APPLICATION OF THE GNOME OIL SPILL MODEL TO THE POTOMAC RIVER

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November 3, 2021
OPERATIONAL SPILL MODELING AT ICPRB

- 1D models
  - Emergency River Spill Model (ERSM) – ICPRB
  - IC Water – US Army/Leidos

- Advantages
  - Quick to run
  - Few data inputs
  - “1D” assumptions
    - Completely soluble contaminant
    - Complete vertical mixing
    - Complete lateral mixing

- Limitations
  - Constant flows

ICPRB’s current operational tools
2D SPILL MODEL OF THE POTOMAC RIVER

- Estimate arrival times of floating contaminants at downstream water supply intakes.
- Predict both the longitudinal and transverse movement of a contaminant plume.
- Consider two-dimensional flow patterns in the river.
  - Contaminant transport model (GNOME)
    → 2D steady and unsteady flow (CATS)
    → 2D unsteady flow (Delft3D, IRIC)
- Use bathymetric LiDAR data from Little Falls to Shepherdstown.
**GNOME MODEL**

- General NOAA Operational Modeling Environment
- Publicly available
- Predicts movement of oil on water bodies with varying winds, currents and other processes.
- Predicts chemical and physical changes (weathering) of oil on water surface.
- Study effects of uncertainty in current and wind observations and forecasts.
2D SPILL MODEL OF THE POTOMAC RIVER
CONTAMINANT TRANSPORT MODEL (GNOME)

- Medium-crude oil
- 100 barrels
- Constant flow

Constant Flow (baseline)

Variable Flow
UNSTEADY FLOW MODEL (DELFT3D/IRIC)

- Model Extent: Point of Rocks to Chain Bridge
- Model setup:
  - Resampled 30m DEM (LiDAR + NOAA NCEI)
  - Discharge boundary conditions at Point of Rock
  - Water level boundary condition below Little Falls
  - 3 inflows (Monocacy, Goose, Seneca)
RIVER FLOW: UNSTEADY FLOW MODEL (DELFT3D)

May to December 2019

Discharge (cfs)

- Modeled
- Observed
RIVER FLOW: IRIC-FASTMECH/DELFT3D

October – November 2019

Graph showing discharge (cfs) over time from 1-October to 10-November 2019, with observed, modeled (Delft3D), and modeled (Fastmech) data points.
October – November 2019
Short Section of River above Point of Rocks

RMSE = 0.213611
using Manning’s n = 0.04
and finer elevation data
1993 OIL SPILL EVENT

- Rupture of section of a pipeline owned and operated by the Colonial Pipeline Company
- 400,000 gallons of diesel fuel into Sugarland Run in Reston, VA
- GNOME model set up
  - Spill date: March 28, 1993
  - Model run time: 3 weeks
  - Spill location: confluence of Potomac River and Sugarland Run.
  - Spill amount: 35,000 gallons over three days
SUMMARY

- Constructed steady state and transient GNOME oil spill model for Potomac River.
- Flow models capture spatio-temporal variability of river flow and water velocities.
- Flow model run times vary with resolution and model type. Can be reduced using restart file and integrating flow model in LFFS.
- GNOME model was used to simulate 1993 oil spill model.
- New tool is an improvement over previously available tools.
FUTURE STEPS

- Enhance Potomac River models
  - Extend model domain up to Shepherdstown & Millville
  - Incorporate into CO-OP’s real-time Low Flow Forecast System (LFFS)
  - Test particle tracking capability of iRIC model
  - Refine grids
- Build 2D Occoquan & Patuxent reservoir spill models