

# GROUNDWATER RECHARGE TOPIC PAPER

## Appendix

Island County / WRIA 6 Watershed Planning Process

### Appendix 1.

#### Derivation of the CARA Susceptibility Map

The Washington Department of Ecology document entitled “Guidance Document for the Establishment of Critical Aquifer Recharge Area Ordinances” was utilized to provide the methodology for creation of the CARA Susceptibility Map. This document outlined a rating system, which could be used for evaluating aquifer susceptibility. The rating system focuses on three factors, which should be considered, these factors are:

1. The overall permeability of vadose zone material (this includes both the permeability of the soil and permeability of material underlying);
2. The thickness of the vadose zone (this may also be considered as the depth to water in unconfined conditions); and,
3. The amount of recharge available (either natural precipitation or artificial irrigation.

Each of these parameters is considered critical in determining susceptibility of underlying aquifers. The guidance document then provides procedures, which could be used to evaluate each of these factors, based upon data available to most jurisdictions. In general the procedures and methodologies outlined in the guidance document were followed in the creation of the CARA Susceptibility Map.

For several of the factors considered, Island County has data available that was considered of higher quality or accuracy than the data utilized in the guidance document. For example, the guidance document utilizes a rather simple method for estimating the amount of recharge available, based on average precipitation and potential evapotranspiration (PET). The USGS recently completed a four-year study in Island County, designed to estimate groundwater recharge. This study utilized a deep percolation model (DPM) which calculates recharge based on numerous factors including daily values of precipitation, precipitation throughfall (rain that reaches land surface beneath vegetation), air temperature, shortwave solar radiation, land-surface altitude, and properties of soils and land cover (vegetation type, surface water, or impervious surfaces), and "direct runoff." In cases where Island County had access to data that was considered more accurate than the data utilized in the DOE guidance document, such as the recharge estimates provided by the USGS study, this data was utilized, but the methodology for application of the data was derived from the guidance document. The specific procedure utilized to evaluate each parameter is discussed below.

#### **Soil Permeability**

Data pertaining to the permeability of soils was derived from the 1958 Soil Survey of Island County. Geographic Information System (GIS) data was obtained from the NRCS web site, including a map of soil type distribution and a table of parameters for each soil type, including soil percolation rates. Soil percolation rate was scored based on the scoring system recommended in the DOE guidance document resulting in the map shown in figure X.

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### Surficial Geology Permeability

Island County Health has a database containing well log data for wells within the county, this data includes stratigraphic descriptions which are geocoded to allow for automated evaluation of stratigraphy. Also included in the digital well data are depth to water measurements and estimations of land-surface altitude.

A short Visual Basic (VBA) program was developed within the database to spatially evaluate surficial geology. The program evaluated surficial geology in a 1000-foot grid across the spatial extents of the county. For each grid cell, the following method was used to derive a grade for surficial geology:

1. Search grid cell for wells that have depth to water (dtw) and stratigraphy data, wells should be accurately located (at least to a parcel) so that elevation estimates can be reasonably close.
2. If less than three wells (meeting above criteria) are found, expand search area until at least three are found.
3. Find the Maximum Water Level Elevation (MaxWLE), out of the selected wells and use that as the top of the aquifer (conservative).
4. Evaluate the stratigraphy above MaxWLE for each well, picking the lowest conductivity unit from each well that is at least five feet thick.
5. Find the highest conductivity section from the list of wells (provides the least protection) and use that to score Surficial Geology. Scoring is based on the system defined in the DOE guidance.

The above procedure yielded a grid of scores, which was imported into ArcGIS to create the surficial geology-rating map.

### Depth to Water

The water well database was also used to evaluate depth to water spatially across Island County. The VBA code described previously was modified to extract the minimum depth to water for each 1000-foot cell in the grid. Gridded depth to water values were graded using the DOE guidance scoring system, yielding the depth to water rating map.

### Groundwater Recharge

The results of the 2003 USGS report estimating groundwater recharge across Island County were utilized in the evaluation and scoring of the recharge parameter. Spatial distribution of recharge was derived from the DPM model output; recharge values were graded using the DOE guidance system yielding the recharge-rating map.

### Summary Aquifer Susceptibility

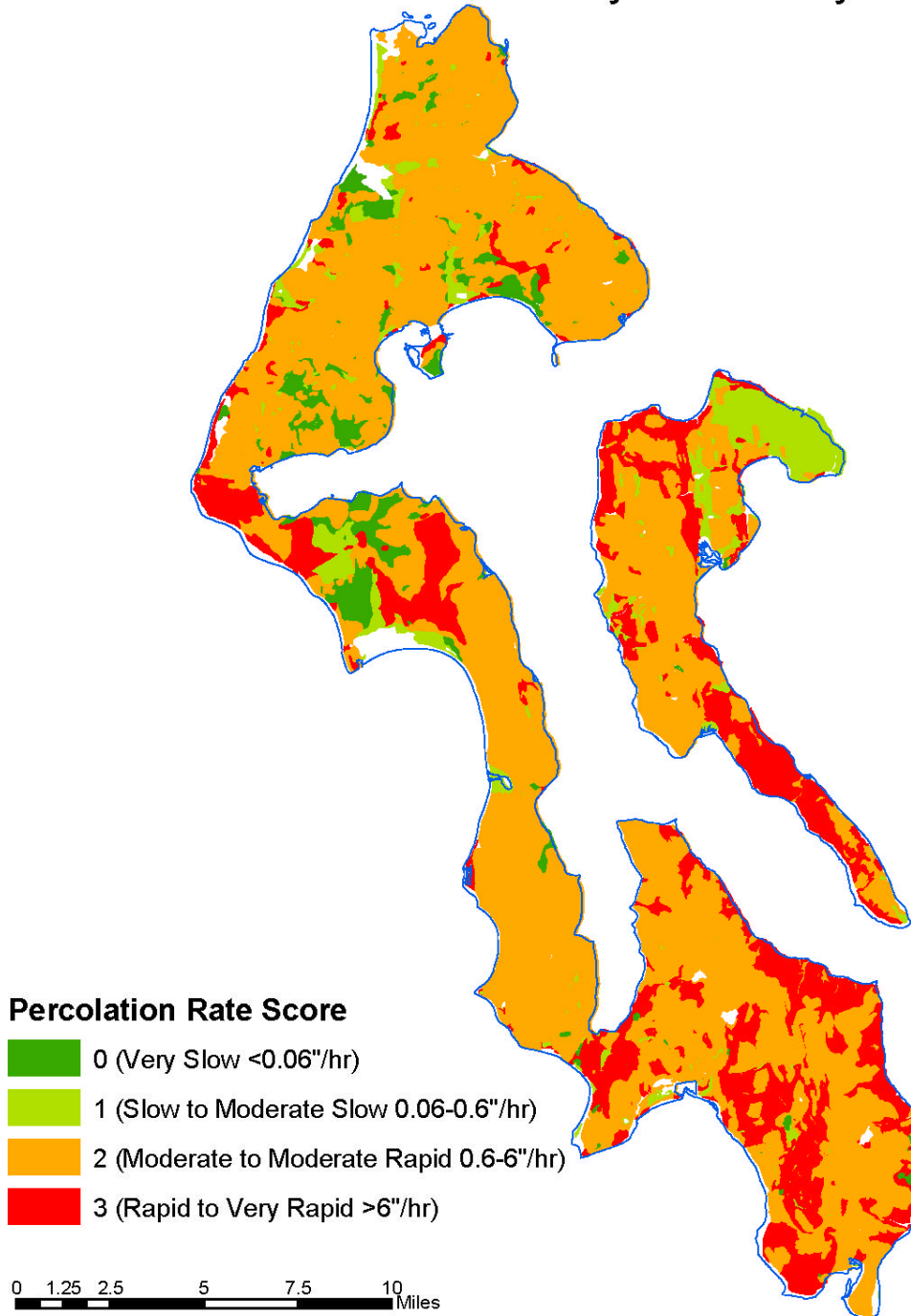
The procedures described above resulted in four maps, consisting of GIS polygons defining scoring of each of the parameters. GIS was then utilized to perform an addition of all four maps, summing the individual scores into a spatially varying summary score. The ranking of the summary score into low, medium and high susceptibility areas was accomplished using the DOE guidance scoring system, resulting in the Draft CARA Susceptibility map.

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### Soil Percolation Rate From Island County Soil Survey



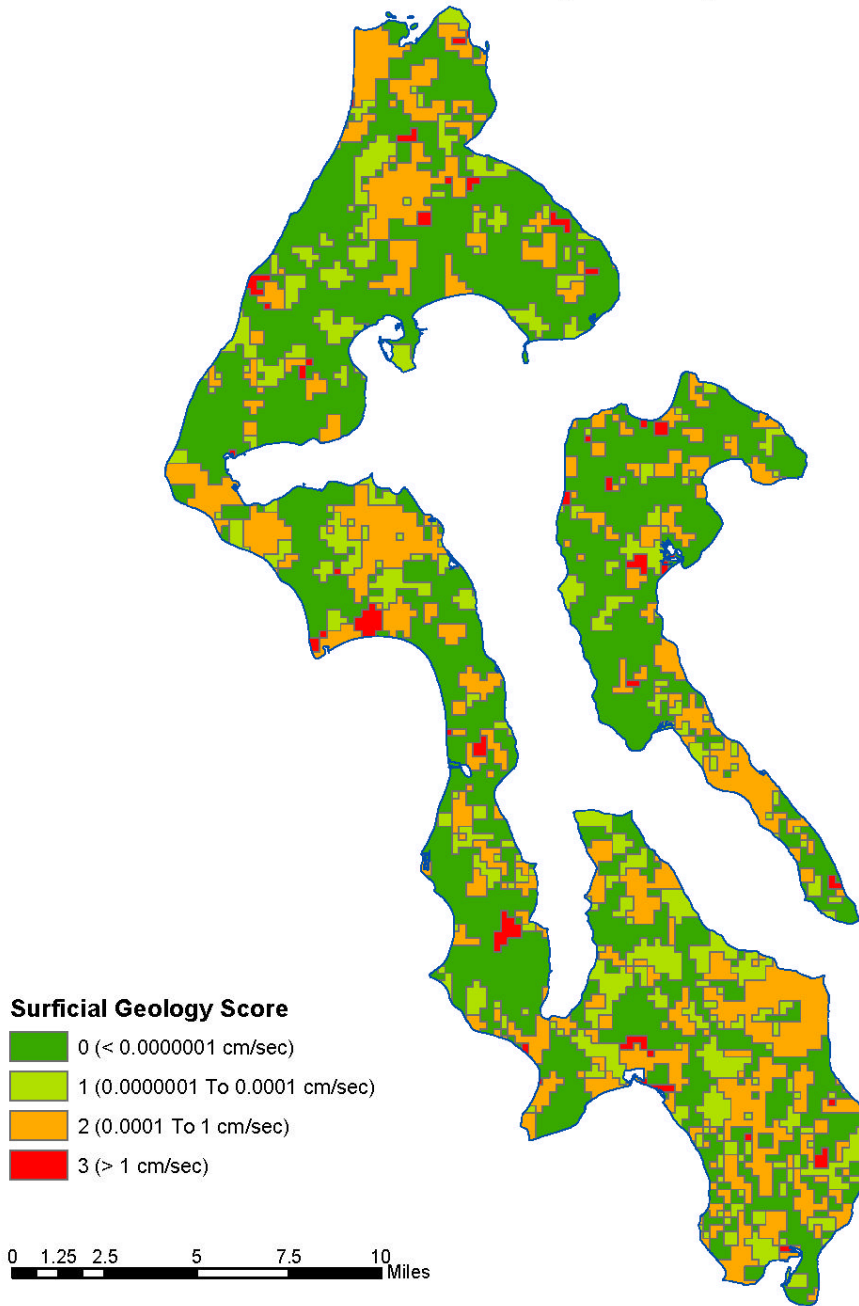
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2

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### Surficial Geology Susceptibility Rating

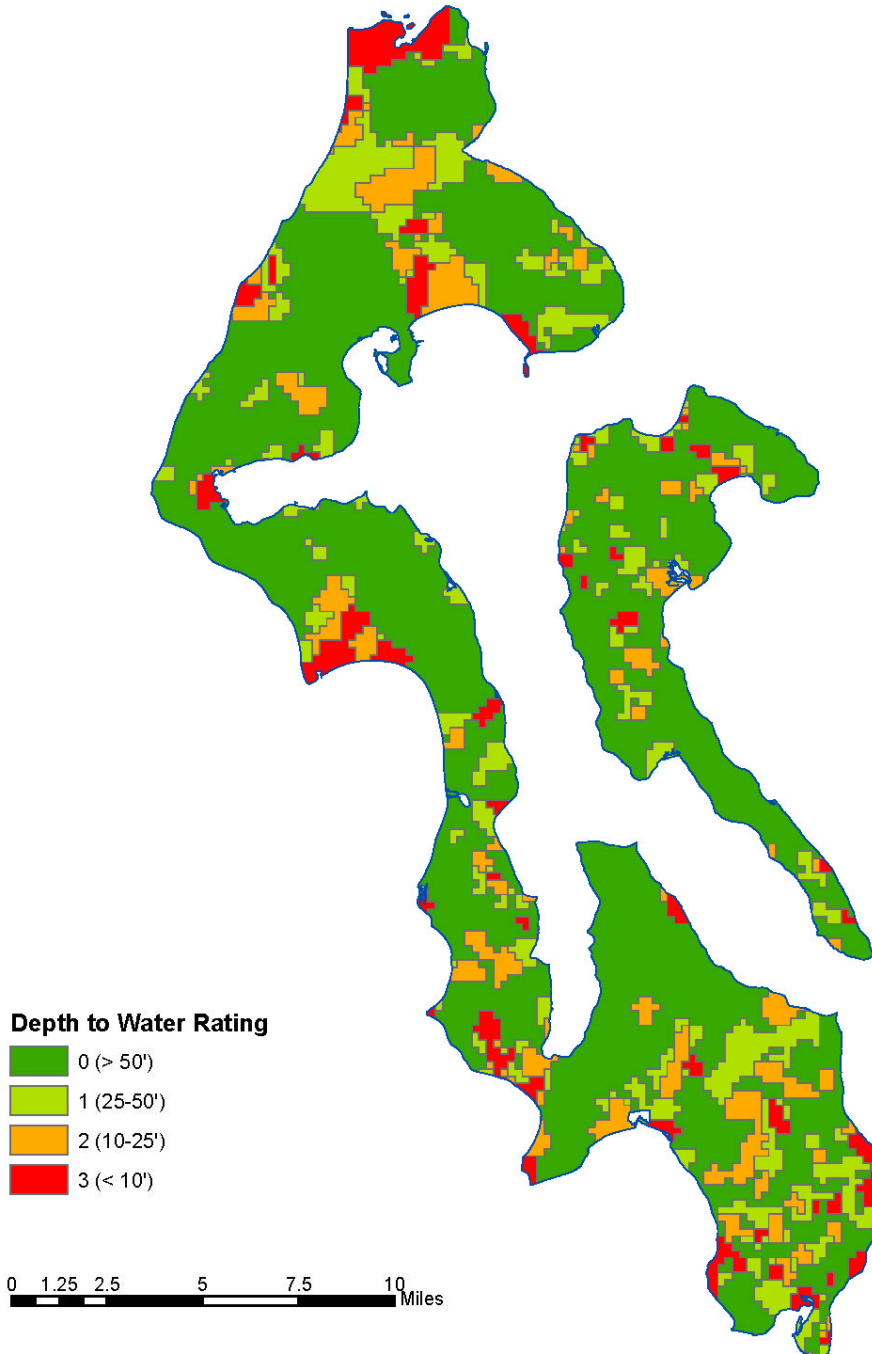


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### Depth to Water Susceptibility Rating

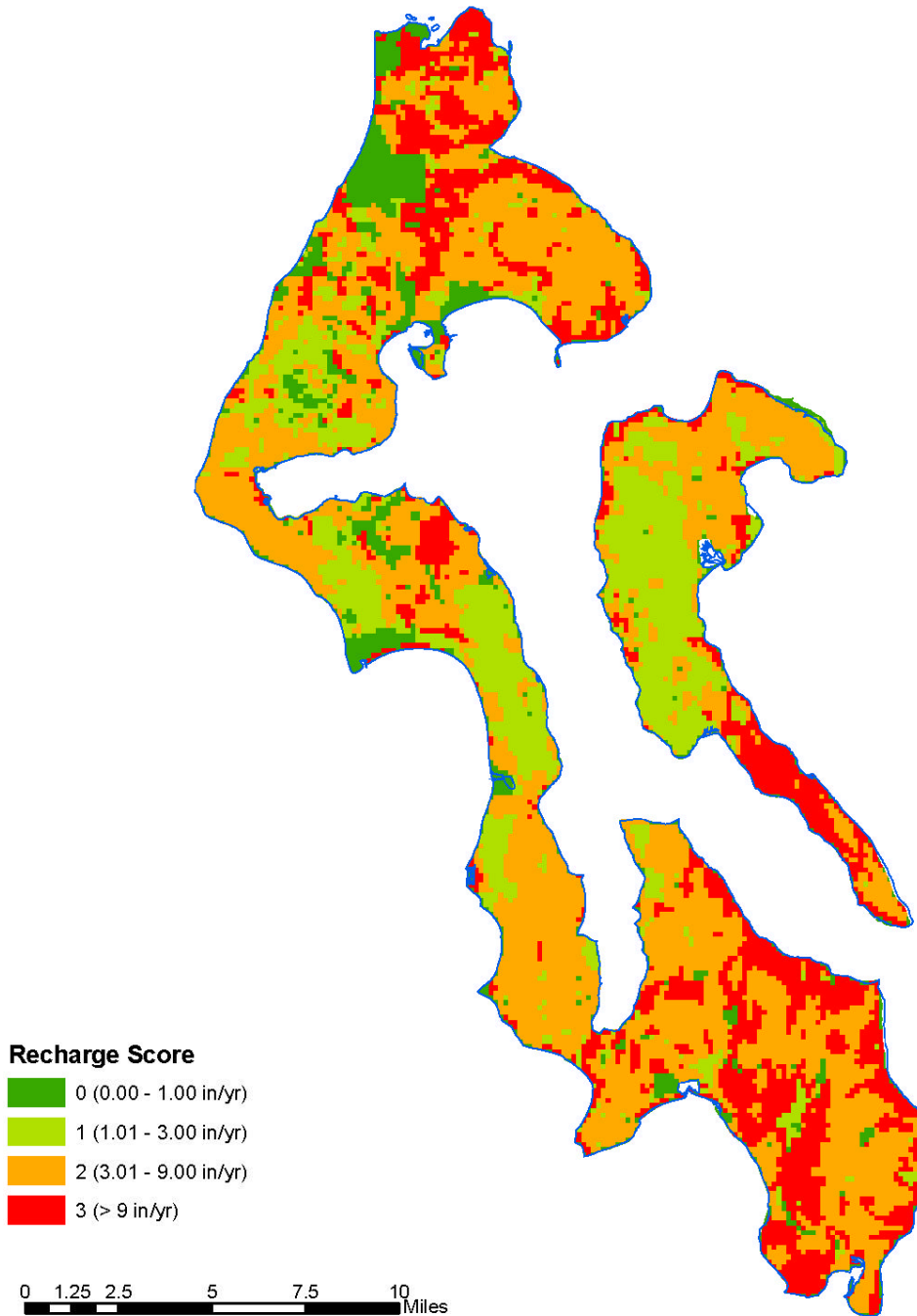


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### Groundwater Recharge Rate Maps From USGS DPM



1  
2

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### Combined CARA Scoring

