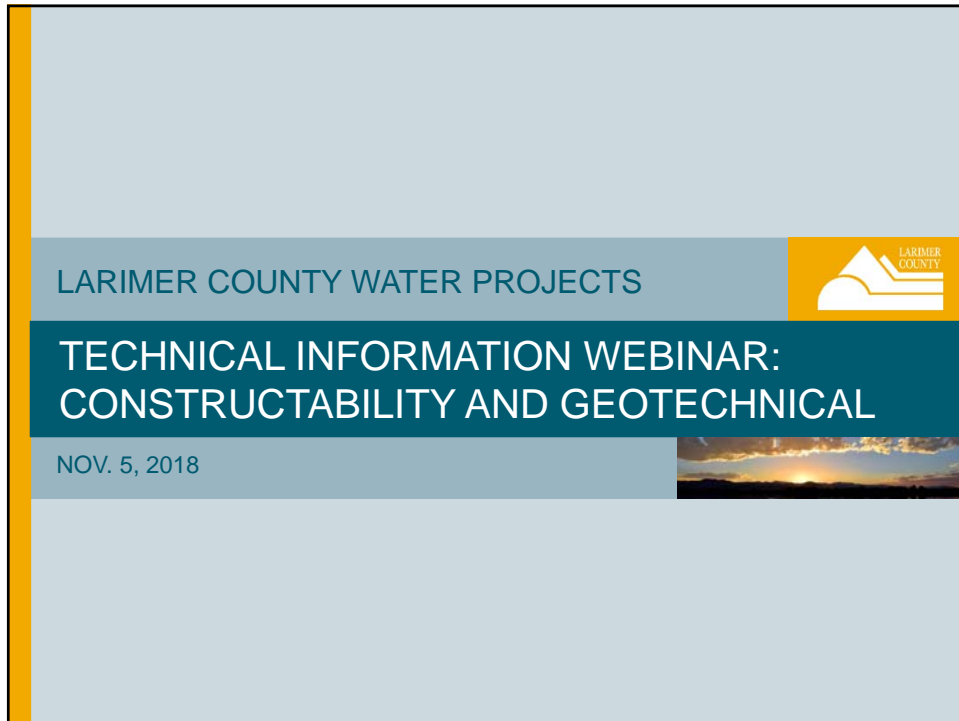



APPENDIX C

Larimer County Hosted Webinars

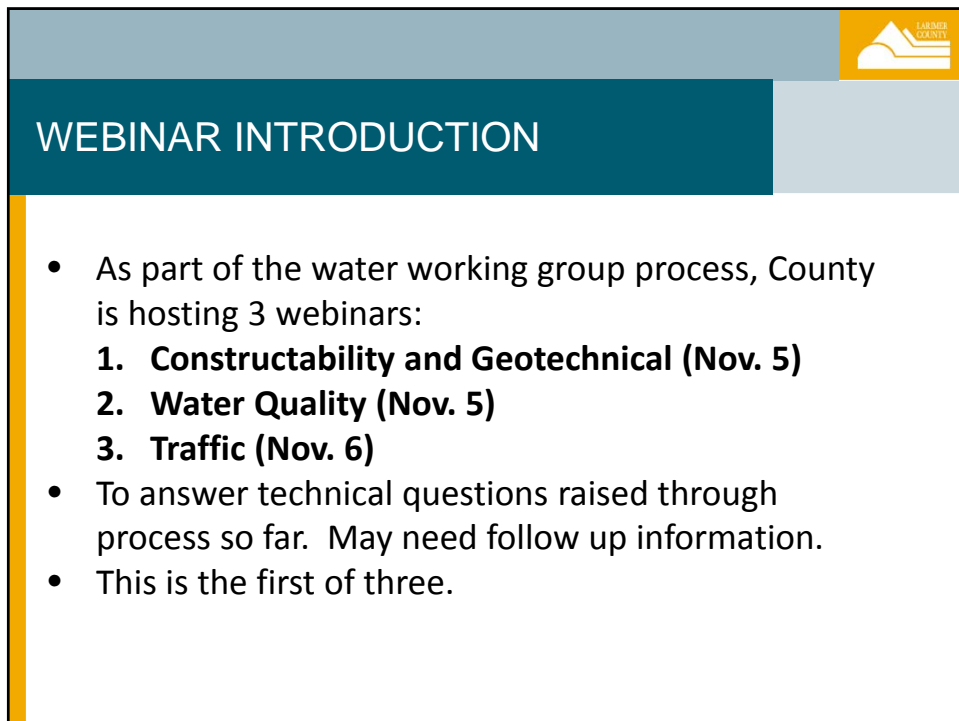



LARIMER COUNTY WATER PROJECTS




**TECHNICAL INFORMATION WEBINAR:
CONSTRUCTABILITY AND GEOTECHNICAL**

NOV. 5, 2018



WEBINAR INTRODUCTION



- As part of the water working group process, County is hosting 3 webinars:
 - 1. Constructability and Geotechnical (Nov. 5)**
 - 2. Water Quality (Nov. 5)**
 - 3. Traffic (Nov. 6)**
- To answer technical questions raised through process so far. May need follow up information.
- This is the first of three.



PURPOSE OF ENGAGEMENT PROCESS

- Requested by Board of County Commissioners when they tabled Thornton's 1041 Permit Application
- Process includes a Working Group and public events
- Reviewing alternatives related to City of Thornton 1041 permit application and new ideas
- Also considering possible co-locations of Northern Water conveyance
- To give the Board of County Commissioners ideas about how to mitigate or minimize impacts and maximize community benefits
- More information at: www.Larimerwaterprojects.org



UPCOMING ENGAGEMENT SCHEDULE

- Working Group #4 - Nov. 13
- Public Meeting - Nov. 15
- Working Group #5 - Nov. 27
- Board of County Commissioners Hearing – Dec. 17

Note: Subject to change



RANGE OF OPTIONS

Working group, public, and applicants have been addressing a range of alternatives through the process. At this stage, the webinars focus around the following:

Option A – Canal Conveyance

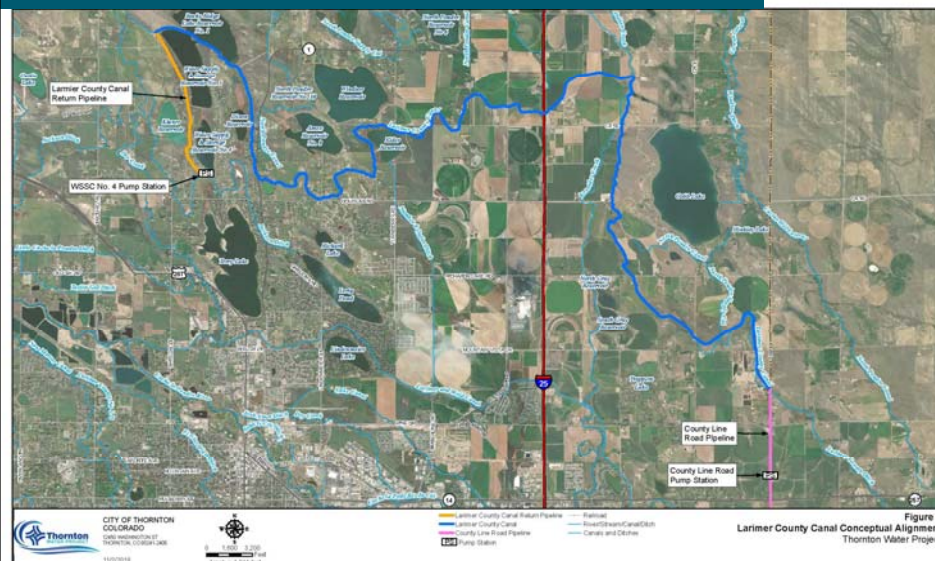
Option B – Douglas Road (CR 54) Pipelines

Option C – North Route (CR 56) Pipelines

Option D – Poudre River Conveyance

Option E – Shields (CR 17) Pipeline to Poudre River Conveyance

OPTION A: CANAL CONVEYANCE



OPTION B: DOUGLAS ROAD (CR 54)

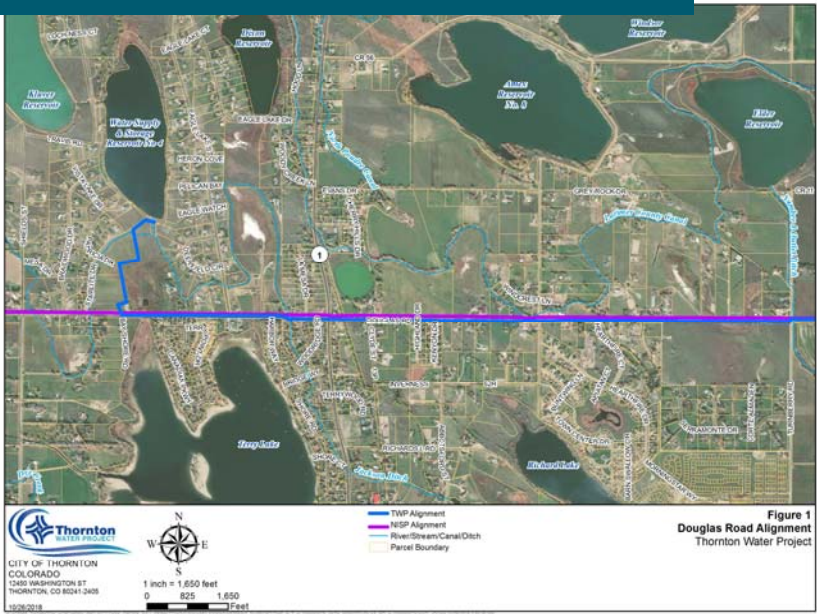
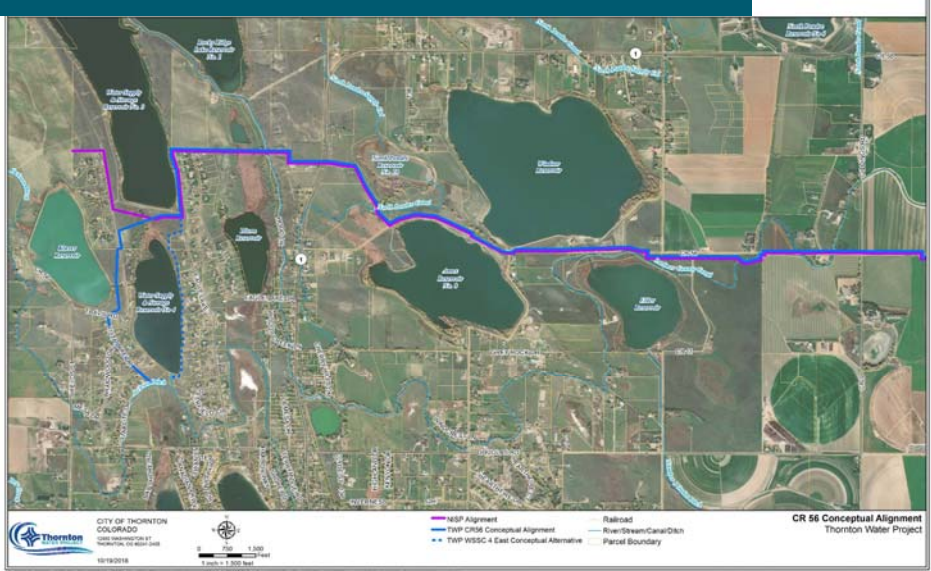
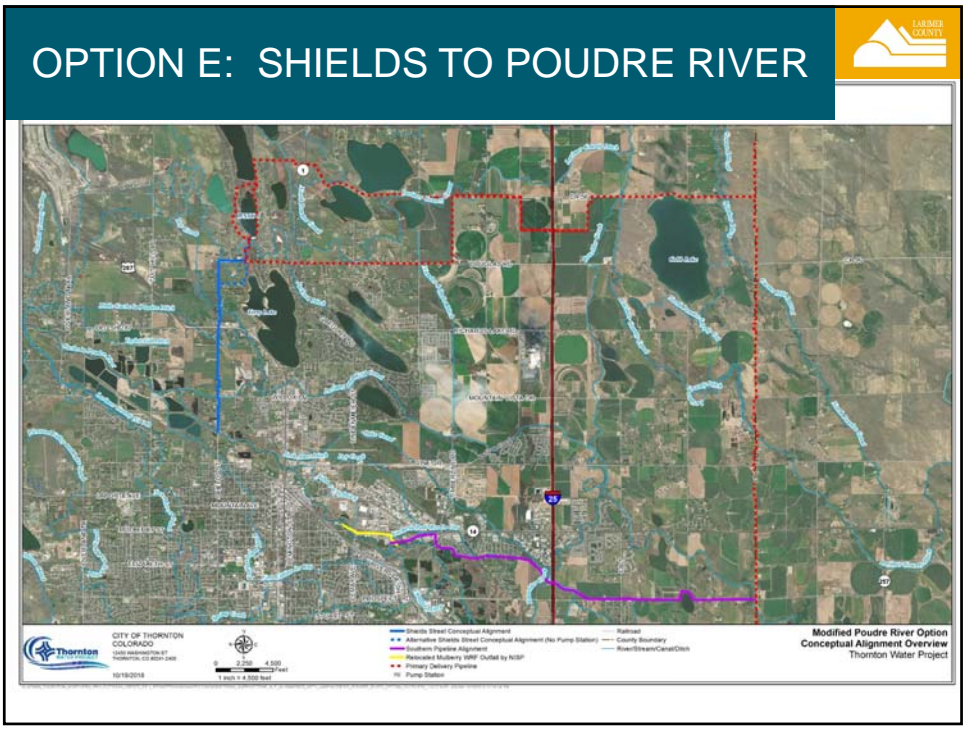
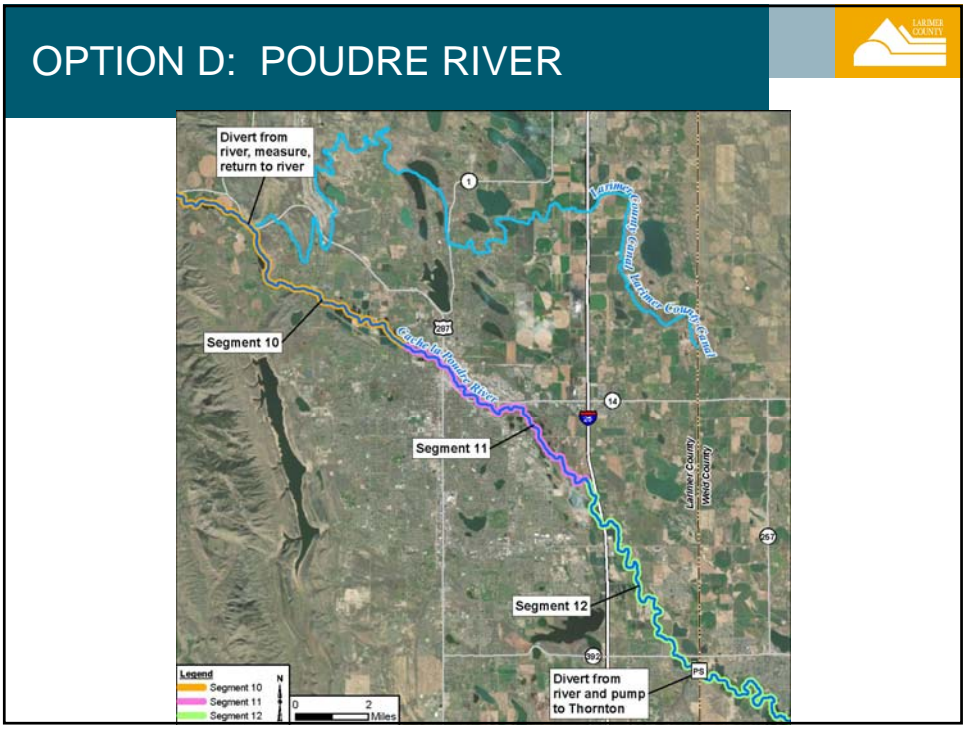


Figure 1
Douglas Road Alignment
Thornton Water Project

OPTION C: NORTH ROUTE (CR 56)



CR 56 Conceptual Alignment
Thornton Water Project





THIS WEBINAR WILL ADDRESS:

Option A – Canal Conveyance

Option B – Douglas Road (CR 54) Pipelines

Option C – North Route (CR 56) Pipelines

Option D – Poudre River Conveyance

**Option E – Shields (CR 17) Pipeline to Poudre
River Conveyance**




CONSULTANTS HIRED BY COUNTY

John Bambei – Bambei Engineering Services

- Professional Engineer
- Water pipeline construction methods

Robin Dornfest – Lithos Engineering

- Professional Geologist
- Geotechnical considerations
- Tunneling
- Lake Taps



WEBINAR INTRODUCTION

IF YOU HAVE QUESTIONS:

- EMAIL HEATHER – heather@peakfacilitation.com
- TEXT HEATHER – 720-299-8796



CONSTRUCTABILITY





CONSTRUCTABILITY

John Bambei, PE

- **Bambei Engineering Services**
- **42+ years experience in Waterworks Industry**
- **Retired as Chief Engineer at Denver Water with 39+ years experience**
- **Active in American Water Works Association and American Society of Civil Engineers**



BAMBEI (CONSTRUCTABILITY) SCOPE

Contractor shall provide constructability review and related support services to Larimer County in conjunction with the proposed City of Thornton water transmission line and a proposed water transmission line for the Northern Integrated Supply Project (NISP) by the Northern Colorado Water Conservancy District (Northern). Services may include but are not limited to:

- Independent review of constructability issues that may be associated with proposed pipeline routes and the construction practices used to install water transmission lines along these routes (existing utility relocation, timing, phasing, duration, production rates, traffic control, appurtenances such as cathodic protection, valves , etc.). The review will of information to be developed by the City of Thornton and/or Northern.
- Consideration of construction traffic control issues (full vs. partial-closure alternatives) and review of assumptions to be used by the County's traffic consultant in assessment of potential traffic impacts during the duration of pipeline construction.
- Attendance and participation as appropriate, at meetings of a citizen Working Group, currently scheduled to be held on October 9th, October 24th, November 13th
- Attendance and participation at an Open House currently scheduled to occur on Thursday November 15th.
- Attendance and participation at Water Project Team meetings comprised of Larimer County, Northern Water and Thornton staff and the County facilitator, to be held during the month of October and through mid-November.
- Preparation of written reviews and a written summary of constructability issues associated with alternatives and with particular emphasis on the preferred corridor route for the pipelines.



CONSTRUCTABILITY

- **Documents available for review**

- Douglas Road Dual Water Pipeline Construction Sequence and Schedule - October 29, 2018 Draft
- Larimer County Road 56 Construction Sequence – October 29, 2018 Draft
- Shields Street Alignment and Construction Sequence – October 26, 2018 Draft
- Modified Poudre River Alternative – October 17, 2018 Draft
- Shields Street/Poudre River Alternative To The Thornton Pipeline Proposal – September 24, 2018 Draft
- Available Information Posted on Project Website
- Google Earth Images
- Route Field Inspection



REVIEW COMMENT QUALIFIERS

- Documents have just recently been received
- Field verification of document sequencing and methods has not yet been performed
- Further evaluation will be necessary
- Understanding that all routes are very preliminary
- No opinion as to which alternative or route should be chosen



PIPELINE ROUTE CONSIDERATIONS

- Route from point to point
- Comply with design conditions
- Impacts to existing and future known utilities
- Impacts to traffic, e.g. emergency access, mail, school
- Soil and groundwater conditions
- Need for permits
- Installation means and methods
- Operation and future maintenance
- Cost

OPTION B: DOUGLAS ROAD (CR 54)



 CITY OF THORNTON
COLORADO
1405 WASHINGTON ST
THORNTON, CO 80241-2405
10/26/2018

1 inch = 1,650 feet
0 825 1,650 Feet

Figure 1
Douglas Road Alignment
Thornton Water Project

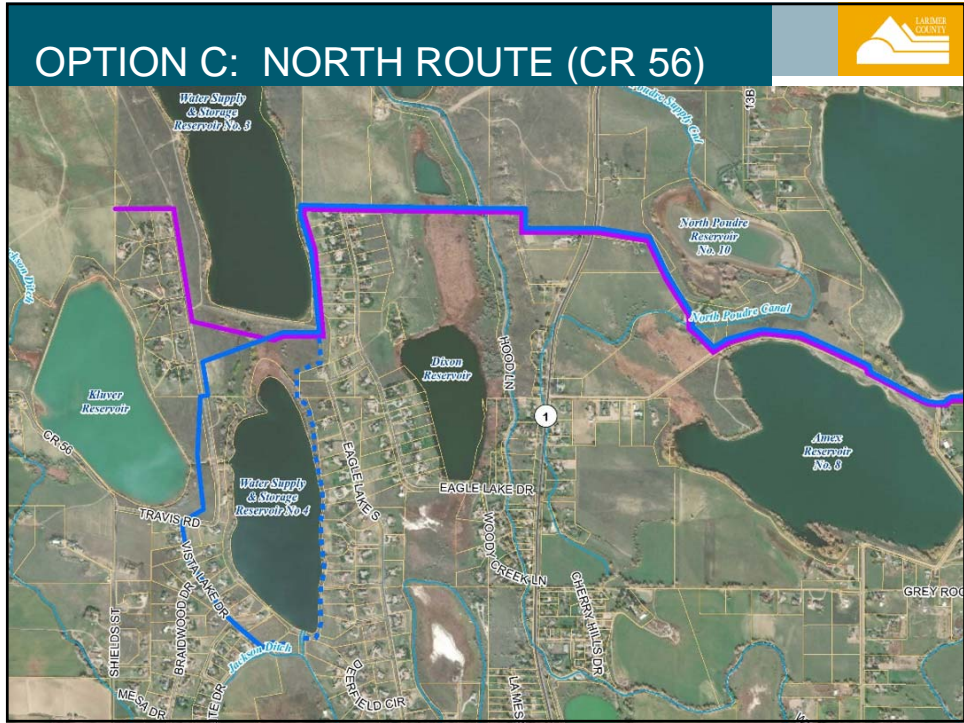


ROUTES – DOUGLAS ROAD (CR 54)

- Douglas Road (CR 54) - Dual Pipelines
 - Appears routing considerations taken into account
 - Impacts to utilities and traffic are biggest issues
 - Project has long duration

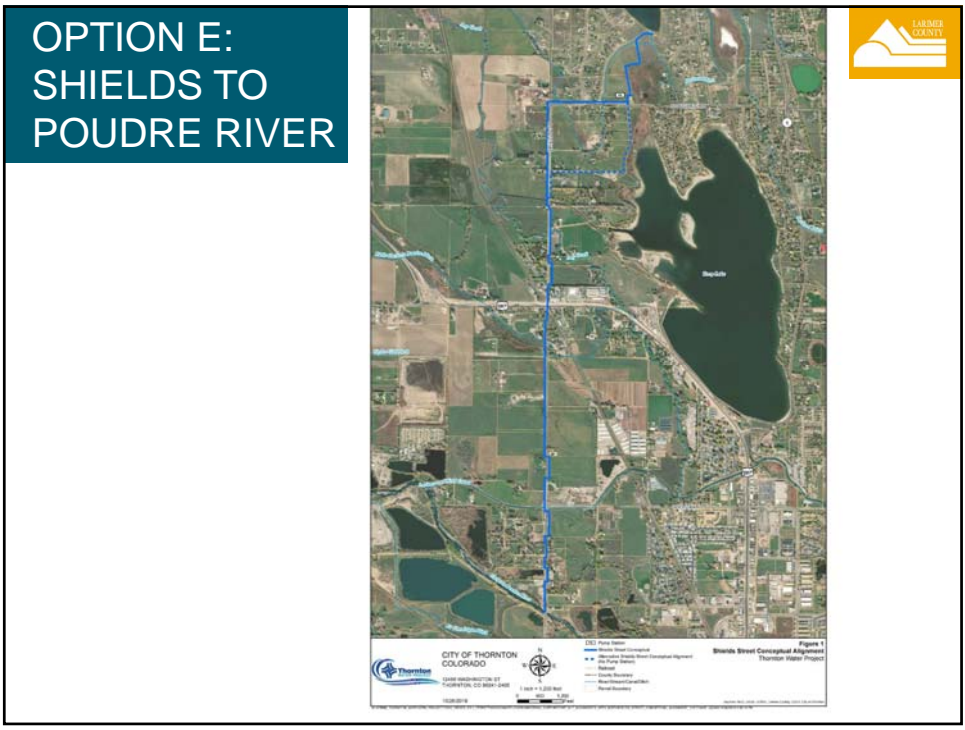
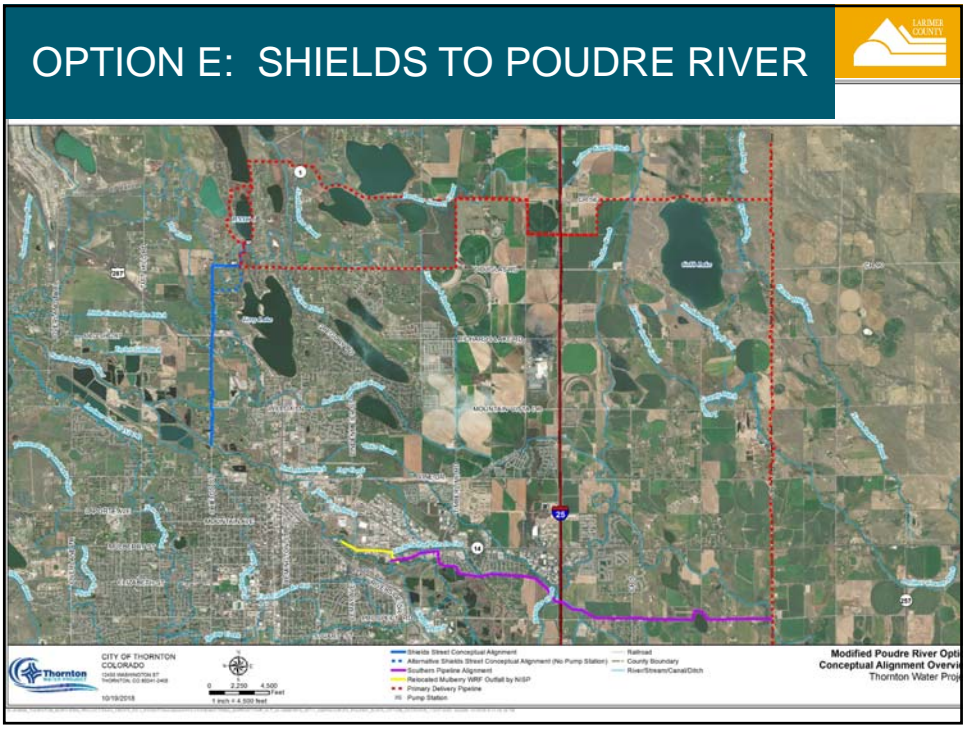
OPTION C: NORTH ROUTE (CR 56)


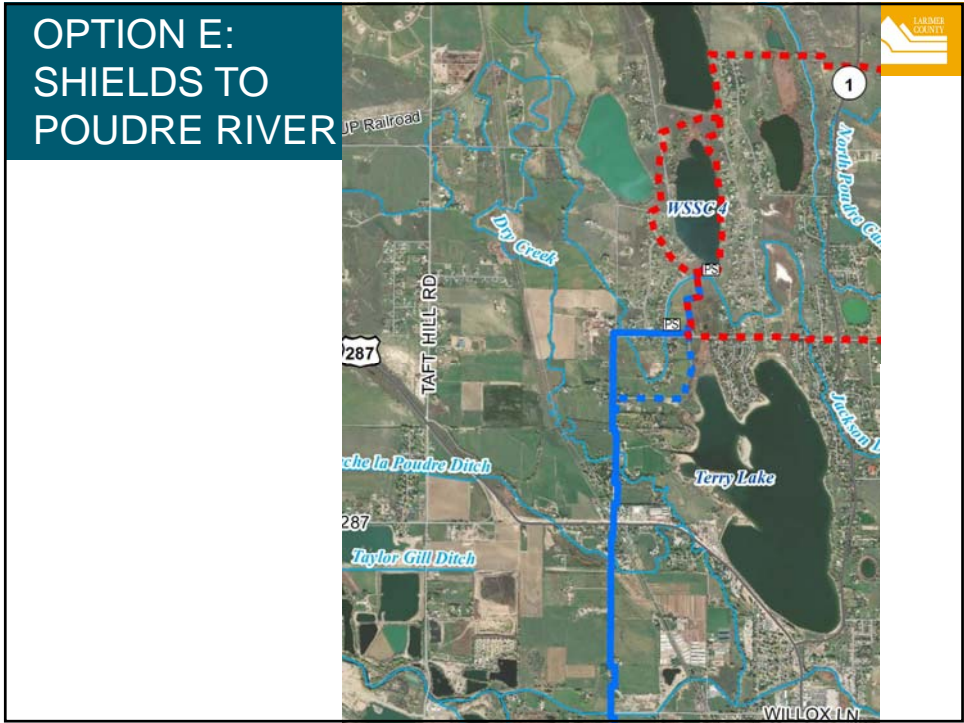




ROUTES – NORTHERN (CR 56)

- County Road 56 – Dual Pipelines
 - Appears routing considerations taken into account
 - Impacts to utilities and traffic minimized with some pipeline location outside of road right-of-way






ROUTES – SHIELDS (CR 17)

- Shields Street – Single Pipeline
 - Appears routing considerations taken into account
 - Impacts to utilities and traffic minimized with some pipeline location outside of road right-of-way




GEOTECHNICAL AND TUNNELING



GEOTECHNICAL CONSIDERATIONS

Robin Dornfest, PG, CPG

- **President Lithos Engineering**
- **18+ years experience in geologic and geotechnical engineering**
- **Fort Collins based company**
- **Main focus on linear infrastructure (pipelines)**
- **Tunnel & Open cut design and construction**





LITHOS (GEOTECH) SCOPE

Project Understanding

We understand that Larimer County (County) is seeking assistance in their evaluation of the proposed Thornton Pipeline Project. Specifically, the County has requested Lithos provide review and comments of the proposed lake tap and associated tunnels related to the Water Supply and Storage (WS&S) Reservoir No. 3.

Proposed Scope of Services

Based on our understanding of the project, Lithos proposes the following scope of services:

- **Task – 1** Review existing alternatives related to a lake tap of WS&S Reservoir No. 3;
- **Task – 2** Attend two public meetings associated with the project;
- **Task – 3** Attend internal County meetings, as needed; and
- **Task – 4** Provide our opinion on the feasibility, risks, and costs by others associated with the alternative that includes a lake tap.



GEOTECHNICAL CONSIDERATIONS

Geotechnical Considerations

- Subsurface conditions & ground behavior
- Shallow groundwater
 - Construction dewatering
 - Need for treatment
- Shallow bedrock
 - Difficult excavation
- Support of excavations
 - Shoring systems to minimize impact





GEOTECHNICAL CONSIDERATIONS

Reasons to Tunnel

- No options for open cut
- Crossing infrastructure
- Crossing environmentally sensitive areas
- Reduce permitting requirements
- Minimize third-party impacts

Reasons not to Tunnel

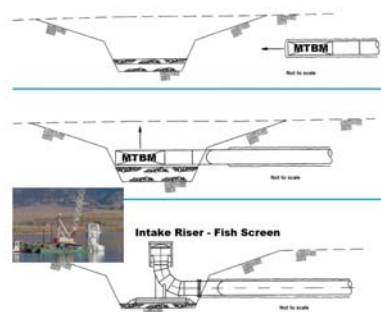
- Expensive
- Inherently risky



GEOTECHNICAL CONSIDERATIONS

Lake Tap Options

- All lake tap options are viable
- Much room for optimization
- Lake tap alternatives require further development if selected
 - Geotechnical investigations
 - Tunnel and shaft designs
 - Intake riser design

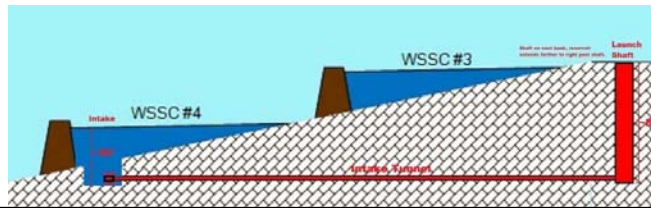




GEOTECHNICAL CONSIDERATIONS

Lake Tap Options

- Expensive and inherently risky
- Lake taps are becoming more common in water storage and conveyance projects
- Nothing in our experience that would preclude construction of a lake tap at the site(s)



WEBINAR INTRODUCTION

IF YOU HAVE QUESTIONS:

- EMAIL HEATHER – heather@peakfacilitation.com
- TEXT HEATHER – 720-299-8796

1

Water Quality & Poudre River Flows

THORNTON WATER PROJECT – WEBINAR – NOVEMBER 5, 2018

What you will see today:

2

- ▶ Recent developments regarding flows for the Poudre River.
- ▶ Alternative concepts discussed at Working Group meetings: conveying water via the Poudre or the Larimer County Canal, or other regional ditch systems.
- ▶ Assessment of constructing a Thornton and a Northern Water pipeline in Douglas Road.
- ▶ Alternative route assessment for Thornton's proposed northern route which will include a pipeline for Northern Water.
- ▶ Expanded list of benefits for Larimer County.

Recent developments regarding flows for the Poudre River

3

- ▶ **On October 23, 2018**, Thornton City Council approved a resolution authorizing Thornton's participation in the Poudre River Instream Flow Augmentation Plan.
- ▶ Thornton to provide approximately **3,000 acre-feet** a year of its water rights to the Colorado Water Conservation Board to augment Poudre River.

Recent developments regarding flows for the Poudre River

4

- ▶ The Colorado Water Conservation Board, the Colorado Division of Parks and Wildlife, the Colorado Water Trust, Northern Water, Cache la Poudre Water Users Association, and the cities of Thornton, Greeley and Ft. Collins have been working on the plan for over 3 years.
- ▶ This is a carefully thought out plan that complies with Colorado Water Law to preserve and improve river flows at critical locations and critical times of the year.

Recent developments regarding flows for the Poudre River

5

- ▶ This provides the benefit of NEW water to several stretches of the river. The value of this water on the water market would be about \$45 million.

Poudre Instream Flow Augmentation Plan

6

- ▶ Emily Hunt – Thornton Water Resources Manager.
- ▶ Thornton has actively participated in the Poudre Runs Through It Study/Action Work Group.
- ▶ Group of community water leaders convened by Colorado State University's Colorado Water Institute for exploring options to improve the Poudre River as a healthy, working river.

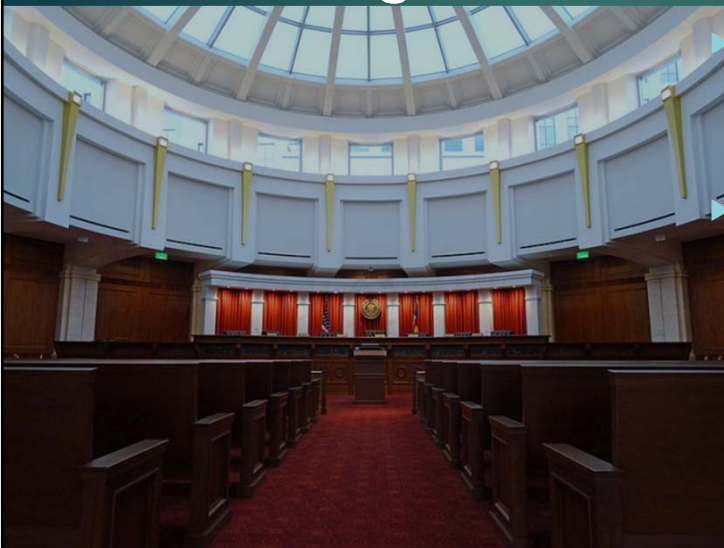
Dave Taussig – Water Attorney White and Jankowski

7

- ▶ Areas of Practice: Water Law, Natural Resources Law, Litigation
- ▶ Bar Admissions:
 - ▶ Colorado, 1987
 - ▶ United States District Court, District of Colorado, 1987
- ▶ Education:
 - ▶ University of Denver Sturm College of Law, Denver, Colorado, 1986
 - J.D., Doctor of Jurisprudence
 - ▶ Colorado State University, Fort Collins, Colorado, 1982
 - B.A., Bachelor of Arts

Poudre Instream Flow Augmentation Plan

8



In Colorado, water rights users must put water to a “beneficial use” such as agricultural use, industrial use or drinking water.

▶ Approving the specific beneficial use of a water right is one of the many authorities of the state Water Courts.

Poudre Instream Flow Augmentation Plan

9



Colorado Water Conservation Board has the exclusive authority "on behalf of the people of the state of Colorado, to appropriate or acquire... such waters of natural streams and lakes as may be required to "preserve" the natural environment to a reasonable degree."

Poudre Instream Flow Augmentation Plan

10



▶ The CWCB is the only entity in the state that can hold an instream flow water right, their partnership in flow restoration efforts is essential.

Poudre Instream Flow Augmentation Plan

11



▶ CWCB obtains input from Colorado Parks and Wildlife regarding target river flows.

Poudre Instream Flow Augmentation Plan

12



▶ the CWCB was authorized to acquire water to "Improve" the environment to a reasonable degree

Poudre Instream Flow Augmentation Plan

13

- ▶ In the Poudre River, multiple and varied types of water rights would need to be acquired to meet the flow needs, which makes a conventional acquisition approach unviable.
- ▶ The flows would be part of an Instream Flow (ISF) Augmentation Plan, which is an innovative approach to increase and protect additional flows in portions of the Poudre River.

Poudre Flows would be developed in three phases

14

- ▶ Phase I generally concerned tasks related to organization of interested parties and engineering feasibility
- ▶ Thornton participated in certain Phase I activities, including reviewing analyses to support the ISF Plan.

Poudre Flows would be developed in three phases

15

- ▶ Phase II generally concerns the tasks needed to obtain approval of the ISF Plan from the CWCB and from the Water Court.
- ▶ Phase III will be implemented when the appropriate administrative and judicial approvals have been obtained.

Information about the Water Supply and Storage Company

16

- ▶ The WSSC system water rights are decreed for diversion at the Larimer County Canal and the Jackson Ditch.
- ▶ WSSC system provides water for municipal and agricultural uses during the irrigation season.
- ▶ WSSC uses native and trans-mountain sources to deliver the water needed by the shareholders.
- ▶ Flows from the River are attributable to the company's water rights that allow diversion from the river, as well as releases from upstream facilities such as Long Draw Reservoir, Chambers Lake, and the Laramie/Poudre Tunnel.

Poudre Instream Flow Augmentation Plan

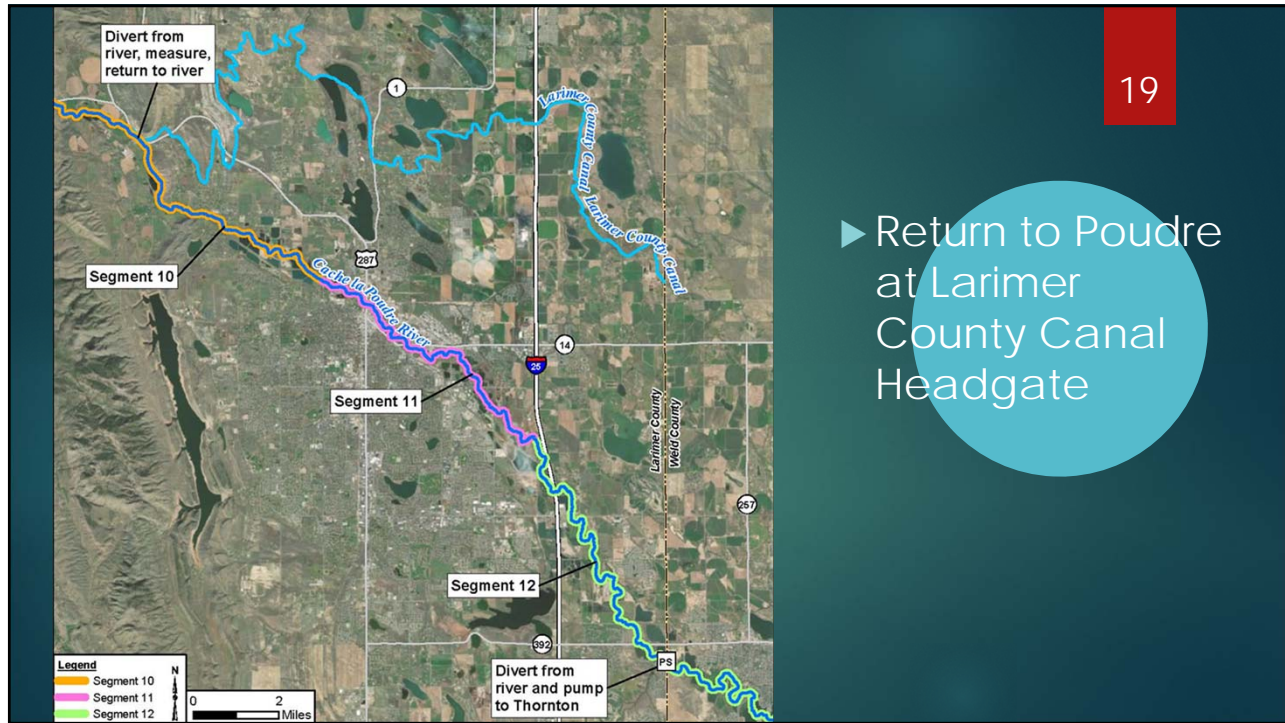
17

- ▶ Thornton's water sources, in partnership with flows provided by other water users, will be used in Poudre Flows by the CWCB to preserve and improve the health of the Poudre River.

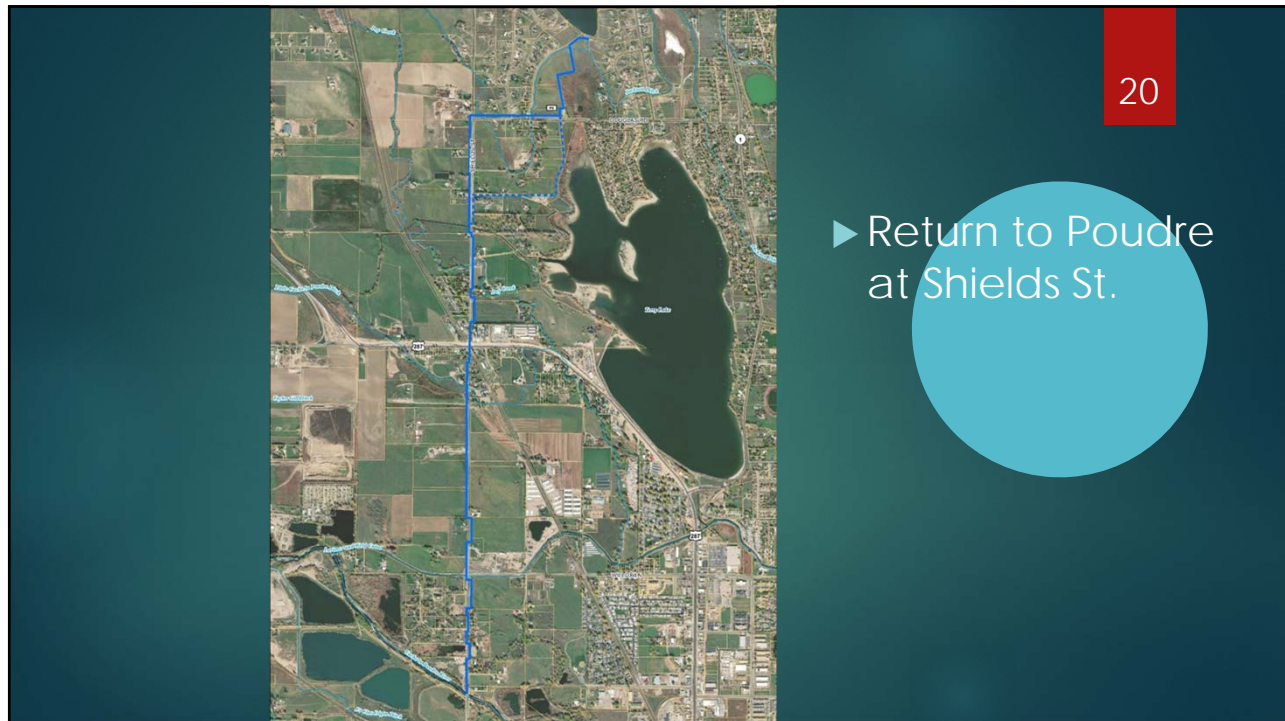
Sending Thornton Water Down The Poudre River

18





▶ Return to Poudre at Larimer County Canal Headgate



▶ Return to Poudre at Shields St.

21

Water Quality Considerations of the Poudre River Supply

11/05/2018

22

Introductions

- ▶ Dr. Bill Bellamy, PE
 - ▶ University of Wyoming Professor of Practice
 - ▶ > 30 years of practical experience developing, designing, and delivering drinking water supply projects
- ▶ Jason Curl, PE
 - ▶ Principal Water Treatment Technologist, Jacobs
 - ▶ >15 years of practical experience developing, designing, and delivering drinking water supply projects

Overview

23

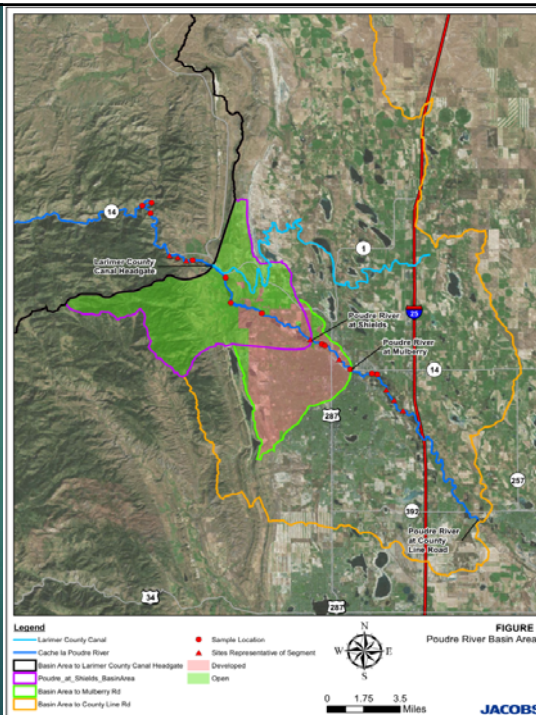
- ▶ Historical Water Supply Selection Approaches
- ▶ Approach
- ▶ Water Quality Overview and Broad Considerations
- ▶ Poudre River Segment 10
- ▶ Poudre River Segment 11
- ▶ Poudre River Segment 12
- ▶ Use of surface conveyance and ditch systems
- ▶ Benefits of storage
- ▶ Cost and Community Impacts of Modifying Supply Intake Location
- ▶ Future Regulations



Area Drainages

- ▶ Indication of agriculture and urban drainage into Segments 11 & 12
- ▶ Location of WWTPs

24



Historic Selection of Drinking Water Sources

25

- ▶ "Supplies should be drawn from the best available source..."
 - ▶ Fair, G.M., Geyer, J.C., Okun, D.A., Water and Wastewater Engineering, John Wiley & Sons, INC. 1968
- ▶ " The main point is that disease-germs shall not be present in our drinking water. If they can be kept out in the first place at reasonable expense, this is the thing to do. Innocence is better than repentance."
 - ▶ Hazen, Allen, The Filtration of Public Water-Supplies, John Wiley & Sons, 1900

Approach

26

- ▶ Evaluated available data, primarily from the Northern Integrated Supply Project.
 - ▶ GEI Consultants, Inc. "Northern Integrated Supply Project Supplemental Draft Environmental Impact Statement; Water Quality Assessment Report, Phase I." January 2015.
- ▶ Considered other reports available
 - ▶ Buchanan, Lisa. "Preliminary Assessment of an Alternative Diversion Location for Thornton Water Rights Using Poudre River Water Quality Data." June 2018.
- ▶ Draw on industry experience in developing and implementing new water supplies for communities around the world

MK1

Water Quality Concerns for Drinking Water Source

27

- ▶ Pathogens – including *Giardia*, *Cryptosporidium*, and viruses, which are acute human health hazards.
- ▶ Total Dissolved Solids (TDS) – taste changes at > 400 mg/L and Secondary Standard 500 mg/L must be reported to customers
- ▶ Sulfates – Secondary Standards 250 mg/L must be reported to customers
- ▶ Nitrogen compounds – Nitrate & Ammonia – biofilm development in distribution system unless additional treatment to remove (e.g., ozone and biological filtration/BAC) also promotes algae growth in storage reservoirs leading to taste and odor, contributes to nitrosamine DBPs
- ▶ *E coli* and coliforms – Pathogen Indicators - resulting from wastewater discharge and urban runoff and agriculture runoff
- ▶ Pesticides and herbicides – introduction from urban and agriculture runoff as well as wastewater treatment plants
- ▶ Contaminants of Emerging Concern (CECs) – pharmaceuticals, personal care products, industrial chemicals, cleaning compounds (identified as endocrine disrupters, carcinogens)
- ▶ Disinfection By-Products (DBPs) – Formed from the combination of certain organic compounds (DBP precursors) and disinfection chemicals such as chlorine and chloramine.
- ▶ Total Organic Carbon (TOC) – bulk measurement of organic compounds which also includes sub-components such as CECs and DBP precursors.
- ▶ Consistency of Supply- change in taste and odor from algae and salt content

Why E coli is an important indicator

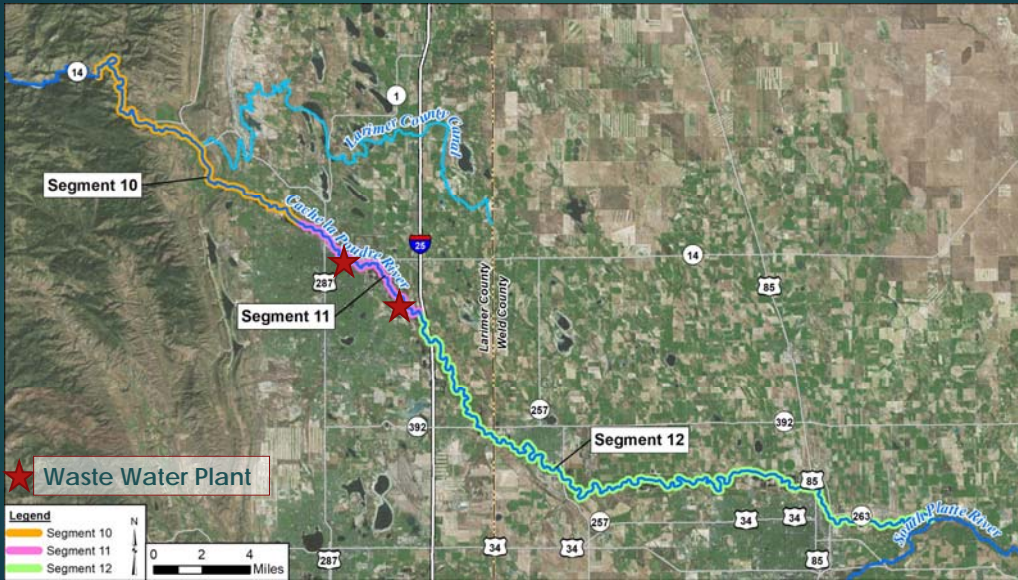
28

- ▶ *E coli* is used as an indicator of fecal contamination (mammal)
- ▶ As *E coli* concentrations increase, it is accepted that there will be human pathogens such as *Giardia*, *Cryptosporidium* and viruses as well
- ▶ Down stream of WWTPs, there is a greater concentration of human pathogens (especially chlorine resistant pathogens such as *Giardia* and *Cryptosporidium*)
- ▶ With high levels of *E coli*, risk of drinking-water pathogen contamination increases, even after treatment, since drinking-water treatment systems are based on % removal or % inactivation
 - ▶ Additional treatment can equate risk, however, if a single treatment process fails, the severity of a disease occurrence will be greater
 - ▶ (e.g., Milwaukee single point failure of coagulation system and > 200,000 cases of *Cryptosporidium*)

MK4

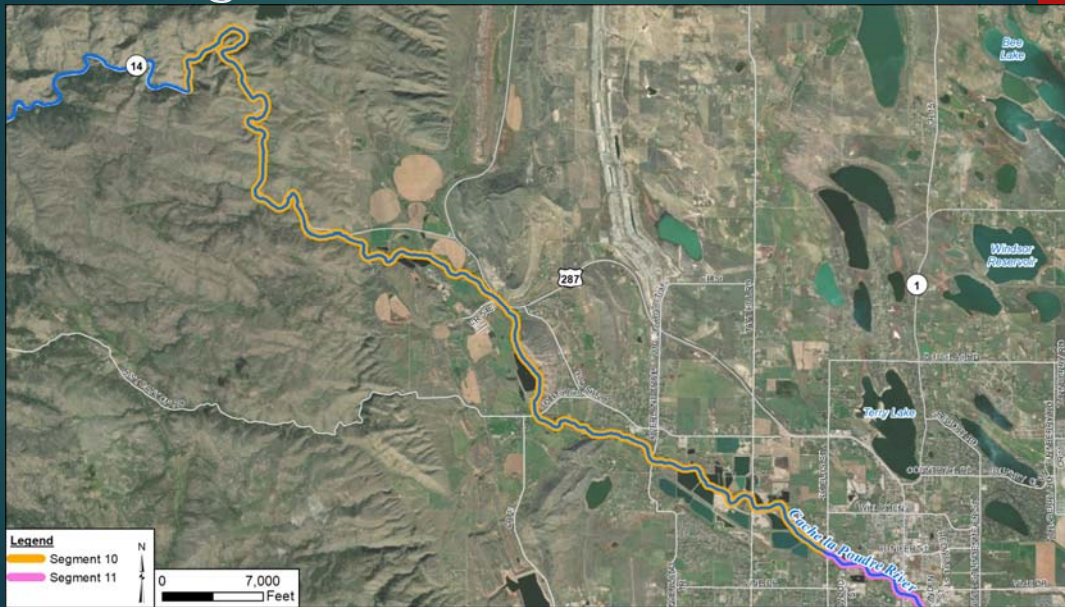
Segments 10, 11, 12 of Poudre River

29



Segment 10 of Poudre River

30



Poudre River at the Larimer County Canal (LCC)

31

- ▶ Segment 10 is designated as a suitable "Water Supply" by the CDPHE
 - ▶ Risk of pathogenic, man made and geologic contamination is at its lowest at this location, when compared to all other locations downstream on the Poudre

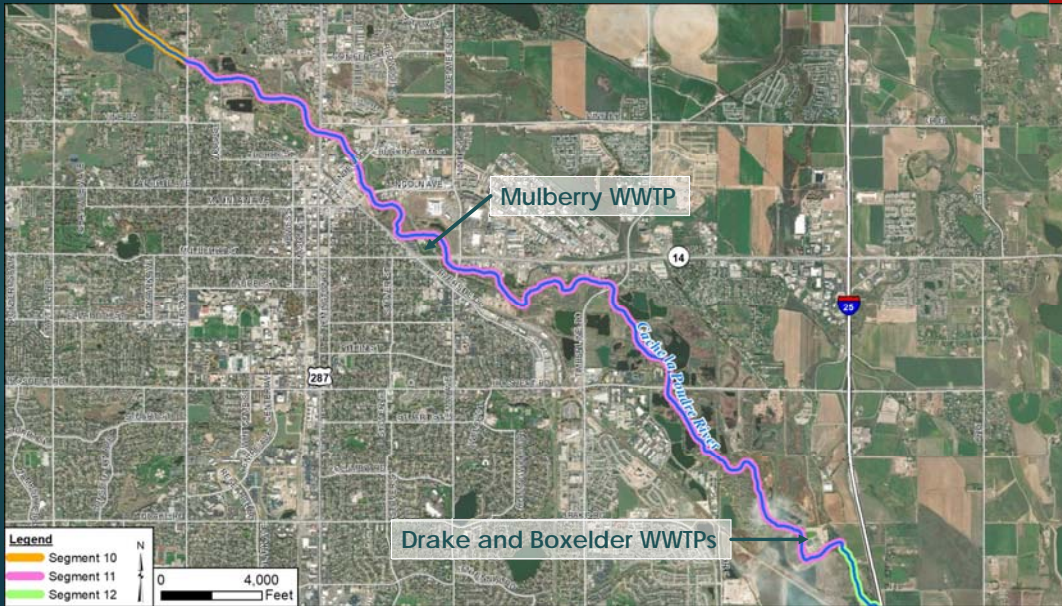
Advantages of Water Supply and Storage Company (WSSC) System

32

- ▶ Ditch system can be operated so that it protects the Thornton water supply from potential contamination events
 - ▶ Wildfires, floods, or spills in the watershed
- ▶ The reservoirs will serve as a pool to mix variable water qualities that may be witnessed over time to provide a predictable water supply, For Example
 - ▶ Blending down high TOC periods and low alkalinity during the spring runoff
 - ▶ Provide consistent water quality which facilitates consistent drinking water treatment
- ▶ Supply can be regulated to demand, optimizing most efficient use and treatment rather than being controlled by availability

Segment 11 of Poudre River

33



Poudre River Above Mulberry Reclamation Facility (1)

34

- ▶ "Urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes. The pollutants include:
 - ▶ • Sediment
 - ▶ • Oil, grease, and toxic chemicals from motor vehicles
 - ▶ • Pesticides and nutrients from lawns and gardens
 - ▶ • Viruses, bacteria, and nutrients from pet waste and failing septic systems
 - ▶ • Road salts
 - ▶ • Heavy metals from roof shingles, motor vehicles, and other sources"
- {USEPA. Protecting Water Quality from Urban Runoff. EPA 841-F-03-003 (2003)}

Poudre River Above Mulberry Reclamation Facility (2)

35

- ▶ Concentrations of *E. Coli* increase significantly when compared to Segment 10. Both the 85th percentile and the maximum *E. Coli* measured values indicate significant increases in *E. Coli*, which also indicates the presence of other pathogens.
- ▶ Data from: {GEI Consultants, Inc. "Northern Integrated Supply Project Supplemental Draft Environmental Impact Statement; Water Quality Assessment Report, Phase I." January 2015.}

Poudre River Below Wastewater Treatment Plants (1)

36

- ▶ "Raw and treated wastewater represents a significant source of emerging pathogens that has the potential to adversely affect downstream drinking water supplies. Discharges of emerging pathogens from wastewater treatment have the potential to reach a water supply intake in a viable state at significant concentrations that could exceed regulatory limits, increase endemic risk from drinking water, and/or require additional drinking water treatment."

{Crockett, Christopher S., *The Role of Wastewater Treatment in Protecting Water Supplies Against Emerging Pathogens*, Water Environment Research, Volume 79, Number 3, March 2007. }

Poudre River Below Wastewater Treatment Plants (2)

37

- ▶ Additional contaminants include nutrients, minerals, TOC, chemicals that are listed in the primary drinking water standards, CECs and DBP precursors. In addition, aesthetics change as water quality deteriorates, such as taste, odor and color.
- ▶ Even waters with similar TOC concentrations have very different CEC and DBP precursor concentrations.
- ▶ CECs include contaminants such as pharmaceuticals and personal care products which have public health implications, with some exhibiting endocrine disrupter characteristics.
 - ▶ The health effects of CECs are not fully understood at this time and are being studied closely.

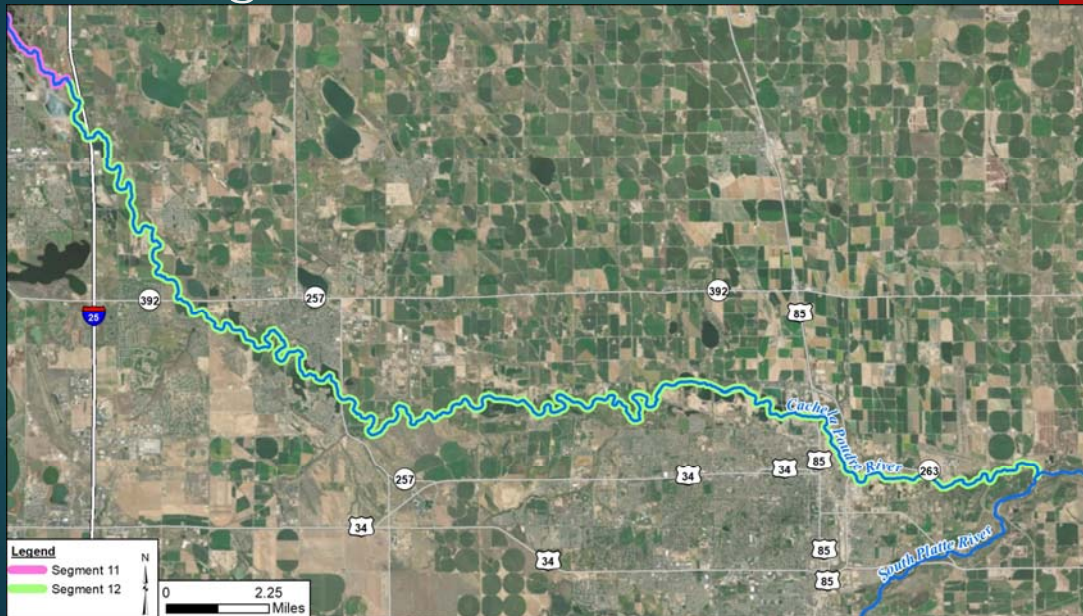
Additional treatment needs after WWTPs

38

- ▶ In addition, the TOC added by WWTP discharges combined with nitrogen and phosphates can increase distribution system regrowth resulting in:
 - ▶ Additional DBPs resulting from the necessary increase in disinfectants to control regrowth
 - ▶ Change in DBPs, favoring nitrosamines in addition to trihalomethane
 - ▶ Potential taste and odor – reducing public confidence in their water supply, resorting to less environmentally sustainable and unregulated means of obtaining good tasting water (bottled water, in home treatment systems, etc.) as well as increasing customer costs

Segment 12 of Poudre River

39



Section 12 water quality impacts

40

- ▶ Impacts are as discussed above concerning urban, agriculture and wastewater inflow; including nutrients, minerals, TOC, chemicals that are listed in the primary drinking water standards, CECs and DBP precursors. In addition, aesthetics change as water quality deteriorates, such as taste, odor and color.
- ▶ In addition there are net inflows from local groundwater gradients, which mobilizes pollutant constituents (geologic impacts), which increase TDS, selenium, and sulfate concentrations

(GEI Consultants, Inc. "Northern Integrated Supply Project Supplemental Draft Environmental Impact Statement; Water Quality Assessment Report, Phase I." January 2015.)

Mineral deterioration in water quality further decreases the desirability of this water as a drinking water source.

This is the worst possible water quality from a public health and cost of treatment perspective

Use of Larimer County Canal to deliver water

41



Water quality concerns using LCC to deliver water

42

- ▶ If water is delivered through LCC, it degrades due to inflows from residential and agricultural activities similar to discussion above; Segment 11.
- ▶ The pollutants include:
 - ▶ • Sediment
 - ▶ • Oil, grease, and toxic chemicals from motor vehicles
 - ▶ • Pesticides and nutrients from lawns and gardens
 - ▶ • Viruses, bacteria, and nutrients from pet waste and failing septic systems
 - ▶ • Road salts
 - ▶ • Heavy metals from roof shingles, motor vehicles, and other sources"

Additional water quality concerns using LCC to deliver water

43

- ▶ Water flowing along the LCC degrades due to inflows as well as geologic features along the canal
 - ▶ TDS and other constituents increase measurably east of the reservoirs
 - ▶ Geologic features as well as inflows into the ditch influence water quality
 - ▶ Without reservoir storage or sufficient base flows in the ditch, this would erode the benefits of managing the water offstream from the Poudre.
 - ▶ To access existing storage while still using the ditch system to convey to the east would require a pump station and a pipeline
 - ▶ Water treatment complexity (e.g., GAC, membranes) will increase as well as the overall cost
 - ▶ Finally, winter operations become impractical because the ditch often freezes.

Treatment Cost Considerations

44

- ▶ If diversion was moved upstream of the Mulberry WRF, additional treatment would be required for increased TOC and pathogens.
 - ▶ Addition of membrane filtration
 - ▶ Assuming 40 mgd of treatment capacity
 - ▶ Capital costs increase - \$85 million
 - ▶ O&M costs increase - \$5.5 million per year
- ▶ If the diversion was moved into Segment 12, treatment would have to be added to address not only the items mentioned above, but also further increases in pathogens, CECs, nutrients as well as increased TDS.
 - ▶ Addition of membrane filtration, reverse osmosis (RO), and complete zero liquid discharge treatment of the brine waste stream from RO
 - ▶ Capital cost increase - \$600 million
 - ▶ O&M cost increase - \$44 million per year

Community Impacts at Treatment Plant Location

45

- ▶ Costs are not the only impact, community impacts such as increased truck traffic, increase solids to landfills, increase power usage and increase greenhouse gases (GHGs) result from these changes
- ▶ Diversion upstream of Mulberry WRF
 - ▶ GHG footprint increase – 2 times
- ▶ Diversion at Windsor
 - ▶ Truck traffic increase – 4 times
 - ▶ GHG footprint increase – 14 times

Future Considerations

46

- ▶ If the water supply location was modified from Thornton's current plan, there will continue to be impacts on drinking water quality regulations into the future.
- ▶ USEPA publishes a Contaminant Candidate List (CCL) every 5 years.
 - ▶ A list of constituents found in water not currently regulated but may be considered for future regulation
 - ▶ The most recent two CCLs, include multiple DBPs under consideration for regulation.
 - ▶ <https://www.epa.gov/ccl/contaminant-candidate-list-3-ccl-3>
 - ▶ <https://www.epa.gov/ccl/contaminant-candidate-list-4-ccl-4-0>
- ▶ Potential future regulations may include additional DBPs and/or lower the maximum contaminant level from current requirements.
- ▶ The impact of urban and agricultural runoff and especially the impact from WWTPs, as well as increased understanding of potential human health impacts are driving these changes.

Conclusions

47

- ▶ All of the above discussion demonstrates why “highest quality” water is recommended and selected by water and public health professionals for potable supplies
- ▶ Operations in concert with reservoir storage (WSSC Reservoir #4) ^{MKS} have significant quality and operational advantages
- ▶ Existing reports and water quality science agree on the progressive deterioration of the Poudre River water quality as it progresses down stream from Segment 10
- ▶ Any of the diversions below LCC diversion will add pathogens, chemicals, CECs - requiring additional facilities, environmental impact, costs and risk mitigation
- ▶ The LCC diversion point and storage in WSSC reservoirs is the best alternative based on
 - ▶ Protection of public health
 - ▶ Reduced environment impacts
 - ▶ Operational considerations
 - ▶ Cost

Thornton's Shares in the Water Supply and Storage Company

48

- ▶ Thornton's use of its WSSC shares is subject to ditch company operations.
- ▶ The water becomes Thornton's once it enters the WSSC system.
- ▶ Leaving water in Poudre River would require a change to Thornton's water decree.



Thornton, WSSC, and Colorado Water Court Contractual Agreements

49



WSSC Headgate

- ▶ Thornton's decree does not authorize a change in point of diversion. Thornton is required by the decree to divert its water at the Larimer County Canal and the Jackson Ditch.
- ▶ Thornton's 1986 Agreement with WSSC allows Thornton to deliver water out of WSSC #4, or any point between the headgate and Rocky Ridge. Agreed to because it protected the other shareholders.
- ▶ Thornton has the right to use storage in WSSC reservoirs based on its pro-rata share ownership, as well as an agreement with WSSC to use excess capacity that was purchased as part of the 1986 agreement.

Amendment of the 1986 WSSC Agreement

50

- ▶ Solving for injuries to remaining shareholders in a ditch system is critical to implementing any project.
- ▶ Taking all of Thornton's water near the head of the ditch would mean there would be additional system losses, operational changes, and infrastructure improvements that would have to be re-done.
- ▶ Thornton would have to re-negotiate its agreement with WSSC, and if WSSC declined to do so, neither Thornton nor anyone else, could force WSSC to agree to something different than in the existing agreement.

Amendment of the 1986 WSSC Agreement

51

- ▶ Thornton would lose the value that it has already paid WSSC for use of the ditch, reservoirs and excess capacity in the reservoirs.
- ▶ amendment could cost Thornton \$300,000 to \$500,000 just for the negotiations
- ▶ Does not include costs associated with the loss of water or costs to build additional facilities or costs to make operational changes to implement a down-the-river option.
- ▶ It could take three to five years to negotiate a new agreement with WSSC.

Change of Water Court Decree

52

- ▶ If a new agreement was negotiated with WSSC, Thornton would have to file to change the point of diversion to a location near Windsor
- ▶ File an application to change the place of storage to the new reservoirs that would be required due to the loss of storage in the WSSC system.
- ▶ It could cost \$750,000 to \$1,000,000 for just the water court case.

Change of Water Court Decree

53

- ▶ Cost does not include costs associated with the increased water treatment due to poorer water quality, infrastructure costs, costs associated with the loss of water to the WSSC system and to the stream, or costs for federal permitting of reconstructing intervening ditch headgates.
- ▶ Could take six to eight years to get through the water court process including appeals.

Reopening of a Water Decree

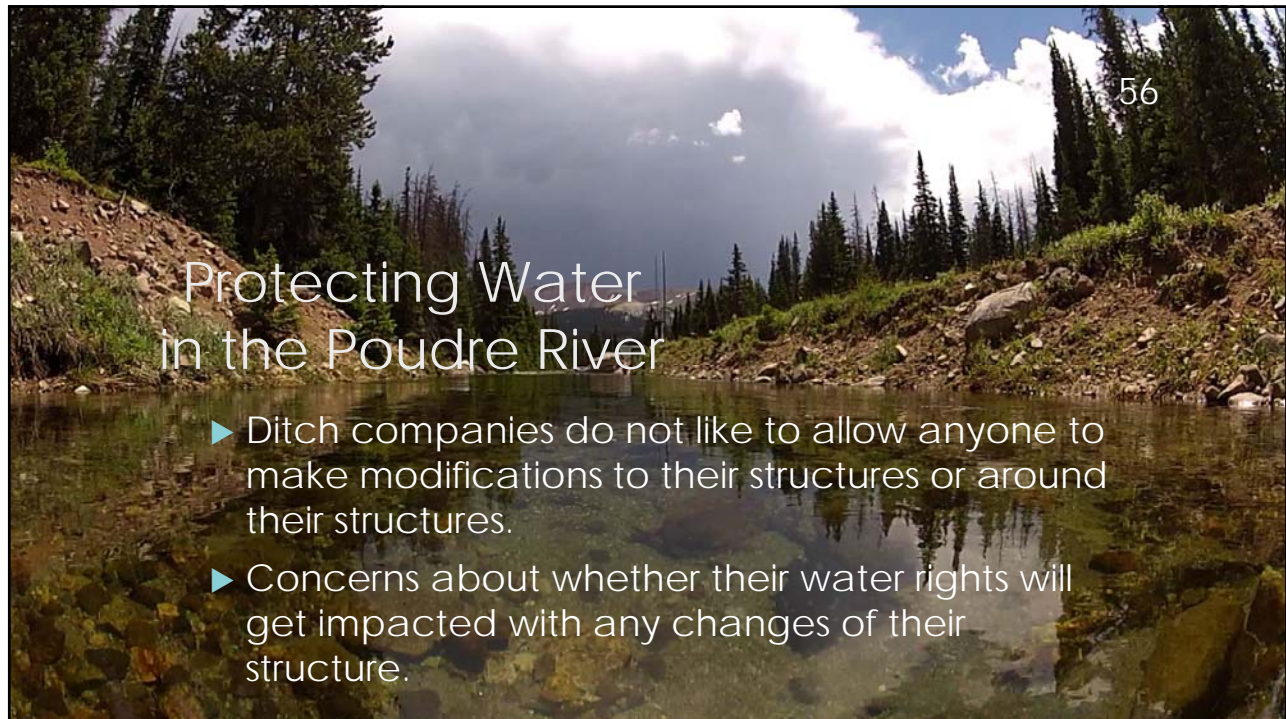
54

- ▶ Significant risk that the decree gets re-opened and additional terms and conditions that result in less water than previously adjudicated or more stringent conditions are placed on operations.
- ▶ Statute also allows the court to include additional terms and conditions on future use. This is a new statute that has not been tested in water court.

Intervening Ditches/Dry-Up

55

- ▶ There are approximately 13 ditches that divert between the Larimer County Canal and Windsor and 5 ditches that sweep the river and dry it up. It would cost \$ 2 million to reconstruct river headgates to allow Thornton's water to be passed around those structures.



Protecting Water in the Poudre River

- ▶ Ditch companies do not like to allow anyone to make modifications to their structures or around their structures.
- ▶ Concerns about whether their water rights will get impacted with any changes of their structure.

Shepherding and Administration issues

57

- ▶ Thornton's additional flows would complicate the Water Commissioners ability to shepherd Thornton's water rights through this reach to ensure that it was not diverted by the intervening ditches.
- ▶ It would increase conflict between the ditch owners, the state water officials and Thornton.
- ▶ Additional stream gauges would need to be constructed in the river to administer and measure these new flows

Shepherding and Administration issues

58

- ▶ There would be an increased risk for flooding along the Poudre River with Thornton having to take its water at the downstream point when the river was in flood stage

Water Losses in River

59

- ▶ state water officials add a stream loss of 0.5% per mile on the Poudre for water users that use the river to transport water. Paying this water is a direct hit into the yield of the WSSC water rights Thornton purchased

Water Structure Needs For Return

60

- ▶ Thornton would need to construct a large structure to move water from the LCC to the Poudre River.
- ▶ WSSC must approve such a structure.
- ▶ Because water is delivered 5 on 2 off, the flows to the river would fluctuate rapidly.
- ▶ This environmental issue would need to be addressed and cause increased difficulty in administrating the river for the state water officials.

Federal Permitting of New Pumping Structure Near Windsor

61

- ▶ Tunneling under the rivers, as Thornton has proposed, avoids a number of the environmental issues, compared with constructing a large pumping plant in the river near Windsor.
- ▶ The goal of our environmental laws is to avoid impacts to the environment as the preferred alternative.
- ▶ It could take five to ten years to complete federal permitting for a Windsor Pumping Plant to obtain a 404 permit.

Water Storage Factors

62

- ▶ Windsor Concept eliminates use of Thornton's storage in WSSC.
- ▶ The total storage volume of WSSC #3, WSSC #4, Kluver and Rocky Ridge is 11,740 acre feet.
- ▶ Thornton's portion of the storage is approximately 5,635 acre feet.
- ▶ In addition, Thornton purchased the right to use the excess capacity in the WSSC reservoirs.
- ▶ Storage is important to Thornton's municipal operations, as it regulates water inflows and outflows, and allows for the water to be delivered to Thornton 365 days a year.



Delivery of Water from WSSC Reservoir #4

65

- ▶ WSSC requires Thornton to deliver water from Reservoir #4.
- ▶ Pipeline will need to be constructed from #4 to the River.
- ▶ Capacity isn't always available in other ditch systems.
- ▶ Thornton would also have to negotiate carriage agreements with those ditch companies for excess capacity and pay for the use of the excess capacity.

Delivery of Water from WSSC Reservoir #4

66

- ▶ Using natural drainages to convey Thornton's water could also increase flooding potential along those drainages.
- ▶ Using other ditch systems and natural drainages would result in the water being delivered to a point lower on the river as compared to a pipeline down Shields St.

Constructing New Storage

67

- ▶ It takes years to identify a reservoir site, permit the construction, and develop a reservoir.
- ▶ Reservoir sites are not common, and are not easily developed.
- ▶ If the reservoir is a reclaimed gravel pit, the time to mine the aggregate is driven by market conditions and can take decades to complete

Constructing New Storage

68

- ▶ Depending on the location of a proposed reservoir, it could require Army Corps of Engineer's permitting, State Permitting and Local Land Use permitting.
- ▶ Cost – The cost to develop water storage is in the range of \$5000 to \$10000 per acre foot.
- ▶ Replacing Thornton's WSSC reservoir storage would cost \$60 million to \$120 million

With No Available Storage

69

- ▶ Thornton could not operate its water system without storage given WSSC's operation of 5-on, 2-off delivery weeks.
- ▶ With WSSC Reservoirs, Thornton can take the WSSC deliveries into available storage space, and draw water out of the reservoir as needed.
- ▶ Reservoirs allow water to be carried from the irrigation season to the non-irrigation season, and from year to year.

With No Available Storage

70

- ▶ Larger facilities to ensure full delivery of water.
- ▶ Without reservoir storage, Thornton would have to take the high flow rates of WSSC deliveries directly to Thornton, which would require a larger pump station and pipeline.
- ▶ Severe operational issues at downstream end (treatment plants) due to changing water quality and flow.

Larger More Costly Pumping Facilities

71

- ▶ Pumping from the Poudre at Windsor would require a larger pump station, and bigger pumps to overcome the additional pressure of pumping from a lower elevation.
- ▶ If water had to be taken as delivered on the 5 on 2 off schedule, a 60 mgd pump station would be needed instead of a 40 mgd pump station as planned at WSSC #4.

2014 Presentation to Thornton City Council

72

- ▶ During a 2014 presentation to Thornton City Council, staff presented concepts for transporting Thornton's water.
- ▶ This was the first time most council members at the time had been briefed on the plan to transport Thornton's water.
- ▶ Staff did its due diligence to present possible scenarios, but not all concepts were reasonable.

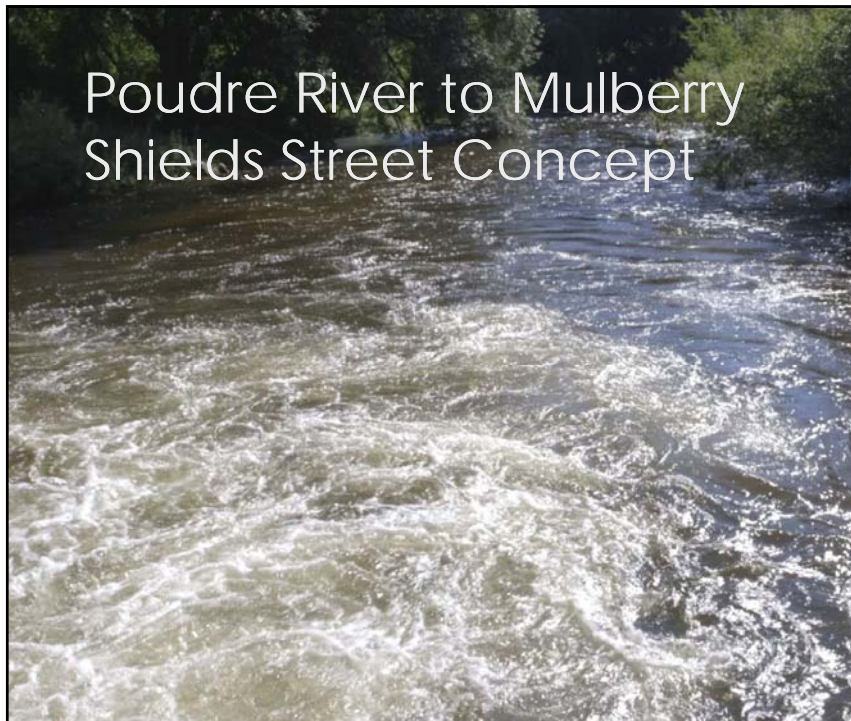
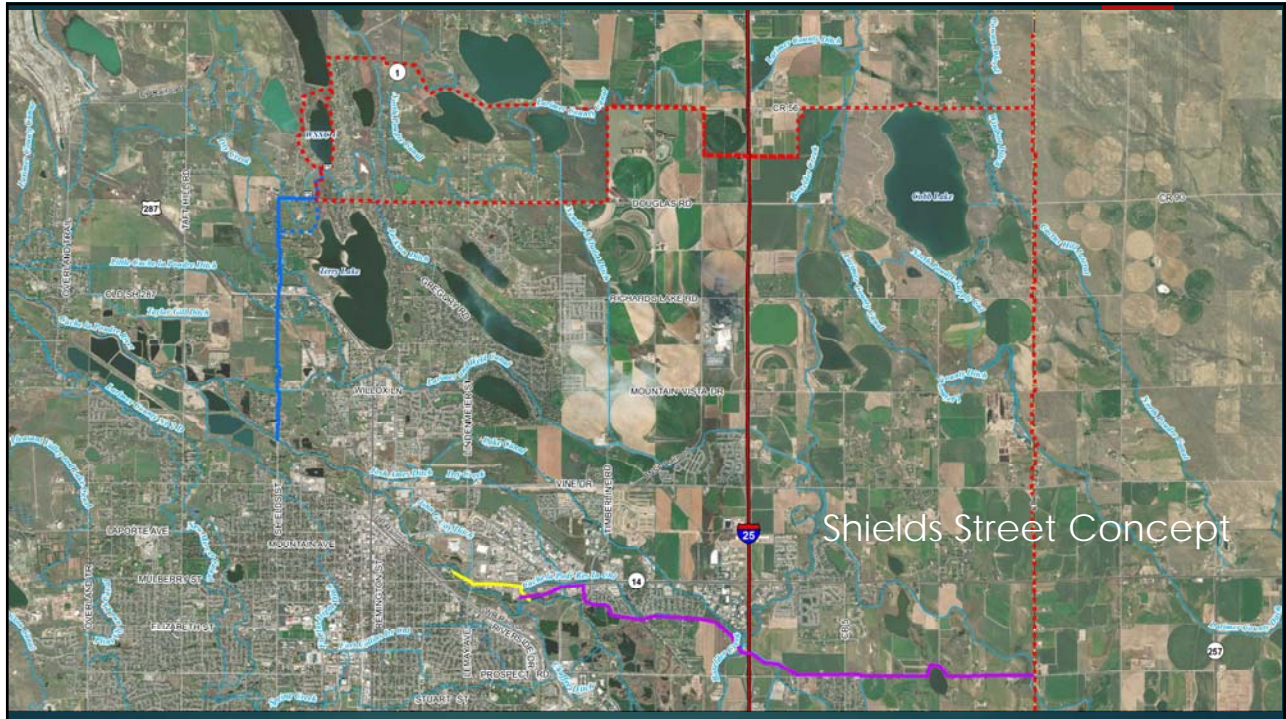
Water Loss – Value Loss

73

- ▶ If Thornton were to run its 14,000 average annual acre feet down the river, there would be a loss of 70 Acre Feet per mile.
- ▶ The market value of an acre foot of high quality Poudre water is about \$15K (WSSC water) to \$60K (CBT) /AF.
- ▶ Thornton would be losing at least \$1 million per mile that the water runs down the river.

Poudre River – Shields Street Options 74

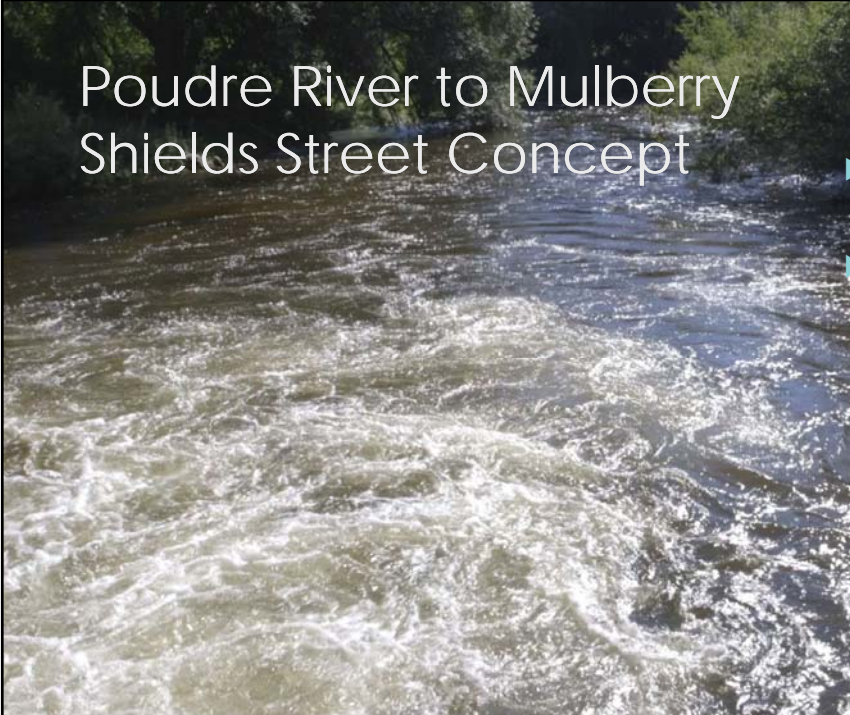
- ▶ Pipeline out of WSSC reservoir #4 that would travel south (either a 10mgd or 40 mgd)
- ▶ Pipeline moves along and through Shields Street to the Poudre River.
- ▶ Allows for WSSC operations to continue as required, and would allow Thornton to regulate releases from storage.



Poudre River to Mulberry Shields Street Concept

76

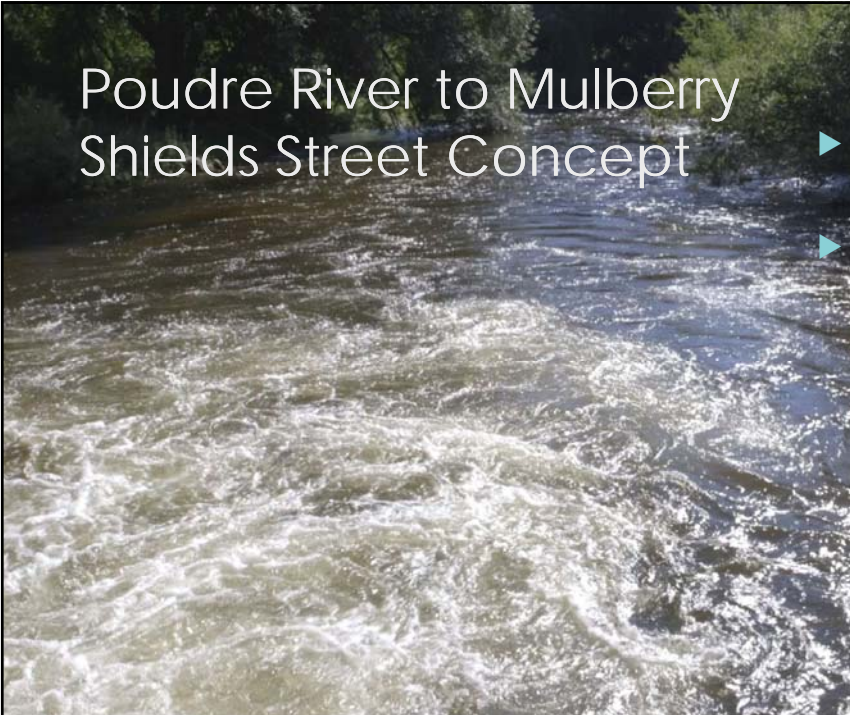
▶ **10 MGD scenario**, the water in this pipeline would be viewed by Thornton as a secondary diversion of Thornton's water – primary pipeline would still be needed – going down County road 56 or down Douglas Road



Poudre River to Mulberry Shields Street Concept

77

- ▶ **10 MGD scenario (continued)**
- ▶ Primary pipeline delivers water to Thornton when the River water quality isn't useable for situations such as ash from fires, overturned tanker trucks, or impacts from flooding.



Poudre River to Mulberry Shields Street Concept

78

- ▶ **10 MGD scenario (continued)**
- ▶ Water travels about two miles down the river to above the Mulberry Waste Water Plant - another pipeline takes the water east – paralleling Northern's pipeline route to another pipeline that travels to Thornton.



Poudre River to Mulberry Shields Street Concept

79

- ▶ **40 MGD Scenario** - all of Thornton's water would go down to the same location and a larger pipeline and facilities would be constructed to transport this volume of water.



Poudre River to Windsor Shields Street Concept

80

- ▶ Two concepts of sending the 10MGD or the 40 MGD volumes down as far as Windsor. **In both of these scenarios**, the water quality and facilities factors – as mentioned prior – would also apply

Sending Water Down Canals/Ditches

81

- ▶ The only facilities that Thornton has the right to use are the WSSC system facilities.
- ▶ Decree requires diversion at Larimer County Canal.
- ▶ 1986 Agreement requires Thornton to take delivery of its water above Rocky Ridge.
- ▶ Any other operation would require the decree and 1986 Agreement to be renegotiated.

Sending Water Down the Larimer County Canal

82

- ▶ In order for Thornton to use its storage in the WSSC reservoirs, a pump station and pipeline would need to be constructed to return the stored water to the ditch.
 - ▶ Similar in size to facilities needed to deliver water down Douglas Road or CR 56
- ▶ If Thornton bypassed the WSSC reservoirs, replacement storage would need to be constructed farther down the ditch.

Sending Water Down Canals/Ditches

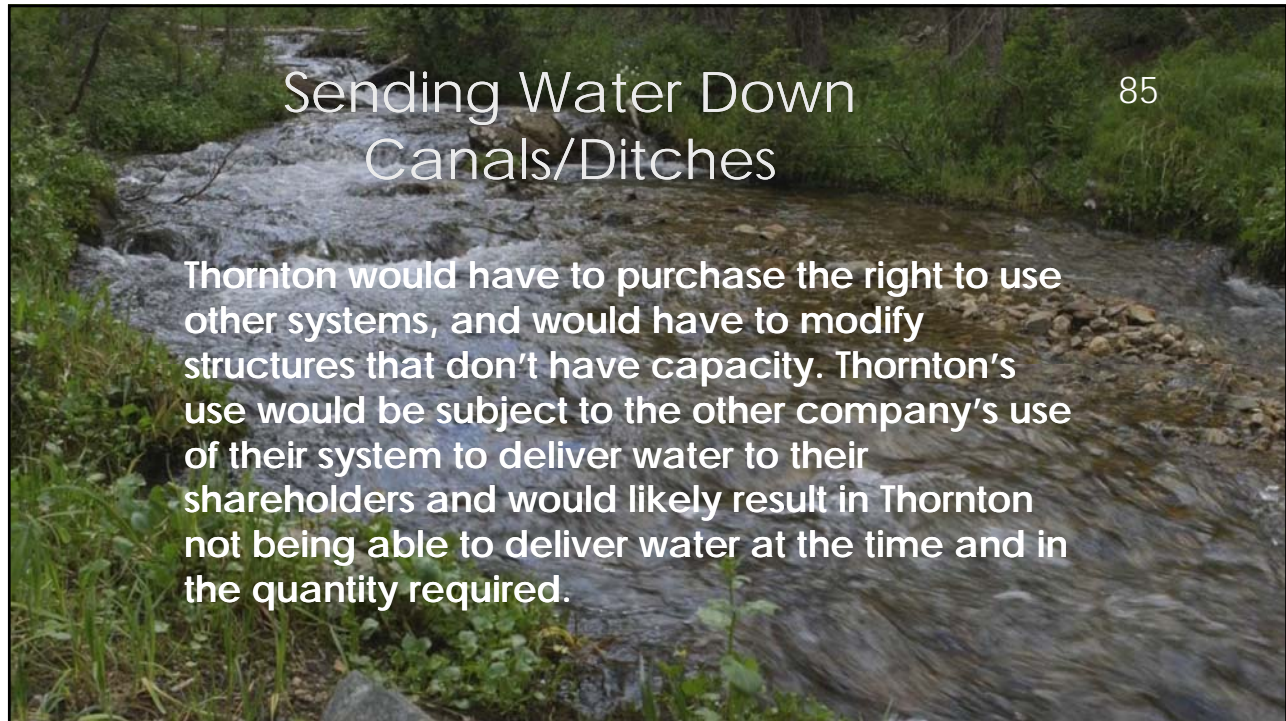
83

- ▶ Thornton requires the ability to deliver its water 24/7/365 in a controlled manner in order to meet treatment plant operational demands.
- ▶ Running water in ditches in the winter, and in particular through extended cold period, isn't a reliable delivery method.
- ▶ In the springtime, weeds blow into ditches and cause blockages which interrupt delivery.
- ▶ Running water in a ditch results in significant water loss due to ditch seepage.

Sending Water Down Canals/Ditches

84

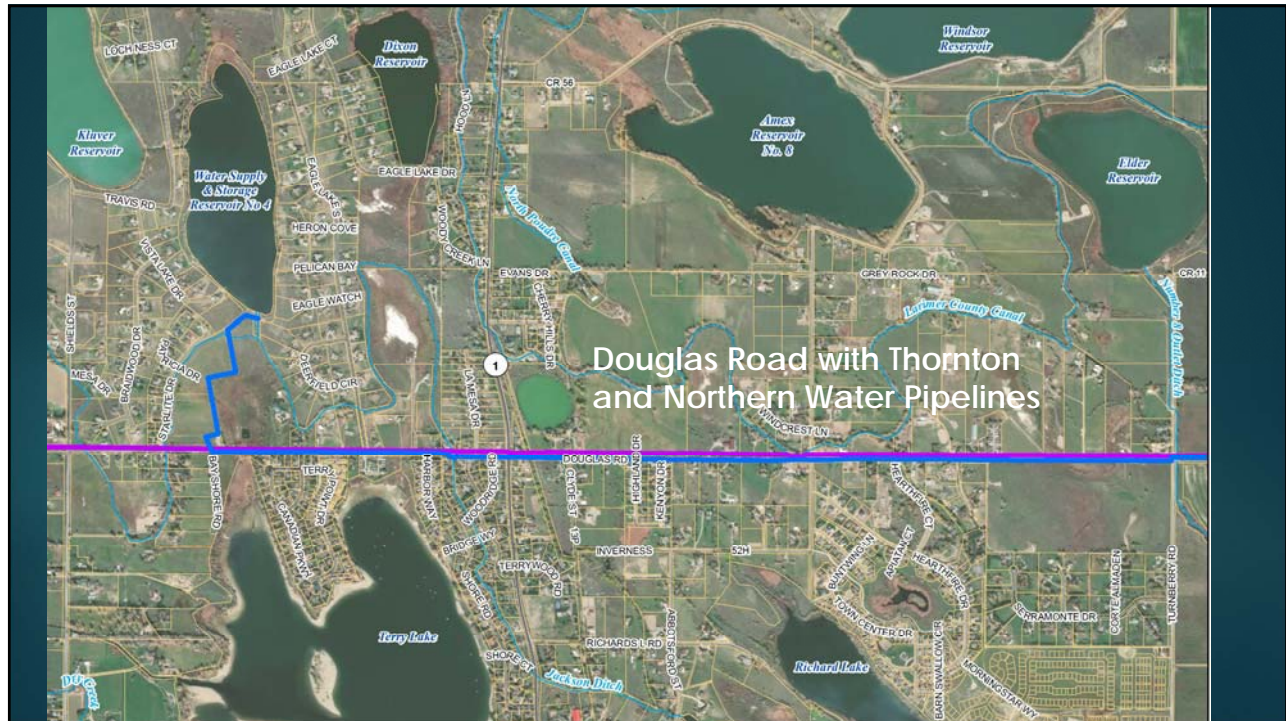
- ▶ Thornton does not have the right to use other ditches, reservoirs and irrigation facilities in the region. They are owned by other ditch and reservoir companies, and are used to deliver water to their own shareholders.
- ▶ Many of them are at capacity, and there wouldn't be additional capacity for Thornton to use consistently to deliver water.



Douglas Road – Including Thornton and Northern Water pipelines

86

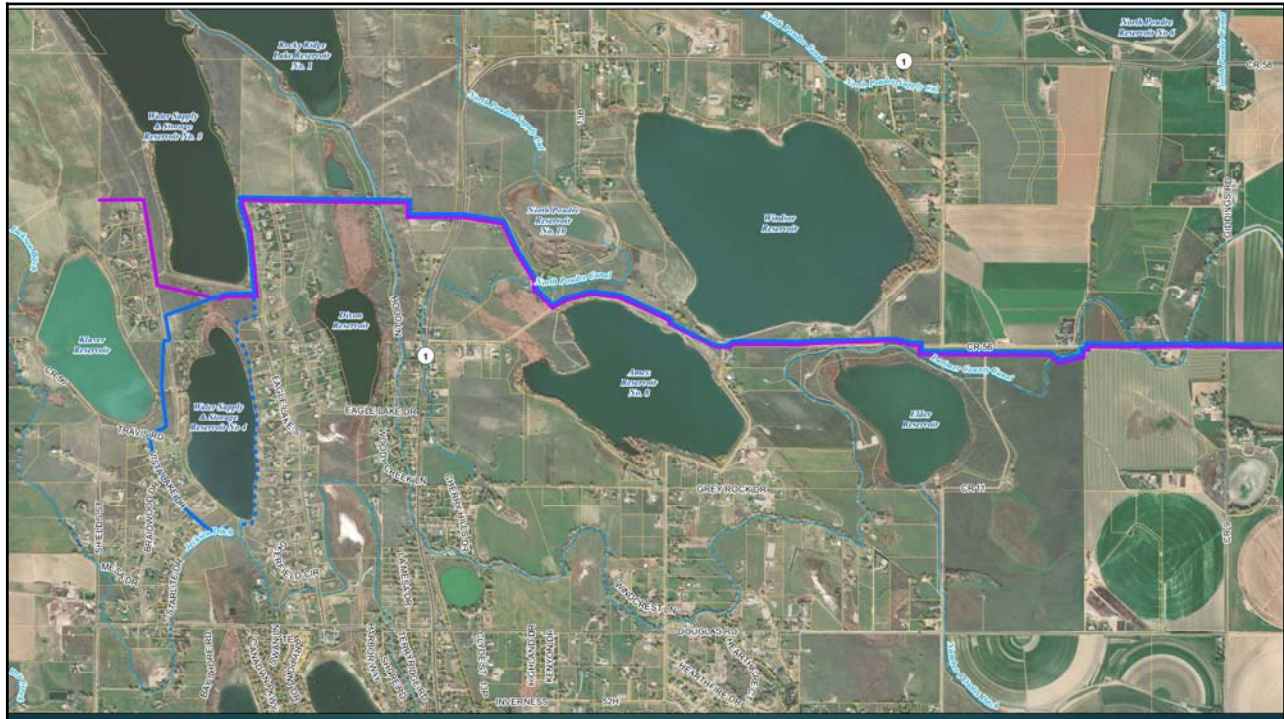
- ▶ No impact regarding water quality as Thornton's water will be coming directly out of the WSSC system
- ▶ No enhancements or negative impacts to flows on the Poudre River
- ▶ Thornton's water hasn't been down the Poudre since the late 1800's.
- ▶ This option creates many obstacles – including a very long construction timeline of 4 years down Douglas Road



County Road 56 Option

88

- ▶ Thornton included in its 1041 permit application.
- ▶ Modifications to Road 56 route – Thornton explored using both sides of WSSC reservoir #4
- ▶ Northern Water's proposed pipeline and Thornton's could parallel each other down a long stretch of County Road 56. Several efficiencies and viability for this route were discovered.
- ▶ No water quality complications.



Cost Impact Summary

90

- ▶ Replace WSSC Storage – 11,740 AF at \$5,000 to \$10,000 per acre foot - \$58.7 to \$117.4 million
- ▶ Treatment to achieve equivalent quality (additional capital costs)
 - ▶ 10 mgd above Mulberry Plant – \$65 million
 - ▶ 40 mgd above Mulberry Plant - \$261 million
 - ▶ 10 mgd at Windsor or downstream on LCC - \$194 million
 - ▶ 40 mgd at Windsor or downstream on LCC - \$776 million
- ▶ Pipelines
 - ▶ 10 mgd Shields St, Mulberry to County Line Road – \$20.5 million
 - ▶ 40 mgd Shields St, Mulberry to County Line Road - \$39.6 million

Cost Impact Summary

91

- ▶ A1 – Canal Conveyance using WSSC storage - \$1.2 billion
- ▶ A2 – Canal Conveyance w/ replacement storage - \$1.2 billion
- ▶ B & C – Douglas or CR 56 Pipelines - \$423 million
- ▶ D1 – Poudre to Windsor w/ replacement storage - \$1.2 billion
- ▶ D2 – Poudre to Windsor w/ no storage - \$1.4 billion
- ▶ E1.1 – 10 mgd Shields St to Timnath Res. Inlet - \$ 521 million
- ▶ E1.2 – 10 mgd Shields St to Windsor - \$628 million
- ▶ E2.1 – 40 mgd Shields St to Timnath Res. Inlet - \$641 million
- ▶ E2.2 – 40 mgd Shields St to Windsor - \$1.1 billion

Recent developments regarding benefits for Larimer County

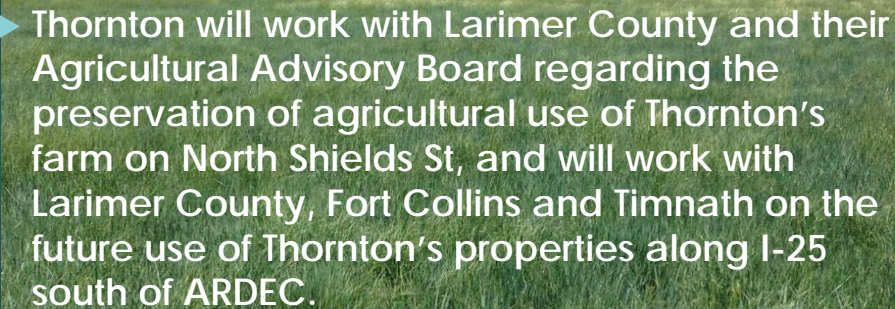
92

- ▶ Thornton is working with Fort Collins to provide property to help create a community open space buffer by using one of its farms toward this purpose.
- ▶ Thornton is engaging the communities where we own farms to ensure a community-driven planning process for future use of Thornton's properties in Larimer & Weld Counties takes place.



Recent developments regarding benefits for Larimer County

93

- 
- ▶ Thornton will work with Larimer County and their Agricultural Advisory Board regarding the preservation of agricultural use of Thornton's farm on North Shields St, and will work with Larimer County, Fort Collins and Timnath on the future use of Thornton's properties along I-25 south of ARDEC.

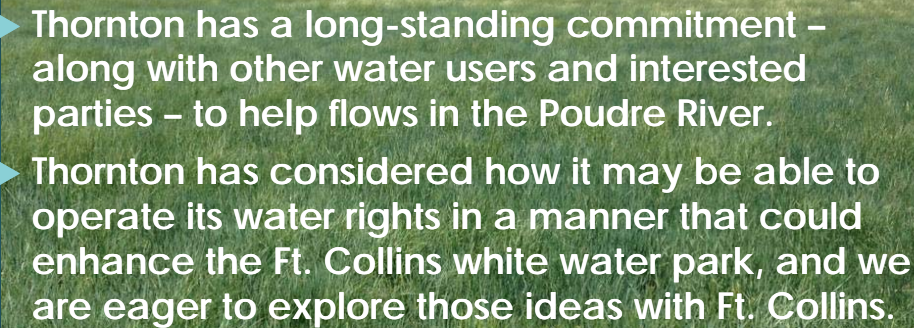
Recent developments regarding benefits for Larimer County

94

- 
- ▶ Thornton is committed to engaging the communities where farms are owned to ensure local input takes place regarding the future use of Thornton's properties in Larimer & Weld Counties. In 2019, Thornton will begin this community-driven planning process.

Recent developments regarding benefits for Larimer County

95

- 
- ▶ Thornton has a long-standing commitment – along with other water users and interested parties – to help flows in the Poudre River.
 - ▶ Thornton has considered how it may be able to operate its water rights in a manner that could enhance the Ft. Collins white water park, and we are eager to explore those ideas with Ft. Collins.

96

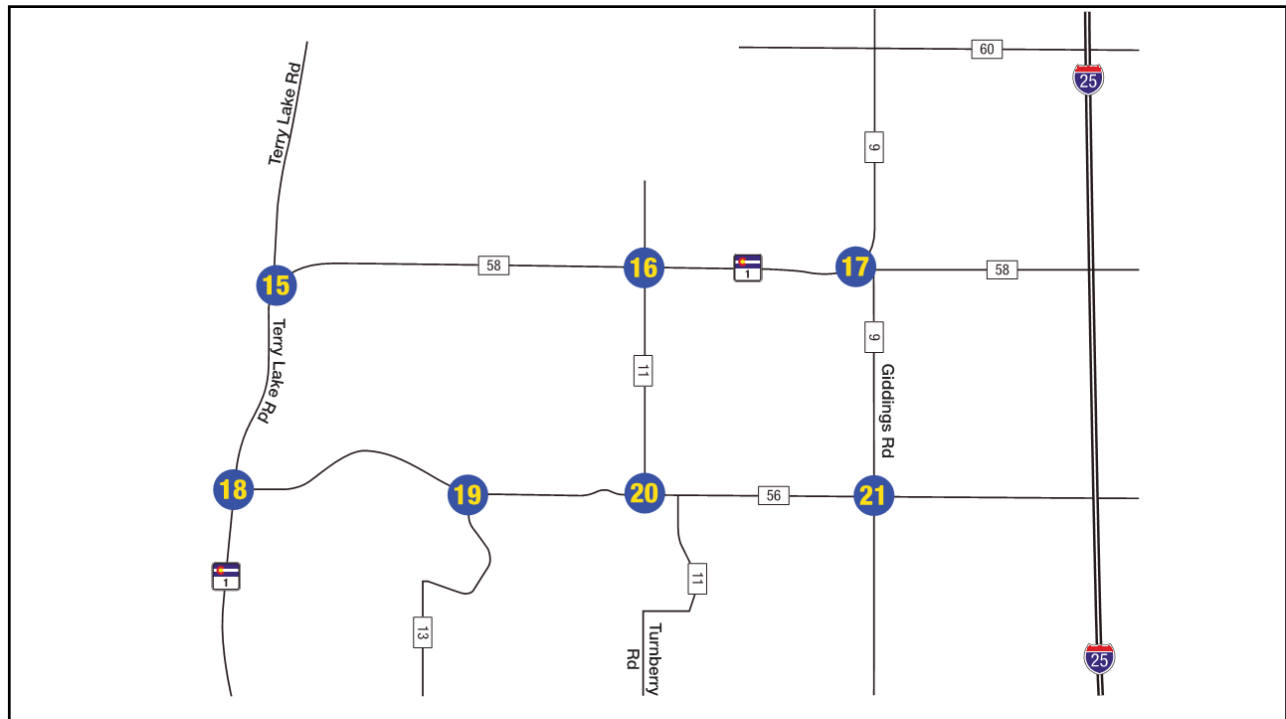
Water Quality & Poudre River Flows Questions and Answers?

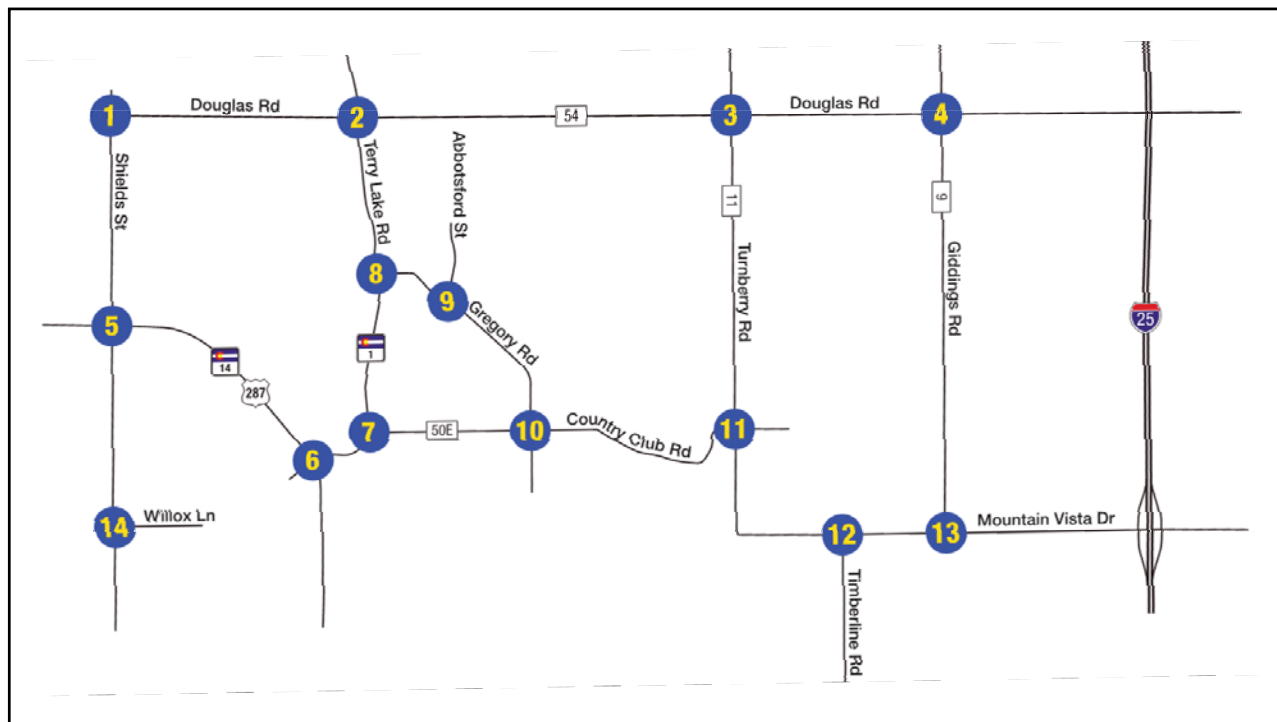
THORNTON WATER PROJECT – WEBINAR – NOVEMBER 5, 2018

Thornton Water Project – Traffic Analyses

Today's Discussion:

- Analysis of Existing Conditions
 - 21 Intersections
- Existing Conditions Memo
 - Posted on the larimerwaterprojects.org website
 - On the Info and Data page under “Technical Memos”
 - Will be posted with the recording of this webinar as well
- Route Impact Comparison
 - Access Impacts
 - Trip Disruptions





Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

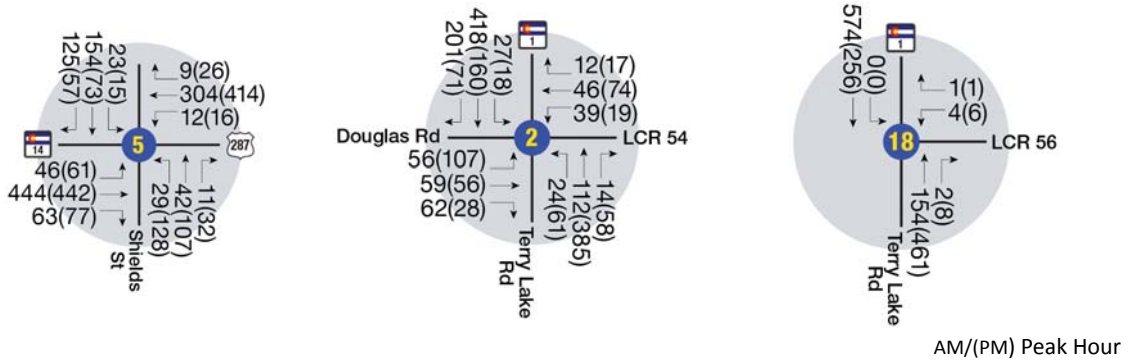
- AM & PM Peak Hour Traffic Volumes
 - Why Peak Hours?
- Compiled Left/Through/Right Vehicle Movements
 - 21 Intersections
- Intersection Characteristics
 - Geometry
 - Traffic Control
 - Traffic Volume Levels



Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

- Traffic Volume Samples



Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

- Traffic Operations
 - Level of Service Analysis
 - Highway Capacity Manual, 2010
 - Transportation Research Board

Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

LEVEL OF SERVICE CRITERIA FOR TWO-WAY STOP CONTROLLED (TWSC) INTERSECTIONS

Level of Service	Delay Range (sec/veh)
A	0.0 - 10.0
B	>10.0 - 15.0
C	>15.0 - 25.0
D	>25.0 - 35.0
E	>35.0 - 50.0
F	> 50.0

Adapted from: Highway Capacity Manual, Transportation Research Board, 2010.

Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

LEVEL OF SERVICE CRITERIA FOR SIGNALIZED INTERSECTIONS

Level of Service	Control Delay (sec/veh)	Qualitative Description
A	≤ 10.0	Good progression, short cycles, very few vehicle-stops.
B	>10.0 - 20.0	Good progression, and/or short cycle lengths, more vehicle-stops.
C	>20.0 - 35.0	Fair progression and/or longer cycle lengths, some individual cycle failures, many vehicle-stops
D	>35.0 - 55.0	Noticeable congestion and cycle failures, unfavorable progression, high v/c ratios, several stops.
E	>55.0 - 80.0	Limit of acceptable delay, poor progression, long cycles, high v/c ratios, frequent cycle failures.
F	> 80.0	Delay is unacceptable to most drivers, volume exceeds capacity, breakdown of traffic flow.

Adapted from: Highway Capacity Manual, Transportation Research Board, 2010.

Thornton Water Project – Traffic Analyses

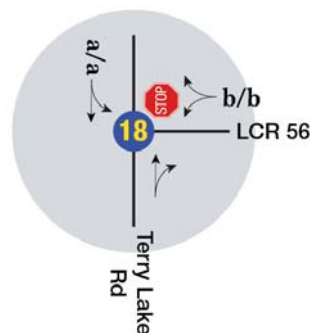
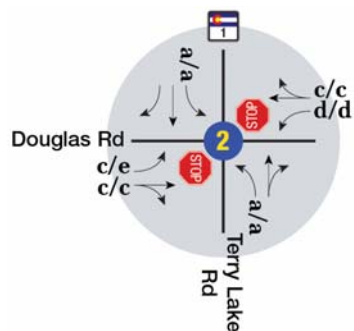
Existing Conditions Analysis

- Traffic Operations
 - Level of Service Analysis
 - Highway Capacity Manual, 2010
 - Transportation Research Board
 - Majority of Intersections/Movements are Operating Well
 - A Few Exceptions

Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

- Traffic Operation Samples

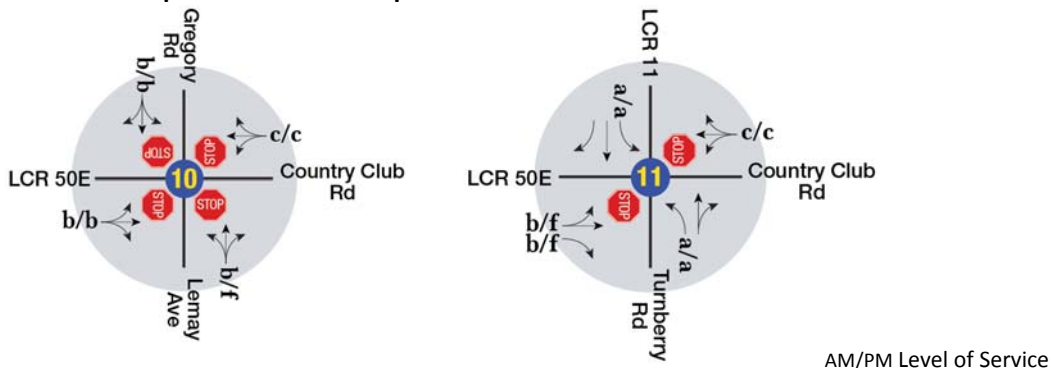


AM/PM Level of Service

Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

- Traffic Operation Samples



Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

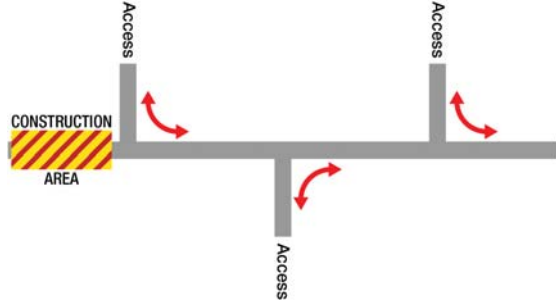
- Access Impacts

Route	Approximate Number of Disrupted Homes
Douglas Road	287
County Road 56	8
Shields Street	125

Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

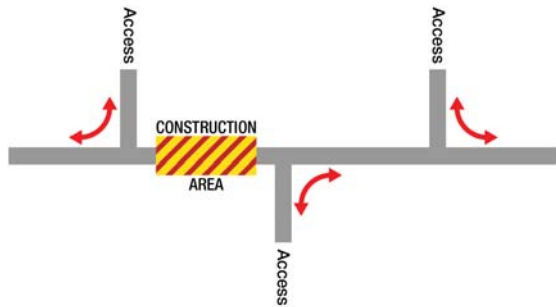
- Trip Disruptions



Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

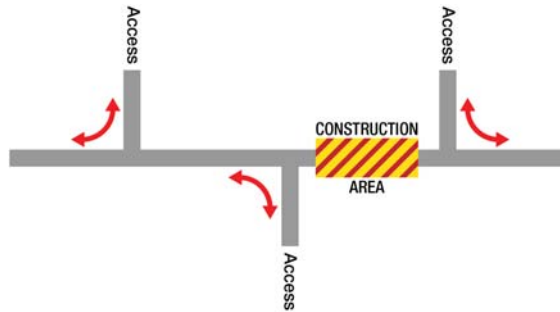
- Trip Disruptions



Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

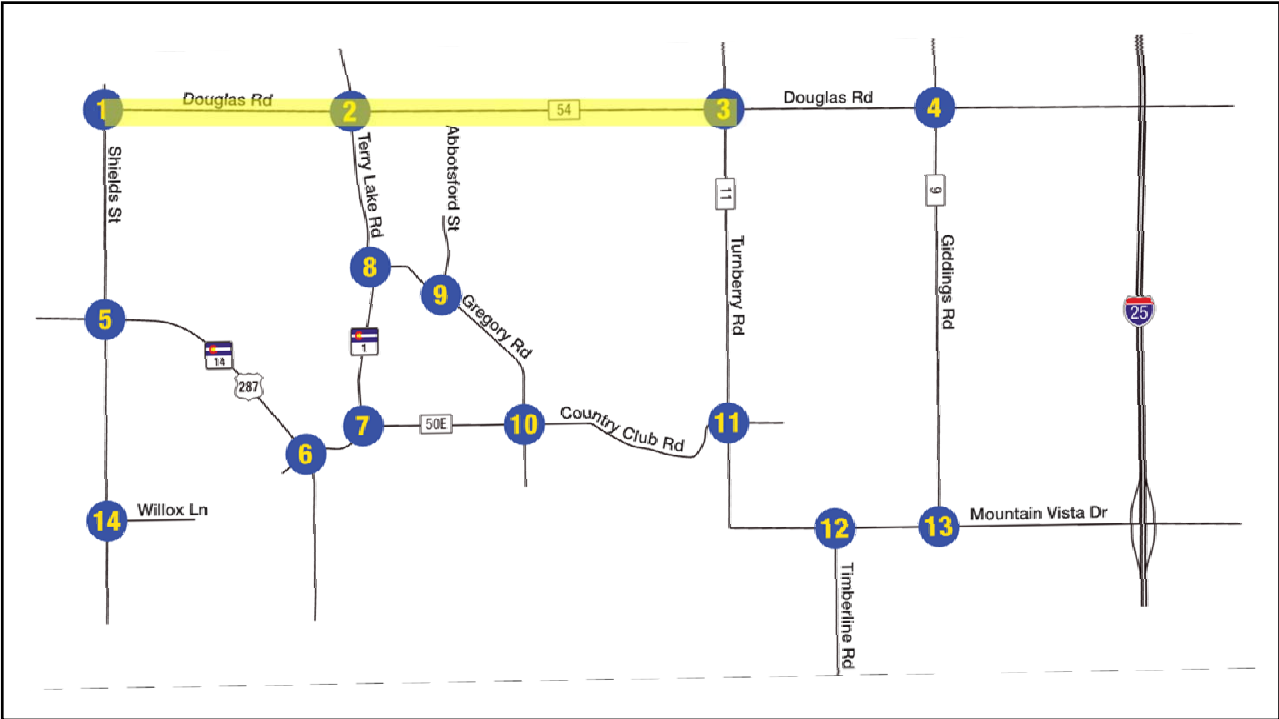
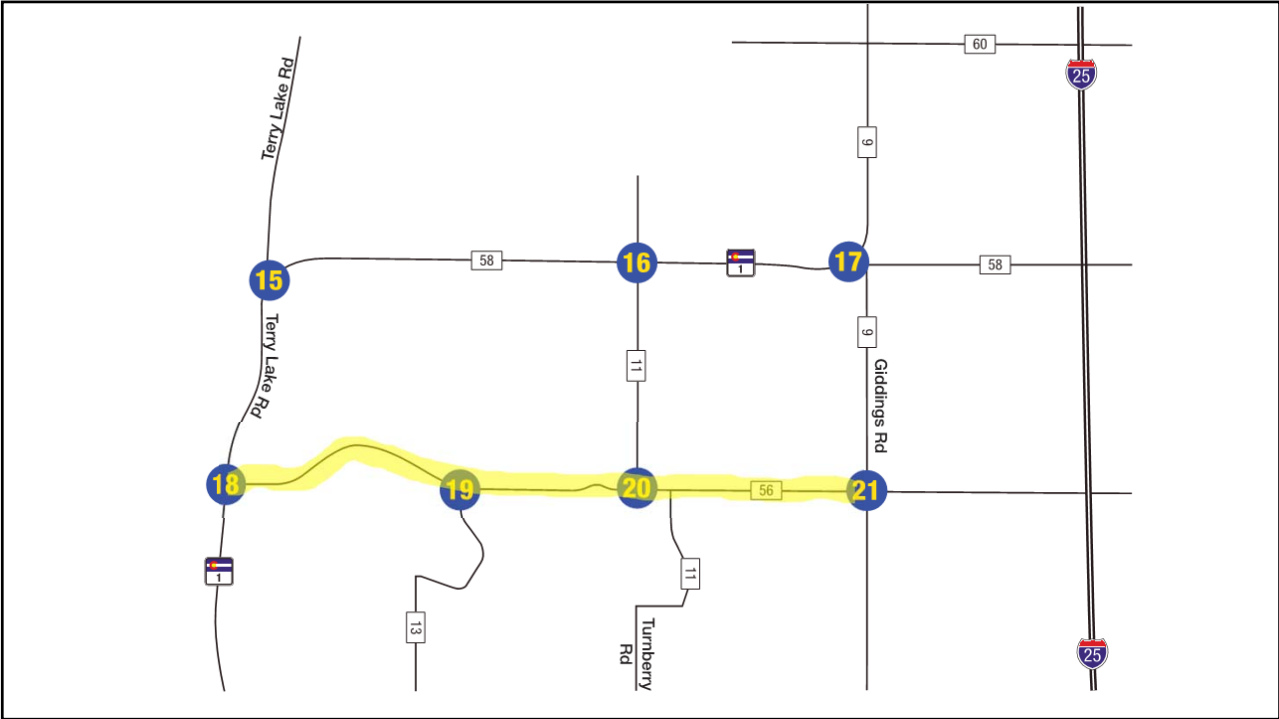
- Trip Disruptions

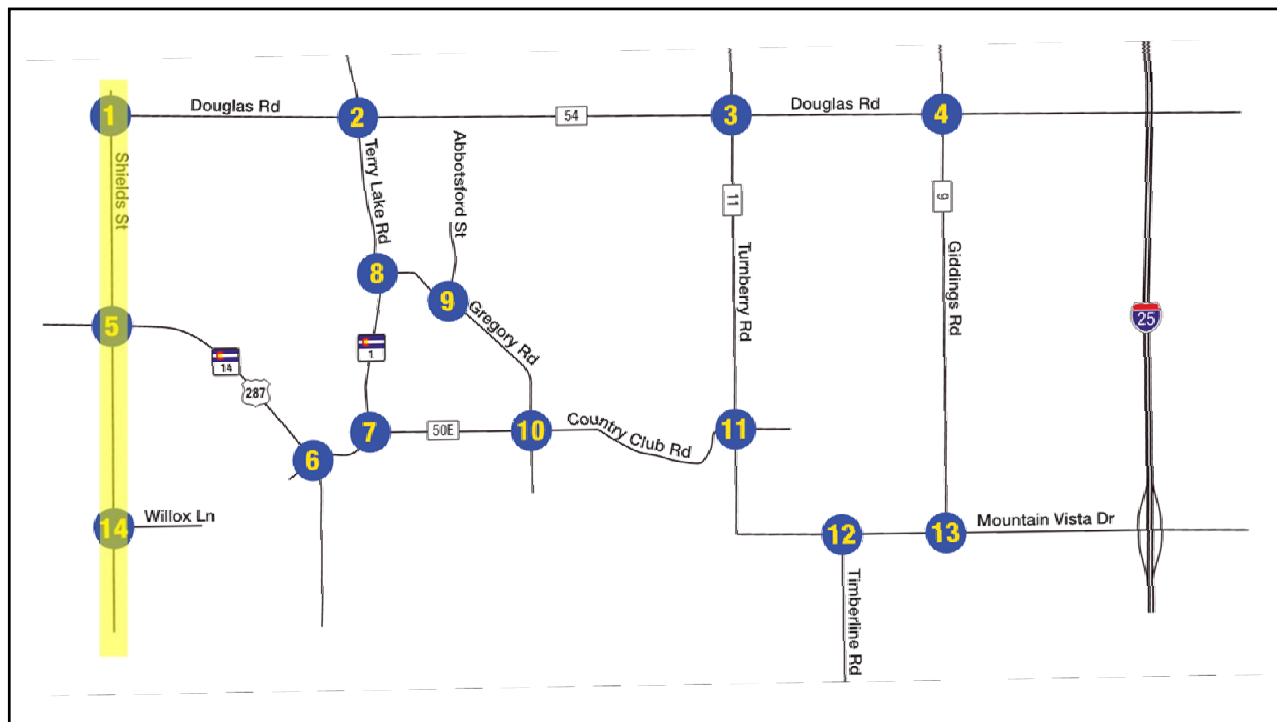


Thornton Water Project – Traffic Analyses

Existing Conditions Analysis

- Available Detour Routes
 - CR 56 Alignment
 - CR 13/CR 11/CR 9
 - Douglas Road Alignment
 - CR 11(Turnberry Road)/CR 9
 - Shield Street Alignment
 - One Lane Open Almost Always Through Work Zone
 - Alternating Directions





Thornton Water Project – Traffic Analyses

Summary

- Traffic Volume/Access Impacts from Construction
 - Least Impacted = County Road 56 Alignment
 - Moderate Impacted = Shields Street Alignment
 - Highest Impacted = Douglas Road Alignment