Brett Milburn, GISP
Allison Jelinek
Langan Engineering & Environmental Services

COMBINING MASS FLUX WITH DATA VISUALIZATION TECHNIQUES USING GIS

WHAT IS MASS FLUX?

Groundwater flow and contaminant concentration data combined to estimate the rate of contaminant mass transfer (e.g., grams per day) past selected transects through an affected groundwater plume [API, 2003].

$$= \frac{\textit{Groundwater Flow x Concentration}}{\textit{Area x Time}}$$

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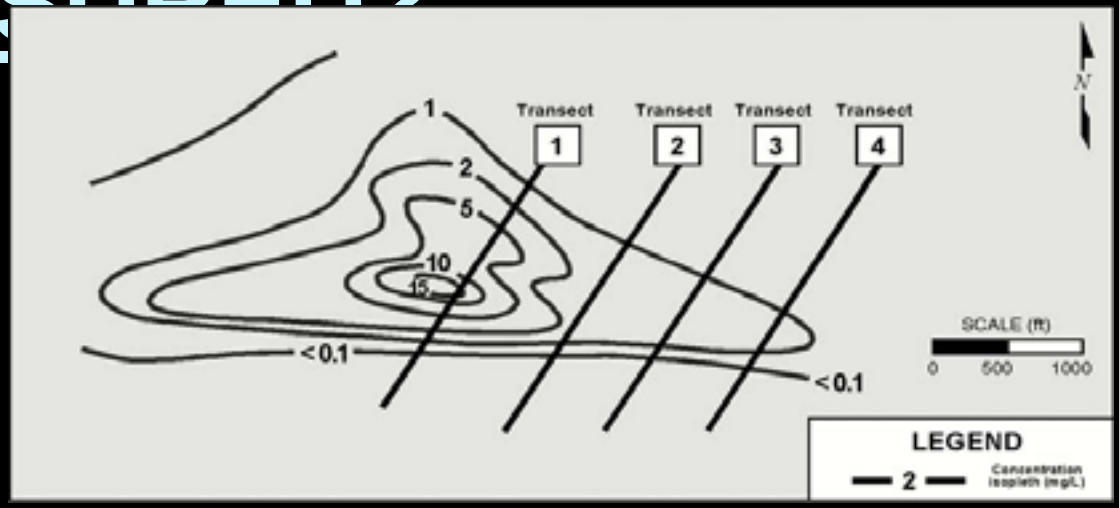
HOW IS MASS FLUX MEASURED?



Transect Approach - Results from one or more transects can be used to evaluate:

- potential water quality impacts on down-gradient supply wells,
- natural attenuation of the contaminant mass with distance down-gradient of the source (as defined by the reduction in mass flux between transects), and
- alternative remedies (based on their anticipated reductions in mass flux from source to receptor).

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WHY VISUALIZE MASS FLUX?

- Estimate:
  - Source Strength and Distribution
  - Plume Attenuation Capacity
  - Potential Impacts to Receptors
- Predict the Effects of Source Remediation on the Downgradient Plume
- Assist in Prioritizing Site Remediation Activities
- Measure Remediation Performance

DATA REQUIRED TO VISUALIZE MASS FLUX

- Aquifer Hydraulic Properties:
  - Transmissivity (in the format of a raster)
  - Effective Porosity (raster)
  - Saturated Thickness (raster)
- Monitoring well locations and hydraulic head (raster)
- Chemical Specific Fate and Transport Parameters
  - Dispersion
  - Retardation
  - Decay coefficient
- Contaminant Source Location
- Analytical Concentration Data

TOOLS REQUIRED TO VISUALIZE MASS FLUX

- ArcView 9.3.1
- Spatial Analyst Extension (Interpolate to Raster)
- Groundwater Analysis Toolbar (older version) or ArcToolbox
  - "Darcy Flow" generates a groundwater flow velocity field from geologic data;
  - "Particle Track" follows the path of advection through the flow field from a point source;
  - "Porous Puff" calculates the hydrodynamic dispersion of an instantaneous point release of a constituent as it is advected along the flow path.

“DARCY FLOW” FUNCTION

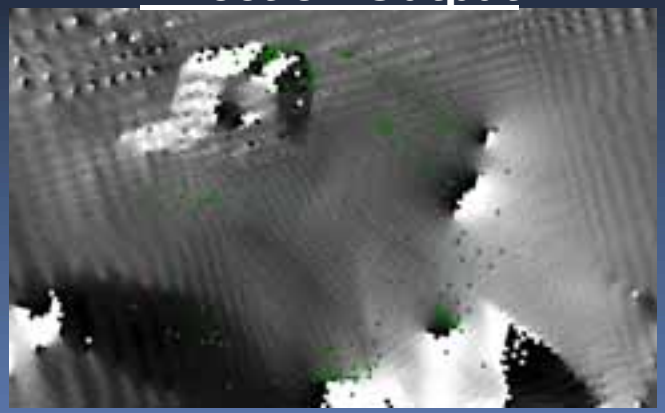
Input Files:

- Groundwater Head Elevation Raster
- Effective Formation Porosity Raster
- Saturated Thickness Raster
- Formation Transmissivity Raster

Output Files:

- Groundwater Volume Balance Raster (measures difference between groundwater flow into and out of each cell)
- Groundwater Direction Raster
- Groundwater Magnitude Raster (ve

Direction Output



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“PARTICLE TRACK” FUNCTION

Input Files:

- Groundwater Direction Raster (generated by Darcy Flow)
- Groundwater Magnitude Raster (generated by Darcy Flow)

Output Files:

- Particle Track ASCII File
- Particle Track Polyline

“POROUS PUFF” FUNCTION

Input Files/Parameters:

Required:

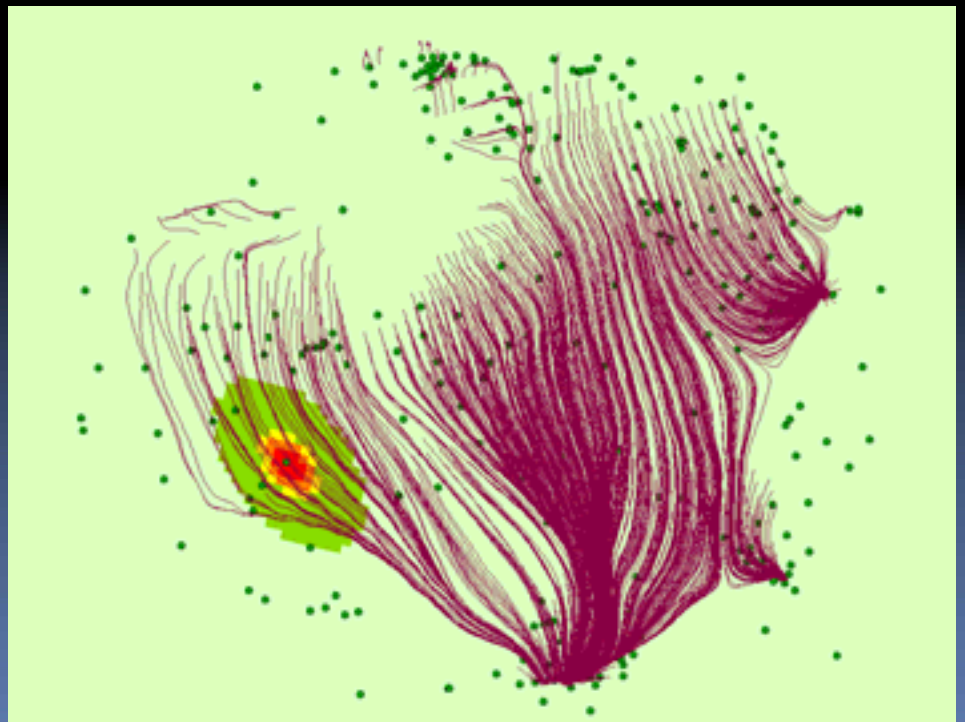
- Particle Track ASCII File (convert to txt file)
- Porosity Raster
- Saturated Thickness Raster
- Mass

Optional:

- Time
- Longitudinal Dispersivity
- Dispersivity Ratio
- Retardation Factor
- Decay Coefficient

Output Files:

- Mass Raster



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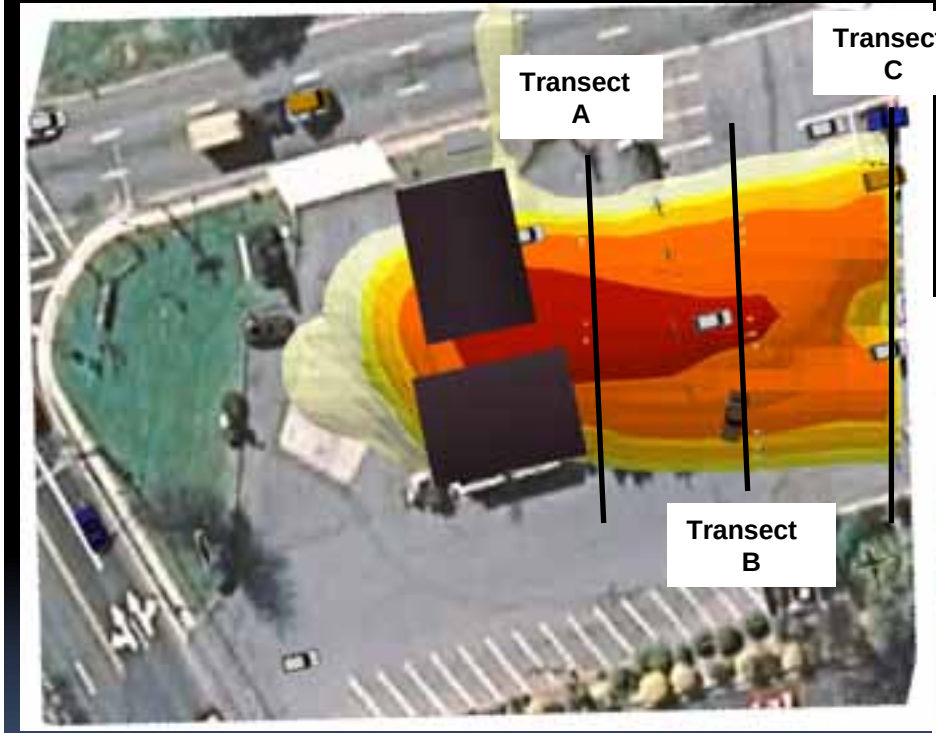
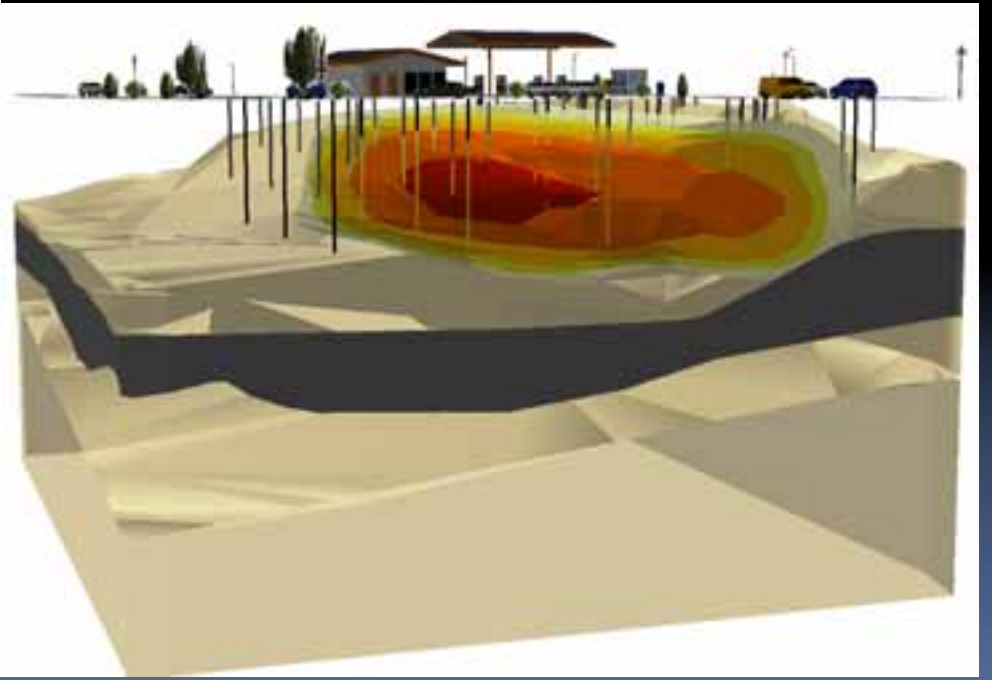
CASE STUDY – 1990 Mass Flux

Aerial Extent of Mass Flux



3D Plane View Of Mass Flux



THANK YOU
&
QUESTIONS?

Contact Information

Brett Milburn, GISP
215-491-6555
bmilburn@langan.com

Allison Jelinek
215-491-6577
ajelinek@langan.com