Utah Recovery Potential Screening and Independent Expert Elicitation Process

September, 2014

Like many state water quality programs, Utah Division of Water Quality (DWQ) is currently exploring methods to evaluate their nutrient-impaired watersheds and prioritize them for management. With assistance from the US Environmental Protection Agency Office of Water (EPA), the DWQ applied Recovery Potential Screening (RPS) for this purpose. An innovative aspect of the Utah Recovery Potential Screening process was the inclusion of an expert elicitation exercise to provide independent validation of the results of the Recovery Potential Screening. Expert elicitation involves comparing the immediate professional judgment of experts with personal knowledge of selected watersheds against the independently-derived RPS assessment results for the same watersheds.

DWQ and EPA developed a database of 150 recovery potential indicators to support this effort. Thirty three ecological, 75 stressor, and 42 social indicators were developed. Most of these indicators were calculated at two watershed scales from the national Watershed Boundary Database, which uses Hydrologic Unit Codes (HUCs). Statewide RPS data were compiled for the larger HUC8 scale (68 in Utah) and the smaller HUC12 scale (2,559 in Utah), enabling screenings to be performable at either watershed scale across Utah, within any part of the state, or within any defined subset of Utah's HUC8 or HUC12 watersheds.

Two RPS scenarios and six screening runs were developed to rank the recovery potential of watersheds from presumptive nutrient enrichment. Based on feedback from Utah Division of Water Quality, scenarios were developed to highlight two general settings: an urban/point-source dominated scenario and a rural/agricultural/non-point source dominated scenario. Scenario development enables identification of specific HUC8s that fit each scenario well and thus share some common properties of pollutants, sources and possible management strategies. A single HUC8 at a time is selected and its HUC12s screened and compared. After selecting one HUC8 each from the urban and rural scenarios, three urban screening runs and three rural screening runs were carried out on their HUC12s.

Urban scenario screenings were applied to the HUC12 watersheds in the Jordan River watershed (HUC 16020204). The Jordan River watershed was the third most urban HUC8, but was selected because it was the focus of initial workshop recovery potential discussions. Rural scenario screenings were applied to the HUC12 watersheds in the Middle Bear watershed (HUC 16010202). Table 1 identifies the indicators selected for the urban screening runs, and Figure 1 illustrates the mapped results for Urban Screening Run 1.

Table 1. Indicators selected for urban screening runs. Green represents ecological indicators, red represents stressor indicators and blue indicates social indicators.

Indicators	Screening Runs		
Indicator Name	**Urban1**	**Urban2**	**Urban3**
Percent Forest	X		X
Percent Natural Cover	X	X	X
Ratio of mean minimum monthly flows to maximum monthly flows (HYDR_AVE)	X	X	X
HUC average annual mean of monthly precipitation (MEANP_AVE)		X	X
Number of permitted dischargers (#UPDES)	X		
Mean Total Nitrogen from DWQ data (Mean TN)		X	

Indicators	Screening Runs		
Indicator Name	Urban1	Urban2	Urban3
Mean Total Phosphorus from DWQ data (Mean TP)		X	
Sampled summer TN divided by predicted mean summer natural background (TN%Mean)	X		X
Sampled TP divided by predicted mean natural background (TP%Mean)	X		X
Number of water returns (#Returns)	X	X	X
Number of publically-owned treatment works within HUC (POTW)	X		
Unstable area in 20 meter corridor with slope greater than 3 degrees (PercentUnstable)	X		
Watershed percent impervious cover by area (PercentImpervious)		X	
Watershed paved road density as length over area (RoadDensityAll)			X
Current Urban % per HUC minus Past Urban % per HUC (PercentIncreaseUrban)	X	X	X
Number of threatened and endangered species (# T&E spp)	X	X	X
Major Fishing River Private (Km)		X	
Major Fish Public Access (Km)	X	X	
Count index - jurisdiction. Inverted so lower count is higher score (# Jurisdictions.1Inv)	X	X	X
Median income per HUC (Income)	X		X
Percent of people in HUC with Bachelor's Degree or Graduate degree (EducationPercent)		X	
Total recreational use value calculated per HUC (REC USE VALUE)			X

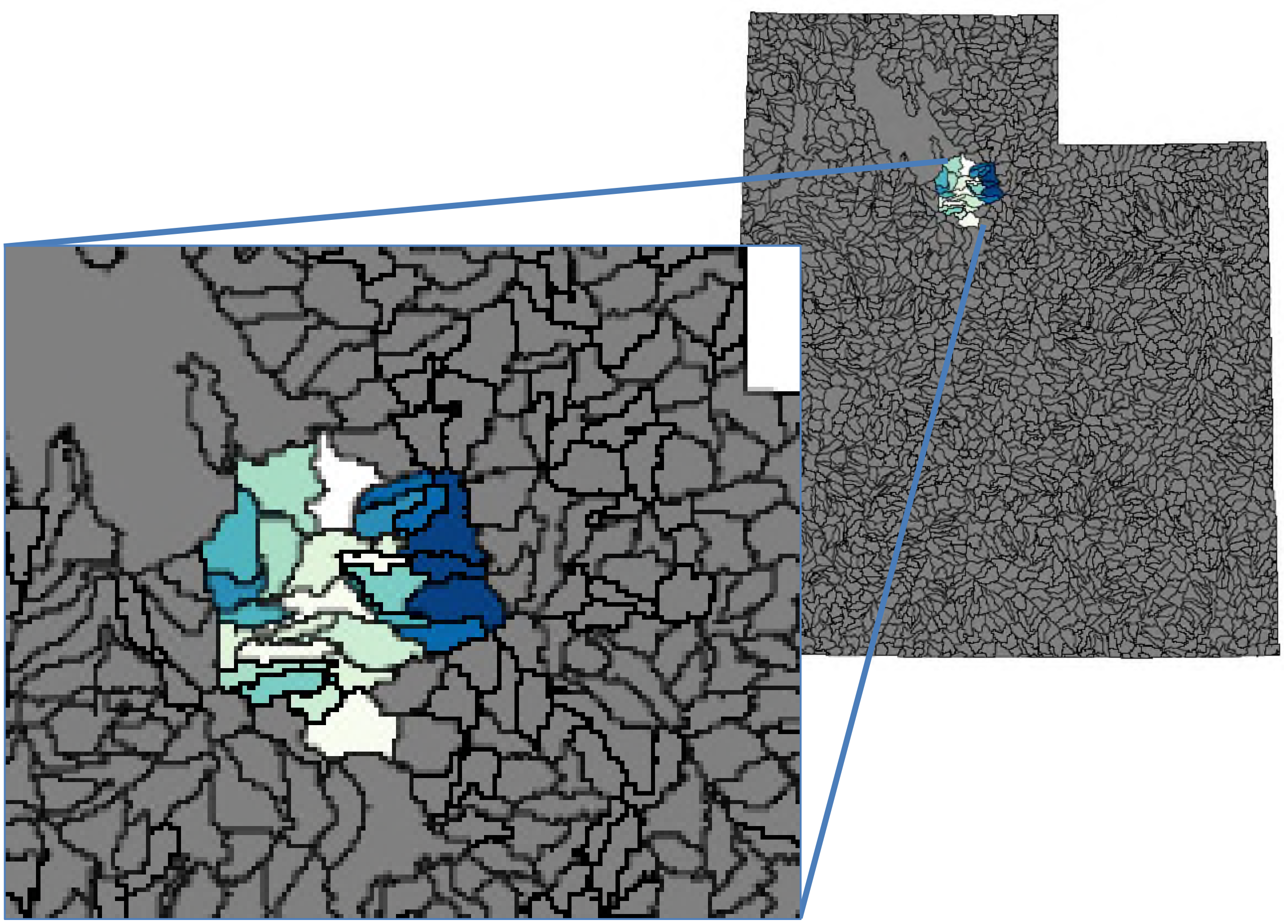

Figure 1. Jordan River Watersheds RPI Score (darker colored watersheds have a higher recovery potential integrated score)

Expert Elicitation – Comparing Recovery Potential Screening to Expert Rankings

Two exercises were conducted to provide a ranking of Jordan Watershed HUC12s outside of the RPS Tool process to allow for an independent comparison of the results of the watershed ranks. The first round was based on the immediate professional judgment of experts with personal knowledge of the watersheds, but without consideration of data. The second round was based on professional judgment using raw, unscored data but no scoring, weighting or combining of scores. The second round also included participants identifying which variables they used and weightings they may have applied, judgmentally.

The round 2 ranking was not completed by any of the Utah experts prior to the workshop; in part, due to the difficulty of ranking by so many (150) variables simultaneously. This emphasizes one important aspect of the RPS process – it reduces the multiple factors or dimensionality of the recovery evaluation process by combining them into synthetic indices. By selecting indicators and applying weights, one can quickly reduce the complexity of the process and operationalize professional decision-making into a systematic and replicable process – two important aspects of defensibility.

The round 1 ranking was conducted by most Utah expert participants. High, medium or low rankings were assigned to each watershed, by trisecting the experts' judgment based ranks of how likely recovery would be. High, medium and low rankings were aggregated to create an expert consensus rank for each watershed. In parallel, an outside expert in general nutrient impacts on streams unfamiliar with the specific watersheds used the recovery potential tool to score the same watersheds, trisecting the resulting recovery potential index (RPI) scores into low, medium, and high qualitative ranks.

Only 4 watersheds varied in their qualitative rankings; none of these were considered consensus high recovery watersheds and none varied by more than one rank (Table 2). For example, the outlets to Little and Big Cottonwood Canyons were considered low by Utah experts but medium by the independent urban scenario RPI scores. These scores were buoyed in the RPI by relatively high social scores, even though stressor and ecology scores were low. Experts based their low scores on the fact that these were highly urban and channelized creeks; although channelization is a recommended RPS stressor indicator, there was no suitable data available for this specific project.

As another example, Corner Canyon-Jordan River was an expert consensus medium recovery potential watershed, whereas it scored low for the independent RPI. This watershed scored very low in ecological and stressor indices, and medium in social indices. Utah experts noted in their comments that this watershed was urbanizing; but, it had a large conserved land parcel that may have promise for infiltration treatment. That information may not have been quantified in the RPI, but the presence of proximate conservation land is a metric that could be added.

This expert elicitation exercise emphasizes that RPS is a methodology that synthesizes a great deal of complexity and results in a repeatable and transparent process that yields results consistent with expert judgment based on both local experience and objective outside consideration of factors important in nutrient stress and watershed protection/recovery. The relative consistency of ranks for nutrient recovery in this basin was striking.

Future RPS applications should consider applying these complementary validation approaches to strengthen confidence in the model results. Although in this example, a relatively small number of watersheds were evaluated, the RPS process can be replicated for thousands of watersheds, while providing the confidence that the results are replicating expert judgment. The expert approach has the added effect of reinforcing RPS concepts and facilitating its acceptance by expert users. The expert elicitation process becomes an added tool in the recovery potential toolbox.

Table 2. Comparison of Utah Expert consensus recovery potential ranking based on general professional judgment and ranking based on the average of Urban scenario ranks conducted by an outside expert using the RPS tool.

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<tr><th>HUC12</th><th>Name</th><th>Utah Experts</th><th>Average Outside Expert RPI Qualitative Rank</th><th>Average RPI Rank</th><th>RPI Comment</th><th>Expert Comments</th></tr>
<tr><td>160202011002</td><td>Outlet Dry Creek-Jordan River</td><td>Medium</td><td>Low</td><td>23</td><td></td><td></td></tr>
<tr><td>160202040101</td><td>Rose Creek</td><td>Medium</td><td>Medium</td><td>14</td><td></td><td></td></tr>
<tr><td>160202040102</td><td>Wood Hollow-Jordan River</td><td>Medium</td><td>Medium</td><td>18</td><td></td><td></td></tr>
<tr><td>160202040103</td><td>Butterfield Creek</td><td>Medium</td><td>Medium</td><td>12</td><td></td><td></td></tr>
<tr><td>160202040105</td><td>Corner Canyon-Jordan River</td><td>Medium</td><td>Low</td><td>19</td><td></td><td>Better to preserve, Galena WLP; Becoming urbanized; Potential wetland filtration</td></tr>
<tr><td>160202040107</td><td>Dry Creek-Jordan River</td><td>Low</td><td>Low</td><td>19</td><td></td><td></td></tr>
<tr><td>160202040201</td><td>Headwaters Big Cottonwood Canyon</td><td>High</td><td>High</td><td>2</td><td></td><td></td></tr>
<tr><td>160202040202</td><td>Headwaters Little Cottonwood Canyon</td><td>High</td><td>High</td><td>3</td><td></td><td></td></tr>
<tr><td>160202040204</td><td>Outlet Little Cottonwood Creek</td><td>Low</td><td>Medium</td><td>11</td><td rowspan="2">Generally Low Stressor and Ecology, Buoyed Socially</td><td>Highly urban channelized; Urbanized</td></tr>
<tr><td>160202040205</td><td>Outlet Big Cottonwood Creek</td><td>Low</td><td>Medium</td><td>13</td><td>Highly urban channelized; Urbanized</td></tr>
<tr><td>160202040206</td><td>Barneys Creek-Jordan River</td><td>Low</td><td>Low</td><td>25</td><td></td><td></td></tr>
<tr><td>160202040301</td><td>Headwaters Mill Creek</td><td>High</td><td>High</td><td>2</td><td></td><td></td></tr>
<tr><td>160202040302</td><td>Parleys Creek</td><td>Medium/High</td><td>High</td><td>3</td><td></td><td></td></tr>
<tr><td>160202040303</td><td>Emigration Creek</td><td>Medium/High</td><td>High</td><td>6</td><td></td><td></td></tr>
<tr><td>160202040305</td><td>Outlet Mill Creek</td><td>Low</td><td>Low</td><td>25</td><td></td><td></td></tr>
<tr><td>160202040306</td><td>Red Butte Creek-Emigration Creek</td><td>Low/Medium</td><td>Medium</td><td>9</td><td></td><td></td></tr>
<tr><td>160202040307</td><td>Parleys Creek-Jordan River</td><td>Low</td><td>Low</td><td>21</td><td></td><td></td></tr>
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