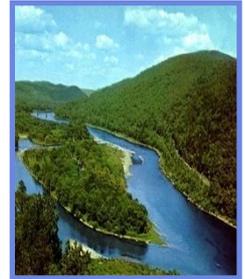


Southern Cumberland Plateau - Water Supply Plan Modeling

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August 27, 2010



Columbia, MD

Portland, OR

Raleigh, NC

Boston, MA

Reliability Criteria

- Preserve 20% of storage in all historic droughts
 - To account for climate change, droughts more severe than those in the record, and inaccuracies in streamflow and precipitation estimates
- Invoke drought plan restrictions no more often than once every 7 – 10 years
- Firm yield analysis does not account for reserve storage, or for seasonal demand patterns and assumes that inflows are perfect

South Cumberland Scenarios

- 1) Existing
- 2) Proposed local drought plans, no transfers
- 3) Proposed local drought plans & transfers
- 4) Regional operation
- 5) Structural alternatives
 - With proposed local drought plans & transfers
 - With regional operation

Use 2030 demands for all scenarios

South Cumberland Schematic



Existing scenario

- Simulate existing storage and operations for all utilities using 2030 demand levels
- No transfers except ‘normal’ transfers
 - Big Creek to Griffith Creek & Cagle/Fredonia
 - Tracy City to Foster Falls and Monteagle (0.05 mgd)

Proposed drought plans scenario

- Simulate existing storage and operations for all utilities using 2030 demand levels
- No transfers except ‘normal’ transfers
- Utilities adhere to proposed drought plans based on storage levels in own systems
 - Stage 1 demand reductions = 10%
 - Stage 2 demand reductions = 20%

Proposed drought plans & transfers scenario

- Simulate existing storage and operations for all utilities using 2030 demand levels
- Emergency transfers allowed
 - Triggered by storage levels
- Utilities adhere to proposed drought plans based on storage levels in own systems
 - Stage 1 demand reductions = 10%
 - Stage 2 demand reductions = 20%

Regional operation scenario

- Simulate existing storage for all utilities using 2030 demand levels
- Emergency transfers allowed
 - Triggered by storage levels
- Utilities adhere to regional drought plan triggered by total storage in the region
 - Stage 1 demand reductions = 10%
 - Stage 2 demand reductions = 20%

Structural alternatives

- Simulate proposed structural alternatives using 2030 demand levels
 - Ramsey Lake
 - Raising Big Fiery Gizzard dam
 - Proposed Big Creek Lake
- Emergency transfers allowed
- Simulate with proposed local drought plans, and with regional operation

South Cumberland alternatives summary

Scenario	Meets storage objective?	Meets frequency objective?
Existing	No	n/a
Proposed local drought plans	No	No
Proposed local drought plans & transfers	Yes	No
Regional operation	Yes	No
Ramsey Lake, proposed drought plans & transfers	Yes	Yes
Ramsey Lake, regional operation	Yes	Yes
Raised Big Fiery Gizzard, proposed drought plans & transfers	No	No
Raised Big Fiery Gizzard, regional operation	No	No
Raised Big Fiery Gizzard + Ramsey Lake, proposed drought plans & transfers	Yes	Yes
Raised Big Fiery Gizzard + Ramsey Lake, regional operation	Yes	Yes
New Big Creek Reservoir	Yes	n/a

Existing scenario

Utility	Below 20% once every	Max # days below 20%	Min. Storage
Big Creek	80 yrs	53	15 MG 6%
Tracy City	16 yrs	47	21 MG 11%
Monteagle	3 yrs	140	0 MG 0%
Sewanee	80 yrs	22	25 MG 16%

Proposed drought plans & transfers with Ramsey Lake

- Each utility has local drought plan
- Add a storage trigger that initiates transfers
 - 80% of storage for Monteagle
 - 70% of storage for Tracy City
 - Tracy City / Big Creek transfers 55% of demand when trigger is hit
- New demand conservation triggers
 - Stage 1 = 40%
 - Stage 2 = 30%

Proposed drought plans & transfers with Ramsey Lake

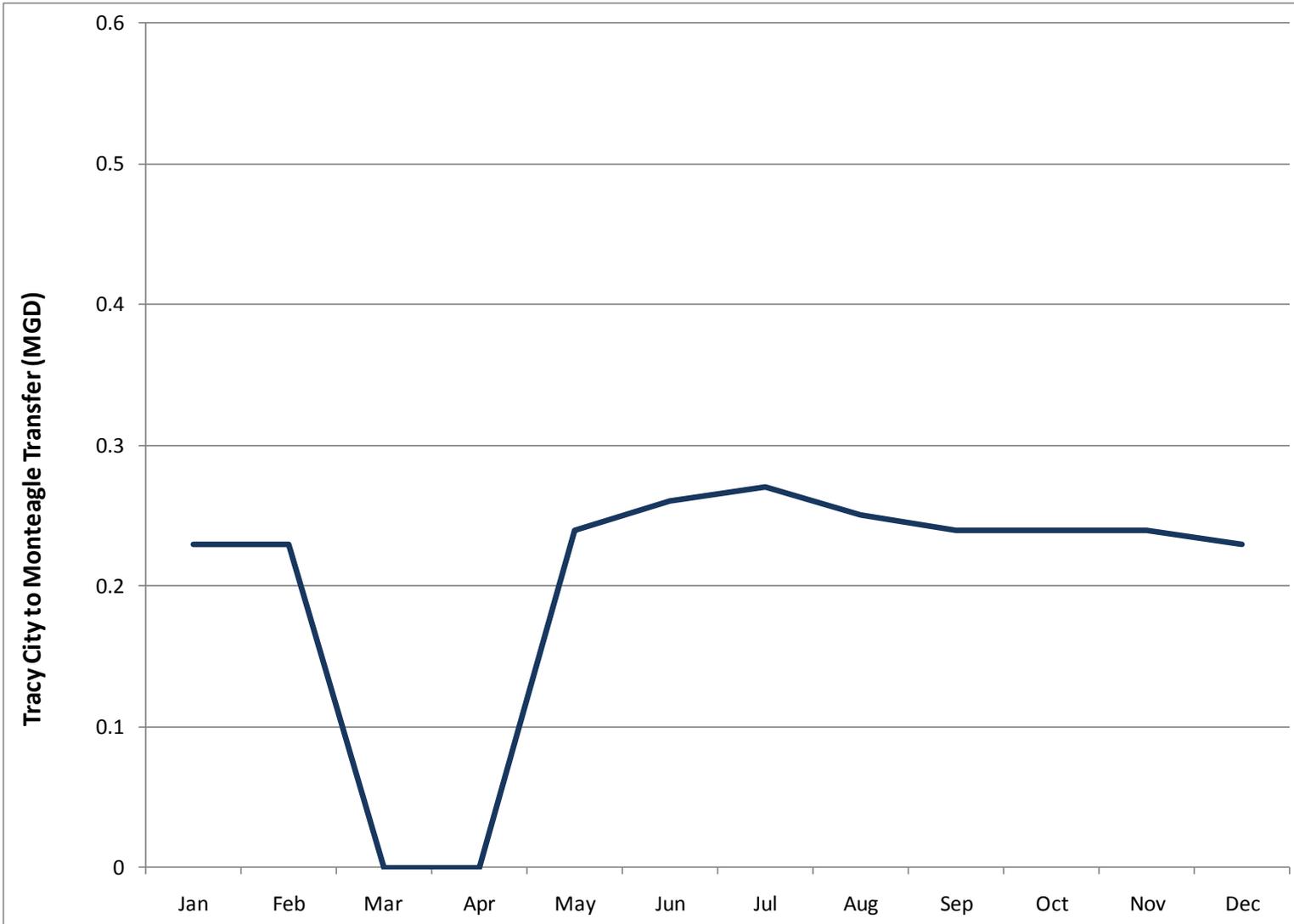
Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek / Ramsey	Never	Never	141 MG 31%	40 yrs	99
Tracy City	Never	Never	57 MG 29%	7 yrs	143
Monteagle	Never	Never	21 MG 23%	7 yrs	165
Sewanee	Never	Never	36 MG 23%	7 yrs	457*

* 1930/1931 is a carry-over drought for some utilities

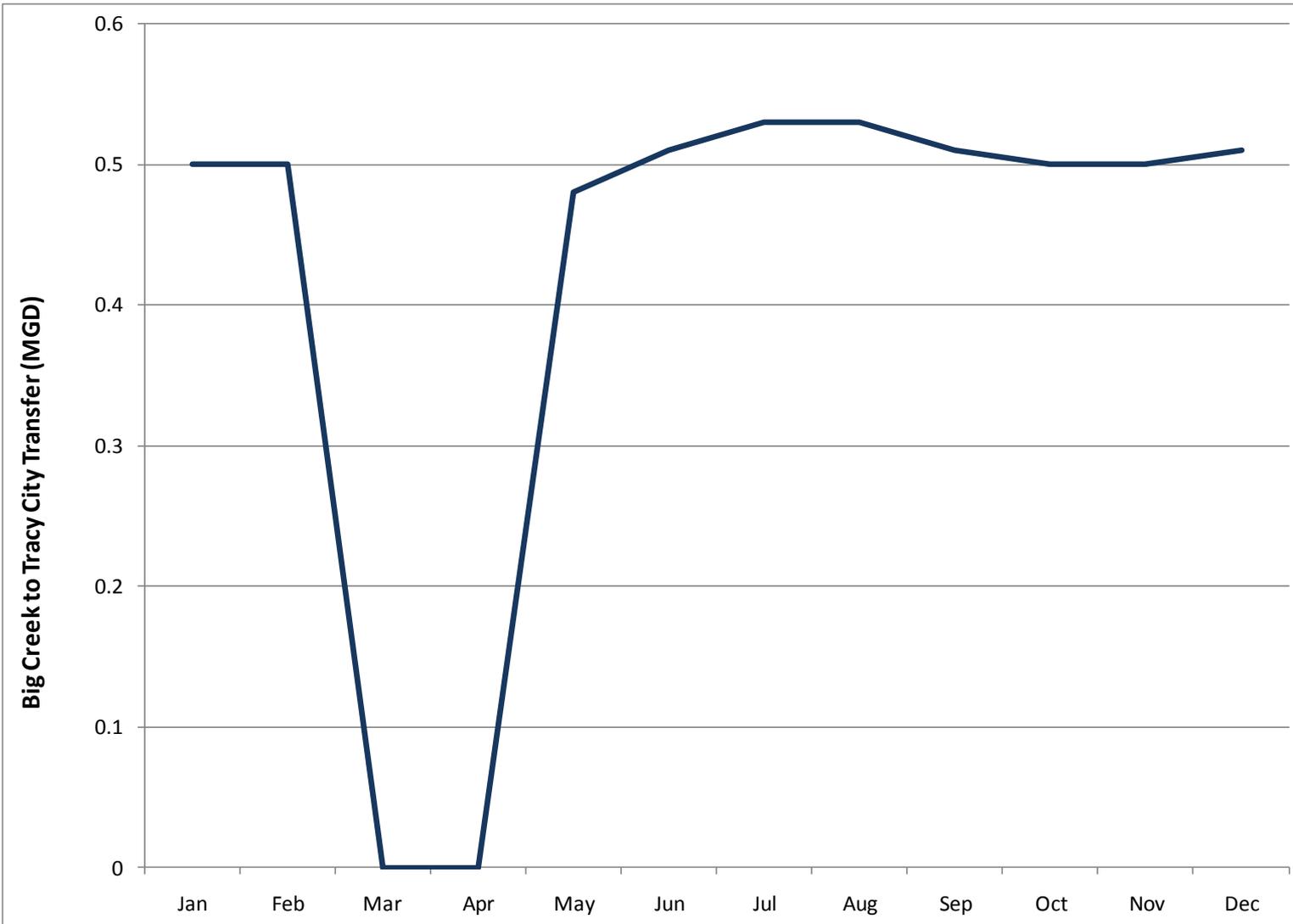
Proposed drought plans & transfers with Ramsey Lake – transfer summary

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	88/236	0.25 / 0.27
Big Creek to Tracy City	<1 years	84/236	0.44 / 0.53

Tracy City to Monteagle transfers by month, Ramsey drought plan & transfers scenario



Big Creek to Tracy City transfers by month, Ramsey drought plan & transfers



Regional operation with Ramsey Lake

- Triggers for all utilities based on total regional storage
- Transfers operation same as previous scenario
- Stage 1
 - Trigger = 48% regional usable storage remaining
 - Demand reduction = 10%
- Stage 2
 - Trigger = 40% usable storage remaining
 - Demand reduction = 20% (total)

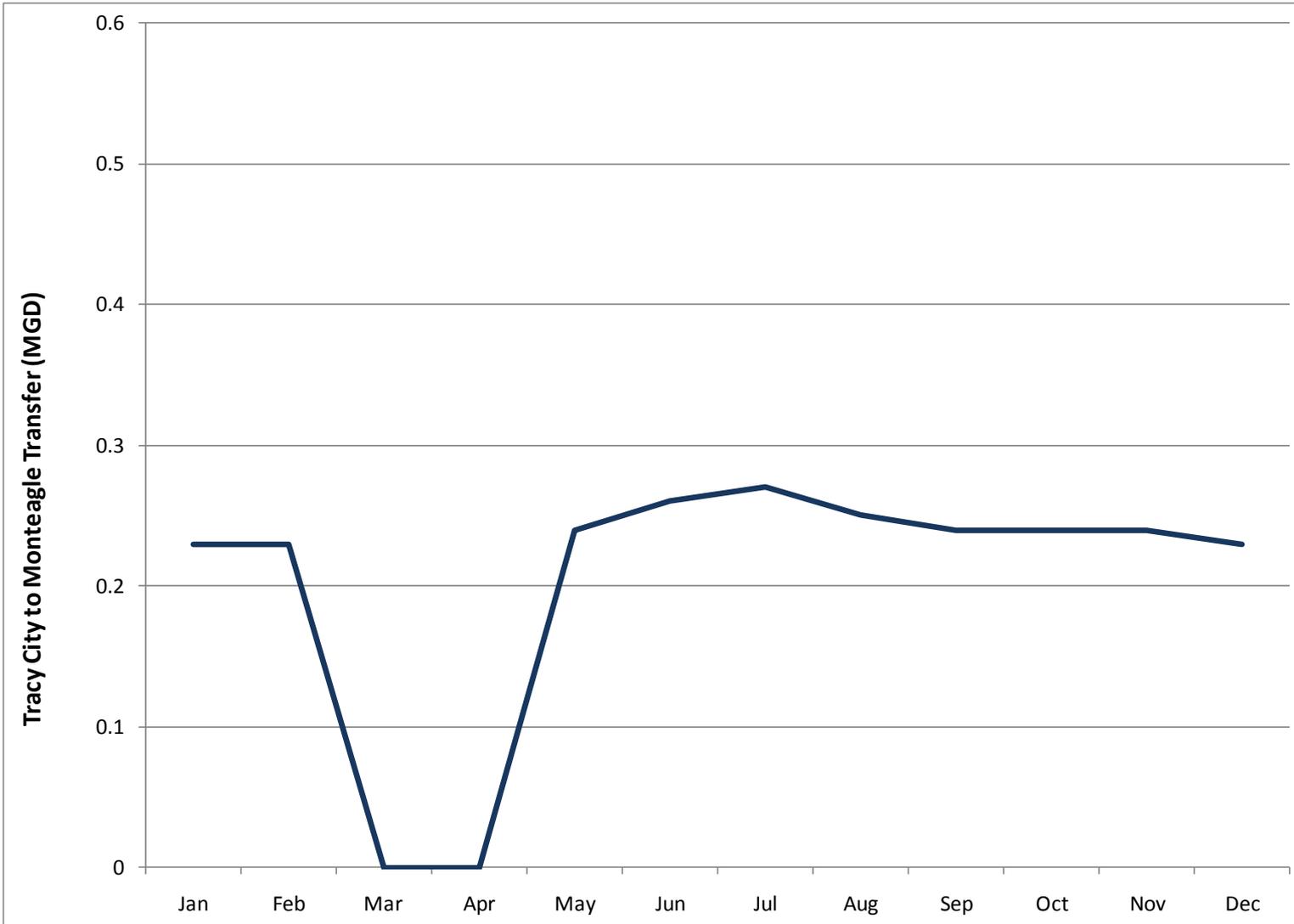
Regional operation with Ramsey Lake

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek / Ramsey	Never	Never	148 MG 33%	7 yrs	147
Tracy City	Never	Never	63 MG 32%	7 yrs	147
Monteagle	Never	Never	18 MG 20%	7 yrs	147
Sewanee	Never	Never	33 MG 21%	7 yrs	147
Regional Storage	Never	Never	267 MG 30%	7 yrs	147

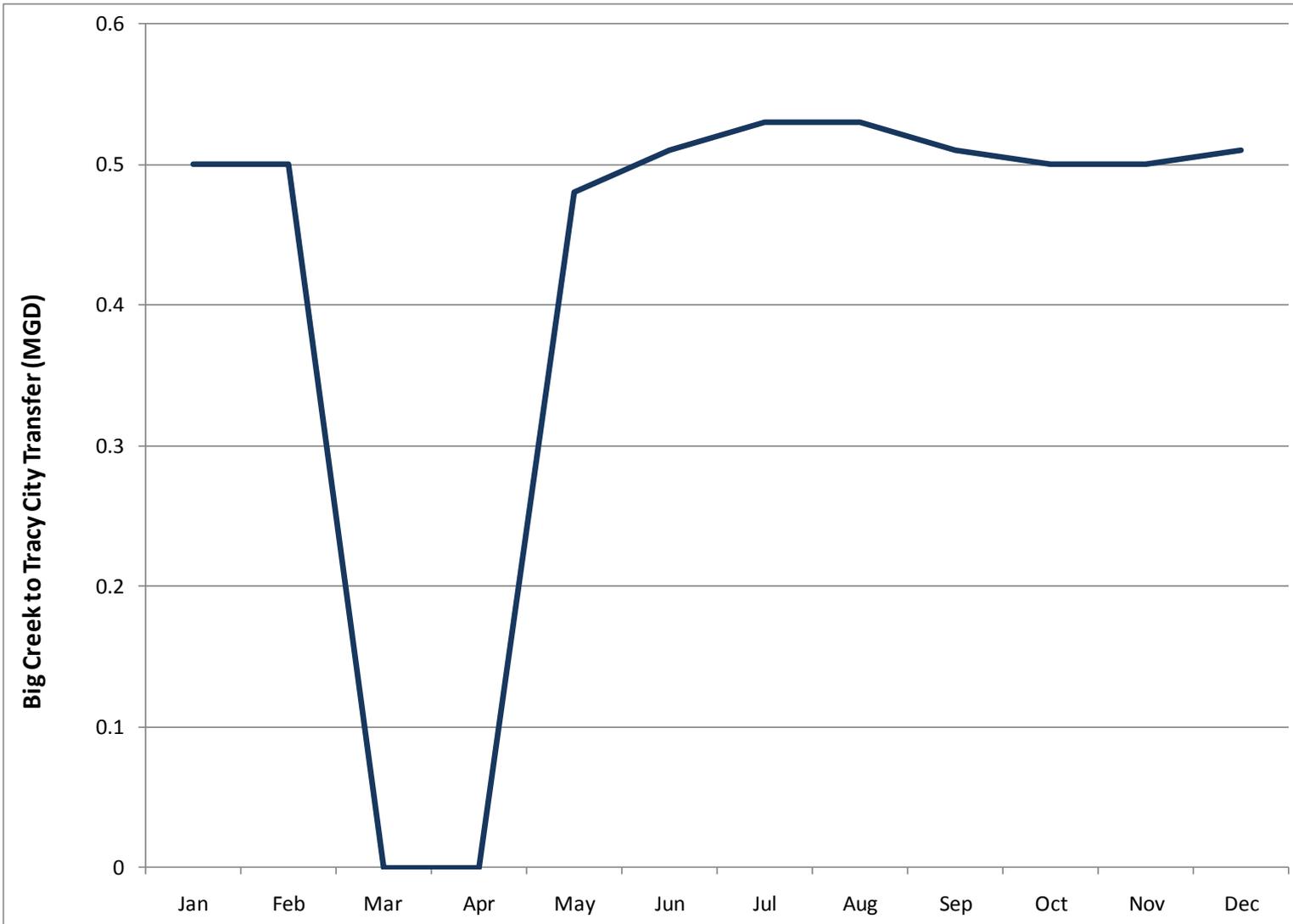
Regional operation with Ramsey Lake – transfer summary

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	44/236	0.25 / 0.27
Big Creek to Tracy City	<1 years	44/236	0.44 / 0.53

Tracy City to Monteagle transfers by month, Ramsey Lake regional operation scenario



Big Creek to Tracy City transfers by month, Ramsey Lake regional operation scenario



Proposed drought plans & transfers with Ramsey Lake & raised Big Fiery Gizzard

- Each utility has local drought plan
- Add a storage trigger that initiates transfers
 - 80% of storage
 - Tracy City / Big Creek transfers 55% of demand when trigger is hit – Big Creek only transfers Monteagle portion
- New demand conservation triggers
 - Stage 1 = 40%
 - Stage 2 = 30%

Proposed drought plans & transfers with Ramsey Lake & raised Big Fiery Gizzard

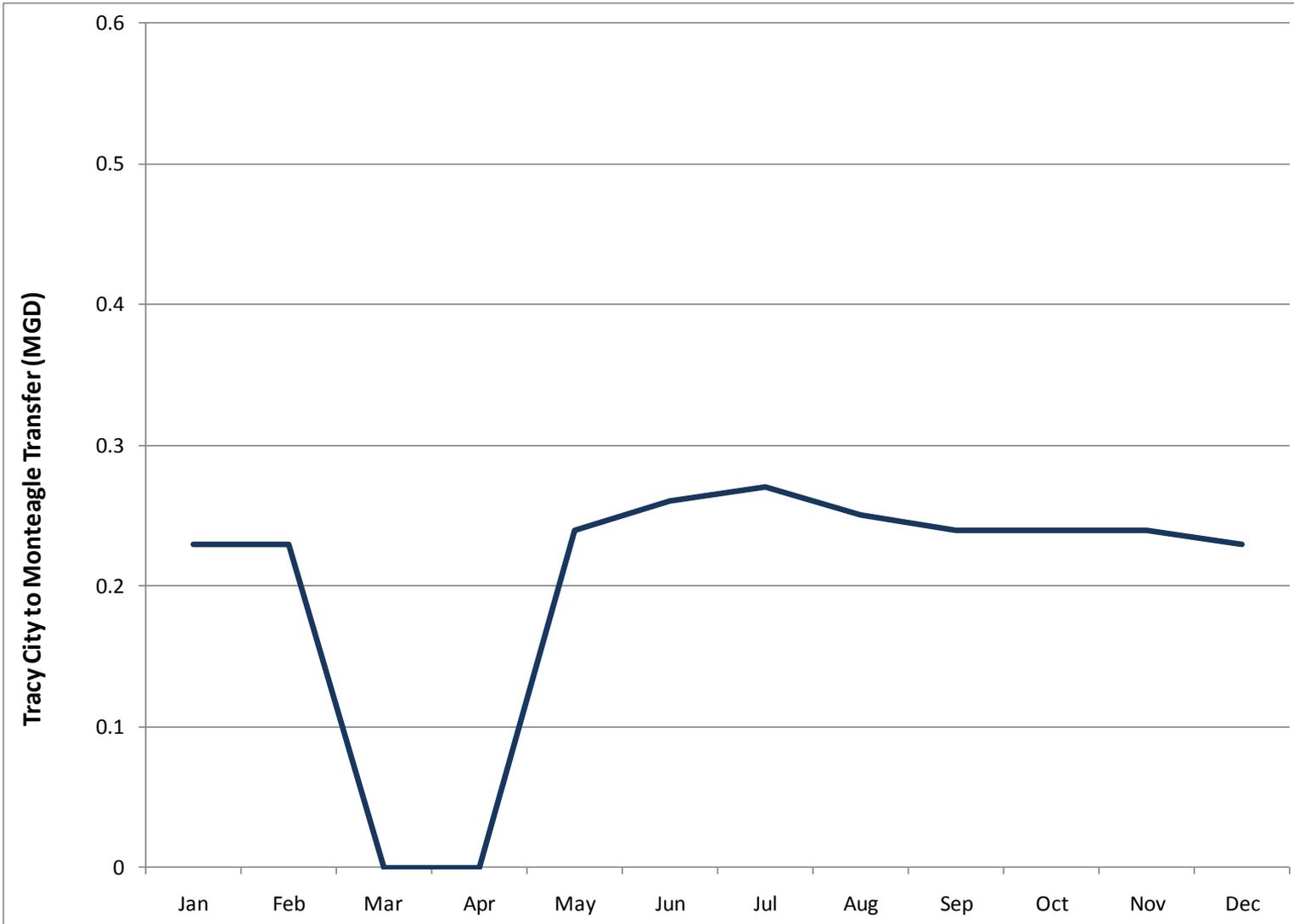
Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek / Ramsey	Never	Never	176 MG 39%	40 yrs	65
Tracy City	Never	Never	79 MG 22%	7 yrs	454*
Monteagle	Never	Never	21 MG 23%	7 yrs	164
Sewanee	Never	Never	36 MG 23%	7 yrs	457*

* 1930/1931 is a carry-over drought for some utilities

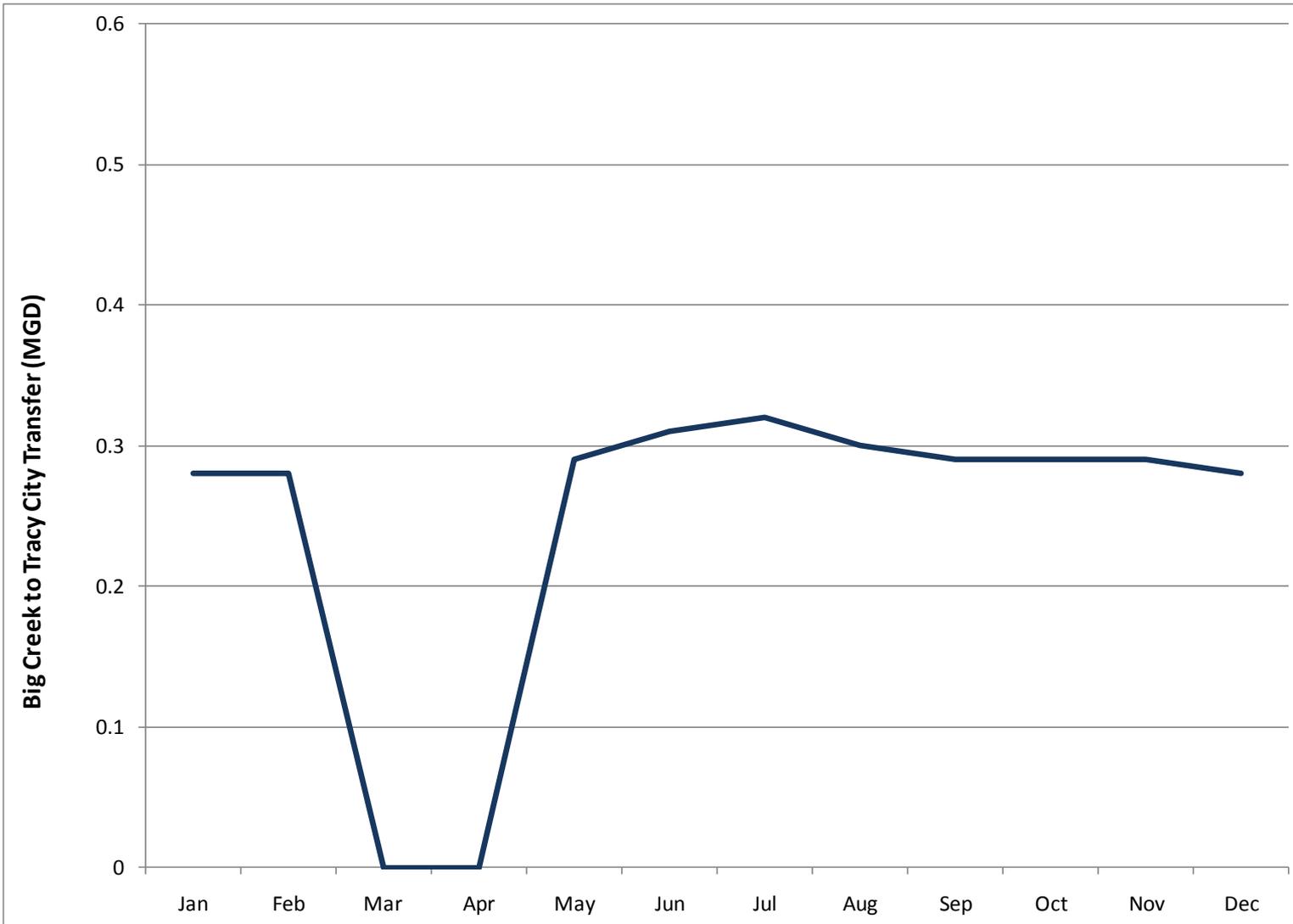
Proposed drought plans & transfers with Ramsey Lake & raised Big Fiery Gizzard

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	88/236	0.25 / 0.27
Big Creek to Tracy City	1.5 years	83/225	0.29 / 0.32

Tracy City to Monteagle transfers, Ramsey & raised Big Fiery Gizzard



Big Creek to Tracy City transfers, Ramsey & raised Big Fiery Gizzard



Regional operation with Ramsey Lake & raised Big Fiery Gizzard

- Each utility has local drought plan
- Add a storage trigger that initiates transfers
 - 80% of storage
 - Tracy City / Big Creek transfers 55% of demand when trigger is hit – Big Creek only transfers Monteagle portion
- New demand conservation triggers
 - Stage 1 = 40%
 - Stage 2 = 30%

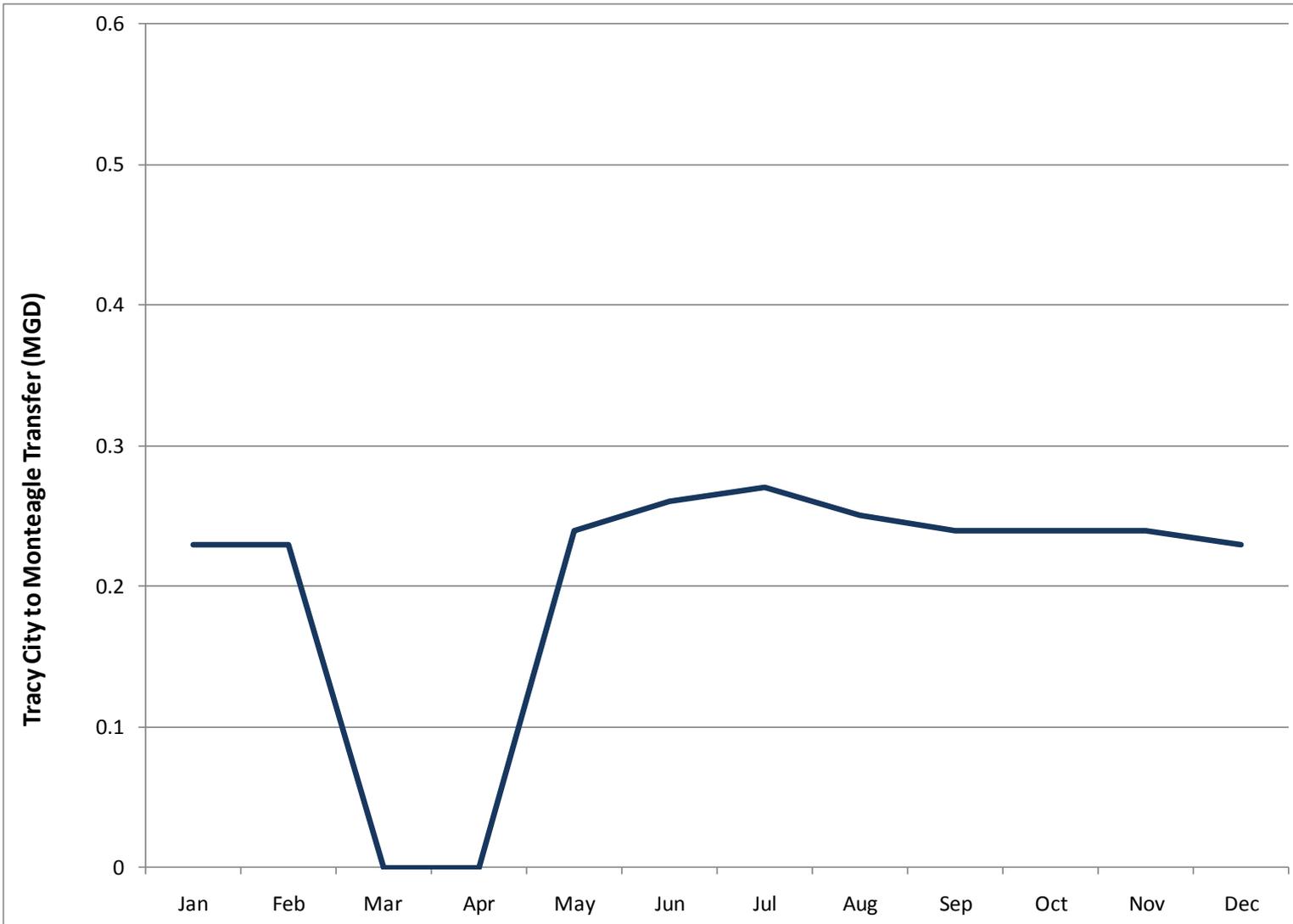
Regional operation with Ramsey Lake & raised Big Fiery Gizzard

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek / Ramsey	Never	Never	188 MG 42%	7 yrs	151
Tracy City	Never	Never	75 MG 21%	7 yrs	151
Monteagle	Never	Never	18 MG 20%	7 yrs	151
Sewanee	Never	Never	33 MG 21%	7 yrs	151
Regional Total	Never	Never	320 MG 30%	7 yrs	151

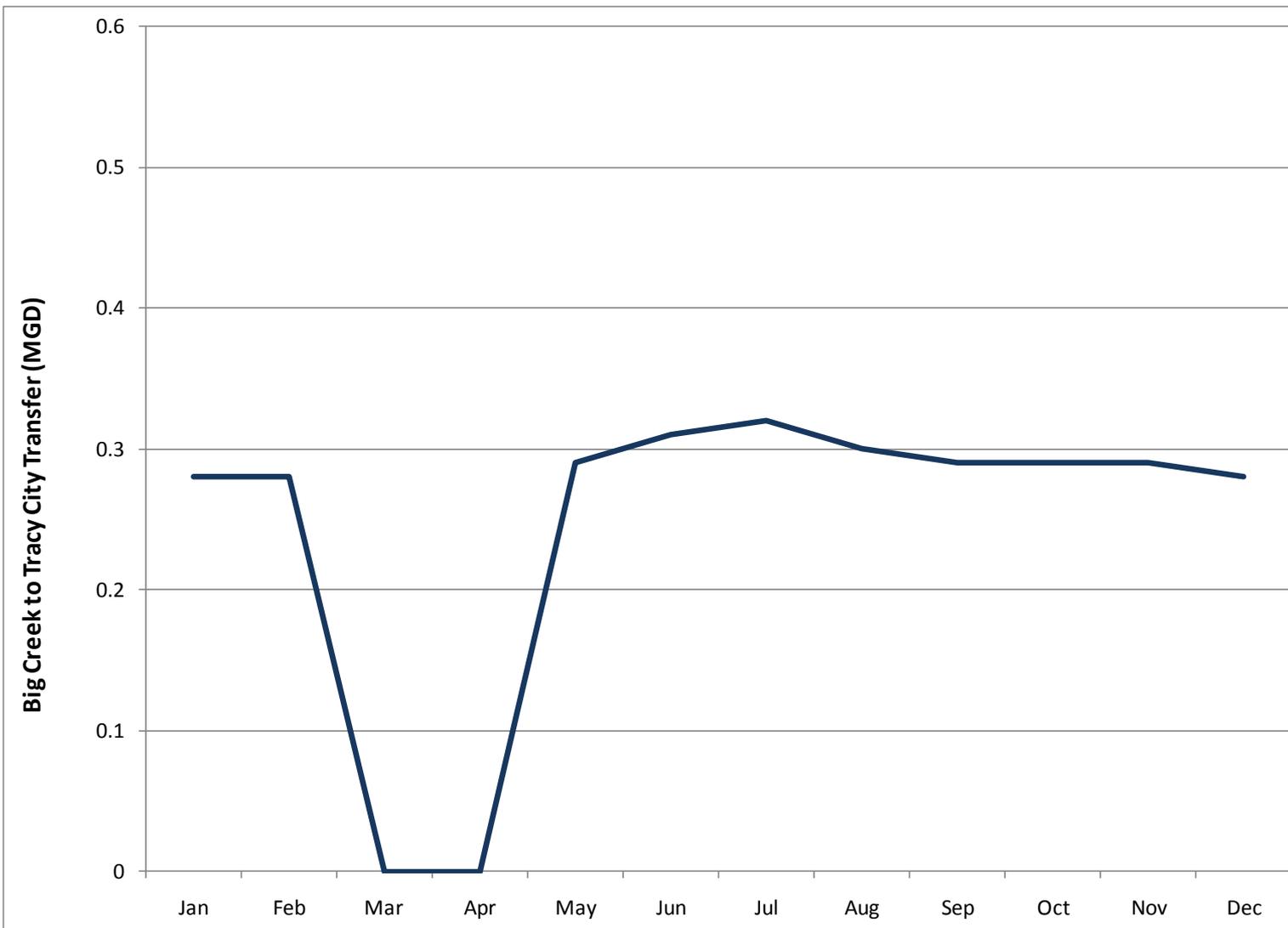
Regional operation with Ramsey Lake & raised Big Fiery Gizzard

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	44/236	0.25 / 0.27
Big Creek to Tracy City	1.5 years	51/225	0.29 / 0.32

Tracy City to Monteagle transfers, Ramsey & raised Big Fiery Gizzard regional op.



Big Creek to Tracy City transfers , Ramsey & raised Big Fiery Gizzard regional op.



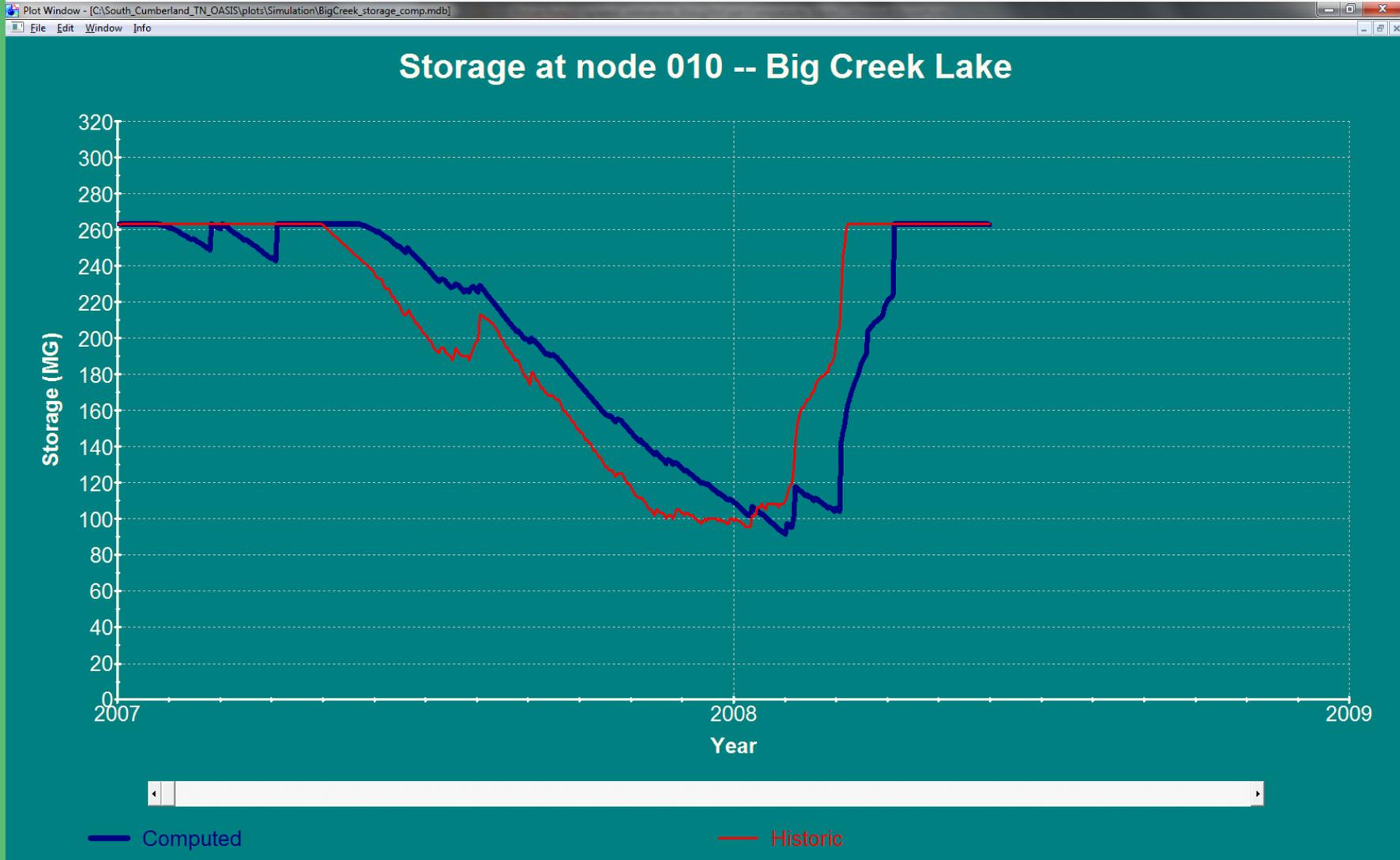
New Big Creek Lake alternative

- Available storage = 1775 MG
- Ran scenario w/ transfers allowed
- Results
 - No shortages
 - Individual utility and region storage never drops below 20% of total storage
 - At a minimum transfers to Tracy City / Monteagle would need to be amount from Ramsey scenarios

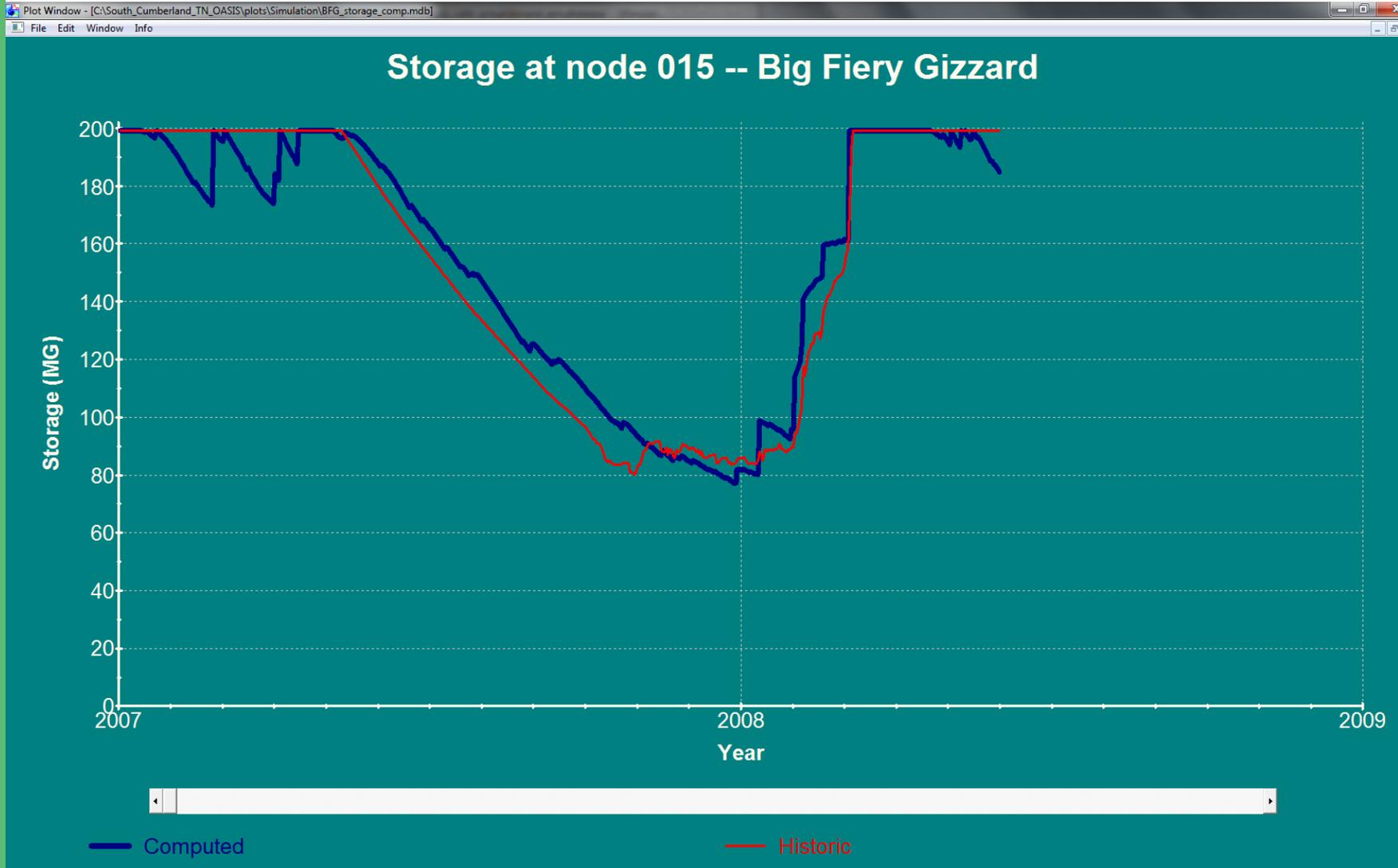
Questions / Discussion

Extra slides

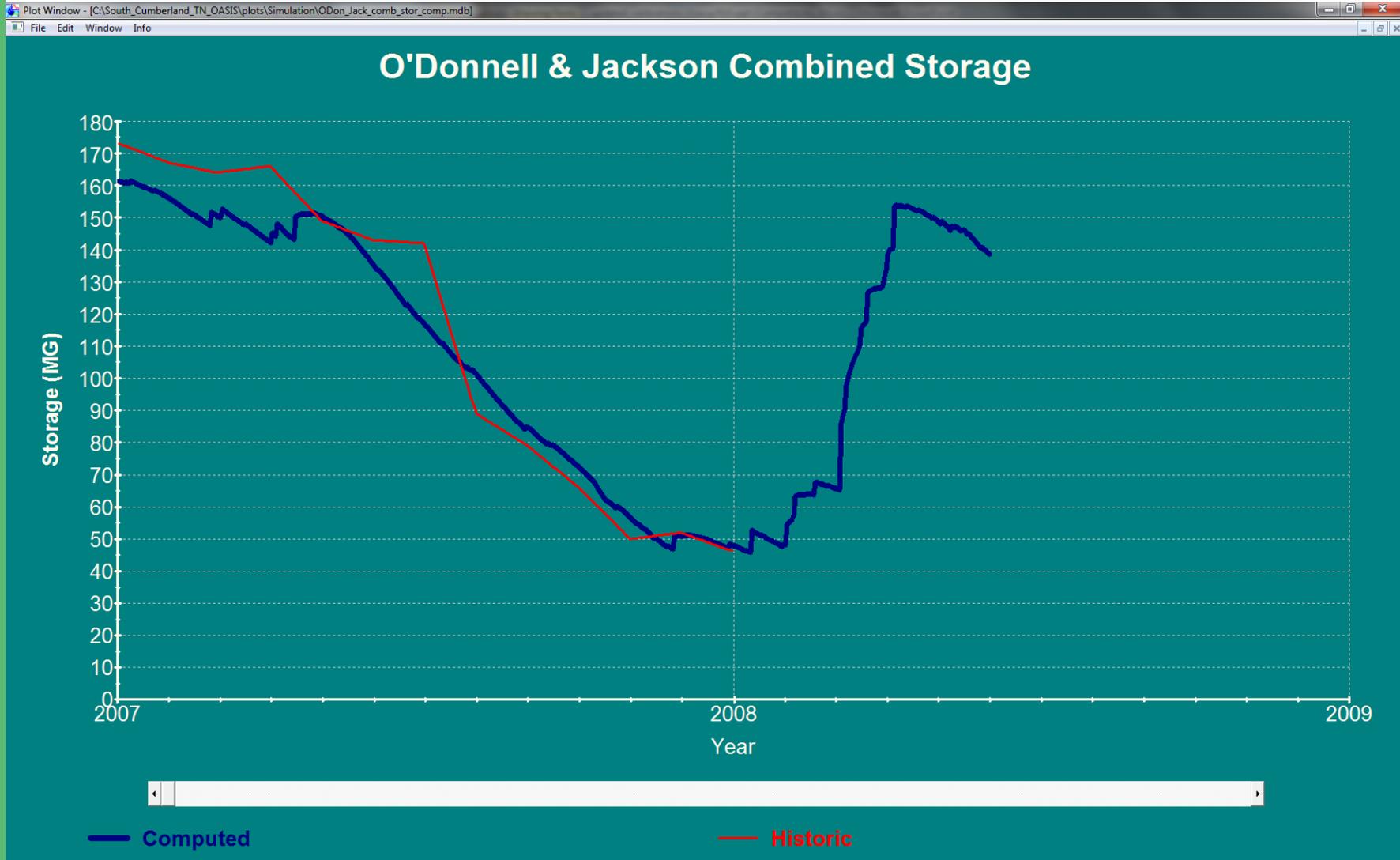
Big Creek Lake validation



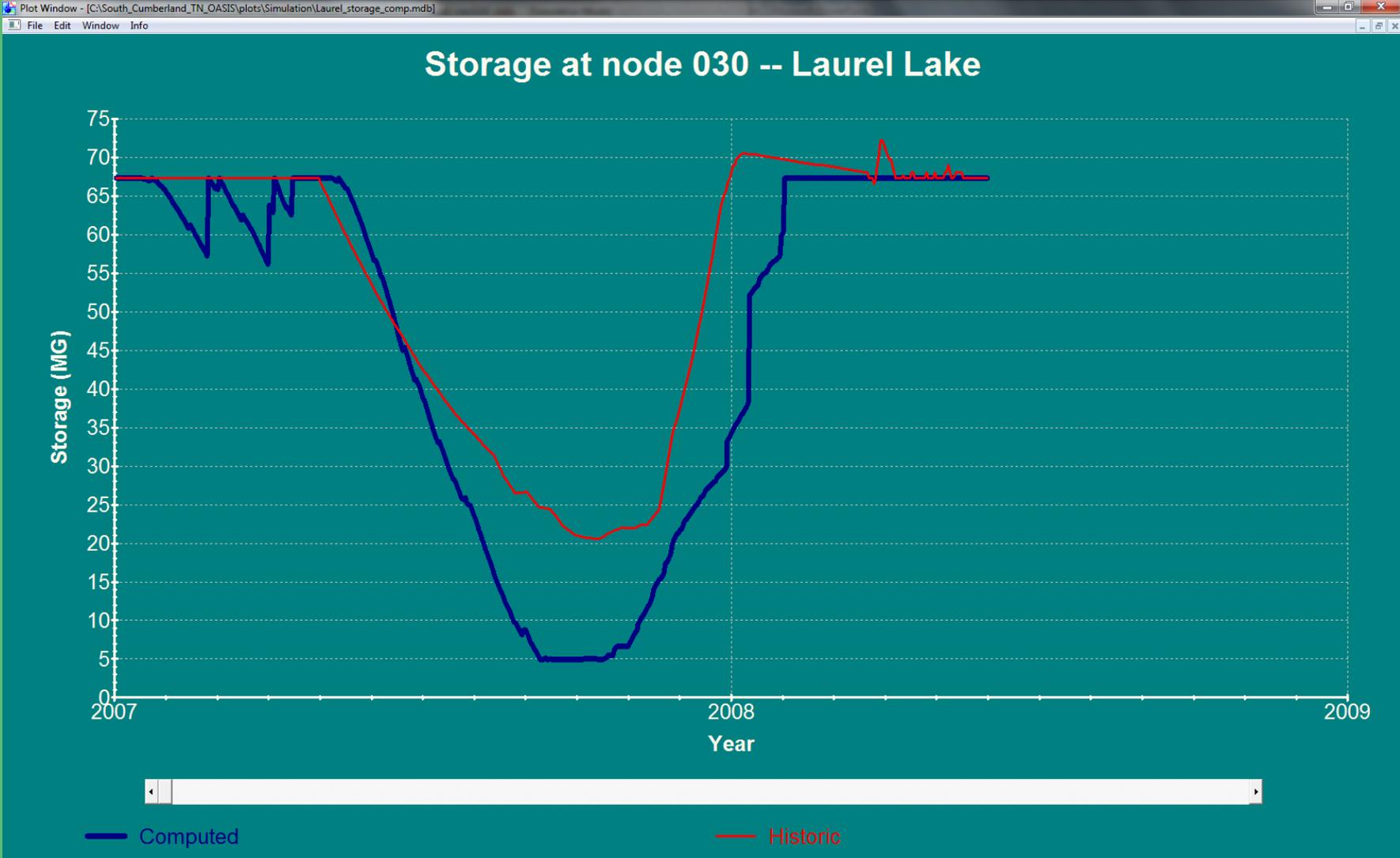
Big Fiery Gizzard validation



Sewanee – Combined O'Donnell and Jackson storage – validation



Lake Laurel validation





Drought plans & transfers with raised Big Fiery Gizzard Dam – alt. minimum release

- Minimum release fixed at 0.53 cfs
- Each utility has local drought plan
- Add a storage trigger that initiates transfers
 - 80% of storage for Monteagle
 - Tracy City Transfers 55% of Monteagle demand
- Demand conservation triggers
 - Stage 1 = 40%
 - Stage 2 = 30%

Drought plans & transfers with raised Big Fiery Gizzard Dam – alt. minimum release

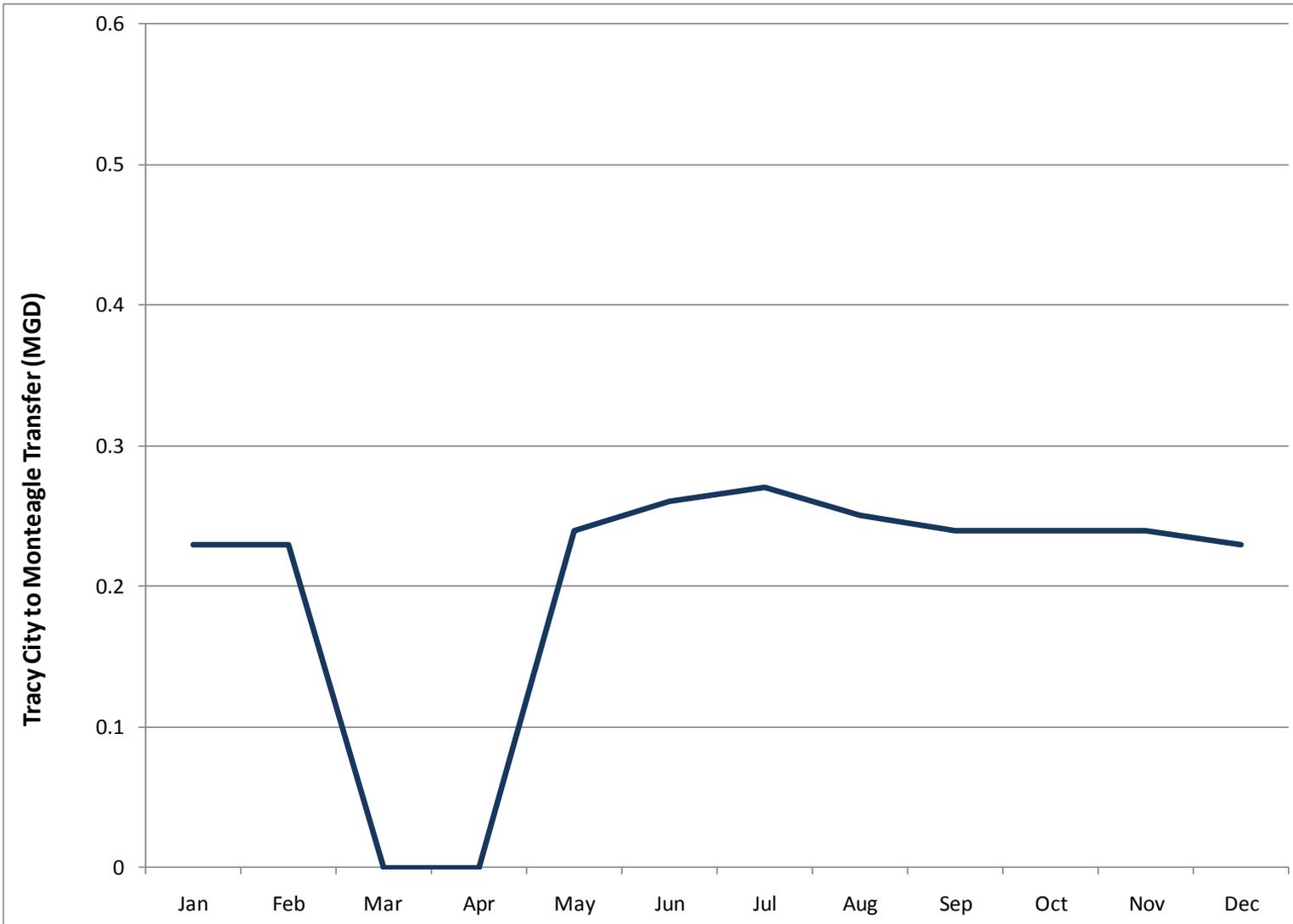
Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek	Never	Never	52 MG 20%	9 yrs	398*
Tracy City	Never	Never	75 MG 20%	8 yrs	439*
Monteagle	Never	Never	21 MG 23%	7 yrs	165
Sewanee	Never	Never	36 MG 23%	7 yrs	457*

* 1930/1931 is a carry-over drought for some utilities

Drought plans & transfers with raised Big Fiery Gizzard Dam – alt. minimum release

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	88/237	0.25 / 0.27

Tracy City to Monteagle transfers, raised Big Fiery Gizzard Dam – alt. minimum release





Drought plans & transfers with raised Big Fiery Gizzard Dam

- Each utility has local drought plan
- Add a storage trigger that initiates transfers
 - 80% of storage for Monteagle
 - Tracy City Transfers 55% of Monteagle demand
- Demand conservation triggers
 - Stage 1 = 40%
 - Stage 2 = 30%

Drought plans & transfers with raised Big Fiery Gizzard Dam

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek	Never	Never	52 MG 20%	9 yrs	398*
Tracy City	20	68	34 MG 9.2%	3 yrs	494*
Monteagle	Never	Never	21 MG 23%	7 yrs	165
Sewanee	Never	Never	36 MG 23%	7 yrs	457*

* 1930/1931 is a carry-over drought for some utilities

Drought plans & transfers with raised Big Fiery Gizzard Dam – transfer summary

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	88/237	0.25 / 0.27

Regional operation with raised Big Fiery Gizzard Dam

- Triggers for all utilities based on total regional storage
- Transfers operation same as previous scenario
- Stage 1
 - Trigger = 50% regional usable storage remaining
 - Demand reduction = 10%
- Stage 2
 - Trigger = 40% usable storage remaining
 - Demand reduction = 20% (total)

Regional operation raised Big Fiery Gizzard Dam

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Drought restrictions once every	Max # days in restrictions
Big Creek	Never	Never	70 MG 26%	3 yrs	497*
Tracy City	20 yrs	71	31 MG 8.5%	3 yrs	497*
Monteagle	Never	Never	21 MG 23%	3 yrs	497*
Sewanee	Never	Never	42 MG 27%	3 yrs	497*
Regional Total	Never	Never	177 MG 20%	3 yrs	497*

* 1930/1931 is a carry-over drought for some utilities

Regional operation with raised Big Fiery Gizzard Dam – transfer summary

Transfer	# Transfer events once every	Avg/Max # days with transfers	Avg/Max amount transferred (MGD)
Tracy City to Monteagle	<1 years	88/237	0.25 / 0.27