Using Monetized Risk and Triple Bottom Line Life-cycle Costs to Make Capital Improvement Decisions

NW Distribution System Transmission Improvements Case Study

One Water Conference - August 27, 2014

One Water

THE CITY OF COLUMBUS
MICHAEL B. COLEMAN, MAYOR

DEPARTMENT OF PUBLIC UTILITIES

Making Capital Improvement Decisions

Columbus DPU Profile

- Serve 1.1 million customers
  - Water
  - Wastewater (Sanitary and Storm)
- Top Issues
  - Aging infrastructure
  - Changing regulations
- CIB is $250M/yr
- Overall budget is $550M/yr

What Drives our Decisions?

1) Reliability/safety of service

- Redundancy
- Reliable assets
- Reliable processes

Drivers

2) Cost

- Efficient delivery of services
- Economic utilization of resources

Drivers

3) Environmental stewardship

What Else Drives our Decisions?

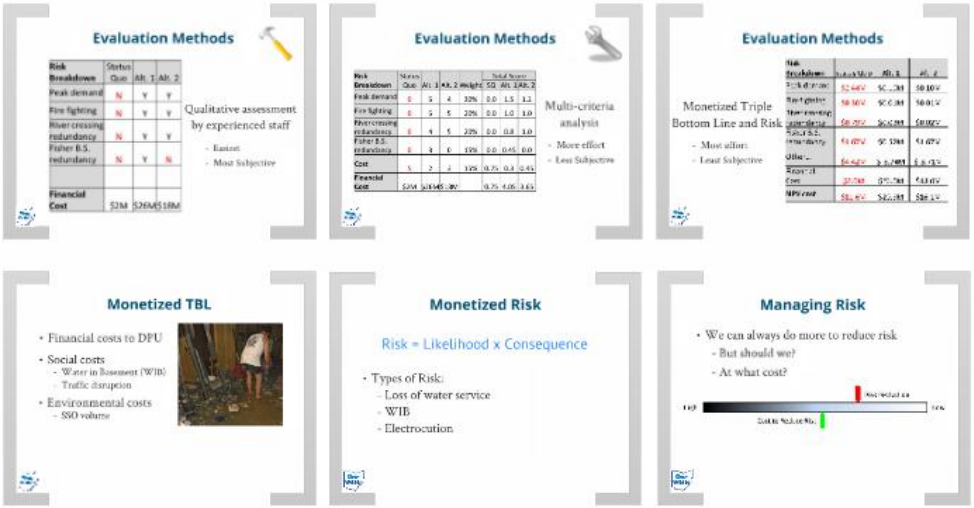
4) Emotion – Altruism, Fear, Worry

- Public welfare
- Bad press
- Blame

Business Drivers Often at Odds

Choosing to Spend Customers' Money

Never black or white



Evaluation Methods

Criteria	Status Quo	Alt. 1 Griggs	Alt. 2 Bethel
Peak Demand	N	Y	Y
Fire Fighting	N	Y	Y
River Crossing Redundancy	N	Y	Y
Fisher Booster Station Redundancy	N	Y	N
Financial Cost	$2 M	$26 M	$18 M

Qualitative assessment by experienced staff

- Easiest
- Most Subjective

Evaluation Methods

Criteria	Status Quo	Alt. 1	Alt. 2	Weight	Score		
					SQ	Alt 1	Alt 2
Peak Demand	0	5	4	30%	0.0	1.5	1.2
Fire Fighting	0	5	5	20%	0.0	1.0	1.0
River Crossing Redundancy	0	4	5	20%	0.0	0.8	1.0
Fisher Booster Station Redundancy	0	3	0	15%	0.0	0.45	0.0
Cost	5	2	3	15%	0.75	0.3	0.45
Total Score					0.75	4.05	3.65

Multi-criteria analysis

- More effort
- Less Subjective

Evaluation Methods

Monetized Triple Bottom Line and Risk

- Most effort
- Least Subjective

Criteria	Status Quo	Alt. 1 Griggs	Alt. 2 Bethel
Peak Demand	$2.44	$0.10	$0.10
Fire Fighting	$0.30	$0.10	$0.10
River Crossing Redundancy	$0.79	$0.03	$0.02
Fisher Booster Station Redundancy	$1.67	$0.52	$1.67
Other	$4.42	($5.74)	($3.71)
Financial Cost	$2.0	$26.0	$18.0
NPV Cost	$11.6	$20.9	$16.1

Cost in Millions

Monetized TBL

- Financial costs to DPU
- Social costs
  - Loss of water service
  - Taste/Odor
  - Water in Basement (WIB)
  - Traffic disruption
- Environmental costs
  - SSO volume
  - Air pollution
  - Loss of biodiversity

Monetizing provides common language

- Everyone understands the value of a dollar
- Make a reasonable estimate of "value"

Monetized Risk

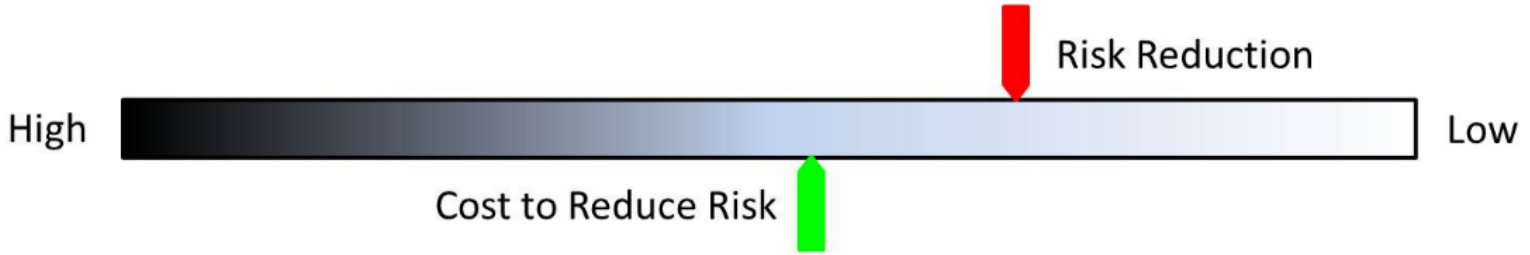
Risk = Likelihood x Consequence

- Types of Risk:
  - Loss of water service
  - WIB
  - Electrocution

Risk can't be eliminated, just managed

Managing Risk

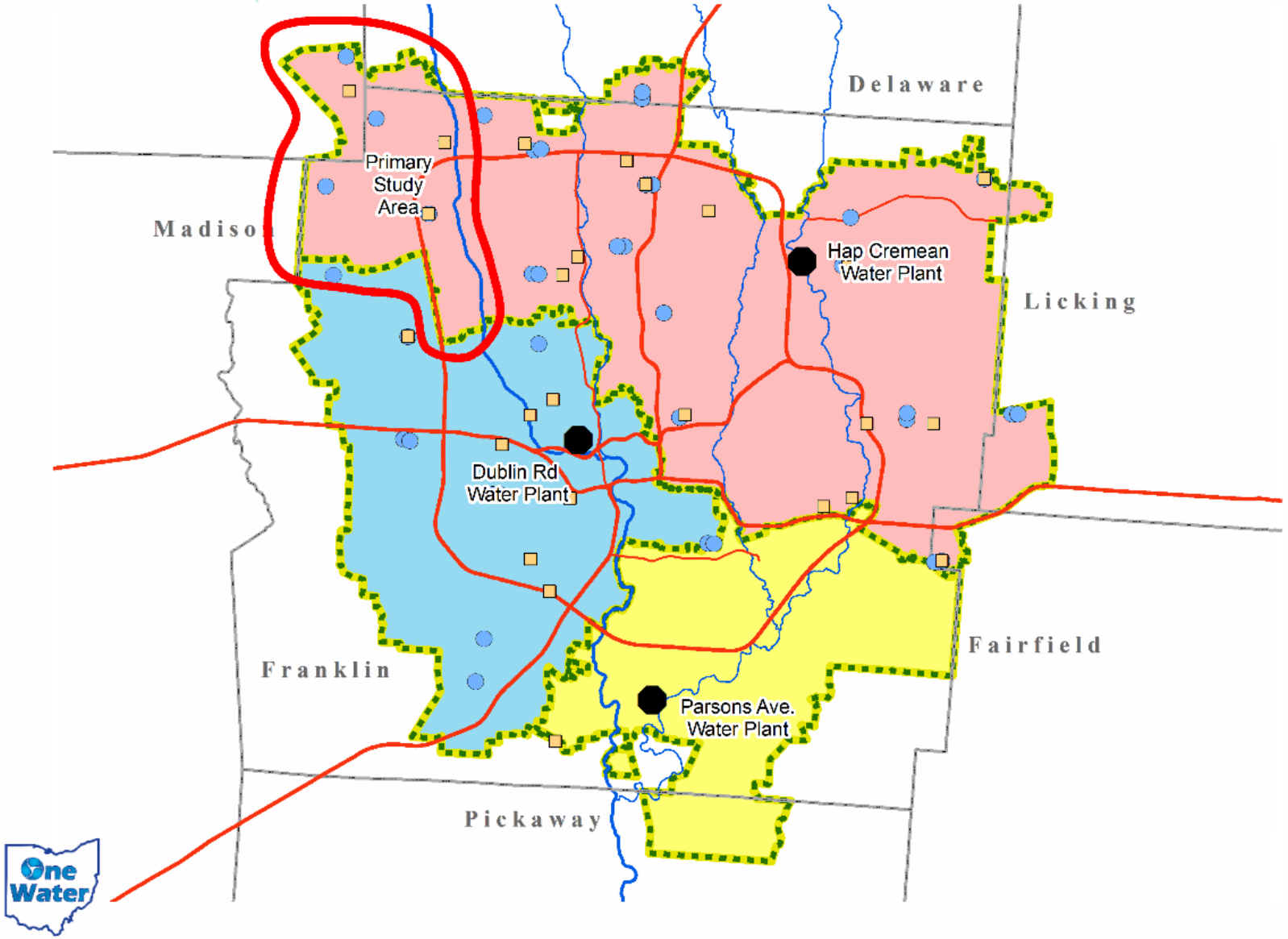
- We can always do more to reduce risk
  - But should we?
  - At what cost?

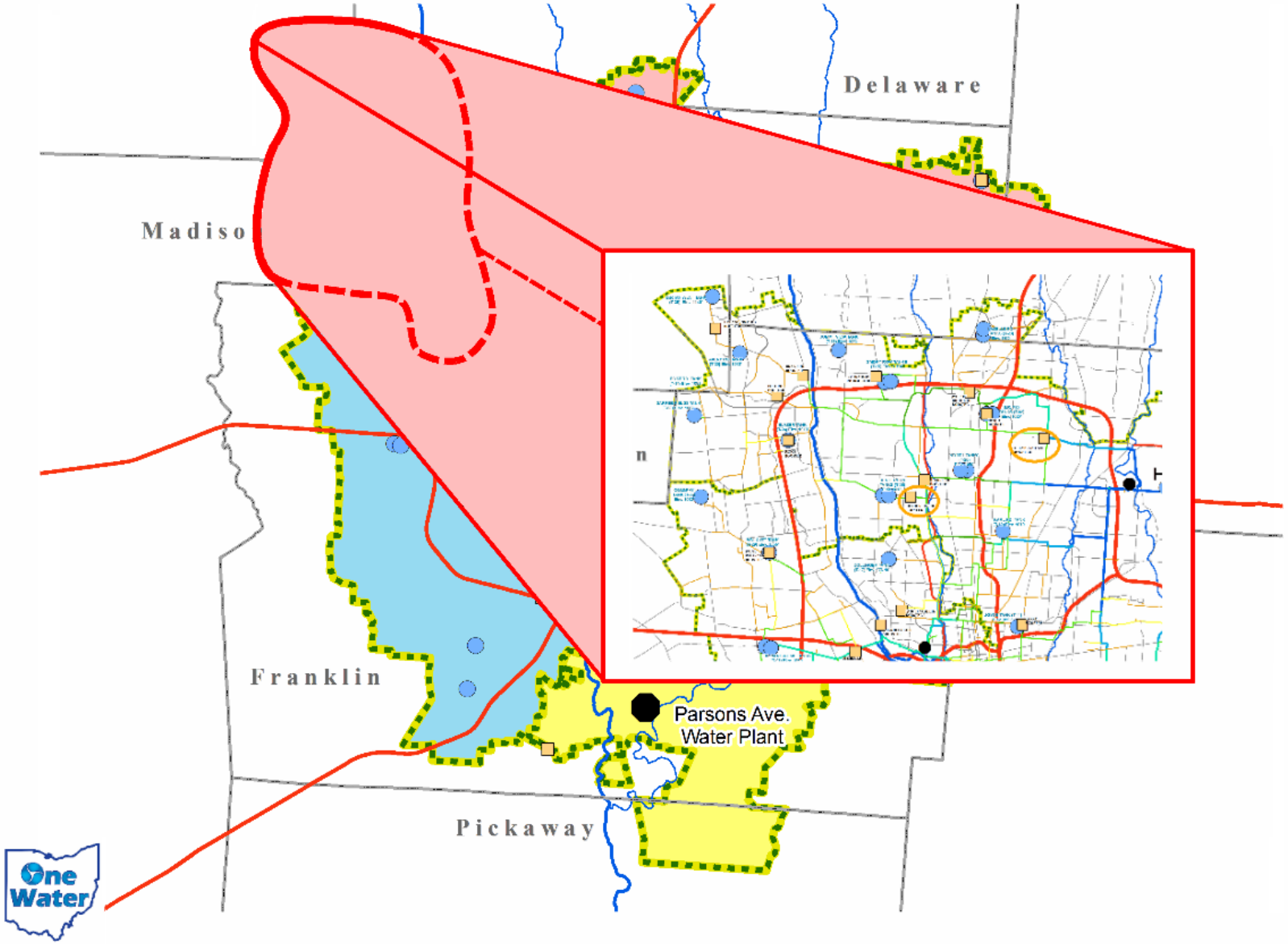


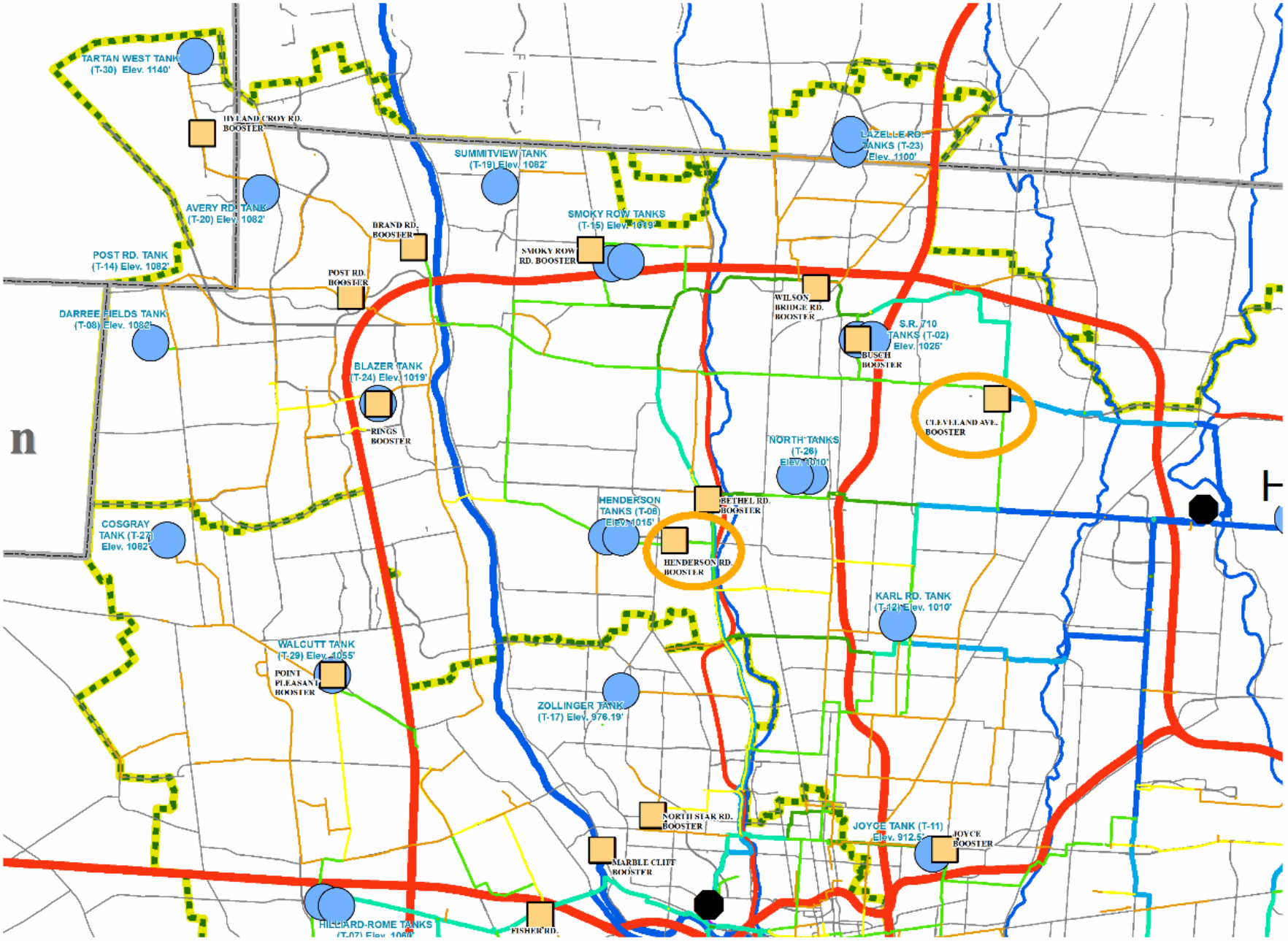
By monetizing we can directly answer the question...
Does risk reduction provide value for customers' money?

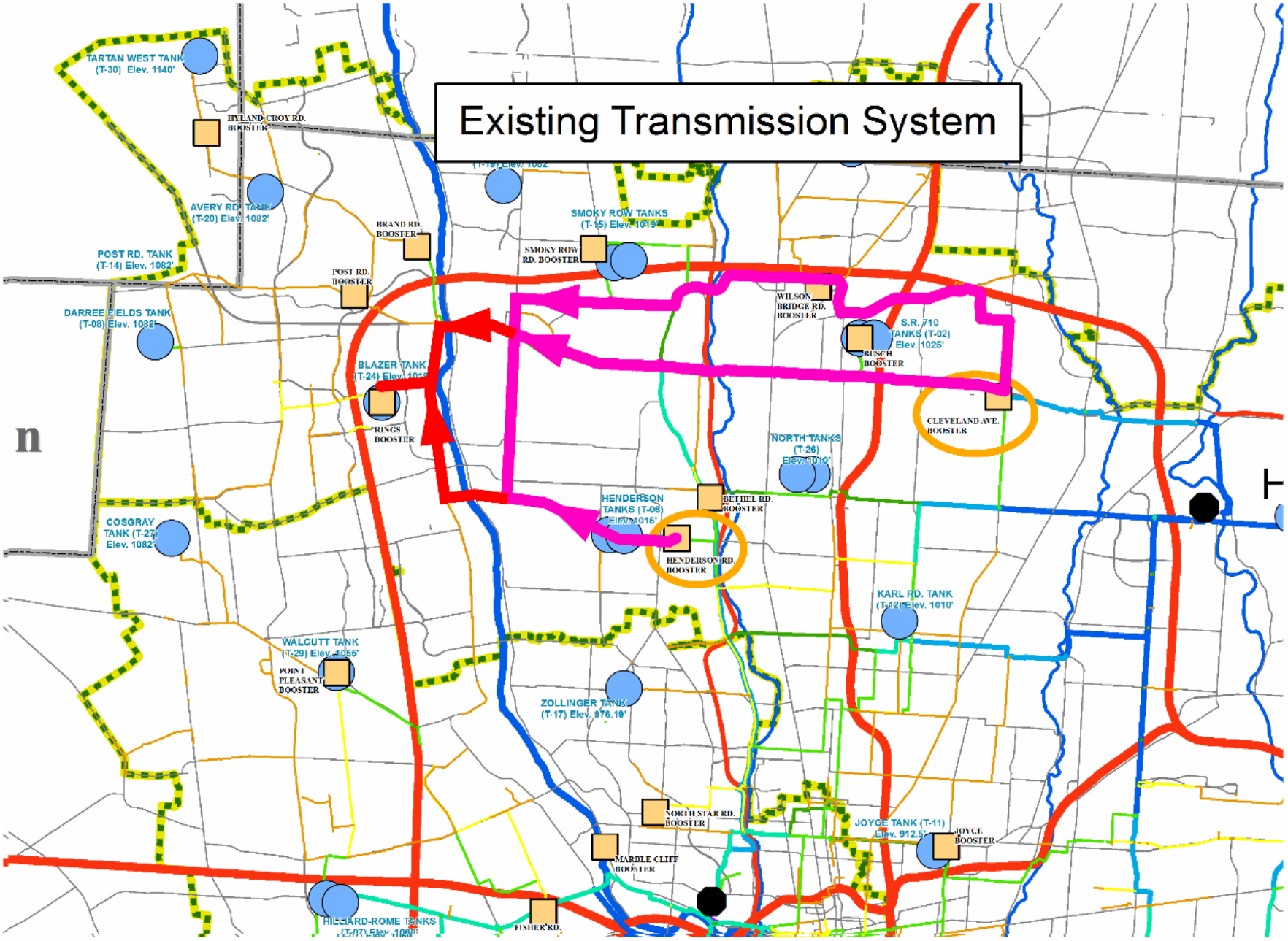
Business Case Evaluation (BCE) Case Study:

Northwest Water Distribution System


Delaware
Primary
Study
Area
Madison
Hap Cremean
Water Plant
Licking
Dublin Rd
Water Plant
Fairfield
Franklin
Parsons Ave.
Water Plant
Pickaway
One
Water


Delaware
Madiso
Franklin
Pickaway
Parsons Ave.
Water Plant
One Water


TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
SUMMITVIEW TANK (T-19) Elev. 1082'
LAZELLE RD. TANKS (T-23) Elev. 1100'
AVERY RD. TANK (T-20) Elev. 1082'
BRAND RD. BOOSTER
SMOKY ROW TANKS (T-15) Elev. 1019'
SMOKY ROW RD. BOOSTER
POST RD. TANK (T-14) Elev. 1082'
POST RD. BOOSTER
WILSON BRIDGE RD. BOOSTER
DARREE FIELDS TANK (T-08) Elev. 1082'
S.R. 710 TANKS (T-02) Elev. 1025'
BUSCH BOOSTER
BLAZER TANK (T-24) Elev. 1019'
RINGS BOOSTER
CLEVELAND AVE. BOOSTER
NORTH TANKS (T-26) Elev. 1010'
HENDERSON TANKS (T-06) Elev. 1015'
BETHEL RD. BOOSTER
COSGRAY TANK (T-27) Elev. 1082'
HENDERSON RD. BOOSTER
KARL RD. TANK (T-12) Elev. 1010'
WALCUTT TANK (T-29) Elev. 1055'
POINT PLEASANT BOOSTER
ZOLLINGER TANK (T-17) Elev. 976.19'
NORTH STAR RD. BOOSTER
JOYCE TANK (T-11) Elev. 912.5'
JOYCE BOOSTER
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS (T-07) Elev. 1060'
FISHER RD.


Existing Transmission System
TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
AVERY RD. TANK (T-20) Elev. 1082'
BRAND RD. BOOSTER
SMOKY ROW TANKS (T-15) Elev. 1019'
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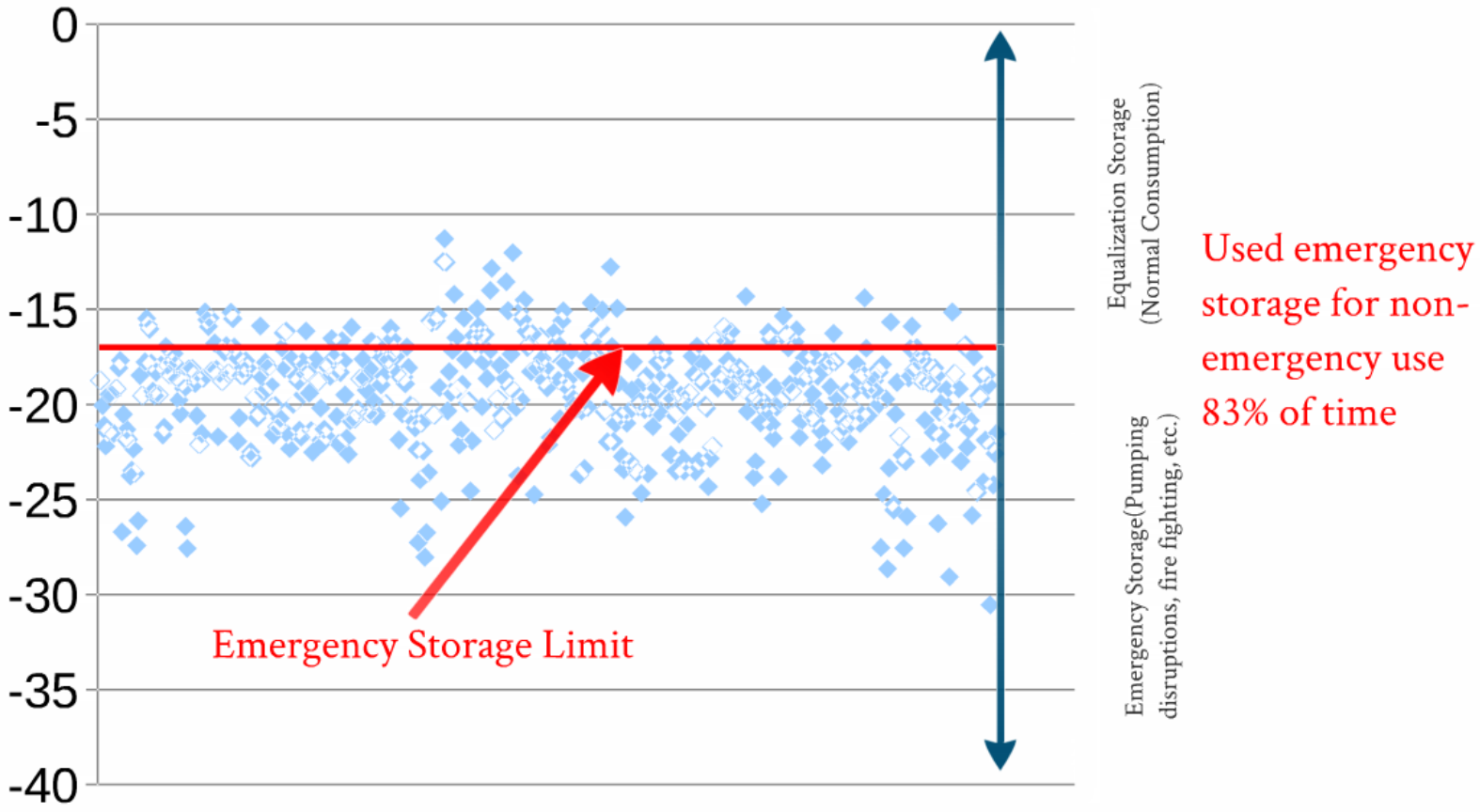
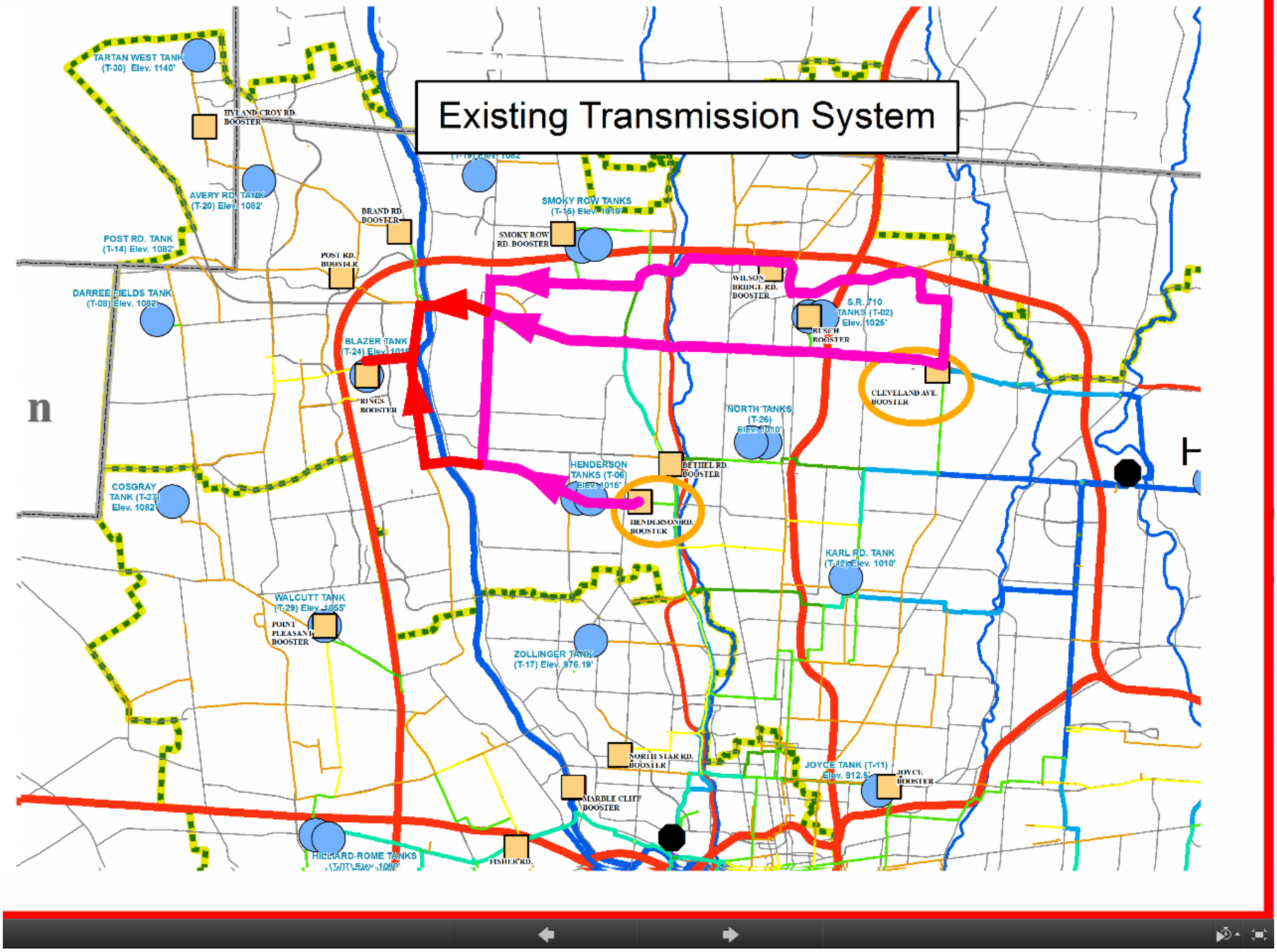
JOYCE TANK (T-11) Elev. 912.5'
JOYCE BOOSTER
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS
FISHER RD.

Problem – NW System Shortage

Blazer Tank: Daily Minimum Water Levels, June-August, 2005-2010



Used emergency storage for non-emergency use 83% of time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TARTAN WEST TANK (T-30) Elev. 1140'
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AVERY RD. TANK (T-20) Elev. 1082'
BRAND RD. BOOSTER
SMOKY ROW TANKS (T-15) Elev. 1019'
SMOKY ROW RD. BOOSTER
POST RD. TANK (T-14) Elev. 1082'
POST RD. BOOSTER
DARREE FIELDS TANK (T-08) Elev. 1082'
BLAZER TANK (T-24) Elev. 1019'
RINGS BOOSTER
WILSON BRIDGE RD. BOOSTER
S.R. 710 TANKS (T-02) Elev. 1025'
BUSCH BOOSTER
CLEVELAND AVE. BOOSTER
NORTH TANKS (T-26) Elev. 1010'
BETHEL RD. BOOSTER
HENDERSON TANKS (T-06) Elev. 1016'
HENDERSON RD. BOOSTER
COSGRAY TANK (T-27) Elev. 1082'
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POINT PLEASANT BOOSTER
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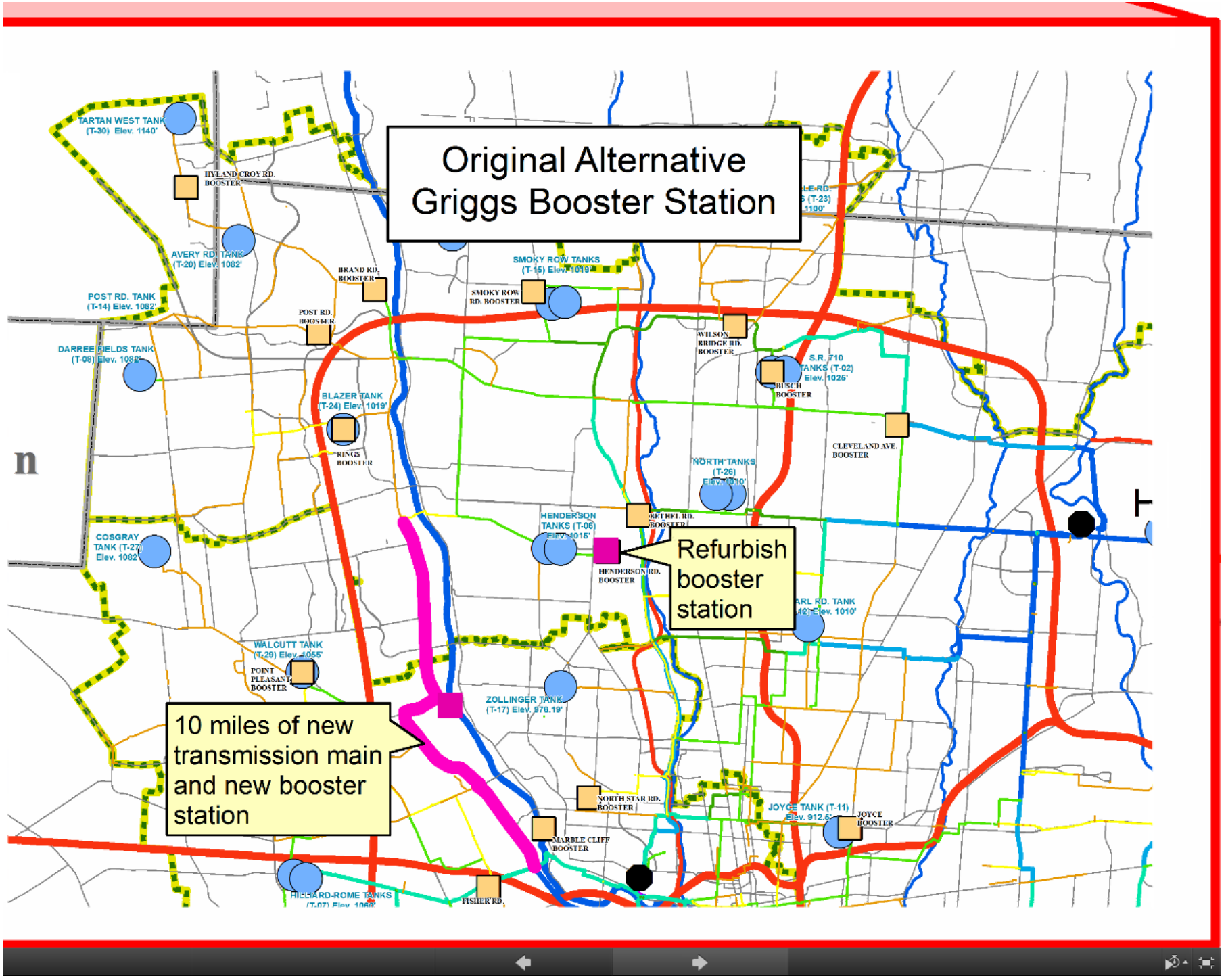
JOYCE BOOSTER
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS
FISHER RD.


Original Alternative
Griggs Booster Station
Refurbish booster station
10 miles of new transmission main and new booster station
TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
AVERY RD. TANK (T-20) Elev. 1082'
POST RD. TANK (T-14) Elev. 1082'
BRAND RD. BOOSTER
POST RD. BOOSTER
DARREE FIELDS TANK (T-08) Elev. 1082'
BLAZER TANK (T-24) Elev. 1019'
RINGS BOOSTER
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BUSCH BOOSTER
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HENDERSON RD. BOOSTER
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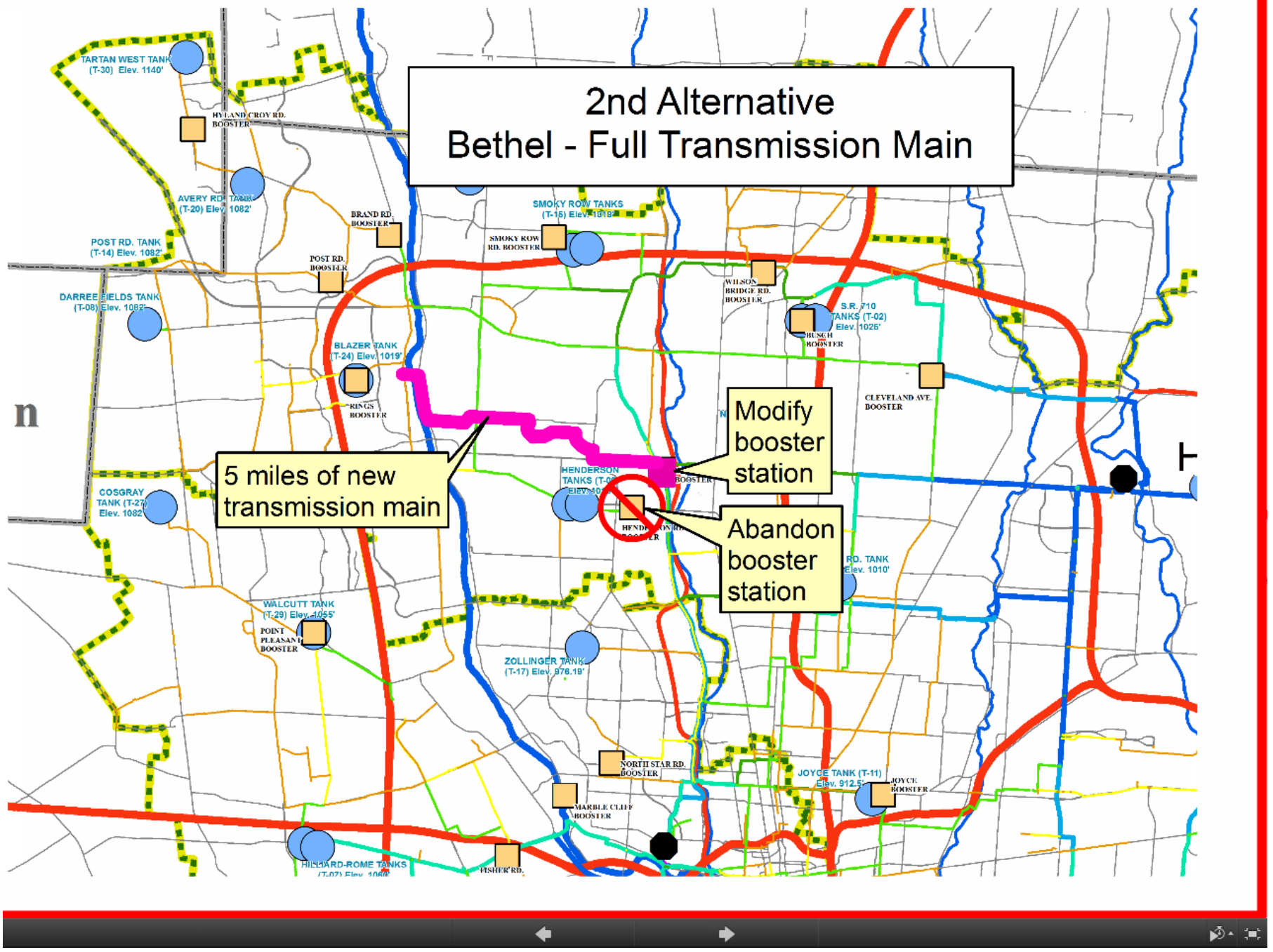
NORTH STAR RD. BOOSTER
MARBLE CLIFF BOOSTER
JOYCE TANK (T-11) Elev. 912.6'
JOYCE BOOSTER
HILLIARD-ROME TANKS (T-07) Elev. 1068'
FISHER RD.


2nd Alternative
Bethel - Full Transmission Main
5 miles of new transmission main
Modify booster station
Abandon booster station
TARTAN WEST TANK (T-30) Elev. 1140'
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AVERY RD. TANK (T-20) Elev. 1082'
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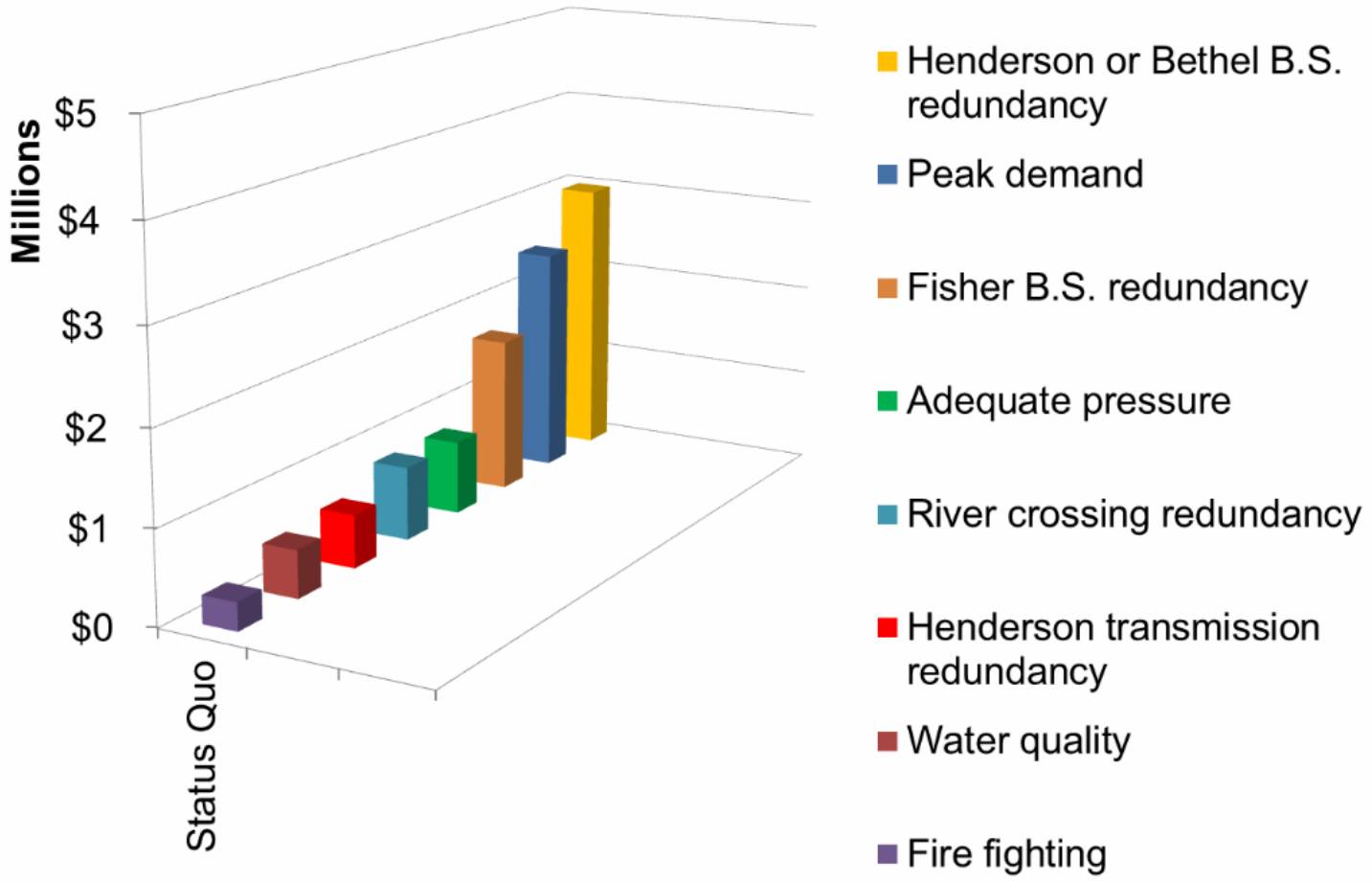
JOYCE BOOSTER
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS
FISHER RD.

Pre-BCE:
Non-monetary Evaluation

Risk Breakdown	Status Quo
Peak Demand	N
Water Quality	N
Adequate Pressure	N
Fire Fighting	N
River Crossing Redundancy	N
Fisher Booster Station Redundancy	N
Henderson Transmission Redundancy	N
Financial Cost	$2 M

BCE: Monetized Social Risk



Risk Example 1:
Peak Demand > Capacity

10% annual likelihood of peak demand > capacity during normal operations

Estimated Consequence of a 8 hour disruption

- 6000 customers lose water service
  $100/day residential, $2000/day non-residential
  $20/customer/hr average
- 6000 customers with low pressure
  $3/customer/hr average

Peak Demand > Capacity
Risk Cost

Outage: 10%/yr x 8 hr x 6000 customers x $20/customer/hr

+

Low pressure: 10%/yr x 8 hr x 6000 customers x $3/customer/hr

=

$110,000/yr

30-yr present value of risk exposure = $2.44 million

Risk Example 2:
Fire Demand > Capacity

Inability to fight fires - likelihood

- Assume 1 large fire per year on average
- 2% probability of inadequate Blazer Tank emergency storage
- 99% of the time, water can be diverted from other areas (choose fire fighting over customer outages)
- 1 fire/yr x 2% inadequate storage x 1% unable to divert flow = 0.02% chance of being unable to fight the fire

Fire Demand > Capacity
Risk Exposure

Inability to fight fires – consequence

- Possible loss of life or property destruction
- Assume $20 million consequence

Inability to fight fires – risk exposure

- Risk cost of fire = 0.02% x $20 M = $4,000/yr
- Risk exposure from outages while fighting fire = $8,910/yr
- Total risk exposure = $4000/yr + $8,910/yr; 30yr PV = $302k

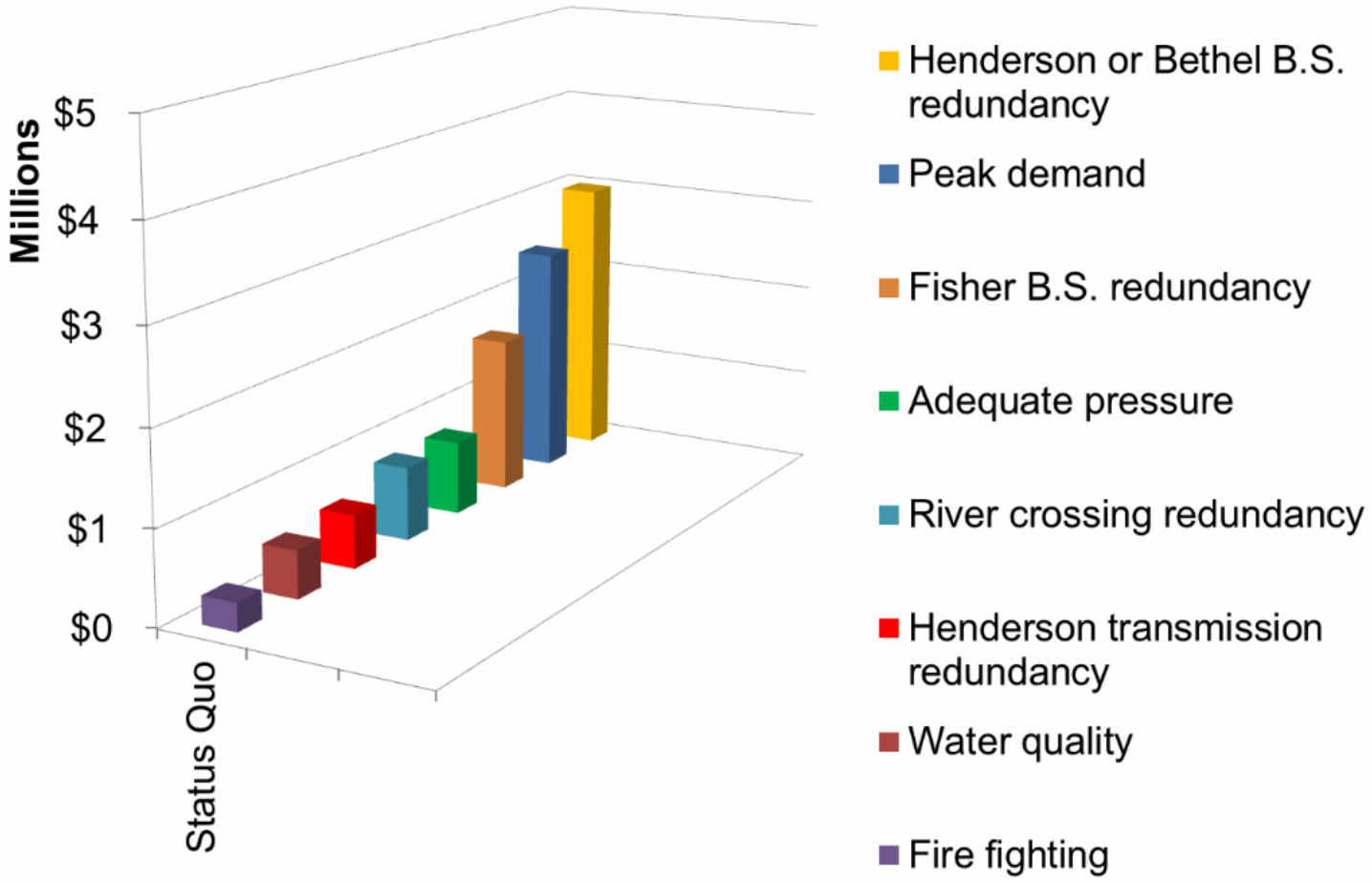
Pre-BCE:
Non-monetary Evaluation

Risk Breakdown	Status Quo
Peak Demand	N
Water Quality	N
Adequate Pressure	N
Fire Fighting	N
River Crossing Redundancy	N
Fisher Booster Station Redundancy	N
Henderson Transmission Redundancy	N
Financial Cost	$2 M

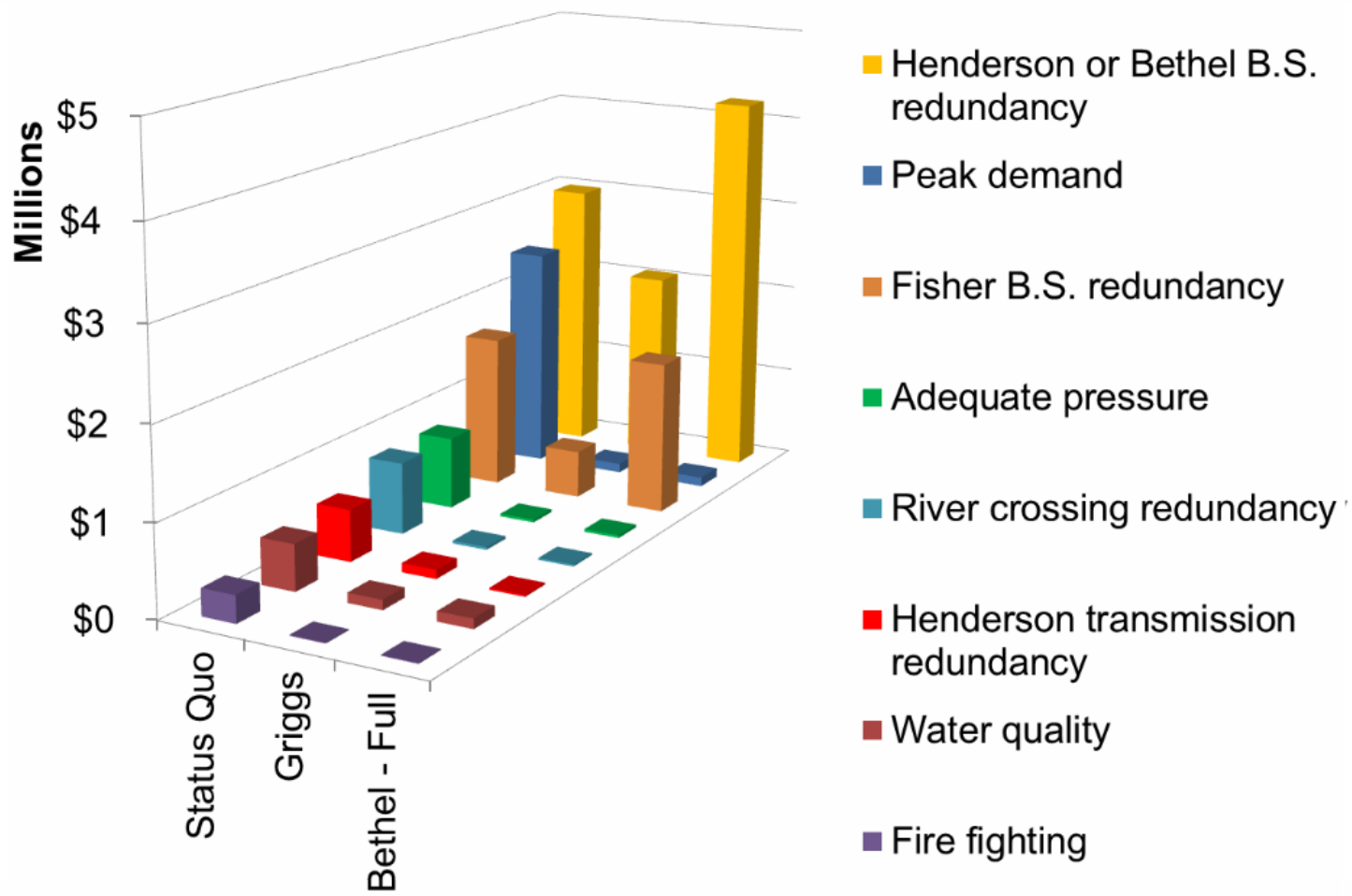
Pre-BCE:
Non-monetary Evaluation

Risk Breakdown	Status Quo	Alt. 1 Griggs	Alt. 2 Bethel
Peak Demand	N	Y	Y
Water Quality	N	Y	Y
Adequate Pressure	N	Y	Y
Fire Fighting	N	Y	Y
River Crossing Redundancy	N	Y	Y
Fisher Booster Station Redundancy	N	Y	N
Henderson Transmission Redundancy	N	Y	Y
Financial Cost	$2 M	$26 M	$18 M

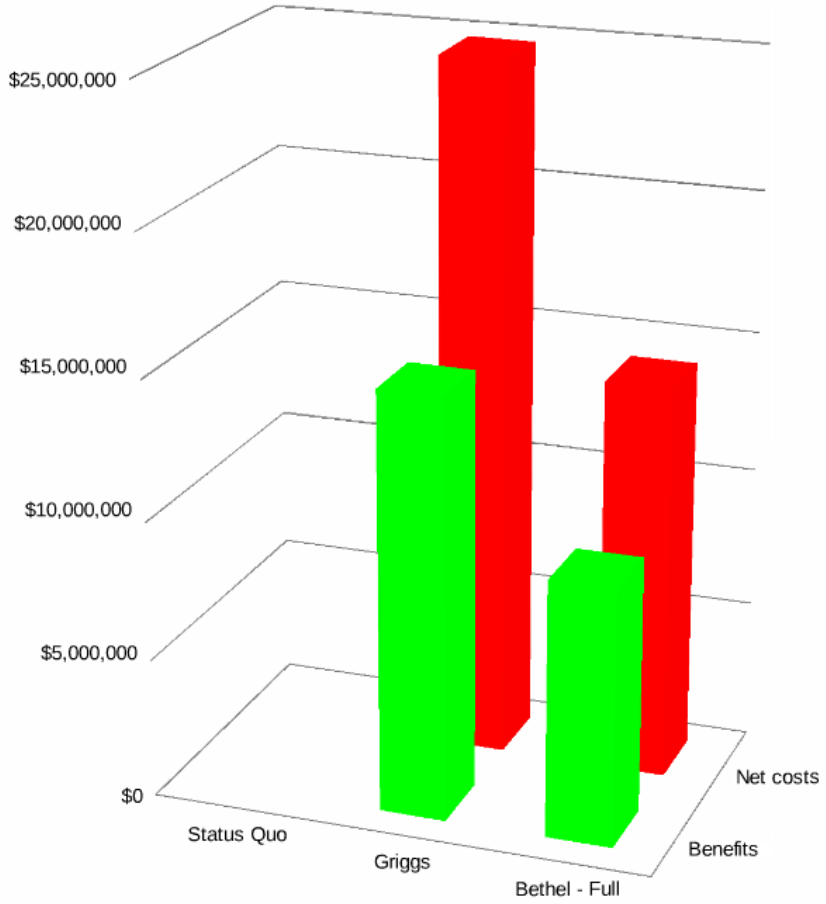
BCE: Monetized Social Risk



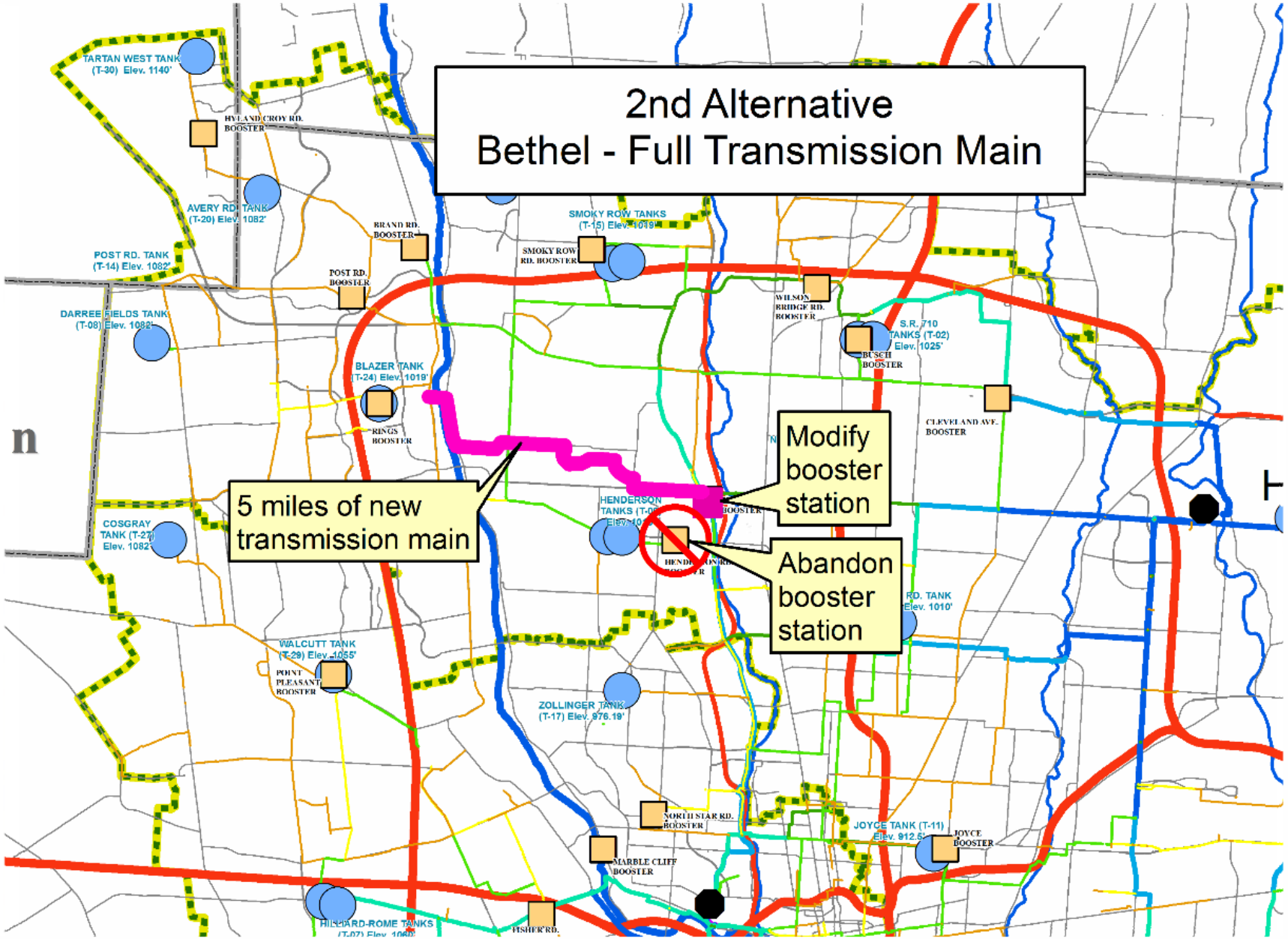
BCE: Monetized Social Risk



Social Risk Reduction v. Cost



Benefits (Risk Reduction) < Costs for both alternatives


2nd Alternative
Bethel - Full Transmission Main
5 miles of new transmission main
Modify booster station
Abandon booster station
TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
AVERY RD. TANK (T-20) Elev. 1082'
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BRAND RD. BOOSTER
POST RD. BOOSTER
DARREE FIELDS TANK (T-08) Elev. 1082'
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WILSON BRIDGE RD. BOOSTER
S.R. 710 TANKS (T-02) Elev. 1025'
BUSCH BOOSTER
CLEVELAND AVE. BOOSTER
HENDERSON TANKS (T-05)
BOOSTER
RD. TANK Elev. 1010'
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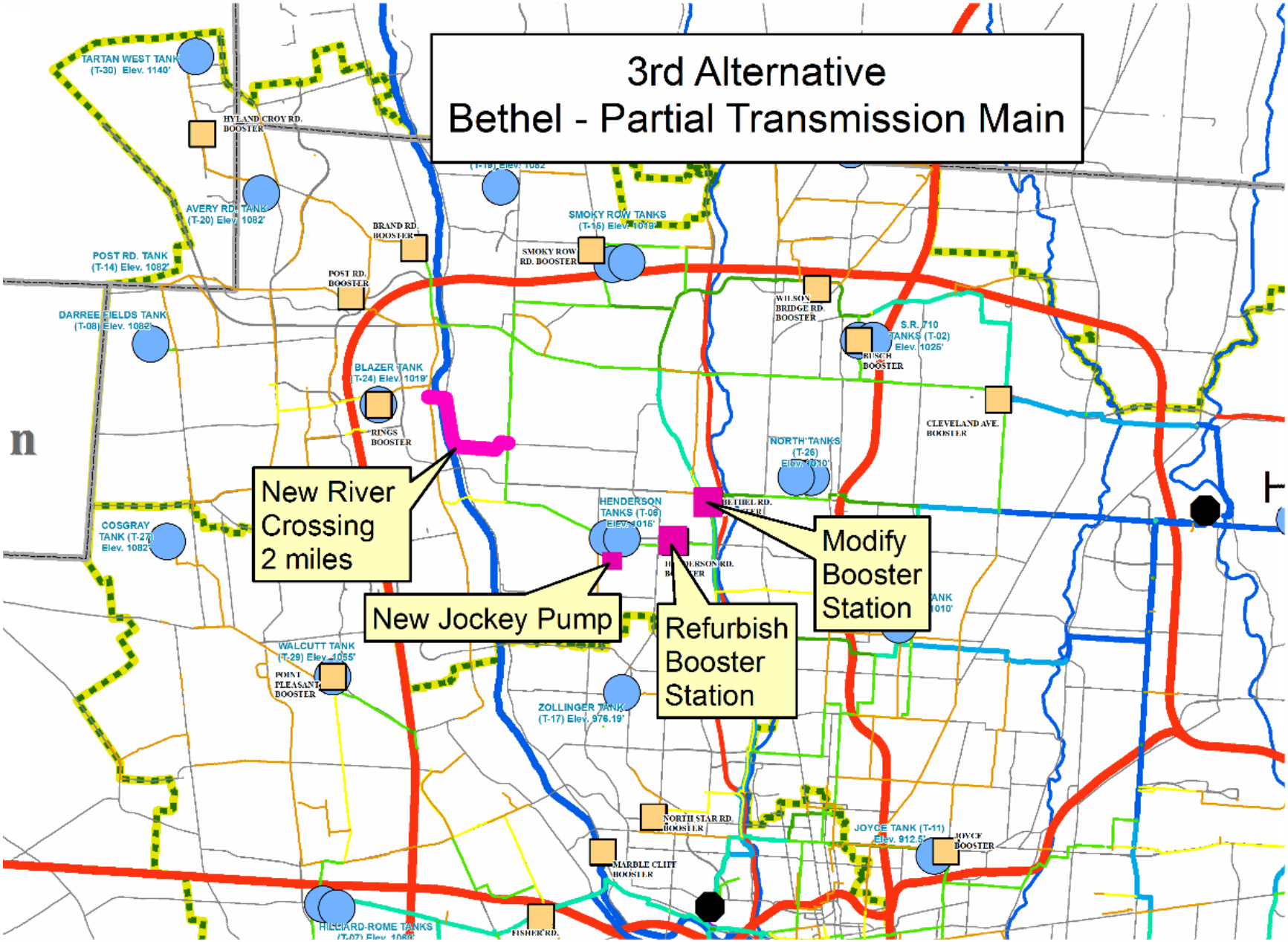
FISHER RD.


3rd Alternative
Bethel - Partial Transmission Main
New River Crossing 2 miles
New Jockey Pump
Refurbish Booster Station
Modify Booster Station
TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
AVERY RD. TANK (T-20) Elev. 1082'
POST RD. TANK (T-14) Elev. 1082'
POST RD. BOOSTER
BRAND RD. BOOSTER
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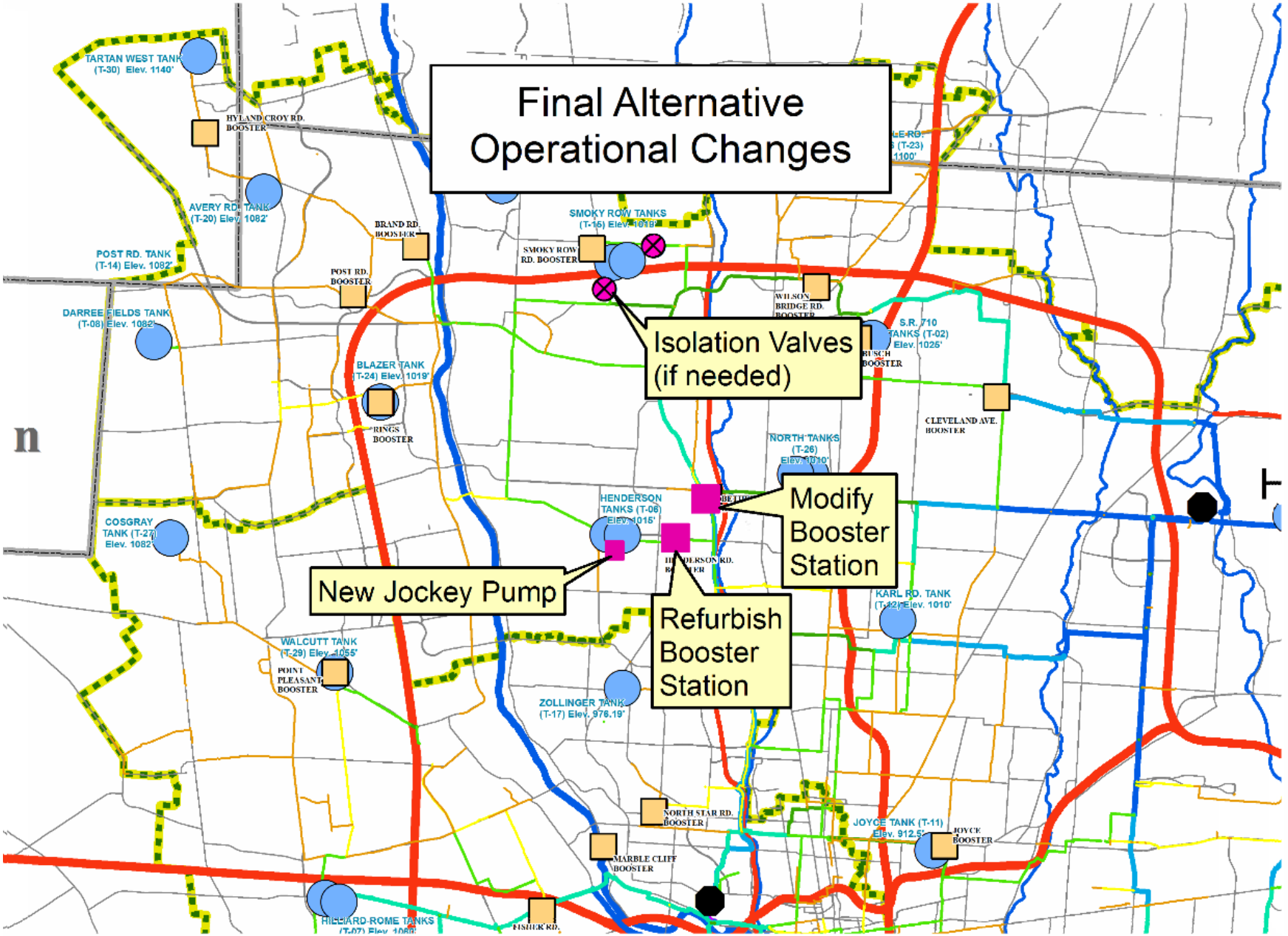
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS
FISHER RD.


Final Alternative Operational Changes
Isolation Valves (if needed)
Modify Booster Station
New Jockey Pump
Refurbish Booster Station
TARTAN WEST TANK (T-30) Elev. 1140'
HYLAND CROY RD. BOOSTER
AVERY RD. TANK (T-20) Elev. 1082'
POST RD. TANK (T-14) Elev. 1082'
DARREE FIELDS TANK (T-08) Elev. 1082'
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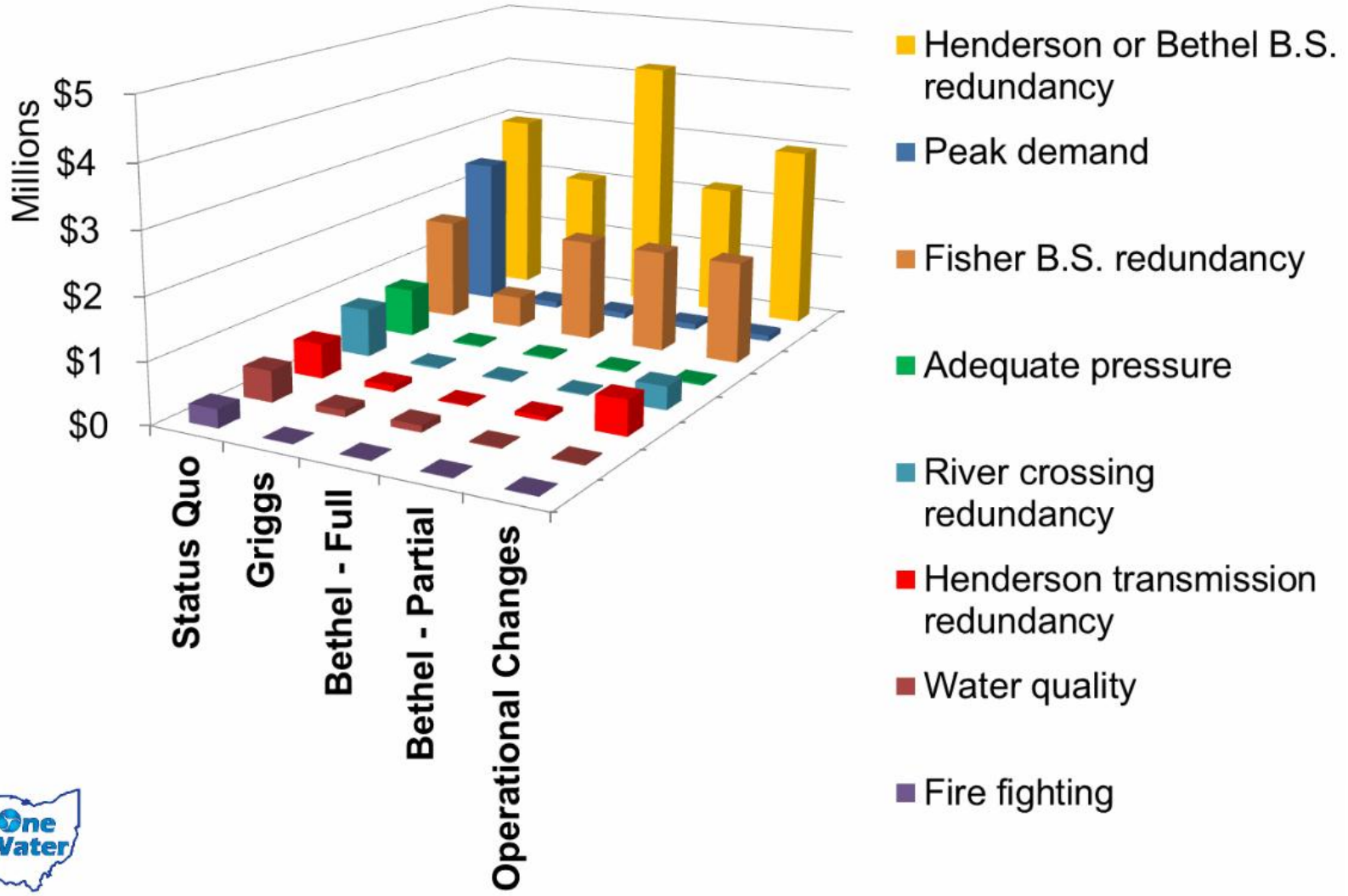
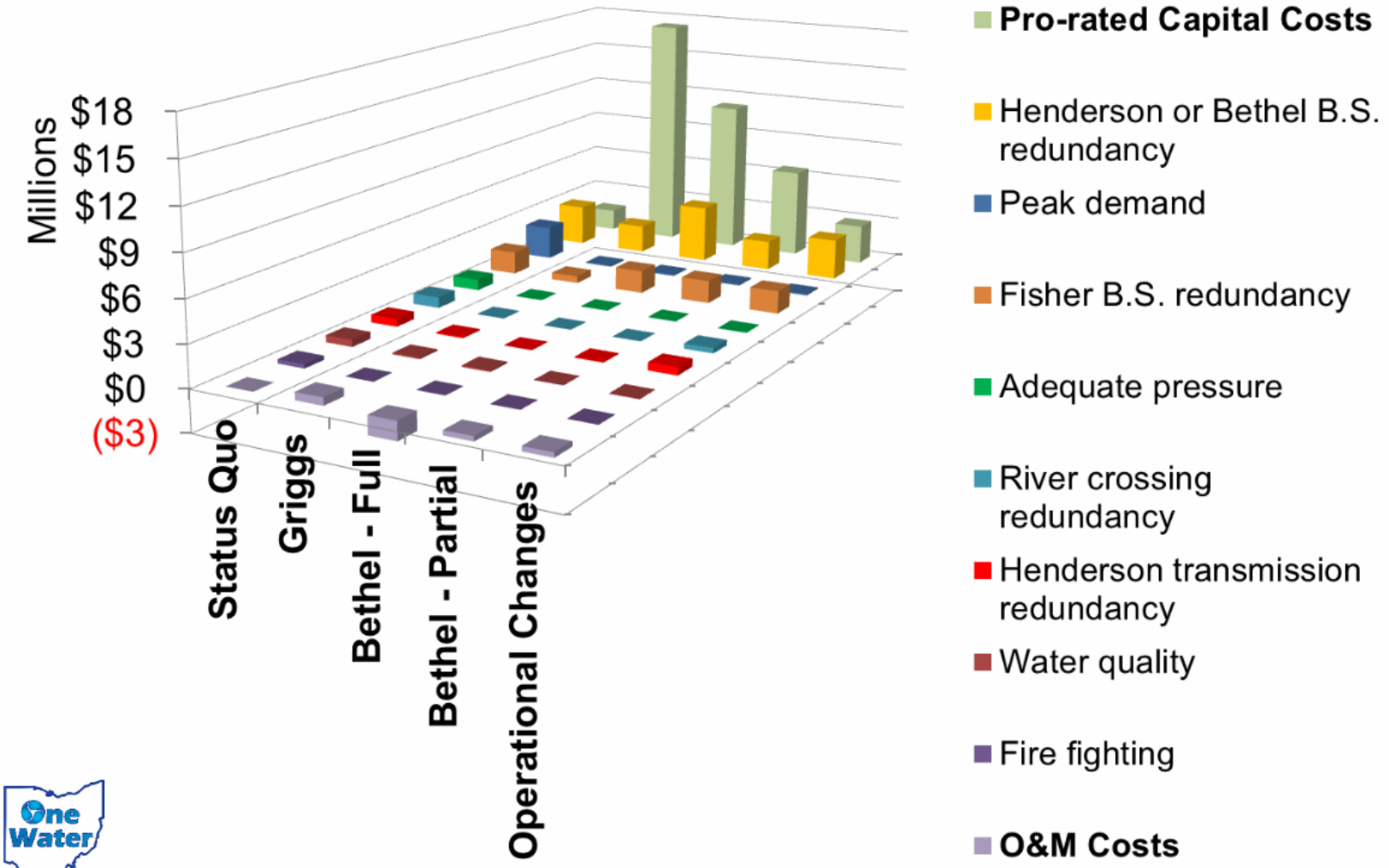
JOYCE BOOSTER
MARBLE CLIFF BOOSTER
HILLIARD-ROME TANKS (T-07) Elev. 1068'
FISHER RD.

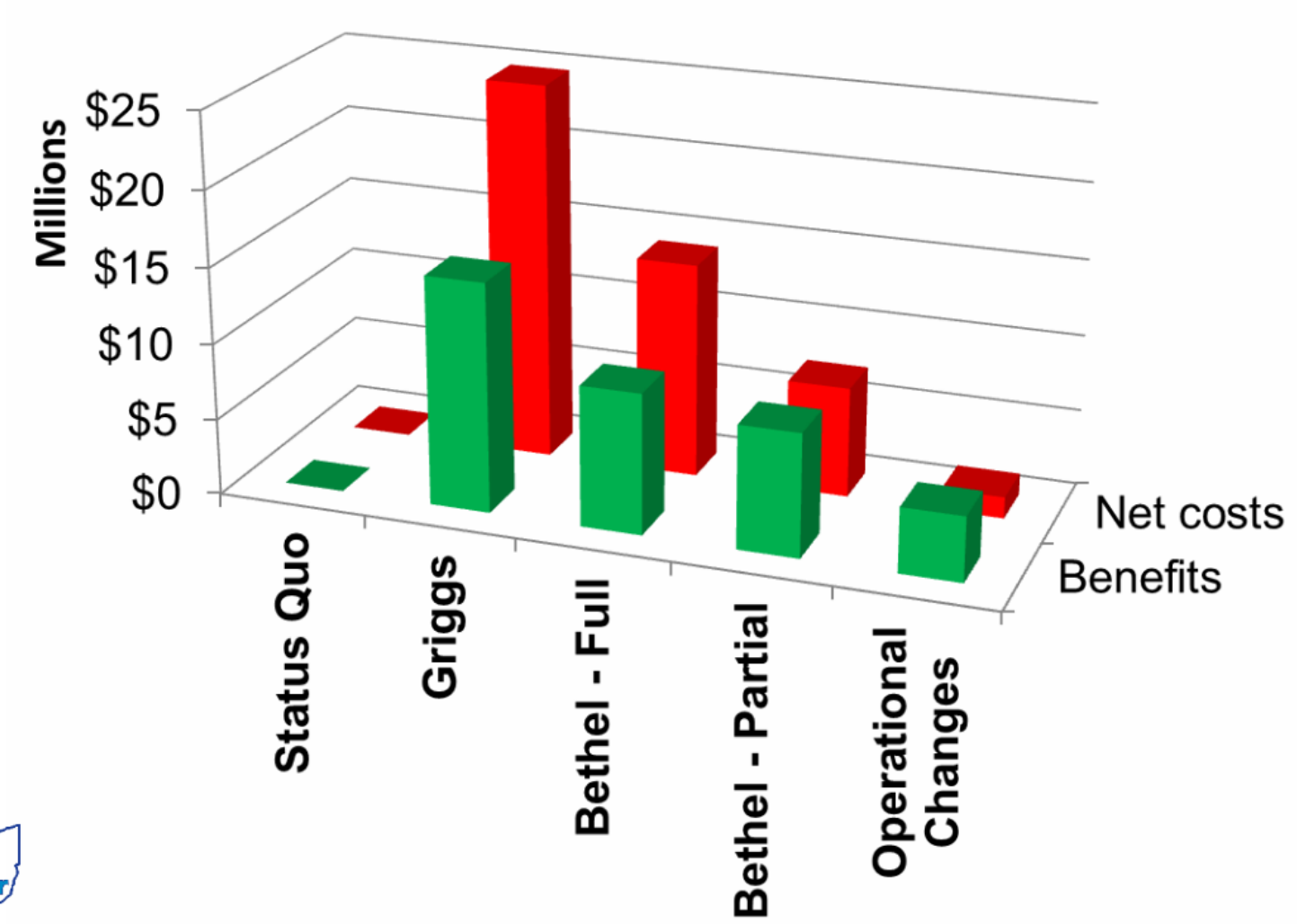
Risk Reduction Matrix



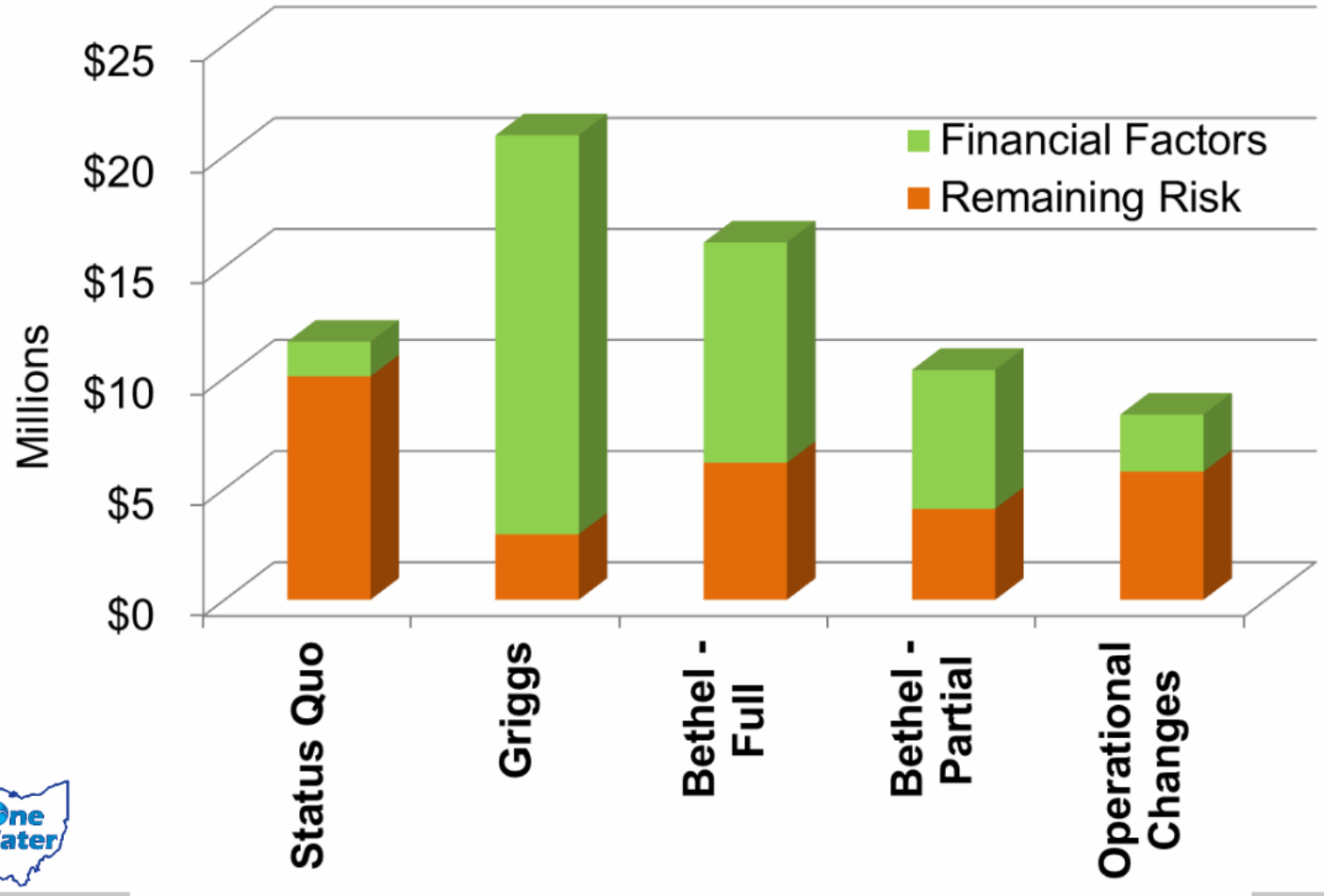
30-yr TBL Matrix



Social Risk Reduction vs. Cost



Triple Bottom Line NPV



George F. Meyers, P.E.

City of Columbus
Department of Public Utilities
Asset Management Office
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Email: gfmeyers@columbus.gov