Kilpatrick Pond and Dam Restoration Feasibility Study

Prepared by:

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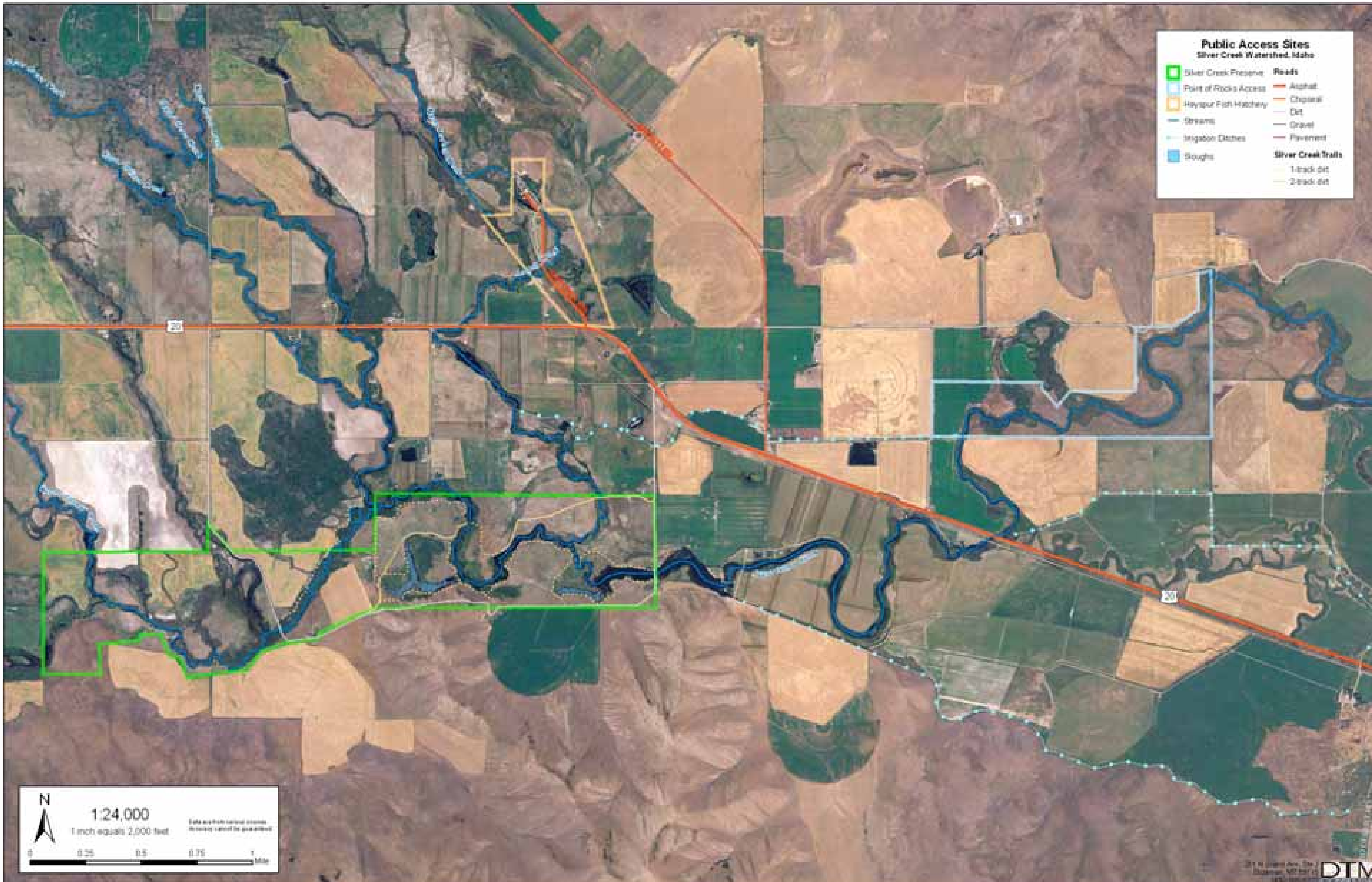
Water and Land Conservation and Restoration

Prepared for:
The Nature Conservancy
April 3, 2007

In Association with:
Applied Geomorphology
Hoitsma Ecological
Oxbow, Inc.
DTM Consulting

Project Goal

Develop conceptual alternatives and assess feasibility for restoring or enhancing natural riparian and stream habitat and processes through Kilpatrick Pond


Public Access Sites
Silver Creek Watershed, Idaho
Silver Creek Preserve
Point of Rocks Access
Hayspur Fish Hatchery
Streams
Irrigation Ditches
Sloughs
Roads
Asphalt
Chipseal
Dirt
Gravel
Pavement
Silver Creek Trails
1-track dirt
2-track dirt
20
N
1:24,000
1 inch equals 2,000 feet
0
0.25
0.5
0.75
1
Mile
DTM

Objectives

- Sediment transport continuity
- Improved habitat connectivity
- Maximized riparian potential
- Reduced thermal impacts by dam
- Improved angling opportunities

Objectives (cont)

- Develop multiple alternatives
  – Identify costs and ecological benefit

- Assess alternatives considering scientific data and stakeholder input

Reach Assessment

- Literature/Data Review
  - Historic Conditions
  - Trends
  - Current Conditions

- Site Visit
  - Floating/Mapping
  - Sediment Gradations
  - Stakeholder Discussions
  - Elevation survey at dam
  - Observation of existing enhancement projects

Primary Findings: Stream Condition

- Silver Creek is not at full potential
  - Overwidened channel
  - Excessive siltation
  - Disruption by pond

⇨ Poor sediment transport conditions, elevated temperatures

⇨ Potentially prone to environmental stressors

Alternatives Development

- Nine alternatives developed
  – Address identified ecological impairments
  – Range from full restoration to modest enhancement

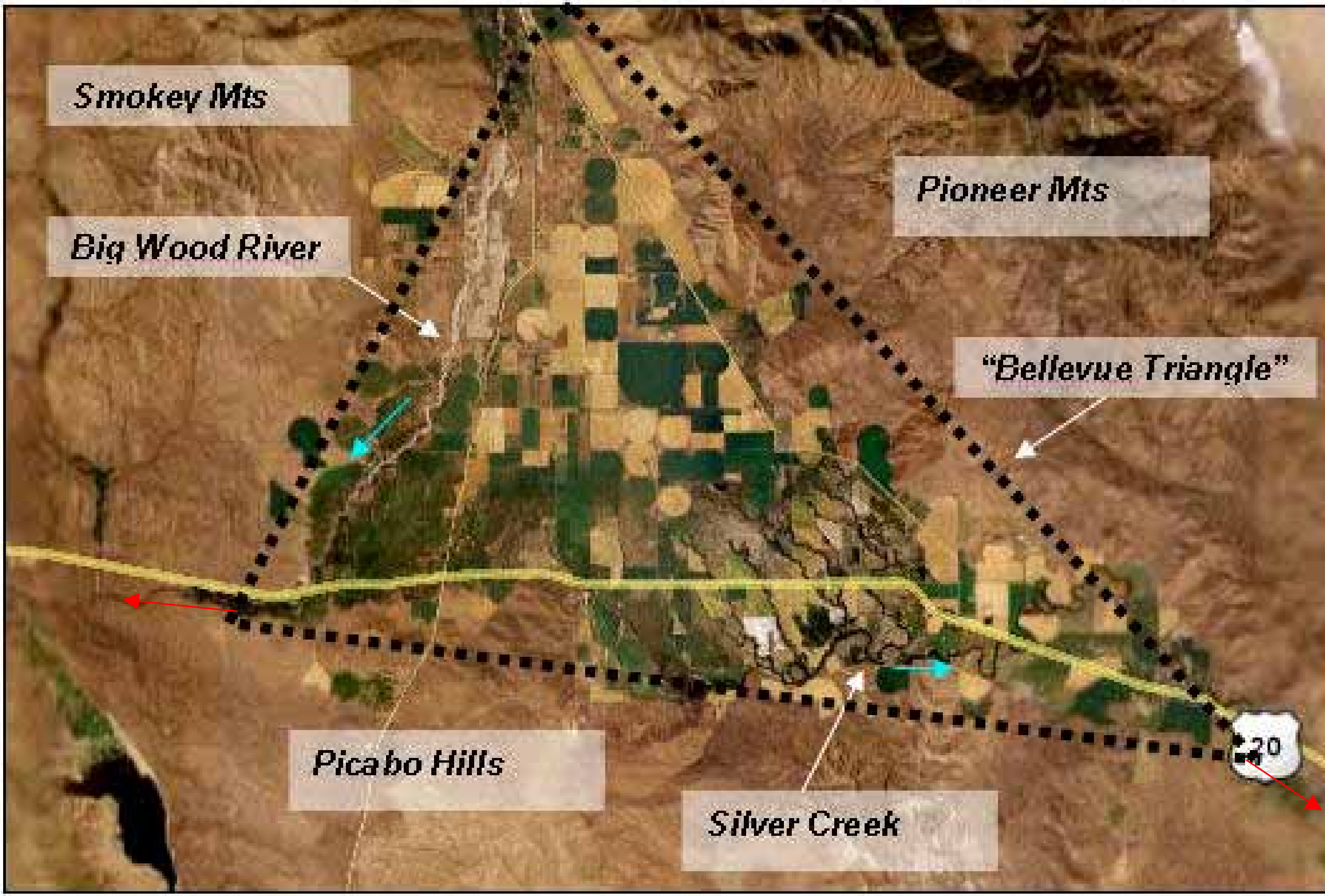
Preferred Alternatives

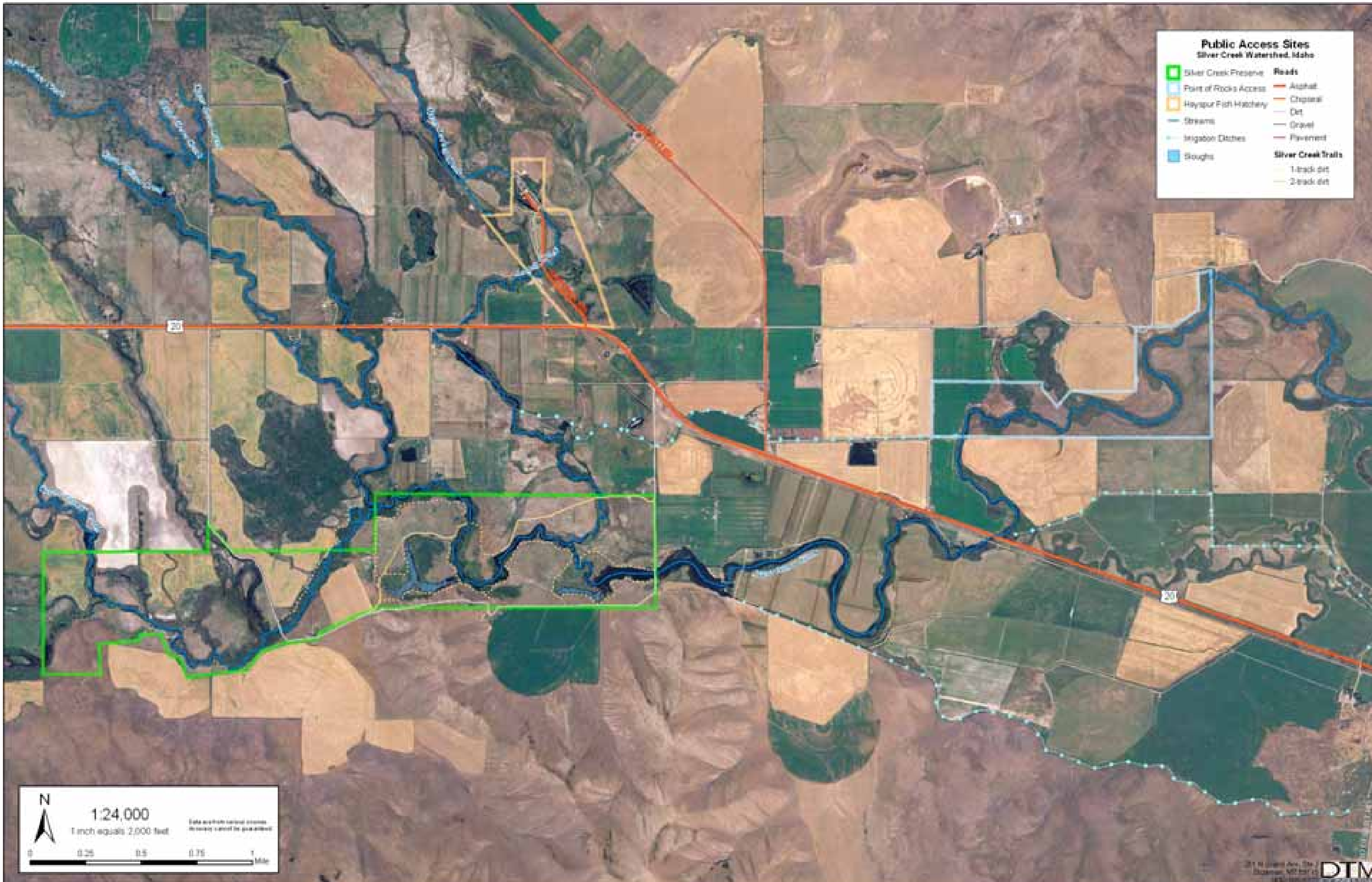
- Constraints/benefits analysis
- Three preferred alternatives identified
- Preferred alternatives developed in greater detail
- Cost/benefits analysis performed on preferred alternatives

Preferred Alternatives

- Bottom release structure on dam
- Dam modification/lowering of pond elevation
- Revegetation of pond sediments

Physical Setting: Bellevue Triangle

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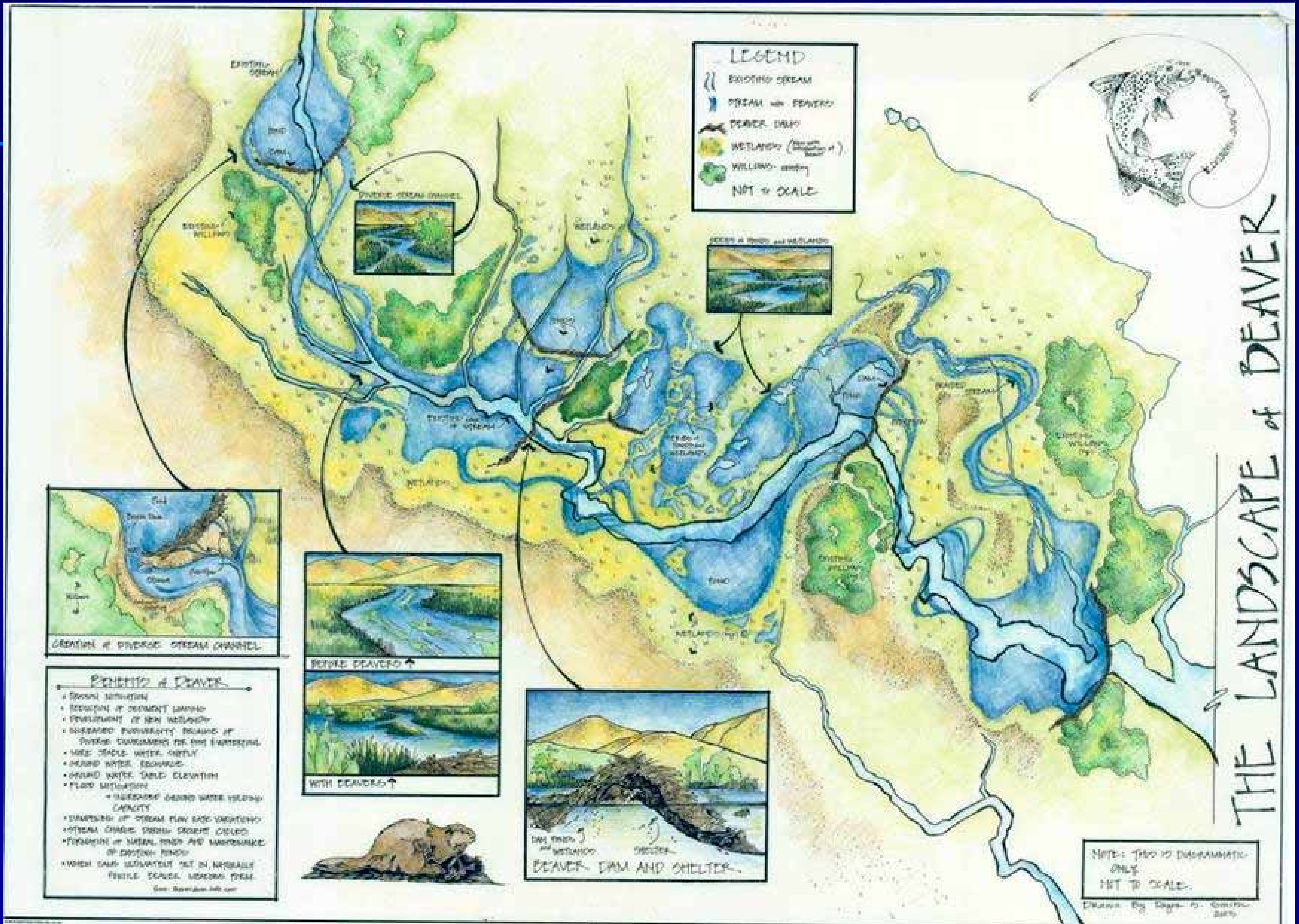
0.25
0.5
0.75
1
Mile
DTM

Historic Impacts

- Riparian
  - Livestock
  - Beaver Trapping
  - Active Clearing

- Channel
  - Sediment loading (agriculture, drainage systems)
  - Hydrology
  - Livestock access

Possible historic influence of beaver in the Silver Creek drainage. The "current" channel is in light blue and the impounded condition represented by the darker blue. (Illustration courtesy of Dayna Smith).



Post- 1970's Management

- Native vegetation restoration
- Riparian fencing
- Bioengineered bank stabilization
- Conversion from flood to sprinkler irrigation, reducing sediment loading

Geomorphology

- Reach Designation
- Backwatering Assessment
- Cross Section Geometry
- Restoration Opportunities

Project Subreaches

Reach 3: Upper Stalker Creek Bridge to Grove Creek

- *Narrow*
- *Gravel Bed*
- *Pool/Riffle*
- *Locally dense woody riparian vegetation*

Reach 2: Grove Creek to Loving Creek

- *Locally overwidened*
- *Deposition of fine sediment on channel margin/Chara beds (overwidened areas)*
- *Fine sediment in bed*




Reach 2

Reach 1: Loving Creek to Kilpatrick Pond ("The S Turns")

- *Backwatered*
- *Variable Width*

Kilpatrick Pond

- *Backwatered*
- *Wide*
- *Shallow*

Purdy Dam

- Constructed in late 1800's
  - Railroad ties and rock
- 40 cfs water right (Kilpatrick Ditch)
- 10 cfs water right (north side RR ranch)

Table 1. Summary of project reach parameters, Purdy Dam to Stalker Creek Bridge.

Reach	***Length (mi)***	***Slope (ft/ft)***	***Sinuosity***	***Mean Discharge***		***Comments***
				2005	2006	
Kilpatrick Pond	0.68	0*	1.09	100	150	Kilpatrick Pond: Inundated channel with no measurable gradient due to extensive infilling of pond. Minor remnant sinuosity; high wetted width
Reach 1	0.32	0.0007	1.41	100	150	Upstream end of Pond to Loving Creek: "S-turn" section, with increased sinuosity and relatively narrow measured cross section.
Reach 2	1.61	0.0007	1.28	80	120	Loving Creek to Grove Creek: Moderate sinuosity, with relatively wide surveyed wetted width
Reach 3	1.25	0.0007	1.6	30	45	Grove Creek to Stalker Creek Bridge: Sinuous reach with relatively small cross section area and mean discharge.

Table 1. Data sources utilized on cross section/profile assessment, Silver Creek.

Reach	Location	Station	Cross Sections	Date	Data Source
Kilpatrick Pond	Upstream end Pond to Dam	11800- 15400	Pond B	1997, 2004	Galena Engineering Inc (2004)
			Pond D		
			Pond F		
			Pond H		
			Pond K		
			Pond M		
			Pond P		
			Pond R		
			Pond T		
			Pond V		
1	Loving Creek to Pond	15400- 17100	T3	2003, 2005, 2006	TNC Monitoring
2	Grove Creek to Loving Creek	17100- 30100	J	2006 (May)	Perrigo (2006)
			K		Perrigo (2006)
			L		Perrigo (2006)
			M		Perrigo (2006)
			N		Perrigo (2006)
			T2	2003, 2005, 2006	TNC Monitoring
3	Mud Creek to Grove Creek	30100- 32200	C	2006 (May)	Perrigo (2006)
			I		Perrigo (2006)
			T3	2003, 2005, 2006	TNC Monitoring

Table 1. Vertical correlation of survey datasets, Silver Creek

Data Source	*Datum*	*Adjustment*
Galena (2004) Pond Survey	Local benchmark with assumed elevation	None
Perrigo (2006)	Local “reference points” with assumed elevation	Adjusted 4.5 feet vertically to match Galena profile
This Effort	High Water Mark at pond	Surveyed high water mark adjusted to match pond elevation in Galena Survey

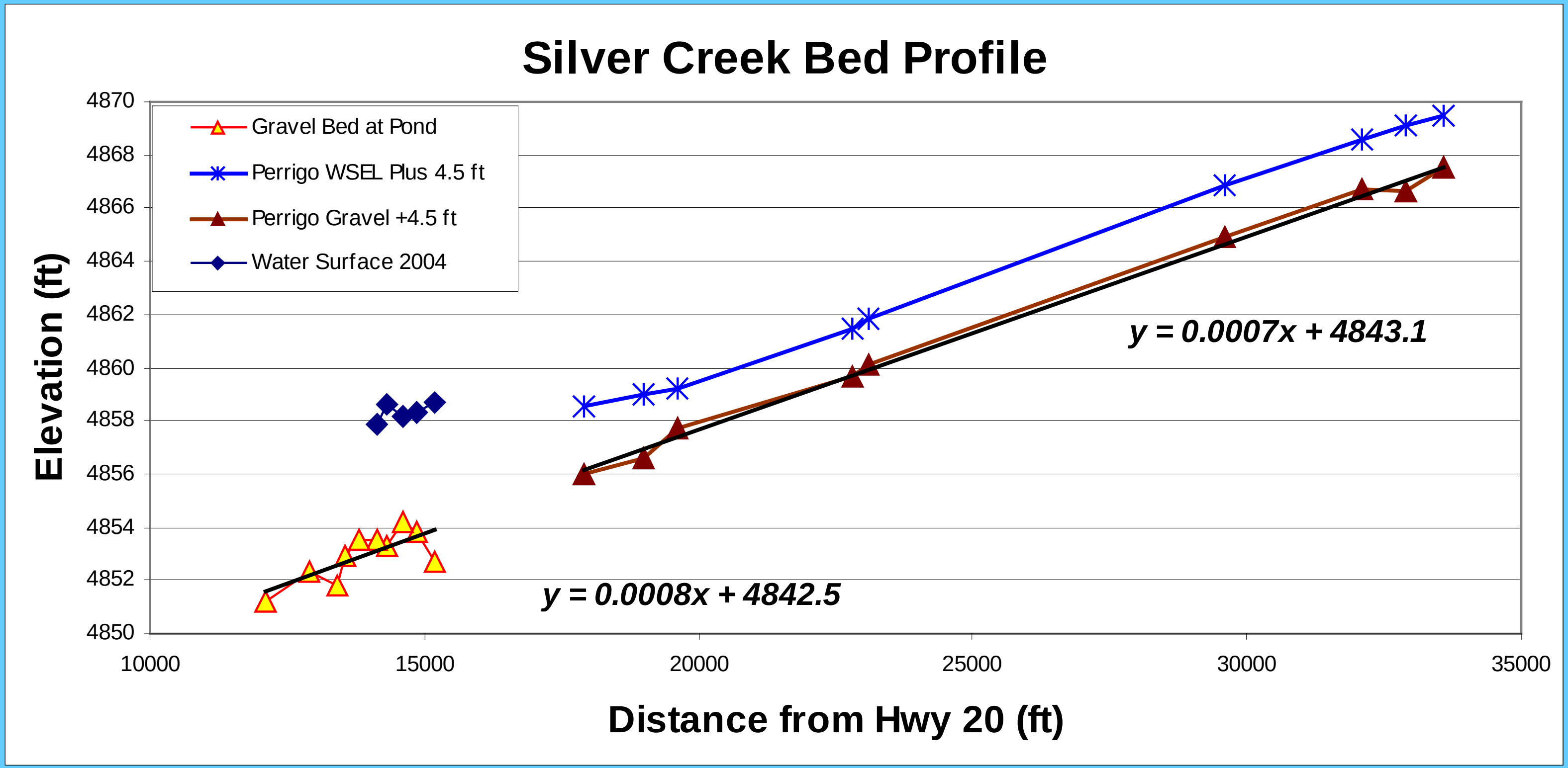


Figure 1. Constructed Silver Creek bed profile based on Galena (2004) pond survey and vertically adjusted Perrigo (2006) channel data.

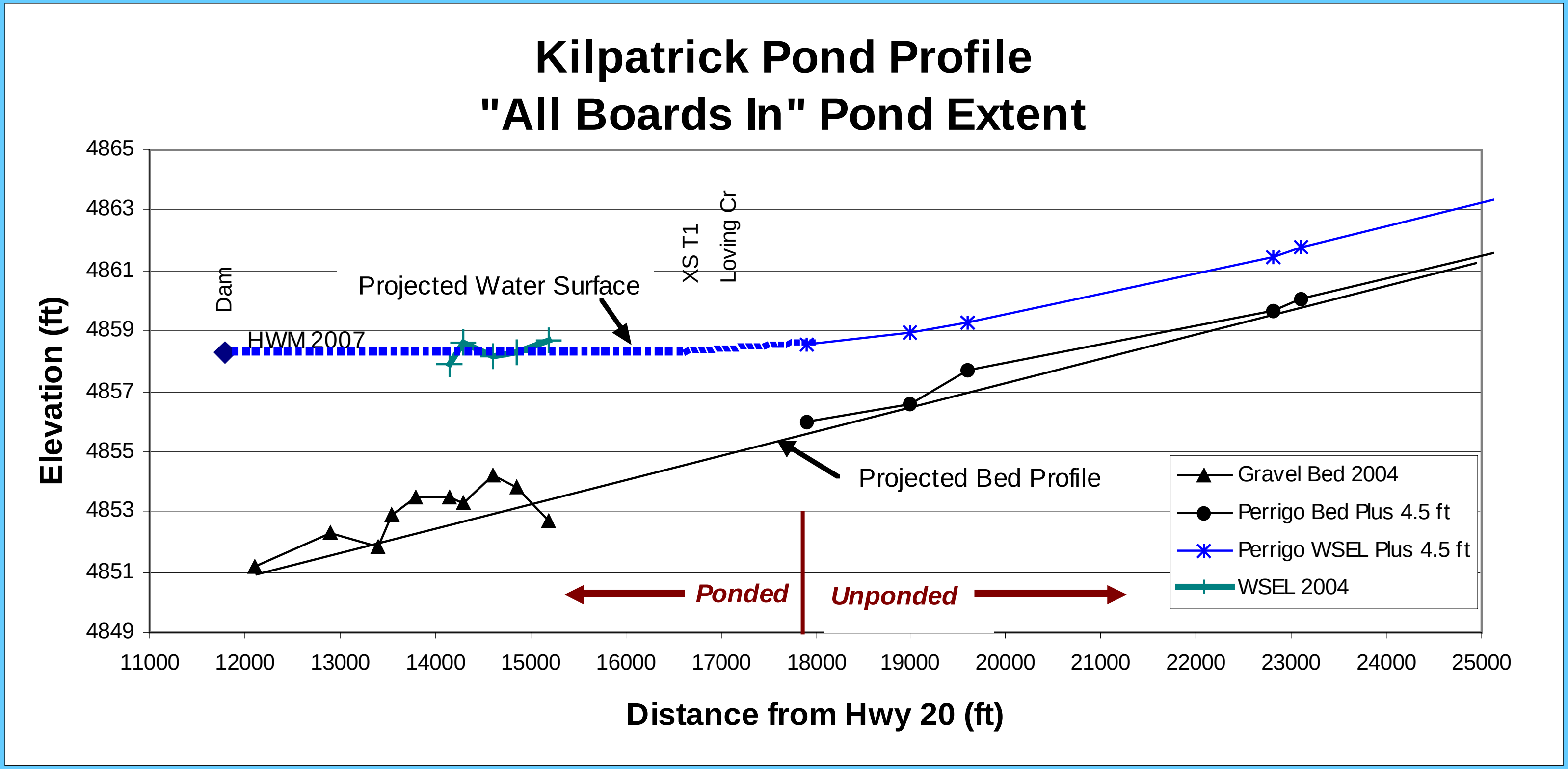


Figure 1. Projected water surface profile of Kilpatrick Pond showing backwatering to area around Loving Creek under "Boards In" scenario. "WSEL" refers to Water Surface Elevation; "HWM" is High Water Mark".

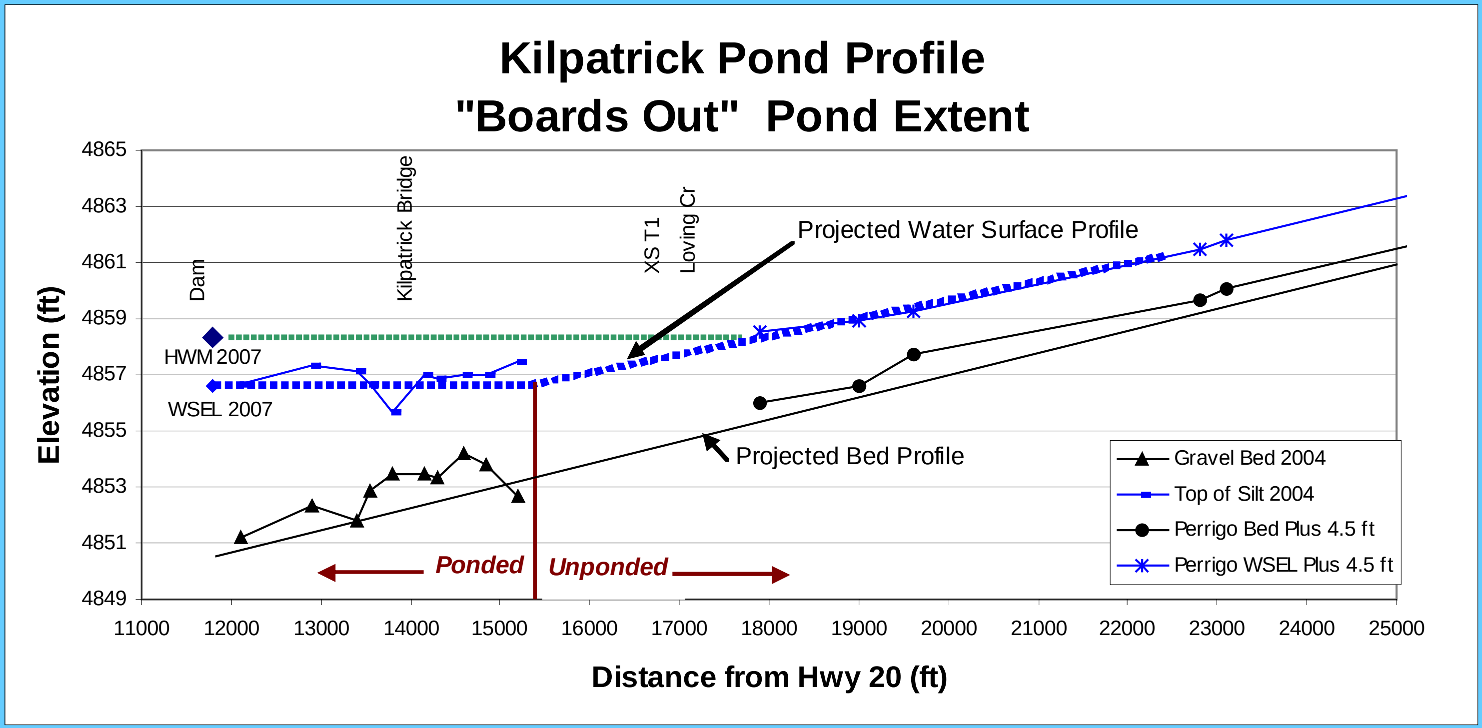
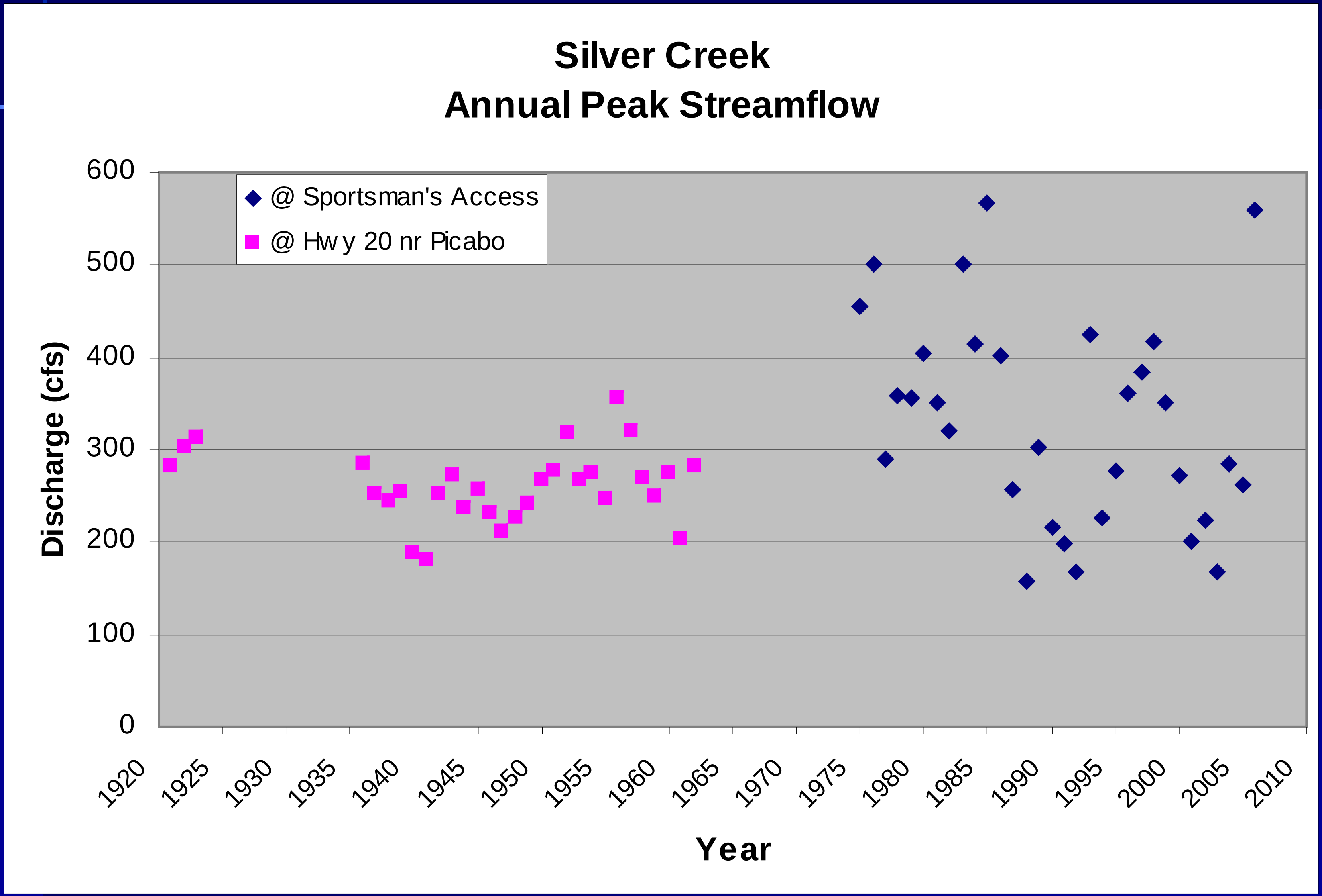


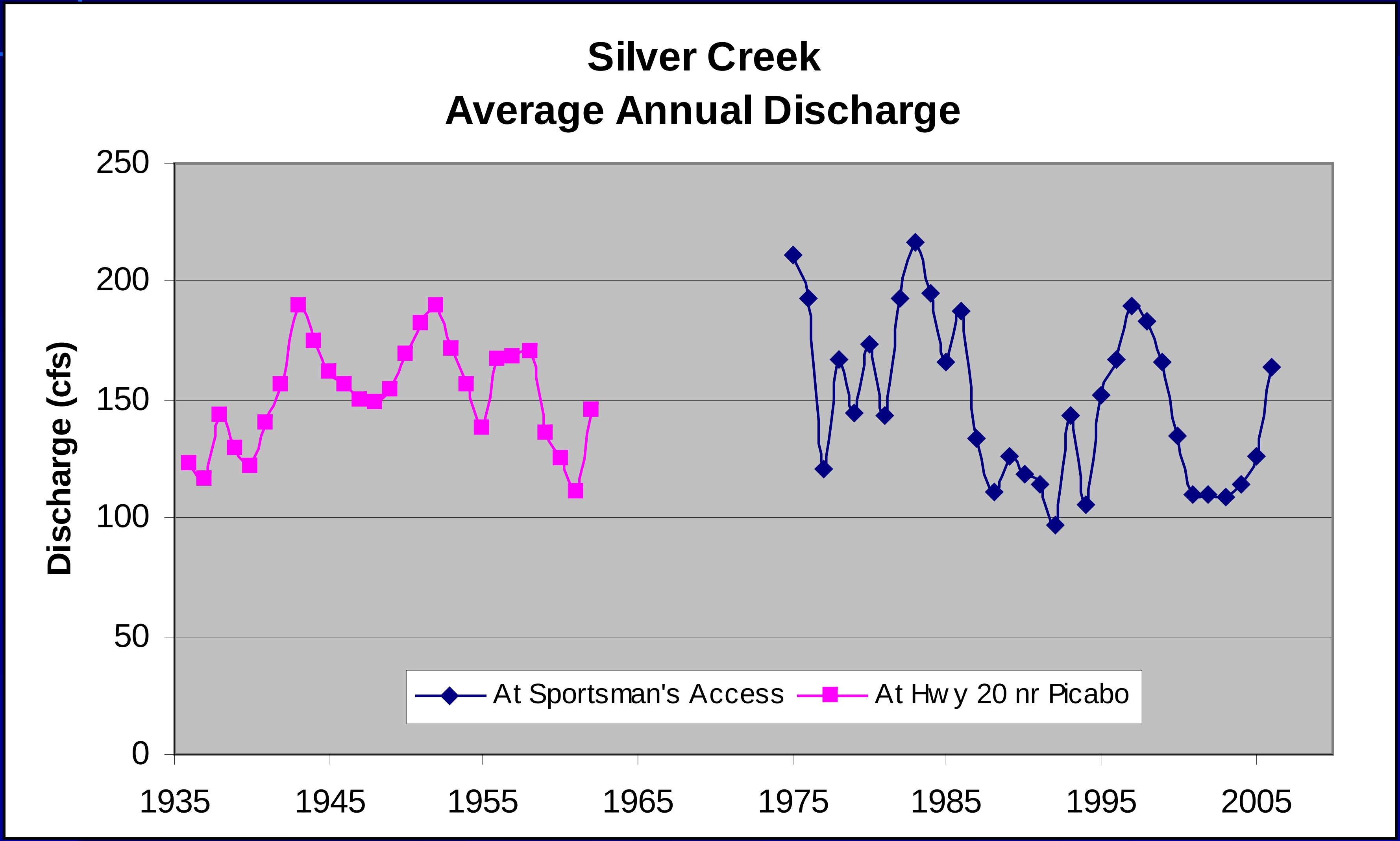
Figure 1. Projected water surface profiles of Kilpatrick Pond showing backwatering to area near Station 155+00 under current "Boards Out" scenario.

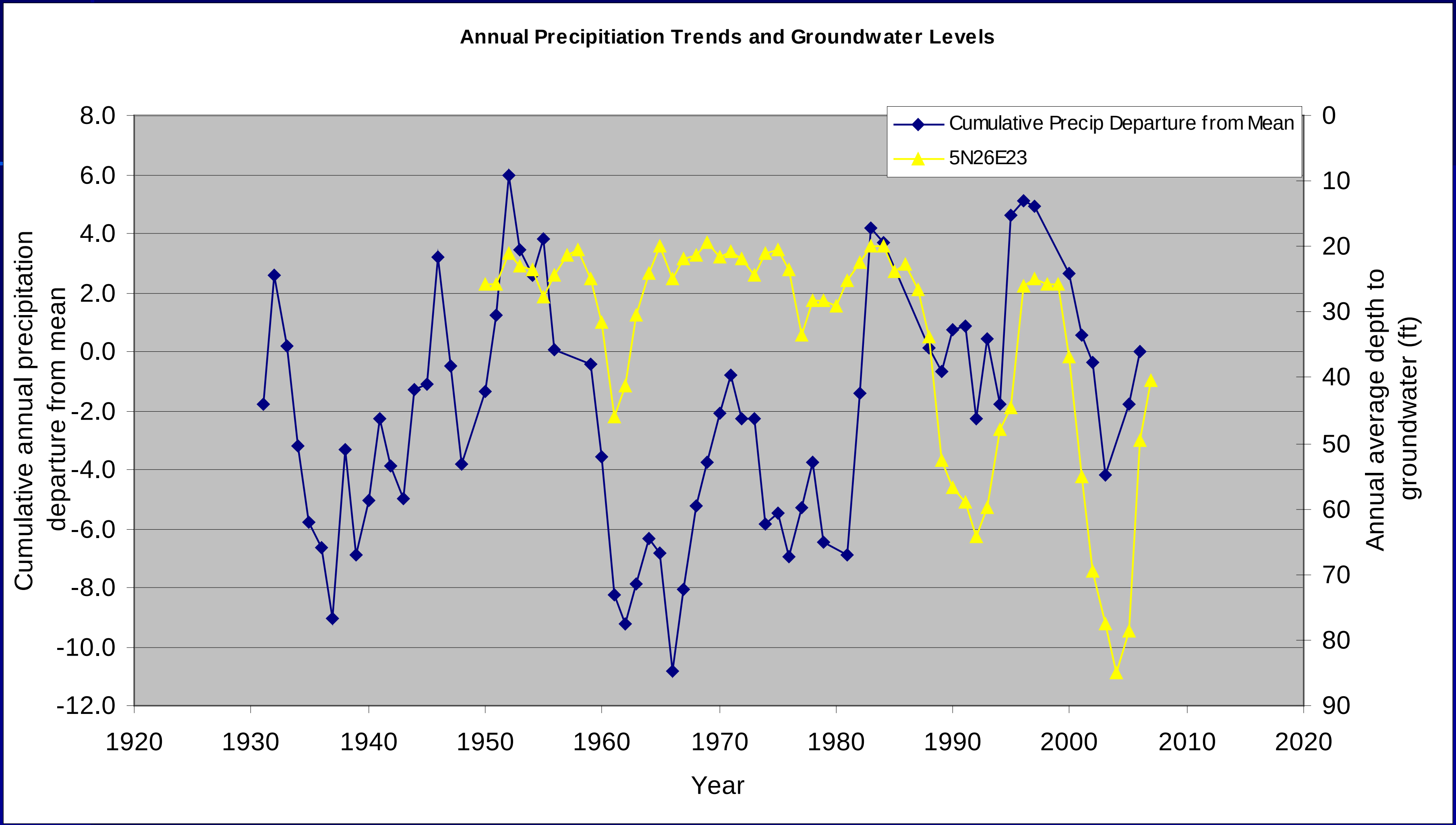
Peak streamflow measurements at USGS gaging sites on Silver Creek, Idaho



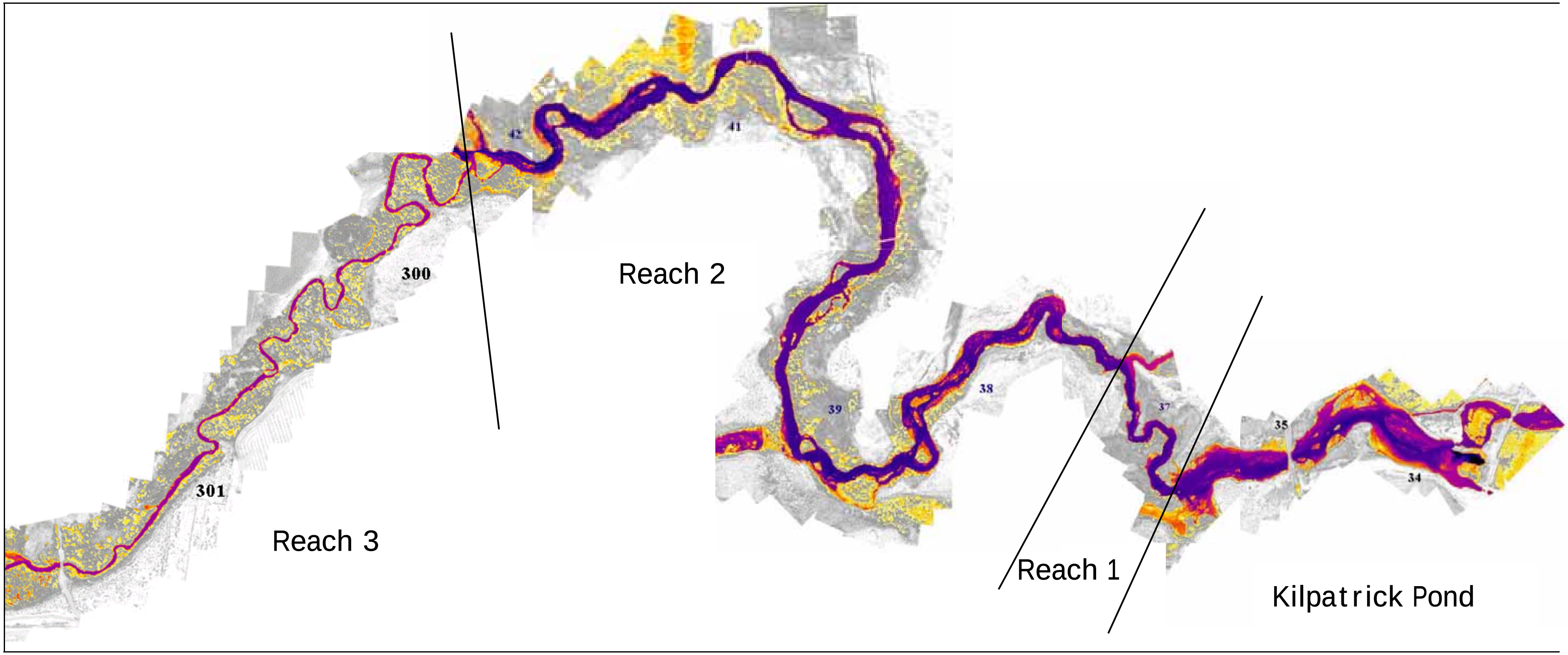
Even spring creeks flood

Average annual discharge for Silver Creek period of record at USGS gaging sites

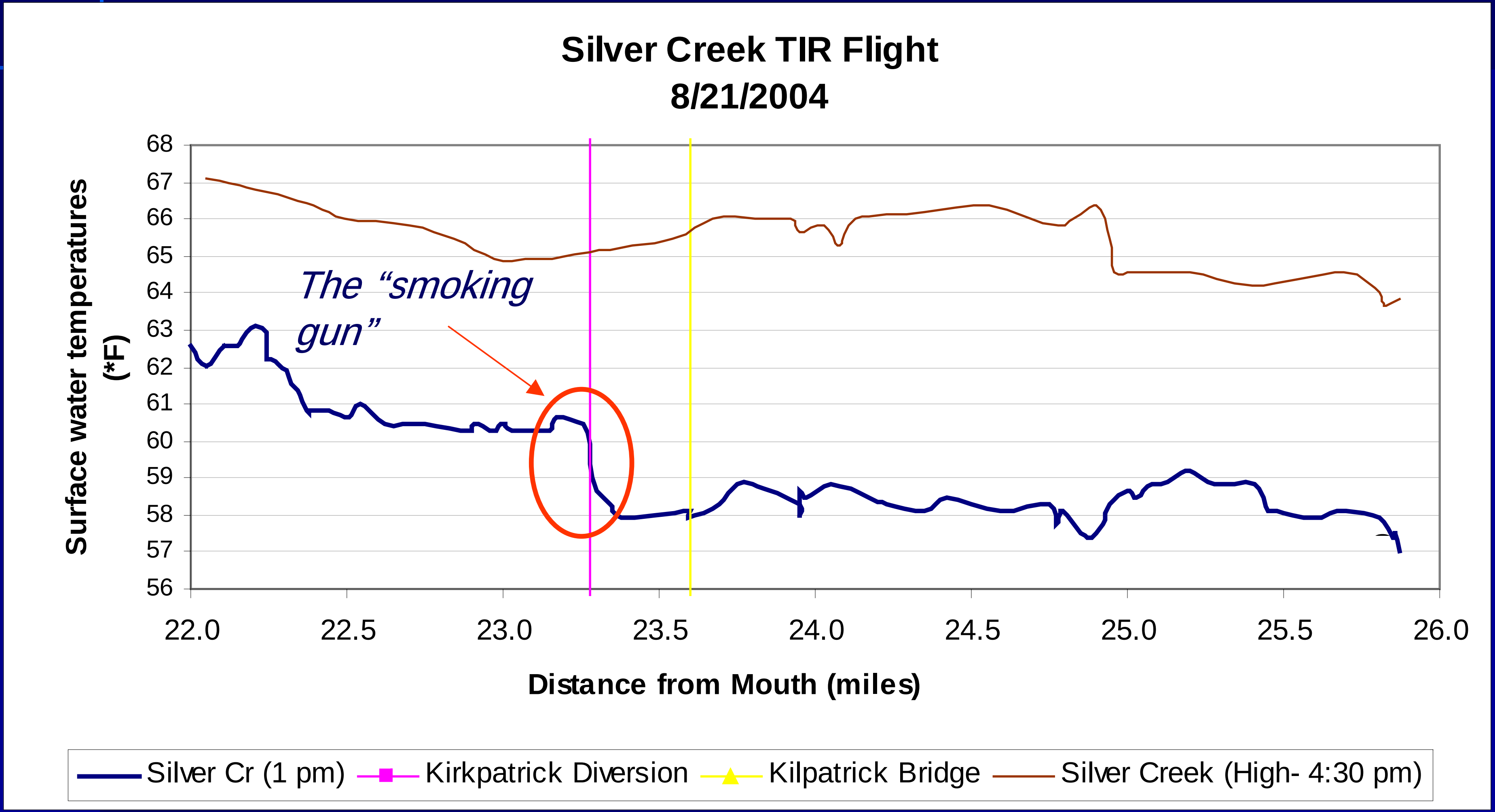



Annual Precipitiation Trends and Groundwater Levels
Cumulative Precip Departure from Mean
5N26E23
Cumulative annual precipitation departure from mean
Annual average depth to groundwater (ft)
Year
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
0
10
20
30
40
50
60
70
80
90
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

Composite map of TIR study area. Yellow and red represent warmer temperatures and blue/violet cooler temperatures.

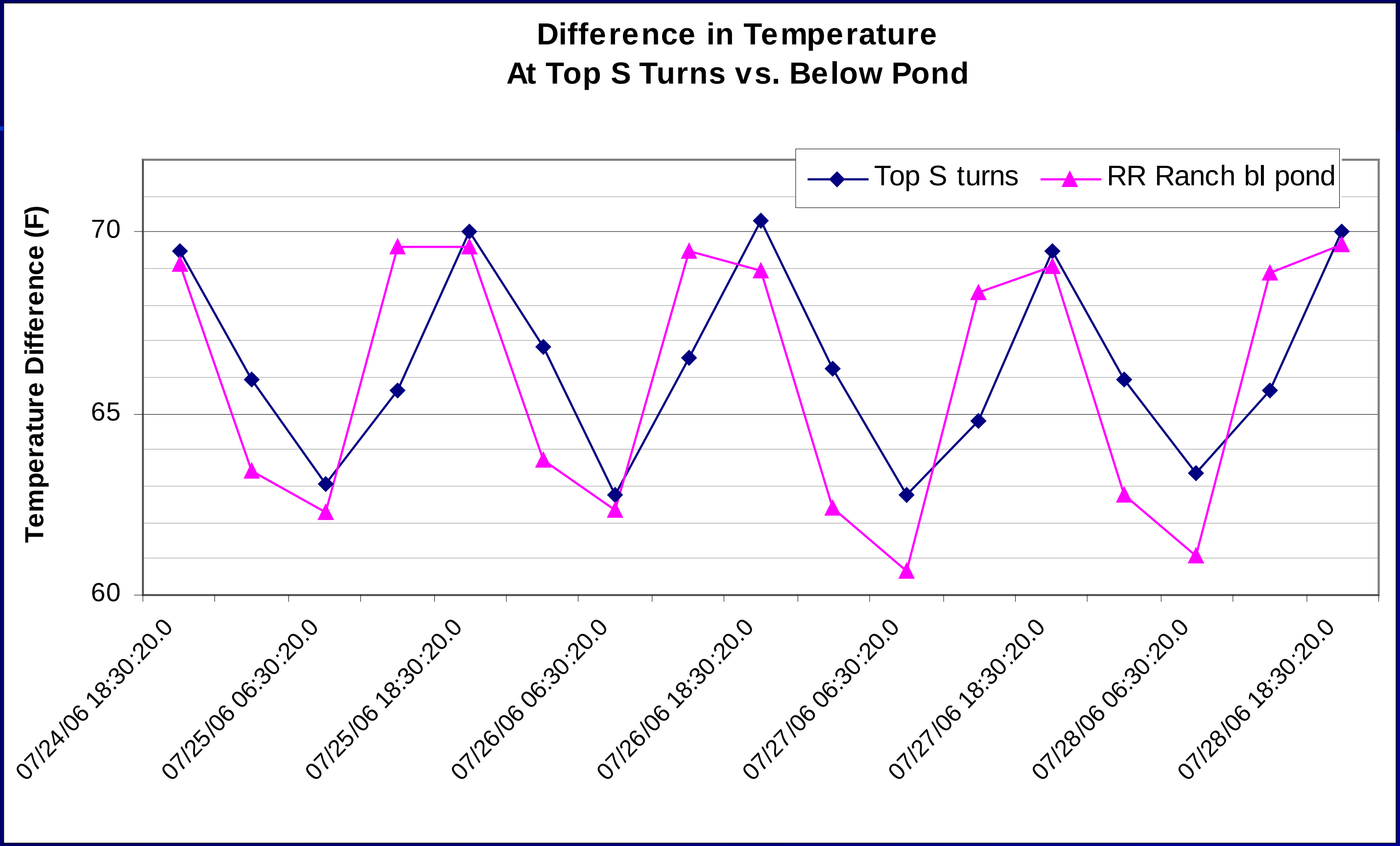


TIR temperatures at 1 pm and 4:30 pm August 21, 2004



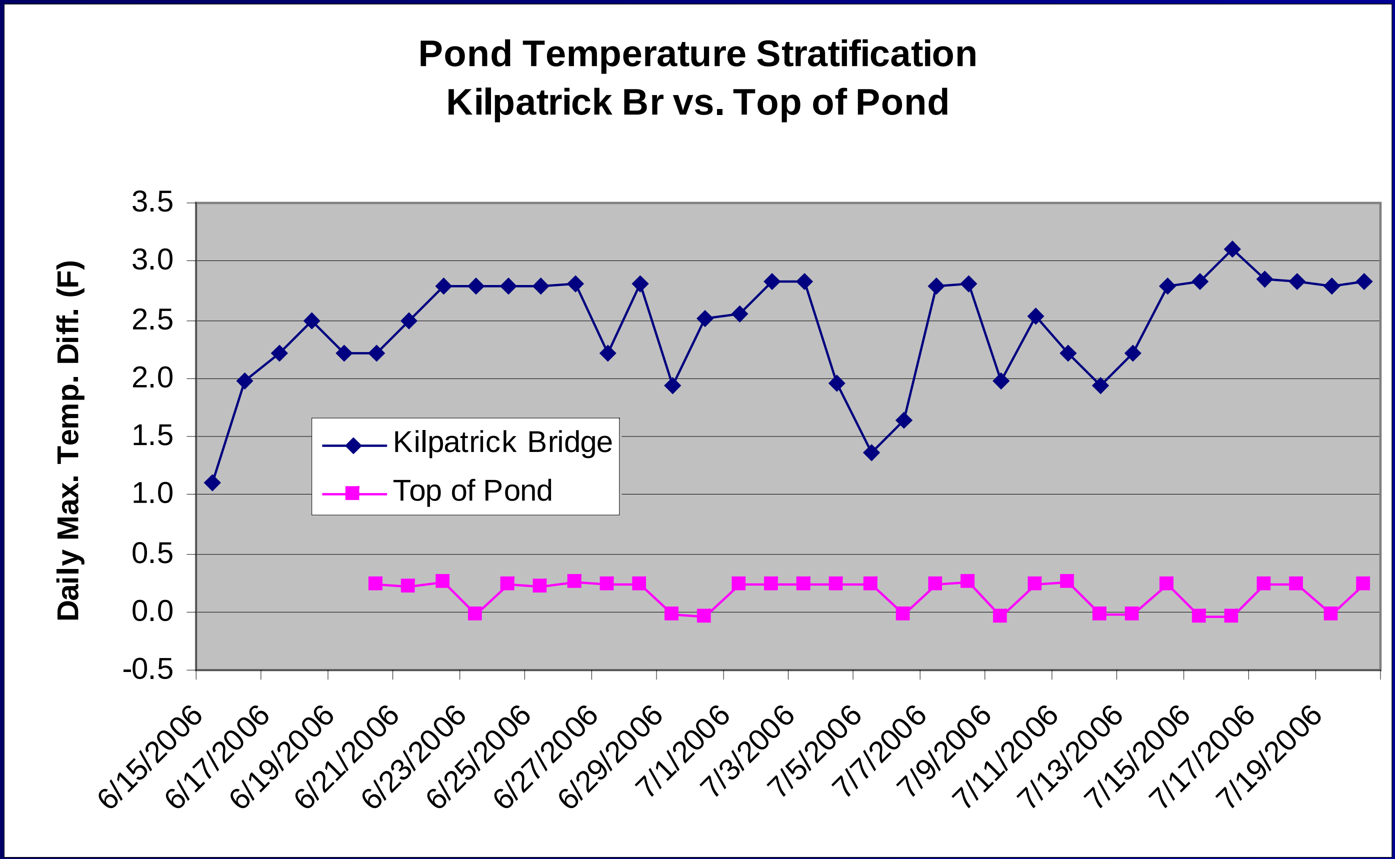
Locations of temperature data loggers

Are their other thermal impacts due to the pond?



The pond is reaching maximum daily temperature 6 hours before the rest of the creek.

Is the pond stratifying?



The pond is stratifying but complete data is limited to measure the full extent and persistence of this downstream to the dam.

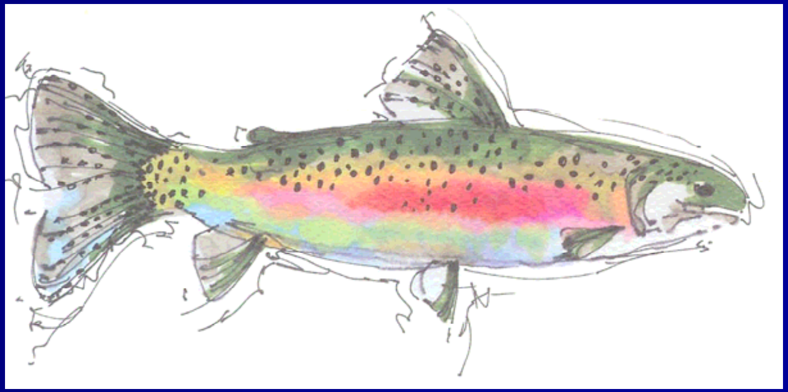
Trout Fishery

- Quantitative data suggests a robust trout fishery but...
- Methods of data collection have limited the use of the data for any significant trend analysis.
- The ability exists to start trend analysis with future sampling.

Qualitative Fisheries Information

- "This is a beautiful stream..., and so full of Trout that they can hardly swim. We caught as many as we wanted of them."

- Oregon Trail Pioneer, 1854



Angling success = trout populations?

- Since 1947 to present, Silver Creek managers, guides and professional observers have noted that the fishery varies CONSIDERABLY in terms of catch-rate year-to-year.
- There is no way to link angling success over the years to changes in fish populations.

Trout Habitat History

- Noted decline in “apparent” quality of fish habitat due to SILT since at least the early 1950’s.
- Silt impacts: decrease in water depth, decrease in spawning habitat; increase in thermal gain; increase chemical oxygen demand; decreased aquatic insect diversity; increased turbidity.

Fish Habitat Under Potential?

- Silt is obviously widely distributed through Silver Creek, the pond and tributaries and it is not a natural condition.

- Silver Creek is therefore under-potential due to obvious silt impairments.
- Thermal impairments are also apparent.

Aquatic Plants and Insects

- Aquatic insect diversity declines in downstream direction – still no good metrics.
- Aquatic vegetation clearly plays a complicated role in the ecosystem.

Is the Fishery at Risk?

- Whirling disease
- Thermal degradation
- Dissolved oxygen
- New Zeland mudsnails.

Due to existing impairments the system is less robust and may be prone to environmental stressors.

A stakeholder weighs in…

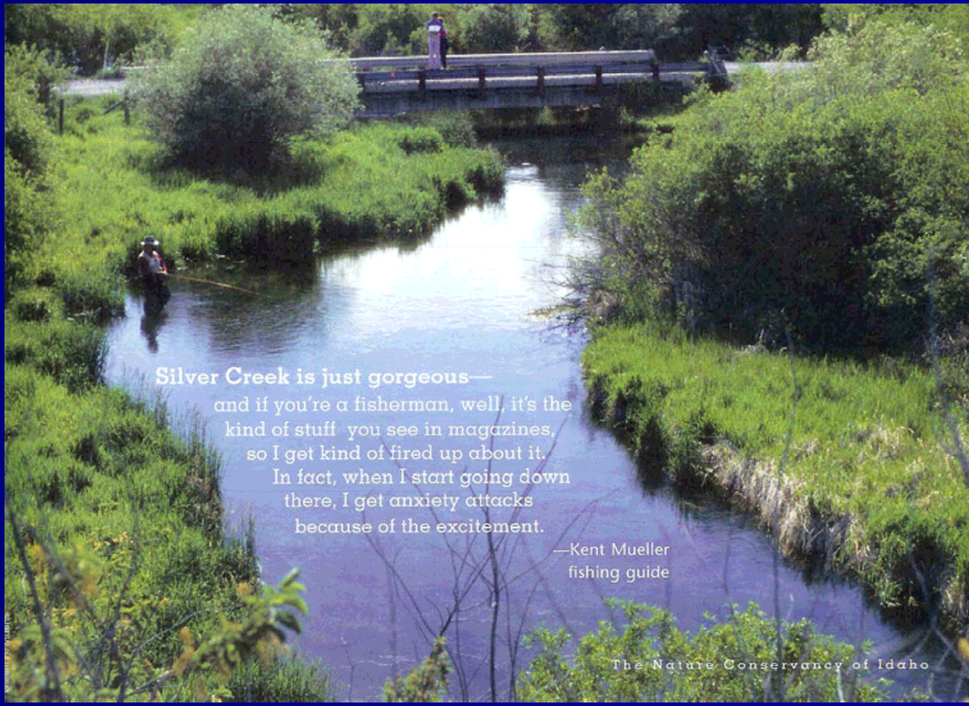
- **Drought**
- **From:** Ketchum resident
  Category: General
  Date: 02/05/2007
  Time: 06:29 PM
- **Comments**
- How will the low water year we will be facing this year factor into the Legacy Project and Silver Creek?

Riparian Conditions

- NRCS (1996) considered Silver Creek seriously under-potential
  - Only 33% of tributaries with adequate cover.
  - Only 10% of mainstem Silver Creek with adequate cover.

Riparian Function

- Shading in summer
- Maintenance of higher temperatures during winter
- Overhead cover
- Platforms for insects
- Bank structure and roughness



Alternatives Analysis

- Discontinuity of sediment transport
- Channel width:depth ratio unfavorable for sediment transport
- Pond is responsible for above background thermal warming
- Natural flow of biota up- and downstream is altered
- Chemical and biological nutrient processing is altered

Guiding Image

- “Implement a project on Kilpatrick Pond that results in measurable improvement in ecological functionality that includes: a reduction in the rate of thermal gain through the pond and impacts to downstream warming; improvement in sediment transport continuity; improvement to connectivity of the impounded environment with downstream reaches (more natural flow of nutrients and biota)”.

Restoration or Enhancement?

- The only true restoration option is the removal of the dam and re-building the channel.
- There are several enhancement alternatives that address some impairments but maintain the recreational and aesthetic value of the pond.

Constraints

- Value of pond
- Irrigation deliveries need to be maintained
- No unmitigated downstream impacts
- Must be permitable
- Cultural – many stakeholders OK with existing situation, others have strong opinions about a fix
- Financial

Constraints

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Strategies Considered

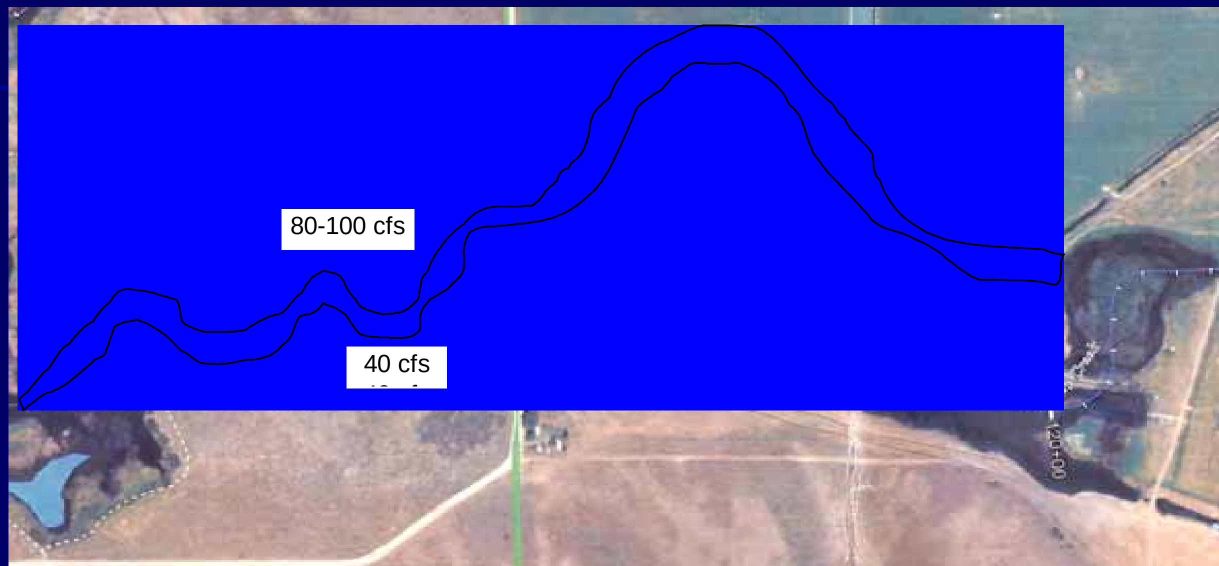
- Dam and pond removal
- Dam alteration
- Sediment removal behind dam
- Pond by-pass channel
- Fish by-pass channel
- Revegetation of pond sediments
- No action

From Savesilver Creek Forum

- **Over Time**
- **From:** In the Creek for 30 years
  Category: Improvements
  Date: 02 Mar 2006
  Time: 12:12:06 -0500

- **Comments**
- Silt. It seems that it silt will always be a problem in Silver Creek. I remember when the Purdy Pond area had 1/2 the silt that it now has and the Conservancy had twice as much silt in it as it has now. Seems the silt has progressed downstream over time from fishermen wading in the Conservancy and has become trapped in the Pond. Seems to me that if Silt where removed from the pond, this man-made problem of Silt would be alleviated for quite some time. Then we can concentrate on the Silt problem downstream of the Pond that is sure to accumulate due to the fact that Silt cannot be trapped in the Pond anymore because there is so much Silt in it that it has no where to go but downstream. Get rid of Silt. Enough talk, studies and speculation, it is time to be pro-active and remove the problem man created.

Alternatives Discarded



- Alternative 3. Build new channel around pond, divert minimum flow through existing pond.
  – Questions about the fate of the pond as a fishery with greatly reduced flows.
  – Concerns about thermal loading in pond unaddressed.
  – Very expensive project.

Alternatives Discarded

- Alternative 7. Dredge Pond Sediments
  - Extremely expensive ($600,000+).
  - Does not address thermal gain.
  - Does not improve sediment transport continuity.
  - Impacts to other Preserve values during implementation.

Preferred Alternatives

- Alternative 1&2. Dam Removal and Restoration

  - Ranked highest in ecological benefit.

  - Pond experience is highly valued by stakeholders.

Preferred Alternatives

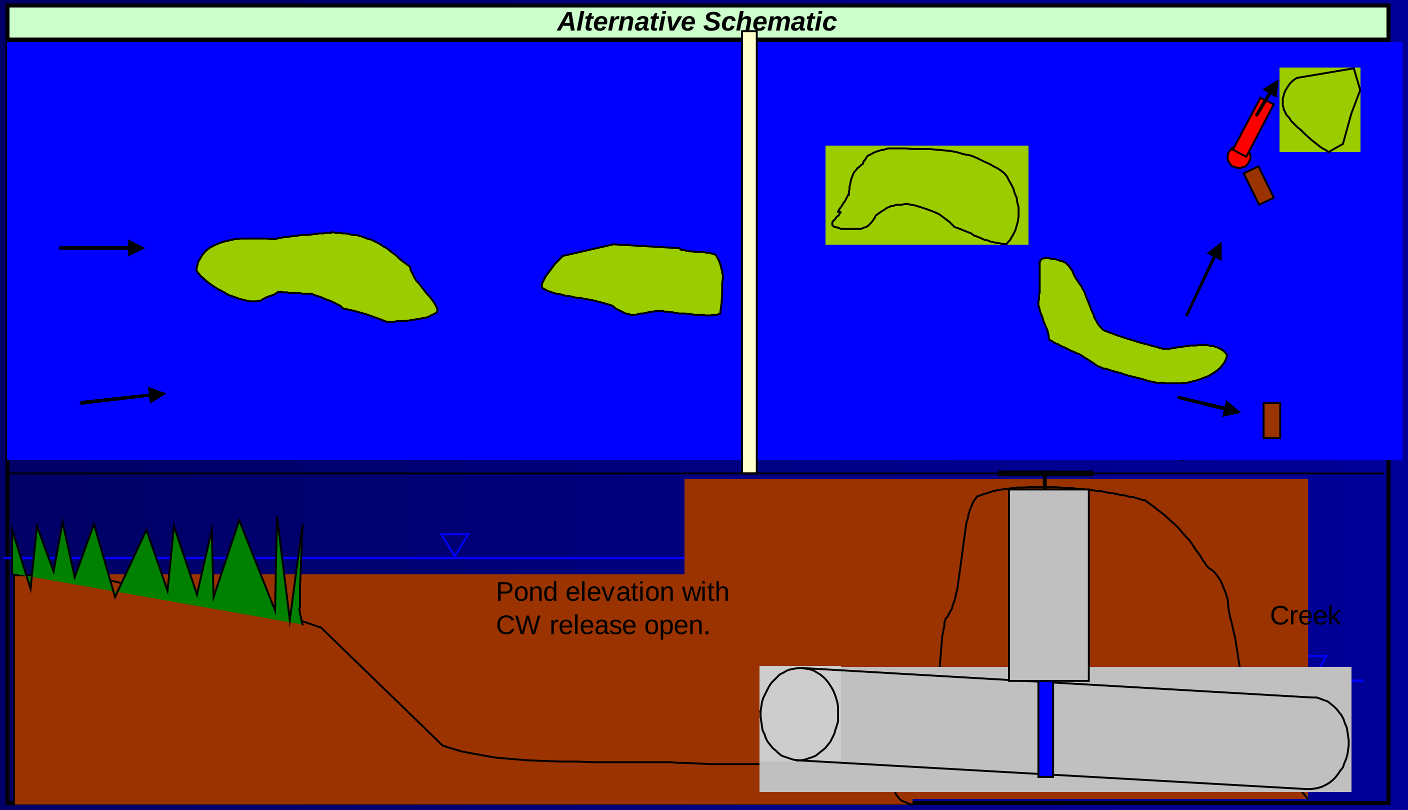
- Alternative 4. Modify Dam/Add Bottom Release Structure
  - Thermal issues at least partly addressed.
  - Sediment transport continuity partly addressed.
  - Maximum flexibility for lowering pond elevation for sediment removal (if desired)

Alternative 4

- Bottom release (150 cfs capacity).
- Hydraulic flushing of sediments behind dam and creation of deep channels.
- Fate of flushed sediments needs to be addressed.

New bottom release structure here

Alternative Schematic



Sediment Release

- Either one big pulse or staged over a longer period of time.
- Not convinced of a long-term downstream habitat risk but:
  - Pool/run infilling possible
  - Degradation of spawning gravels
  - High turbidity, increase in BOD and COD

Mitigating Risk of Release

- Comprehensive restoration program downstream.
- Encouraging deposition of sediments in lateral, mid-channel and point bars to narrow downstream channel.
- Active and adaptive management of the sediment release.
- Long duration, low intensity releases

Technical Design Elements

- Outlet sized to discharge approx. average annual hydrograph.
- Geotechnical evaluation of existing dam and upstream sediments and topography.
- Civil engineering of structure

Cost:Benefit

- Ecological benefits considered fair.
- Cost: $300,000+
- If pond angling conditions improve (greater depth in pond) overall cost:benefit could be good.

Alternative 5

- Modification of Dam, Lower Minimum Outlet Elevation
  - Allows for lowering pond pool elevation for either mechanical removal of sediments or revegetating sediments.

Technical Design Elements

- Somewhat challenging design and installation scenarios given retro-fit must occur in an active spillway.
- Geotechnical evaluation will be required so work does not destabilize dam.

Cost:Benefit

- Ecological benefits unclear though it would allow for easier removal of some impounded sediments.
- Cost: $65,000+
- Cost:Benefit is neutral unless revegetation of pond sediments proved beneficial.

Alternative 8

- Revegetation of Exposed Sediments
  - With pond in lowered condition, plant emergent vegetation on exposed sediments.
  - Establishment may be challenging
  - Recommend a phased/trial approach

Naturally Vegetated Silt Deposits

Cost:Benefits

- Possible but unpredictable reduction in thermal gain in the pond.
- Possible improvement in angling habitat (scour channels on vegetative edges).
- Improvement in waterfowl habitat.
- Cost: $80,000/acre
- Cost:benefit open to discussion.

No Action Alternative

- Considered to be valid given likely cost:benefits of other alternatives.
- The fishery is still robust.
- Consequences of no action could include stakeholder concerns and inability to reduce system stress at a future date.

Appendix D

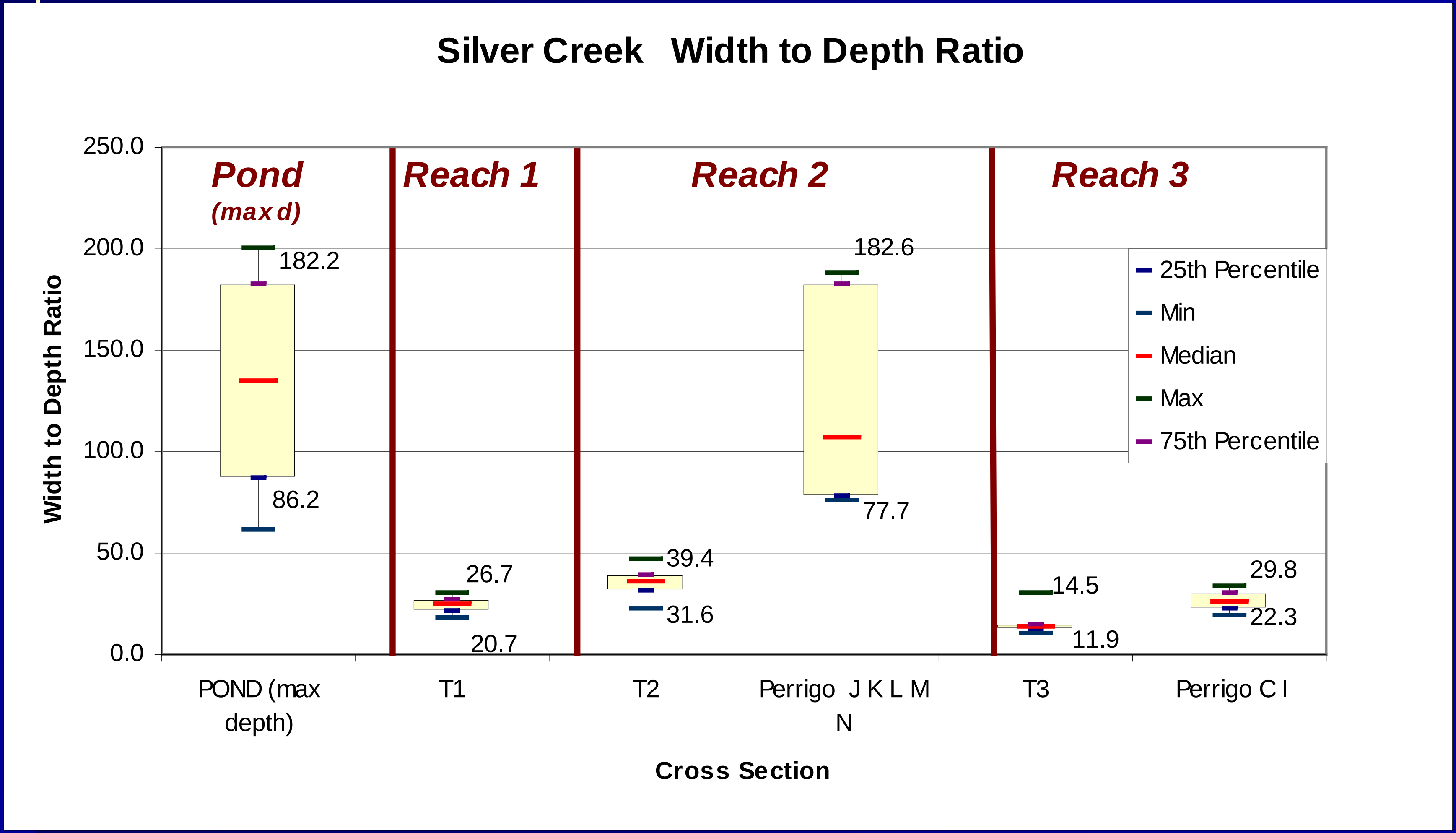
- Systemic Evaluation, Prioritization and Restoration
  - Acknowledges known impairments and decades of sporadic stream project work in the watershed (shows need).
  - Evaluate restoration needs in entire watershed (minimum area approx 30 stream miles)
  - Prioritize restoration reaches and implement

Table 1. Cross section data and associated N values used in morphologic assessment

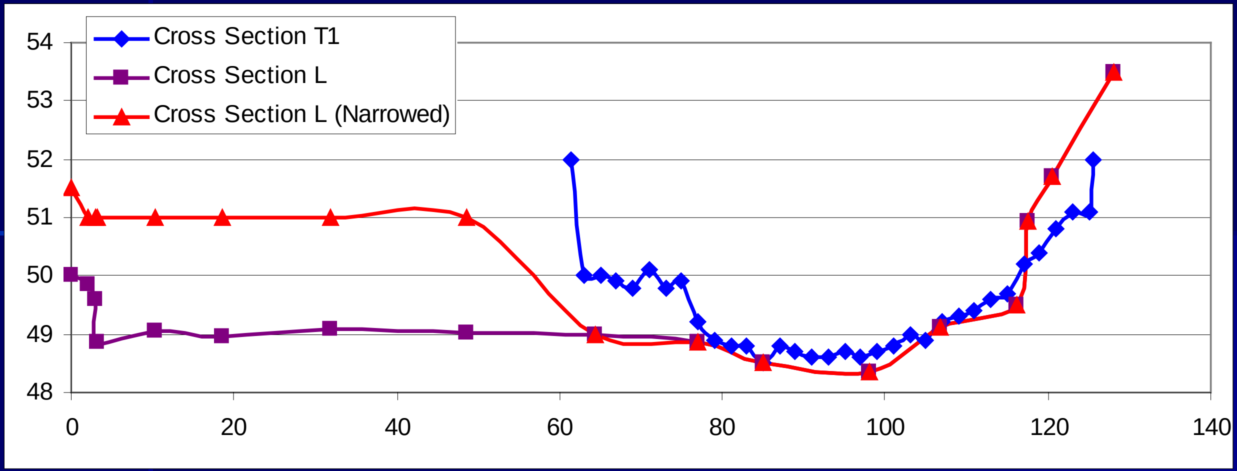
Data Source	***Type of Data***	***Reach***	***N value***
Galena (2004)	Pond Survey	Kilpatrick Pond	8 (2004)
TNC Monitoring Point T1	Discharge Measurements	1	25 flow measurements 2005-2006
TNC Monitoring Point T2	Discharge Measurements	2	18 flow measurements 2005-2006
Perrigo (2006)	Channel Cross Section Survey	2	5 (May 2006)
TNC Monitoring Point T3	Discharge Measurements	3	19 flow measurements 2005-2006
Perrigo (2006)	Channel Cross Section Survey	3	2 (May 2006)

Examples of varying channel width on Silver Creek

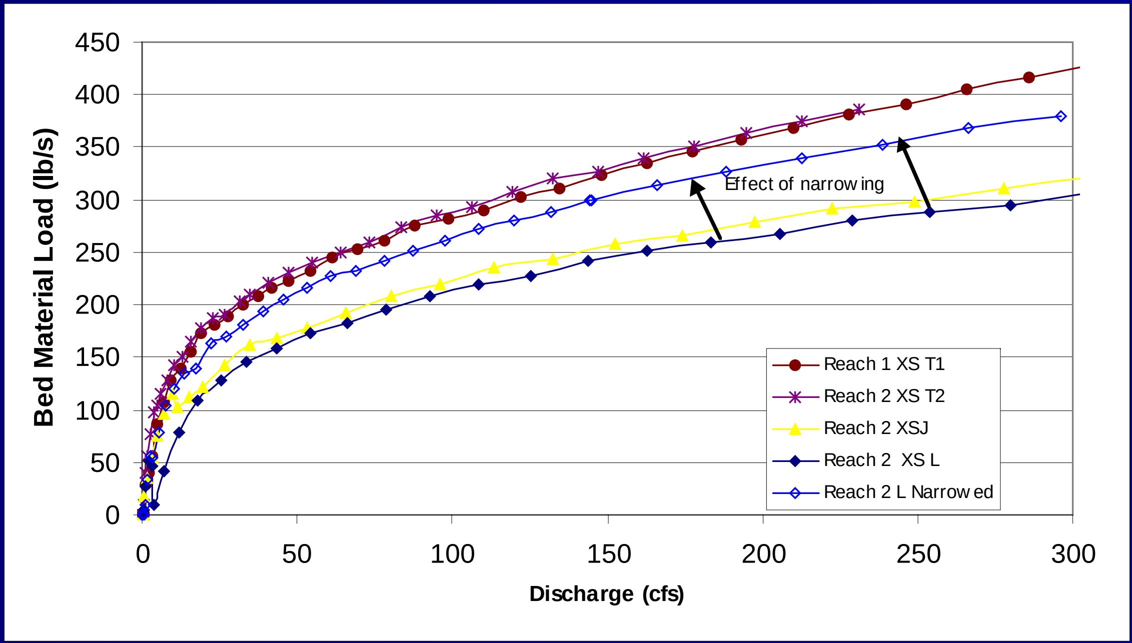
Measured wetted width to depth ratios, Kilpatrick Pond and Silver Creek; 25th and 75th percentile values are labeled.



Modified (narrowed) Cross Section L, shown in comparison to existing Cross Sections L and T1.



Bedload discharge rating curves showing effects of Cross Section L narrowing on transport competency.



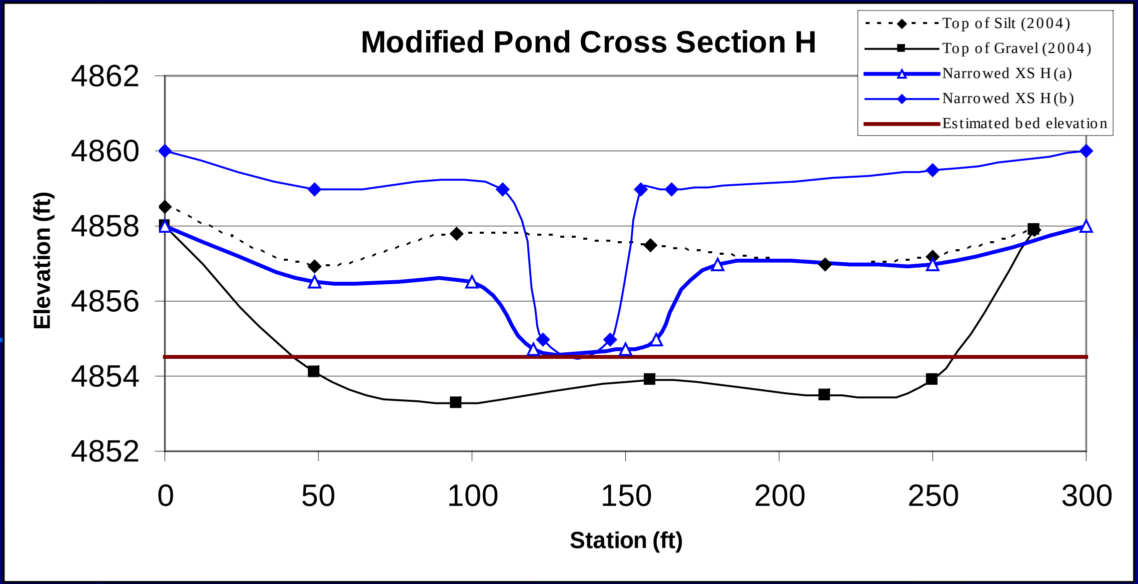


Figure 30. Plotted cross sections for existing and two narrowed configurations, Cross Section H in Kilpatrick Pond.

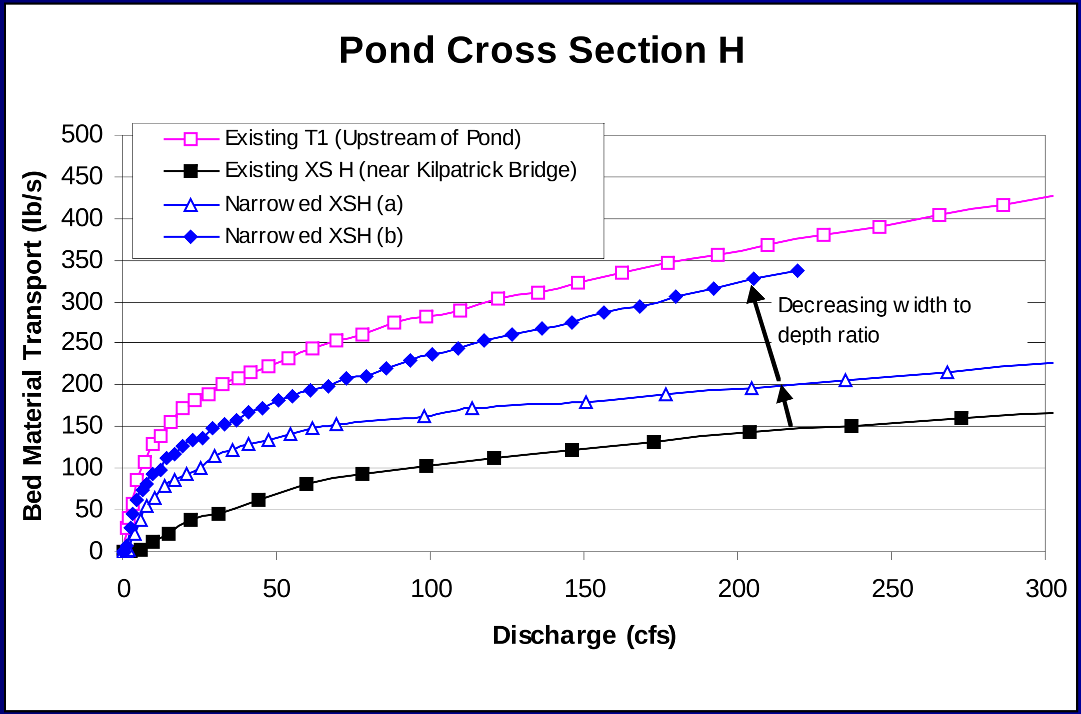


Figure 31. Bed material load rating curves for existing and narrowed XS H, and existing XS T1 located upstream of pond.

Implementation

- Riparian, stream habitat and geomorphic assessment. Will need a new method for habitat mapping.
- On-going monitoring programs expanded (temperature, spawning, aquatic vegetation trends, aquatic insects).

Prioritization

- Will ultimately rely on careful field observation and professional and management judgments.
- Top of the watershed down, or most degraded reaches first?

Restoration Thoughts

- Adjusting channel width:depth ratios to transport sediment will likely be major driver.
- Riparian planting techniques well developed.
- Techniques for doing in-channel work may require working with agencies to develop more cost-effective approaches than have been utilized to-date.

Restoration Example

Before

After

Fox Creek, Idaho, 2006 – Channel narrowed by excavator building sob banks and barbs operating within the channel banks ($15/ft)

Conceptual Program Costs

- Watershed Assessment/Preliminary Alternatives:$60-70,000
- Restoration Design and Permitting – depends on project size.
- Tributary restoration work: $15-20/ft.
- Silver Creek Mainstem: $20-40/ft

THANKS FOR YOUR TIME!

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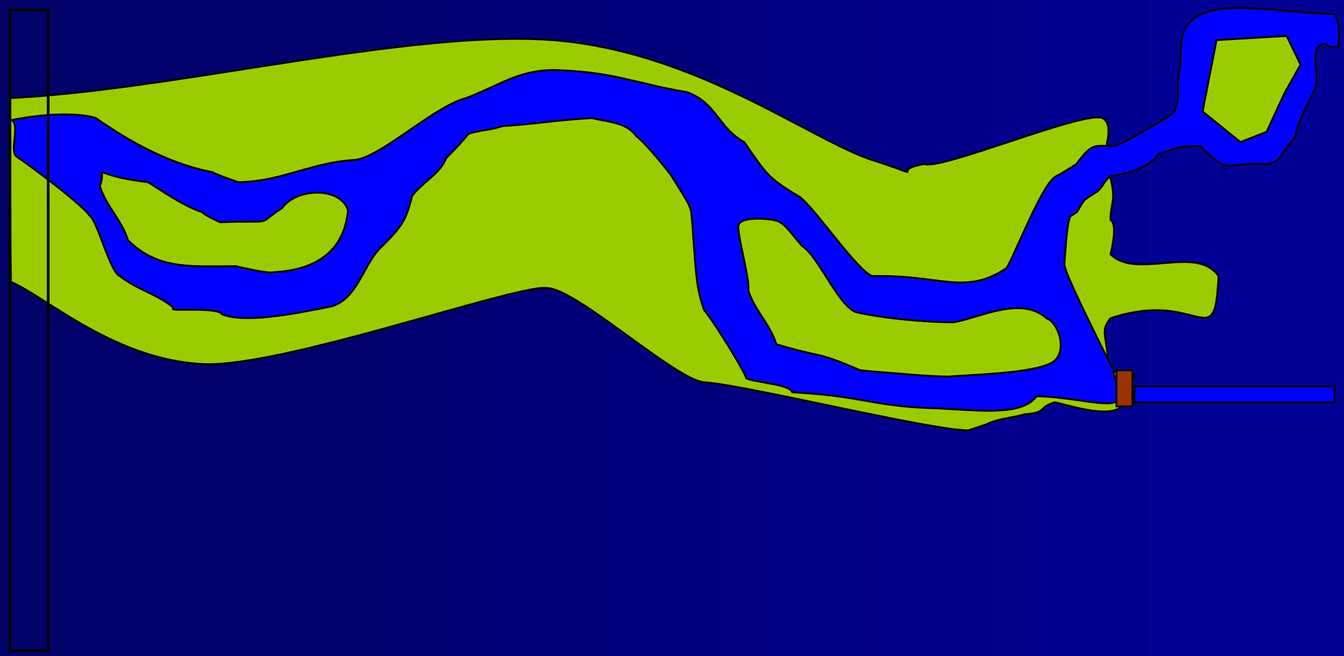
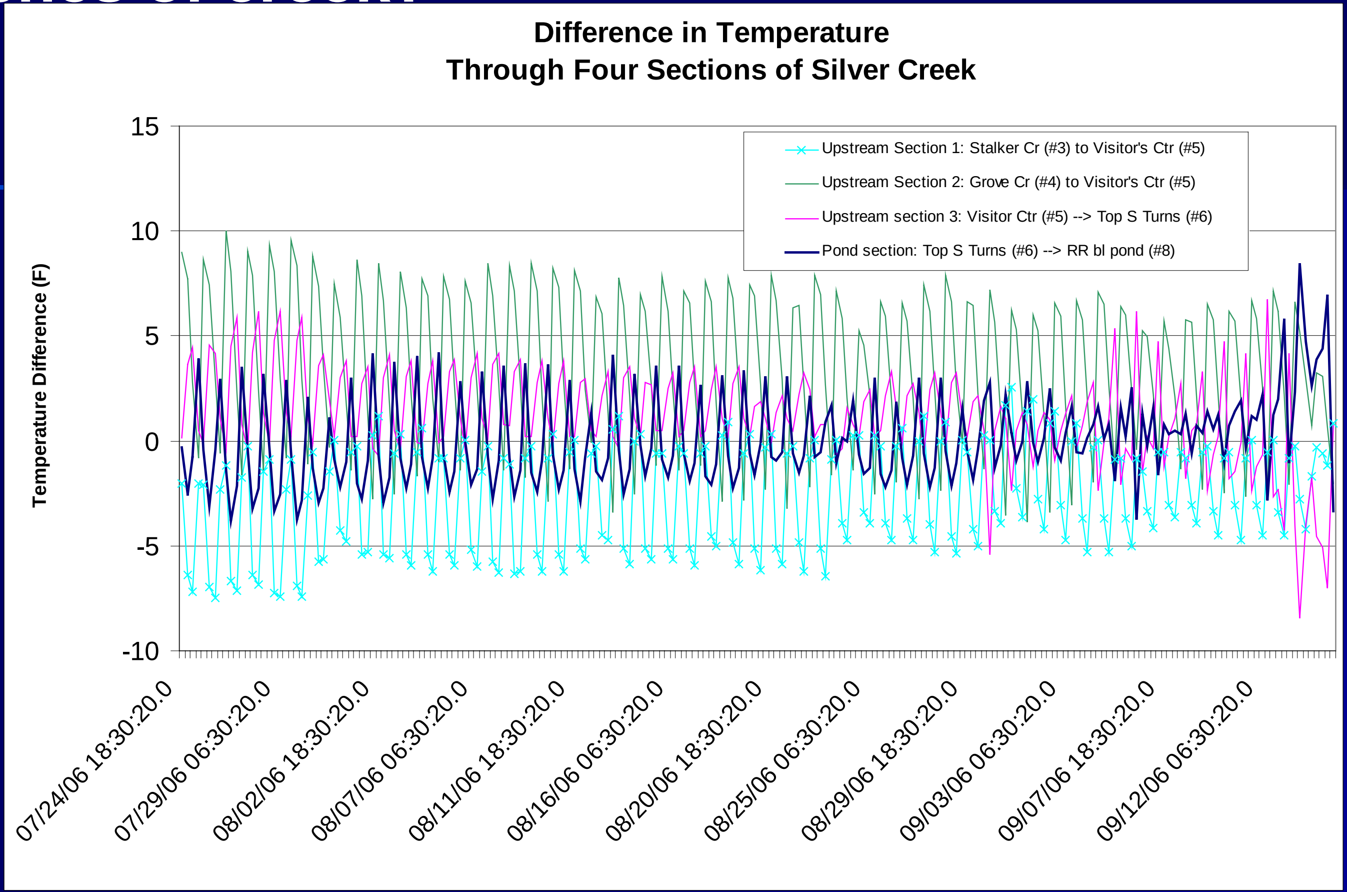
Full Restoration




Dan Armitage

Is warming through the pond higher than other reaches of creek?



Inconclusive, downstream warming trends are very complex!