APPENDIX B11. BIOLOGICAL PERFORMANCE TOOL

1. BIOLOGICAL PERFORMANCE TOOL

An important component of the Study of Fish Passage Feasibility at Watana Dam is the development of a biological performance tool that can be used to qualitatively estimate potential passage outcomes for different fish passage alternatives identified, developed, and refined as the feasibility study progresses. The feasibility of providing fish passage will be dependent on a suite of biological, hydrologic, and engineering factors to be considered collectively for a given passage alternative. The biological performance tool will provide a means of integrating these various factors to estimate likely passage outcomes for each alternative in terms of passage success.

Factors that will likely be incorporated into the biological performance tool include:

1.1. Biological Factors

- multiple target species
- relevant life stages
- life stage periodicity
- passage behavior (e.g., flow-related migration)
- reservoir survival
- dam passage survival (e.g., turbine, spill, or passage facility survival)

1.2. Hydrologic Factors

- daily inflow
- various water-year types

1.3. Engineering Factors

- project operations
- passage facility alternatives
- expected performance of specific facility alternatives (e.g., collection efficiency or percent passage)

Specific to downstream passage, the biological performance tool will be developed based on the following assumptions:

- Up to 5 species
- Up to 3 lifestages (smolts, fingerlings, fry)
- Flow conditions based on daily inflow
- Model output for 5 different flow years (high, med-high, medium, med-low, low)

- 4 discrete downstream passage alternatives, including provisions for turbine/spill survival (e.g., tributary collector, upper reservoir collector, lower reservoir floating surface collector, conventional screens)

The Clackamas River Downstream Migrant Mortality Model developed for a multi-dam hydroelectric project on the Clackamas River, Oregon provides an example of a downstream module that would be included in the biological performance tool. The Clackamas model is a daily simulation model that routes water and fish through various flow routes in the system. There are several potential routes at each dam facility, and the flow is first apportioned to the bypass, then to the turbine and finally to the spillway. The model incorporates user specified periodicity to account for the fish migration distribution during different periods in a year. The model also incorporates a "flow response factor" to adjust the rate of migration as a function of river flow; higher rates of migration can be assigned to higher flow periods if deemed appropriate for a given species. The model also provides for a mechanism to alter the percentage of fish that pass via various routes in a facility as a function of river flow. Thus, when river flows are high, the model can simulate more fish passing over the spillway. Along each potential route, the model utilizes user-specified route-specific mortality rates to account for the route passage condition. Example model input/output interfaces are shown in Figures B11-1 through B11-4. While the Clackamas model is more complex than the Susitna-Watana Project because it includes multiple dams, it illustrates conceptually the modeling approach proposed.

In addition to a downstream passage module, as described above, the biological performance tool can include module(s) to address specific upstream passage issues. Examples of challenging issues that can be addressed with this tool include volitional passage versus collection and transport and options to sort species and stocks. This module will be developed to address specific upstream passage concerns.

The biological performance tool will provide output with which to compare various passage scenarios. In addition, the biological performance tool will include a user interface that will allow for "real-time gaming" in which input parameters and scenarios can be readily modified. The intent of providing such an interface is to allow for discussion-based modifications to the model in support of the workshop approach of the feasibility study.

While the biological performance tool can provide estimates of expected passage outcomes, the considerable uncertainty related to post-project conditions (including fish behavior and migration, community structure, and population levels) will limit the accuracy of any estimates of future passage performance. Nonetheless, the biological performance tool will provide a relative means to compare the performance of different scenarios for evaluating fish passage feasibility.

2. FIGURES

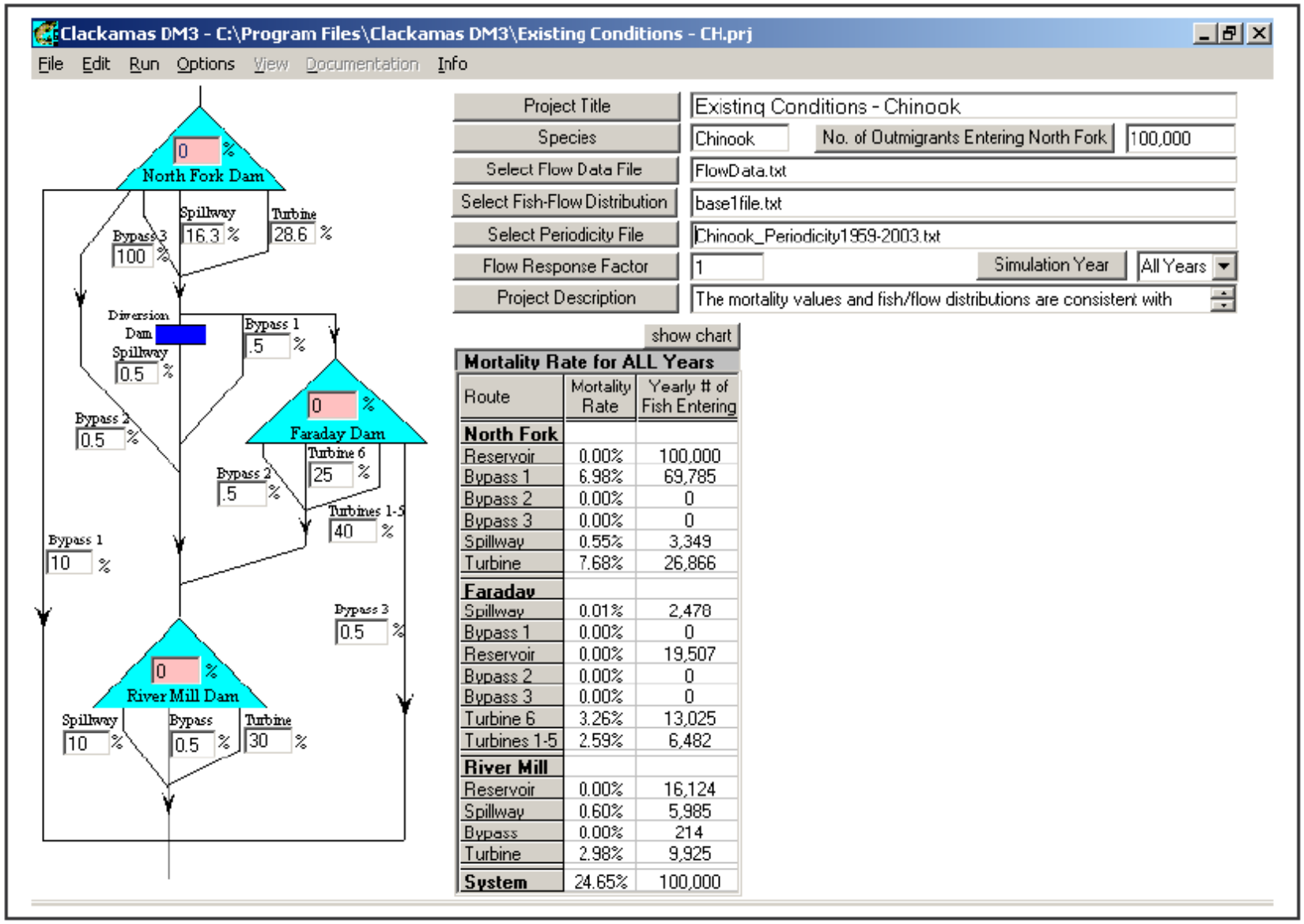


Figure B11-1. Main startup screen of the Clackamas River Downstream Migrant Mortality Model.

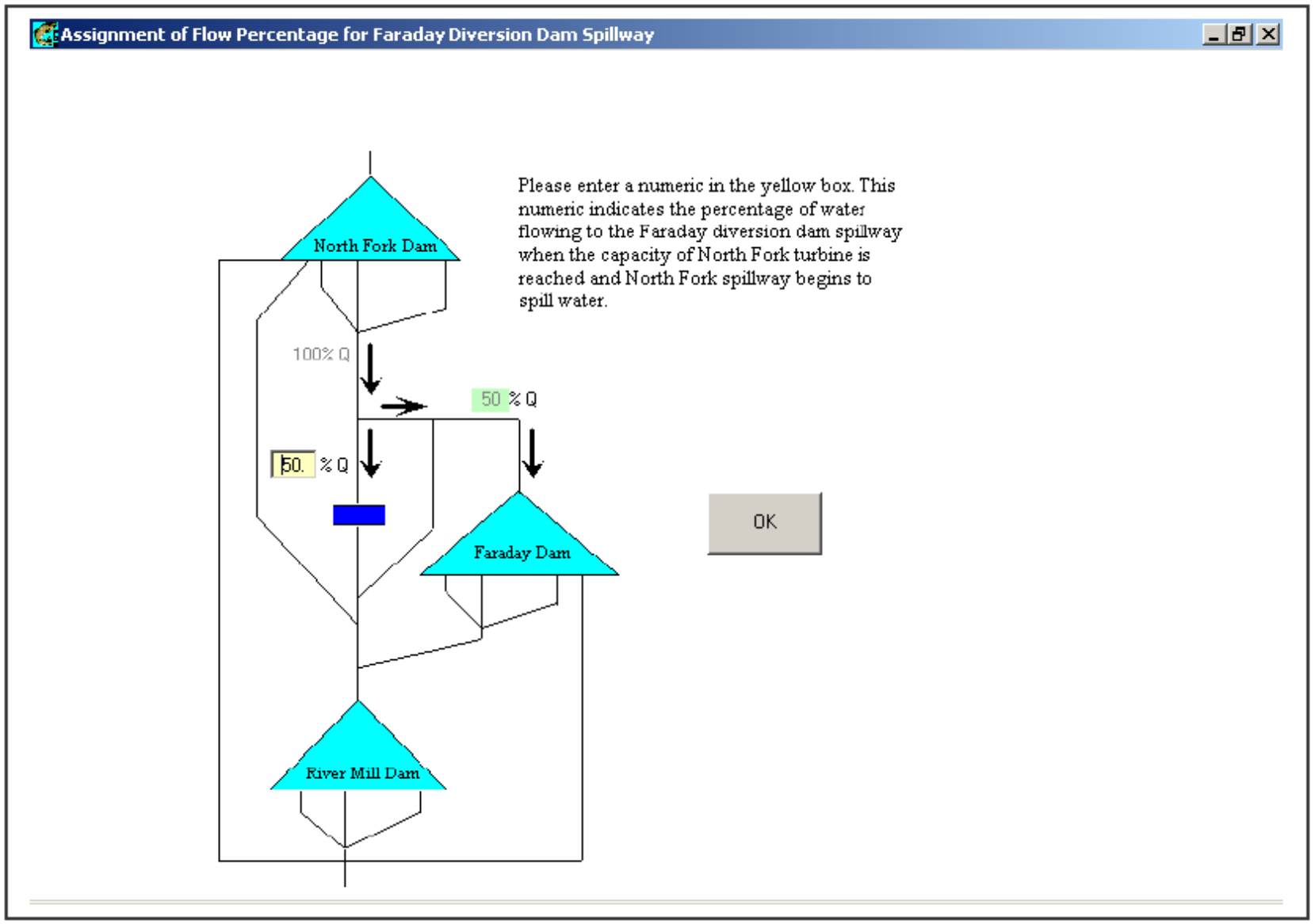
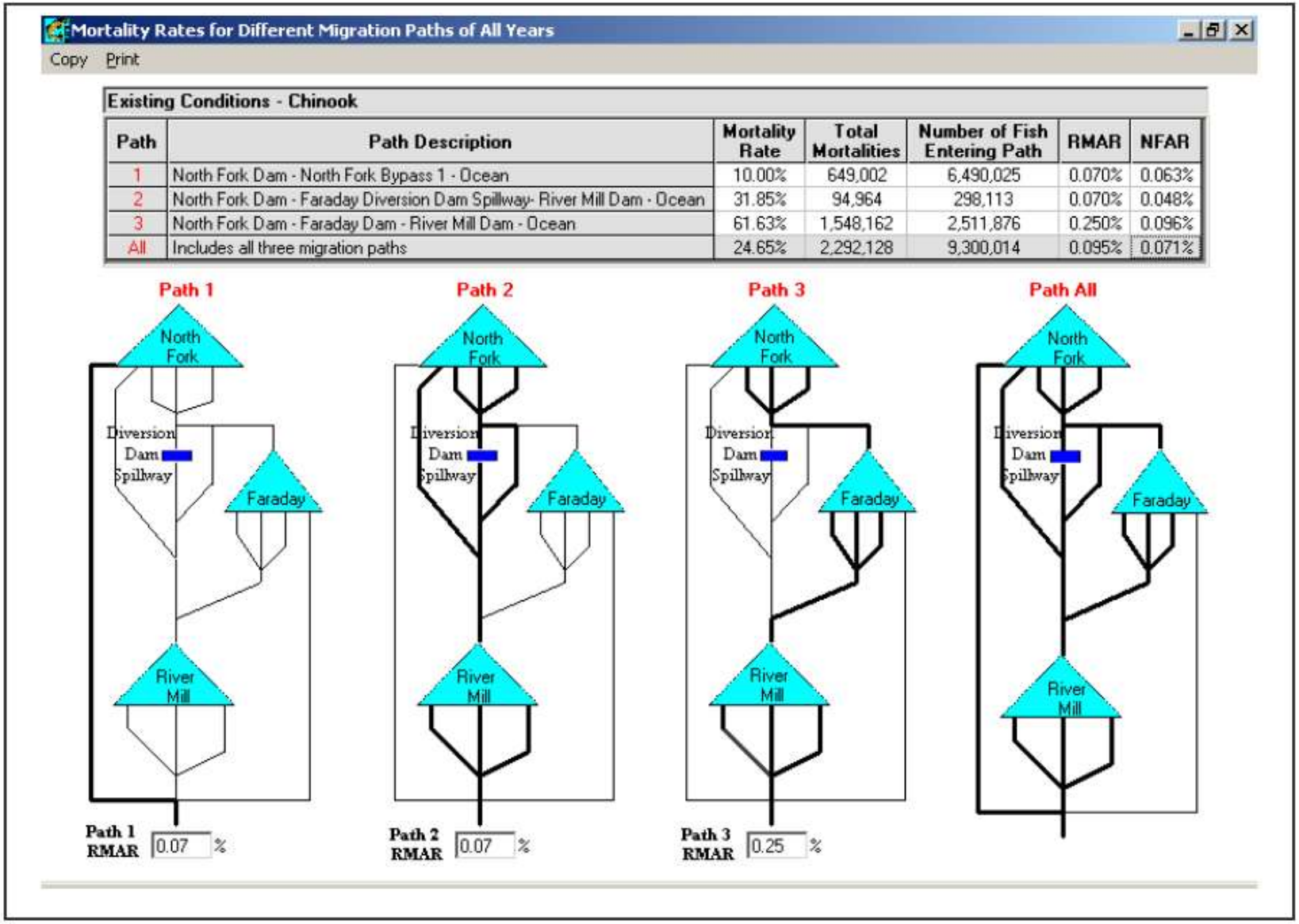
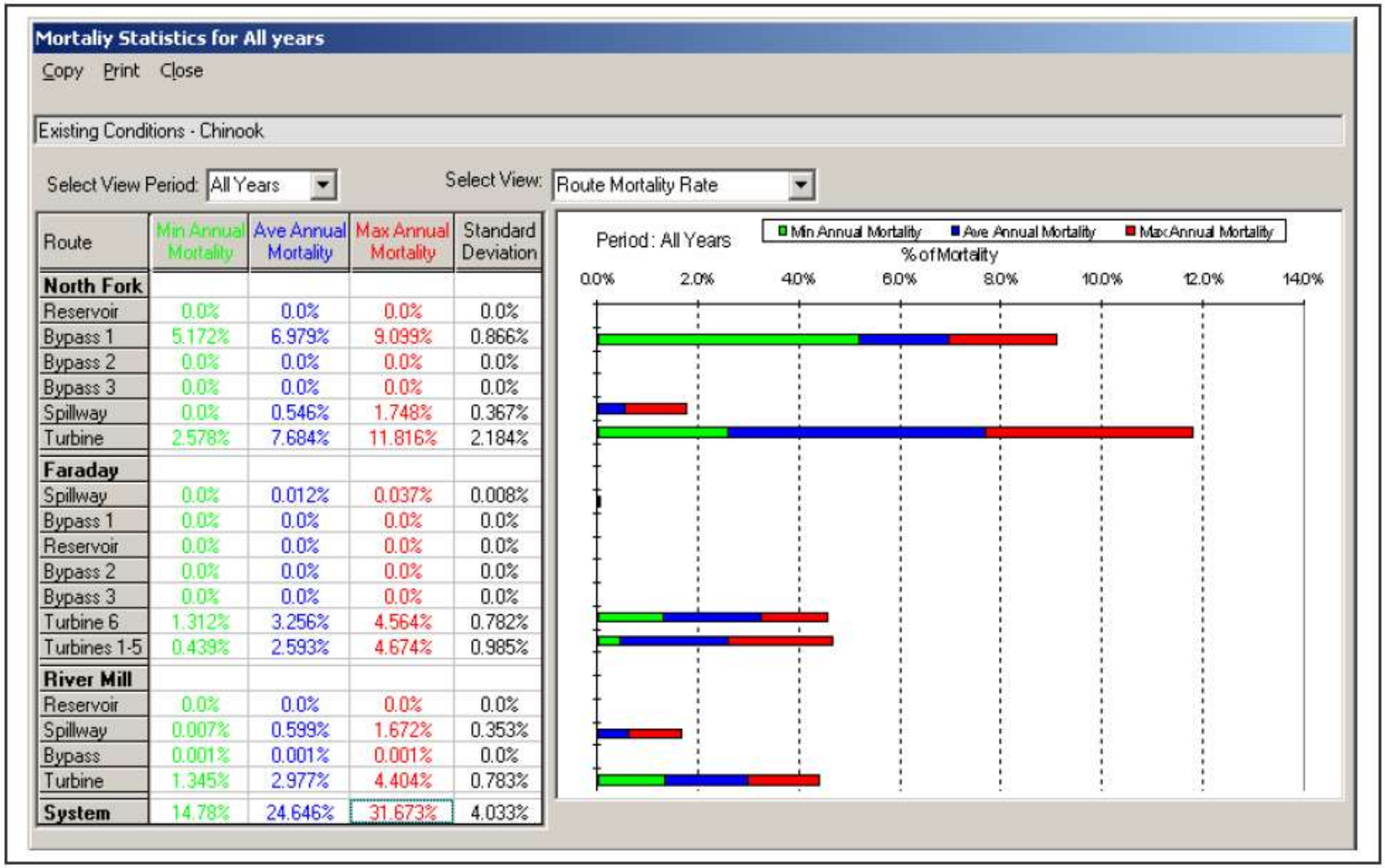


Figure B11-2. Assignment of flow percentage in the Clackamas River Downstream Migrant Mortality Model.



Path	Path Description	Mortality Rate	Total Mortalities	Number of Fish Entering Path	RMAR	NFAR
1	North Fork Dam - North Fork Bypass 1 - Ocean	10.00%	649,002	6,490,025	0.070%	0.063%
2	North Fork Dam - Faraday Diversion Dam Spillway- River Mill Dam - Ocean	31.85%	94,964	298,113	0.070%	0.048%
3	North Fork Dam - Faraday Dam - River Mill Dam - Ocean	61.63%	1,548,162	2,511,876	0.250%	0.096%
All	Includes all three migration paths	24.65%	2,292,128	9,300,014	0.095%	0.071%

Figure B11-3. Assignment of mortality rates for different migration paths in the Clackamas River Downstream Migrant Mortality Model.



Route	Min Annual Mortality	Ave Annual Mortality	Max Annual Mortality	Standard Deviation
North Fork				
Reservoir	0.0%	0.0%	0.0%	0.0%
Bypass 1	5.172%	6.979%	9.099%	0.866%
Bypass 2	0.0%	0.0%	0.0%	0.0%
Bypass 3	0.0%	0.0%	0.0%	0.0%
Spillway	0.0%	0.546%	1.748%	0.367%
Turbine	2.578%	7.684%	11.816%	2.184%
Faraday				
Spillway	0.0%	0.012%	0.037%	0.008%
Bypass 1	0.0%	0.0%	0.0%	0.0%
Reservoir	0.0%	0.0%	0.0%	0.0%
Bypass 2	0.0%	0.0%	0.0%	0.0%
Bypass 3	0.0%	0.0%	0.0%	0.0%
Turbine 6	1.312%	3.256%	4.564%	0.782%
Turbines 1-5	0.439%	2.593%	4.674%	0.985%
River Mill				
Reservoir	0.0%	0.0%	0.0%	0.0%
Spillway	0.007%	0.599%	1.672%	0.353%
Bypass	0.001%	0.001%	0.001%	0.0%
Turbine	1.345%	2.977%	4.404%	0.783%
System	14.78%	24.646%	31.673%	4.033%

Figure B11-4. Mortality statistics from the Clackamas River Downstream Migrant Mortality Model.