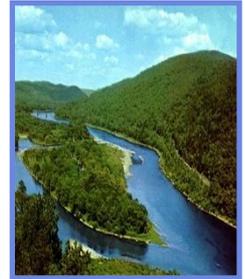


TN State Water Supply Pilot Study

OASIS Modeling



Columbia, MD

Raleigh, NC

Portland, OR

Boston, MA

Reliability Objectives

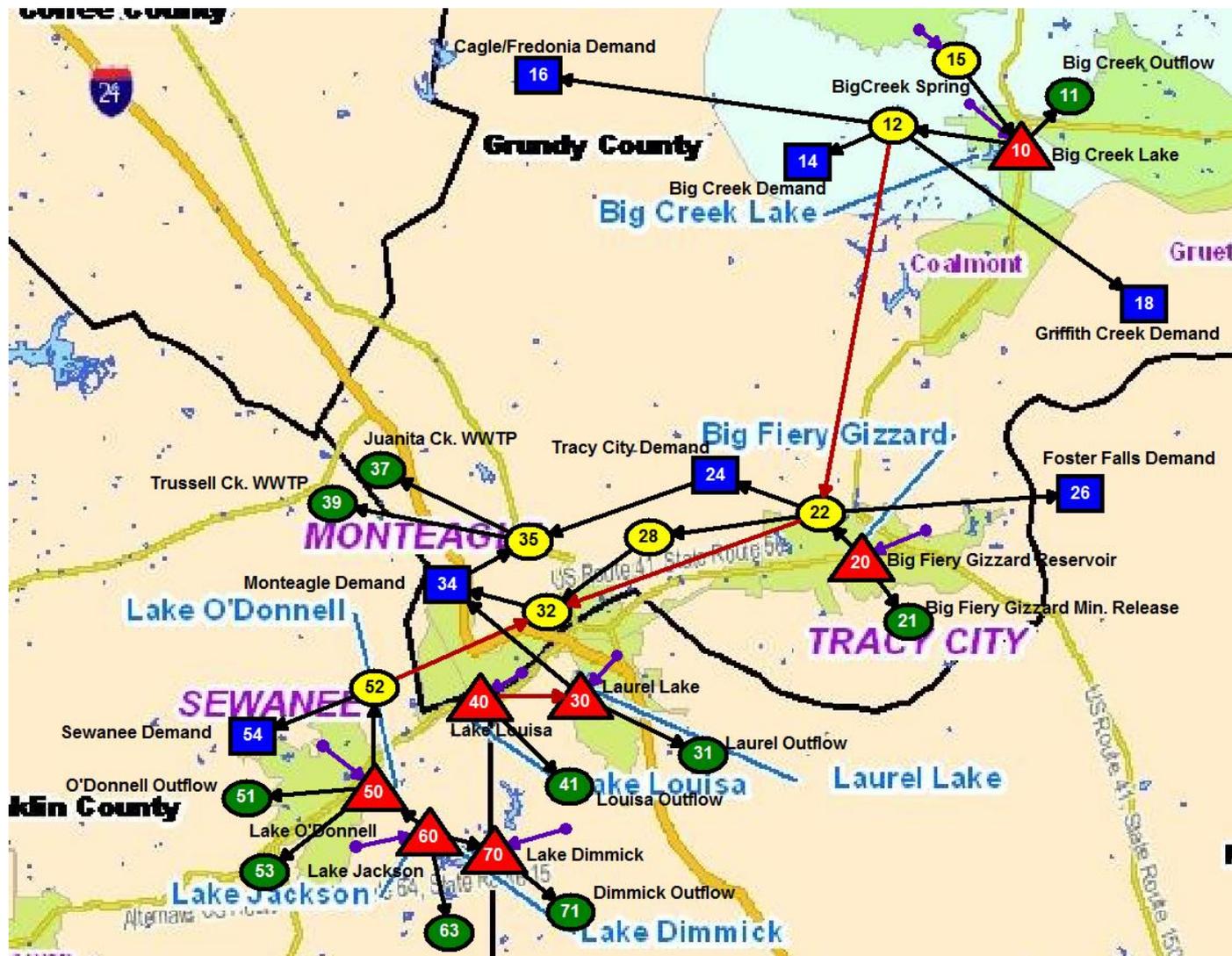
- Preserve 20% of storage in all historic droughts
 - To account for climate change, droughts more severe than those in the record, and inaccuracies in streamflow and precipitation estimates
- Invoke Stage 1 drought plan restrictions no more often than once every 7 – 10 years, Stage 2 every 16-20 years
- Firm yield analysis does not account for distribution system storage, or for seasonal demand patterns and assumes that inflows are perfect

South Cumberland Scenarios

- 1) Basecase – no drought plans, no transfers
- 2) Local drought plans, no transfers
- 3) Regional cooperation
 - No restrictions on transfers
 - Transfers made when primary source is depleted
- 4) Regional cooperation with local drought plans
- 5) Regional drought plan (applies to all systems)

Use 2030 demands for all scenarios

South Cumberland Schematic



Local Drought Plans

- Simulate drought plans for each utility using sample from NC regulations
- Stage 1
 - Trigger = 70% usable storage remaining
 - Demand reduction = 10%
- Stage 2
 - Trigger = 40% usable storage remaining
 - Demand reduction = 20% (total)

Regional Drought Plan

- Goal - a drought plan based on total usable storage that preserved 20% of usable storage during the worst drought in the record
- Stage 1
 - Trigger = 55% storage remaining
 - Demand reduction = 10%
 - Lift restrictions when storage refills to 90%
- Stage 2
 - Trigger = 45% Storage remaining
 - Demand reduction = 20% (total)
 - Lift restrictions when storage refills to 80%

1) Basecase

Utility	Below 20% once every	Max # days below 20%	Min. Storage
Big Creek	never	0	97 MG
Tracy City	5 yrs	125	0 MG
Monteagle	2.5 yrs	153	0 MG
Sewanee	80 yrs	34	19 MG

2) Local Drought Plans

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Ph. 1 events once every	Ph. 2 events once every	Max # days in restrict- ions
Big Creek	never	0	109 MG	2.5 yrs	never	199
Tracy City	6 yrs	108	1 MG	< 1 yrs ¹	2 yrs	270
Monteagle	3 yrs	148	0 MG	1 yrs ¹	2 yrs	247
Sewanee	never	0	43 MG	1.5 yrs	7 yrs	565 ²

1 - Some years have multiple activations of the drought plan

2 -1930/1931 is a carry-over drought for Sewanee

3) Regional Cooperation

Utility	Below 20% once every	Max # days below 20%	Min. Storage
Big Creek	80 yrs	11	42 MG
Tracy City	5 yrs	125	0 MG
Monteagle	2.5 yrs	153	0 MG
Sewanee	14 yrs	100	2 MG

3) Regional Cooperation – Transfers

Transfer	# Transfer events once every	Max # days with transfers	Avg/Max amount transferred (MGD)
Sewanee to Monteagle	3 years	43	0.4 / 0.5
Tracy City to Monteagle	11 years	41	0.4 / 0.5
Big Creek to Tracy City	20 years	35	1.0 / 1.2

Note: Gave preference for transfers to Monteagle from Sewanee, then Tracy City, then Big Creek. Transfers initiated when reservoir storage depleted.

4) Regional Cooperation

Local Drought Plans

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Ph. 1 events once every	Ph. 2 events once every	Max # days in restrict- ions
Big Creek	never	0	100 MG	2.5 yrs	80	199
Tracy City	6 yrs	111	1 MG	< 1 yrs ¹	2 yrs	272
Monteagle	3 yrs	148	0 MG	1 yrs ¹	1.7 yrs	247
Sewanee	40 yrs	28	24 MG	1.5 yrs	7 yrs	565 ²

- 1 - Some years have multiple activations of the drought plan
- 2 -1930/1931 is a carry-over drought for Sewanee

4) Regional Cooperation with Local Drought Plans – transfer summary

Transfer	# Transfer events once every	Max # days with transfers	Avg/Max amount transferred (MGD)
Sewanee to Monteagle	7 years	36	0.3 / 0.4
Tracy City to Monteagle	16 years	25	0.3 / 0.4
Big Creek to Tracy City	40 years	20	0.7 / 1.0

Note: Gave preference for transfers to Monteagle from Sewanee, then Tracy City, then Big Creek. Transfers initiated when reservoir storage depleted.

5) Regional Drought Plan

Utility	Below 20% once every	Max # days below 20%	Min. Storage	Ph. 1 events once every	Ph. 2 events once every	Max # days in restrict- ions
Region	80 yrs	19	121 MG	2 yrs	4 yrs	215

5) Regional Drought Plan – transfers

Transfer	Drought Plan?	# Transfer events once every	Max # days with transfers	Avg/Max amount transferred (MGD)
Sewanee to Monteagle	Regional	4 years	9	0.3 / 0.4
Tracy City to Monteagle	Regional	12 years	24	0.3 / 0.5
Big Creek to Tracy City	Regional	20 years	22	0.75 / 1.0

Note: Gave preference for transfers to Monteagle from Sewanee, then Tracy City, then Big Creek. Transfers initiated when reservoir storage depleted.

Summary

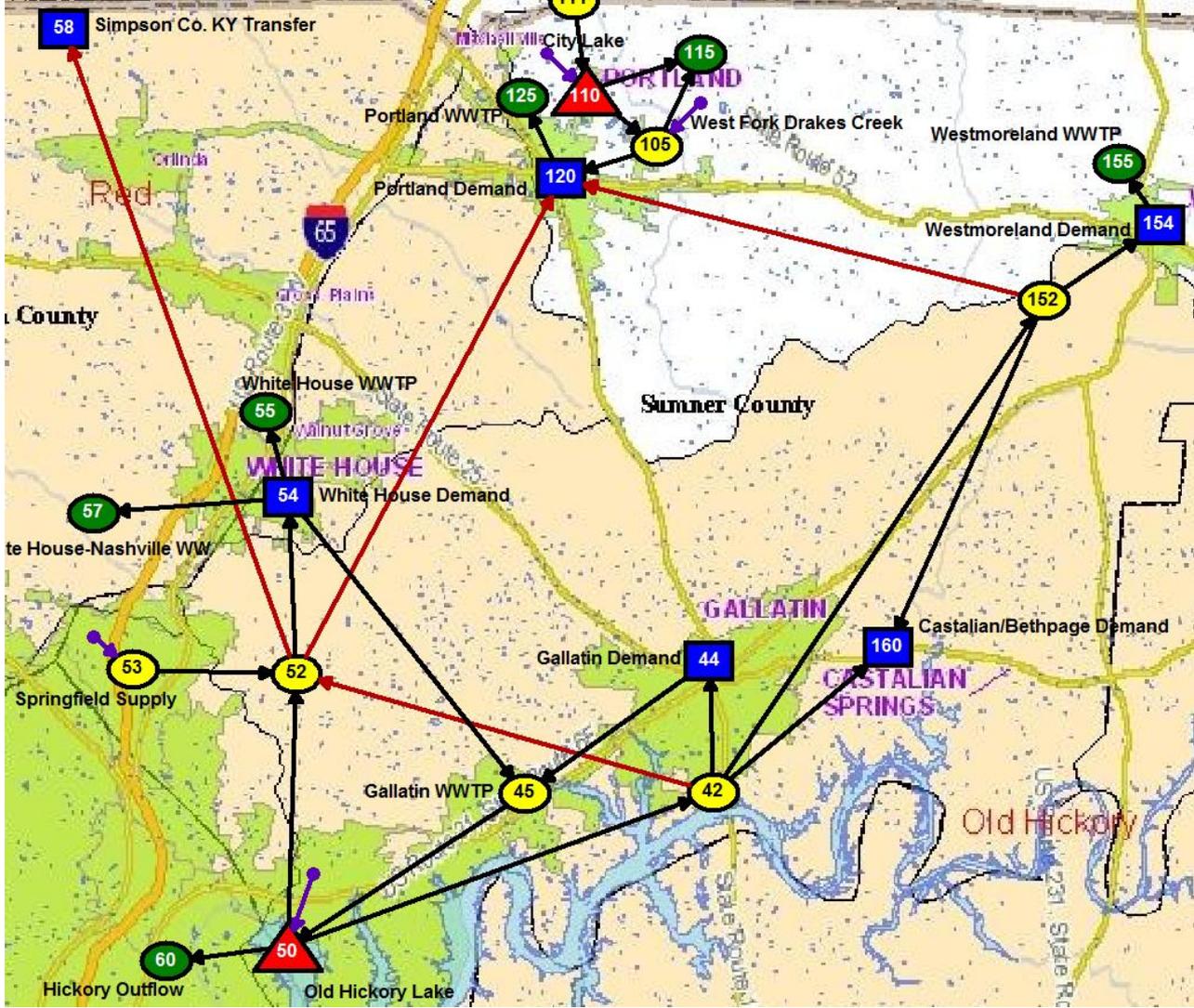
- South Cumberland Pilot Area
 - Big Creek and Sewanee have reliable sources
 - Local drought plan implementation does not improve Tracy City or Monteagle reliability
 - Regional cooperation and drought measures ensure water source is not depleted
 - Require drought mitigation measures to be enacted every 2-4 years – not acceptable
 - Additional source development appears necessary to reduce drought impacts

North Central Scenarios

- 1) Basecase – no drought plan or transfers
- 2) Local drought plan (Portland), no transfers
- 3) Regional cooperation
 - No restrictions on transfers
 - Transfers made when primary source is depleted
- 4) Regional cooperation with local drought plan

Use 2030 demands for all scenarios

North Central Schematic



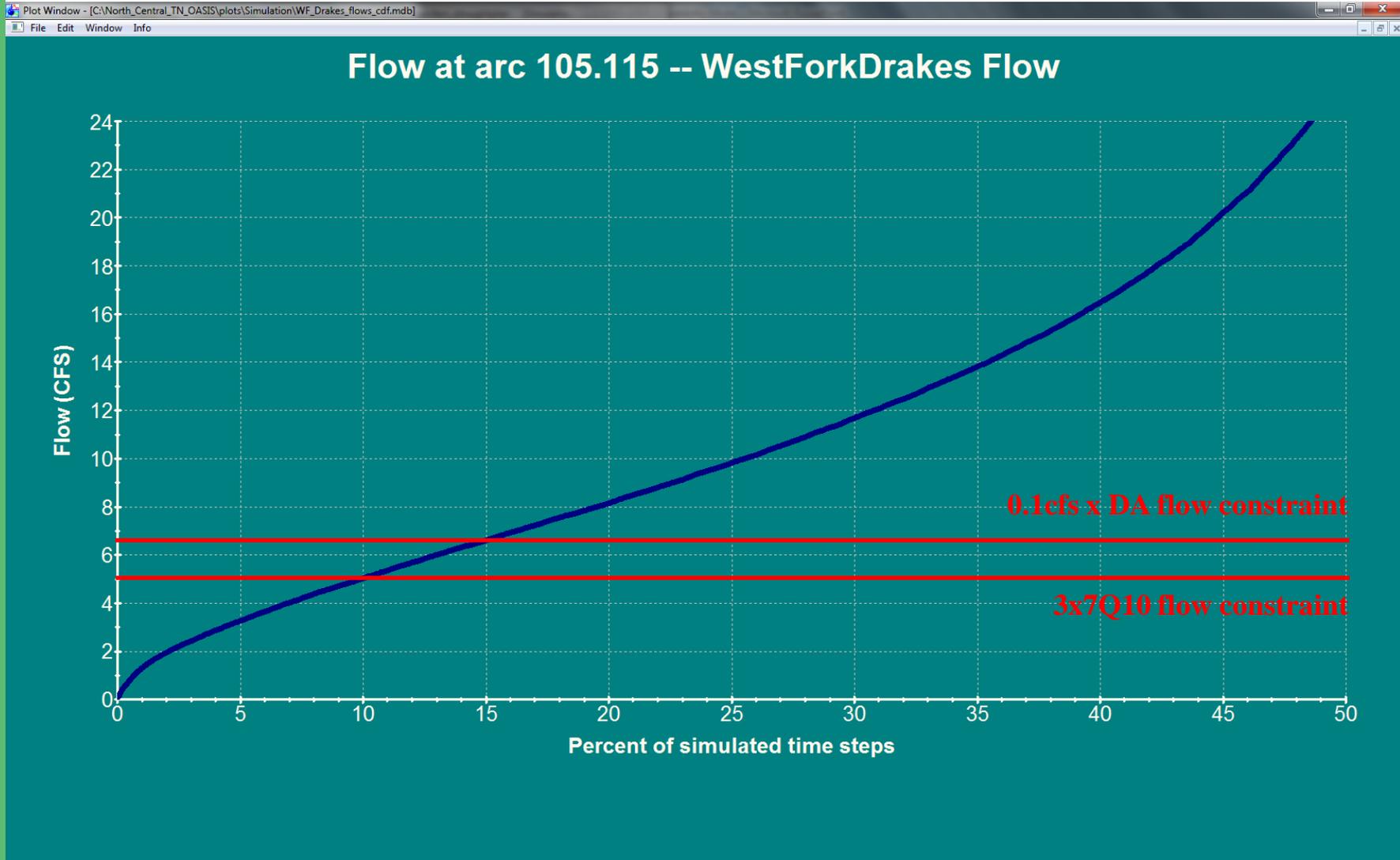
1) Basecase scenario - Portland

Below 20% once every	Max days below 20%	Min. Storage
16 yrs	122	0 MG

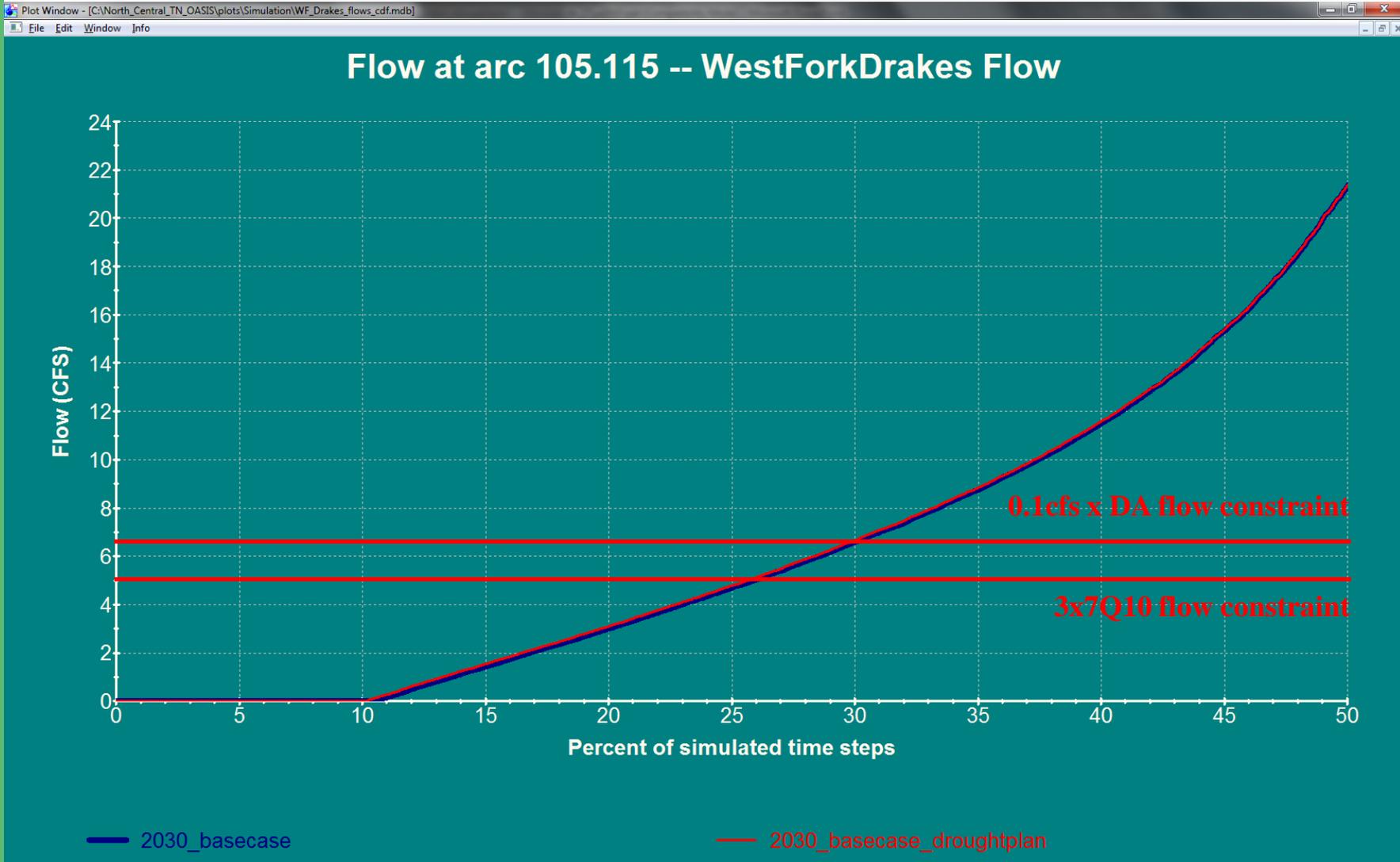
2) Local drought plan - Portland

Below 20% once every	Max days below 20%	Min. Storage	Ph. 1 events once every	Ph. 2 events once every	Max # days in restrictions
40 yrs	100	0 MG	3 yrs	16 yrs	168

WF Drakes Creek flows without any withdrawals



WF Drakes Creek flows – Impact of drought plan



3) Regional cooperation – transfers summary

Scenario	# Transfer events once every*	Max # days with transfers	Avg/Max amount transferred
Transfers	20 years	39	1.9 / 2.9 MGD

*Gave preference to transfers from White House, Westmoreland is also able to transfer to Portland

Note: Storage and flow results same as scenario 1 because transfers are not made unless Portland's internal supply is depleted

3) Regional cooperation with local drought plan – transfers summary

Scenario	# Transfer events once every	Max # days with transfers	Avg/Max amount transferred
Transfers with drought plan	80 years	26	1.9 / 2.5 MGD

Summary

- North Central Tennessee Pilot Area
 - Portland does not have a reliable source of water
 - Implementation of local drought mitigation measures improves reliability – too frequently enacted
 - Large periodic transfers from adjacent utility required to make up deficit

Next Steps :

- Each utility has local drought plan – existing triggers will be incorporated into evaluation
- Add a storage trigger that initiates transfers
 - 70% of storage (instead of 0%) - proposed
 - Start by transferring the amount that would be conserved in Stage 1 (10%), and increase as further triggers are met
- Also will complete similar run w/ regional drought plan
- Evaluate effectiveness of alternatives