South Platte Storage Study

Project Presentation

Interbasin Compact Commission

February 20, 2018

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MWH now part of Stantec

LeonardRice ENGINEERS, INC.

Background

Authorization and Management

- **Authorized by House Bill 16-1256**
- **Prepared for the Colorado General Assembly, in coordination with the Colorado Water Conservation Board, the Colorado Division of Water Resources, and the South Platte Basin and Metro Roundtables**
- **Funded by Water Supply Reserve Fund grant**
- **Conducted by Stantec and Leonard Rice Engineers**
- **Managed by CWCB and Lower South Platte Water Conservancy District**

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SPSS Objectives

- Estimate flow leaving the State in excess of the minimum legally required amounts over the past 20 years
- Identify multipurpose water storage options along the lower South Platte River
- Consider new reservoirs, enlargement / rehabilitation of existing reservoirs, and alternative storage mechanisms (e.g., ASR)

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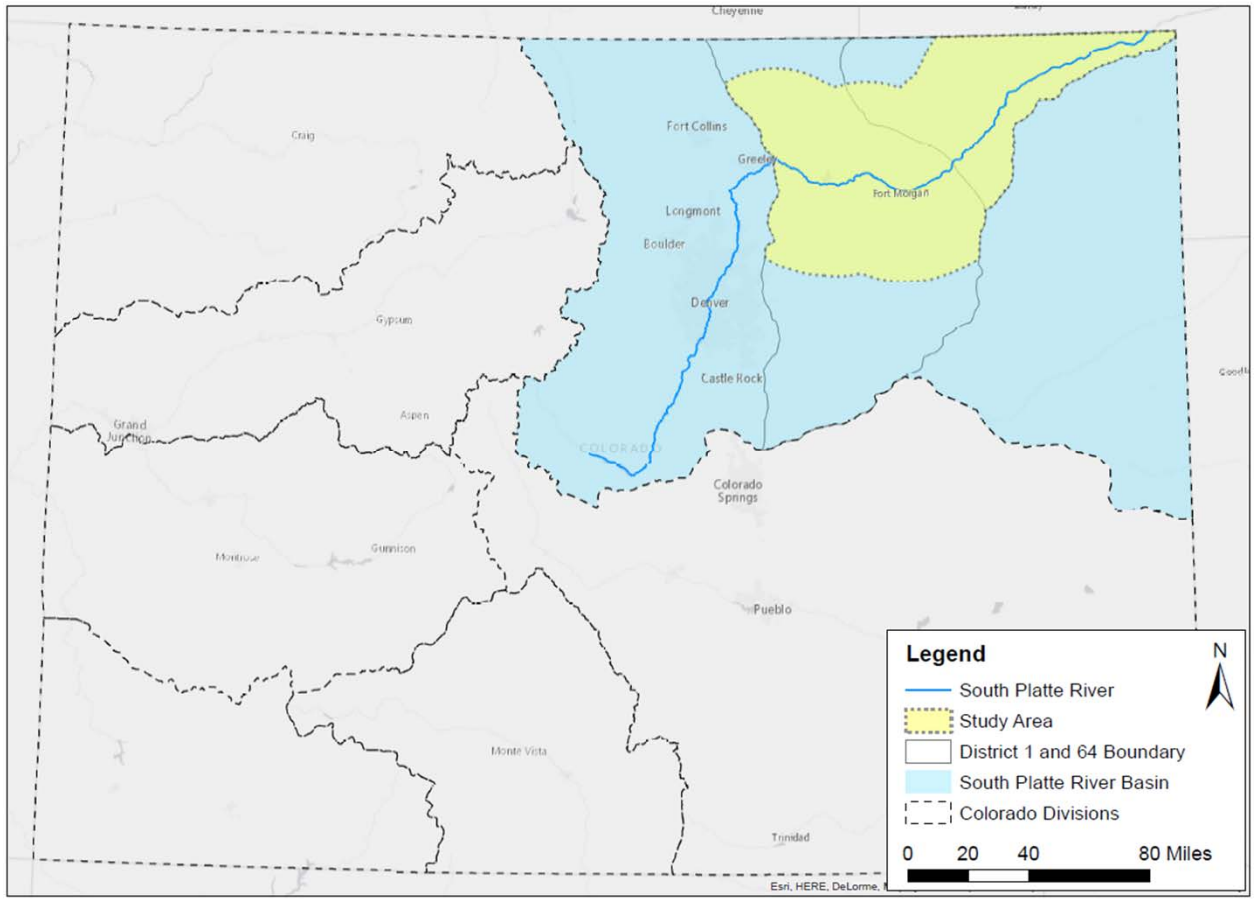
SPSS Study Area

Lower South Platte River Basin between Greeley and the State Line



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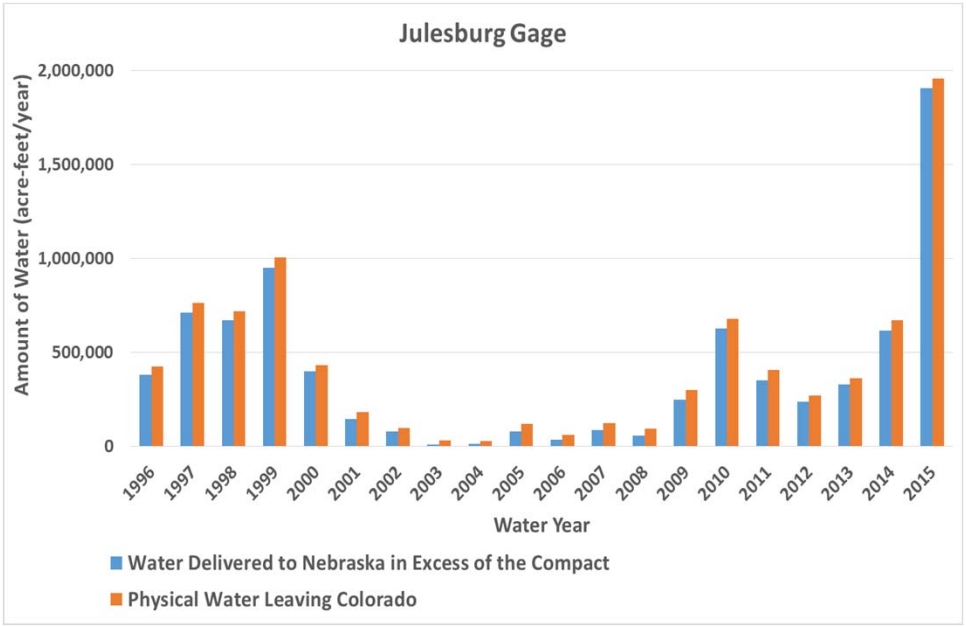
Study Findings

Nearly 300,000 AFY could have been diverted over the past 20 years

Statistic	Physical Water Leaving Colorado (Julesburg Gage)	Water Delivered to Nebraska in Excess of the Compact (1)(2)
Annual Median (ac-ft/yr)	331,000	293,000
Annual Average (ac-ft/yr)	436,000	397,000
Minimum Year (ac-ft/yr)	29,000	10,000
Maximum Year (ac-ft/yr)	1,957,000	1,904,000
Total for 20-yr Period 1996-2015 (ac-ft)	8,728,000	7,939,000

(1) Storable flow Julesburg gage
(2) Future environmental flow obligations could reduce legally available water.



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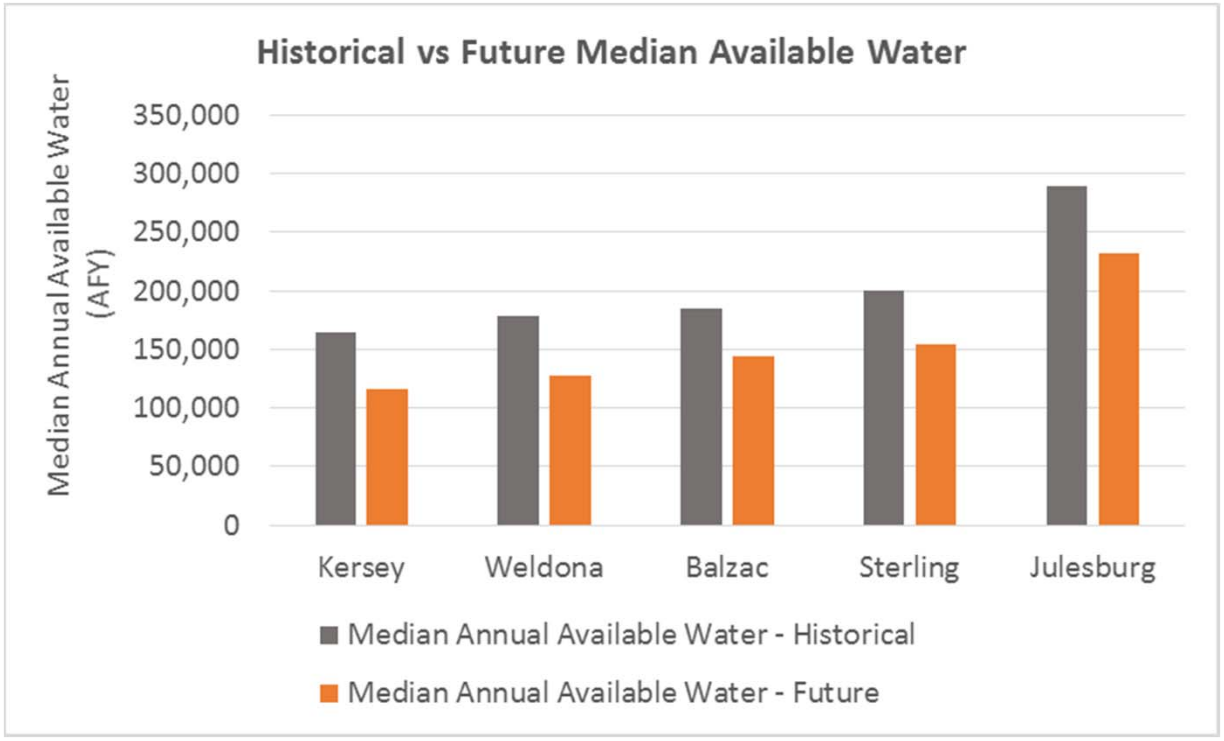
In the future, about 116,000 AFY will be available at Kersey and 230,000 AFY at Julesburg

- **Account for 60% IPP implementation and perfection of conditional water rights**
- **Water is available only in wet years and runoff season**
- **20-30% less available water in the future**



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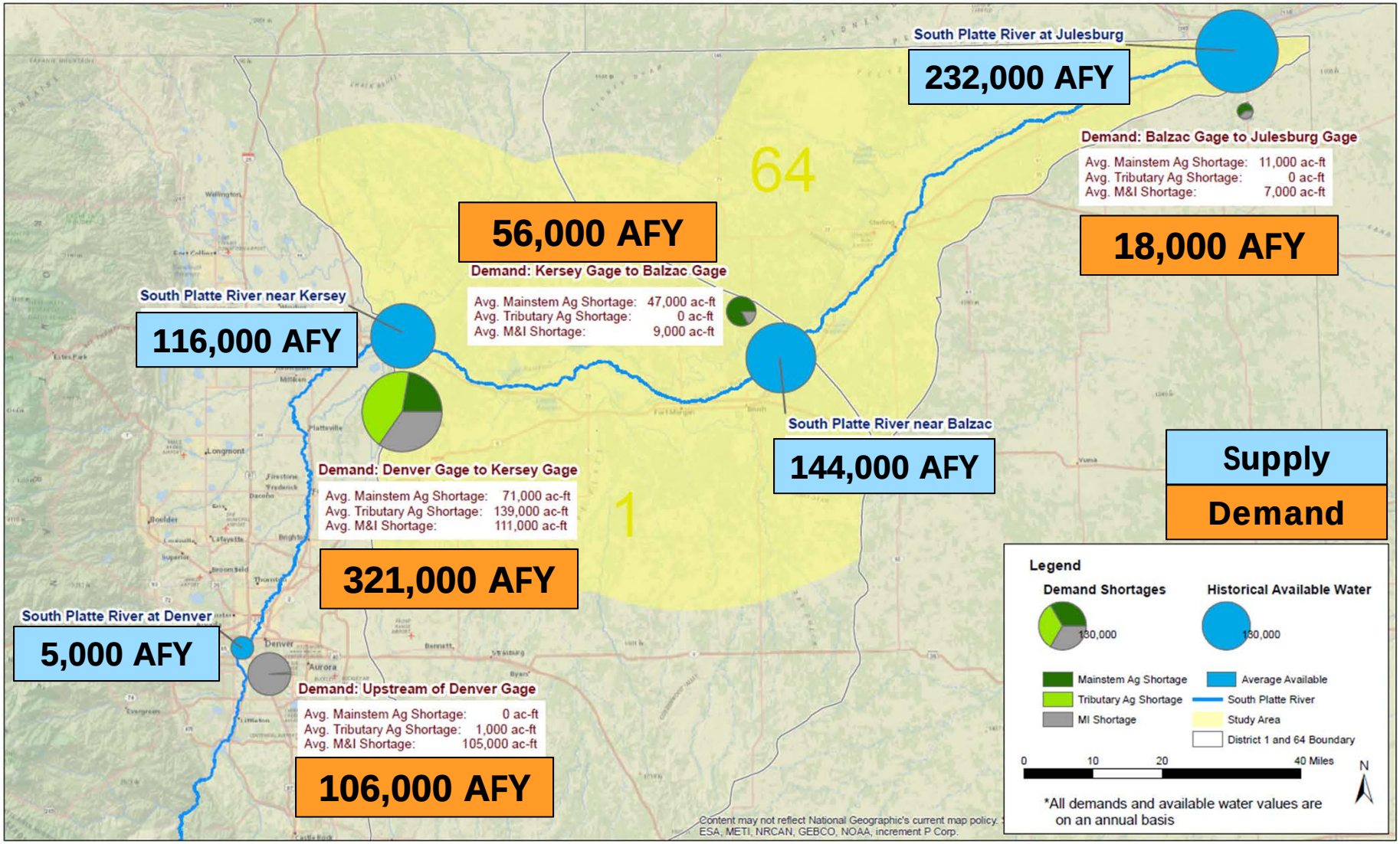
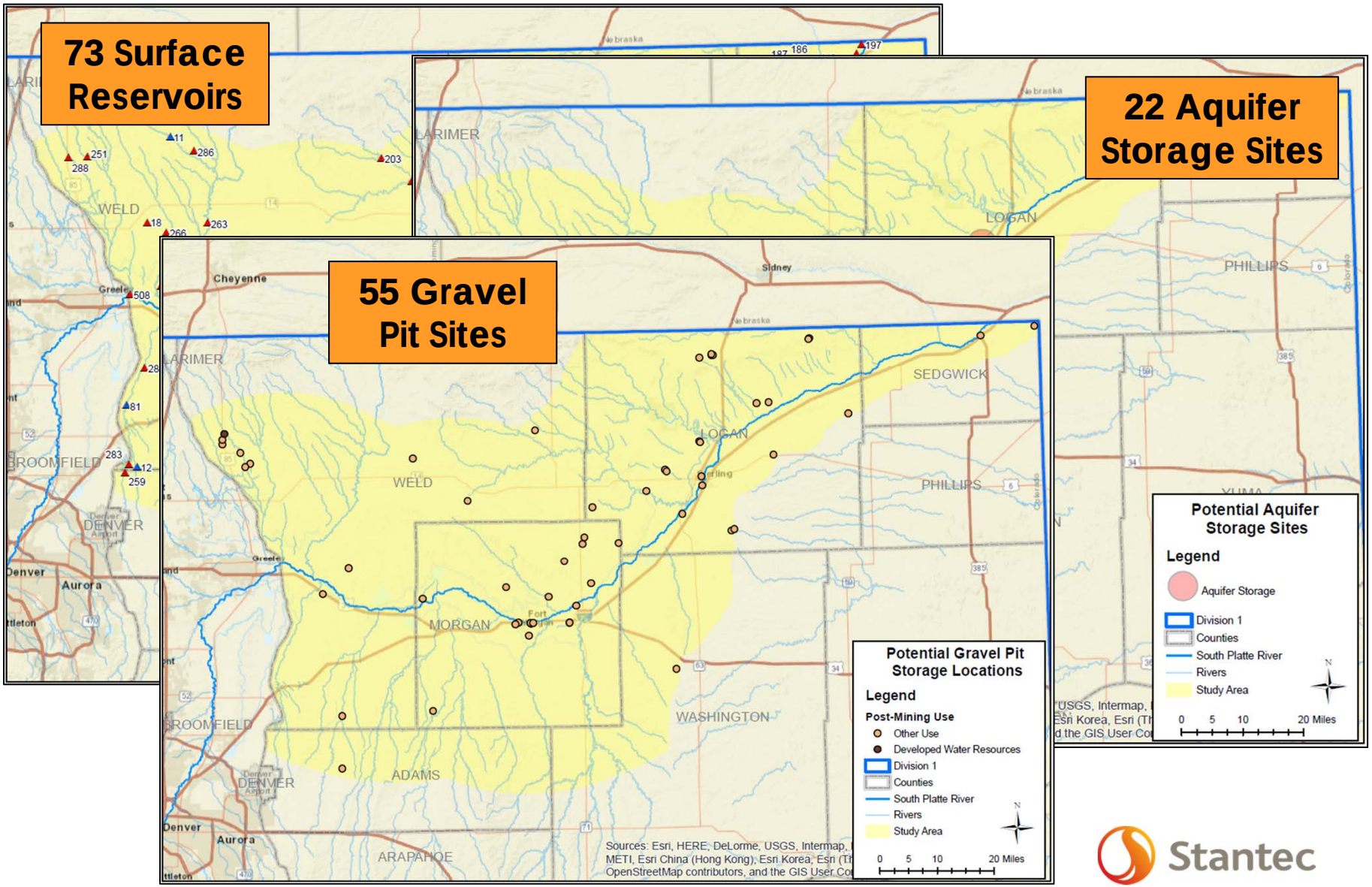
SPSS storage could meet a portion of Ag and M&I gap of 500,000 AFY in 2050 (SWSI 2010 Gap)



There was lots of information to start with



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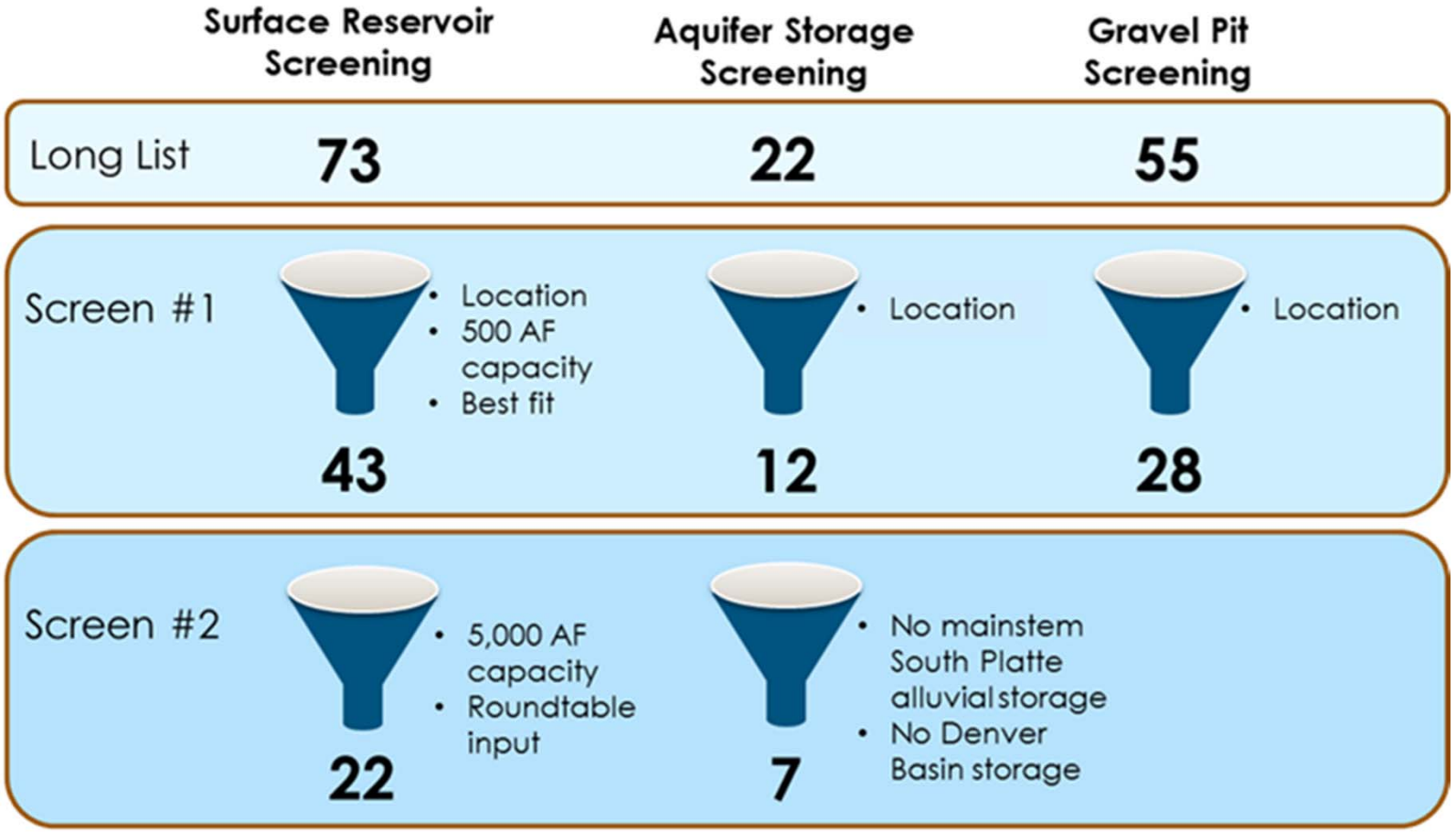
Storage options were screened to simplify analysis – None should be eliminated from future consideration!



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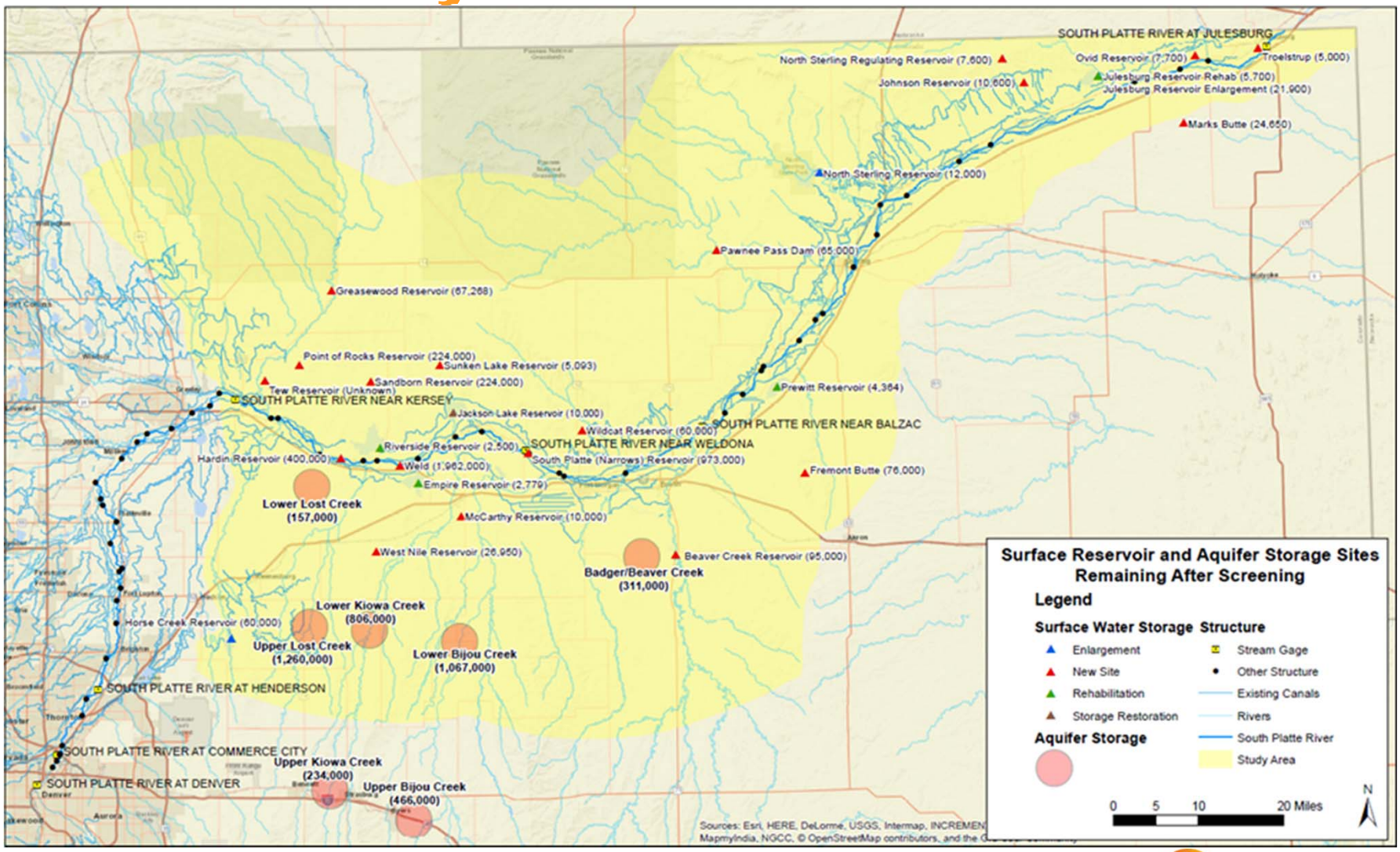
Sites remaining after screening span entire study area



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Storage Options Sorted by Average Score	Storage Category	Average of Scores for 3 Weighting Scenarios (1)
New Reservoirs		
Wildcat Reservoir	New – Off Channel	14.3
Point of Rocks Reservoir	New – Off Channel	13.5
Beaver Creek Reservoir	New – Off Channel	13.2
Johnson Reservoir	New – Off Channel	11.7
North Sterling Regulating Reservoir	New – Off Channel	11.7
Fremont Butte	New – Off Channel	11.2
South Platte (Narrows) Reservoir	New - Mainstem	11.2
Sandborn Reservoir	New – Off Channel	11.0
Ovid Reservoir	New – Off Channel	10.8
Troelstrup	New – Off Channel	10.8
Pawnee Pass Dam	New – Off Channel	10.7
Sunken Lake Reservoir	New – Off Channel	10.2
Greasewood Reservoir	New – Off Channel	9.8
McCarthy Reservoir	New – Off Channel	9.3
Hardin Reservoir	New – Mainstem	8.7
West Nile Reservoir	New – Off Channel	8.5
Modified Existing Reservoirs		
Julesburg Reservoir (Rehabilitation)	Rehabilitation	17.8
Riverside Reservoir	Rehabilitation	16.0
Empire Reservoir	Rehabilitation	16.0
Jackson Lake Reservoir	Rehabilitation	15.2
Prewitt Reservoir	Rehabilitation	14.3
Julesburg Reservoir (Enlargement)	Enlargement	13.7
North Sterling Reservoir	Enlargement	11.7
Aquifer Storage		
Lower Lost Creek	Aquifer	19.2
Lower Bijou Creek	Aquifer	17.5
Upper Lost Creek	Aquifer	16.7
Lower Kiowa Creek	Aquifer	16.0
Badger/Beaver Creek	Aquifer	15.8
Upper Bijou Creek	Aquifer	13.5
Upper Kiowa Creek	Aquifer	13.5

(1) Range of possible averaged scores is 0 – 34

Cursory Triple Bottom Line analysis indicated relative merits of sites

- **21 criteria**
- **3 weighting scenarios**
- **No site would be eliminated based on this assessment**

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Past surface reservoir cost estimates were updated

- Include design, permitting, land acquisition, capital cost
- Maximum size
- Unit Cost:
  - $74-$5,000/AF for new reservoirs
  - $1,300-$5,400/AF for enlargements and rehabs

Dam Type/Name	Storage Capacity (ac-ft)	Estimated 2017 Cost ($ million)	Unit Cost ($/ac-ft)
New Site			
Sandborn Reservoir	224,000	$131	$580
West Nile Reservoir	26,950	$59	$2,100
McCarthy Reservoir	10,000	$27	$2,500
South Platte (Narrows) Reservoir	1,960,000	$145	$74
Wildcat Reservoir	60,000	$79	$1,300
Pawnee Pass Dam	75,000	$254	$3,400
Fremont Butte	76,000	$74	$980
North Sterling Regulating Reservoir	7,600	$38	$5,000
Johnson Reservoir	10,600	$24	$2,300
Ovid Reservoir	7,700	$24	$3,100
Troelstrup	5,000	$19	$3,700
Beaver Creek	95,000	$66	$690
Enlargement			
North Sterling Reservoir Enlargement	12,000	$22	$1,800
Julesburg Reservoir Enlargement	21,900	$46	$2,100
Rehabilitation			
Empire Reservoir Rehab	2,779	$14	$5,000
Prewitt Reservoir Rehab	4,364	$5.5	$1,300
Julesburg Reservoir Rehab	5,700	$31	$5,400
Jackson Lake Reservoir Rehab	10,000	$37	$3,700
Riverside Reservoir Rehab	2,500	$13	$5,200

Groundwater storage options were analyzed differently

- **Used CWCB 2007 groundwater storage assessment**
- **Scaled smaller (much less than physical basin capacity) as supplemental storage or augmentation flow options**

Characteristic	Lower Lost Creek Basin	Badger/Beaver Basin
Storage Capacity (ac-ft)	157,000	311,000
Storage per Acre (ac-ft/ac)	5.7	4.4
Maximum Inflow (ac-ft/month)	5,000	5,000
Maximum Outflow (ac-ft/month)	4,000	4,000
Infiltration Rate (ft/day)	1.0	1.0
Extraction Well Capacity (gpm)	500	500
Approximate Well Count	60	60
Losses in Aquifer (% of inflow)	10	10

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8 Representative storage concepts were analyzed

Storage Solution Concepts	Potential Storage Sites and Maximum Capacities
Mainstem Storage	South Platte (Narrows) Reservoir Site (1,960,000 ac-ft)
Upper Basin Storage	Sandborn Reservoir Site (224,000 ac-ft)
Mid Basin Storage North	Wildcat Reservoir Site (60,000 ac-ft) Pawnee Pass Reservoir Site (75,000 ac-ft)
Mid Basin Storage South	Beaver Creek Reservoir Site (95,000 ac-ft)
Lower Basin Storage	Julesburg Reservoir Enlargement/Rehabilitation (27,600 ac-ft) Ovid Reservoir Site (7,700 ac-ft) Troelstrup Reservoir Site (5,000 ac-ft)
Existing Reservoir Improvements	Julesburg Reservoir Enlargement/Rehabilitation (27,600 ac-ft) North Sterling Reservoir Enlargement (12,000 ac-ft) Prewitt Reservoir Rehabilitation (4,364 ac-ft) Riverside Reservoir Rehabilitation (2,500 ac-ft) Jackson Lake Reservoir Rehabilitation (10,000 ac-ft)
Groundwater Basin Storage West	Lower Lost Creek Aquifer (157,000 ac-ft)
Groundwater Basin Storage East	Beaver/Badger Aquifer (311,000 ac-ft)

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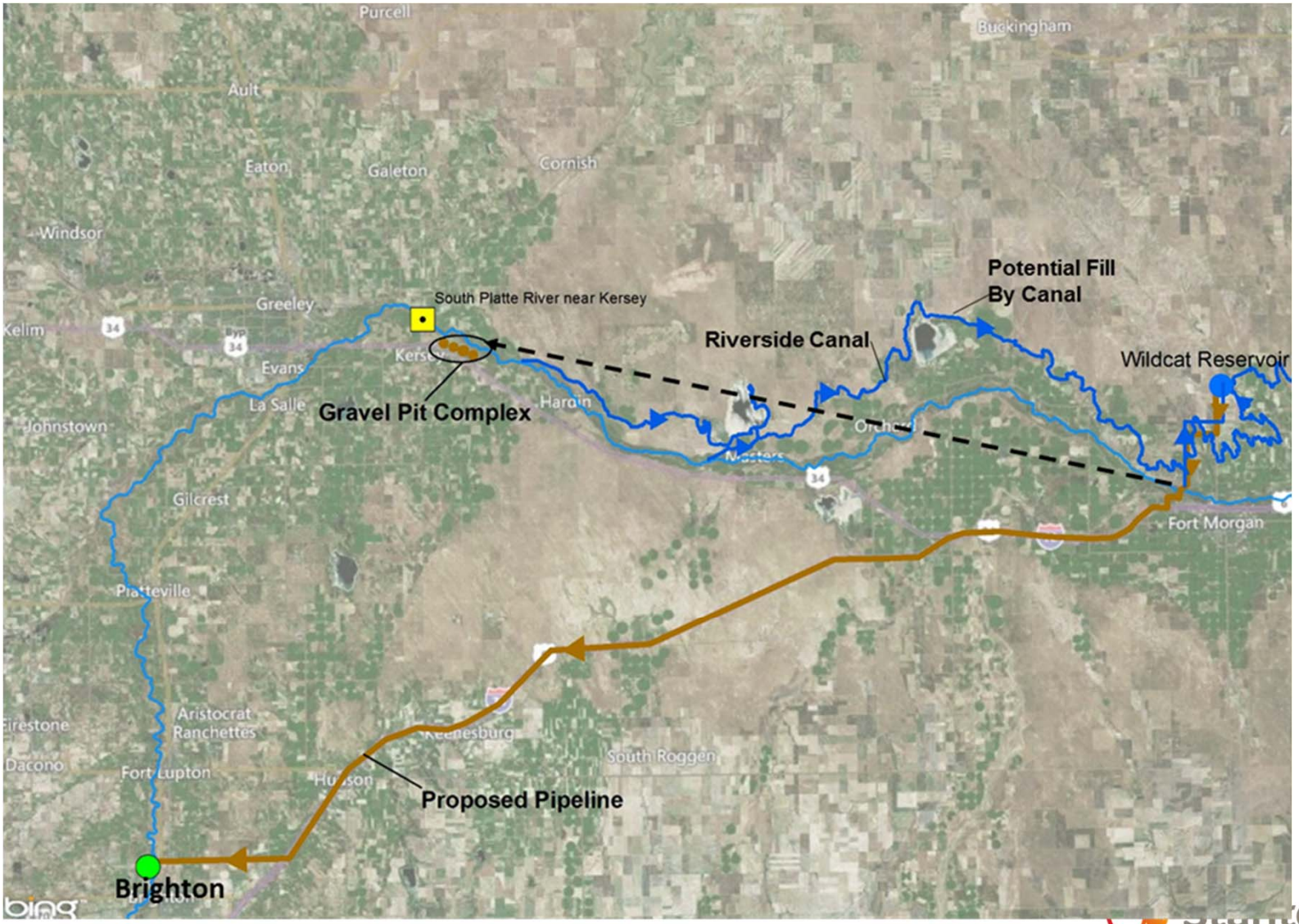
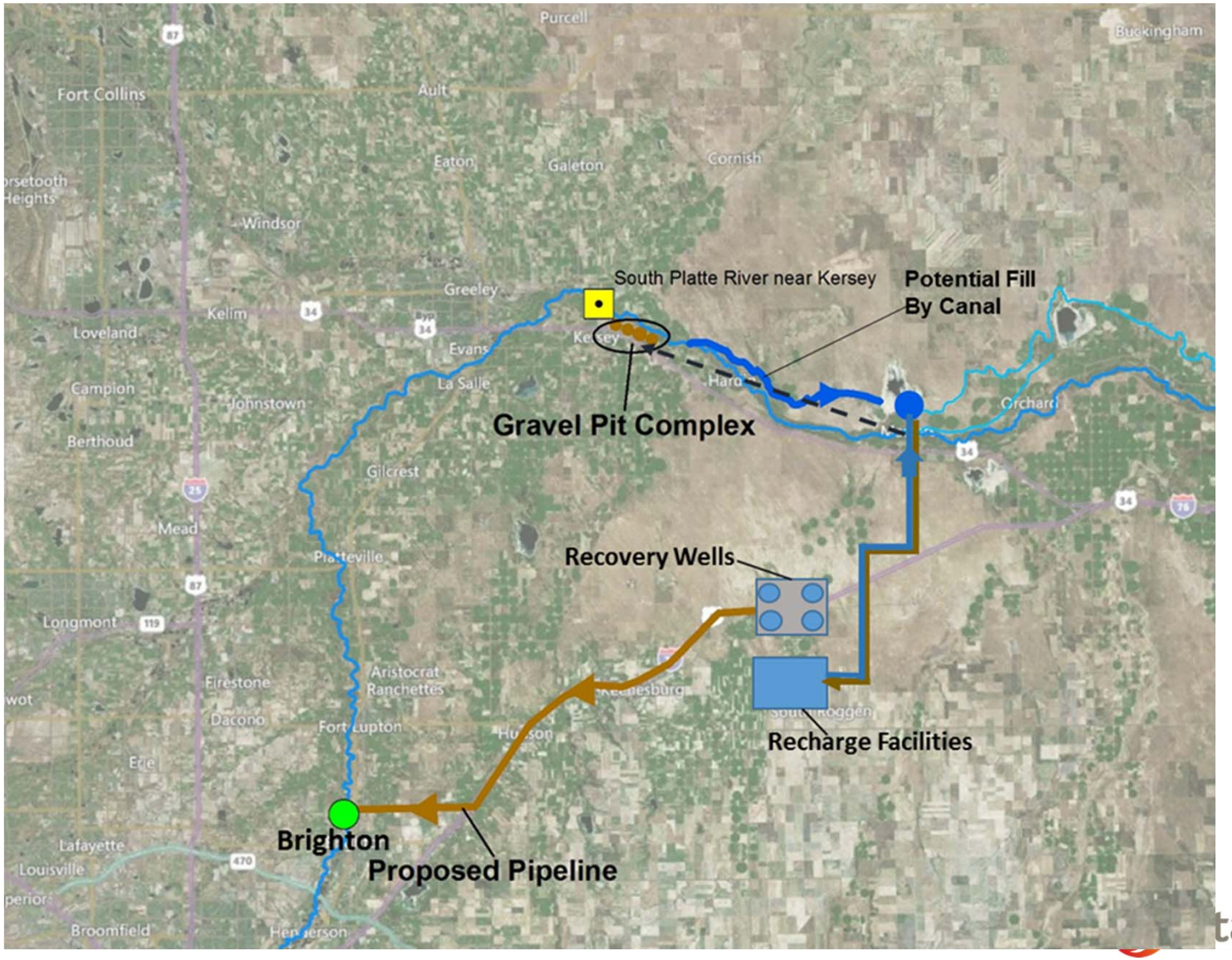
Sample Surface Storage Concept – Mid Basin North Storage



Sample ASR Storage Concept – Groundwater Basin West Concept



Storage concept results

Storage Concept	Maximum Storage (AF)	Firm Yield (AFY)		Average Annual Yield (AFY)	Total Cost ($M)		Unit Cost($/AFY Firm Yield)
		With Pipeline	W/O Pipeline	With Pipeline	With Pipeline	W/O Pipeline	W/O Pipeline
Mainstem Dam	1,960,000	62,000	47,000	81,000	$525	$190	$ 3,300
Upper Basin Storage	224,000	22,000	20,000	48,000	$621	$344	$26,000
Mid Basin Storage North	60,000	9,000	7,000	43,000	$652	$265	$29,000
Mid Basin Storage South	95,000	11,000	8,000	46,000	$910	$518	$47,000
Existing Reservoirs	40,300	17,000	15,000	59,000	$664	$387	$23,000
Lower Basin Storage	56,500	24,000	24,000	48,000	$1,037	$255	$11,000
Groundwater Storage West	-	8,400	8,400	-	$435	$322	$38,000
Groundwater Storage East	-	8,000	8,000	-	$469	$244	$31,000

Firm yield = 9K – 62K AFY w/ pipeline; 7K – 47K AFY w/o pipeline

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Average annual yield = 43K – 81K AFY w/ pipeline; 35K – 60K AFY w/o pipeline

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Total cost = $190M - $1.0B

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Total cost = $190M - $1.0B

Unit cost = $3,000 – $47,000/AFY

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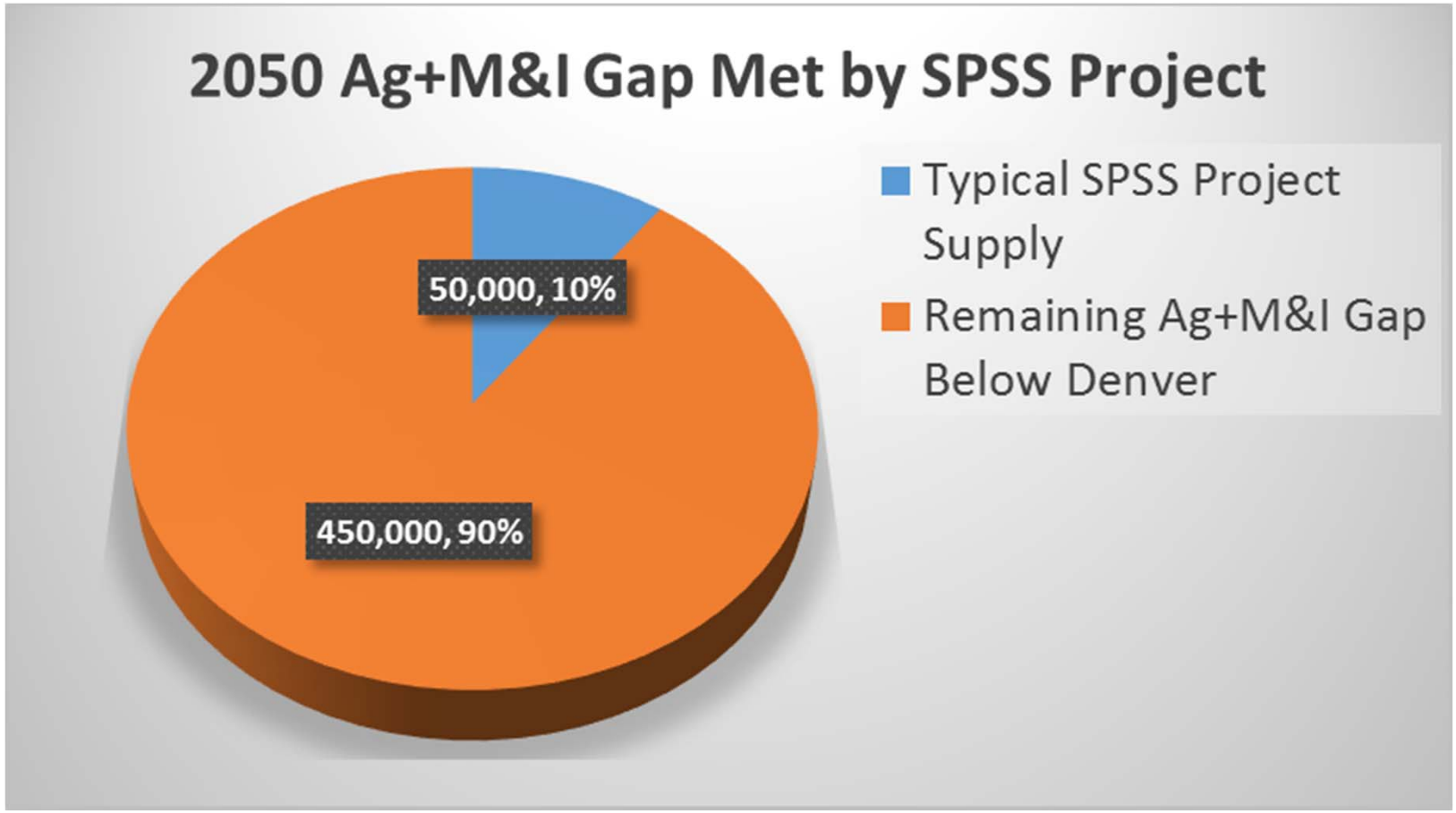
Individual storage concepts are not able to meet majority of 2050 South Platte Basin Supply Gap below Denver



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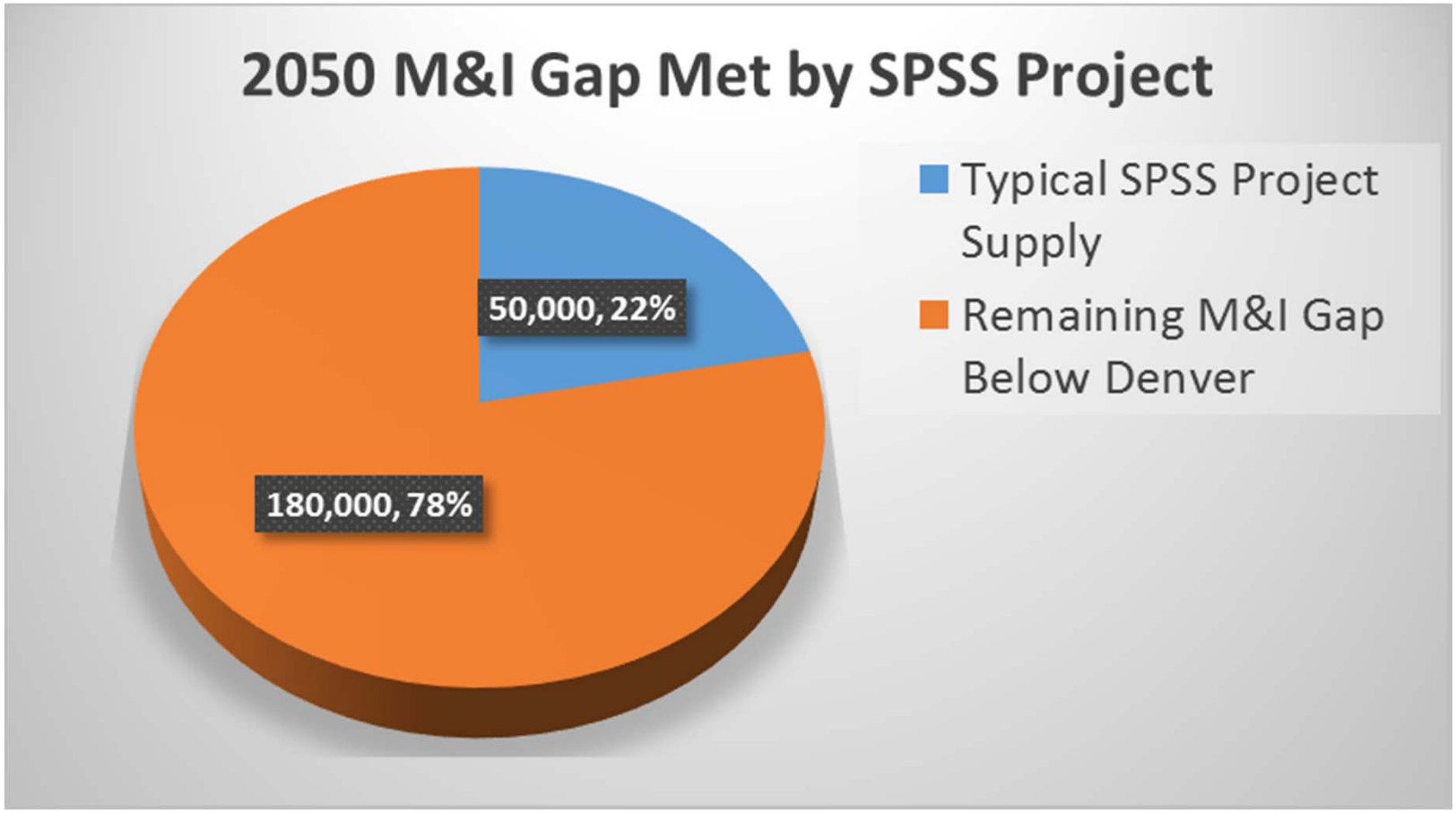

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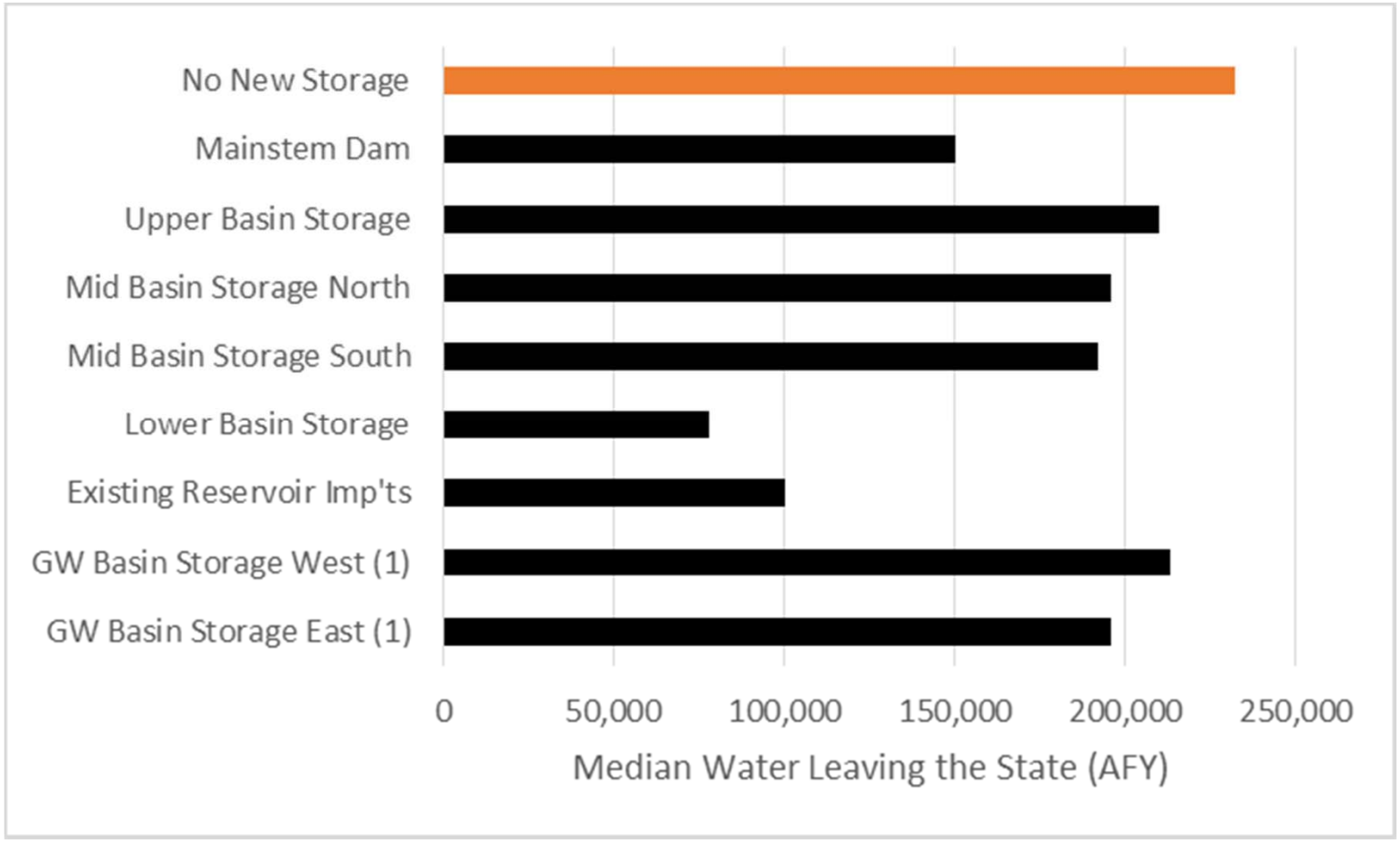
Individual storage concepts are not able to capture most available water



(1) Assumes maximum size to capture peak spring runoff. Actual projects would be smaller and leave more water at the state line.

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Conclusions and Recommendations

Key Conclusions

1. A large supply of water is physically and legally available, but only during wet years and over short periods
2. Mainstem options have the most benefit but are likely not permittable and have significant social impacts
3. Many off-channel options appear feasible and could be combined in many different concepts, but yields are severely limited by diversion constraints
4. Concepts are expensive relative to previous supply projects in Colorado
5. Any options and concepts could be candidates for further study under the right circumstances; none should be eliminated now
6. Even several conjunctively operated storage projects would not be capable of addressing majority of South Platte Basin supply gap

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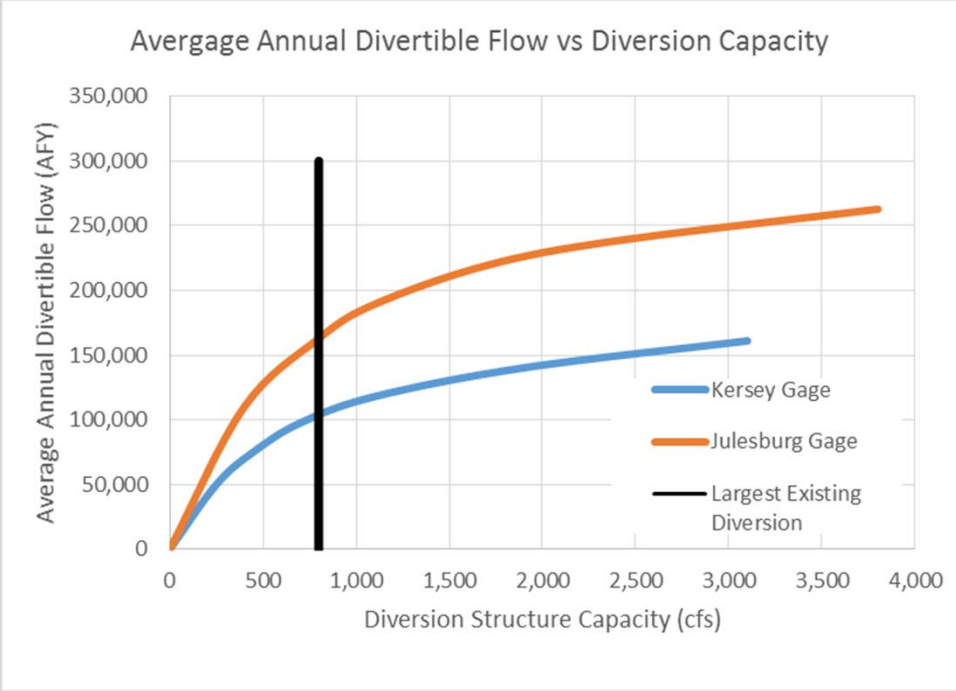
Key Obstacles

- **Off-channel storage effectiveness is severly constrained by diversion capacity**
  - **Largest existing diversion = approx. 800 cfs**
  - **With 800 cfs diversion, average annual available divertible flow = 105,000 AFY at Kersey and 160,000 AFY at Julesburg (historical period) – much less than 300,000 AFY available in the river**
  - **No way to effectively capture very high flows**



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Key Obstacles

- **Water quality will affect M&I uses and groundwater recharge**
  - M&I use requires advanced treatment – add about $1.5 million/1,000 AFY in capital cost
  - Recharge in designated basins requires treatment due to non-degradation requirement
  - Carry-over storage will degrade in quality over time in Plains reservoirs
- **Environmental flow requirements could reduce available water**
  - Study did not assume new minimum environmental or recreational flows in study area or downstream (only South Platte River Compact)

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Key Obstacles

- **Collaboration will be needed to implement the most effective concepts**
  - Find win-win projects for M&I and Ag users
  - Find win-win projects for upper and lower basin water users
  - Develop efficient conjunctive surface and groundwater storage projects
- **SPSS generalized costs do not include important components of a specific project**
  - Treatment costs were not included
  - O&M including power cost for pumping and treatment components would be larger than capital cost over project life-cycle
  - M&I water delivered to Kersey or Brighton in SPSS concepts still has to be moved to customers

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Recommendations

1. Develop better estimates of future hydrology and exchange potential
2. Assess potential for using existing irrigation infrastructure to divert and deliver water to storage
3. Seek cooperative storage projects with multiple users, components and purposes
4. Investigate how storage would support future Alternative Transfer Method projects
5. Investigate conjunctive surface and groundwater storage options
6. Evaluate storage options upstream of Greeley
7. Analysis was based on free river conditions; consider other water sources, e.g., reusable return flows
8. Explore short-list of feasible concepts with Roundtable support in more detail (engineering, operations, cost)
9. Site-specific and owner-specific analyses will be needed to validate individual storage concepts

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Discussion