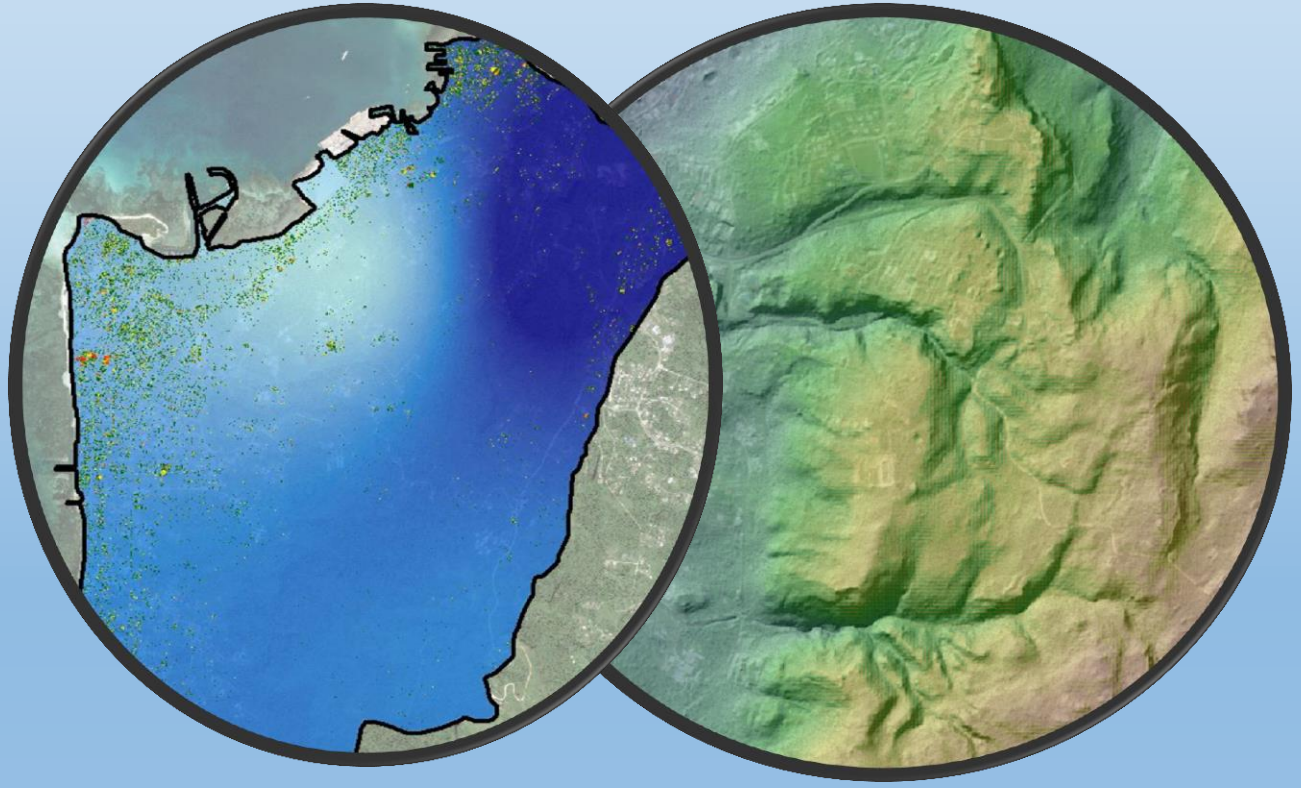
GIS Application of the Revised Universal Soil Loss Equation

(Fun With Watershed Data!)



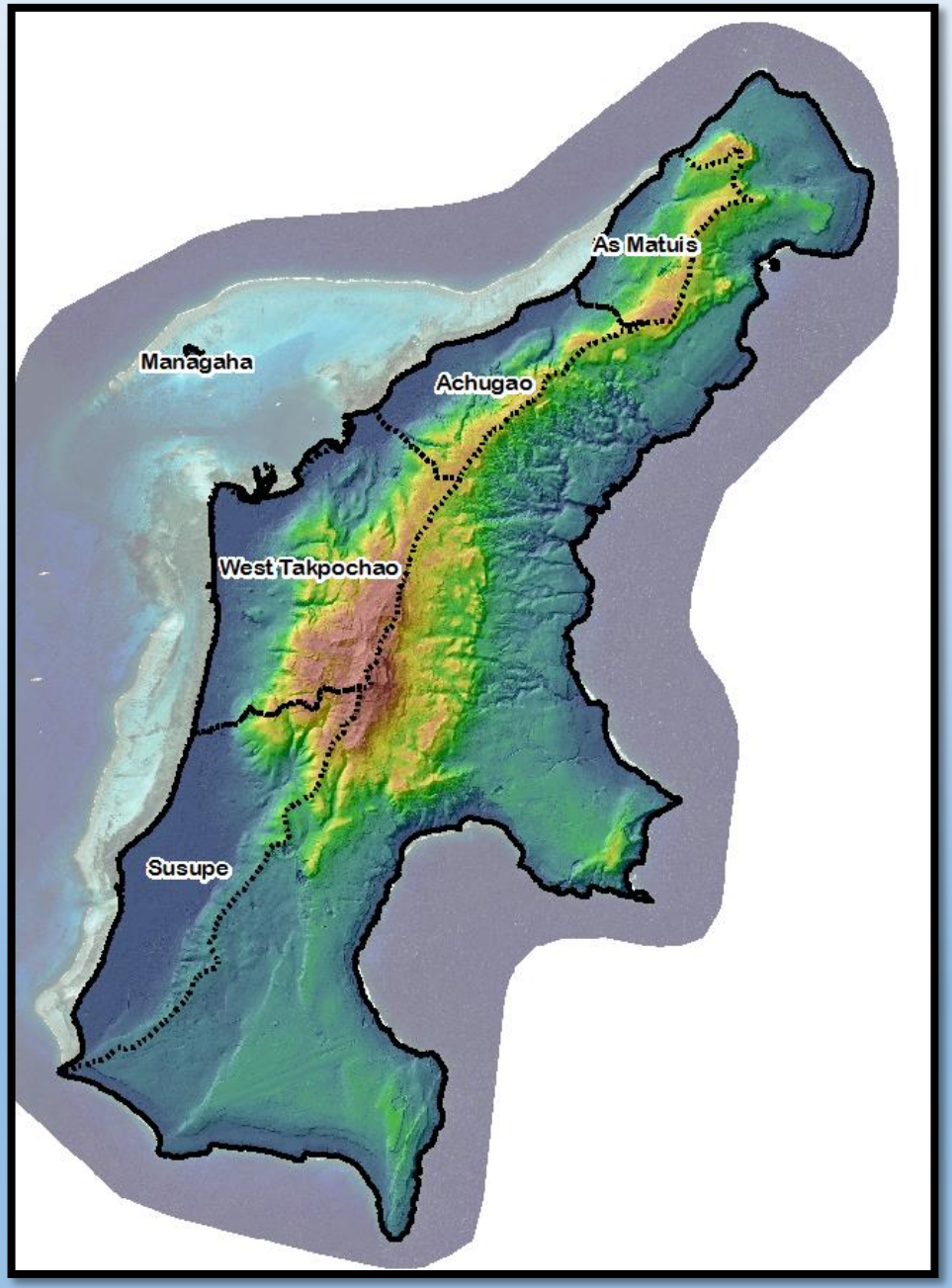
Robbie Greene – "GIS Guy", CNMI Bureau of Environmental & Coastal Quality

Pay Attention!

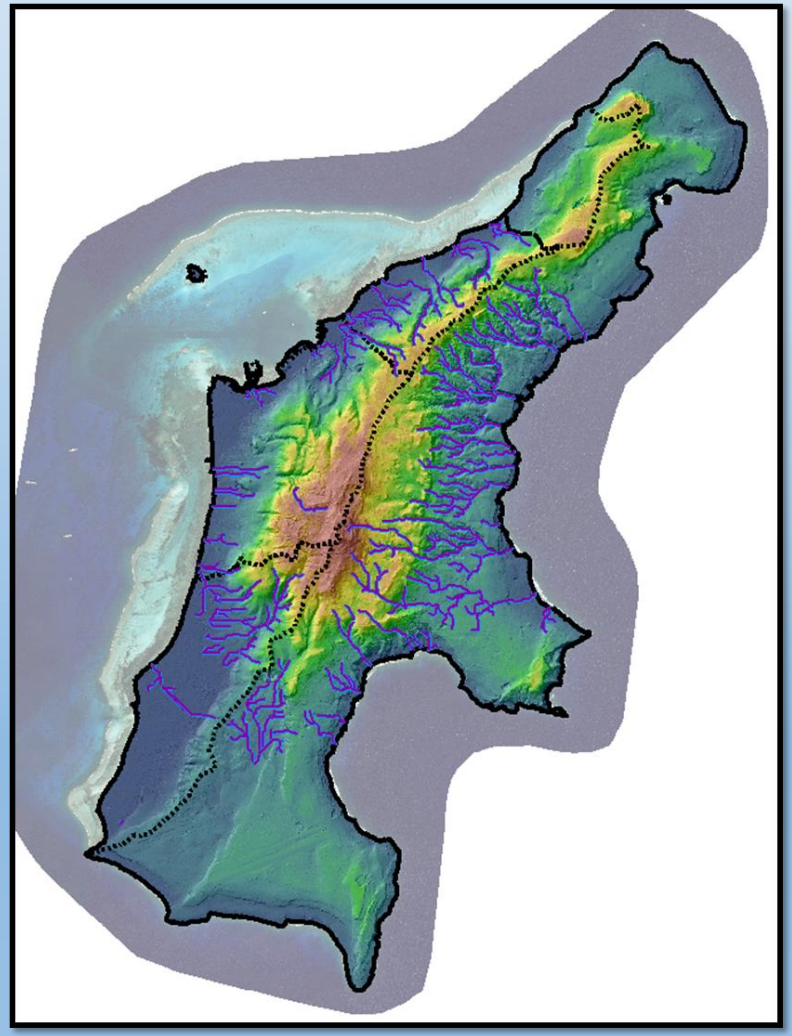
- A quick & dirty assessment of potential runoff
- How can we get a bit more sophisticated with our data?
- Why all the analysis?

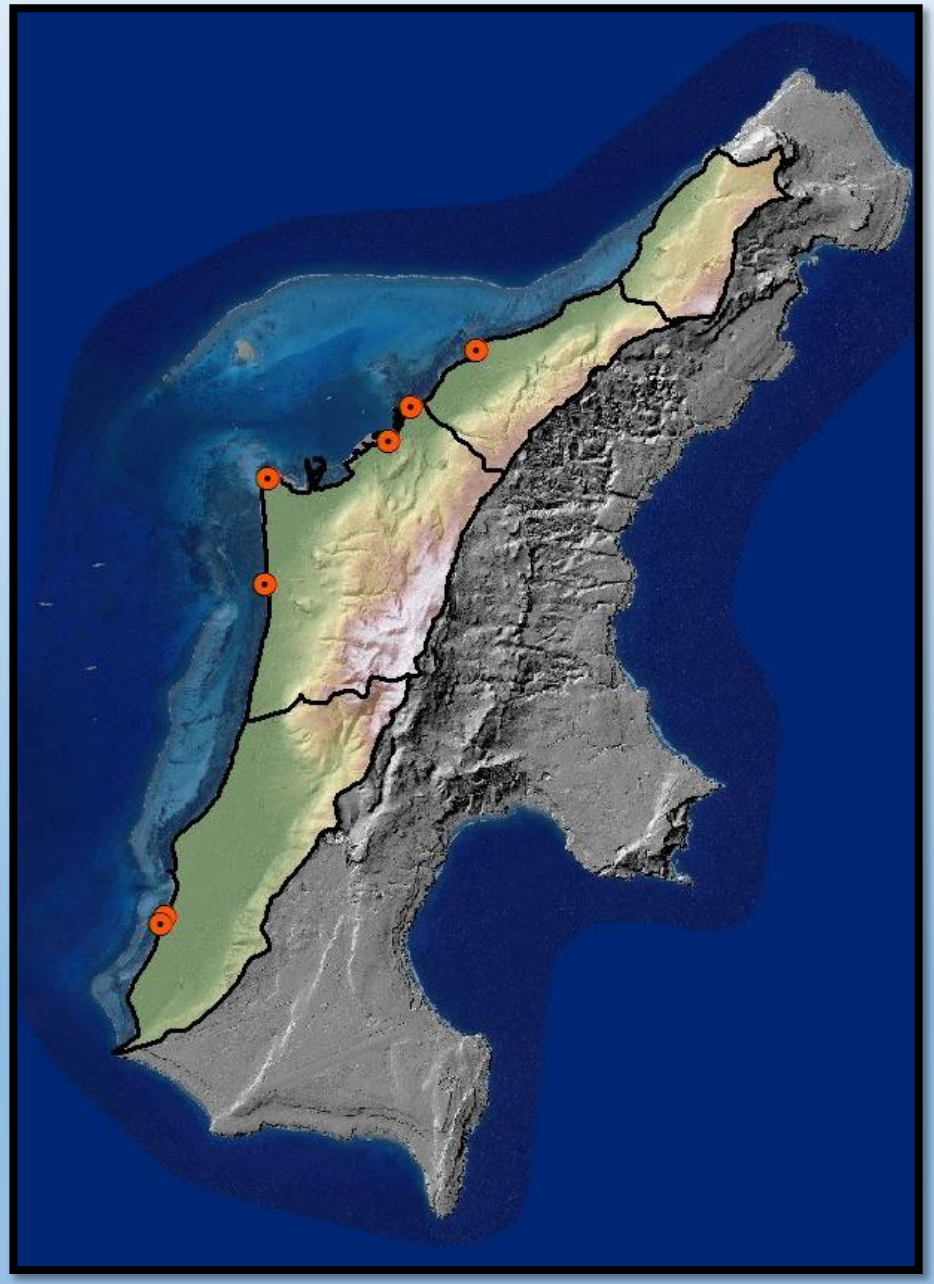
Priority Watersheds & Density of Development

- We see nasty stuff headed into our waters, and we know it comes from a large area.
- Landcover data is our best proxy for large-scale pollutant loading
- 2007 U.S. Army Corps Elevation Data enables modelling!

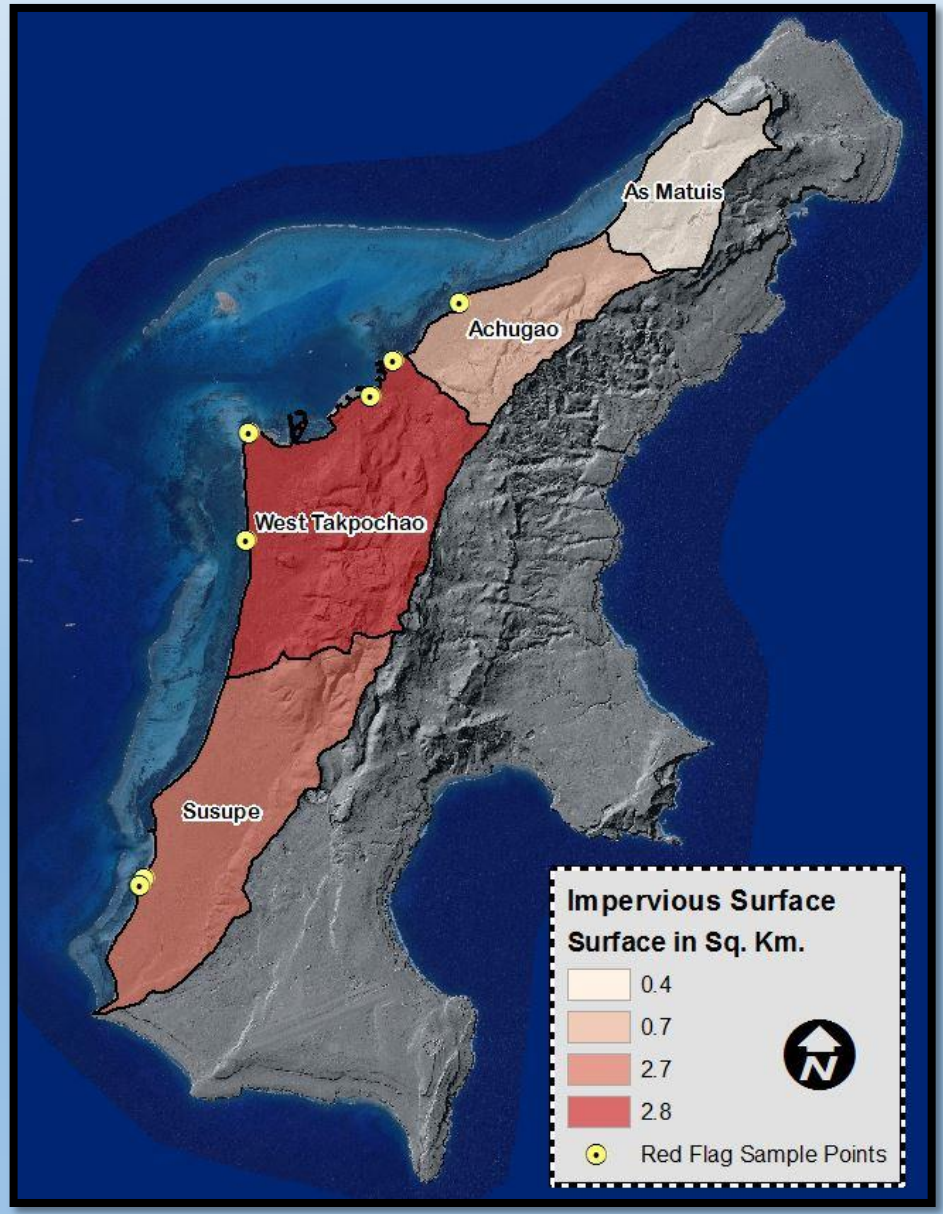


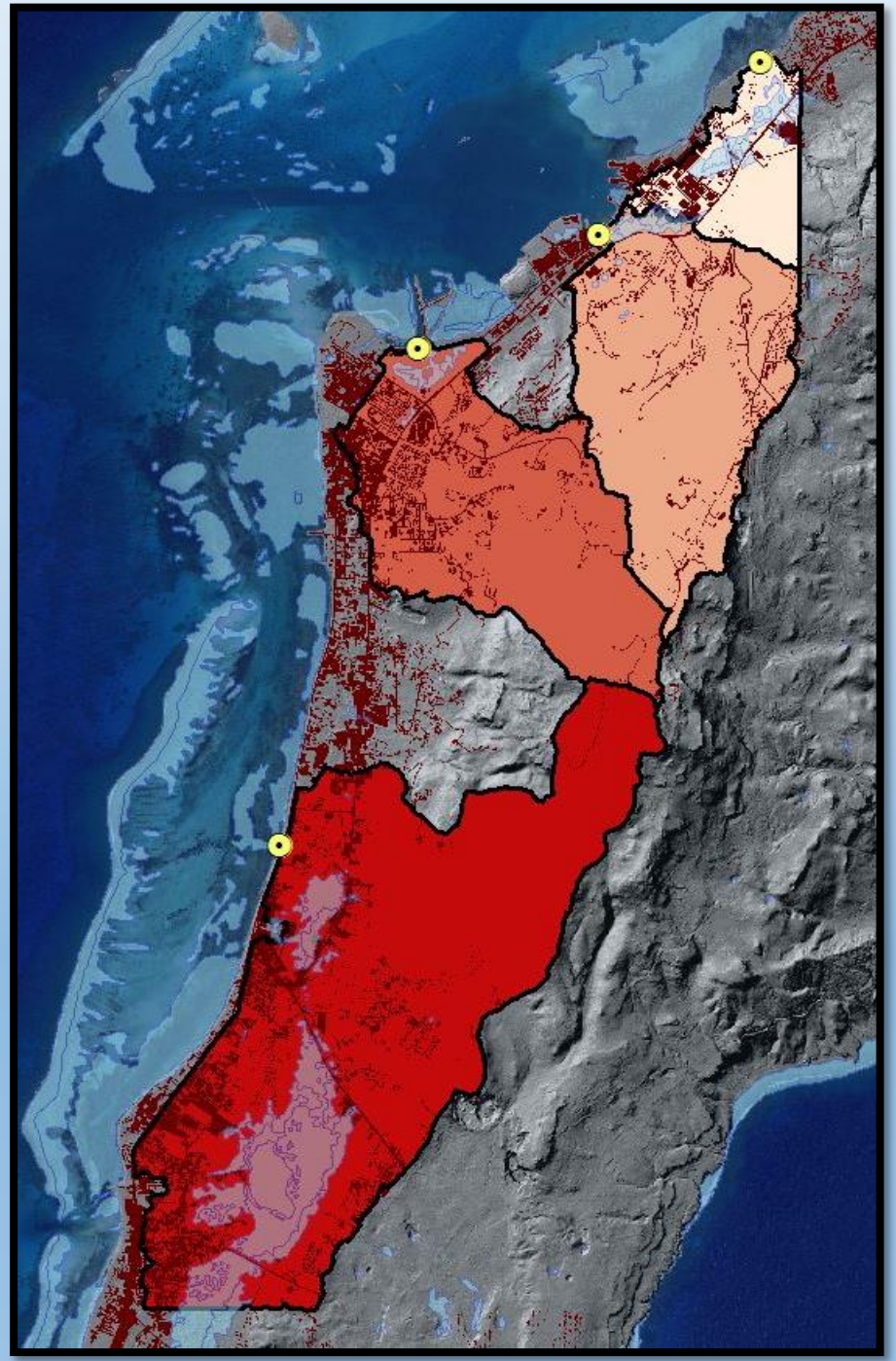
Surface Hydrology & Critical Outflow Points



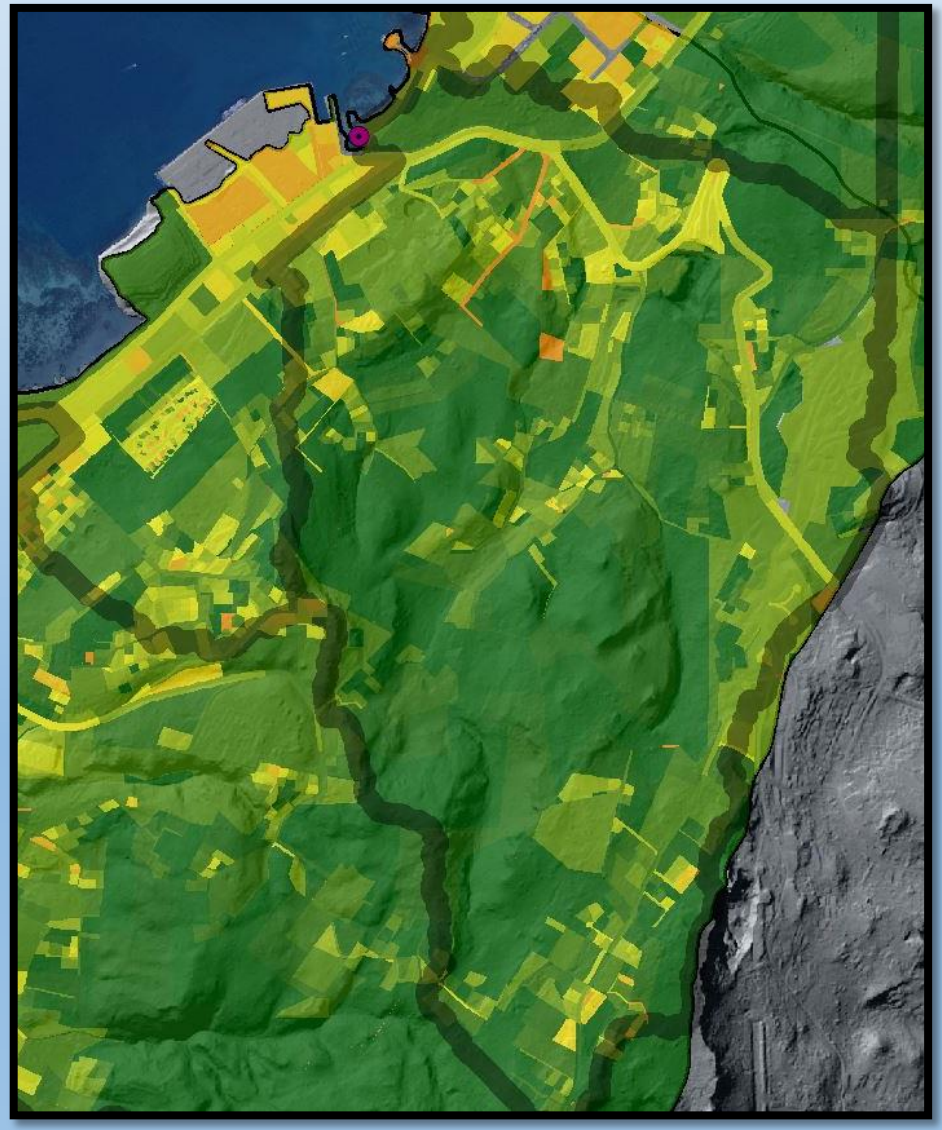


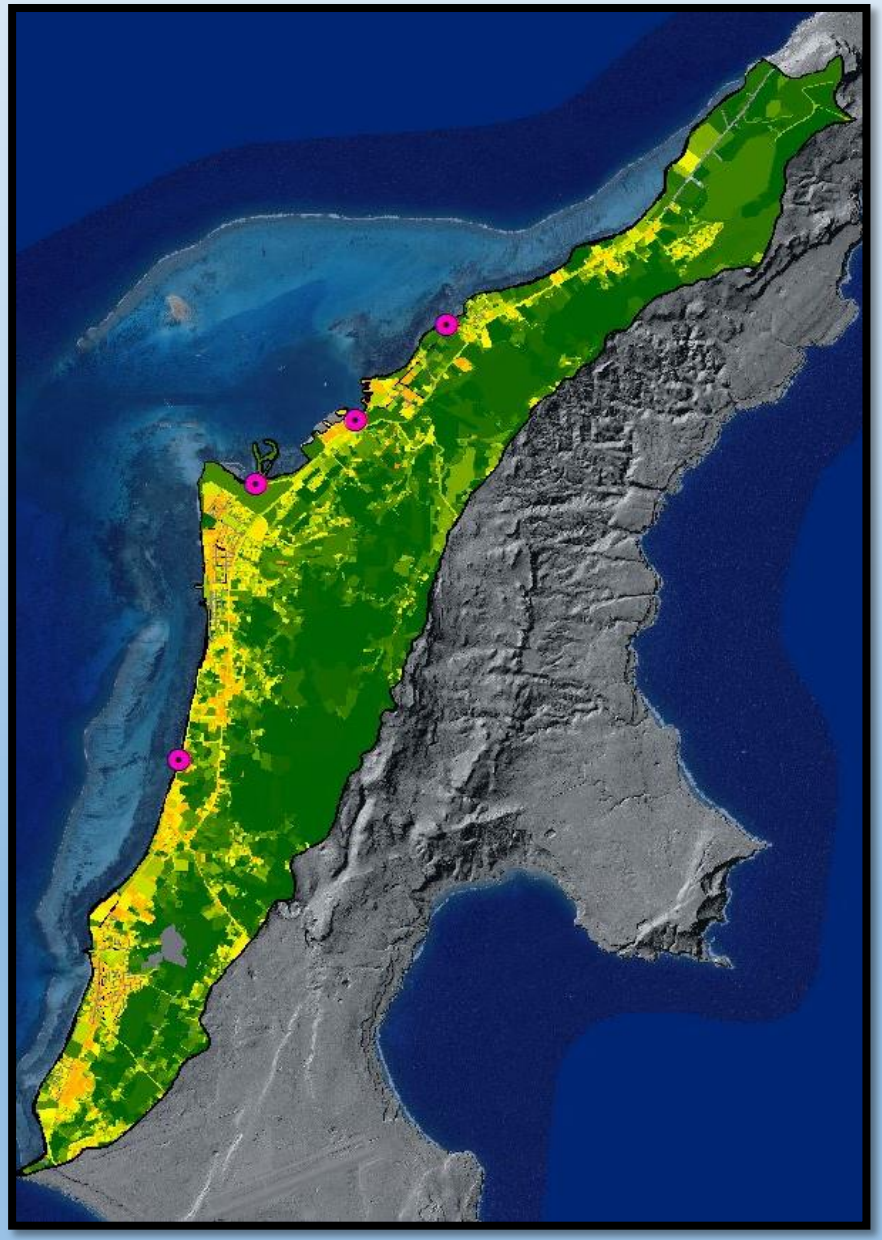
Impervious Surface Within (sub)water sheds





Targeting Run-Off at The Parcel Scale





RUSLE:

Revised
Universal
Soil
Loss
Equation

$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P \qquad [1\text{-}2]$$

where

A = computed spatial average soil loss and temporal average soil loss per unit of area, expressed in the units selected for K and for the period selected for R. In practice, these are usually selected so that A is expressed in ton $\cdot$ acre^{-1} $\cdot$ yr^{-1}, but other units can be selected (that is, t $\cdot$ ha^{-1} $\cdot$ yr^{-1}).

R = rainfall-runoff erosivity factor—the rainfall erosion index plus a factor for any significant runoff from snowmelt.

K = soil erodibility factor—the soil-loss rate per erosion index unit for a specified soil as measured on a standard plot, which is defined as a 72.6-ft (22.1-m) length of uniform 9% slope in continuous clean-tilled fallow.

L = slope length factor—the ratio of soil loss from the field slope length to soil loss from a 72.6-ft length under identical conditions.

S = slope steepness factor—the ratio of soil loss from the field slope gradient to soil loss from a 9% slope under otherwise identical conditions.

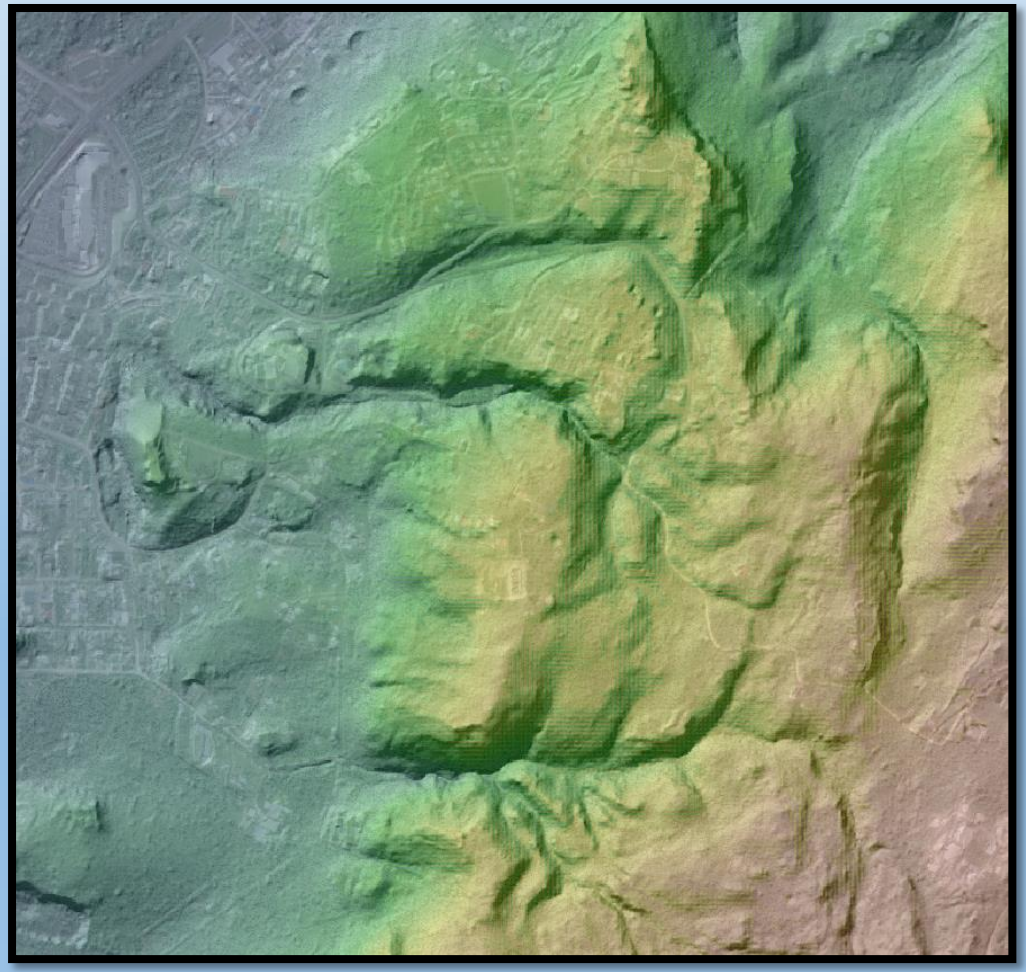
C = cover-management factor—the ratio of soil loss from an area with specified cover and management to soil loss from an identical area in tilled continuous fallow.

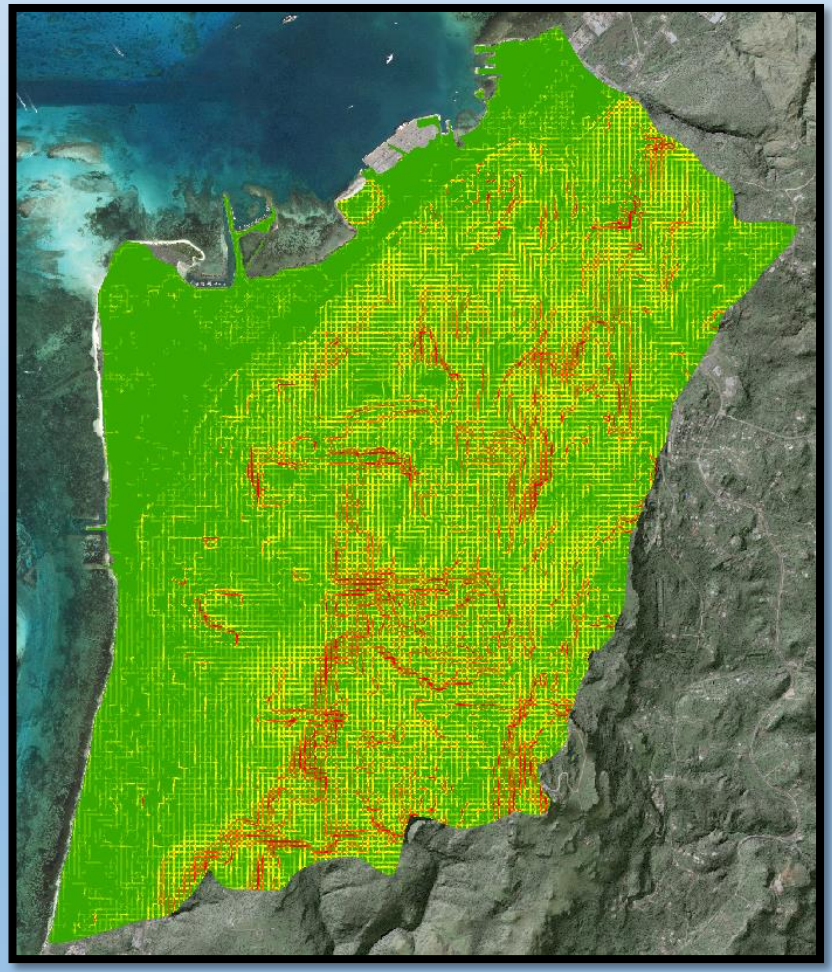
P = support practice factor—the ratio of soil loss with a support practice like contouring, stripcropping, or terracing to soil loss with straight-row farming up and down the slope.

RUSLE is an erosion model designed to predict the longtime average annual soil loss (A) carried by runoff from specific field slopes in specified cropping

L = slope length factor—the ratio of soil loss from the field slope length to soil loss from a 72.6-ft length under identical conditions.

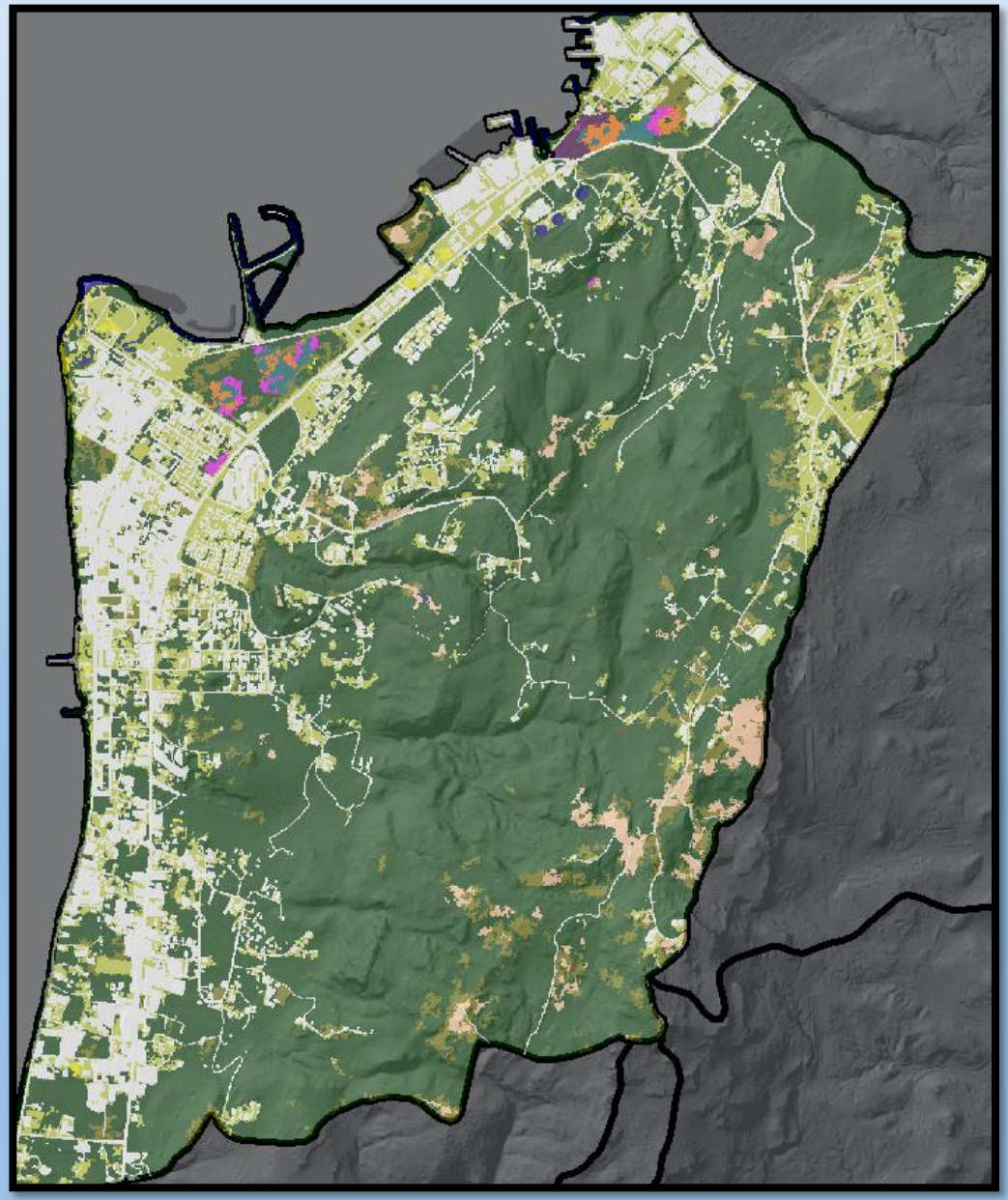
S = slope steepness factor—the ratio of soil loss from the field slope gradient to soil loss from a 9% slope under otherwise identical





conditions

C = cover-management factor—the ratio of soil loss from an area with specified cover and management to soil loss from an identical area

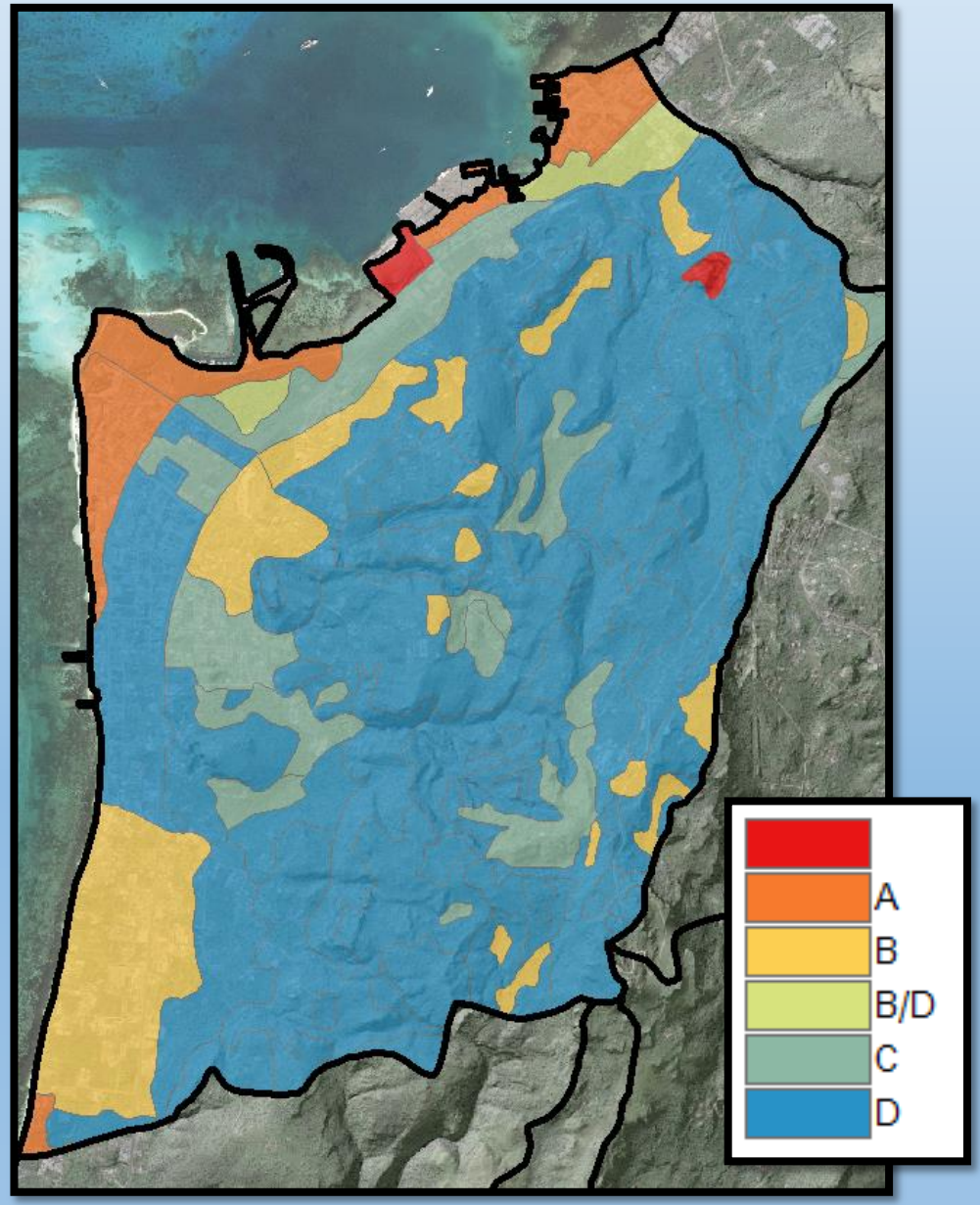


Name	Cover-Factor
Background	0.000
No Data	0.000
High Intensity Developed	0.000
Medium Intensity Developed	0.010
Low Intensity Developed	0.030
Developed Open Space	0.005
Cultivated Land	0.240
Pasture/Hay	0.050
Grassland	0.120
Deciduous Forest	0.009
Evergreen Forest	0.004
Mixed Forest	0.007
Scrub/Shrub	0.014
Palustrine Forested Wetland	0.003
Palustrine Scrub/Shrub W...	0.003
Palustrine Emergent Wetland	0.003
Estuarine Forested Wetland	0.003
Estuarine Scrub/Shrub We...	0.003

NSPECT Coefficients by C-CAP Class

factor for any significant runoff from snowmelt.

K = soil erodibility factor—the soil-loss rate per erosion index unit



R = rainfall-runoff erosivity factor—the rainfall erosion index

Adapted R-Factor Revision based on Reinard & Friemund (1994) Correlation:

(This is basically doing what WERI did to adapt Cooley's study to FSM, but Adapting WERI/Dumaliang's revised values to Saipan)

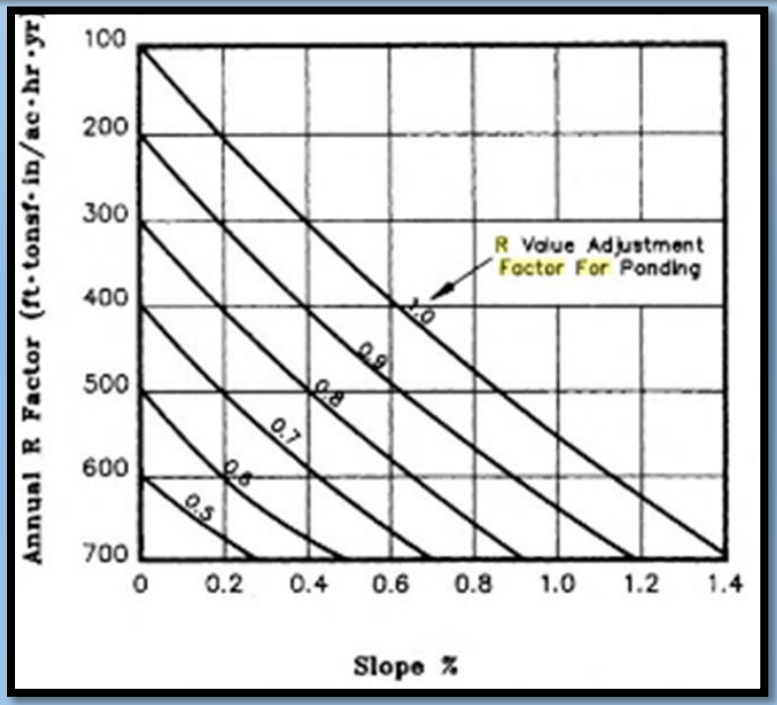
$$R_n = R_{known} \times (P_n / P_{known})$$

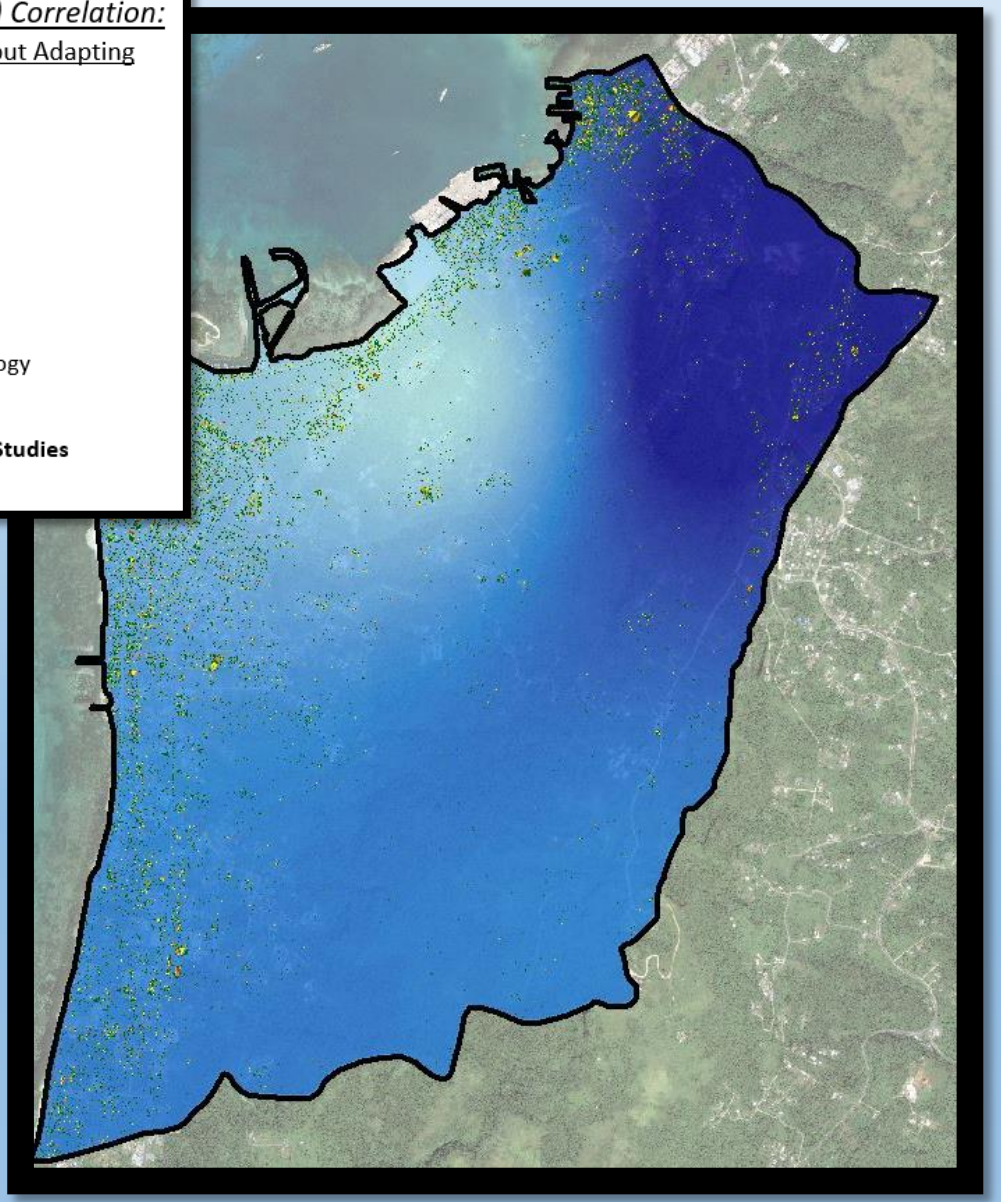
For Saipan Rn (or Revised R factor)

Where **Rknown =** is the **Rn for Guam based on Dumaliang (1998)** and Khosrowpanah & Heitz (2001)

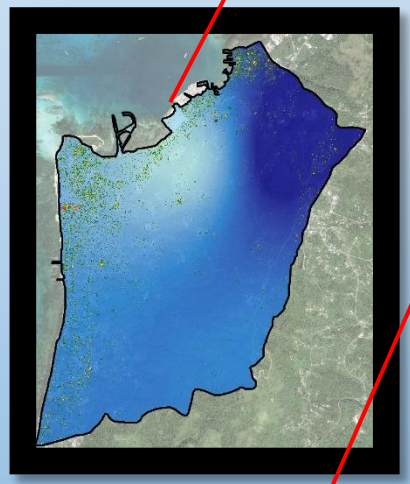
Pn = new precipitation **values based on Lander**'s Saipan Rainfall Climatology Maps

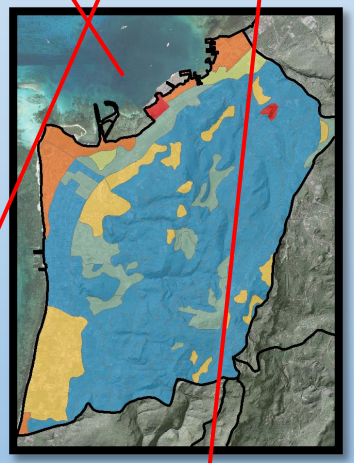
Pknown = old precipitation **values used in Khosrowpanah & Dumaliang Studies** (as opposed to the Cooley study, which used Hawaii's)

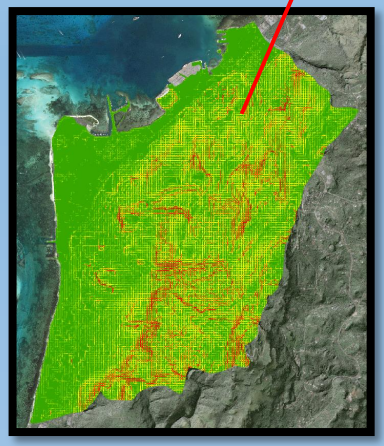


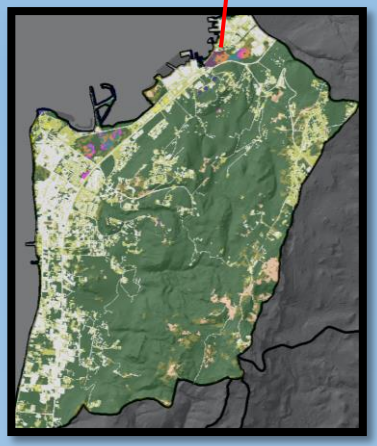


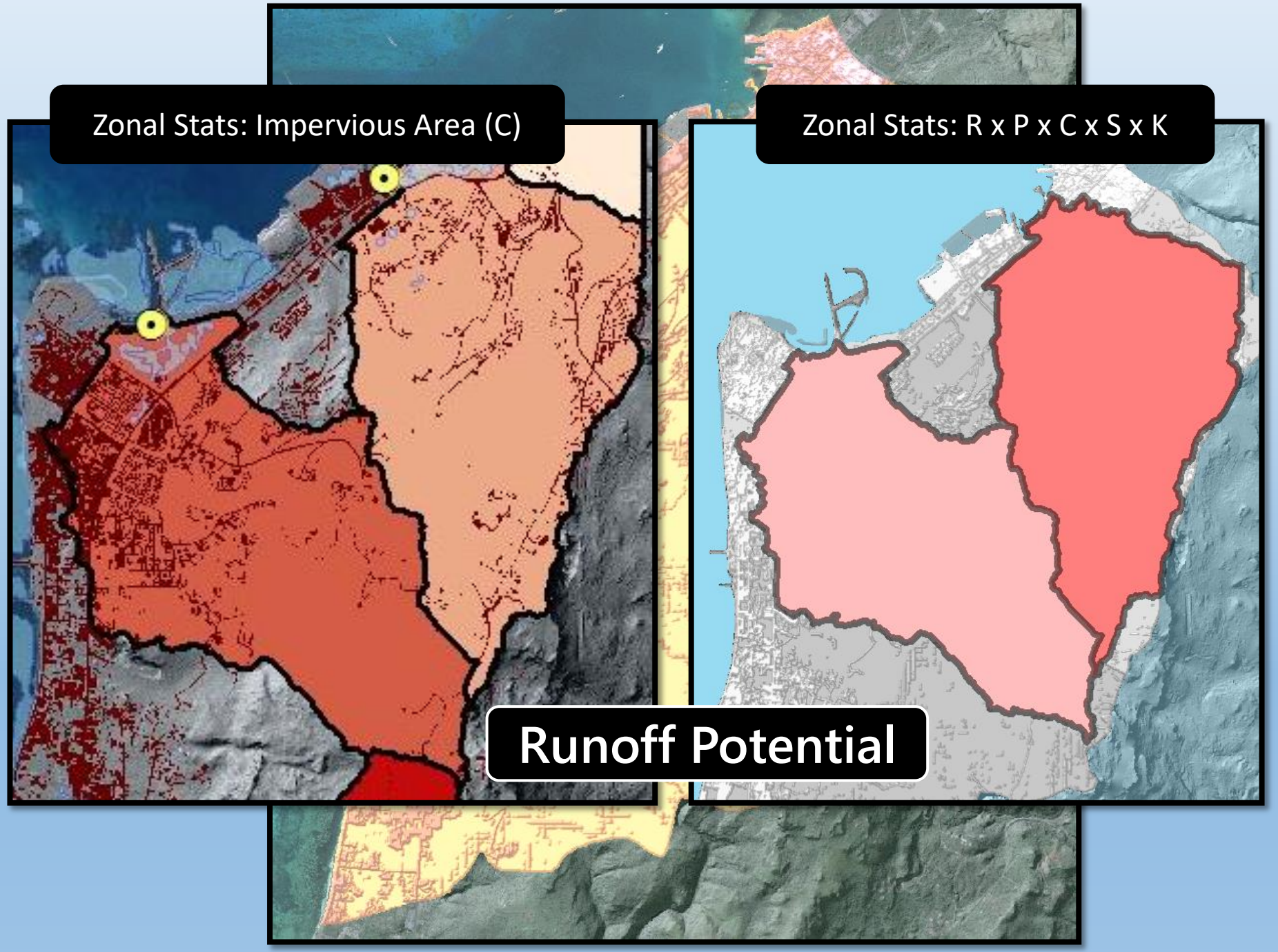
$$A = R \cdot K \cdot L \cdot S \cdot C \cdot P$$

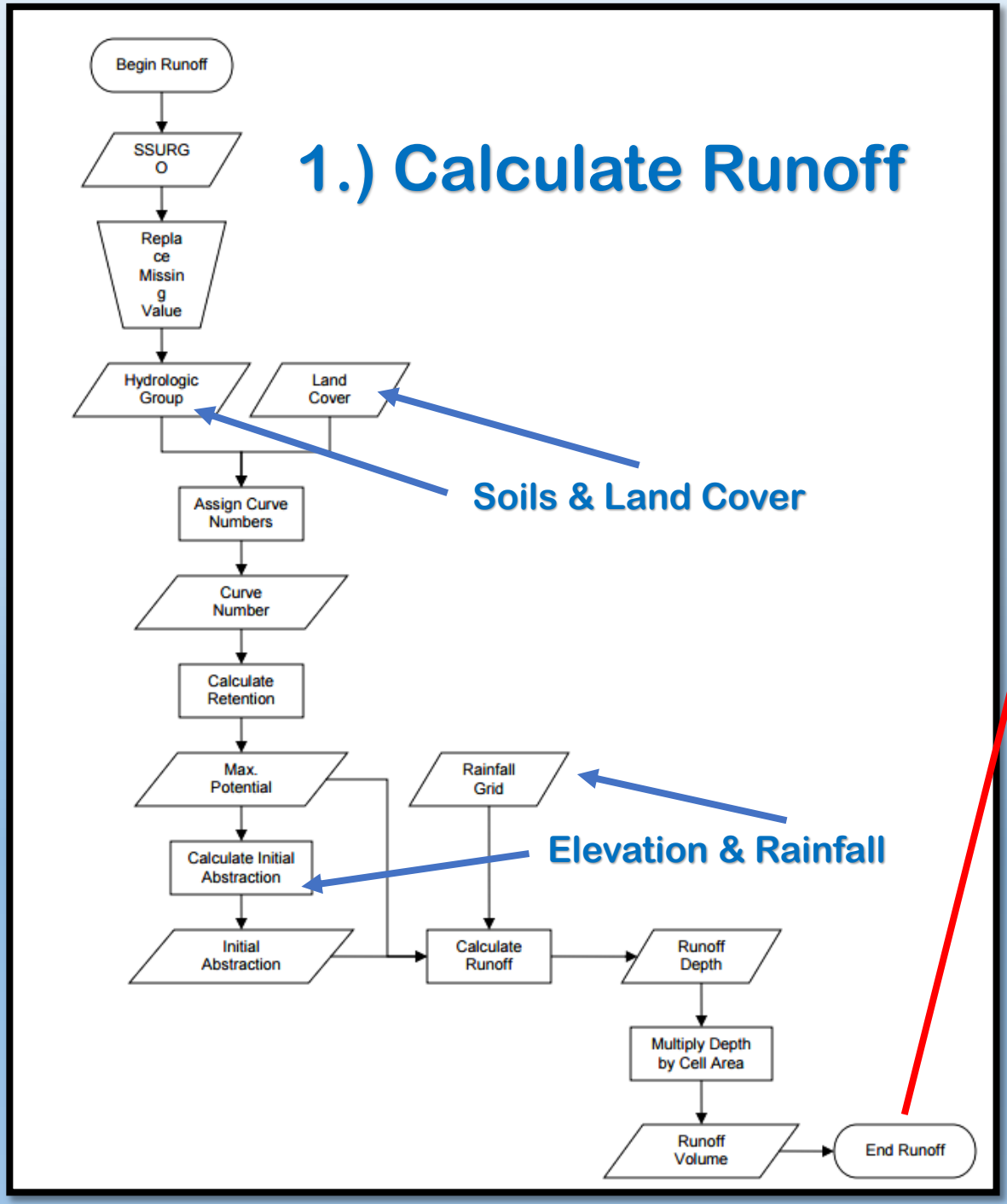


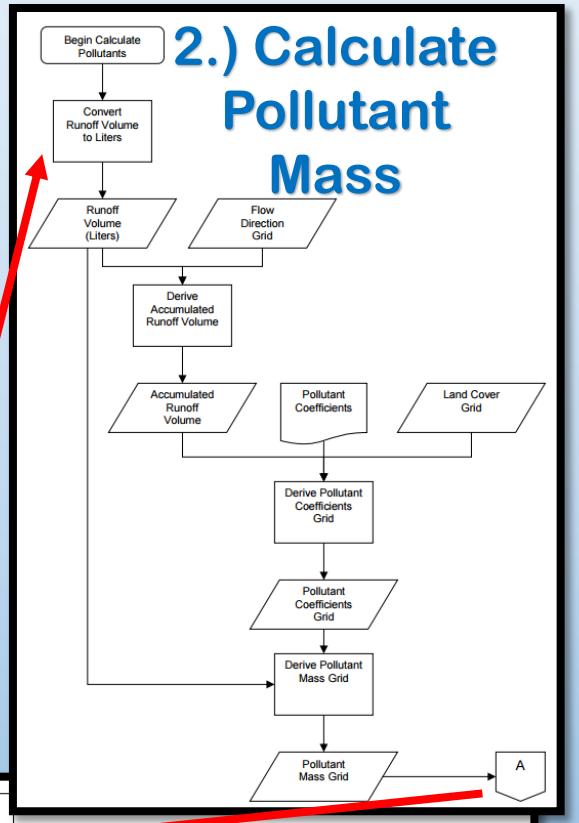


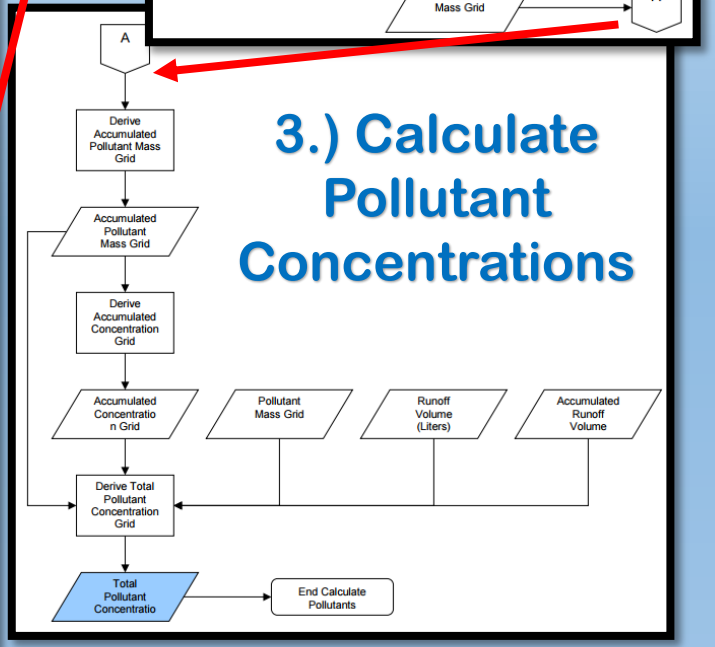




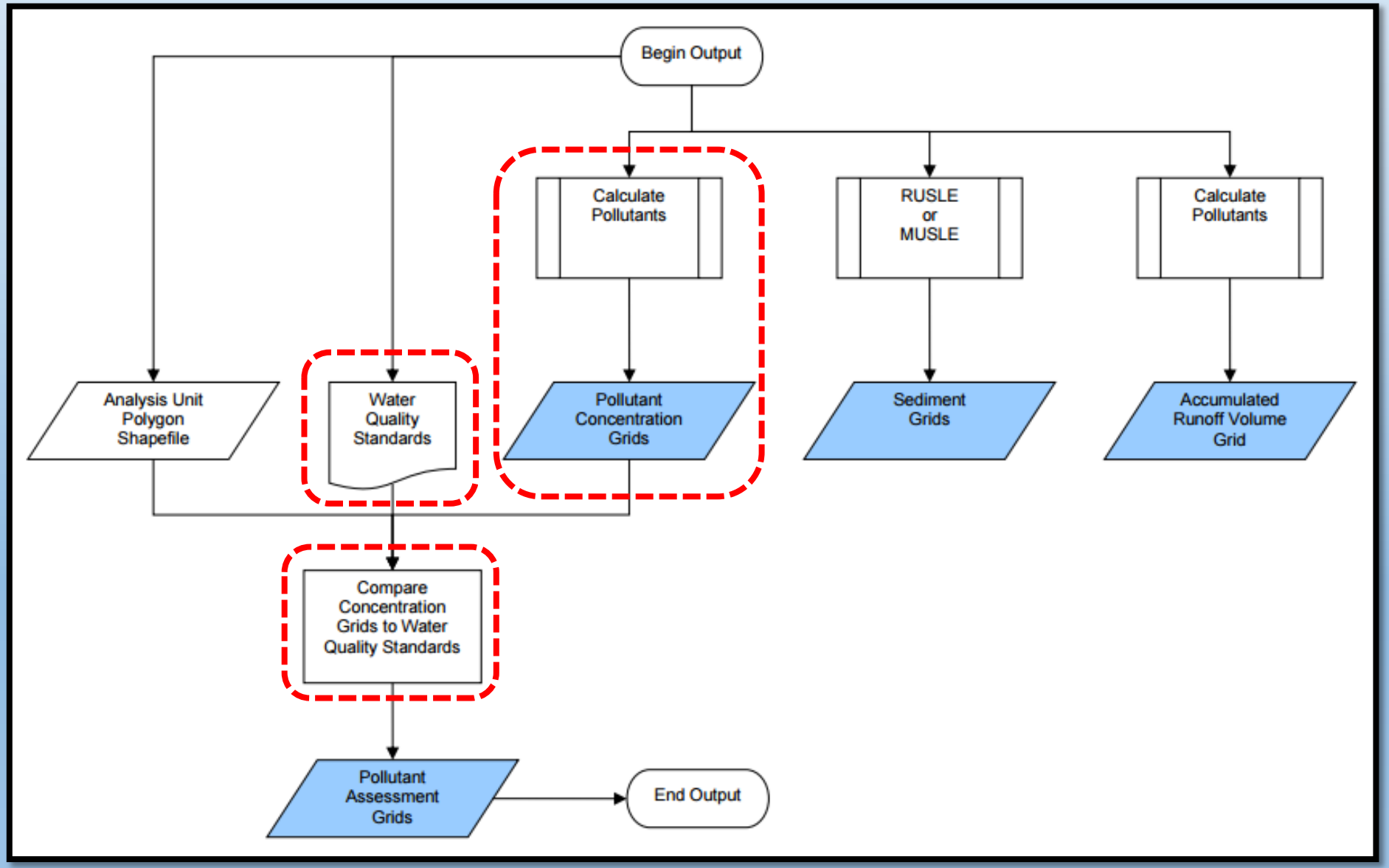

Zonal Stats: Impervious Area (C)
Zonal Stats: R x P x C x S x K
Runoff Potential

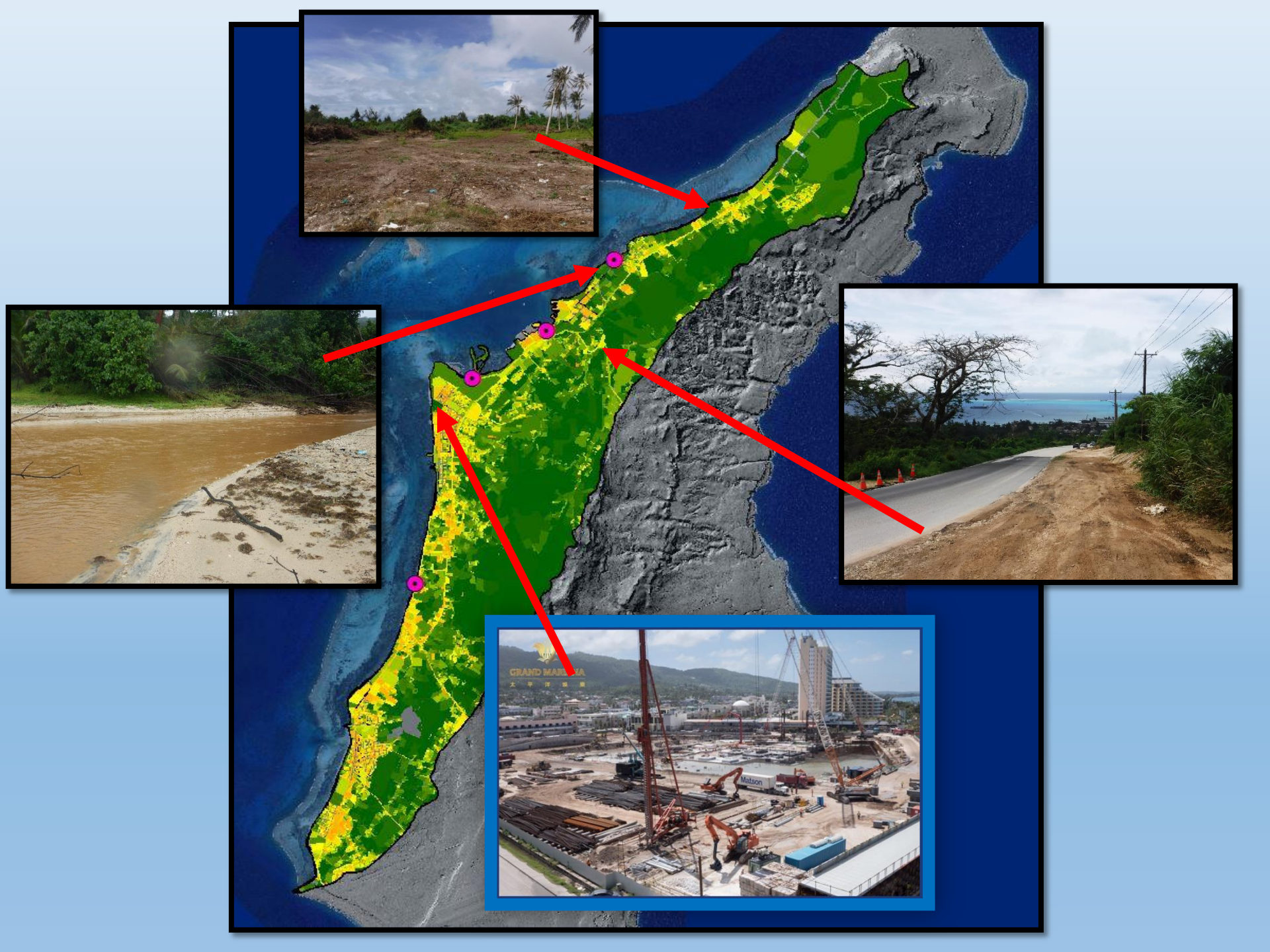

Begin Runoff
SSURGO
Replace Missing Value
Hydrologic Group
Land Cover
Assign Curve Numbers
Curve Number
Calculate Retention
Max. Potential
Rainfall Grid
Calculate Initial Abstraction
Initial Abstraction
Calculate Runoff
Runoff Depth
Multiply Depth by Cell Area
Runoff Volume
End Runoff
1.) Calculate Runoff
Soils & Land Cover
Elevation & Rainfall

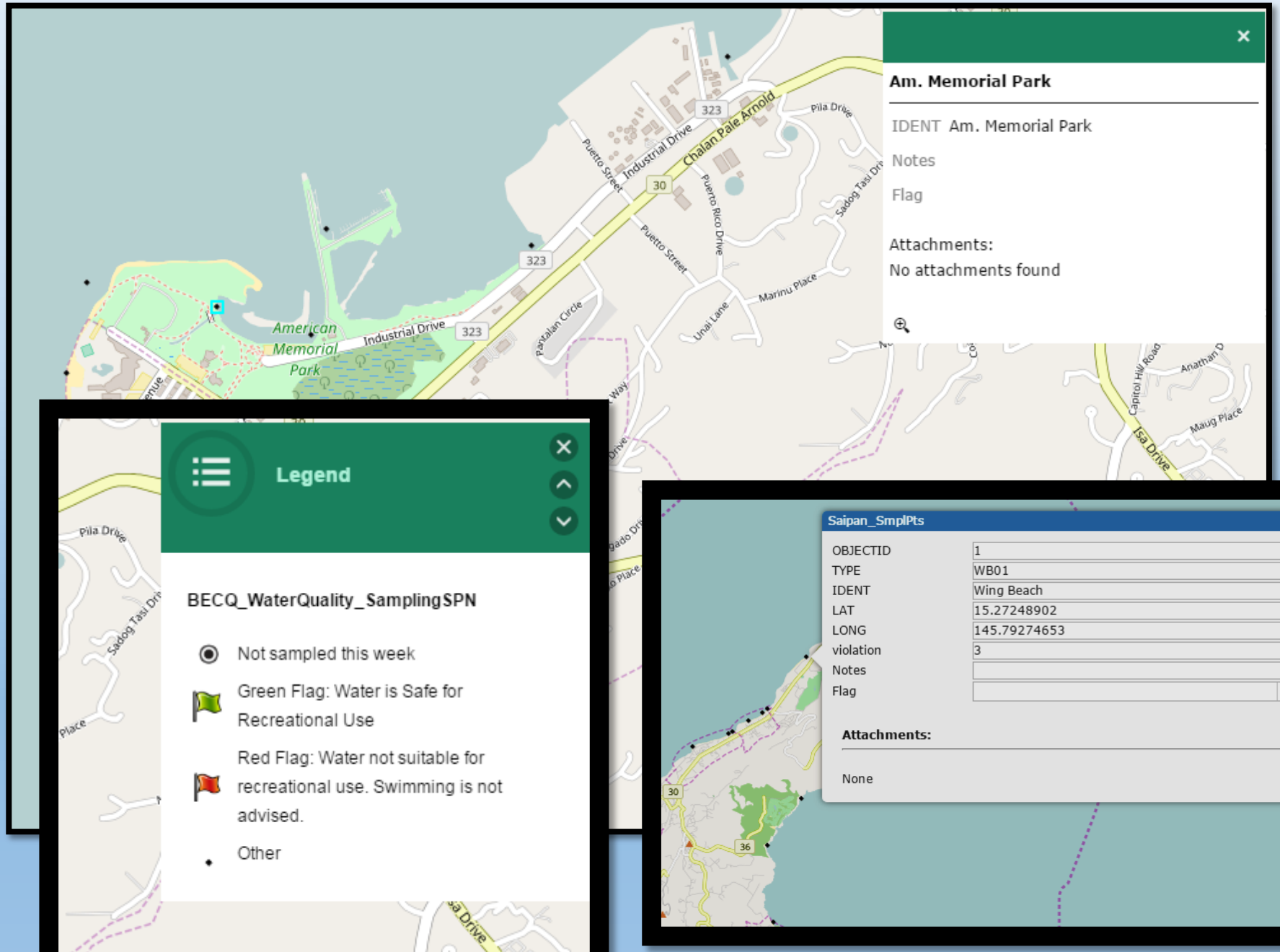

Begin Calculate Pollutants
Convert Runoff Volume to Liters
Runoff Volume (Liters)
Flow Direction Grid
Derive Accumulated Runoff Volume
Accumulated Runoff Volume
Pollutant Coefficients
Land Cover Grid
Derive Pollutant Coefficients Grid
Pollutant Coefficients Grid
Derive Pollutant Mass Grid
Pollutant Mass Grid
A
2.) Calculate Pollutant Mass


A
Derive Accumulated Pollutant Mass Grid
Accumulated Pollutant Mass Grid
Derive Accumulated Concentration Grid
Accumulated Concentration Grid
Pollutant Mass Grid
Runoff Volume (Liters)
Accumulated Runoff Volume
Derive Total Pollutant Concentration Grid
Total Pollutant Concentratio
End Calculate Pollutants
3.) Calculate Pollutant Concentrations

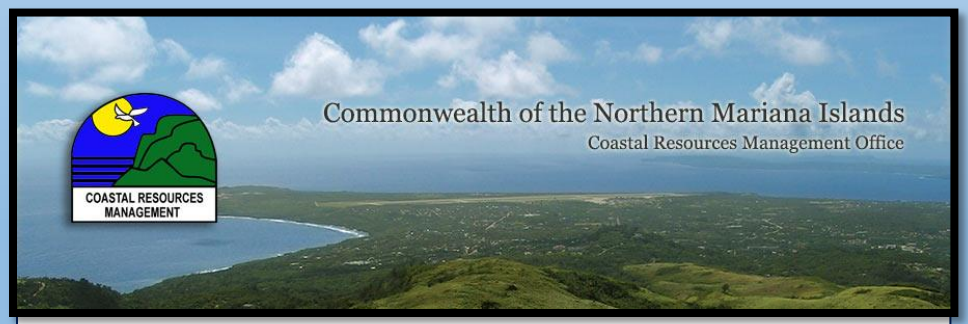
Analysis: Where can *YOU* help?




GRAND MARINA
Matson


Am. Memorial Park
IDENT Am. Memorial Park
Notes
Flag
Attachments:
No attachments found
American Memorial Park
Industrial Drive
Chalan Pale Arnold
323
30
Puetto Street
Puerto Rico Drive
Pantalan Circle
Unai Lane
Marinu Place
Pila Drive
Sadog Tasi Drive
Capitol Hill Road
Anathan D
Maug Place
Isa Drive
Legend
BECQ_WaterQuality_SamplingSPN
Not sampled this week
Green Flag: Water is Safe for Recreational Use
Red Flag: Water not suitable for recreational use. Swimming is not advised.
Other
Saipan_SmplPts
OBJECTID 1
TYPE WB01
IDENT Wing Beach
LAT 15.27248902
LONG 145.79274653
violation 3
Notes
Flag
Attachments:
None
36

Questions?
Comments?
Deep Thoughts?



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