

DRINKING WATER SOURCE PROTECTION

Trent Conservation Coalition Source Protection Region



Water Budgets

October 6, 2009



Expert People. Better Decisions.



Overview



§ Water Budgets

§ Tier 1

§ Tier 2

§ Lindsay



Water Budgets

§ Overview

- Main Outputs – Water Budget and %Water Demand

§ Water Budget Equation

- $P + G_{\text{net}} = ET + Q + \Delta S$

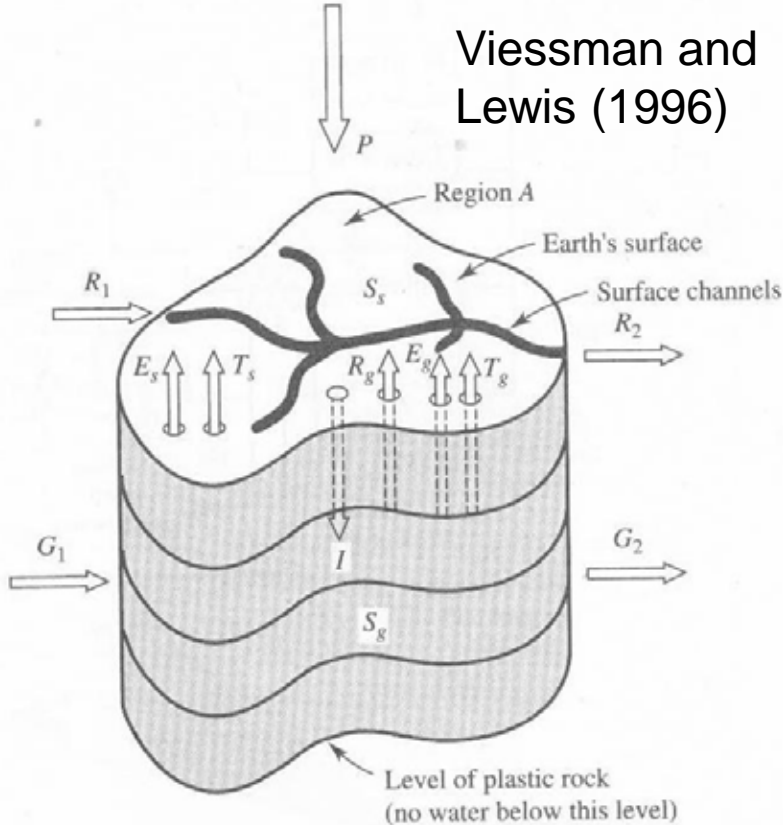
§ %Water Demand Equation

- $\% = \frac{\text{Demand}}{Q_{50} - Q_{10}} \times 100$

$$Q_{50} - Q_{10}$$

- $\% = \frac{\text{Demand}}{Q_R - Q_{10}} \times 100$

$$Q_R - Q_{10}$$



Water Budgets



§ Conceptual Water Budget

- Data Gathering
- Development of Broad Scale Understanding

§ Tier 1 – Simple Water Budget

- Uses Information from Conceptual Water Budget
- WBs and %Water Demand Calculated per subwatershed

§ Tier 2 – Complex Water Budget

- Refines information from Tier 1; Complex Model Applied
- WBs and %Water Demand Calculated per subwatershed

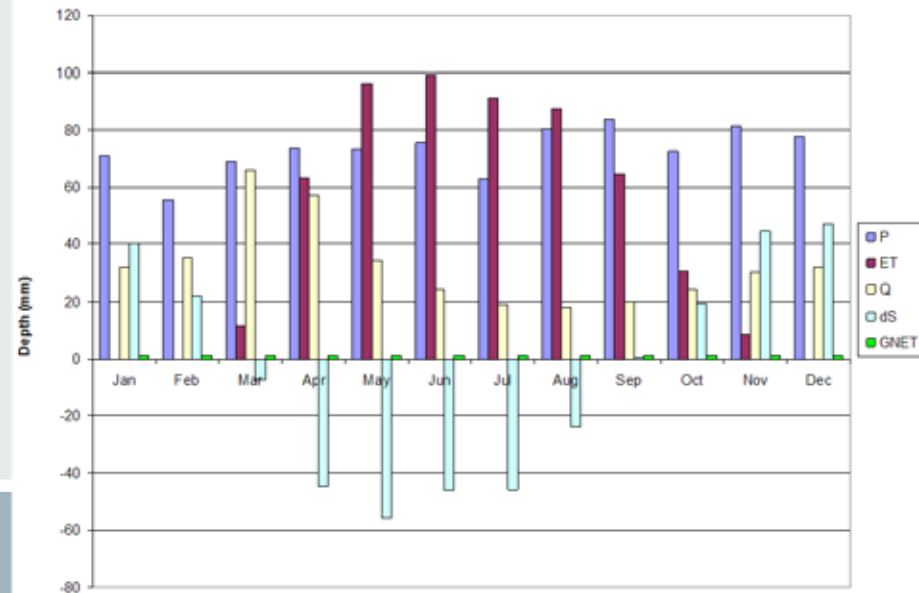


Tier 1 Water Budget

Month	P (mm)	ET (mm)	G _{net} (mm)	Q (mm)	DS (mm)
Jan	71	0	1.3	32	40
Feb	56	0	1.3	35	22
Mar	69	12	1.3	66	-7
Apr	74	63	1.3	57	-45
May	74	96	1.3	34	-56
Jun	76	99	1.3	24	-46
Jul	63	91	1.3	19	-46
Aug	80	88	1.3	18	-24
Sep	84	65	1.3	20	0
Oct	72	30	1.3	24	19
Nov	81	8	1.3	30	44
Dec	78	0	1.3	32	47
Annual	878	552	15	391	

- Shelter Valley Brook Example

- Water Budget Completed for all subwatersheds in the TCC



Tier 1 Water Budget



§ Demand

- Permitted > 50,000 L/d
- Unpermitted Agriculture
- Unpermitted Domestic
- Consumptive use factors
- Examples: municipal supplies, water bottlers and golf courses

Tier 1 Water Budget



Example Crowe River at Marmora

Month	Supply	Reserve	S-R	Demand		Stress	
	Q50 (mm)	Q10 (mm)	Q50-Q10 (mm)	Current (mm)	Future (mm)	Current (%)	Future (%)
Jan	25	12	13	0.003	0.03	0.02	0.2
Feb	22	10	12	0.003	0.03	0.02	0.3
Mar	38	18	20	0.003	0.03	0.01	0.2
Apr	97	62	35	0.003	0.03	0.01	0.1
May	59	25	34	0.003	0.03	0.01	0.1
Jun	19	10	9	0.003	0.03	0.03	0.4
Jul	8	3	5	0.003	0.03	0.05	1
Aug	4	2	2	0.003	0.04	0.1	2
Sep	3	1	2	0.003	0.03	0.1	1
Oct	9	2	6	0.003	0.03	0.04	1
Nov	21	5	16	0.003	0.03	0.02	0.2
Dec	32	10	21	0.003	0.03	0.01	0.1

- % Water Demand calculated for every subwatershed GW & SW

Tier 1 Water Budget



Surface Water Stress Level Assignment

Stress Level Assignment	Maximum Monthly % Water Demand
Low	< 20%
Moderate	20% - 50%
Significant	> 50%

Groundwater Stress Level Assignment

Stress Level Assignment	Average Annual	Maximum Monthly
Low	0 - 10%	0 – 25%
Moderate	> 10%, <= 25%	> 25%, <= 50%
Significant	> 25%	> 50%

Tier 1 Water Budget



§ Identified as Stressed and have a Municipal Supply

- Lindsay Surface water Stress / SW Supply
- Havelock Groundwater Stress / GW Supply
- Brighton Groundwater Stress / GW Supply
- Colborne Groundwater Stress / GW Supply
- Orono Surface water Stress / GW Supply

§ Tier 2 must be completed for those Identified Above

Tier 2 Water Budget



§ Overall Tier 2 Requirements

- Complete a water budget on identified subwatersheds
- Simulate several scenarios to assign a subwatershed “stress level”
- Refine Demand Estimates

§ A Complex Model Must be Developed to:

- Generate the terms of the water budget
- Estimate the supply term
- Calculate the level of the aquifer / reservoir

Tier 2 Water Budget



§ Model Selection

- Based on ability of model to represent hydrologic system
- Approved by Peer Review Committee

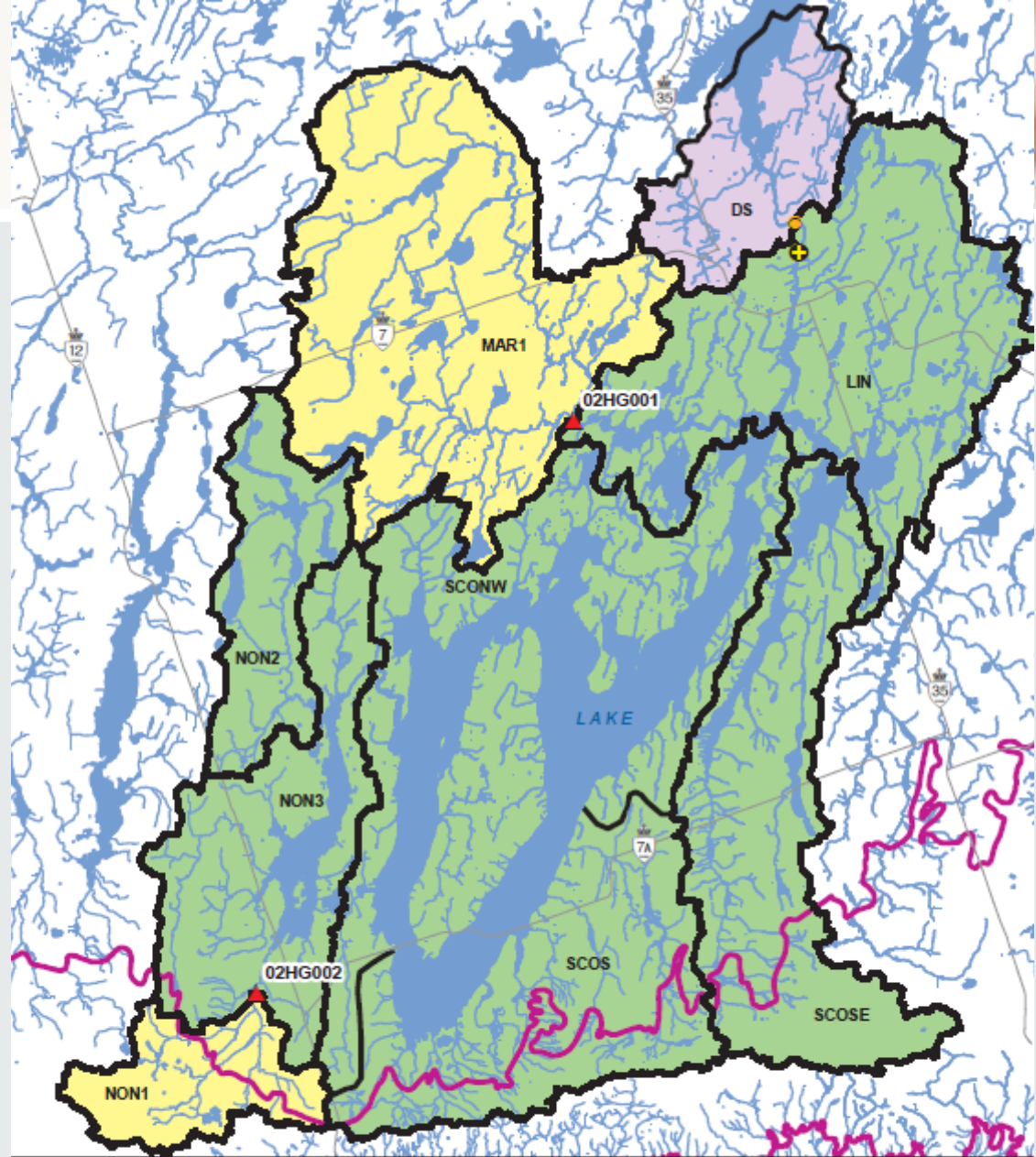
§ Models Selected

- Lindsay – HSPF and RESCOM by XCG SW
- Havelock – MODFLOW by XCG GW
- Brighton / Colborne – MODFLOW by EARTHFX
- Orono – HSPF and MODFLOW by Ganaraska and UoG

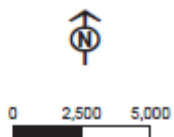
Lindsay

§ Details

- Drainage Area approximately 1,000 sq.km
- 2 Gauged watersheds
- Control Structure at Lindsay



Lindsay Watershed

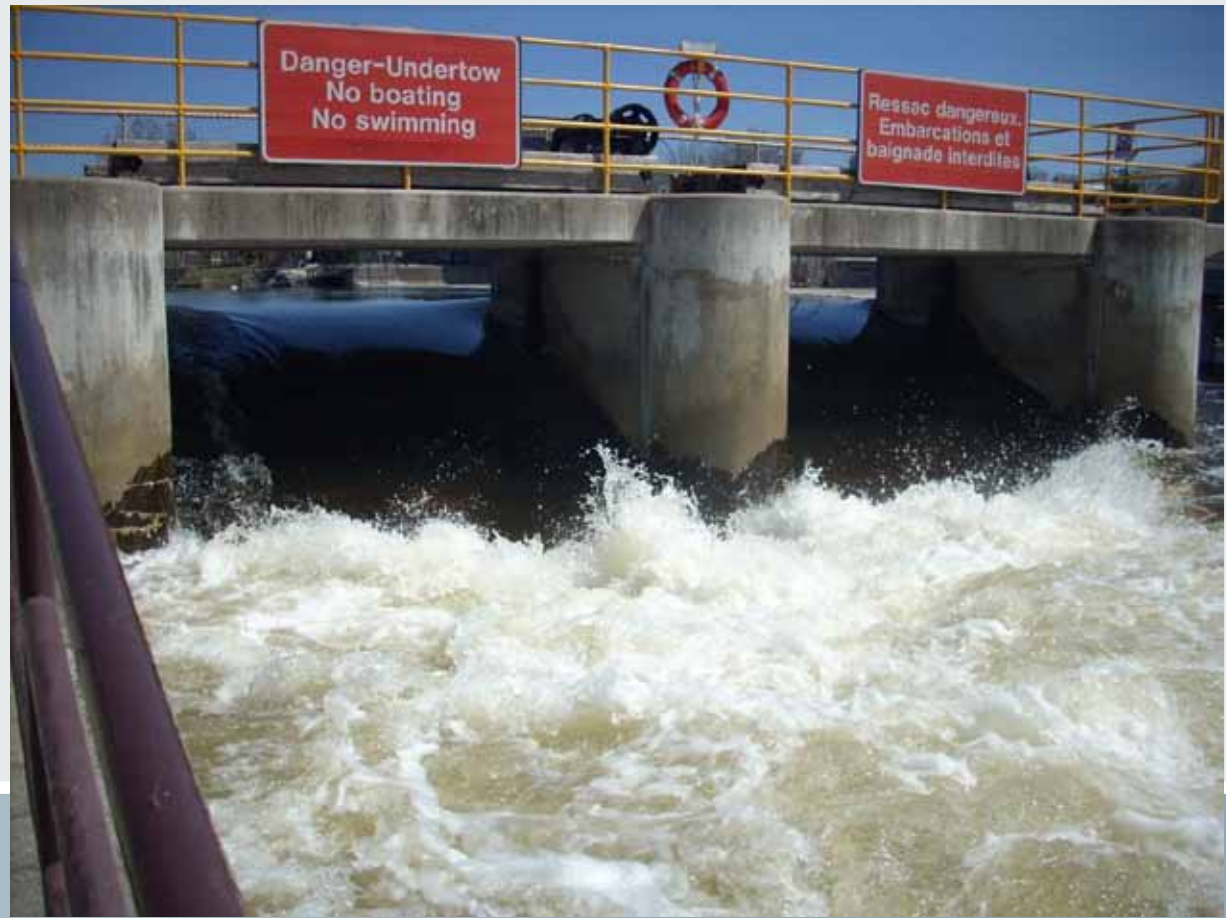


Lindsay



§ How Does Water Get Out

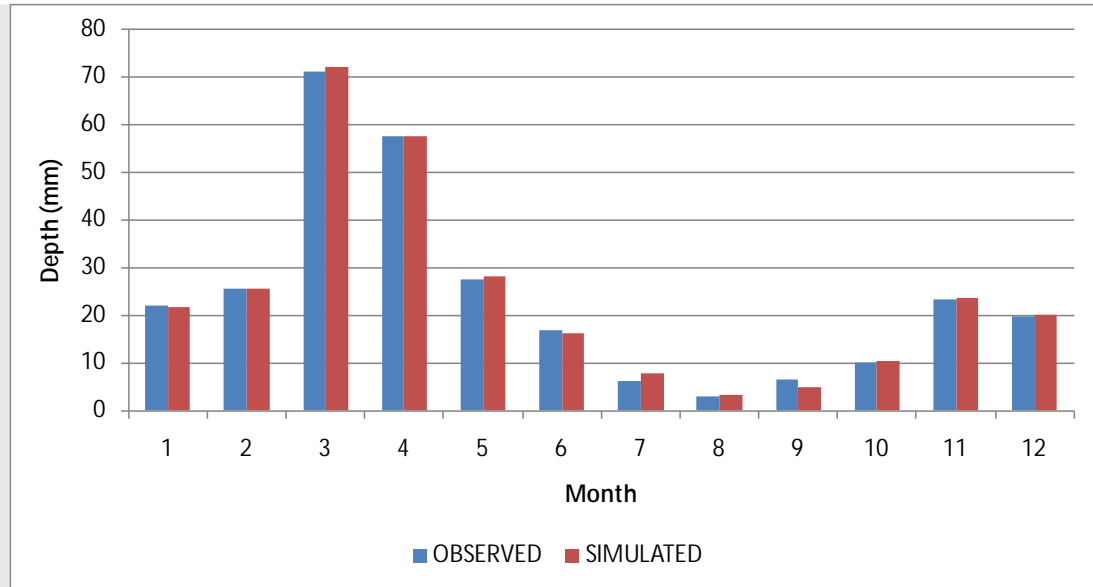
- Over Logs
- Locks
- Spillway
- Leakage



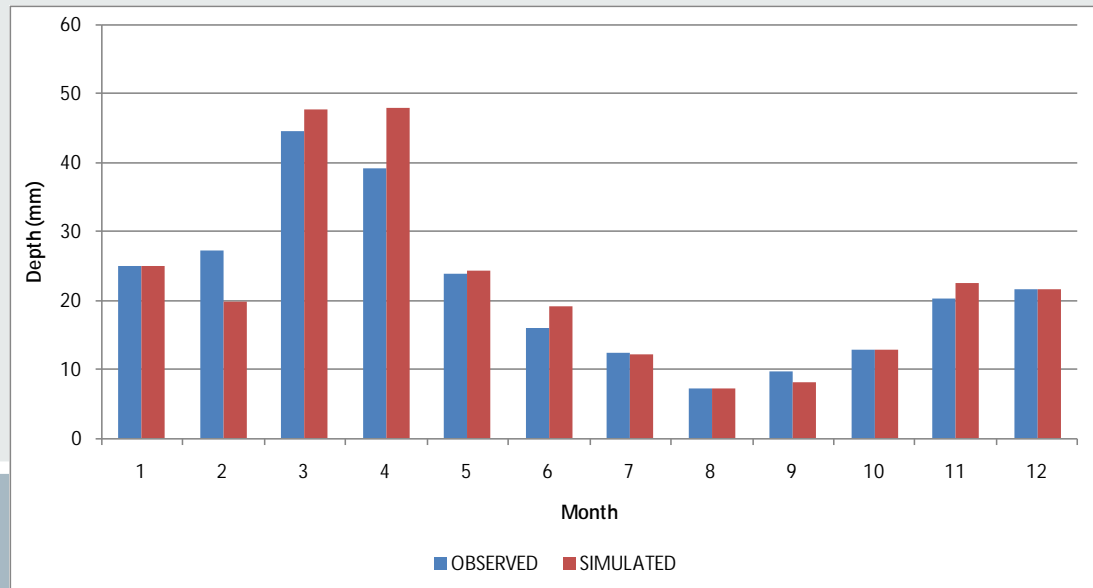
Lindsay



§ Mariposa Brook



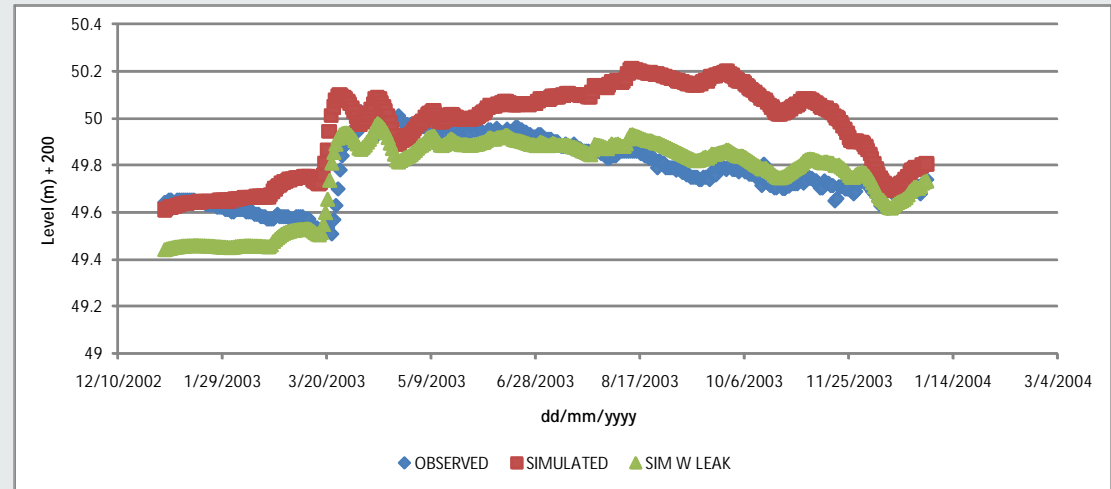
§ Nonquon River



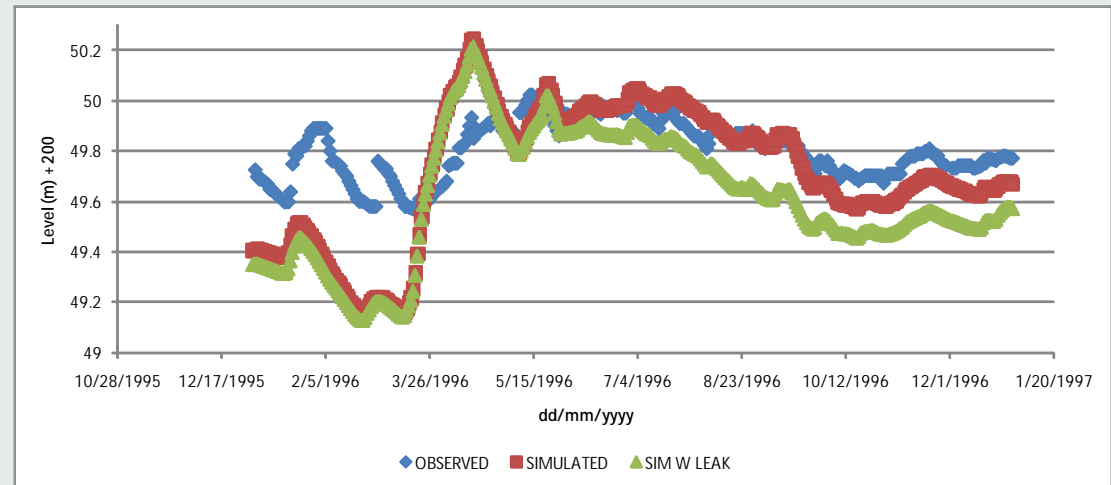
Lindsay



§ Lindsay Dam 2003



§ Lindsay Dam 1996



Lindsay



§ Model Calibration Accepted by Peer Review Committee

§ Model Applied for Scenarios

- %Water Demand Equation
- Does the Water Level Fall Below the Intake
- Preliminary Results Suggest Low Stress

§ Waiting for Final Peer Review Comments