IMPROVING PUBLIC SAFETY AT LOW HEAD DAMS IN COLORADO


Bill McCormick, P.E., P.G., Head Dam Safety Branch, Colorado Division of Water Resources

Alex Alma and Amy Moyer, Colorado Parks and Wildlife
Introduction

Presentation Overview

- Introduction
- Hydraulic Hazards of Low Head Dams
- Colorado’s Low Head Dam Safety Initiative
- Conclusions & Next Steps
Low Head Dam – Stoner Creek (KY)

Video by Karl Kingery, P.E., WWE
Brigham Young University (BYU) Low Head Dam Fatality Database

These drownings are preventable!

- More than 200 locations documented
- Hundreds of fatalities
- Not an all-inclusive list
Hydraulic Hazards of Low Head Dams
LOW HEAD DAMS OFTEN HAVE SMOOTH WATER ABOVE THE DAM AND BOILS BELOW THE DAM
PLEASE STAY OFF THE DAM
**CASE I**
- Low tailwater with swept-out jump.
- Persons will usually be swept downstream.

**CASE II**
- Normal tailwater with optimum jump.
- Modest entrapment for persons, although logs and sideways canoes can get trapped in small "hole".
**CASE III**

- High tailwater with submerged hydraulic jump
- The resulting "hydraulic" will trap a person in the reverse rolling current
- Rescue boats will be "sucked" towards falling jet
- Diving to the bottom may cause the person to be carried downstream

**CASE IV**

- Very high tailwater associated with high flows inundates the drop structure
- No hydraulic jump occurs
- No unusual hazard to persons or boats
Dangers Posed by Low-Head Dams
The recirculating currents and turbulent waters below can swamp vessels and drown boaters.
Colorado Low Head Dam Safety Initiative

- Discussions at CO DNR began in January 2019
- Identified absence of defined responsibility/authority for regulation of Low Head Dams
- How to make positive change to this situation?
- Create Inventory – identify the extent of this issue across the state
- Steering Committee – Gather advisory group to discuss possible approaches
Colorado Low Head Dam Safety Initiative

- Hired an intern to develop Low Head Dam Inventory
- LHD Steering Committee – Formed July 2019
- Strategic Partnerships established
Steering Committee

Colorado Department of Natural Resources, Assistant Director for Water - Amy Moyer
Colorado Department of Natural Resources, Assistant Director for CPW - Doug Vilsack
Colorado Division of Water Resources, Chief of Dam Safety - Bill McCormick
Colorado Parks & Wildlife, SE Region Assistant Regional Manager - Brad Henley
Colorado Water Conservation Board - Chief of Flood and Stream protection - Kevin Houck
Colorado Office of Outdoor Recreation Industry, Director - Nathan Fey
Colorado Division of Homeland Security and Emergency Management, State Hazard Mitigation Officer - Steven Boand
Mile High Flood District - Kevin Stewart
Wright Water Engineers - Andrew Earles
General public - Ruth Wright
Strategic Partnerships

Ditch & Reservoir Company Alliance

The definitive resource for networking, information exchange, and advocacy among ditch and reservoir companies, irrigation districts, laterals, and private ditches.

Colorado, US River List
Colorado Low Head Dam Inventory

- 753 Diversions
- 247 Grade Control
- 100 Recreational
Inventory Study Report

Colorado Low Head Dam Inventory Project 2019

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Colorado Low Head Dam Inventory Website
Signage – Lower Platte and Beaver Diversion, Brush, CO
Signage – Lower Platte and Beaver Diversion, Brush, CO
Signage – Lower Platte and Beaver Diversion, Brush, CO
Signage – Lower Platte and Beaver Diversion, Brush, CO
Signage – Lower Platte and Beaver Diversion, Brush, CO
Water Plan Grant Activities

- **Warn/Educate**
  - Website Development
  - PSA Partnerships/Case Studies

- **Control Exposure**
  - Signage
  - Incentivizing portage/explaining limited liability

- **Mitigate or Eliminate the Hazard**
  - Modify dams for multiple purposes
  - Remove dams for multiple reasons

- **Prepare for Emergency Response**
  - Educate and train first responders
  - Response planning

- $50K ($20k CWCB, $15k in-kind, $15k FEMA NDSP)
CO DNR Next Steps

- Execute CO Water Plan grant work plan; website, stakeholder outreach, signage, first responder training
- Establish where a Low Head Dam program lives within DNR
- Continue strategic partnerships with American Whitewater and DARCA to help disseminate inventory information
- Work with CDHSEM-Mitigation Section and apply for BRIC grants
- Work with CWCB to use their loan and grant programs to fund beneficial activities at Low Head dams
Conclusions and Next Steps

- Low head dam drownings can be prevented through combination of education, outreach, signage, physical dam modifications, and other practices.

- The hazards of low head dams are often latent and cannot be discerned by a typical recreational river user.

- The State of Colorado has been developing a program to improve safety at low head dams over the past year. Next steps for the State are to get inventory online, refine the database, conduct public outreach presentations and stakeholder meetings, and continue to install signs at dams with the potential to cause fatalities.

- If you have photographs or other information on low head dams in Colorado, please contact Bill, Andrew, or Karl, so that we can include your information in the database.
Questions & Answers

Andrew Earles, Ph.D., P.E.
Wright Water Engineers, Inc.
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kkingery@wrightwater.com

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Colorado Division of Water Resources
bill.mccormick@state.co.us
THINKING DIFFERENTLY

UNIQUE STORMWATER CASE STUDIES
EMILY C. VILLINES, CPSM, MA

- 14 YEARS IN INDUSTRY
- SUPPORT PROBLEM SOLVING
- FAVORITE TRAVEL: TANABE, JAPAN
JESS N. KORDZIEL, EI, CFM

- 4 YEARS IN INDUSTRY
- DESIGN ENGINEER
- FAVORITE TRAVEL: TONGARIRO, NZ
MAGGIE LEWIS, PE

+ 6 YEARS IN INDUSTRY

+ WATER RESOURCES ENGINEER

+ FAVORITE TRAVEL: CORN ISLANDS, NICARAGUA
CASE STUDY 1
DALLAS FORT WORTH NATIONAL CEMETERY
WHAT IF THERE’S NO SEWER MAIN OR EXISTING STORM SEWER TO TIE INTO?
OUTFALL INTO A NATURAL CHANNEL
AFTER WATER QUALITY ENHANCEMENT!
THE USUAL DRAINAGE PLAN IS A THREE STEP PROCESS:
1. RUNOFF/SHEETFLOW
2. CHANNEL FLOW/CURB GUTTER
3. PIPE TO DETENTION
FOR A CEMETERY:
1. UNDERDRAIN
2. SHEETFLOW
3. CURB/GUTTER
4. INLETS
5. DITCHES/CHANNELS
6. LOW TAILWATER BASINS
7. RELEASE TO EX CHANNEL
GRADE IS SET
ONCE THE WATER HAS RUN OFF, WHAT’S IN IT?
FOR CEMETERIES? ALL THAT…

AND MORE
SEE THAT DETENTION POND?
CEMETERY DOES NOT WANT TO SEE THAT POND.
POTABLE WATER IRRIGATION COSTS FOR A CEMETERY ARE VERY HIGH
WHY NOT USE WHAT’S ALREADY THERE?
Case Study 2:
Sterling Hills Water Quality and Detention Pond
There are hundreds of water quality ponds in Colorado that have been designed using historical design standards. Many of these ponds do not include design features which are now required by many municipalities and MHFD.
Often homeowners and business associations are required to perform maintenance of ponds due to MS4 permits and local stormwater ordinances.

Working closely with the City of Aurora and the Sterling Hills West Metro District was key to this project’s success!
Maintenance and restoration of relic ponds is necessary to ensure functionality and to comply with stormwater and water rights legislation.

Spending money on infrastructure is not nationally trending ... let alone investing in existing facilities.

A retrofit to an existing facility to aid in maintenance can **save money** in the long run.
Retrofit Challenge: Restrictive claystone layer below pond resulted in a near constant base flow
Often this fluctuation can be hard to predict by stormwater professionals. Base flows can change in a developing watershed and the need to provide a design to aid routine maintenance became more apparent over time...
Troubleshooting: WWE staff conducted groundwater monitoring on-site for several months to assess this fluctuation.
Solution: Underdrain and sand blanket layer
Lack of forebays in original design led to build-up of sediment over time.
Solution: Retrofit design included sediment forebays at all piped inflows to pond
Retrofit Challenge: Standing water in “dry” pond
Solution: Design of micropool and initial surcharge volume for outlet structure
Sediment and Erosion Control in bottom of pond
Solution: Temporary flow bypass

<table>
<thead>
<tr>
<th>Description</th>
<th>EA</th>
<th>LS</th>
<th>LS</th>
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<tbody>
<tr>
<td>Water Control</td>
<td>$5,000.00</td>
<td>$5,000.00</td>
<td>$5,000.00</td>
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<td>Water Control and Dewatering</td>
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<td>$562,000.00</td>
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<td>$75,000.00</td>
<td>$47,405.40</td>
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<td>Water Control/Dewatering</td>
<td>$98,000.00</td>
<td>$98,000.00</td>
<td>$98,000.00</td>
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<tr>
<td></td>
<td>$13,000.00</td>
<td>$160,028.00</td>
<td>$90,009.33</td>
</tr>
</tbody>
</table>
Retrofit Challenge: Highly visible area called for creation of a more aesthetic and functional pond

“One person’s trash is another pond’s purpose”
Solution: Landscaping services requested by engineers
QUESTIONS?
Trash Vault Squads:
Introducing infrastructure to K-12 students

Donny Roush, City & County of Denver
Troy Carmann, ICON Engineering
Who doesn’t want this?
Engineer-ese vs. Educate-ese

• Be bilingual (or find a translator)
• Know your young people
• Learning environments = chaotic
• ...so, try a learning target
• Connect to a bigger picture
• Consider “One Water”
Denver’s Stormwater Education & Outreach
Denver’s Stormwater Education & Outreach
Thanks

This project supported by the 2019 CASFM Research Grant.
Trash vaults at DPS schools

Bruce Randolph 6-12
- 765 students
- District-run, traditional
- Clayton neighborhood
- Adjacent to 39th Ave. Greenway

Joe Shoemaker ECE-5
- 471 students
- District-run, innovation
- Hampden Heights neighborhood
- Adjacent to Cherry Creek
Trash vaults at DPS schools
@ Bruce

What we did:
- Student & teacher recruitment
- Walking tour
- Trash measuring demo
- Virtual field work to river

What we planned:
- Field work to river
- Peer-to-peer presentation
- Visit existing outdoor classrooms
- Build & install trash measuring device

With:
- Vanessa Alvear, 6th Grade Science Teacher
- Alanna, Karlo, D'Quarius, Daniel, Angel, Yahir
What we did:
• Walking tour
• Interpreting drawings
• Review & revision of design
• Trash measuring demo
• Volume calculations of vault

What we planned:
• Peer-to-peer presentation
• Monitoring of trash measuring device
• Support of “Water around the World” learning expedition

With:
• Ryan Pleune, Adventure/Fitness Teacher
• Calin, Callum, Beckett, Heidi, Yandel, Oriane
...about those ed translators

- Environmental education as a field
- Professional certification
- North American Association for Environmental Education
- Colorado Alliance for Environmental Education
Trash Vault

Squads:

Introducing infrastructure to K-12 students
Co-Creating a Regional Vision for People + Nature
Taking a watershed approach

Dana Coelho, Alliance Director
Metro Denver Nature Alliance

September 29, 2020
Colorado Association of Stormwater and Floodplain Managers
Align nature-based efforts to ensure more equitable access to nature and to promote healthy people, communities, and natural places.

Connecting Communities. Championing Nature.
www.metrodna.org
In support of our mission & vision, Metro DNA performs three mutually reinforcing roles.

Our work is rooted in both conservation + equity.
Collaborative Projects

Metro DNA-led

• **Nature Narratives:** crafting and elevating a shared story and partner voices

• **Safe Summer Kick Off on Get Outdoors Day:** building community health, wealth, and safety through connections to the natural world; partnership with SouthWest Denver Coalition, Denver Parks & Recreation, and National Park Service

• **Regional Vision:** Defining shared social-ecological goals and strategies to achieve those goals; partnership with The Nature Conservancy and Biohabitats

Partner-led

• **City Nature Challenge:** documenting observations of wild plants and animals; Wild Foundation, CO DNR, and TNC

• **Summit for Action:** two-day workshop on solutions-based recommendations for Justice, Equity, Diversity, Accessibility and Inclusion; Ecoinclusive

• **Rx for PRONTOS:** a dialog prescription programs for parks, recreation, outdoors, nature, trails, and open space across the state; Colorado Public Health and Parks & Rec Collaborative, CDPHE, and NPS

• **Stewardship Mapping and Assessment Project (STEW-MAP):** understanding our environmental stewardship “landscape” – who does what, where, and how are we all connected organizationally; Denver Urban Field Station
CONVERGENCE:

Water/Climate  +  Habitat Loss  +  Environmental Justice

Biohabitats
**How to Create Nature Champions:**

- Provide fun, hands-on nature experiences.
- Take learning outside.
- Repeat!

Time in nature during childhood and role models who care for nature are the two biggest factors that contribute to environmental stewardship in adulthood.

**The Benefits of Time in Nature:**

- Better Social Skills
- Enhanced Health
- Increased Self Esteem
- Improved Grades
- Pro-Environment Behaviors
- Stronger Emotional Connections to People and Nature

**Green Network Benefits:**

- **Protect Ecological Resources**
  - Water cleaning and storage
  - Wildlife habitat

- **Provide Beautification**
  - Passive recreation
  - Gathering/socializing

- **Create Reinvestment & Growth Potential**
  - Economic development

- **Provide Equity & Empowerment**
  - Environmental education
  - Transportation alternatives

- **Improve Health & Quality of Life**
  - Cooling and shade
  - Active recreation
  - Food production

Additional research on the benefits of nature available at childrensnature.org/research
“We have confidence that [a] unified vision of conservation will result in significant progress over the long term. The coming together of nature conservation, historical preservation, ecosystem services, environmental justice and civil rights, sustainability, public health, and science communities is overdue, but when fully accomplished will reap significant reward. As these interests increasingly practice the skills of collaboration, and gain experience in working closely together in more common cause, they will find their collective ‘voice’ to be powerful, influential, and effective.”
Regional Conservation Assessment

leverage existing data and planning documents to identify high-quality, connected, and climate-resilient habitat in the metro area
POTENTIAL & EXISTING CONNECTIVITY/VULNERABILITY

Figure 2: Wild Lifelines™

Natural Flow

CPW

Biohabitats

Biohabitats
We all do better when everyone thrives.
PRECEDEMENTS

Regional water/ecological data + Social-ecological

Inspire deeper understanding of stewardship and dynamics of water

Address human & environmental challenges

Bring people together in shared vision and provide hope

Inspire investments & build momentum

GREEN INFRASTRUCTURE PLAYBOOK
Regional planning framework & ecoregions

FOOTHILLS

MONTANE FOREST & FOOTHILL SHRUBLAND

FRONT RANGE FANS

ROLLING PLAINS

SANDSAGE PRAIRIE

CLEAR CREEK

S. PLATE
# MDNA Ecoregions & Potential Conservation Targets

All data in acres except where noted as %

## Role of MDNA Ecoregions in Statewide Conservation Planning

<table>
<thead>
<tr>
<th>Ecoregions in Denver Metro Area</th>
<th>Acres in CO</th>
<th>Acres in US</th>
<th>% of ecoregion type in CO</th>
<th>CO proportion of 1/2 Earth Target</th>
<th>Existing (2018) Protected Areas</th>
<th>CO ecoregional target GAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpine Zone</td>
<td>2,368,625</td>
<td>5,510,834</td>
<td>43%</td>
<td>1,184,313</td>
<td>2,249,737</td>
<td>(1,065,424)</td>
</tr>
<tr>
<td>Crystalline Mid-Elevation Forests</td>
<td>2,850,523</td>
<td>4,984,183</td>
<td>57%</td>
<td>1,425,262</td>
<td>1,733,802</td>
<td>(308,541)</td>
</tr>
<tr>
<td>Crystalline Subalpine Forests</td>
<td>3,050,267</td>
<td>3,914,655</td>
<td>78%</td>
<td>1,525,134</td>
<td>2,678,385</td>
<td>(1,153,252)</td>
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<tr>
<td>Flat to Rolling Plains</td>
<td>8,455,697</td>
<td>20,767,327</td>
<td>41%</td>
<td>4,227,849</td>
<td>458,557</td>
<td>3,769,291</td>
</tr>
<tr>
<td>Foothill Grasslands</td>
<td>1,155,168</td>
<td>1,155,168</td>
<td>100%</td>
<td>577,584</td>
<td>86,422</td>
<td>491,162</td>
</tr>
<tr>
<td>Foothill Shrublands</td>
<td>2,986,015</td>
<td>7,259,594</td>
<td>41%</td>
<td>1,493,008</td>
<td>1,239,154</td>
<td>253,853</td>
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<tr>
<td>Front Range Fans</td>
<td>500,215</td>
<td>500,215</td>
<td>100%</td>
<td>250,108</td>
<td>122,166</td>
<td>127,941</td>
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<tr>
<td>Moderate Relief Plains</td>
<td>3,969,131</td>
<td>8,075,630</td>
<td>49%</td>
<td>1,984,566</td>
<td>534,383</td>
<td>1,450,182</td>
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<tr>
<td>Piedmont Plains and Tablelands</td>
<td>8,546,418</td>
<td>8,546,418</td>
<td>100%</td>
<td>4,273,209</td>
<td>1,483,492</td>
<td>2,789,717</td>
</tr>
<tr>
<td>Pine-Oak Woodlands</td>
<td>371,522</td>
<td>371,522</td>
<td>100%</td>
<td>185,761</td>
<td>17,848</td>
<td>167,913</td>
</tr>
<tr>
<td>Rolling Sand Plains</td>
<td>2,956,328</td>
<td>6,778,348</td>
<td>44%</td>
<td>1,478,164</td>
<td>316,183</td>
<td>1,161,981</td>
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<tr>
<td><em>Other ecoregions in state</em></td>
<td>37,209,909</td>
<td></td>
<td></td>
<td>18,604,955</td>
<td>10,920,129</td>
<td>7,684,825</td>
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<tr>
<td>Total acres in state (all types)</td>
<td>28,790,091</td>
<td></td>
<td></td>
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</table>

Red indicates ecoregions only found in Colorado
### MDNA Counties with ecoregions found only in Colorado

#### Pine-Oak Woodlands

<table>
<thead>
<tr>
<th></th>
<th>CO Ecoregion Gap target</th>
<th>County total acres</th>
<th>Protected in acres</th>
<th>Remaining u % target avail acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adams</td>
<td>167,913</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Arapahoe</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Broomfield</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Denver</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Jefferson</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Douglas</strong></td>
<td>202,761</td>
<td>10,795</td>
<td>191,966</td>
<td>114%</td>
</tr>
<tr>
<td>Boulder</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
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</table>

#### Front Range Fans

<table>
<thead>
<tr>
<th></th>
<th>CO Ecoregion Gap target</th>
<th>County total acres</th>
<th>Protected in acres</th>
<th>Remaining u % target avail acres</th>
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</thead>
<tbody>
<tr>
<td>Adams</td>
<td>127,941</td>
<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Arapahoe</td>
<td>6,015</td>
<td>1,005</td>
<td>5,010</td>
<td>4%</td>
</tr>
<tr>
<td>Broomfield</td>
<td>14,299</td>
<td>2,189</td>
<td>12,110</td>
<td>9%</td>
</tr>
<tr>
<td>Denver</td>
<td>8,046</td>
<td>1,361</td>
<td>6,686</td>
<td>5%</td>
</tr>
<tr>
<td>Jefferson</td>
<td>92,977</td>
<td>33,068</td>
<td>59,909</td>
<td>47%</td>
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<tr>
<td><strong>Douglas</strong></td>
<td>18,830</td>
<td>6,955</td>
<td>11,875</td>
<td>9%</td>
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<tr>
<td>Boulder</td>
<td>159,326</td>
<td>51,989</td>
<td>107,337</td>
<td>84%</td>
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#### Foothill Grasslands

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<th>County total acres</th>
<th>Protected in acres</th>
<th>Remaining u % target avail acres</th>
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<td>Adams</td>
<td>491,162</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Arapahoe</td>
<td>20,245</td>
<td>5,787</td>
<td>14,457</td>
<td>3%</td>
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<td>Broomfield</td>
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<td>0%</td>
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<td>Denver</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
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<tr>
<td>Jefferson</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0%</td>
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<tr>
<td><strong>Douglas</strong></td>
<td>91,759</td>
<td>7,517</td>
<td>84,242</td>
<td>17%</td>
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<td>Boulder</td>
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<td>0</td>
<td>0</td>
<td>0%</td>
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#### Piedmont Plains and Tablelands

<table>
<thead>
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<th></th>
<th>CO Ecoregion Gap target</th>
<th>County total acres</th>
<th>Protected in acres</th>
<th>Remaining u % target avail acres</th>
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</thead>
<tbody>
<tr>
<td>Adams</td>
<td>2,789,717</td>
<td>102,346</td>
<td>6,208</td>
<td>96,137</td>
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<tr>
<td>Arapahoe</td>
<td>104,364</td>
<td>6,711</td>
<td>97,654</td>
<td>4%</td>
</tr>
<tr>
<td>Broomfield</td>
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<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Denver</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Jefferson</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Douglas</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Boulder</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0%</td>
</tr>
</tbody>
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By: [Biohabitats](https://www.biohabitats.com)
Project Timeline + Process

Conservation by Design Step: “Identify Challenges”
Core Team – Prep of baseline materials
Spatial Analysis & Modeling of Habitat Connectivity

Within the Greater Denver Metro Region

Chris Riehak | April 25, 2020
Introduction

Conservation and restoration have become planning priorities in urban-wildlife interface areas across the country due to increased habitat fragmentation resulting from urban sprawl and increasing populations. This fragmentation habitat connectivity can result in negative impacts for ecological function and health for natural communities. Habitat connectivity analysis is a method to improve understanding of these connections and wildlife movement patterns across the landscape and is important in helping to develop strategic approaches.

Purpose

Determine the optimal habitat connectivity patterns within the Greater Denver Metro area for the Mule Deer, which rely heavily on a variety of habitats and riparian areas. It is a good representation of a umbrella species within the study area. The goal is to identify primary connectivity corridors and from this output, identify pinchpoints or areas of impedence and restoration areas that contain the highest potential for improving connectivity.

A Deer Migration You Have to See to Believe | National Ge...

Researchers have only recently found the longest large mammal migration in the continental United States: Mule deer migrate 150 miles...
Spatial Analysis & Modeling of Habitat Connectivity

https://www.cosatube.com

Programs Used for Analysis

ArcGIS Pro  CircuitScape
Study Area

- Metro Denver Nature Alliance
- 7 Counties
- Intersected with USGS HUC12 Watersheds
- 6,148 square miles
EPA Level IV Ecoregions (West to East)

- Alpine
- Crystalline Sub-alpine Forests
- Crystalline Mid-Elevation Forests
- Foothill Shrublands
- Front Range Fans
- Moderate Relief Plains
- Pine-Oak Woodlands
- Flat to Rolling Plains
- Piedmont Plains and Tablelands
- Foothill Grasslands
- Rolling Sand Plains
Existing Land Cover Data

- Source: Denver Regional Council of Governments (DRCOG) 3-meter pilot land cover study
- Used as a template for land cover classification in remaining study area.
Colorado Parks and Wildlife Wildlife Mapping

- Mule Deer Concentration Area (dark)
- Mule Deer Resident Population (light)
- Assists in defining core habitat cores in prairies and grasslands of Eastern Plains.
- Land cover classification tends to struggle differentiating cover types in semi arid regions.
Land Cover Classification

- 2017 USDA NAIP Imagery (1-meter) 4-band imagery (NIR) allows for vegetation extraction.
- 636 individual images, Mosaicked into a single image.
- Imagery clipped into 15 quadrants for manageable land cover classification.
Final Land Cover Classification

- 11 classes (excluding shadows)
- All classified segments mosaicked into a single raster and clipped to study area boundary.
- Resampled to 10-meter resolution for processing and analysis of habitat cores.
Habitat Core Analysis

- Utilized land cover classes of tree canopy, grassland, prairie, herbaceous and shrublands.
- Region Group geoprocessing tool creates outputs that identify contiguous/connected regions and assigns a unique ID.
- Zonal Geometry geoprocessing tool calculates the area of these unique rasters.
- Manual digitization of "Habitat Core" polygons are created around core areas.
- CPW Mule Deer habitat information was utilized in plains to determine specific habitat core areas.
Landscape Resistance

- Determines impedance to movement across the landscape
- Impervious surfaces such as buildings, roads, rock outcrops are 30-160
- Waterbodies are 20
- Croplands are 8
- Shrubland, Vegetation, Grassland/Prairie are 1-3
Circuitscape Current Map

- Represents connectivity and ease of movement across the landscape.
- Lower values = low resistance to movement
- Higher values = high resistance to movement
- Can begin to visualize currents and patterns across the study area.
Least Cost Path Analysis

- Shortest and most efficient path from one habitat core to another.
- Theoretically represents the most cost efficient route given the input information.
- This would be the most optimal path for a Mule Deer to take to get from one habitat core to another.
- Often follows riparian areas and waterways.
**Pinpoint Analysis**

- Hybrid approach using least cost pathways and circuit theory to identify most efficient movement pathways.
- Helps to identify critical pinpoints within these pathways that often occur at wildlife-urban interface.
Barrier Analysis
(Approximated Restoration Value)

- Detects important barriers that affect the quality and/or location of corridors.
- Restoration practices in these areas will theoretically have the most positive impact for improving habitat connectivity.
- Concentrated along least cost path corridors and wildland-urban interface.
- East/Southeast Denver and North Denver are biggest hot spots.
Project Timeline + Process

Collect, Process, & Share Data
- Complete classification of 2016 1m land cover data and conduct accuracy assessment
- Obtain and review other relevant spatial data
- Get updates on parallel studies (CDOT, CPW) at different scale

Develop & Confirm Methodology
- High Quality and Resilient Habitat Assessment
  - Habitat framework
  - Focal species
  - Metrics and weighting
  - Connectivity Analysis
    - Focal habitats/guilds/species
    - Habitat cores
    - Resistance/barrier values
  - Check in and review meetings (monthly)

Conduct Mapping & Analysis
- Execute High Quality and Resilient Habitat Assessment
- Review with Advisory group
- Incorporate minor refinement (if necessary)
- Execute Connectivity Analysis for one species/movement guild
- Review with Advisory group
- Repeat for additional species/movement guilds
Project team + collaborators

- **Core Team**: TNC, Biohabitats, and Metro DNA; meet weekly to coordinate all aspects of the project.

- **Leadership Council**: decision makers from land and water management agencies committed to project implementation, meets 2-3 times per year.

- **Technical Advisory Team**: technical experts from a range of institutions who will directly shape the analysis and project outcomes, meets once every other month.
Project deliverables

- **Regional Conservation Strategy**: portfolio of targets, metrics, and priority lands and waters to guide collaborative actions.

- **Biodiversity Atlas for decision-makers**: publicly-available geo-database used to prioritize protection, restoration, and enhancement activities.

- **A diverse, engaged, and invested** Leadership Council, Technical Advisory Team, and partner network.

https://www.marc.org/Environment/Natural-Resources/Natural-Resources-Inventory/Natural-Resource-Inventory.html
Desired outcomes

• Influencing how decision makers prioritize lands and waters to protect, connect, restore, and enhance;
• Ensuring all people can have equitable access to nature and build community well-being;
• Supporting wildlife in the face of a changing climate;
• Creating a base of ecological knowledge to inform future policy, planning, and funding actions;
• Deepening collaboration between key organizations in the region; and
• Improving planning and decision-making through the development of shared goals, priorities, and metrics.
GOAL SCENARIO:
Our job is to filter for decision-makers!

NATURAL HABITAT & CONNECTIVITY

Regional Conservation Assessment
• Close Coordination with Land Managers & Decision Makers
• Science-Driven Assessment & Map of Priority Areas to Protect, Restore, and Enhance
• Key Focal & Indicator Wildlife Species

SOCIAL VULNERABILITY & ACCESS TO NATURE

• Socioeconomic Status
• Household Composition & Disability
• Minority Status & Linguistic Isolation
• Housing & Transportation
• 10-Minute Walk to a Park

REGIONAL VISION FOR PEOPLE + NATURE

• Provide decision-makers with information and strategies to efficiently incorporate conservation needs into policies.
• Combined, dynamic, and applicable vision for nature, natural infrastructure, access, and land use for the Metro Denver region

Regional Outcomes

- Improved Water & Air Quality
- Species Preservation & Restoration
- Equitable Access to Recreation & Nature
- Stable / Decreased Greenhouse Gas Emissions
- Decreased Mitigation & Restoration Costs
- Shrinking Inequality Gap
Metro Denver Nature Alliance (MetroDNA)

Overview:

Metro Denver Nature Alliance (MetroDNA) is an emerging alliance of organizations with a compelling vision: Within one generation, the Metro Denver area will be a thriving place for both people and nature.

The Metro Denver Nature Alliance will provide the critically needed regional awareness, vision, and coordination to help our entire community become a thriving place for both people and the rest of the natural world. Primary aims include: 1) working collaboratively to understanding existing needs and assets of local community organizations; 2) leveraging those assets to improve the health of people and nature; and 3) deepening people's connection to the natural world, especially children from under-reversed communities. Recognizing that there are many organizations already working directly with residents and communities, the unique function of MetroDNA will be to serve the organizations as our direct stakeholders who in turn represent their constituents in the community.


Help Documents:

Description of data layers:

Web Portal Users Guide:

www.metrodna.org/projects/trust-for-public-land-mapping-project/
The Denver Stewardship Mapping and Assessment Project (STEW-MAP)

Across the country, people are planting trees, organizing community gardens, monitoring local ecosystems, and cleaning up nearby parks or natural areas. Those who do this work may not think of what they do as “stewardship,” however, they are indeed stewards of their local environments. Care of shared natural resources in urban areas increasingly relies on the work of environmental stewardship groups and coalitions. At the same time, land managers and other decision makers often do not understand the roles and contributions of civic stewards. Stewards themselves may also not be aware of others doing similar work in their area.

Why do we need STEW-MAP?

At present, no natural resource agency or organization is collecting or distributing comprehensive civic stewardship data at the local level. The Denver Stewardship Mapping and Assessment Project (STEW-MAP) will fill this gap by surveying formal and informal stewardship groups across Denver and metro counties. Based on methodology developed by the New York City Urban Field Station, the Denver STEW-MAP will paint a picture of the region’s environmental stewardship landscape, documenting where the many private and public sector organizations work, how they are connected, and from where they source information and tools.

STEW-MAP will enable government and civic groups alike to enhance the capacity of the stewards of our communities. This tool can support civic participation, increase neighborhoods’ social cohesion, and support requests for funding and programming. Better understanding of civic environmental stewardship in urban areas will lead to less duplication of effort and better coordinated land and resource management. By collecting, analyzing, and sharing this information, the USDA Forest Service will be able to meet its obligation to provide timely civic stewardship information to local land managers and policy makers.

Methodology

The Denver Stewardship Mapping and Assessment Project (STEW-MAP) seeks to answer the question: What are the social and spatial (geographic) interactions among groups that conserve, manage, monitor, advocate for, and educate the public about their local environments? Methods include an organizational-level survey with subsequent maps and social network diagrams created from survey responses. In this way, the project adds a social layer of understanding to the natural resources that conservation organizations bring to the table.
Where does stewardship happen?

24 mapped areas
24 respondents named at least one group for a total of 183 different named groups.

Average number of connections: 9.17 groups

Top 4 named organizations:
- City and County of Denver: 9
- US Forest Service: 8
- Colorado Parks & Wildlife: 6
- Metro DNA: 6
Living infrastructure

A strategically planned and managed network of working landscapes, natural lands and waterways at multiple scales that conserve ecosystem functions, restore ecosystem processes and regenerate healthy, robust and resilient communities.

Image Courtesy of CMG
PARTNER BENEFITS
network connections, mission alignment and context within a shared vision, increased capacity, expanded reach, and leveraged resources

COMMON OUTCOMES
more equitable access to nature, healthier people and places

Learn more + engage!
www.metrodna.org/projects/regional-vision

Become a partner!
www.metrodna.org/join

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Covid-19: The Unplanned Risk in Risk MAP

By: Marta Blanco Castano and Thuy Patton
Colorado Water Conservation Board (CWCB)

CASFM Virtual Conference
September 29, 2020 @ 3:30pm
Agenda

• Background on CWCB
• 2020 – The ‘Jumanji’ Year
• Program Messaging
• Engagement Trends
• Outreach Prior to Covid
  • Website and Resources Tour
• Outreach during Covid and Moving Forward
• Takeaways and Lessons Learned
• Wrap Up – Q/A
CWCB is a Cooperating Technical Partner (CTP) with FEMA since 2002

“To Conserve, Develop, Protect and Manage Colorado’s Water for Present and Future Generations”
2020 – The ‘Jumanji’ Year

• Spring snowmelt began at the height of Covid lockdowns
  • CWCB on potential flood alert (remember 1997 and other late spring/early summer floods!)

• Severe drought

• Wildfires
Program Messaging

“What’s the goal again??”

Flood Mapping Program Manager

- Developers
- Watershed Coalitions
- Farmers/Ranchers
- Other Federal and State Govt. (emergency managers)
- Local Government (FPA, GIS, planners, etc.)
- Consultants/Contractors
- Recreational Needs
- Elected Officials
- Citizens
Crafting the Message

• Care about what you know, and showing that you care
  • Doing a little research on the stakeholder or community beforehand (roles, sensitive history, ongoing issues, prevalent hazards, etc.)
  • Why are we here and what’s in it for you?
  • Be a good listener → understand their concerns and how they will be addressed
  • “We are in this together” – Partnership messaging

• Individualized messaging/outreach for each community as follow up

• Ask about preferred communication avenues
Engagement Trends over Time

- **Map Mod** - Outreach offered only at beginning and near end of project.
- **Risk MAP** – focusing more on outreach and communication.
- Additional milestone meetings added → Flood Risk Review, Resilience, community focused kickoffs
- Training needed for more effective communication → engineers vs. community members
Engagement Trends Cont.

**Colorado Patterns:**
- Rural environment versus more urban
- Technical challenges/limitations:
  - GIS capabilities/software issues
  - Lack of local resources
  - Transitioning to 2D modeling
- Turnover/FPA has multiple roles and limited time

**BUT:**
- Audiences are more engaged post 2013 floods
- More review involvement from local communities and their contractors
Outreach Prior to Covid

- Online Portal for Mapping Projects – [www.coloradohazardmapping.com](http://www.coloradohazardmapping.com)
- Quarterly Newsletter Distribution
- Memorandum of Understanding (MOU) / Memorandum of Agreement (MOA)
  - Project outline/summary
  - Expectations from all partners
  - Local community responsibilities
  - High level schedule/milestones
  - Acknowledgement from community
- Training Needs – Developing video tutorials:
  - How to's and Overview of Mapping Process (for FAQs and newer FPAs)
  - 2D technical group
- Updated central database of community contacts
- Questionnaires – to obtain local input and feedback
Outreach During Covid and Moving Forward

• Early onset emails to communities with important program information and to obtain local operation status

• Immediate shift to Virtual Platforms
  • Hybrid meetings when available (some virtual, some in person)
  • Working with local community platforms when requested
  • Pre recorded tutorials and resources provided ahead of meetings
  • Various video meeting and digital collaboration platforms available

• More frequent touch points (emails/calls/surveys)

• Increase use of website as a resource in addition to:
  • New trainings and videos
  • Increased database of resources
Takeaways/Lessons Learned

• Track responses and check in frequently
• Take the lead but keep local concerns in mind
• Keep messaging succinct and consistent – information overload is not effective!
• Recognize the uniqueness of each community:
  • Rural communities are more likely to request in person meetings
  • Must be able to accommodate local needs
• Maintain normal processes as much as possible
  • Most seek normalcy and the ability to continue operating/serving constituents
Takeaways/Lessons Learned Cont.

• This too shall pass:
  • Even with Covid’s new standards, flood and other hazard risks still exist and our program must evolve to adapt and meet needs of local communities

• Take note of what worked well and what didn’t – share experiences and resources to empower decision-making and effective partnerships

• Follow up with local communities more than usual – we are unsure of longer term impacts still
THANK YOU! Questions?

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Previous Flood Mapping Program Manager - Colorado Water Conservation Board (CWCB)
(In the twilight zone – now at FEMA Region 8)

http://coloradohazardmapping.com/ and https://cwcb.colorado.gov/