Last Updated: June 2018

Colorado Water Conservation Board

Water Plan Grant Application

Instructions

To receive funding for a Water Plan Grant, applicant must demonstrate how the project, activity, or process (collectively referred to as "project") funded by the CWCB will help meet the measurable objectives and critical actions in the Water Plan. Grant guidelines are available on the CWCB website.

If you have questions, please contact CWCB at (303) 866-3441 or email the following staff to assist you with applications in the following areas:

Water Storage Projects	Anna.Mauss@state.co.us
Conservation, Land Use Planning	Kevin.Reidy@state.co.us
Engagement & Innovation Activities	Ben.Wade@state.co.us
Agricultural Projects	Alexander.Funk@state.co.us
Environmental & Recreation Projects	Chris.Sturm@state.co.us

FINAL SUBMISSION: Submit all application materials in one email to *waterplan.grants@state.co.us* in the original file formats [Application (word); Statement of Work (word); Budget/Schedule (excel)]. Please do not combine documents. In the subject line, please include the funding category and name of the project.

Water Project Summary

Name of Applicant	Colorado Open Lands
Name of Water Project	Riparian Reconnect Project Implementation

CWP Grant Request Amount	$ 84,290
Other Funding Sources: Park County Land & Water Trust Fund	$ 106,798
Other Funding Sources: Participating Landowners	$ 73,600
Other Funding Sources: EcoMetrics (in-kind)	$ 6,000
Applicant Funding Contribution	$ 0
Total Project Cost	$ 270,688

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Applicant & Grantee Information
Name of Grantee(s): Colorado Open Lands
Mailing Address: 1546 Cole Blvd #200, Lakewood, CO 80228
FEIN: 84-0866211
Organization Contact: Cheryl Cufre
Position/Title: Director of Land Stewardship
Email: ccufre@coloradoopenlands.org
Phone: 303-988-2373 x 219
Grant Management Contact : Cheryl Cufre
Position/Title: Director of Land Stewardship
Email: ccufre@coloradoopenlands.org
Phone: 303-988-2373 x 219
Name of Applicant (if different than grantee)
Mailing Address
Position/Title
Email
Phone

Description of Grantee/Applicant
Provide a brief description of the grantee's organization (100 words or less).
Colorado Open Lands (COL) is a statewide nonprofit land trust that exists to protect Colorado's land and water resources, primarily through the use of conservation easements. To date, COL has preserved 437 conservation easements covering over 375,000 acres. COL also works to protect our state's natural heritage through on-the-ground restoration projects across the state. One of our major restoration programs is Riparian Reconnect, a comprehensive, large-scale restoration effort to increase stream and wetland function by restoring disconnected and degraded riparian areas. This grant will help fund Riparian Reconnect's work in the South Platte Headwaters and Upper South Platte watersheds.

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Type of Eligible Entity (check one)	
	Public (Government): Municipalities, enterprises, counties, and State of Colorado agencies. Federal agencies are encouraged to work with local entities. Federal agencies are eligible, but only if they can make a compelling case for why a local partner cannot be the grant recipient.
	Public (Districts): Authorities, Title 32/special districts (conservancy, conservation, and irrigation districts), and water activity enterprises.
	Private Incorporated: Mutual ditch companies, homeowners associations, corporations.
	Private Individuals, Partnerships, and Sole Proprietors: Private parties may be eligible for funding.
X	**Non-governmental organizations (NGO):** Organization that is not part of the government and is non-profit in nature.
	Covered Entity: As defined in Section 37-60-126 Colorado Revised Statutes.

Type of Water Project (check all that apply)	
	Study
X	Construction
	Identified Projects and Processes (IPP)
	Other

Category of Water Project (check the primary category that applies and include relevant tasks)		
	Water Storage - Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap. *Applicable Exhibit A Task(s):*	
	Conservation and Land Use Planning - Activities and projects that implement long-term strategies for conservation, land use, and drought planning. *Applicable Exhibit A Task(s):*	
	Engagement & Innovation - Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website. *Applicable Exhibit A Task(s):*	
	Agricultural - Projects that provide technical assistance and improve agricultural efficiency. *Applicable Exhibit A Task(s):*	
X	Environmental & Recreation - Projects that promote watershed health, environmental health, and recreation. *Applicable Exhibit A Task(s): Tarryall Notch Ranch restoration including permitting, construction and monitoring. Twelve Mile Ranch restoration including construction of treatments and monitoring. Elk Creek Highlands restoration including construction of treatments and monitoring.*	
	Other	Explain:

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Location of Water Project	
Please provide the general county and coordinates of the proposed project below in **decimal degrees**. The Applicant shall also provide, in Exhibit C, a site map if applicable.	
County/Counties	Park
Latitude	(1) 39.32071, (2) 39.112738, (3) 39.530098
Longitude	(1) -105.855877, (2) -106.081827, (3) -105.551369

Water Project Overview

Please provide a summary of the proposed water project (200 words or less). Include a description of the project and what the CWP Grant funding will be used for specifically (e.g., studies, permitting process, construction). Provide a description of the water supply source to be utilized or the water body affected by the project, where applicable. Include details such as acres under irrigation, types of crops irrigated, number of residential and commercial taps, length of ditch improvements, length of pipe installed, and area of habitat improvements, where applicable. If this project addresses multiple purposes or spans multiple basins, please explain. The Applicant shall also provide, in Exhibit A, a detailed Statement of Work, Budget, Other Funding Sources/Amounts and Schedule.

This grant will provide funding for stream and riparian restoration on three properties in Park County. Projects were identified through years of watershed-scale assessment and will be treated using strategies developed over 20 years of intensive reach-scale monitoring, evaluation, restoration, adaptive management and study.

(1) Tarryall Notch Ranch: Tarryall Creek, Riparian area ~ 103 acres, Stream length ~ 7,700 feet
The ranch was assessed in 2008 and the riparian area was found to be severely degraded with almost no shrub cover. Woody vegetation was re-established over the past 10 years via an aggressive restoration program managed by COL, implemented by the Riparian Reconnect technical partners and funded by CWCB and Park County. The property is now finally ready for geomorphic and biological treatments to re-establish the native Stage-0 beaver stream condition.

(2) Twelve Mile Ranch: Cave, Sheep, and Twelvemile Creeks, Riparian area ~ 215 acres, stream length ~ 40,900 feet
Treatments will aim at reducing beaver-human conflict on all three drainages and restoring Cave Creek which has degraded and begun drying up.

(3) Elk Creek Highlands: Elk Creek, Riparian area ~ 13 acres, stream length ~ 4,500 feet
Treatments will aim to restore the degraded riparian area and improve habitat.

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Measurable Results		
To catalog measurable results achieved with the CWP Grant funds, please provide any of the following values as applicable:		
	New Storage Created (acre-feet)	
	New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive	
	Existing Storage Preserved or Enhanced (acre-feet)	
53,100 linear feet	Length of Stream Restored or Protected (linear feet)	
	Efficiency Savings (indicate acre-feet/year OR dollars/year)	
331 acres	Area of Restored or Preserved Habitat (acres)	
	Quantity of Water Shared through Alternative Transfer Mechanisms	
	Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning	
	Number of Coloradans Impacted by Engagement Activity	
	Other	Explain:

Water Project Justification
Provide a description of how this water project supports the goals of Colorado's Water Plan, the most recent Statewide Water Supply Initiative, and the applicable Roundtable Basin Implementation Plan and Education Action Plan. The Applicant is required to reference specific needs, goals, themes, or Identified Projects and Processes (IPPs), including citations (e.g. document, chapters, sections, or page numbers). The proposed water project shall be evaluated based upon how well the proposal conforms to Colorado's Water Plan Framework for State of Colorado Support for a Water Project (CWP, Section 9.4, pp. 9-43 to 9-44;)
Mitigating or reducing the impact of buy and dry water transfers is a priority of both the Colorado Water Plan (CWP) and the South Platte Basin Implementation Plan (BIP). In section S.3.1, the BIP states that, "*In recent years, these transfers have predominantly been from agriculture to municipal use – a process known as 'buy and dry' where agricultural water rights are willingly sold to municipalities to supplement their supply, resulting in the loss of irrigated agricultural lands. Although this method can help to address the projected water supply gap, there are negative economic and environmental impacts associated with 'buy and dry*'". Furthermore, "*reducing the state's trend toward 'buy and dry' transfers of water rights from agriculture to municipal use as demand increases*" is one of the key challenges listed in the Colorado Water Plan, along with "*incorporating environmental and recreational values so important to the economy and quality of life in each of the state's river basins*" (sec S.1. BIP). This restoration project aims to recover some of the environmental and recreation water benefits that were lost following a century of land use that culminated in the "buy and dry" transfer of water from most of the South Platte Headwaters to downstream municipalities. Many of the irrigated lands from which agricultural water was transferred were originally wet riparian habitats along small anastomosed creeks and beaver streams. Agricultural conversion in the 1800s through mid-1900s caused some habitat loss, but most riparian habitats retained some aquatic and wetland function while they were

being flood irrigated. Buy and dry water transfers over the past several decades, however, left much of the region in a condition with channelized or entrenched streams and dried or degraded riparian habitat resulting in a loss of environmental and recreational water use benefits.

This "gap" in environmental and recreation water benefits can be mitigated by implementing simple treatments to help these habitats recover naturally and sustainably by reconnecting streams to riparian floodplains. These proposed Riparian Reconnect projects will improve local habitat (including game fish and wildlife important for recreation as well as native species), watershed-wide hydrological function, sustainability and resilience by restoring the native geomorphic and biological processes to small headwaters streams.

The primary aim of these projects is directly parallel with the fifth CWP goal for environmental and recreation projects (CWP Section 6.6, page 6-157) to "*Maintain watershed health by protecting or restoring watersheds that could affect critical infrastructure and/or environmental and recreational areas."* These projects will establish 331 acres of riparian protection area and restore lost function to large portions of that. By doing this in a sustainable and resilient way (restoring the native systems and processes that existed for millennia before human intervention), the projects meet the fourth CWP environmental and recreation goal to, "*Understand, protect, maintain, and improve conditions of streams, lakes, wetlands, and riparian areas to promote self-sustaining fisheries and functional riparian and wetland habitat to promote long-term sustainability and resiliency*." They are also in alignment with the other three CWP environmental and recreation goals. The primary designated use on all three properties is trout fishing, and trout fisheries are simply not sustainable in these tiny high-elevation creeks in when they are degraded. Special care is being taken to avoid and mitigate impacts to agricultural and residential infrastructure that could arise from human-beaver conflicts that might increase when habitat benefits are restored. Several aquatic and riparian-dependent imperiled species and state species of concern may also benefit indirectly by increased habitat and greater connectivity.

In addition to the environmental and recreation benefits, restoring the native Stage-0 stream and riparian condition to these areas should promote increased groundwater recharge, more water storage in natural alluvial aquifers, flood peak attenuation, and resilience to natural disasters including wildfire, flood, and drought. The most often-cited ecosystem services benefit of restored riparian wetland is water quality improvement. All these hydrological and water quality benefits are highlighted in CWP Chapter 7 on water resource management and protection, sections 7.1, 7.2, and 7.3.

Related Studies

Please provide a list of any related studies, including if the water project is complementary to or assists in the implementation of other CWCB programs.

Related studies: The Riparian Reconnect partners have been actively studying watershed health, condition, and restoration in the South Platte Headwaters for two decades, and CWCB has been a partner for most of those efforts. The premise of Riparian Reconnect of using simple process-based restoration to mitigate or eliminate ecological stressors and allow systems to function naturally, evolved over 16 years of stream restoration project monitoring sponsored by CWCB, Park County and other Riparian Reconnect partners. COL and EcoMetrics were lead partners in watershed assessments of river stability and sediment supply (WARSSS) in both the South Platte Headwaters and North Fork South Platte basins completed in 2010 and 2011. In 2015, EcoMetrics and Johnson Environmental Consulting were primary investigators of a 3-year inventory of all stream and wetland resources in Park County and partners with Colorado Natural Heritage Program in developing the Watershed Restoration Toolbox, which was piloted in this basin. All these efforts were supported by CWCB, Park County, and other partners; and they were instrumental in identifying the proposed Riparian Reconnect projects as high priorities for restoration.

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Previous CWCB Grants, Loans or Other Funding
List all previous or current CWCB grants (including WSRF) awarded to both the Applicant and Grantee. Include: 1) Applicant name; 2) Water activity name; 3) Approving RT(s); 4) CWCB board meeting date; 5) Contract number or purchase order; 6) Percentage of other CWCB funding for your overall project.
Applicant Name: Colorado Open Lands Water Activity Name: Riparian Reconnect (WSRF) Contract number or purchase order: 201800000789 Applicant Name: Colorado Open Lands Water Activity Name: Tarryall Meadow Ranch Watershed Reclamation and Habitat Enhancement (WSRF) Contract number or purchase order: 12000000086 Applicant Name: Colorado Open Lands Water Activity Name: Fourmile Creek Stream Channel & Floodplain Enhancement Project (WSRF) Contract number or purchase order: 11000000002 Applicant Name: Colorado Open Lands Water Activity Name: Tarryall Creek Riparian Restoration and Bank Stabilization (WSRF) Contract number or purchase order: 09000000104 Applicant Name: Colorado Open Lands Water Activity Name: North Fork of the South Platte Headwaters WARSSS Assessment (HRF) Contract number or purchase order: 11000000037

Taxpayer Bill of Rights
The Taxpayer Bill of Rights (TABOR) may limit the amount of grant money an entity can receive. Please describe any relevant TABOR issues that may affect your application.
No relevant TABOR issues related to this application are known.

Last Updated: June 2018

Submittal Checklist	
X	I acknowledge the Grantee will be able to contract with CWCB using the Standard Contract.
Exhibit A	
X	Statement of Work(1)
X	Budget & Schedule(1) (**Exhibit B**)
	Engineer's statement of probable cost (projects over $100,000)
X	Letters of Matching and/or Pending 3rd Party Commitments(1)
Exhibit C	
X	Map (if applicable) (1) (**Exhibit C-4**)
X	Photos/Drawings/Reports (**Exhibit C-1, C-2, C-3**)
X	Letters of Support (Optional) (**Exhibit C-5, C-6, C-7**)
	Certificate of Insurance (General, Auto, & Workers' Comp.) (2)
	Certificate of Good Standing with Colorado Secretary of State(2)
	W-9(2)
	Independent Contractor Form(2) (If applicant is individual, not company/organization)
Engagement & Innovation Grant Applicants ONLY	
	Engagement & Innovation Supplemental Application(1)

(1) Required with application.
(2) Required for contracting. While optional at the time of this application, submission can expedite contracting upon CWCB Board approval.

Riparian Reconnect Restoration Project Proposal

Statement of Work

Background

Riparian Reconnect is a long-term program with multiple partners and multiple projects in a systematic process guided by Colorado Open Lands and EcoMetrics. It is landscape-scale restoration soup-to-nuts, involving resource inventory, identifying opportunities, prioritization, detailed assessment, land protection, design, implementation, monitoring, reporting, and adaptive management.

The aim of Riparian Reconnect is to recover the hydrological, geomorphic, ecological, and habitat benefits of functioning wetland that were lost when riparian areas became hydrologically disconnected and degraded. This can be accomplished by reversing or mitigating the causes of impairment so that the systems can once again function naturally and self-sustainably. When properly functioning, these systems provide habitat and hydrological benefits such as water storage, flood attenuation, and base flow maintenance; water quality benefits such as temperature regulation, pH buffering, metal and salt sequestration, and nutrient processing; erosion control; stream stability; sediment retention and storage; and support of native vegetation.

This program is an extension of the unique partnership which includes Colorado Open Lands (Cheryl Cufre, Joel Nystrom), Park County (Gary Nichols), EcoMetrics (Mark Beardsley, Jessica Doran), Gillilan Associates (Scott Gillian), and Johnson Environmental Consulting (Dr. Brad Johnson). These partners have worked together for more than 10 years, completing a wide range of riparian and wetland restoration projects in Park County.

With the support of CWCB and other funding partners, Riparian Reconnect has successfully completed site assessments and conceptual designs on 6 properties spanning 8 streams across Park County. Beaver system restoration projects have been implemented on two properties (DM Ranch and Upper Fourmile Ranch) with construction on a third project scheduled for spring 2019. Riparian Reconnect's unique approach to landscape-scale restoration has been proven to successfully implement meaningful improvements that move the needle on the long-term health of riparian systems.

Project Tasks

Task 1: Tarryall Notch Ranch Restoration- Tarryall Creek

Landscape-level improvement on The Tarryall Notch Ranch began in 2008 and 2009 with the establishment of a conservation easement, livestock management, and a large-scale riparian planting effort. These land management changes and willow plantings successfully restored dense shrub cover to the riparian area on most of the property. While riparian condition has improved somewhat, the hydrologic condition of the stream is still impaired by slight entrenchment. Monitoring of the 2008-09 treatments and a 2018 assessment suggest that there is little potential for the system to become hydrologically reconnected without further treatments. The proposed project on this property will speed up the restoration process by constructing beaver dam analogs to fulfill the roles of natural beaver dams until a sustainable population of beavers returns, while also creating deep water habitat and cover to entice migrating beavers to settle on site. Existing Riparian Reconnect funds were used to develop treatment plans, and the funds from this grant

will support permitting, construction, and monitoring. The conceptual plan is attached as Exhibit C-1. This project aims to restore hydrologic connectivity to 14,300 ft of stream and 99.4 acres of riparian area.

Deliverable for Task 1: ACOE permit, documentation of implementation of treatment design, documentation of monitoring of pretreatment condition, as built condition, and 3 year post project condition.

Task 2: Twelve Mile Ranch – Cave Creek, Sheep Creek, and Twelve Mile Creek

Twelve Mile Ranch is an 840-acre property in Park County Colorado with a conservation easement held by Colorado Open Lands. Three first-order perennial headwaters streams (Sheep Creek, Twelve Mile Creek, and Cave Creek) flow through it, with a combined valley length of about 3.6 miles that support more than 260 acres of riparian and wetland habitat. Funded by Riparian Reconnect, an assessment of restoration potential was completed in 2018 which identified opportunities to protect and improve the health of 40,900 feet of stream and 215 acres of riparian area. Recommendations for restoration and management are summarized in Exhibit C-2. This project has two focuses: 1) beaver maintenance (conflict management) which aims to alter beaver behavior to maintain ranch infrastructure while maximizing habitat and ecosystem benefits, and 2) stream and riparian restoration which aims to improve stream and riparian function and habitat benefits by restoring natural processes typical of small beaver streams. Specific objectives and strategies are described on page 13 of Exhibit C-2. Funds from this grant will be used implement treatments.

Deliverable for Task 2: Documentation of details of implementation of beaver maintenance treatments and stream and riparian restoration treatments. Documentation of monitoring of pretreatment condition, as built condition, and 3-year post project condition.

Task 3: Elk Creek Highlands – Elk Creek

The project property on Elk Creek is owned by Elk Creek Highlands Property Owners Association and is managed as open space for the landowner group. It is located at the headwaters of Elk Creek with most of the watershed in Mount Evans Wilderness Area. Beavers have been absent from this riparian complex since 2015 and the system has shifted away from a highly diverse mix of aquatic and terrestrial habitat to a simplified single channel system with a depressed water table, decreased wetland area, and compromised habitat quality. While fluctuations of beaver population are known to be a natural occurrence, the geographical isolation of this site from any neighboring beaver populations decreases the likelihood of natural reestablishment of beaver. This project aims to improve stream and riparian function and habitat benefits (4,500 ft of stream and 13.6 acres of riparian) by restoring natural processes typical of healthy beaver systems. The potential for future beaver maintenance to manage beaver behavior to maintain road crossings is also built in to the project. Site assessment, restoration plan and timeline are detailed in Exhibit C-3.

Deliverable for Task 3: Documentation of details of implementation of stream and riparian restoration treatments and beaver maintenance treatments, if needed. Documentation of monitoring of pretreatment condition, as built condition, and 3-year post project condition.

COLORADO OPEN LANDS

EcoMetrics
Stream and Riparian Monitoring, Assessment and Restoration

Project Timeline

Task	Details	Start	Completion
1. **Tarryall Notch Ranch** – Tarryall Creek	permitting	Q2 2019	Q3 2019
	construction	Q4 2019	Q4 2019
	monitoring	Q2 2019	Q4 2021
2. **Twelve Mile Ranch** – Twelve Mile Creek, Cave Creek, Sheep Creek	permitting	Q2 2019	Q3 2019
	construction	Q4 2019	Q4 2019
	monitoring	Q2 2019	Q4 2021
3. **Elk Creek Highlands** – Elk Creek	permitting	Q2 2019	Q3 2019
	construction	Q4 2019	Q4 2019
	monitoring	Q2 2019	Q4 2021

Letters of Matching and/or Pending 3rd Party Commitments

We are seeking matching funds from three sources, the Park County Land & Water Trust Fund (LWTF), three participating landowners and in-kind contributions from EcoMetrics. We will be presenting our proposal to the LWTF board on February 6th. The board then makes a recommendation to the county commissioners whom which are able to award the funding request in late February or early March. Commitments for matching funds from the three participating landowners is also pending. The in-kind contribution by EcoMetrics has been committed.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Water Plan Grant - Detailed Budget Estimate
Fair and Reasonable Estimate

Prepared Date: January 6, 2019
Name of Applicant: Colorado Open Lands
Name of Water Project: Riparian Reconnect Project Implementation

Riparian Reconnect - Park County, South Platte Headwaters Beaver Stream Restoraton

	Stream/ riparian scientist project manager	Stream/ riparian scientist professional	Stream/ riparian scientist technical	Stream/ riparian skilled labor	Stream/ riparian labor/ volunteer	Excavator and operator	Truck/trailer	Subtotal	Direct costs (materials, equipment, etc.)	Project Total	CWCB Funds	Matching Funds
	$ 135	$ 120	$ 105	$ 60	$ 40	$ 150	$ 60					
Task 1 - Tarryall Notch Ranch stream/riparian restoration										**$103,818**	**$34,090**	**$69,728**
Project coordination	10	6						$ 2,070	$ -	$2,070	$0	$2,070
Assessment and design	14	44	14					$ 8,640	$ 720	$9,360	$0	$9,360
Permitting	20	10	16					$ 5,580	$ 280	$5,860	$0	$5,860
Restoration treatments	66	64		120		120	16	$ 42,750	$ 4,940	$47,690	$14,690	$33,000
Monitoring, study, report	4	96	68					$ 19,200	$ 10,200	$29,400	$19,400	$10,000
Contingency/maintenance (10%)								$ -	$ 9,438	$9,438	$0	$9,438
Task 2 - Twelvemile Ranch stream/riparian restoration										**$115,170**	**$35,000**	**$80,170**
Project coordination	12	8						$ 2,580	$ 120	$2,700	$0	$2,700
Assessment and design		98	8					$ 12,600	$ 400	$13,000	$0	$13,000
Permitting	26		22					$ 5,820	$ 180	$6,000	$3,000	$3,000
Beaver management treatments		52	56	80				$ 16,920	$ 8,080	$25,000	$10,000	$15,000
Restoration treatments	48	16	28	72		84		$ 28,260	$ 4,740	$33,000	$10,000	$23,000
Monitoring, study, report	4	96	68					$ 19,200	$ 5,800	$25,000	$10,000	$15,000
Contingency/maintenance (10%)								$ -	$ 10,470	$10,470	$2,000	$8,470
Task 3 - Elk Creek Highlands stream/riparian restoration										**$51,700**	**$15,200**	**$36,500**
Project coordination		8	8					$ 1,800	$ -	$1,800	$0	$1,800
Assessment and design	2	36	14					$ 6,060	$ 340	$6,400	$2,000	$4,400
Permitting	24		16					$ 4,920	$ 280	$5,200	$200	$5,000
Restoration treatments		46	46	52	90			$ 17,070	$ 5,530	$22,600	$6,000	$16,600
Monitoring, study, report		44	40					$ 9,480	$ 1,520	$11,000	$5,000	$6,000
Contingency/maintenance (10%)								$ -	$ 4,700	$4,700	$2,000	$2,700
TOTAL										**$270,688**	**$84,290**	**$186,398**

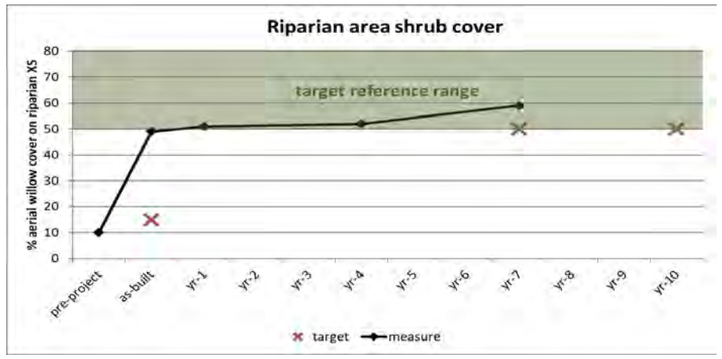
Tarryall Notch Ranch: Assessment for Riparian Reconnect

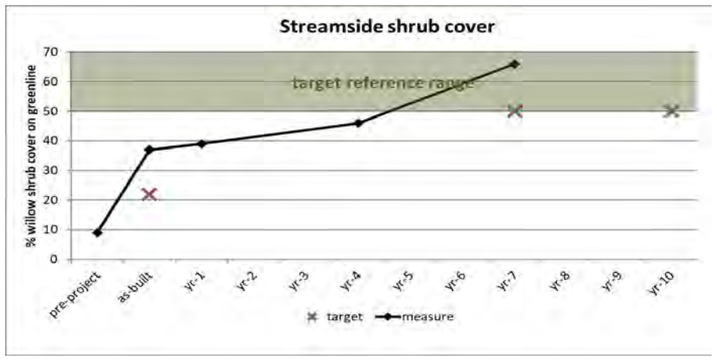
Stream condition summary

The property has two distinct reaches. On the upper 1/3 Tarryall Creek flows down a relatively high gradient relict alluvial fan in a well-defined trench that effectively constrains the riparian area within it to about 60-150 feet wide. At the toe of the fan, the valley flattens out into a very wide low-gradient wetland complex where the whole valley is backed up behind tight geological control at the notch and riparian width is completely unconfined. The reaches were subject to similar land use history and the same stressors, but they differ in character. The alluvial fan reach is a relatively steep, straight, wide, and shallow Stage 1c stream with bank heights 1.0-1.5 ft and widths 20-35 ft. The lower reach is a much lower gradient meandering Stage 1b stream that is narrower and deeper with bank heights 1.5-2.5 ft and widths 6-12 ft. Both reaches are moderately entrenched single-thread channels. Most of the lower reach runs along the valley edge. The properties just upstream and downstream have intact Stage 0 beaver complexes.

Restoring riparian shrubs

When we first evaluated the Tarryall Notch Ranch in 2007, the immediate restoration priority was to reestablish riparian shrubs. At that time, there were almost no shrubs taller than a few inches due to extreme livestock grazing pressure. Livestock were excluded from the riparian zone from 2008 through 2018 and major willow planting efforts were made in 2008 and 2009. 600 whole willow shrubs and about 1000 willow stems were planted on the alluvial fan reach, and about 1750 willow stems were planted on the upper half of the broad wetland reach. These treatments succeeded in restoring dense shrub cover to the riparian area on most of the property.



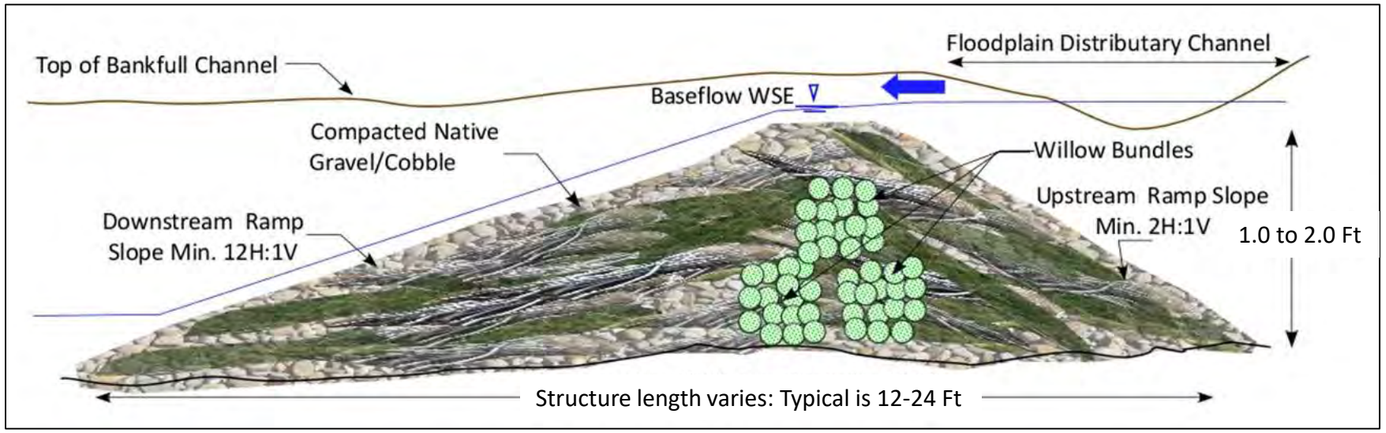


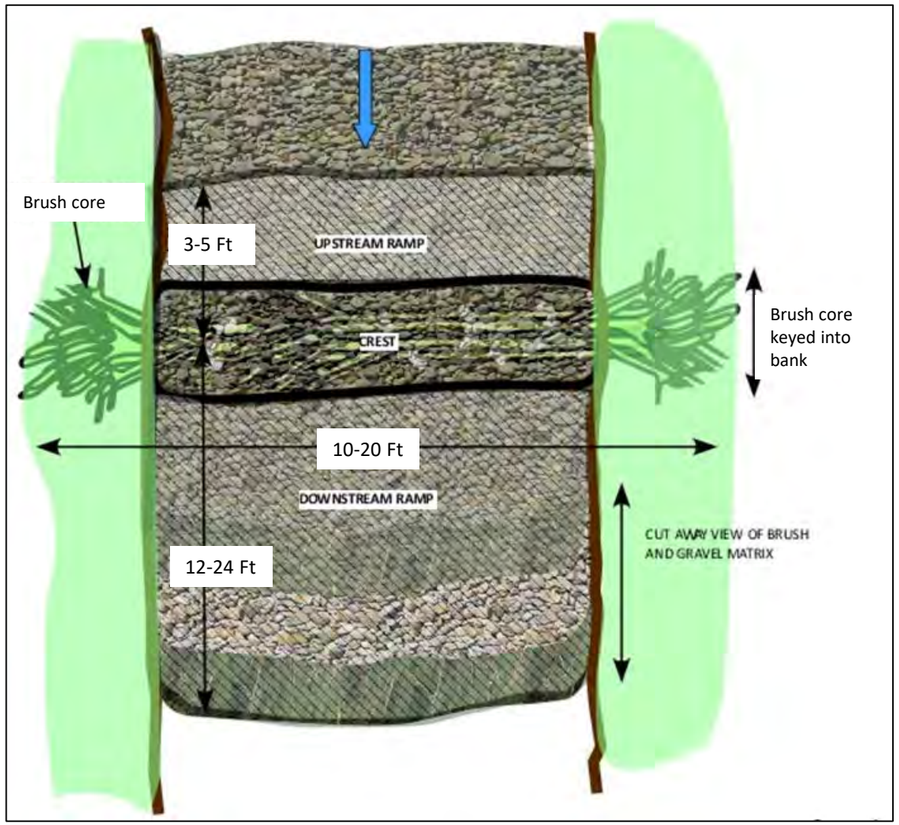
Despite the riparian vegetation improvements, hydrological recovery has yet to respond. The stream on both reaches is still a moderately entrenched single-thread channel that rarely overbanks. Water table in the adjacent riparian zone and wetland is depressed as a result, and the site still has a long way to go to achieve reference-standard hydrological, ecological, habitat, and fishery benefits.

On to step 2. Restoring hydrology

Restoring hydrology

The hydrological and habitat goals of this project depend on restoring base flow connectivity between the stream and riparian zone, as would be typical of the native Stage-0 condition. This would provide floodplain saturation and groundwater recharge, support riparian wetland, and improve aquatic habitat. Our long-term strategy is to restore beavers to the site as a keystone geomorphic agent. On this site, where beavers have been absent so long, passive recovery via immigration may take many years or decades. Beaver dam analogs (BDAs) will maintain these functions for the short term, and to encourage beaver reoccupation of the site by providing the deep water and cover they need.



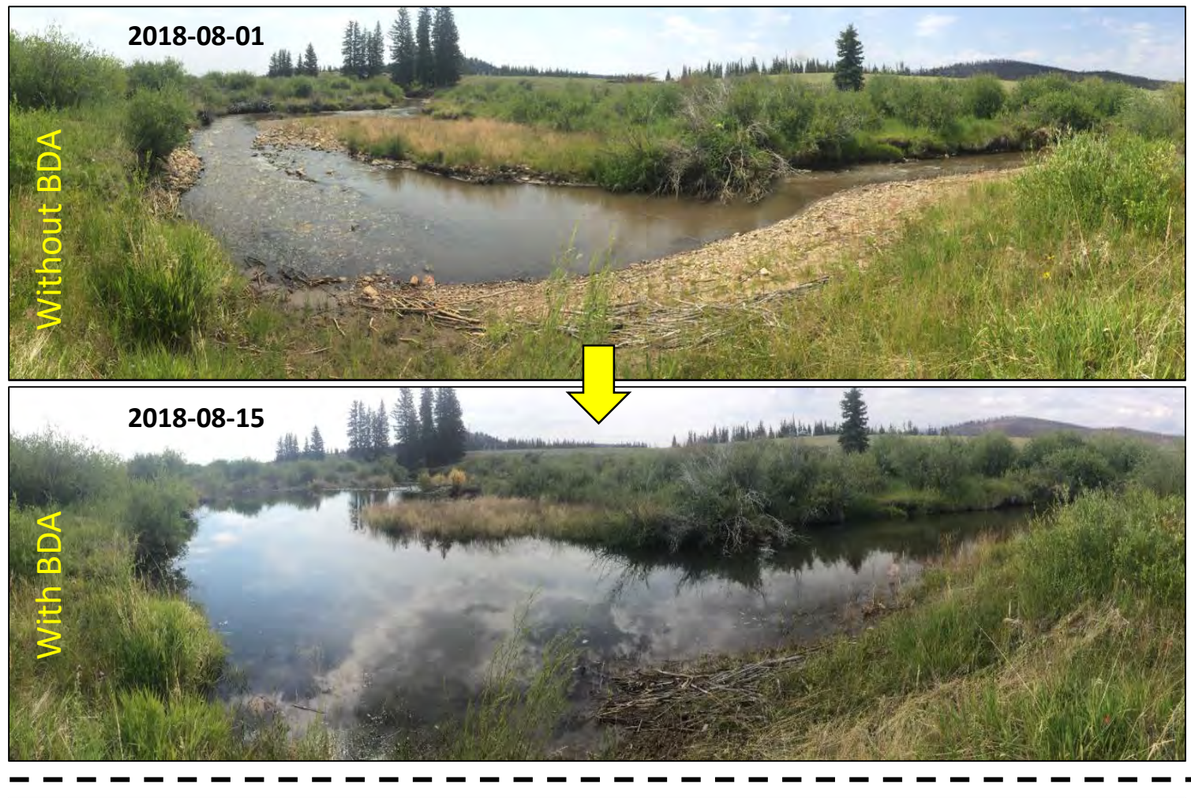


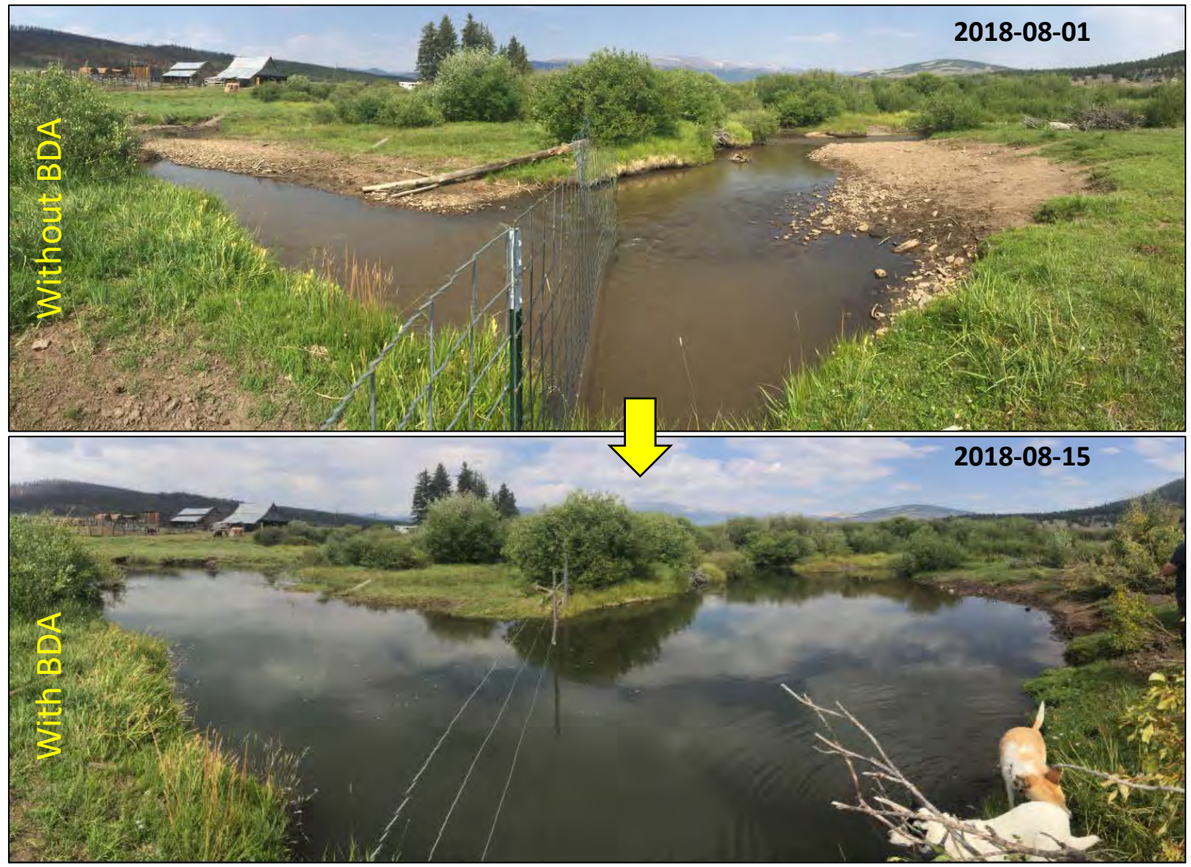
BDA design specs

The diagrams above and left show specifications for BDAs proposed on Tarryall Notch Ranch. Like natural beaver dams, BDAs are designed to persist through normal runoff events, but are not permanent structures. They are constructed of native materials that assimilate into the streamscape.

BDA function

BDAs mimic natural channel-spanning beaver dams to create deep water habitat, raise the surrounding water table, and reactivate floodplain swales and side channels. Examples from the DM Ranch are shown in the photos to the right.





Restoring hydrology

Long-term reoccupation of the reach by beavers would go a long way towards completing the restoration process. With bank heights in the 2-foot range, beaver dams could easily and effectively reestablish an anastomosed planform and floodplain connectivity with season-long wetland hydrology. Beaver activity would also spur the dynamic processes that create and maintain aquatic and terrestrial habitat diversity that is lacking in the streams current channelized form. Now that the forage base (willows) has been effectively restored, the site can sustain a population of beavers but, except for one dam on the extreme lower end of the property, the animals have so far not returned on their own.

The proposed Riparian Reconnect project on Tarryall Notch Ranch aims to speed the passive restoration process in two ways. Beaver dam analogs fulfill the roles of natural beaver dams until a sustainable population of beavers returns. At the same time, BDAs create deep water habitat and cover that will entice migrating beavers to settle on site. Several small feeder cuts are also planned to reconnect overflow channels and floodplain swales, initiating the development of high-flow channel branches and anastomosis typical of the natural Stage-0 beaver stream form. The proposed Tarryall Notch Ranch project is like the DM Ranch project in that it involves simple construction of BDAs and subtle feeder cuts, without the need for major channel work, floodplain re-grading, or riparian revegetation that we did on Upper Fourmile. It would be similar to the Lone Rock project in terms of scale and construction methods. The BDAs on Tarryall Notch Ranch would be much smaller than those on DM and could be built using a small track hoe and without having to bring in large trees or logs.

Mimicking beaver dams: Typical BDAs on DM Ranch viewed from upstream (upper right) and downstream (lower right) raise water stage and reconnect floodplain swales and off-channel wetland habitat (left). The BDAs on Tarryall Notch Ranch will be similar to these, but scaled to match the smaller size of Tarryall Creek.

Enticing beaver: BDAs also provide deep water habitat and cover that entice migrating beavers to settle on the site. Several of the BDAs on DM Ranch were occupied by beavers in the first season. We suspect this would be the case at Tarryall Notch Ranch as well, given that there are active beaver colonies nearby both upstream and downstream.

Plan A

<u>Plan A</u>
Treat the alluvial fan reach and portions of the wetland reach that can be accessed with a track hoe. High-intensity monitoring.

<u>Total estimated budget: $103,818</u>

<u>Management: $2,070</u>

<u>Assessment and design: $9,360</u>
- o Assessment and concept design
- o Final design
- o Report and budget

<u>Permitting: $5,860</u>
- o Delineation
- o ACOE Pre-construction notice

<u>Treatments: $47,690</u>
- o 23 on-channel BDAs
- o 2 off-channel BDA (speedbumps)
- o 14 feeder swales
- o Seeding

<u>Monitoring: $29,400</u>
- o Photopoints
- o Habitat surveys
- o Vegetation surveys
- o Geomorphic surveys

<u>10% Contingency: $9,438</u>
- o Overages
- o Maintenance
- o Adaptive management

Twelvemile Ranch:
A reconnaissance assessment of stream and riparian condition for the Riparian Reconnect project with recommendations for restoration and management

Prepared by EcoMetrics December 26, 2018

Contents

Riparian Reconnect

COLORADO OPEN LANDS

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Stream & Riparian Monitoring, Assessment & Restoration

Johnson Environmental Consulting

Gillilan Associates Inc.

Twelvemile Ranch:
A reconnaissance assessment of stream and riparian condition for the Riparian Reconnect project with recommendations for restoration and management

Purpose and scope

This assessment was conducted to determine the potential for preserving or improving resource value on Twelvemile Ranch through the Riparian Reconnect program. Riparian Reconnect is a collaborative program managed by Colorado Open Lands stewardship program focused on protecting and restoring natural healthy streams and riparian areas in Colorado mountain headwaters systems to maximize ecosystem services, habitat, and benefits to landowners.

EcoMetrics scientists evaluated Twelvemile Ranch over several site visits in fall 2018, during which we toured the streams and riparian areas with landowners who have been observing the property for more than 40 years. Their knowledge of the property is an invaluable source of information. We also relied heavily on historical aerial photography dating back to 1955, USGS hydrological models, existing datasets, CNHP reports and recently updated riparian/wetland maps, a county-wide inventory of streams and wetlands, and our own local knowledge gained over 20 years working as stream and wetland scientists in the South Platte Headwaters.

These analyses were integrated into reach-scale stream health assessments that provide an overview of how well these systems are functioning compared to the natural reference condition. We then considered what types of actions Riparian Reconnect could take to protect or restore functionality of these important headwaters systems on Twelvemile Ranch. Actions that benefit both the resource and landowner needs are win-win opportunities that make for ideal projects.

The report concludes with a set of recommendations for future work and next steps that can serve as the basis for discussion between Twelvemile Ranch owners and Riparian Reconnect as partners in stewardship.

Introduction to Twelvemile Ranch

Twelvemile Ranch is an 840-acre property in Park County Colorado with a conservation easement held by Colorado Open Lands. Three first-order perennial headwaters streams (Sheep Creek, Twelvemile Creek, and Cave Creek) flow through it, with a combined valley length of about 3.6 miles that support more than 260 acres of riparian and wetland habitat.

The primary use of the property is natural open space that provides passive recreation for the landowners, a club formed in the 1940s limited to about 20 families. The current members greatly appreciate the natural condition of the ranch, it's natural beauty, and the fish and wildlife benefits provided by its relatively unimpacted natural habitat. They especially appreciate the importance of beavers, since both trout and waterfowl would be scarce or nonexistent on these tiny creeks were it not for the aquatic habitat beavers create and maintain.

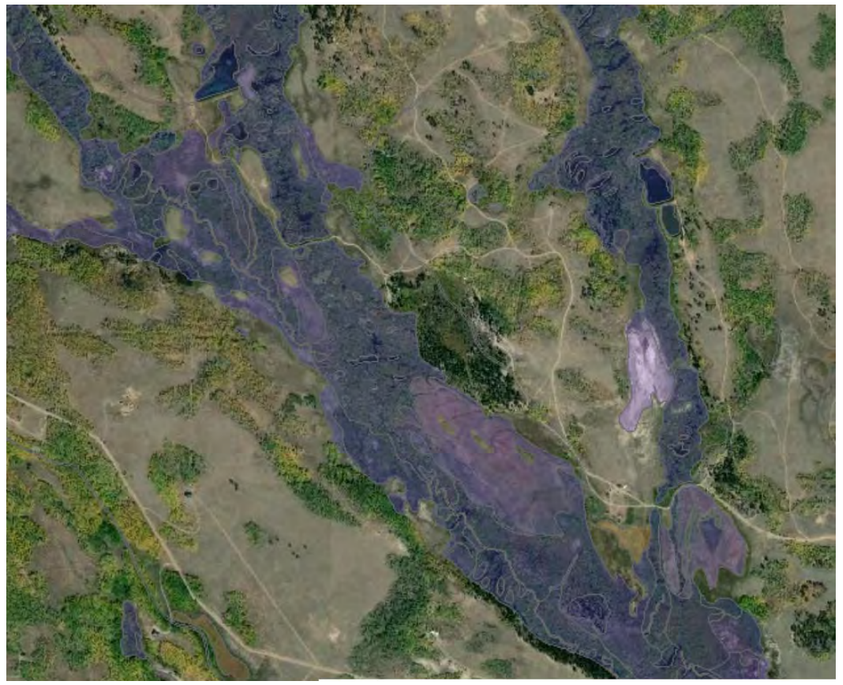
The property also has a small ranching component with about 40 acres of irrigated hay meadow, a small herd of cattle, and a ranch headquarters. The other use is residential, with a network of unimproved roads connecting the 20 or so cabins and small home sites.

These factors make Twelvemile Ranch an ideal setting for conservation and stewardship to promote natural land values and ecosystem services.

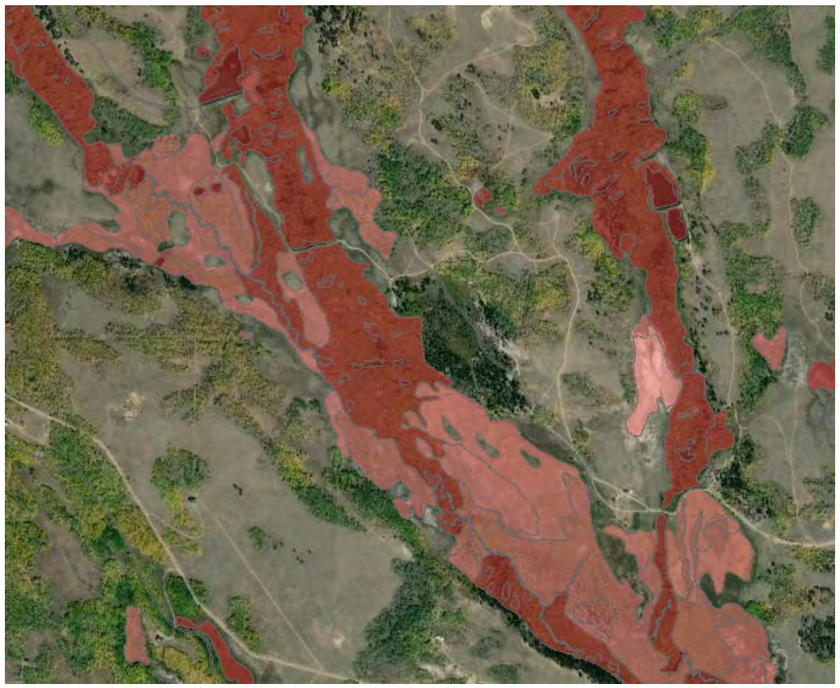
Ecosystem services and conservation value

CNHP wetland functions evaluation

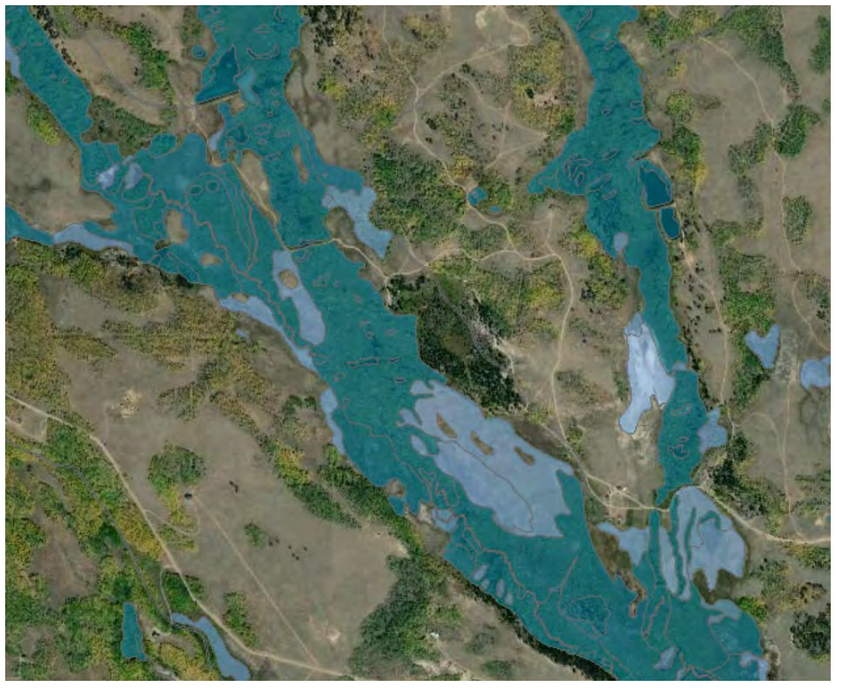
The maps below show the importance of Twelvemile Ranch wetland for biodiversity and wildlife functions (left), water quality functions (middle), and water quantity functions (right). The entire riparian zones on Sheep, Twelvemile, and Cave Creeks are highlighted for each of the three ecosystem services categories. Please consult the CNHP Watershed Toolbox Mapper website to see how these areas plot out with respect to individual functions in each of these functional categories.



CNHP Biodiversity and wildlife functions



CNHP Water quality functions



CNHP Water quantity functions

Ecosystem services and conservation value

In addition to the local benefits of aesthetics and recreation, and also in addition to obvious regional benefits as habitat for fish, wildlife, and native biota, intact headwaters riparian systems like these are a critical component of watershed health.

The beaver-mediated riparian complexes on Sheep, Twelvemile, and Cave Creeks provide a myriad of functions that support health of the South Platte Watershed at large and especially the South Fork of the South Platte just downstream. When functioning, these riparian areas work like great sponges that store runoff in ponds, floodplain wetland, and alluvial aquifers that discharge it slowly to keep streams flowing year-round. In this way, they buffer the effects of extreme weather, like floods and drought, which is increasingly important for climate change resilience.

They also provide resilience to fire. Perhaps the greatest damage from forest fire is caused by the ensuing period of erosion and sedimentation to streams. Streams with well-connected riparian areas and beave ponds are sediment sinks. Rather than flushing through to larger rivers downstream, the sediment trapped in these headwaters systems is composted with accumulating organic material like wood, detritus, and ash into rich floodplain soil.

The ponds and complex channel networks typical of these small beaver streams have maximum groundwater connection which means they also function like filters. Water flows through these systems slowly, not just as surface flow, but also through saturated ground to mediate temperature fluctuation. naturally through soil biogeochemical processes through these systems. Water quality is enhanced by saturation and long retention times that give soil biogeochemical processes time to assimilate nutrients and solutes.

Beaver stream function

Beaver stream health

On small beaver streams, health and function is tied closely to the level of beaver activity. While fluctuating beaver activity is normal, prolonged inactivity is a problem. Many factors affect beaver colony survival and reproduction including habitat limitations (usually deep water or cover), food (usually woody deciduous shrubs and trees), predation, and disease. When areas become vacated or when populations crash, the amount of time it takes for them to be recolonized depends on the proximity to other beaver populations, migration barriers, and attractiveness of the site to dispersing beavers.

Beaver activity is the most important factor in evaluating health and function of the streams on Twelvemile Ranch. This report includes a study of beaver activity that tracks pond area, by reach, from 1999 to 2017.

Beaver stream habitat

Small beaver streams are dynamic. Where beavers are present, their dams slow flows and create ponds that trap sediment and spread water laterally to maintain wide contiguous wetland. The habitat that beaver create along small headwaters streams is critical to a host of aquatic and terrestrial species. Nearly all fish and wildlife depend on riparian habitat provided by beavers during some portion of their lives. Without the deep ponds, adult trout could not survive harsh winters or droughts. Shallow water and wetland is habitat for waterfowl, and complex shrub canopies are ideal for game and birds.

But populations fluctuate and beaver colonies move. Where they are absent for more than a few years, their dams begin to fail, resulting in a more channelized stream form. As ponds dry out, the exposed sediment that they trapped is colonized by pioneer riparian species like sedges and willows, driving plant community succession. The dynamic cycles of dam-building and failure are important for maintaining physical habitat complexity and species diversity.

But when beavers are absent for a long time, the depressed water table stresses riparian plants and shrinks the wetland area. If riparian vegetation becomes to dried out and degraded, beavers are less and less apt to recolonize an area and the stream evolves towards a more permanent entrenched channel with less aquatic habitat, poor diversity, and less wetland. Ultimately that means less habitat for native species, and fewer fish and wildlife.

Watersheds and hydrology

Twelvemile Ranch sits on the eastern flanks of the south end of the Mosquito Range at just below 10,000 ft. Streamflows have typical snowmelt-dominated flow regimes with peak flows in June and base flows in late summer thorough fall, winter, and spring. These are tiny headwaters creeks that normally flow less than one CFS in summer.

← Looking upstream on Twelvemile Creek. Most of the 9.5-square-mile contributing watershed is in the alpine and subalpine terrain in the background.

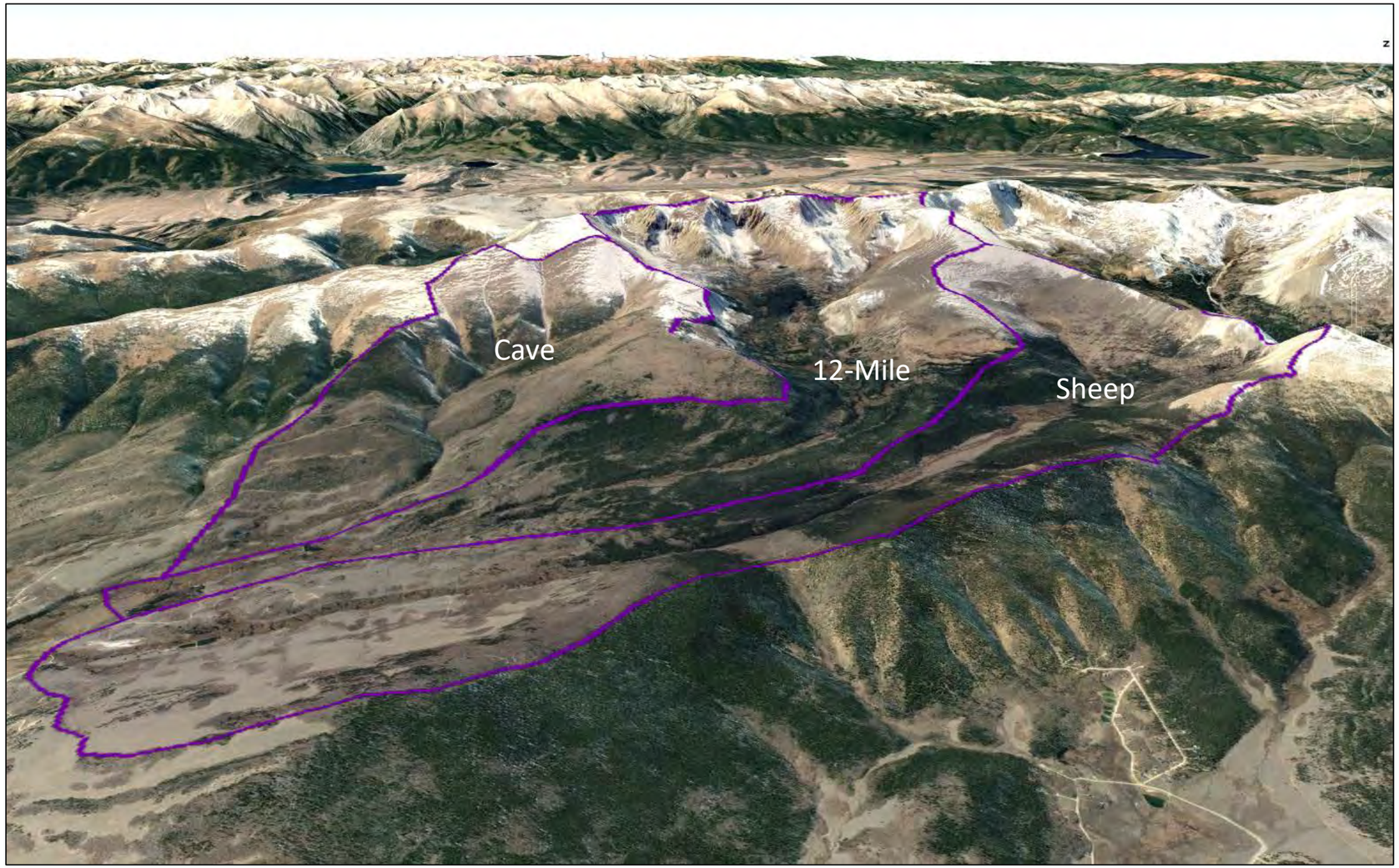
Hydrological statistics

Flow statistics for Sheep, Twelvemile, and Cave Creek as predicted using USGS regression equations for the Mountain region, basin characteristics and estimated 20 inches annual precipitation. All three are small first-order perennial streams. Typical low flows tend to be 1-2 CFS with annual peaks of 20-40 CFS on Sheep and Twelvemile Creeks. Values for Cave Creek are roughly half that.

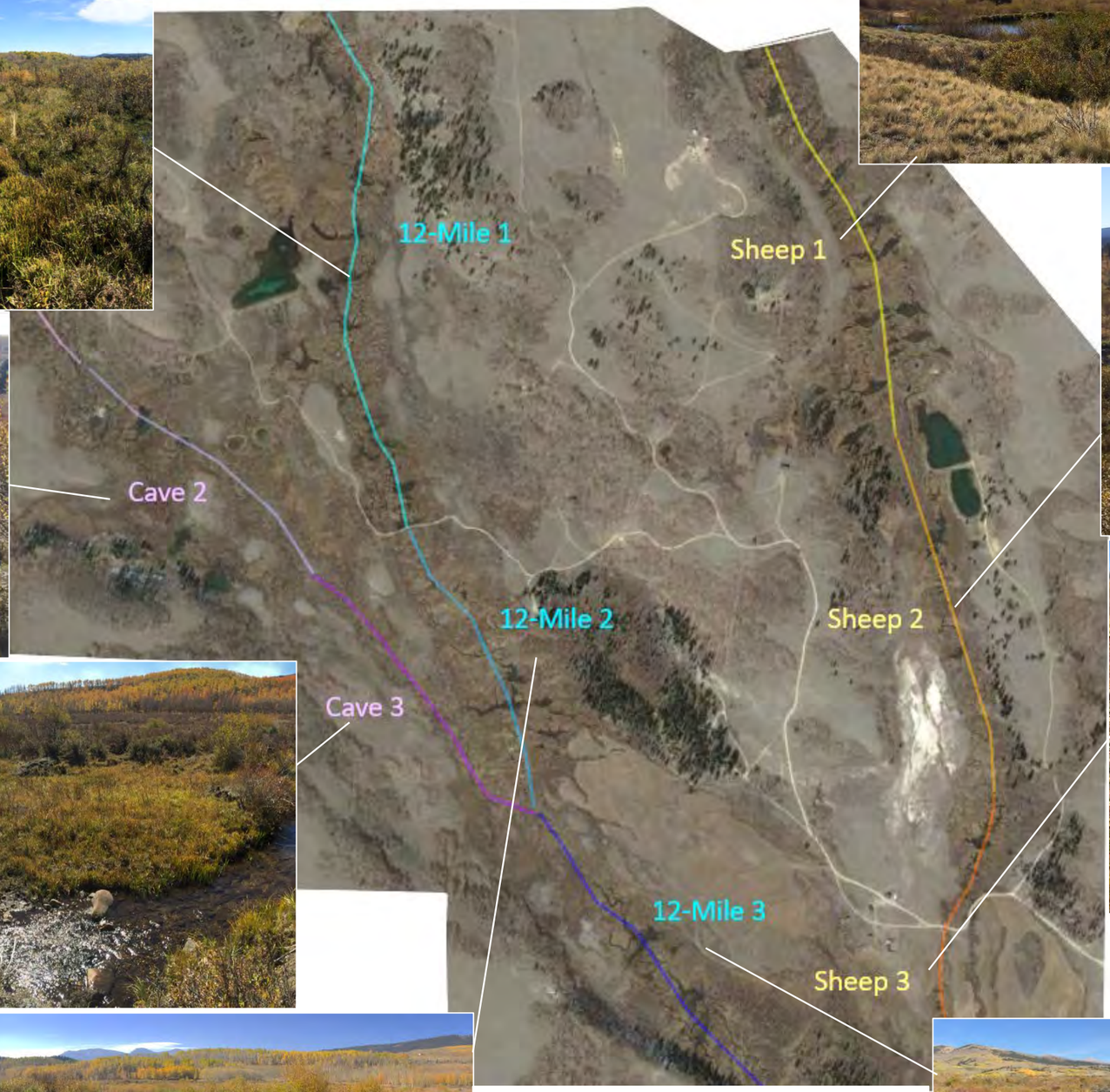
Watershed	Sheep Creek	12-Mile Creek	Cave Creek
Drainage area (square miles)	8.2	9.5	5.0
2-year max flood (CFS)	42	49	30
10-year max flood (CFS)	83	96	58
100-year max flood (CFS)	129	148	91
7-day 2-year max flood (CFS)	29	33	19
7-day 10-year max flood (CFS)	52	58	34
7-day 50-year max flood (CFS)	76	86	50
7-day 2-year minimum (CFS)	0.6	0.7	0.3
7-day 10-year minimum (CFS)	0.2	0.3	0.1
7-day 50-year minimum (CFS)	0.2	0.2	0.1
10% duration (CFS)	11.5	13.1	7.4
25% duration (CFS)	3.3	3.8	2.0
50% duration (CFS)	1.4	1.6	0.9
75% duration (CFS)	0.8	0.9	0.5
90% duration (CFS)	0.4	0.5	0.2

Watersheds

Sheep, Twelvemile, and Cave Creek watersheds are 8.2, 9.5, and 5.0 square miles, respectively.



Stream functional assessment reaches



Assessment Reaches

Streams and riparian areas were divided into eight reaches, as shown here. Each reach is evaluated independently.

Stream health and functional assessment summary

Sheep Creek

Stream Health Report Card: Sheep Creek, Reach 1		
Watershed	Flow regime	A
	Sediment regime	A-
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	A
	Riparian vegetation	A-
	Organic material	A
Stream	Stream morphology	A
	Stability	A
	Physical structure	A
Biotia		A-
Reach condition score		A

Stream Health Report Card: Sheep Creek, Reach 2		
Watershed	Flow regime	A
	Sediment regime	A-
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	A-
	Riparian vegetation	A-
	Organic material	A-
Stream	Stream morphology	B+
	Stability	A-
	Physical structure	B+
Biotia		A-
Reach condition score		A-

Stream Health Report Card: Sheep Creek, Reach 3		
Watershed	Flow regime	B
	Sediment regime	A-
	Water quality	A
	Landscape support	A-
Riparian	Floodplain function	C
	Riparian vegetation	B-
	Organic material	A-
Stream	Stream morphology	B
	Stability	B
	Physical structure	B
Biotia		B-
Reach condition score		B-

Twelvemile Creek

Stream Health Report Card: Twelvemile Creek, Reach 1		
Watershed	Flow regime	A
	Sediment regime	A-
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	A-
	Riparian vegetation	A-
	Organic material	A
Stream	Stream morphology	A-
	Stability	A
	Physical structure	A-
Biotia		A-
Reach condition score		A

Stream Health Report Card: Twelvemile Creek, Reach 2		
Watershed	Flow regime	B+
	Sediment regime	A-
	Water quality	A
	Landscape support	A-
Riparian	Floodplain function	B+
	Riparian vegetation	B+
	Organic material	B
Stream	Stream morphology	B
	Stability	B+
	Physical structure	B-
Biotia		B-
Reach condition score		B

Stream Health Report Card: Twelvemile Creek, Reach 3		
Watershed	Flow regime	A-
	Sediment regime	A-
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	A-
	Riparian vegetation	B-
	Organic material	A-
Stream	Stream morphology	B+
	Stability	A-
	Physical structure	B
Biotia		B
Reach condition score		B+

Cave Creek

Cave Creek
Reach 1
Not assessed

Stream Health Report Card: Cave Creek, Reach 2		
Watershed	Flow regime	A-
	Sediment regime	B+
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	B-
	Riparian vegetation	C+
	Organic material	B-
Stream	Stream morphology	C+
	Stability	B
	Physical structure	C+
Biotia		C
Reach condition score		B-

Stream Health Report Card: Cave Creek, Reach 3		
Watershed	Flow regime	A-
	Sediment regime	B+
	Water quality	A
	Landscape support	A
Riparian	Floodplain function	B-
	Riparian vegetation	B-
	Organic material	B-
Stream	Stream morphology	B-
	Stability	B
	Physical structure	C+
Biotia		C
Reach condition score		B-

Stream Reach		Functional Health Grade	Valley length (Feet)	Riparian area (acres)
Sheep	Sheep 1	A	2750	31.9
	Sheep 2	A-	2160	16.9
	Sheep 3	B-	2010	16.6
Telvemile	12-Mile 1	A	3430	38.2
	12-Mile 2	B	1900	23.3
	12-Mile 3	B+	2380	24.3
Cave	Cave 2	B-	2640	40.1
	Cave 3	B-	1740	9.0

Results

Twelvemile Ranch streams are in good condition, with grades in the A to B range, due to a history of riparian protection and gentle land use. The Cave Creek reaches and Twelvemile Reach 2 could be improved with restoration.

Grade	Score	Impairment
A	90-100	None
B	80-89	Mild
C	70-79	Significant
D	60-69	Severe
F	50-59	Profound

Stream health and function is evaluated by rating 10 critical components (below). Each is graded by the degree of impairment compared to natural unimpaired reference reaches according to the table above.

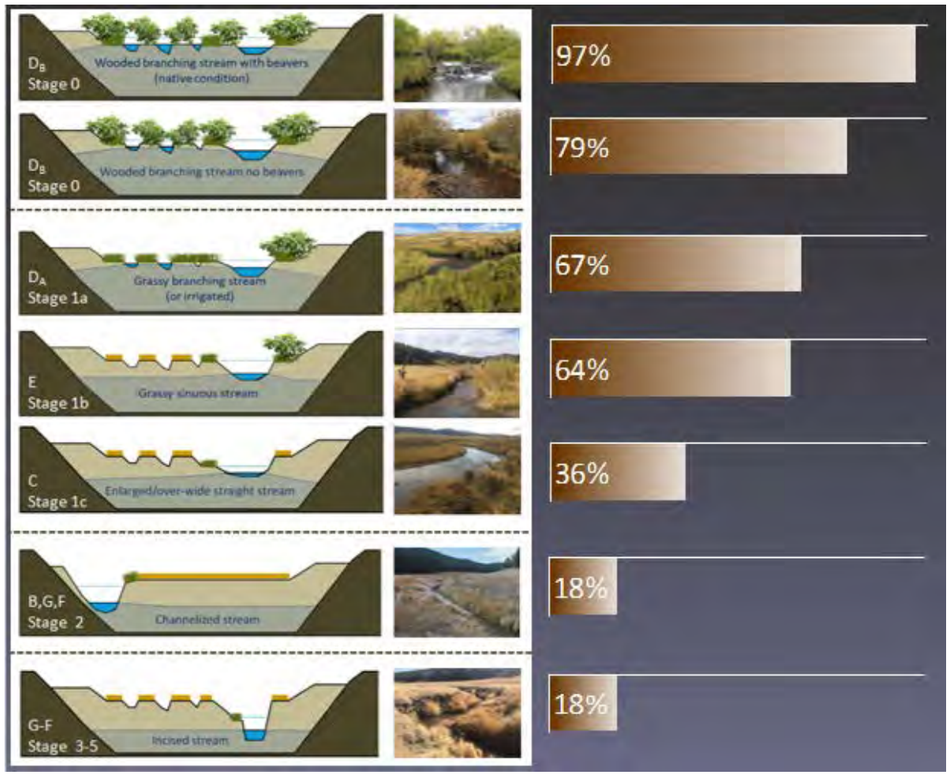
Stream Health Assessment Framework		
Watershed	Flow Regime	Amount and timing of water supplied to the reach from the contributing watershed.
	Sediment regime	Amount, timing, and type of sediment supplied to the reach from the contributing watershed.
	Water Quality	Water quality and physicochemical properties inherited to the reach from the contributing watershed.
	Landscape support	Surrounding land use, buffer capacity, and landscape connectivity.
Riparian	Floodplain function	Frequency, extent, and duration of floodplain activation/saturation on the reach.
	Riparian vegetation	Condition and structure of the riparian vegetation community.
	Organic material	Supply of wood and organic debris to the reach.
Stream	Stream morphology	Overall form of the reach, including stream evolutionary state, and characteristic planform, dimension, and profile.
	Stability & resilience	Ability of the reach to maintain characteristic form and structure via dynamic equilibrium and resilience to disturbance.
	Physical structure	Coarse-and fine-scale physical habitat structure including water depth, velocity, structural components, and substrate.
Biotic structure		Community and trophic structure of the organisms that inhabit the reach for all or portions of their life histories.
Reach condition		Overall functional condition of the reach, scored as a weighted average from the state variables.

Stream function and beavers

SEM Stage & Classification

Relative Habitat and Ecosystem Benefits

Twelvemile Reaches

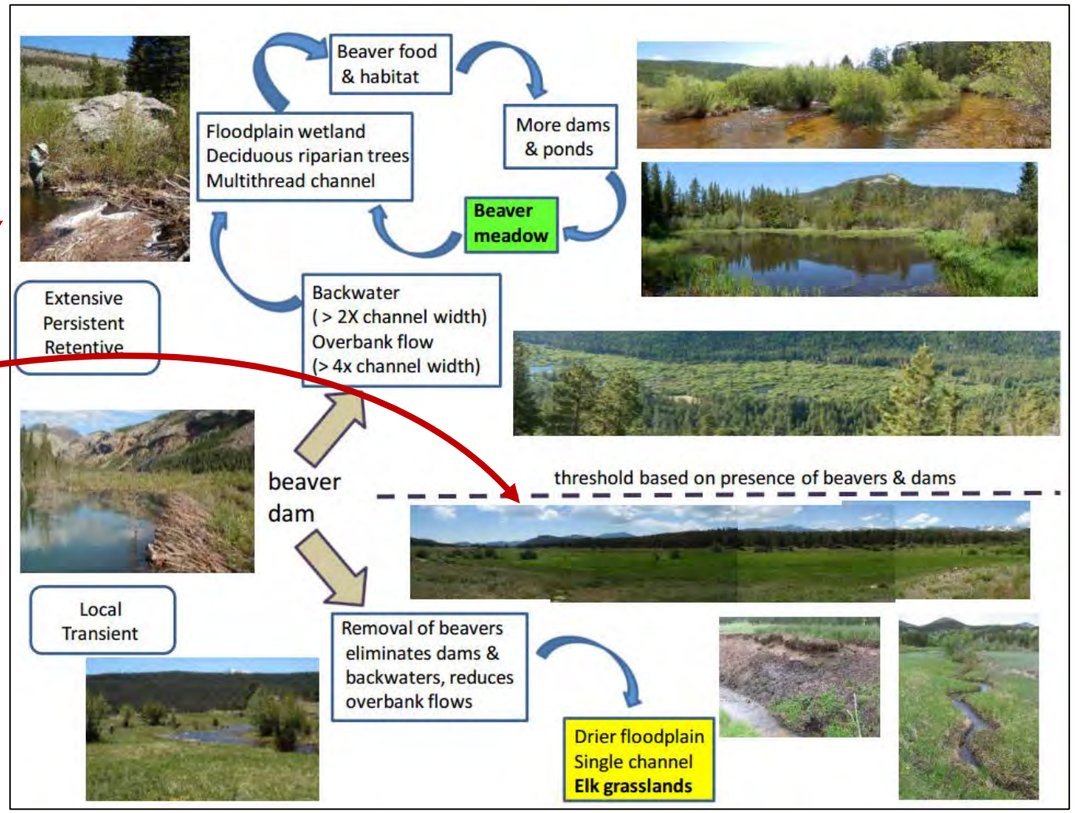


Stream health – Functional assessment of small beaver streams

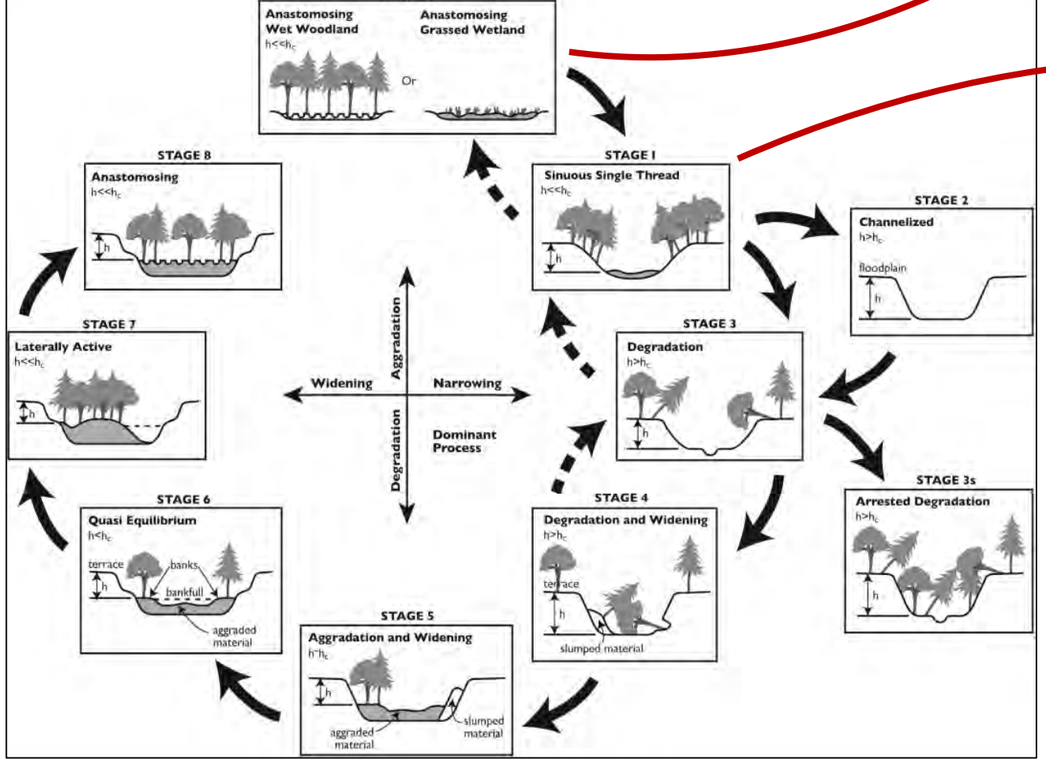
Stream health and function of small beaver streams depends, to a large degree, on whether beavers are active.

- Active beaver complexes like Sheep 1, and Twelvemile 1, correspond to Stage 0 in the Stream Evolution model (lower left diagram), which has the most habitat and ecological benefits (upper left chart).
- Temporarily and partially inactive beaver complexes like Sheep 2 & 3 and Twelvemile 2 & 3, still fall into the Stage 0 category but have decreased habitat and ecological benefits.
- Inactive beaver complexes like Cave 2 & 3 have shifted to Stage 1 with even fewer habitat and ecological benefits.
- Streams that incise go through advanced stages with extreme loss of function. The streams on Twelvemile Ranch are at low risk of further incision.

The diagram below describes the shift from Stage 0 to Stage 1 as a threshold of beaver activity.



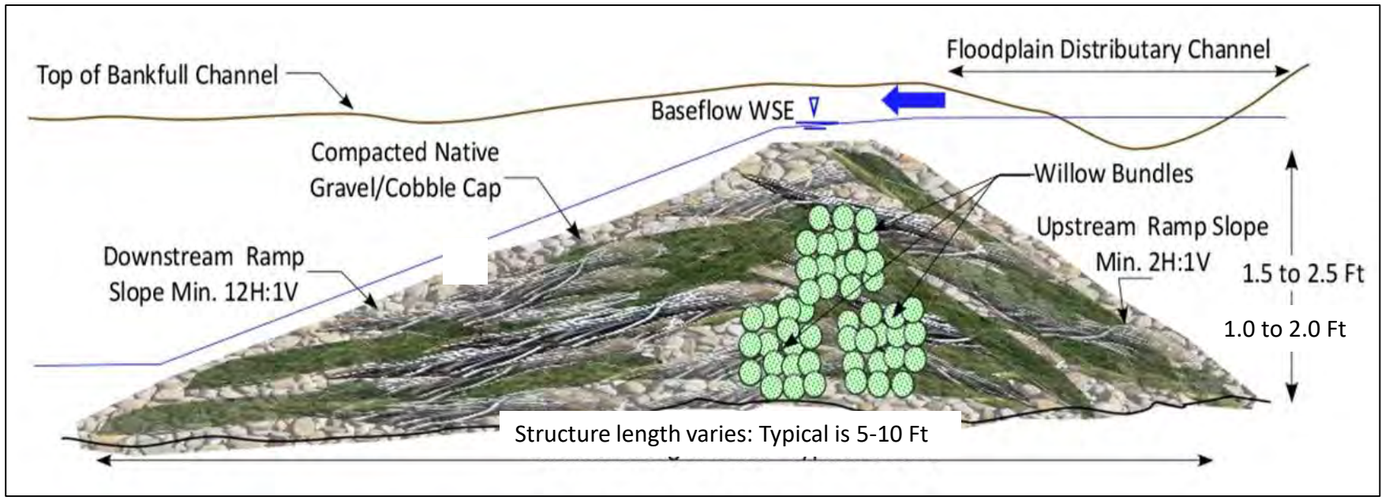
↑ This diagram (Wohl 2018) describes the transition from beaver complex (Stage 0) to single-thread stream channel (Stage 1) occurs when beaver activity declines below a threshold.



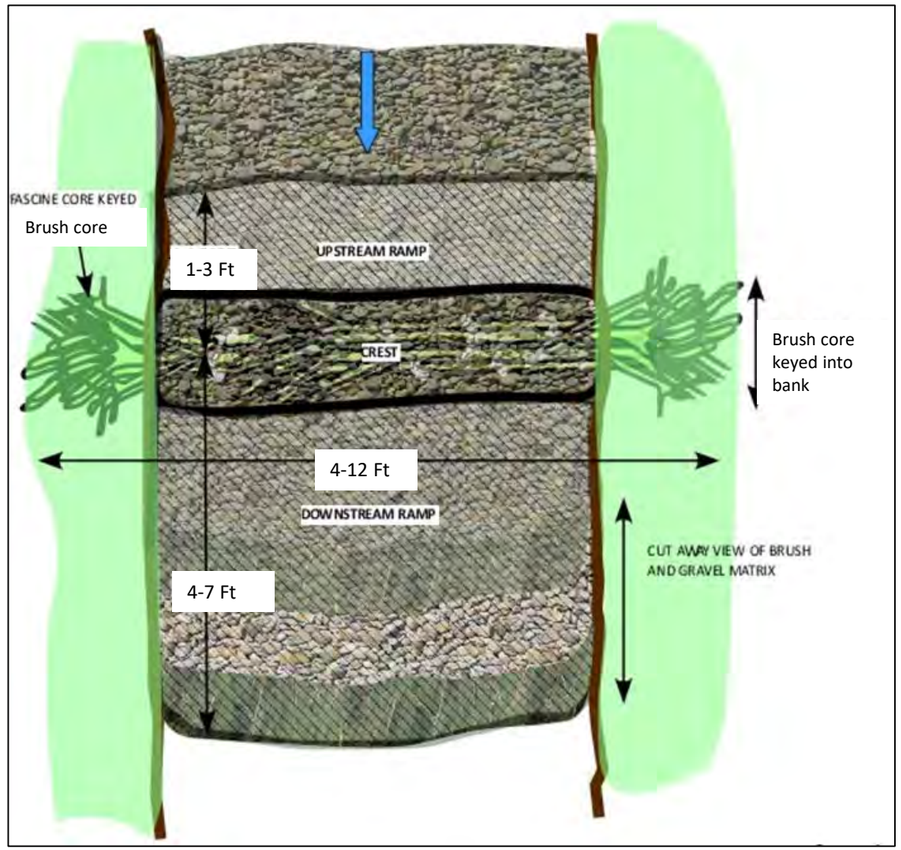
← The Stream Evolution Model (Cluer and Thorne 2014) describes how natural, highly functional floodplain-connected streams can degrade and erode further into deep gullies. The level of stream function, and hydrologic, habitat, and ecosystem benefits depends on the stage in this geomorphic evolution process.

Restoration concepts: Beaver dam repair and rebuilding

Repairing or reconstructing beaver dams in places where beavers have been inactive is a good way to ensure continued function and habitat benefits during periods of prolonged beaver absence. Repaired dams also create deep water and cover that attracts dispersing beavers and entices them to recolonize an area. These treatments are highly recommended on Cave Creek, and could also be employed a spot treatments along Sheep and Twelvemile Creeks.



↑Repairing breached beaver dams with coir logs and sod. ↓ Before and after.



Design specs

The diagrams above and left show specifications for repairing cross-channel dams. These structures are designed to persist through normal runoff events, but are not permanent. They are constructed of native materials that assimilate into the streamscape over time.

Heavy equipment can greatly improve the quality and efficiency of beaver dam repair and construction, especially on larger creeks

Management concepts: Sheep Creek road crossing and diversion

Sheep Creek road and ditch maintenance

The main road into Twelvemile Ranch must be maintained year-round as it is the only access to the Ranch. There is also a diversion with a flume and head gate on Sheep Creek just upstream of the road to divert flow int an irrigation ditch. Flow into the ditch must be regulated according to the adjudicated water right.

Notes:

- There are 3 culverts where the road crosses Sheep Creek.
- Sheep Creek crosses the road through the two west culverts.
- Historically, the main channel was the western one, following flow path 1, with flow into path 2 likely occurring during high flows.
- That pattern is currently reversed. Now most flow follows flow path 2. The main western branch on path 1 is dry during normal summer flow.
- Flow into the ditch (flow path 4) is regulated at the head gate.
- Daily maintenance at the head gate is necessary to prevent beavers from flooding the head gate and diverting water into the ditch via flow paths 3 and 4.

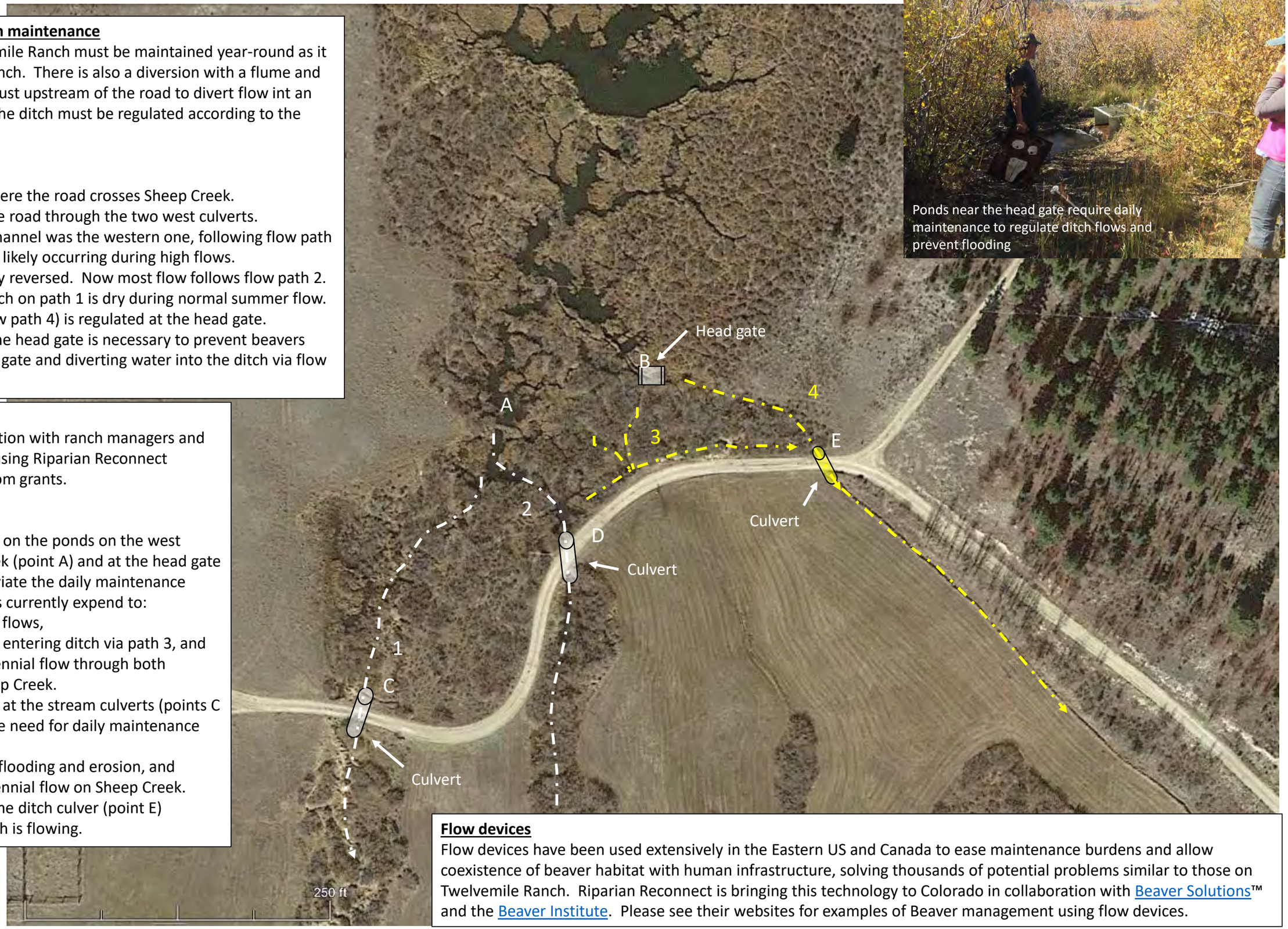
Maintenance strategy

Develop a plan in collaboration with ranch managers and owners, and implement it using Riparian Reconnect expertise and cost share from grants.

Concepts:

- A series of flow devices on the ponds on the west branches of Sheep Creek (point A) and at the head gate (point B) may help alleviate the daily maintenance burden ranch managers currently expend to:
  - (1) manage ditch flows,
  - (2) prevent flows entering ditch via path 3, and
  - (3) maintain perennial flow through both branches of Sheep Creek.
- Additional flow devices at the stream culverts (points C and D) may alleviate the need for daily maintenance to:
  - (1) prevent road flooding and erosion, and
  - (2) maintain perennial flow on Sheep Creek.
- Continue maintaining the ditch culver (point E) manually while the ditch is flowing.

Ponds near the head gate require daily maintenance to regulate ditch flows and prevent flooding



Flow devices

Flow devices have been used extensively in the Eastern US and Canada to ease maintenance burdens and allow coexistence of beaver habitat with human infrastructure, solving thousands of potential problems similar to those on Twelvemile Ranch. Riparian Reconnect is bringing this technology to Colorado in collaboration with Beaver Solutions™ and the Beaver Institute. Please see their websites for examples of Beaver management using flow devices.

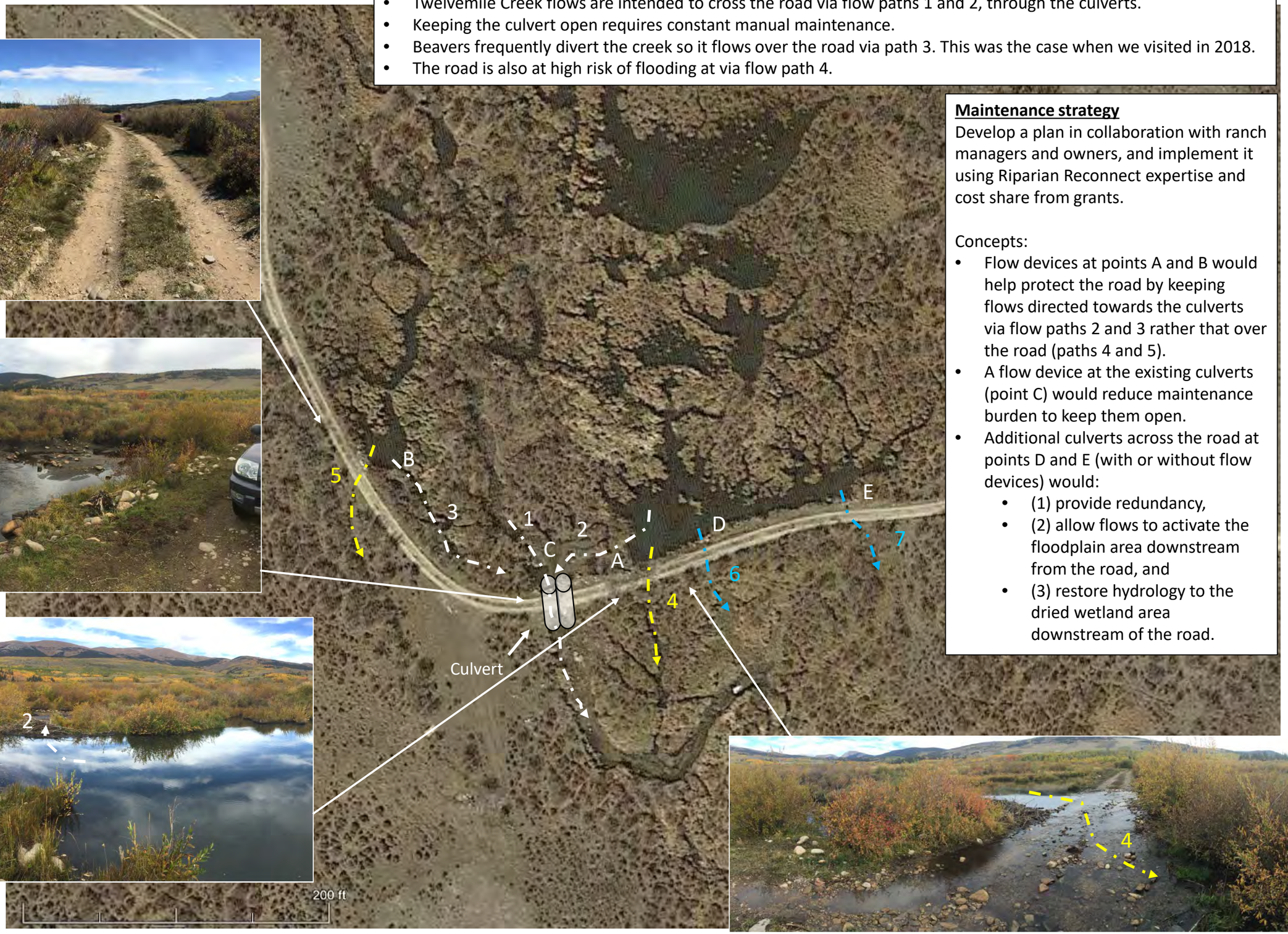
Management concepts: Twelvemile Creek road crossing

Twelvemile Creek road maintenance

Road flooding and road damage are common where the road crosses Twelvemile Creek.

Notes:

- Twelvemile Creek flows are intended to cross the road via flow paths 1 and 2, through the culverts.
- Keeping the culvert open requires constant manual maintenance.
- Beavers frequently divert the creek so it flows over the road via path 3. This was the case when we visited in 2018.
- The road is also at high risk of flooding at via flow path 4.



Maintenance strategy

Develop a plan in collaboration with ranch managers and owners, and implement it using Riparian Reconnect expertise and cost share from grants.

Concepts:

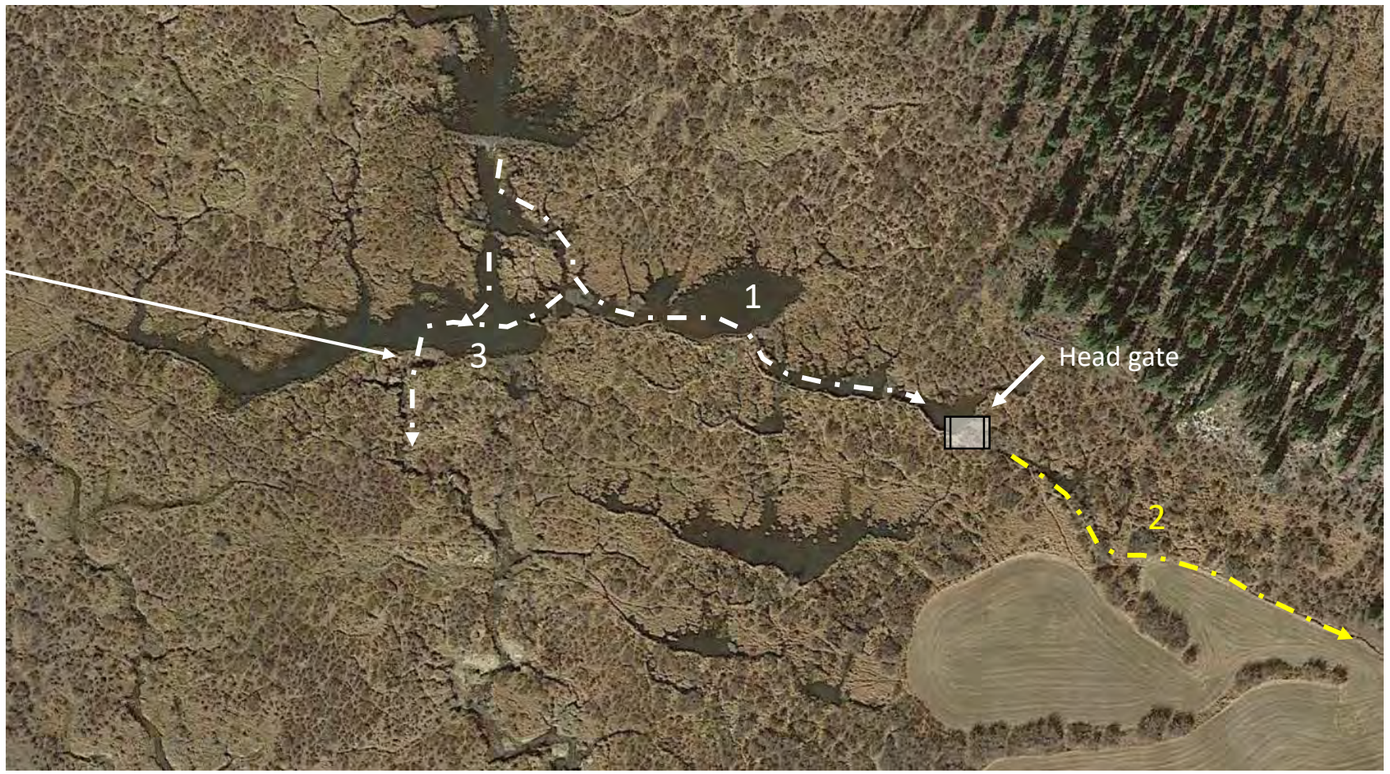
- Flow devices at points A and B would help protect the road by keeping flows directed towards the culverts via flow paths 2 and 3 rather that over the road (paths 4 and 5).
- A flow device at the existing culverts (point C) would reduce maintenance burden to keep them open.
- Additional culverts across the road at points D and E (with or without flow devices) would:
  - (1) provide redundancy,
  - (2) allow flows to activate the floodplain area downstream from the road, and
  - (3) restore hydrology to the dried wetland area downstream of the road.

Upper ranch road crossing
Depending on beaver activity upstream, a portion of Twelvemile Creek flows follow the flow path shown, flooding the road as it was in 2018. A culvert and possibly a flow device could help manage this situation.

Twelvemile diversion maintenance
For the diversion to function, some portion of flow must follow path 1 to the head gate and ditch (path 2). A beaver dam that failed in 2018 greatly increases the risk of this path drying up, as flows preferentially direct towards path 3. Repairing this dam would mitigate this risk to the water right. Flow devices could also be considered if necessary.

Management concepts: Upper ranch road crossing

Management concepts: Twelvemile diversion



Riparian Reconnect restoration plan and timeline for Twelvemile Ranch

Beaver maintenance (conflict management)

Goal

- Manage beaver behavior to maintain ranch infrastructure while maximizing habitat and ecosystem benefits

Objectives

- Provide for continued beaver activity near roads, diversions, ditches, hay meadows, and other infrastructure
- Reduce risk of road flooding and road damage
- Maintain flow to diversion points so irrigation water rights can be efficiently exercised
- Prevent out-of-priority diversions caused by flooding into ditches
- Reduce negative impacts of roads and infrastructure on stream and riparian health
- Reduce maintenance burden

Strategy and timeline

- Develop partnership (spring 2019)
  - Meet with landowners and ranch managers
  - Present and develop beaver maintenance concepts
- Secure funding (spring 2019)
  - Allocate existing funds as available
  - Identify funding needs
  - Pursue additional grant funds and landowner cost-share as needed
- Prepare detailed design and budget (spring 2019)
  - Sheep Creek road crossing and diversion ditch
  - Twelvemile Creek road crossing
  - Upper ranch road crossing
  - Twelvemile diversion and irrigation ditch
  - Other areas
- Implement treatments (summer 2019)
  - Construction and oversight by Riparian Reconnect technical team
  - Construction support and assistance from Twelvemile Ranch manager
- Monitoring and maintenance (ongoing)
  - Routine inspections and maintenance can likely be handled by ranch manager
  - Riparian Reconnect partners can be available for technical assistance

Stream and riparian restoration

Goal

- Improve stream and riparian function and habitat benefits by restoring natural processes typical of healthy small beaver streams

Objectives

- Promote long-term sustainable beaver activity by continuing passive management and riparian protection
- Restore hydrological and ecological functions typical of beaver activity in places where beavers are absent by repairing and rebuilding beaver dams
- Increase beaver activity and consistency by restoring favorable habitat conditions (pond area, deep water, and cover)

Strategy and timeline

- Develop partnership (spring/summer 2019)
  - Meet with landowners and ranch managers
  - Present and develop restoration concepts
  - Field trip with full Riparian Reconnect team to prioritize restoration efforts and scope
- Secure funding (summer/fall 2019)
  - Allocate existing funds as available
  - Identify funding needs
  - Pursue additional grant funds and landowner cost-share as needed
  - Quantify existing functional conditions and habitat, and identify potential gains for funding proposals
- Prepare detailed design and budget (fall/winter 2019)
  - Cave Creek – beaver dam repair/rebuild project
  - Twelvemile and Sheep Creek spot treatments
- Implement treatments (Summer 2020)
  - Construction and oversight by Riparian Reconnect technical team
  - Construction support and assistance from Twelvemile Ranch manager
- Monitoring and maintenance (ongoing)
  - Restoration monitoring by EcoMetrics (2020-2022)
  - Routine inspections and maintenance can likely be handled by ranch manager
  - Riparian Reconnect partners can be available for ongoing technical assistance

Research , education, and outreach

This partnership and projects will provide excellent opportunities to pursue scientific research studies and for education and outreach to improve understanding and awareness of the importance of healthy headwaters systems for watershed-scale hydrologic benefits, ecosystem services, and fish and wildlife habitat.

Riparian Reconnect

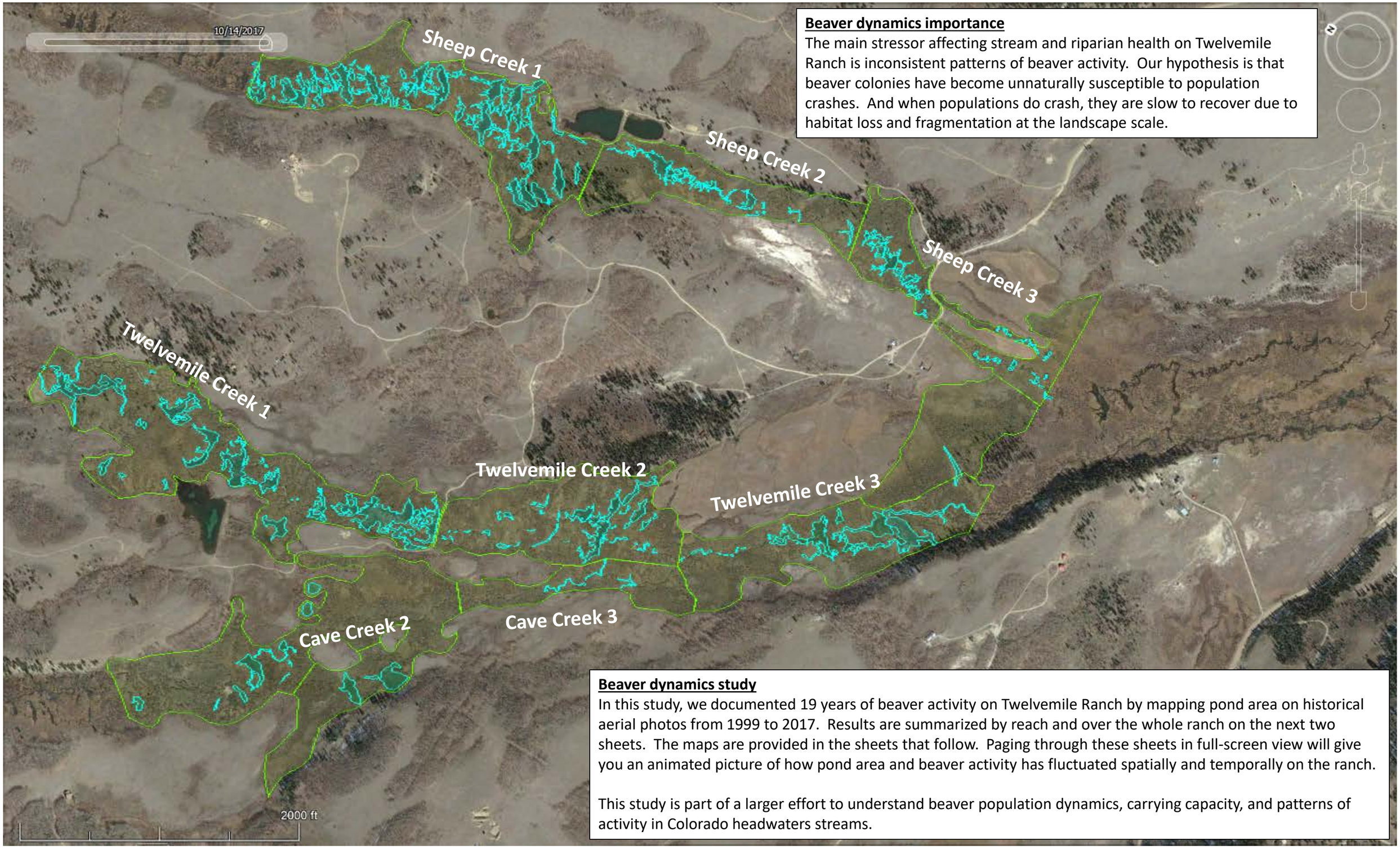
Colorado Open Lands

EcoMetrics
Stream & Riparian Monitoring, Assessment & Restoration

Johnson Environmental Consulting

Gillilan Associates Inc.

Twelvemile Ranch: Beaver stream dynamics study — Introduction



Beaver dynamics importance

The main stressor affecting stream and riparian health on Twelvemile Ranch is inconsistent patterns of beaver activity. Our hypothesis is that beaver colonies have become unnaturally susceptible to population crashes. And when populations do crash, they are slow to recover due to habitat loss and fragmentation at the landscape scale.

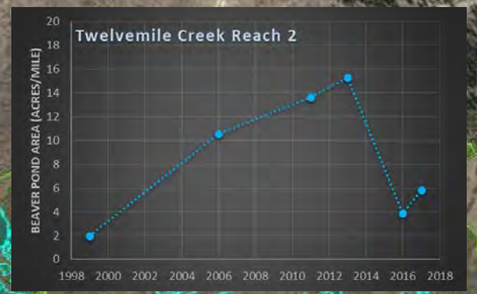
Beaver dynamics study

In this study, we documented 19 years of beaver activity on Twelvemile Ranch by mapping pond area on historical aerial photos from 1999 to 2017. Results are summarized by reach and over the whole ranch on the next two sheets. The maps are provided in the sheets that follow. Paging through these sheets in full-screen view will give you an animated picture of how pond area and beaver activity has fluctuated spatially and temporally on the ranch.

This study is part of a larger effort to understand beaver population dynamics, carrying capacity, and patterns of activity in Colorado headwaters streams.

Twelvemile Ranch: Beaver stream dynamics study — Summary

10/14/2017



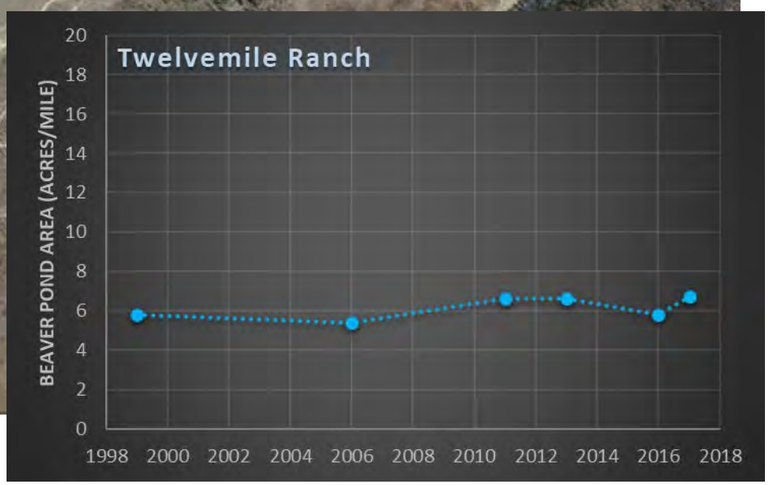
2000 ft

Beaver dynamics summary (by stream mile)

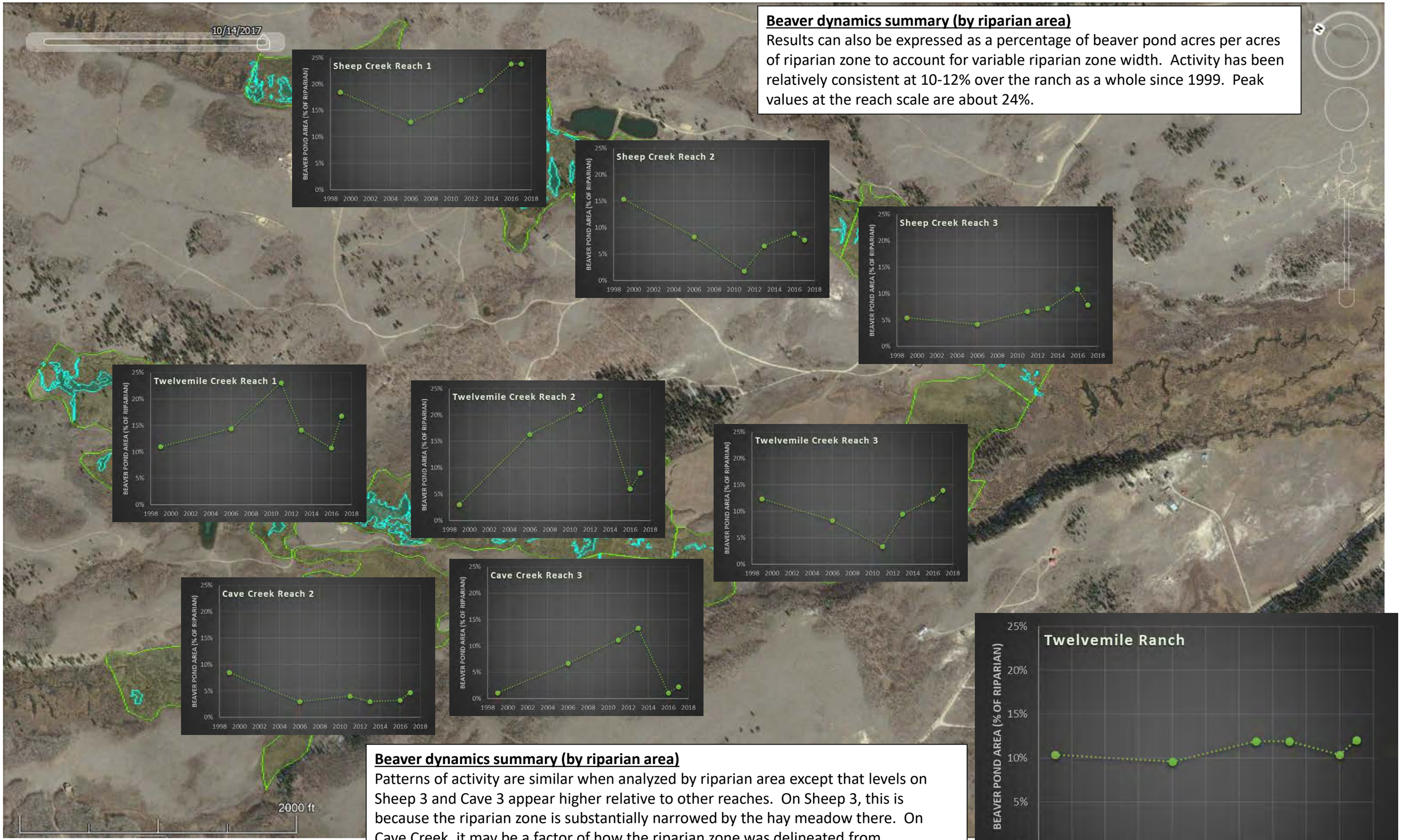
Beaver activity, measured as pond are per stream valley mile, has been consistent over the ranch as a whole since 1999 at about 6 pond acres per mile, but variability within and among reaches is great. Peak values around 14-16 acres/mile on several reaches suggest a carrying capacity near that level.

Beaver dynamics summary (by stream mile)

Sheep 1 and Twelvemile 1 and 2 all reached peak values at 14-16 acres/mile, but they vary in the degree of fluctuation. Sheep 2 and 3, and both the Cave Creek reaches were consistently below 6 acres/mile. All of the reaches except Sheep 1 and Twelvemile 1 had years with less than 2 acres/mile.



Twelvemile Ranch: Beaver stream dynamics study — Summary



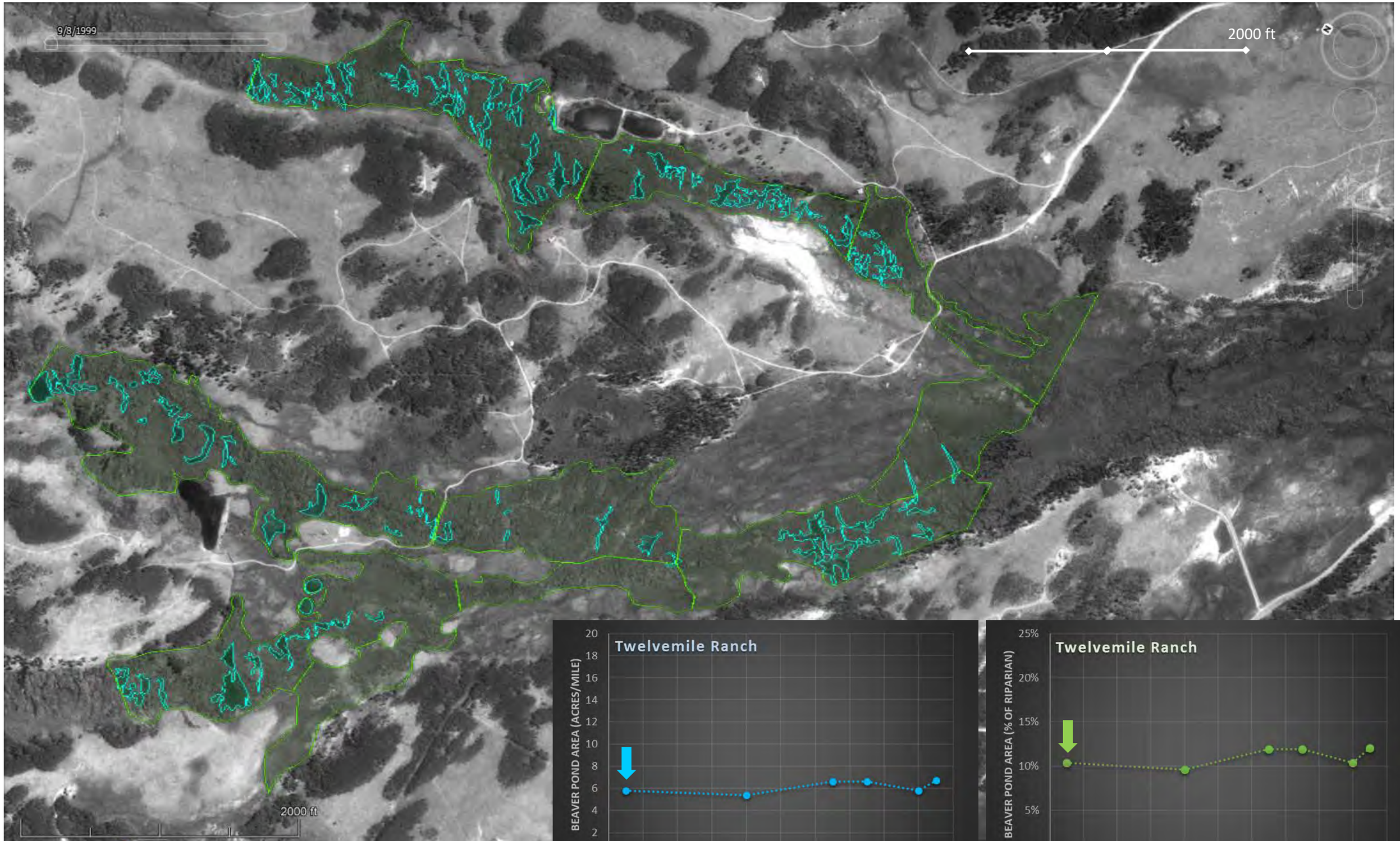
Beaver dynamics summary (by riparian area)

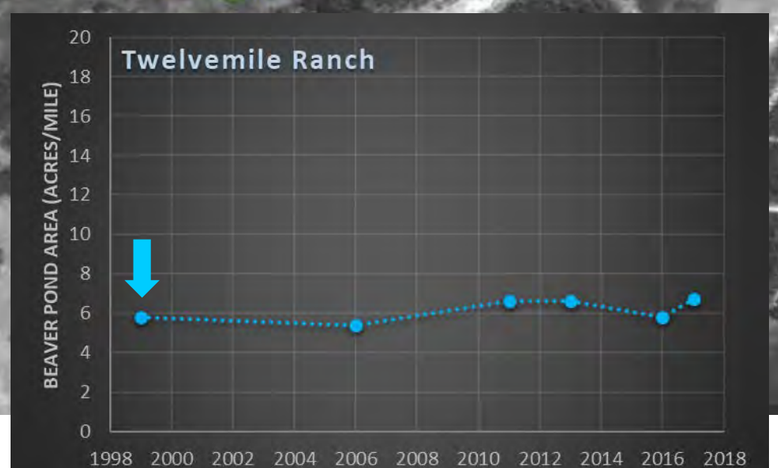
Results can also be expressed as a percentage of beaver pond acres per acres of riparian zone to account for variable riparian zone width. Activity has been relatively consistent at 10-12% over the ranch as a whole since 1999. Peak values at the reach scale are about 24%.

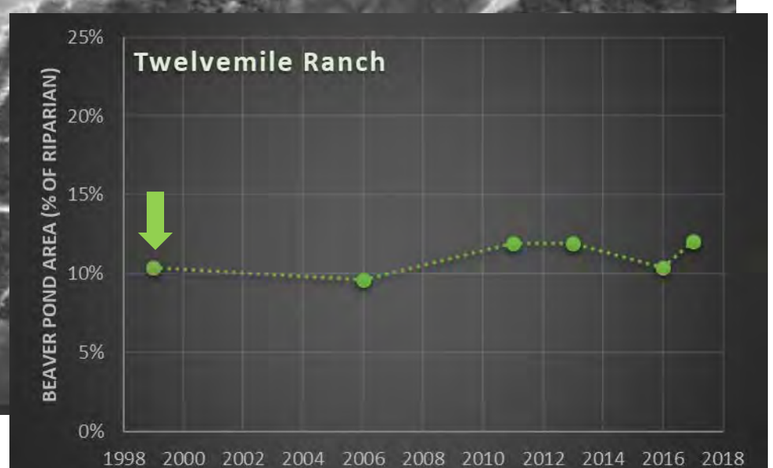
Beaver dynamics summary (by riparian area)

Patterns of activity are similar when analyzed by riparian area except that levels on Sheep 3 and Cave 3 appear higher relative to other reaches. On Sheep 3, this is because the riparian zone is substantially narrowed by the hay meadow there. On Cave Creek, it may be a factor of how the riparian zone was delineated from Twelvemile in the confluence area where the two creeks share the same valley bottom.

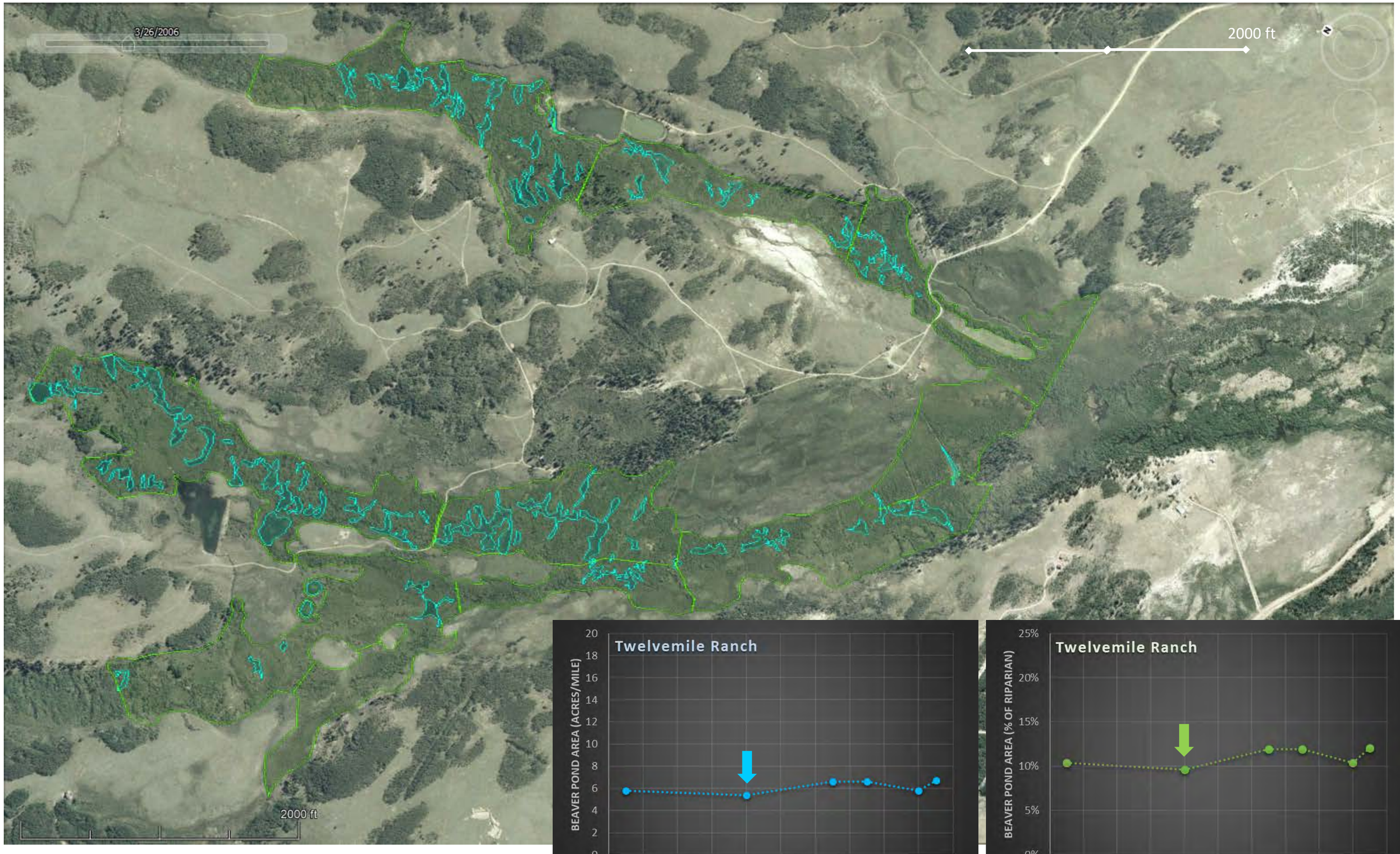
Twelvemile Ranch — 1999

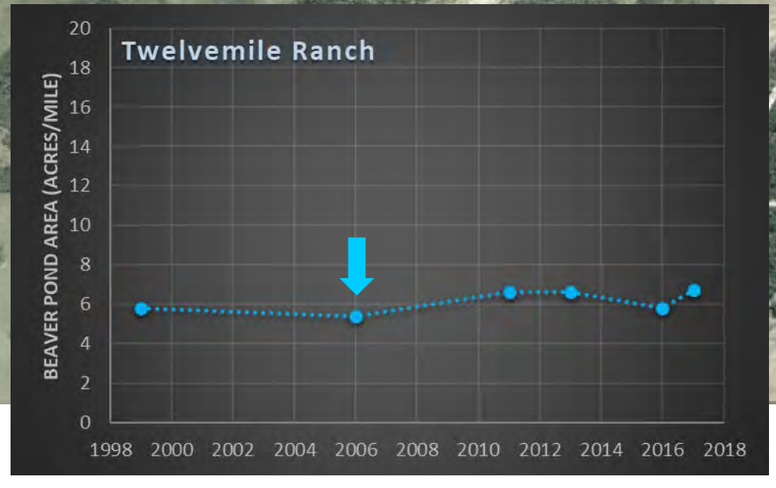


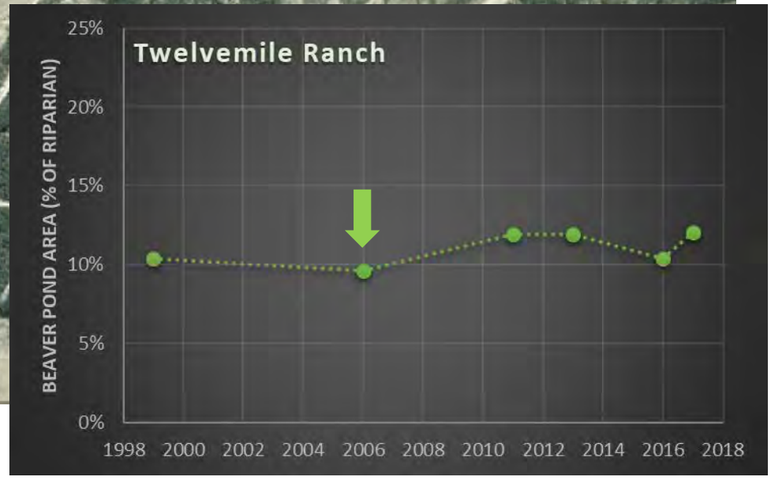




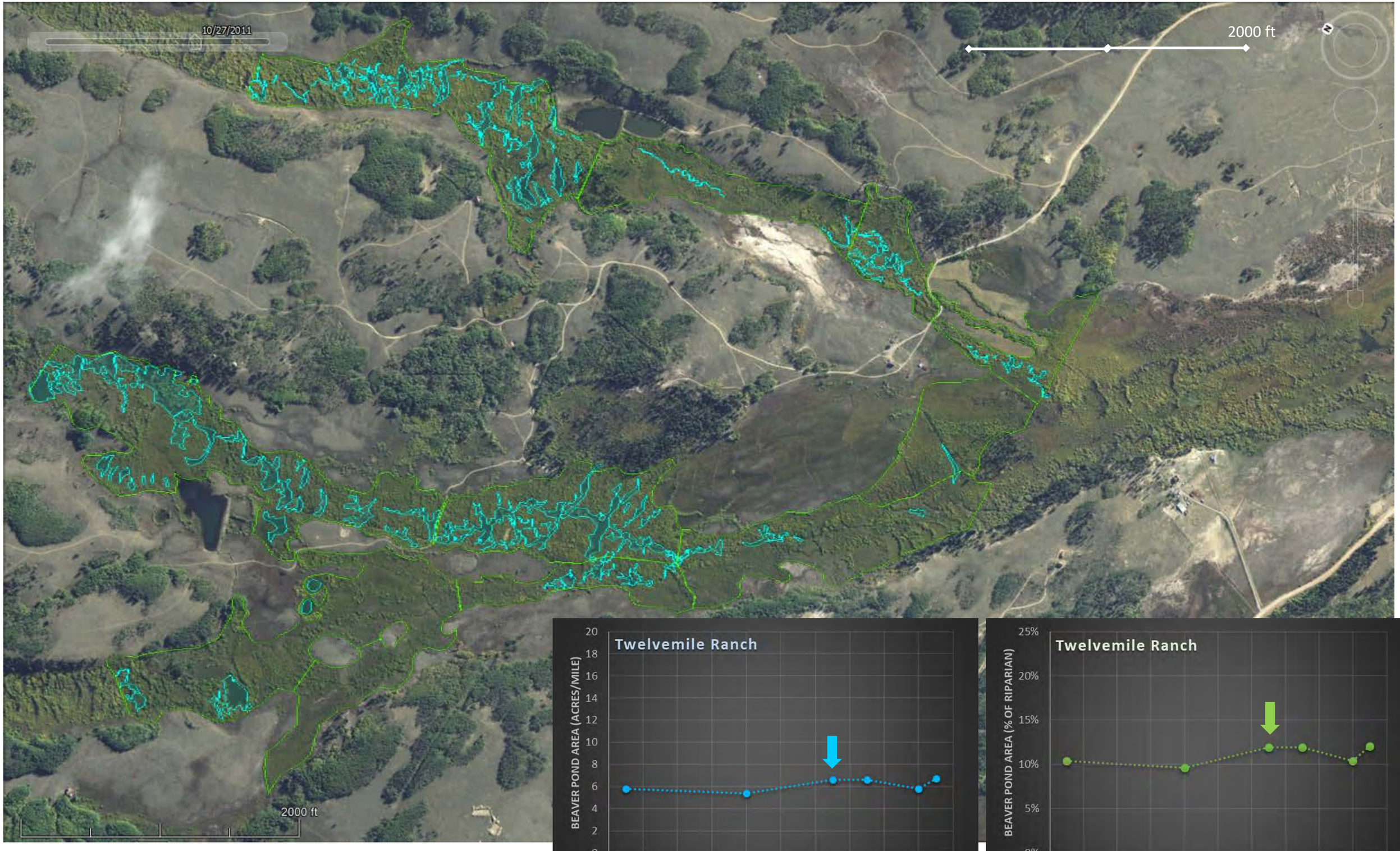
Twelvemile Ranch — 2006

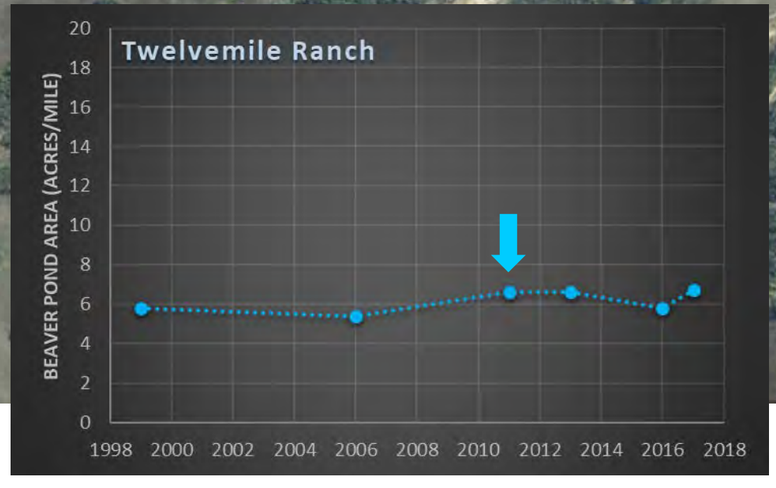


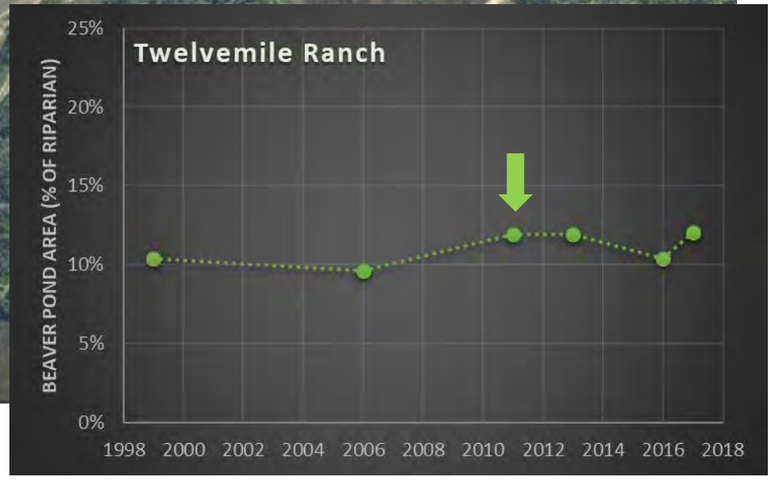




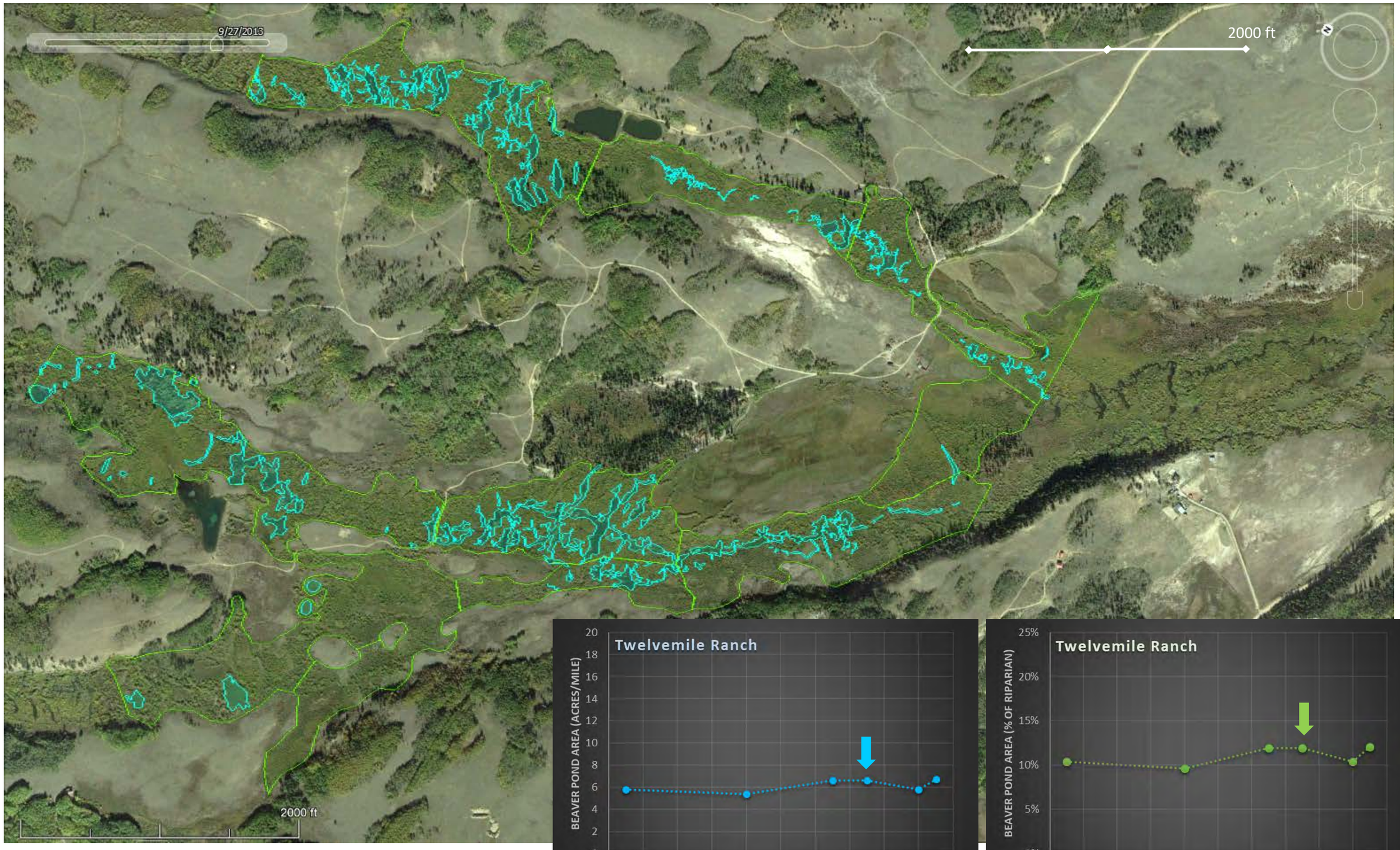
Twelvemile Ranch — 2011

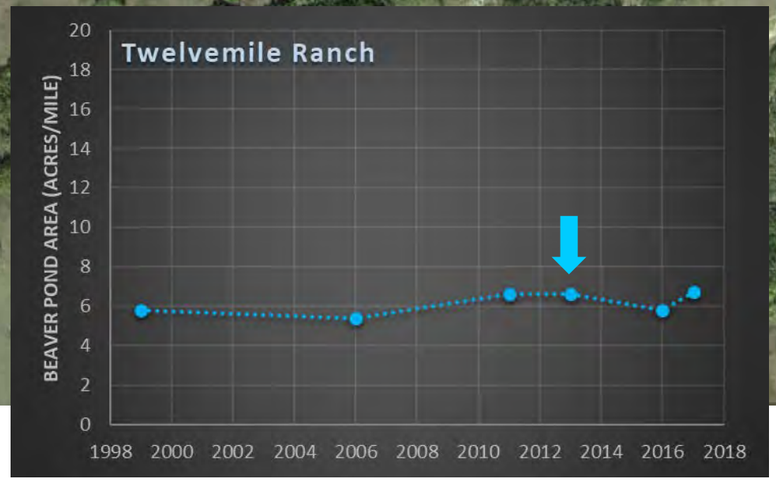


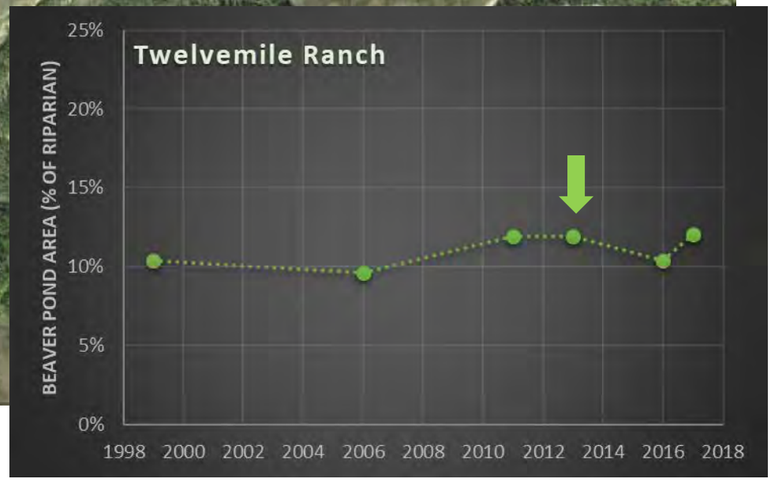




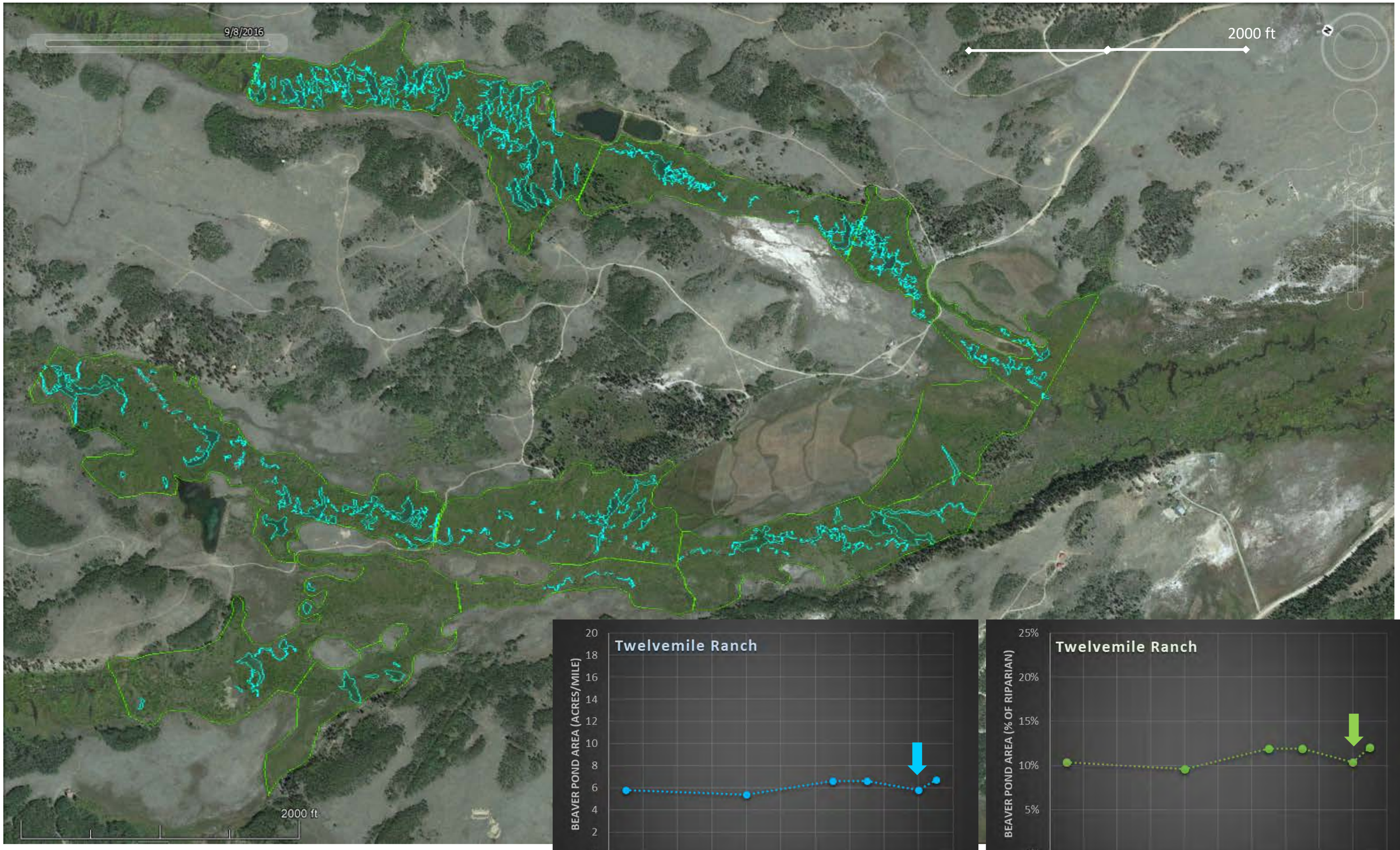
Twelvemile Ranch — 2013

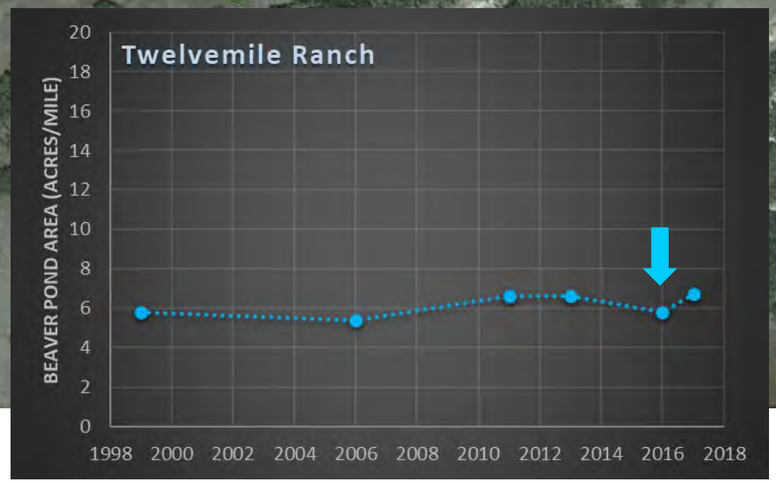


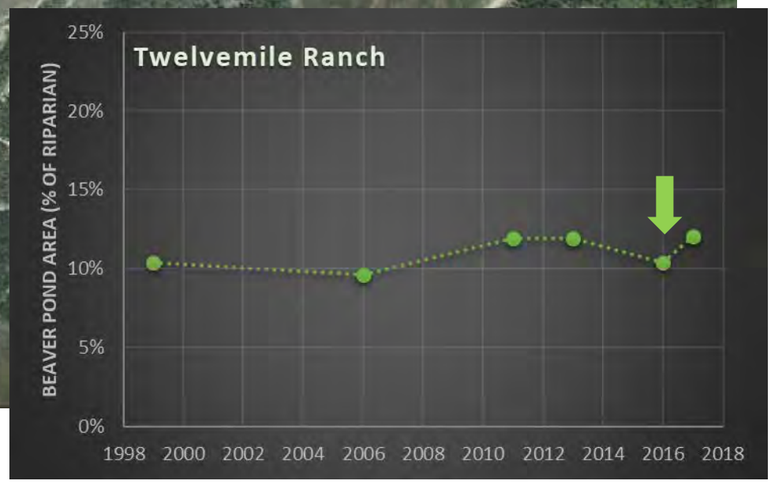




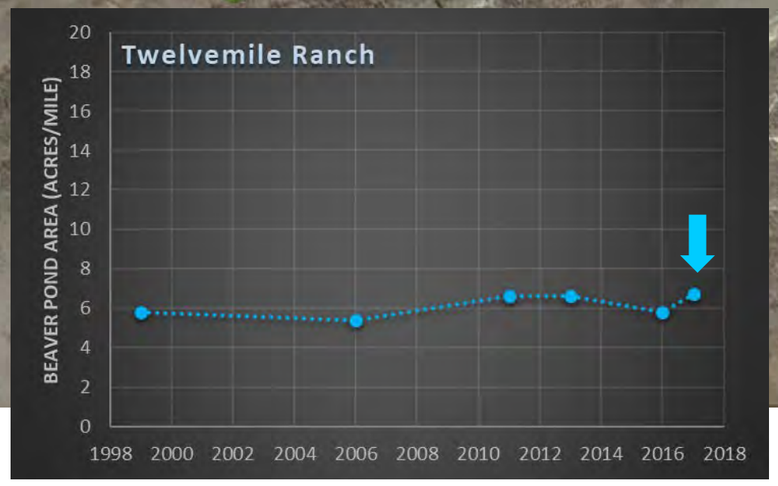
Twelvemile Ranch — 2016

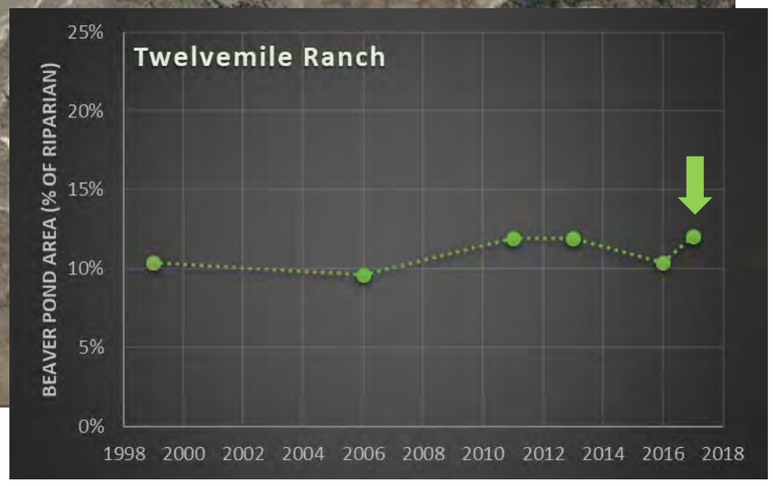




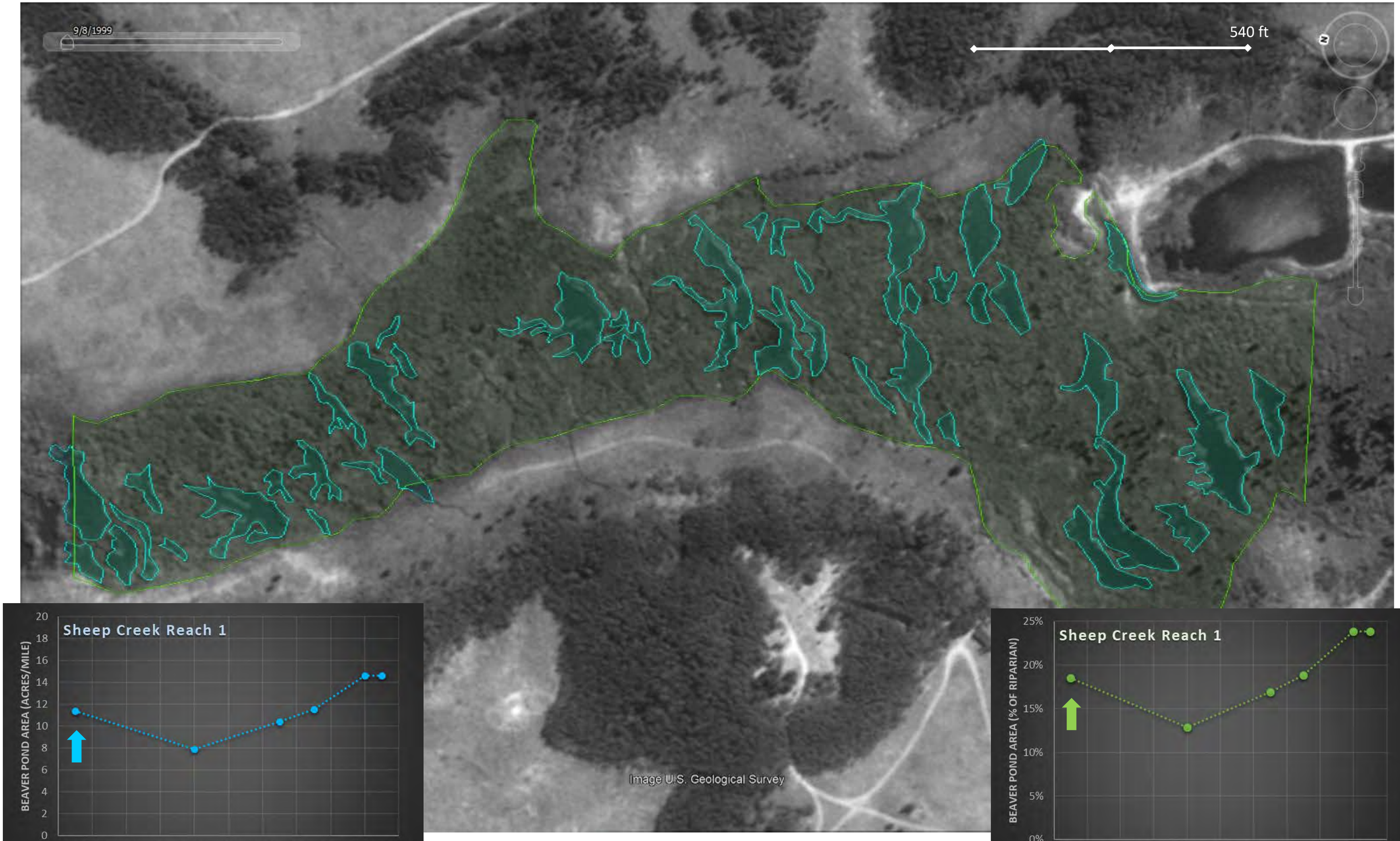


Twelvemile Ranch — 2017



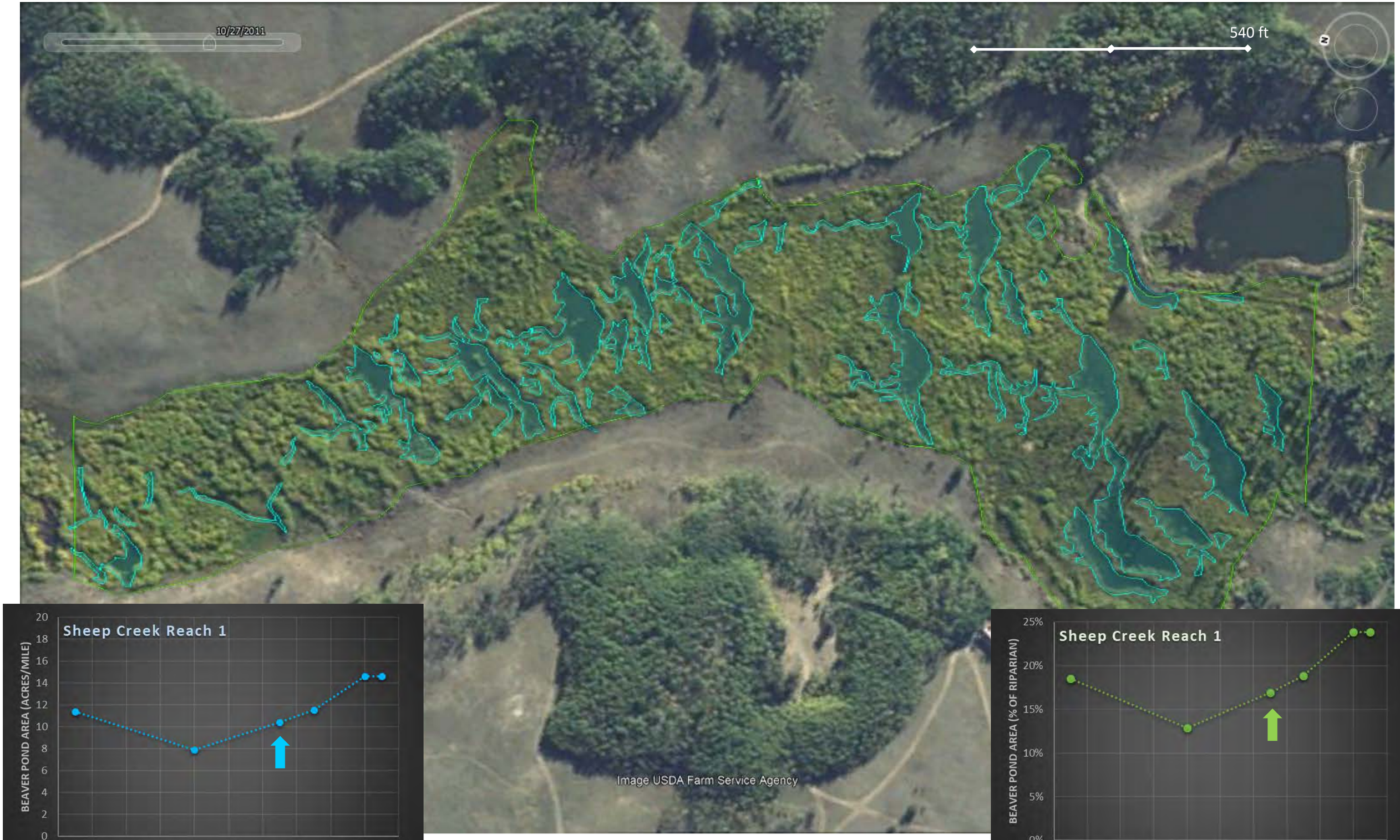


Sheep Creek Reach 1 — 1999



Sheep Creek Reach 1 — 2006

Sheep Creek Reach 1 — 2011



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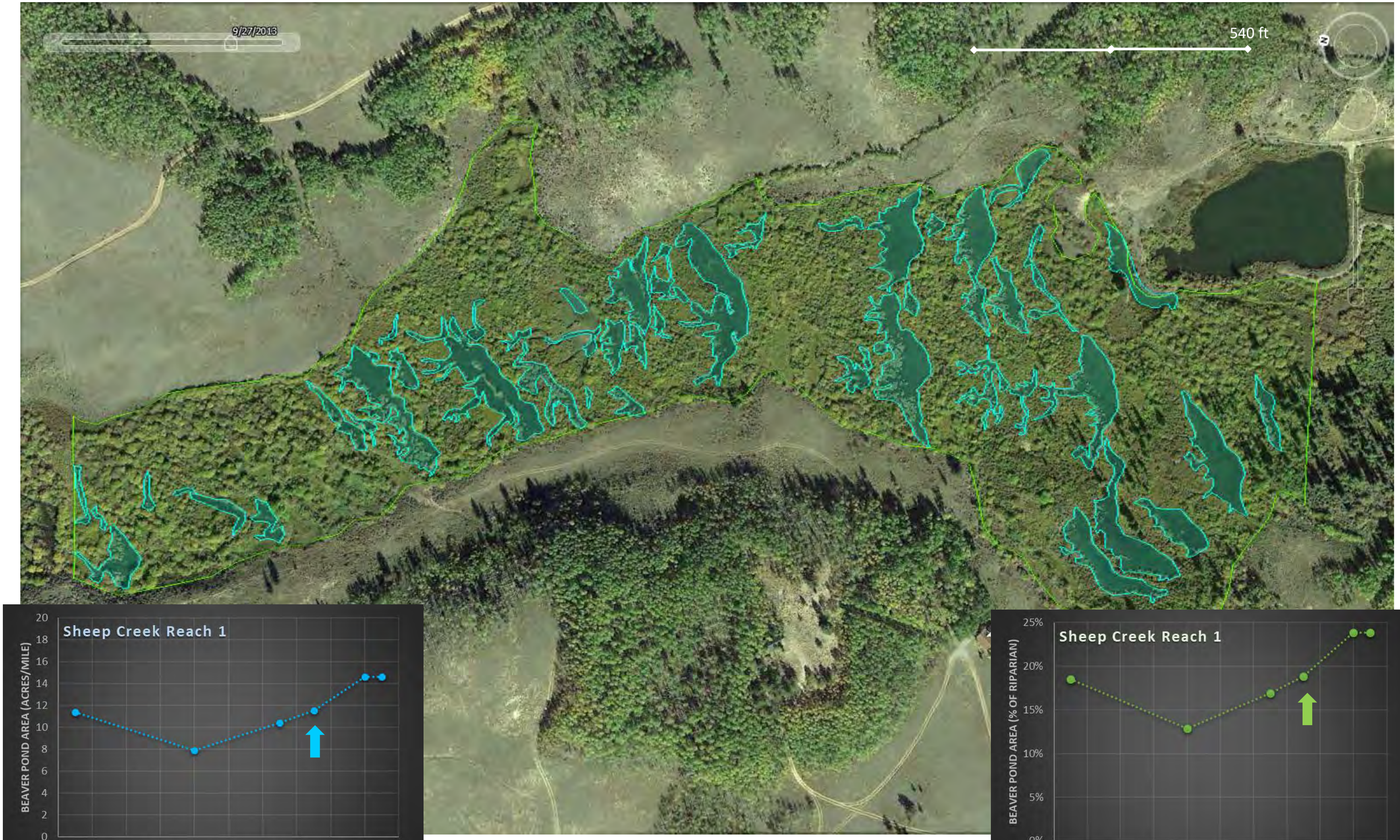
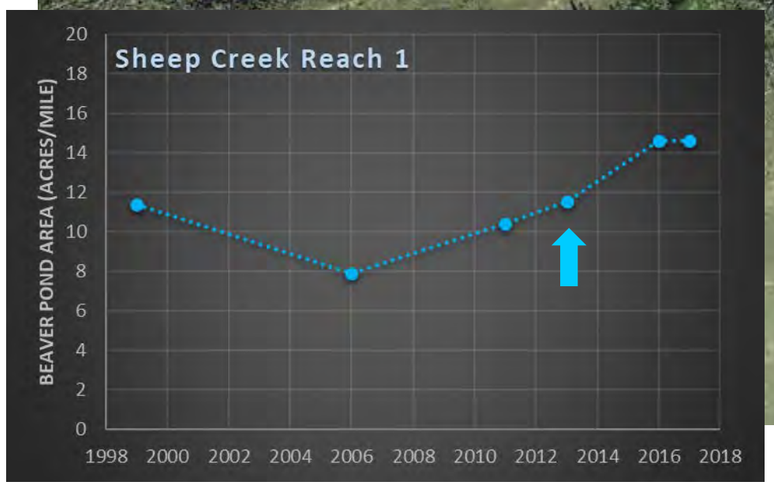
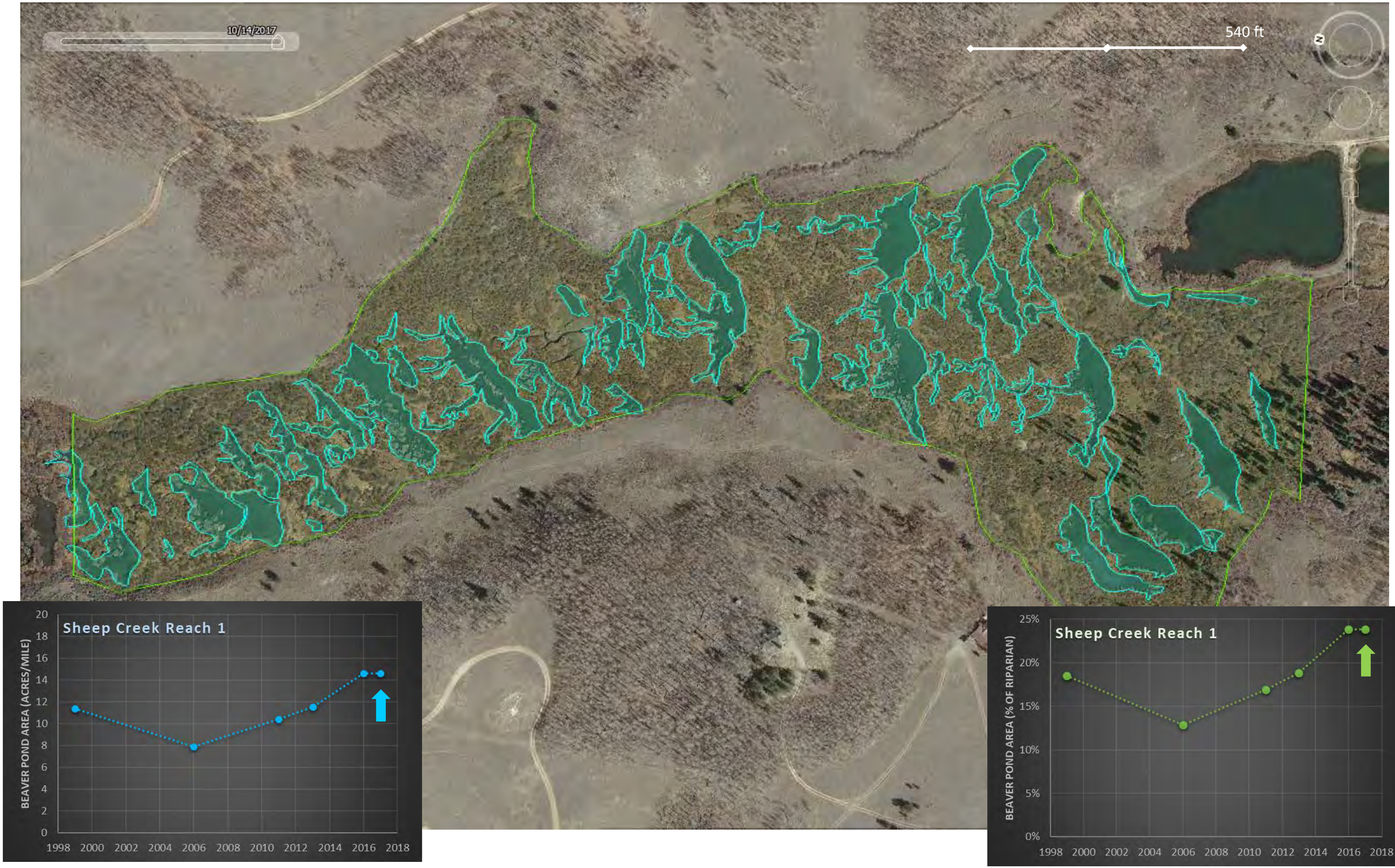




Sheep Creek Reach 1 — 2016

Sheep Creek Reach 1 — 2017



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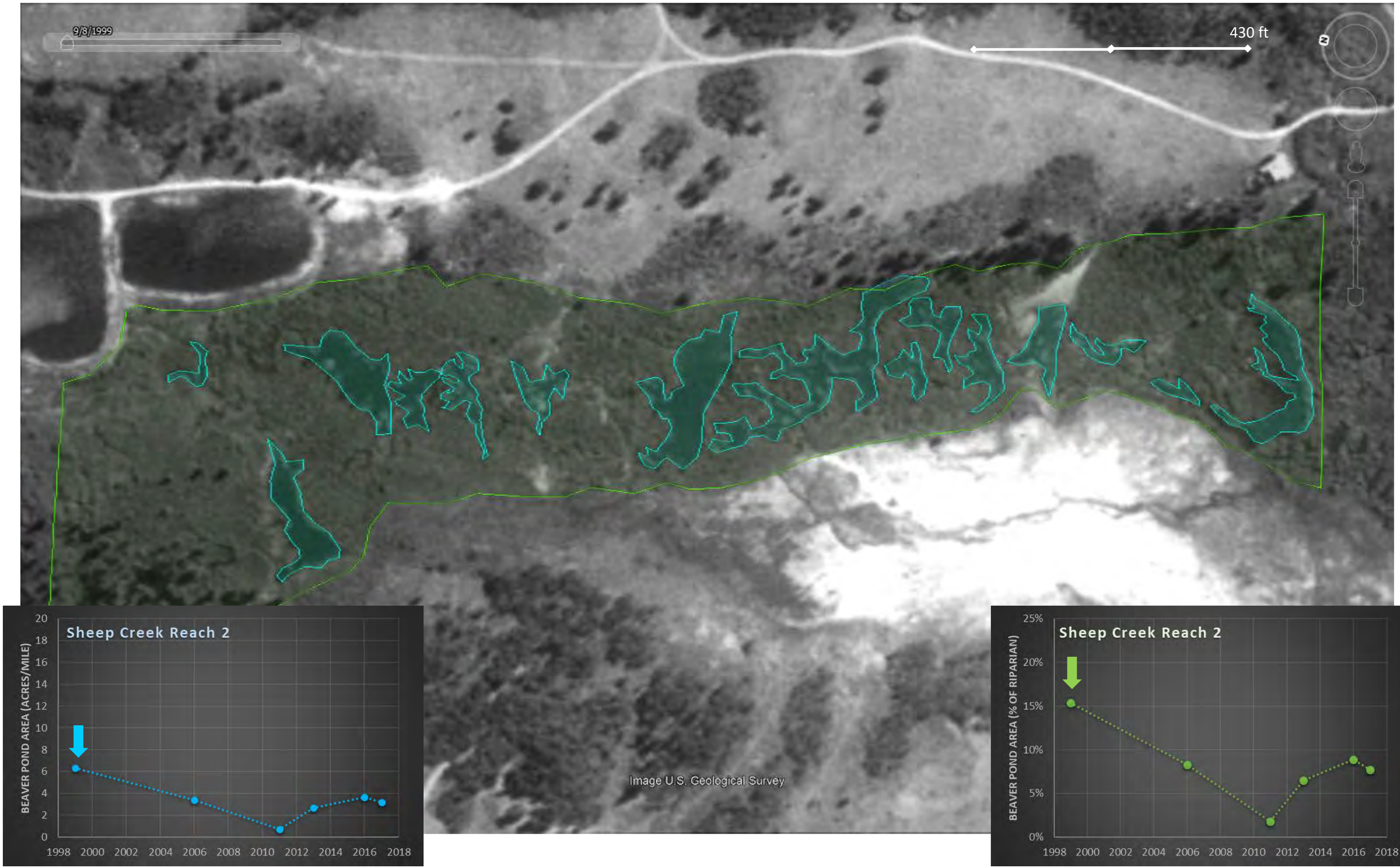

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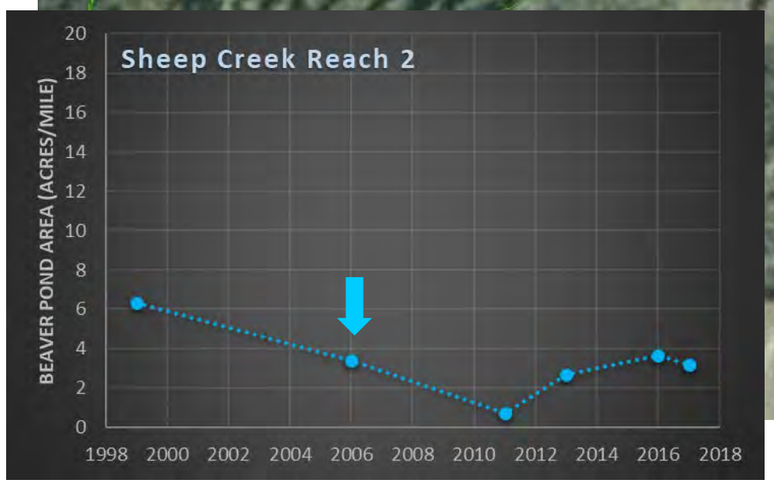

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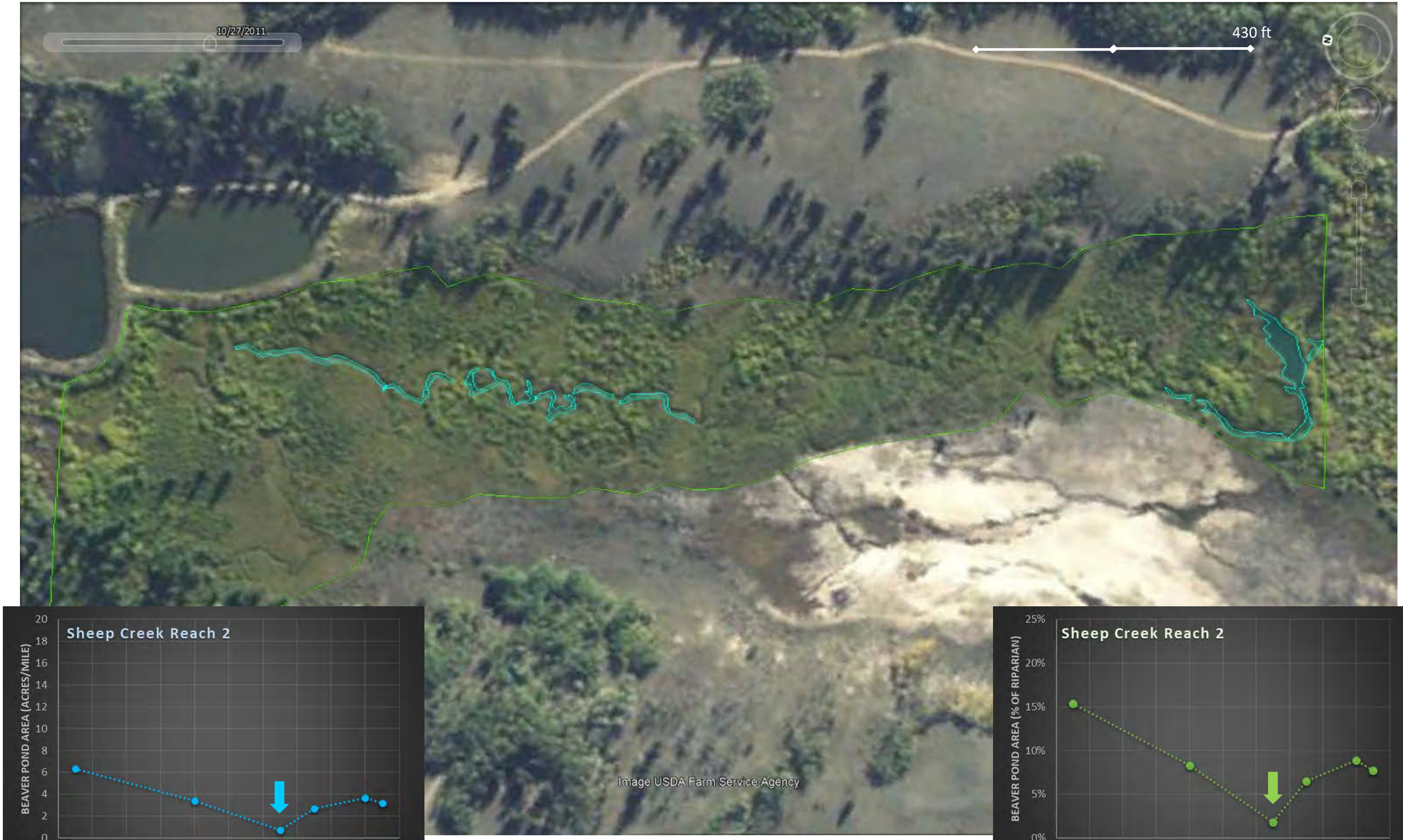

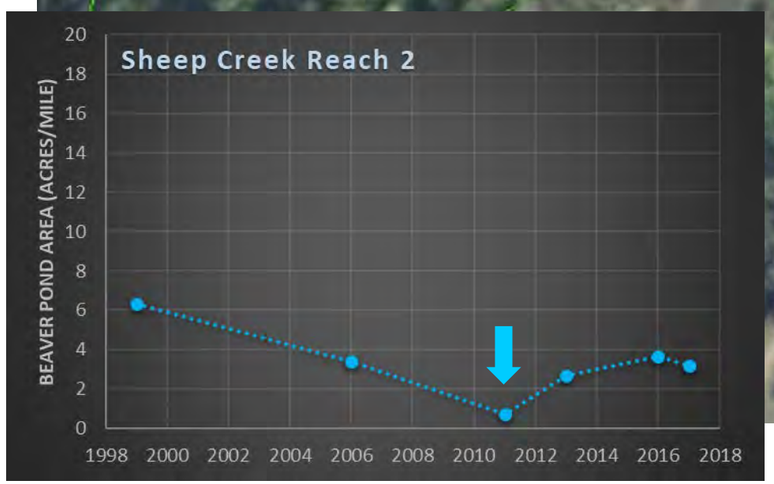

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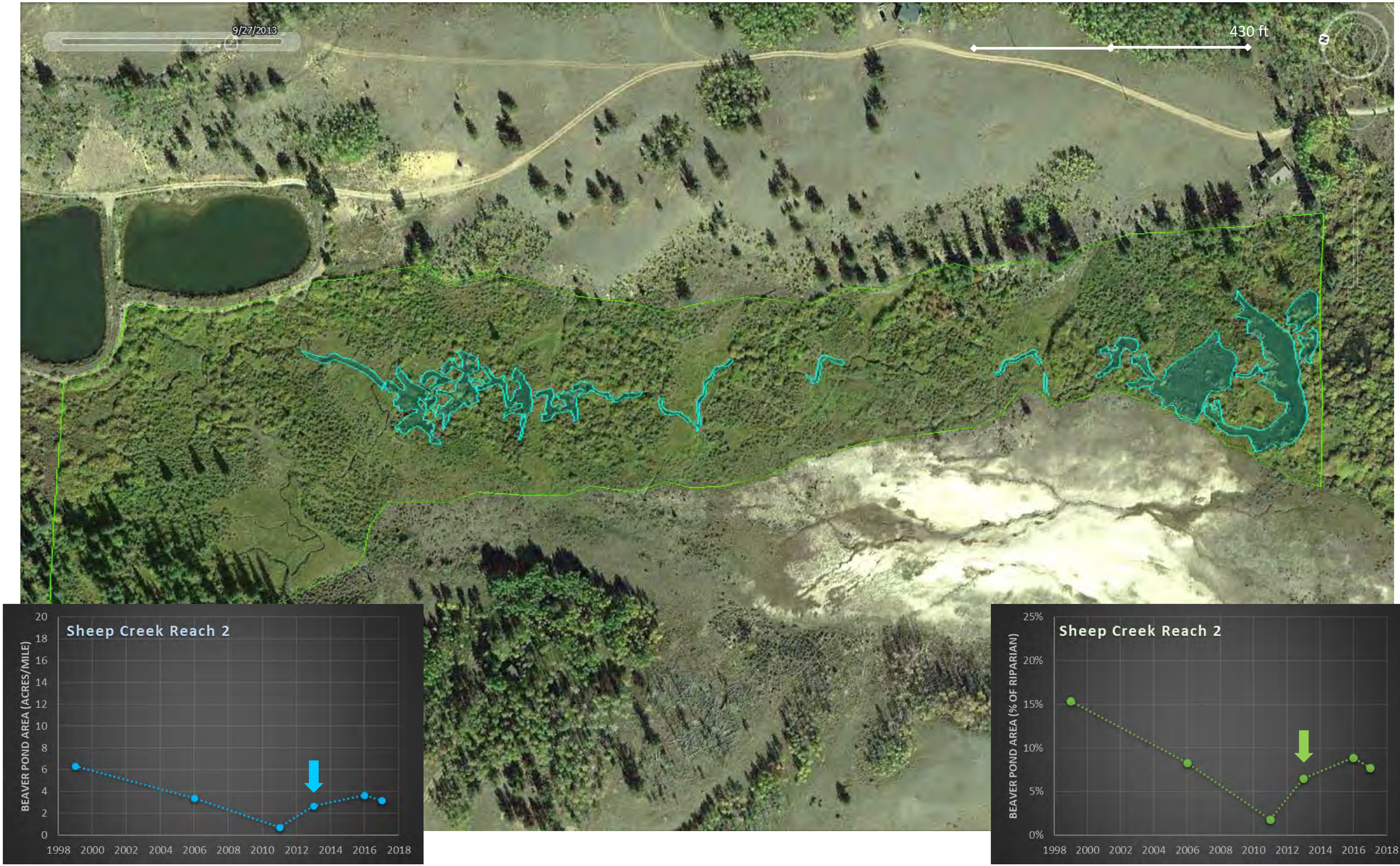

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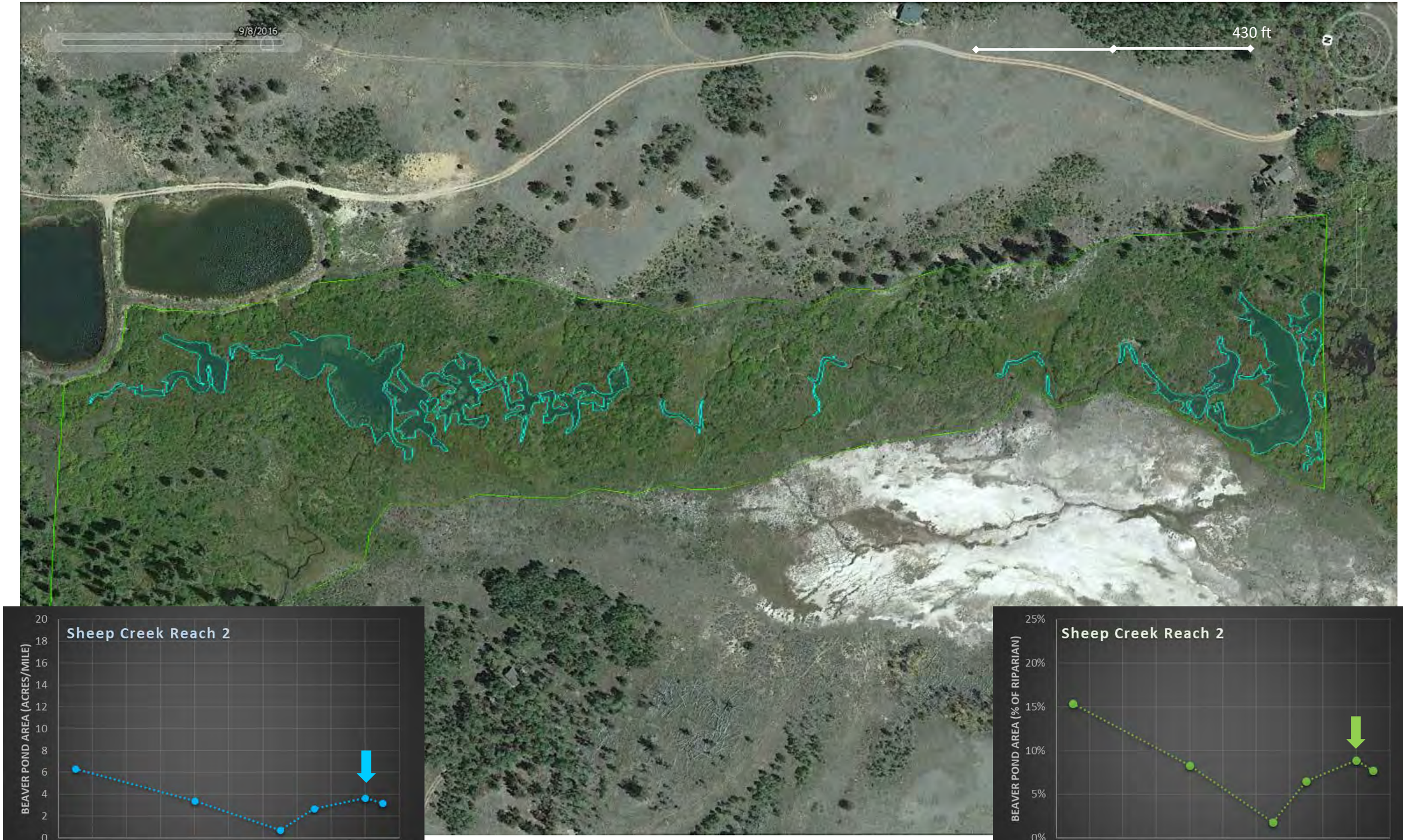

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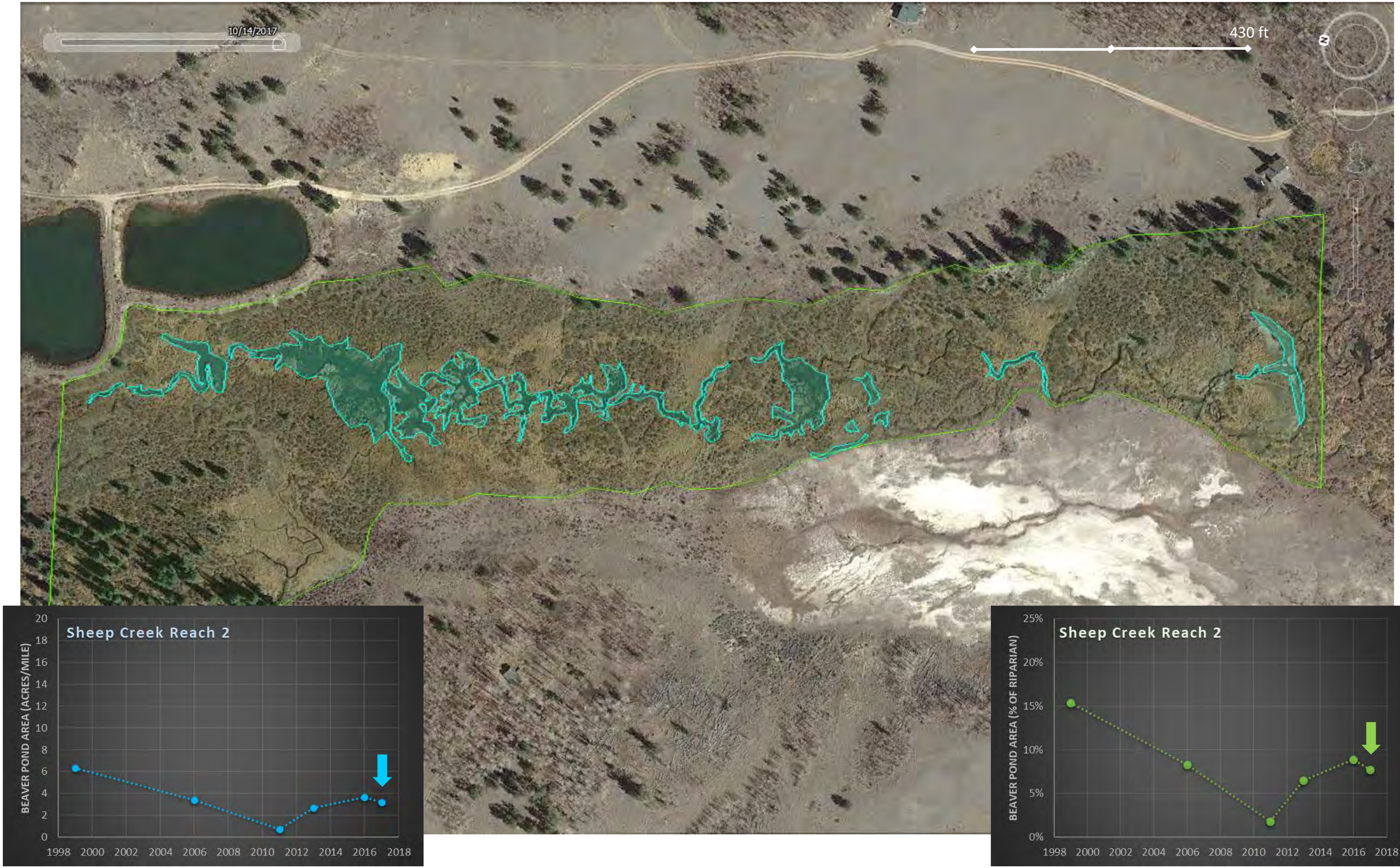
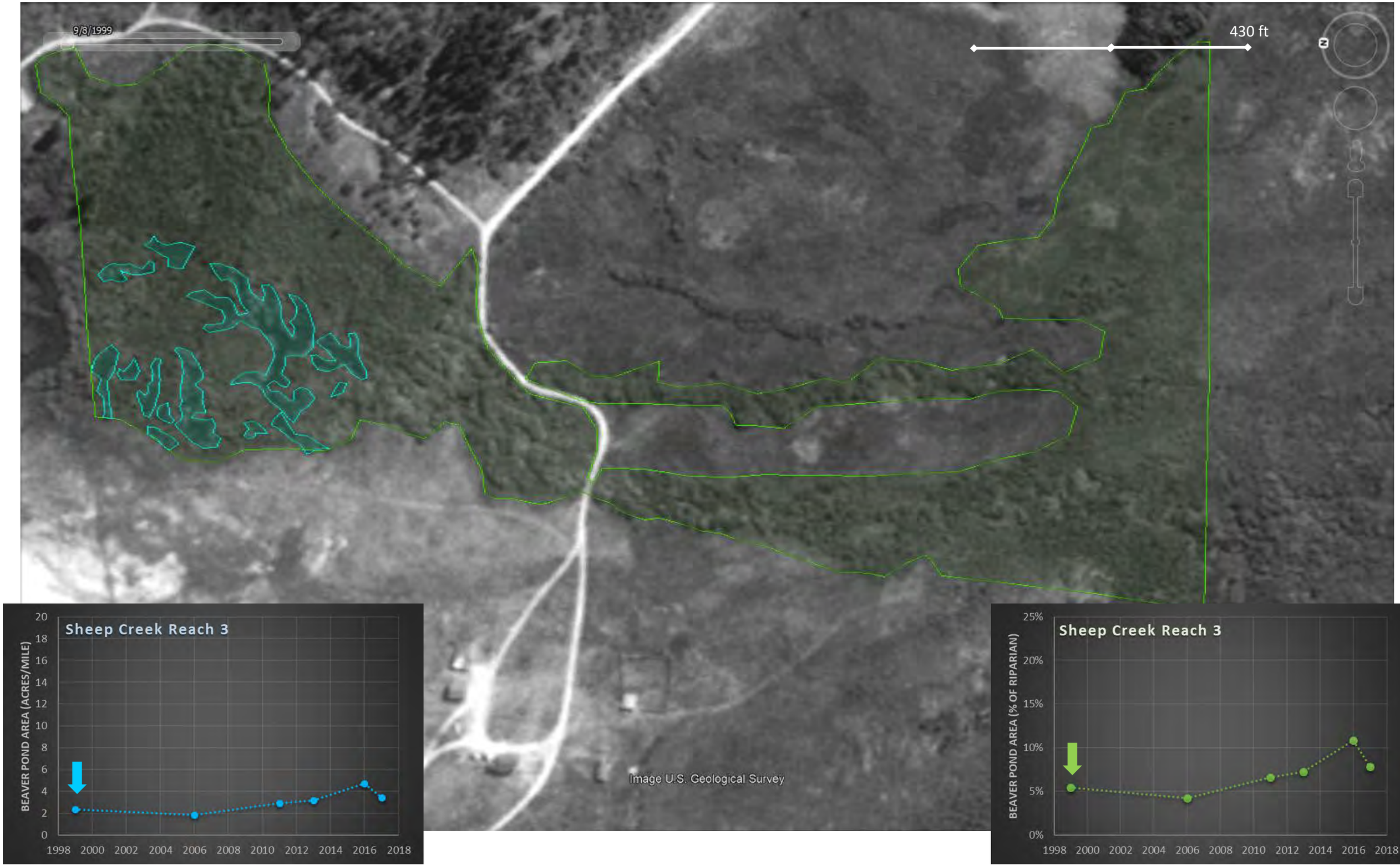


Sheep Creek Reach 3 — 1999



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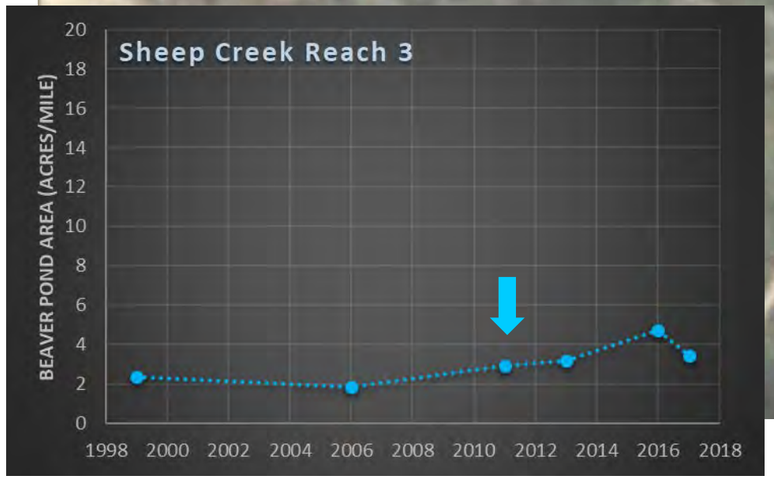
Sheep Creek Reach 3 — 2011



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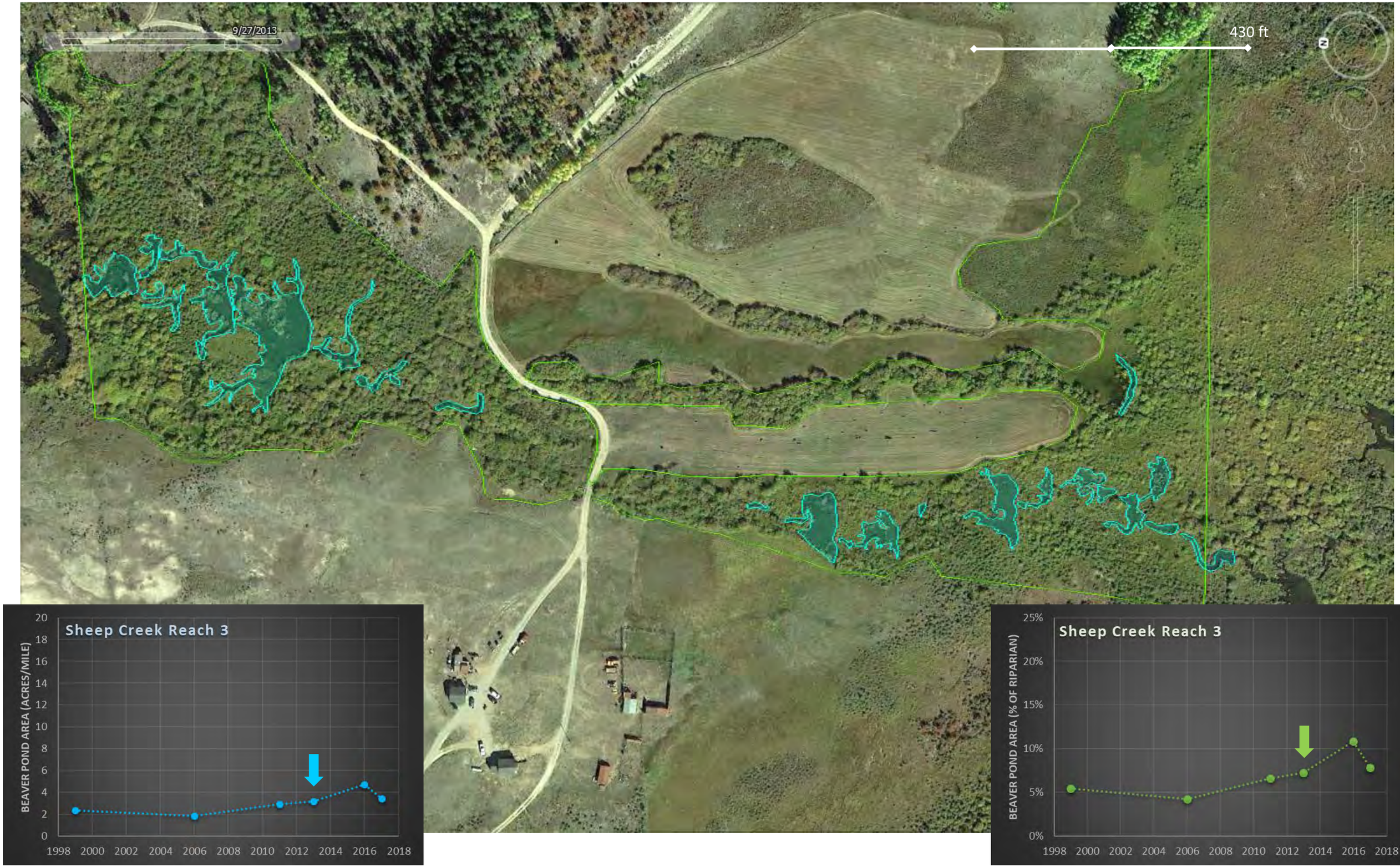
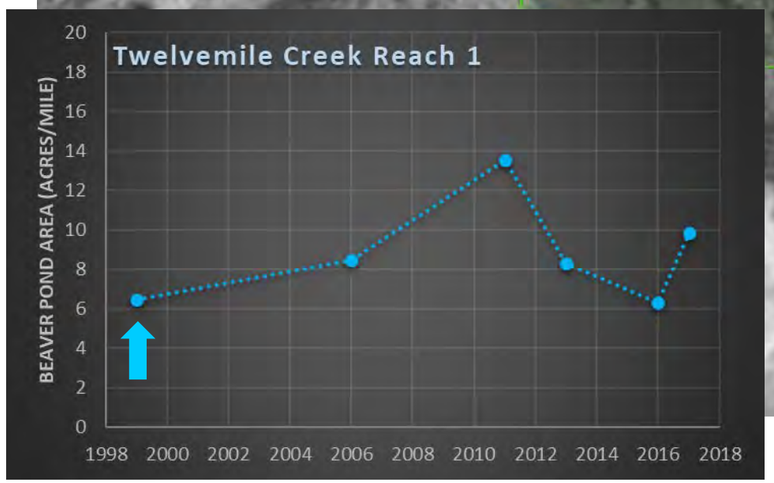


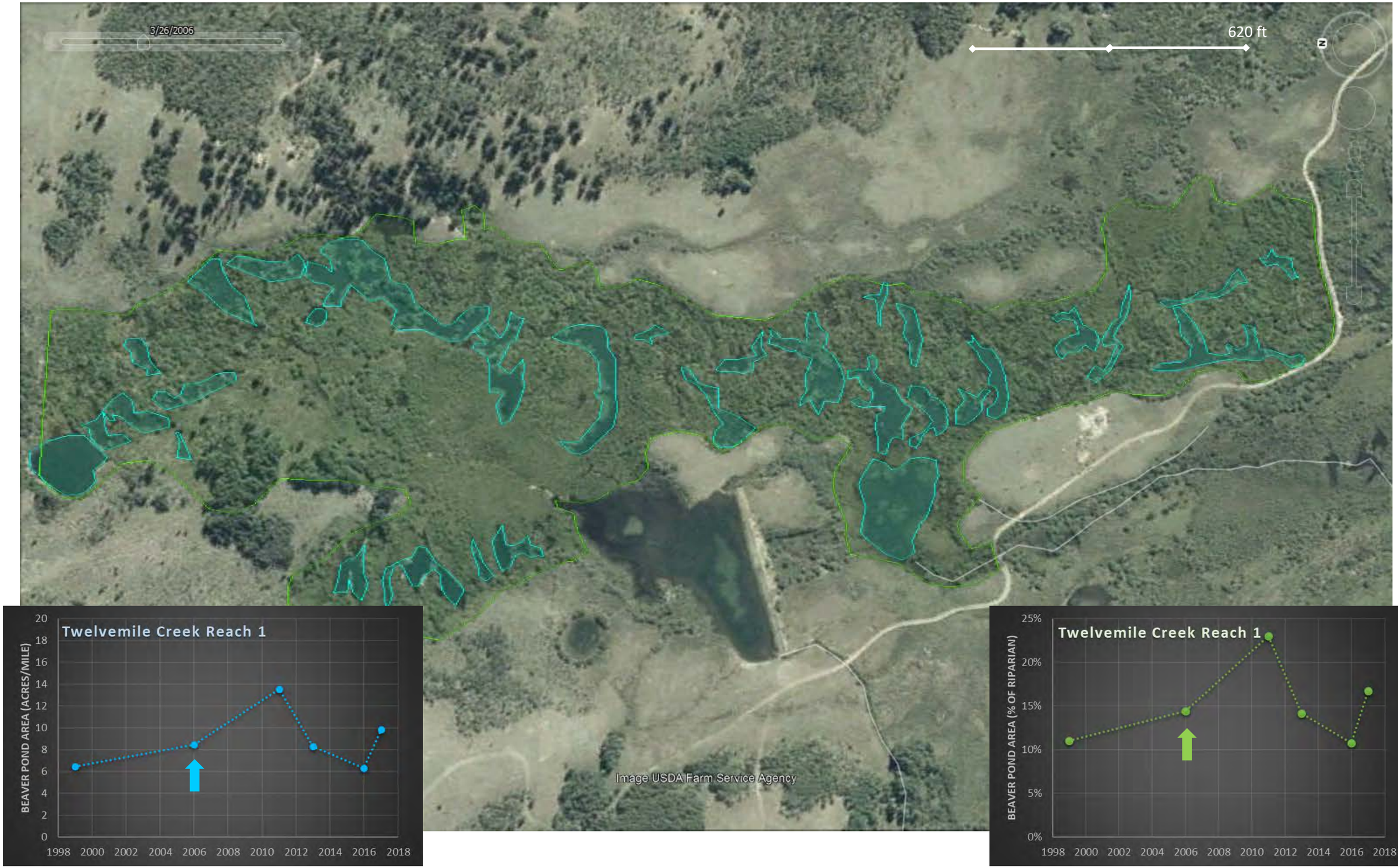
Sheep Creek Reach 3 — 2016

Sheep Creek Reach 3 — 2017

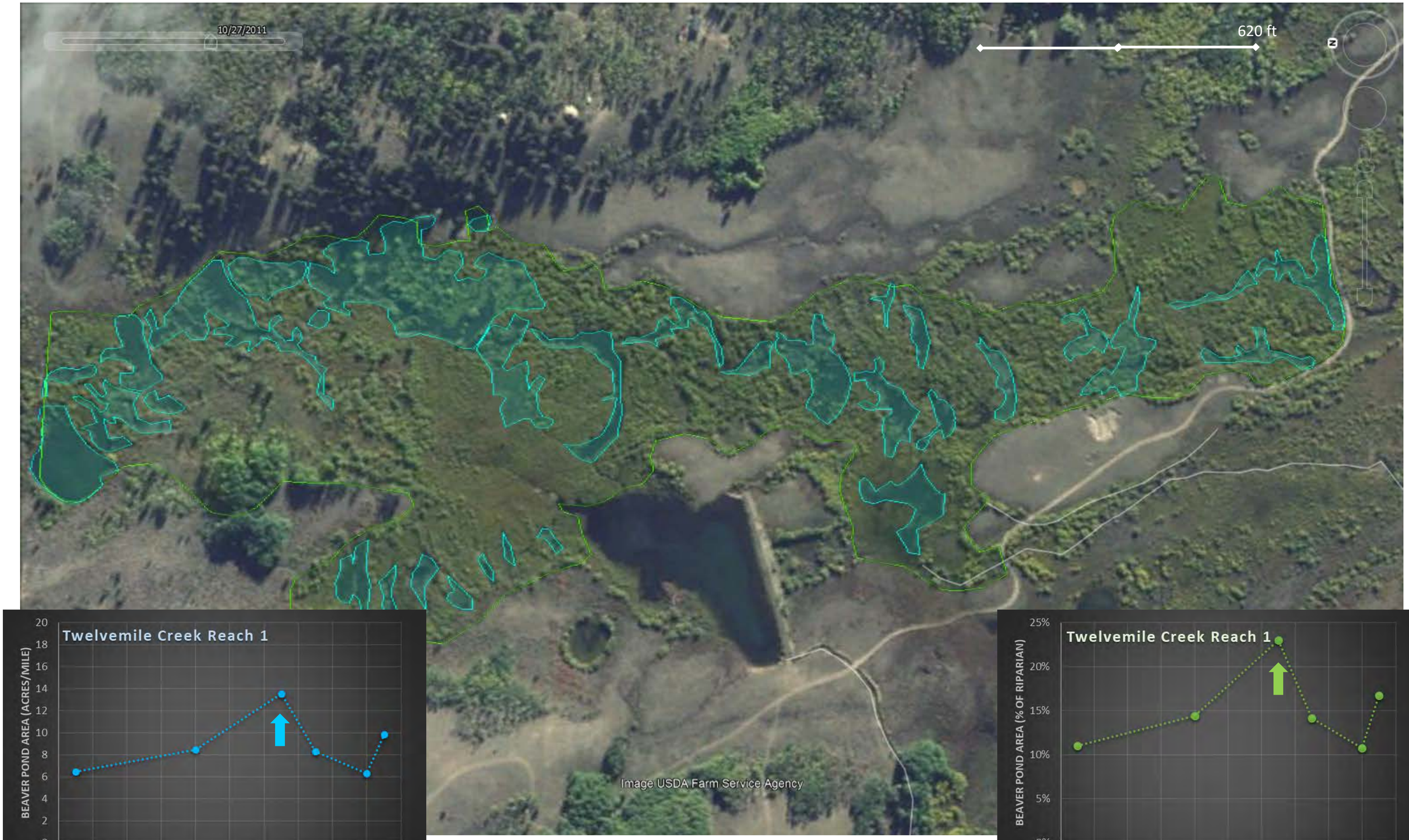
Twelvemile Creek Reach 1 — 1999

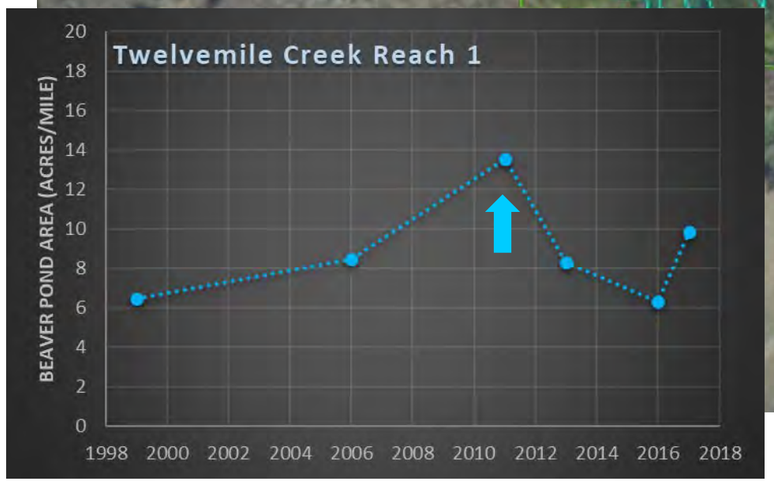


Twelvemile Creek Reach 1 — 2006



Twelvemile Creek Reach 1 — 2011





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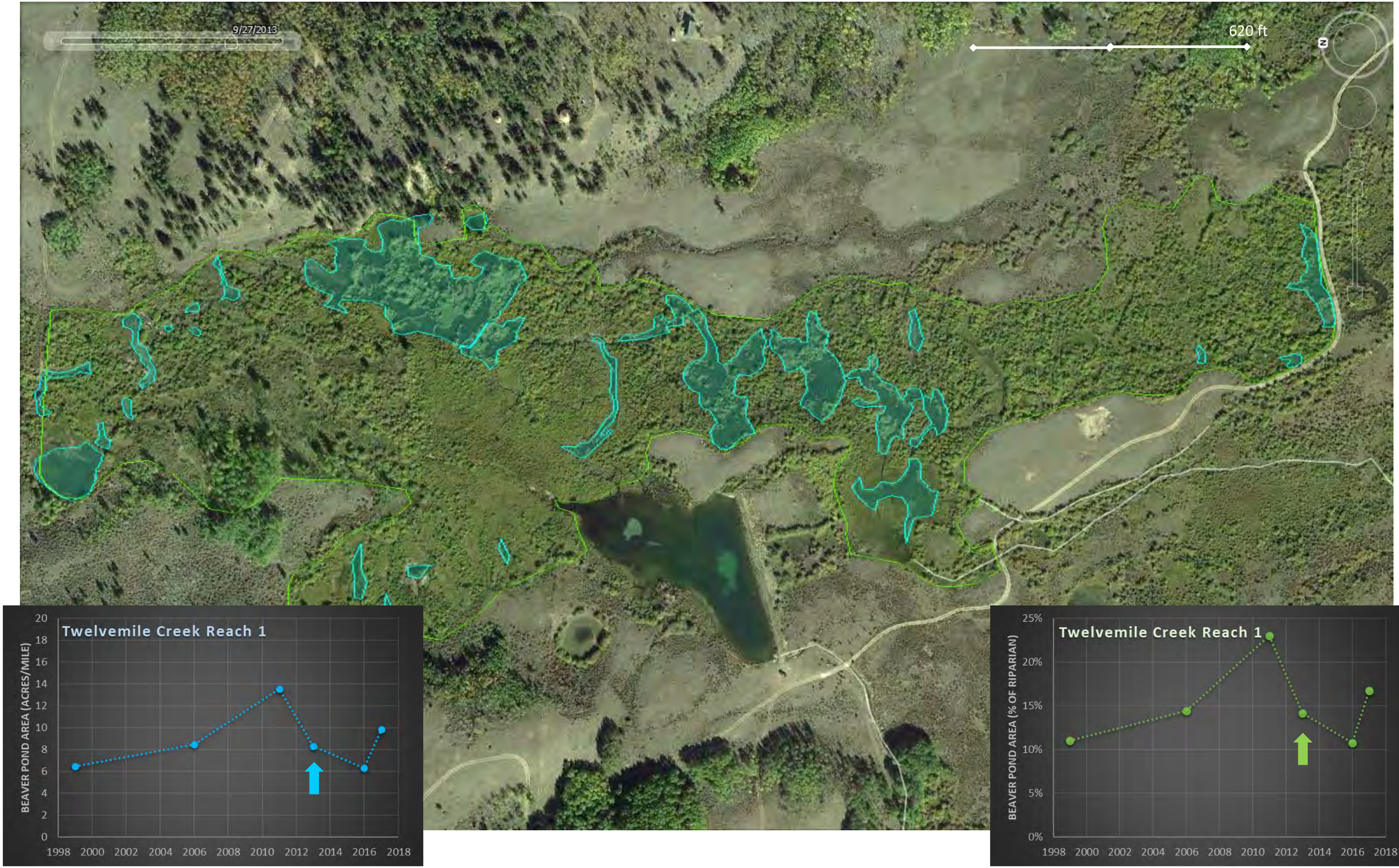

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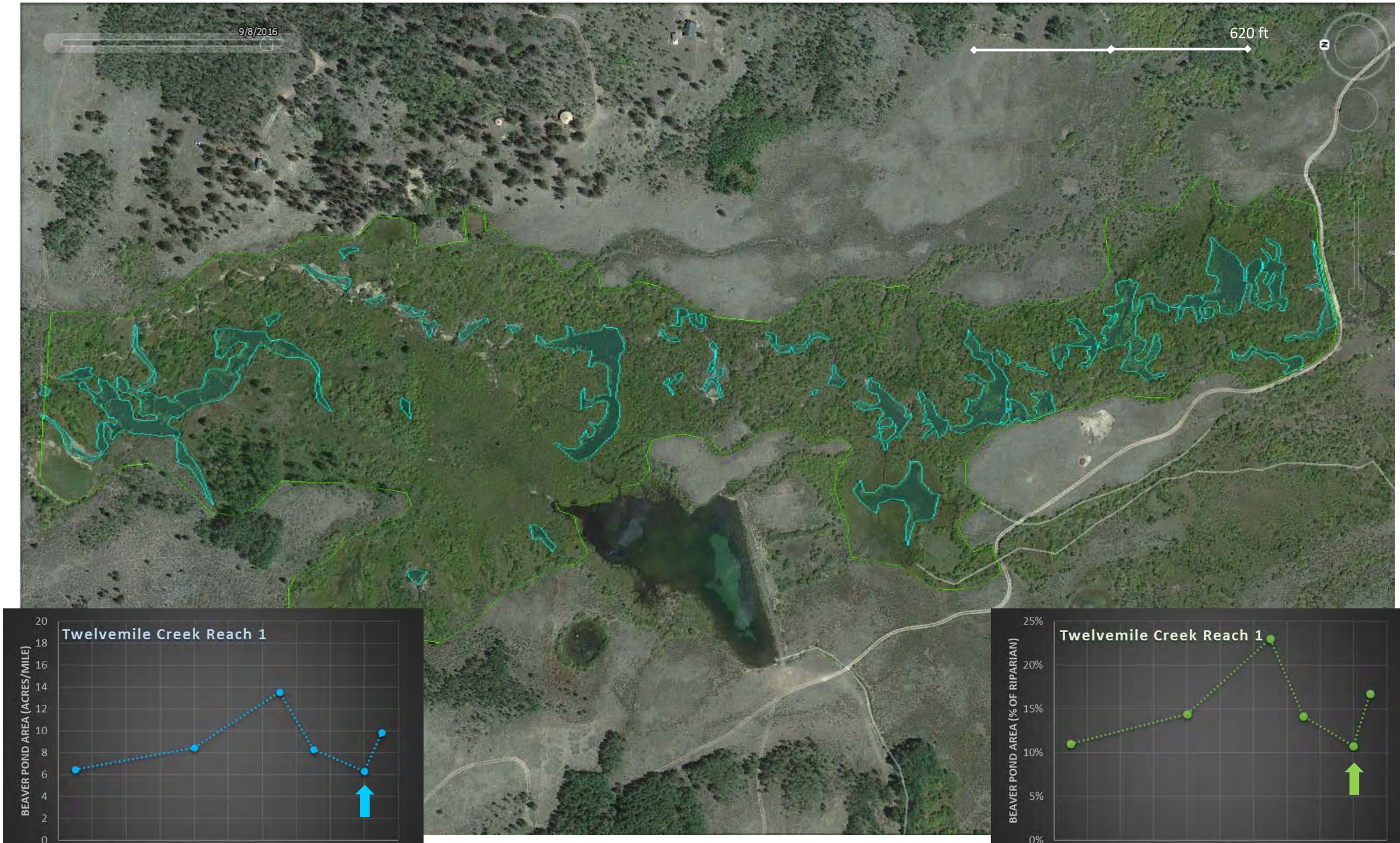
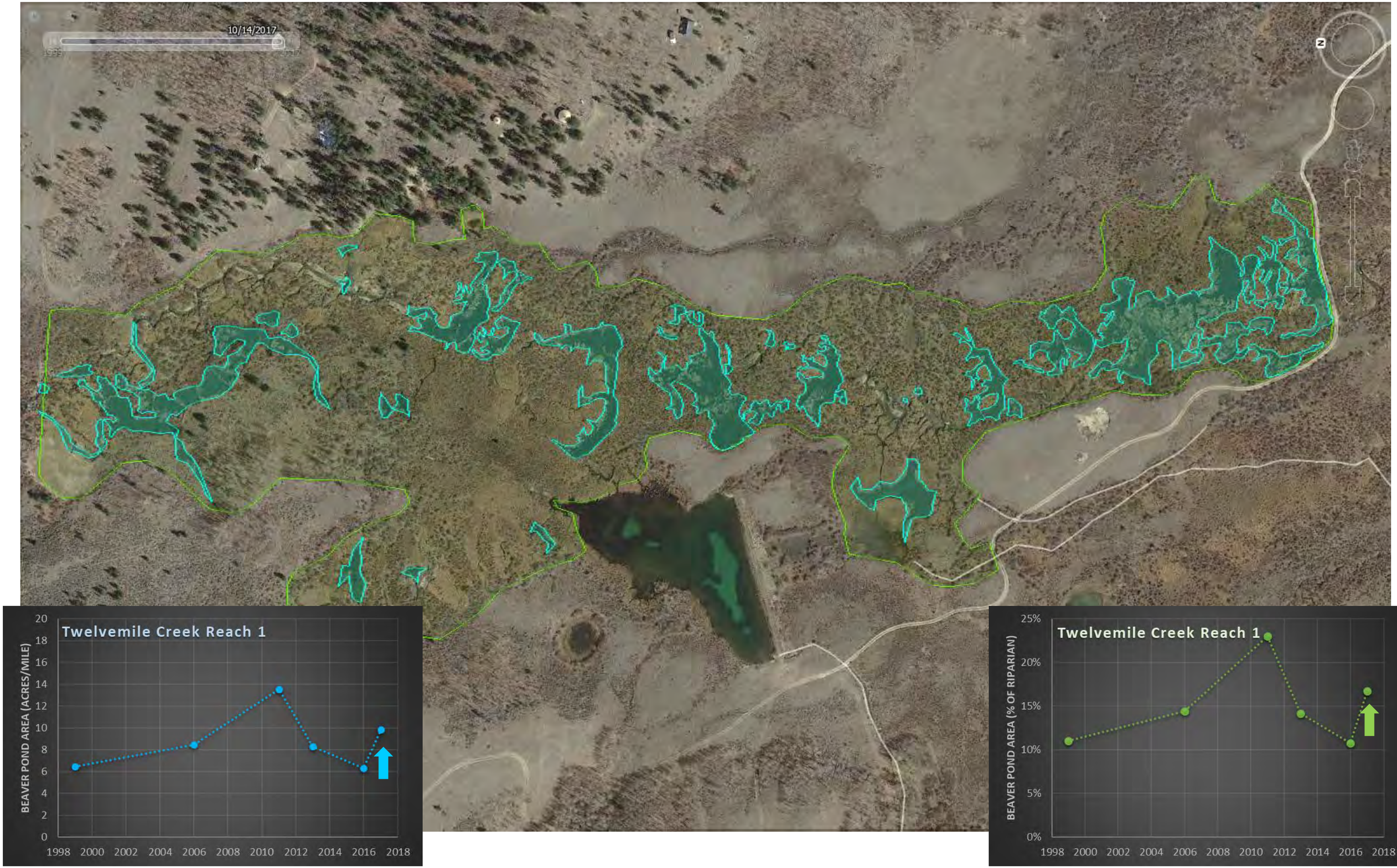
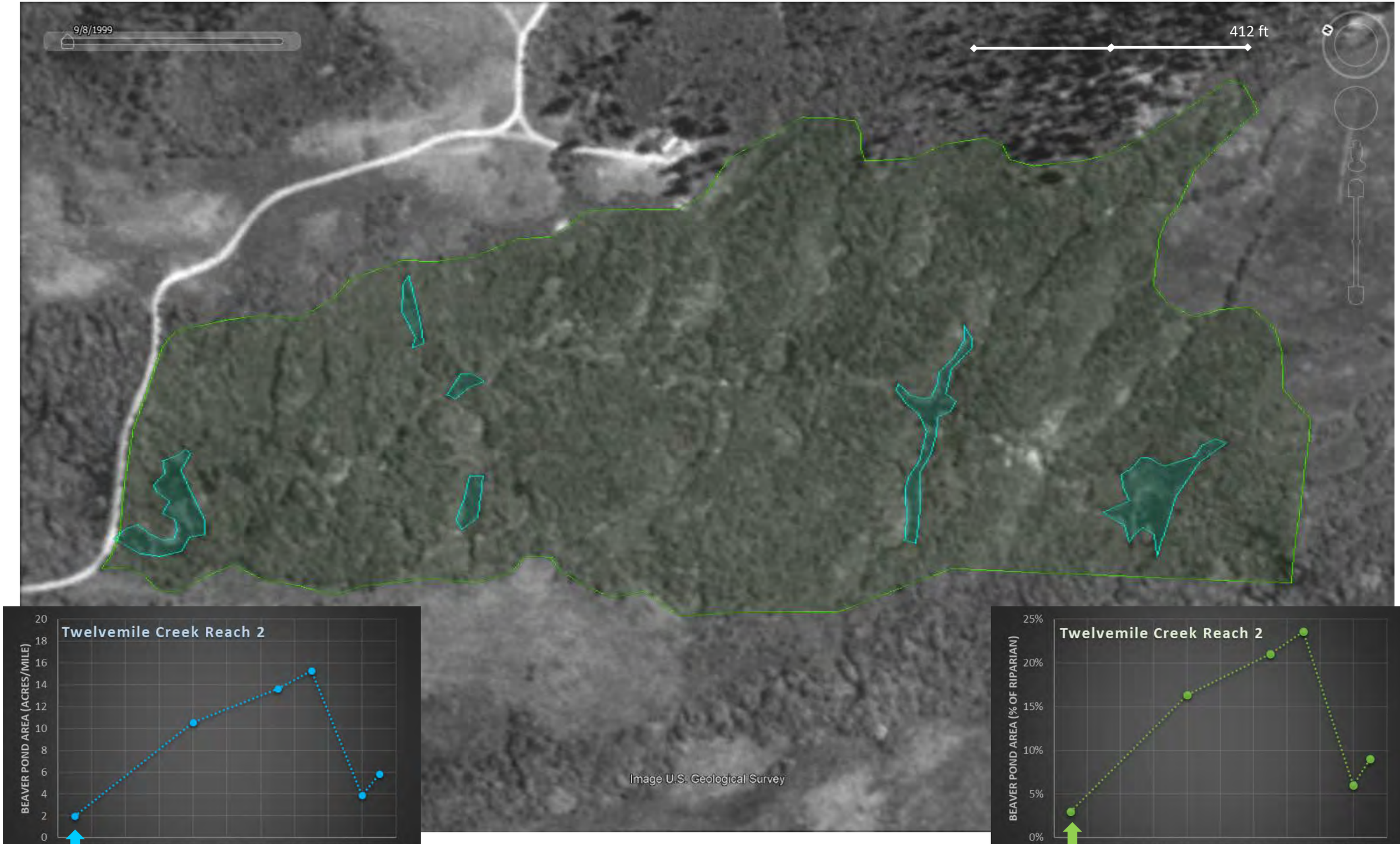
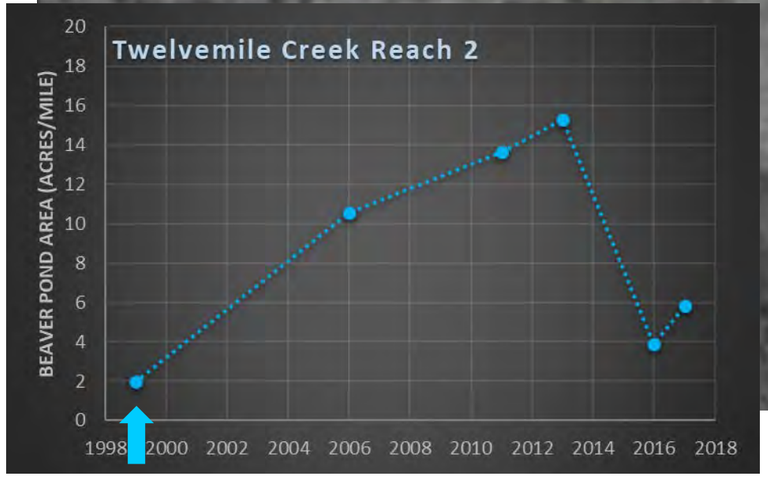


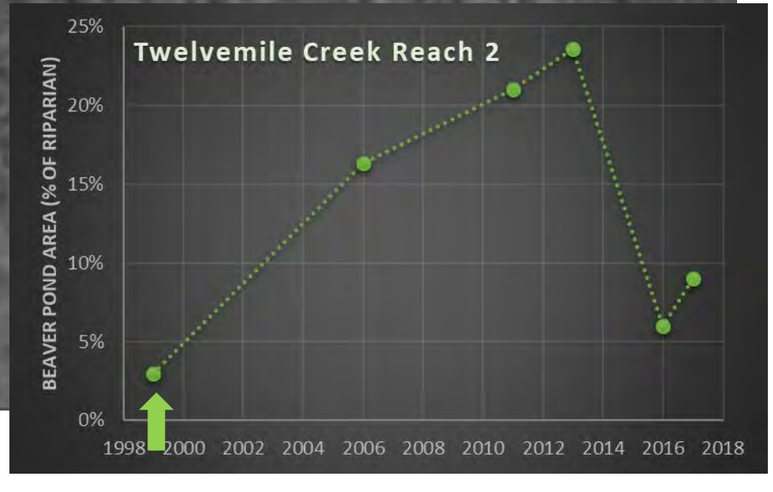
Twelvemile Creek Reach 1 — 2017



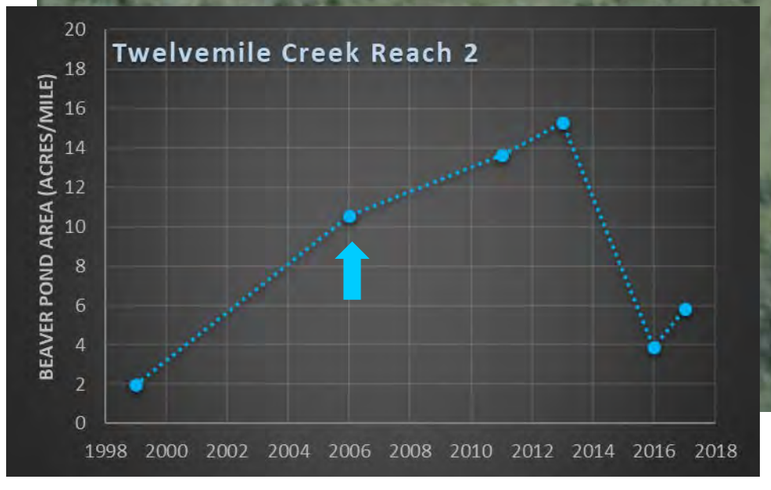
Twelvemile Creek Reach 2 — 1999







Twelvemile Creek Reach 2 — 2006



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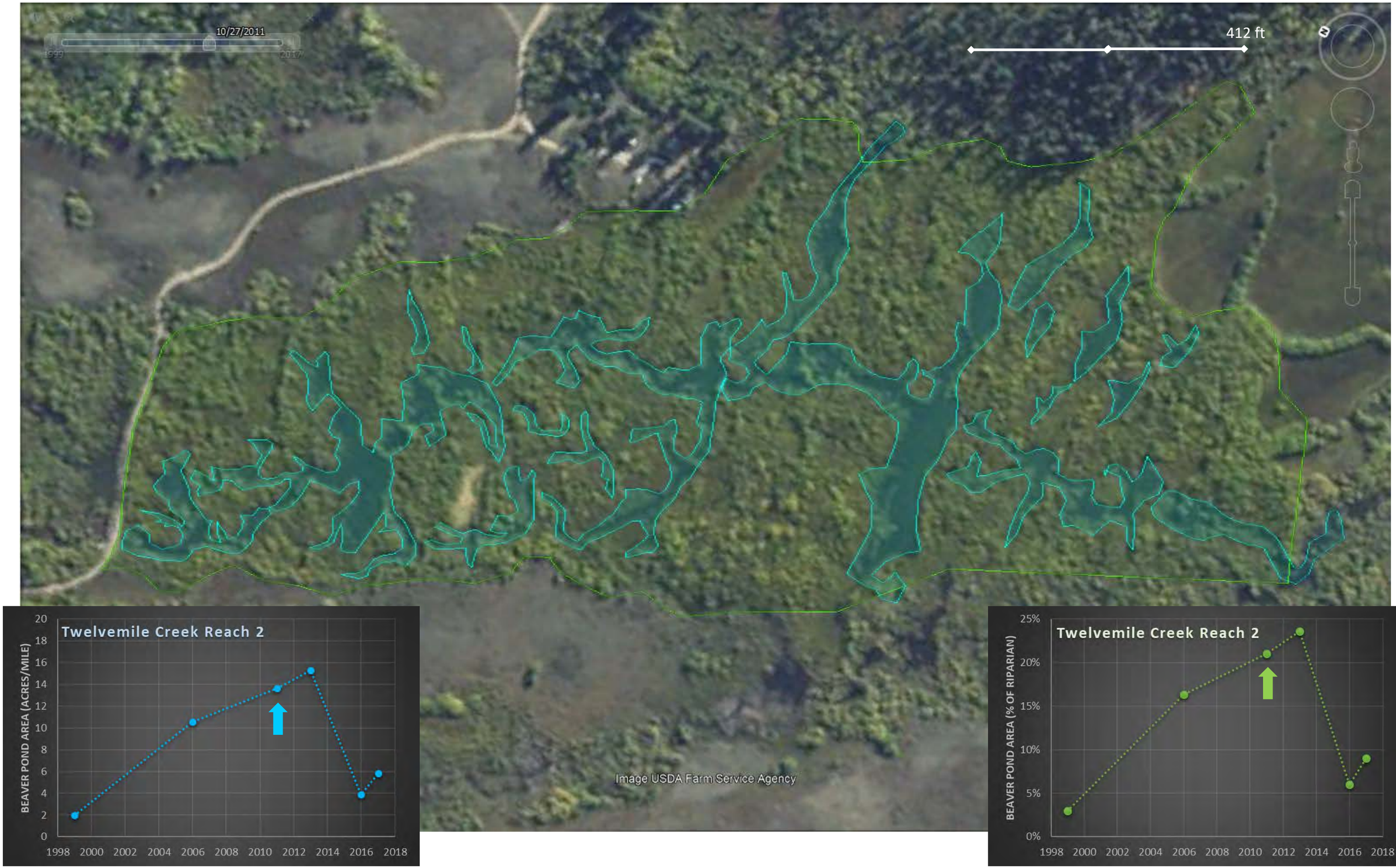

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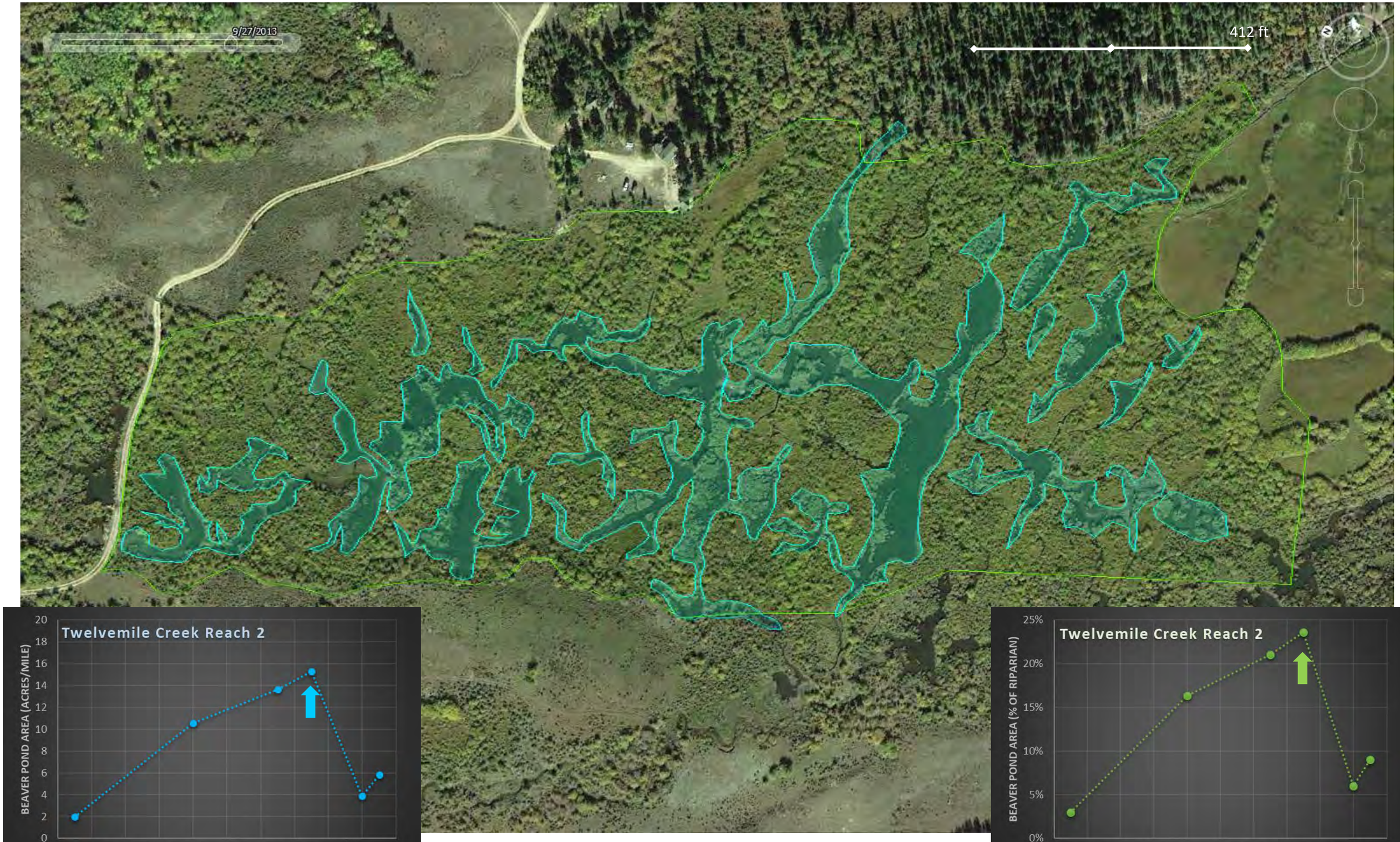

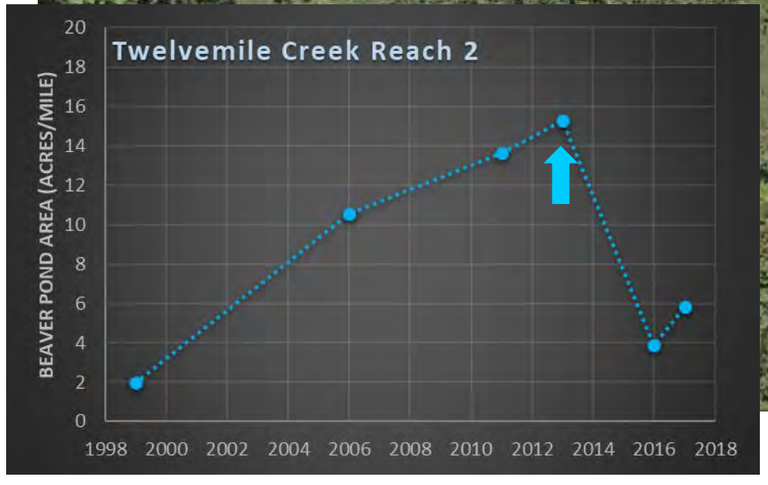

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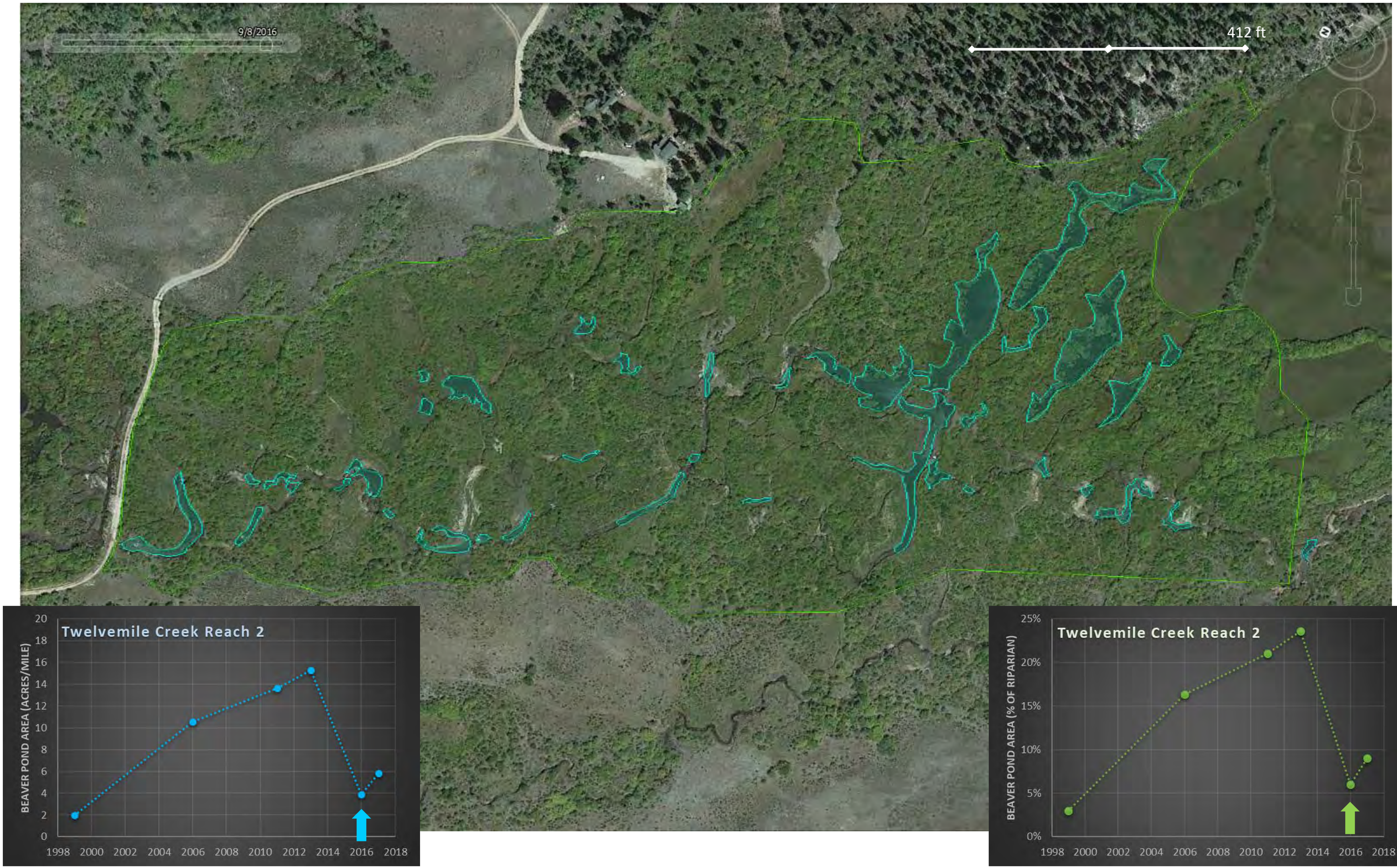

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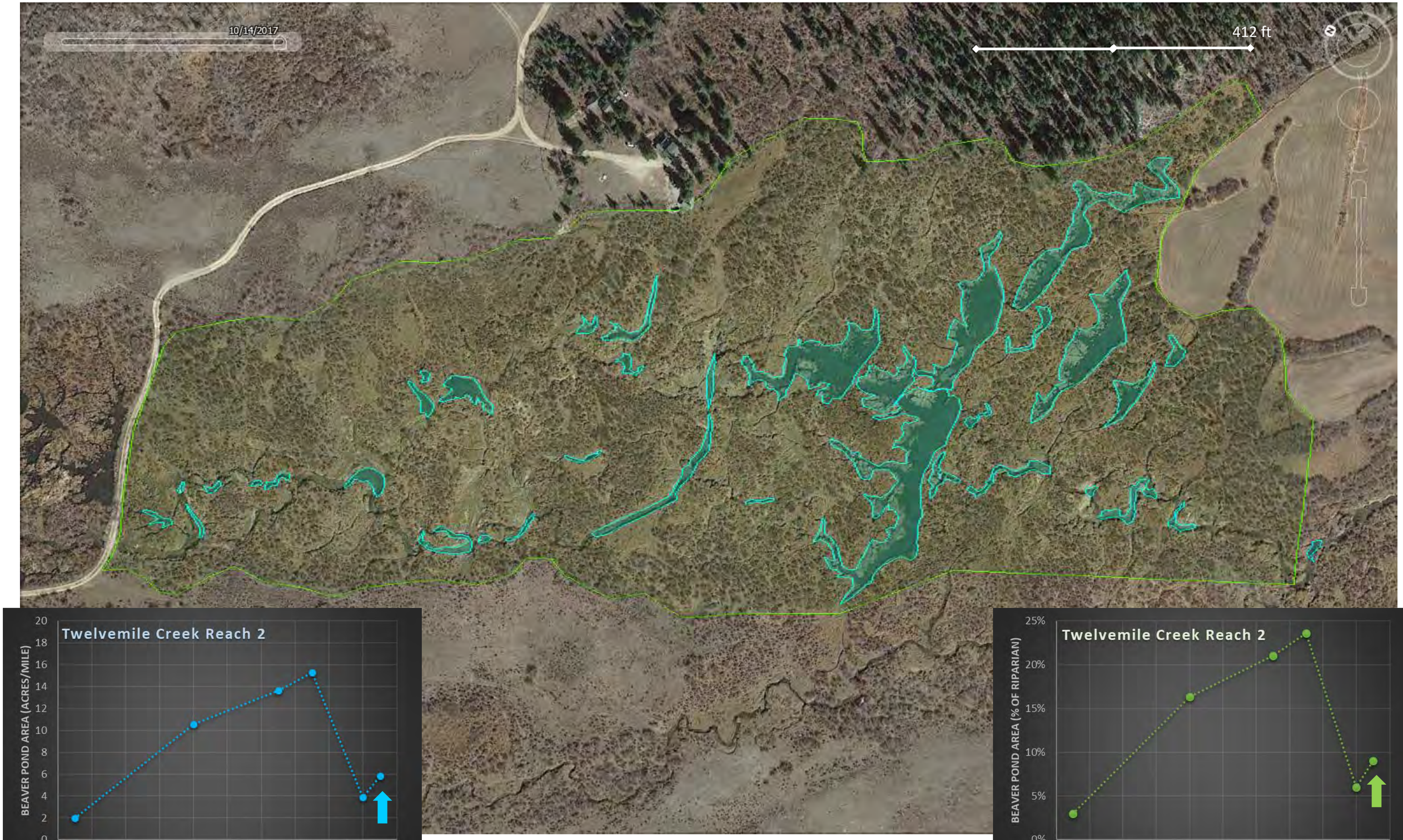

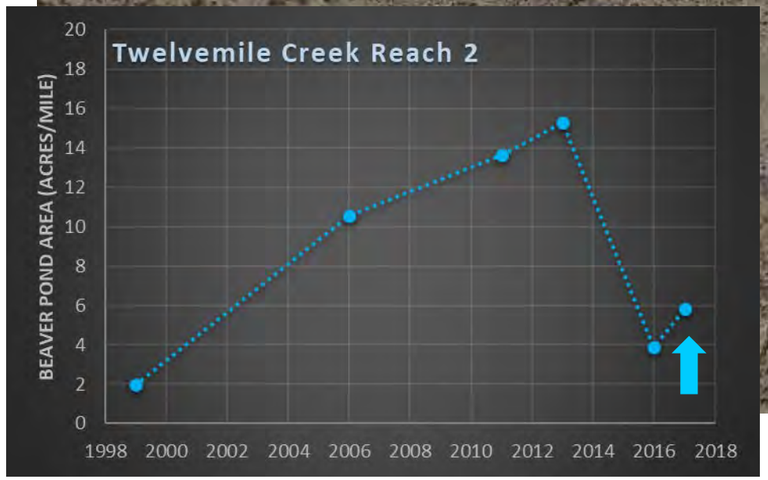

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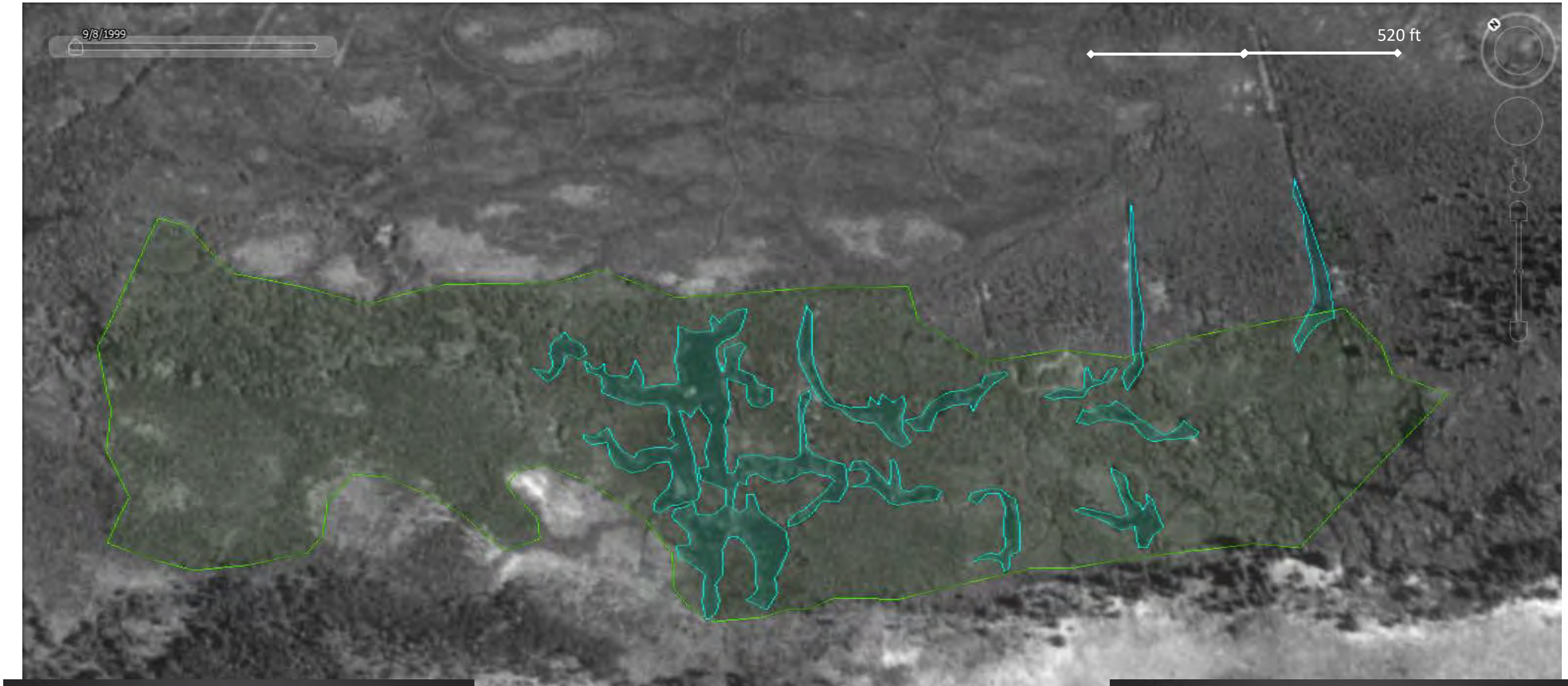

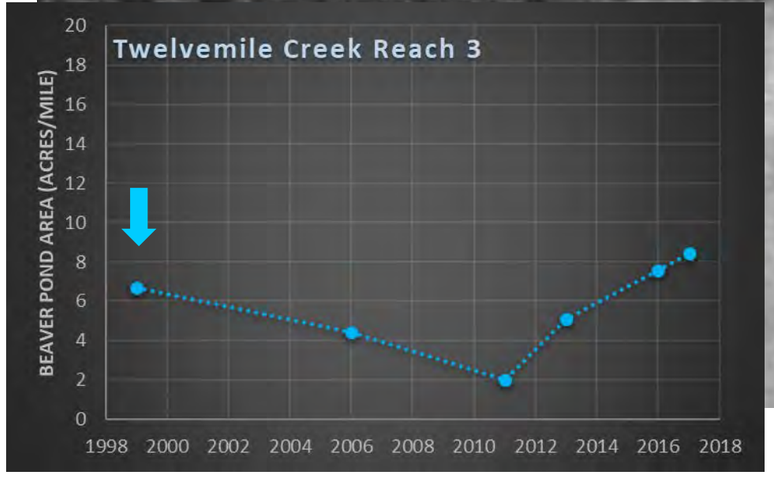

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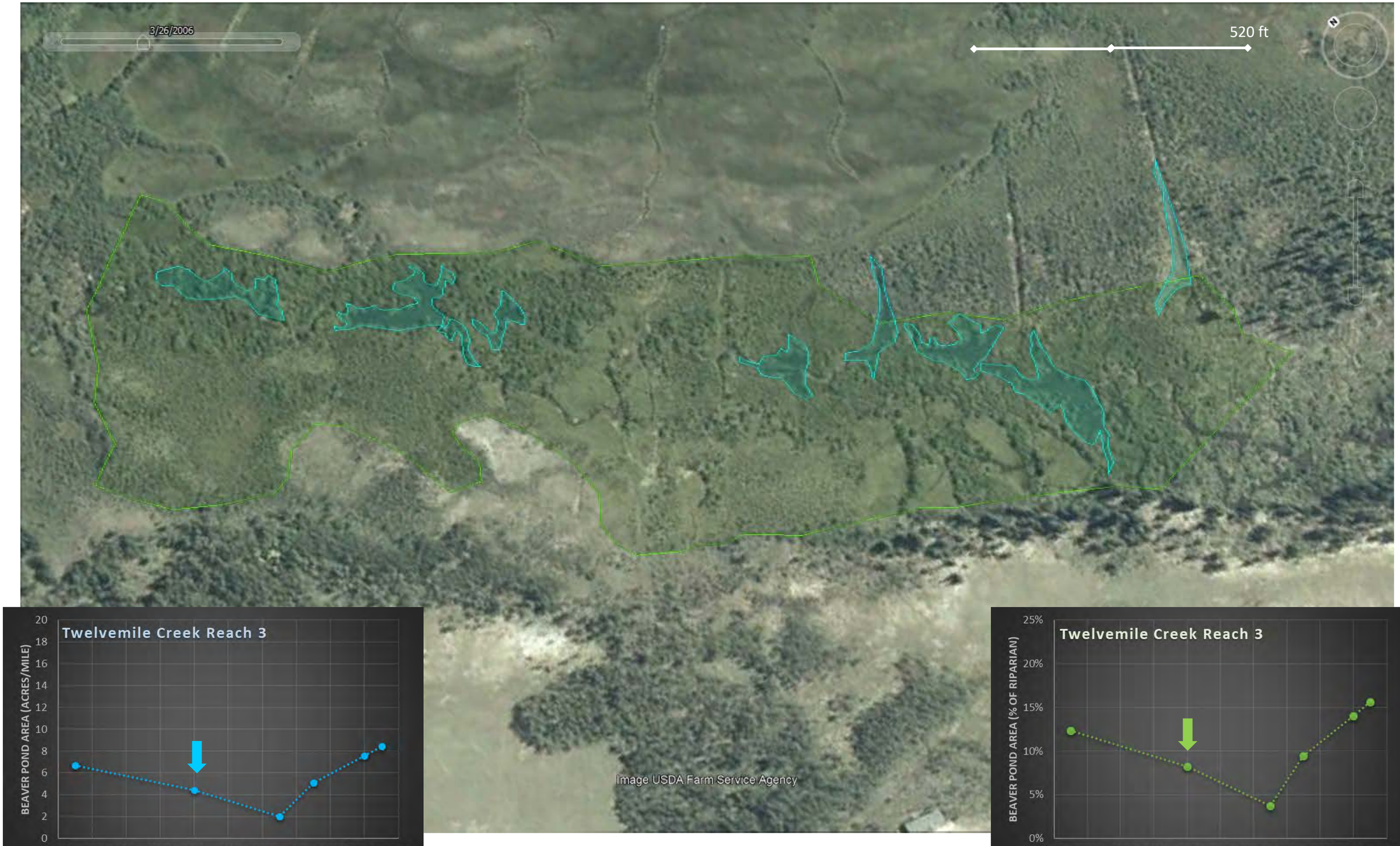

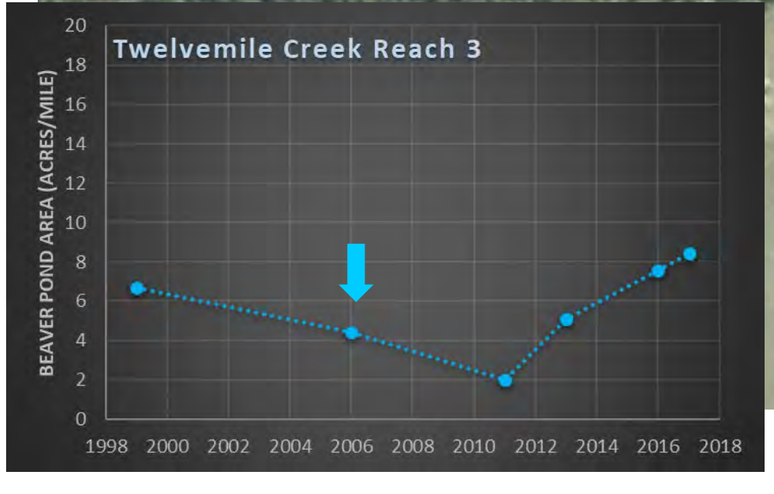

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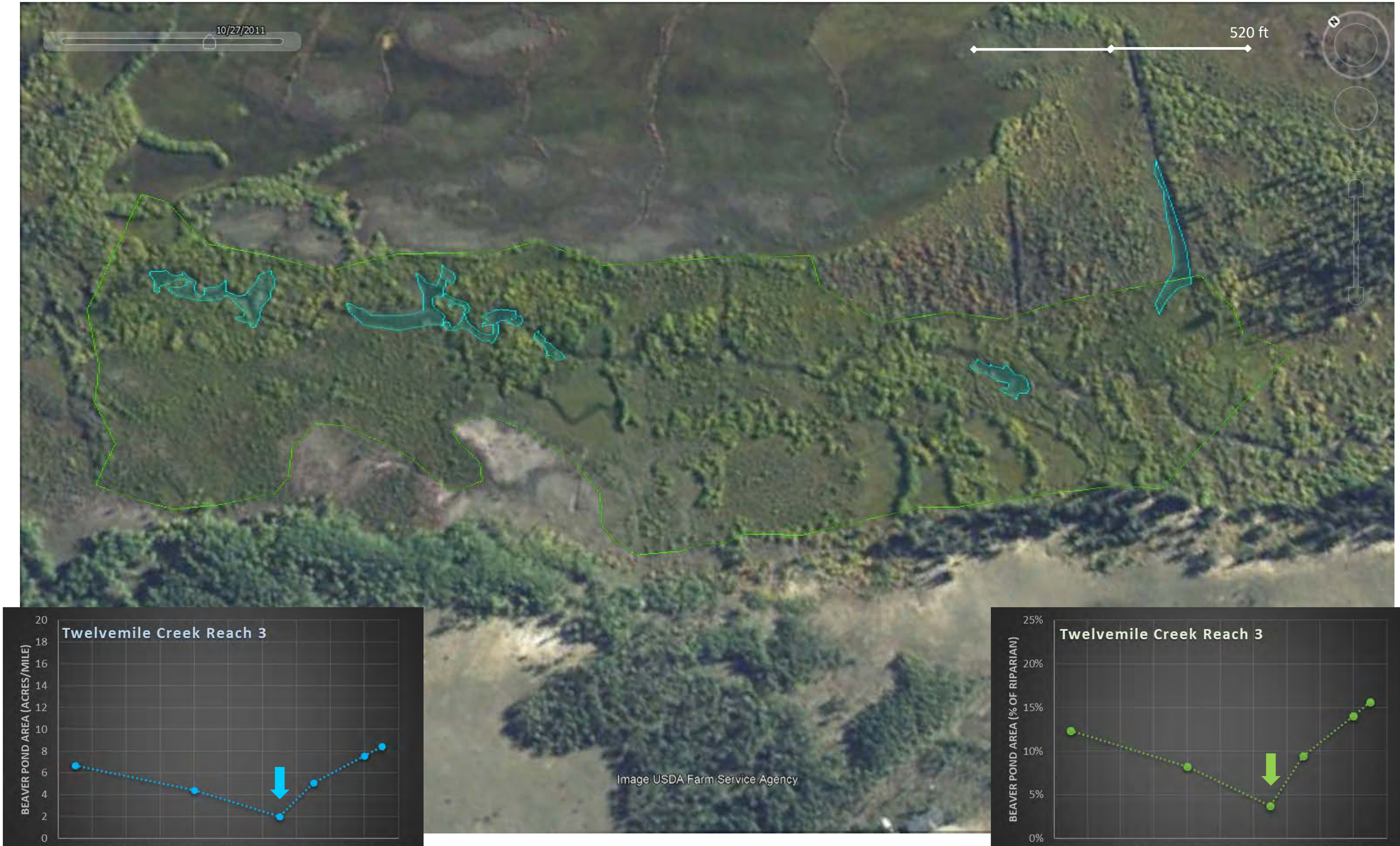

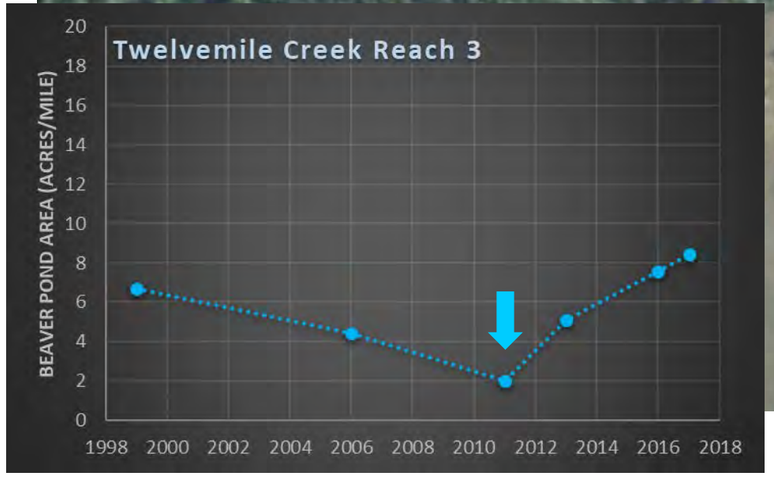

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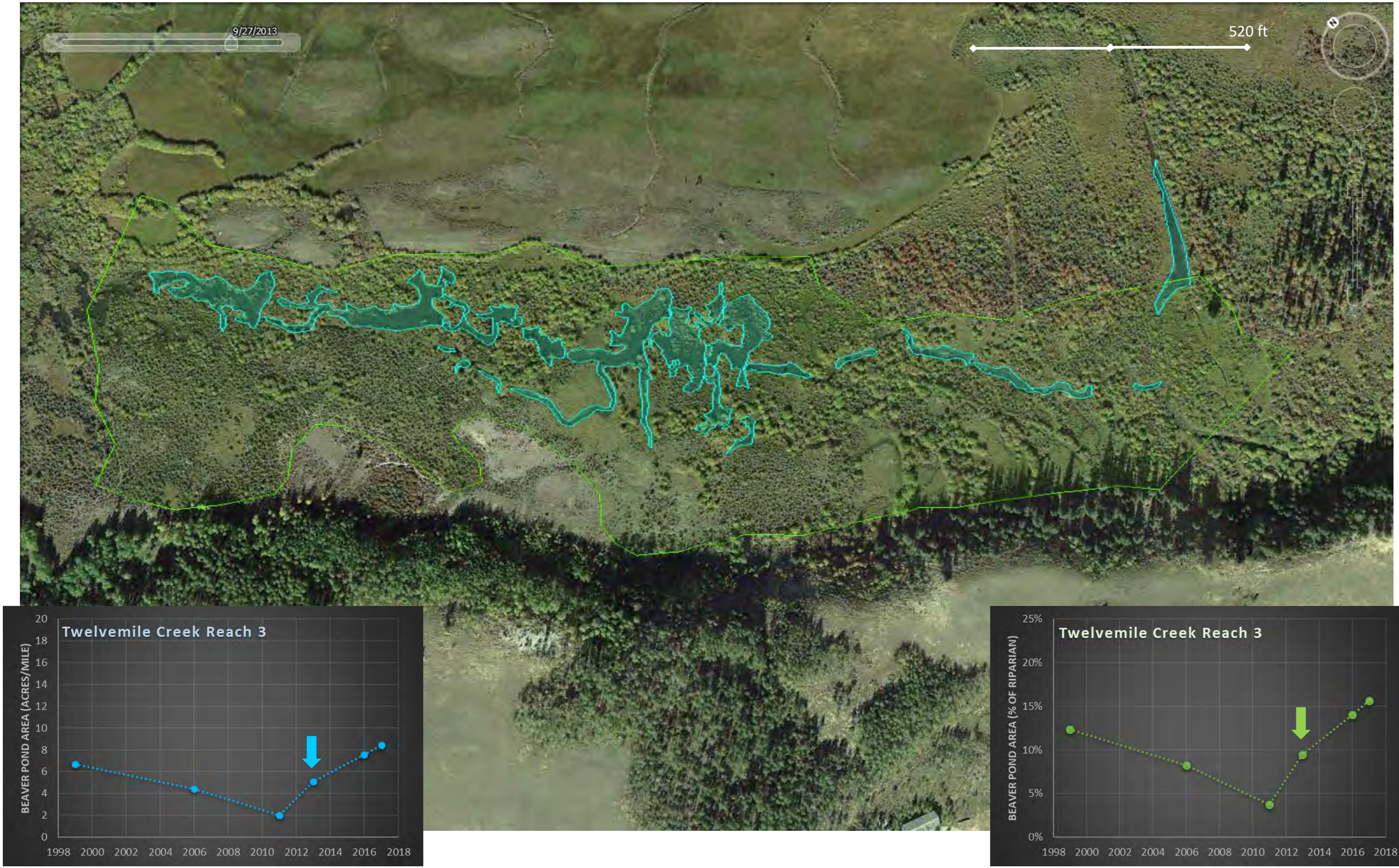

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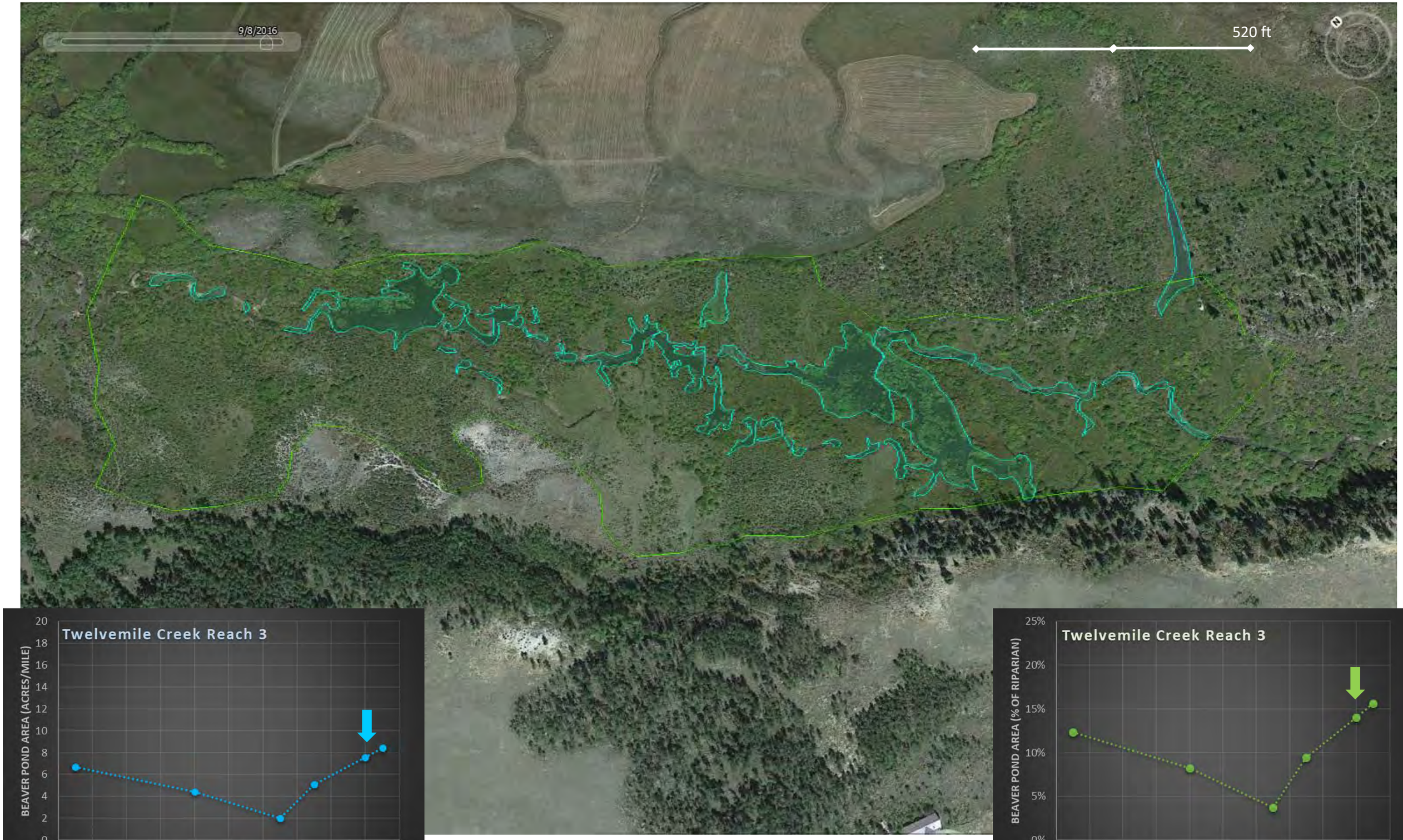

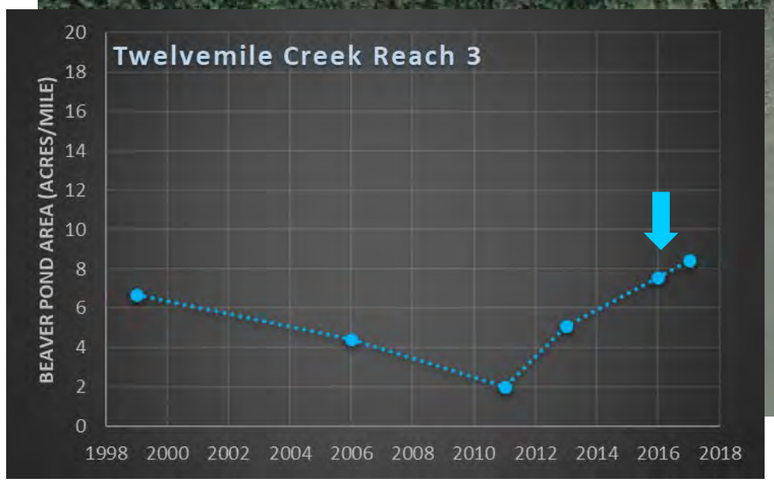

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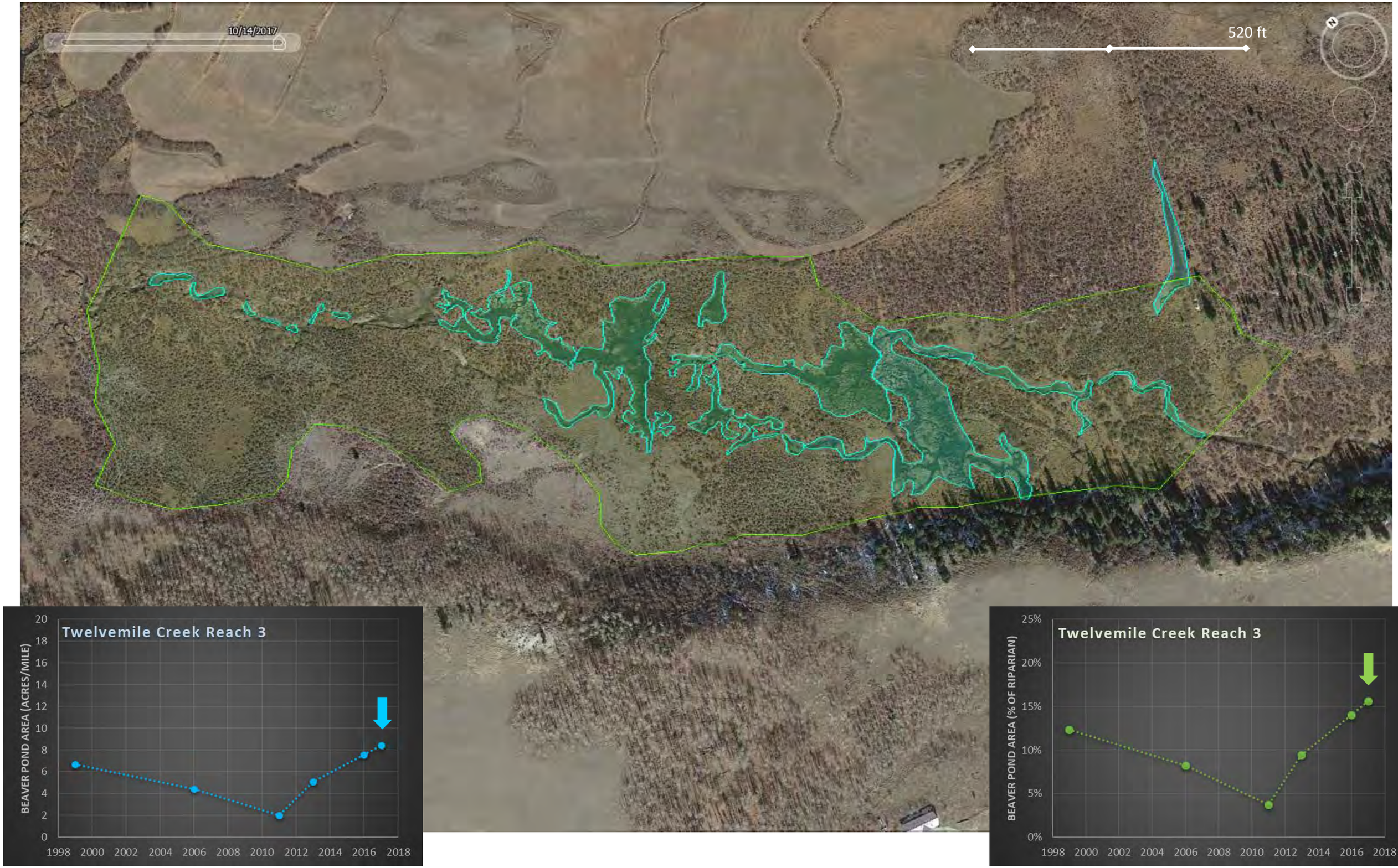

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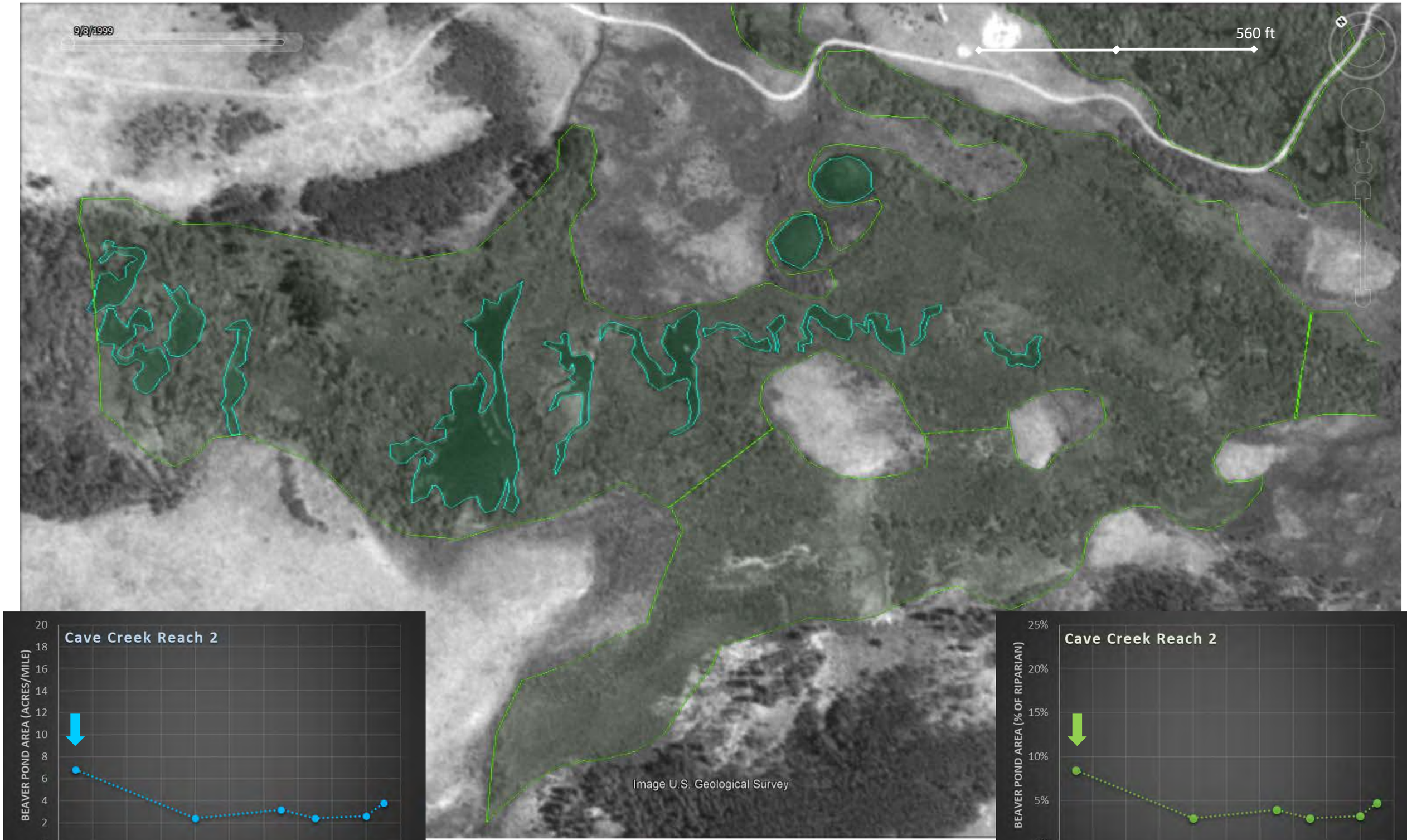

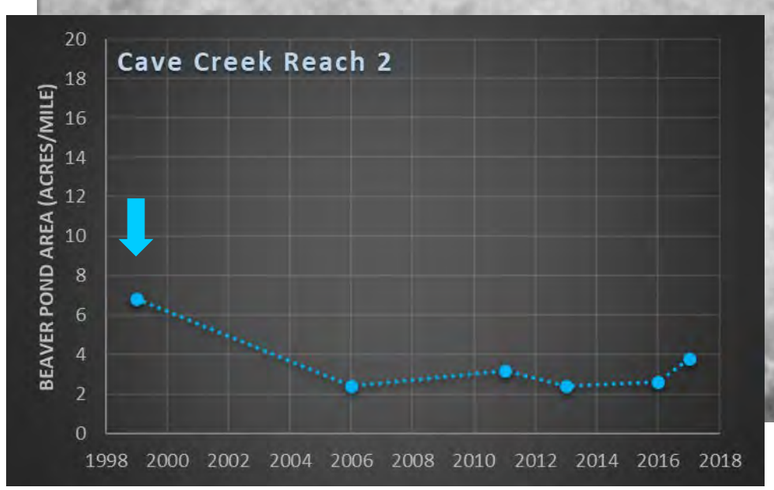

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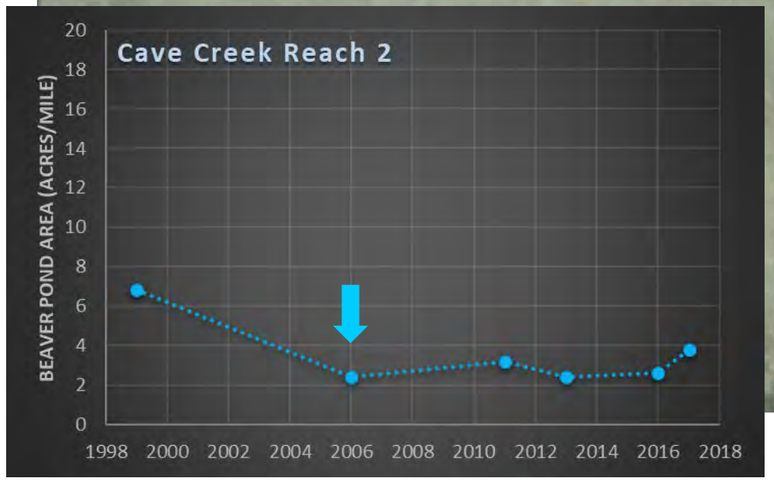

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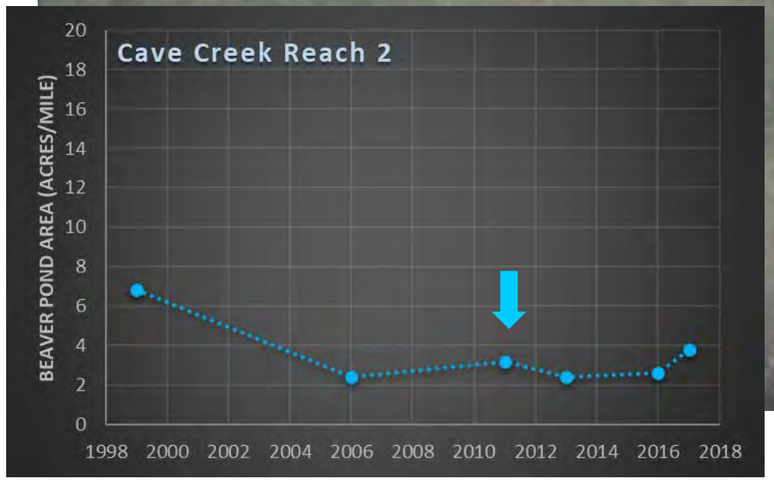

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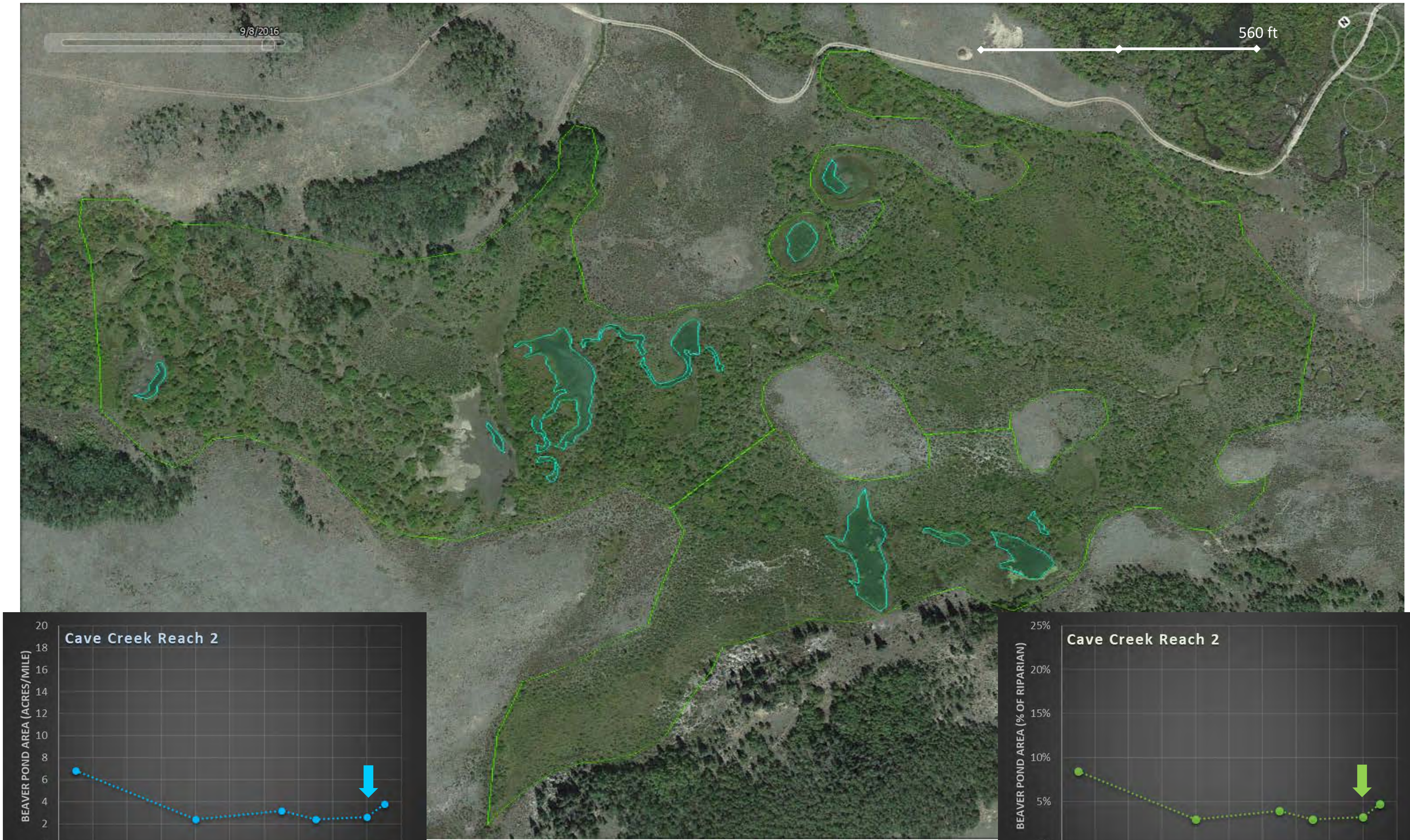

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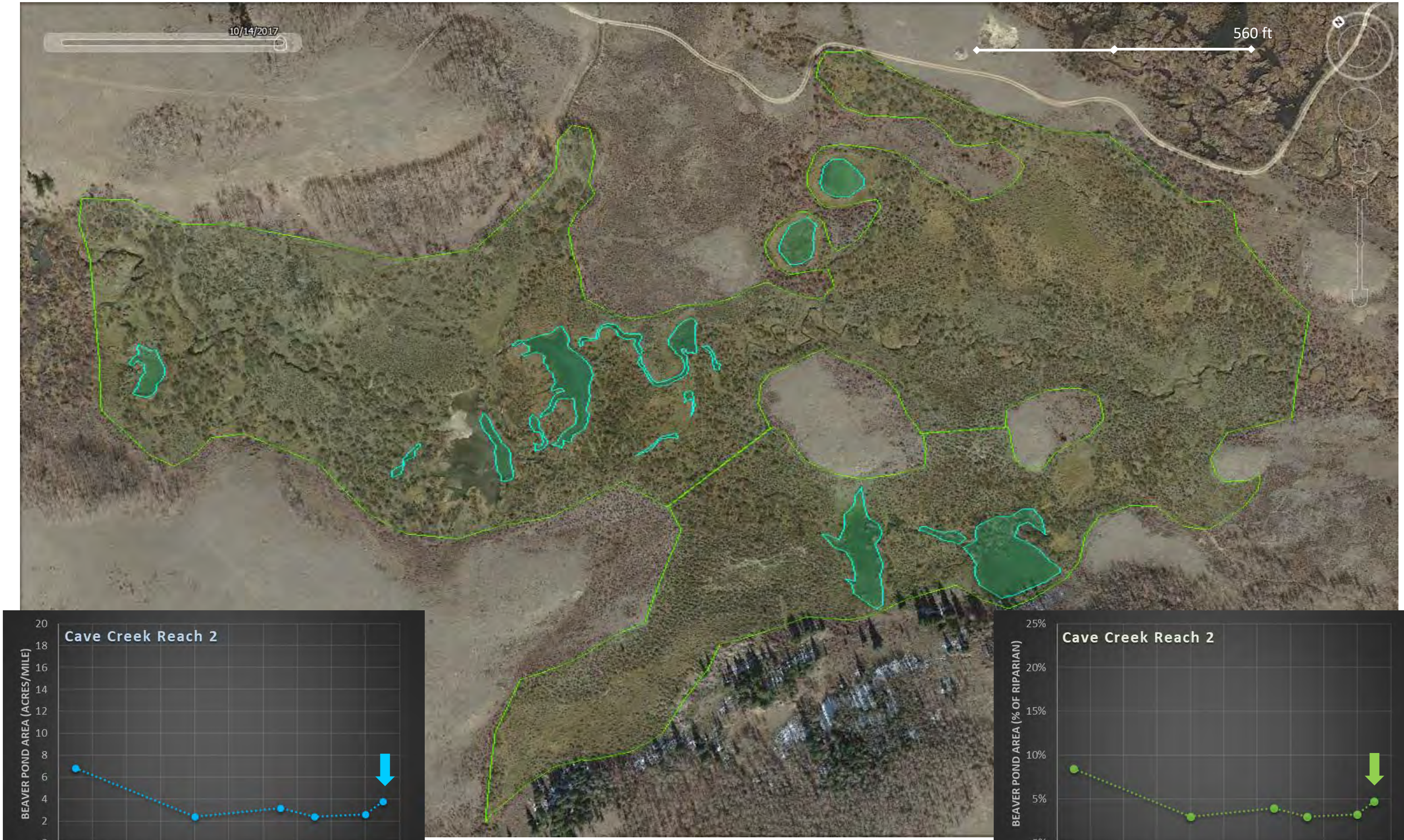

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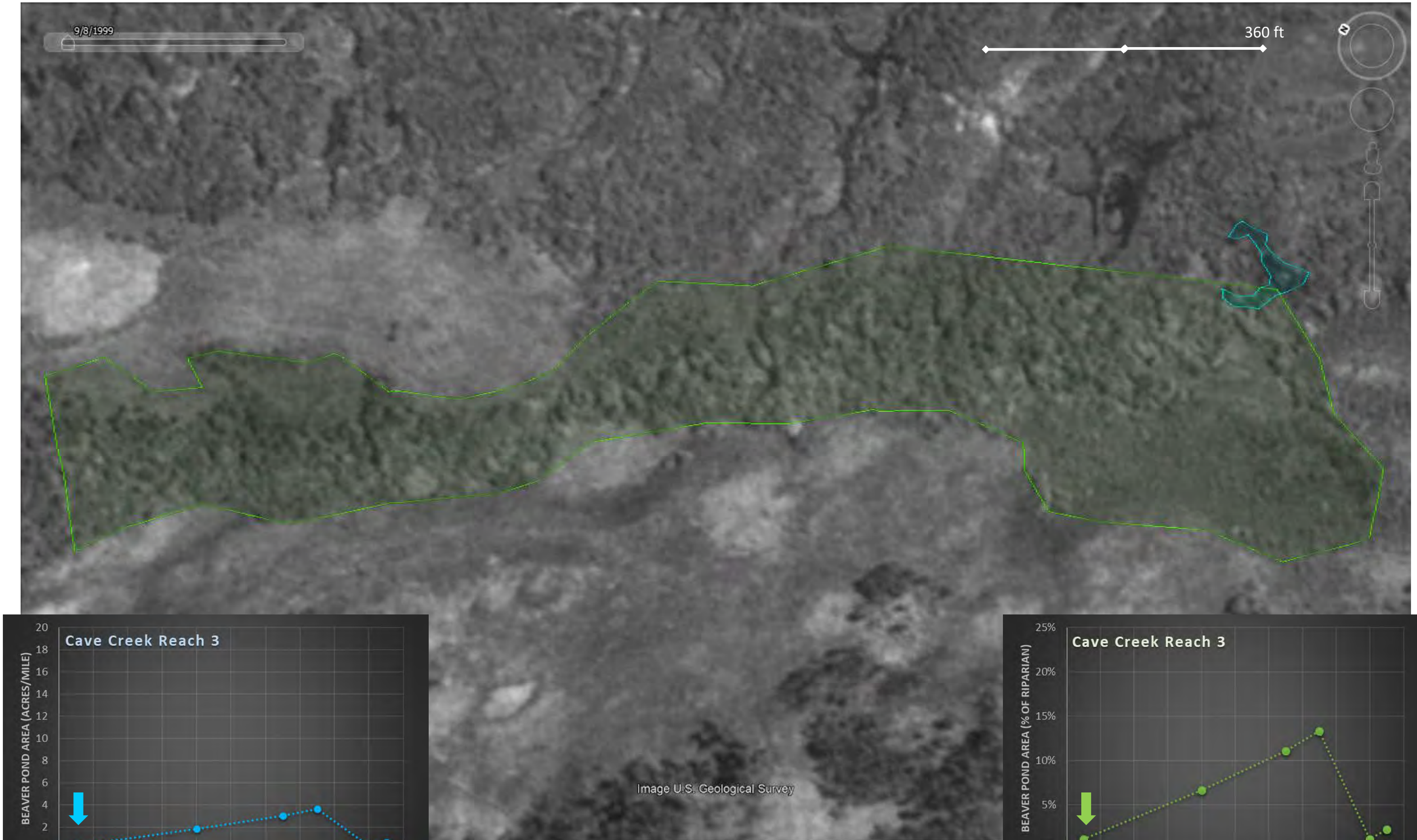
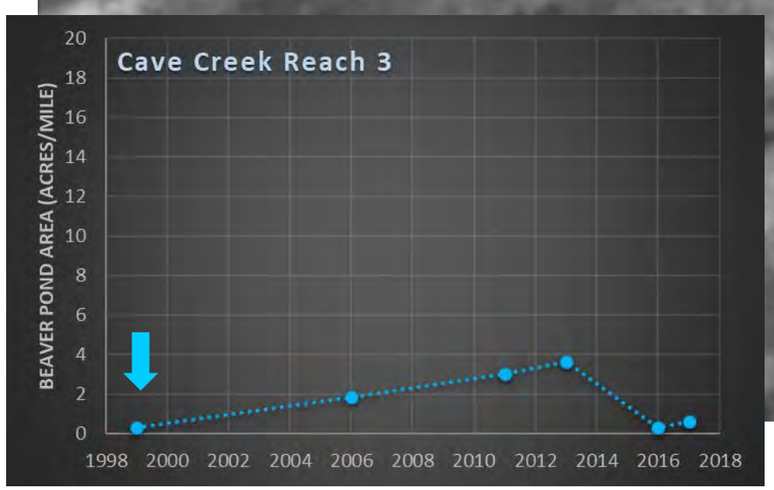
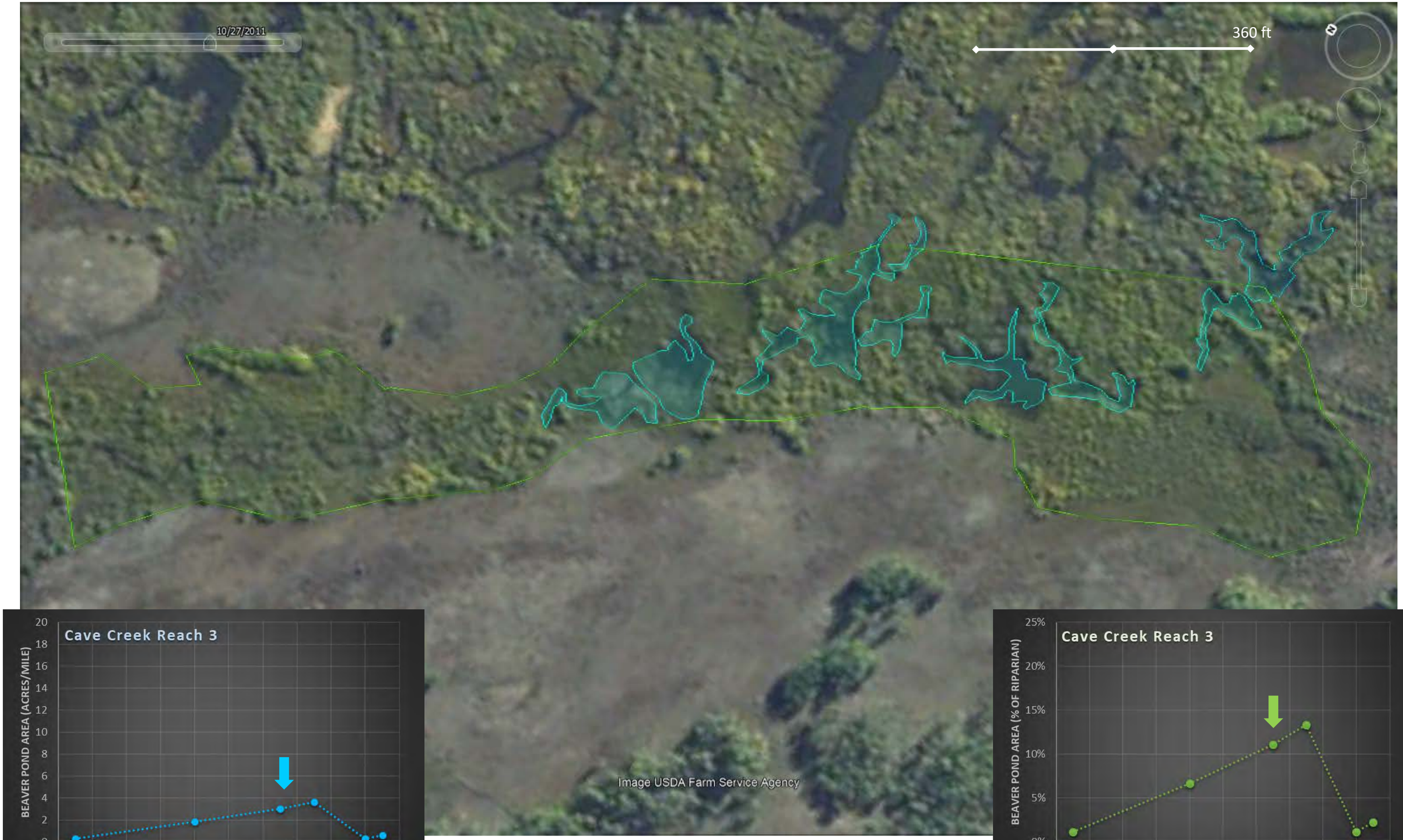
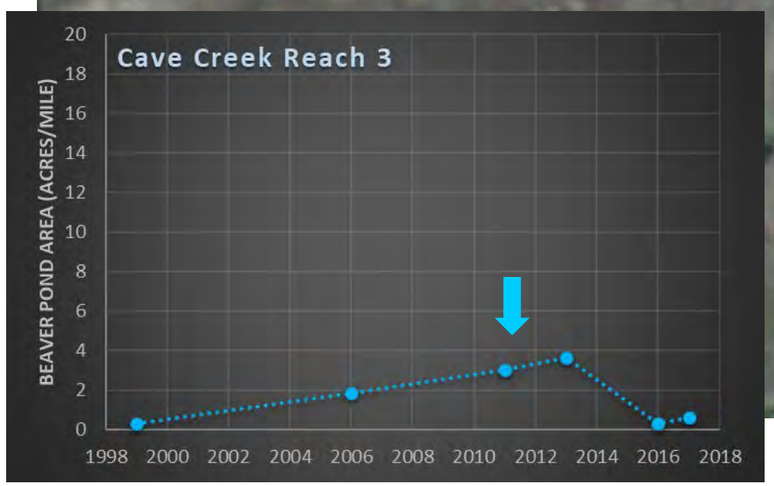




Cave Creek Reach 3 — 2006

Cave Creek Reach 3 — 2011





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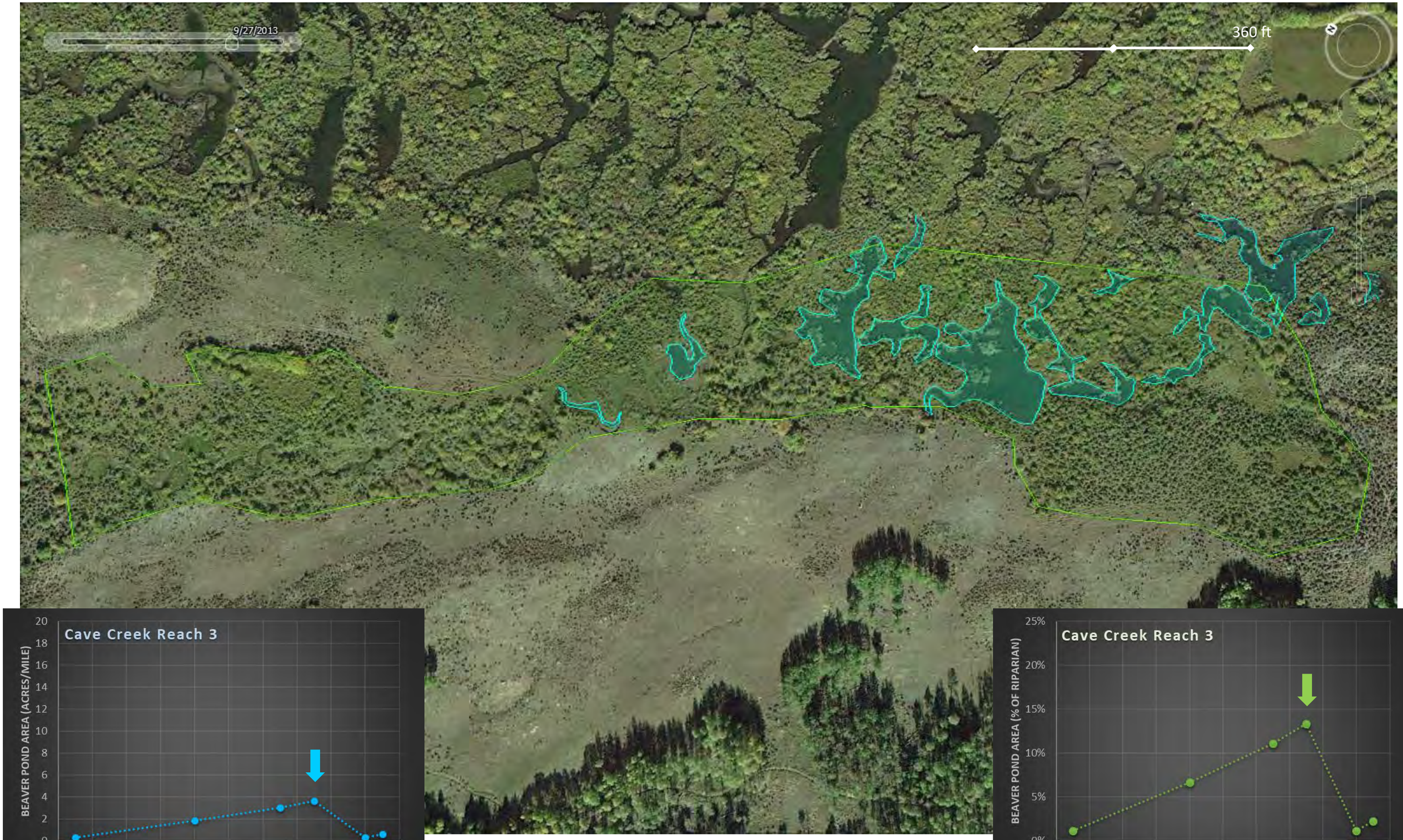

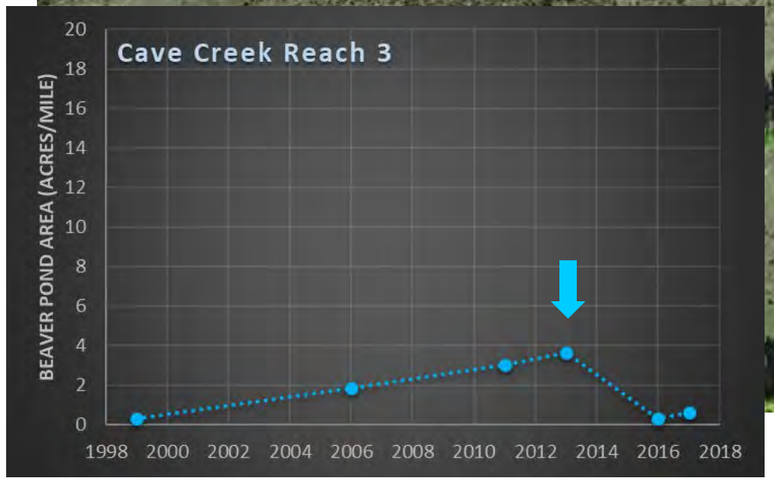

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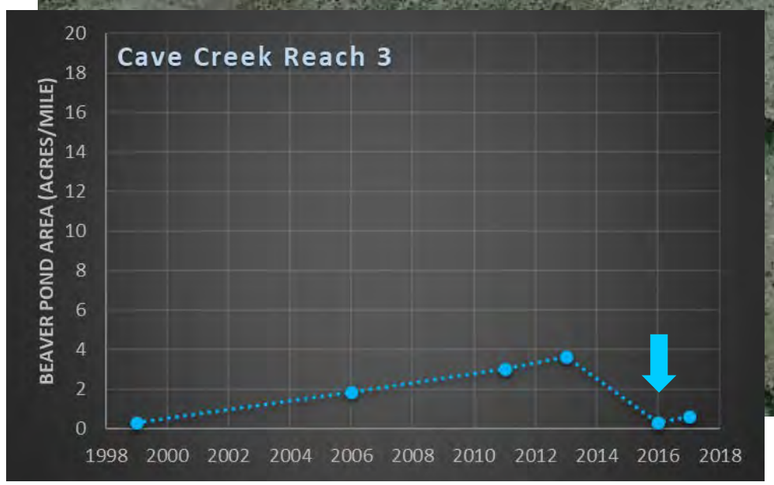
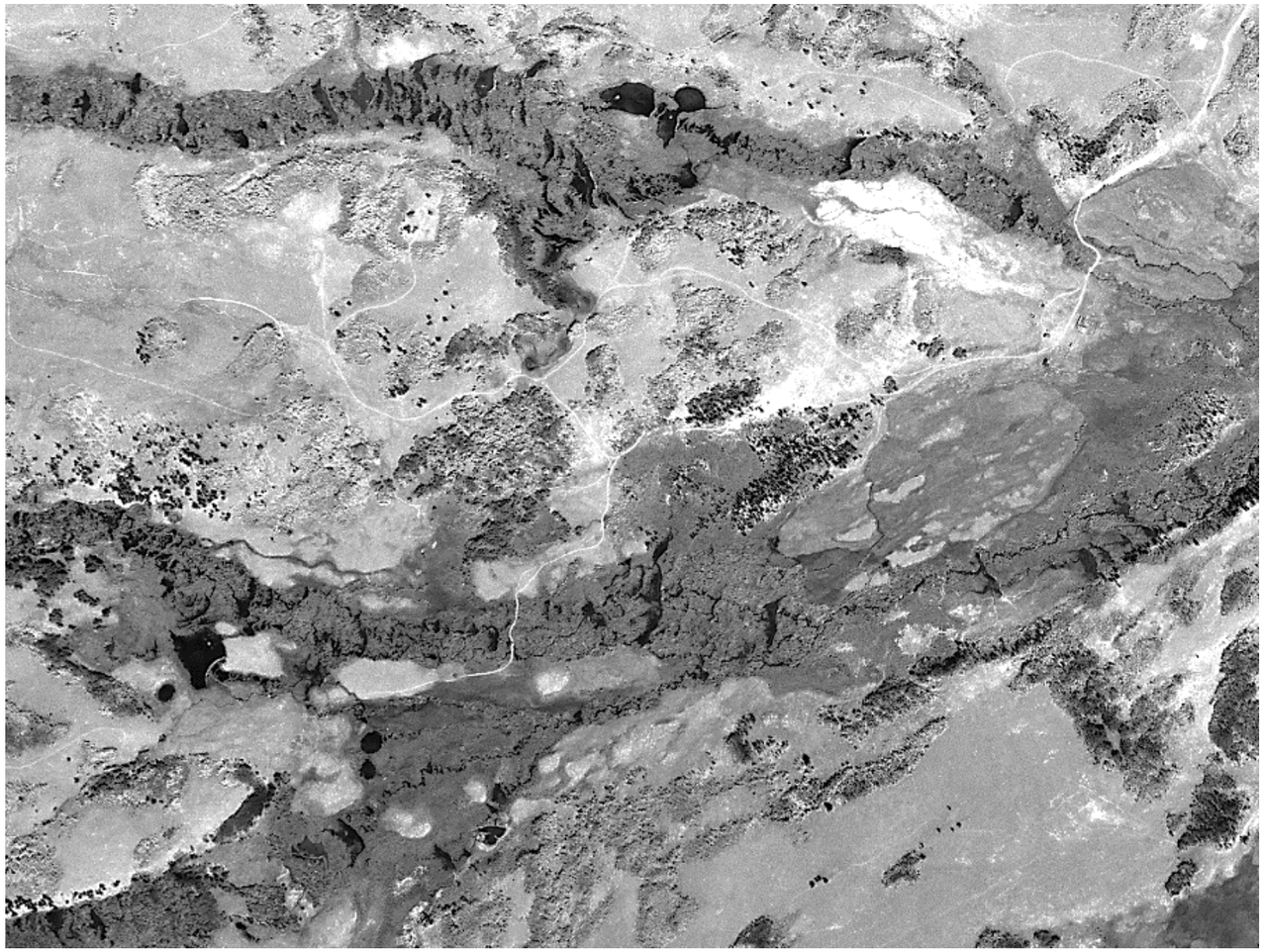


Cave Creek Reach 3 — 2017

Twelvemile Ranch: Historical perspectives

Historical research

Historical context is critical to effective conservation and restoration. Based on the history of South Park, Twelvemile Ranch was likely homesteaded in the mid- to late 1800s, but ranching was apparently not developed to the industrial scale that many of the other valley-bottom properties in South Park were. Except for about 40 acres of managed hay meadow, the riparian areas remain largely intact. We studied historical aerial photos dating back to 1953 and talked with long-time residents to gain perspective on land use and history of the ranch over the past 65 years. Clipped sections of the aerial photos corresponding to stream and riparian reaches can be seen on the sheets that follow.



Historical perspectives — land use

- Land use has been consistent since the 1950s, with low-intensity cattle grazing and about 40 acres of irrigated meadow used to cultivate hay.
- Primary land use since the 1940s has been as open space for the Twelvemile Fishing Club.
- Several home and cabin sites have been developed over the past 65 years, but the road network is largely unchanged.
- The three reservoirs on the property were built prior to 1953.
- The creeks and reservoirs are home to brook, brown, cutthroat, and rainbow trout, as well as native fish. A history of the fishery and stocking could provide greater insight.

Historical perspectives — beaver activity

- Coexistence with beaver activity has been a priority of ranch management since the 1940s, reflecting the value landowners place on the fish and wildlife habitat benefits they provide.
- 1953 aerials show a high level of beaver activity at that time, with beaver pond area likely exceeding the amounts we've measured since 1999.
- Beaver activity in 1983 appears to have been very low.
- Concerns over beaver decline in the 1980s prompted ranch owners to relocate beavers to the ranch. Beavers were released to the ranch in two separate efforts. One brought beavers from the Arkansas basin and the other beavers from the Lower South Platte.

Twelvemile Ranch: Sheep Creek Reach 1

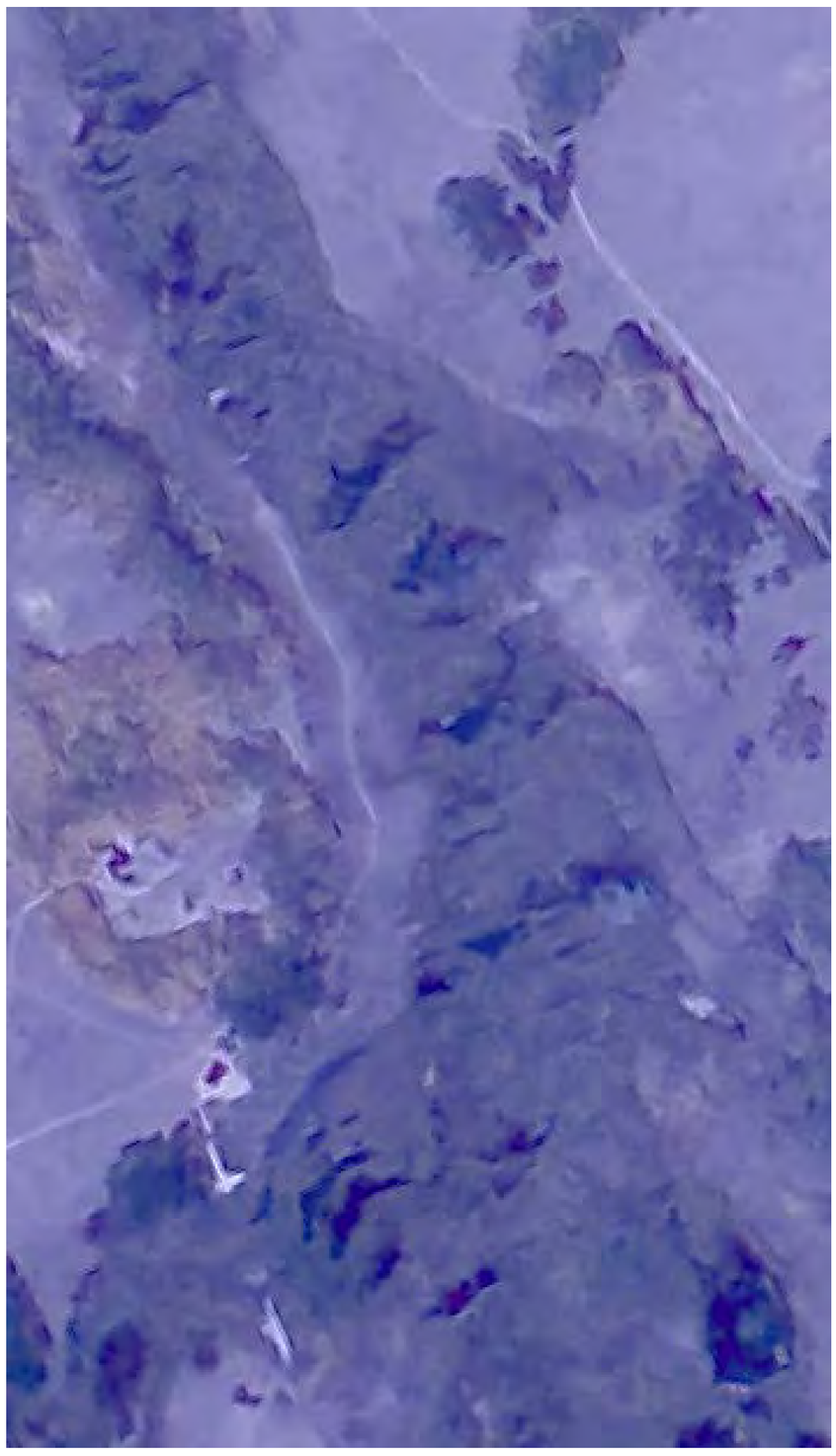
2017

2013

1999

Twelvemile Ranch: Sheep Creek Reach 1

1983



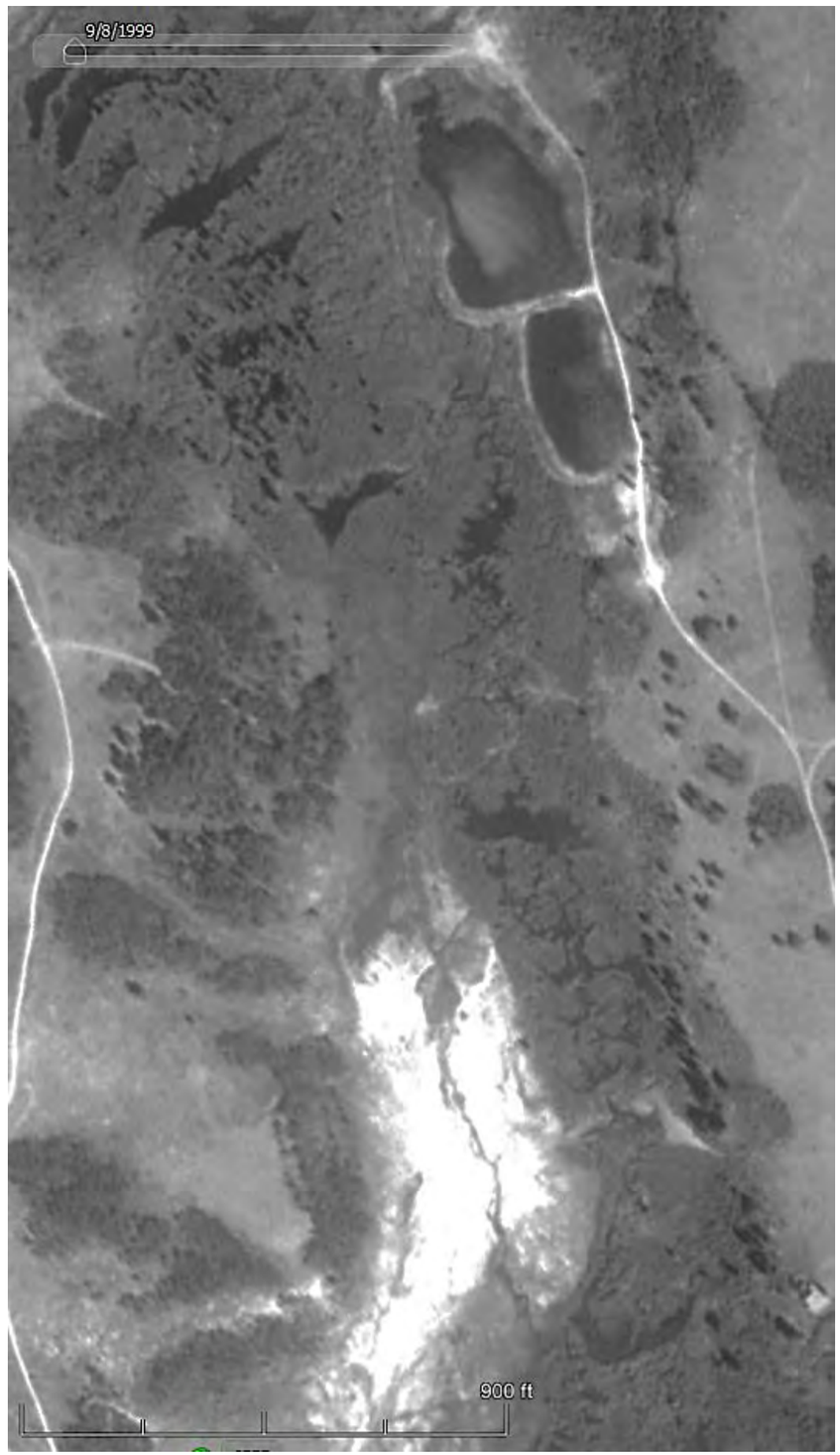
1971

1953

Twelvemile Ranch: Sheep Creek Reach 1

2017

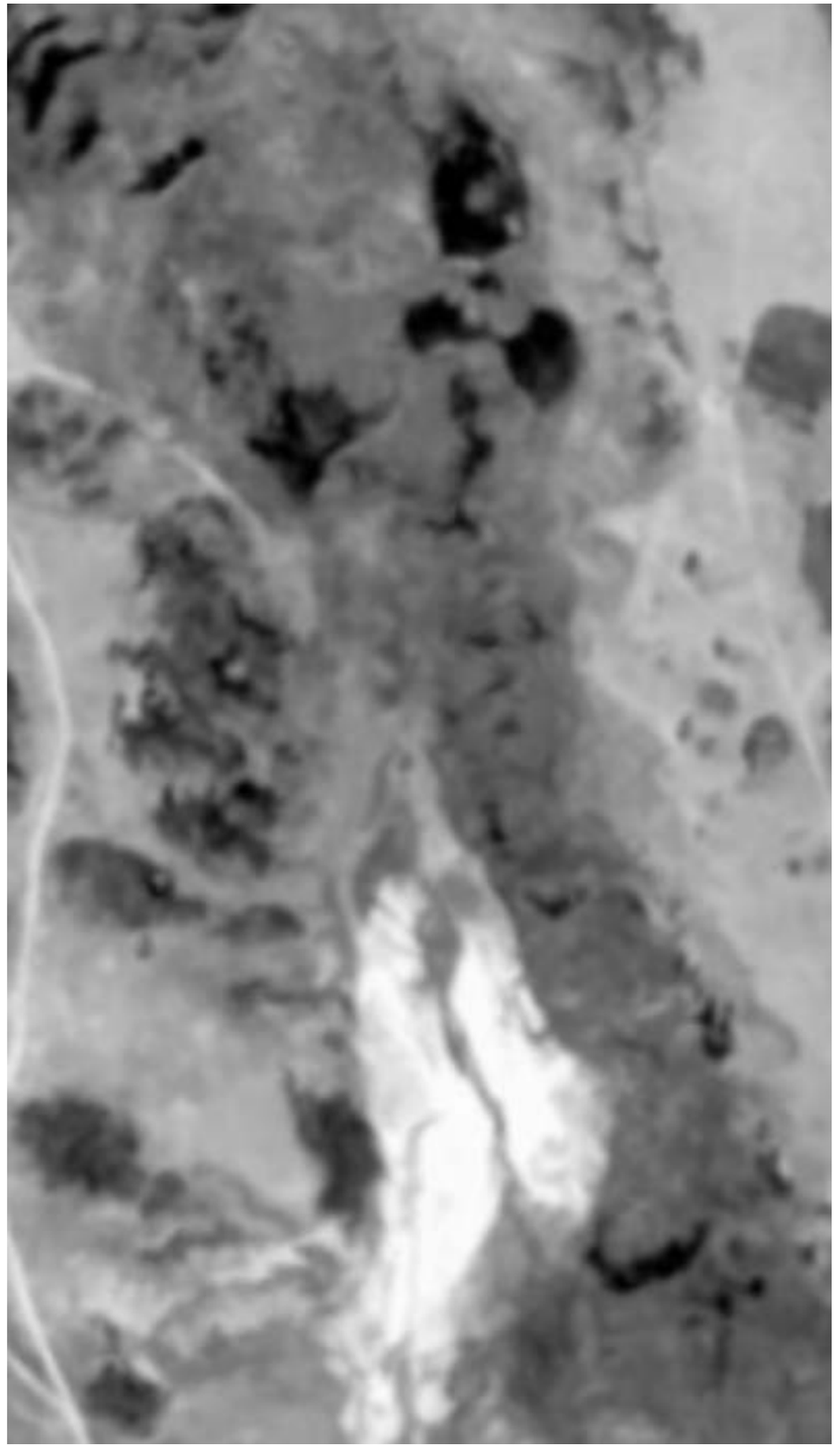
2013



1999

Twelvemile Ranch: Sheep Creek Reach 2

1983



1971

1953

Twelvemile Ranch: Sheep Creek Reach 3

2017

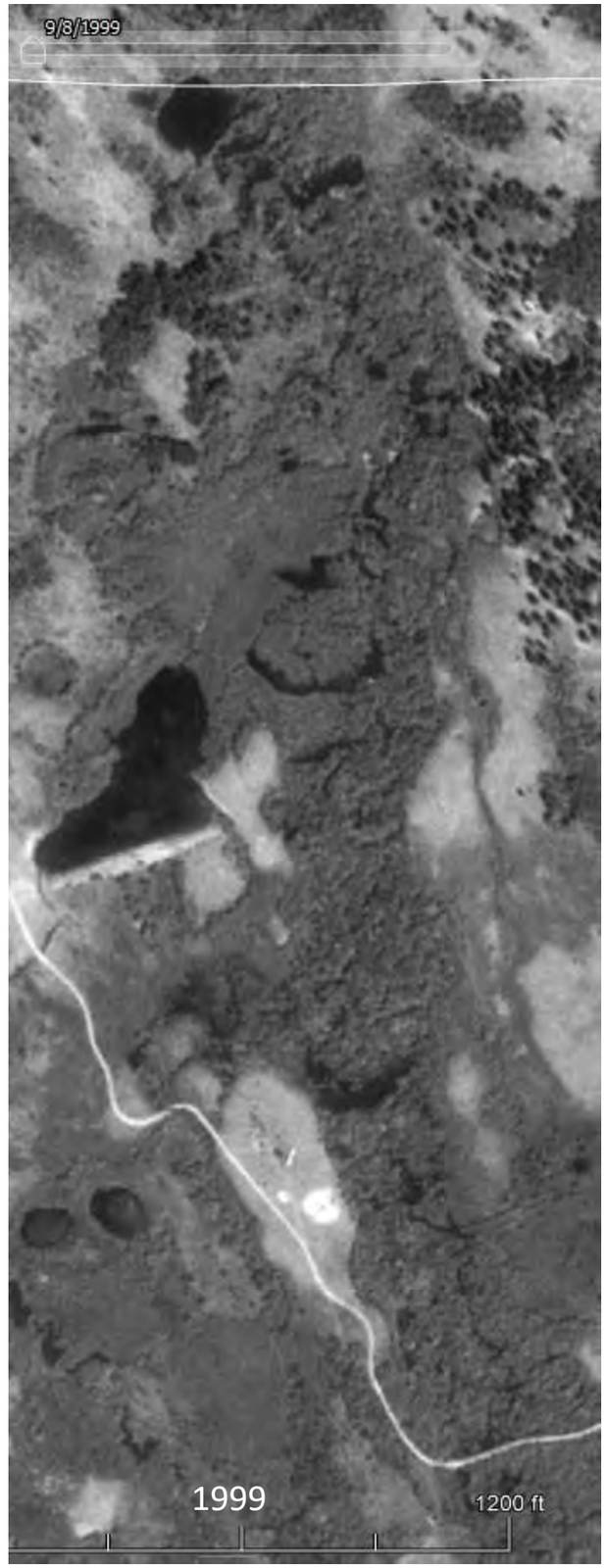
2013

1999

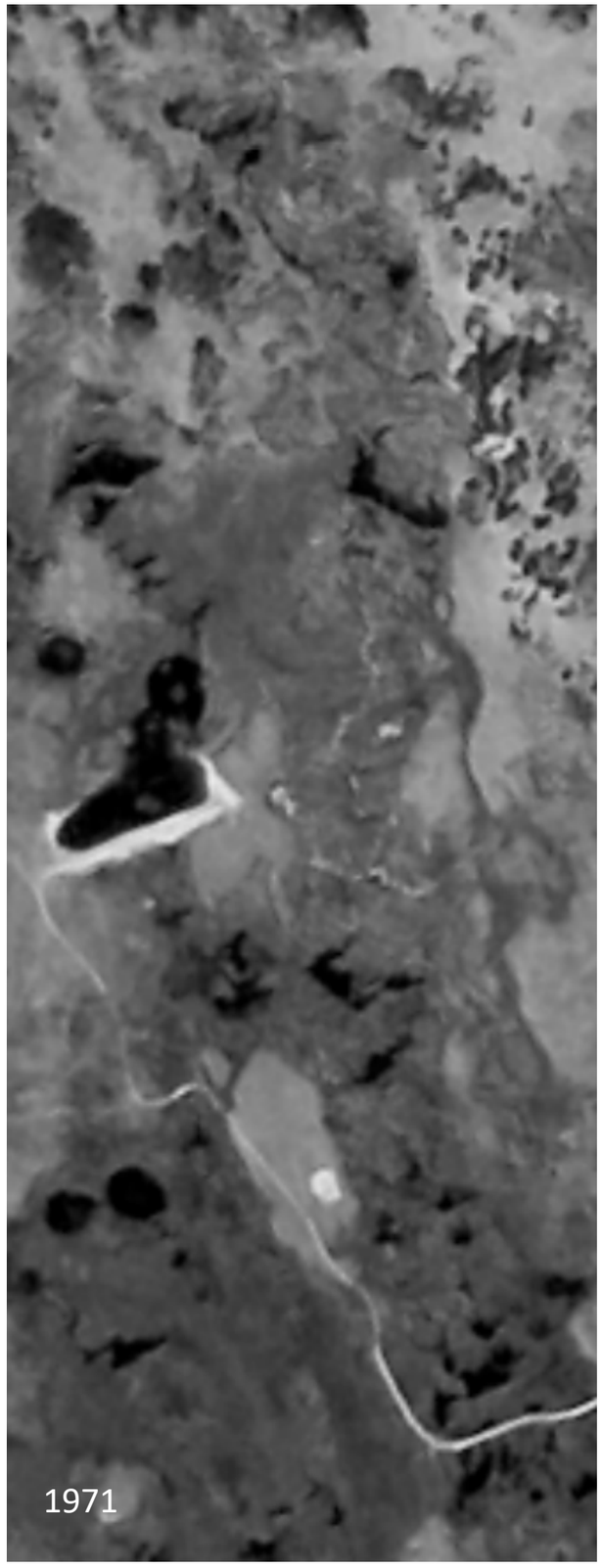
1983

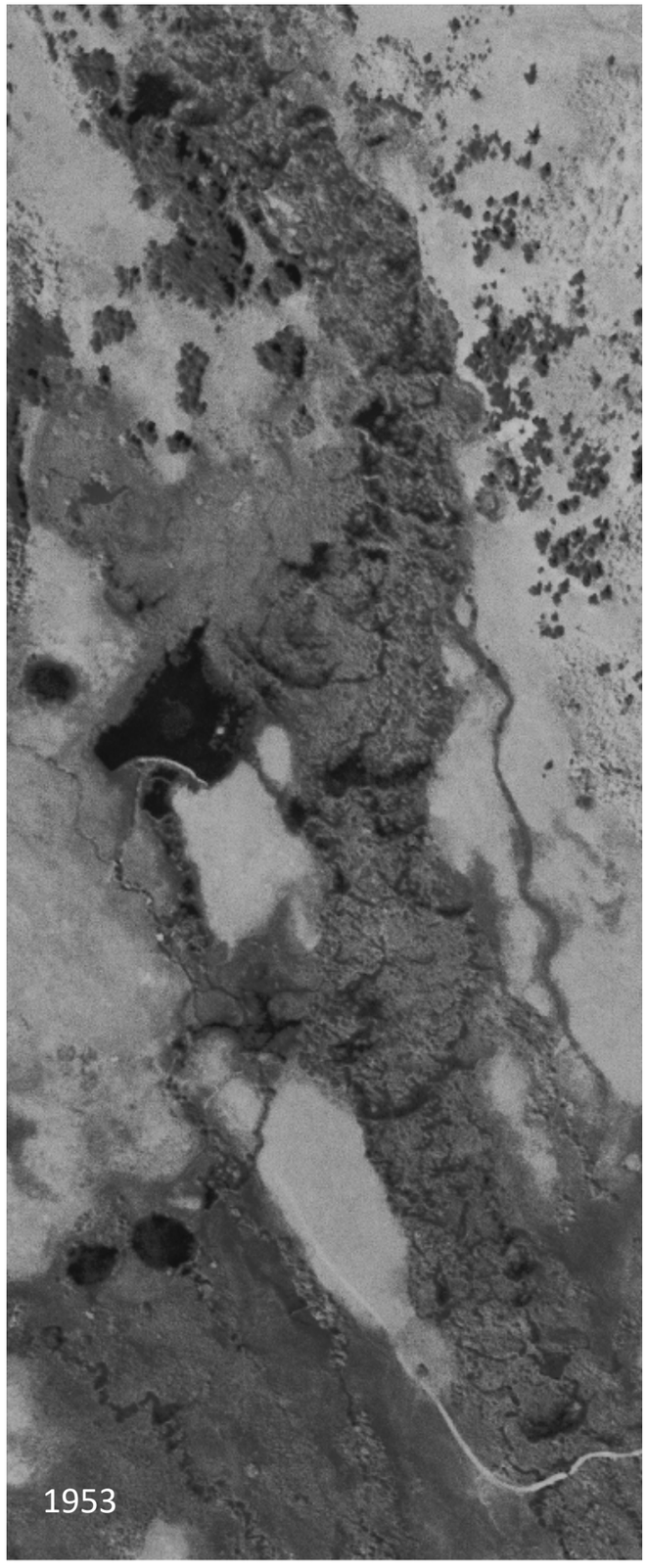
1953

Twelvemile Ranch: 12-Mile Creek Reach 1



Twelvemile Ranch: 12-Mile Creek Reach 1





Twelvemile Ranch: 12-Mile Creek Reach 2

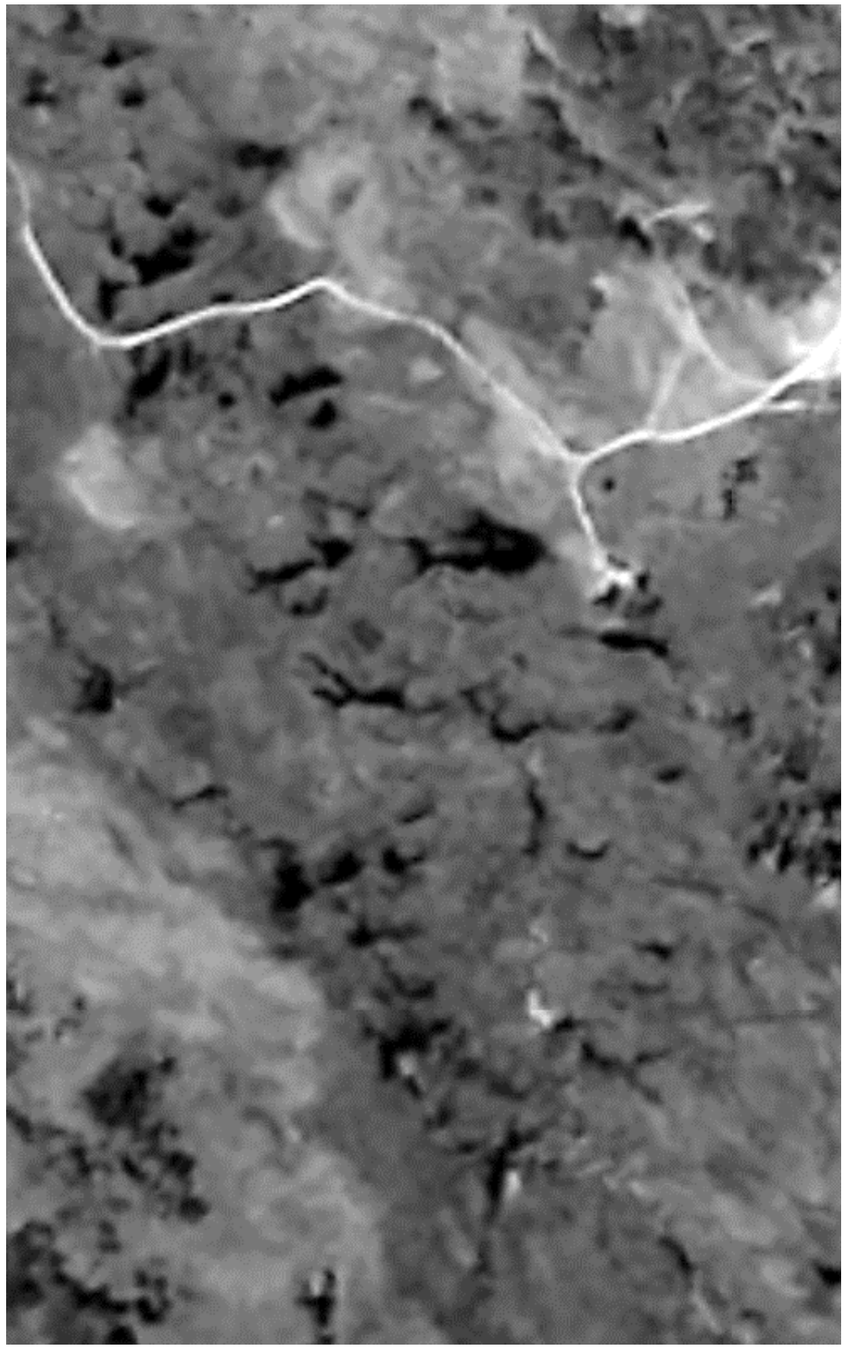
2017

2013

1999

Twelvemile Ranch: 12-Mile Creek Reach 2

1983



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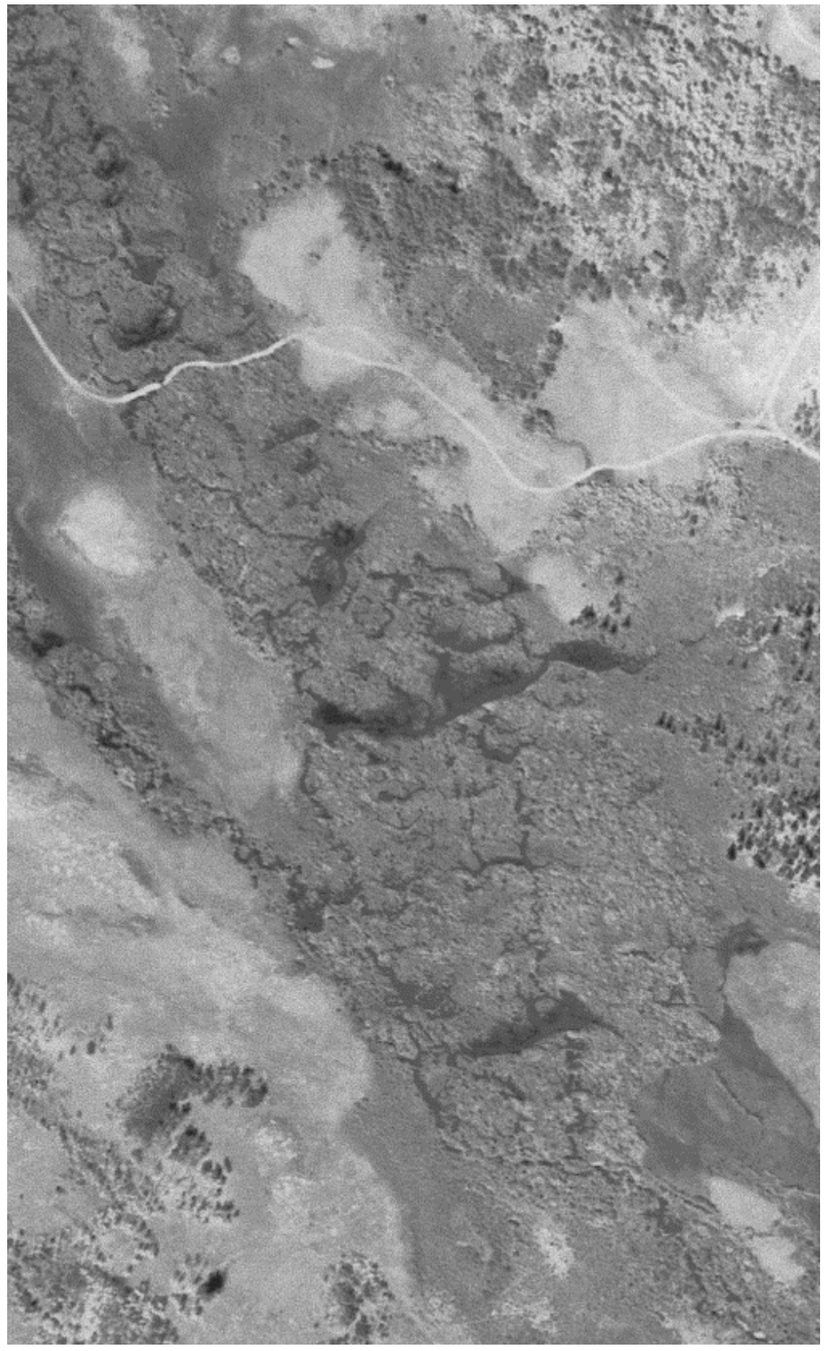

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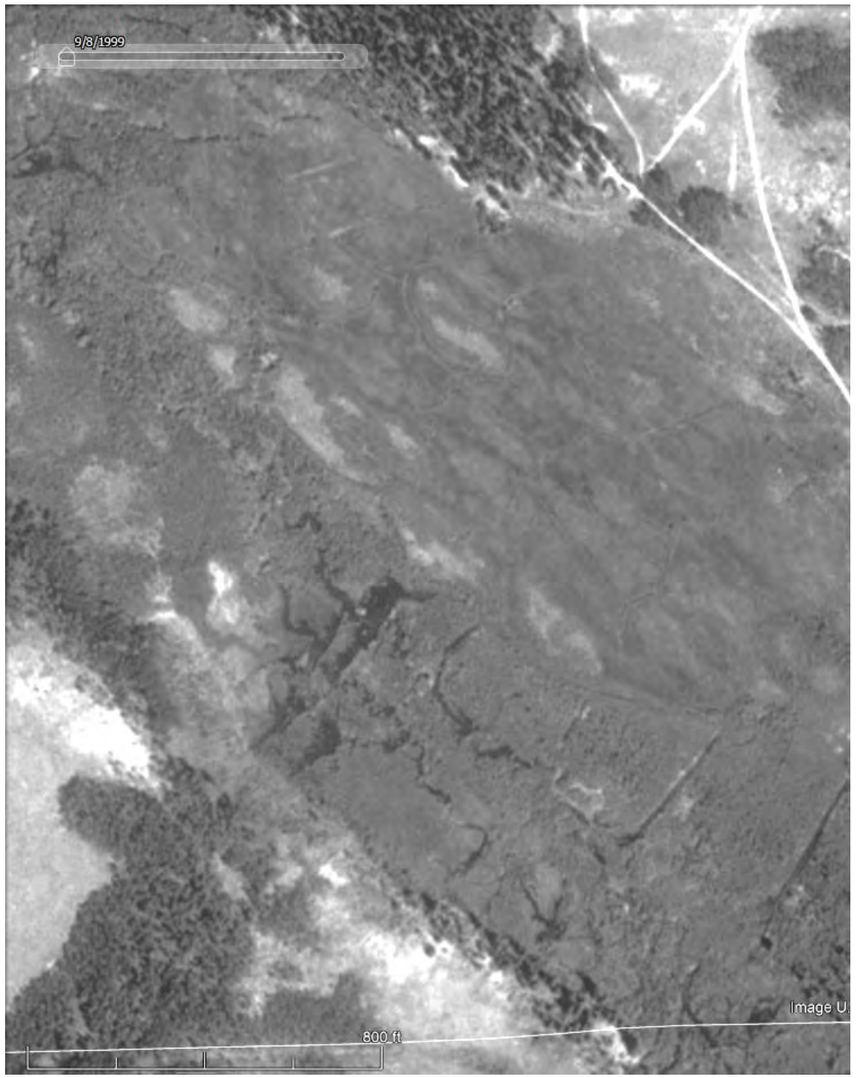
Twelvemile Ranch: 12-Mile Creek Reach 3

2017

2013



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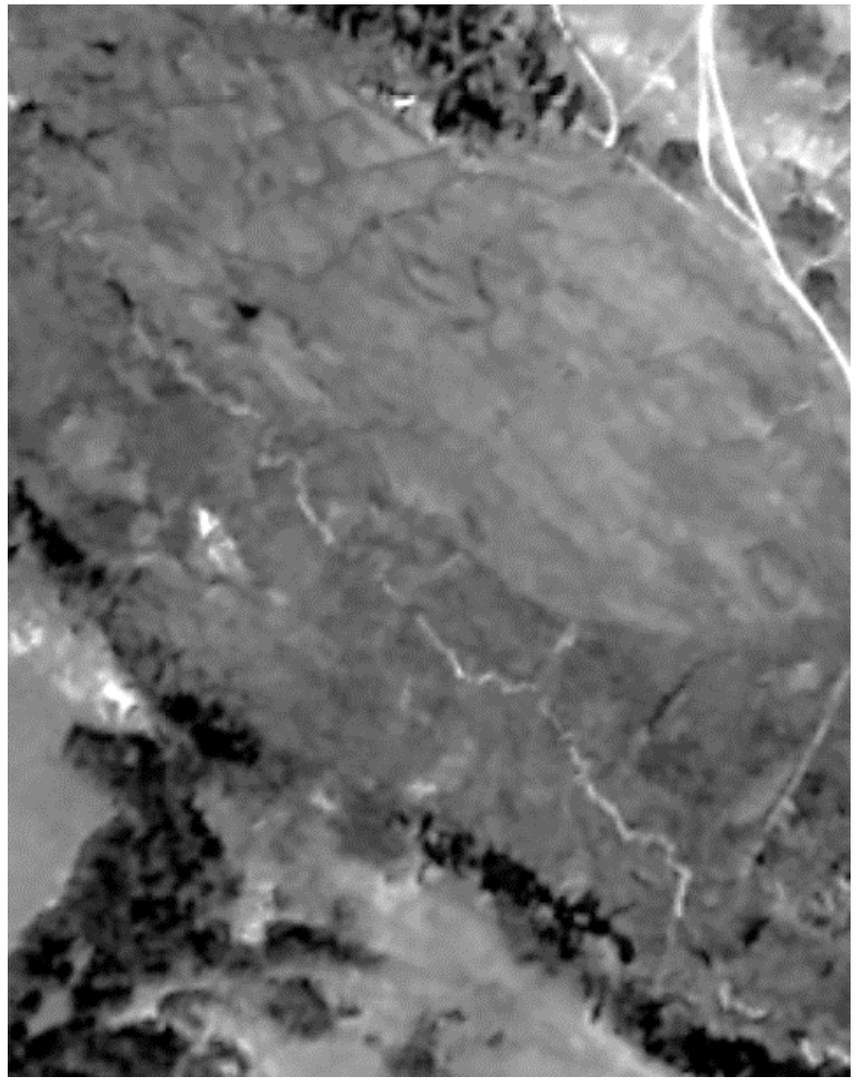
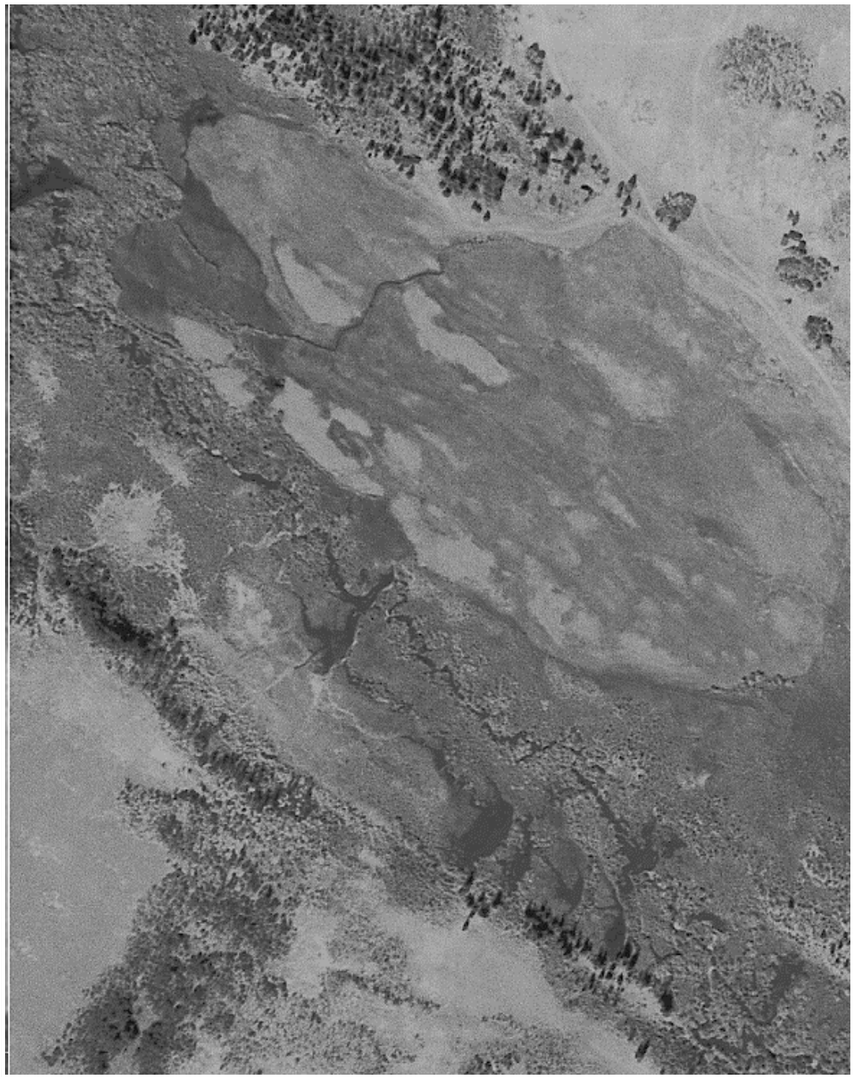
Twelvemile Ranch: 12-Mile Creek Reach 3

1983



1971

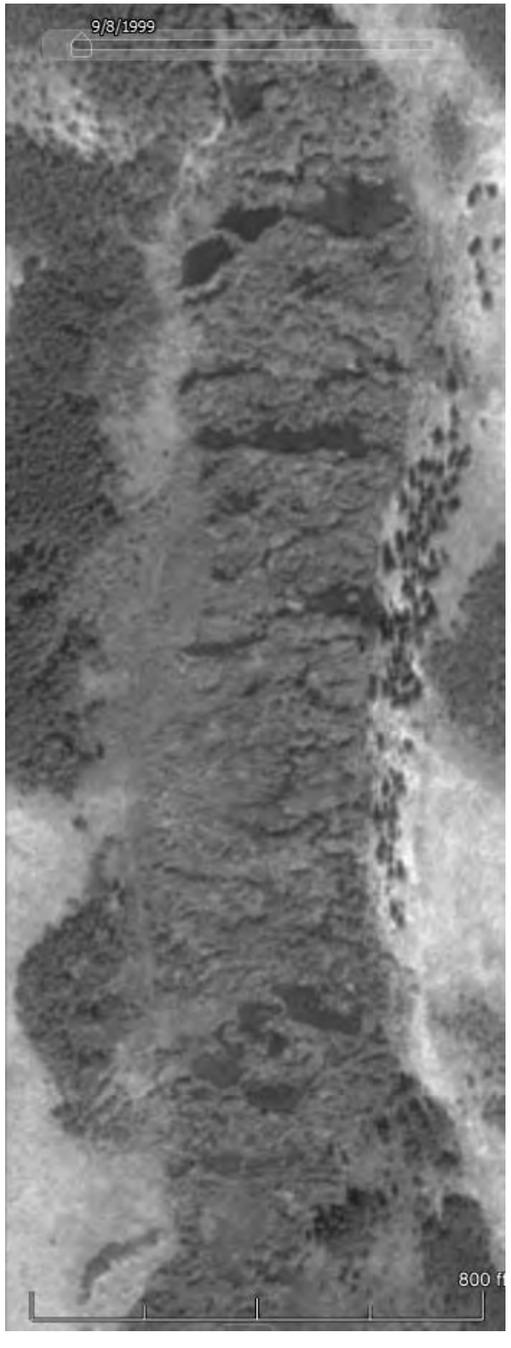


1953

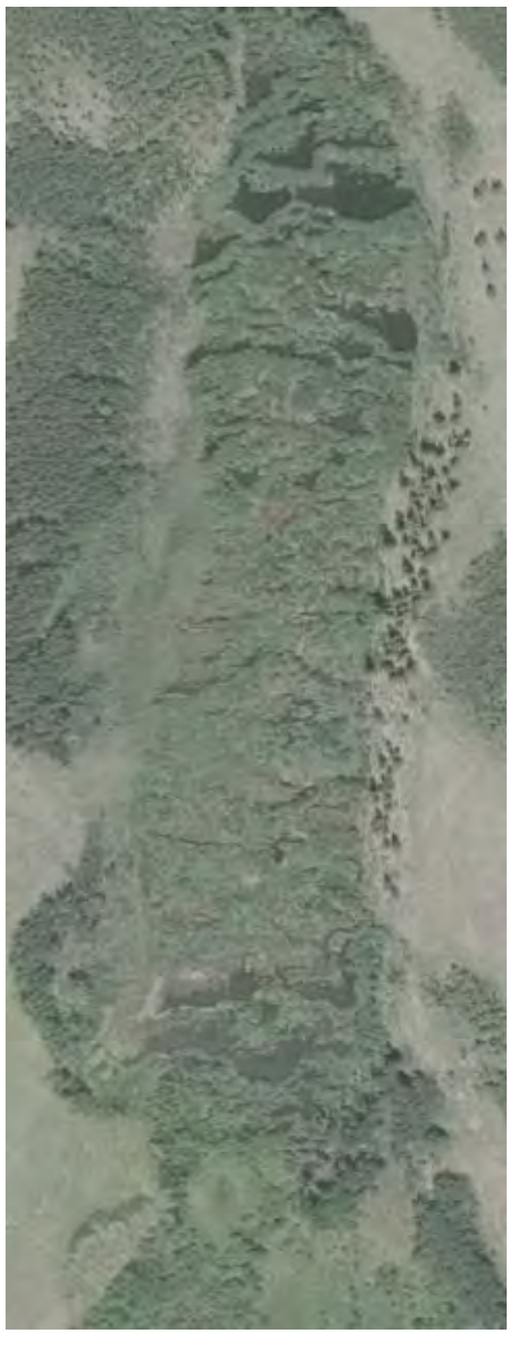
Twelvemile Ranch: Cave Creek Reach 1 (Most of this reach is not on Twelvemile Ranch)

2017

2013



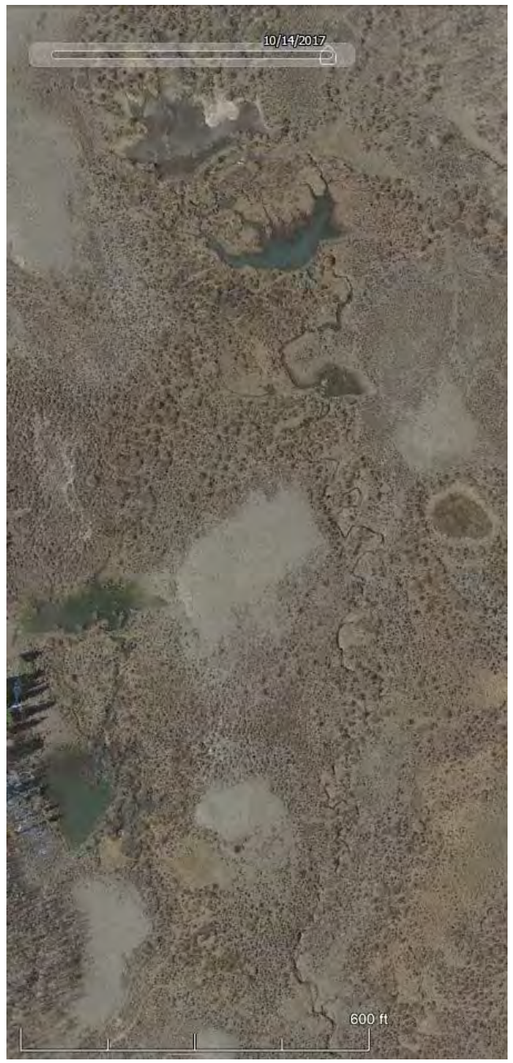
1999



1983

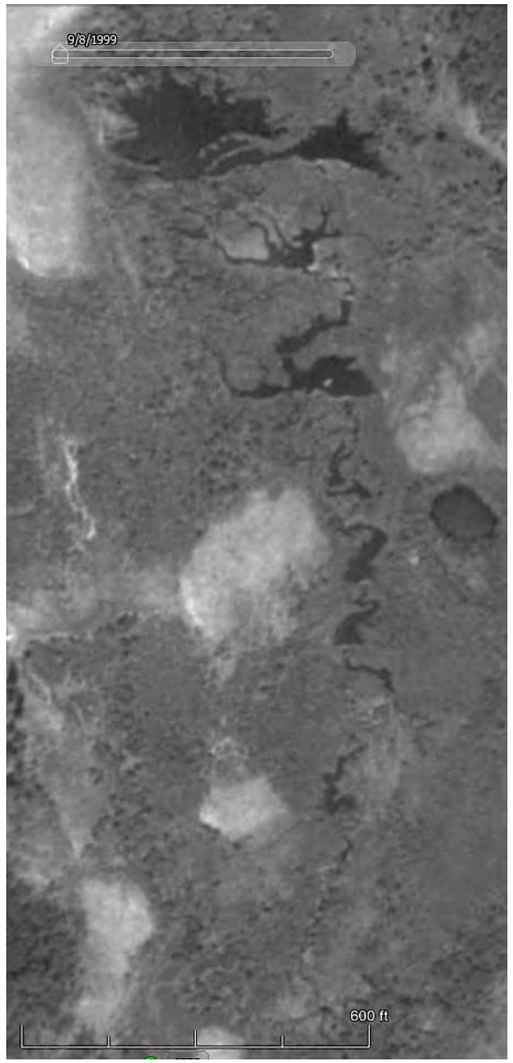
1953

Twelvemile Ranch: Cave Creek Reach 2



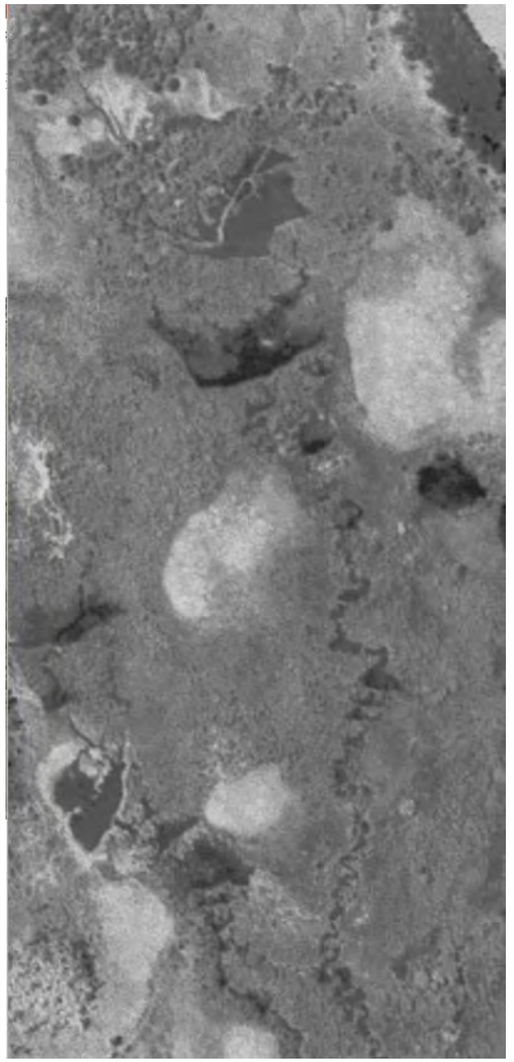
2017

2013



1999

1983

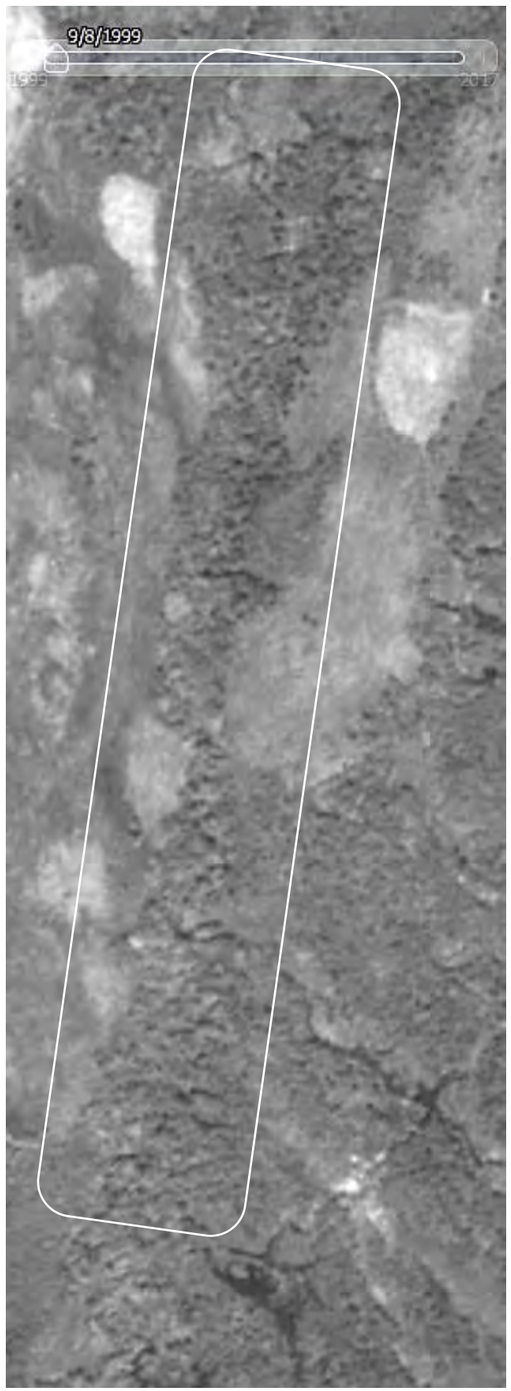


1953

Twelvemile Ranch: Cave Creek Reach 3

2017

2013



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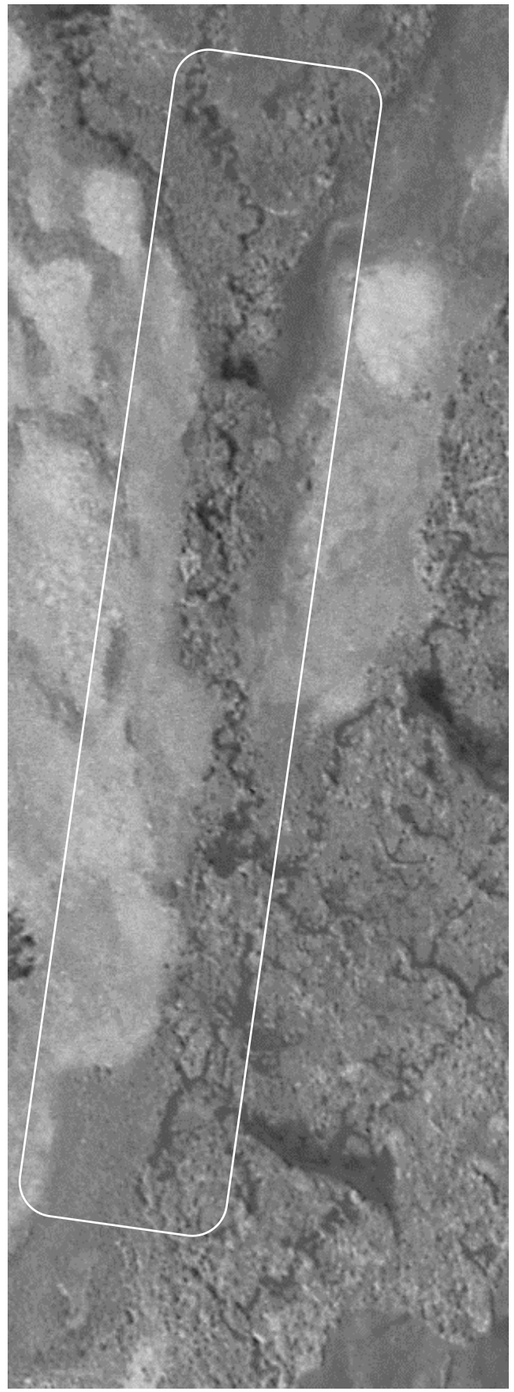
1983



1953

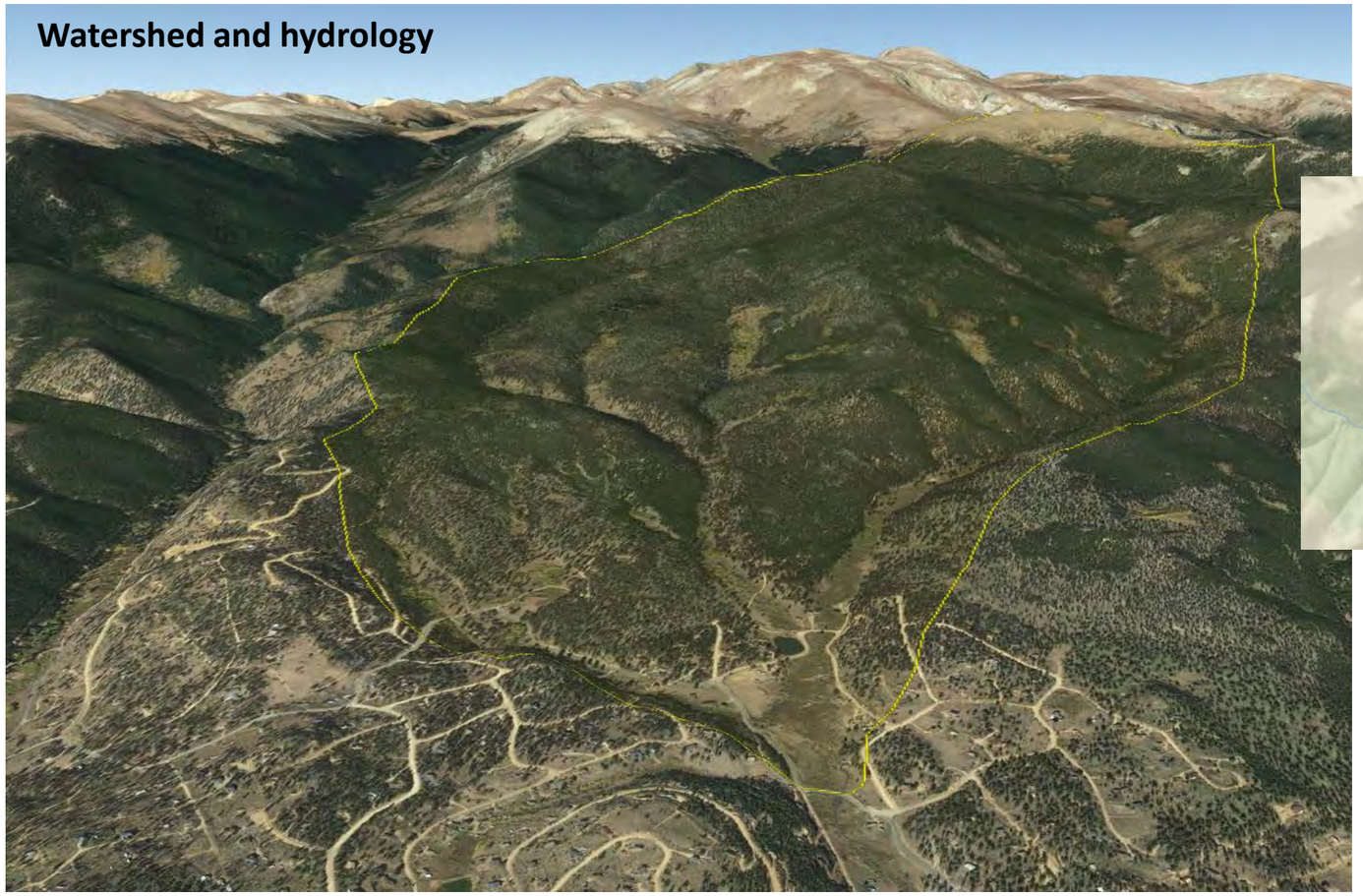
Elk Creek Highlands Property Owners Open Space Reach:
A reconnaissance assessment of stream and riparian condition for the Riparian Reconnect project with recommendations for restoration and management

Riparian Reconnect

Contents

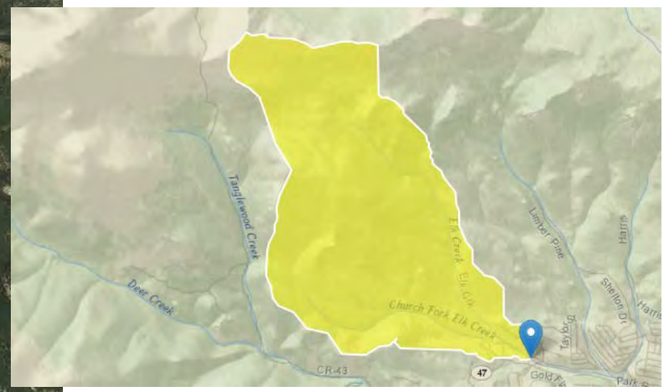
Prepared by EcoMetrics January 5, 2018

Watershed and hydrology



Watershed

The watershed feeding the ECHPOA reach is 5.1 square miles of forested area. Most of it is in the Mount Evans Wilderness Area.



Hydrological statistics

Flow statistics for Elk Creek on the ECHPOA reach were predicted using USGS regression equations for the Mountain region, basin characteristics and estimated 18.7 inches annual precipitation. Elk Creek is a small first-order perennial streams. Typical low flows tend to be 1-2 CFS with annual peaks of 15-25 CFS.

Hydrology parameter	ECHPOA reach
Drainage area (square miles)	5.1
2-year max flood (CFS)	26
10-year max flood (CFS)	53
100-year max flood (CFS)	85
7-day 2-year max flood (CFS)	17
7-day 10-year max flood (CFS)	31
7-day 50-year max flood (CFS)	46
7-day 2-year minimum (CFS)	0.2
7-day 10-year minimum (CFS)	0.1
7-day 50-year minimum (CFS)	0.1
10% duration (CFS)	6.5
25% duration (CFS)	1.8
50% duration (CFS)	0.8
75% duration (CFS)	0.4
90% duration (CFS)	0.2

Ecosystem services and conservation value

Ecosystem services and conservation value

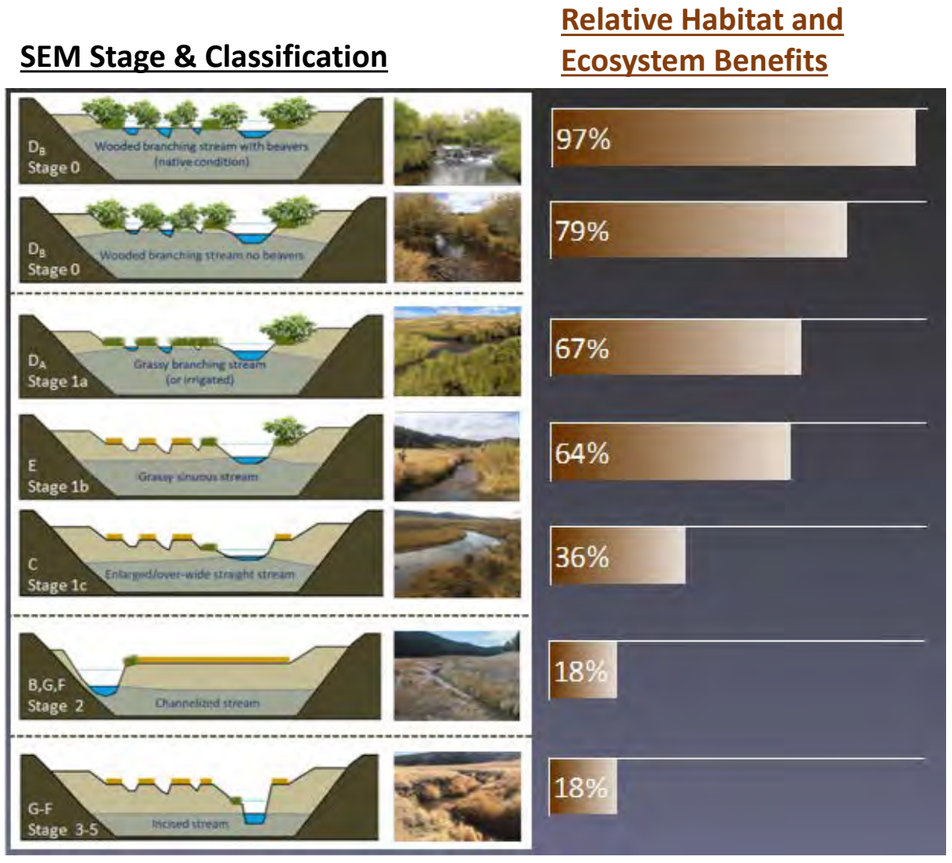
Over and above the local benefits of aesthetics, recreation, and fish and wildlife habitat, intact headwaters riparian systems like these are a critical component of watershed health.

The beaver-mediated riparian complex on Elk Creek provides a myriad of functions that support health of the South Platte Watershed at large and especially the North Fork of the South Platte just downstream. When functioning, these riparian areas work like great sponges that store runoff in ponds, floodplain wetland, and alluvial aquifers that discharge slowly to keep Elk Creek flowing year-round downstream. In this way, they buffer the effects of extreme weather, like floods and drought, which is increasingly important for climate change resilience.

They also provide resilience to fire. Perhaps the greatest damage from forest fire is caused by the ensuing period of erosion and sedimentation to streams. Streams with well-connected riparian areas and beaver ponds excel at retaining sediment sinks. Rather than flushing through to larger rivers downstream, the sediment trapped in these headwaters systems is composted with accumulating organic material like wood, detritus, and ash into rich floodplain soil.

The ponds and complex channel networks typical of functional small beaver streams have maximum groundwater connection which means they also function like filters. Water flows through these systems slowly, not just as surface flow, but also through saturated ground to mediate temperature fluctuation. naturally through soil biogeochemical processes through these systems. Water quality is enhanced by saturation and long retention times that give soil biogeochemical processes time to assimilate nutrients and solutes.

Stream health and function



Restoration strategy

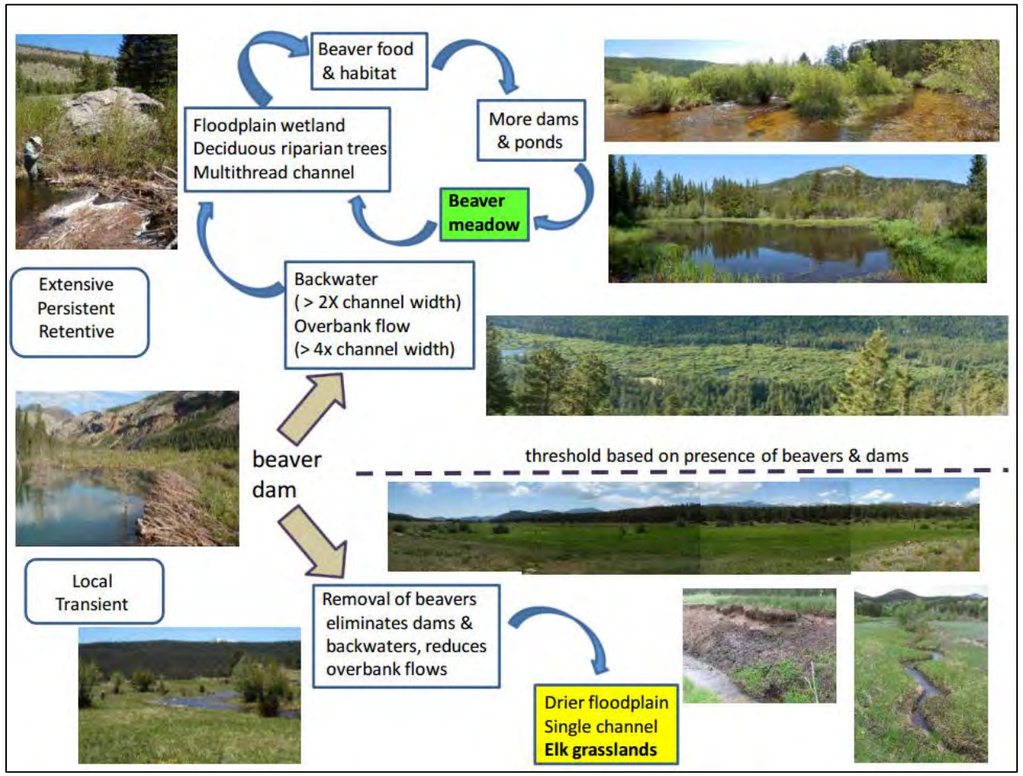
Prolonged absence of beaver from the ECHPOA reach corresponds to a shift from Stage 0 to Stage 1a or 1b of stream evolution. The restoration strategy aims to reverse this process to regain valuable stream functions and reduce the risk of further degradation.

Beaver stream health and function

Small beaver streams are dynamic. Where beavers are present, their dams slow flows and create ponds that trap sediment and spread water laterally to maintain wide contiguous wetland. The habitat that beaver create along small headwaters streams is critical to a host of aquatic and terrestrial species. Nearly all fish and wildlife depend on riparian habitat provided by beavers during some portion of their lives. Without the deep ponds, adult trout could not survive harsh winters or droughts. Shallow water and wetland is habitat for waterfowl, and complex shrub canopies are ideal for game and birds.

But populations fluctuate and beaver colonies move. Where they are absent for more than a few years, their dams begin to fail, resulting in a more channelized stream form. As ponds dry out, the exposed sediment that they trapped is colonized by pioneer riparian species like sedges and willows, driving plant community succession. The dynamic cycles of dam-building and failure are important for maintaining physical habitat complexity and species diversity.

But when beavers are absent for a long time, the depressed water table stresses riparian plants and shrinks the wetland area. If riparian vegetation becomes too dried out and degraded, beavers are less apt to recolonize an area and the stream evolves towards a more permanent entrenched channel with less aquatic habitat, poor diversity, and less wetland. Ultimately that means less habitat for native species, and fewer fish and wildlife.



↑ This diagram (Wohl 2018) describes the transition from beaver complex (Stage 0) to single-thread stream channel (Stage 1) occurs when beaver activity declines below a threshold as it did on the ECHPOA reach between 2011 and 2015. The restoration strategy aims to reverse this process.

Elk Creek: ECHPOA, Open-space Reach		
Watershed	Flow regime	A
	Sediment regime	A
	Water quality	A
	Landscape support	B-
Riparian	Floodplain function	C+
	Riparian vegetation	B+
	Organic material	B+
Stream	Stream morphology	C+
	Stability	B
	Physical structure	B-
Biotia		C
Reach condition score		B

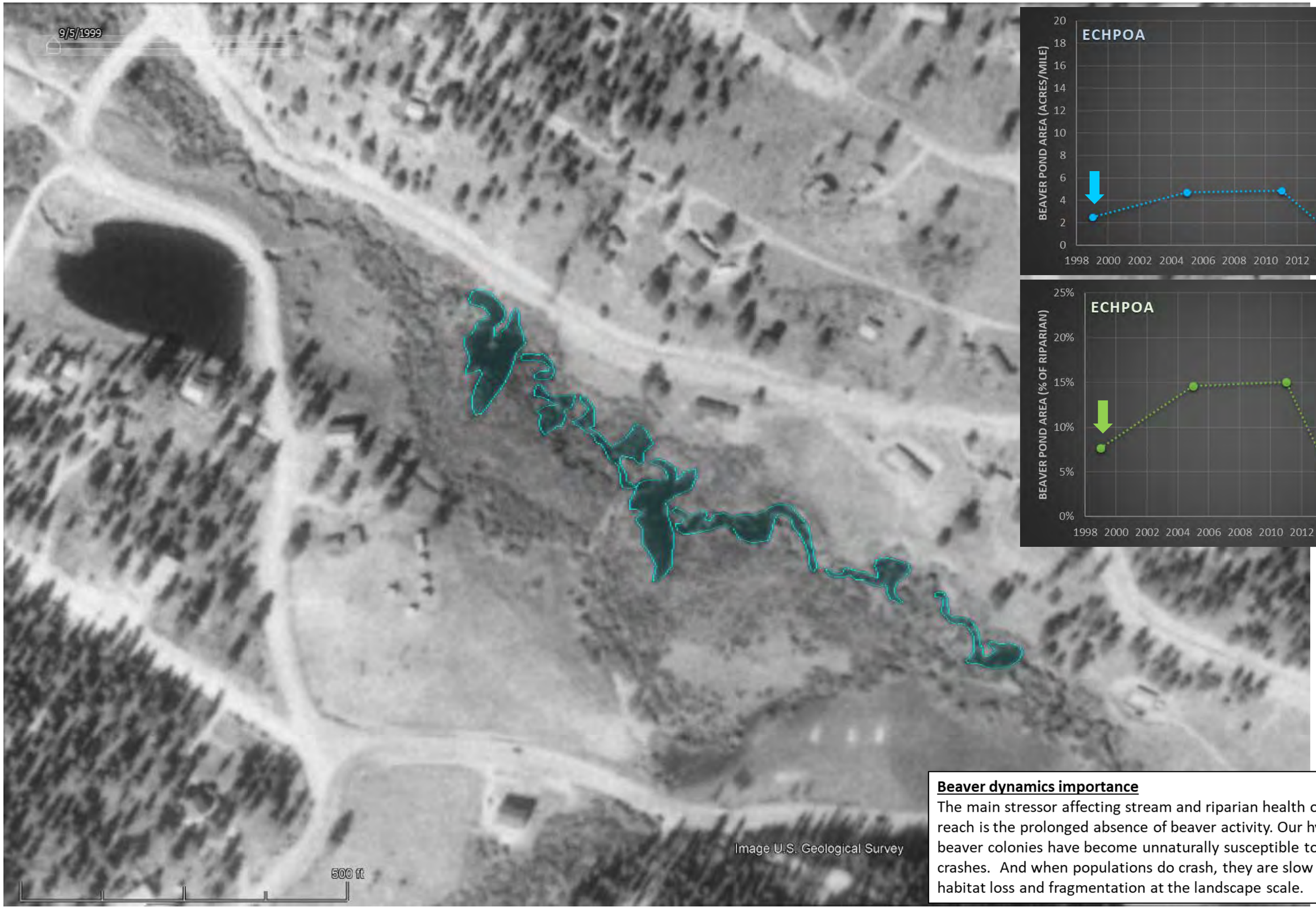
↑ Existing condition

Grade	Score	Impairment
A	90-100	None
B	80-89	Mild
C	70-79	Significant
D	60-69	Severe
F	50-59	Profound

Stream health

Stream health and function is evaluated by rating 10 critical components (below). Each is graded by the degree of impairment compared to natural unimpaired reference reaches according to the table above. Restoring a Stage 0 active beaver complex will significantly improve floodplain function, stream morphology, physical structure, and biota.

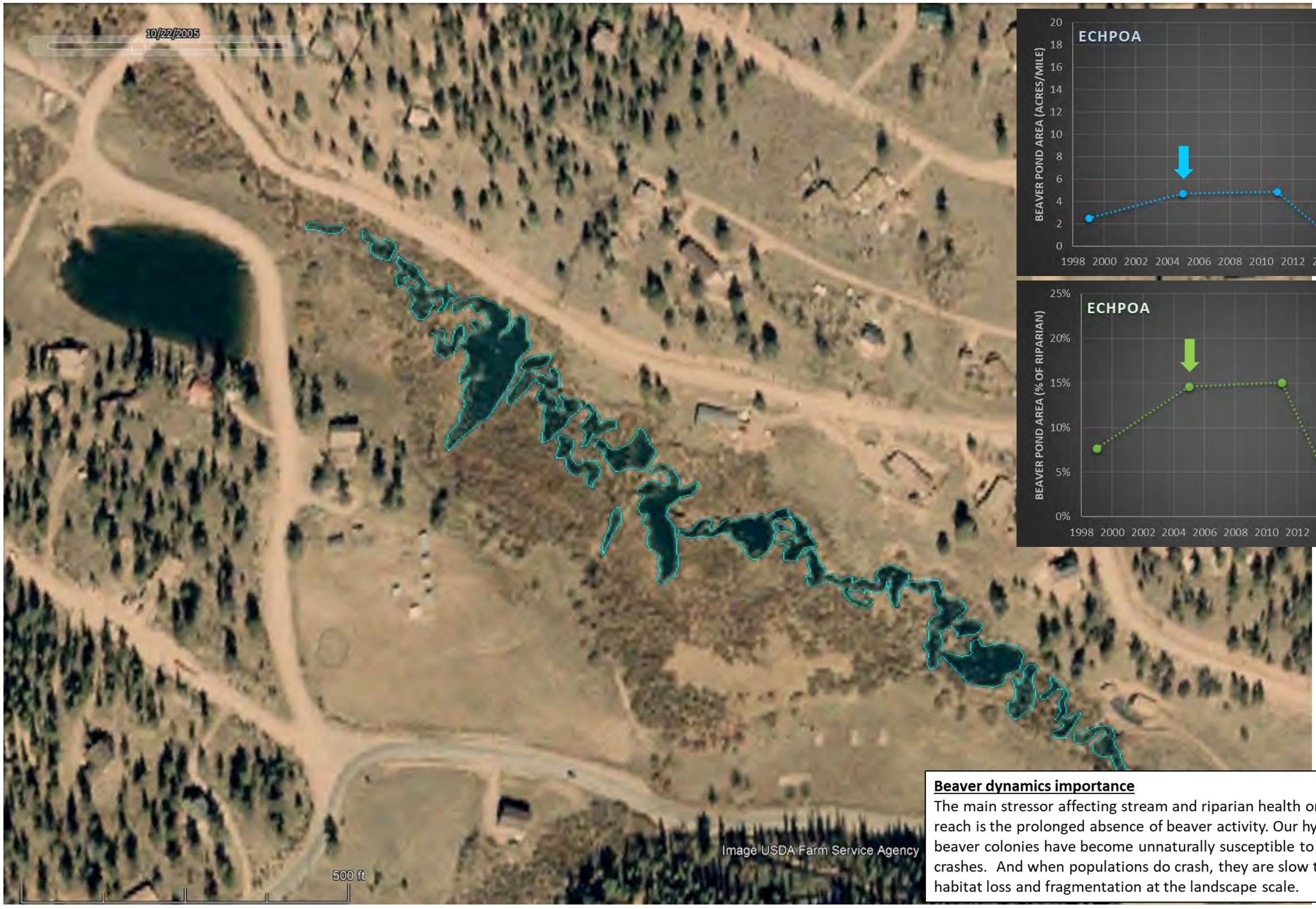
Beaver activity — 1999



Beaver dynamics importance

The main stressor affecting stream and riparian health on the ECHPOA reach is the prolonged absence of beaver activity. Our hypothesis is that beaver colonies have become unnaturally susceptible to population crashes. And when populations do crash, they are slow to recover due to habitat loss and fragmentation at the landscape scale.

Beaver activity — 2005



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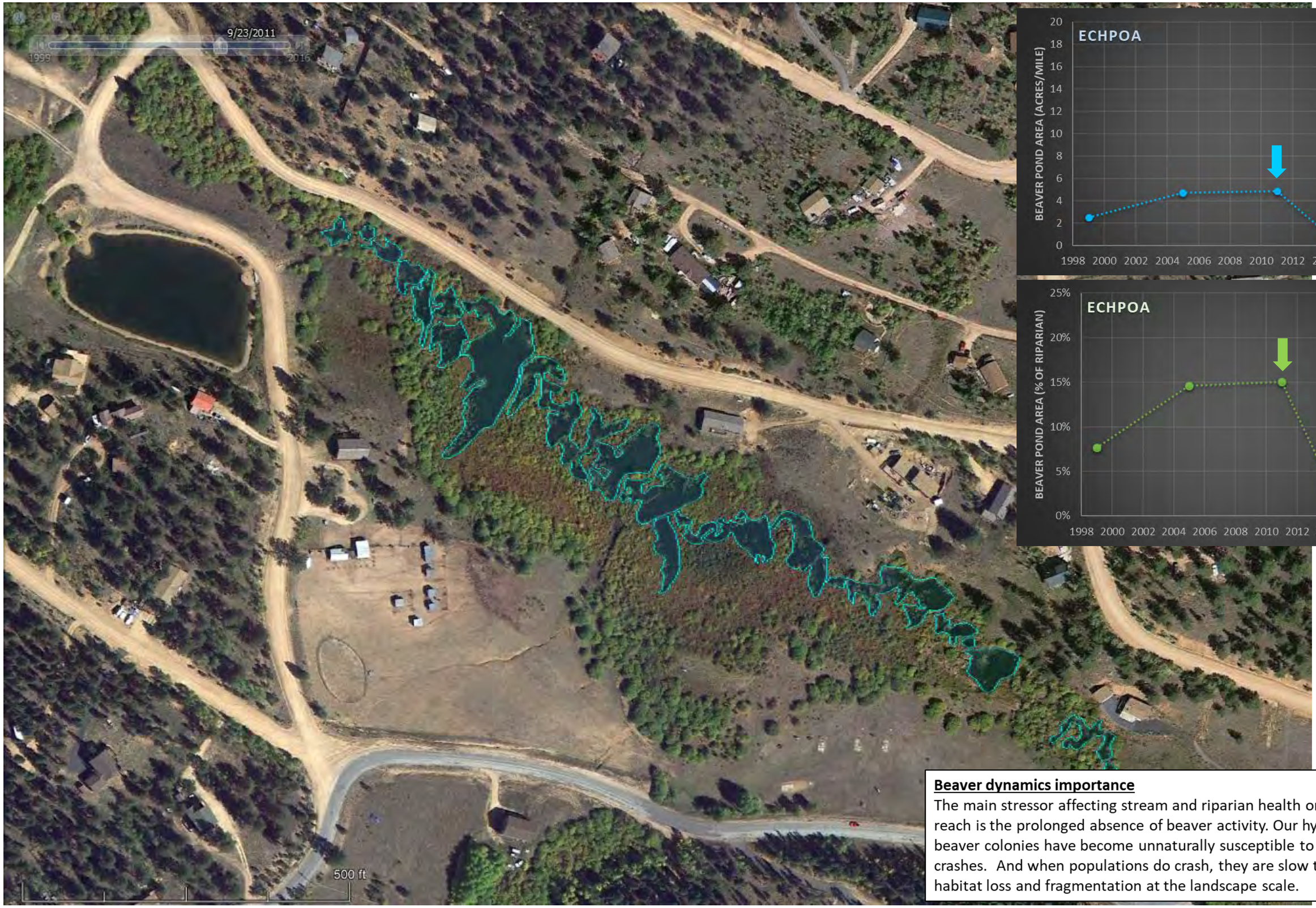
Beaver activity — 2011



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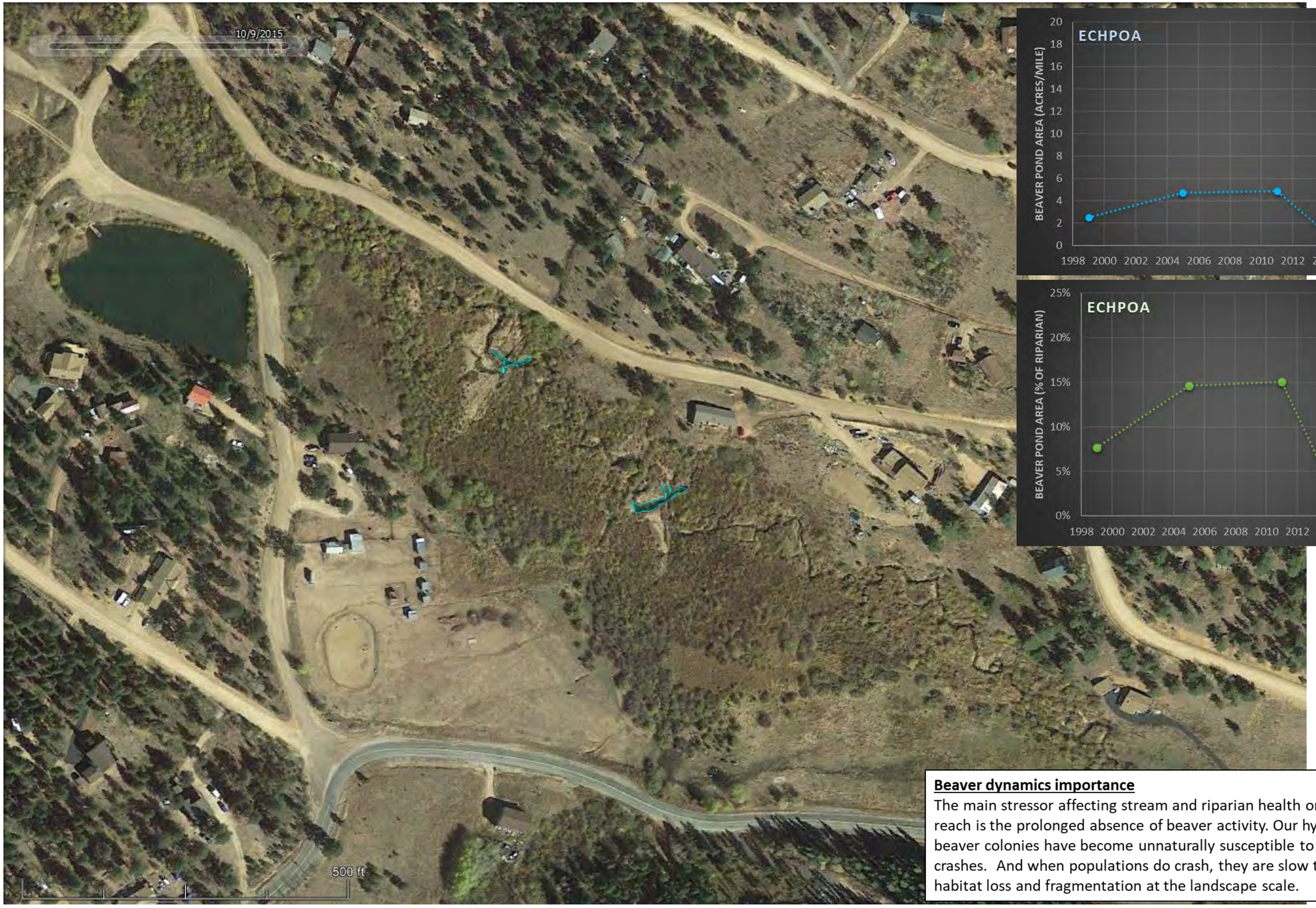
Beaver activity — 2015



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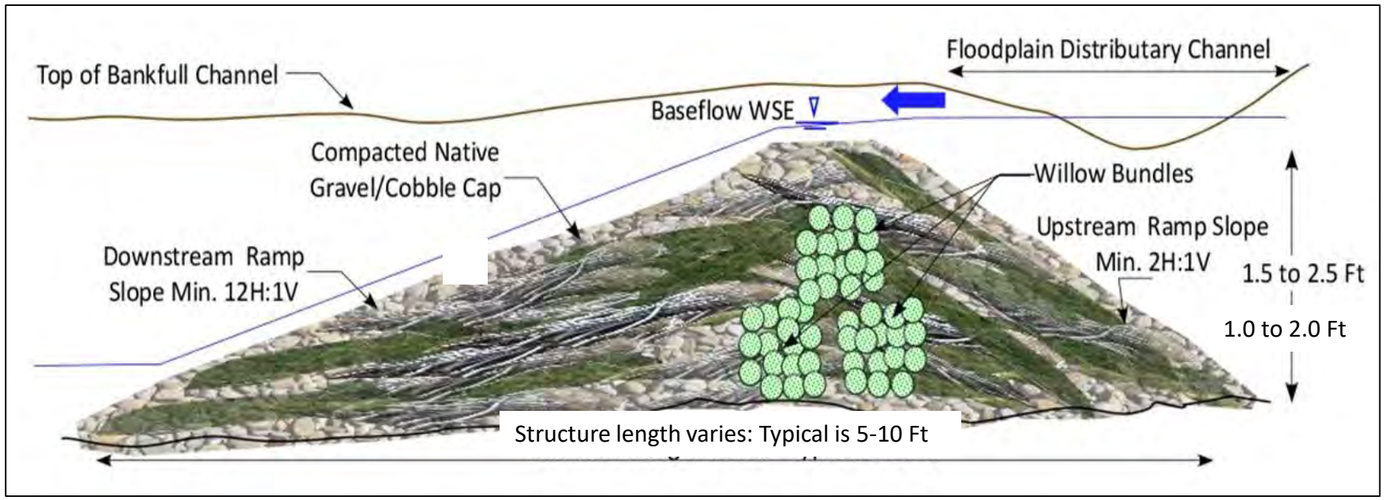
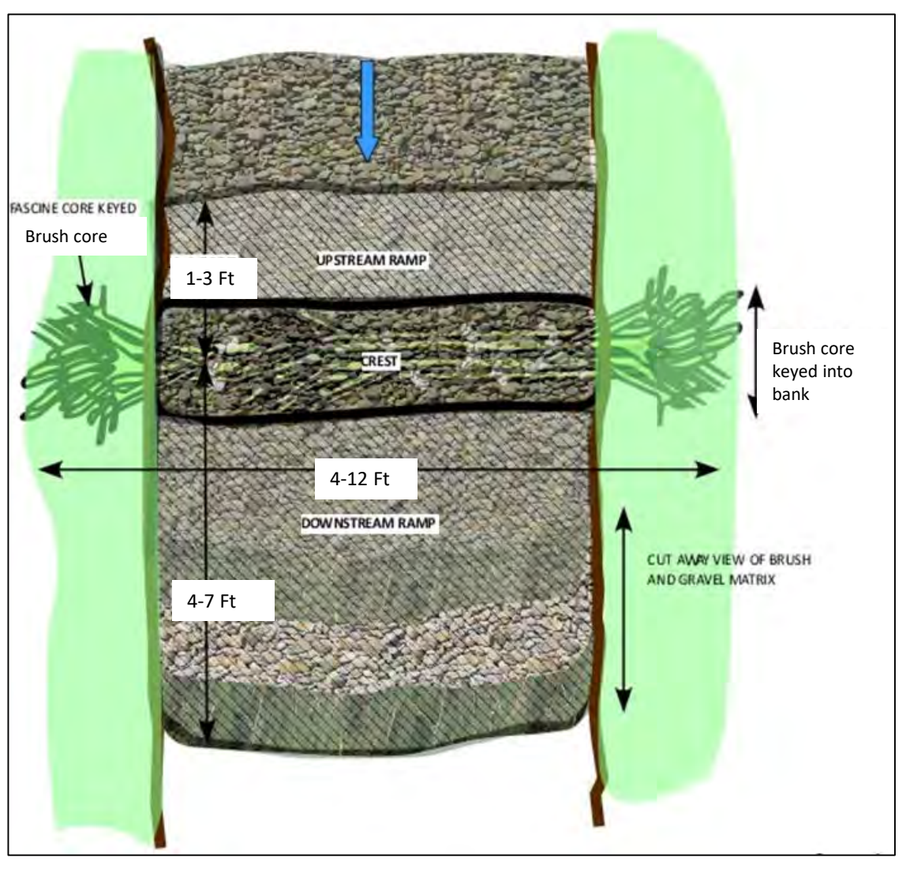
Restoration concepts: Beaver dam repair and rebuilding

Repairing or reconstructing beaver dams in places where beavers have been inactive is a good way to ensure continued function and habitat benefits during periods of prolonged beaver absence. Repaired dams also create deep water and cover that attracts dispersing beavers and entices them to recolonize an area.



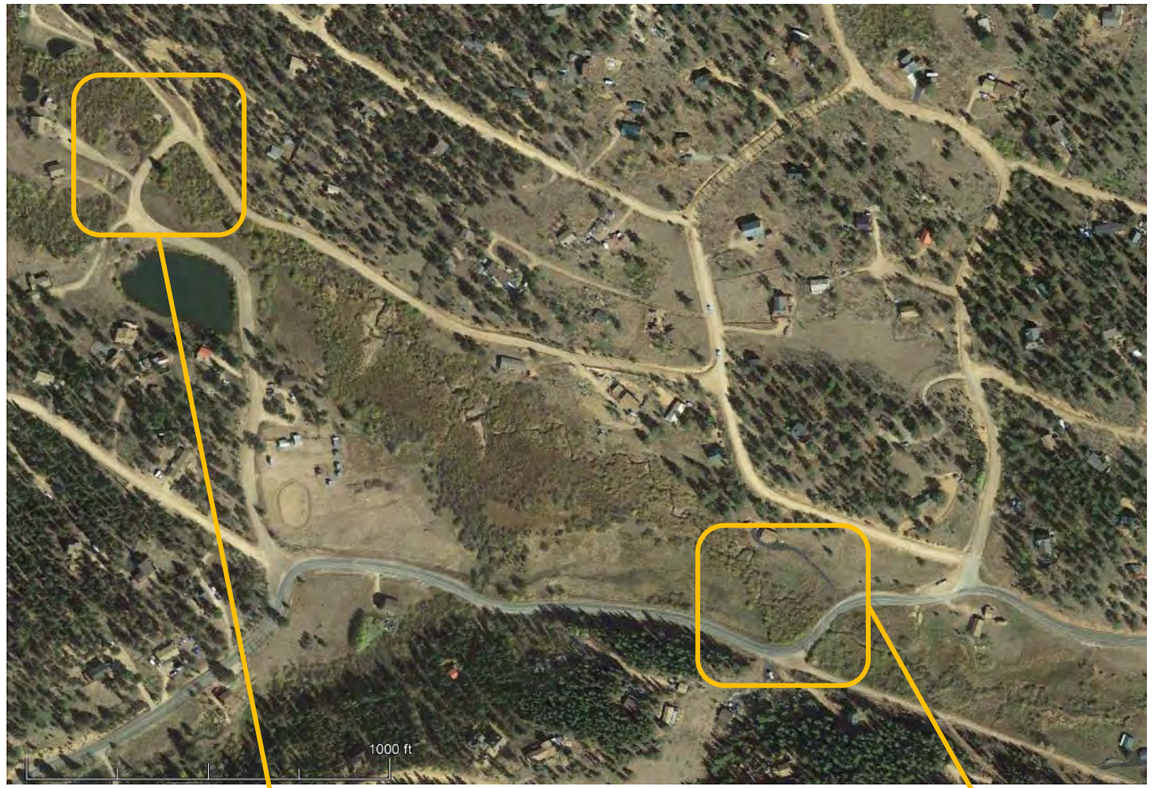


Design specs

The diagrams above and left show specifications for repairing cross-channel dams. These structures are designed to persist through normal runoff events, but are not permanent. They are constructed of native materials that assimilate into the streamscape over time.

↑Repairing breached beaver dams with coir logs and sod.

Managing potential beaver/road conflicts



↓ Elk Creek culvert at the upper road crossing

<u>Maintaining culverts in beaver habitat</u>

Restoring beaver habitat on the ECHPOA reach cold mean an increased risk that beavers will plug culverts. Identifying these potential conflict areas allows us to prepare for potential issues and prepare in advance to reduce the risk of damage or maintenance issues.

Flow devices and other emerging technologies have been used extensively in the Eastern US and Canada to allow coexistence of beaver habitat with human infrastructure, solving thousands of potential problems similar to the potential culvert issues on Elk Creek. Riparian Reconnect is bringing this technology to Colorado in collaboration with Beaver Solutions™ and the Beaver Institute. Please see their websites for examples of Beaver conflict management using flow devices.

Riparian Reconnect restoration plan and timeline

<u>Stream and riparian restoration</u>

Goal

- Improve stream and riparian function and habitat benefits by restoring natural processes typical of healthy small beaver streams

Objectives

- Promote long-term sustainable beaver activity by continuing passive management and riparian protection
- Restore hydrological and ecological functions in places where beavers are absent by repairing and rebuilding beaver dams
- Increase beaver activity and consistency by restoring favorable habitat conditions (pond area, deep water, and cover)

Strategy and timeline

- Develop partnership (spring/summer 2019)
  - Meet with landowners
  - Present and develop restoration concepts
- Secure funding (summer/fall 2019)
  - Allocate existing funds as available and identify funding needs
  - Pursue additional grant funds and landowner cost-share as needed
  - Quantify existing functional conditions and habitat, and identify potential gains for funding proposals
- Prepare detailed design and budget (summer 2019)
  - Dam repair locations and design specs
- Implement treatments (Fall 2019)
  - Construction and oversight by Riparian Reconnect technical team
  - Volunteer labor from COL and ECHPOA
- Monitoring and maintenance (ongoing)
  - Restoration monitoring by EcoMetrics (2019-2021)
  - Routine inspections and maintenance can likely be handled by landowners
  - Riparian Reconnect partners can be available for ongoing technical assistance

<u>Beaver maintenance (conflict management)</u>

Goal

- Manage beaver behavior to maintain road crossings while maximizing habitat and ecosystem benefits

Objectives

- Provide for continued beaver activity near roads
- Reduce risk of road flooding and road damage
- Reduce maintenance burden

Strategy and timeline

- Meet with landowners and county maintenance staff to present and develop beaver maintenance concepts.
- Decide whether to proceed.
- Proceed with design, funding, and implementation as directed.

The **stream and riparian restoration plan** would repair about 10 breached beaver dams, allowing them to continue functioning during prolonged absence of beaver. Dam repairs would be made using native materials (sod, willow stems, willow fascines) and soft biodegradable coir logs that will grow and assimilate into the landscape. Dam repairs aim to restore up to about 2.5 acres of pond area and about 5 acres of wetland, creating habitat ideal for recolonization by beaver.

COLORADO OPEN LANDS

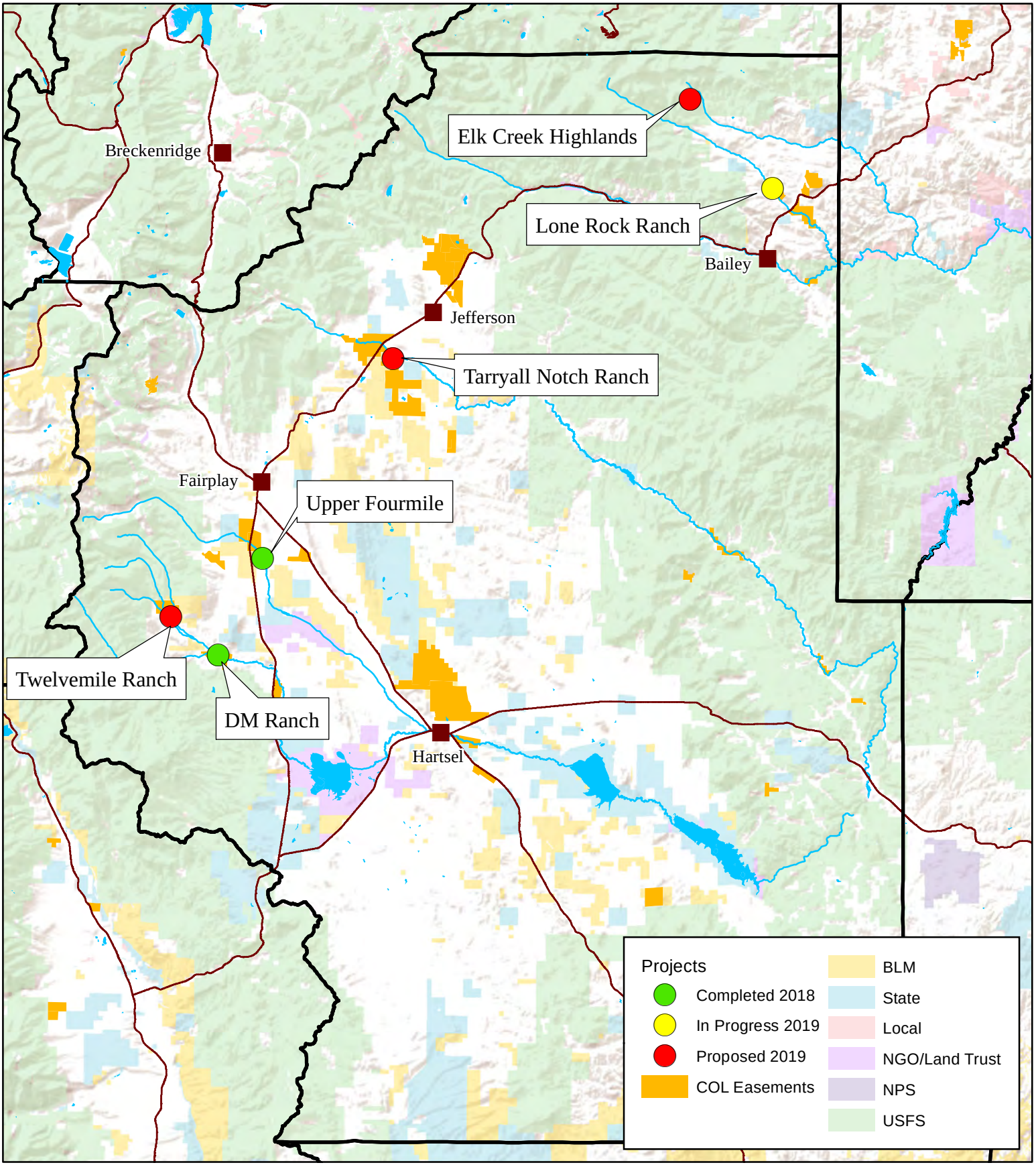
EcoMetrics
Stream & Riparian Monitoring, Assessment & Restoration

Johnson Environmental Consulting

Gillilan Associates Inc.

RIPARIAN RECONNECT CONTEXT MAP

PARK COUNTY



Preparer: Colorado Open Lands Date: January 24, 2019. Data Source: COMaP v20180412, CDOT
Public Access should not be inferred from this map. This map is not a survey and should not be construed as one.

0 3 6 12 Miles

N

RIVER ROAD LAND, LLC

January 30, 2019

Colorado Water Conservation Board
Colorado Water Plan Grant
1313 Sherman St., Room 718
Denver, CO 80203

Re: Authorization and Support for Colorado Open Lands' Colorado Water Plan Grant Application

To Whom It May Concern:

As the owner of Tarryall Notch Ranch, I am writing in support of the proposal being submitted by Colorado Open Lands for CWCB's Colorado Water Plan grant program. Over the past ten years and due to Colorado Open Lands efforts, willows and other vegetation have recovered along Tarryall Creek due to livestock exclusion and major planting efforts, but the creek itself has yet to respond. Our plan is to construct beaver dam analog structures to fill the role that natural beaver dams play, and also to entice migrating beavers to settle on site. With this funding, we will be able to restore the connectivity between the creek and the riparian zone and return these areas back to a healthy, natural condition. I enthusiastically approve of this proposal and thank you for your consideration.

Sincerely,

Matthew S. Waller
President

5828 COLEHURST, DALLAS, TEXAS 75230

January 31, 2019

Colorado Water Conservation Board
Colorado Water Plan Grant
1313 Sherman St. Room 718
Denver, CO 80203

RE: Authorization and Support for Colorado Open Lands' Colorado Water Plan Grant Application

To Whom It May Concern:

This letter is to inform you that Elk Creek Highlands Property Owners Association (ECHPOA) is the owner of Elk Creek Highlands/Meadows Outlot B, Filing 7, Block 22, at address 86 Elk Creek Drive, Bailey, Colorado. ECHPOA is excited by and aware of the proposal being submitted by Colorado Open Lands for CWCB's Colorado Water Plan Grant Program. ECHPOA fully supports the project and authorize the proposed work to be completed on Outlot B property. With this funding, we will be able to restore the riparian area that was damaged in the flood of 2013. All five board members of ECHPOA enthusiastically support this proposal and thank you for your consideration.

Sincerely,

Paul R. Ellis

President, ECHPOA

Paul R. Ellis

Karen Fox Ellis

Secretary/Treasurer ECHPA

Karen Fox Ellis

1/29/19

Colorado Water Conservation Board
Colorado Water Plan Grant
1313 Sherman St. Room 718
Denver, CO 80203

RE: Authorization and Support for Colorado Open Lands' Colorado Water Plan Grant Application

To Whom It May Concern:

This letter is to inform you that I, President of Twelve Mile Ranch, am excited by and aware of the proposal being submitted by Colorado Open Lands for CWCB's Colorado Water Plan Grant Program. I, and the ranch membership, fully support the project and authorize the proposed work to be completed on the ranch property. With this funding, we will be able to complete needed riparian improvement projects that will enhance the ranch infrastructure and wetland wildlife habitat as an integral part of the South Platte watershed. Our association with Colorado Open Lands has been a great asset and we look forward to working with them in the future.

I enthusiastically support this proposal and thank you for your consideration.

Sincerely,

David W. Marshall

Dave Marshall

President

Twelve Mile Ranch

Edward C. Nichols
87 S. Ash St
Denver, CO 80246

Colorado Water Conservation Board
Colorado Water Plan Grant
1313 Sherman St. Room 718
Denver, CO 80203

RE: Authorization and Support for Colorado Open Lands' Colorado Water Plan Grant Application

Dear Members of the Colorado Water Conversation Board

I want to express my complete support for CWCB's Colorado Water Plan Grant Program regarding the 12 Mile Ranch. The wetlands and the very rare fen surfacing on the 12 Mile property are unique and have been maintained in their native, natural environment. However, this needs as much protection and attention to maintain its' natural environment as possible.

In addition, while the riparian habitat at the ranch is virtually commercially undisturbed, it still needs support and attention to continue to function and support in that natural habitat manner. The CWCB's support could allow enhancements and fixes to be put in place for this purpose. The addition of habitat and beaver dam restoration projects would assist in this pursuit.

Please let me know of any further information you might want to allow this request to move forward.

Best regards.

Ed Nichols

Edward C. Nichols
Former President and CEO History Colorado
Former SHPO – State of Colorado