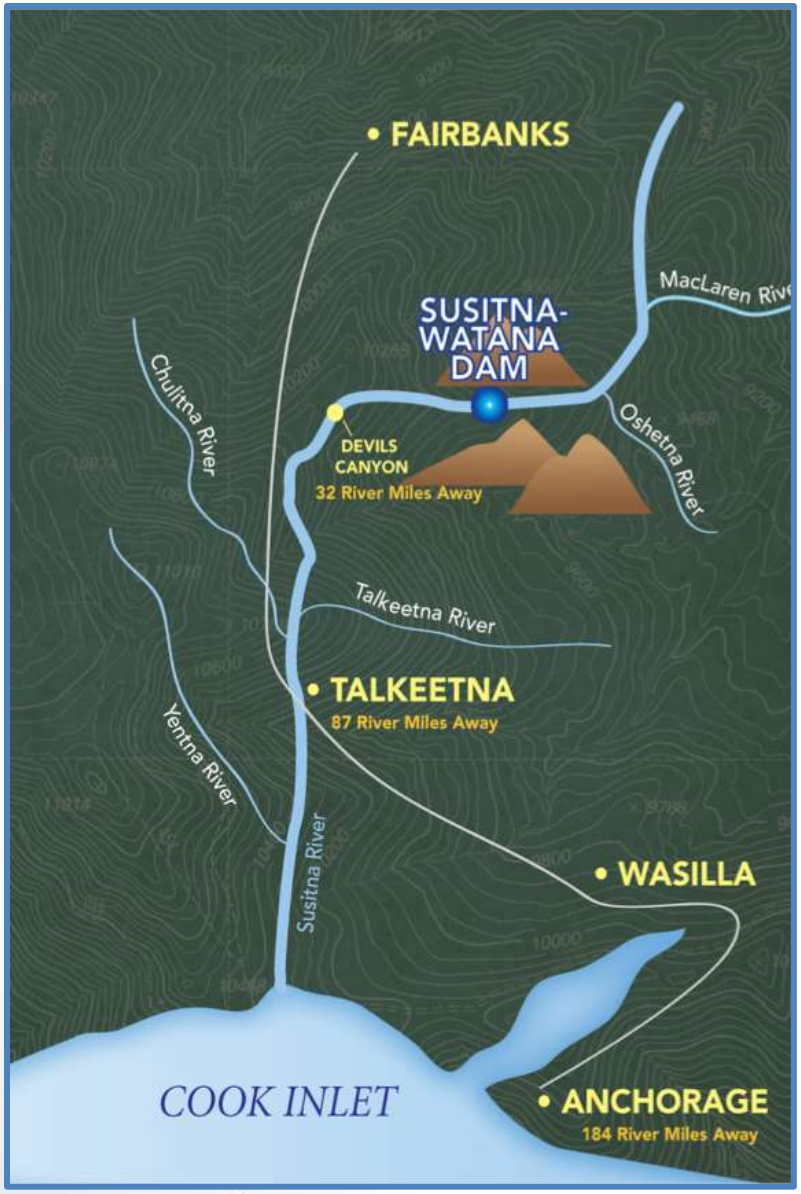


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# Technical Team Meeting

## *Riverine Modeling Meeting*

## ***2-D Fish Habitat Middle River Focus Areas***

*November 13-15, 2013*

Prepared by Miller Ecological Consultants and R2 Resource Consultants

# Overview



- Presentation overview:
  - Describe the 2-D habitat objectives
  - Describe the modeling approach
  - Present the work flow process and interdependencies to other models
- Note: The examples shown are for illustration of the process and model inputs and outputs. Any reference to specific life stage requirements or site locations are used to illustrate the steps that will be taken in the habitat modeling not actual conditions.

# Objectives



- Compute usable area (square feet) for current conditions
  - Effective spawning through emergence (open water and under ice)
  - Juvenile Rearing (open water and under ice)
  - Connection between main channel and lateral habitats under ice (flooding of lateral habitat under ice)
  - Inundation (breaching) of lateral habitats in open water conditions
  - Usable area for other free swimming life stages as a function of flow (open water and under ice)
- Compute usable area for project operation conditions
  - Same as above
- Compare project operation to current conditions to determine change

# 2-D Based Habitat Model

- Incorporates concepts from traditional PHABSIM/IFIM
  - Hydraulics and suitability criteria
  - Calculates usable area
- Habitat area calculated from 2-D hydraulic model using GIS tools to combine hydraulic output data or other parameters (e.g. groundwater, water quality)
- Model uses HSC and HSI analysis for evaluation
- Data dependencies from the following: hydraulic models for open water and ice processes, substrate and cover data from field data collection, groundwater data, water quality data, HSC and HSI analysis
- Provides visual and quantitative result for decision framework

# Hydraulic Model Data Used for Fish Habitat in Focus areas



- Two Dimensional data from hydraulic/sediment transport modeling and ice process modeling
- Habitat model can use either SRH-2D or River2D output
- Analysis uses full range of flows for existing conditions and project operations

– Data from each source is in the form of csv files or the River2D "CDG" simulation files, including the following data:

  - Geo-referenced coordinate data for all model nodes (same coordinate system as survey data)
  - Water Surface (ft)
  - Bed elevation (ft)
  - Water velocity (ft/s)
  - Water Depth (ft)
  - Cell area ($ft^2$)

# Example CSV 2D hydraulic output format for input to fish habitat modeling

| Point_ID | X_ft | Y_ft | Bed_Elev_ft | Area_ft2 | Water_Elev_ft | Water_Depth_ft | Vel_Mag_ft_p_s |
|---|---|---|---|---|---|---|---|
| 224 | 1612317.31 | 3058505.34 | 368.46 | 671.97 | 369.91 | 1.45 | 1.90 |
| 225 | 1612344.56 | 3058508.81 | 367.00 | 764.88 | 369.90 | 2.90 | 2.92 |
| 226 | 1612373.24 | 3058512.77 | 366.46 | 784.97 | 369.92 | 3.46 | 3.38 |
| 227 | 1612401.91 | 3058516.72 | 365.97 | 804.87 | 369.96 | 3.99 | 3.59 |
| 228 | 1612430.58 | 3058520.68 | 365.51 | 825.12 | 369.99 | 4.48 | 3.70 |
| 229 | 1612459.26 | 3058524.63 | 365.25 | 845.13 | 370.00 | 4.75 | 3.76 |
| 230 | 1612487.93 | 3058528.58 | 365.12 | 865.22 | 370.01 | 4.89 | 3.74 |
| 231 | 1612516.60 | 3058532.54 | 364.96 | 885.44 | 370.01 | 5.04 | 3.69 |
| 232 | 1612545.28 | 3058536.49 | 364.80 | 905.33 | 370.00 | 5.21 | 3.58 |
| 233 | 1612573.95 | 3058540.45 | 364.52 | 925.28 | 370.01 | 5.49 | 3.53 |
| 234 | 1612602.62 | 3058544.40 | 364.20 | 945.48 | 370.04 | 5.84 | 3.96 |

# Ground Water and Water Quality Data Used for Fish Habitat in Focus areas



- Temporal and spatial groundwater data or groundwater process for the range of flows under current and project operations.
- Temporal and spatial water quality data for a range of flows for existing conditions and project operations.

– Data from each source is in the form of csv or GIS data files, including the following data:

  - Geo-referenced coordinates for all data.
  - Ground water – upwelling locations or ground water process for the Focus area.
  - Water Quality data for the spatial extent of the focus area.

# Example HSC curve

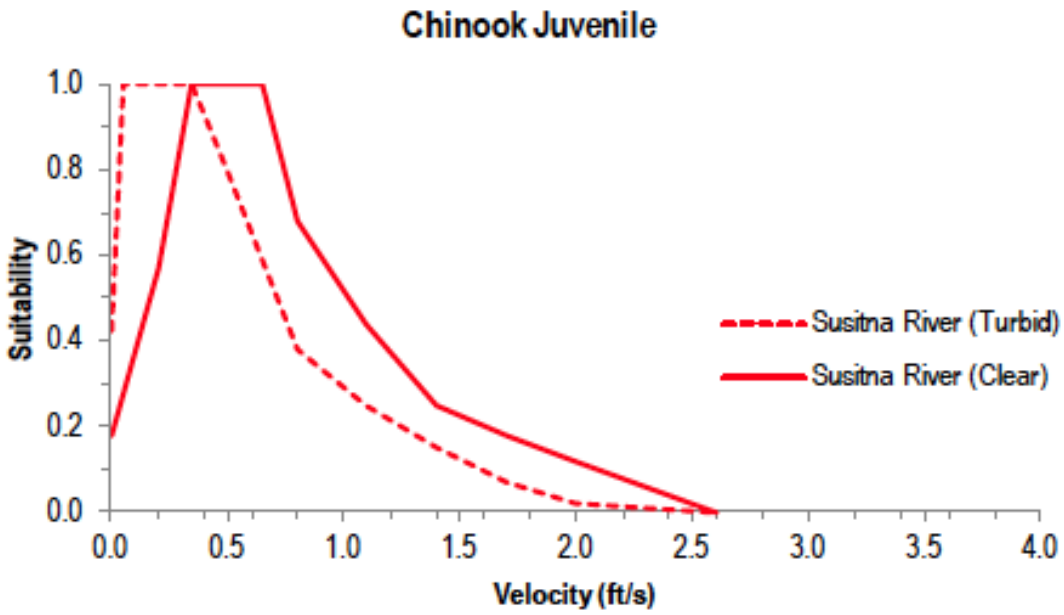


**Figure 8.5-4. Example HSC curves for rearing juvenile Chinook salmon in the Middle Susitna River developed during the 1980s instream flow studies. Source: Suchanek et al. 1984b.**

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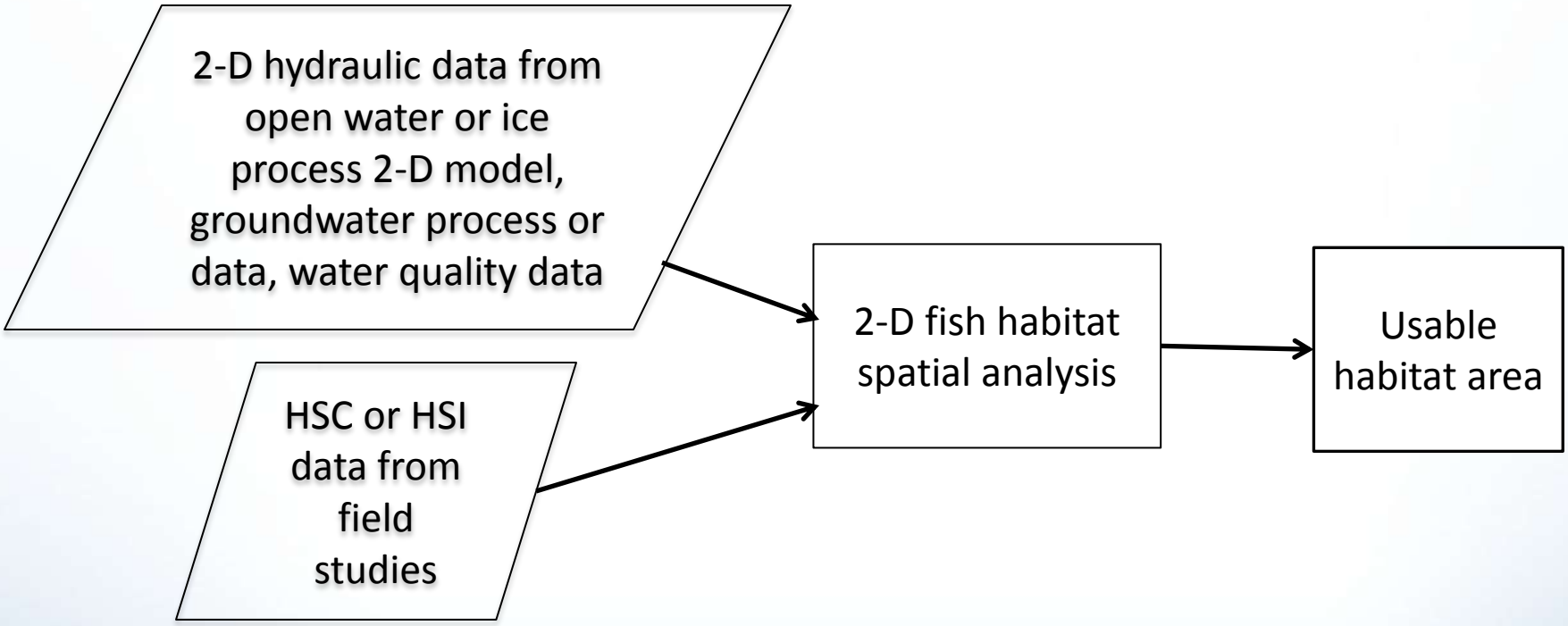
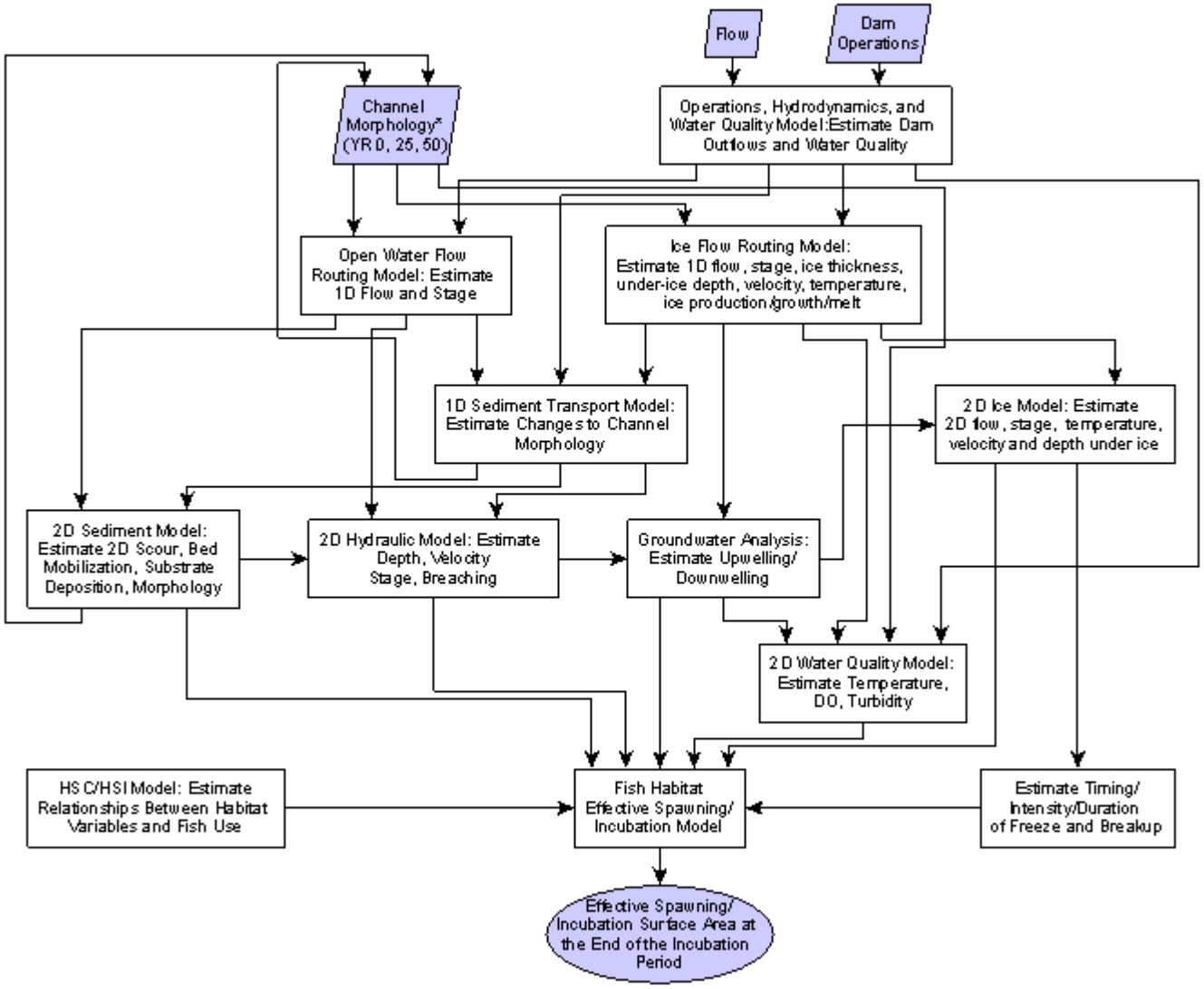
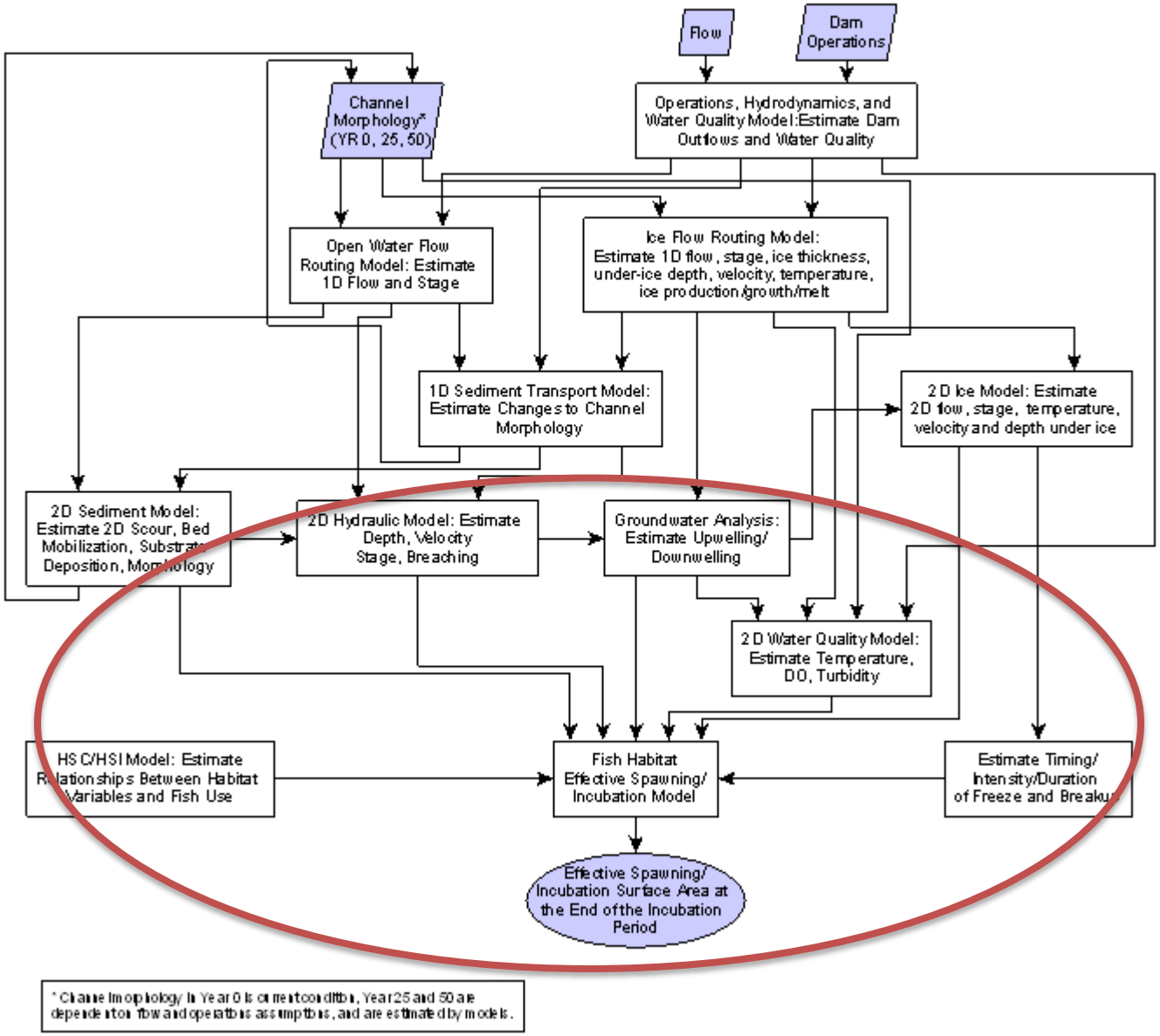
# Generalized data flow for 2-D fish habitat analysis

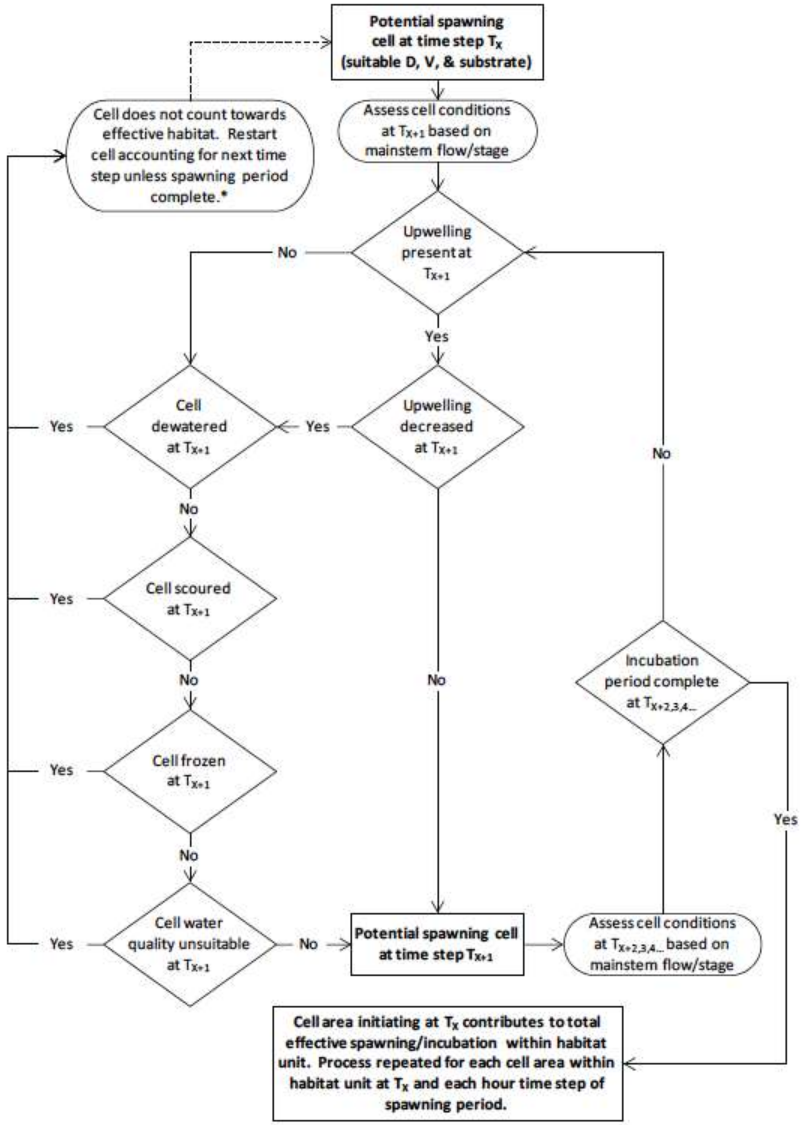


# What are Project Impacts to Total Effective Spawning/Incubation/Emergence Habitat Area in FA-104 (Whiskers Slough)?



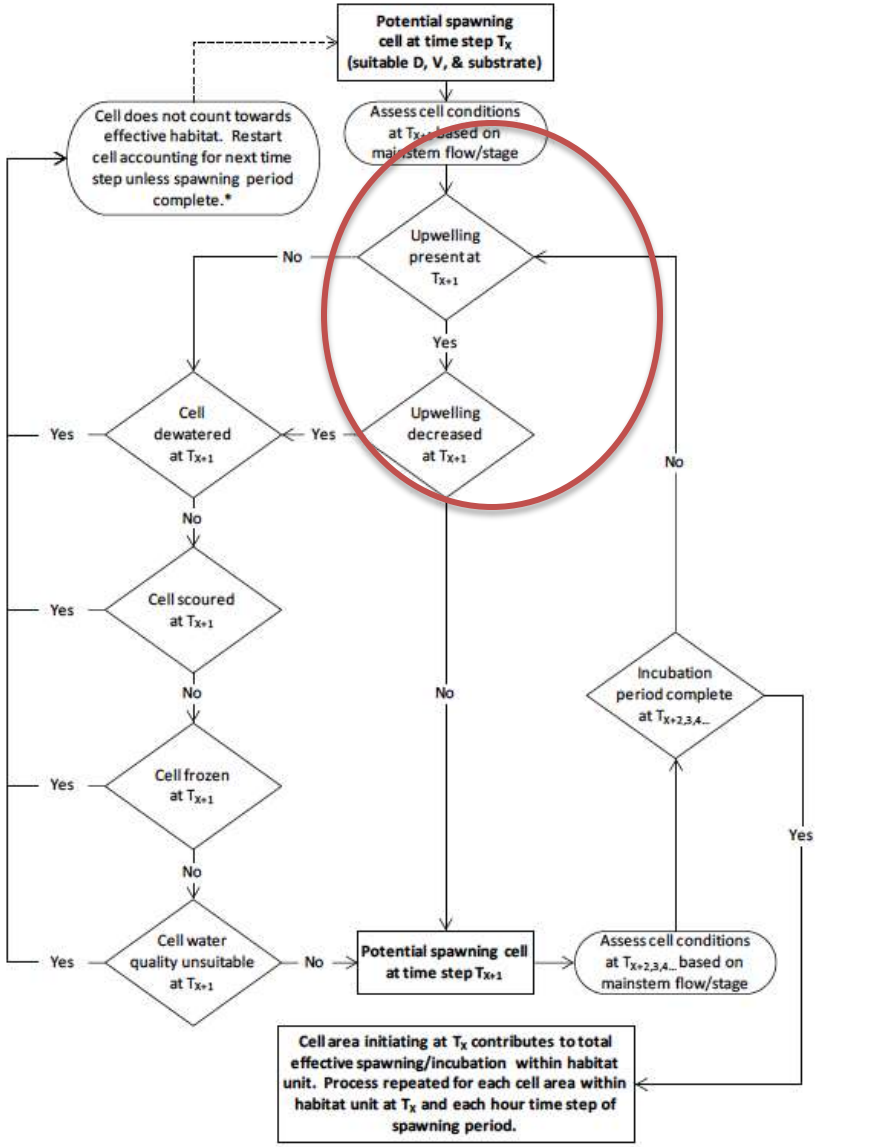
# What are Project Impacts to Total Effective Spawning/Incubation/Emergence Habitat Area in FA-104 (Whiskers Slough)?






* If subsequent time step is still within the spawning period and the cell still meets criteria for the duration of incubation period, effective habitat for this cell would be weighted according to the duration of the remaining spawning period.

**Figure 8.5-32. Conceptual diagram depicting the Effective Spawning/Incubation Model.**




* If subsequent time step is still within the spawning period and the cell still meets criteria for the duration of incubation period, effective habitat for this cell would be weighted according to the duration of the remaining spawning period.

**Figure 8.5-32. Conceptual diagram depicting the Effective Spawning/Incubation Model.**

# Groundwater data/analysis input and use by 2-D fish habitat modeling

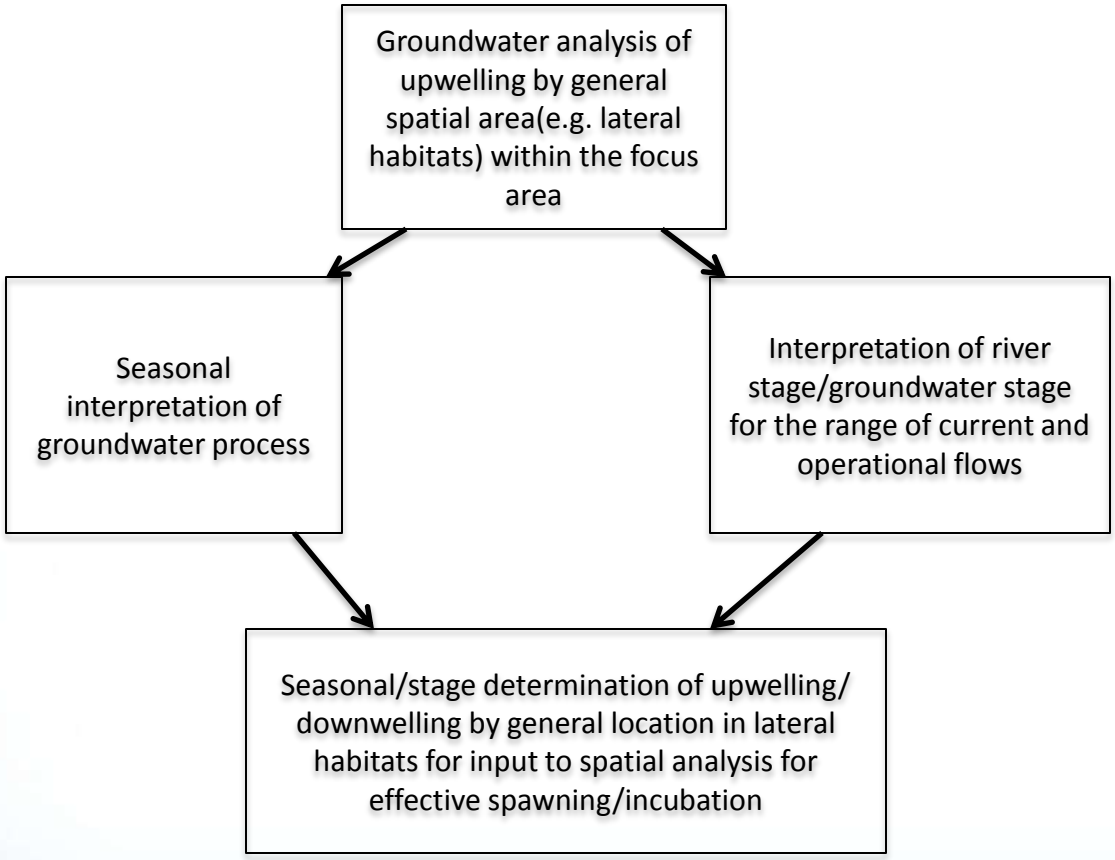
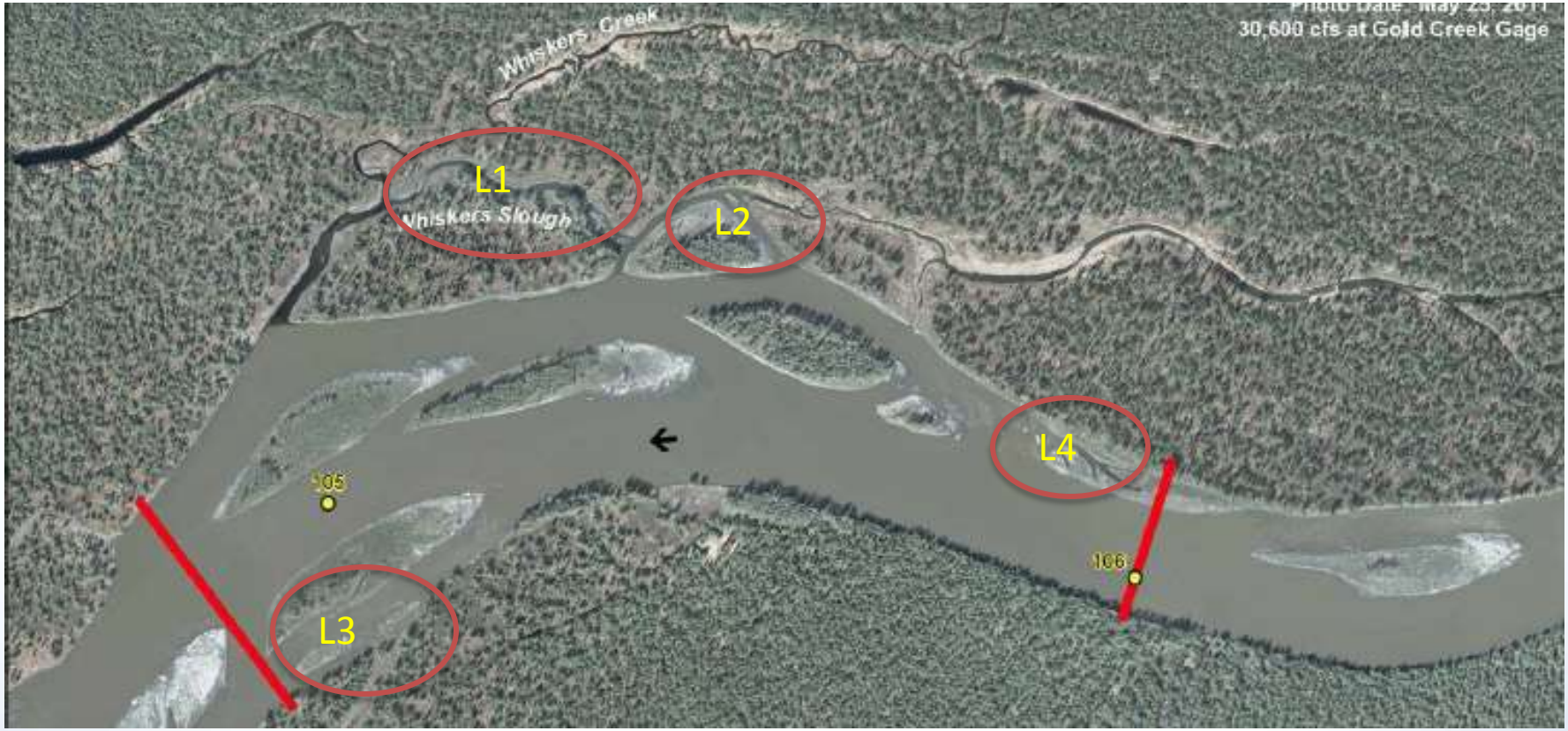


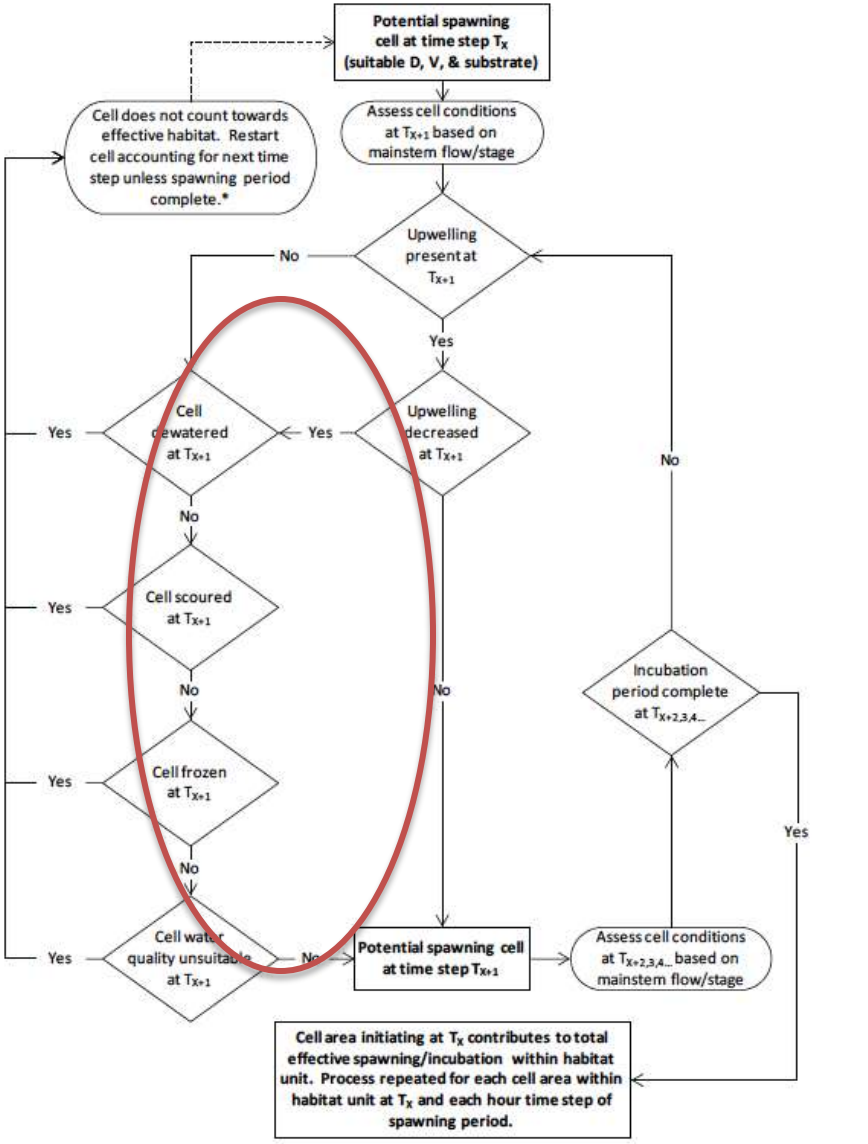
Illustration of locations where ground water is input to effective spawning using map of FA 104 (Whiskers Slough)



# Example matrix of ground water conditions as input to fish habitat

Ground water upwelling trend by season for current conditions at FA **XX**.

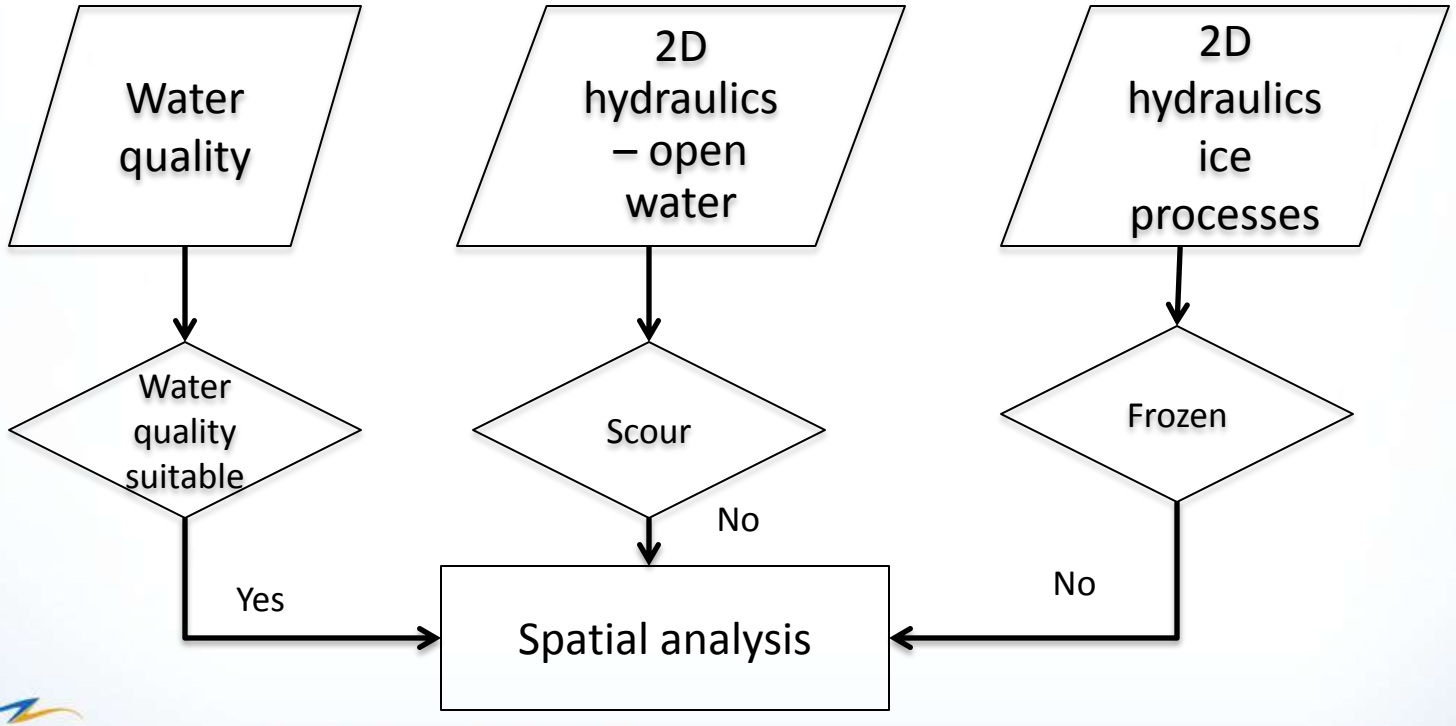
| Season/Month | Lateral habitat 1 | Lateral habitat 2 | Lateral habitat 3 | Lateral habitat 4 |
|---|---|---|---|---|
| **May** | Present/increasing | Present/steady | Present/increasing | Present/increasing |
| **June** | Present/increasing | Present/steady | Present/increasing | Present/increasing |
| **July** | Present/increasing | Present/decreasing | Present/increasing | Present/increasing |
| **August** | Present/increasing | Present/decreasing | Present/increasing | Present/increasing |
| **September** | Present/increasing | Present/decreasing | Present/increasing | Present/increasing |
| **October** | Present/steady | Present/decreasing | Present/steady | Present/steady |
| **November** | Present/steady | Present/decreasing | Present/steady | Present/steady |
| **December** | Present/steady | Absent | Present/steady | Present/steady |
| **January** | Present/steady | Absent | Present/steady | Present/steady |
| **February** | Present/steady | Absent | Present/steady | Present/steady |
| **March** | Present/steady | Absent | Present/steady | Present/steady |
| **April** | Present/steady | Absent | Present/steady | Present/steady |

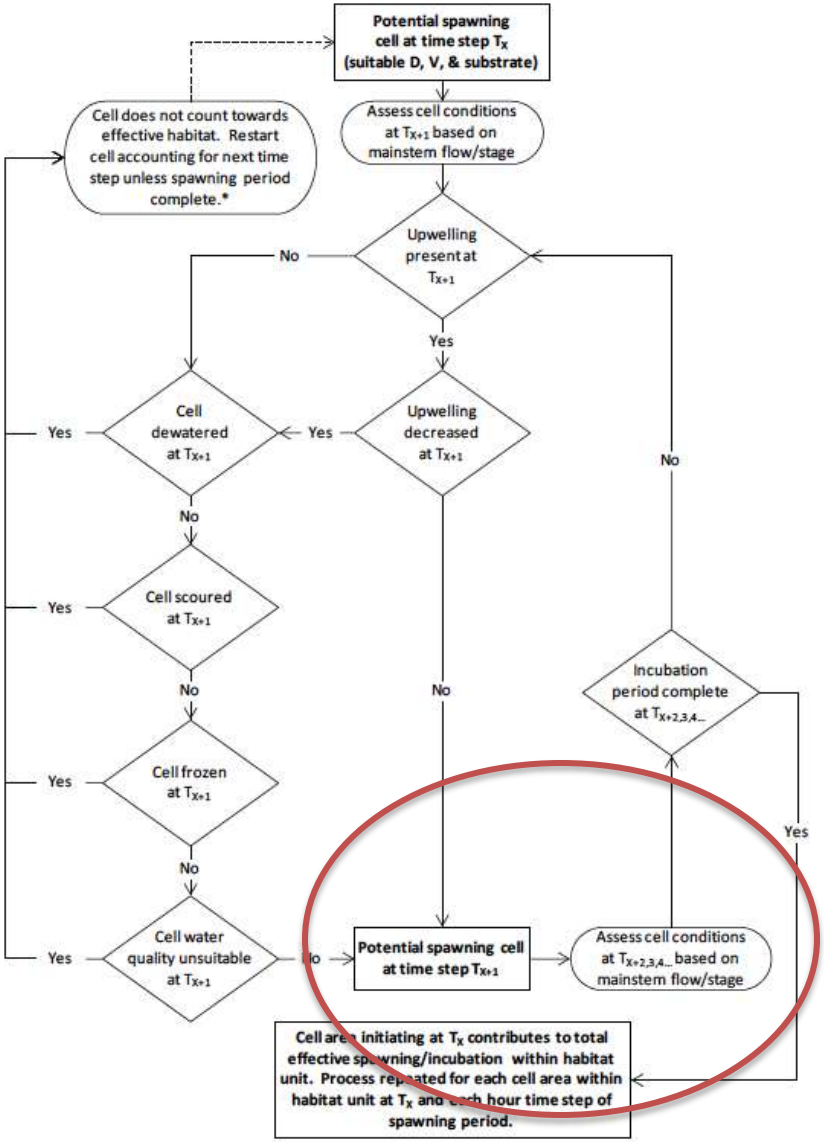



* If subsequent time step is still within the spawning period and the cell still meets criteria for the duration of incubation period, effective habitat for this cell would be weighted according to the duration of the remaining spawning period.

**Figure 8.5-32. Conceptual diagram depicting the Effective Spawning/Incubation Model.**

# Example of other inputs from physical models






* If subsequent time step is still within the spawning period and the cell still meets criteria for the duration of incubation period, effective habitat for this cell would be weighted according to the duration of the remaining spawning period.

**Figure 8.5-32. Conceptual diagram depicting the Effective Spawning/Incubation Model.**

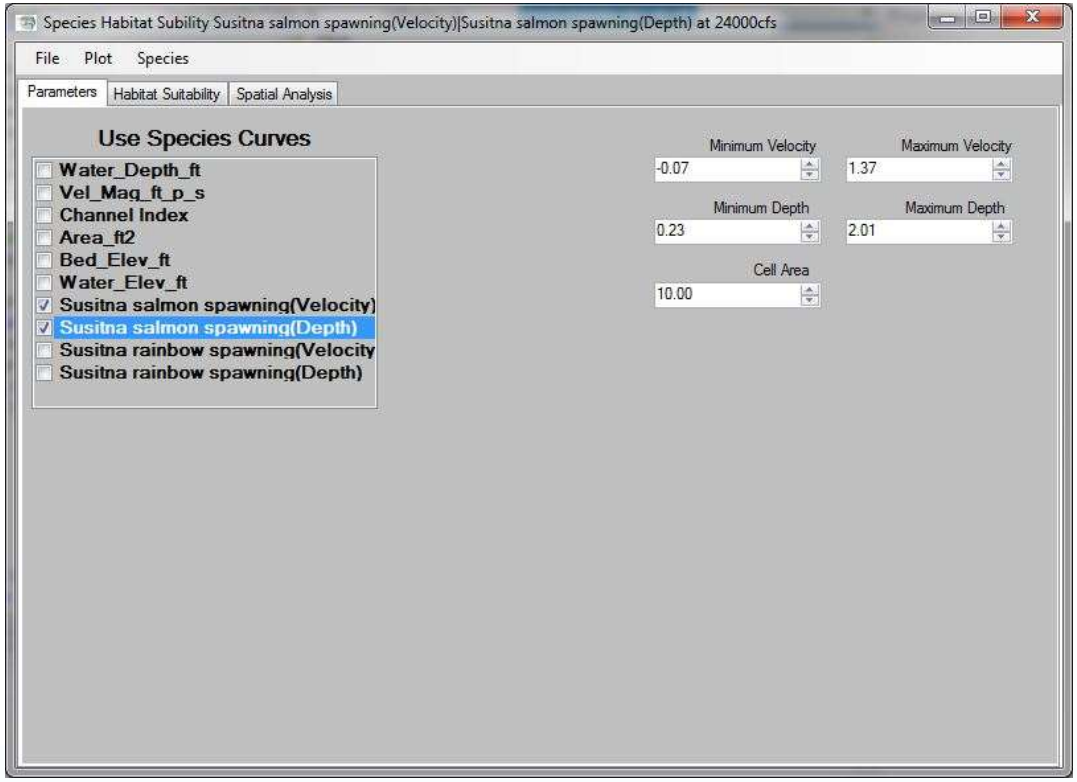
# 2-D Fish Habitat Spatial Analysis



- Process Hydraulic Flow Data
  - CSV file geo-referenced data x,y,z, velocity, depth, channel index
- Create spatial data layers for each flow
- Conduct the Usable Area Modeling/HSI modeling
  - Combine spatial data and habitat equations
- Produce habitat graphics and CSV files with habitat values at each node
- Produce habitat versus discharge response functions

# Example of Visual Basic (VB) interface to run usable habitat calculations





# Example tabular output from VB model

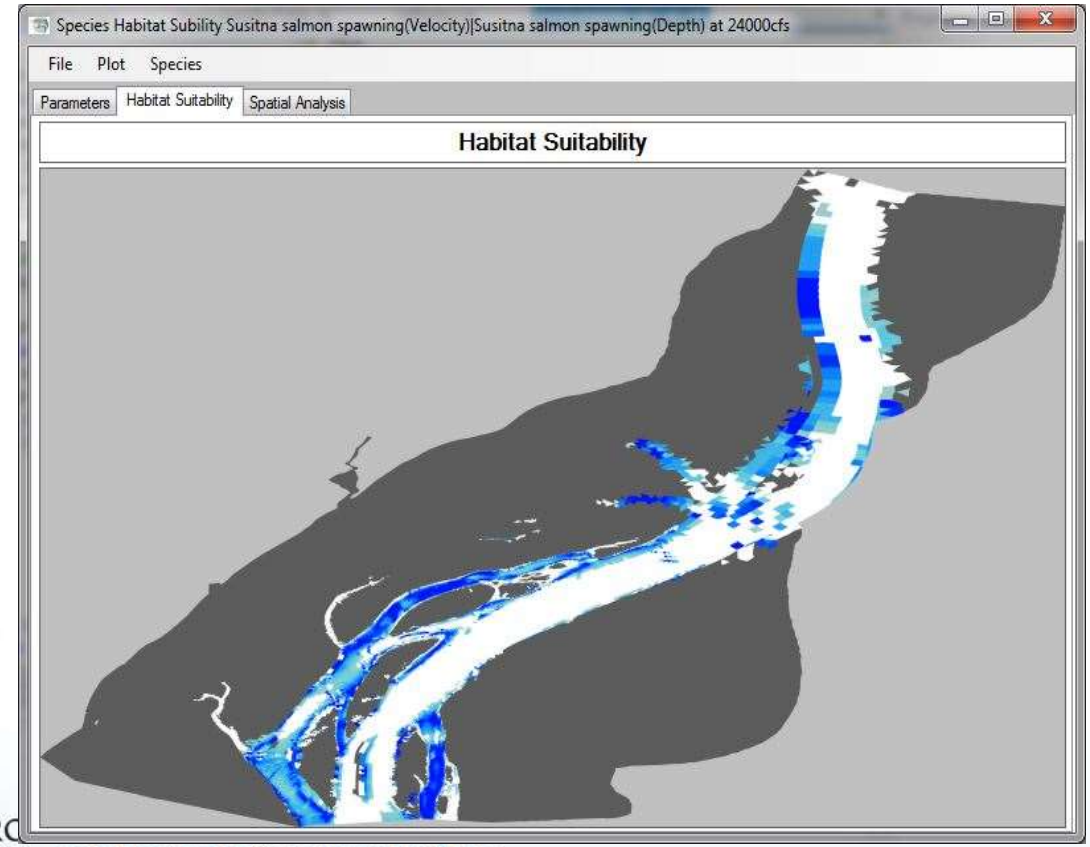
Susitna

24000

| Element | X_ft | Y_ft | Water_Depth | Vel_Mag_ft_ | Channel Inde | Area_ft2 | Bed_Elev_ft | Water_Elev_ | CombinedSuitability |
|---|---|---|---|---|---|---|---|---|---|
| 224 | 1612317.31 | 3058505.34 | 1.45142063 | 1.89297965 | 1 | 671.973633 | 368.4555 | 369.906971 | 1 |
| 225 | 1612344.56 | 3058508.81 | 2.89994079 | 2.91381384 | 1 | 764.879395 | 367.00475 | 369.904691 | 0.5009 |
| 226 | 1612373.24 | 3058512.77 | 3.46214843 | 3.36780936 | 1 | 784.972656 | 366.46125 | 369.923398 | 0.3575 |
| 227 | 1612401.91 | 3058516.72 | 3.98751612 | 3.57528354 | 1 | 804.868164 | 365.9735 | 369.961016 | 0.292 |
| 228 | 1612430.58 | 3058520.68 | 4.48178826 | 3.68629196 | 1 | 825.115723 | 365.50725 | 369.989038 | 0.257 |
| 229 | 1612459.26 | 3058524.63 | 4.75105305 | 3.74198589 | 1 | 845.133301 | 365.2525 | 370.003553 | 0.2394 |
| 230 | 1612487.93 | 3058528.58 | 4.88657576 | 3.72980522 | 1 | 865.217773 | 365.12225 | 370.008826 | 0.2432 |
| 231 | 1612516.6 | 3058532.54 | 5.04314729 | 3.67187706 | 1 | 885.438965 | 364.96425 | 370.007397 | 0.2615 |
| 232 | 1612545.28 | 3058536.49 | 5.20718851 | 3.5695903 | 1 | 905.33252 | 364.7965 | 370.003689 | 0.2938 |
| 233 | 1612573.95 | 3058540.45 | 5.48707932 | 3.52104594 | 1 | 925.276367 | 364.5235 | 370.010579 | 0.3092 |
| 234 | 1612602.62 | 3058544.4 | 5.83765184 | 3.95456998 | 1 | 945.479981 | 364.1975 | 370.035152 | 0.1722 |

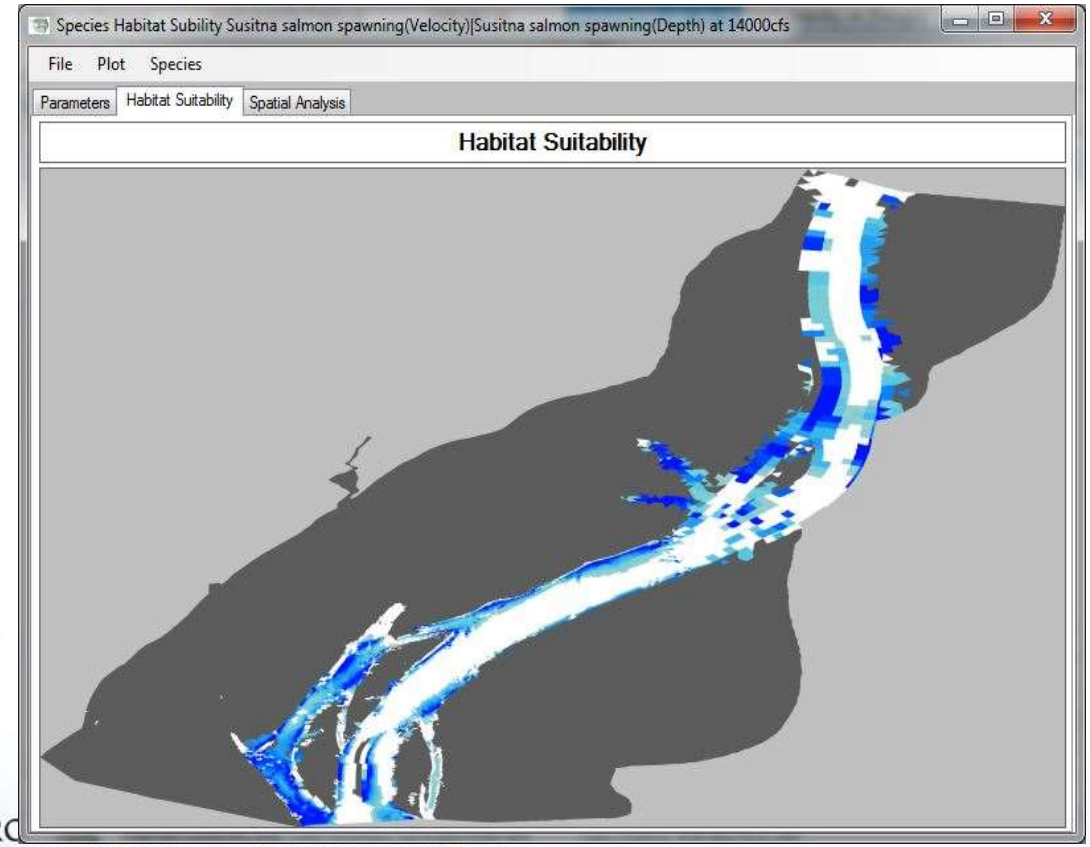
# Example of graphical output from VB interface



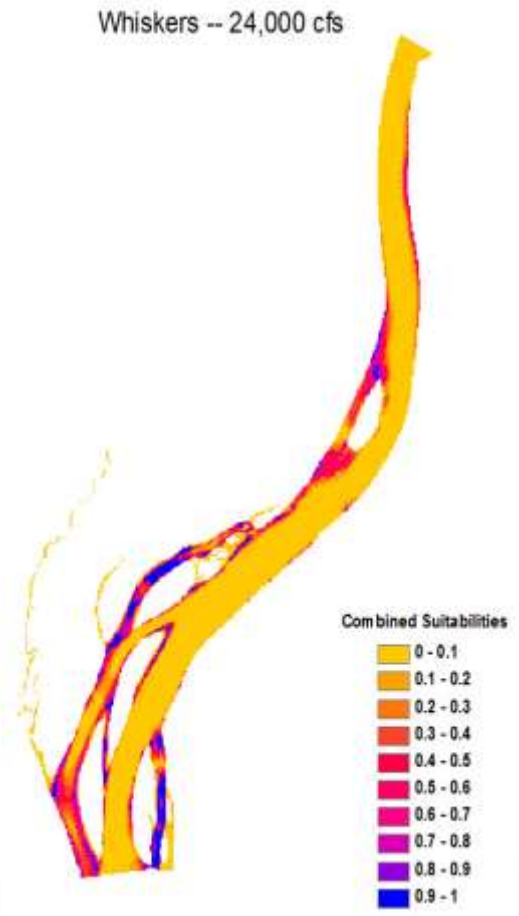


# Example of graphical output from VB interface

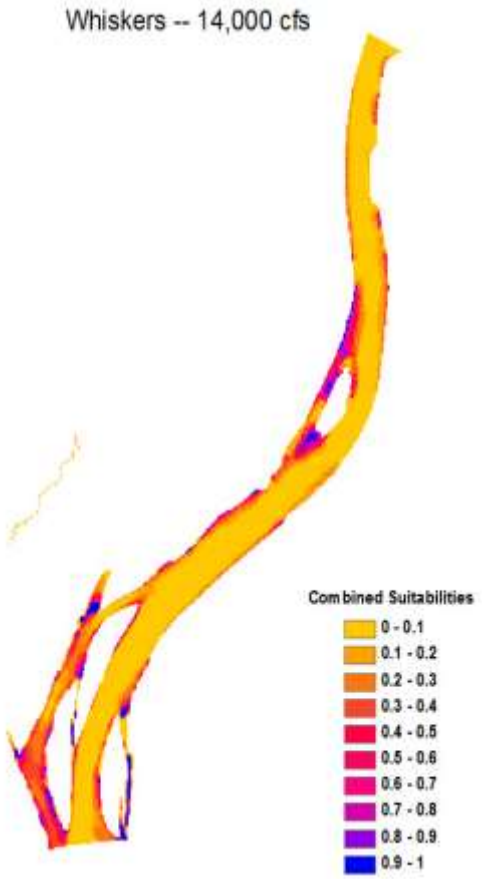




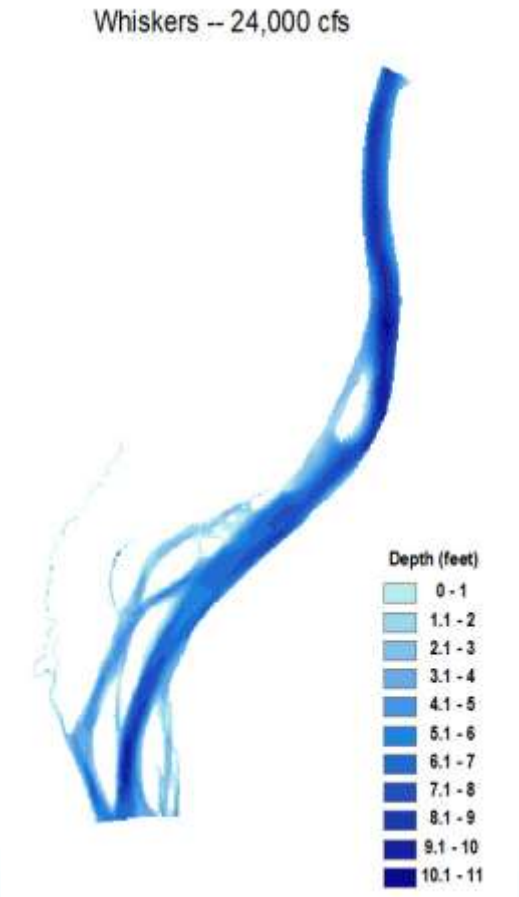
# Example of GIS visualization for 24,000 cfs



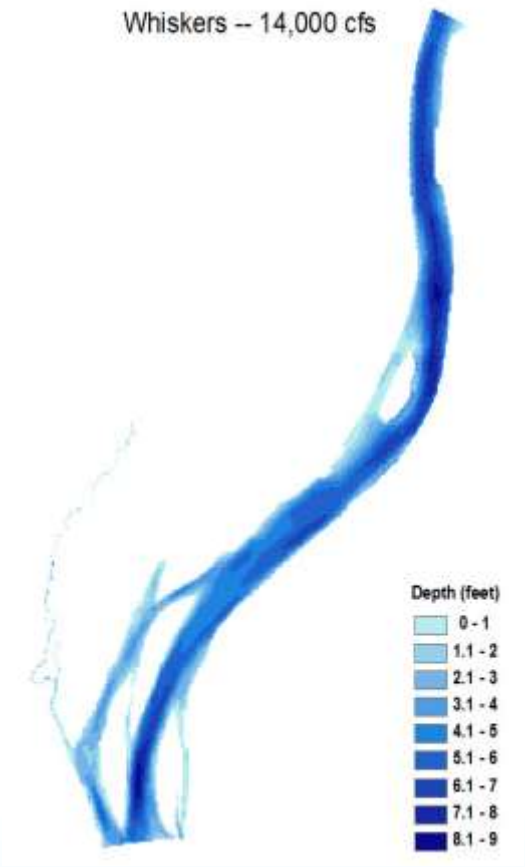
# Example of GIS visualization for 14,000 cfs



# GIS screen shot of depth 24,000 cfs



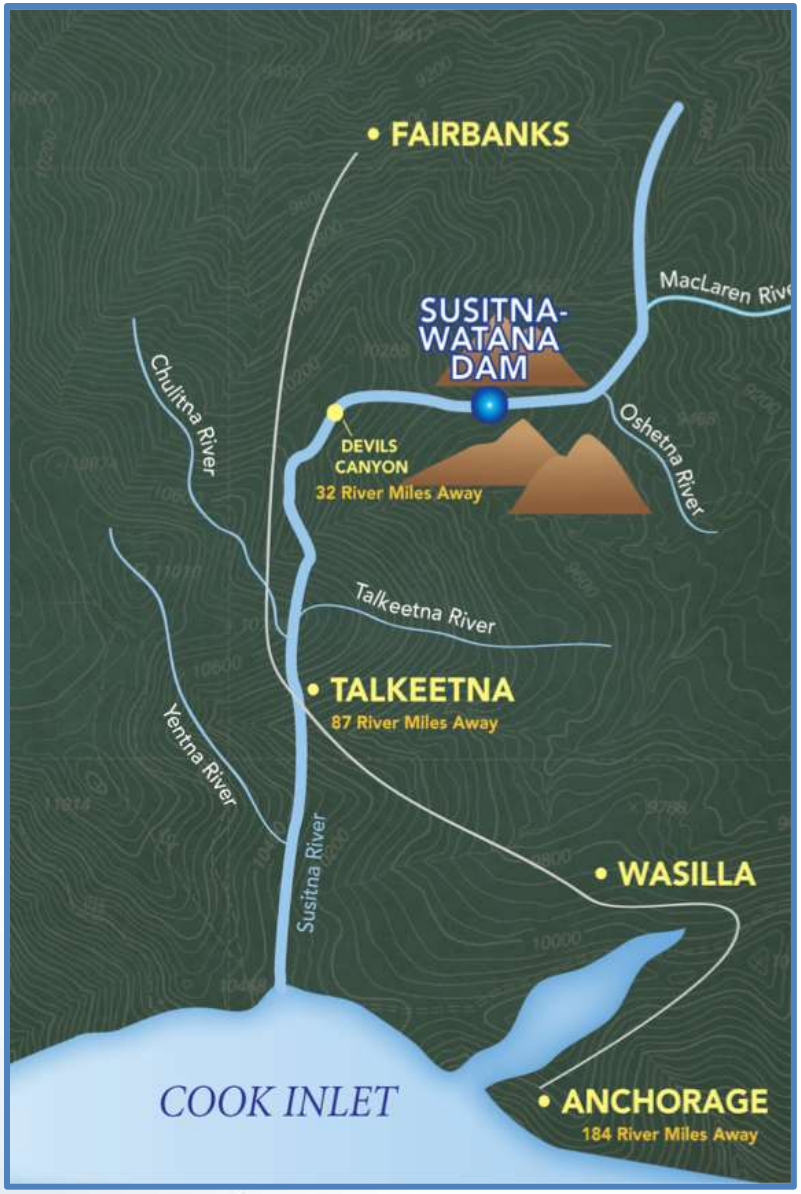
# GIS screen shot of depth 14,000 cfs



# Summary

- Approach provides tabular and graphical data outputs for input to DSS or other decision processes.
- The analysis sequence is similar to other 2-D habitat analysis with the addition of explicit inclusion of ground water conditions, breaching in lateral habitats, and water quality.
- A similar approach will be used on other species and life stages of interest.

# 2-D Fish Habitat Middle River Focus Areas




## Questions

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