Jun 21st, 1:00 PM - 1:15 PM

Modeling: What is in your Toolbox? Analytical Tools for Fish Passage Alternatives Analysis

MaryLouise Keefe
R2 Resource Consultants, Inc.

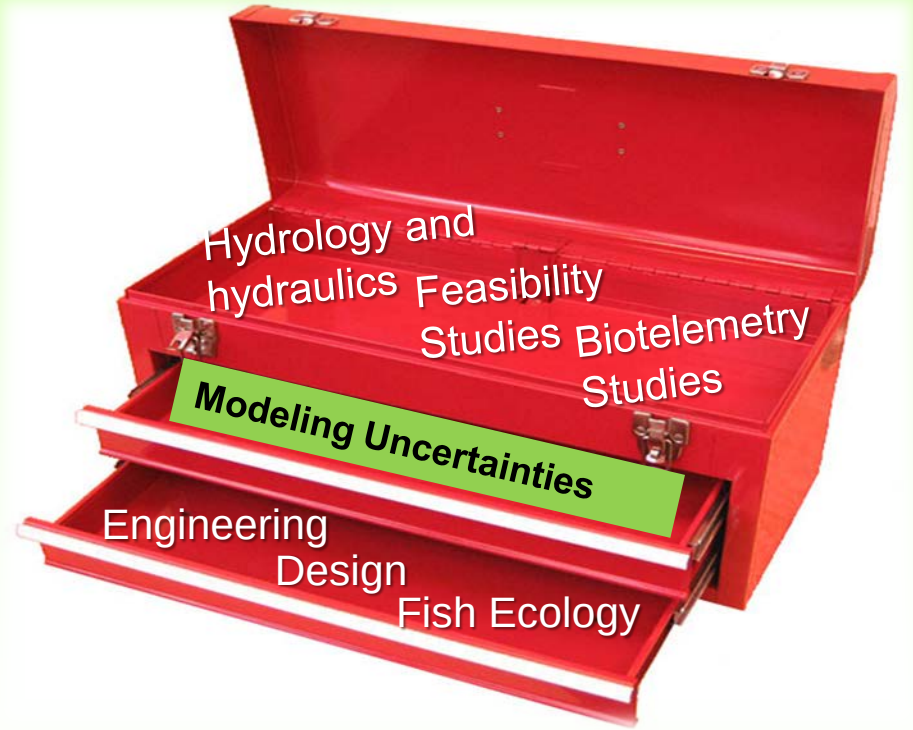
Phil Hilgert
R2 Resource Consultants, Inc.

Alice Shelly
R2 Resource Consultants, Inc.

Tim Sullivan
R2 Resource Consultants, Inc.

What is in your Toolbox? Analytical tools for fish passage alternatives analysis.

Dr. MaryLouise Keefe, Phil Hilgert, Alice Shelly and Tim Sullivan
R2 Resource Consultants, Inc.



R2 Resource Consultants, Inc.

Project variation requires integration of site-specific information








Passage Projects often rely heavily on expert opinion

COSO'S PROFESSIONAL JUDGMENT PROCESS

1. Define the problem and identify fundamental objectives,
2. Consider alternatives,
3. Gather and evaluate information,
4. Reach a conclusion, and
5. Articulate and document your rationale.

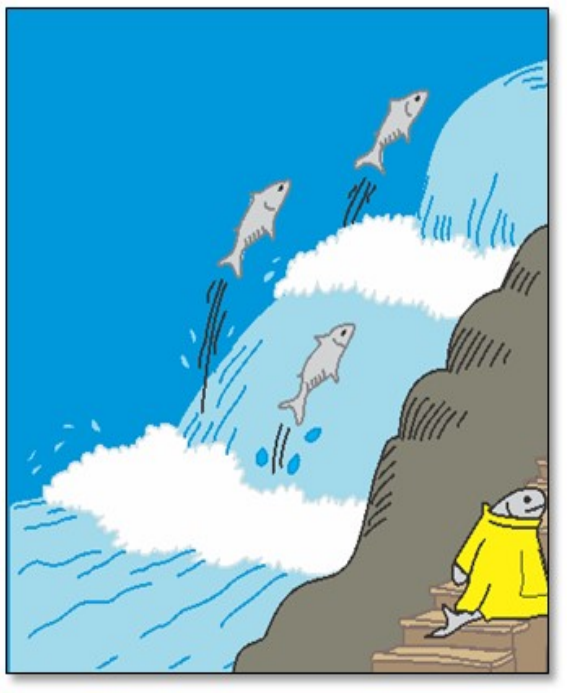
For higher-quality decisions, don't cut short steps 1 and 2 of the decision process. Make sure you carefully identify the objective and consider all alternatives and diverging views. Encourage the expression of different opinions.

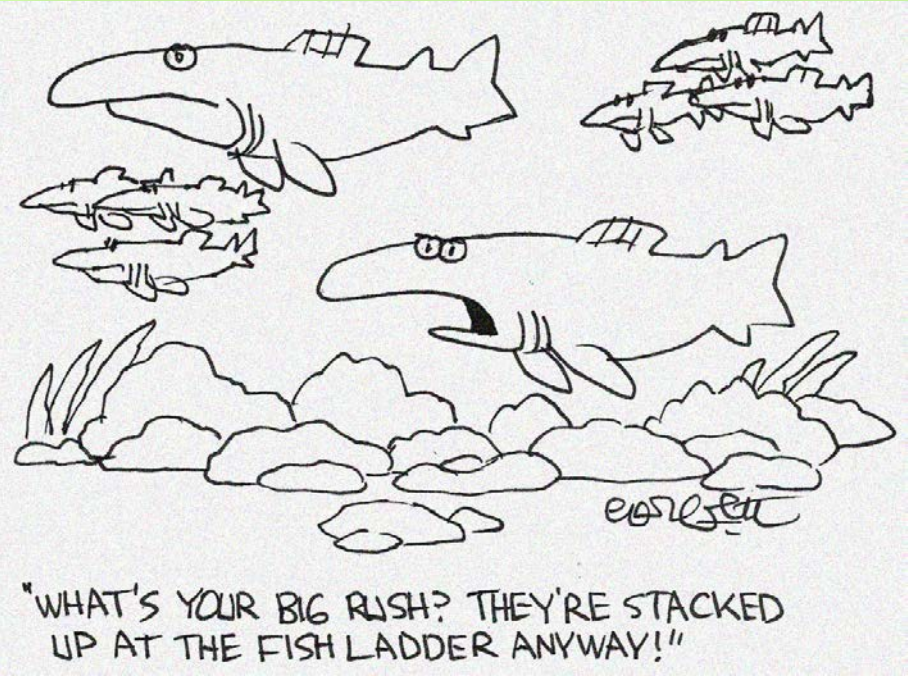
Source: Adapted from KPMG LLP, Steven M. Glover, and Douglas F. Prawitt, "Enhancing Board Oversight: Avoiding Judgment Traps and Biases," Committee of Sponsoring Organizations of the Treadway Commission (COSO), March 2012, http://bit.ly/1bS5zdy.

Without data you're just another person with an opinion
– W. Edwards Deming

R2 Resource Consultants, Inc.

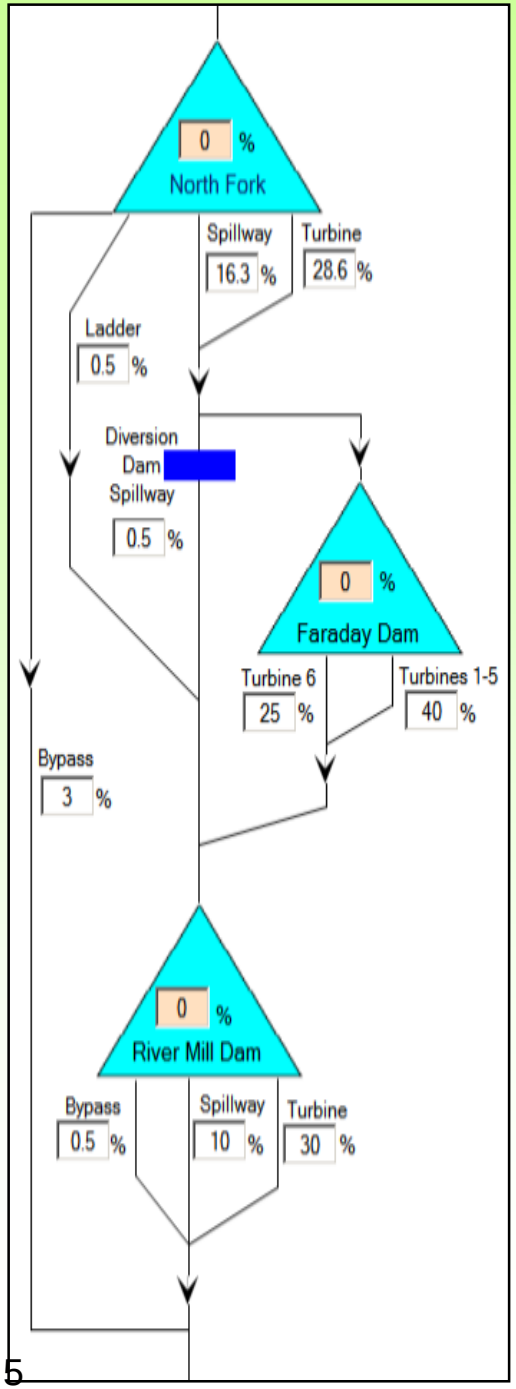
Can we improve decision making and increase our fish passage effectiveness?





We are striving for "known unknowns" or at least … a better understanding of which unknowns are important and which are not.

R2 Resource Consultants, Inc.



Example 1: Downstream Migrant Mortality Model (DM3)

Complex Hydroelectric Project

- 3 powerhouses
- 4 dam structures
- Multiple potential migratory pathways

-DM3 apportioned fish through migratory pathways

-Used existing data on passage efficiency and mortality at each node

-Output = total system survival

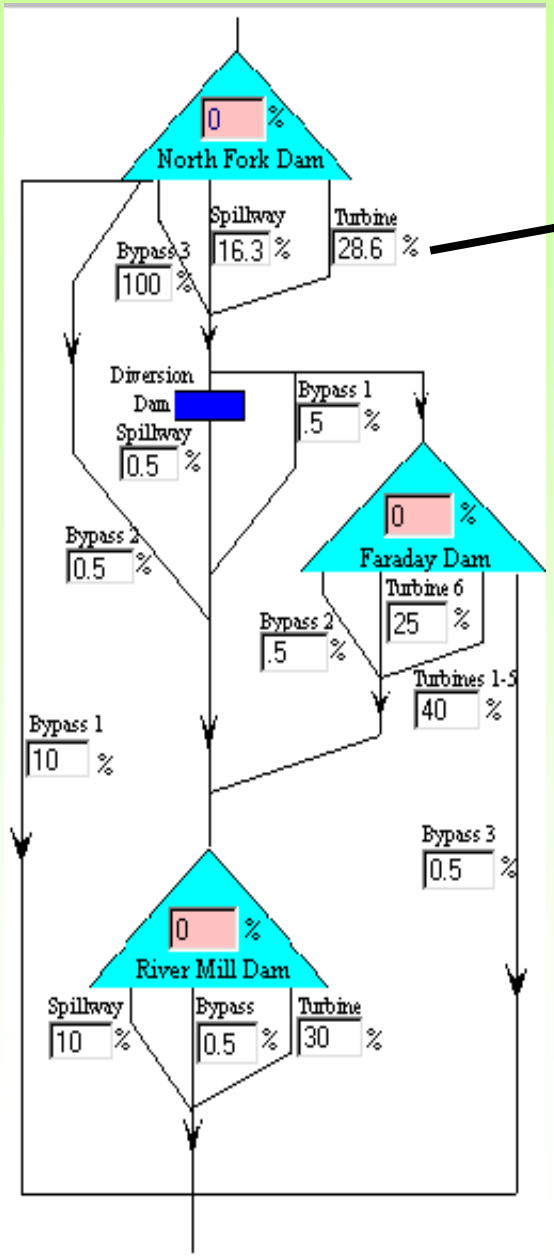
R2 Resource Consultants, Inc.

Incorporating Uncertainty

- To learn how the uncertainty in individual parameters affects uncertainty in the system-wide mortality estimate.

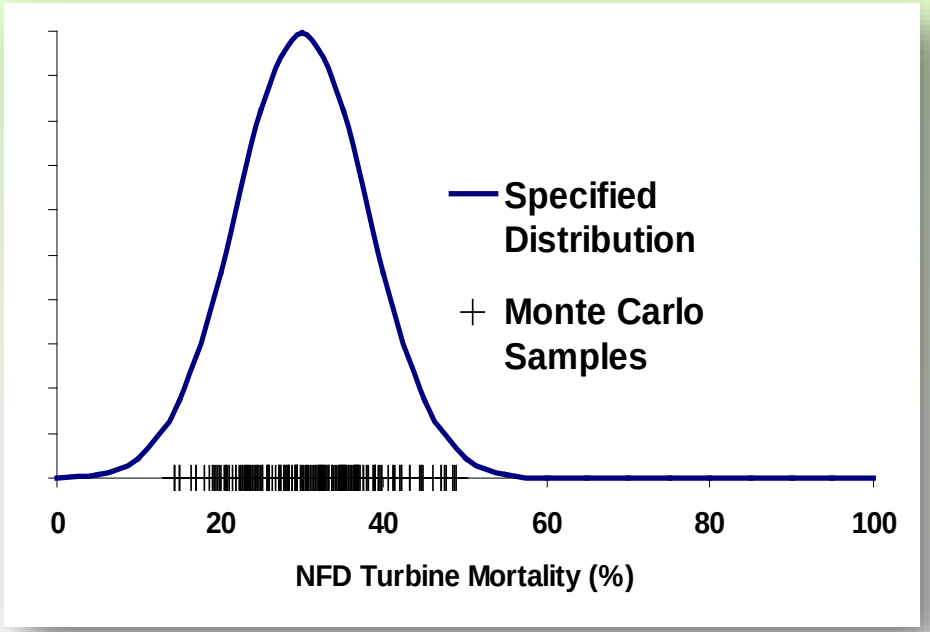
- Gaming identifies advantages of alternate protection and passage measures at each node.

Incorporate uncertainty around parameters



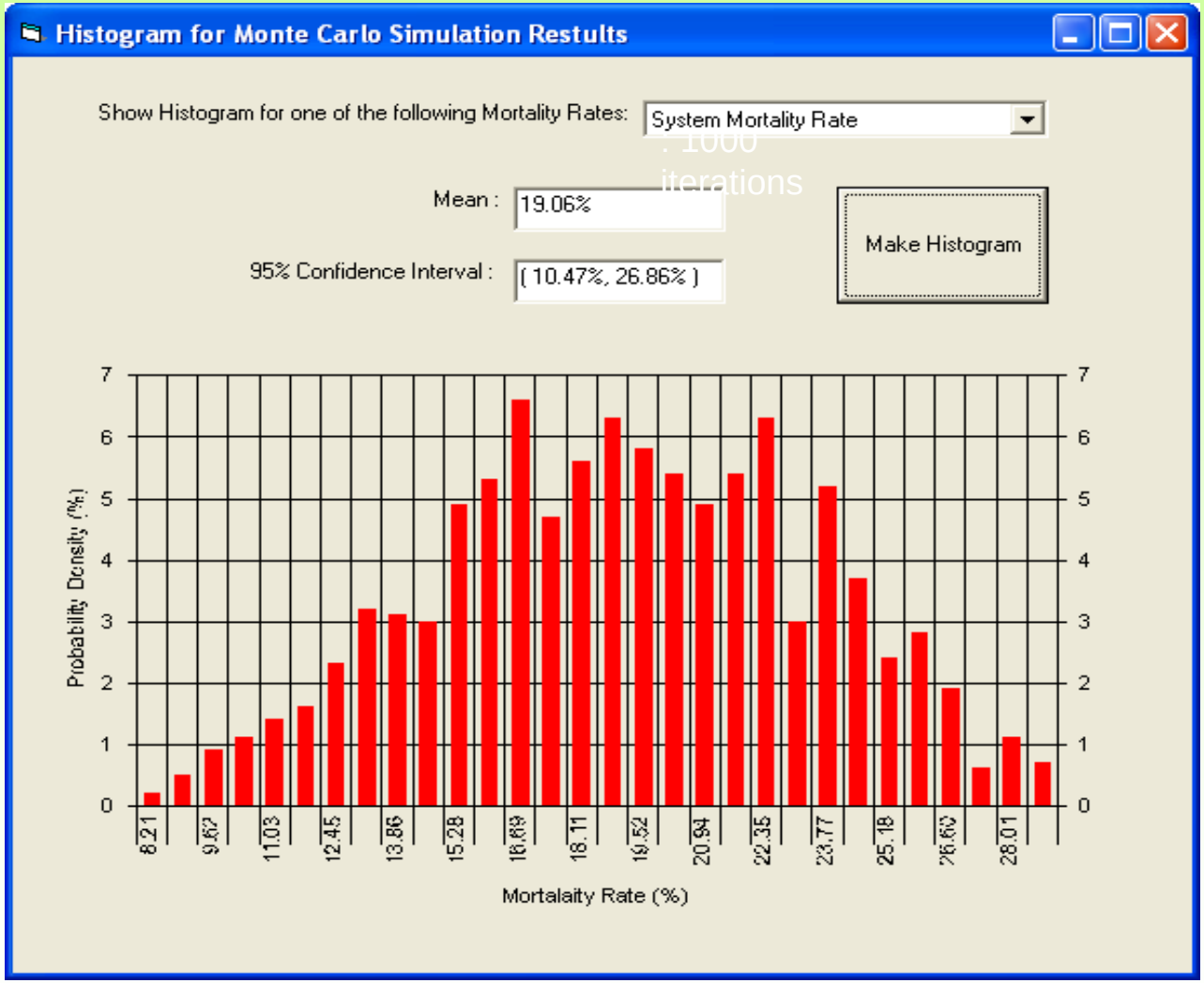
Added uncertainty around mean turbine mortality

Mean	28.6 %
SD	8.0 %



R2 Resource Consultants, Inc.

Outcome: A survival rate with confidence interval to define a measurable system performance metric



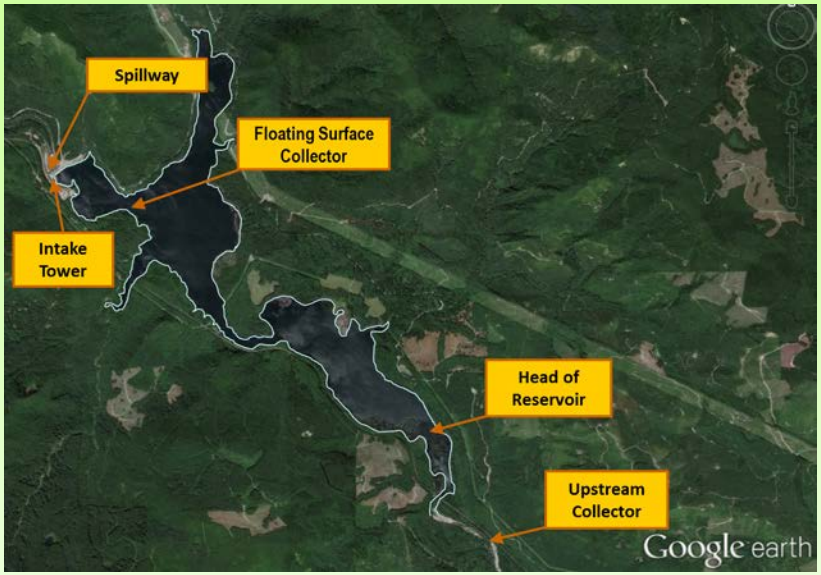
R2 Resource Consultants, Inc.

Example 2: The Biological Performance Tool (BPT)

- Provides a structured analytical process for downstream passage
- Relative comparison of passage alternatives
- Facility design, location, size, operation
- Visual Basic program
- Keep it as simple as needed to address questions
- Process transparency for stakeholders

BPT Assumptions for Downstream Alternatives

- Periodicity
- Response to freshets
- Capture efficiencies at collectors
- Collection and transport mortality
- Reservoir mortality
- Passage capture and mortality

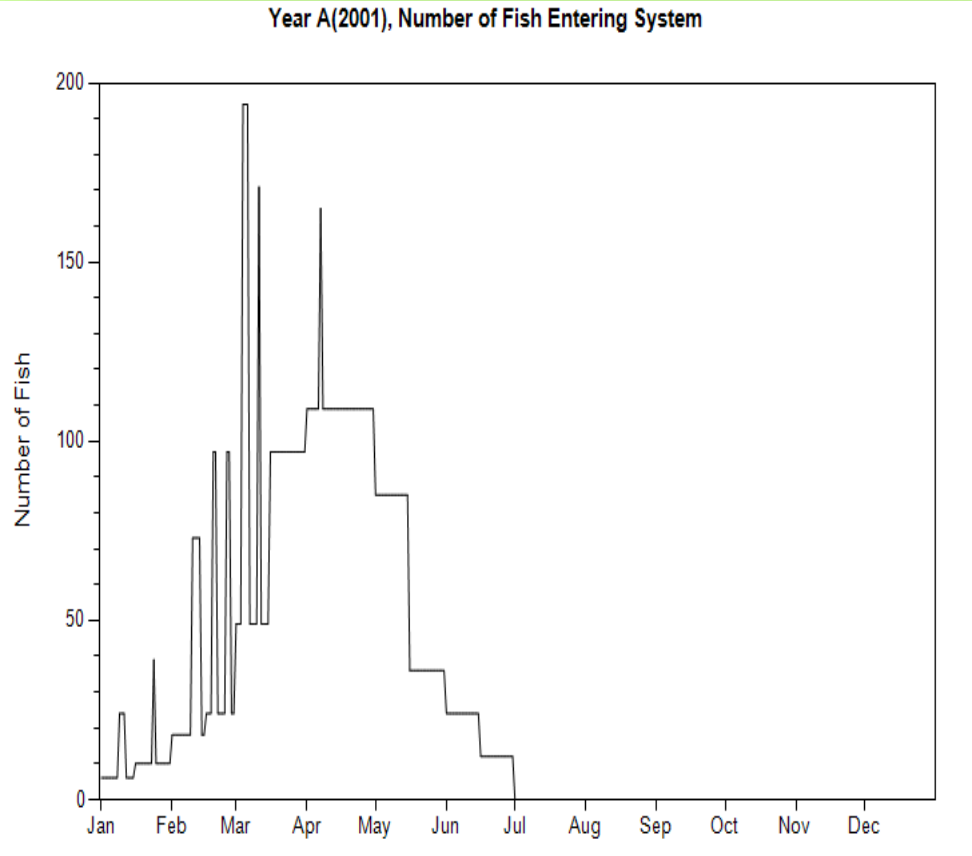


Species	Freshwater Life Phase	Jan 1-15	Jan 16-31	Feb 1-15	Feb 16-28	Mar 1-15	Mar 16-31	Apr 1-15	Apr 16-30	May 1-15	May 16-31	Jun 1-15	Jun 16-30	Jul 1-15	Jul 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-30	Oct 1-15	Oct 16-31	Nov 1-15	Nov 16-30	Dec 1-15	Dec 16-31
Steelhead	Upstream Migration																								
	Spawning																								
	Incubation																								
	Juvenile Rearing																								
	Juvenile Outmigration																								

R2 Resource Consultants, Inc.

Assumptions

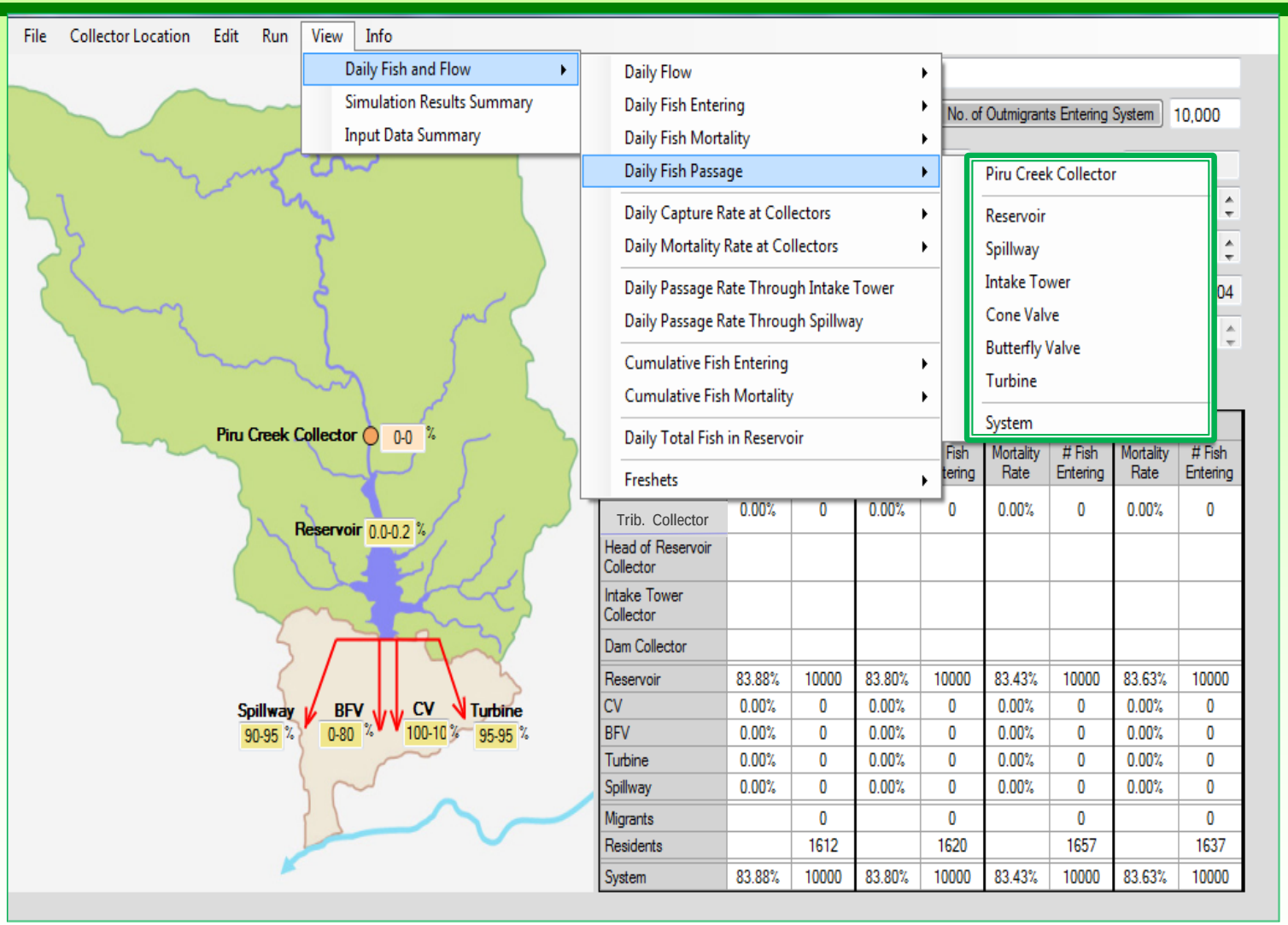
- Response functions (assumptions) are user-specified and easily modified
- Assumptions reflect significant uncertainty
- Low and high estimates provides sensitivity analyses



* Output used to compare performance of alternate facilities, not an indication of future passage rate

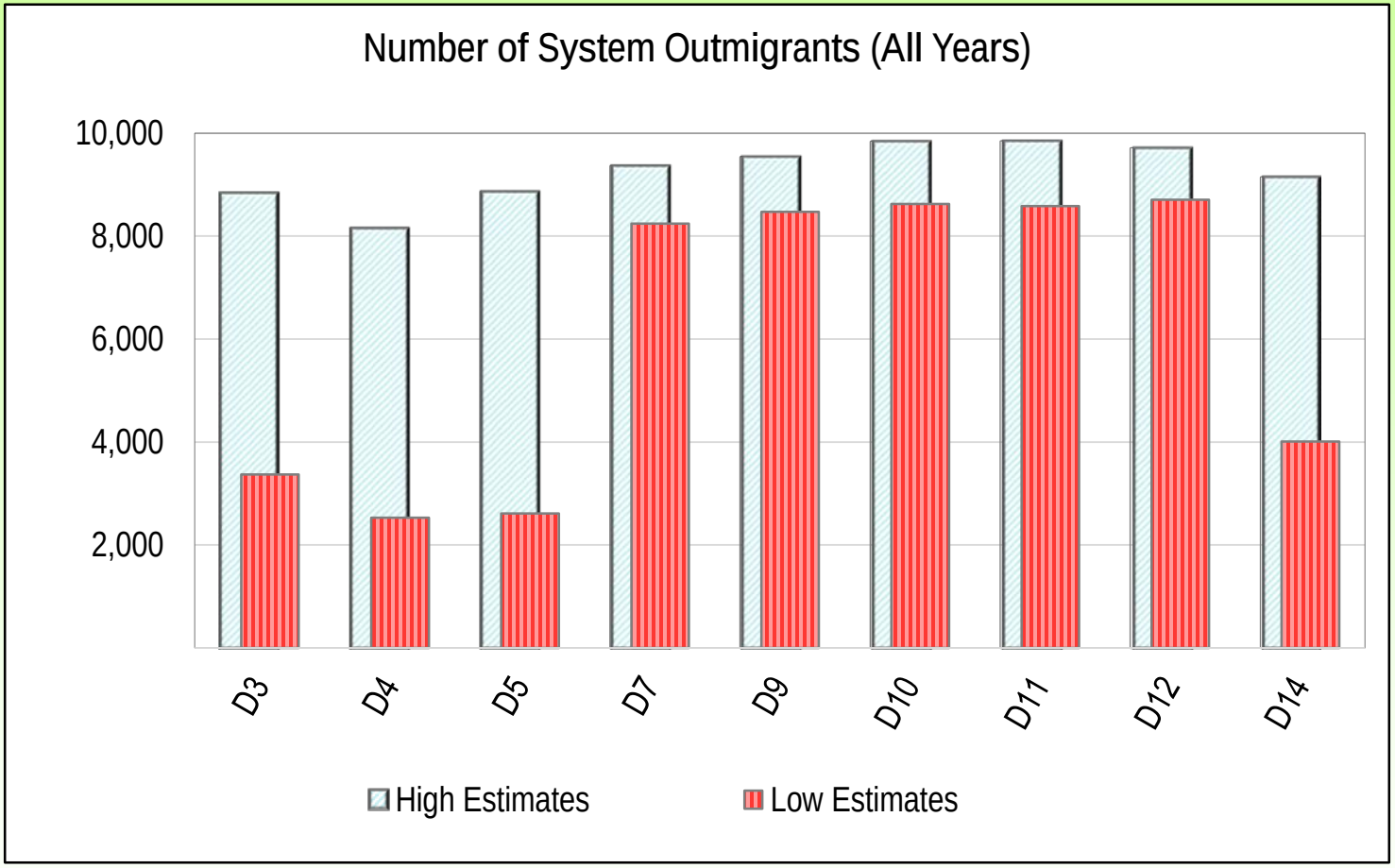
R2 Resource Consultants, Inc.

Example BPT Framework



R2 Resource Consultants, Inc.

Example BPT Results



R2 Resource Consultants, Inc.

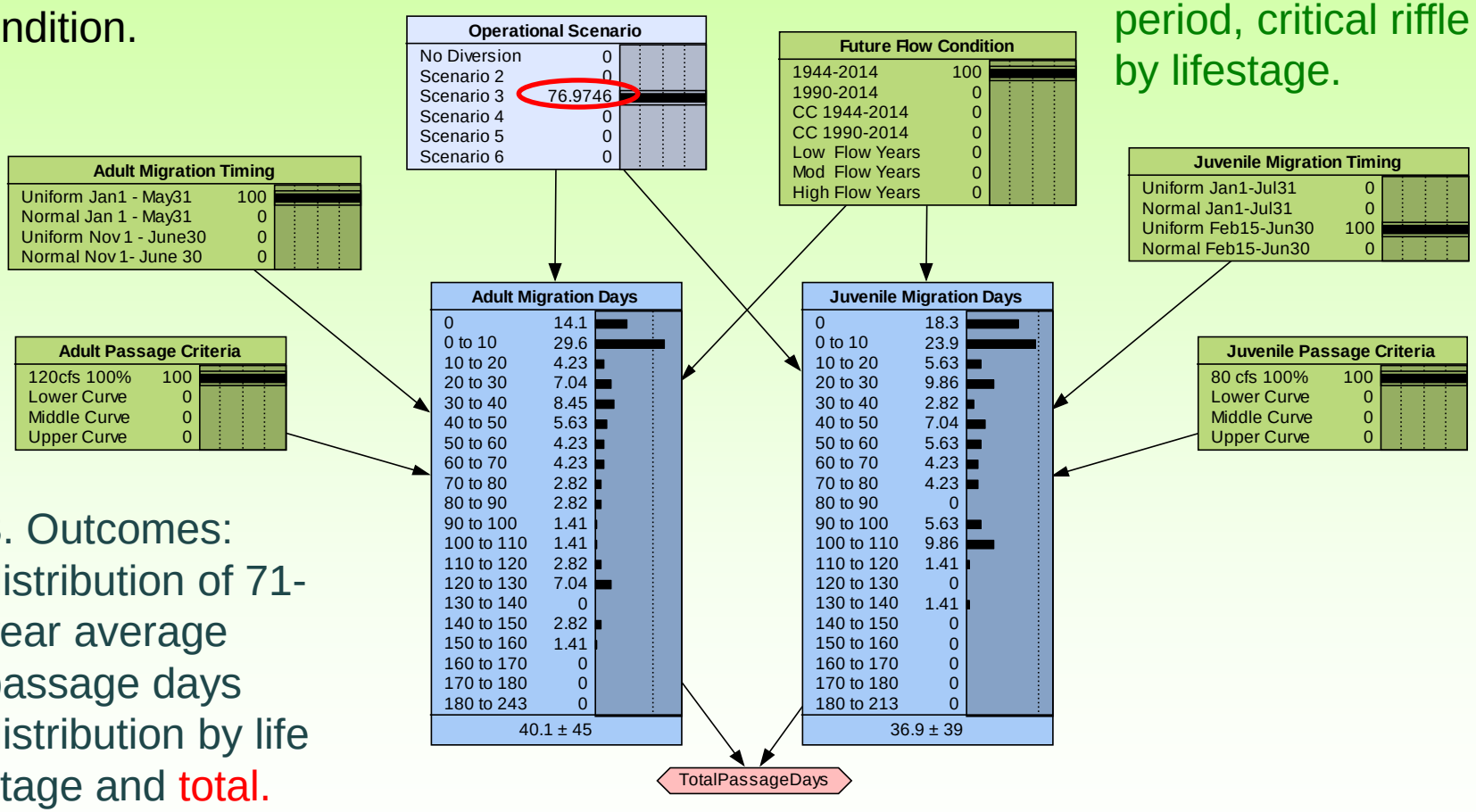
Example 3: Incorporating biological uncertainty into a decision network

- Existing passage model estimates flows below an existing diversion for multiple operational scenarios
  - 71-year historic flow record.
- Flow record provides a measure of environmental stochasticity, additional variability in other system uncertainties/model assumptions.
- For example…
  - What flow conditions best support adult passage? juvenile passage?
  - What is the migration timing and duration?
  - How hydrologically different will the next 20 years be from the last 71 years?
- Important to establish whether uncertainties of assumptions could impact operational decisions.

Model Framework

1. Select scenario: operational condition.

2. Define assumptions: hydrology, migration period, critical riffle flow by lifestage.



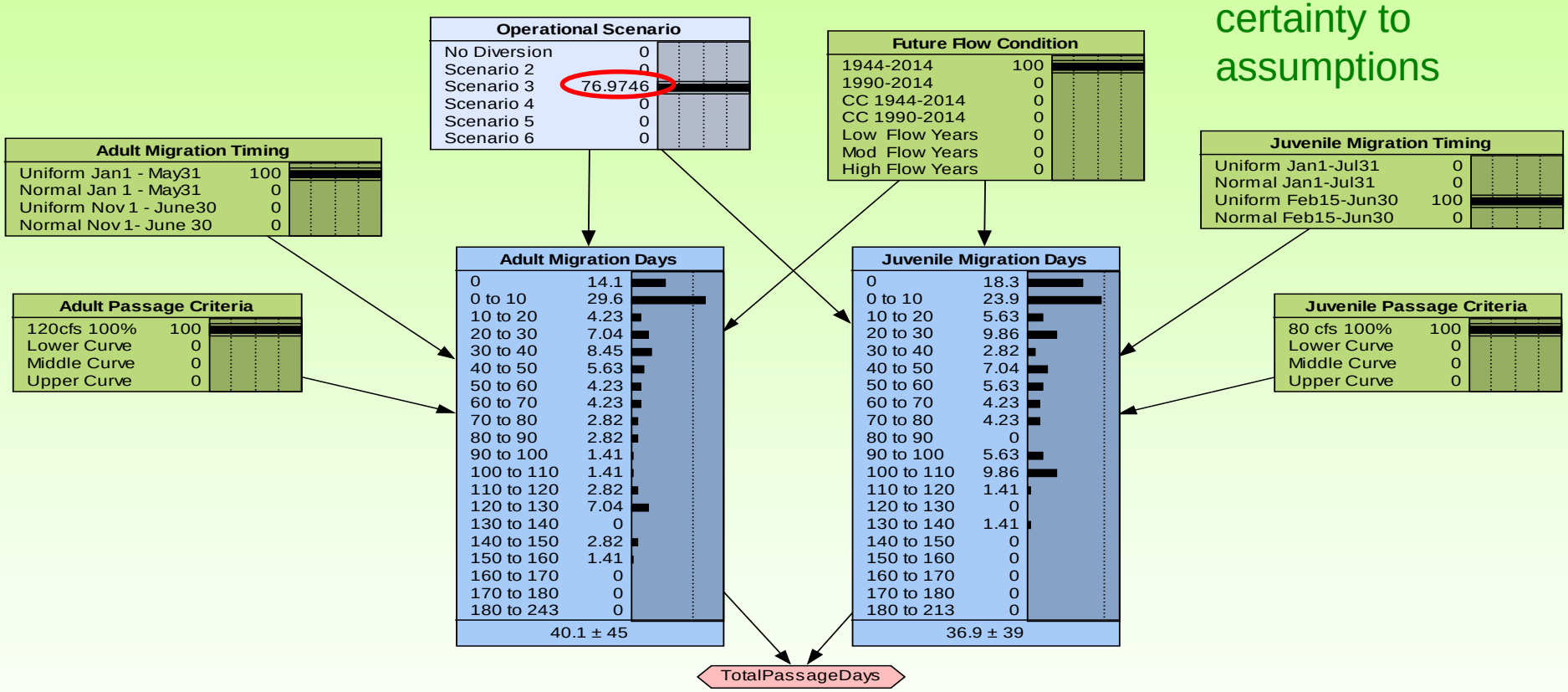
3. Outcomes: distribution of 71-year average passage days distribution by life stage and total.

Decision Network displayed using Netica ©

R2 Resource Consultants, Inc.

Decision Network Display #1: Fixed Assumptions, One Scenario, Assumptions Fixed

Apply 100% certainty to assumptions

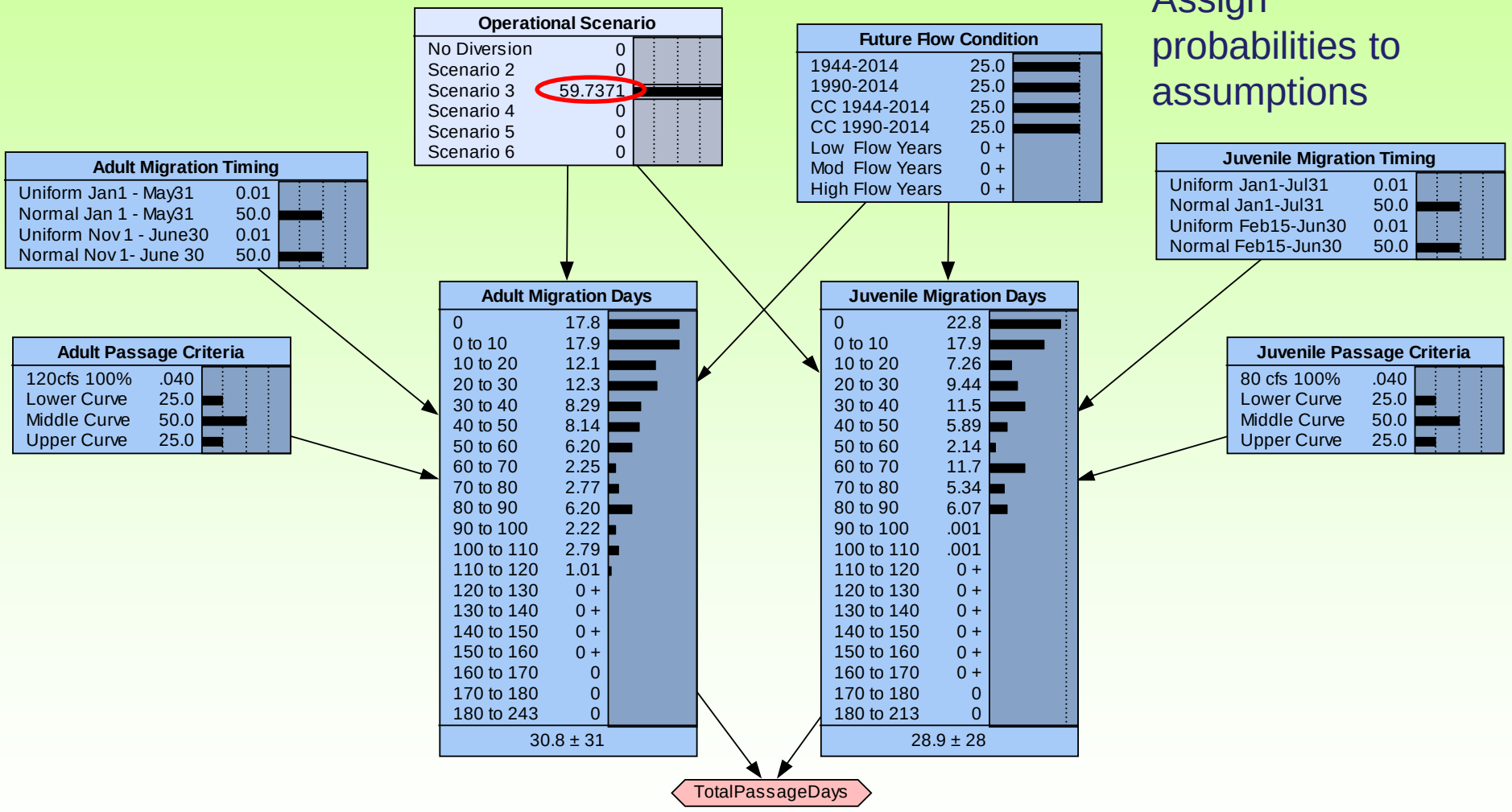


Selecting different sets of assumptions will change the distribution of annual results and average estimate.

Decision Network displayed using Netica ©

R2 Resource Consultants, Inc.

Decision Network Display #2- Probabilistic weighting of assumptions for one scenario

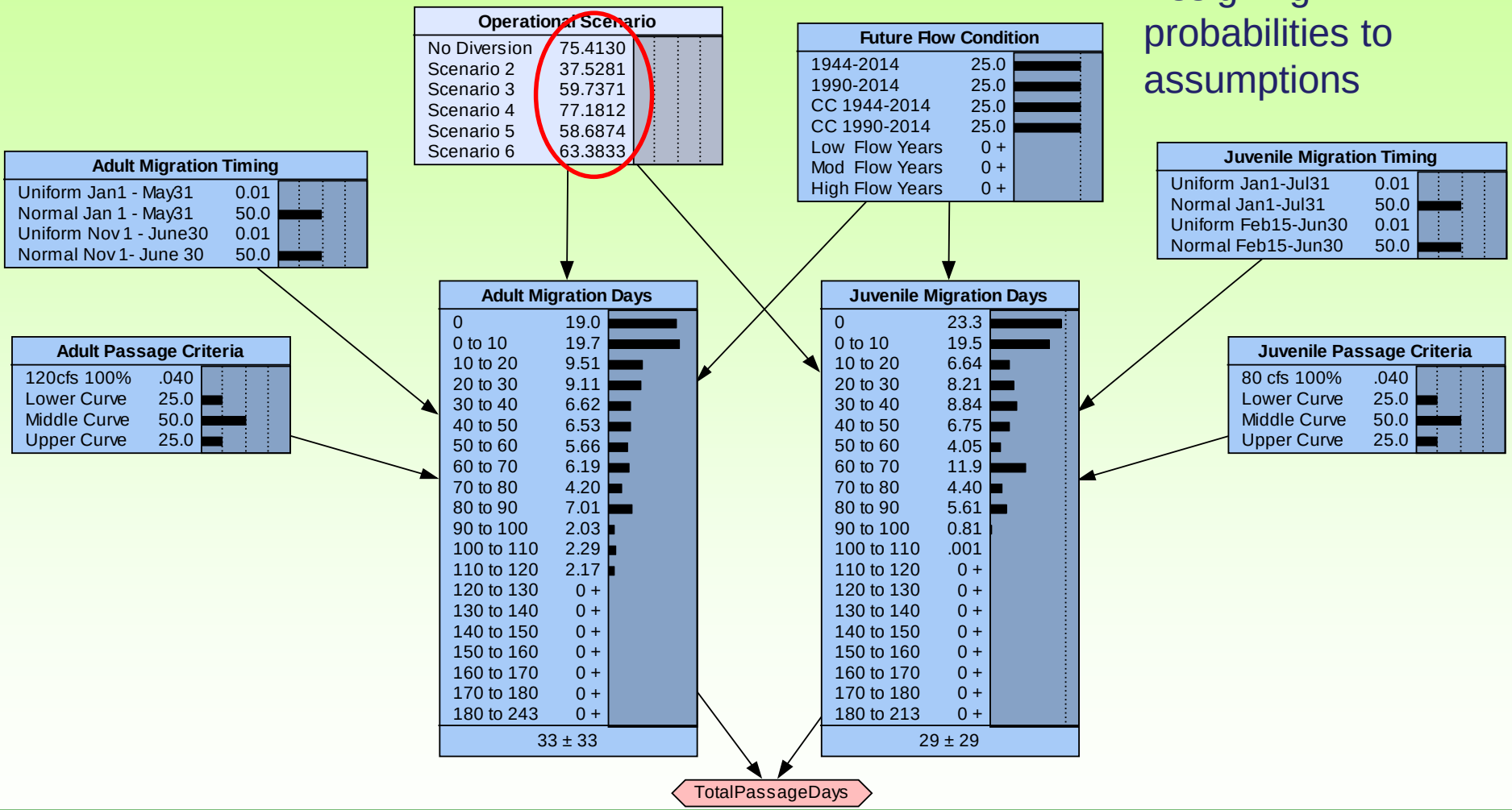


Decision Network displayed using Netica ©

R2 Resource Consultants, Inc.

Decision Network Display #3 - Probabilistic weighting of assumptions to compare scenarios

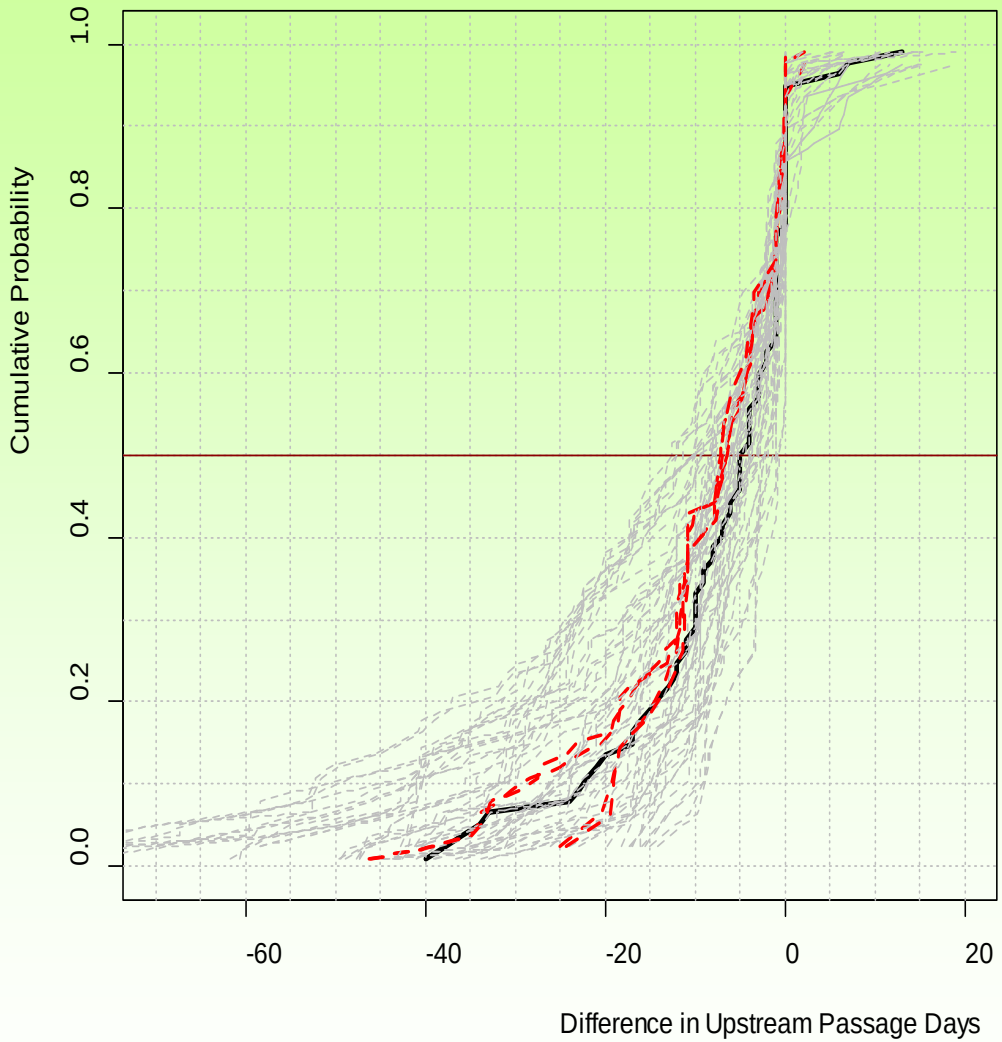
Assigning probabilities to assumptions



Decision Network displayed using Netica ©

R2 Resource Consultants, Inc.

Comparison of two scenarios with uncertainty



- 80% of years have negative differences- one scenario better
- 50% or years diff <5 days
- Some years –other scenario better
- Is there too much uncertainty to differentiate?
- Added sensitivity analysis, to identify strongest influence of uncertainties….migration timing.

Conclusion……

These models help us take available information to the next level by…

-gaming possible outcomes,
-quantifying the importance of data gaps
-designing future monitoring to achieve project objectives.

In the end, we can make better decisions that reduce risk for all parties.

Questions?