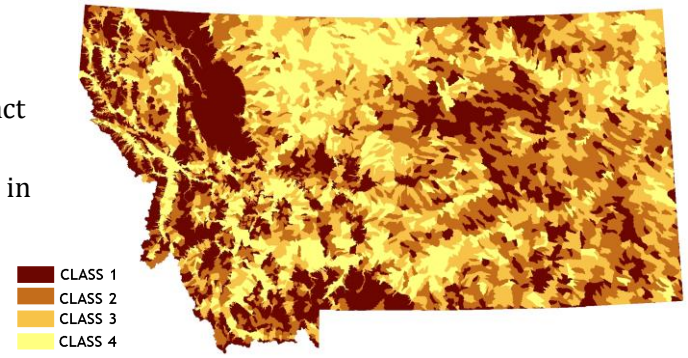
WATERSHED INTEGRITY



SUMMARY: We characterized the level of human impact on streams and river basins by creating a score of watershed integrity for each river basin and sub-basin in Montana. Watershed Integrity (WI) is a summation of human impacts that contribute to the impairment of streams and watersheds. The 13 variables are supported by literature as best predictors of watershed health in Pacific Northwest and Rocky Mountain streams and include impacts that are likely to affect water quality, water quantity, watershed connectivity, stream function, and the overall health of stream systems. Variables include: 1) % urban, 2) % riparian buffer as urban, 3) % cultivated cropland, 4) % riparian buffer as cultivated cropland, 5) road density, 6) road density in riparian buffer, 7) # producing oil / gas wells, 8) # unique points of irrigation diversion, 9) # surface / placer mines, 10) # dams with storage >20 surface acres, 11) presence of large in-stream reservoirs, 12) presence of impaired streams (303d listed by Dept of Environmental Quality), 13) # of Wetland Modification Project Permits (Army Corps of Engineer 404 permits).

MEASUREMENT UNIT: Upper and lower portions of 6th Code HUCs (4,271 in State)

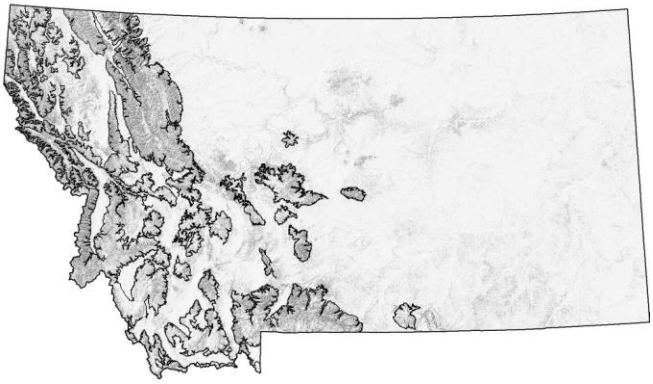
DATA SOURCE(S) / QUALITY: Montana Department of Natural Resources and Conservation: **water rights & points of diversion**; Montana Department of Environmental Quality: **303d list of impaired waterbodies**; Army Corps of Engineers: **404 Permits (Wetland Modification Project Permits);** US Census: **TGR Roads 2000**; Montana Natural Heritage Program: **land use**; Montana Natural Resource Information System: **mines, dams, oil and gas wells**. Montana Department of Revenue: **Farm Land Use-Type (FLU)**. All data sets used were current (within one year) at the time of publication and contained statewide coverage.

DATA SOURCES
- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- Extrapolation based on expert opinion

METHODS: Variables were summarized by 6th Code HUC and each HUC was given a score based on density, frequency or presence of each variable. In HUCs west of the lower Yellowstone and Missouri basins, HUCs were split into valley and mountain portions to account for differences in land use management and stream gradient. Valley segments of watersheds are generally lower in gradient, have a different suite of native species present, and have different ownership characteristics than mountainous stream reaches that are generally high gradient and publicly owned.

Variables used to represent watershed integrity were selected from literature as best explaining the variability seen in watershed health throughout Pacific Northwest and high elevation prairie streams. Variables presence, density, or frequency were summarized by 6th Code HUCs in prairie systems (lower Missouri and Yellowstone), and by sub-basin (upper and lower) for streams west of the lower Missouri and Yellowstone ecoregions. The elevation contour that best explained the division between valley and mountain topography was selected as the division between upper and lower portions of most western HUCs.



Map showing elevation contours used to divide HUCs into mountain and valley sub-basins

HUC scores for each variable ranged from 0 to 30 with five categories possible for most variables. Scoring breaks for each variable were made using the Natural Breaks (Jenks) Method of categorization. Variables shown by literature as being highly correlated to watershed health (% cultivated cropland, road density, % urban) received more weight than others. Calculations for riparian buffers are based on increasing buffer widths for stream orders 2 – 8, with buffers 5 to 246 meters, respectively. Each 6 th Code HUC score was calculated by adding scores for each variable and dividing by possible points, such that: WI Score = HUC total / total possible.

FINAL CATEGORIZATION: Scores for watershed integrity were normally distributed. We created four categories of watershed integrity based on quartiles that represented a gradient of integrity from highest to low. Perfect score for a watershed was 1.00, whereas the lowest scoring HUC was 0.48

CLASS	RANGE OF VALUES	SQUARE MILES (% of State)
1	0.901 - 1.00	40,669 (24%)
2	0.831 – 0.90	49,476 (29%)
3	0.766 – 0.83	42 265 (25%)
4	0 - 0.765	35,754 (21%)

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