Asset Management Workshop

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Presentation Goals

- Asset management – An economist view
- Major Rehab Guidance
- Major Rehab Tool

What is Asset Management?

- A business process and a decision making framework that covers an extended time horizon.

  From “Asset Management Overview” - DOT

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- Draws from economics and engineering theory and practice.
- Considers a broad range of assets.
- Incorporates the economic assessment of tradeoffs between alternative investment options at both the project level and the network or system level.
- All to help agencies make cost-effective investment decisions.

From “Asset Management Overview” - DOT

- **A business process**
  - Inventory and assessment of assets kept current over time’
  - Information developed specifically for decision making process
- **and a decision making framework that covers an extended time horizon.**
  - Use major rehab framework

Project History

- Describe the physical condition of the project and project features including an assessment of the engineering condition and reliability of each.
- Provide a history of project cost. Describe and display on an annual basis the operation, maintenance, repair and rehabilitation cost history of the project.
- Describe and display instances of service disruption and emergency repairs.
- Describe and document quantitatively historical changes in the service level capable of being provided by the project.

Economic Considerations

- The base condition is the alternative which all other plans will be measured against. In comparison to other Corps planning studies, the base condition is synonymous with the “without project” condition.
- select the probability of unsatisfactory performance
- Based on the existing physical condition of, and the current and forecasted demands on the features, estimate the frequency of service disruption and the physical consequences resulting over the planning period.
- Develop an event tree.
- Estimate all costs necessary to correct the service disruption.
- Estimate the economic cost for each disruption.
- Combine the frequency of service disruption with the consequences of disruption.
- Monte Carlo simulation is one technique for combining risks and determining expected values.

Engineering Considerations

- Reliability Analysis
- The base condition is the alternative which all other plans will be measured against. In comparison to other Corps planning studies, the base condition is synonymous with the “without project” condition.
- Probability of Unsatisfactory Performance
  - Reliability Indices
  - Hazard Functions
  - Historical Frequency of Occurrence Analyses
  - Expert Elicitation.
- Calibration of Reliability Models.
- Time Dependent Reliability
  - **Projections of future changes in reliability**

Engineering Considerations

- Engineering Characterization of Structural Features. The complex nature, time and cost of reliability analyses require that the number of elements analyzed for any project or feature be reduced to the critical elements, or to representative groups or sections.
- Engineering Consequences. The engineering, or physical, consequences of the expected level of performance should be described in detail for each performance function evaluated.
- Engineering Evaluation of Alternatives. Alternatives investigated should include the use of new materials, new repair techniques and innovative designs as well as all reasonable alternative configurations.

Environmental Considerations

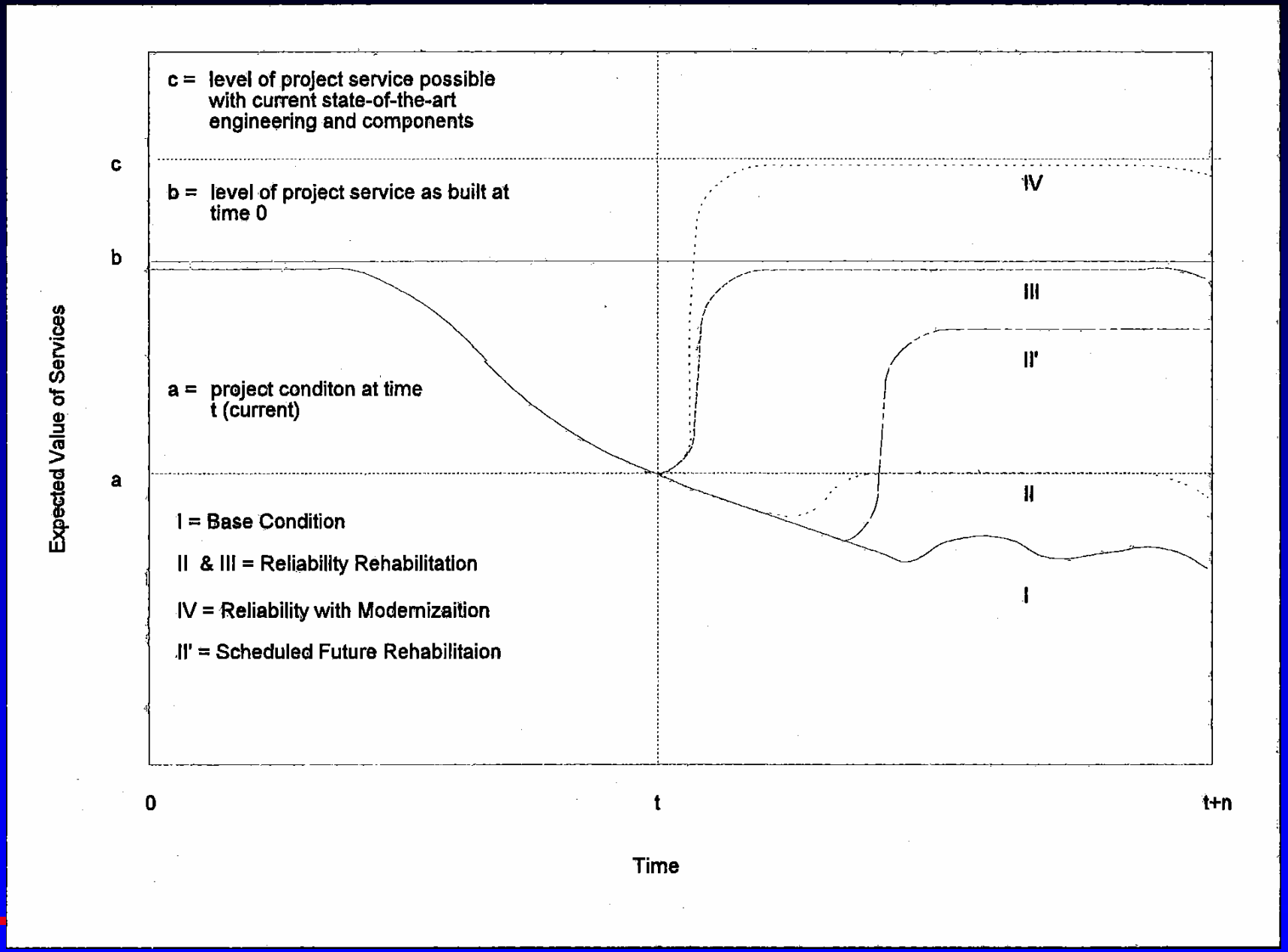
- Environmental Effects.
- Coordination and Correspondence.
- Reports and Studies.
- NEPA documentation

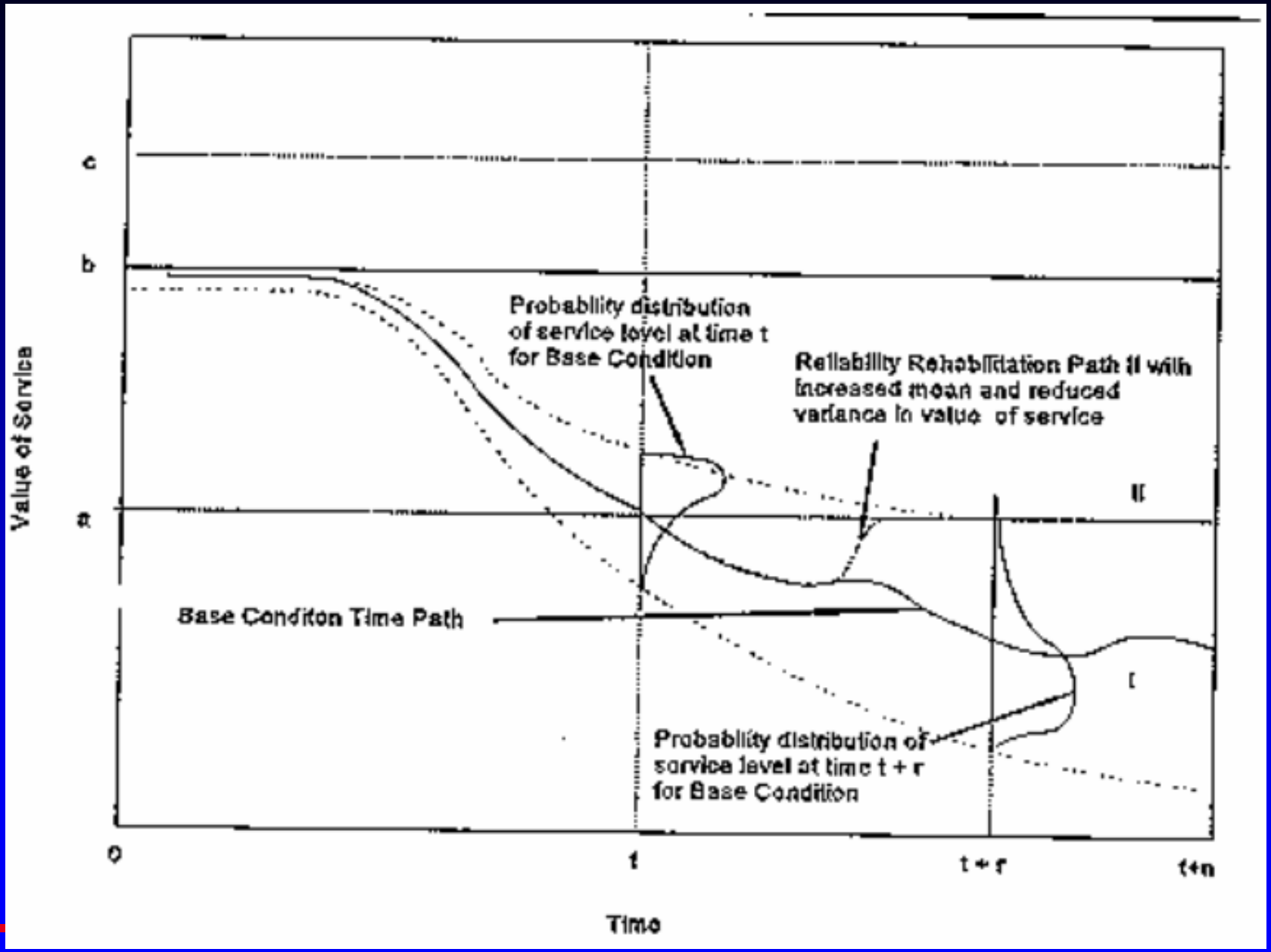
Assessment of Alternatives

- Critical Assumptions and Key Variables. The assessment should identify which …variables is critical to reported economic evaluation of each rehabilitation alternative.
- Reporting of Statistical Results. The output from the analysis of reliability based costs and benefits are statistics generated by analytical procedures or simulations involving probabilities.
- Recommended Plan. Provide a recommendation supported by the engineering, economic and environmental analysis.

CONCEPTUAL APPROACH

- In thinking about the maintenance budget it is important to remember that the evaluation considers ***alternative future streams of project services and costs and the reliabilities of those services and costs*****.** Any maintenance plan results in a different stream of these variables. The purpose of a risk-based benefit-cost analysis is to determine the economic efficiency of alternative plans. The evaluation must account for the fact that each O&M plan may differ in terms of its effects on project future service levels and/or project reliability.


c = level of project service possible with current state-of-the-art engineering and components
b = level of project service as built at time 0
a = project conditon at time t (current)
I = Base Condition
II & III = Reliability Rehabilitation
IV = Reliability with Modernizaition
II' = Scheduled Future Rehabilitaion
c
b
a
IV
III
II'
II
I
Expected Value of Services
0
t
t+n
Time



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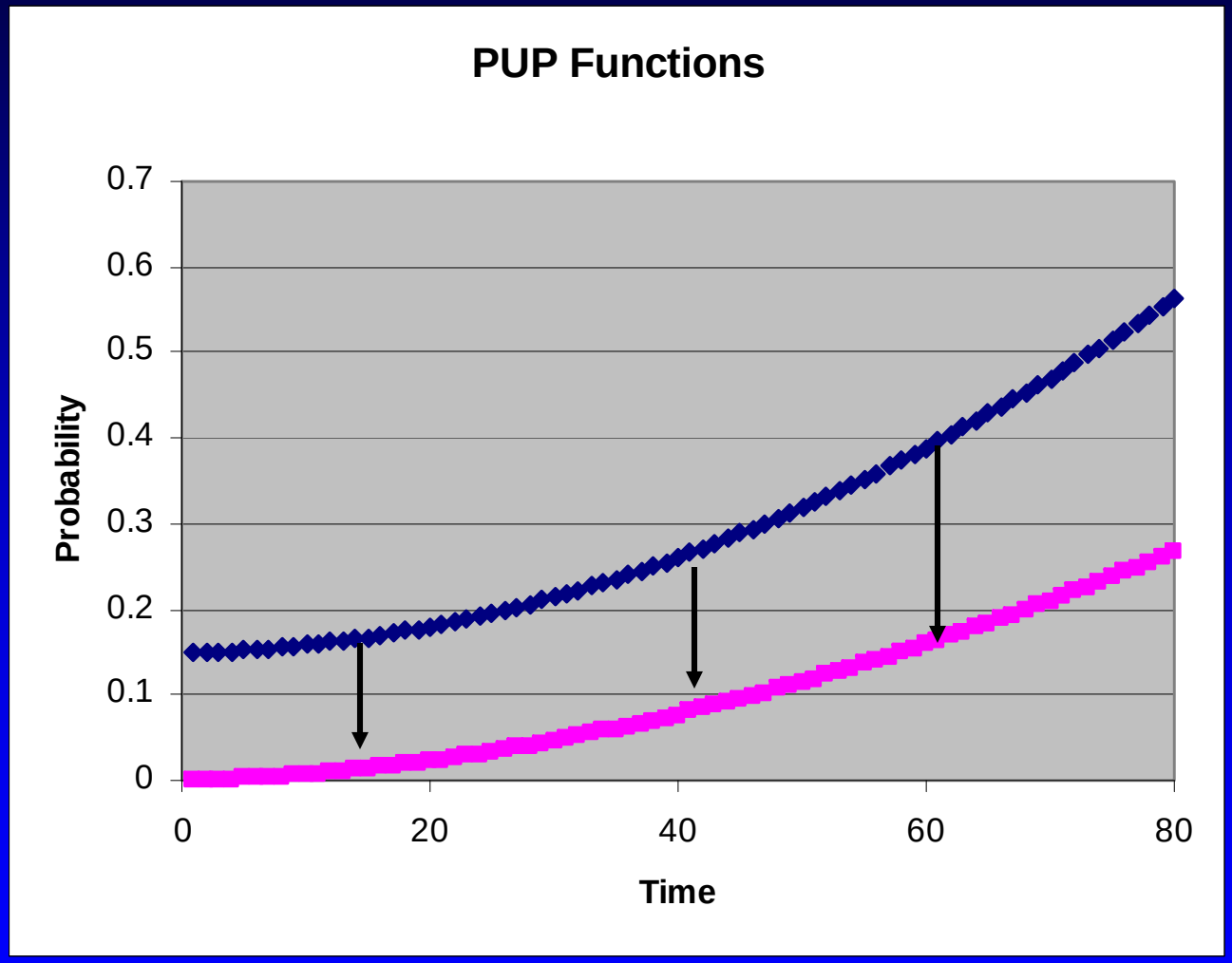
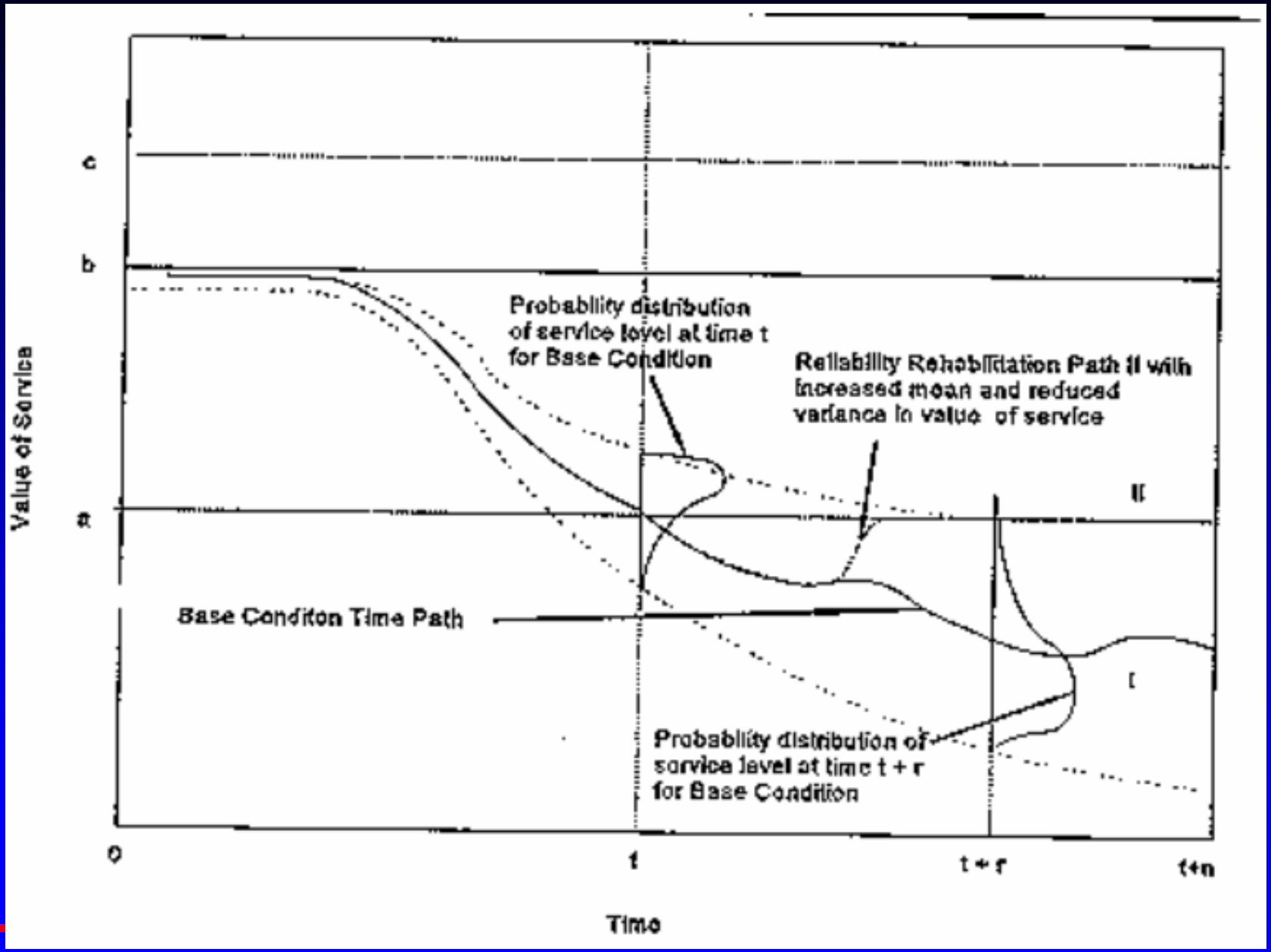

PUP Functions
Probability
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
20
40
60
80
Time



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- The Level of detail should be commensurate with the proposed actions.

Analysis Must Answer

1. Why are we doing this now?
2. What are the consequences of not doing this now?
3. Which project or component is in the most critical condition?
4. Which maintenance strategy is the best?

Navigation
5x5 Risk Matrix

Consequence / Economic Impact	Probability / Condition				
	F	D	C	B	A
1	Extreme Risk	Extreme Risk	High Risk	High Risk	Moderate Risk
2	Extreme Risk	Extreme Risk	High Risk	Moderate Risk	Low Risk
3	High Risk	High Risk	Moderate Risk	Low Risk	Low Risk
4	High Risk	Moderate Risk	Low Risk	Low Risk	Negligible Risk
5	Moderate Risk	Low Risk	Low Risk	Negligible Risk	Negligible Risk

“Good to Better”

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“Good to Great”

- Change business process to meet information needs
  - Probability of performance over time assuming alternative maintenance strategies
  - Estimation of consequences for alternative performance levels
- Develop decision support tools for life-cycle asset management
  - We can achieve “simplicity” through technology and training.

New Software Tool

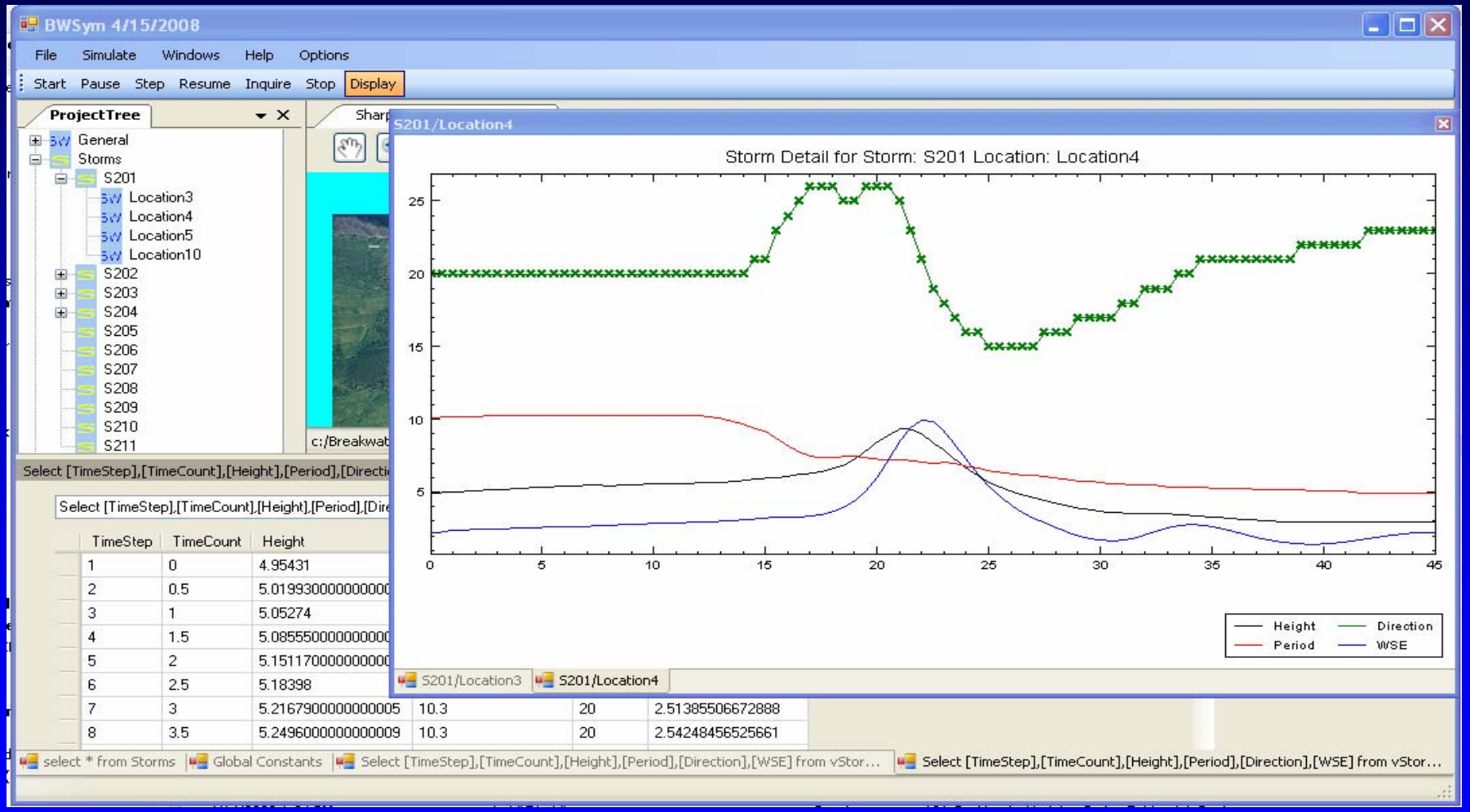
- Rubble Mound Breakwater

New Software Tool

- Event-driven Monte Carlo Simulation
  - Storm Events
    - Beach*fx* Approach
      - Bootstrap sampling with replacement
    - Extend to include storm time detail
  - Breakwater Reaches
  - Damage to Breakwater
    - F(wave, stone size)
  - Wave Transmission
  - Consequences

- Jeff Melby – Domain Expert
  - Fortran Code for Neah Bay

Rubble Mound Breakwater Prototype



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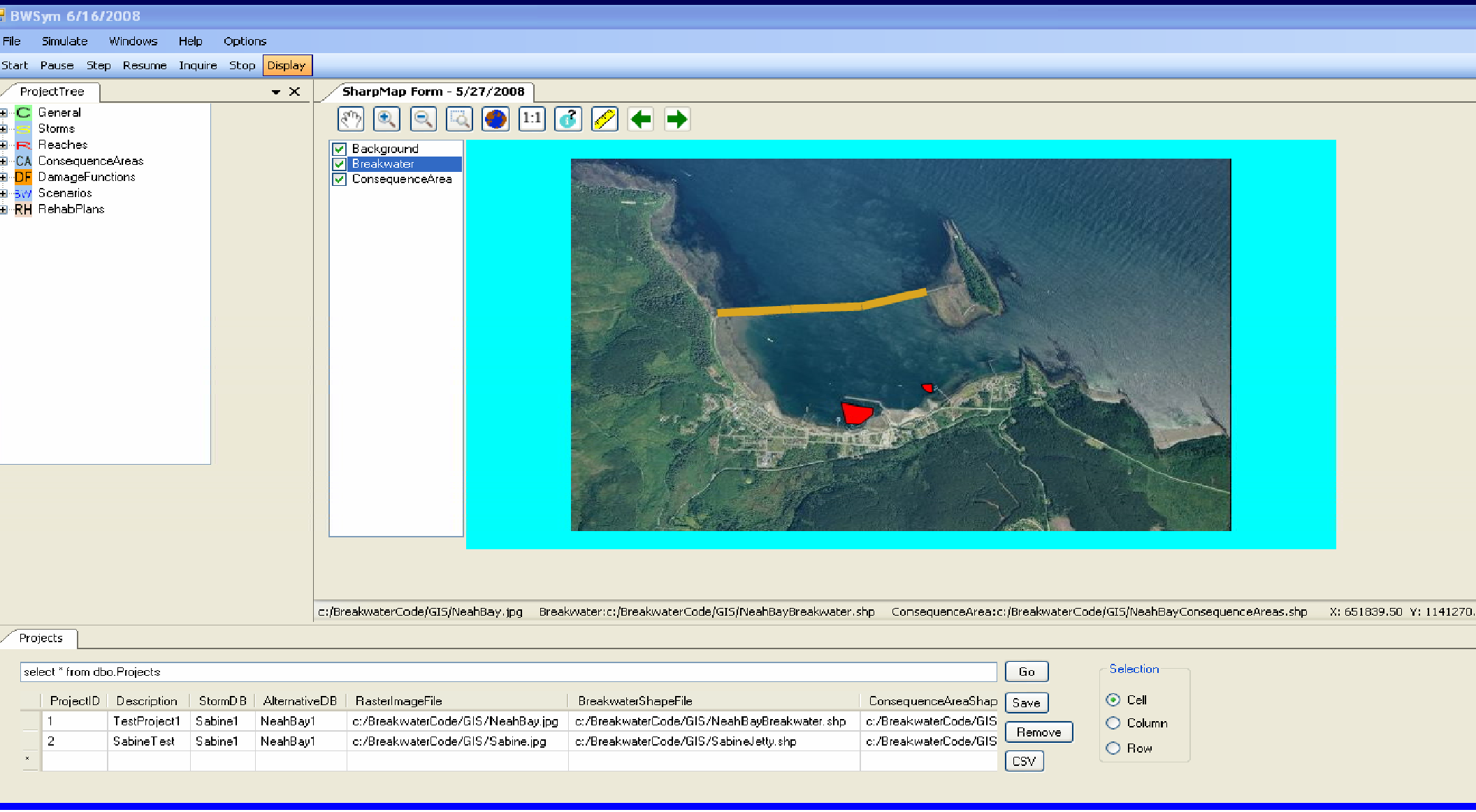
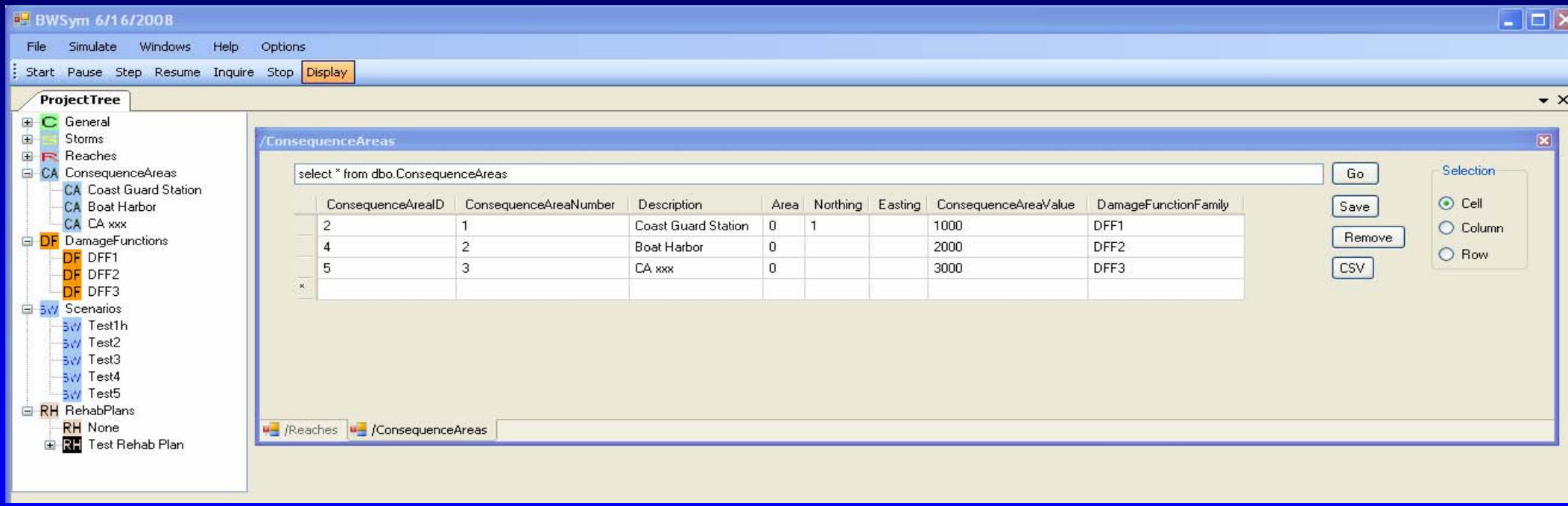
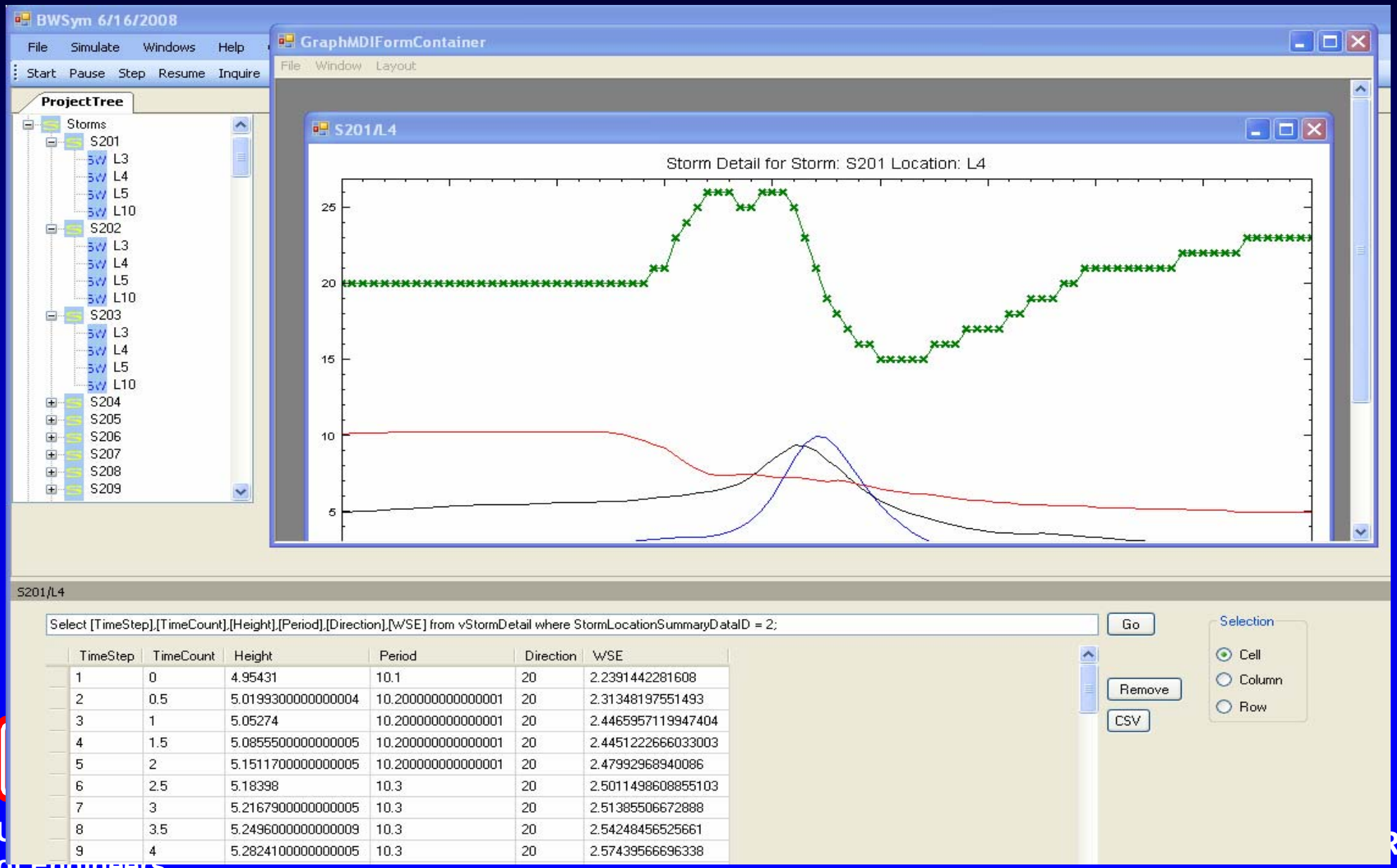
3-Pane View


BWSym 6/16/2008
File Simulate Windows Help Options
Start Pause Step Resume Inquire Stop Display
ProjectTree
General
Storms
Reaches
ConsequenceAreas
DamageFunctions
Scenarios
RehabPlans
SharpMap Form - 5/27/2008
1:1
Background
Breakwater
ConsequenceArea
c:/BreakwaterCode/GIS/NeahBay.jpg Breakwater:c:/BreakwaterCode/GIS/NeahBayBreakwater.shp ConsequenceArea:c:/BreakwaterCode/GIS/NeahBayConsequenceAreas.shp X: 651839.50 Y: 1141270.
Projects
select * from dbo.Projects
Go
Save
Remove
CSV
Selection
Cell
Column
Row
ProjectID Description StormDB AlternativeDB RasterImageFile BreakwaterShapeFile ConsequenceAreaShap
1 TestProject1 Sabine1 NeahBay1 c:/BreakwaterCode/GIS/NeahBay.jpg c:/BreakwaterCode/GIS/NeahBayBreakwater.shp c:/BreakwaterCode/GIS
2 SabineTest Sabine1 NeahBay1 c:/BreakwaterCode/GIS/Sabine.jpg c:/BreakwaterCode/GIS/SabineJetty.shp c:/BreakwaterCode/GIS

Project Tree and Data Grid

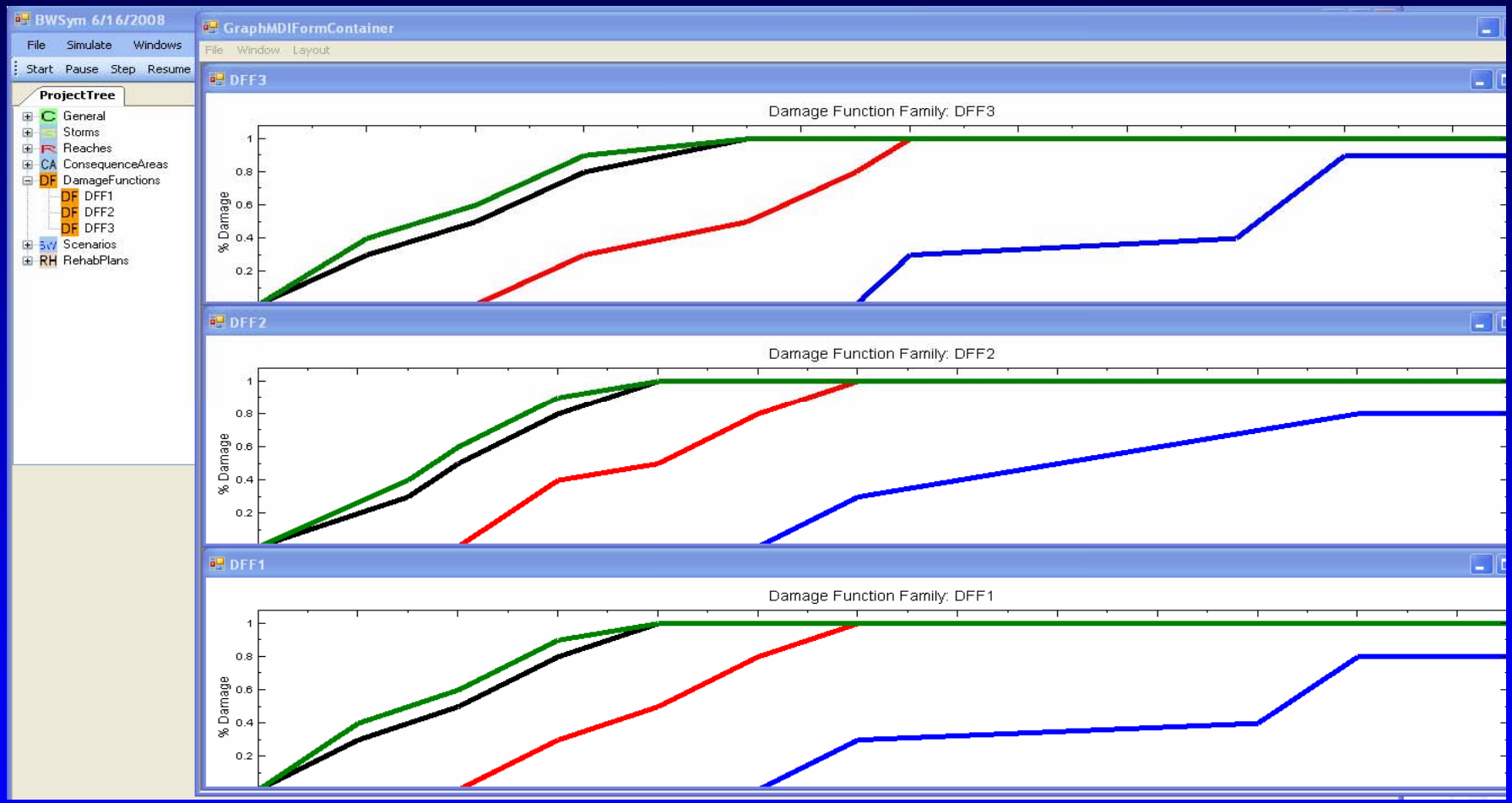


Storm Detail

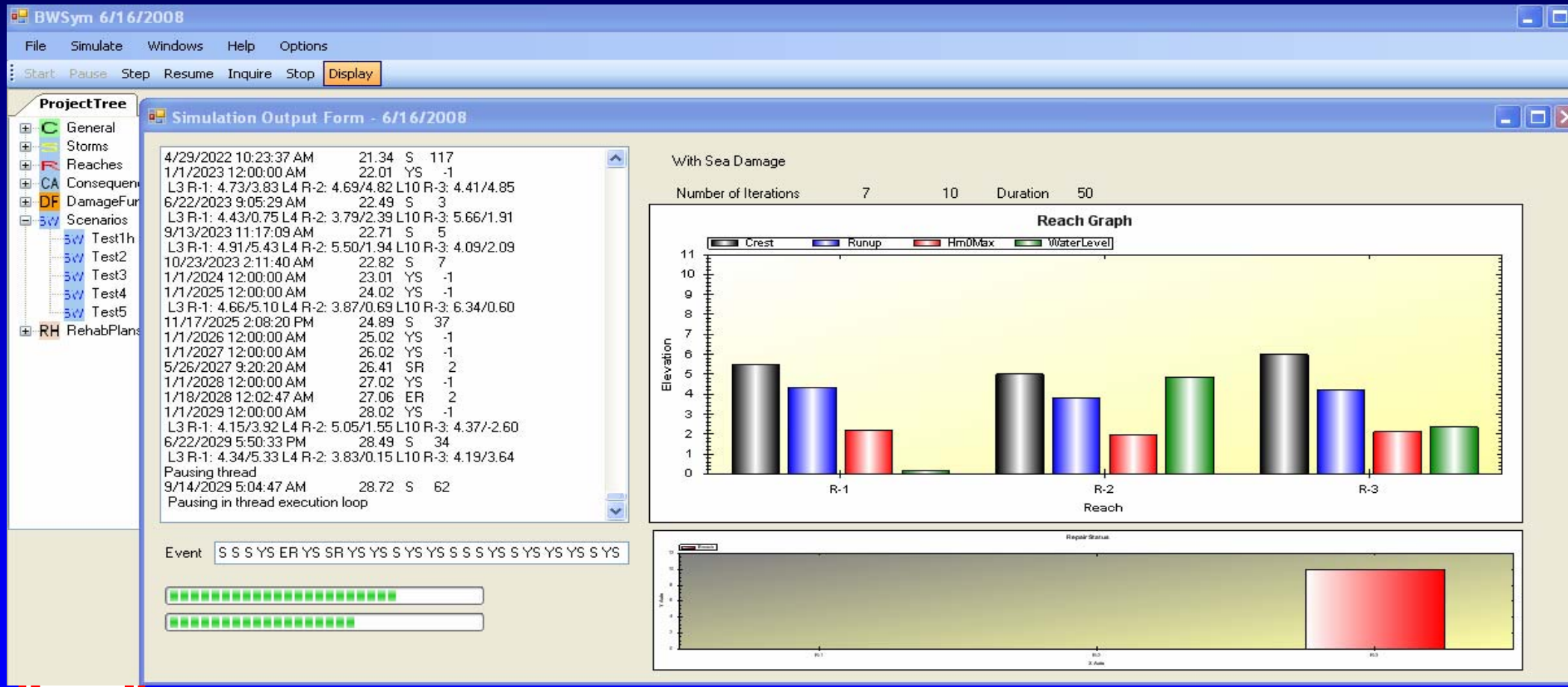


TimeStep	TimeCount	Height	Period	Direction	WSE
1	0	4.95431	10.1	20	2.2391442281608
2	0.5	5.0199300000000004	10.200000000000001	20	2.31348197551493
3	1	5.05274	10.200000000000001	20	2.4465957119947404
4	1.5	5.0855500000000005	10.200000000000001	20	2.4451222666033003
5	2	5.1511700000000005	10.200000000000001	20	2.47992968940086
6	2.5	5.18398	10.3	20	2.5011498608855103
7	3	5.2167900000000005	10.3	20	2.51385506672888
8	3.5	5.2496000000000009	10.3	20	2.54248456525661
9	4	5.2824100000000005	10.3	20	2.57439566696338

Damage Functions

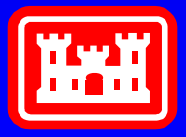


Simulation

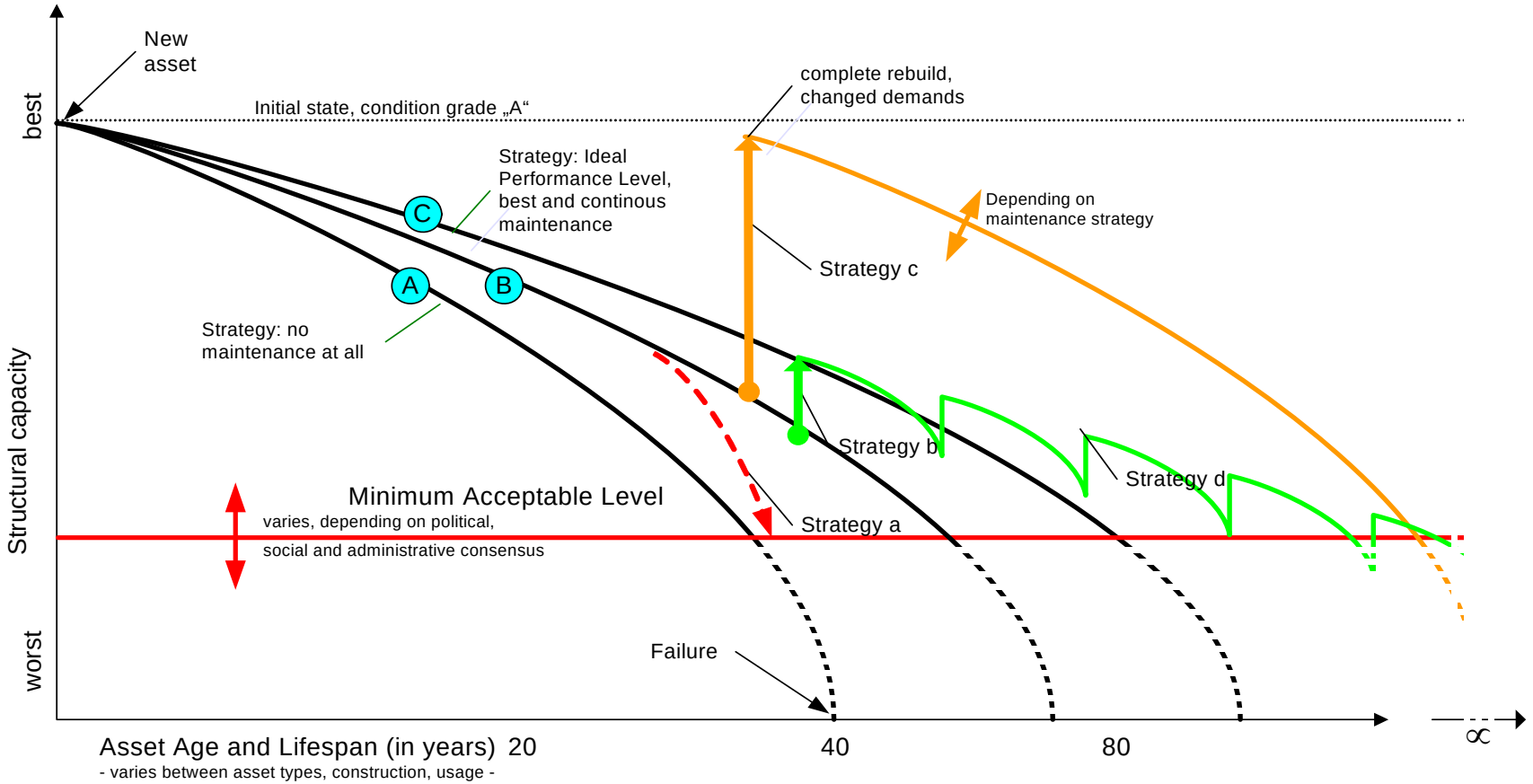

BWSym 6/16/2008
File Simulate Windows Help Options
Start Pause Step Resume Inquire Stop Display
ProjectTree
General
Storms
Reaches
Consequen
DamageFur
Scenarios
Test1h
Test2
Test3
Test4
Test5
RehabPlans
Simulation Output Form - 6/16/2008
4/29/2022 10:23:37 AM 21.34 S 117
1/1/2023 12:00:00 AM 22.01 YS -1
L3 R-1: 4.73/3.83 L4 R-2: 4.69/4.82 L10 R-3: 4.41/4.85
6/22/2023 9:05:29 AM 22.49 S 3
L3 R-1: 4.43/0.75 L4 R-2: 3.79/2.39 L10 R-3: 5.66/1.91
9/13/2023 11:17:09 AM 22.71 S 5
L3 R-1: 4.91/5.43 L4 R-2: 5.50/1.94 L10 R-3: 4.09/2.09
10/23/2023 2:11:40 AM 22.82 S 7
1/1/2024 12:00:00 AM 23.01 YS -1
1/1/2025 12:00:00 AM 24.02 YS -1
L3 R-1: 4.66/5.10 L4 R-2: 3.87/0.69 L10 R-3: 6.34/0.60
11/17/2025 2:08:20 PM 24.89 S 37
1/1/2026 12:00:00 AM 25.02 YS -1
1/1/2027 12:00:00 AM 26.02 YS -1
5/26/2027 9:20:20 AM 26.41 SR 2
1/1/2028 12:00:00 AM 27.02 YS -1
1/18/2028 12:02:47 AM 27.06 ER 2
1/1/2029 12:00:00 AM 28.02 YS -1
L3 R-1: 4.15/3.92 L4 R-2: 5.05/1.55 L10 R-3: 4.37/-2.60
6/22/2029 5:50:33 PM 28.49 S 34
L3 R-1: 4.34/5.33 L4 R-2: 3.83/0.15 L10 R-3: 4.19/3.64
Pausing thread
9/14/2029 5:04:47 AM 28.72 S 62
Pausing in thread execution loop
Event S S S YS ER YS SR YS YS S YS YS S S S YS S YS YS YS S YS
With Sea Damage
Number of Iterations 7 10 Duration 50
Reach Graph
Crest Runup HmOMax WaterLevel
Elevation
0 1 2 3 4 5 6 7 8 9 10 11
R-1 R-2 R-3
Reach

Status

- Working framework for User Interface
- Threaded Event-Driven Simulation
- Initial development and sample population of SQL Server Databases
- Event Driven
  - Seasonal Storms
    - Storm Summary Information
      - No storm time detail at present
  - Repair
  - Rehabilitation



What Asset Management Does



Thank you for your attention.