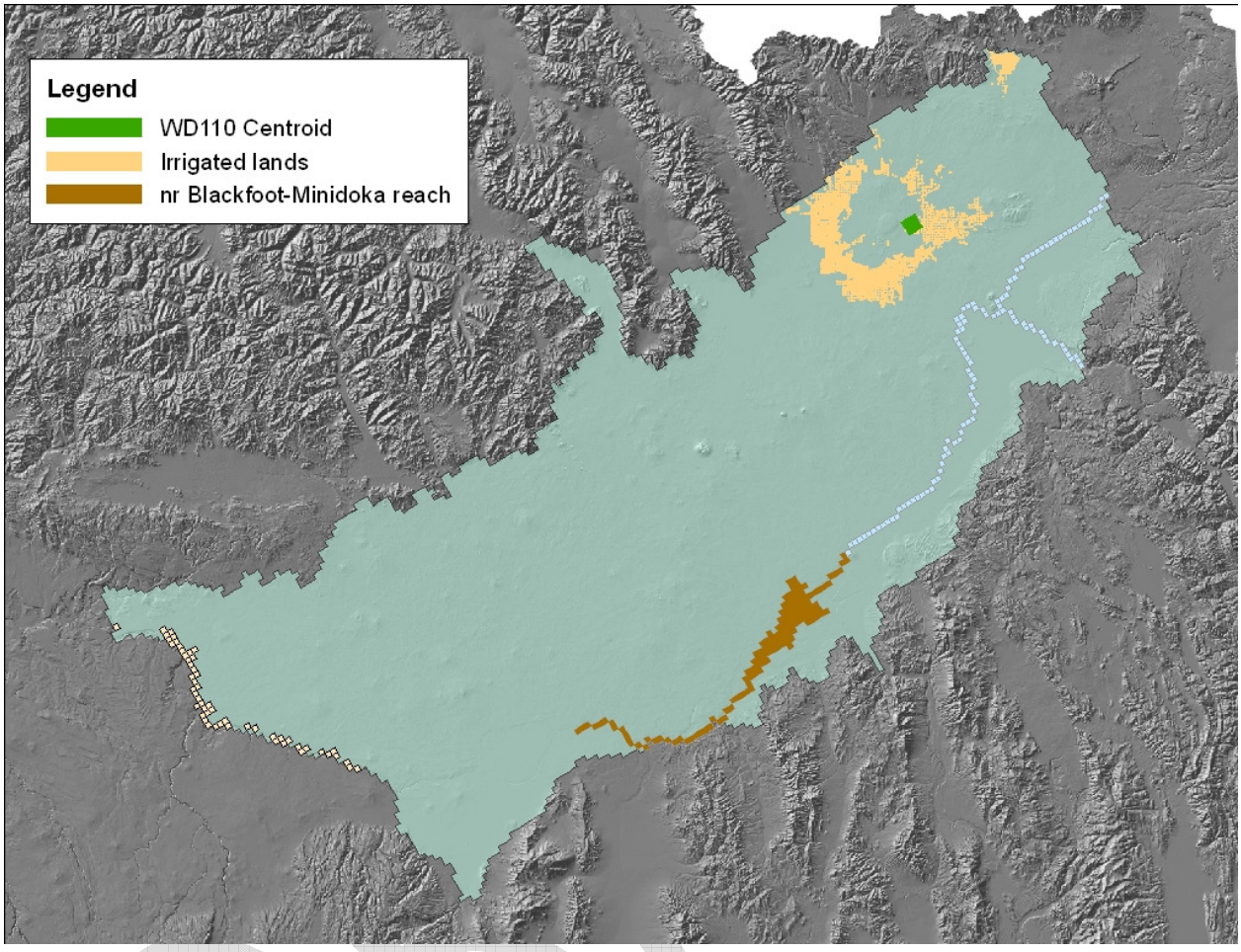




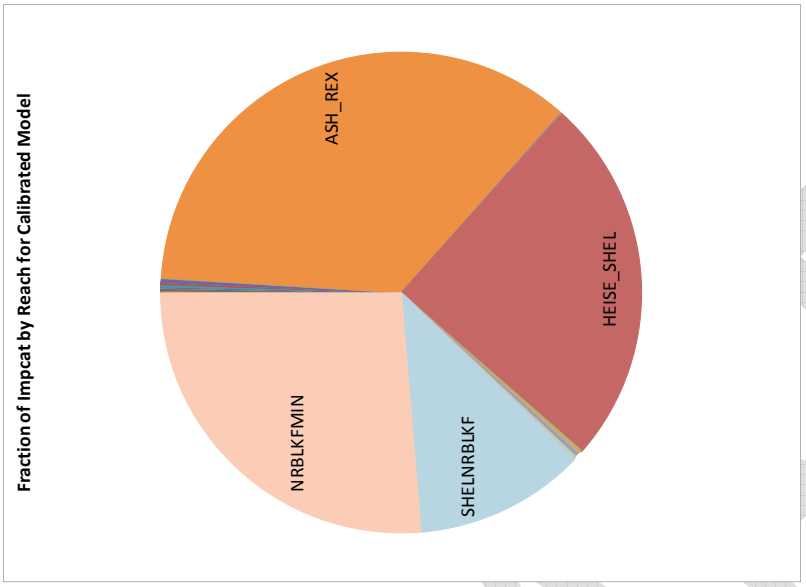
Impact of Water District 110 on Clear Lakes Spring using calibration run E110712A001.

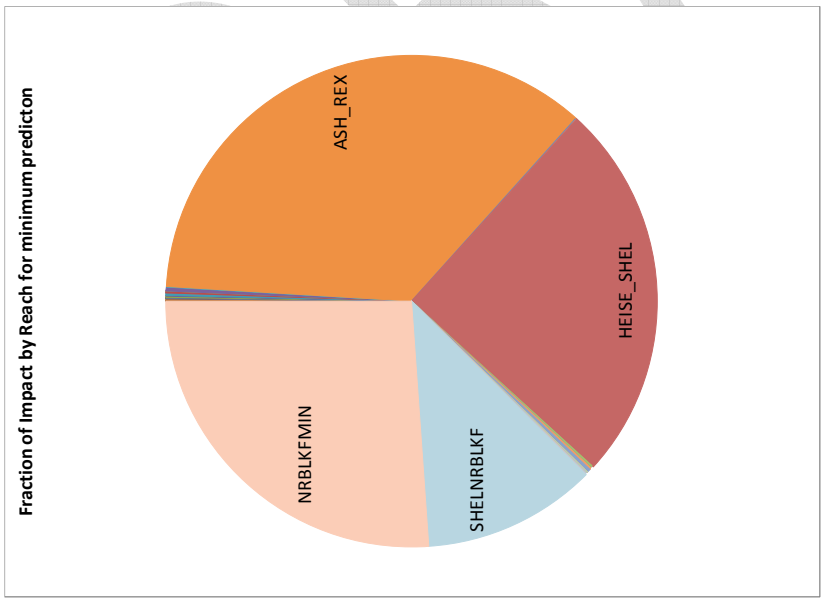


Impact of Water District 110 on near Blackfoot-Minidoka using calibration run E120116A008.

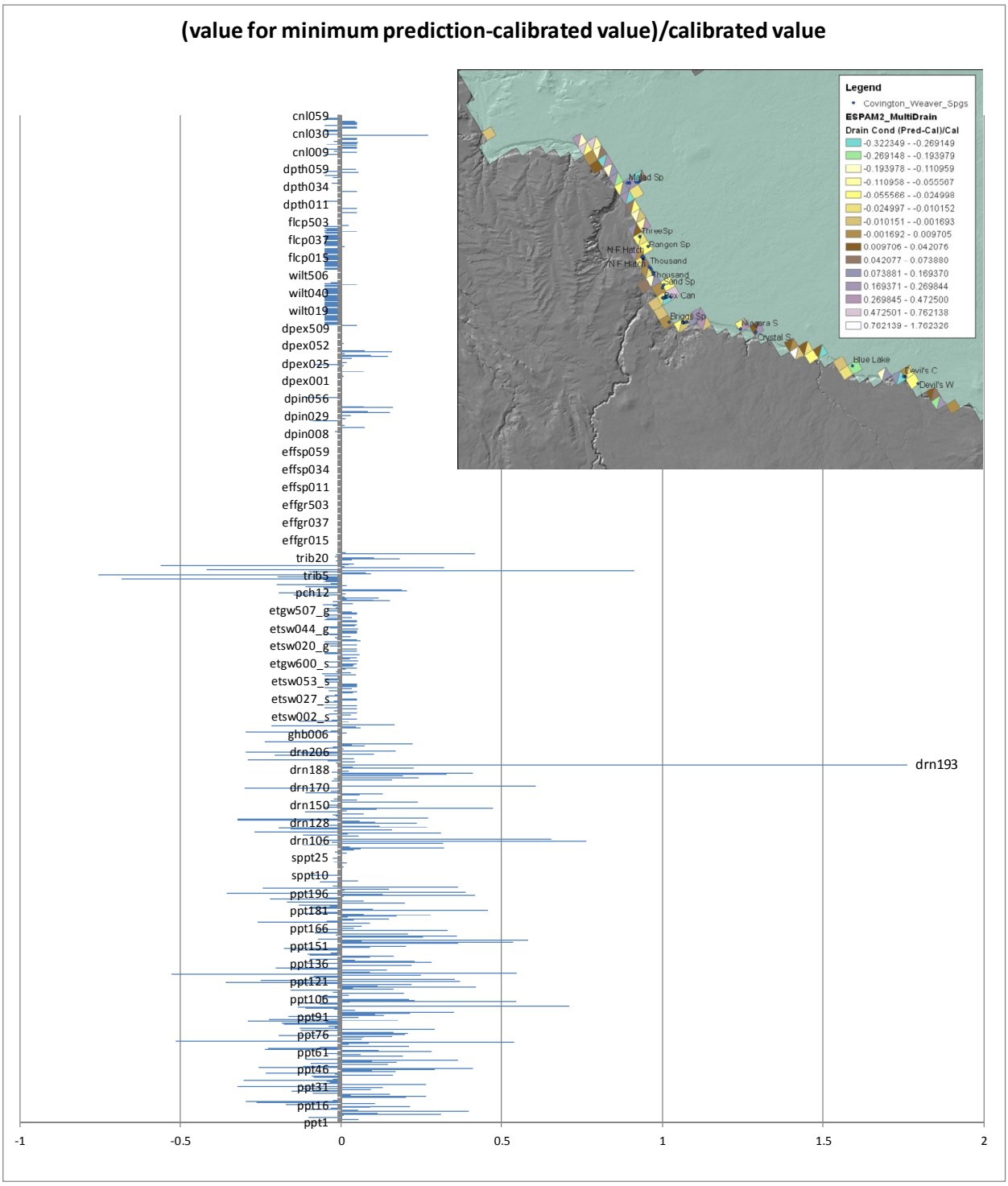


Impact of Water District 110 on near Blackfoot-Minidoka using calibration run E120116A008.

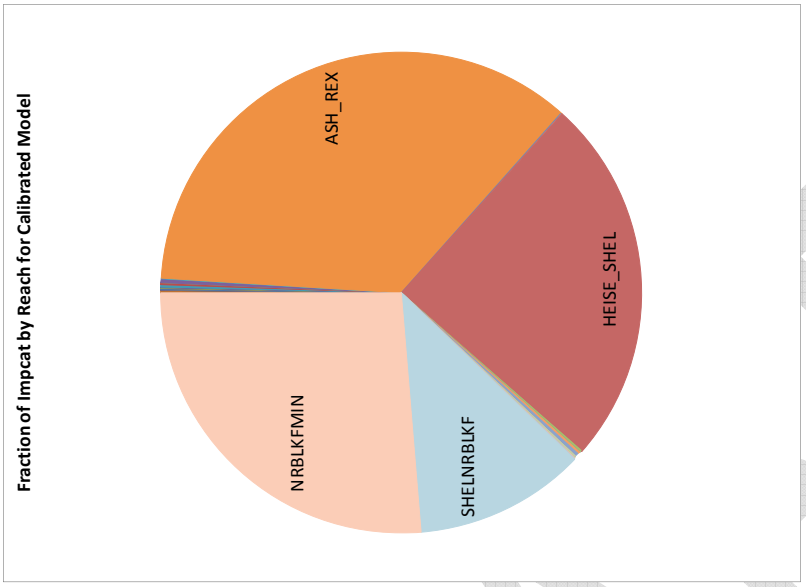


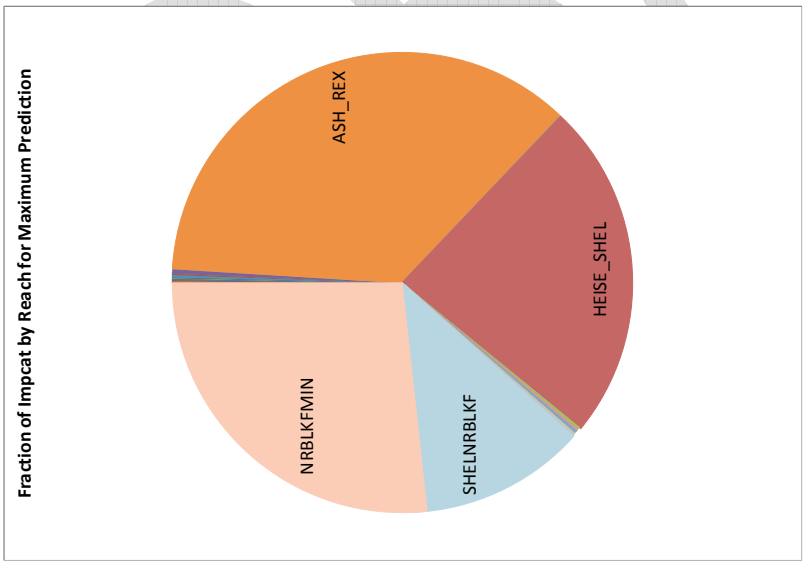


Impact of Water District 110 on near Blackfoot-Minidoka using calibration run E120116A008.

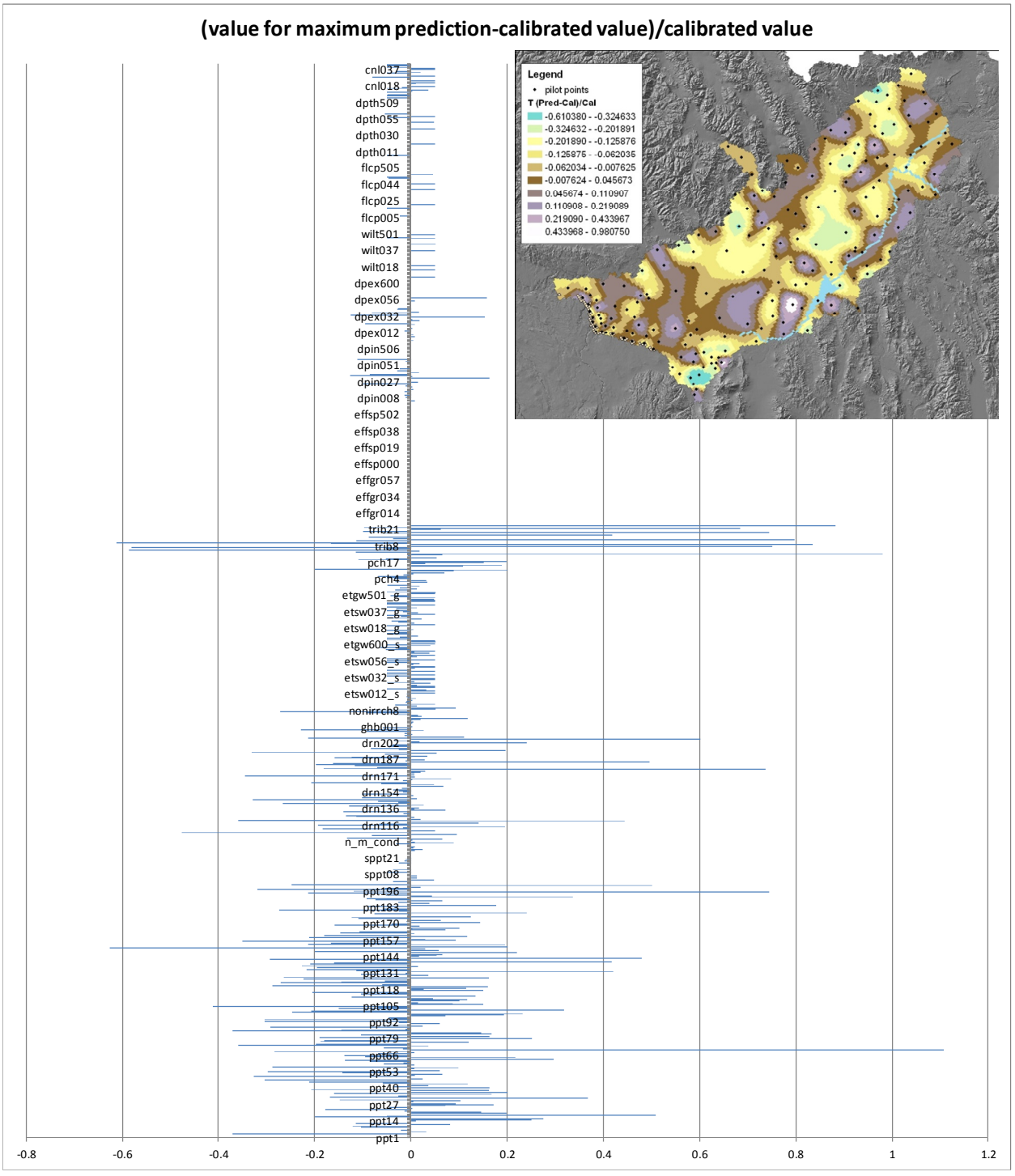


Impact of Water District 110 on near Blackfoot-Minidoka using calibration run E120116A008.

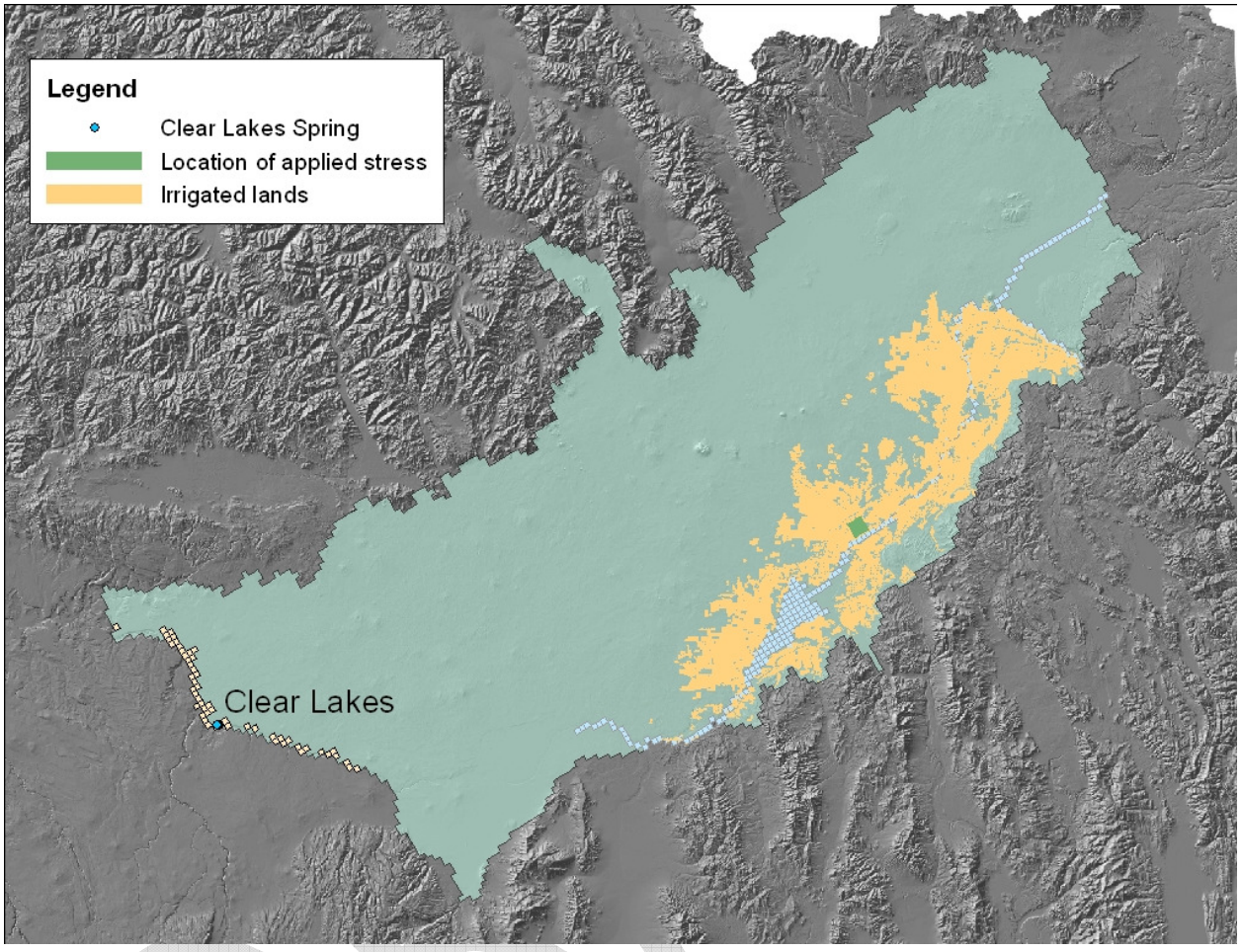




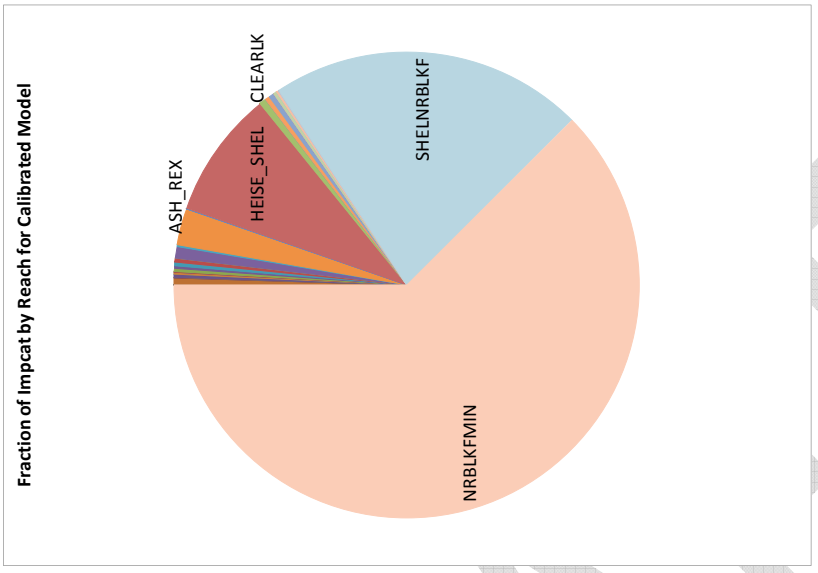
Impact of Water District 110 on near Blackfoot-Minidoka using calibration run E120116A008.

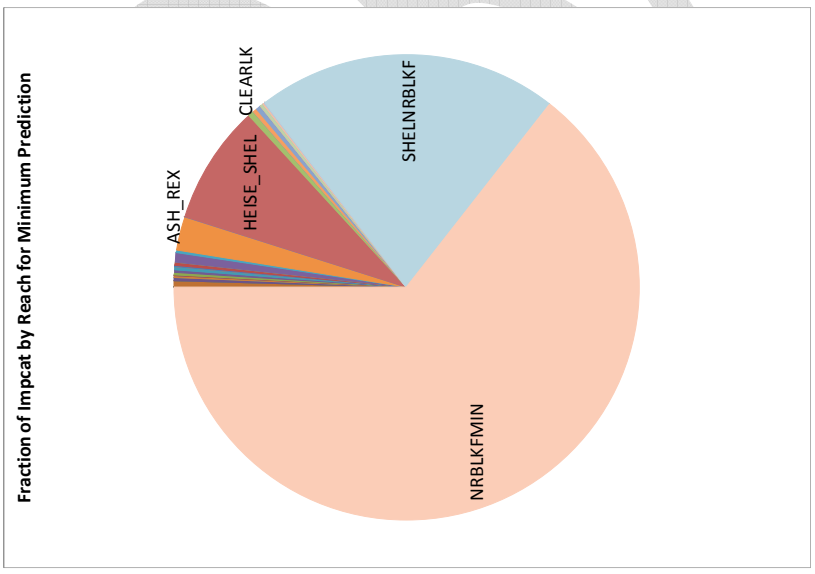


Impact of Water District 120 on Clear Lakes Spring using calibration run E110712A001.

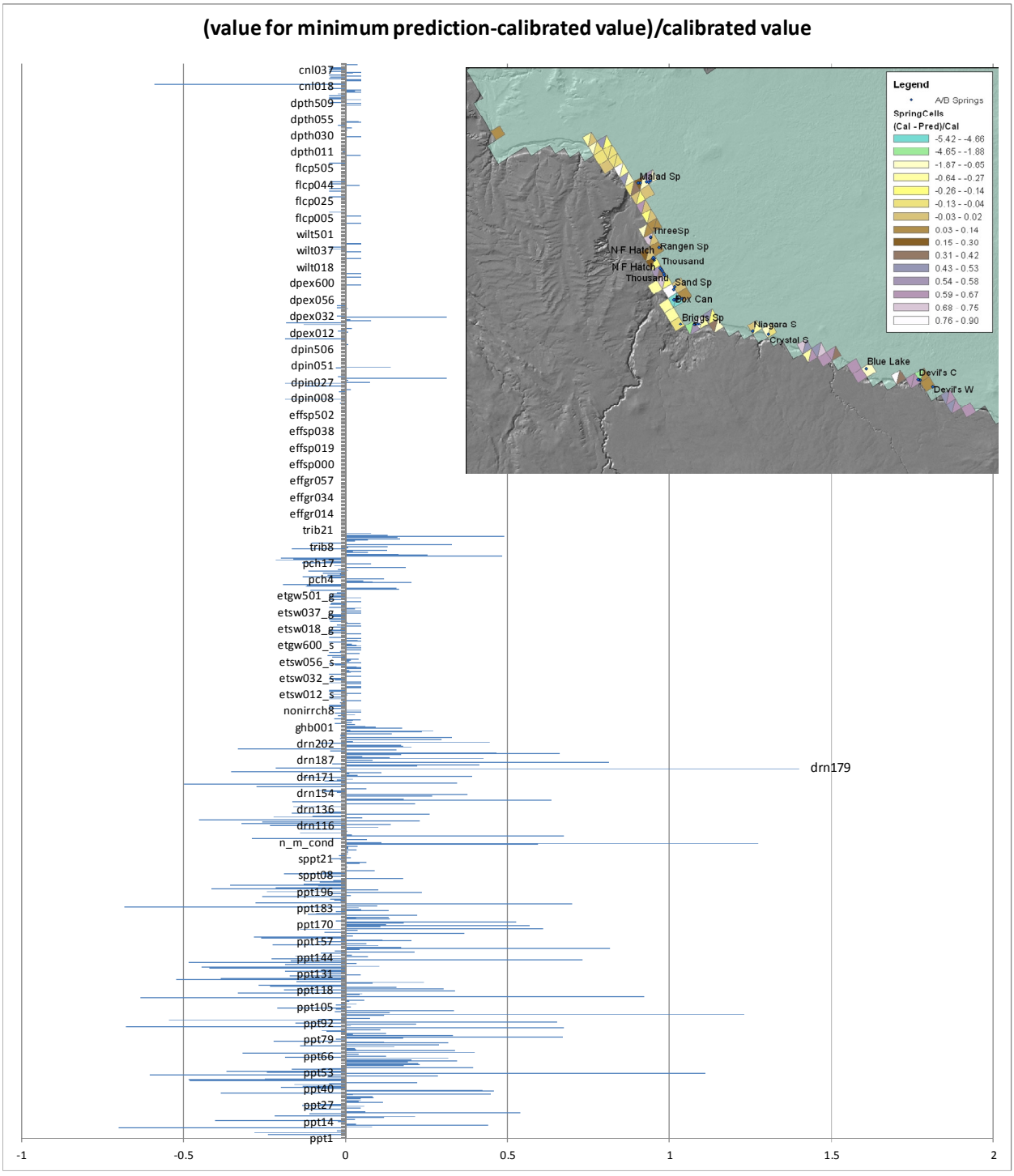


Impact of Water District 120 on Clear Lakes Spring using calibration run E110712A001.

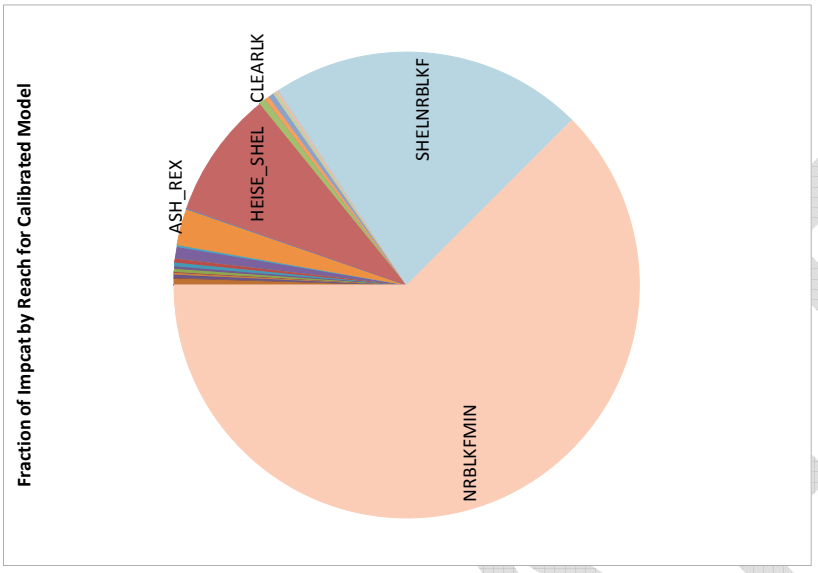


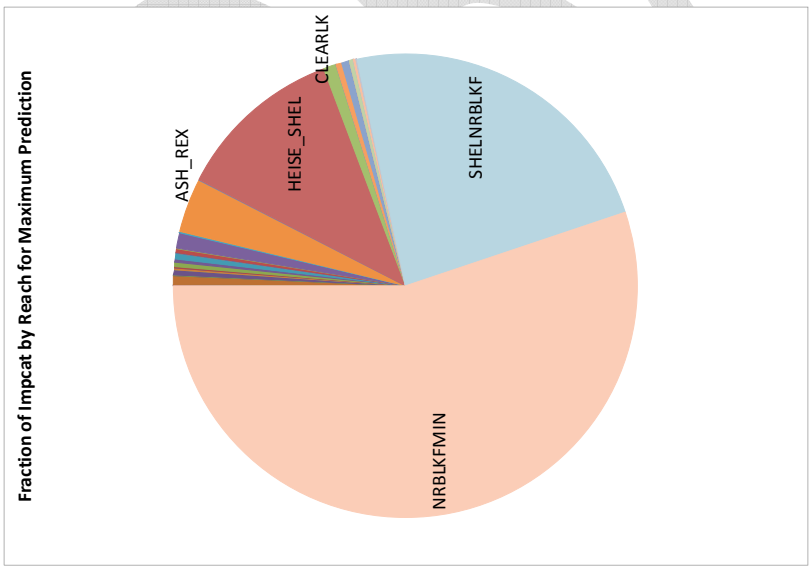


Impact of Water District 120 on Clear Lakes Spring using calibration run E110712A001.

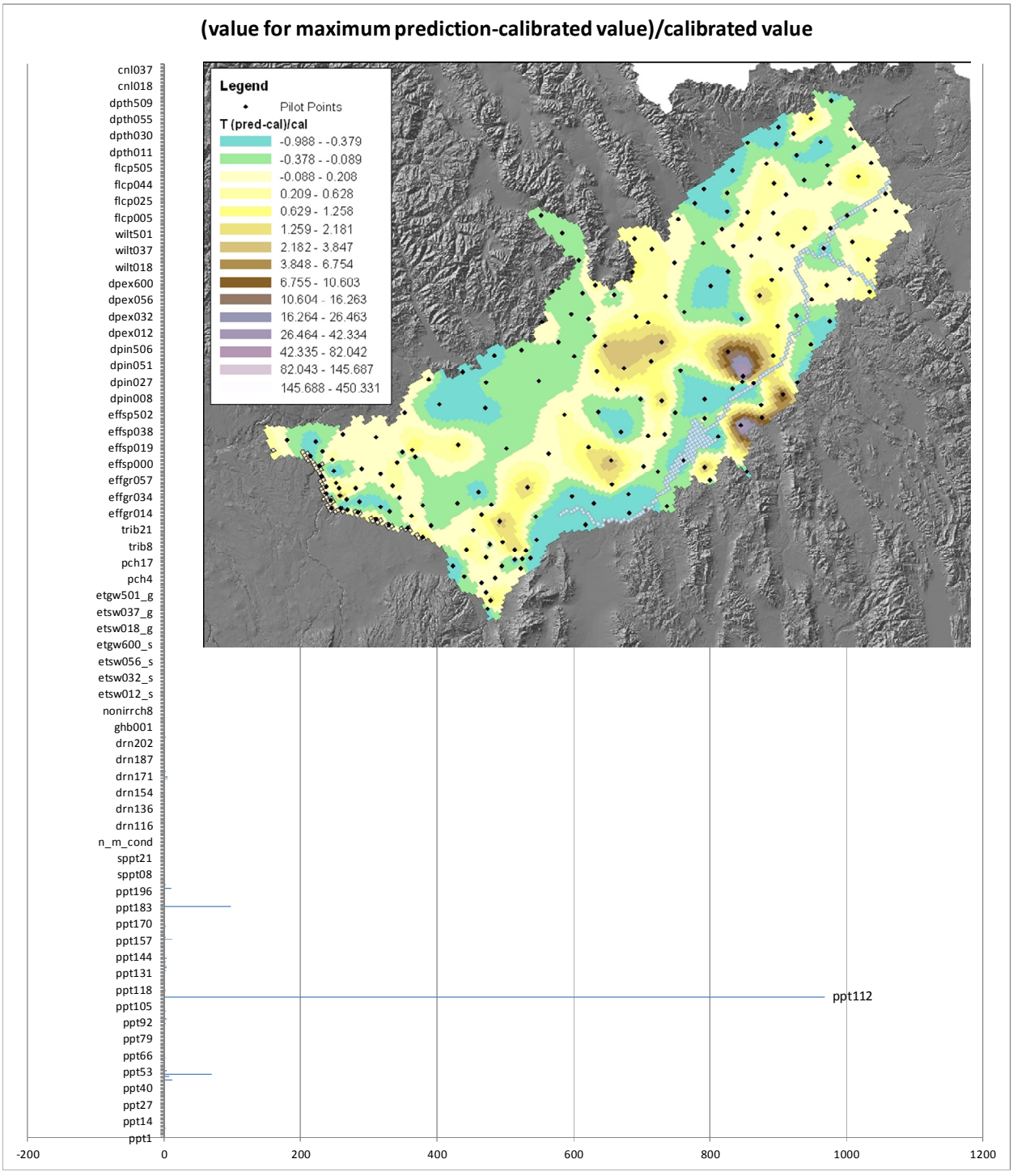


Impact of Water District 120 on Clear Lakes Spring using calibration run E110712A001.

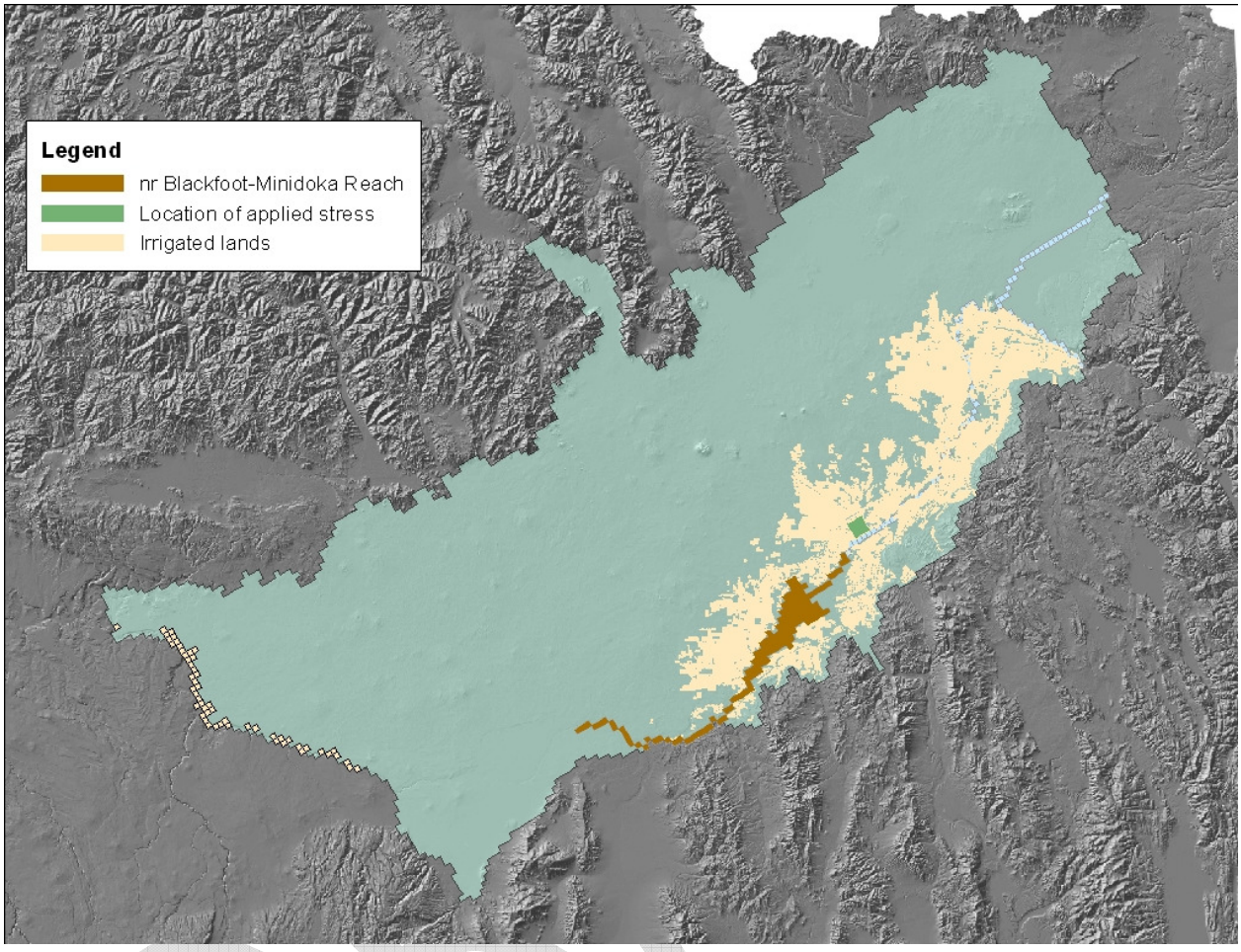




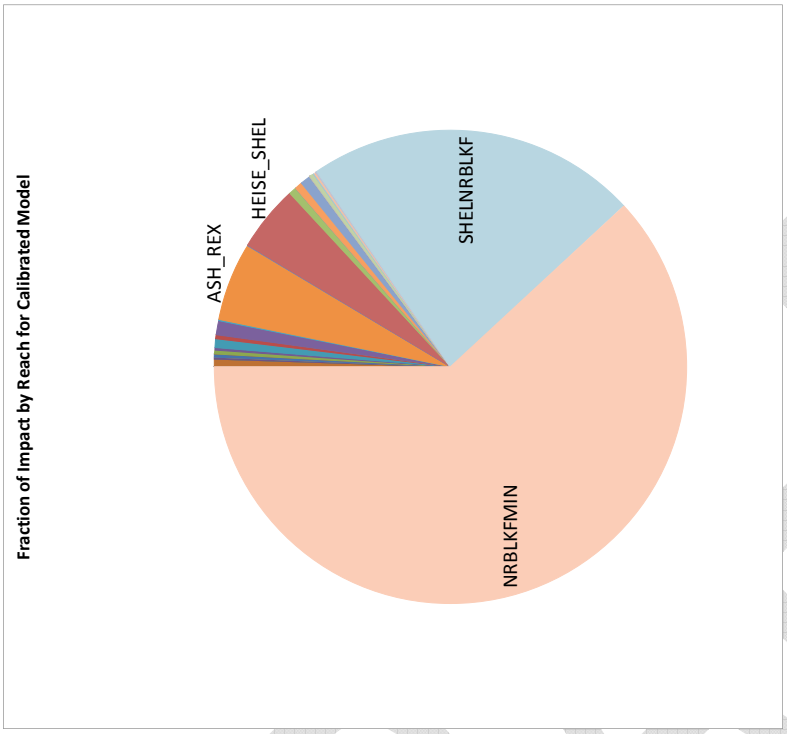
Impact of Water District 120 on Clear Lakes Spring using calibration run E110712A001.

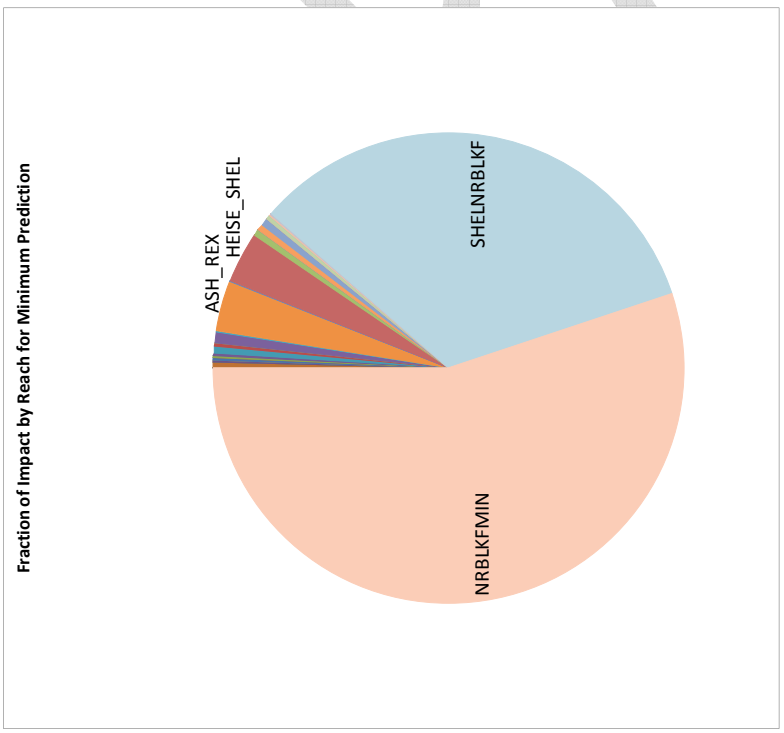


Impact of Water District 120 on near Blackfoot-Minidoka using calibration run E120116A008.

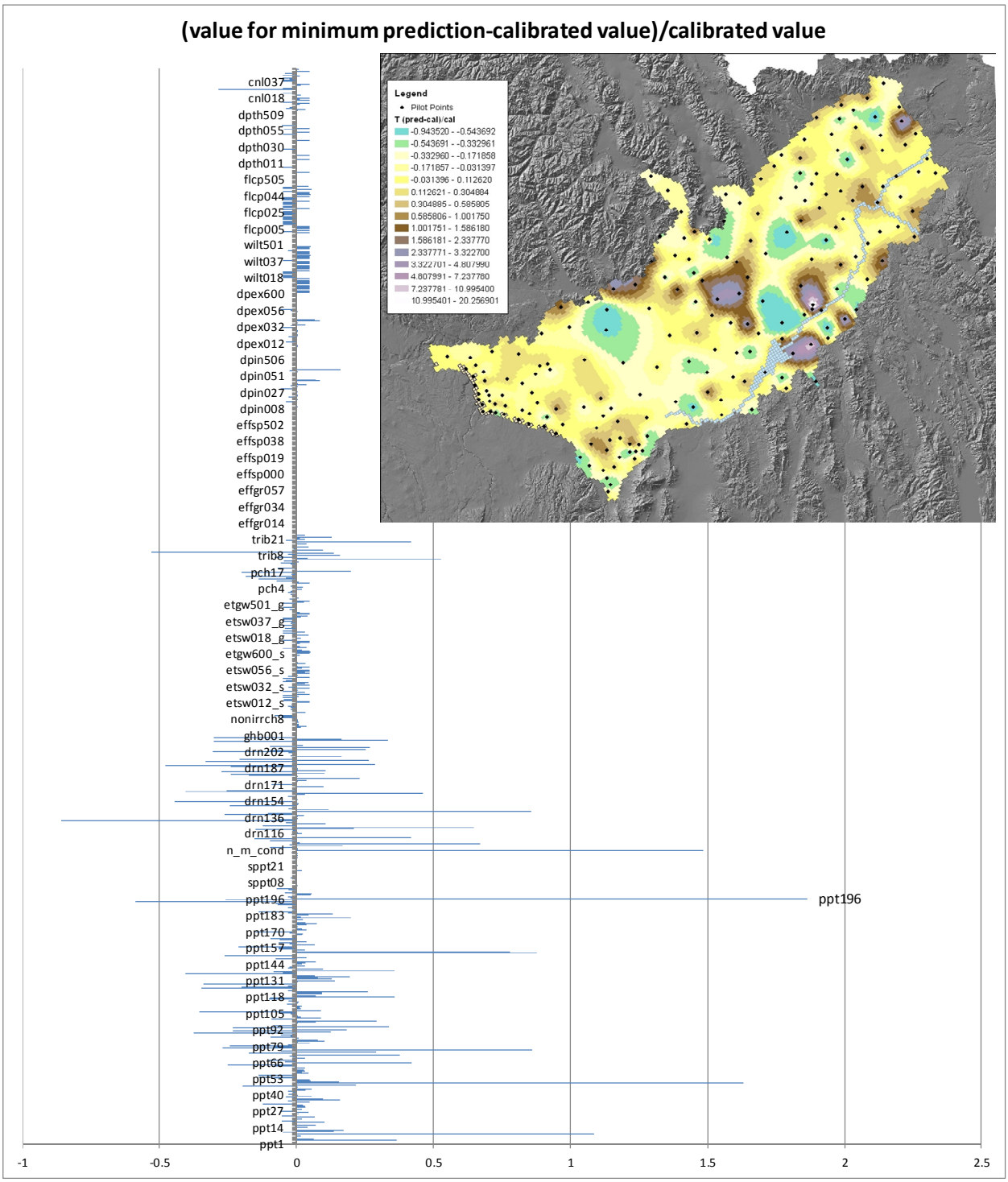


Impact of Water District 120 on near Blackfoot-Minidoka using calibration run E120116A008.

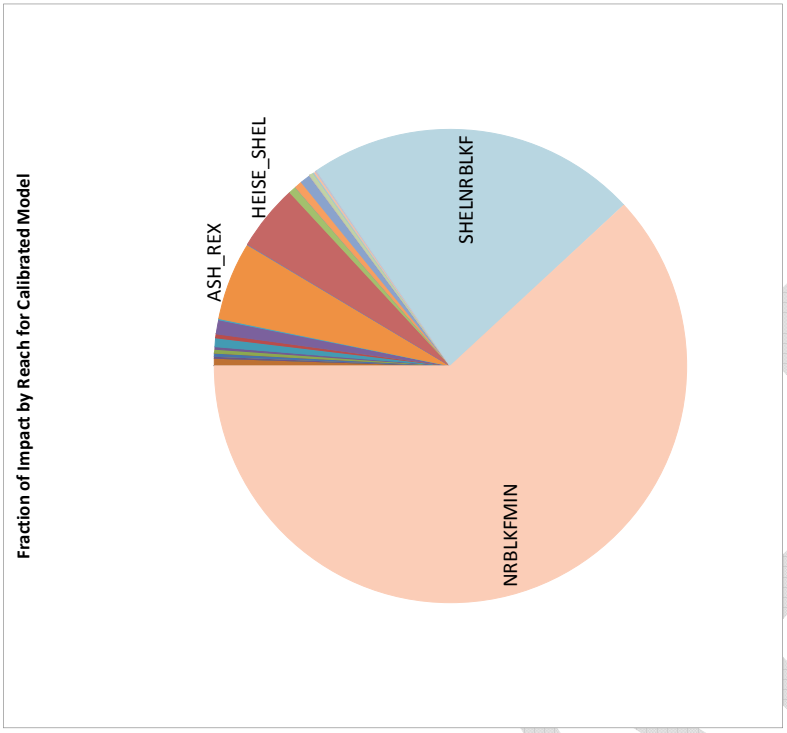


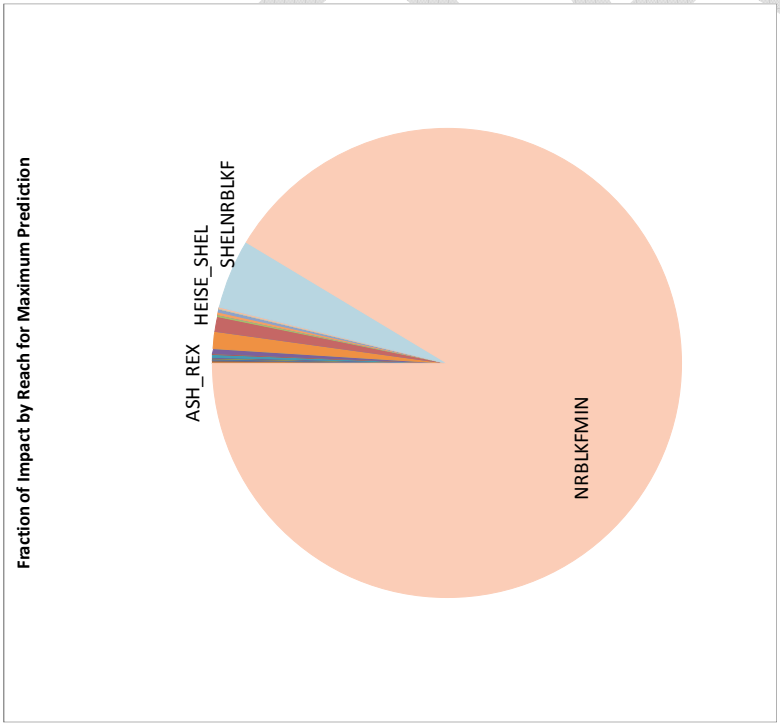


Impact of Water District 120 on near Blackfoot-Minidoka using calibration run E120116A008.

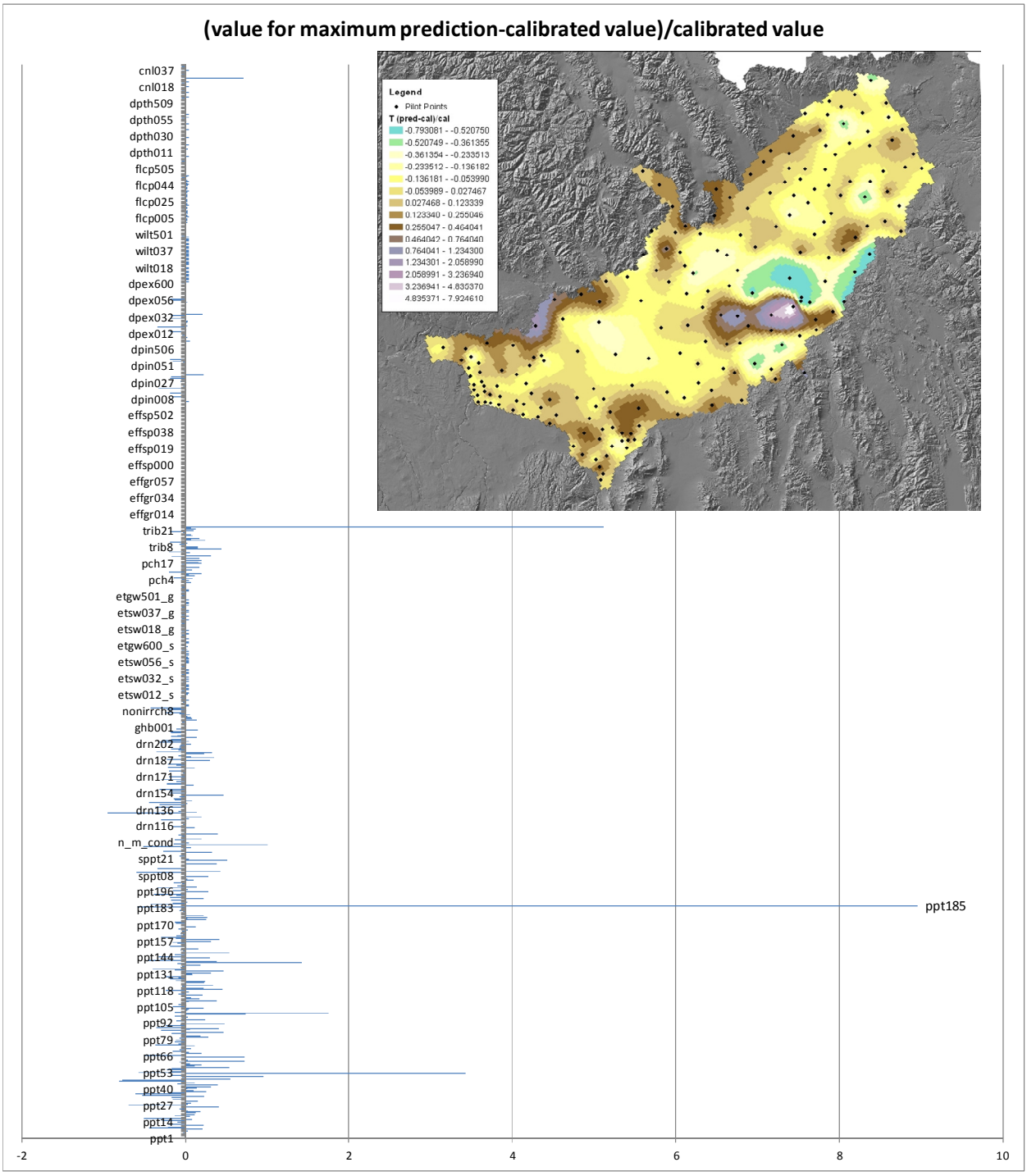


Impact of Water District 120 on near Blackfoot-Minidoka using calibration run E120116A008.

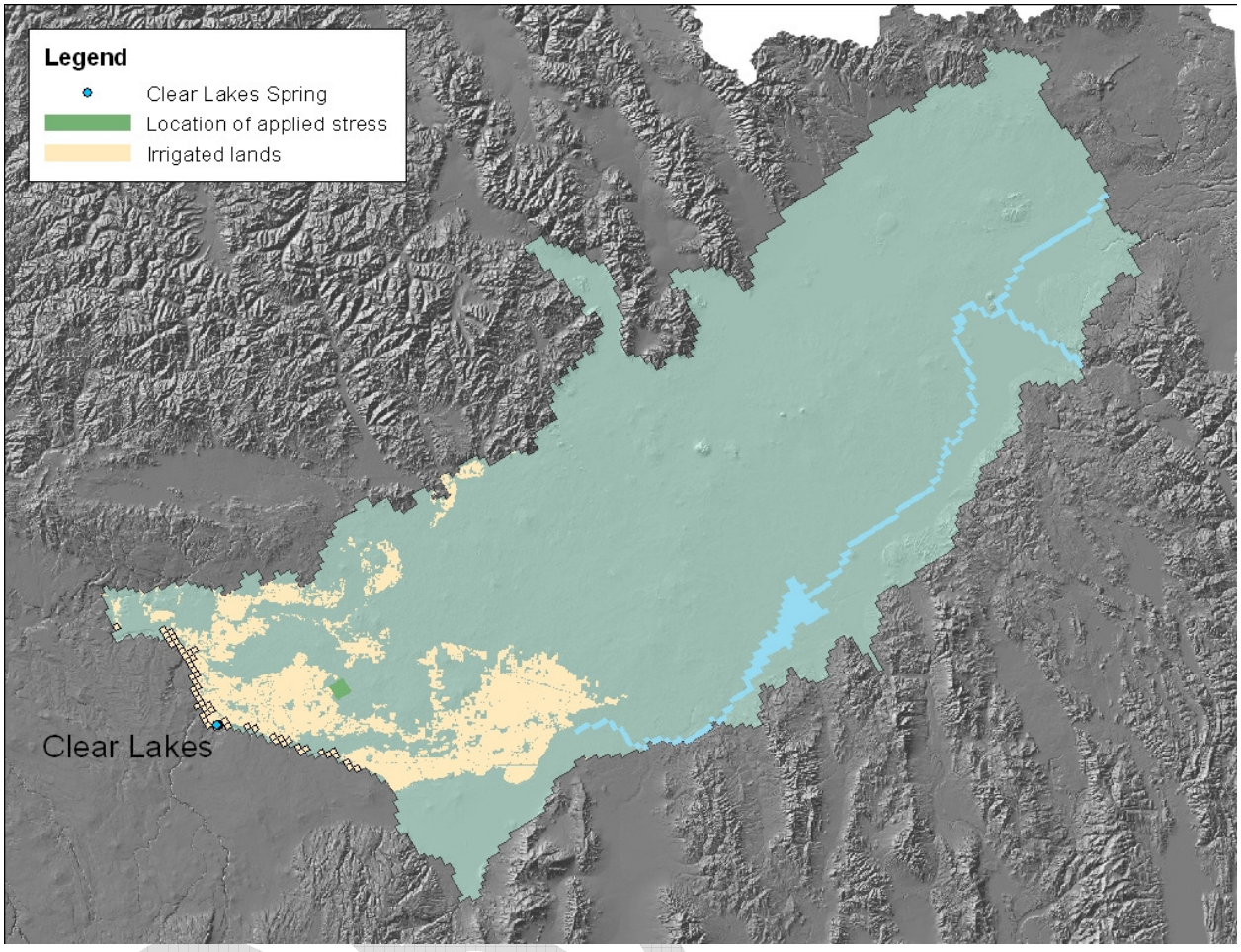




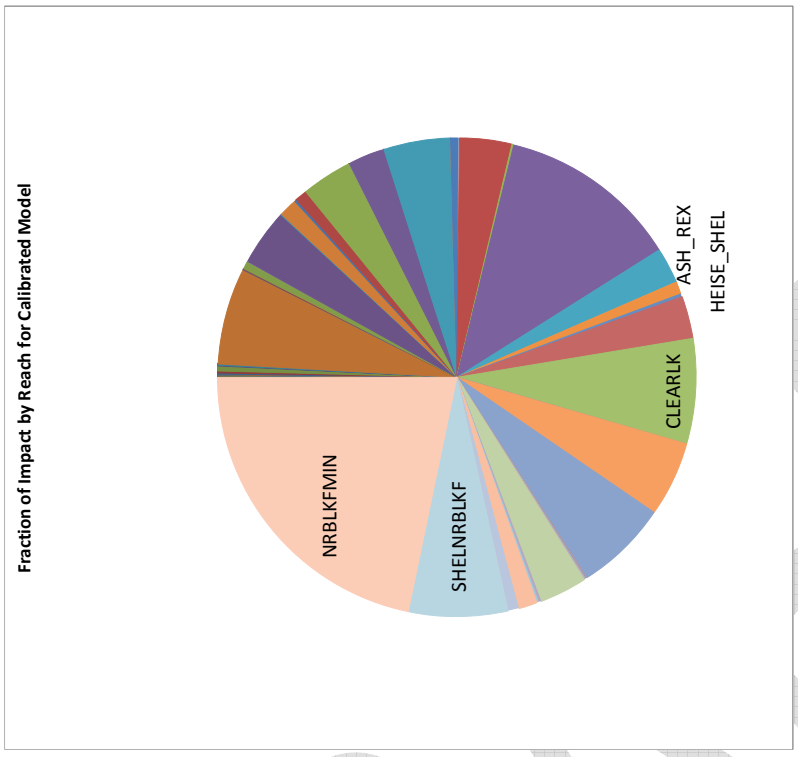
Impact of Water District 120 on near Blackfoot-Minidoka using calibration run E120116A008.

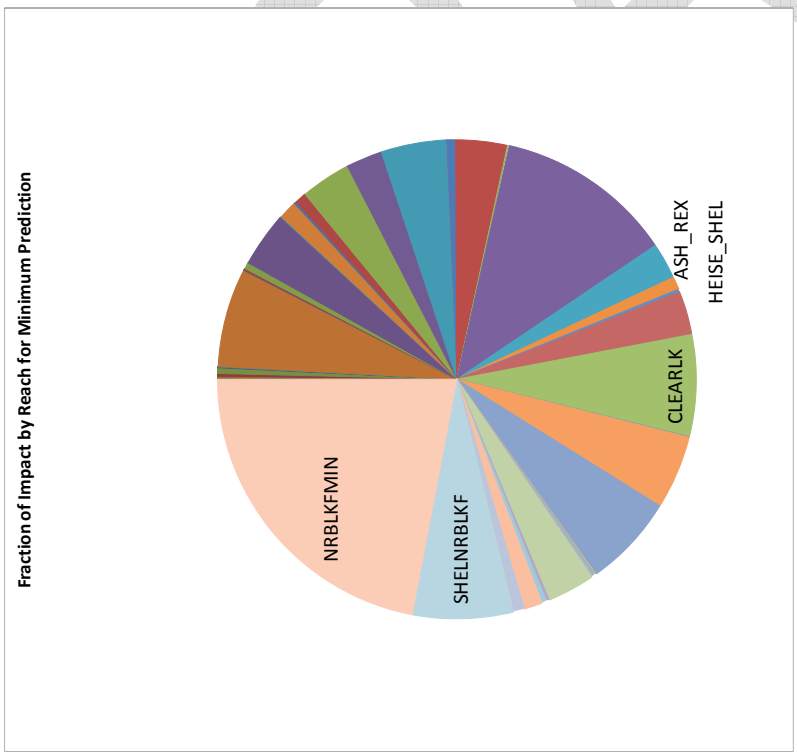


Impact of Water District 130 on Clear Lakes Spring using calibration run E110712A001.

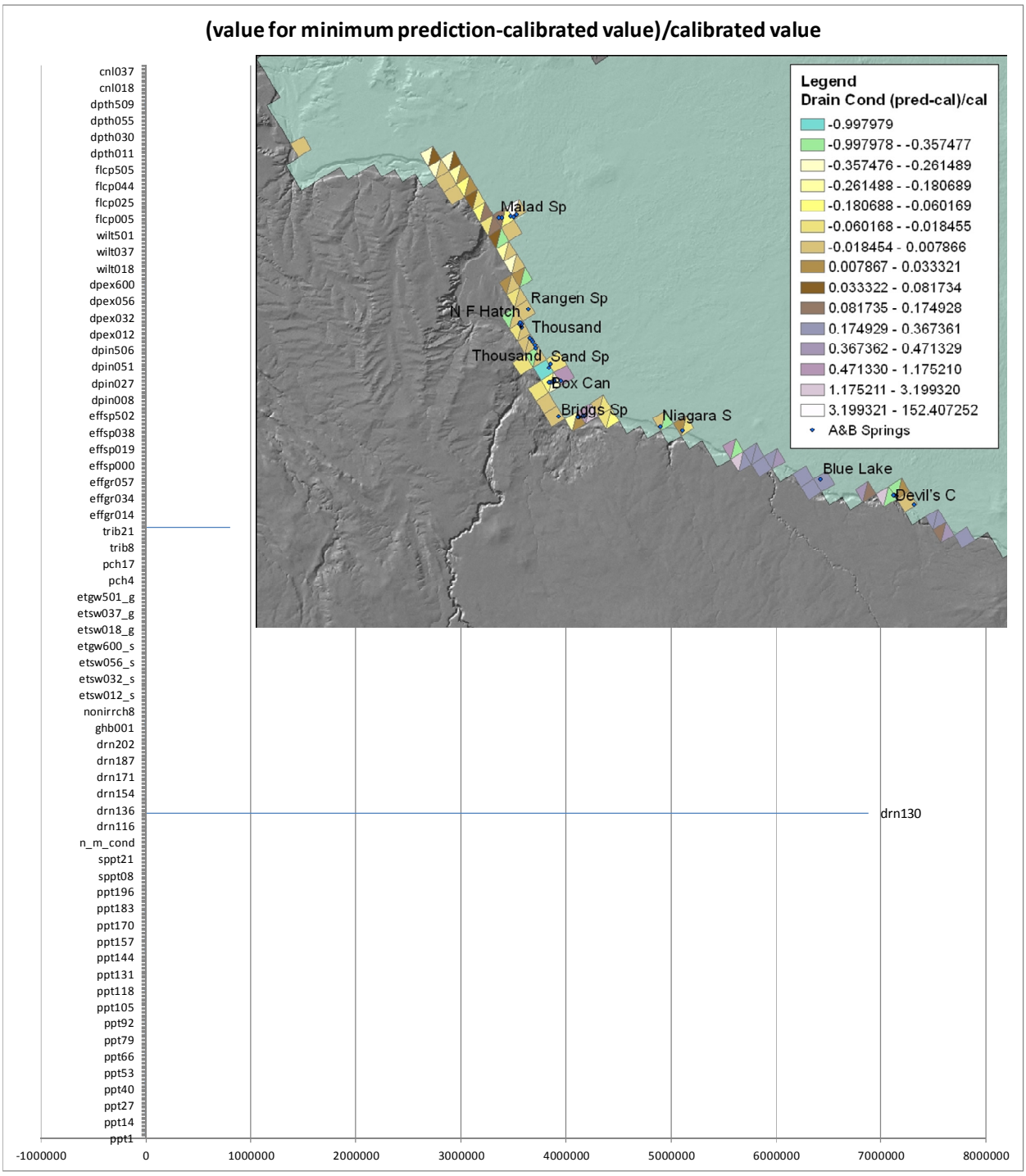


Impact of Water District 130 on Clear Lakes Spring using calibration run E110712A001.





Impact of Water District 130 on Clear Lakes Spring using calibration run E110712A001.



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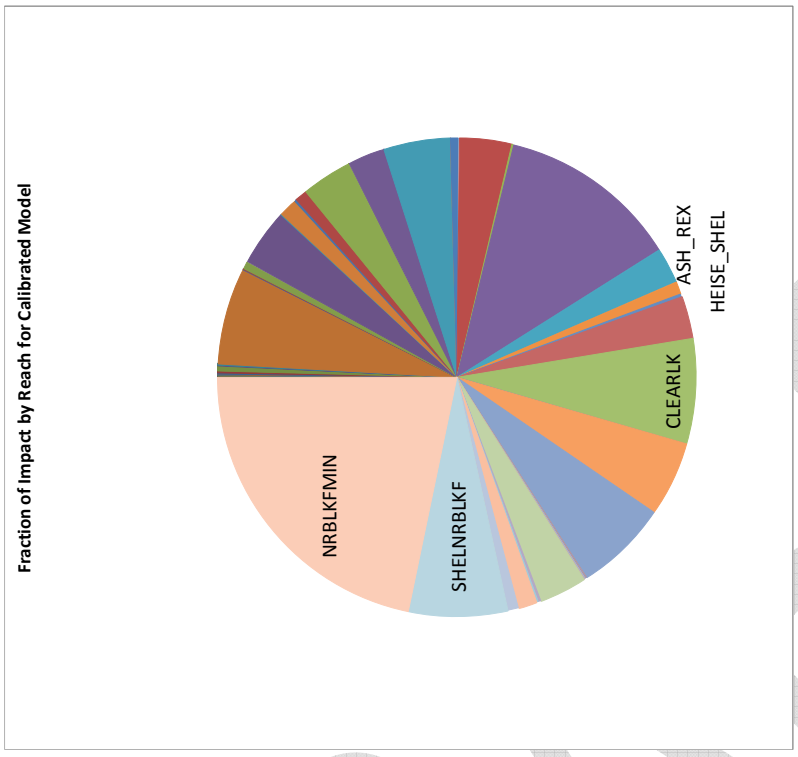
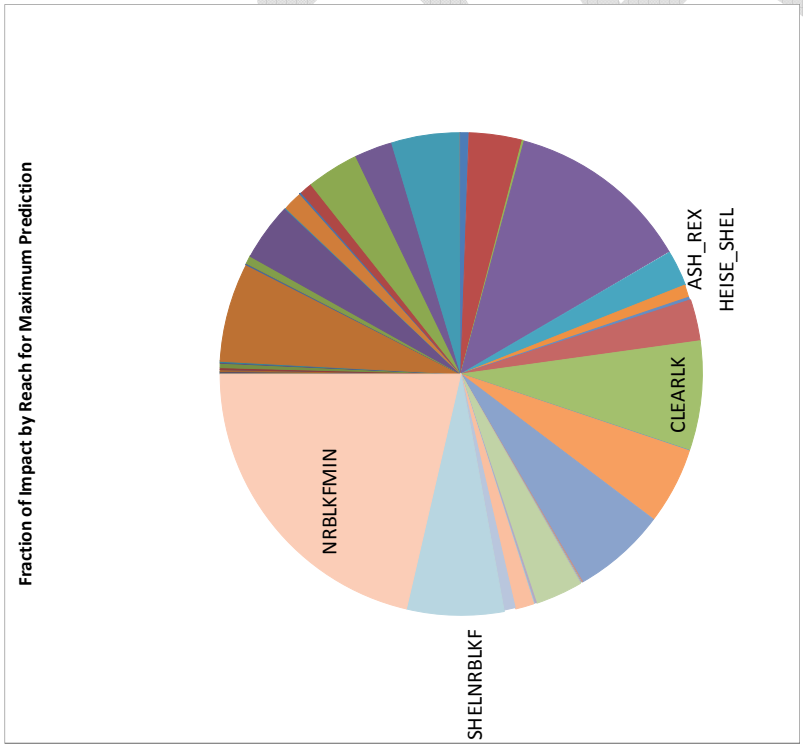
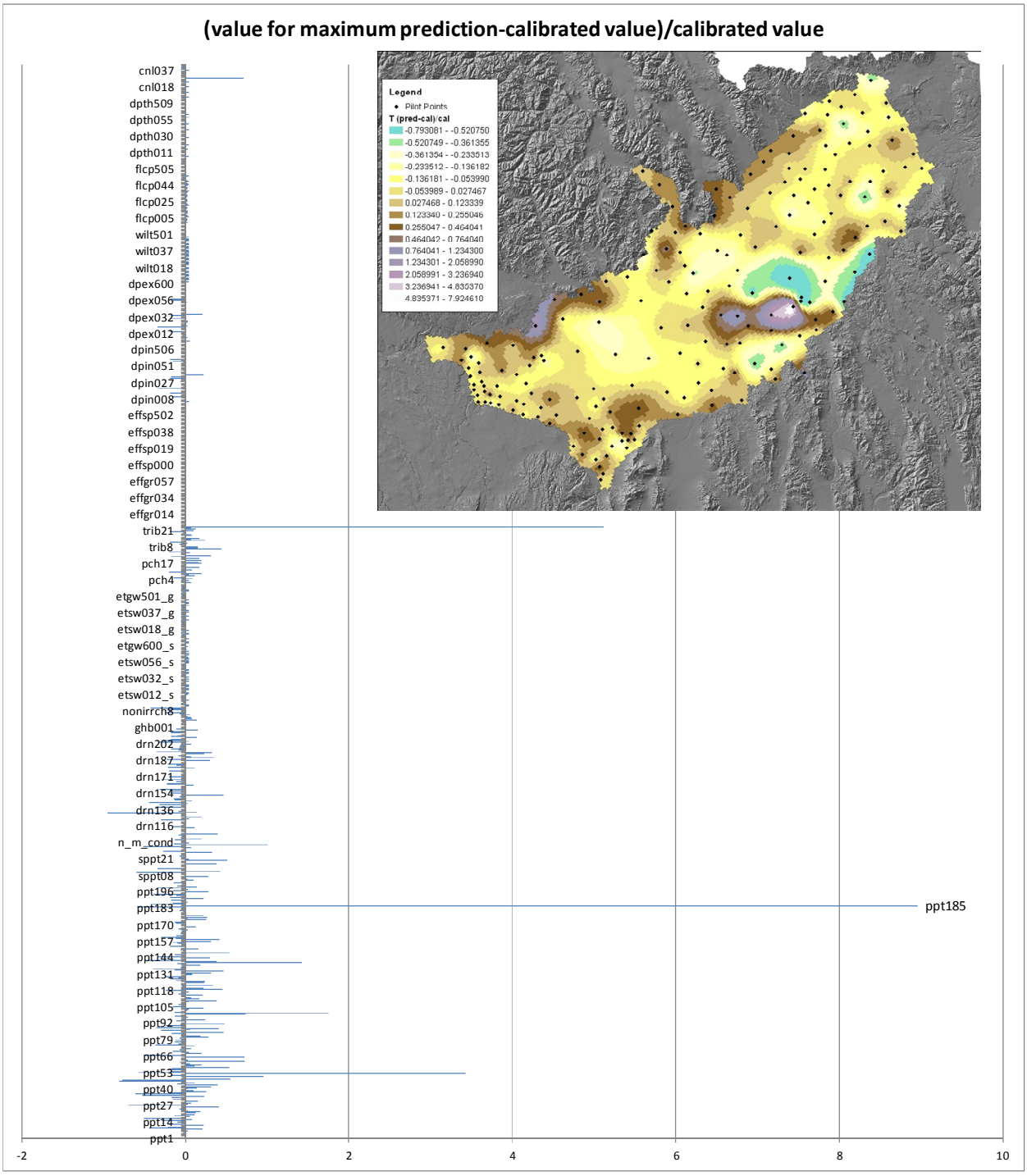
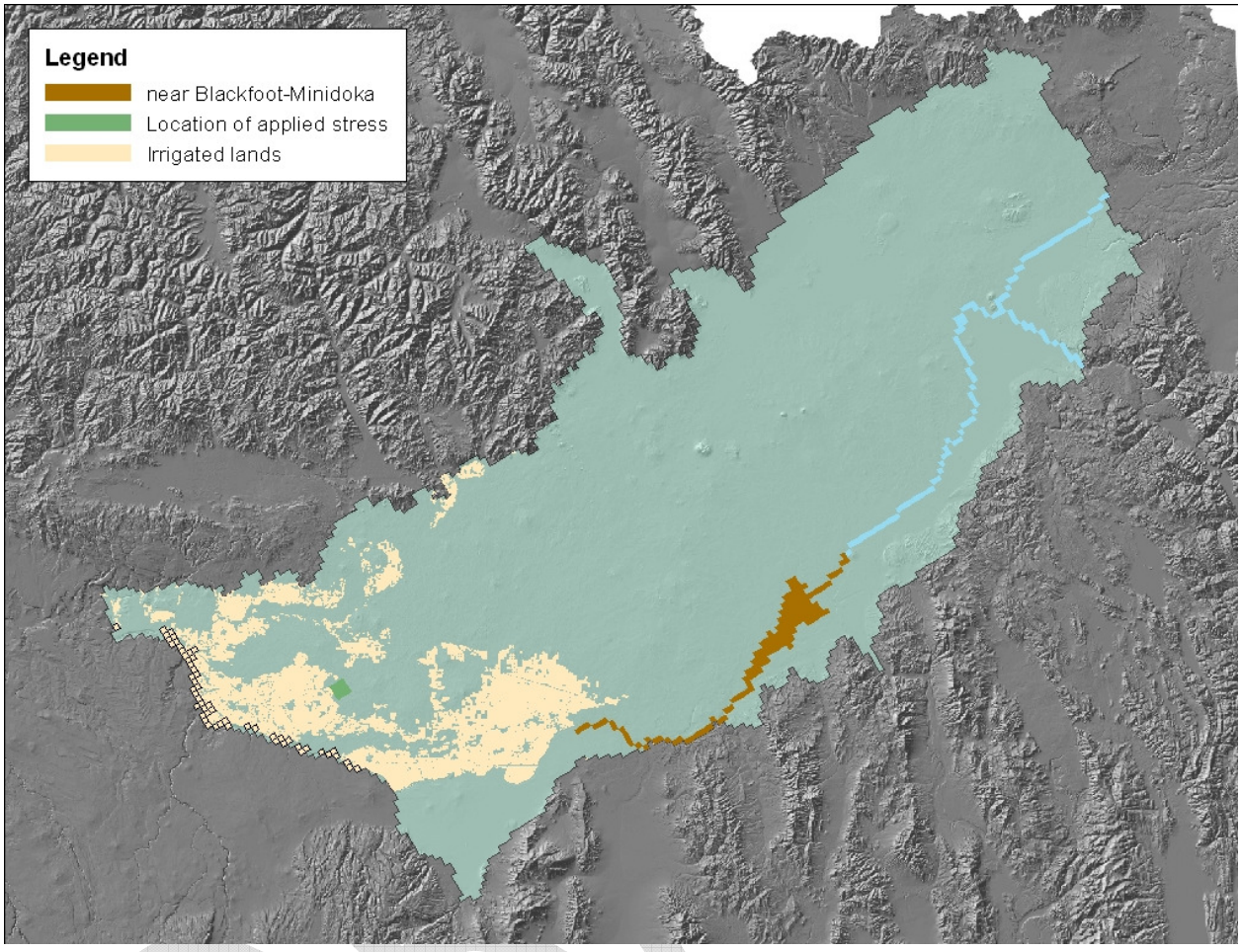




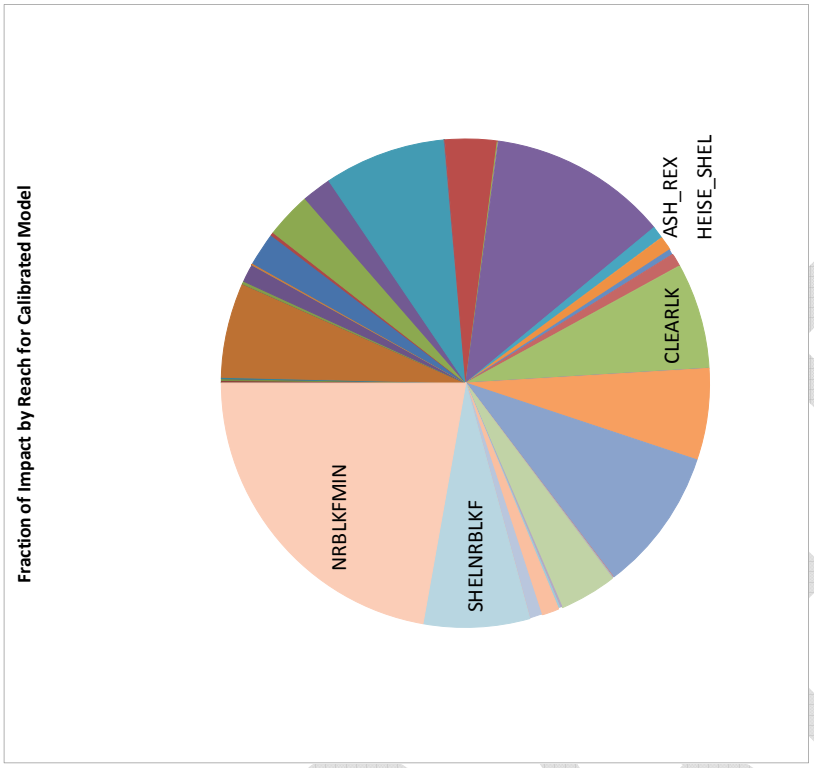
Impact of Water District 130 on Clear Lakes Spring using calibration run E110712A001.

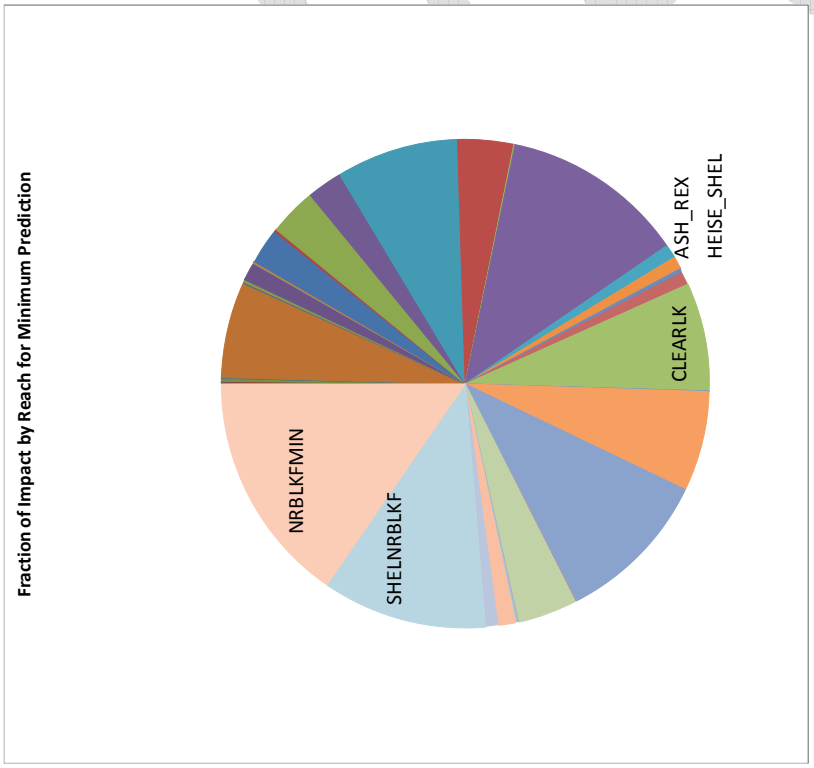


Impact of Water District 130 on near Blackfoot-Minidoka using calibration run E120116A008..

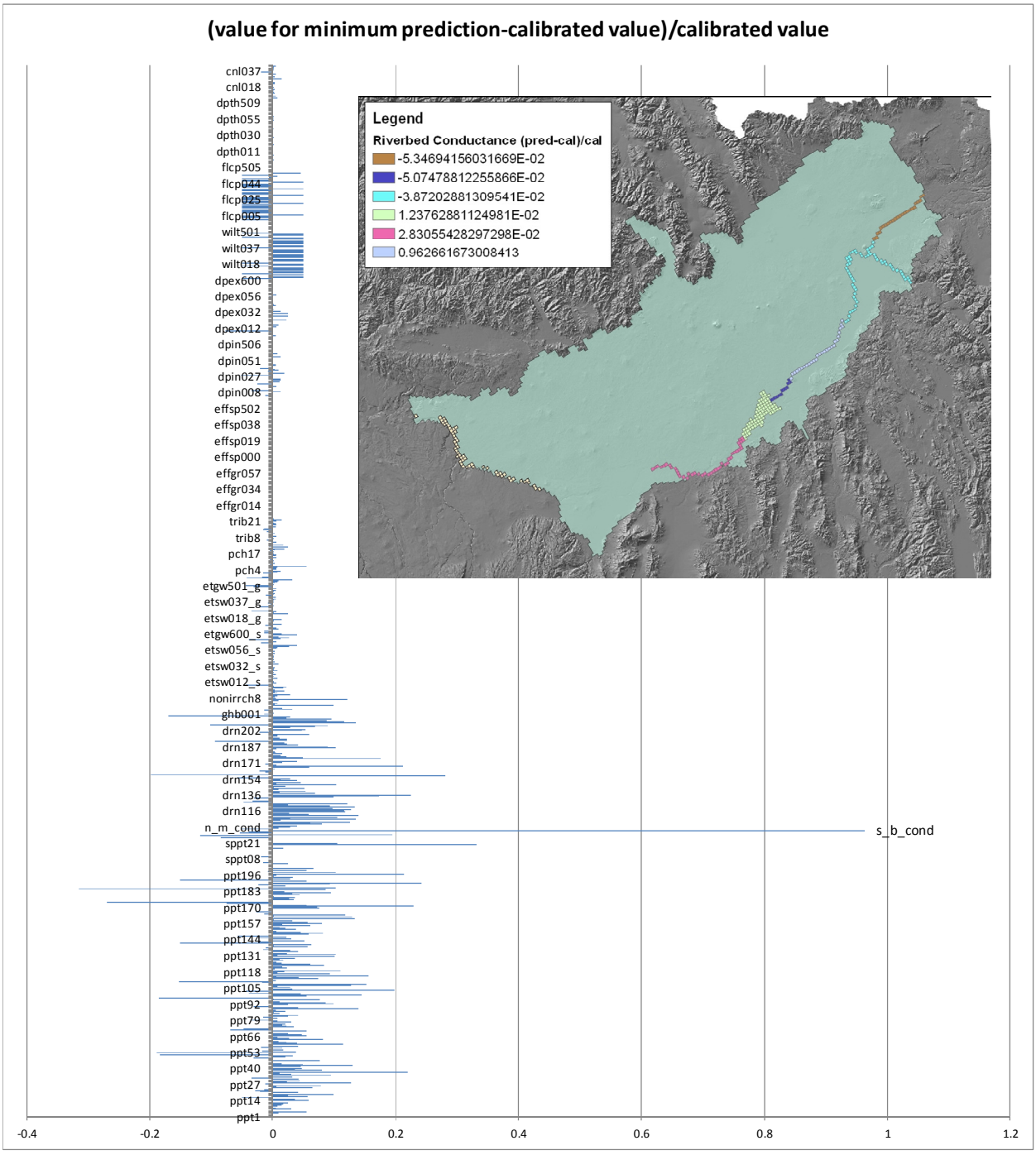


Impact of Water District 130 on near Blackfoot-Minidoka using calibration run E120116A008.

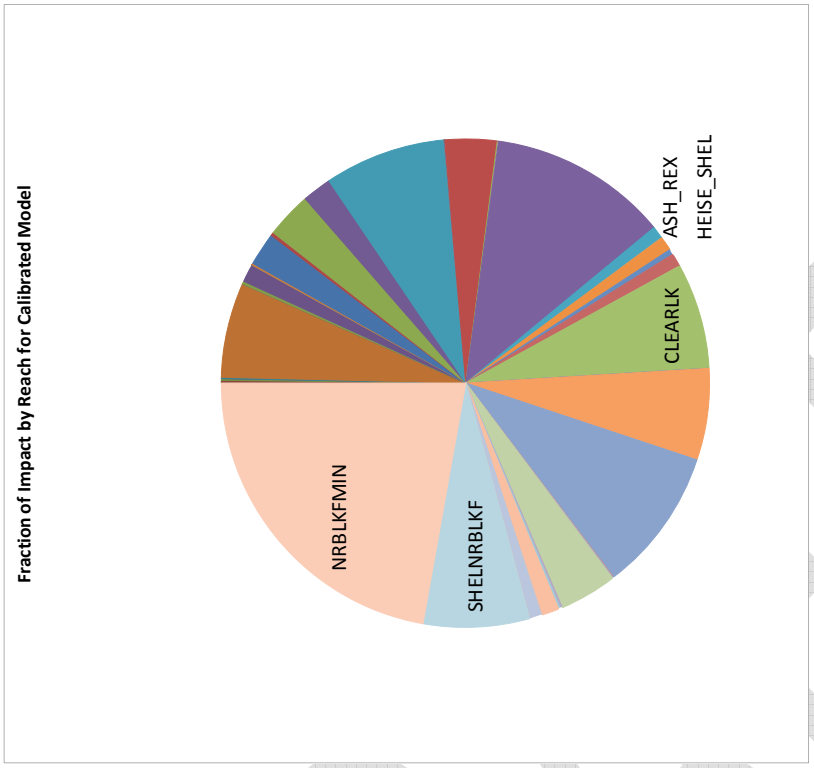


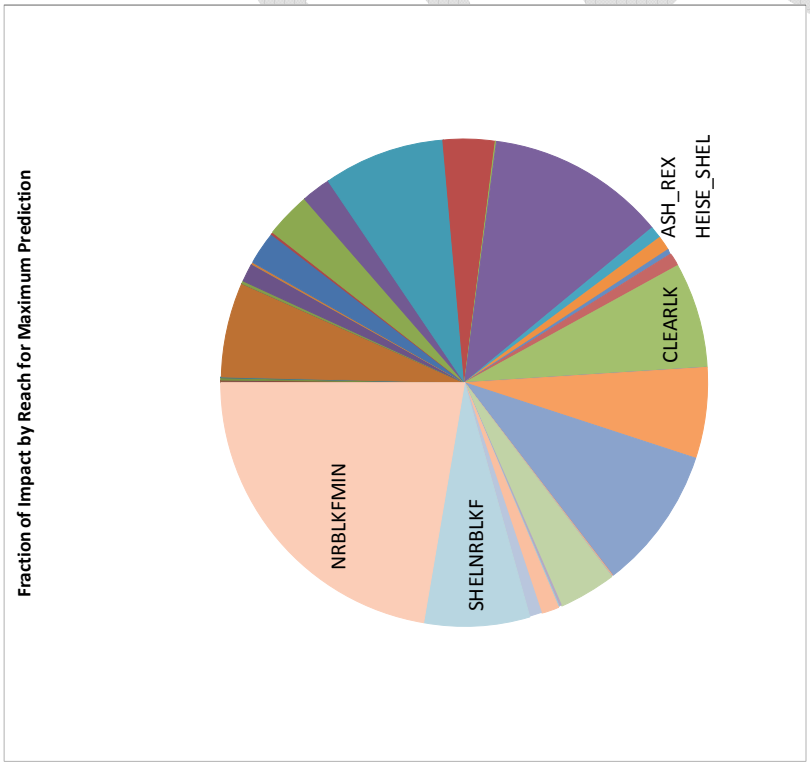


Impact of Water District 130 on near Blackfoot-Minidoka using calibration run E120116A008.



Impact of Water District 130 on near Blackfoot-Minidoka using calibration run E120116A008.





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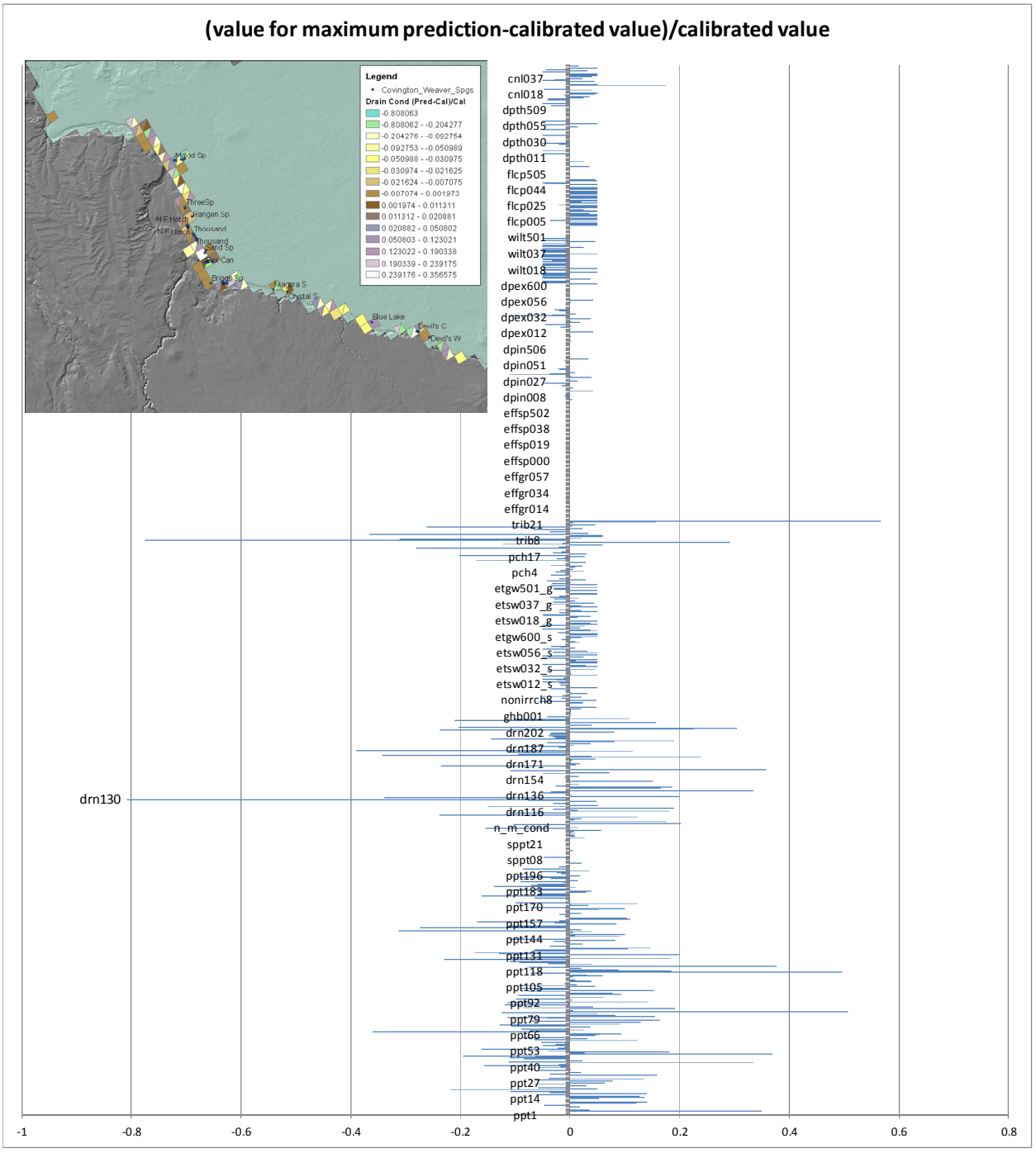
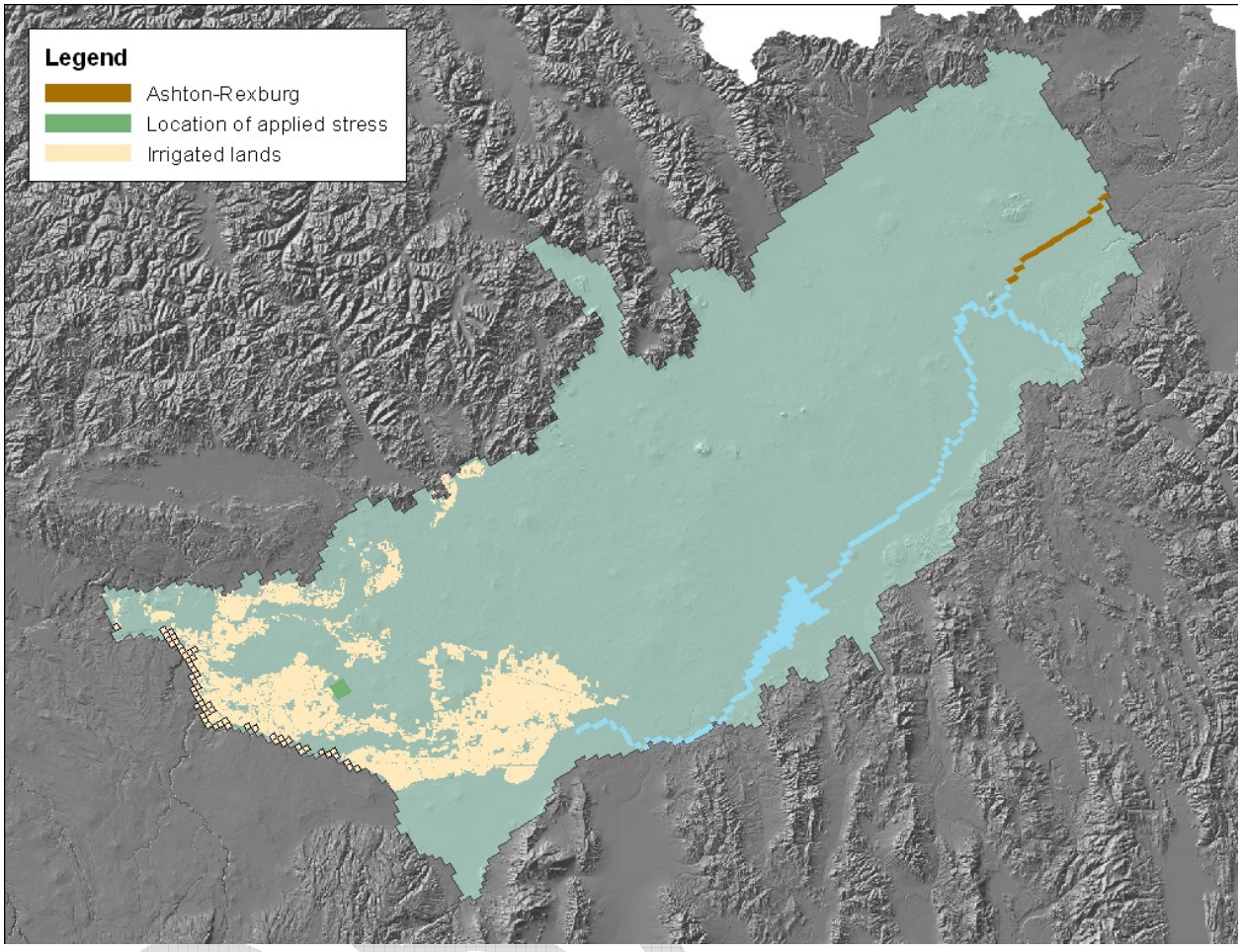


Impact of Water District 130 on Ashton-Rexburg using calibration run E120116A008.



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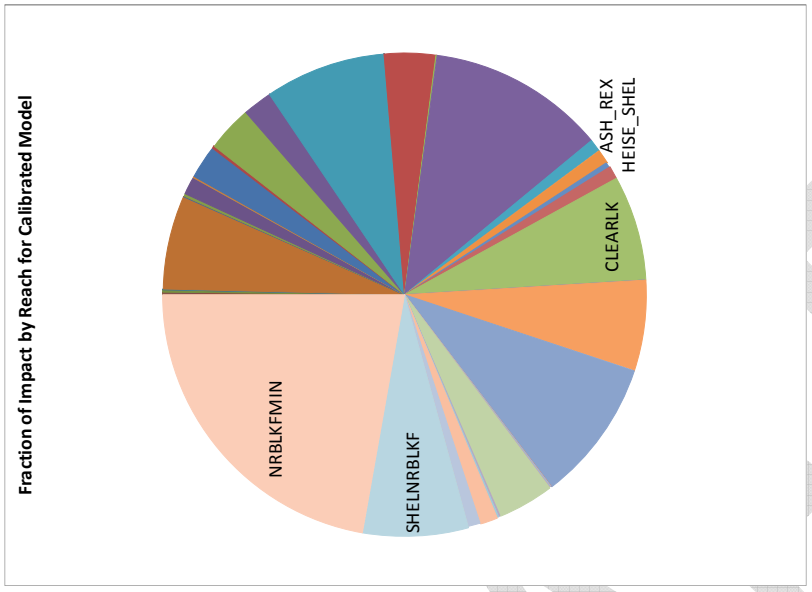
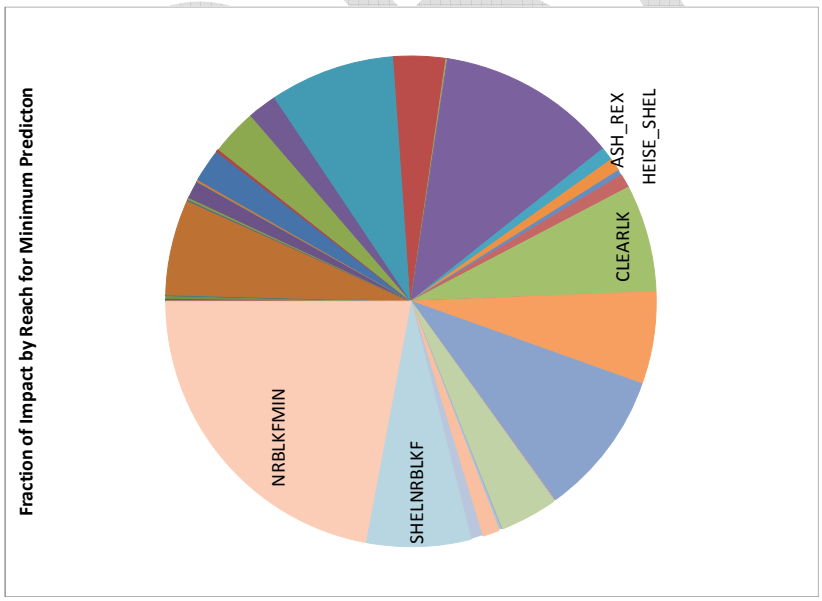
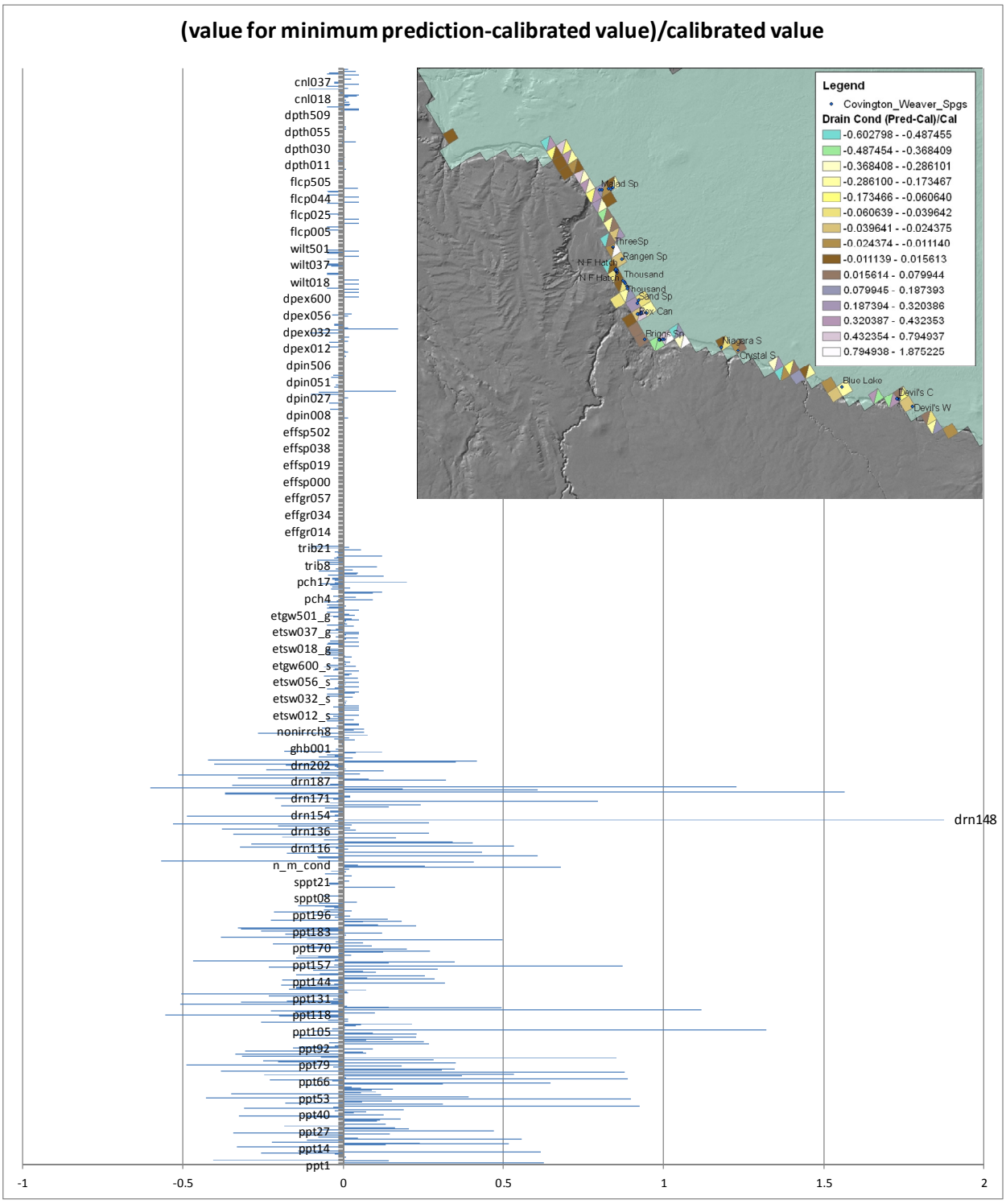




Impact of Water District 130 on Ashton-Rexburg using calibration run E120116A008.



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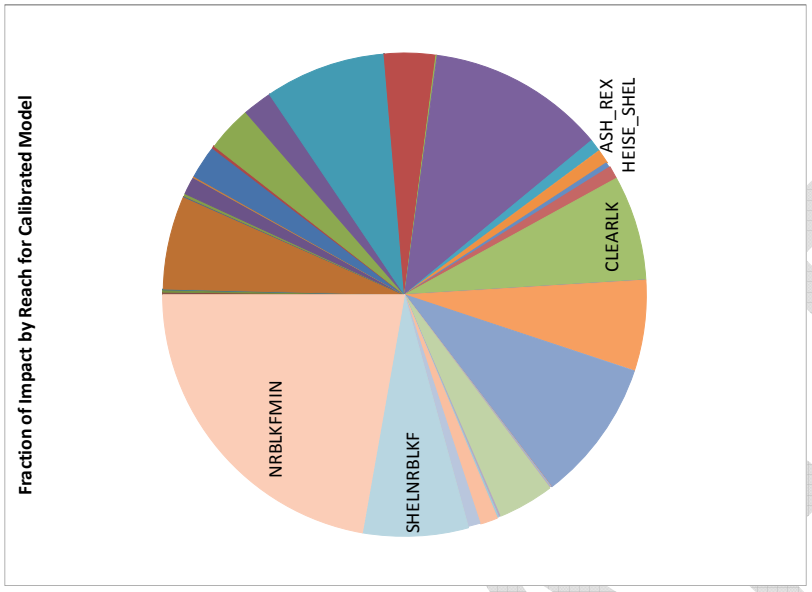
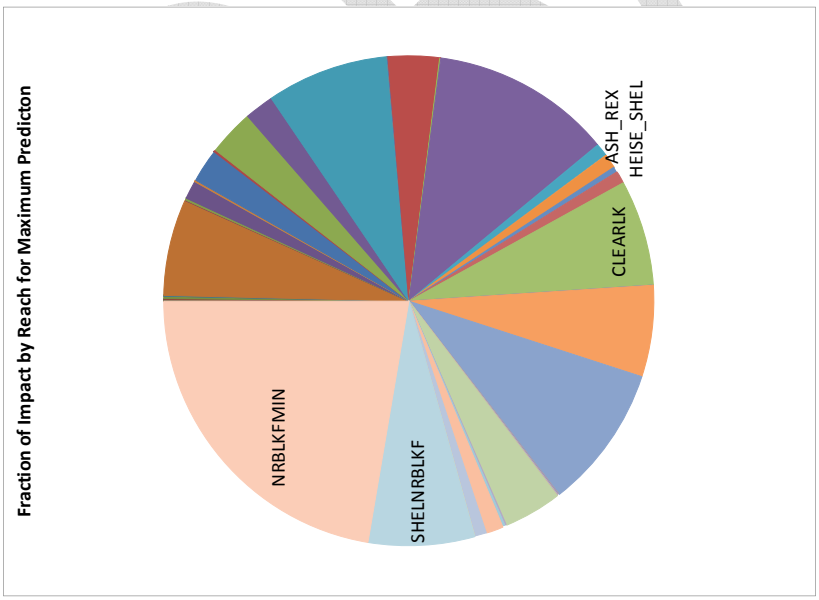
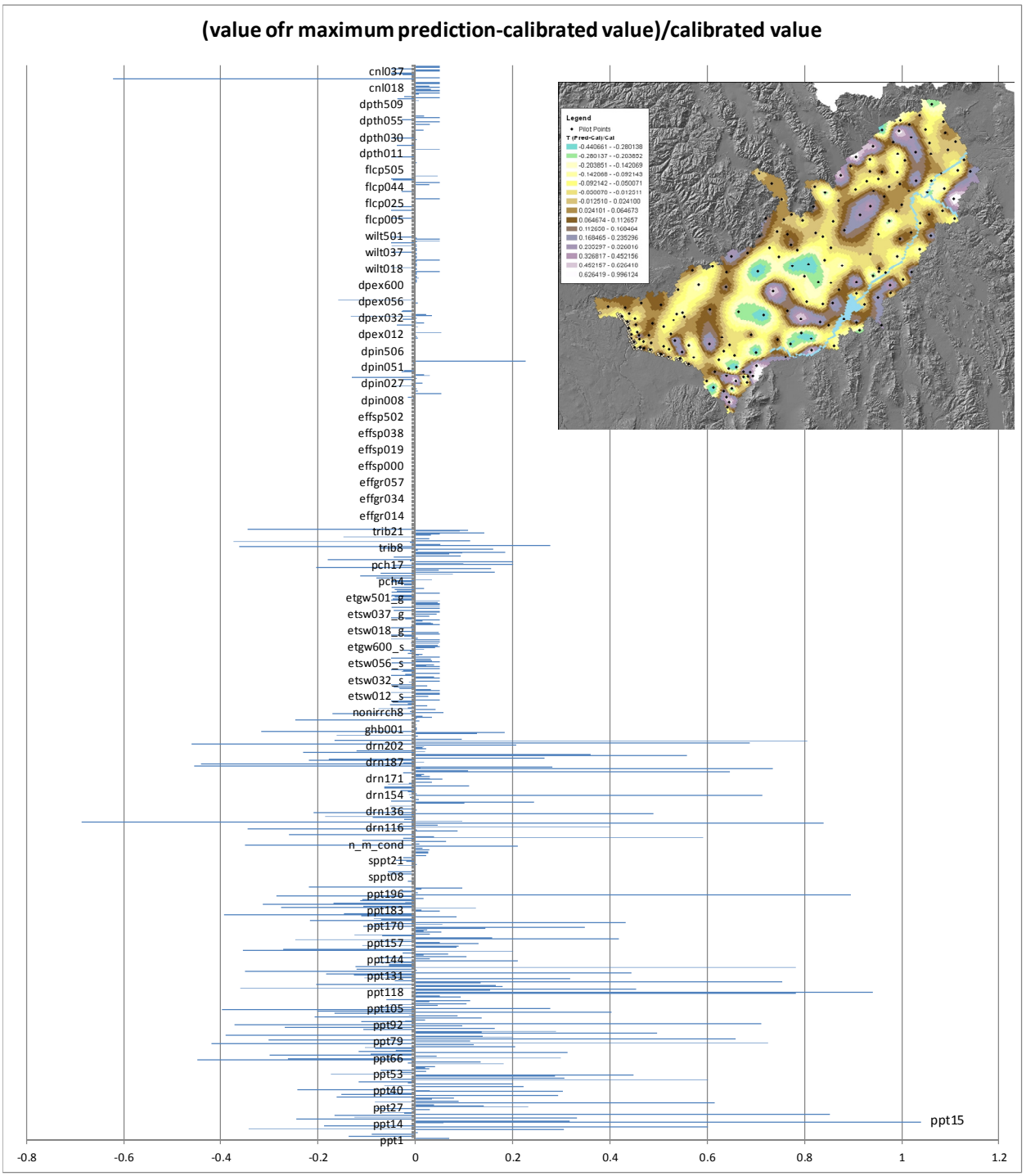
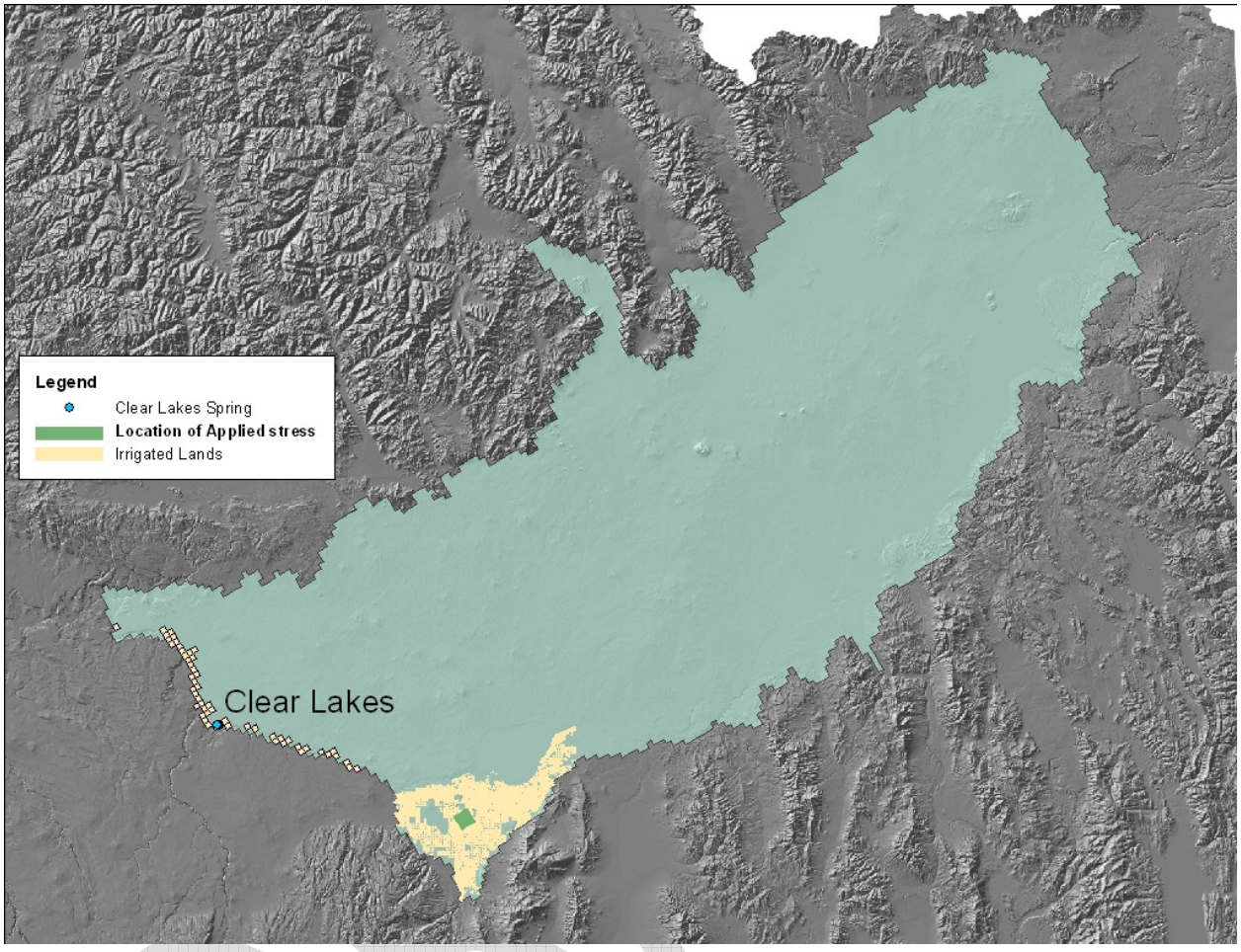




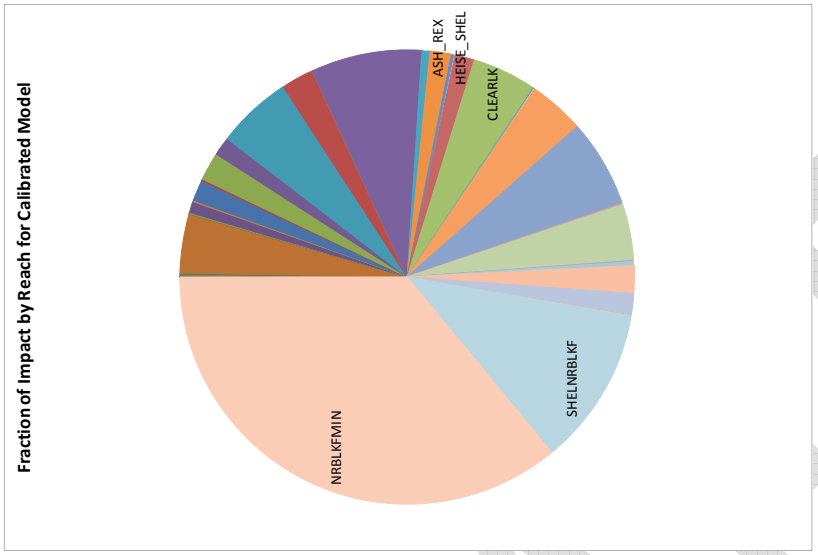
Impact of Water District 130 on Ashton-Rexburg using calibration run E120116A008.

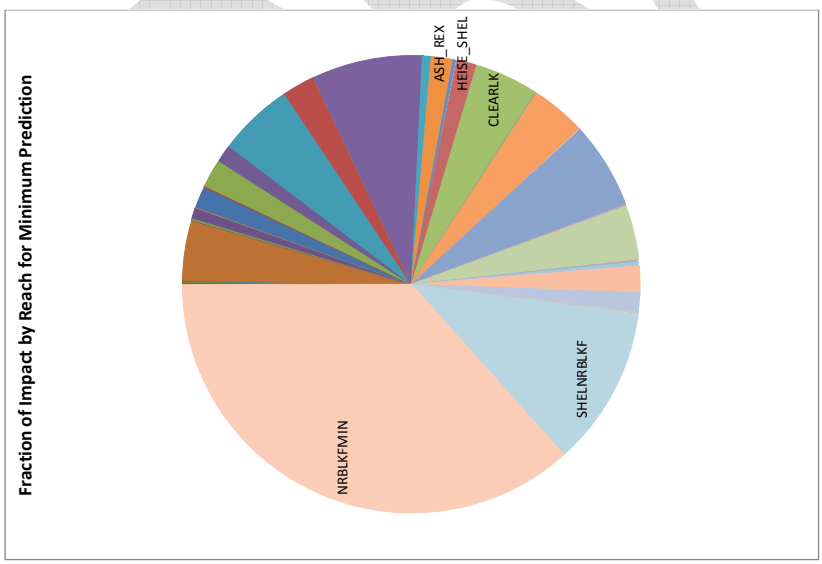


Impact of Water District 140 on Clear Lakes Spring using calibration run E120116A008.

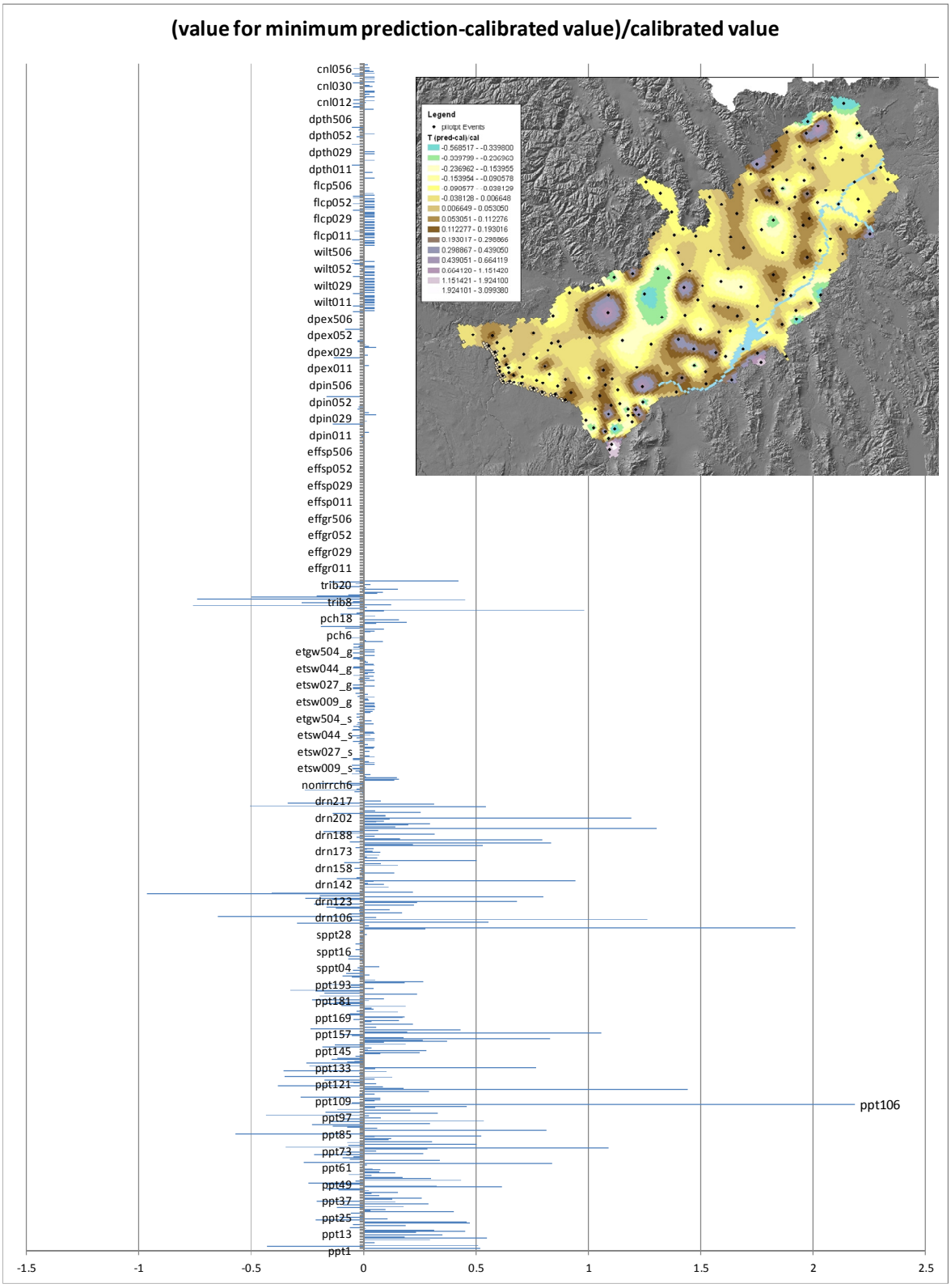


Impact of Water District 140 on Clear Lakes Spring using calibration run E120116A008.





Impact of Water District 140 on Clear Lakes Spring using calibration run E120116A008.



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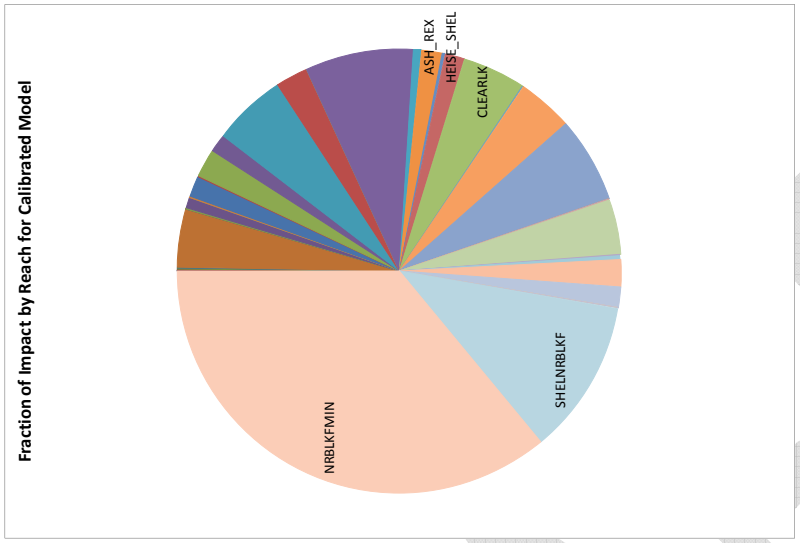
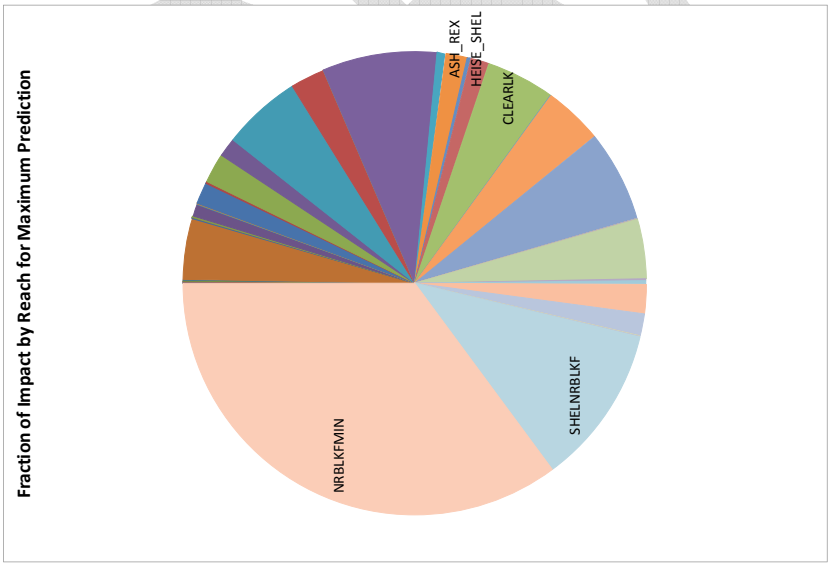
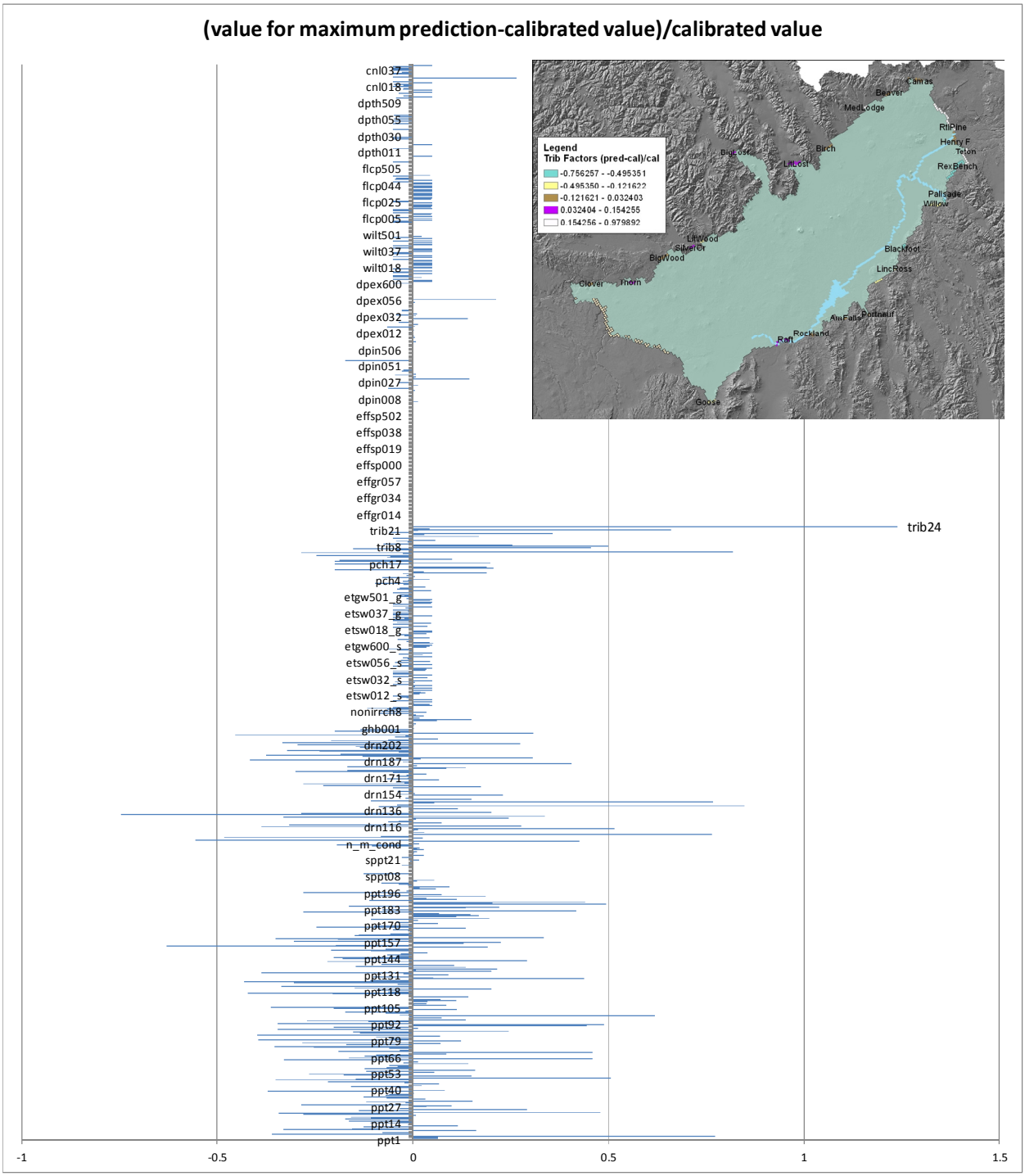
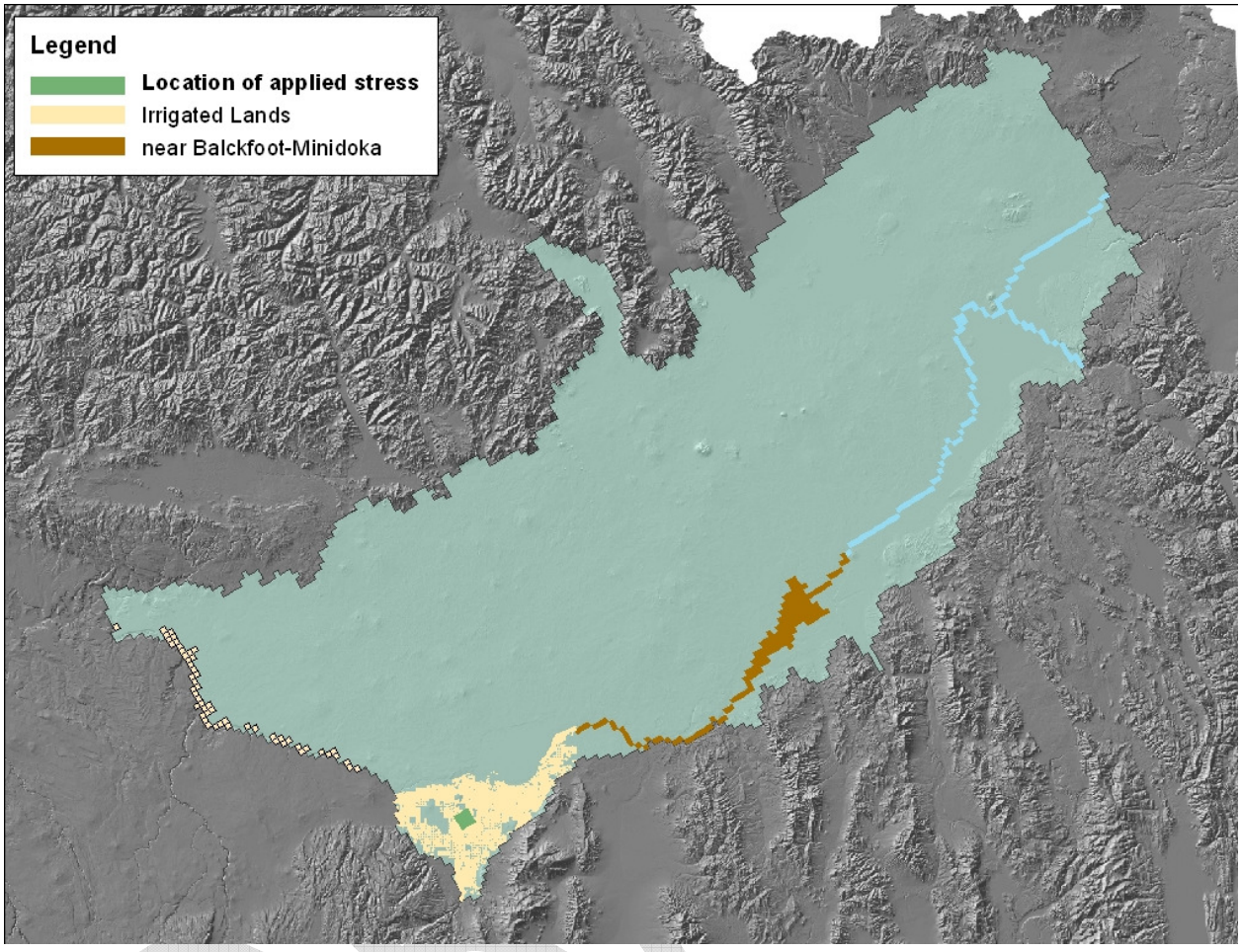




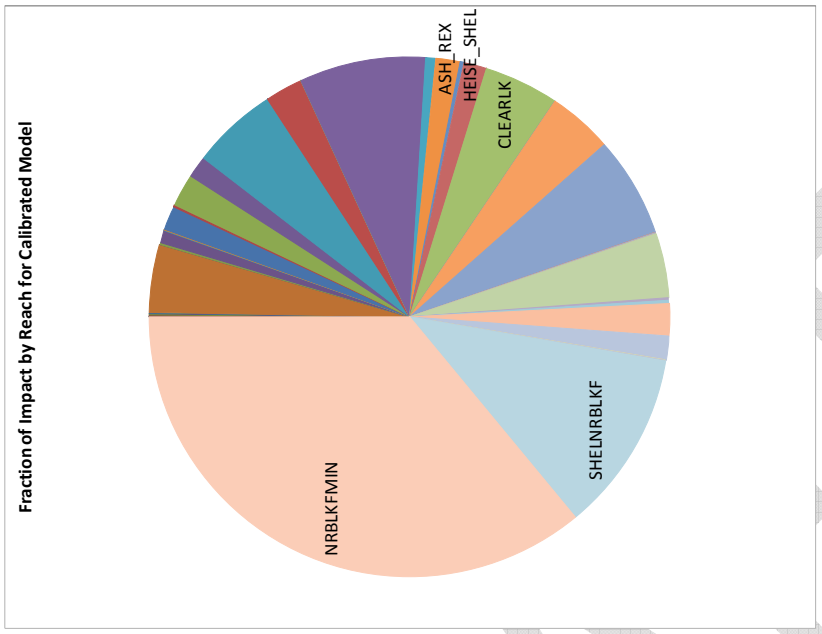
Impact of Water District 140 on Clear Lakes Spring using calibration run E120116A008.

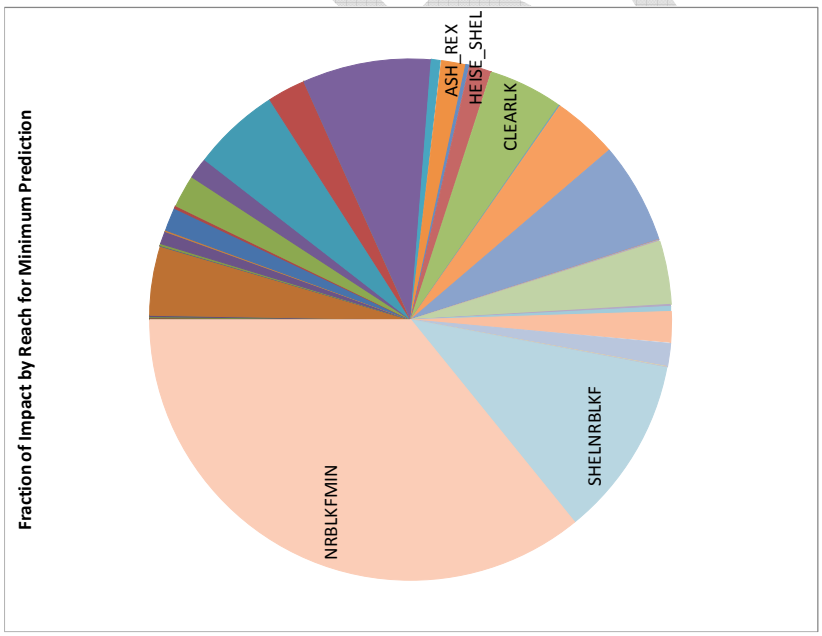


Impact of Water District 140 on near Blackfoot-Minidoka using calibration run E120116A008.

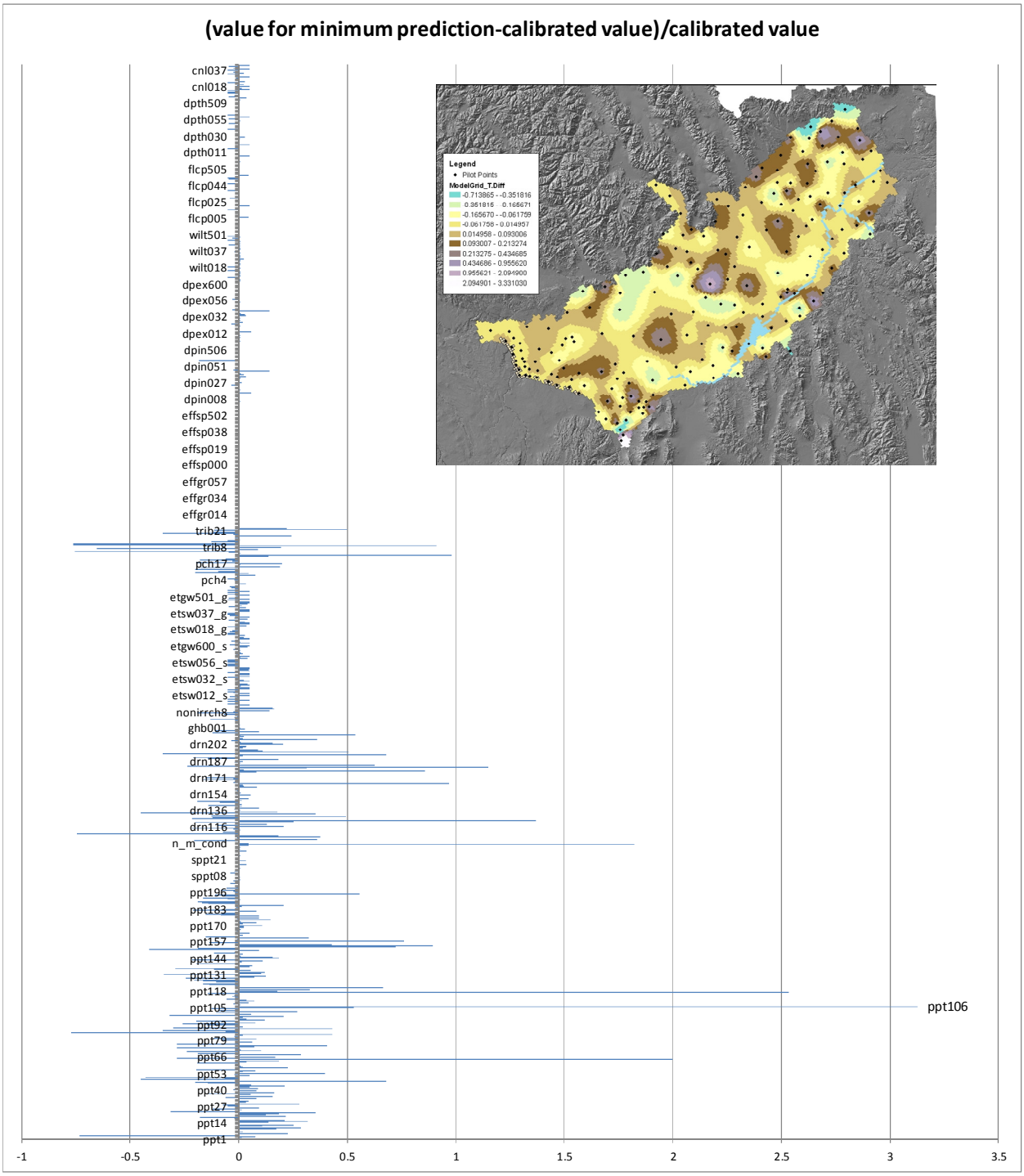


Impact of Water District 140 on near Blackfoot-Minidoka using calibration run E120116A008.

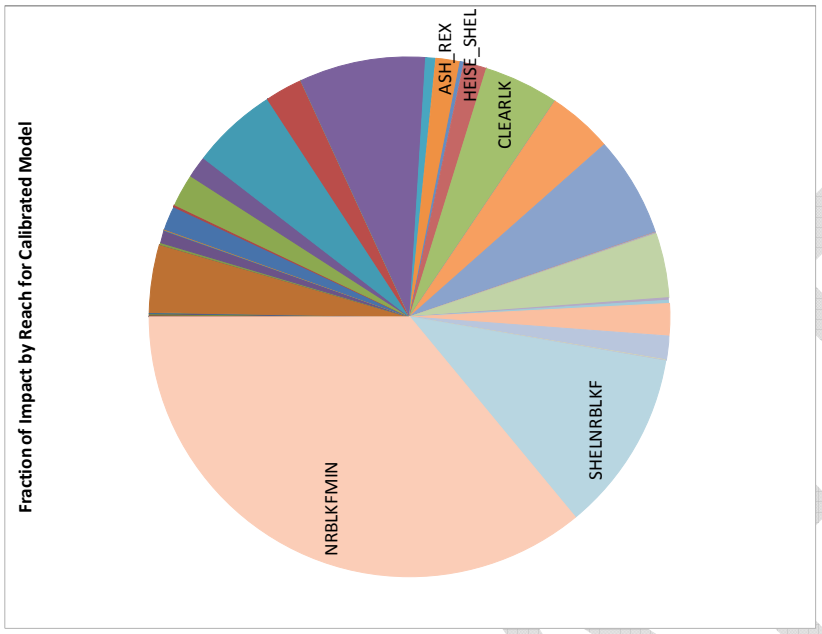


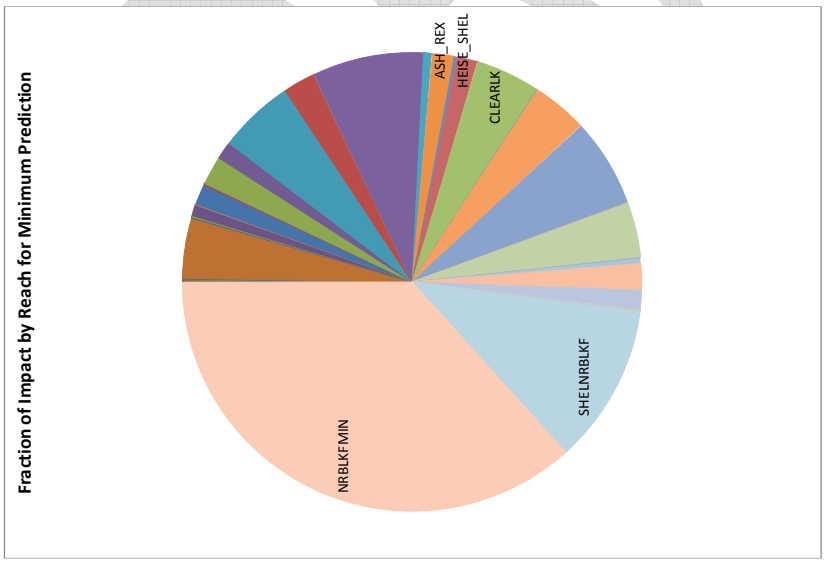


Impact of Water District 140 on near Blackfoot-Minidoka using calibration run E120116A008.

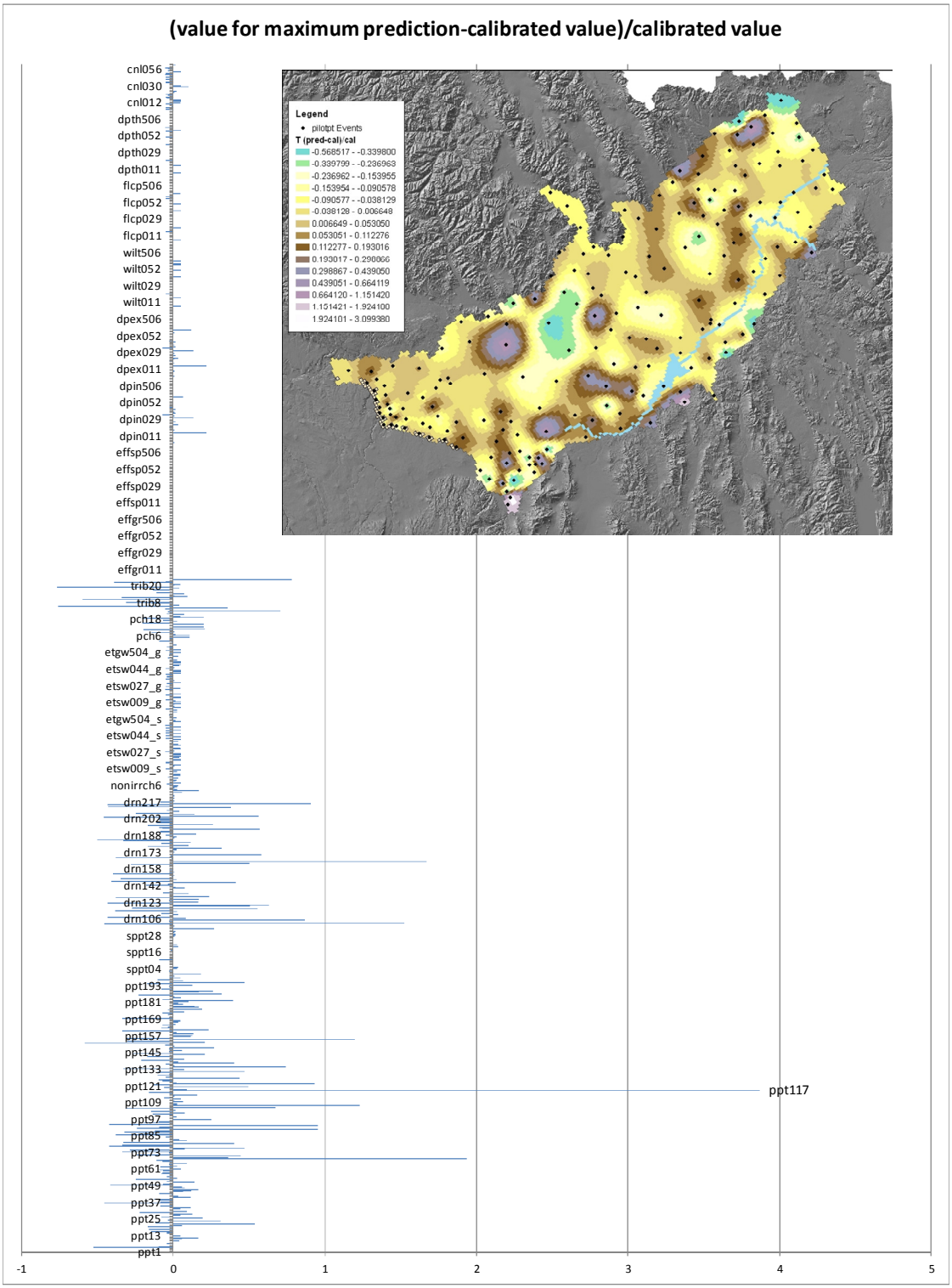


Impact of Water District 140 on near Blackfoot-Minidoka using calibration run E120116A008.





Impact of Water District 140 on near Blackfoot-Minidoka using calibration run E120116A008.



Appendix B

Parameter list and discriptions

ppt1	Pilot point 1
ppt2	Pilot point 2
ppt3	Pilot point 3
ppt4	Pilot point 4
ppt5	Pilot point 5
ppt6	Pilot point 6
ppt7	Pilot point 7
ppt8	Pilot point 8
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sppt28 Specific yield point 28
a_r_cond Riverbed conductance for Ashton-Rexburg reach
h_s_cond Riverbed conductance for Heise-Shelley reach
s_b_cond Riverbed conductance for Shelley-near Blackfoot reach
b_n_cond Riverbed conductance for near Blackfoot-Neeley reach
amf_cond Riverbed conductance for bottom of American Falls Reservoir
n_m_cond Riverbed conductance for Neeley-Minidoka reach
drn101 Conductance for drain 101
drn102 Conductance for drain 102
drn103 Conductance for drain 103
drn104 Conductance for drain 104
drn105 Conductance for drain 105
drn106 Conductance for drain 106
drn108 Conductance for drain 108
drn109 Conductance for drain 109
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drn112 Conductance for drain 112
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drn116 Conductance for drain 116
drn117 Conductance for drain 117
drn119 Conductance for drain 119
drn120 Conductance for drain 120
drn122 Conductance for drain 122

drn123 Conductance for drain 123
drn125 Conductance for drain 125
drn126 Conductance for one of the drains in the Malad complex
drn128 Conductance for one of the drains in the Malad complex
drn129 Conductance for one of the drains in the Malad complex
drn130 Conductance for one of the drains in the Malad complex
drn133 Conductance for drain 133
drn135 Conductance for drain 135
drn136 Conductance for drain 136
drn137 Conductance for drain 137
drn139 Conductance for drain 139
drn140 Conductance for drain 140
drn142 Conductance for drain 142
drn143 Conductance for drain 143
drn145 Conductance for drain 145
drn146 Conductance for drain 146
drn147 Conductance for drain 147
drn148 Conductance for one of the drains in the Three Springs complex
drn150 Conductance for one of the drains in the Three Springs complex.
drn151 Conductance for drain 151
drn153 Conductance for drain 153
drn154 Conductance for the drain representing Rangen
drn155 Conductance for one of the drains representing National Fish Hatchery/Magic
drn157 Conductance for one of the drains representing National Fish Hatchery/Magic
drn158 Conductance for one of the drains representing Thousand Springs/Magic
drn160 Conductance for one of the drains representing Thousand Springs/Magic
drn161 Conductance for drain 161
drn162 Conductance for drain 162
drn163 Conductance for drain 163
drn164 Conductance for one of the drains representing Sand Springs
drn165 Conductance for one of the drains representing Sand Springs
drn166 Conductance for drain 166
drn167 Conductance for drain 167
drn170 Conductance for drain 170
drn171 Conductance for drain 171
drn172 Conductance for drain 172
drn173 Conductance for the drain representing Briggs
drn174 Conductance for one of the drains representing Clear Lakes
drn176 Conductance for one of the drains representing Clear Lakes
drn177 Conductance for one of the drains representing Clear Lakes
drn179 Conductance for one of the drains representing Clear Lakes
drn180 Conductance for drain 180

drn181 Conductance for drain 181
drn182 Conductance for drain 182
drn184 Conductance for drain 194
drn185 Conductance for one of the drains representing Niagara
drn186 Conductance for one of the drains representing Niagara
drn187 Conductance for drain 187
drn188 Conductance for drain 188
drn189 Conductance for drain 189
drn190 Conductance for drain 190
drn191 Conductance for drain 191
drn193 Conductance for drain 193
drn194 Conductance for drain 194
drn195 Conductance for drain 195
drn196 Conductance for drain 196
drn197 Conductance for drain 197
drn199 Conductance for drain 199
drn200 Conductance for drain 200
drn201 Conductance for drain 201
drn202 Conductance for the drain representing Blue Lake
drn203 Conductance for drain 203
drn205 Conductance for drain 205
drn206 Conductance for drain 206
drn208 Conductance for drain 208
drn209 Conductance for one of the drains representing Devils Corral
drn210 Conductance for one of the drains representing Devils Corral
drn211 Conductance for the drain representing Devils Washbowl
drn212 Conductance for drain 212
drn213 Conductance for drain 213
drn214 Conductance for drain 214
drn216 Conductance for drain 216
drn217 Conductance for drain 217
ghb001 General head boundary conductance for Lower Salmon Falls-King Hill reach
ghb002 General head boundary conductance for Buhl-Lower Salmon Falls reach
ghb003 General head boundary conductance for Thousand Springs/Magic/Ntl Fish Hatchery
ghb004 General head boundary conductance for Blue Heart
ghb005 General head boundary conductance for Kimberly-Buhl reach
ghb006 General head boundary conductance for Crystal Springs
nonirrch1 Scalar for non-irrigated recharge on thin soil in polygon 1
nonirrch2 Scalar for non-irrigated recharge on thin soil in polygon 2
nonirrch3 Scalar for non-irrigated recharge on thin soil in polygon 3
nonirrch4 Scalar for non-irrigated recharge on thin soil in polygon 4
nonirrch5 Scalar for non-irrigated recharge on thin soil in polygon 5

nonirrch6 Scalar for non-irrigated recharge on rock in polygon 6
nonirrch7 Scalar for non-irrigated recharge on rock in polygon 7
nonirrch8 Scalar for non-irrigated recharge on rock in polygon 8
nonirrch9 Scalar for non-irrigated recharge on thick soil in polygon 9
nonirrch10 Scalar for non-irrigated recharge thick soil in polygon 10
nonirrch11 Scalar for on-irrigated recharge thick soil in polygon 11
wetlands ET from wetlands scalar
etsw000_s ET scalar for sprinkler irrigated land in the null entity
etsw001_s ET scalar for sprinkler irrigated land in the A&B entity
etsw002_s ET scalar for sprinkler irrigated land in the Aberdeen-Springfield entity
etsw005_s ET scalar for sprinkler irrigated land in the Big Lost River entity
etsw008_s ET scalar for sprinkler irrigated land in the Blaine Co entity
etsw009_s ET scalar for sprinkler irrigated land in the Burgess entity
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etsw011_s ET scalar for sprinkler irrigated land in the Butte/Market Lake entity
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etsw032_s ET scalar for sprinkler irrigated land in the Northside entity
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etsw055_s ET scalar for sprinkler irrigated land in the Labelle entity
etsw056_s ET scalar for sprinkler irrigated land in the Sugar City entity

etsw057_s ET scalar for sprinkler irrigated land in the Blackfoot-Chubbuck entity
etsw058_s ET scalar for sprinkler irrigated land in the American Falls 2 entity
etsw059_s ET scalar for sprinkler irrigated land in the Gooding-Richfield entity
etgw501_s ET scalar for sprinkler irrigated land in Ground Water entity 501
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etgw503_s ET scalar for sprinkler irrigated land in Ground Water entity 503
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etgw507_s ET scalar for sprinkler irrigated land in Ground Water entity 507
etgw508_s ET scalar for sprinkler irrigated land in Ground Water entity 508
etgw509_s ET scalar for sprinkler irrigated land in Ground Water entity 509
etgw600_s ET scalar for sprinkler irrigated land in Ground Water entity 600
etsw000_g ET scalar for gravity irrigated land in the null entity
etsw001_g ET scalar for gravity irrigated land in the A&B entity
etsw002_g ET scalar for gravity irrigated land in the Aberdeen-Springfield entity
etsw005_g ET scalar for gravity irrigated land in the Big Lost River entity
etsw008_g ET scalar for gravity irrigated land in the Blaine Co entity
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etsw039_g ET scalar for gravity irrigated land in the Chester entity
etsw040_g ET scalar for gravity irrigated land in the Oakley entity

etsw044_g ET scalar for gravity irrigated land in the Monteview entity
etsw051_g ET scalar for gravity irrigated land in the Dubois entity
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etsw058_g ET scalar for gravity irrigated land in the American Falls 2 entity
etsw059_g ET scalar for gravity irrigated land in the Gooding-Richfield entity
etgw501_g ET scalar for gravity irrigated land in Ground Water entity 501
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etgw503_g ET scalar for gravity irrigated land in Ground Water entity 503
etgw504_g ET scalar for gravity irrigated land in Ground Water entity 504
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etgw507_g ET scalar for gravity irrigated land in Ground Water entity 507
etgw508_g ET scalar for gravity irrigated land in Ground Water entity 508
etgw509_g ET scalar for gravity irrigated land in Ground Water entity 509
etgw600_g ET scalar for gravity irrigated land in Ground Water entity 600
pch1 Perched seepage scalar for Camas Cr
pch2 Perched seepage scalar for segment 2 of the Big Lost River
pch3 Perched seepage scalar for segment 3 of the Big Lost River
pch4 Perched seepage scalar for segment 4 of the Big Lost River
pch5 Perched seepage scalar for the Little Lost River
pch6 Perched seepage scalar for Medicine Lodge Cr
pch7 Perched seepage scalar for Malad River
pch8 Perched seepage scalar for Birch Cr
pch9 Perched seepage scalar for segment 1 of the Big Lost River
pch10 Perched seepage scalar for Lone Tree
pch11 Perched seepage scalar for Basin 31 flood control basin
pch13 Perched seepage scalar for Mud Lake
pch14 Perched seepage scalar for Camas National Wildlife Refuge
pch15 Perched seepage scalar for Birch Cr hydropower Plant
pch16 Perched seepage scalar for Big Lost flood control basins
pch17 Perched seepage scalar for part of Twin Falls Canal
pch18 Perched seepage scalar for Lake Murtaugh
pch19 Perched seepage scalar for segment 1 of Beaver Cr
pch20 Perched seepage scalar for segment 2 of Beaver Cr
pch21 Perched seepage scalar for segment 1 of Little Wood River
pch22 Perched seepage scalar for Big Wood and segment 2 of Little Wood River
trib1 Tributary underflow scalar for Little Lost River
trib2 Tributary underflow scalar for Medicine Lodge Cr

trib3 Tributary underflow scalar for Birch Cr
trib4 Tributary underflow scalar for Beaver Cr
trib5 Tributary underflow scalar for Blackfoot River
trib6 Tributary underflow scalar for Silver Cr
trib7 Tributary underflow scalar for Little Wood River
trib8 Tributary underflow scalar for Big Wood River
trib9 Tributary underflow scalar for Teton River
trib10 Tributary underflow scalar for Rexburg Bench
trib11 Tributary underflow scalar for South Fork (Palisade)
trib12 Tributary underflow scalar for Willow Cr
trib13 Tributary underflow scalar for Bannock Cr (Am Falls)
trib14 Tributary underflow scalar for Raft River
trib15 Tributary underflow scalar for Big Lost River
trib16 Tributary underflow scalar for Henrys Fork
trib17 Tributary underflow scalar for Thorn Cr
trib18 Tributary underflow scalar for Clover Cr
trib19 Tributary underflow scalar for Lincoln and Ross Cr
trib20 Tributary underflow scalar for Portneuf River
trib21 Tributary underflow scalar for Rock Cr
trib22 Tributary underflow scalar for Goose Cr
trib23 Tributary underflow scalar for Rattle Snake and Pine Cr
trib24 Tributary underflow scalar for Camas Cr@
effgr000_g Maximum efficiency for gravity irrigated land in the null entity
effgr001_g Maximum efficiency for gravity irrigated land in the A&B entity
effgr002_g Maximum efficiency for gravity irrigated land in the Aberdeen-Springfield entity
effgr005_g Maximum efficiency for gravity irrigated land in the Big Lost River entity
effgr008_g Maximum efficiency for gravity irrigated land in the Blaine Co entity
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effgr029_g Maximum efficiency for gravity irrigated land in the Mud Lake entity

effgr030_g Maximum efficiency for gravity irrigated land in the New Sweden entity
effgr032_g Maximum efficiency for gravity irrigated land in the Northside entity
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effgr058_g Maximum efficiency for gravity irrigated land in the American Falls 2 entity
effgr059_g Maximum efficiency for gravity irrigated land in the Gooding-Richfield entity
effgr501_g Maximum efficiency for gravity irrigated land in Ground Water entity 501
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effgr503_g Maximum efficiency for gravity irrigated land in Ground Water entity 503
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effgr507_g Maximum efficiency for gravity irrigated land in Ground Water entity 507
effgr508_g Maximum efficiency for gravity irrigated land in Ground Water entity 508
effgr509_g Maximum efficiency for gravity irrigated land in Ground Water entity 509
effgr600_g Maximum efficiency for gravity irrigated land in Ground Water entity 600
effsp000_g Maximum efficiency for sprinkler irrigated land in the null entity
effsp001_g Maximum efficiency for sprinkler irrigated land in the A&B entity
effsp002_g Maximum efficiency for sprinkler irrigated land in the Aberdeen-Springfield entity
effsp005_g Maximum efficiency for sprinkler irrigated land in the Big Lost River entity
effsp008_g Maximum efficiency for sprinkler irrigated land in the Blaine Co entity
effsp009_g Maximum efficiency for sprinkler irrigated land in the Burgess entity
effsp010_g Maximum efficiency for sprinkler irrigated land in the Burley entity
effsp011_g Maximum efficiency for sprinkler irrigated land in the Butte/Market Lake entity
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effsp019_g Maximum efficiency for sprinkler irrigated land in the Fort Hall entity

effsp020_g Maximum efficiency for sprinkler irrigated land in the Harrison entity
effsp022_g Maximum efficiency for sprinkler irrigated land in the Idaho entity
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effsp029_g Maximum efficiency for sprinkler irrigated land in the Mud Lake entity
effsp030_g Maximum efficiency for sprinkler irrigated land in the New Sweden entity
effsp032_g Maximum efficiency for sprinkler irrigated land in the Northside entity
effsp034_g Maximum efficiency for sprinkler irrigated land in the Peoples entity
effsp035_g Maximum efficiency for sprinkler irrigated land in the Progressive entity
effsp036_g Maximum efficiency for sprinkler irrigated land in the Liberty entity
effsp037_g Maximum efficiency for sprinkler irrigated land in the Reno entity
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effsp058_g Maximum efficiency for sprinkler irrigated land in the American Falls 2 entity
effsp059_g Maximum efficiency for sprinkler irrigated land in the Gooding-Richfield entity
effsp501_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 501
effsp502_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 502
effsp503_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 503
effsp504_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 504
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effsp506_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 506
effsp507_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 507
effsp508_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 508
effsp509_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 509
effsp600_g Maximum efficiency for sprinkler irrigated land in Ground Water entity 600
dpin000 Deep percolation fraction for inefficient loss for irrigated land in the null entity
dpin001 Deep percolation fraction for inefficient loss for irrigated land in the A&B entity
dpin002 Deep percolation fraction for inefficient loss for irrigated land in the Aberdeen-Springfield entity
dpin005 Deep percolation fraction for inefficient loss for irrigated land in the Big Lost River entity
dpin008 Deep percolation fraction for inefficient loss for irrigated land in the Blaine Co entity
dpin009 Deep percolation fraction for inefficient loss for irrigated land in the Burgess entity
dpin010 Deep percolation fraction for inefficient loss for irrigated land in the Burley entity

dpin011 Deep percolation fraction for inefficient loss for irrigated land in the Butte/Market Lake entity
dpin012 Deep percolation fraction for inefficient loss for irrigated land in the Canyon entity
dpin014 Deep percolation fraction for inefficient loss for irrigated land in the Blackfoot entity
dpin015 Deep percolation fraction for inefficient loss for irrigated land in the Dewey entity
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dpin018 Deep percolation fraction for inefficient loss for irrigated land in the Falls entity
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dpin022 Deep percolation fraction for inefficient loss for irrigated land in the Idaho entity
dpin025 Deep percolation fraction for inefficient loss for irrigated land in the Little Wood entity
dpin027 Deep percolation fraction for inefficient loss for irrigated land in the Milner entity
dpin028 Deep percolation fraction for inefficient loss for irrigated land in the Minidoka entity
dpin029 Deep percolation fraction for inefficient loss for irrigated land in the Mud Lake entity
dpin030 Deep percolation fraction for inefficient loss for irrigated land in the New Sweden entity
dpin032 Deep percolation fraction for inefficient loss for irrigated land in the Northside entity
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dpin035 Deep percolation fraction for inefficient loss for irrigated land in the Progressive entity
dpin036 Deep percolation fraction for inefficient loss for irrigated land in the Liberty entity
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dpin057 Deep percolation fraction for inefficient loss for irrigated land in the Blackfoot-Chubbuck entity
dpin058 Deep percolation fraction for inefficient loss for irrigated land in the American Falls 2 entity
dpin059 Deep percolation fraction for inefficient loss for irrigated land in the Gooding-Richfield entity
dpin501 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 501
dpin502 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 502
dpin503 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 503
dpin504 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 504
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dpin506 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 506
dpin507 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 507
dpin508 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 508
dpin509 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 509

dpin600 Deep percolation fraction for inefficient loss for irrigated land in Ground Water entity 600
dpex000 Deep percolation fraction for excess water for irrigated land in the null entity
dpex001 Deep percolation fraction for excess water for irrigated land in the A&B entity
dpex002 Deep percolation fraction for excess water for irrigated land in the Aberdeen-Springfield entity
dpex005 Deep percolation fraction for excess water for irrigated land in the Big Lost River entity
dpex008 Deep percolation fraction for excess water for irrigated land in the Blaine Co entity
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dpex058 Deep percolation fraction for excess water for irrigated land in the American Falls 2 entity
dpex059 Deep percolation fraction for excess water for irrigated land in the Gooding-Richfield entity
dpex501 Deep percolation fraction for excess water for irrigated land in Ground Water entity 501

dpex502 Deep percolation fraction for excess water for irrigated land in Ground Water entity 502
dpex503 Deep percolation fraction for excess water for irrigated land in Ground Water entity 503
dpex504 Deep percolation fraction for excess water for irrigated land in Ground Water entity 504
dpex505 Deep percolation fraction for excess water for irrigated land in Ground Water entity 505
dpex506 Deep percolation fraction for excess water for irrigated land in Ground Water entity 506
dpex507 Deep percolation fraction for excess water for irrigated land in Ground Water entity 507
dpex508 Deep percolation fraction for excess water for irrigated land in Ground Water entity 508
dpex509 Deep percolation fraction for excess water for irrigated land in Ground Water entity 509
dpex600 Deep percolation fraction for excess water for irrigated land in Ground Water entity 600
wilt000 Wilting point for irrigated land in the null entity
wilt001 Wilting point for irrigated land in the A&B entity
wilt002 Wilting point for irrigated land in the Aberdeen-Springfield entity
wilt005 Wilting point for irrigated land in the Big Lost River entity
wilt008 Wilting point for irrigated land in the Blaine Co entity
wilt009 Wilting point for irrigated land in the Burgess entity
wilt010 Wilting point for irrigated land in the Burley entity
wilt011 Wilting point for irrigated land in the Butte/Market Lake entity
wilt012 Wilting point for irrigated land in the Canyon entity
wilt014 Wilting point for irrigated land in the Blackfoot entity
wilt015 Wilting point for irrigated land in the Dewey entity
wilt016 Wilting point for irrigated land in the Egin entity
wilt018 Wilting point for irrigated land in the Falls entity
wilt019 Wilting point for irrigated land in the Fort Hall entity
wilt020 Wilting point for irrigated land in the Harrison entity
wilt022 Wilting point for irrigated land in the Idaho entity
wilt025 Wilting point for irrigated land in the Little Wood entity
wilt027 Wilting point for irrigated land in the Milner entity
wilt028 Wilting point for irrigated land in the Minidoka entity
wilt029 Wilting point for irrigated land in the Mud Lake entity
wilt030 Wilting point for irrigated land in the New Sweden entity
wilt032 Wilting point for irrigated land in the Northside entity
wilt034 Wilting point for irrigated land in the Peoples entity
wilt035 Wilting point for irrigated land in the Progressive entity
wilt036 Wilting point for irrigated land in the Liberty entity
wilt037 Wilting point for irrigated land in the Reno entity
wilt038 Wilting point for irrigated land in the Rexburg entity
wilt039 Wilting point for irrigated land in the Chester entity
wilt040 Wilting point for irrigated land in the Oakley entity
wilt044 Wilting point for irrigated land in the Monteview entity
wilt051 Wilting point for irrigated land in the Dubois entity
wilt052 Wilting point for irrigated land in the Small entity
wilt053 Wilting point for irrigated land in the Howe entity

wilt055 Wilting point for irrigated land in the Labelle entity
wilt056 Wilting point for irrigated land in the Sugar City entity
wilt057 Wilting point for irrigated land in the Blackfoot-Chubbuck entity
wilt058 Wilting point for irrigated land in the American Falls 2 entity
wilt059 Wilting point for irrigated land in the Gooding-Richfield entity
wilt501 Wilting point for irrigated land in Ground Water entity 501
wilt502 Wilting point for irrigated land in Ground Water entity 502
wilt503 Wilting point for irrigated land in Ground Water entity 503
wilt504 Wilting point for irrigated land in Ground Water entity 504
wilt505 Wilting point for irrigated land in Ground Water entity 505
wilt506 Wilting point for irrigated land in Ground Water entity 506
wilt507 Wilting point for irrigated land in Ground Water entity 507
wilt508 Wilting point for irrigated land in Ground Water entity 508
wilt509 Wilting point for irrigated land in Ground Water entity 509
wilt600 Wilting point for irrigated land in Ground Water entity 600
flcp000 Field capacity for irrigated land in the null entity
flcp001 Field capacity for irrigated land in the A&B entity
flcp002 Field capacity for irrigated land in the Aberdeen-Springfield entity
flcp005 Field capacity for irrigated land in the Big Lost River entity
flcp008 Field capacity for irrigated land in the Blaine Co entity
flcp009 Field capacity for irrigated land in the Burgess entity
flcp010 Field capacity for irrigated land in the Burley entity
flcp011 Field capacity for irrigated land in the Butte/Market Lake entity
flcp012 Field capacity for irrigated land in the Canyon entity
flcp014 Field capacity for irrigated land in the Blackfoot entity
flcp015 Field capacity for irrigated land in the Dewey entity
flcp016 Field capacity for irrigated land in the Egin entity
flcp018 Field capacity for irrigated land in the Falls entity
flcp019 Field capacity for irrigated land in the Fort Hall entity
flcp020 Field capacity for irrigated land in the Harrison entity
flcp022 Field capacity for irrigated land in the Idaho entity
flcp025 Field capacity for irrigated land in the Little Wood entity
flcp027 Field capacity for irrigated land in the Milner entity
flcp028 Field capacity for irrigated land in the Minidoka entity
flcp029 Field capacity for irrigated land in the Mud Lake entity
flcp030 Field capacity for irrigated land in the New Sweden entity
flcp032 Field capacity for irrigated land in the Northside entity
flcp034 Field capacity for irrigated land in the Peoples entity
flcp035 Field capacity for irrigated land in the Progressive entity
flcp036 Field capacity for irrigated land in the Liberty entity
flcp037 Field capacity for irrigated land in the Reno entity
flcp038 Field capacity for irrigated land in the Rexburg entity

flcp039 Field capacity for irrigated land in the Chester entity
flcp040 Field capacity for irrigated land in the Oakley entity
flcp044 Field capacity for irrigated land in the Monteview entity
flcp051 Field capacity for irrigated land in the Dubois entity
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flcp056 Field capacity for irrigated land in the Sugar City entity
flcp057 Field capacity for irrigated land in the Blackfoot-Chubbuck entity
flcp058 Field capacity for irrigated land in the American Falls 2 entity
flcp059 Field capacity for irrigated land in the Gooding-Richfield entity
flcp501 Field capacity for irrigated land in Ground Water entity 501
flcp502 Field capacity for irrigated land in Ground Water entity 502
flcp503 Field capacity for irrigated land in Ground Water entity 503
flcp504 Field capacity for irrigated land in Ground Water entity 504
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flcp506 Field capacity for irrigated land in Ground Water entity 506
flcp507 Field capacity for irrigated land in Ground Water entity 507
flcp508 Field capacity for irrigated land in Ground Water entity 508
flcp509 Field capacity for irrigated land in Ground Water entity 509
flcp600 Field capacity for irrigated land in Ground Water entity 600
dpth000 Rooting depth for irrigated land in the null entity
dpth001 Rooting depth for irrigated land in the A&B entity
dpth002 Rooting depth for irrigated land in the Aberdeen-Springfield entity
dpth005 Rooting depth for irrigated land in the Big Lost River entity
dpth008 Rooting depth for irrigated land in the Blaine Co entity
dpth009 Rooting depth for irrigated land in the Burgess entity
dpth010 Rooting depth for irrigated land in the Burley entity
dpth011 Rooting depth for irrigated land in the Butte/Market Lake entity
dpth012 Rooting depth for irrigated land in the Canyon entity
dpth014 Rooting depth for irrigated land in the Blackfoot entity
dpth015 Rooting depth for irrigated land in the Dewey entity
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dpth020 Rooting depth for irrigated land in the Harrison entity
dpth022 Rooting depth for irrigated land in the Idaho entity
dpth025 Rooting depth for irrigated land in the Little Wood entity
dpth027 Rooting depth for irrigated land in the Milner entity
dpth028 Rooting depth for irrigated land in the Minidoka entity
dpth029 Rooting depth for irrigated land in the Mud Lake entity
dpth030 Rooting depth for irrigated land in the New Sweden entity

dpth032 Rooting depth for irrigated land in the Northside entity
dpth034 Rooting depth for irrigated land in the Peoples entity
dpth035 Rooting depth for irrigated land in the Progressive entity
dpth036 Rooting depth for irrigated land in the Liberty entity
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dpth051 Rooting depth for irrigated land in the Dubois entity
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dpth057 Rooting depth for irrigated land in the Blackfoot-Chubbuck entity
dpth058 Rooting depth for irrigated land in the American Falls 2 entity
dpth059 Rooting depth for irrigated land in the Gooding-Richfield entity
dpth501 Rooting depth for irrigated land in Ground Water entity 501
dpth502 Rooting depth for irrigated land in Ground Water entity 502
dpth503 Rooting depth for irrigated land in Ground Water entity 503
dpth504 Rooting depth for irrigated land in Ground Water entity 504
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dpth507 Rooting depth for irrigated land in Ground Water entity 507
dpth508 Rooting depth for irrigated land in Ground Water entity 508
dpth509 Rooting depth for irrigated land in Ground Water entity 509
dpth600 Rooting depth for irrigated land in Ground Water entity 600
cnl001 Scalar for canal seepage in the A&B entity
cnl002 Scalar for canal seepage in the Aberdeen-Springfield entity
cnl005 Scalar for canal seepage in the Big Lost River entity
cnl008 Scalar for canal seepage in the Blaine County entity
cnl009 Scalar for canal seepage in the Burgess entity
cnl010 Scalar for canal seepage in the Burley entity
cnl011 Scalar for canal seepage in the Butte/Market Lake entity
cnl012 Scalar for canal seepage in the Canyon entity
cnl014 Scalar for canal seepage in the Blackfoot entity
cnl015 Scalar for canal seepage in the Dewey entity
cnl016 Scalar for canal seepage in the Egin entity
cnl018 Scalar for canal seepage in the Falls entity
cnl019 Scalar for canal seepage in the Fort Hall entity
cnl020 Scalar for canal seepage in the Harrison entity
cnl022 Scalar for canal seepage in the Idaho entity

cnl025 Scalar for canal seepage in the Little Wood entity
cnl027 Scalar for canal seepage in the Milner entity
cnl028 Scalar for canal seepage in the Minidoka entity
cnl029 Scalar for canal seepage in the Mud Lake entity
cnl030 Scalar for canal seepage in the New Sweden entity
cnl032 Scalar for canal seepage in the Northside entity
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cnl037 Scalar for canal seepage in the Reno entity
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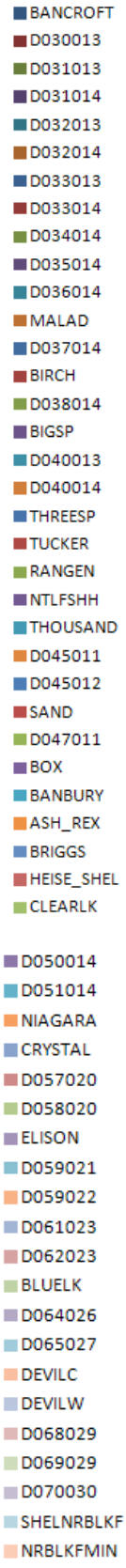
cnl040 Scalar for canal seepage in the Oakley entity
cnl044 Scalar for canal seepage in the Montvew entity
cnl053 Scalar for canal seepage in the Howe entity
cnl055 Scalar for canal seepage in the Labelle entity
cnl056 Scalar for canal seepage in the Sugar City entity
cnl057 Scalar for canal seepage in the Blackfoot Chubbuck entity
cnl058 Scalar for canal seepage in the American Falls 2 entity
cnl059 Scalar for canal seepage in the Gooding-Richfield entity

Appendix C

Color ramp for pie diagrams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D030013
D031013
D031014
D032013
D032014
D033013
D033014
D034014
D035014
D036014
MALAD
D037014
BIRCH
D038014
BIGSP
D040013
D040014
THREESP
TUCKER
RANGEN
NTLFSHH
THOUSAND
D045011
D045012
SAND
D047011
BOX
BANBURY
ASH_REX
BRIGGS
HEISE_SHEL
CLEARLK
D050014
D051014
NIAGARA
CRYSTAL
D057020
D058020
ELISON
D059021
D059022
D061023
D062023
BLUELK
D064026
D065027
DEVILC
DEVILW
D068029
D069029
D070030
SHELNRBLKF
NRBLKFMIN