The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry or the U.S. Department of Health and Human Services

Approach to Numerical Groundwater-Flow and Contaminant Fate and Transport Modeling

René J. Suárez-Soto

Environmental Health Scientist

Agency for Toxic Substances and Disease Registry

29 APR 09

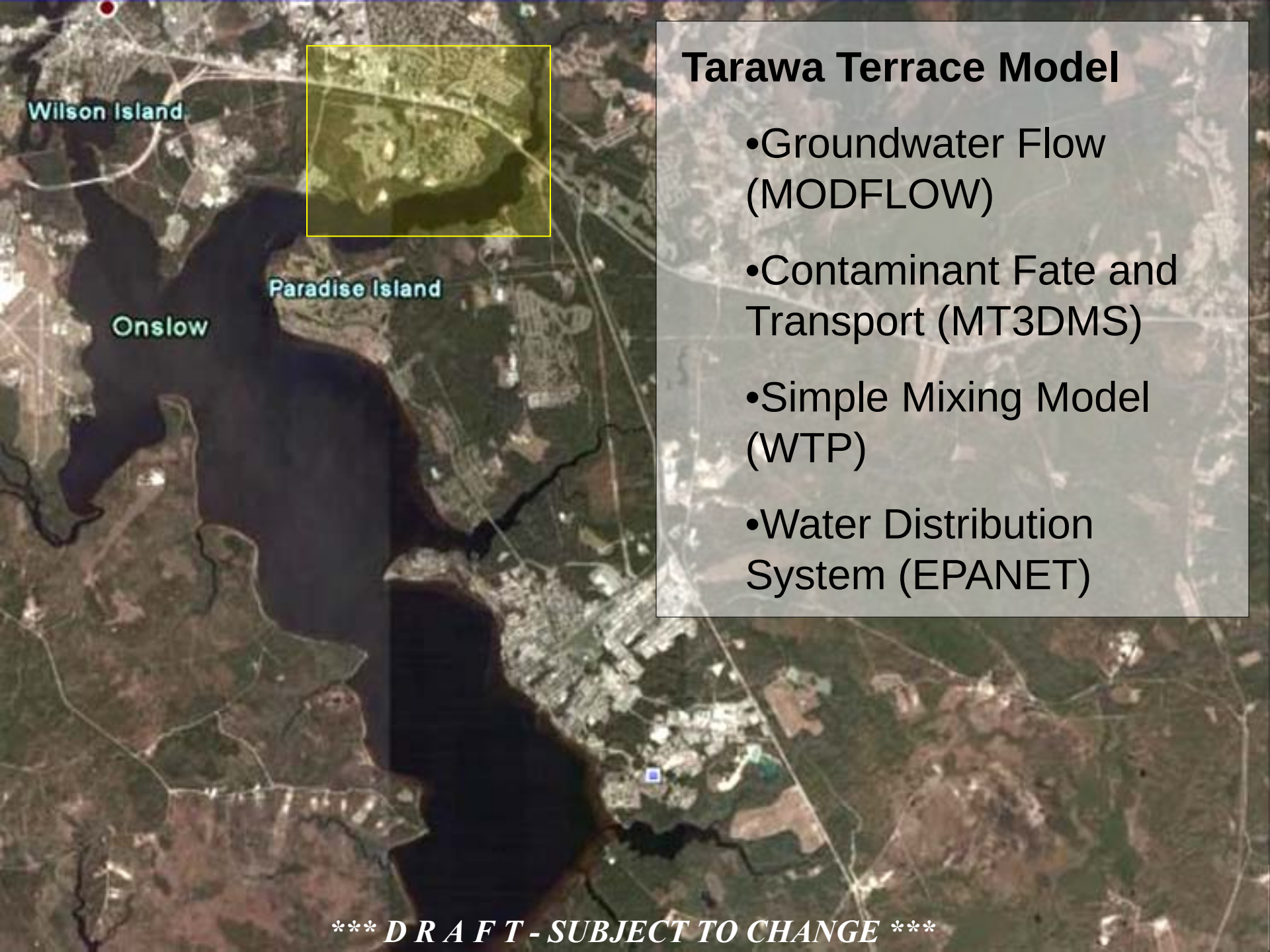
*** D R A F T - SUBJECT TO CHANGE ***

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Hadnot Point/Holcomb Boulevard Modeling Approach

- Groundwater Flow Modeling-Regional
  - Steady-State
  - Transient
- Groundwater Flow Modeling-Local
- Contaminant Fate and Transport-Local

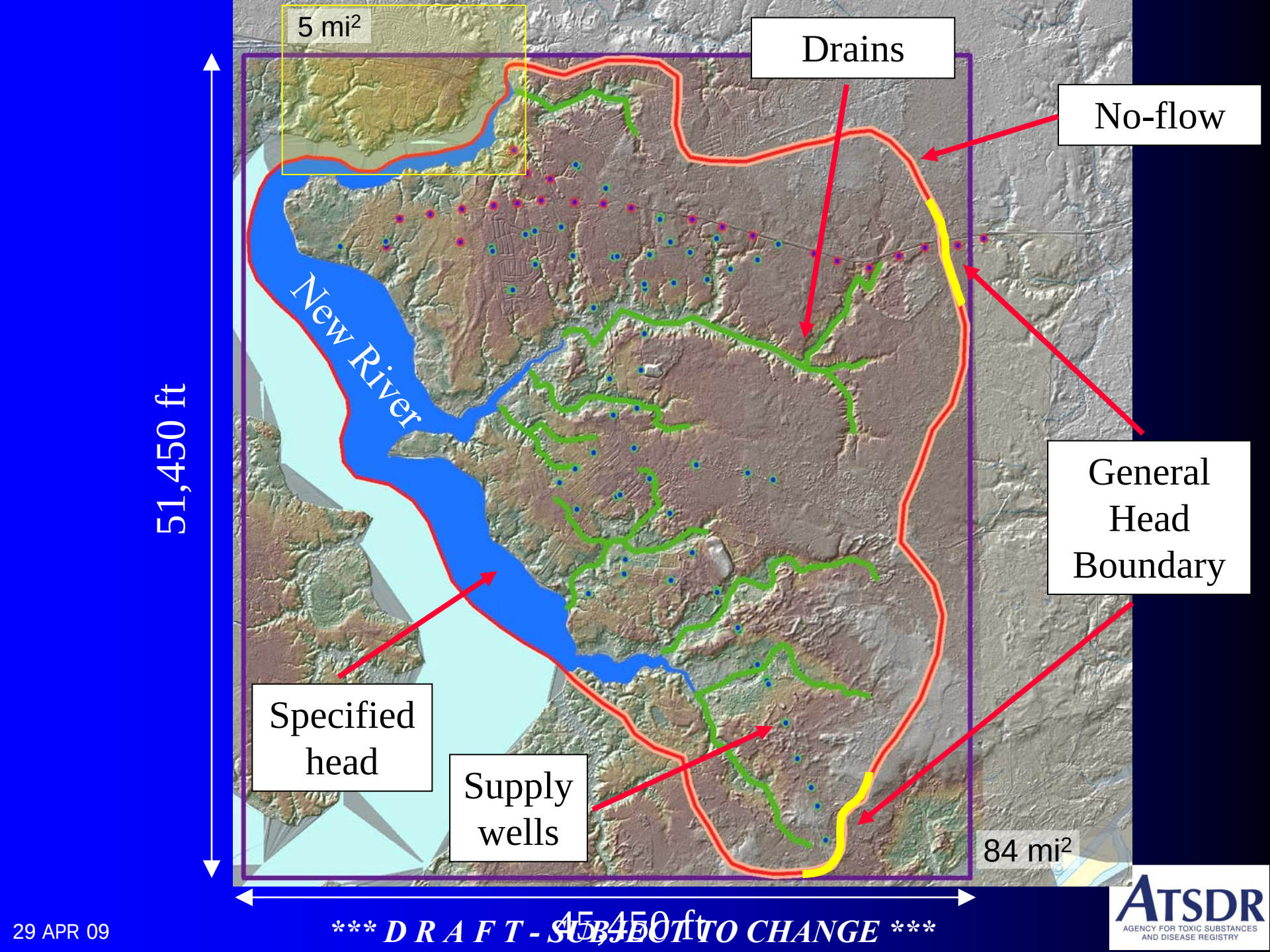
*** D R A F T - SUBJECT TO CHANGE ***



Tarawa Terrace Model

- Groundwater Flow (MODFLOW)
- Contaminant Fate and Transport (MT3DMS)
- Simple Mixing Model (WTP)
- Water Distribution System (EPANET)

*** D R A F T - SUBJECT TO CHANGE ***

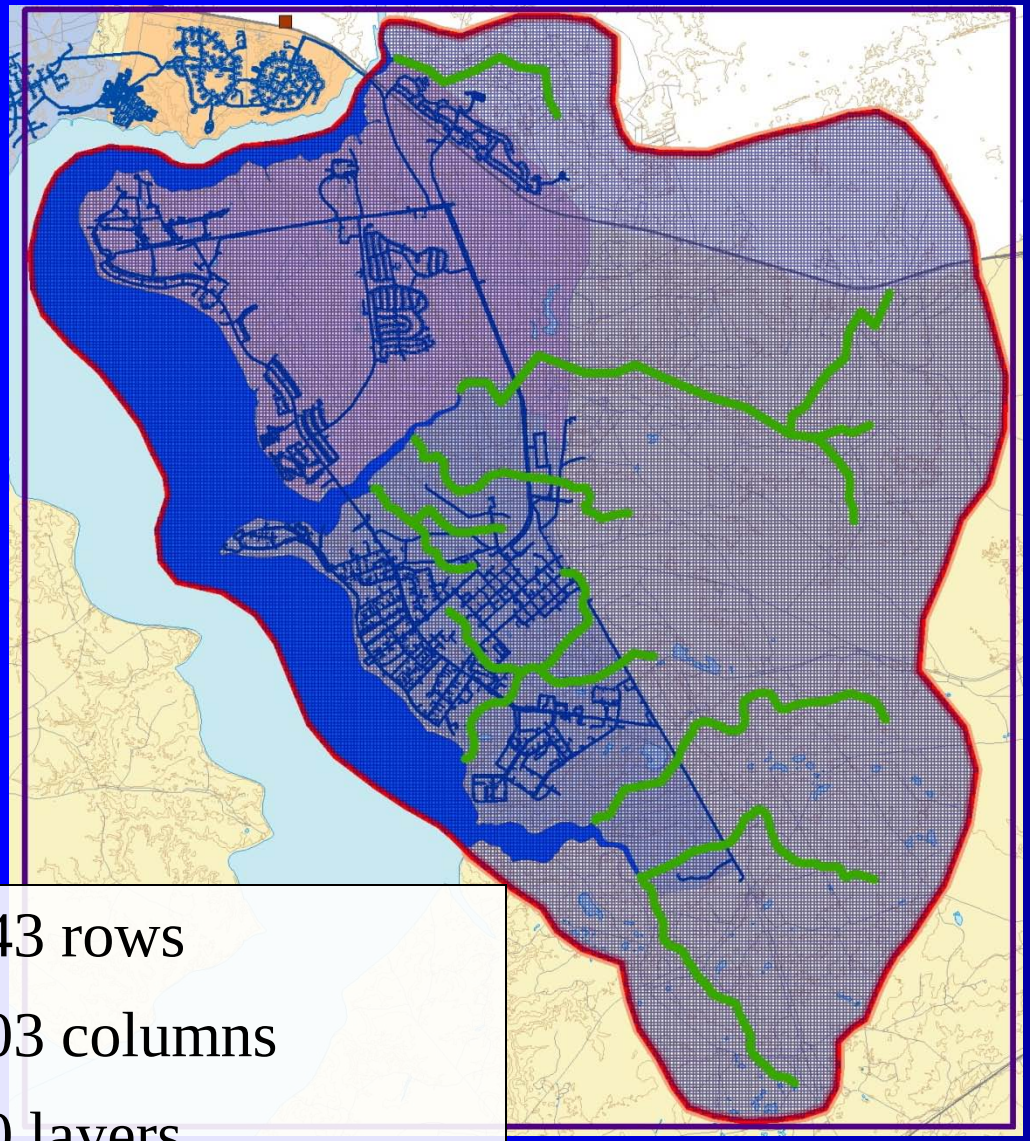


29 APR 09

*** D R A F T - SUBJECT TO CHANGE ***

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

HPHB grid design



GEOHYDROLOGIC UNIT	MODEL LAYER
Brewster Boulevard Upper Aquifer	LAYER 1
Brewster Boulevard Upper Confining Unit	
Brewster Boulevard Lower Aquifer	
Brewster Boulevard Lower Confining Unit	
Tarawa Terrace aquifer	LAYER 2
Tarawa Terrace confining unit	LAYER 3
Upper Castle Hayne aquifer–River Bend unit	LAYER 4
Local confining unit	LAYER 5
Upper Castle Hayne aquifer–Lower unit	LAYER 6
Middle Castle Hayne confining unit	LAYER 7
Middle Castle Hayne aquifer	LAYER 8
Lower Castle Hayne confining unit	LAYER 9
Lower Castle Hayne aquifer	LAYER 10
Beaufort Confining Unit	BASE OF MODEL

343 rows

303 columns

10 layers

Cell size=150 ft/side

*** D R A F T - SUBJECT TO CHANGE ***

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

PEST optimization

Iteration	Φ	Horizontal Hydraulic Conductivity						Recharge	
		Layer 1 ft/day	Layer 2 ft/day	Layer 4 ft/day	Layer 6 ft/day	Layer 8 ft/day	Layer 10 ft/day	Zone 1	Zone 2
1	60479	13.5	23.5	37.4	37.4	15.5	15.5	0.00200	0.00200
2	42427	2.7	24.7	35.4	37.0	15.8	17.1	0.00141	0.00308
3	41891	5.1	26.4	34.3	37.1	16.5	18.8	0.00141	0.00365
4	40987	6.9	29.4	29.9	36.0	15.7	21.2	0.00136	0.00369
5	40914	3.6	31.8	6.0	29.2	10.5	31.6	0.00134	0.00313
6	40900	3.5	32.3	1.2	28.4	9.1	34.5	0.00134	0.00298
Total model calls = 78									

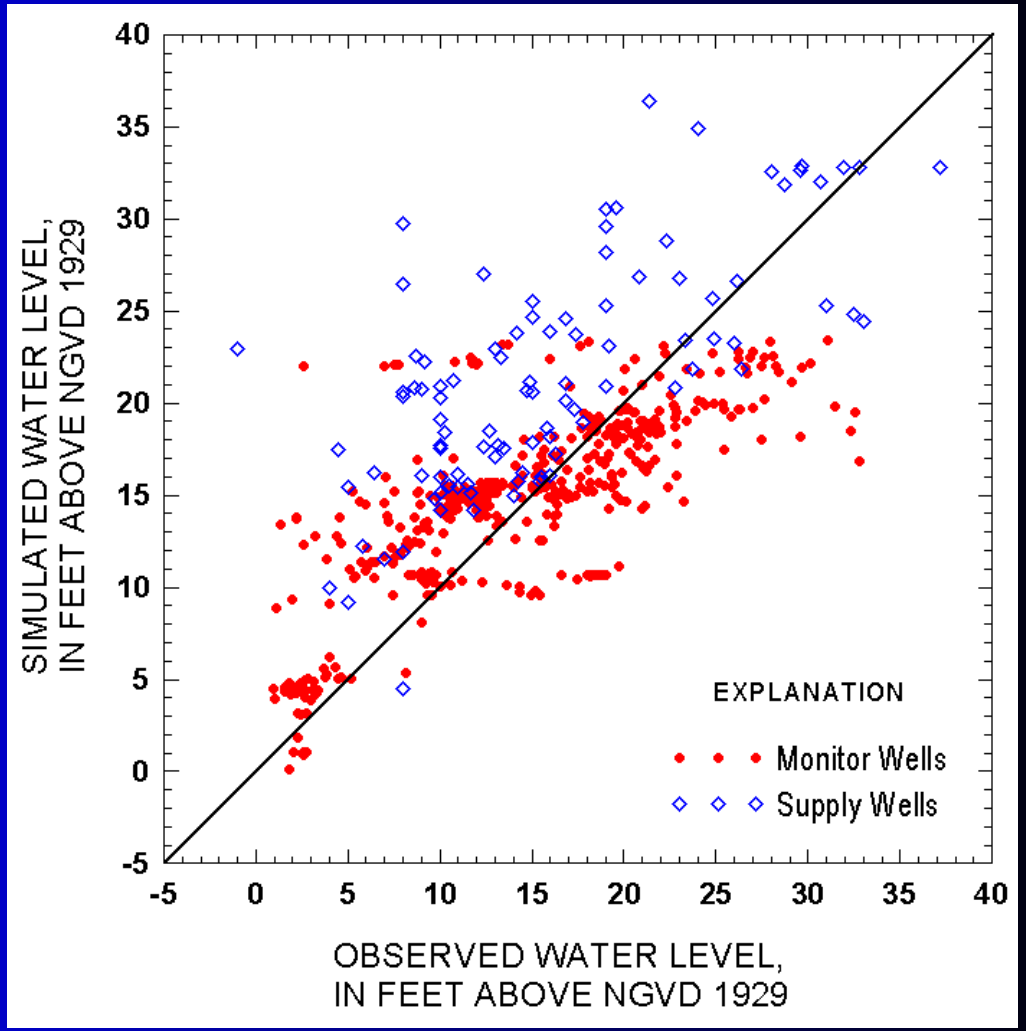
$$\Phi = \sum_{i=1}^{n} \left(h_o - h_s \right)^2$$

*** D R A F T - SUBJECT TO CHANGE ***

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Calibration results

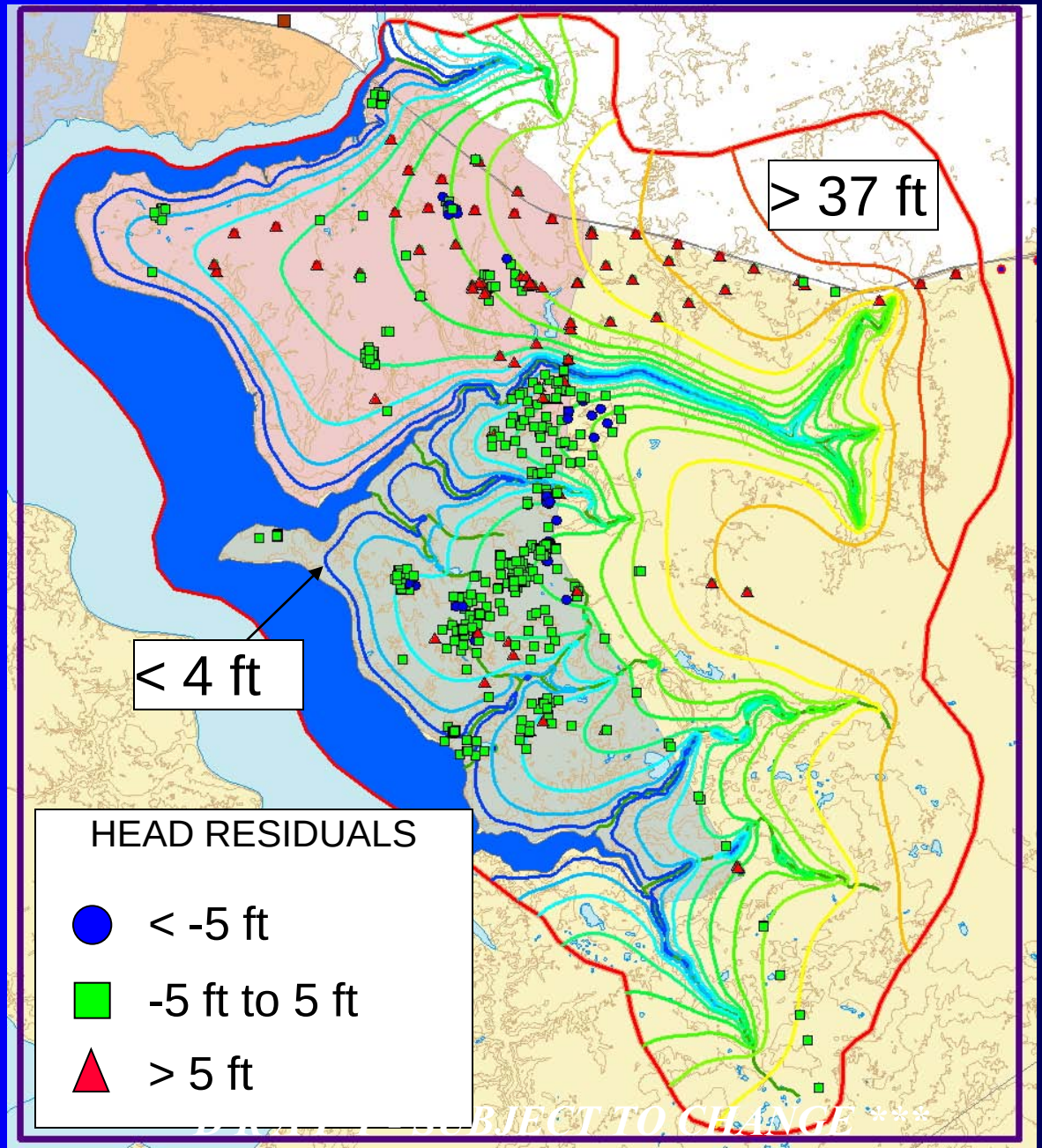
- Automated Parameter Calibration
  - PEST
  - UCODE
- RMS Error = 5.46 ft



*** D R A F T - SUBJECT TO CHANGE ***

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Steady-State Model Preliminary Results



*** SUBJECT TO CHANGE ***

29 APR 09

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

HPHB and TT side-by-side comparison

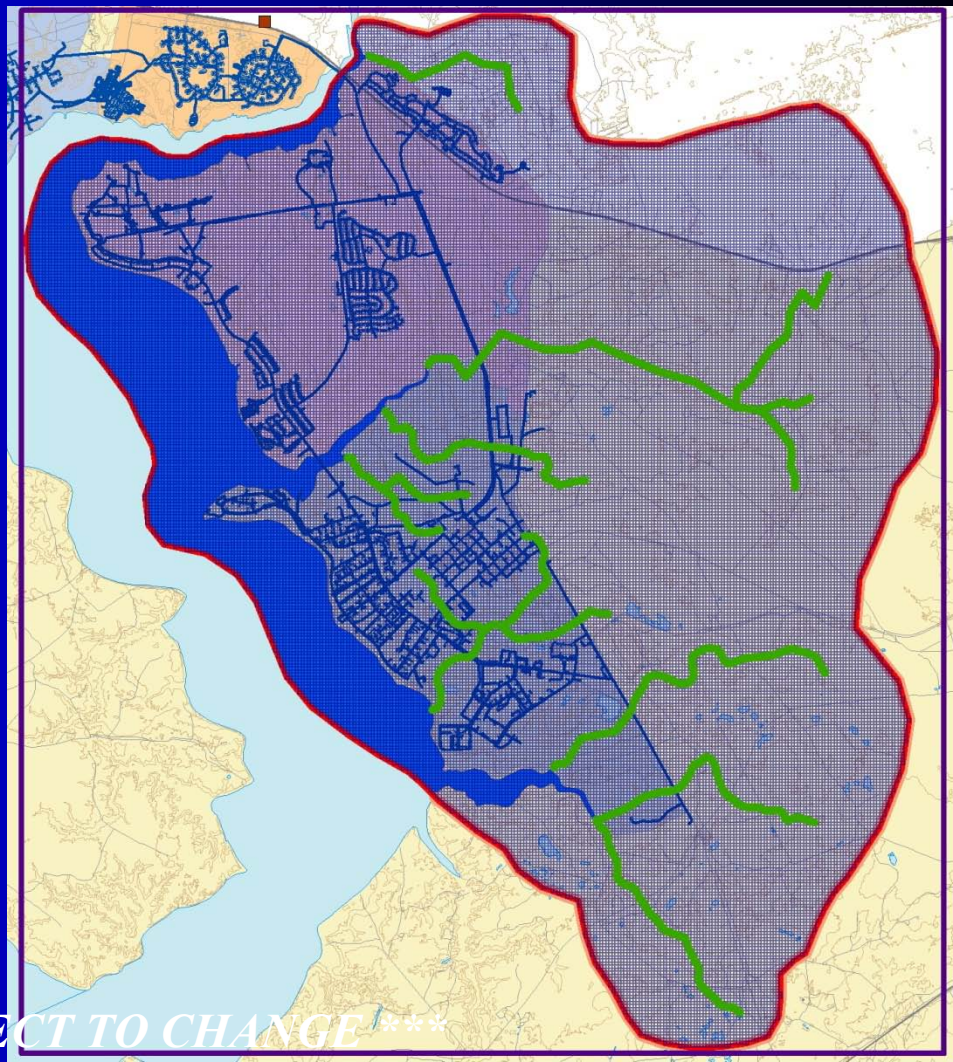
	Tarawa Terrace	HPHB
Row	200	343
Column	270	303
Layer	7	10
Cell Size	50 ft	150 ft
Available data:		
Water level		
Steady state	59 measurements	546 measurements
Transient	789 measurements	5407 measurements
Contaminant concentration	PCE 36 supply wells 25 WTP	Chlorinated Solvents 100 supply wells 31 HP WTP

*** D R A F T - SUBJECT TO CHANGE ***

Proposed approach

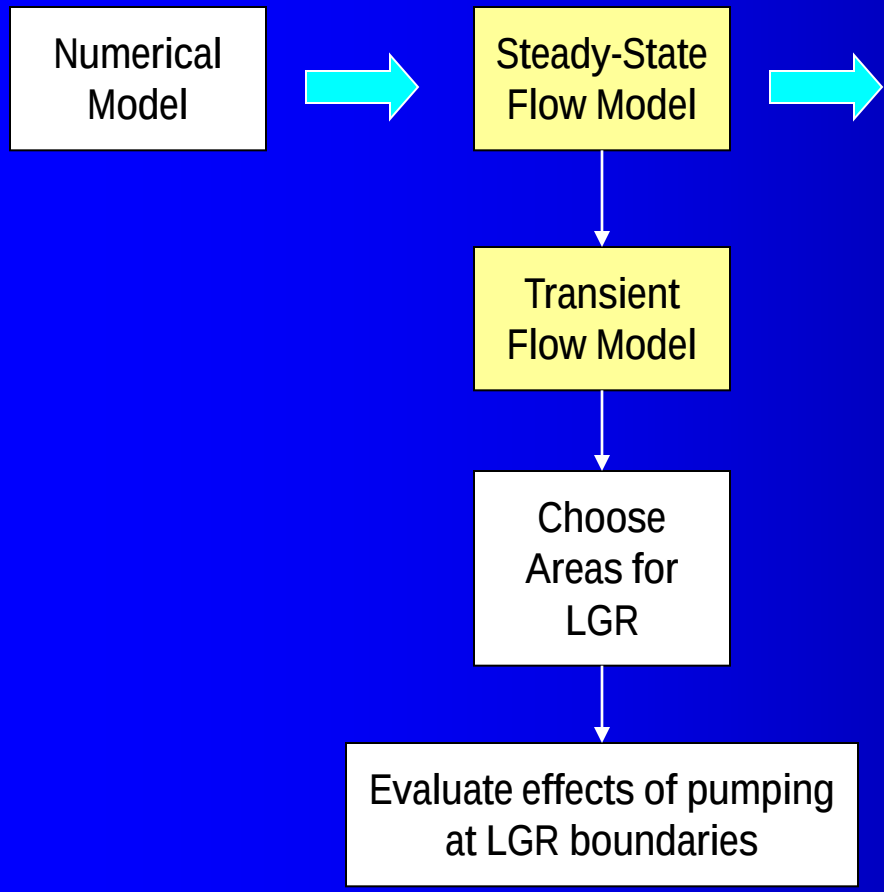
Numerical Model → Steady-State Flow Model → Transport model on LGR models

Steady-State Flow Model
↓
Transient Flow Model
↓
Choose Areas for LGR
↓
Evaluate effects of pumping at LGR boundaries



*** D R A F T - SUBJECT TO CHANGE ***

Proposed approach



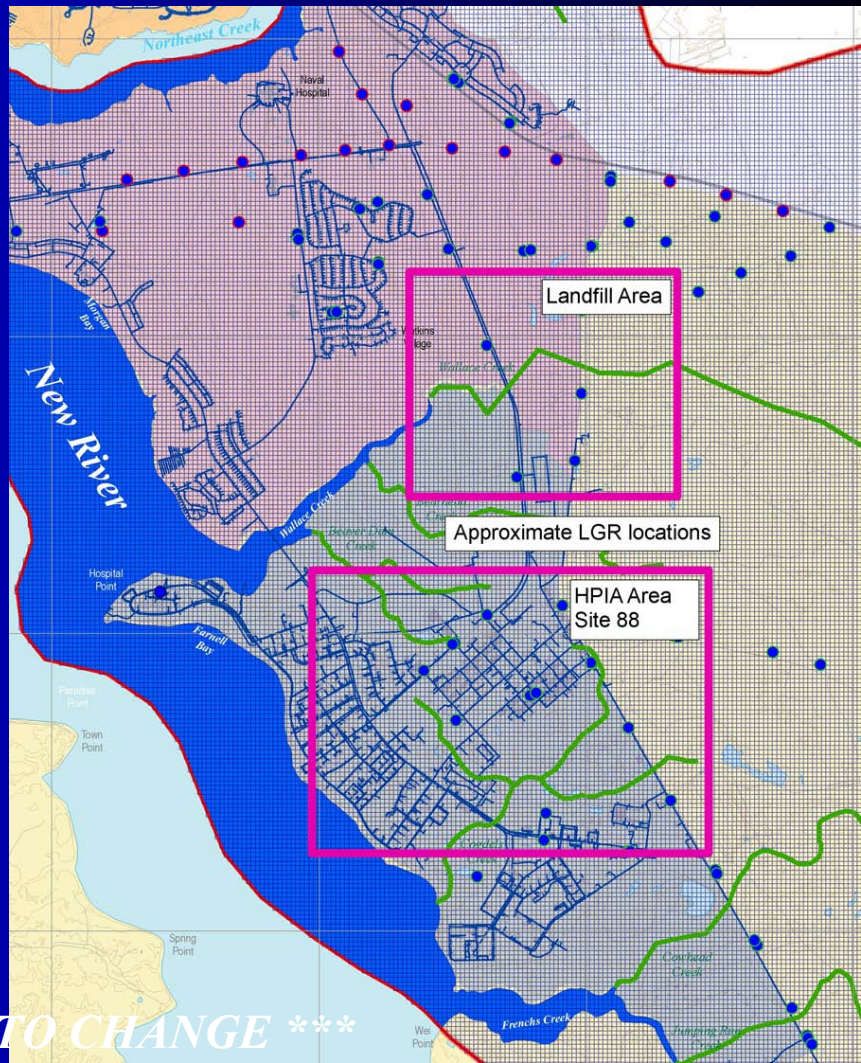
- MODFLOW 2000
- PEST

*** D R A F T - SUBJECT TO CHANGE ***

Proposed approach

Numerical Model → Steady-State Flow Model → Transport model on LGR models

Steady-State Flow Model → Transient Flow Model → Choose Areas for LGR → Evaluate effects of pumping at LGR boundaries

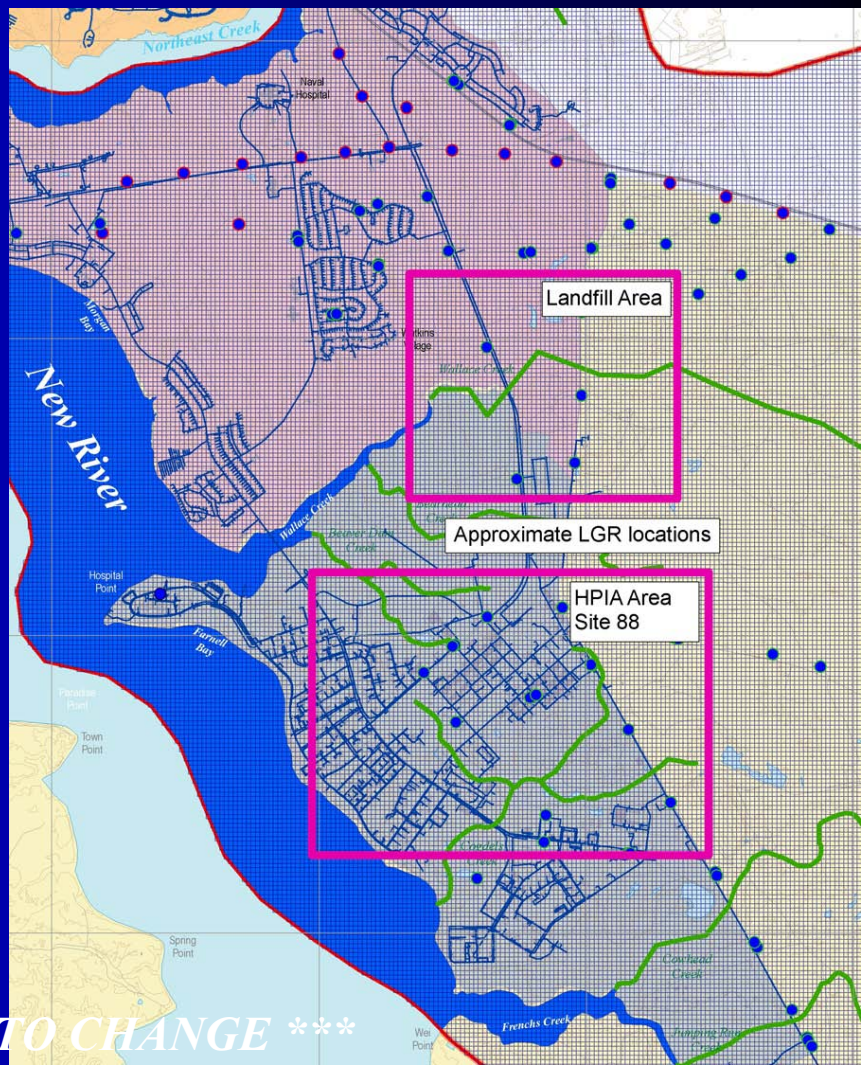


*** D R A F T - SUBJECT TO CHANGE ***

Proposed approach

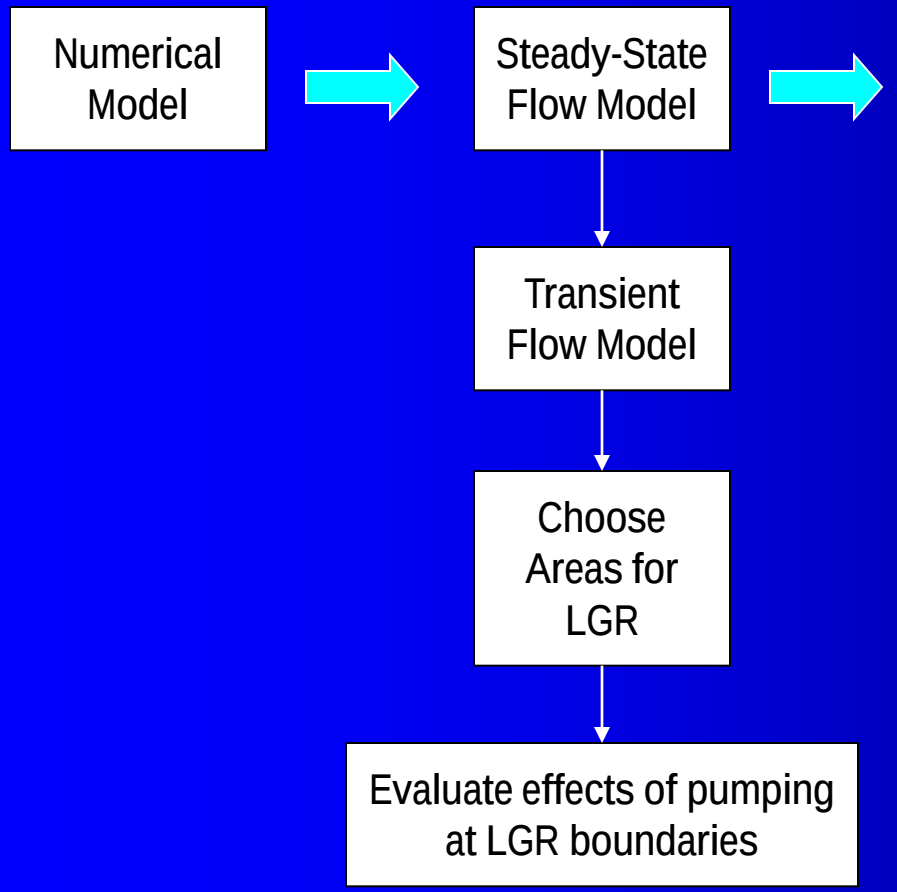
Numerical Model → Steady-State Flow Model → Transport model on LGR models

Steady-State Flow Model → Transient Flow Model → Choose Areas for LGR → Evaluate effects of pumping at LGR boundaries



*** D R A F T - SUBJECT TO CHANGE ***

Proposed approach



- MT3DMS
- PEST

*** D R A F T - SUBJECT TO CHANGE ***

Questions

*** D R A F T - SUBJECT TO CHANGE ***