U.S. Army Corps of Engineers
Walla Walla District

Numerical Model Analysis of System-wide Dissolved Gas Abatement Alternatives

Appendix C

Complete One-Dimensional Simulation Results

Draft Report

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1 System-wide One-Dimensional Simulation Results

1.1 Fast-Track Scenarios

This section presents the complete results of the one-dimensional simulations of the fast-track alternative scenarios. The fast-track scenarios are summarized in Table 1.1. A more detailed description of the scenarios is presented in the main report, Section 2.2.

Table 1.1: Fast-Track Alternatives Model Simulations

Project	Baseline	No. 1	No. 2	No. 3	No. 4
Lower Granite 8/8	Standard Spill	Uniform Spill	Standard Spill	Uniform Spill Power House/Spillway-Wall	Uniform Spill Power House/Spillway-Wall Raised Tail Race
Little Goose 6/8	Uniform Spill 6/8	Uniform Spill 6/8	2 Deflectors Uniform Spill	Uniform Spill 8/8 Power House/Spillway-Wall	Uniform Spill 8/8 Power House/Spillway-Wall Raised Tail Race
Lower Monumental 6/8	Uniform Spill 6/8	Uniform Spill 6/8	2 Deflectors Uniform Spill	Uniform Spill 8/8 Power House/Spillway-Wall	Uniform Spill 8/8 Power House/Spillway-Wall Raised Tail Race
Ice Harbor 10/10	Standard Spill	Uniform Spill	Standard Spill	Standard Spill	Standard Spill
McNary 18/21 (22*)	Standard Spill	Uniform Spill 18/22	Uniform Spill 22/22	Uniform Spill 22/22 Power House/Spillway-Wall	Uniform Spill 22/22 Power House/Spillway-Wall
John Day 18/20	Standard Spill	Uniform SPill 18/20	Standard Spill 20/20	Uniform Spill 20/20	Uniform Spill 20/20
The Dalles 0/23	Standard Spill	Uniform Spill	Standard Spill	Uniform Spill 23/23	Uniform Spill 23/23
Bonneville 13/16 (18**)	Standard Spill	Uniform Spill 13/19	Uniform Spill 18/18	Uniform Spill 18/18	Uniform Spill 18/18 Raised Tail Race

* McNary has 22 spillway bays, but only 21 are currently operational.

** The Bonneville standard spillway patterns limits bays 1 and 18 to a 4-inch gate opening.

1.1.1 Low Flow Year (1994)

Table 1.2: 10% exceedance of TDG percent saturation of MASS1 fast track time series output: low flow season (1994)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	109.0	108.3	109.0	108.3	109.9
LGS-sp	SRM 70.1	114.0	114.0	111.4	111.4	111.6
LMN-sp	SRM 41.6	111.4	111.4	108.7	108.7	109.8
IHR-sp	SRM 9.5	114.6	114.5	114.6	114.6	114.6
MCN-sp	CRM 292.5	119.6	111.2	110.4	109.9	109.9
JDA-sp	CRM 215.75	118.2	106.6	118.2	106.2	106.2
TDA-sp	CRM 191.5	125.2	124.7	125.2	115.5	115.5
BON-sp	CRM 146.5	128.3	121.1	114.9	114.9	113.9
LWG-fms	SRM 106.75	113.7	113.7	113.7	113.3	113.1
LGS-fms	SRM 69.5	113.6	113.5	113.1	112.2	111.9
LMN-fms	SRM 40.75	112.0	112.0	111.4	110.8	110.8
IHR-fms	SRM 6.0	114.1	114.1	114.0	113.9	113.8
MCN-fms	CRM 290.5	112.6	110.9	110.6	111.0	111.0
JDA-fms	CRM 214.75	110.1	107.0	109.8	107.1	107.1
TDA-fms	CRM 189.0	114.3	113.4	114.2	109.7	109.7
BON-fms	CRM 140.5	118.3	115.4	113.2	111.1	110.5
LGS-fb	SRM 70.1	112.4	112.2	112.4	112.0	112.0
LMN-fb	SRM 41.6	113.0	113.0	112.5	111.5	111.4
IHR-fb	SRM 9.5	112.0	111.9	110.7	109.9	109.7
MCN-fb	CRM 292.5	110.5	110.5	110.4	110.3	110.3
JDA-fb	CRM 215.75	107.8	107.6	107.4	107.6	107.6
TDA-fb	CRM 191.5	108.1	106.5	107.8	106.6	106.6
BON-fb	CRM 146.5	111.9	111.1	111.8	108.2	108.2
TID-fb	CRM 122.0	118.0	115.4	113.0	111.2	110.5
TID-fb	CRM 76.0	116.0	113.6	111.9	110.2	109.7

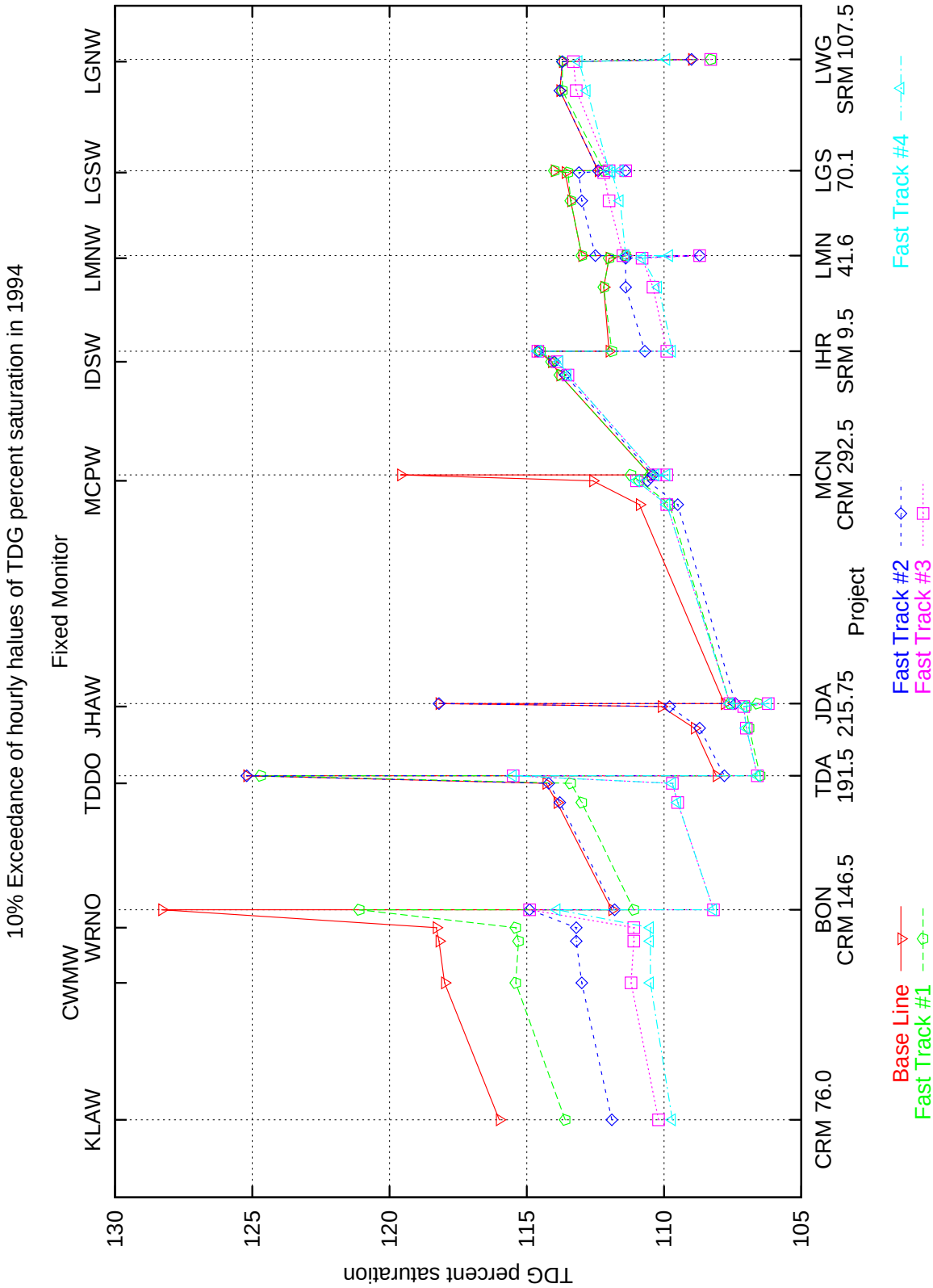

Figure 1.1: Comparison of the 10% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: low flow season (1994)

Table 1.3: 25% exceedance of TDG percent saturation of MASS1 fast track time series output: low flow season (1994)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	100.0	100.0	100.0	100.0	100.0
LGS-sp	SRM 70.1	107.4	107.4	105.1	105.1	107.0
LMN-sp	SRM 41.6	100.0	100.0	100.0	100.0	100.0
IHR-sp	SRM 9.5	112.4	112.0	112.4	112.4	112.4
MCN-sp	CRM 292.5	112.7	104.3	104.3	103.6	103.6
JDA-sp	CRM 215.75	114.0	103.7	114.0	103.5	103.5
TDA-sp	CRM 191.5	123.0	122.4	123.0	111.8	111.8
BON-sp	CRM 146.5	126.6	117.7	111.9	111.9	111.7
LWG-fms	SRM 106.75	109.1	109.0	109.1	108.1	107.9
LGS-fms	SRM 69.5	111.4	111.4	110.7	109.3	109.3
LMN-fms	SRM 40.75	110.1	110.1	109.4	108.7	108.7
IHR-fms	SRM 6.0	111.6	111.3	111.5	111.5	111.5
MCN-fms	CRM 290.5	109.9	108.1	108.1	108.6	108.6
JDA-fms	CRM 214.75	107.8	104.3	107.6	104.3	104.3
TDA-fms	CRM 189.0	109.6	108.5	109.6	106.4	106.4
BON-fms	CRM 140.5	116.0	112.6	110.8	108.9	108.7
LGS-fb	SRM 70.1	110.4	110.3	110.4	109.1	108.4
LMN-fb	SRM 41.6	111.4	111.4	110.6	109.6	109.4
IHR-fb	SRM 9.5	109.8	109.7	109.2	108.8	108.7
MCN-fb	CRM 292.5	108.3	108.2	108.3	108.3	108.3
JDA-fb	CRM 215.75	104.4	104.2	104.2	104.4	104.4
TDA-fb	CRM 191.5	105.6	104.0	105.5	104.0	104.0
BON-fb	CRM 146.5	108.2	107.6	108.1	105.5	105.5
TID-fb	CRM 122.0	115.3	112.2	110.5	108.7	108.5
TID-fb	CRM 76.0	113.3	110.9	109.3	107.9	107.5

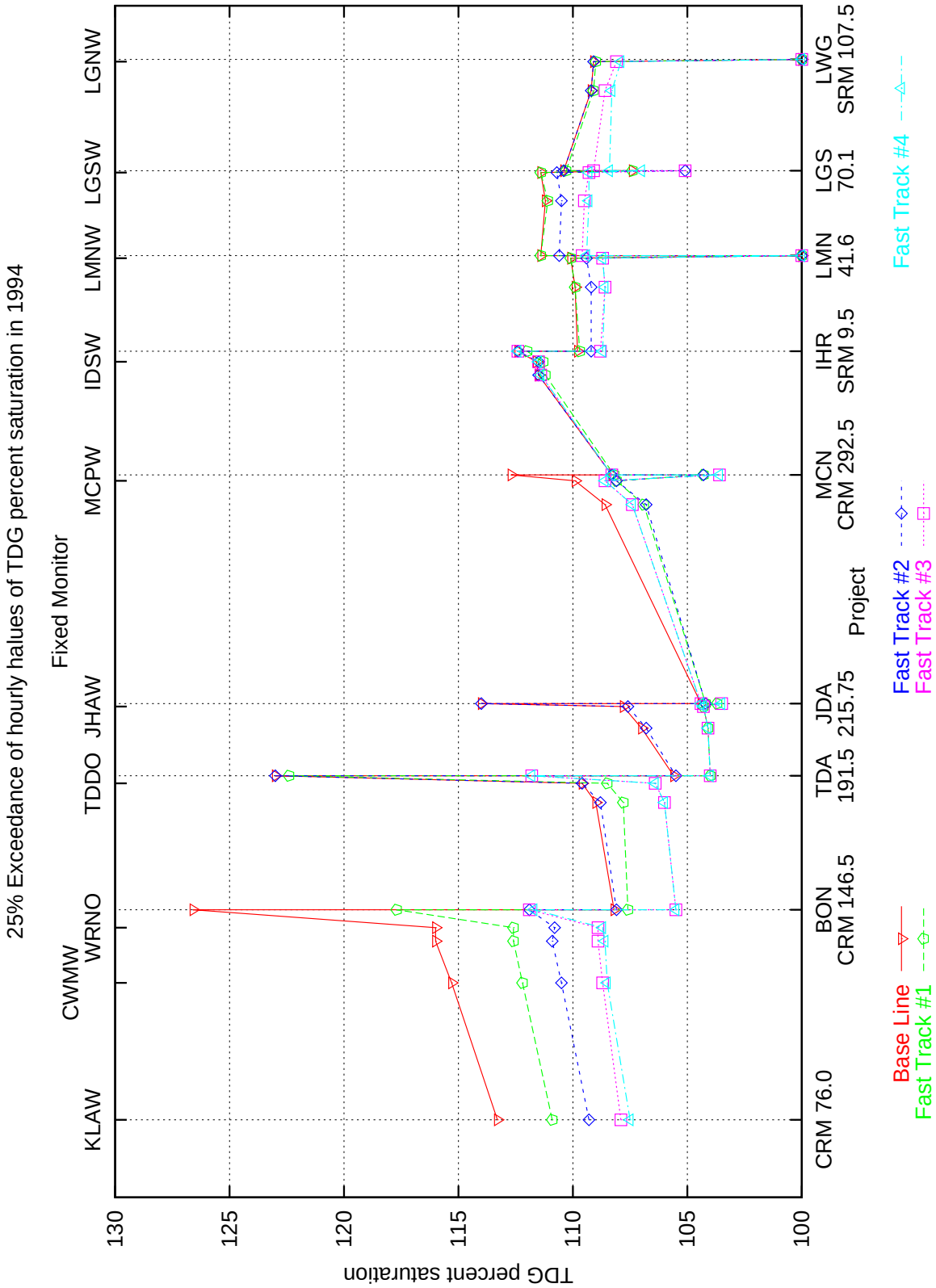

Figure 1.2: Comparison of the 25% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: low flow season (1994)

Table 1.4: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: low flow season (1994)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	115.7	115.2	115.7	115.2	112.6
LGS-sp	SRM 70.1	115.2	115.2	112.5	112.5	112.4
LMN-sp	SRM 41.6	116.0	116.0	113.3	113.3	113.1
IHR-sp	SRM 9.5	115.2	115.1	115.2	115.2	115.2
MCN-sp	CRM 292.5	121.9	115.7	114.5	114.2	114.2
JDA-sp	CRM 215.75	119.3	107.5	119.3	107.1	107.1
TDA-sp	CRM 191.5	125.7	125.0	125.7	115.9	115.9
BON-sp	CRM 146.5	128.4	127.2	120.0	120.0	116.1
LWG-fms	SRM 106.75	115.1	114.5	115.1	113.7	113.4
LGS-fms	SRM 69.5	114.1	114.1	113.6	112.4	112.1
LMN-fms	SRM 40.75	112.7	112.7	111.8	111.4	111.5
IHR-fms	SRM 6.0	114.9	114.8	114.8	114.7	114.7
MCN-fms	CRM 290.5	114.1	112.7	112.0	112.0	112.0
JDA-fms	CRM 214.75	110.5	107.5	110.3	107.5	107.5
TDA-fms	CRM 189.0	114.9	113.6	114.7	110.1	110.1
BON-fms	CRM 140.5	119.5	119.3	115.7	114.5	112.2
LGS-fb	SRM 70.1	112.6	112.4	112.6	112.2	112.2
LMN-fb	SRM 41.6	113.1	113.1	112.6	111.7	111.5
IHR-fb	SRM 9.5	112.4	112.3	111.0	110.1	109.9
MCN-fb	CRM 292.5	110.8	110.8	110.8	110.8	110.8
JDA-fb	CRM 215.75	108.2	107.9	107.8	108.2	108.2
TDA-fb	CRM 191.5	109.1	106.8	108.8	106.9	106.9
BON-fb	CRM 146.5	112.7	111.7	112.5	108.8	108.8
TID-fb	CRM 122.0	119.4	119.2	115.6	114.2	112.1
TID-fb	CRM 76.0	117.3	116.3	113.6	112.6	110.8

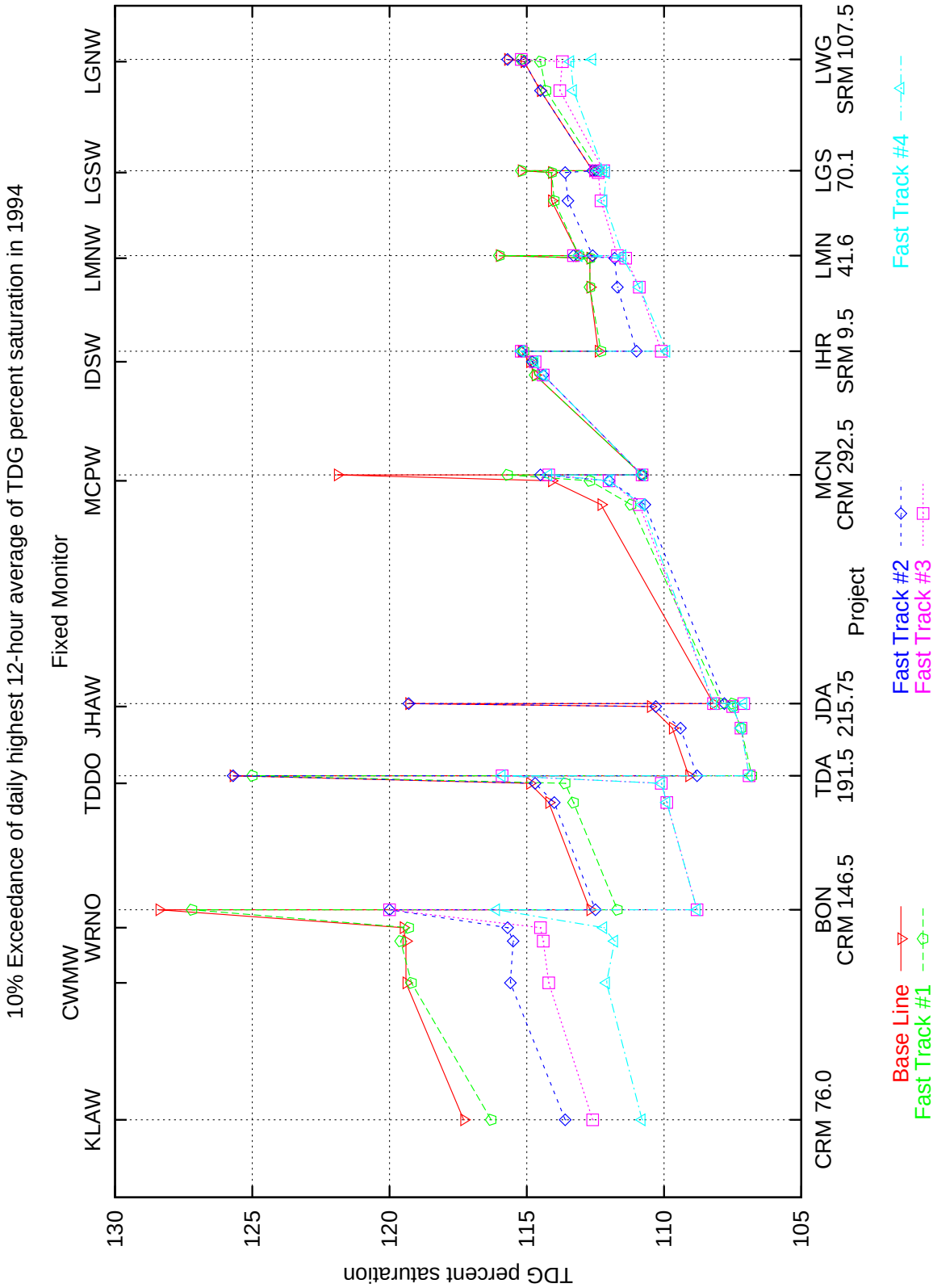

Figure 1.3: Comparison of the 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: low flow season (1994)

Table 1.5: 25% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: low flow season (1994)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	100.0	100.0	100.0	100.0	100.0
LGS-sp	SRM 70.1	111.0	111.0	108.7	108.7	108.3
LMN-sp	SRM 41.6	100.0	100.0	100.0	100.0	100.0
IHR-sp	SRM 9.5	112.7	112.5	112.7	112.7	112.7
MCN-sp	CRM 292.5	117.7	109.4	109.1	109.1	109.1
JDA-sp	CRM 215.75	115.2	105.7	115.2	105.3	105.3
TDA-sp	CRM 191.5	123.8	123.1	123.8	112.3	112.3
BON-sp	CRM 146.5	127.3	120.3	114.1	114.1	113.0
LWG-fms	SRM 106.75	113.0	112.6	113.0	111.2	109.7
LGS-fms	SRM 69.5	112.0	112.0	111.2	110.1	110.0
LMN-fms	SRM 40.75	110.8	110.7	109.9	109.5	109.5
IHR-fms	SRM 6.0	112.3	111.8	112.3	112.2	112.2
MCN-fms	CRM 290.5	112.2	109.2	109.2	109.2	109.2
JDA-fms	CRM 214.75	109.3	104.8	109.1	104.7	104.7
TDA-fms	CRM 189.0	110.6	109.5	110.5	106.9	106.9
BON-fms	CRM 140.5	117.7	114.7	112.3	110.3	109.7
LGS-fb	SRM 70.1	110.7	110.5	110.7	109.2	108.7
LMN-fb	SRM 41.6	111.6	111.6	111.0	109.9	109.7
IHR-fb	SRM 9.5	110.0	110.0	109.6	109.0	109.0
MCN-fb	CRM 292.5	108.6	108.6	108.6	108.6	108.6
JDA-fb	CRM 215.75	104.6	104.3	104.3	104.6	104.6
TDA-fb	CRM 191.5	106.5	104.2	106.3	104.2	104.2
BON-fb	CRM 146.5	109.5	108.8	109.4	106.1	106.1
TID-fb	CRM 122.0	117.2	114.3	112.2	110.2	109.7
TID-fb	CRM 76.0	114.5	112.2	110.4	108.9	108.4

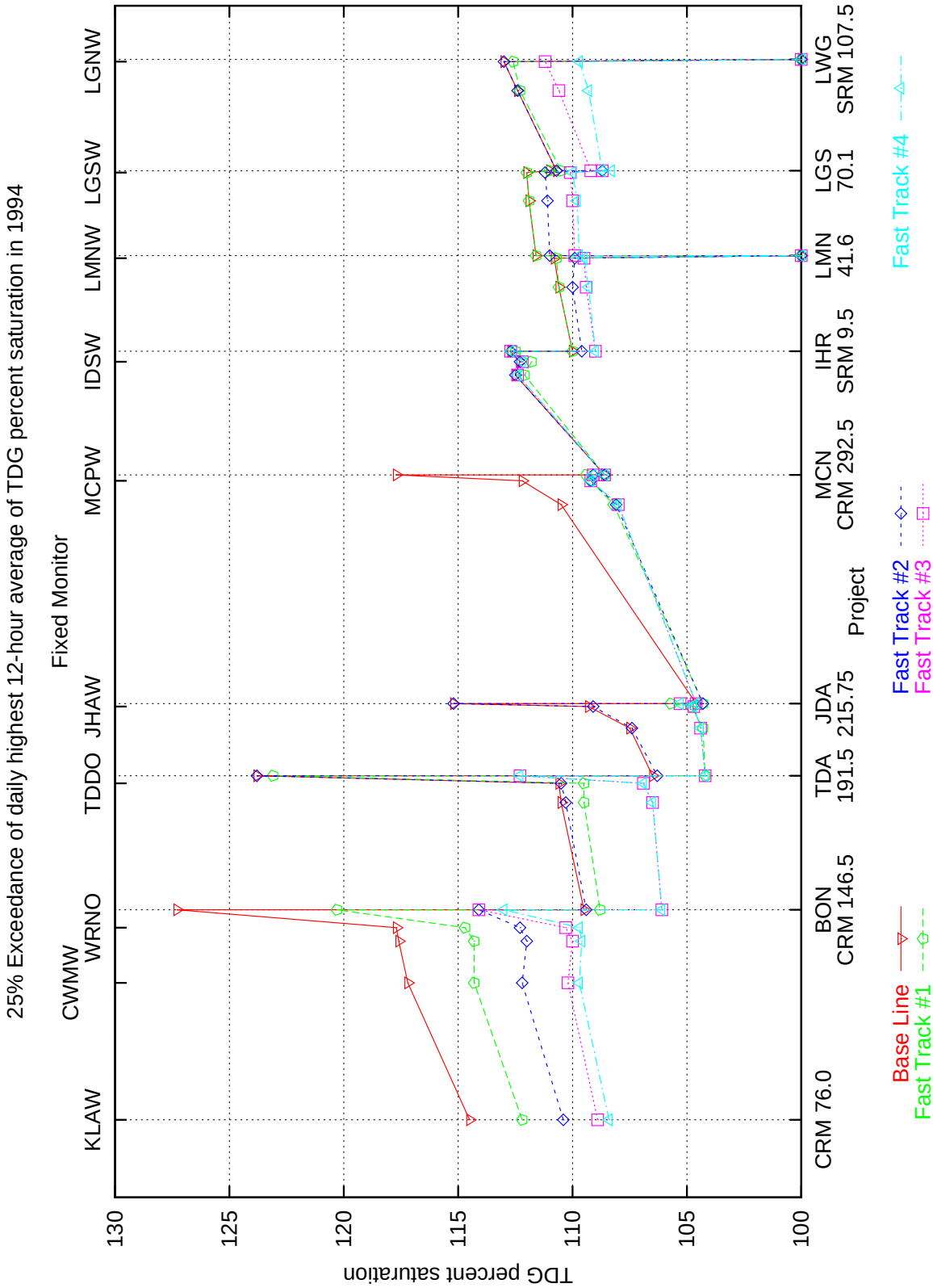

Figure 1.4: Comparison of the 25% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: low flow season (1994)

Table 1.6: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: low flow season (1994)

Location	Project	River Mile	Baseline		Fast Track #1		Fast Track #2		Fast Track #3		Fast Track #4	
			Days	%	Days	%	Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	4	2.4	4	2.4	4	2.4	4	2.4	0	0.0
> 120	LGS	SRM 70.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	LMN	SRM 41.6	3	1.8	3	1.8	0	0.0	0	0.0	0	0.0
	IHR	SRM 9.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	MCN	CRM 292.5	22	13.2	0	0.0	0	0.0	0	0.0	0	0.0
	JDA	CRM 215.75	7	4.2	0	0.0	7	4.2	0	0.0	0	0.0
	TDA	CRM 191.5	101	60.5	89	53.3	101	60.5	0	0.0	0	0.0
	BON	CRM 146.5	129	77.2	47	28.1	17	10.2	17	10.2	0	0.0
FMS	LWG	SRM 106.75	4	2.4	0	0.0	4	2.4	0	0.0	0	0.0
> 120	LGS	SRM 69.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	LMN	SRM 40.75	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	IHR	SRM 6.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	MCN	CRM 290.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	JDA	CRM 214.75	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	TDA	CRM 189.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	BON	CRM 140.5	9	5.4	13	7.8	0	0.0	0	0.0	0	0.0
Forebay	LGS	SRM 70.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
> 115	LMN	SRM 41.6	4	2.4	4	2.4	2	1.2	0	0.0	0	0.0
	IHR	SRM 9.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	MCN	CRM 292.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	JDA	CRM 215.75	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	TDA	CRM 191.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	BON	CRM 146.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	TID	CRM 122.0	56	33.5	39	23.4	21	12.6	13	7.8	0	0.0
	TID	CRM 76.0	38	22.8	27	16.2	9	5.4	6	3.6	0	0.0

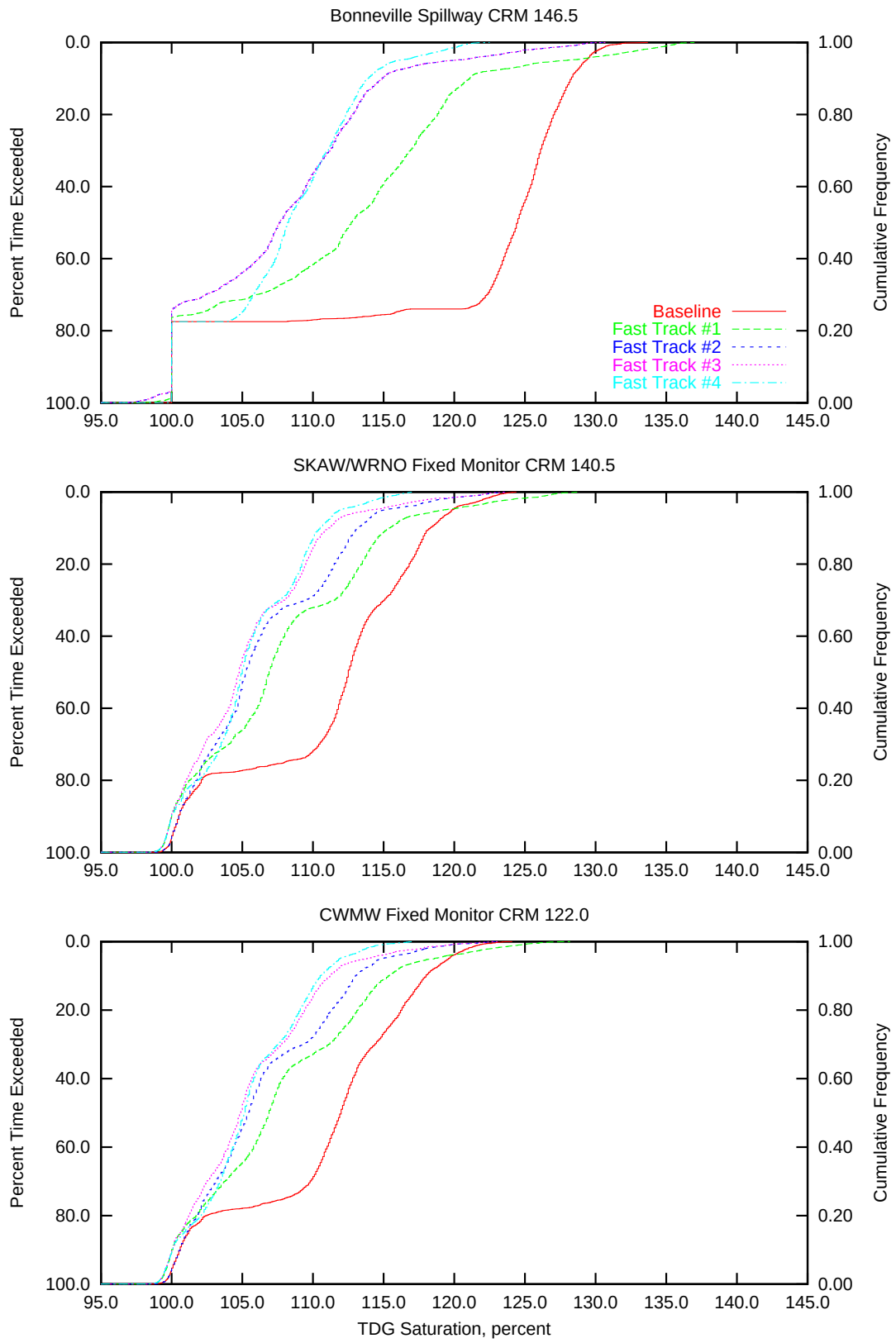

Figure 1.5: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a low flow (1994) season.

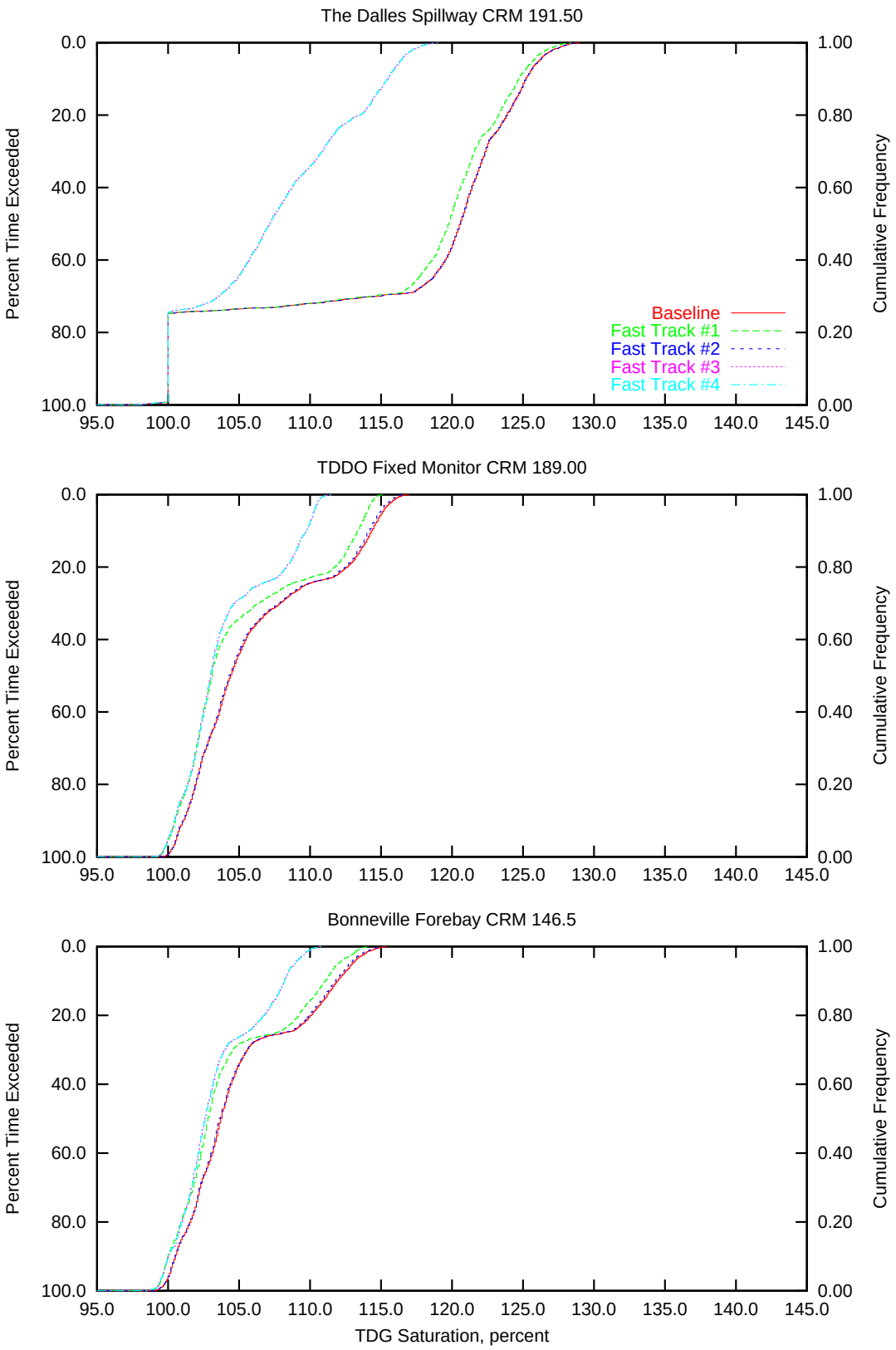

Figure 1.6: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a low flow (1994) season.

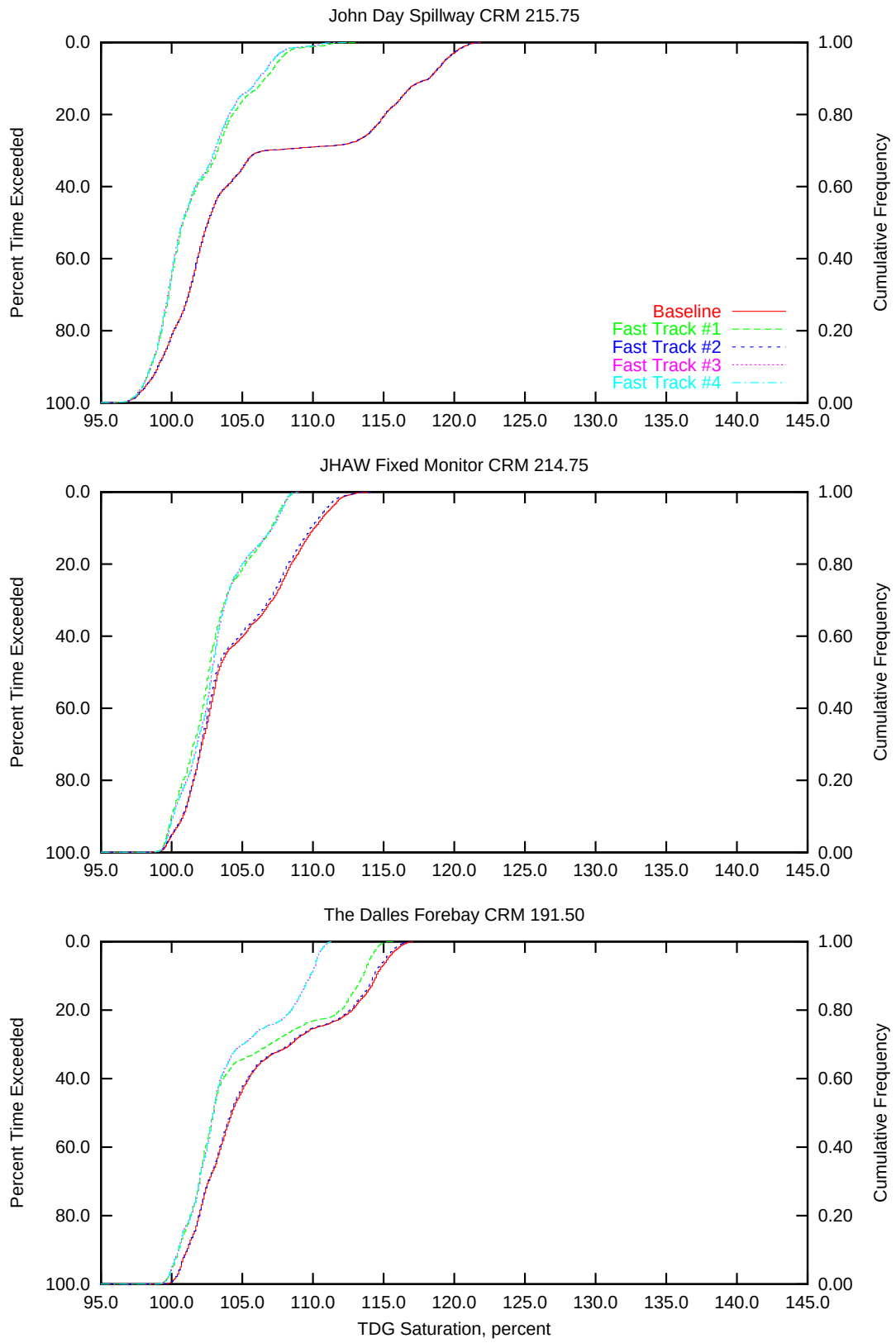

Figure 1.7: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a low flow (1994) season.

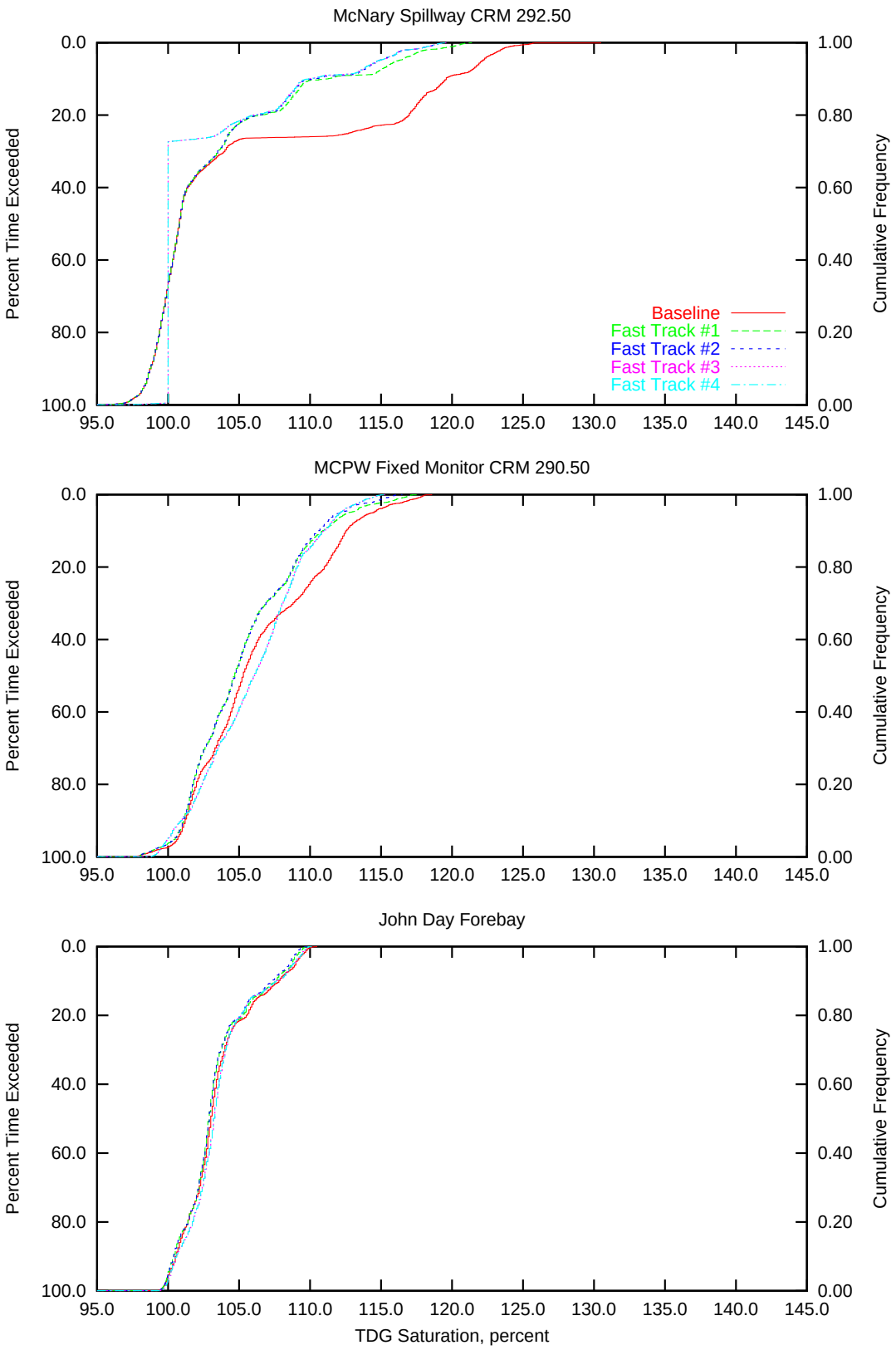

Figure 1.8: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a low flow (1994) season.

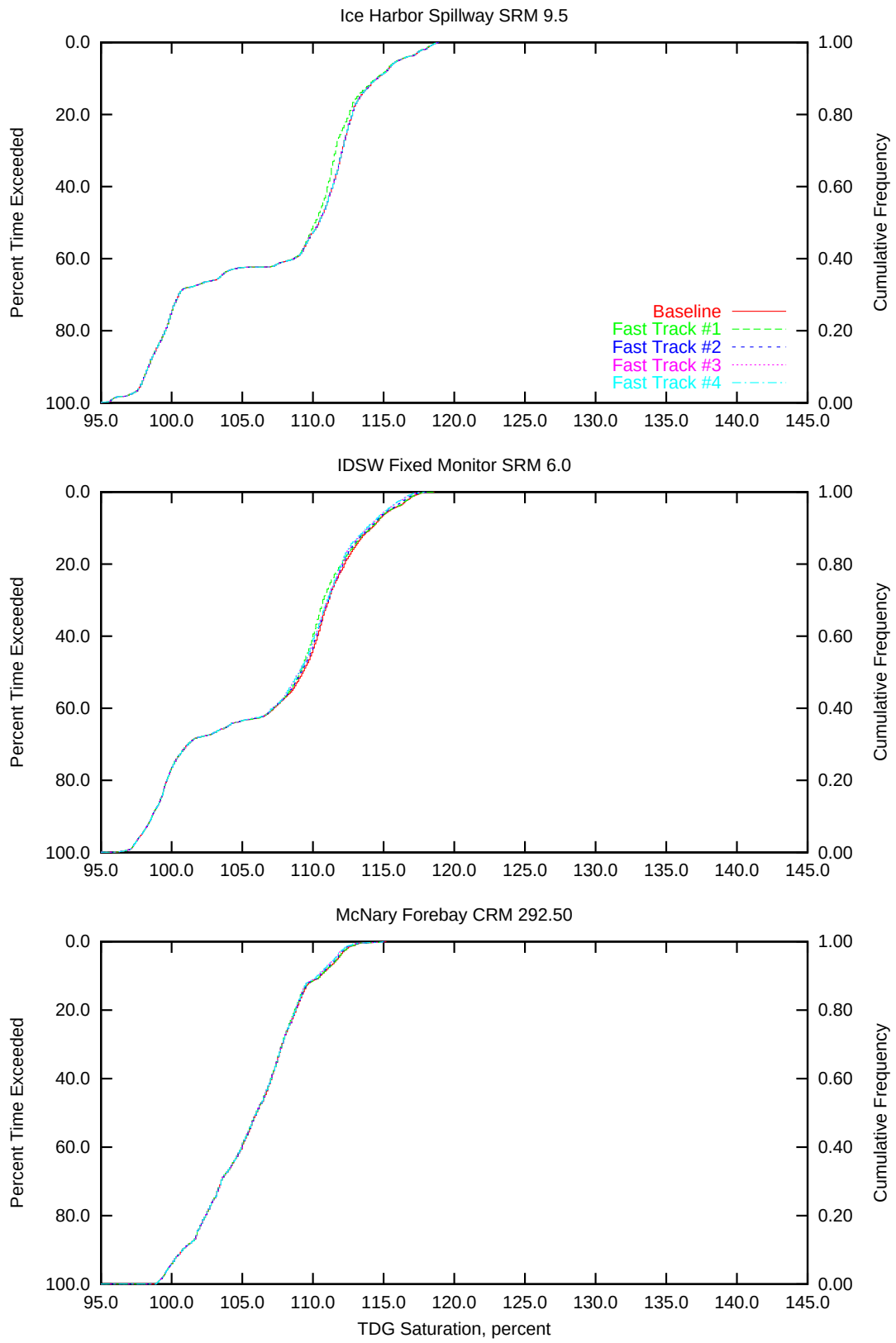

Figure 1.9: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a low flow (1994) season.

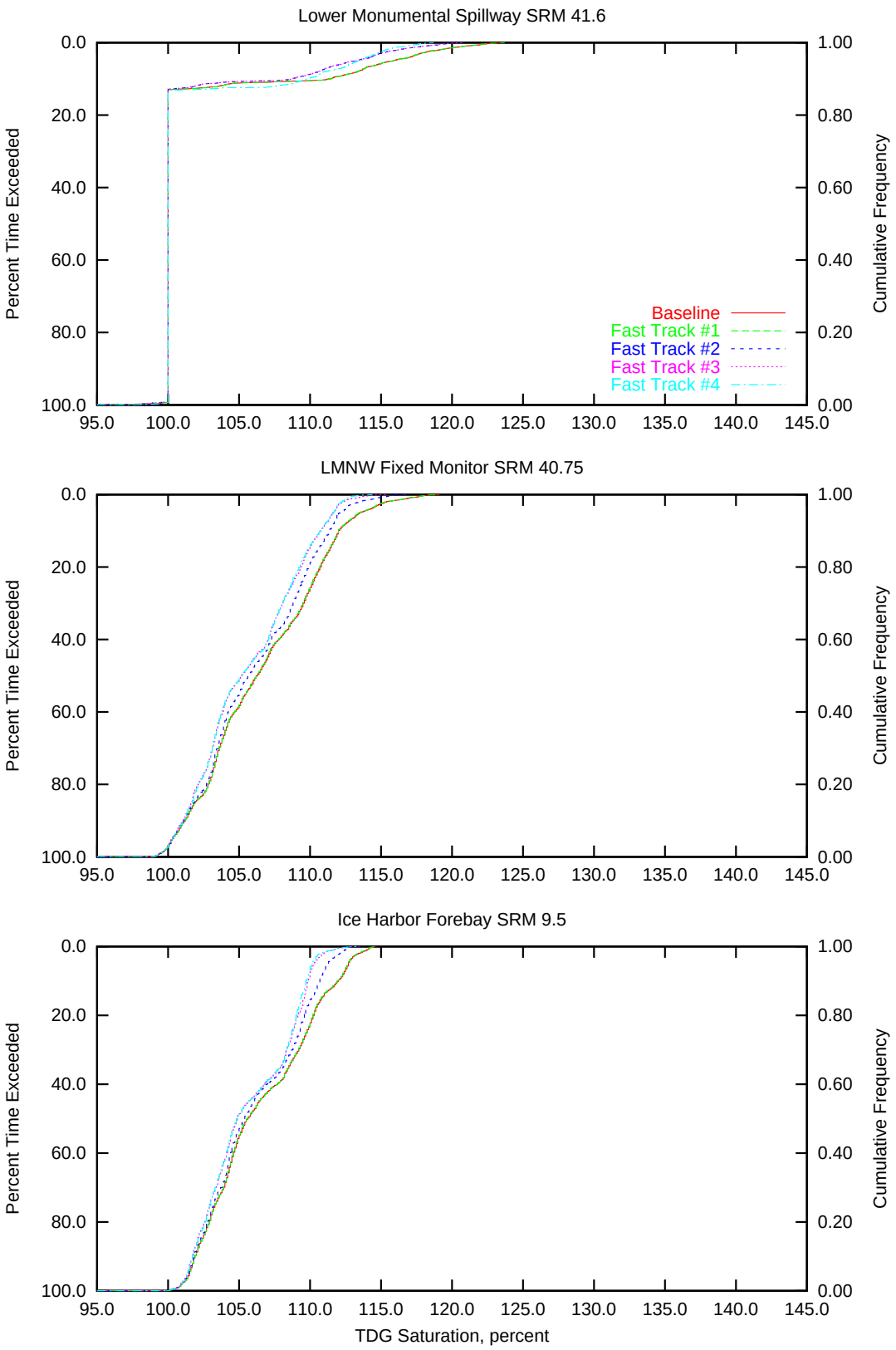

Figure 1.10: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a low flow (1994) season.

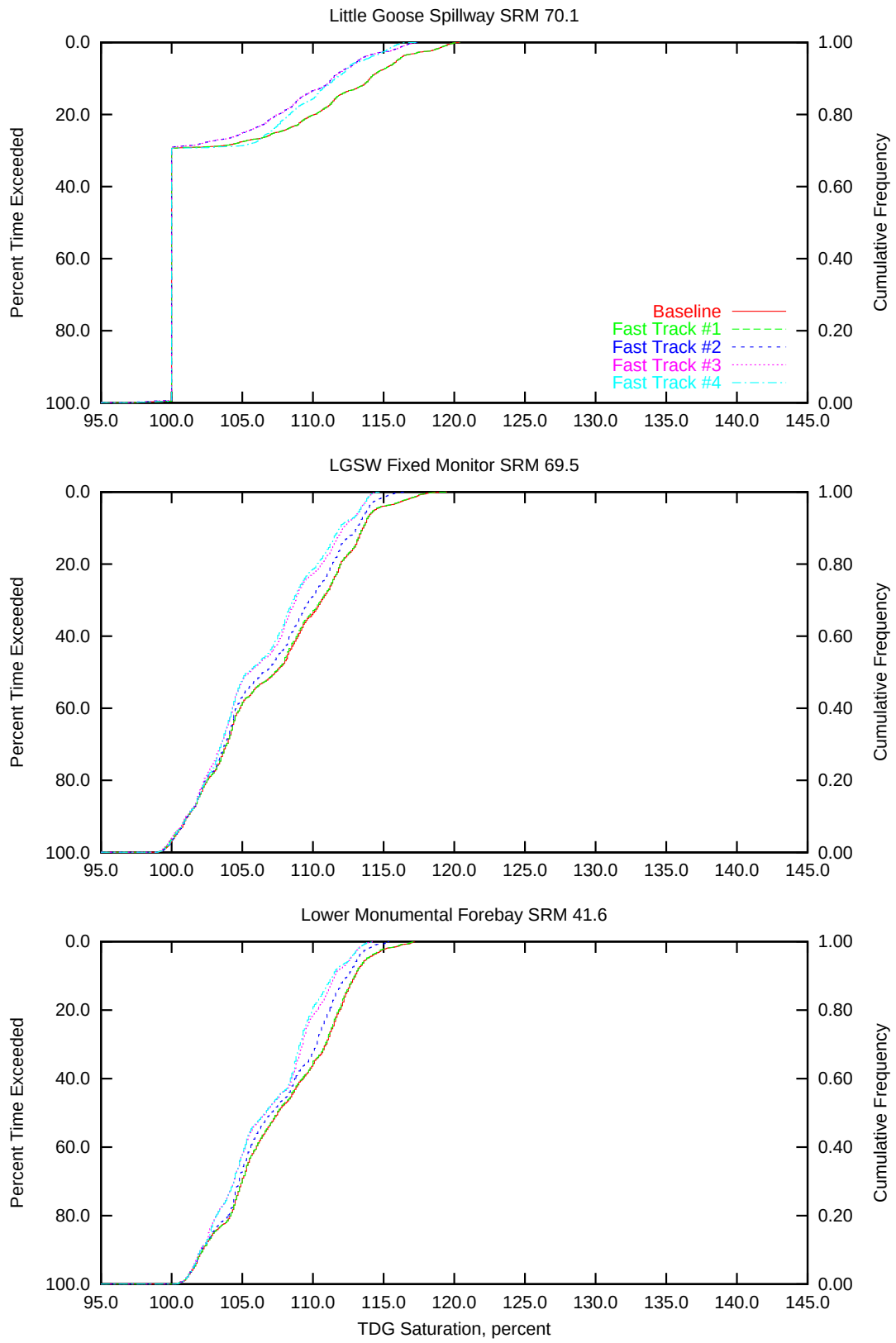

Figure 1.11: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a low flow (1994) season.

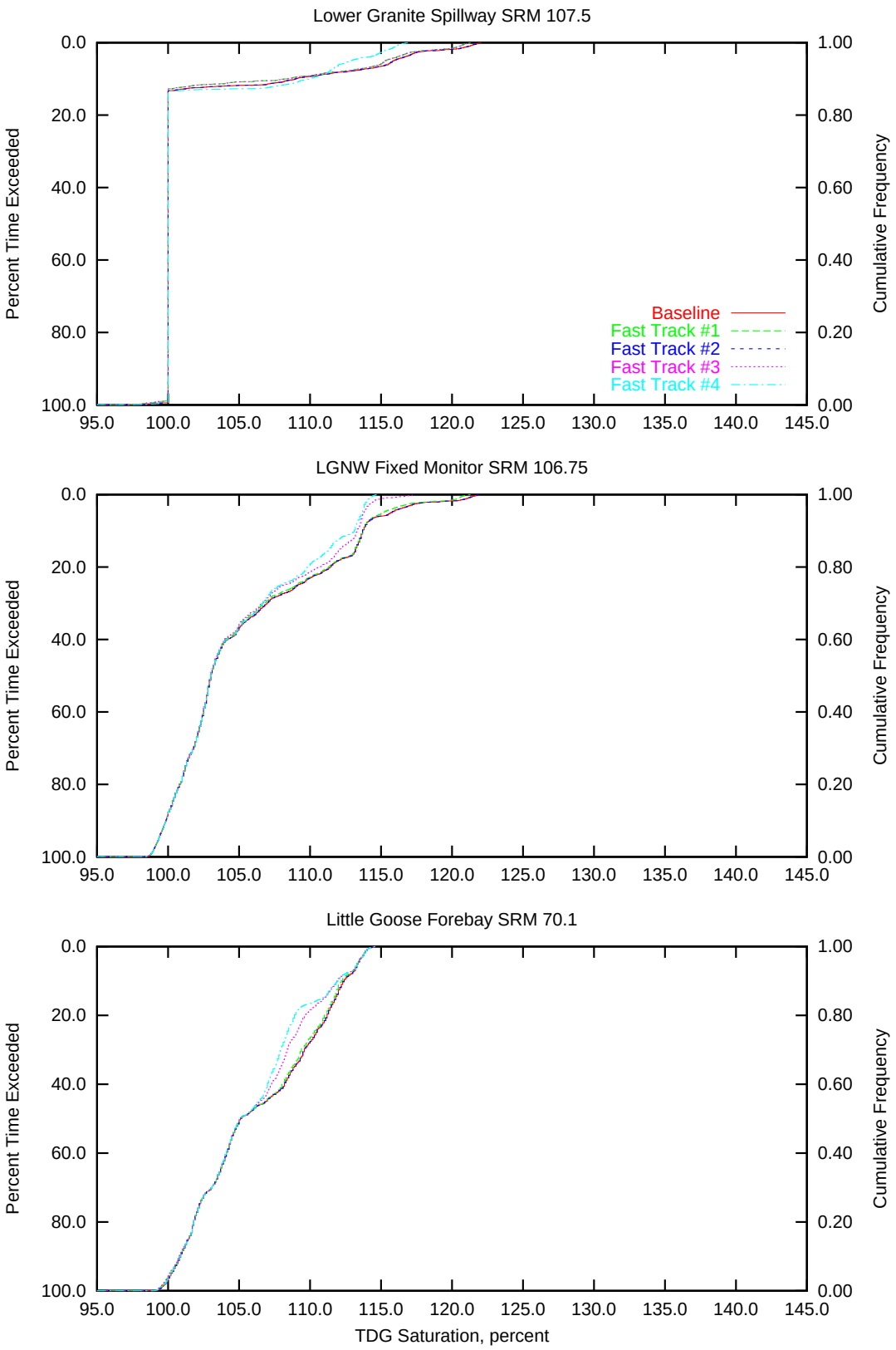

Figure 1.12: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a low flow (1994) season.

1.1.2 Medium/High Flow Year (1996)

Table 1.7: 10% exceedance of TDG percent saturation of MASS1 fast track time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	123.5	123.2	123.5	123.2	118.2
LGS-sp	SRM 70.1	126.1	126.1	123.6	123.5	118.6
LMN-sp	SRM 41.6	127.3	127.3	125.5	125.5	121.4
IHR-sp	SRM 9.5	118.8	118.5	118.8	118.8	118.8
MCN-sp	CRM 292.5	130.4	129.9	125.9	125.9	125.9
JDA-sp	CRM 215.75	121.6	121.2	121.6	120.2	120.2
TDA-sp	CRM 191.5	125.4	125.2	125.4	121.1	121.1
BON-sp	CRM 146.5	132.5	135.5	133.4	133.4	126.9
LWG-fms	SRM 106.75	118.8	118.5	118.8	111.3	109.8
LGS-fms	SRM 69.5	125.4	125.4	123.0	117.4	113.9
LMN-fms	SRM 40.75	124.6	124.6	122.6	119.4	116.5
IHR-fms	SRM 6.0	120.1	119.8	119.6	118.8	118.1
MCN-fms	CRM 290.5	127.1	126.7	123.7	123.1	123.0
JDA-fms	CRM 214.75	119.4	119.1	118.0	117.2	117.2
TDA-fms	CRM 189.0	122.6	122.5	122.2	119.2	119.2
BON-fms	CRM 140.5	126.7	127.6	127.0	125.9	122.3
LGS-fb	SRM 70.1	117.3	117.2	117.3	111.1	109.6
LMN-fb	SRM 41.6	123.5	123.5	121.5	116.6	113.4
IHR-fb	SRM 9.5	123.1	123.1	121.3	118.4	115.9
MCN-fb	CRM 292.5	118.4	118.3	118.3	118.0	117.8
JDA-fb	CRM 215.75	118.2	118.0	116.0	115.4	115.4
TDA-fb	CRM 191.5	118.0	117.8	116.8	116.0	115.9
BON-fb	CRM 146.5	120.3	120.0	119.8	117.1	117.1
TID-fb	CRM 122.0	126.2	127.0	126.4	125.1	121.8
TID-fb	CRM 76.0	123.4	123.6	123.7	122.5	119.5

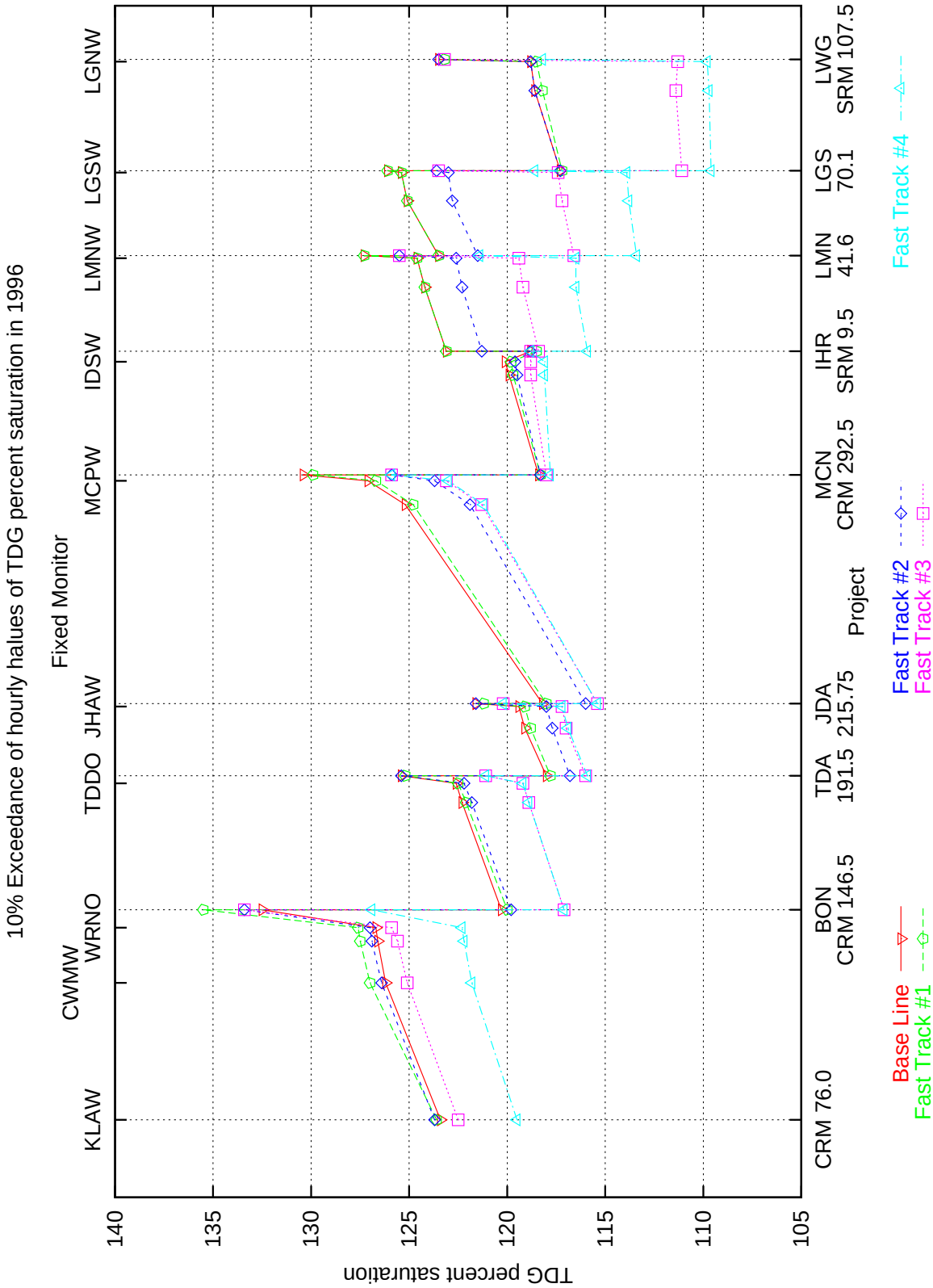

Figure 1.13: Comparison of the 10% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Table 1.8: 25% exceedance of TDG percent saturation of MASS1 fast track time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	118.7	118.2	118.7	118.2	115.0
LGS-sp	SRM 70.1	120.5	120.5	117.5	117.5	114.2
LMN-sp	SRM 41.6	121.1	121.1	118.4	118.4	115.8
IHR-sp	SRM 9.5	114.4	114.3	114.4	114.4	114.4
MCN-sp	CRM 292.5	123.7	122.6	119.8	119.6	119.6
JDA-sp	CRM 215.75	116.2	114.8	116.2	113.8	113.8
TDA-sp	CRM 191.5	123.5	123.1	123.5	116.2	116.2
BON-sp	CRM 146.5	128.0	132.3	127.0	127.0	121.6
LWG-fms	SRM 106.75	113.8	113.6	113.8	109.3	108.2
LGS-fms	SRM 69.5	119.3	119.2	117.2	112.8	110.7
LMN-fms	SRM 40.75	118.5	118.5	116.4	114.1	112.0
IHR-fms	SRM 6.0	115.4	115.3	115.0	114.5	114.1
MCN-fms	CRM 290.5	120.5	119.8	117.9	117.2	117.1
JDA-fms	CRM 214.75	113.9	113.0	113.0	111.8	111.8
TDA-fms	CRM 189.0	119.2	118.7	118.8	114.3	114.3
BON-fms	CRM 140.5	122.0	123.5	121.3	119.7	116.9
LGS-fb	SRM 70.1	113.0	112.7	113.0	108.5	107.6
LMN-fb	SRM 41.6	118.0	117.9	116.2	112.9	110.8
IHR-fb	SRM 9.5	117.0	116.9	115.3	113.6	111.5
MCN-fb	CRM 292.5	114.9	114.8	114.8	114.6	114.4
JDA-fb	CRM 215.75	113.2	112.9	111.6	111.3	111.2
TDA-fb	CRM 191.5	113.4	112.5	112.4	111.4	111.4
BON-fb	CRM 146.5	117.6	117.0	117.2	113.1	113.1
TID-fb	CRM 122.0	121.8	122.9	121.0	119.4	116.8
TID-fb	CRM 76.0	118.2	118.5	116.8	115.4	113.6

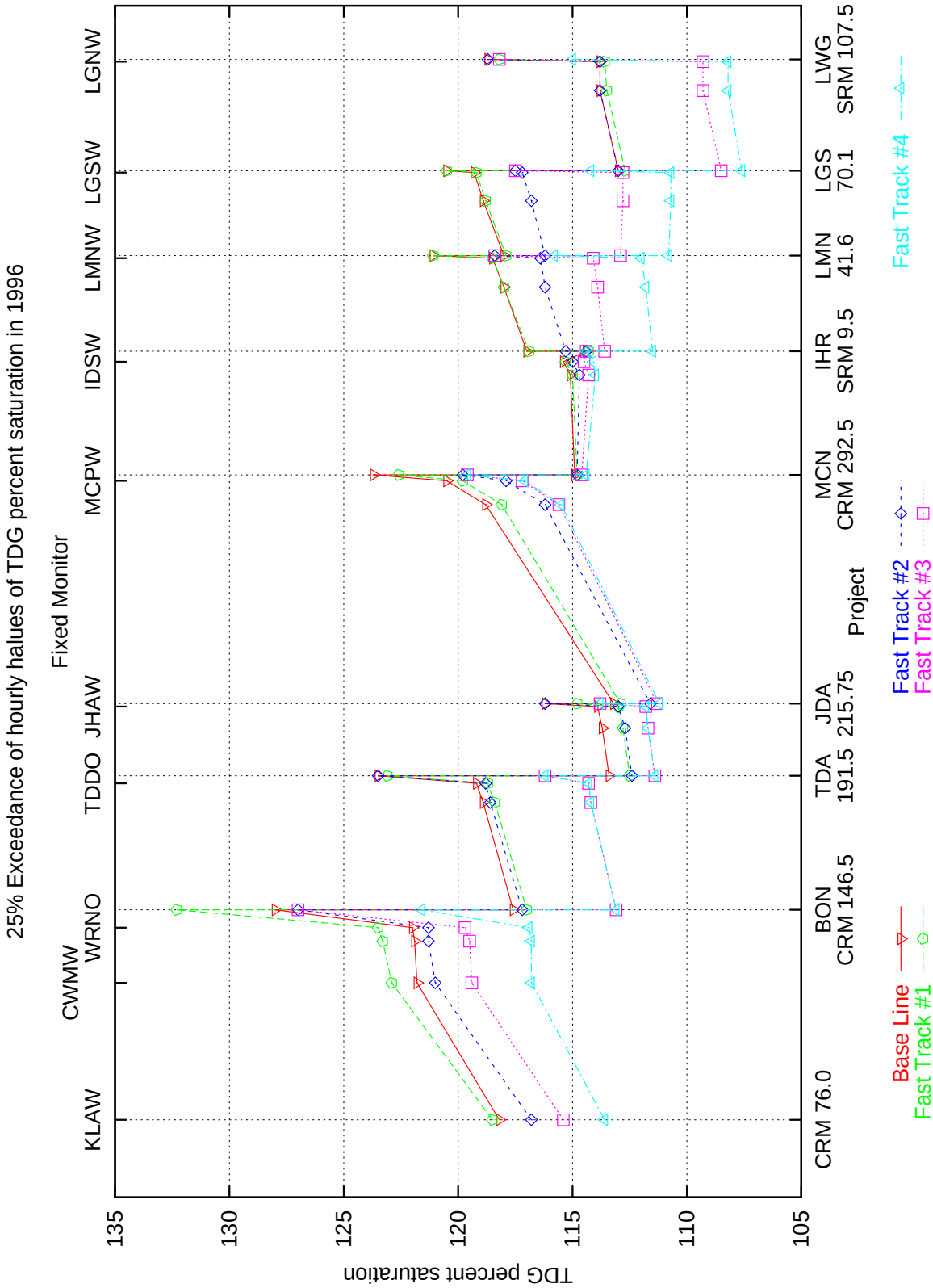

Figure 1.14: Comparison of the 25% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Table 1.9: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	124.8	124.7	124.8	124.7	119.3
LGS-sp	SRM 70.1	127.4	127.4	125.1	125.1	119.7
LMN-sp	SRM 41.6	128.5	128.5	126.9	126.9	122.8
IHR-sp	SRM 9.5	119.9	119.5	119.9	119.9	119.9
MCN-sp	CRM 292.5	132.2	131.9	127.6	127.6	127.6
JDA-sp	CRM 215.75	122.6	122.0	122.6	121.1	121.1
TDA-sp	CRM 191.5	125.8	125.5	125.8	121.6	121.6
BON-sp	CRM 146.5	133.8	136.4	134.9	134.9	128.1
LWG-fms	SRM 106.75	119.5	119.5	119.5	112.3	110.3
LGS-fms	SRM 69.5	126.8	126.8	124.7	118.7	114.7
LMN-fms	SRM 40.75	125.5	125.5	123.6	121.1	118.1
IHR-fms	SRM 6.0	120.9	120.7	120.4	119.5	118.8
MCN-fms	CRM 290.5	128.7	128.8	125.0	124.5	124.4
JDA-fms	CRM 214.75	120.0	119.6	118.7	117.8	117.8
TDA-fms	CRM 189.0	123.0	122.8	122.5	119.8	119.8
BON-fms	CRM 140.5	127.9	128.2	129.1	128.3	124.0
LGS-fb	SRM 70.1	118.5	118.2	118.5	111.7	110.0
LMN-fb	SRM 41.6	124.6	124.6	122.6	117.2	114.0
IHR-fb	SRM 9.5	124.1	124.1	122.4	119.6	116.8
MCN-fb	CRM 292.5	118.7	118.7	118.6	118.4	118.3
JDA-fb	CRM 215.75	118.4	118.3	116.2	115.9	115.8
TDA-fb	CRM 191.5	118.7	118.3	117.3	116.5	116.4
BON-fb	CRM 146.5	120.8	120.6	120.4	117.7	117.6
TID-fb	CRM 122.0	127.6	127.9	129.0	128.1	123.8
TID-fb	CRM 76.0	124.1	124.9	124.8	124.0	120.3

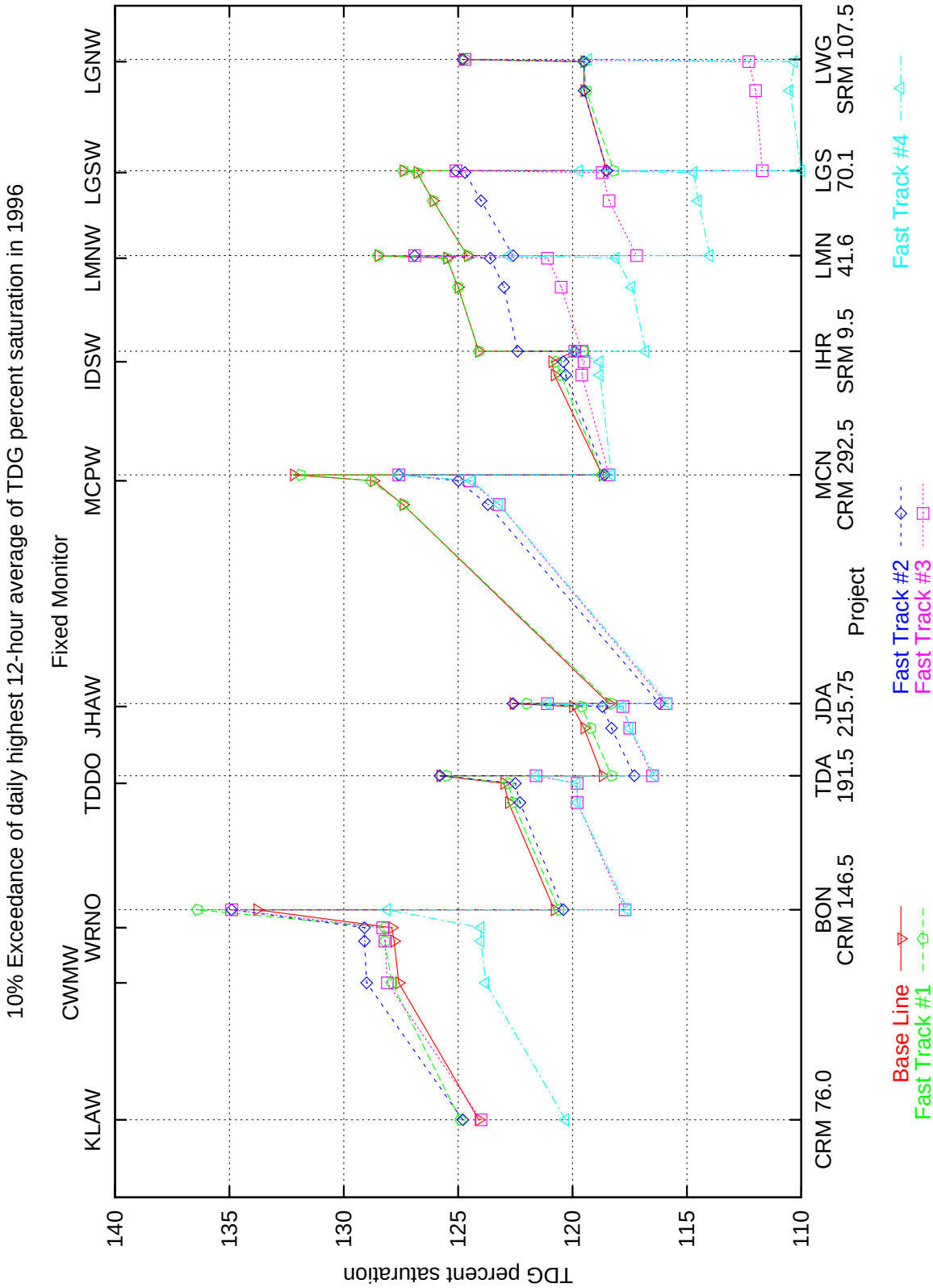

Figure 1.15: Comparison of the 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Table 1.10: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: medium flow season (1996)

Location	Project	River Mile	Baseline		Fast Track #1		Fast Track #2		Fast Track #3		Fast Track #4	
			Days	%	Days	%	Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	42	25.1	38	22.8	42	25.1	38	22.8	9	5.4
> 120	LGS	SRM 70.1	55	32.9	55	32.9	41	24.6	41	24.6	15	9.0
	LMN	SRM 41.6	54	32.3	54	32.3	46	27.5	46	27.5	31	18.6
	IHR	SRM 9.5	16	9.6	13	7.8	16	9.6	16	9.6	16	9.6
	MCN	CRM 292.5	67	40.1	60	35.9	42	25.1	41	24.6	41	24.6
	JDA	CRM 215.75	30	18.0	24	14.4	30	18.0	21	12.6	21	12.6
	TDA	CRM 191.5	136	81.4	130	77.8	136	81.4	31	18.6	31	18.6
	BON	CRM 146.5	153	91.6	121	72.5	69	41.3	69	41.3	55	32.9
FMS	LWG	SRM 106.75	16	9.6	14	8.4	16	9.6	1	0.6	0	0.0
> 120	LGS	SRM 69.5	53	31.7	53	31.7	39	23.4	8	4.8	0	0.0
	LMN	SRM 40.75	41	24.6	41	24.6	37	22.2	23	13.8	3	1.8
	IHR	SRM 6.0	20	12.0	19	11.4	18	10.8	15	9.0	12	7.2
	MCN	CRM 290.5	51	30.5	43	25.7	37	22.2	36	21.6	36	21.6
	JDA	CRM 214.75	16	9.6	14	8.4	9	5.4	4	2.4	4	2.4
	TDA	CRM 189.0	37	22.2	37	22.2	36	21.6	15	9.0	15	9.0
	BON	CRM 140.5	71	42.5	70	41.9	56	33.5	46	27.5	34	20.4
Forebay	LGS	SRM 70.1	32	19.2	33	19.8	32	19.2	8	4.8	0	0.0
> 115	LMN	SRM 41.6	64	38.3	62	37.1	58	34.7	36	21.6	11	6.6
	IHR	SRM 9.5	58	34.7	56	33.5	49	29.3	38	22.8	25	15.0
	MCN	CRM 292.5	46	27.5	46	27.5	46	27.5	46	27.5	44	26.3
	JDA	CRM 215.75	37	22.2	35	21.0	29	17.4	27	16.2	26	15.6
	TDA	CRM 191.5	36	21.6	35	21.0	34	20.4	29	17.4	29	17.4
	BON	CRM 146.5	81	48.5	73	43.7	76	45.5	35	21.0	35	21.0
	TID	CRM 122.0	141	84.4	130	77.8	82	49.1	70	41.9	58	34.7
	TID	CRM 76.0	107	64.1	91	54.5	69	41.3	53	31.7	37	22.2

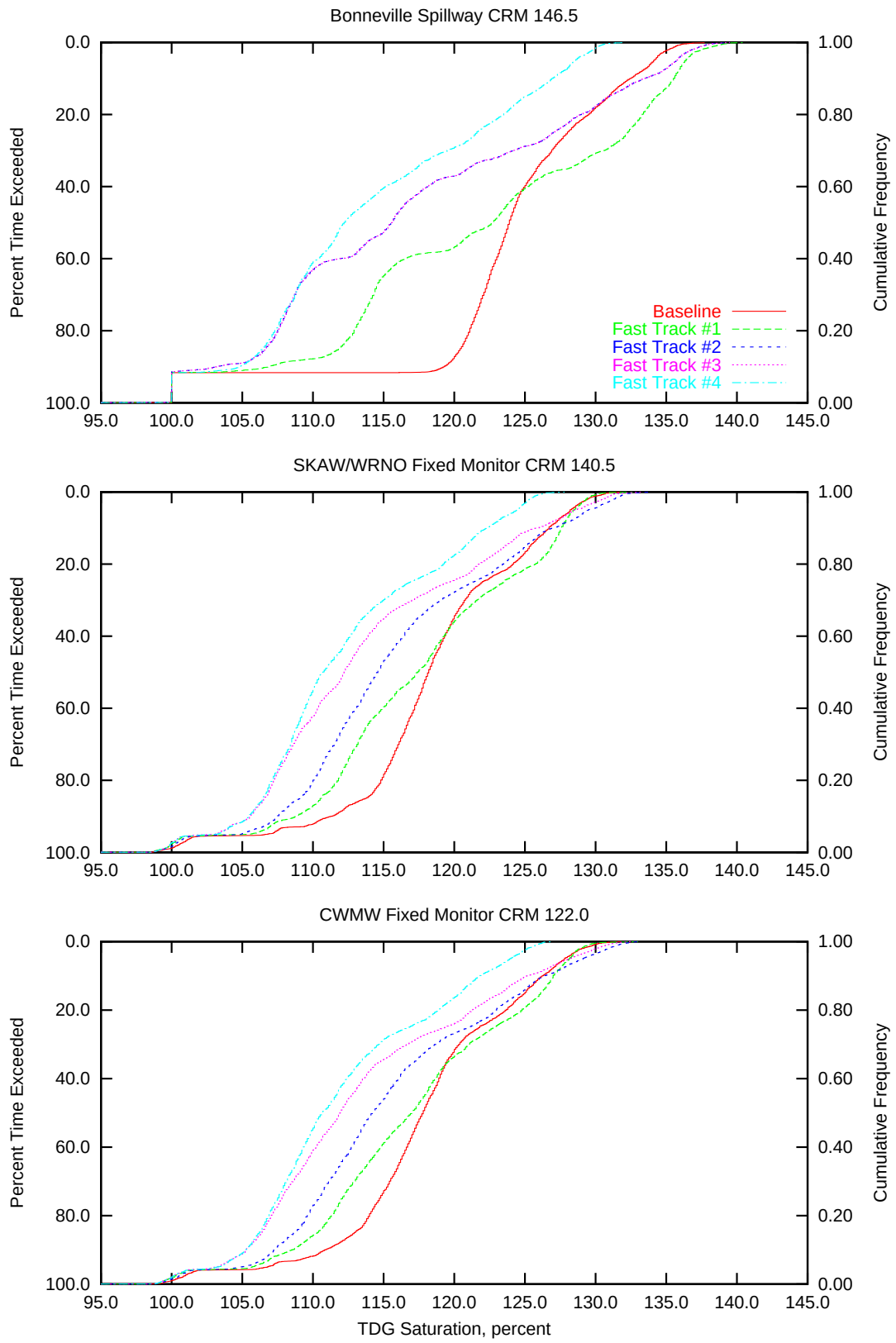

Figure 1.16: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a medium flow (1996) season.

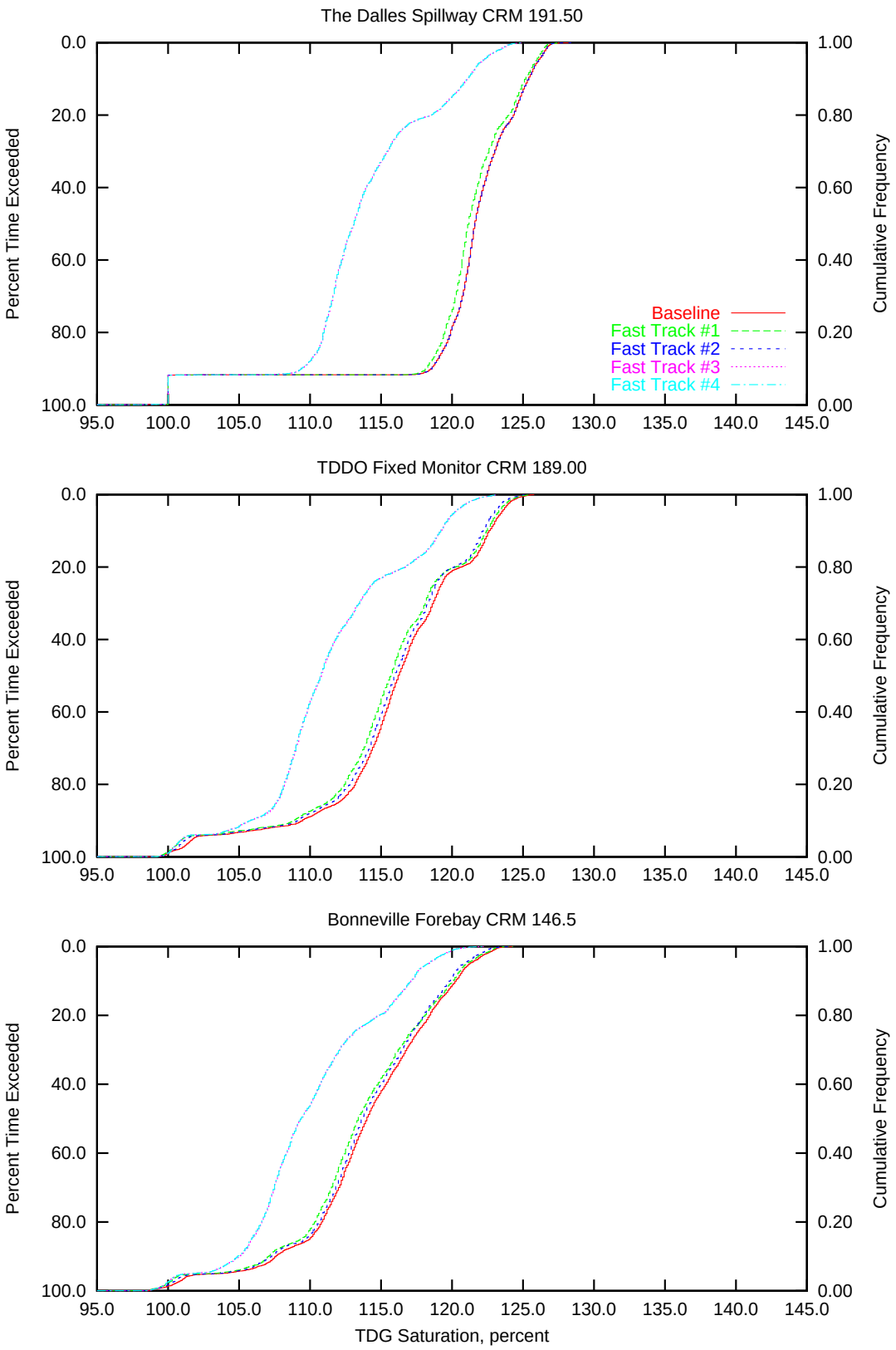

Figure 1.17: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a medium flow (1996) season.

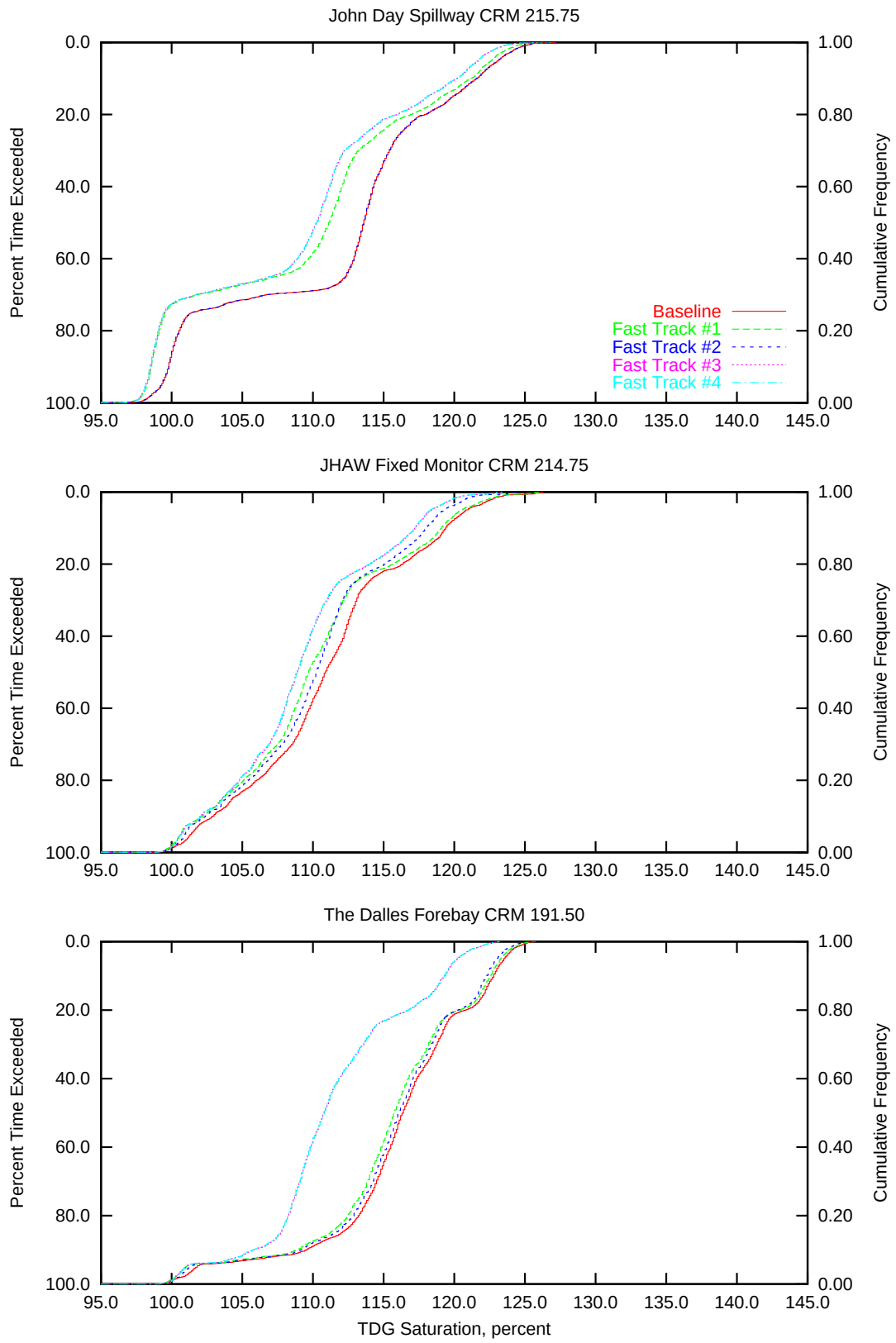

Figure 1.18: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a medium flow (1996) season.

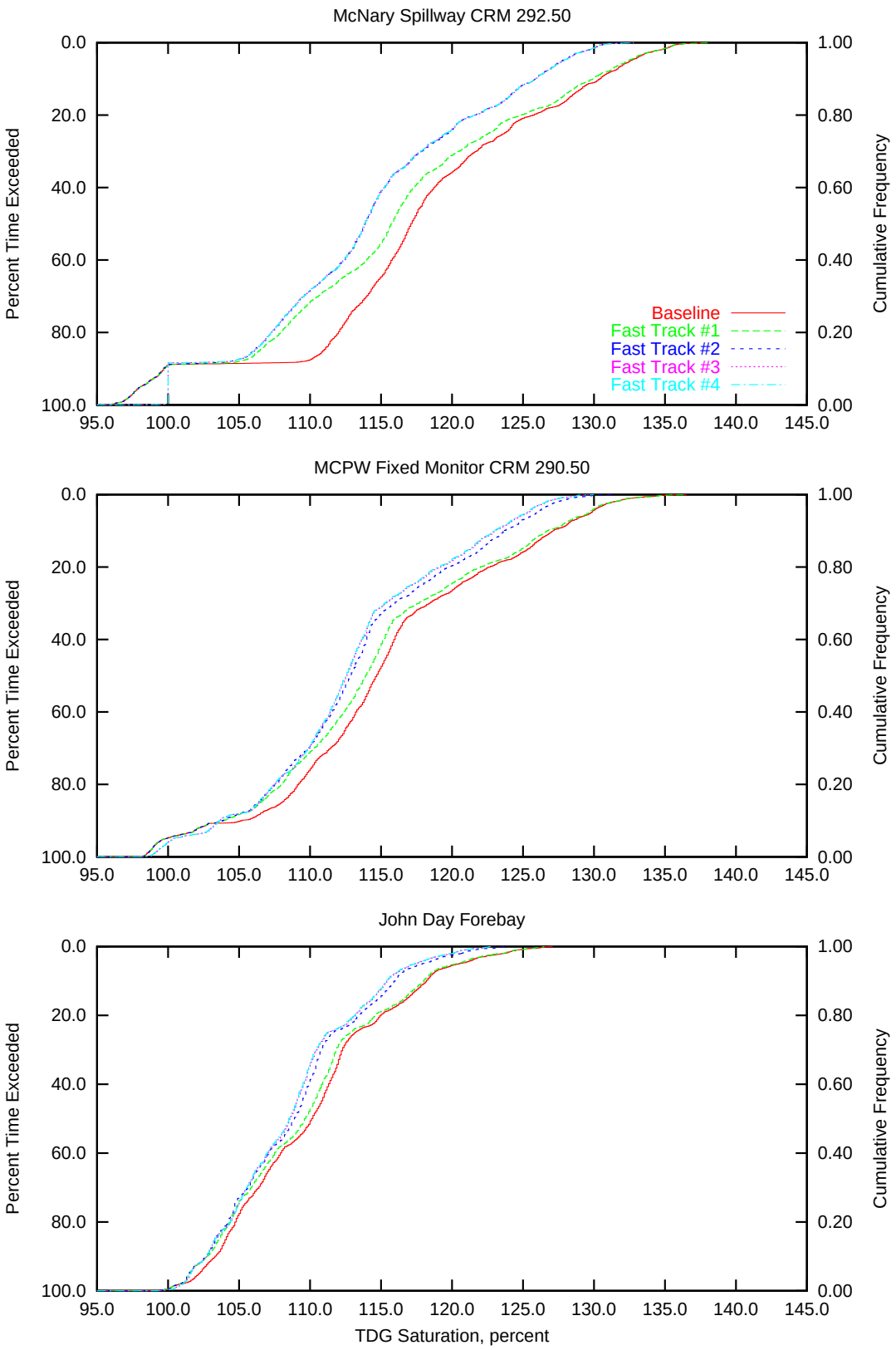

Figure 1.19: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a medium flow (1996) season.

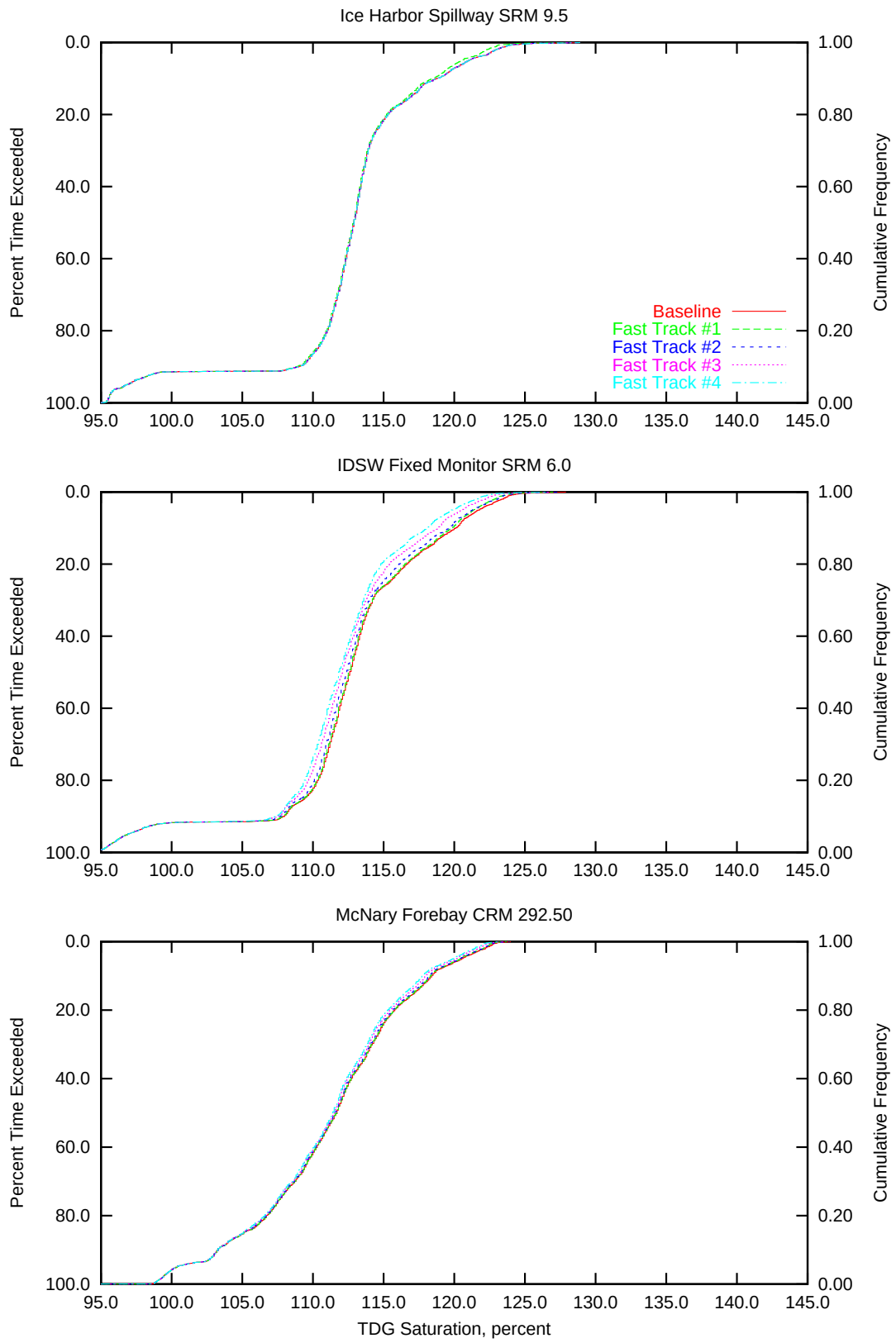

Figure 1.20: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a medium flow (1996) season.

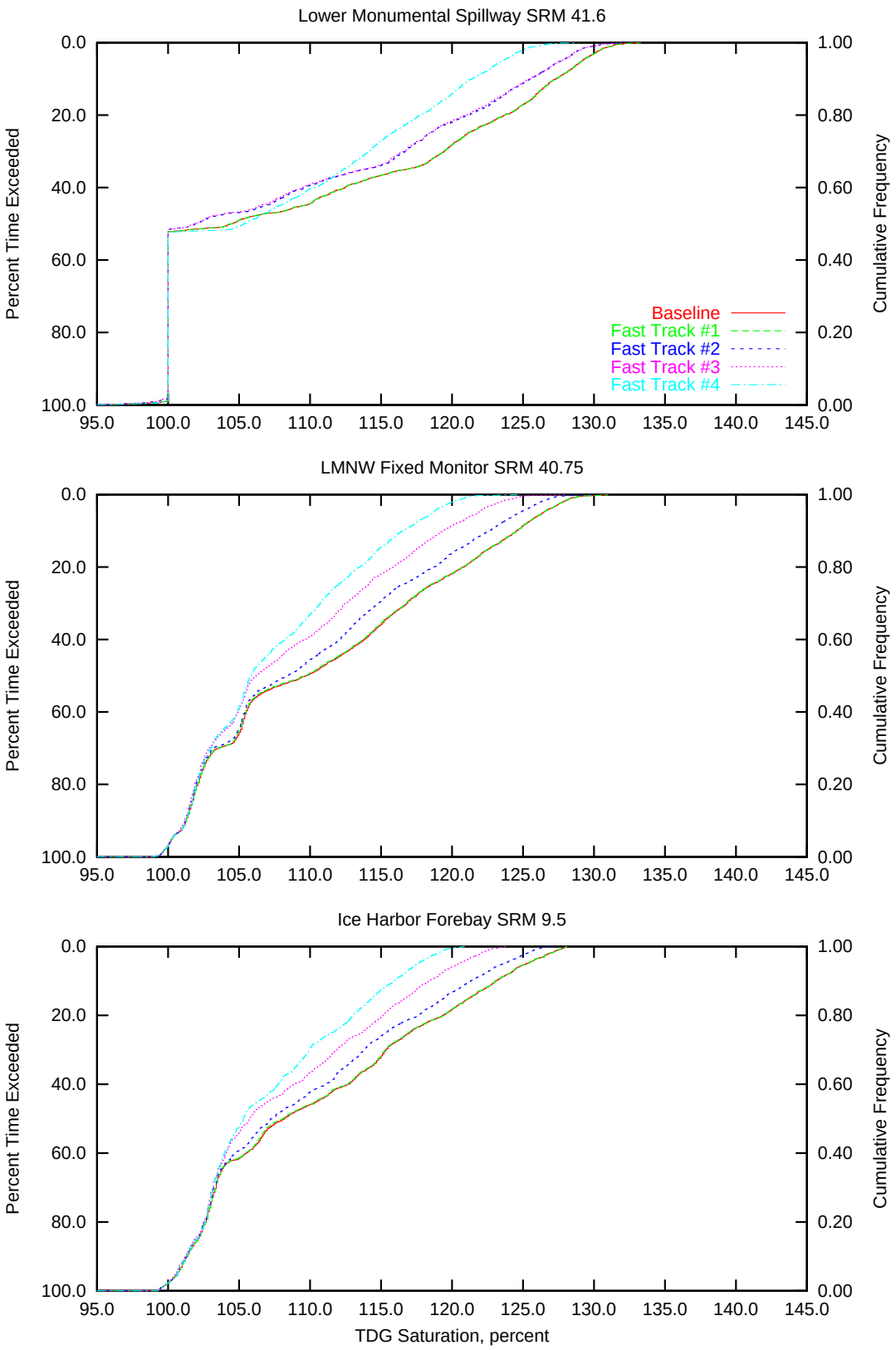

Figure 1.21: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a medium flow (1996) season.

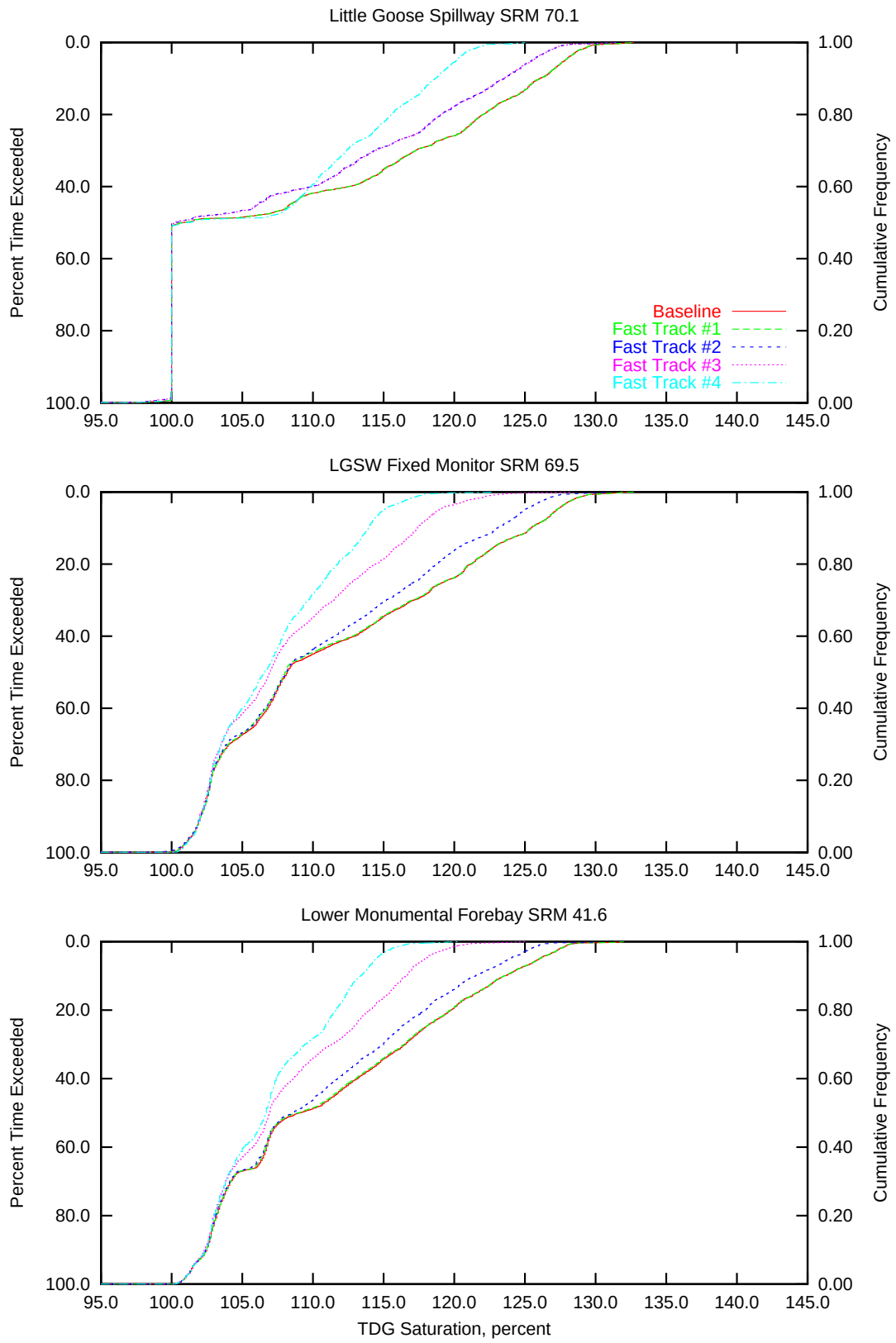

Figure 1.22: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a medium flow (1996) season.

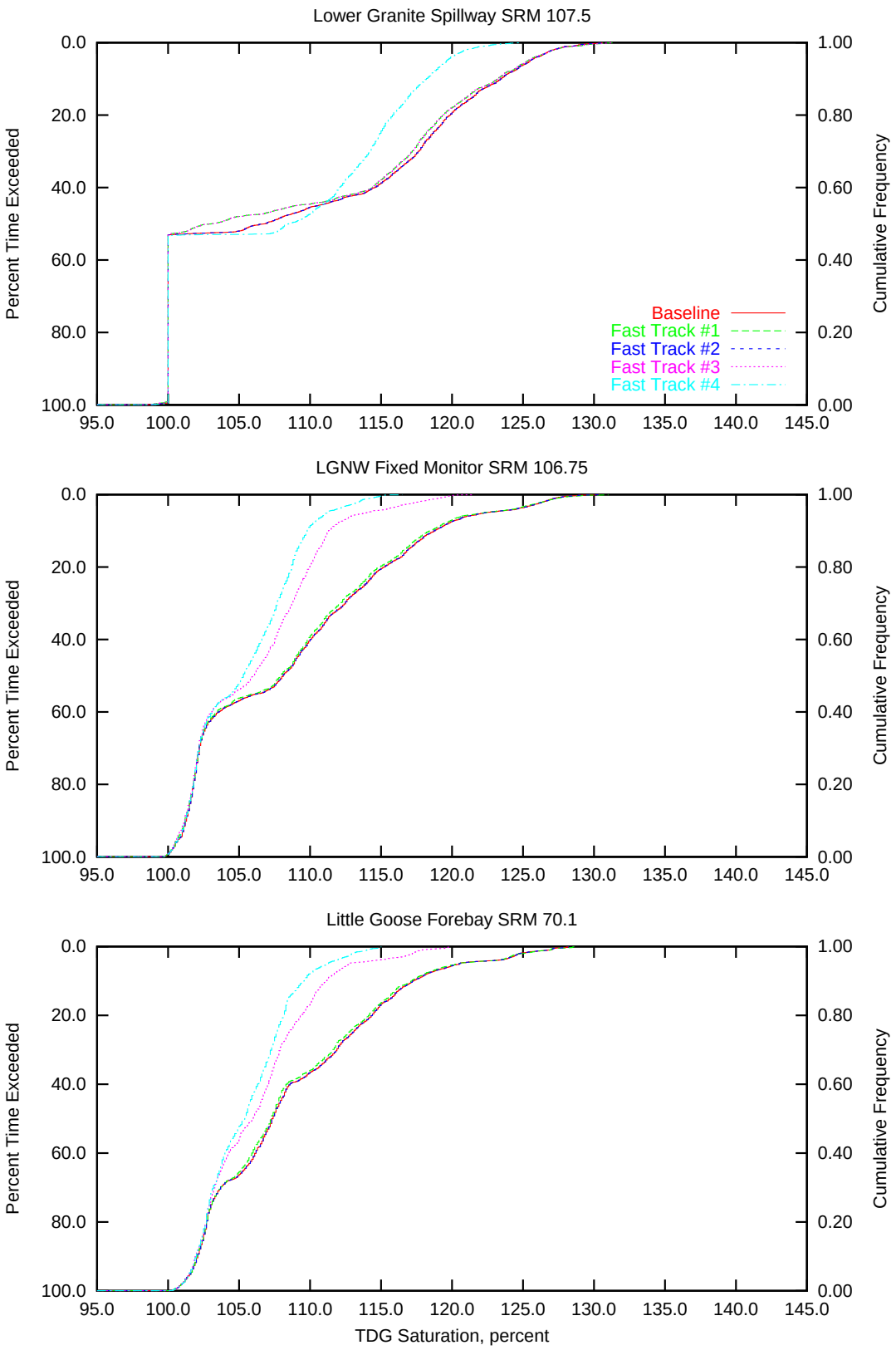

Figure 1.23: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a medium flow (1996) season.

1.1.3 High Flow Year (1997)

Table 1.11: 10% exceedance of TDG percent saturation of MASS1 fast track time series output: high flow season (1997)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	124.7	124.6	124.7	124.6	119.4
LGS-sp	SRM 70.1	126.2	126.2	123.5	123.5	118.8
LMN-sp	SRM 41.6	128.2	128.2	126.6	126.6	122.5
IHR-sp	SRM 9.5	121.1	120.4	121.1	121.1	121.1
MCN-sp	CRM 292.5	136.0	136.1	130.8	130.9	130.9
JDA-sp	CRM 215.75	127.7	127.0	127.7	126.4	126.4
TDA-sp	CRM 191.5	126.3	126.2	126.3	125.4	125.4
BON-sp	CRM 146.5	132.9	133.3	135.5	135.5	129.6
LWG-fms	SRM 106.75	119.0	118.9	119.0	111.9	110.1
LGS-fms	SRM 69.5	125.1	125.1	122.8	116.9	113.7
LMN-fms	SRM 40.75	125.4	125.3	123.4	120.0	117.0
IHR-fms	SRM 6.0	121.6	121.2	121.4	120.8	120.2
MCN-fms	CRM 290.5	132.2	132.2	128.4	127.7	127.7
JDA-fms	CRM 214.75	125.7	125.4	124.2	123.3	123.3
TDA-fms	CRM 189.0	125.5	125.3	125.0	124.2	124.2
BON-fms	CRM 140.5	127.9	126.4	129.8	129.5	126.2
LGS-fb	SRM 70.1	118.2	118.1	118.2	111.7	110.0
LMN-fb	SRM 41.6	124.3	124.3	122.2	116.7	113.5
IHR-fb	SRM 9.5	124.5	124.5	122.6	119.5	116.6
MCN-fb	CRM 292.5	122.4	122.2	122.3	122.0	121.9
JDA-fb	CRM 215.75	124.5	124.5	121.6	121.0	121.0
TDA-fb	CRM 191.5	124.1	123.8	122.6	121.8	121.8
BON-fb	CRM 146.5	123.2	123.0	122.7	121.8	121.8
TID-fb	CRM 122.0	127.5	126.0	129.5	129.1	125.9
TID-fb	CRM 76.0	125.4	123.3	127.1	126.8	124.0

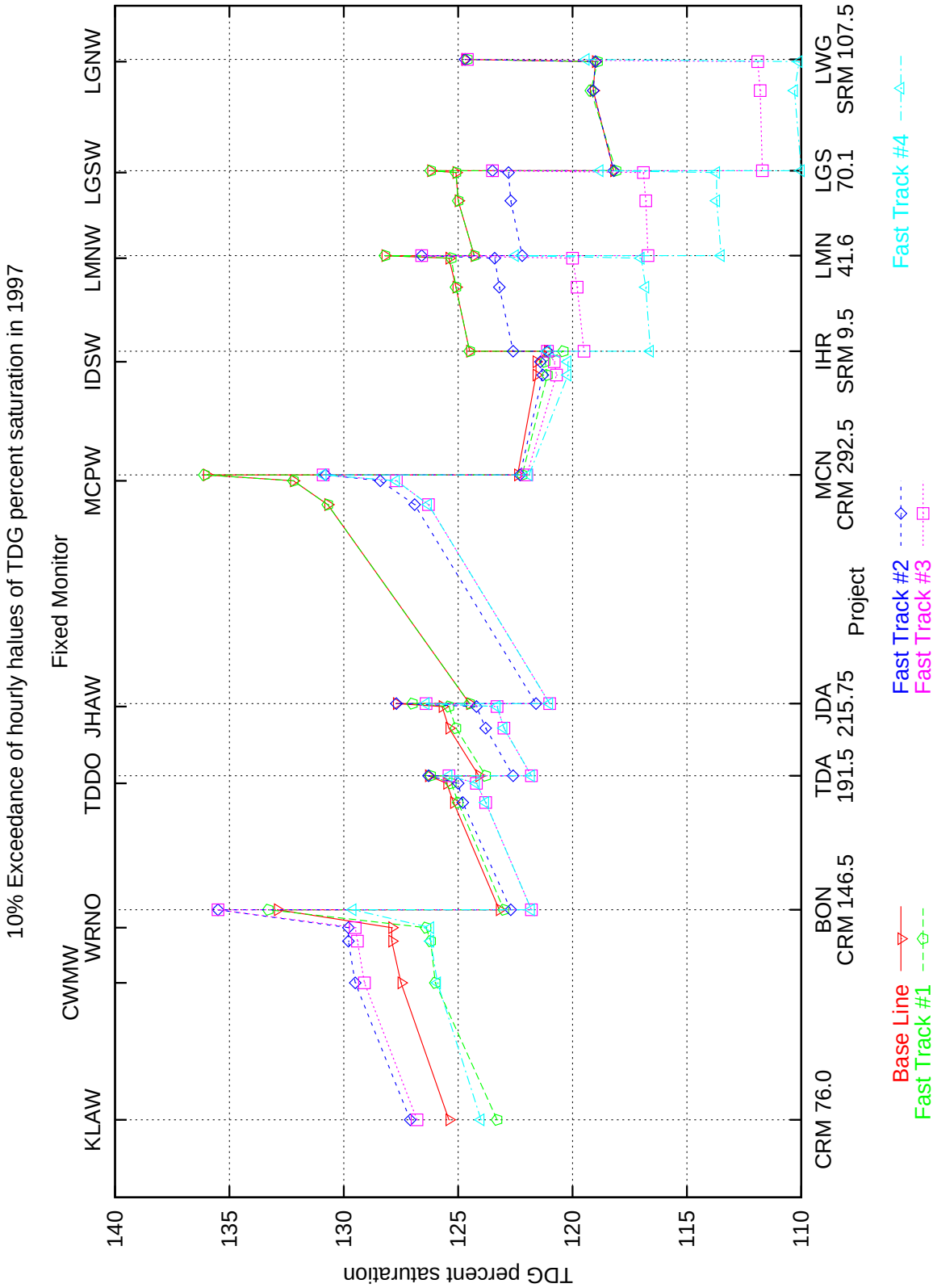

Figure 1.24: Comparison of the 10% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: high flow season (1997)

Table 1.12: 25% exceedance of TDG percent saturation of MASS1 fast track time series output: high flow season (1997)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	119.8	119.3	119.8	119.3	115.9
LGS-sp	SRM 70.1	122.0	122.0	118.9	119.0	115.2
LMN-sp	SRM 41.6	125.0	125.0	122.6	122.6	119.0
IHR-sp	SRM 9.5	117.7	117.2	117.7	117.7	117.7
MCN-sp	CRM 292.5	129.7	129.3	125.1	125.1	125.1
JDA-sp	CRM 215.75	123.3	122.8	123.3	121.9	121.9
TDA-sp	CRM 191.5	124.3	124.0	124.3	121.6	121.6
BON-sp	CRM 146.5	129.7	128.1	132.6	132.6	126.9
LWG-fms	SRM 106.75	113.0	112.7	113.0	109.3	108.8
LGS-fms	SRM 69.5	119.8	119.7	117.5	112.3	110.4
LMN-fms	SRM 40.75	120.1	120.1	118.1	115.1	113.0
IHR-fms	SRM 6.0	118.0	117.6	117.5	116.8	116.4
MCN-fms	CRM 290.5	126.1	125.8	123.0	122.5	122.4
JDA-fms	CRM 214.75	120.8	120.5	119.4	118.6	118.5
TDA-fms	CRM 189.0	122.6	122.4	122.3	120.4	120.4
BON-fms	CRM 140.5	124.8	123.0	126.6	125.8	122.5
LGS-fb	SRM 70.1	112.5	112.4	112.5	109.1	108.7
LMN-fb	SRM 41.6	119.0	119.0	117.0	112.1	110.2
IHR-fb	SRM 9.5	119.3	119.3	117.4	114.3	112.4
MCN-fb	CRM 292.5	119.0	118.9	118.8	118.6	118.5
JDA-fb	CRM 215.75	119.6	119.4	117.3	116.9	116.8
TDA-fb	CRM 191.5	119.5	119.3	118.3	117.6	117.5
BON-fb	CRM 146.5	120.6	120.5	120.2	118.6	118.6
TID-fb	CRM 122.0	124.4	122.4	126.5	125.6	122.5
TID-fb	CRM 76.0	121.6	119.8	123.5	122.9	120.3

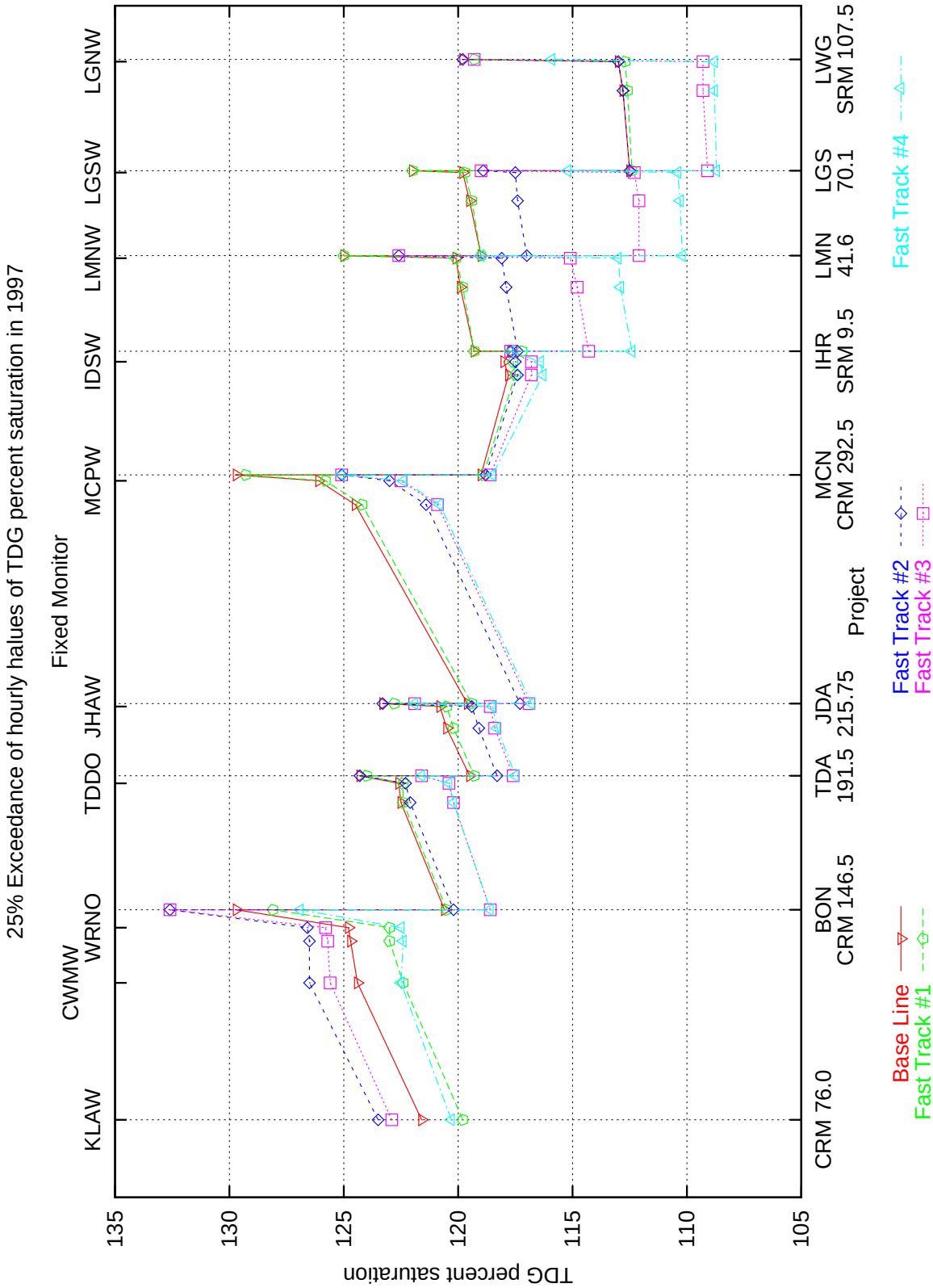

Figure 1.25: Comparison of the 25% exceedance of hourly halues of TDG percent saturation of MASS1 time series output: high flow season (1997)

Table 1.13: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: high flow season (1997)

Location	Rivier Mile	Base Line	Fast Track #1	Fast Track #2	Fast Track #3	Fast Track #4
LWG-sp	SRM 107.5	126.9	126.9	126.9	126.9	121.0
LGS-sp	SRM 70.1	126.8	126.8	124.1	124.4	119.6
LMN-sp	SRM 41.6	129.0	129.0	127.5	127.4	123.4
IHR-sp	SRM 9.5	122.4	121.7	122.4	122.4	122.4
MCN-sp	CRM 292.5	137.1	137.3	131.8	131.8	131.8
JDA-sp	CRM 215.75	128.1	127.4	128.1	126.8	126.8
TDA-sp	CRM 191.5	126.8	126.7	126.8	126.2	126.2
BON-sp	CRM 146.5	133.3	134.0	135.8	135.8	129.9
LWG-fms	SRM 106.75	122.9	122.8	122.9	114.1	111.3
LGS-fms	SRM 69.5	126.0	126.0	123.6	118.1	114.4
LMN-fms	SRM 40.75	126.2	126.2	124.7	121.6	118.6
IHR-fms	SRM 6.0	122.7	122.0	122.5	122.1	121.8
MCN-fms	CRM 290.5	133.4	133.4	129.4	128.6	128.6
JDA-fms	CRM 214.75	126.2	125.8	124.7	123.8	123.8
TDA-fms	CRM 189.0	126.0	125.8	125.6	124.8	124.8
BON-fms	CRM 140.5	128.6	126.8	130.2	129.9	126.7
LGS-fb	SRM 70.1	120.7	120.5	120.7	113.2	110.8
LMN-fb	SRM 41.6	125.1	125.1	122.8	117.4	114.1
IHR-fb	SRM 9.5	125.4	125.4	123.8	120.8	117.9
MCN-fb	CRM 292.5	123.2	123.0	123.1	122.8	122.6
JDA-fb	CRM 215.75	125.1	125.1	122.1	121.6	121.5
TDA-fb	CRM 191.5	125.0	124.7	123.5	122.7	122.7
BON-fb	CRM 146.5	123.7	123.5	123.3	122.7	122.7
TID-fb	CRM 122.0	128.1	126.5	129.9	129.6	126.3
TID-fb	CRM 76.0	126.1	124.1	127.8	127.3	124.5

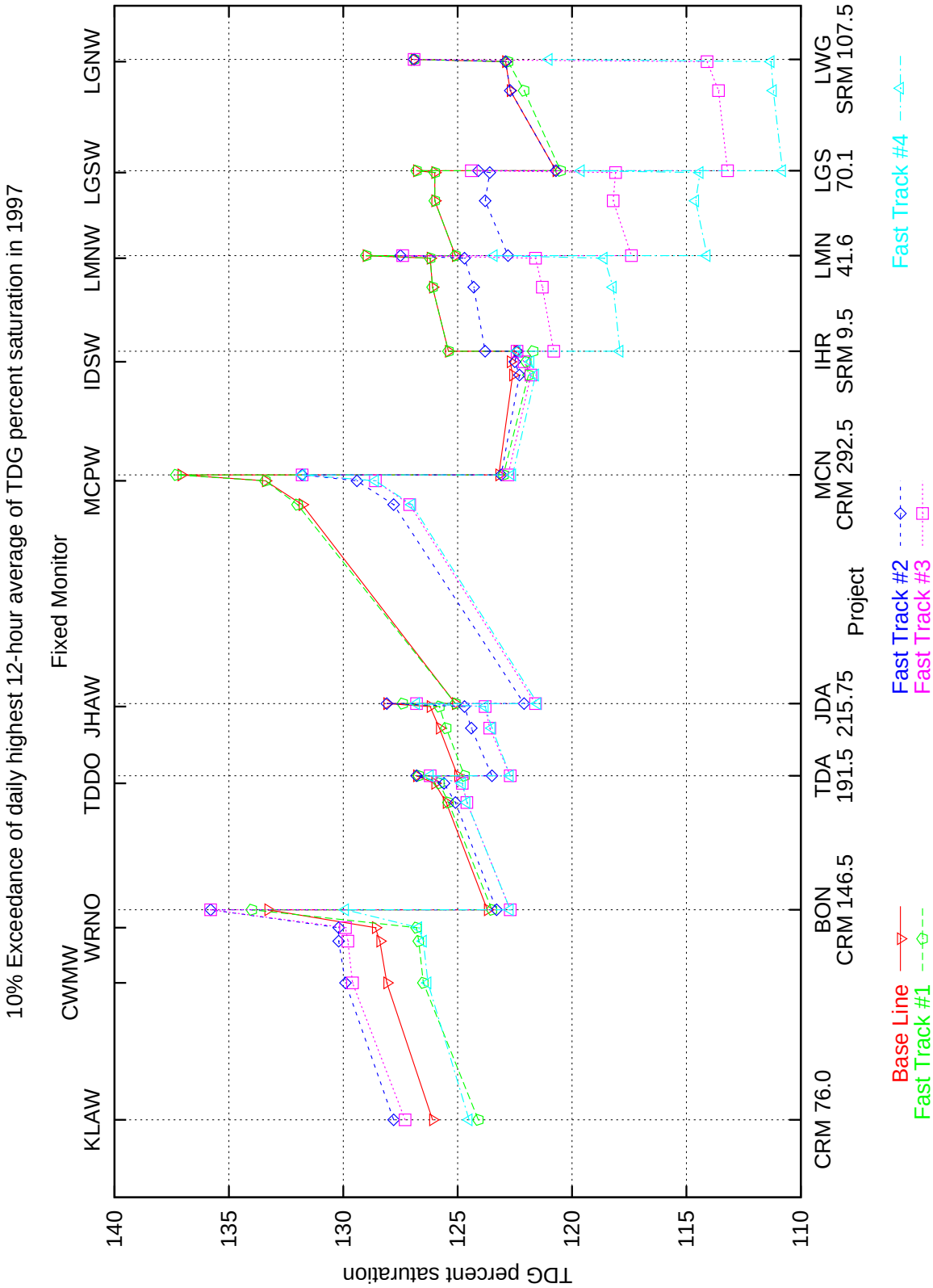

Figure 1.26: Comparison of the 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: high flow season (1997)

Table 1.14: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 fast track time series output: high flow season (1997)

Location	Project	River Mile	Baseline		Fast Track #1		Fast Track #2		Fast Track #3		Fast Track #4	
			Days	%	Days	%	Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	53	31.7	47	28.1	53	31.7	47	28.1	21	12.6
> 120	LGS	SRM 70.1	60	35.9	60	35.9	45	26.9	45	26.9	12	7.2
	LMN	SRM 41.6	64	38.3	64	38.3	59	35.3	59	35.3	43	25.7
	IHR	SRM 9.5	33	19.8	29	17.4	33	19.8	33	19.8	33	19.8
	MCN	CRM 292.5	74	44.3	71	42.5	67	40.1	67	40.1	67	40.1
	JDA	CRM 215.75	60	35.9	57	34.1	60	35.9	53	31.7	53	31.7
	TDA	CRM 191.5	124	74.3	116	69.5	124	74.3	57	34.1	57	34.1
	BON	CRM 146.5	147	88.0	111	66.5	73	43.7	73	43.7	68	40.7
FMS	LWG	SRM 106.75	25	15.0	23	13.8	25	15.0	0	0.0	0	0.0
> 120	LGS	SRM 69.5	51	30.5	51	30.5	43	25.7	7	4.2	0	0.0
	LMN	SRM 40.75	53	31.7	53	31.7	37	22.2	27	16.2	8	4.8
	IHR	SRM 6.0	32	19.2	32	19.2	32	19.2	29	17.4	28	16.8
	MCN	CRM 290.5	69	41.3	68	40.7	59	35.3	54	32.3	54	32.3
	JDA	CRM 214.75	45	26.9	45	26.9	43	25.7	40	24.0	40	24.0
	TDA	CRM 189.0	66	39.5	66	39.5	64	38.3	48	28.7	48	28.7
	BON	CRM 140.5	71	42.5	68	40.7	69	41.3	68	40.7	59	35.3
Forebay	LGS	SRM 70.1	39	23.4	37	22.2	39	23.4	6	3.6	0	0.0
> 115	LMN	SRM 41.6	62	37.1	62	37.1	59	35.3	35	21.0	8	4.8
	IHR	SRM 9.5	63	37.7	63	37.7	58	34.7	44	26.3	31	18.6
	MCN	CRM 292.5	67	40.1	67	40.1	66	39.5	65	38.9	64	38.3
	JDA	CRM 215.75	69	41.3	67	40.1	59	35.3	58	34.7	57	34.1
	TDA	CRM 191.5	68	40.7	68	40.7	66	39.5	59	35.3	59	35.3
	BON	CRM 146.5	92	55.1	83	49.7	88	52.7	67	40.1	67	40.1
	TID	CRM 122.0	137	82.0	128	76.6	97	58.1	73	43.7	69	41.3
	TID	CRM 76.0	120	71.9	105	62.9	75	44.9	69	41.3	68	40.7

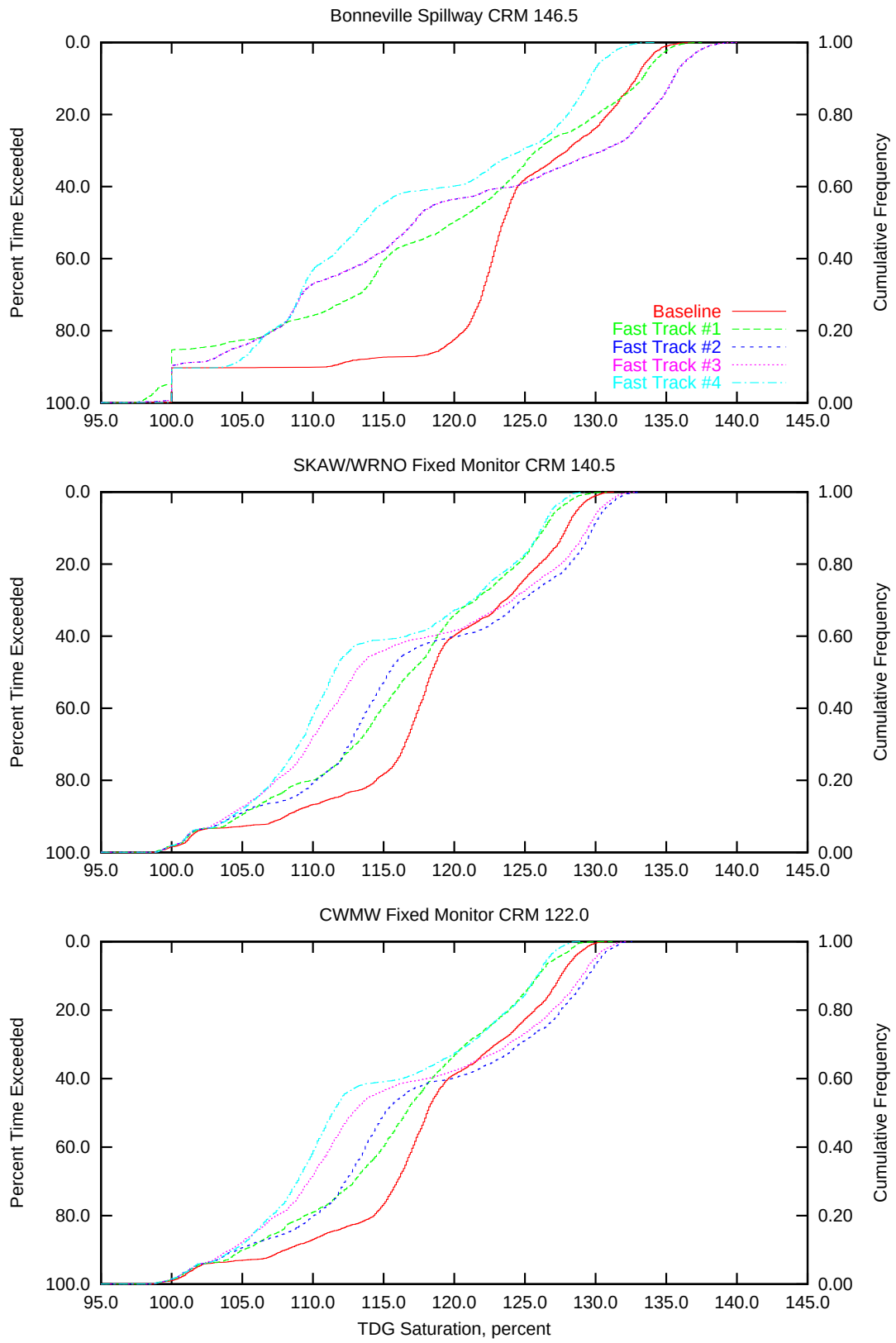

Figure 1.27: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a high flow (1997) season.

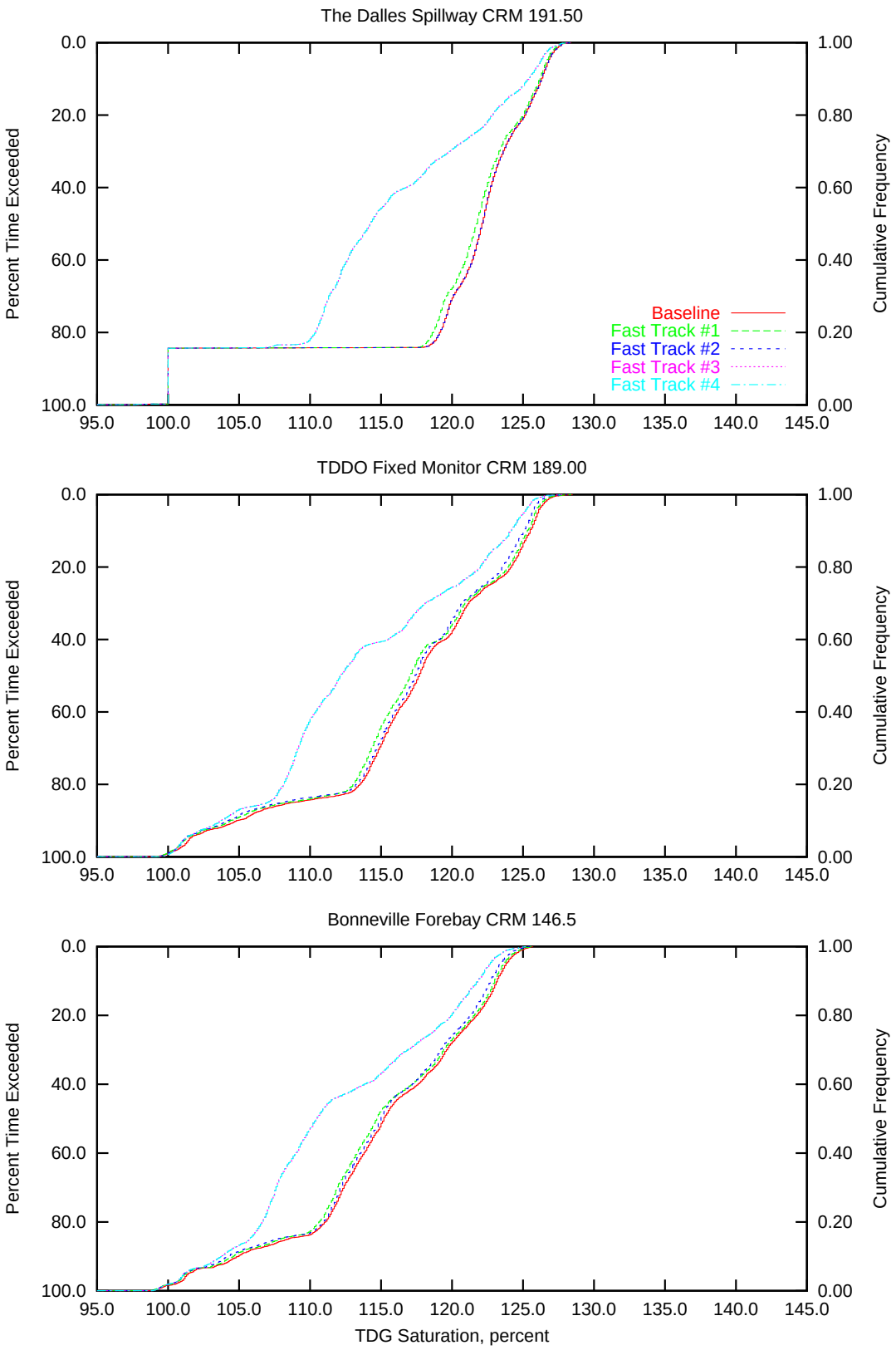

Figure 1.28: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a high flow (1997) season.

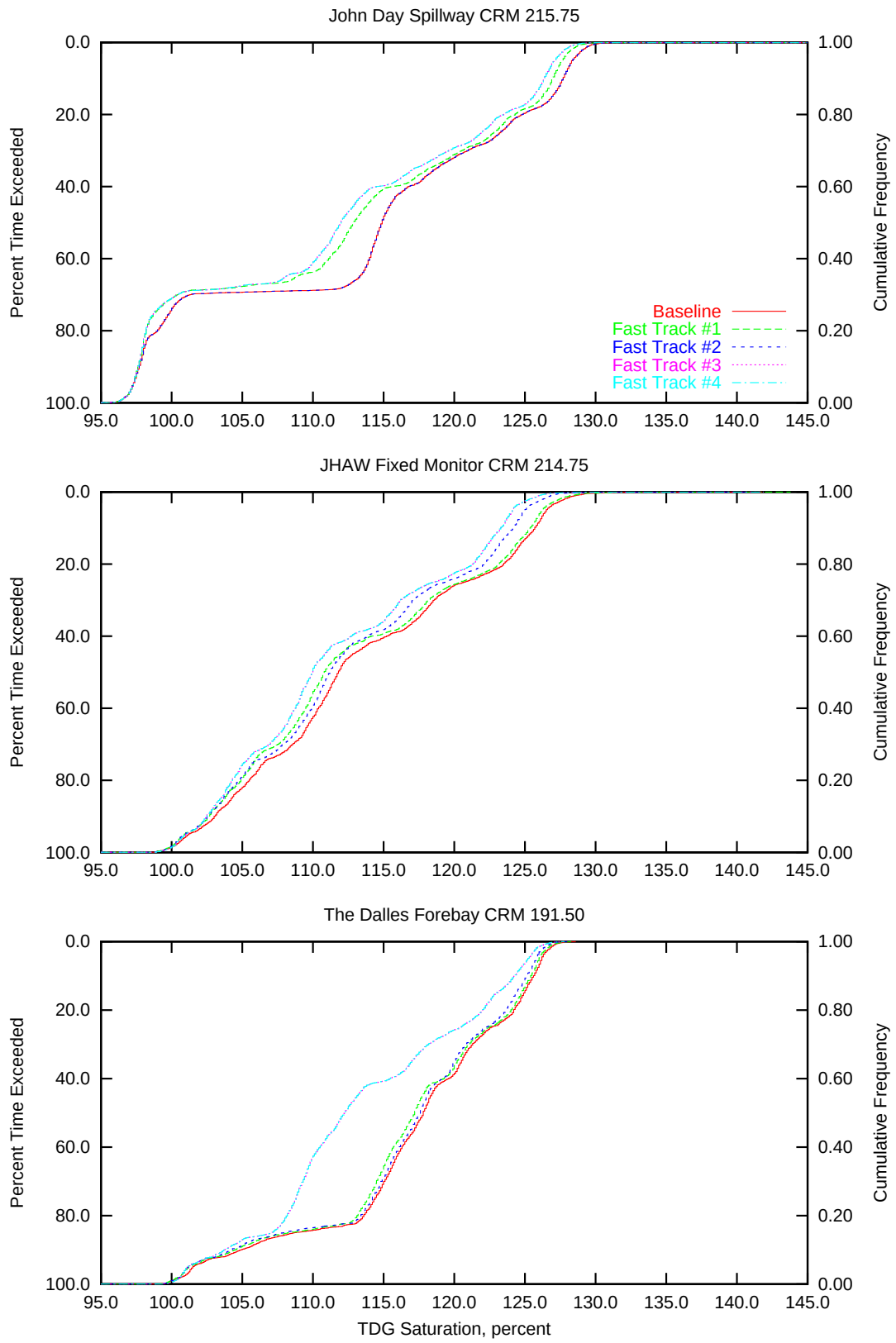

Figure 1.29: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a high flow (1997) season.

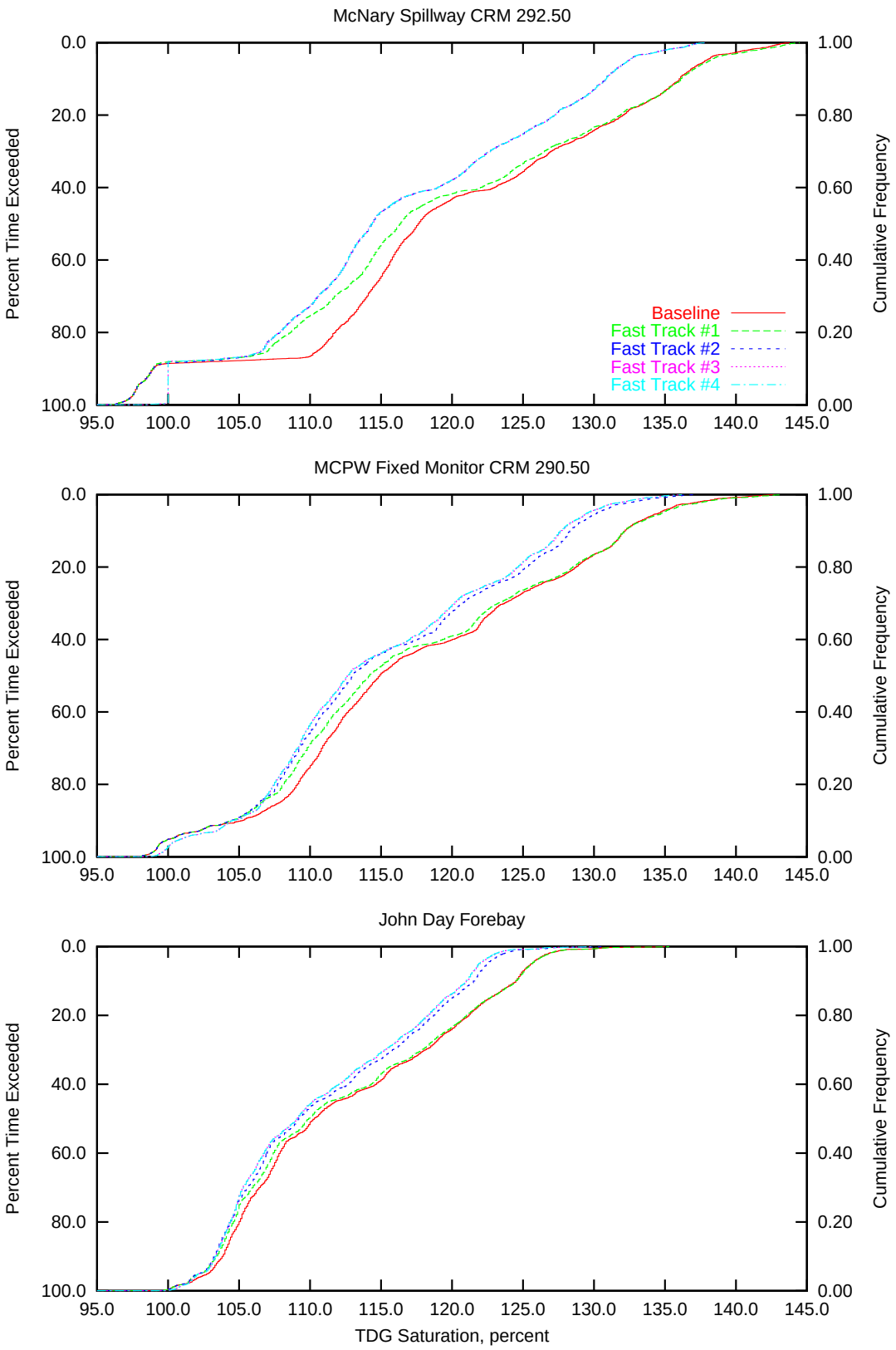

Figure 1.30: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a high flow (1997) season.

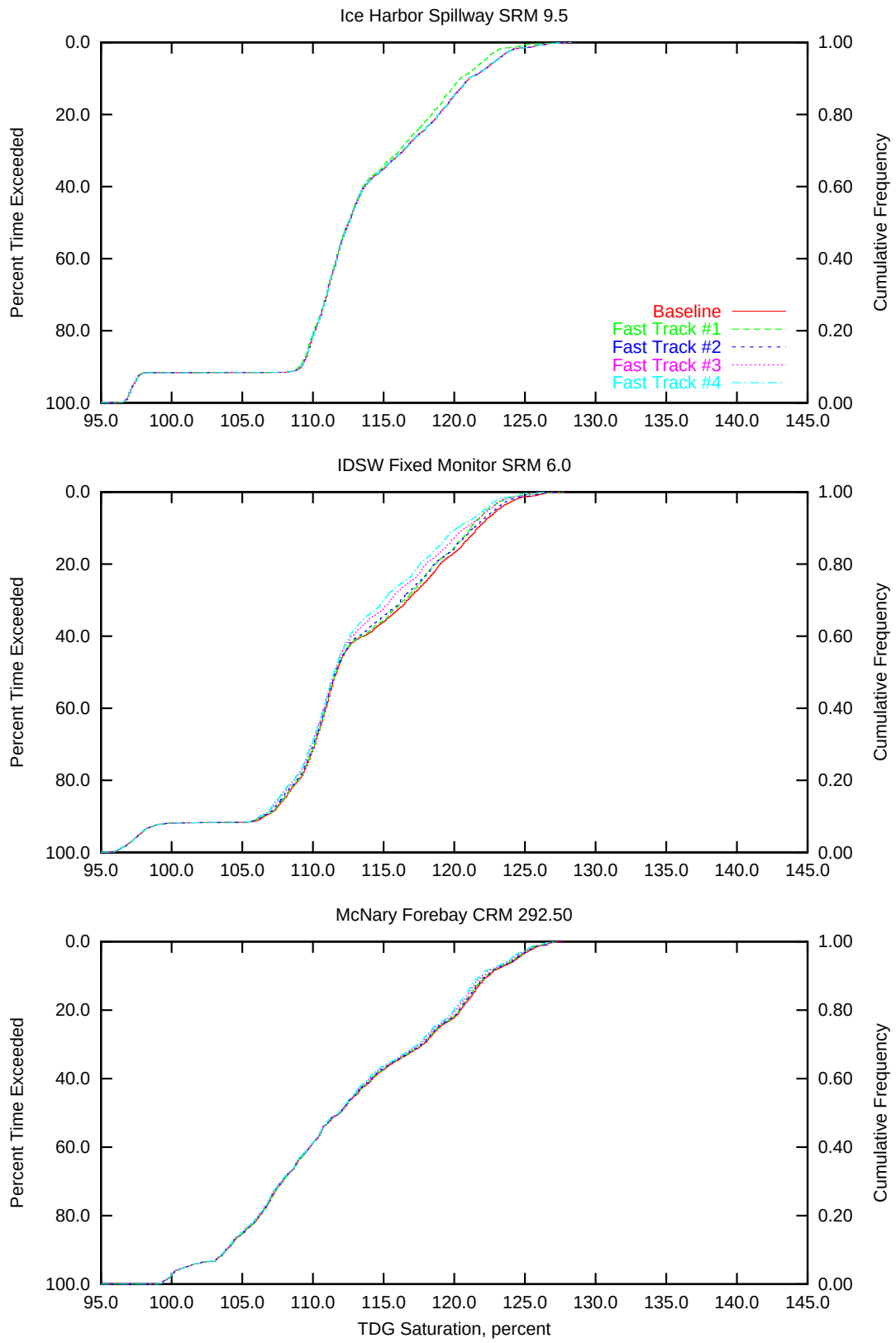

Figure 1.31: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a high flow (1997) season.

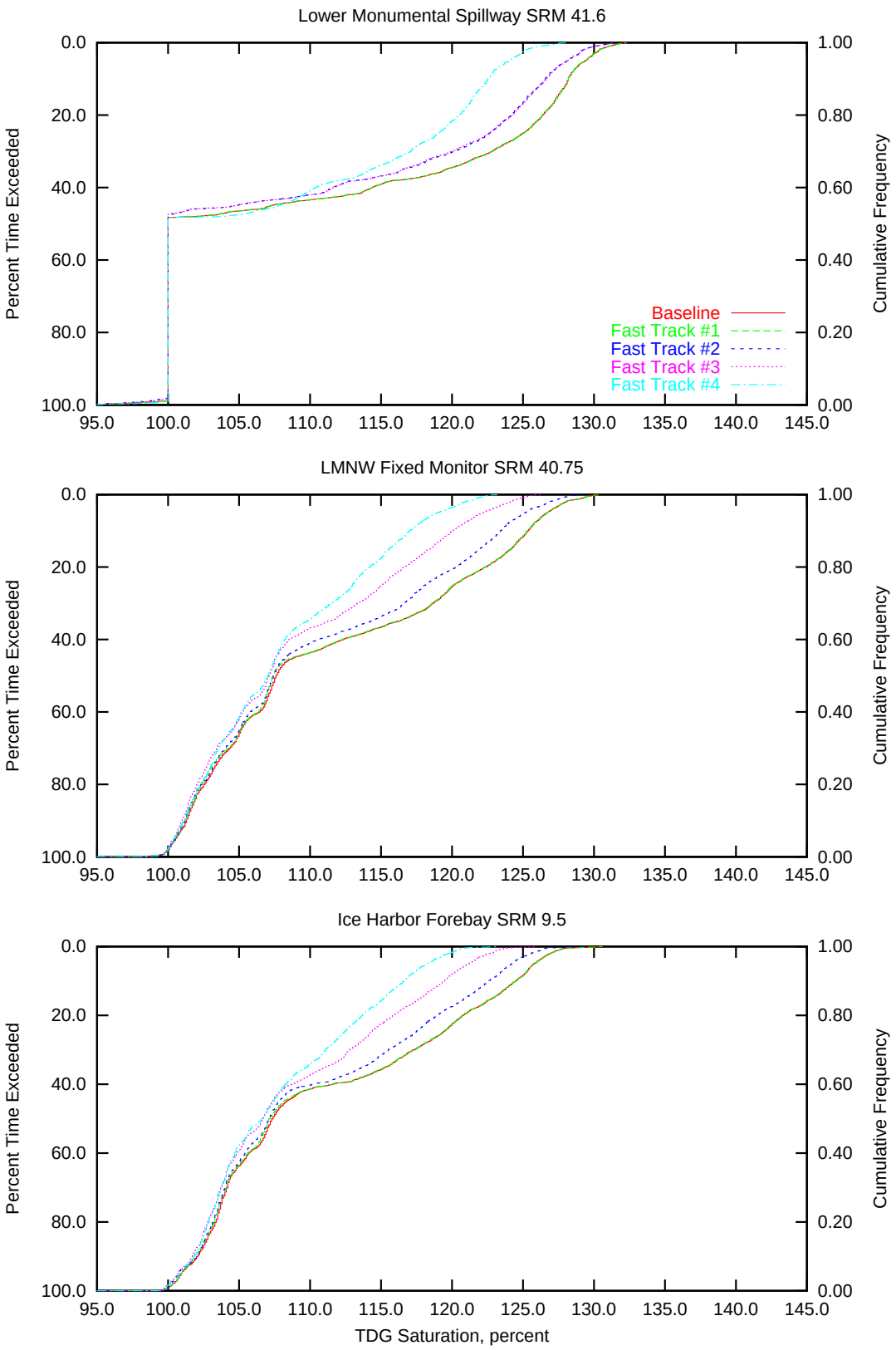

Figure 1.32: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a high flow (1997) season.

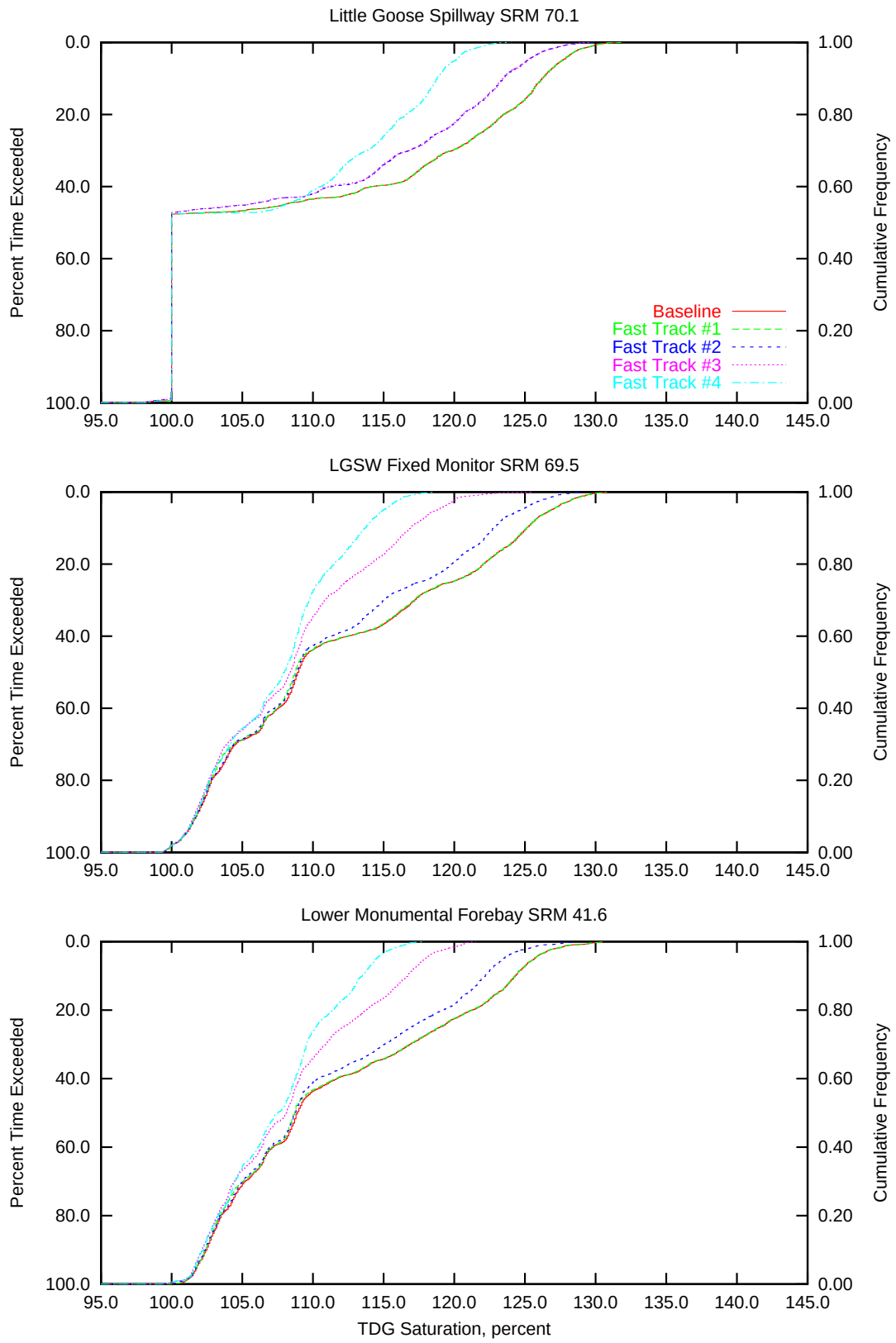

Figure 1.33: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a high flow (1997) season.

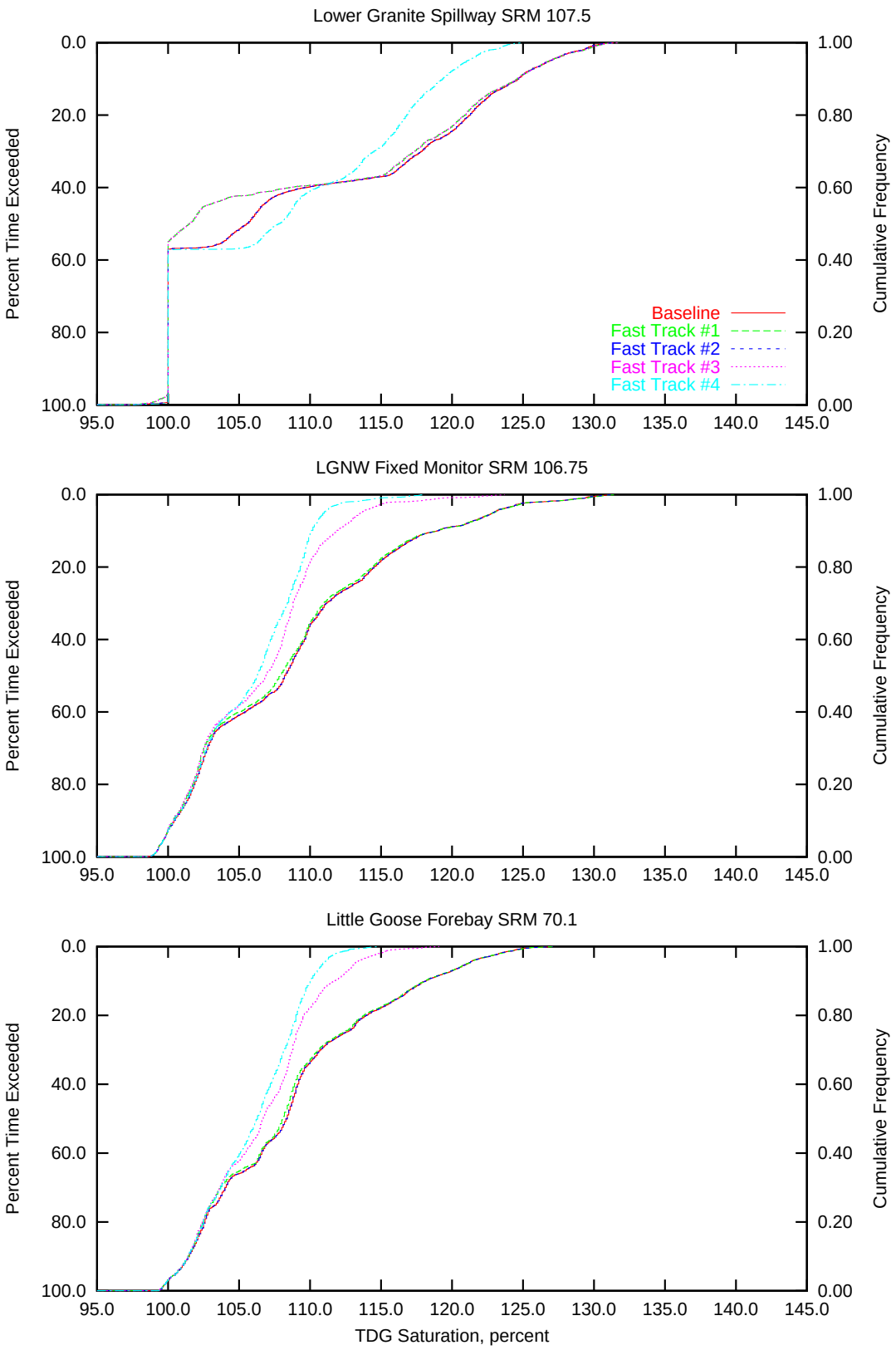

Figure 1.34: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a high flow (1997) season.

1.2 Long Term Scenarios

This section presents the complete results of the one-dimensional simulations of the long term alternative scenarios. The long term scenarios are summarized in Table 1.15. A more detailed description of the scenarios is presented in the main report, Section 2.2.

Table 1.15: Individual project modifications for the long term system-wide scenarios.

	Scenario		
Project	**Long Term #1**	**Long Term #2**	**Long Term #3**
Bonneville	Fast-Track #4	Fast-Track #4	Submerged Radial Gates Uniform Spill
The Dalles	Fast-Track #3	Fast-Track #3	Fast-Track #3
John Day	Additional Bays (6) Nonuniform Spill[a]	Additional Bays (6) Nonuniform Spill[a]	Additional Bays (6) Nonuniform Spill[a]
McNary	Fast-Track #3	Additional Bays (9) Uniform Spill	Additional Bays (9) Uniform Spill
Ice Harbor	Fast-Track #1	Fast-Track #1	Divider Wall Only Uniform Spill
Lower Monumental	Fast-Track #3	Fast-Track #3	Additional Bays (9) Divider Wall Uniform Spill
Little Goose	Fast-Track #3	Additional Bays (9) Divider Wall Uniform Spill	Additional Bays (9) Divider Wall Uniform Spill
Lower Granite	Additional Bays (9) Uniform Spill	Additional Bays (9) Divider Wall Uniform Spill	Additional Bays (9) Divider Wall Uniform Spill

[a]The additional bays would be opened first, one at a time, up to a flow of 6300 cfs. After all new bays are open, spill would be distributed evenly over the original 20 bays.

1.2.1 Medium/High Flow Year (1996)

Table 1.16: 10% exceedance of TDG percent saturation of MASS1 long term time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Long Term #1	Long Term #2	Long Term #3
LWG-sp	SRM 107.5	123.5	114.1	114.3	114.3
LGS-sp	SRM 70.1	126.1	123.5	115.3	115.3
LMN-sp	SRM 41.6	127.3	125.5	125.5	115.9
IHR-sp	SRM 9.5	118.8	118.5	118.5	118.4
MCN-sp	CRM 292.5	130.4	125.9	118.8	118.8
JDA-sp	CRM 215.75	121.6	118.0	118.0	118.0
TDA-sp	CRM 191.5	125.4	121.1	121.1	121.1
BON-sp	CRM 146.5	132.5	126.9	126.9	100.0
LWG-fms	SRM 106.75	118.8	109.8	108.9	109.8
LGS-fms	SRM 69.5	125.4	116.4	111.5	112.3
LMN-fms	SRM 40.75	124.6	119.0	116.9	112.8
IHR-fms	SRM 6.0	120.1	118.5	117.9	115.7
MCN-fms	CRM 290.5	127.1	123.6	118.5	118.2
JDA-fms	CRM 214.75	119.4	116.6	114.4	114.3
TDA-fms	CRM 189.0	122.6	119.1	118.3	118.3
BON-fms	CRM 140.5	126.7	122.2	122.0	116.3
LGS-fb	SRM 70.1	117.3	109.4	108.2	109.5
LMN-fb	SRM 41.6	123.5	115.4	111.2	112.2
IHR-fb	SRM 9.5	123.1	118.0	116.1	112.6
MCN-fb	CRM 292.5	118.4	117.8	117.7	116.9
JDA-fb	CRM 215.75	118.2	115.9	112.6	112.4
TDA-fb	CRM 191.5	118.0	115.5	113.4	113.3
BON-fb	CRM 146.5	120.3	117.0	116.3	116.3
TID-fb	CRM 122.0	126.2	121.8	121.4	116.2
TID-fb	CRM 76.0	123.4	119.5	119.2	114.4

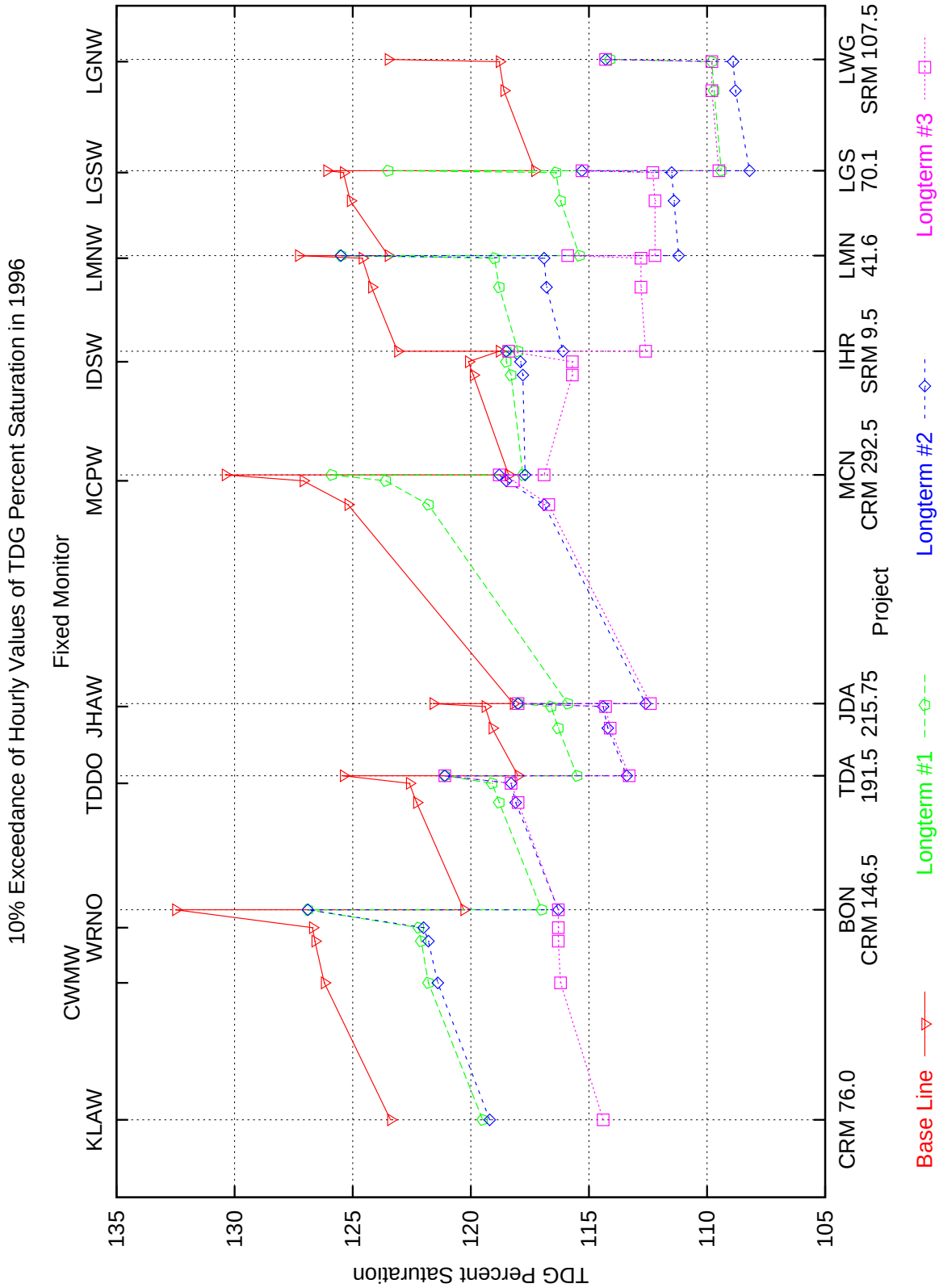

Figure 1.35: Comparison of the 10% exceedance of of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.17: 25% exceedance of TDG percent saturation of MASS1 long term time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Long Term #1	Long Term #2	Long Term #3
LWG-sp	SRM 107.5	118.7	111.7	112.1	112.1
LGS-sp	SRM 70.1	120.5	117.5	111.5	111.5
LMN-sp	SRM 41.6	121.1	118.4	118.4	111.3
IHR-sp	SRM 9.5	114.4	114.3	114.3	114.3
MCN-sp	CRM 292.5	123.7	119.8	114.8	114.8
JDA-sp	CRM 215.75	116.2	114.3	114.3	114.3
TDA-sp	CRM 191.5	123.5	116.2	116.2	116.2
BON-sp	CRM 146.5	128.0	121.6	121.6	100.0
LWG-fms	SRM 106.75	113.8	108.2	107.1	108.4
LGS-fms	SRM 69.5	119.3	112.0	108.9	109.7
LMN-fms	SRM 40.75	118.5	113.4	111.7	109.6
IHR-fms	SRM 6.0	115.4	114.3	114.0	111.3
MCN-fms	CRM 290.5	120.5	117.8	114.5	114.3
JDA-fms	CRM 214.75	113.9	111.9	110.9	110.8
TDA-fms	CRM 189.0	119.2	114.4	113.9	113.8
BON-fms	CRM 140.5	122.0	116.9	116.6	112.5
LGS-fb	SRM 70.1	113.0	107.7	106.8	107.7
LMN-fb	SRM 41.6	118.0	112.0	109.0	109.9
IHR-fb	SRM 9.5	117.0	113.0	111.3	109.4
MCN-fb	CRM 292.5	114.9	114.5	114.4	113.8
JDA-fb	CRM 215.75	113.2	111.5	110.1	109.9
TDA-fb	CRM 191.5	113.4	111.5	110.5	110.4
BON-fb	CRM 146.5	117.6	113.1	112.6	112.5
TID-fb	CRM 122.0	121.8	116.8	116.6	112.5
TID-fb	CRM 76.0	118.2	113.6	113.5	111.0

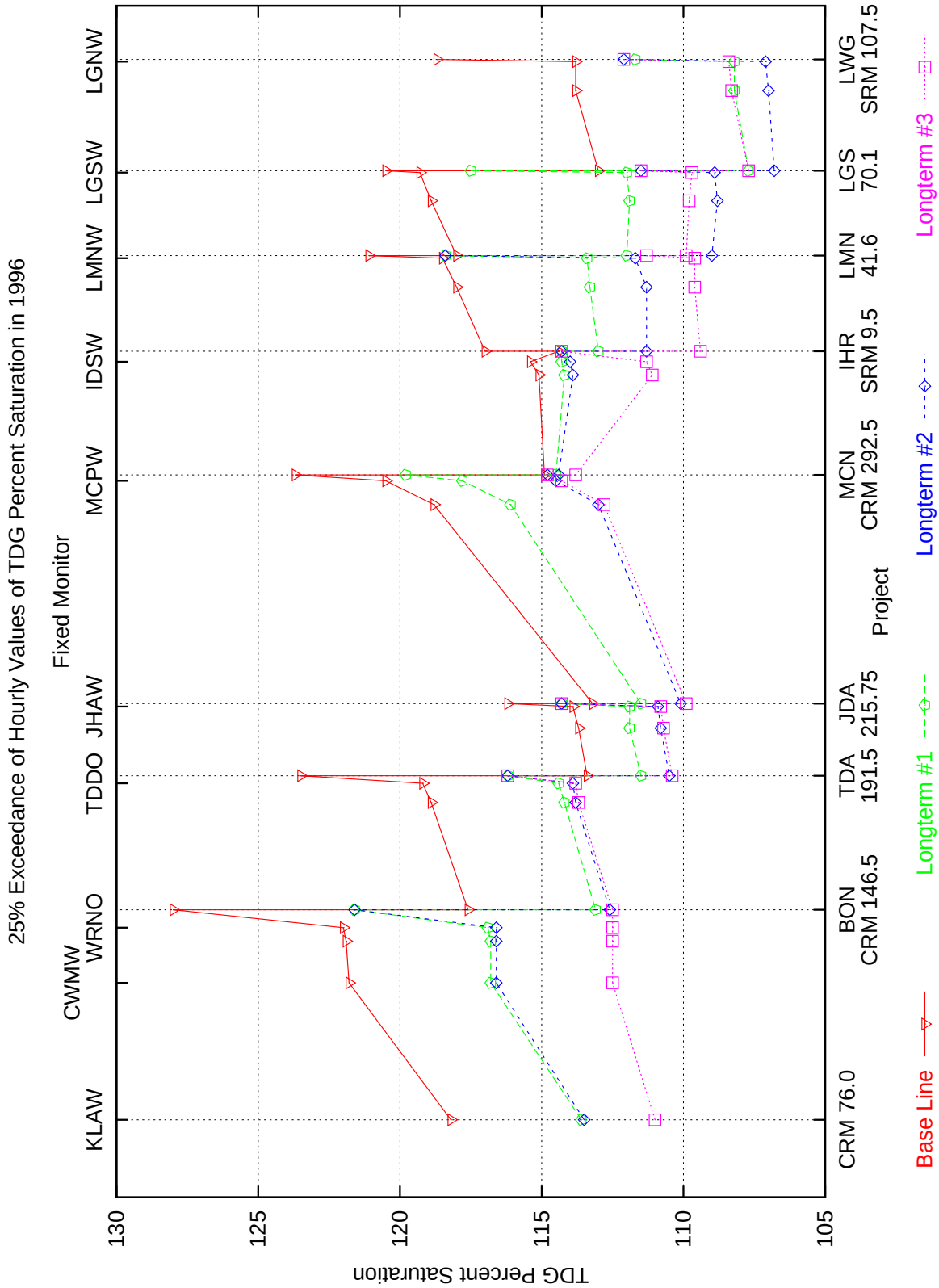

Figure 1.36: Comparison of the 25% exceedance of of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.18: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 long term time series output: medium flow season (1996)

Location	Rivier Mile	Base Line	Long Term #1	Long Term #2	Long Term #3
LWG-sp	SRM 107.5	124.8	114.9	114.9	114.9
LGS-sp	SRM 70.1	127.4	125.1	116.5	116.5
LMN-sp	SRM 41.6	128.5	126.9	126.9	117.0
IHR-sp	SRM 9.5	119.9	119.5	119.5	119.5
MCN-sp	CRM 292.5	132.2	127.6	119.8	119.8
JDA-sp	CRM 215.75	122.6	118.6	118.6	118.6
TDA-sp	CRM 191.5	125.8	121.6	121.6	121.6
BON-sp	CRM 146.5	133.8	128.1	128.1	100.0
LWG-fms	SRM 106.75	119.5	110.1	109.2	110.2
LGS-fms	SRM 69.5	126.8	118.0	112.2	113.2
LMN-fms	SRM 40.75	125.5	120.9	118.7	113.8
IHR-fms	SRM 6.0	120.9	119.2	118.5	116.5
MCN-fms	CRM 290.5	128.7	124.9	119.5	119.2
JDA-fms	CRM 214.75	120.0	117.1	115.0	114.9
TDA-fms	CRM 189.0	123.0	119.7	119.0	119.0
BON-fms	CRM 140.5	127.9	124.0	123.7	116.9
LGS-fb	SRM 70.1	118.5	109.8	108.7	110.0
LMN-fb	SRM 41.6	124.6	116.3	112.0	112.7
IHR-fb	SRM 9.5	124.1	119.2	117.1	113.2
MCN-fb	CRM 292.5	118.7	118.4	118.2	117.5
JDA-fb	CRM 215.75	118.4	116.1	112.8	112.7
TDA-fb	CRM 191.5	118.7	116.0	114.1	114.0
BON-fb	CRM 146.5	120.8	117.6	117.2	117.2
TID-fb	CRM 122.0	127.6	123.8	123.6	116.9
TID-fb	CRM 76.0	124.1	120.3	120.2	114.8

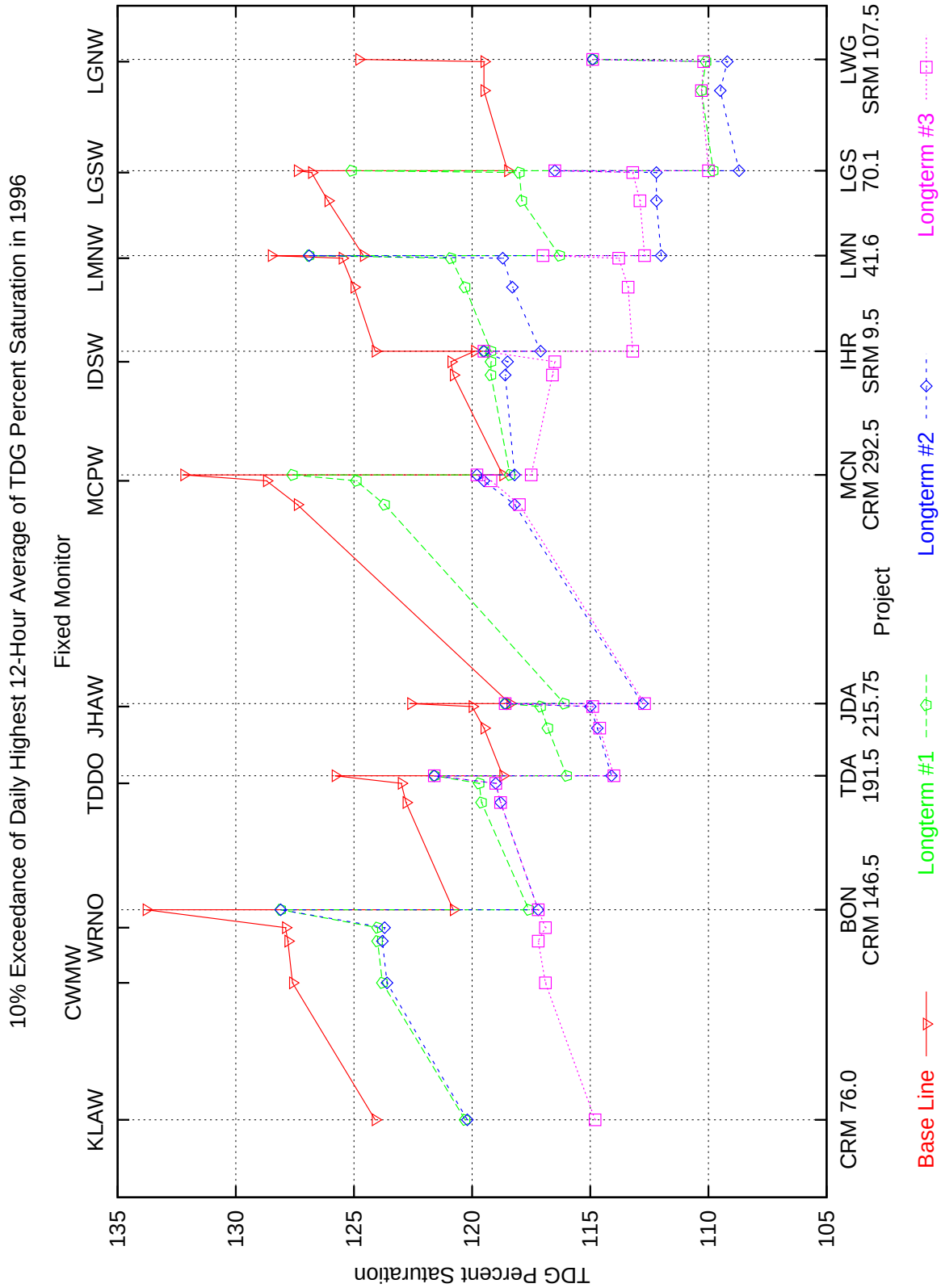

Figure 1.37: Comparison of the 10% exceedance of Daily Highest 12-Hour Average of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.19: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 long term time series output: medium flow season (1996)

Location	Project	River Mile	Baseline		Long Term #1		Long Term #2		Long Term #3	
			Days	%	Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	42	25.1	0	0.0	0	0.0	0	0.0
> 120	LGS	SRM 70.1	55	32.9	41	24.6	1	0.6	1	0.6
	LMN	SRM 41.6	54	32.3	46	27.5	46	27.5	1	0.6
	IHR	SRM 9.5	16	9.6	13	7.8	13	7.8	13	7.8
	MCN	CRM 292.5	67	40.1	42	25.1	16	9.6	16	9.6
	JDA	CRM 215.75	30	18.0	8	4.8	8	4.8	8	4.8
	TDA	CRM 191.5	136	81.4	31	18.6	31	18.6	31	18.6
	BON	CRM 146.5	153	91.6	55	32.9	55	32.9	0	0.0
FMS	LWG	SRM 106.75	16	9.6	0	0.0	0	0.0	0	0.0
> 120	LGS	SRM 69.5	53	31.7	6	3.6	0	0.0	0	0.0
	LMN	SRM 40.75	41	24.6	23	13.8	9	5.4	0	0.0
	IHR	SRM 6.0	20	12.0	14	8.4	10	6.0	1	0.6
	MCN	CRM 290.5	51	30.5	37	22.2	12	7.2	11	6.6
	JDA	CRM 214.75	16	9.6	2	1.2	0	0.0	0	0.0
	TDA	CRM 189.0	37	22.2	14	8.4	7	4.2	7	4.2
	BON	CRM 140.5	71	42.5	33	19.8	32	19.2	0	0.0
Forebay	LGS	SRM 70.1	32	19.2	1	0.6	0	0.0	1	0.6
> 115	LMN	SRM 41.6	64	38.3	25	15.0	2	1.2	2	1.2
	IHR	SRM 9.5	58	34.7	35	21.0	28	16.8	5	3.0
	MCN	CRM 292.5	46	27.5	45	26.9	43	25.7	35	21.0
	JDA	CRM 215.75	37	22.2	28	16.8	7	4.2	7	4.2
	TDA	CRM 191.5	36	21.6	28	16.8	11	6.6	9	5.4
	BON	CRM 146.5	81	48.5	36	21.6	33	19.8	33	19.8
	TID	CRM 122.0	141	84.4	58	34.7	56	33.5	32	19.2
	TID	CRM 76.0	107	64.1	37	22.2	36	21.6	15	9.0

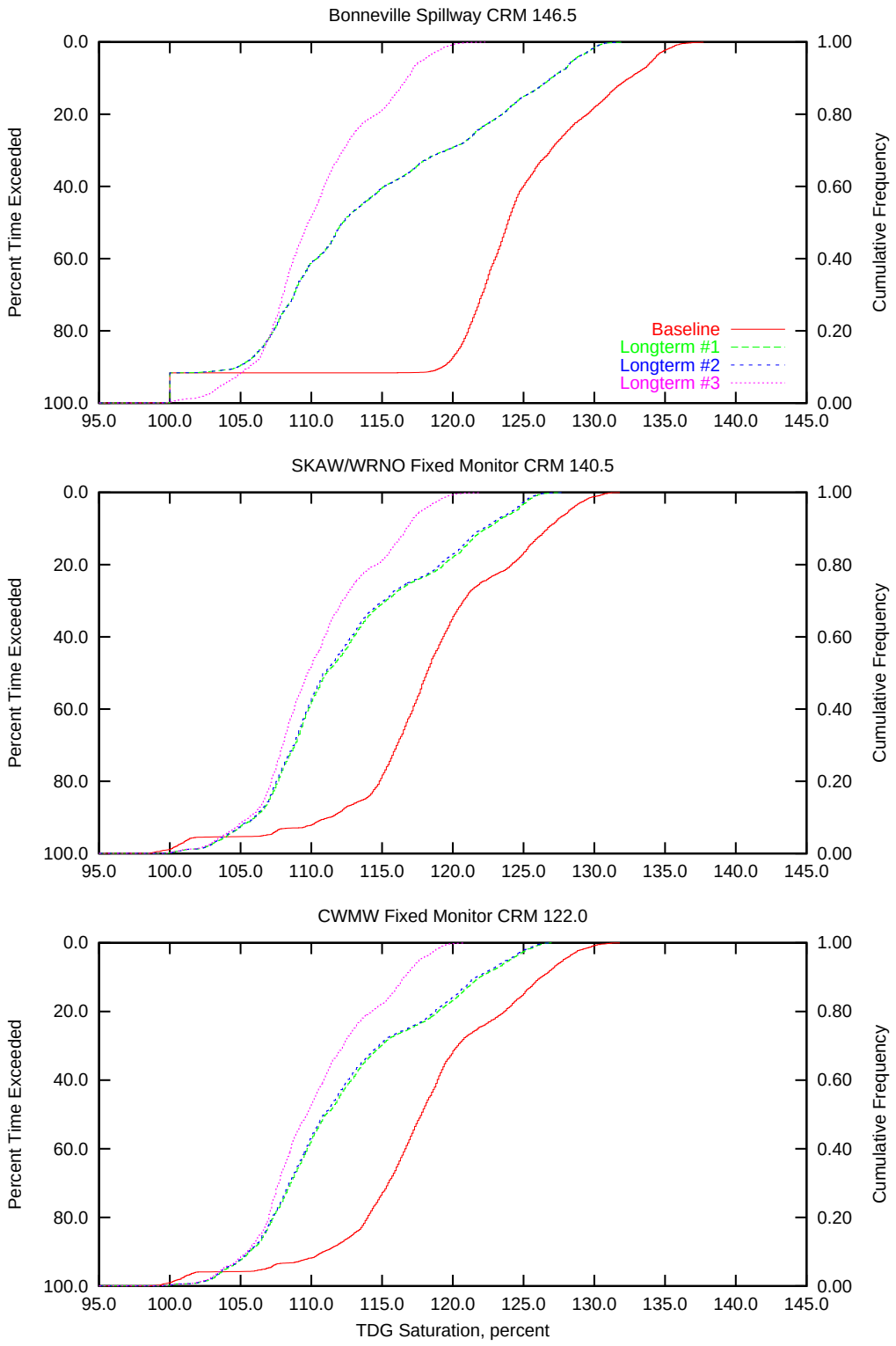

Figure 1.38: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a medium flow (1996) season.

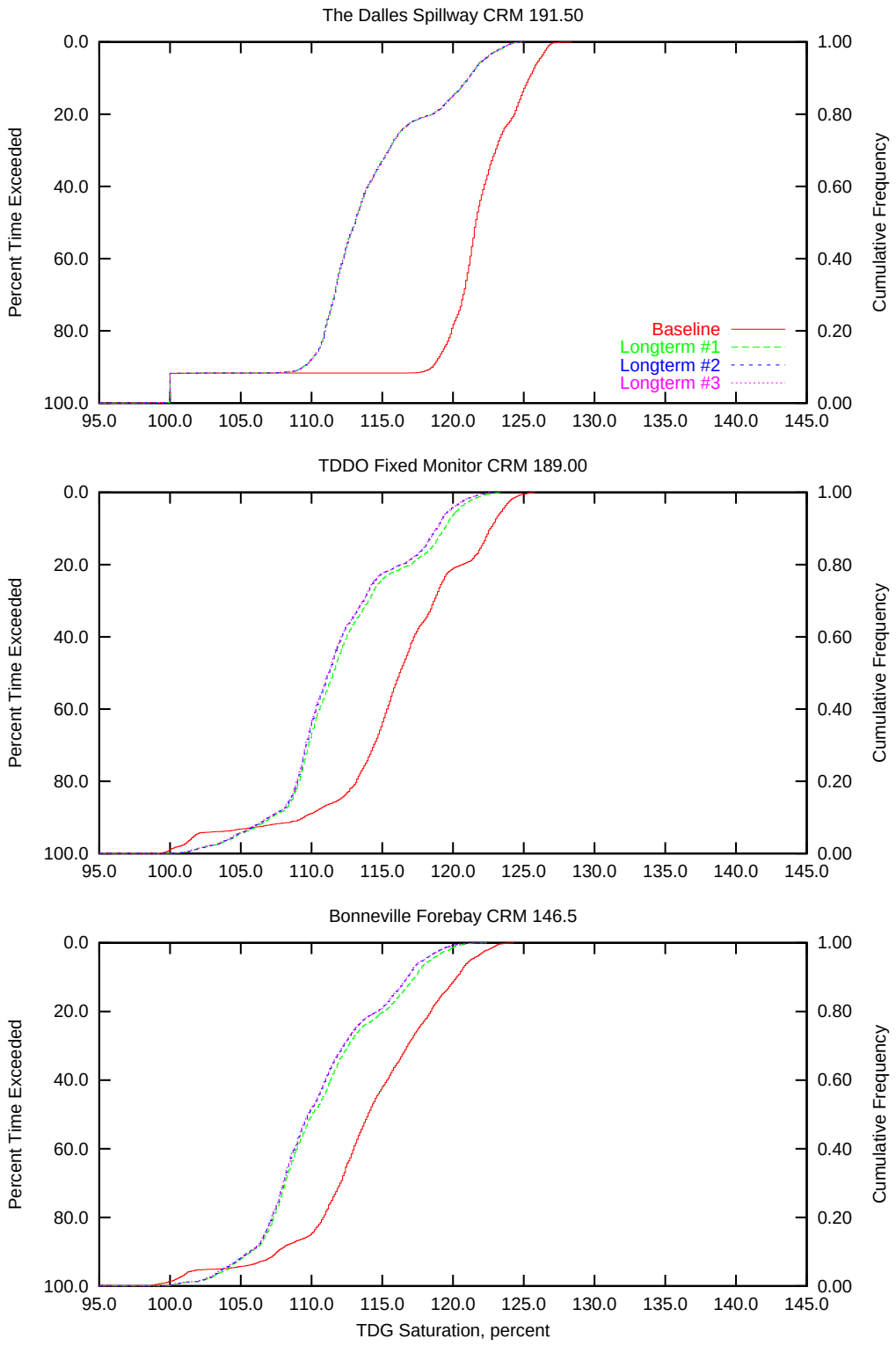

Figure 1.39: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a medium flow (1996) season.

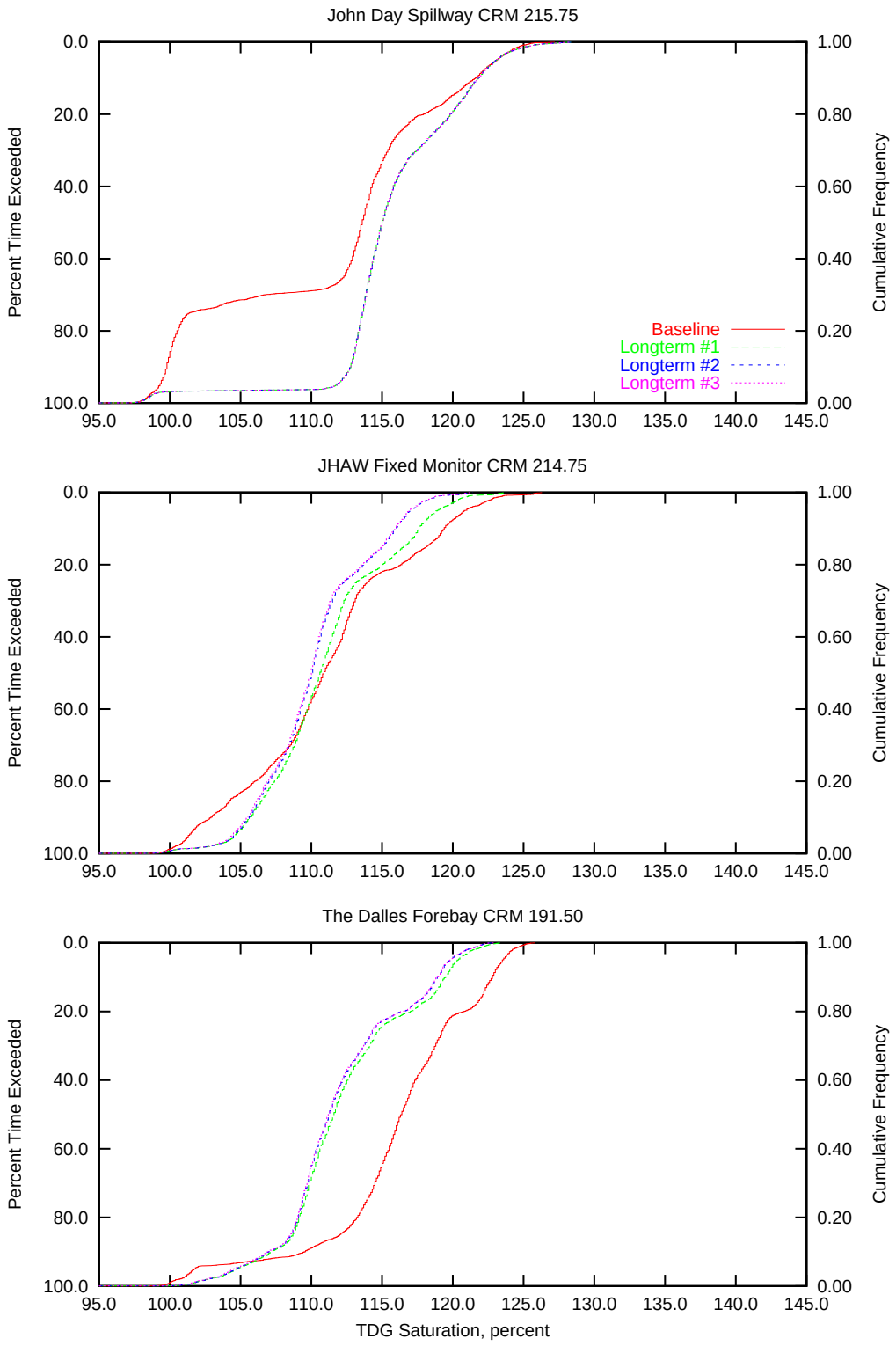

Figure 1.40: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a medium flow (1996) season.

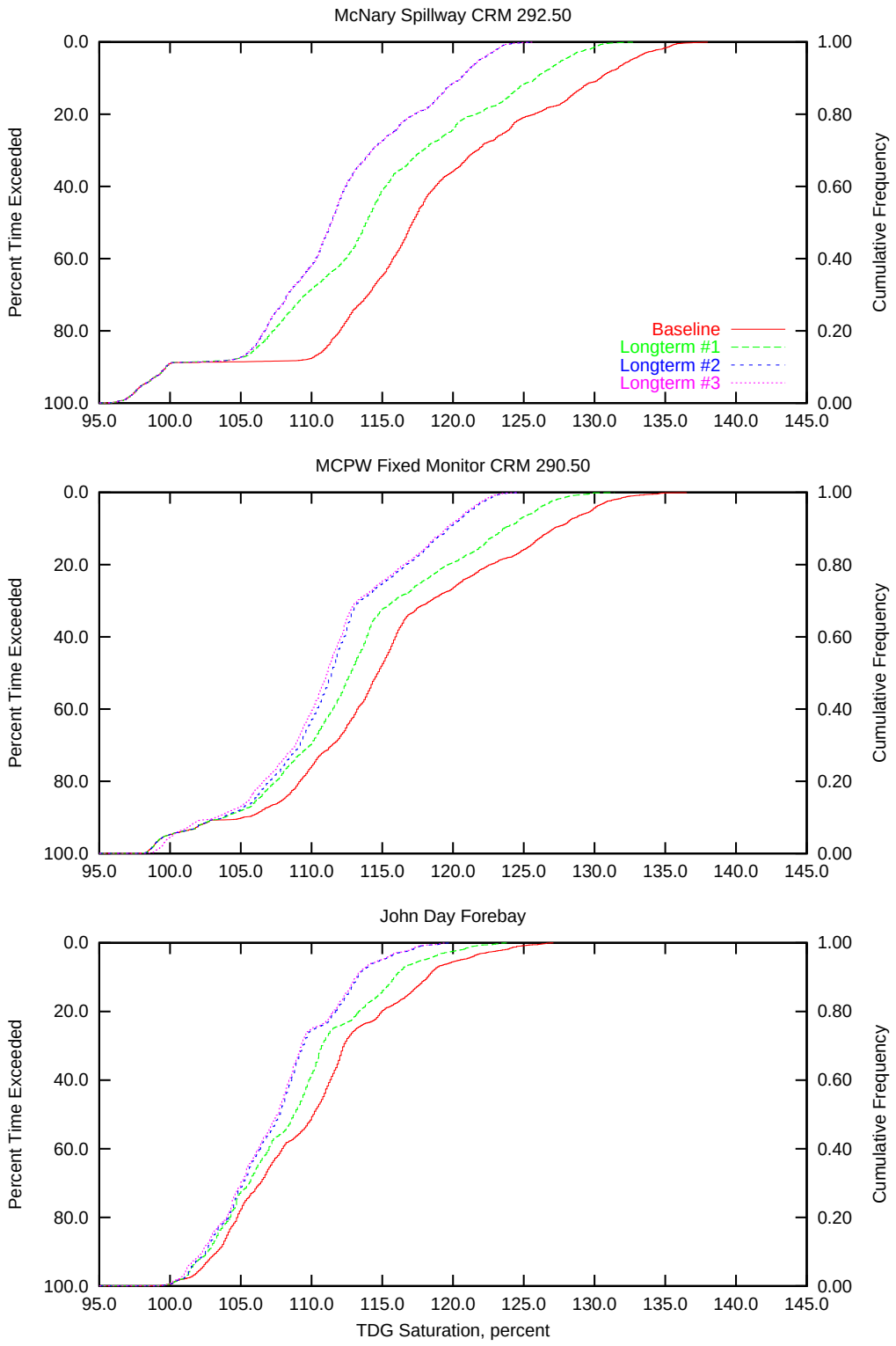

Figure 1.41: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a medium flow (1996) season.

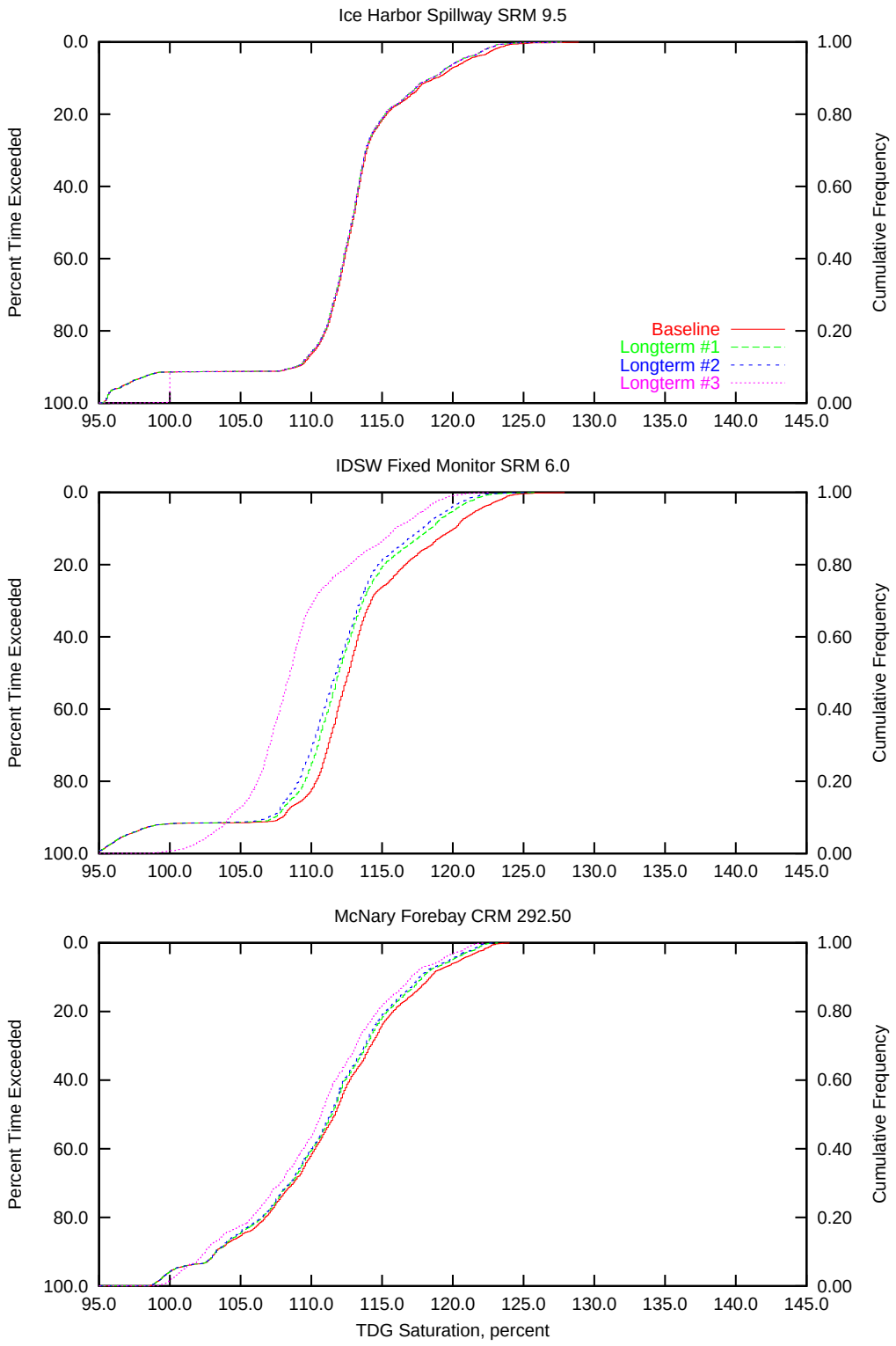

Figure 1.42: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a medium flow (1996) season.

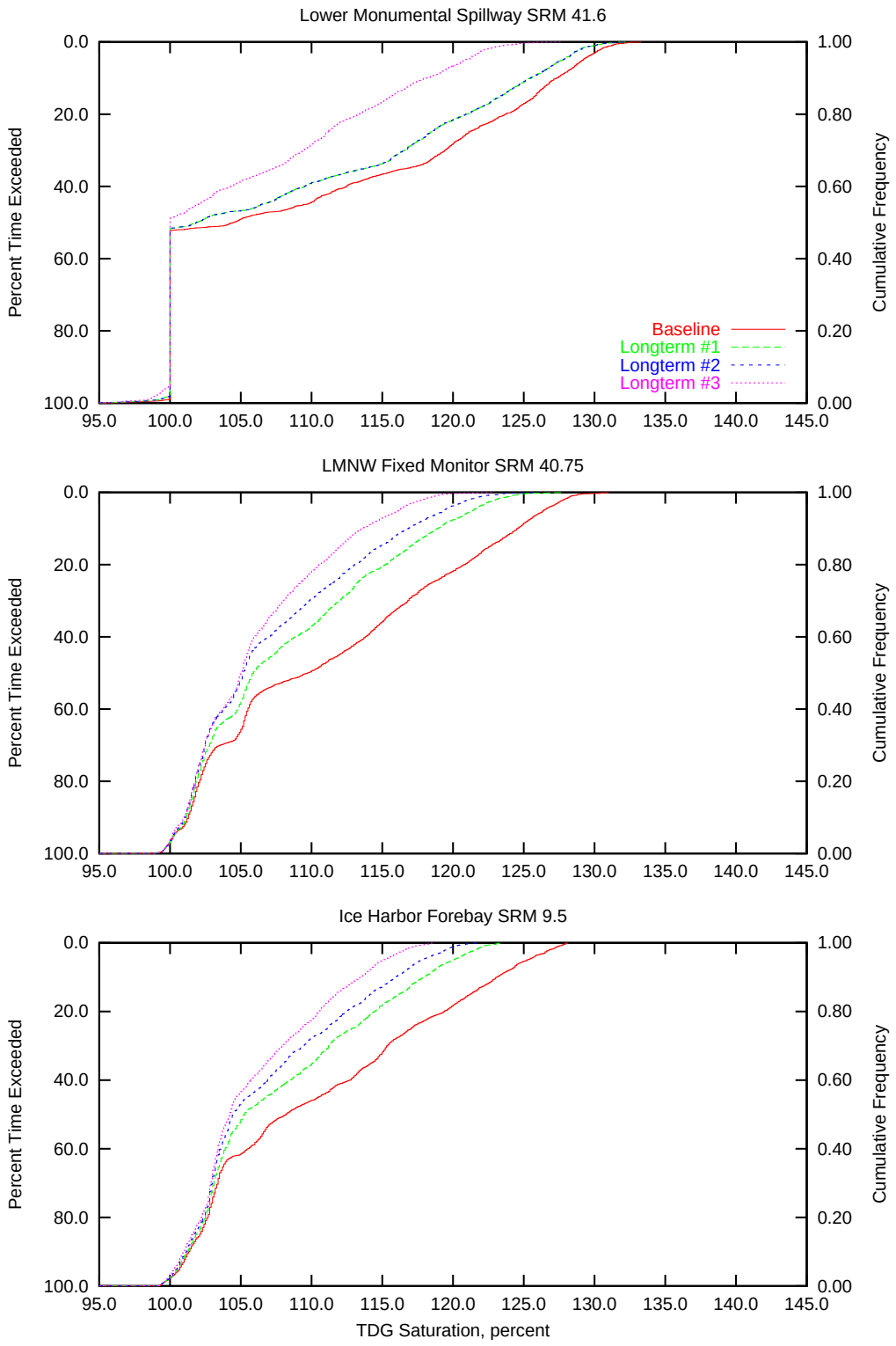

Figure 1.43: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a medium flow (1996) season.

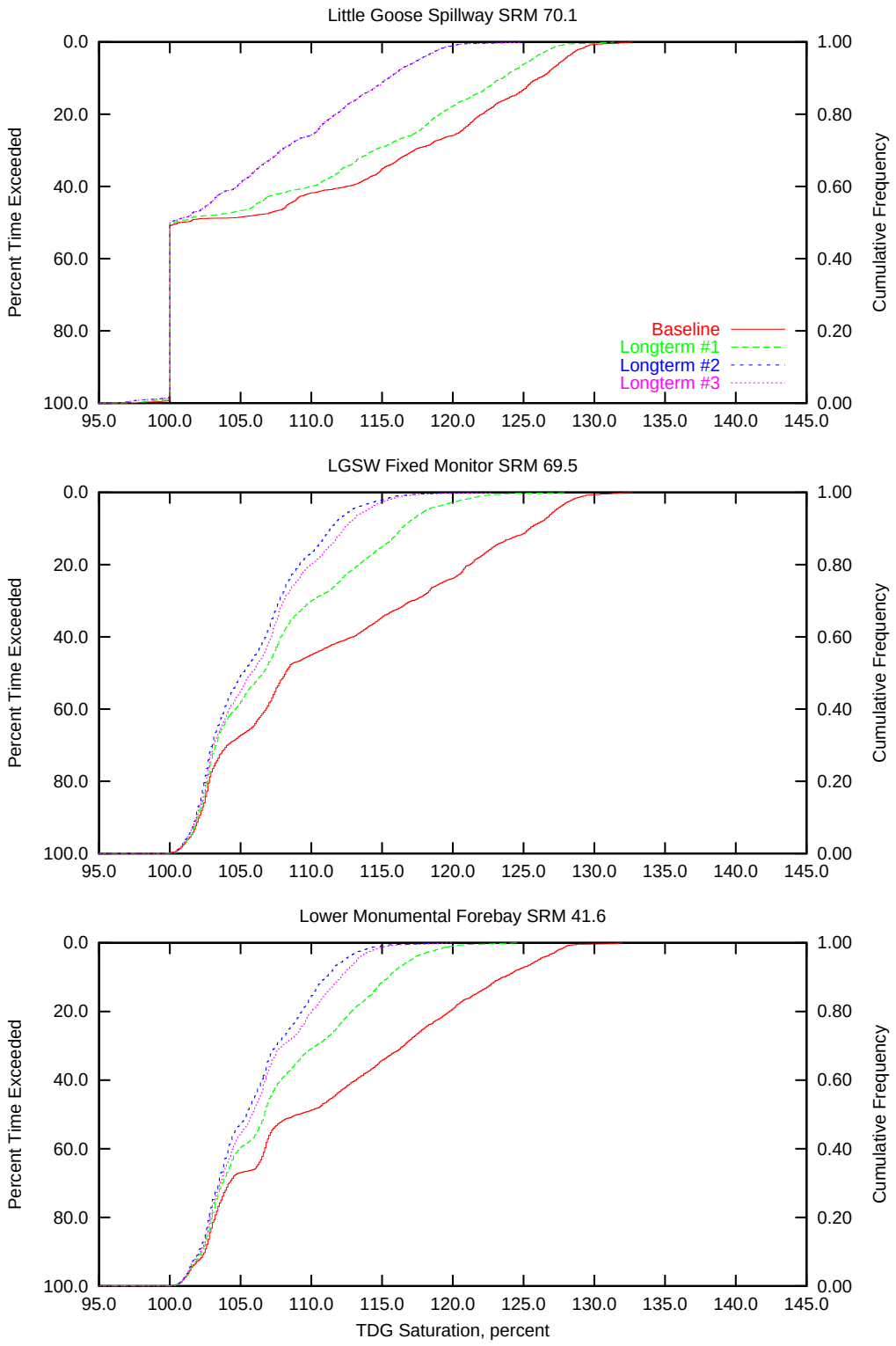

Figure 1.44: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a medium flow (1996) season.

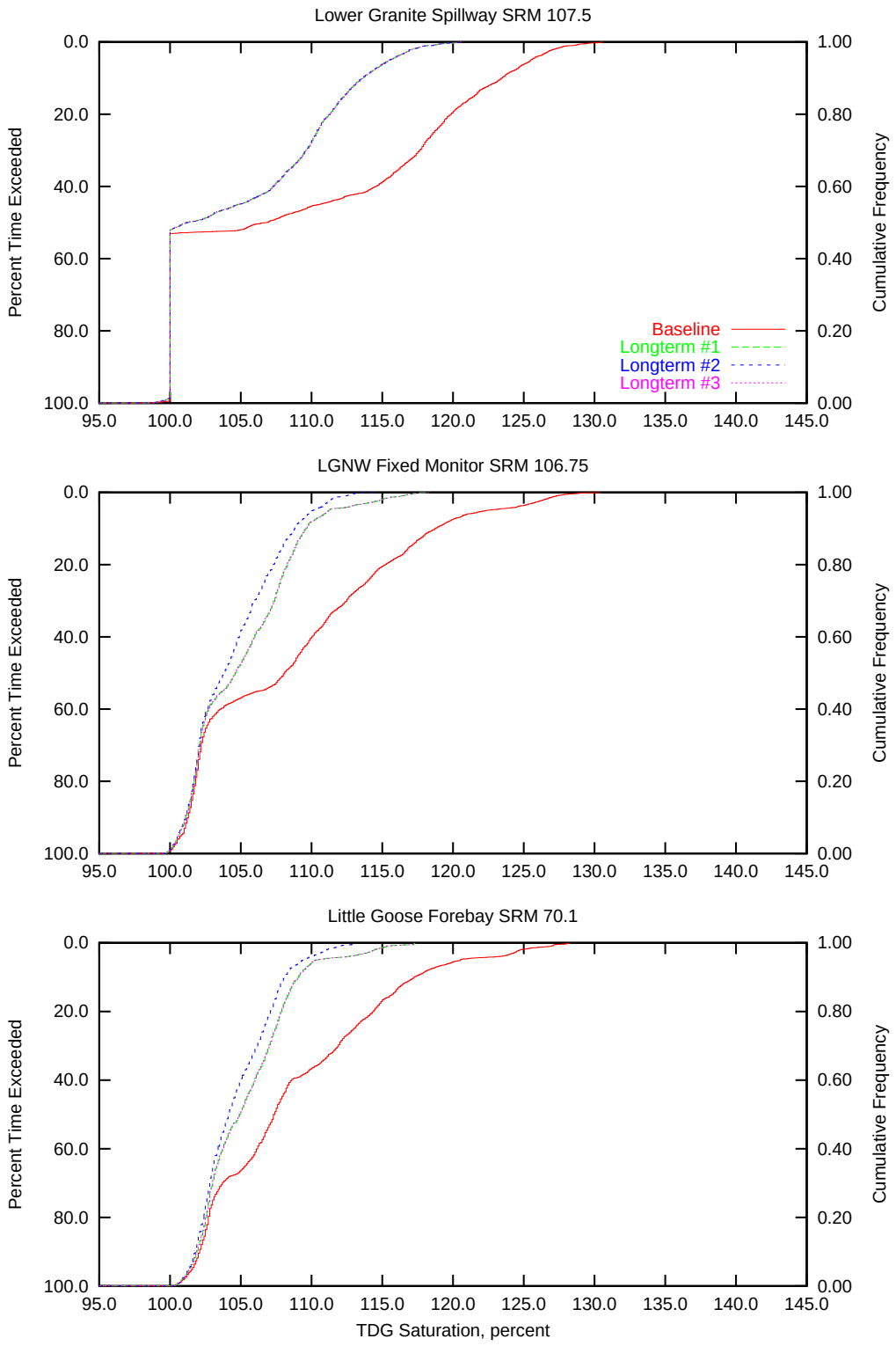

Figure 1.45: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a medium flow (1996) season.

1.3 Alternative Spill Scenarios

Table 1.20: Comparison of observed flow and spill at Bonneville during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow Year**		**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	154.0	43.6	26.3	87.9	59.2	94.5	63.9
	Med.	(1996)	330.6	137.9	40.3	119.9	35.8	123.5	37.0
	High	(1997)	336.1	115.4	30.6	130.6	37.4	134.7	38.9
May	Low	(1994)	212.0	94.5	44.2	87.7	41.6	95.6	45.2
	Med.	(1996)	351.2	154.6	43.0	132.0	36.8	135.6	38.0
	High	(1997)	456.3	243.9	53.1	229.4	49.9	229.3	49.8
June	Low	(1994)	195.0	72.4	37.5	87.7	45.8	95.6	50.1
	Med.	(1996)	385.5	199.5	51.0	161.1	40.7	163.8	41.6
	High	(1997)	483.6	281.9	57.3	256.5	52.1	256.7	52.2
July	Low	(1994)	152.5	59.8	39.4	87.7	58.4	95.4	63.6
	Med.	(1996)	247.8	85.9	35.5	87.7	36.3	95.6	39.4
	High	(1997)	277.3	93.9	34.6	88.4	32.3	95.9	35.0
August	Low	(1994)	94.9	30.0	29.9	83.7	89.9	84.9	90.8
	Med.	(1996)	189.2	91.0	49.0	87.6	47.1	95.6	51.4
	High	(1997)	202.9	106.7	52.0	87.6	43.8	95.6	47.2

Table 1.21: Comparison of observed flow and spill at The Dalles during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow**	**Year**	**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	147.2	0.7	0.5	5.9	4.9	94.2	64.0
	Med.	(1996)	320.7	150.5	44.1	27.7	7.5	200.8	62.9
	High	(1997)	326.9	118.1	29.8	42.6	9.9	193.5	60.5
May	Low	(1994)	203.6	52.3	25.8	3.0	1.5	130.3	64.0
	Med.	(1996)	341.8	195.9	56.3	40.1	10.3	209.0	61.6
	High	(1997)	458.0	293.9	64.2	144.1	30.6	229.9	50.8
June	Low	(1994)	188.7	56.8	29.5	3.4	2.0	120.7	64.0
	Med.	(1996)	377.9	226.6	59.4	70.0	16.7	217.7	58.4
	High	(1997)	487.3	316.2	64.6	174.2	34.0	233.1	48.8
July	Low	(1994)	147.8	8.7	7.0	4.8	3.9	94.5	64.0
	Med.	(1996)	236.6	134.1	57.0	2.6	1.2	151.1	64.0
	High	(1997)	266.9	169.7	63.7	4.3	1.6	171.0	64.0
August	Low	(1994)	90.7	4.2	5.4	8.6	10.9	58.1	64.0
	Med.	(1996)	179.0	100.1	56.9	3.9	2.4	114.5	64.0
	High	(1997)	194.5	123.9	63.7	3.5	2.0	124.6	64.0

Table 1.22: Comparison of observed flow and spill at John Day during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow**	**Year**	**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	148.0	0.9	0.6	132.9	92.1	43.7	32.5
	Med.	(1996)	326.9	57.2	16.0	124.6	40.3	95.1	29.5
	High	(1997)	332.6	45.9	10.5	117.3	38.7	100.7	30.3
May	Low	(1994)	208.8	9.4	4.4	146.4	71.1	67.8	32.5
	Med.	(1996)	354.2	73.3	19.8	116.0	34.3	102.4	29.4
	High	(1997)	472.5	154.0	32.1	118.1	24.9	142.5	30.0
June	Low	(1994)	193.3	8.3	4.7	147.7	78.7	59.6	32.5
	Med.	(1996)	392.9	94.9	23.3	108.6	28.8	115.6	29.7
	High	(1997)	503.8	189.6	36.2	149.4	29.4	160.6	31.7
July	Low	(1994)	149.4	7.8	6.3	136.5	93.2	43.5	32.5
	Med.	(1996)	244.8	33.7	14.6	136.9	58.7	77.2	32.4
	High	(1997)	278.3	50.4	18.7	123.3	46.4	84.9	31.7
August	Low	(1994)	89.7	5.8	7.2	89.6	100.0	26.0	32.5
	Med.	(1996)	183.9	38.5	21.7	150.4	84.4	59.2	32.5
	High	(1997)	200.6	41.2	22.6	136.7	72.1	61.8	32.5

Table 1.23: Comparison of observed flow and spill at McNary during the three simuation seasons.

Month	Flow Year		Average Project Flow			"Spill Man."		"Spill Cap"	
			Total (kcfs)	Spill (kcfs)	Spill (%)	Spill (kcfs)	Spill (%)	Spill (kcfs)	Spill (%)
April	Low	(1994)	142.1	0.2	0.1	137.8	97.8	76.8	55.0
	Med.	(1996)	311.9	142.7	44.4	185.1	59.9	175.0	55.7
	High	(1997)	312.9	151.5	45.6	196.0	62.9	182.1	57.2
May	Low	(1994)	200.3	27.5	13.0	162.4	81.8	108.8	54.0
	Med.	(1996)	338.6	183.4	52.8	202.2	59.6	197.3	57.7
	High	(1997)	449.2	281.2	62.2	301.2	66.7	301.2	66.7
June	Low	(1994)	189.0	21.2	9.9	160.7	86.5	101.5	53.4
	Med.	(1996)	381.2	246.4	64.0	237.1	61.6	235.9	61.1
	High	(1997)	482.4	319.6	65.2	334.9	68.8	334.7	68.7
July	Low	(1994)	146.2	4.7	3.3	145.0	99.4	81.0	55.7
	Med.	(1996)	246.0	98.4	38.6	161.7	67.4	133.2	54.9
	High	(1997)	274.8	109.3	38.9	164.3	60.8	148.4	54.2
August	Low	(1994)	89.9	0.4	0.4	89.8	100.0	44.6	54.0
	Med.	(1996)	183.1	33.7	17.1	159.6	88.5	103.0	56.3
	High	(1997)	198.5	46.6	21.7	160.6	82.8	114.1	59.2

Table 1.24: Comparison of observed flow and spill at Ice Harbor during the three simuation seasons.

Month	Flow Year		Average Project Flow			"Spill Man."		"Spill Cap"	
			Total (kcfs)	Spill (kcfs)	Spill (%)	Spill (kcfs)	Spill (%)	Spill (kcfs)	Spill (%)
April	Low	(1994)	51.3	12.2	20.4	51.4	100.0	50.3	98.7
	Med.	(1996)	115.1	42.1	35.0	107.1	94.9	75.3	68.2
	High	(1997)	126.2	56.6	40.0	104.3	87.6	82.4	69.0
May	Low	(1994)	76.9	26.1	34.4	76.8	100.0	71.5	94.1
	Med.	(1996)	123.2	48.7	36.6	107.7	90.7	78.1	66.8
	High	(1997)	165.5	93.7	55.6	120.8	74.9	91.8	55.1
June	Low	(1994)	38.0	16.7	42.9	38.0	100.0	38.0	100.0
	Med.	(1996)	139.9	70.0	47.2	107.0	81.0	84.6	63.4
	High	(1997)	163.9	98.7	58.4	114.8	73.1	94.7	58.2
July	Low	(1994)	40.3	9.0	24.6	40.3	100.0	40.3	100.0
	Med.	(1996)	56.1	24.5	49.3	56.1	100.0	53.9	97.5
	High	(1997)	75.2	38.0	54.7	75.1	100.0	65.6	90.3
August	Low	(1994)	12.7	0.0	0.1	12.7	100.0	12.7	100.0
	Med.	(1996)	39.0	24.1	63.5	39.0	100.0	38.9	100.0
	High	(1997)	51.6	36.5	76.9	51.5	100.0	50.2	98.7

Table 1.25: Comparison of observed flow and spill at Lower Monumental during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow**	**Year**	**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	50.2	0.0	0.0	35.7	79.3	0.5	0.6
	Med.	(1996)	115.6	31.0	24.8	39.1	34.9	29.0	23.1
	High	(1997)	130.1	33.0	21.9	52.8	40.1	42.4	27.9
May	Low	(1994)	75.2	9.0	12.2	39.1	53.5	3.7	4.0
	Med.	(1996)	125.1	44.7	32.9	46.1	37.3	36.9	25.9
	High	(1997)	174.0	64.0	35.3	73.4	40.6	73.2	40.4
June	Low	(1994)	37.1	5.1	12.1	34.5	95.2	0.0	0.0
	Med.	(1996)	145.3	61.8	39.9	59.4	39.9	53.4	33.0
	High	(1997)	166.1	64.2	35.4	69.7	40.6	68.4	39.4
July	Low	(1994)	39.5	0.0	0.0	35.9	93.0	0.0	0.0
	Med.	(1996)	56.3	5.0	7.6	37.0	73.2	1.5	1.6
	High	(1997)	73.1	1.9	2.0	36.8	56.6	4.6	4.6
August	Low	(1994)	12.7	0.2	2.1	12.7	100.0	0.0	0.0
	Med.	(1996)	38.9	1.1	2.3	35.7	93.6	0.0	0.0
	High	(1997)	49.3	0.6	1.6	34.9	78.2	0.1	0.1

Table 1.26: Comparison of observed flow and spill at Little Goose during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow**	**Year**	**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	50.1	7.0	9.1	40.7	87.5	0.4	0.4
	Med.	(1996)	112.8	33.3	28.1	47.5	44.2	26.8	21.9
	High	(1997)	120.2	33.7	26.2	53.4	47.7	32.3	22.1
May	Low	(1994)	76.6	23.3	30.0	49.0	65.6	3.5	3.7
	Med.	(1996)	121.2	49.7	39.5	51.4	44.9	33.4	24.5
	High	(1997)	162.4	65.2	39.4	63.3	38.1	61.7	36.8
June	Low	(1994)	37.5	4.6	10.8	36.7	98.7	0.0	0.0
	Med.	(1996)	140.2	58.5	39.7	59.3	43.5	47.4	30.3
	High	(1997)	155.5	53.5	31.9	62.2	40.0	56.7	34.8
July	Low	(1994)	39.3	0.0	0.0	38.6	98.8	0.0	0.0
	Med.	(1996)	54.6	4.3	6.5	43.6	85.3	1.0	1.1
	High	(1997)	67.7	0.4	0.6	45.9	72.7	2.2	2.3
August	Low	(1994)	12.8	0.0	0.0	12.8	100.0	0.0	0.0
	Med.	(1996)	38.3	0.1	0.2	37.7	99.2	0.0	0.0
	High	(1997)	46	0.5	1.4	40.6	91.7	0.0	0.0

Table 1.27: Comparison of observed flow and spill at Lower Granite during the three simuation seasons.

			Average Project Flow			"Spill Man."		"Spill Cap"	
Month	**Flow Year**		**Total** (kcfs)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)	**Spill** (kcfs)	**Spill** (%)
April	Low	(1994)	48.6	0.0	0.0	45.4	95.8	0.6	0.7
	Med.	(1996)	114.5	47.4	39.7	61.9	56.8	30.1	24.9
	High	(1997)	121.9	27.7	20.0	63.2	56.6	36.5	25.8
May	Low	(1994)	77.0	16.3	20.8	63.1	83.2	5.6	6.1
	Med.	(1996)	127.1	47.6	36.0	62.9	52.9	39.3	28.6
	High	(1997)	169.0	58.7	33.6	72.8	42.5	66.5	38.0
June	Low	(1994)	38.1	7.7	16.5	38.0	100.0	0.0	0.0
	Med.	(1996)	145.0	51.6	33.0	68.6	50.1	52.4	33.0
	High	(1997)	161.4	60.8	34.6	71.7	45.3	63.2	37.7
July	Low	(1994)	39.2	0.0	0.0	39.2	100.0	0.0	0.0
	Med.	(1996)	54.4	3.4	4.4	50.0	94.6	1.6	1.8
	High	(1997)	68.9	3.4	5.2	58.3	87.9	3.3	3.4
August	Low	(1994)	12.9	0.4	2.8	12.9	100.0	0.0	0.0
	Med.	(1996)	37.7	0.1	0.2	37.6	100.0	0.0	0.0
	High	(1997)	46.2	0.4	1.0	45.7	99.4	0.0	0.0

1.3.1 Simulated Spill in the Spill Cap Scenario

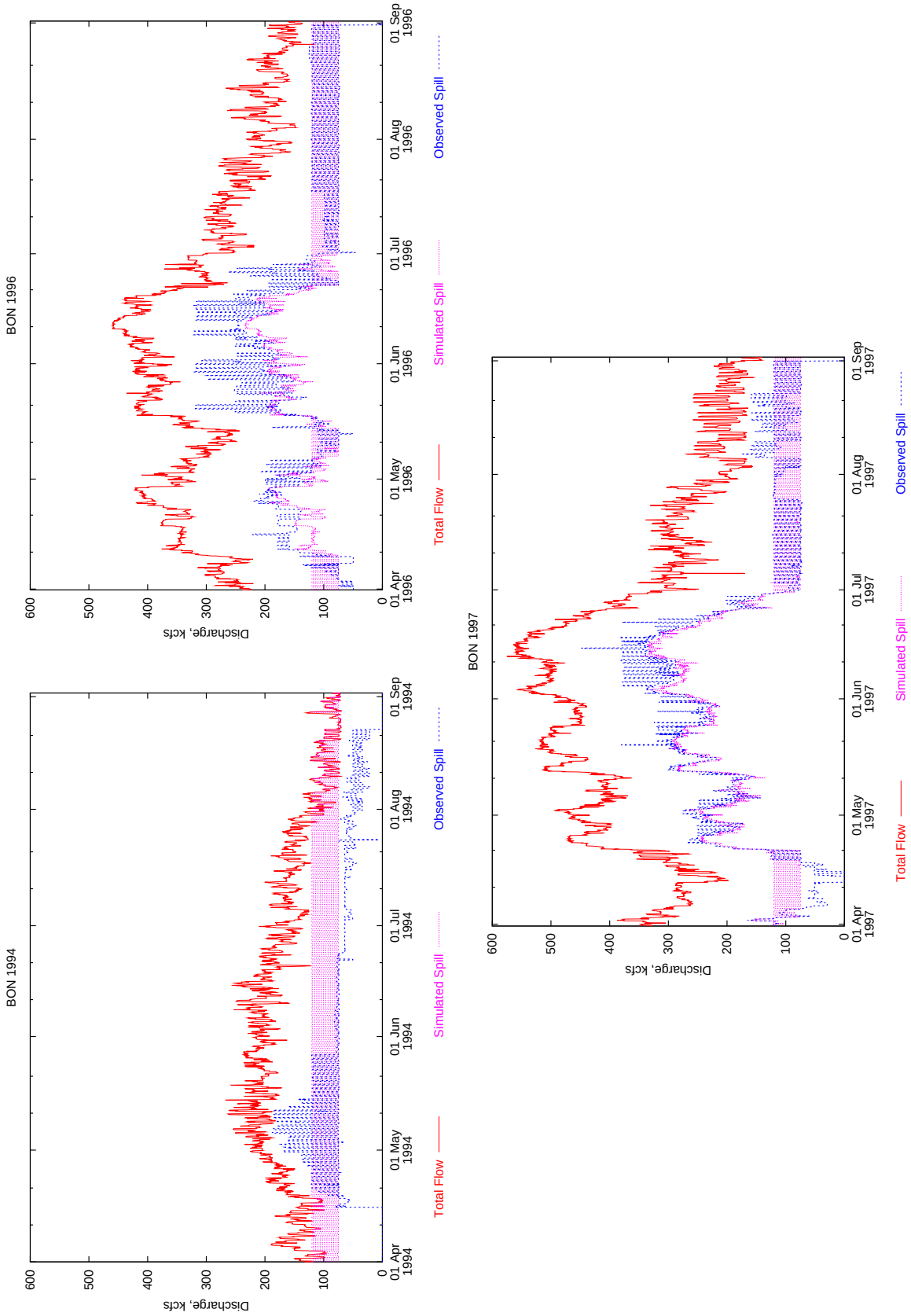

Figure 1.46: Comparison of actual and simulated spill at Bonneville under the Spill Cap" simulation scenario.

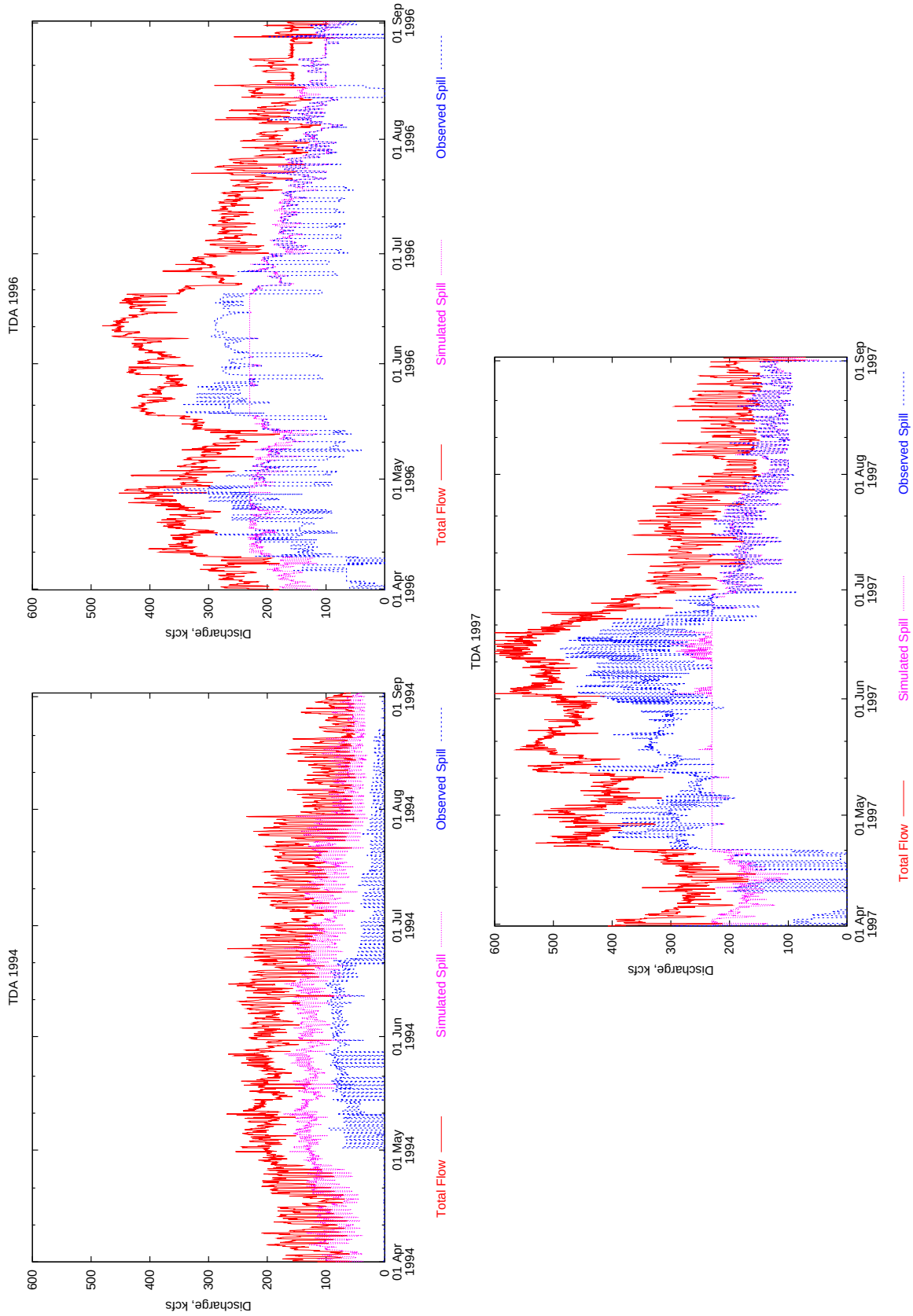

Figure 1.47: Comparison of actual and simulated spill at The Dalles under the Spill Cap" simulation scenario.

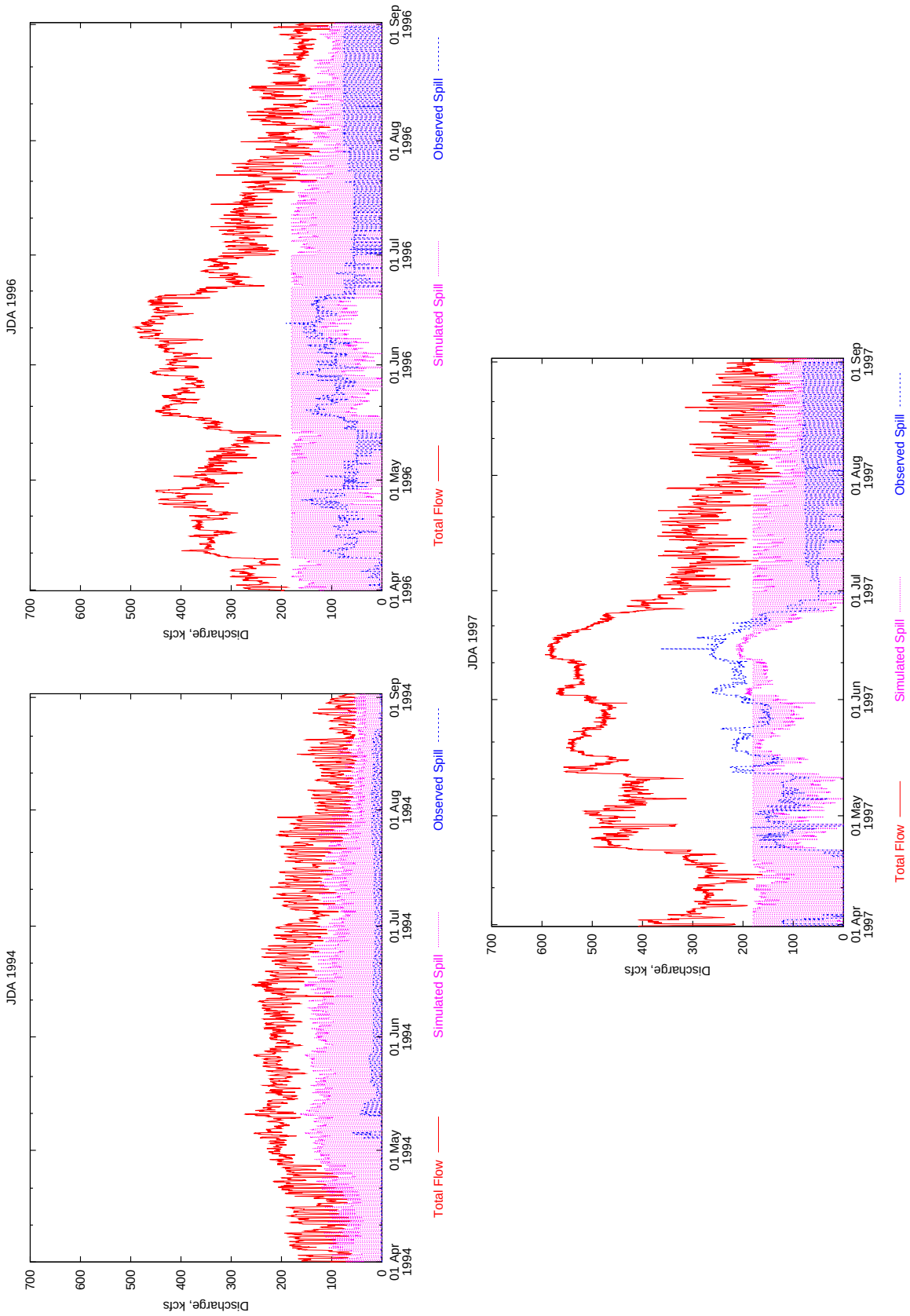

Figure 1.48: Comparison of actual and simulated spill at John Day under the Spill Cap" simulation scenario.

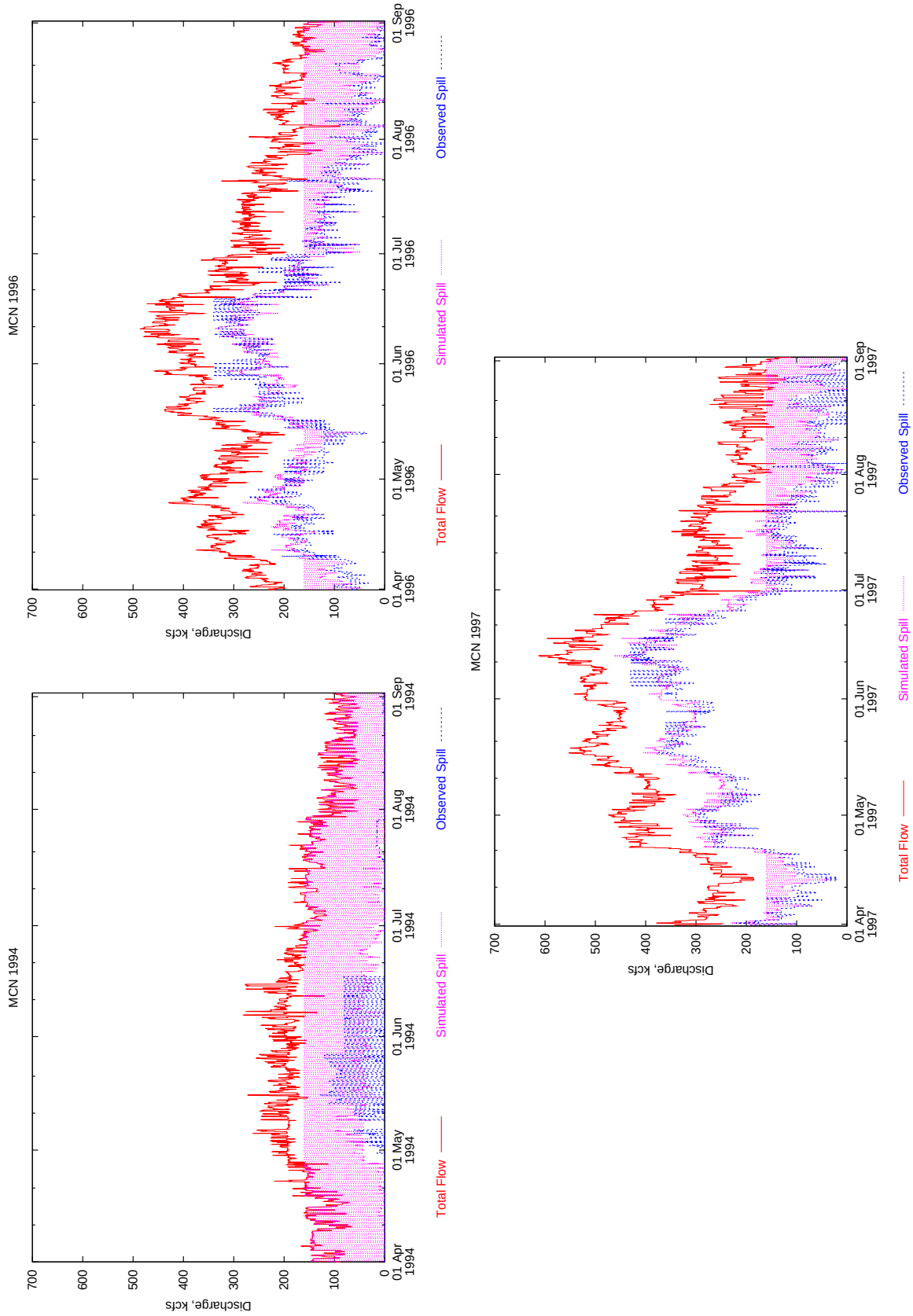

Figure 1.49: Comparison of actual and simulated spill at McNary under the Spill Cap" simulation scenario.

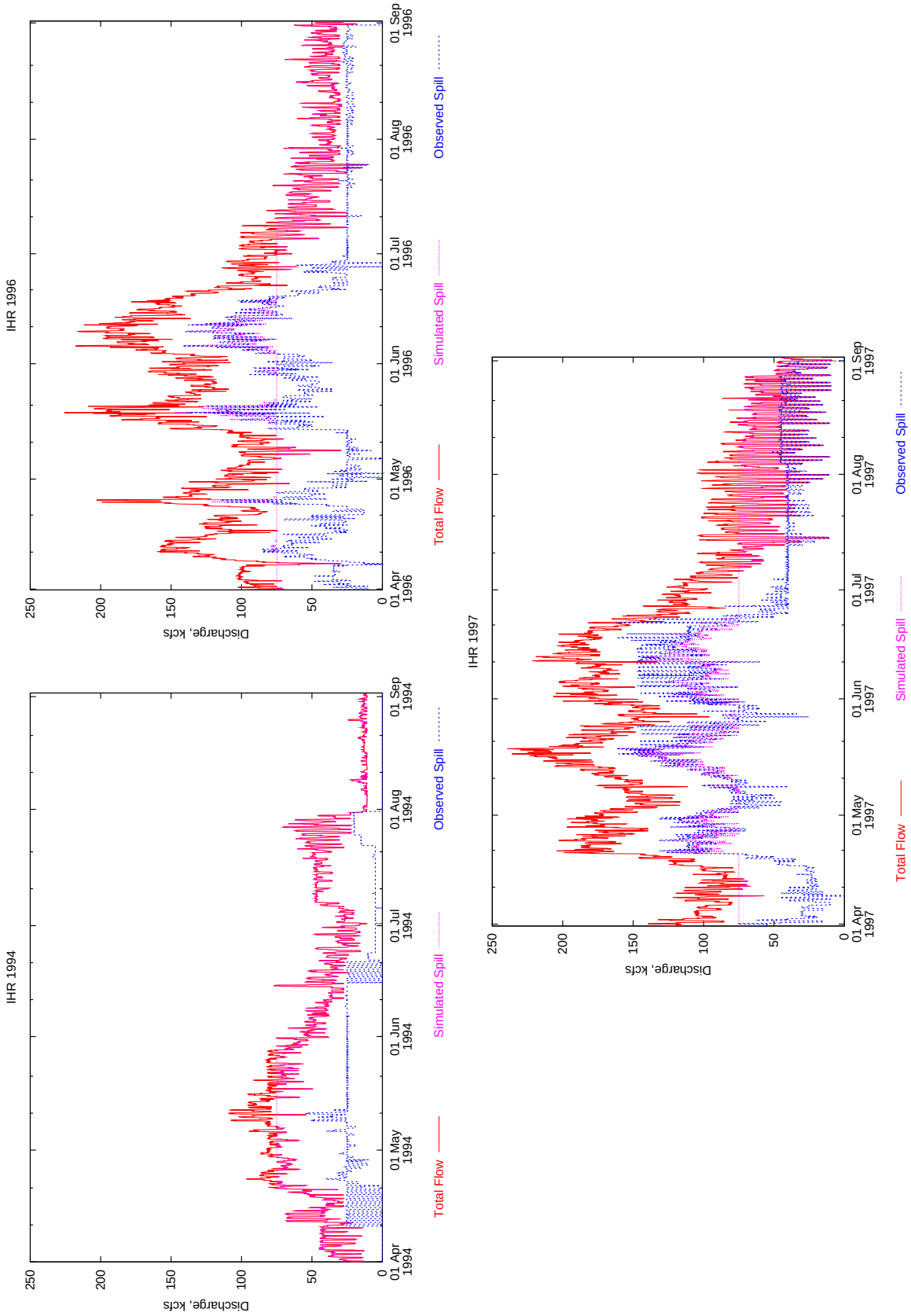

Figure 1.50: Comparison of actual and simulated spill at Ice Harbor under the Spill Cap" simulation scenario.

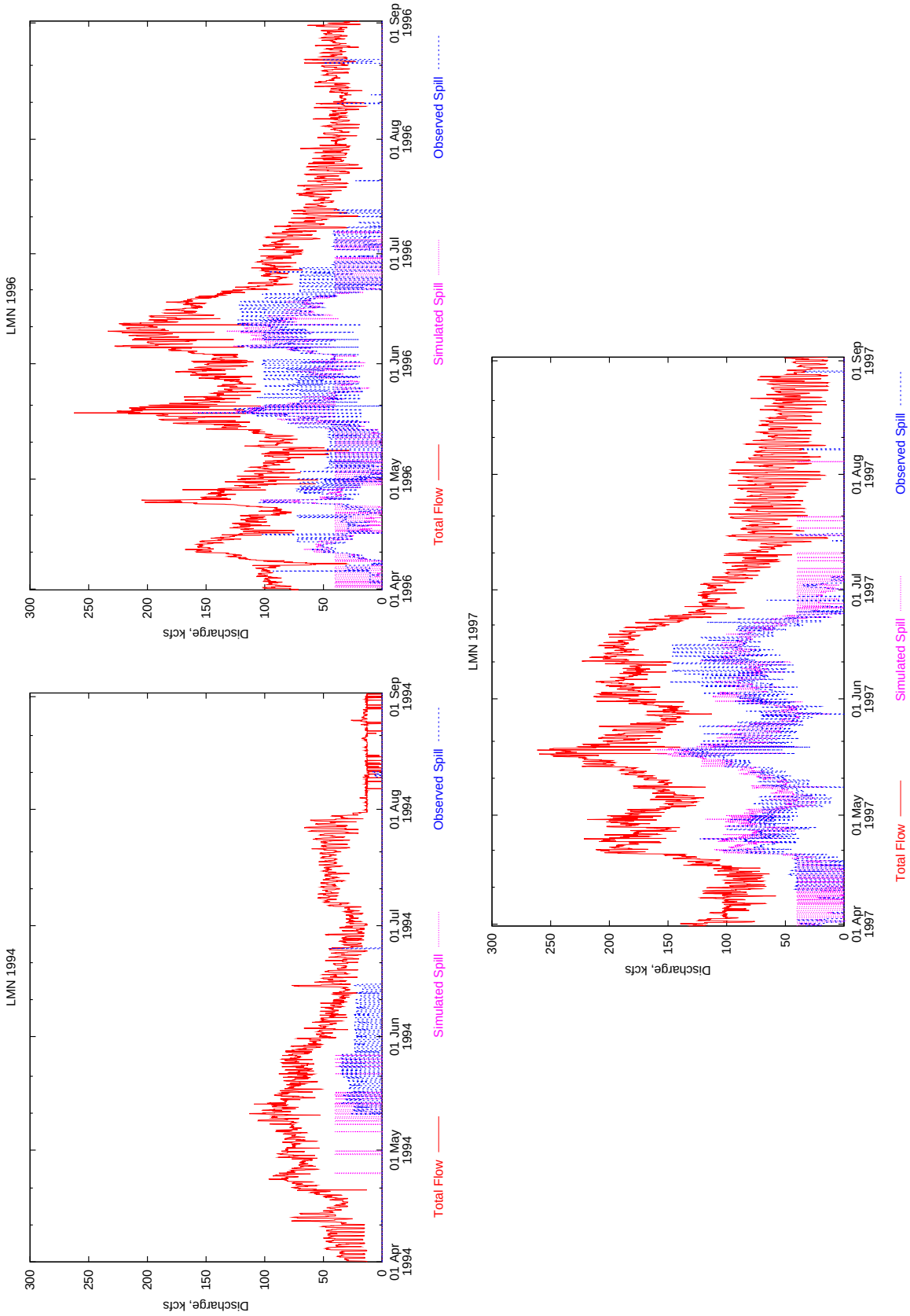

Figure 1.51: Comparison of actual and simulated spill at Lower Monumental under the Spill Cap" simulation scenario.

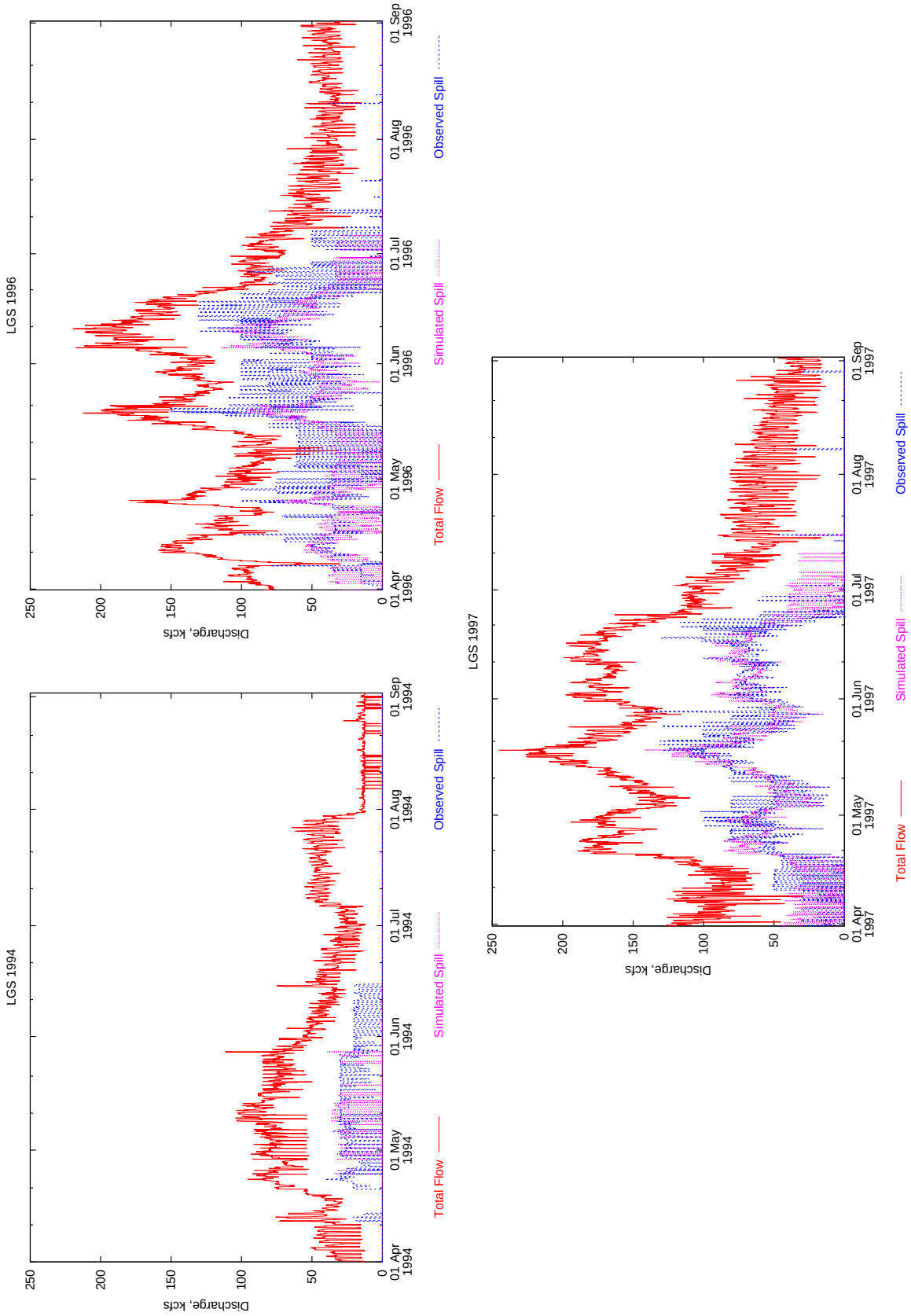

Figure 1.52: Comparison of actual and simulated spill at Little Goose under the Spill Cap" simulation scenario.

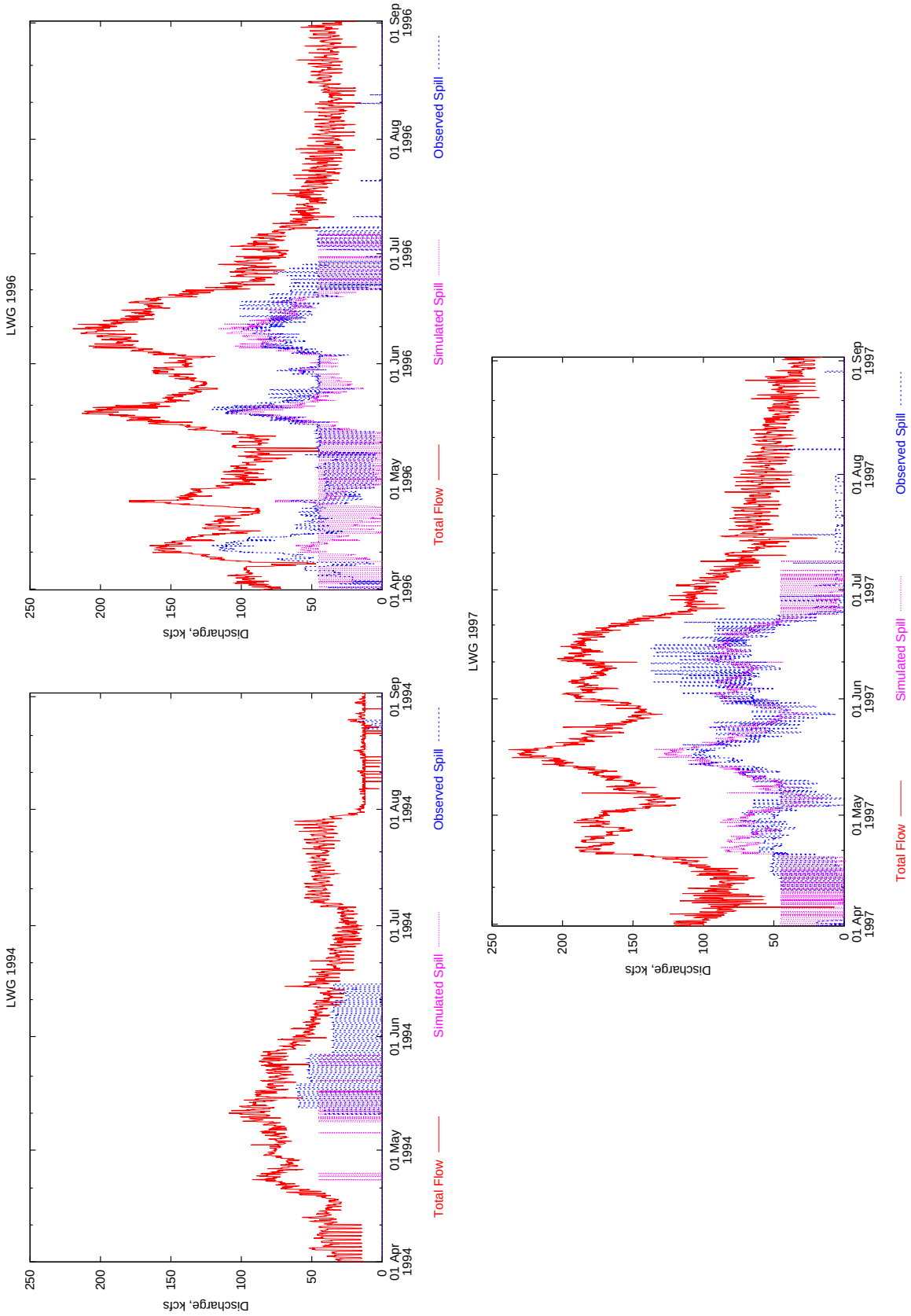

Figure 1.53: Comparison of actual and simulated spill at Lower Granite under the Spill Cap" simulation scenario.

1.3.2 Simulated Spill in the Spill Management Scenario

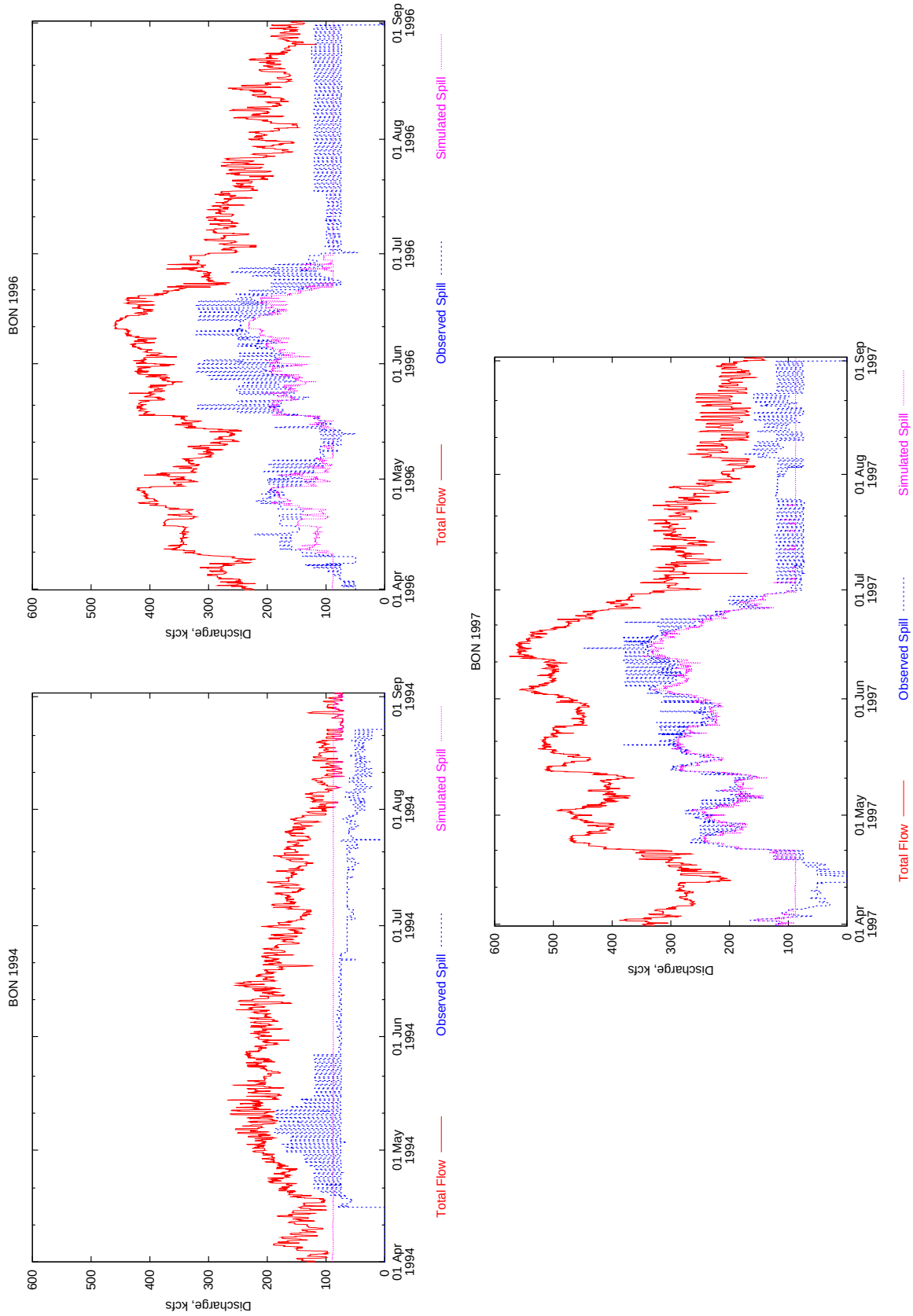

Figure 1.54: Comparison of actual and simulated spill at Bonneville under the Spill Management" simulation scenario.

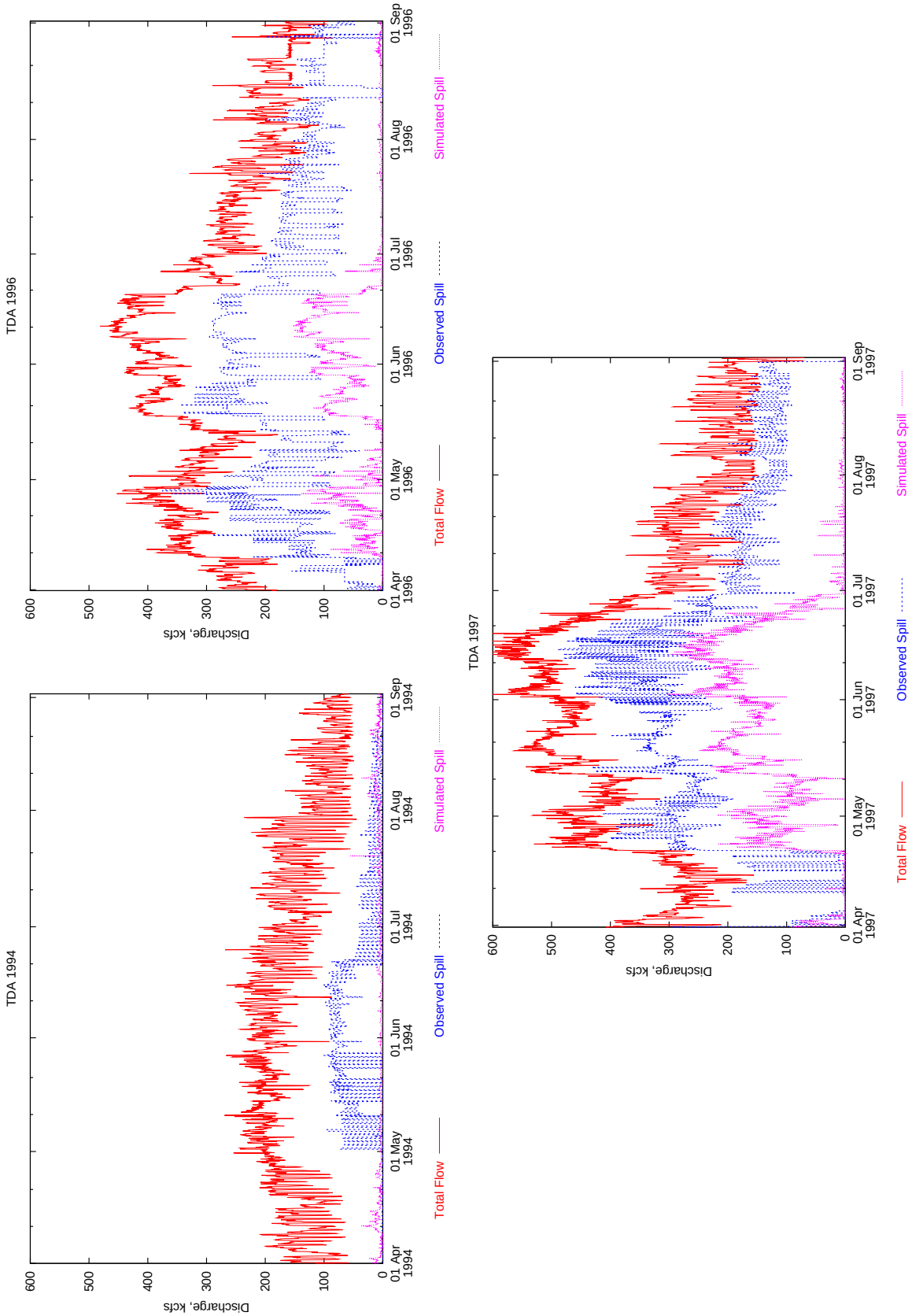

Figure 1.55: Comparison of actual and simulated spill at The Dalles under the Spill Management" simulation scenario.

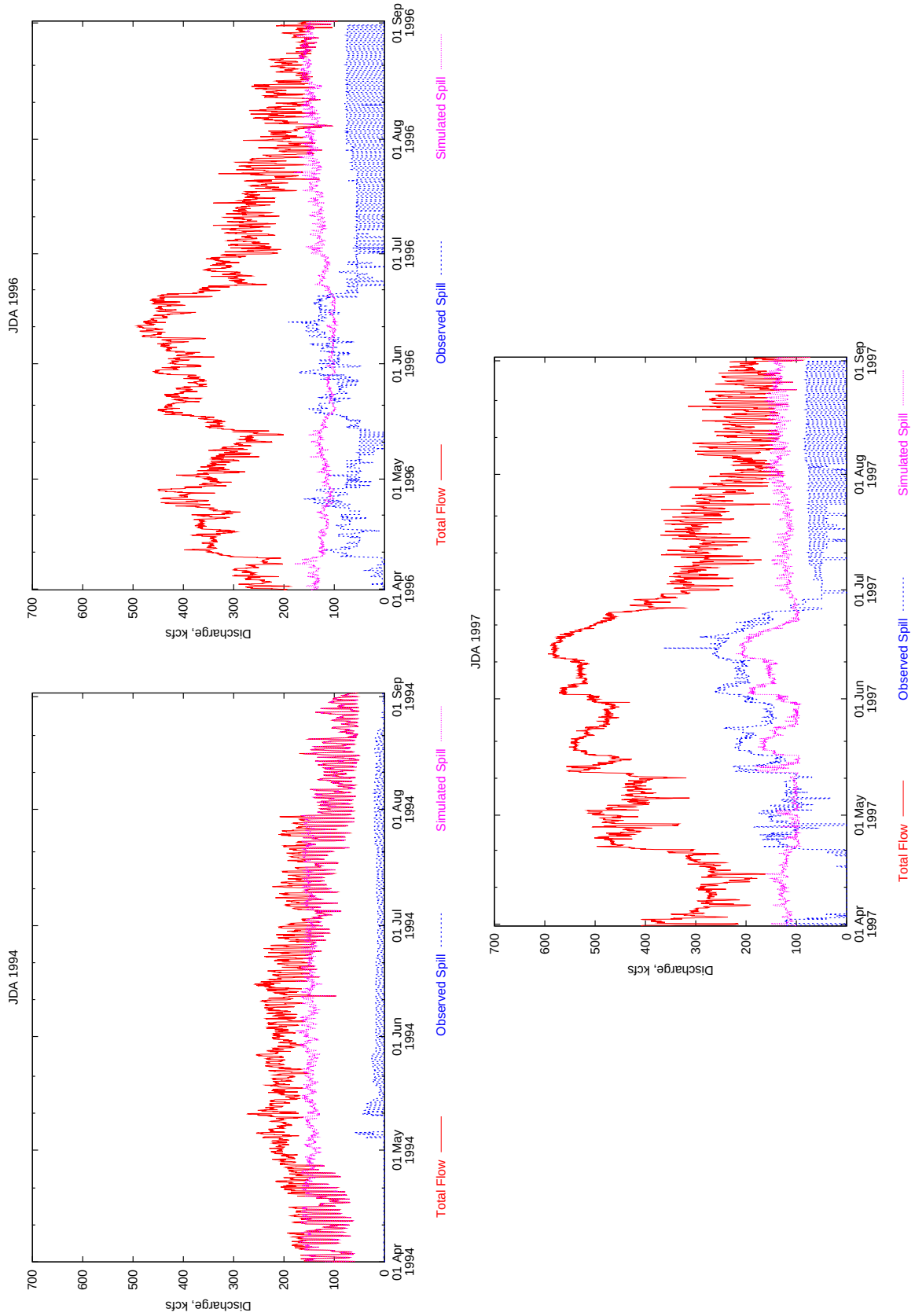

Figure 1.56: Comparison of actual and simulated spill at John Day under the Spill Management" simulation scenario.

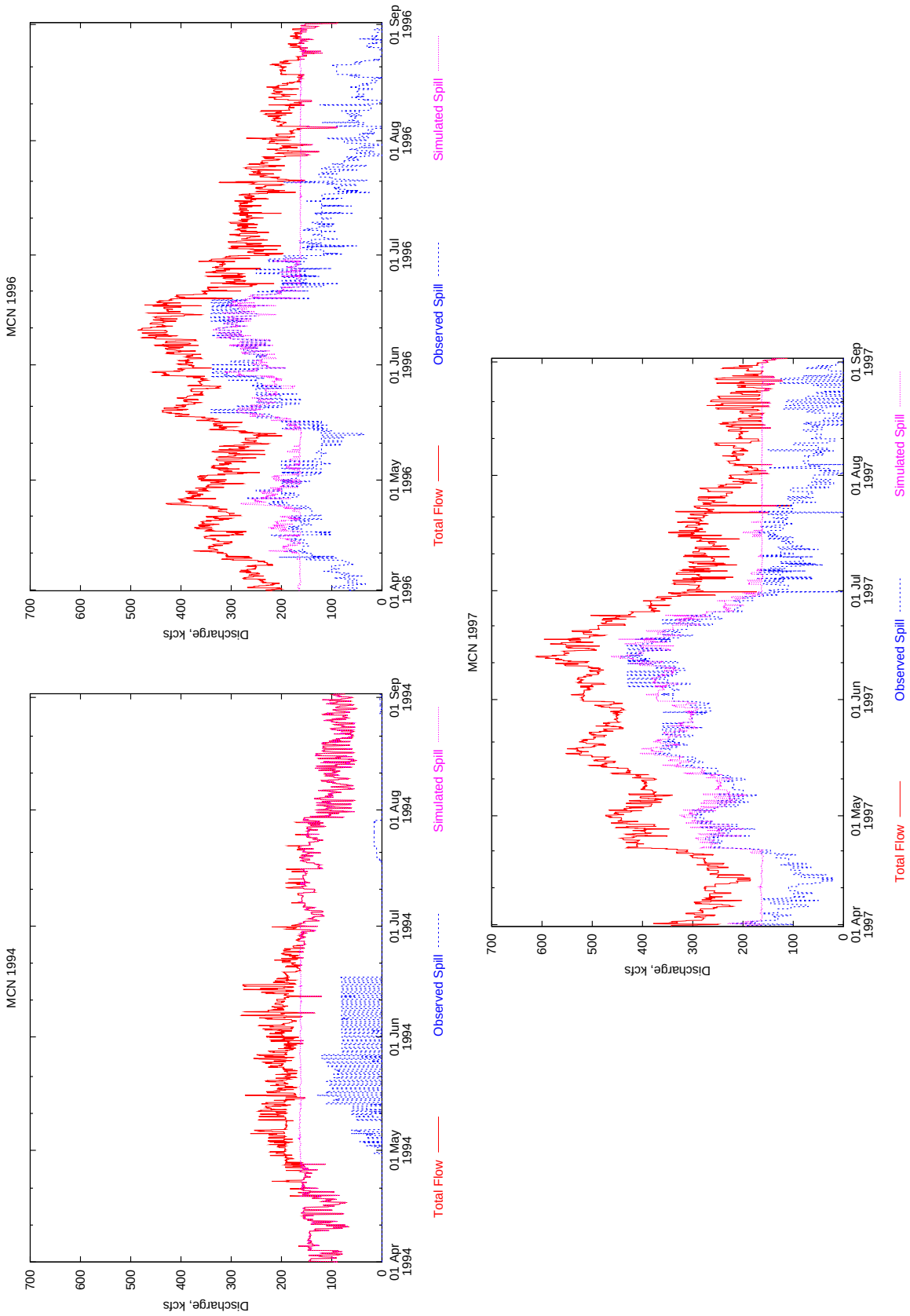

Figure 1.57: Comparison of actual and simulated spill at McNary under the Spill Management" simulation scenario.

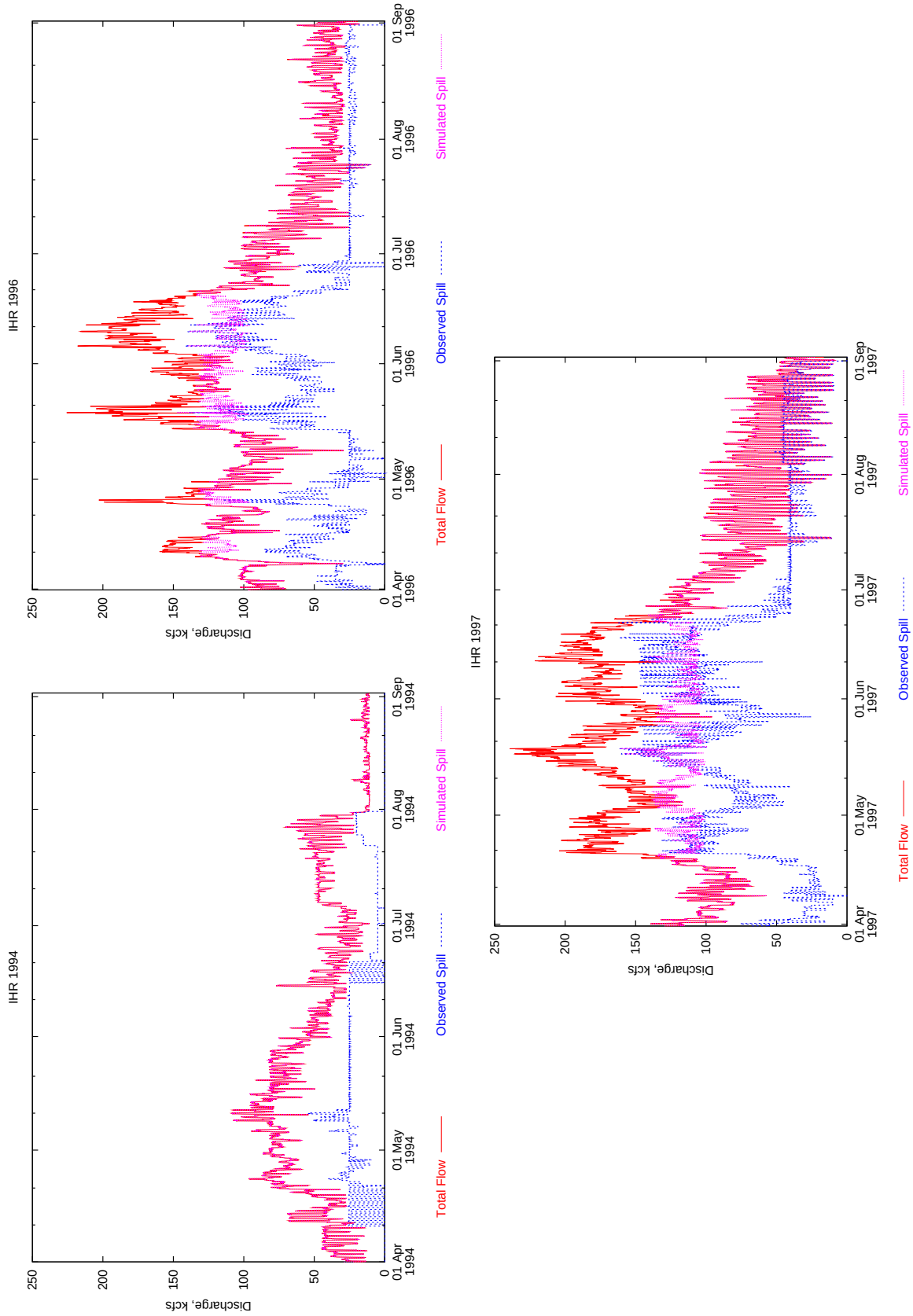

Figure 1.58: Comparison of actual and simulated spill at Ice Harbor under the Spill Management" simulation scenario.

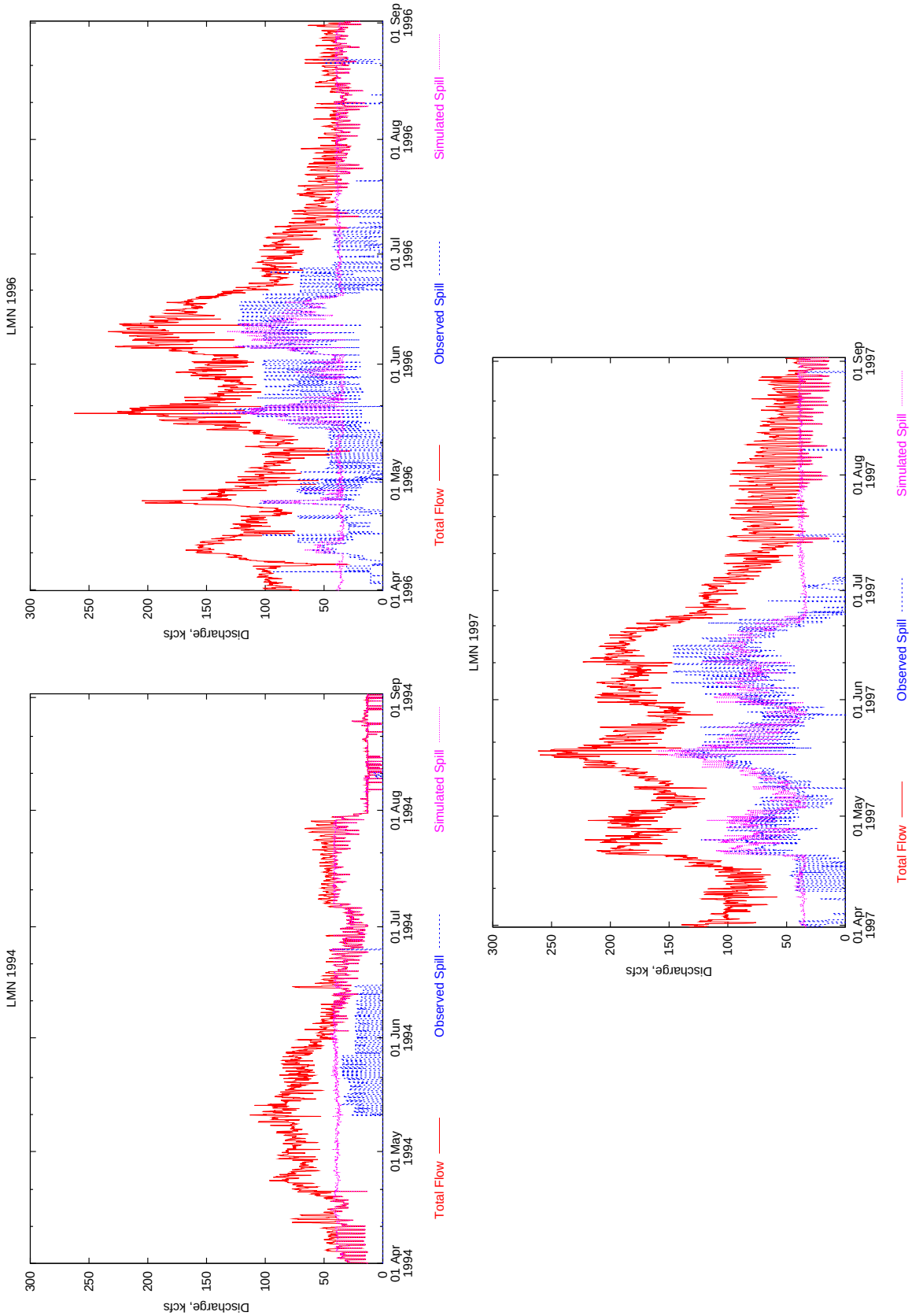

Figure 1.59: Comparison of actual and simulated spill at Lower Monumental under the Spill Management" simulation scenario.

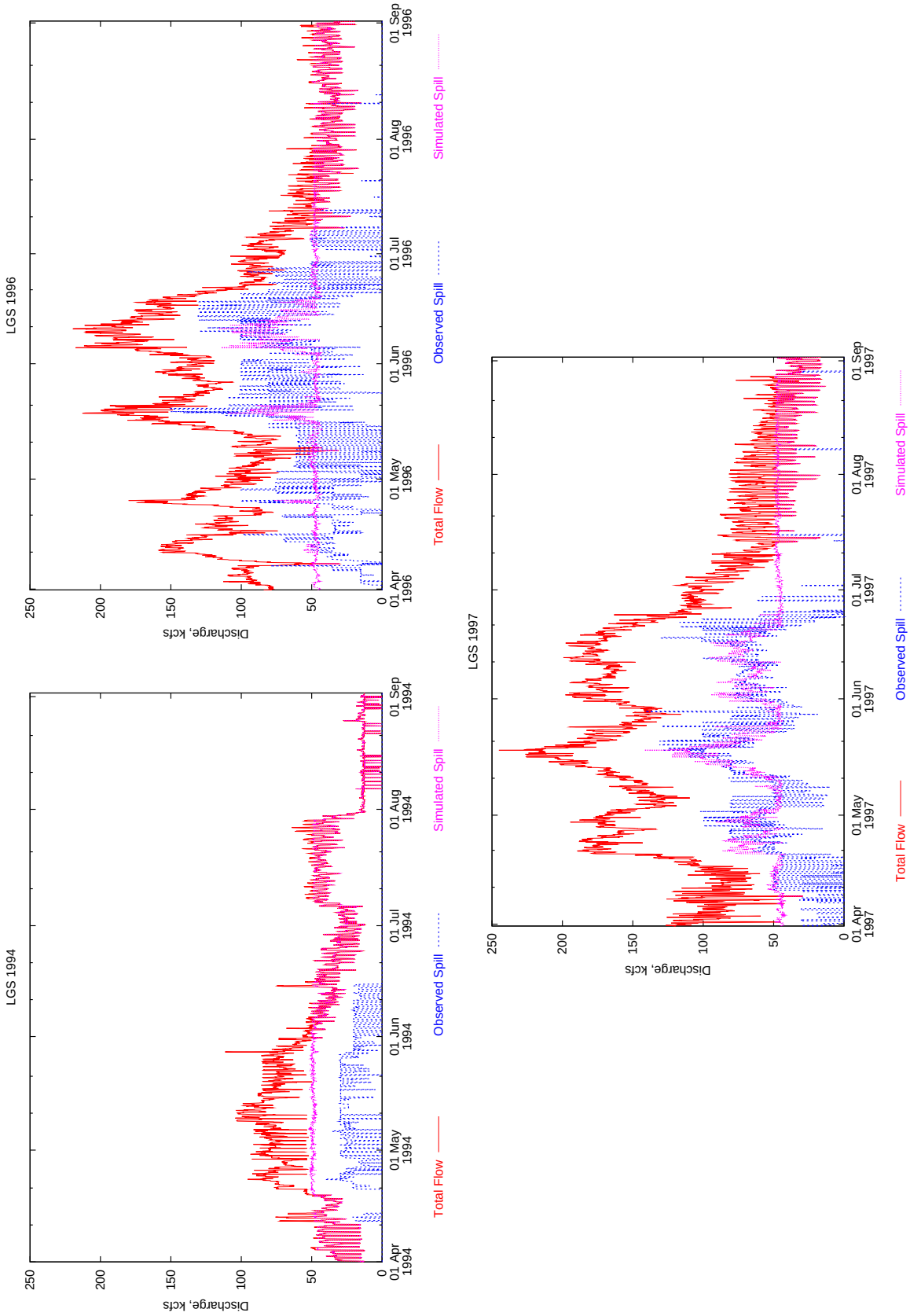

Figure 1.60: Comparison of actual and simulated spill at Little Goose under the Spill Management" simulation scenario.

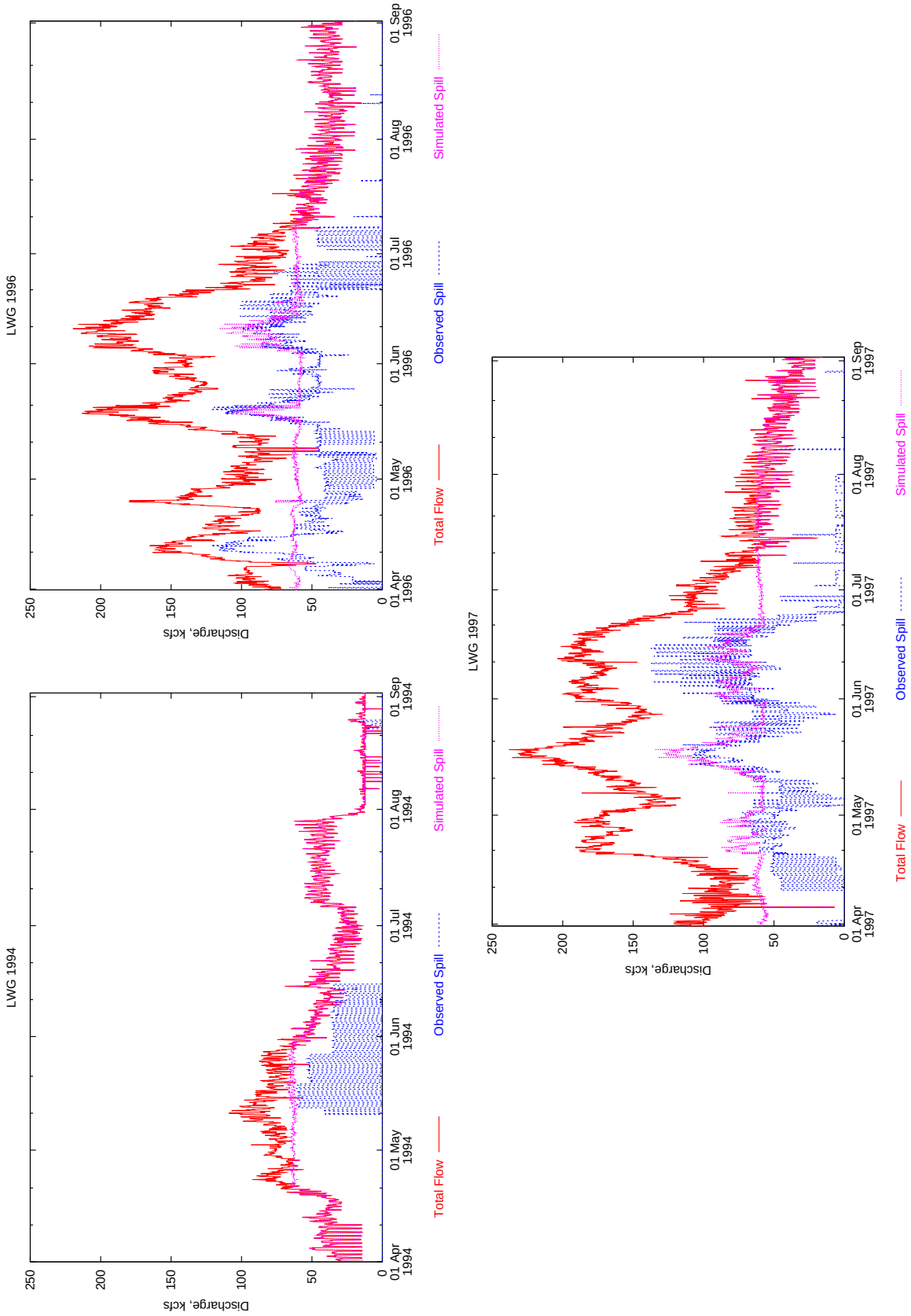

Figure 1.61: Comparison of actual and simulated spill at Lower Granite under the Spill Management" simulation scenario.

1.3.3 Low Flow Year (1994)

Table 1.28: 10% exceedance of TDG percent saturation of MASS1 time series output: low flow season (1994)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	108.3	120.7	100.0
LGS-sp	SRM 70.1	114.0	122.3	100.0
LMN-sp	SRM 41.6	111.4	121.2	100.0
IHR-sp	SRM 9.5	114.5	116.3	116.2
MCN-sp	CRM 292.5	111.2	123.8	122.0
JDA-sp	CRM 215.75	106.6	123.4	119.8
TDA-sp	CRM 191.5	124.7	123.9	125.6
BON-sp	CRM 146.5	121.1	123.1	129.3
LWG-fms	SRM 106.75	113.7	120.7	113.2
LGS-fms	SRM 69.5	113.5	122.2	112.1
LMN-fms	SRM 40.75	112.0	120.9	110.2
IHR-fms	SRM 6.0	114.1	116.0	115.9
MCN-fms	CRM 290.5	110.9	123.2	120.8
JDA-fms	CRM 214.75	107.0	122.1	117.2
TDA-fms	CRM 189.0	113.4	119.0	120.4
BON-fms	CRM 140.5	115.4	119.1	124.8
LGS-fb	SRM 70.1	112.2	119.4	112.0
LMN-fb	SRM 41.6	113.0	121.2	111.5
IHR-fb	SRM 9.5	111.9	118.7	109.8
MCN-fb	CRM 292.5	110.5	111.3	111.3
JDA-fb	CRM 215.75	107.6	113.6	110.6
TDA-fb	CRM 191.5	106.5	119.0	114.0
BON-fb	CRM 146.5	111.1	116.7	117.7
TID-fb	CRM 76.0	113.6	116.4	119.5

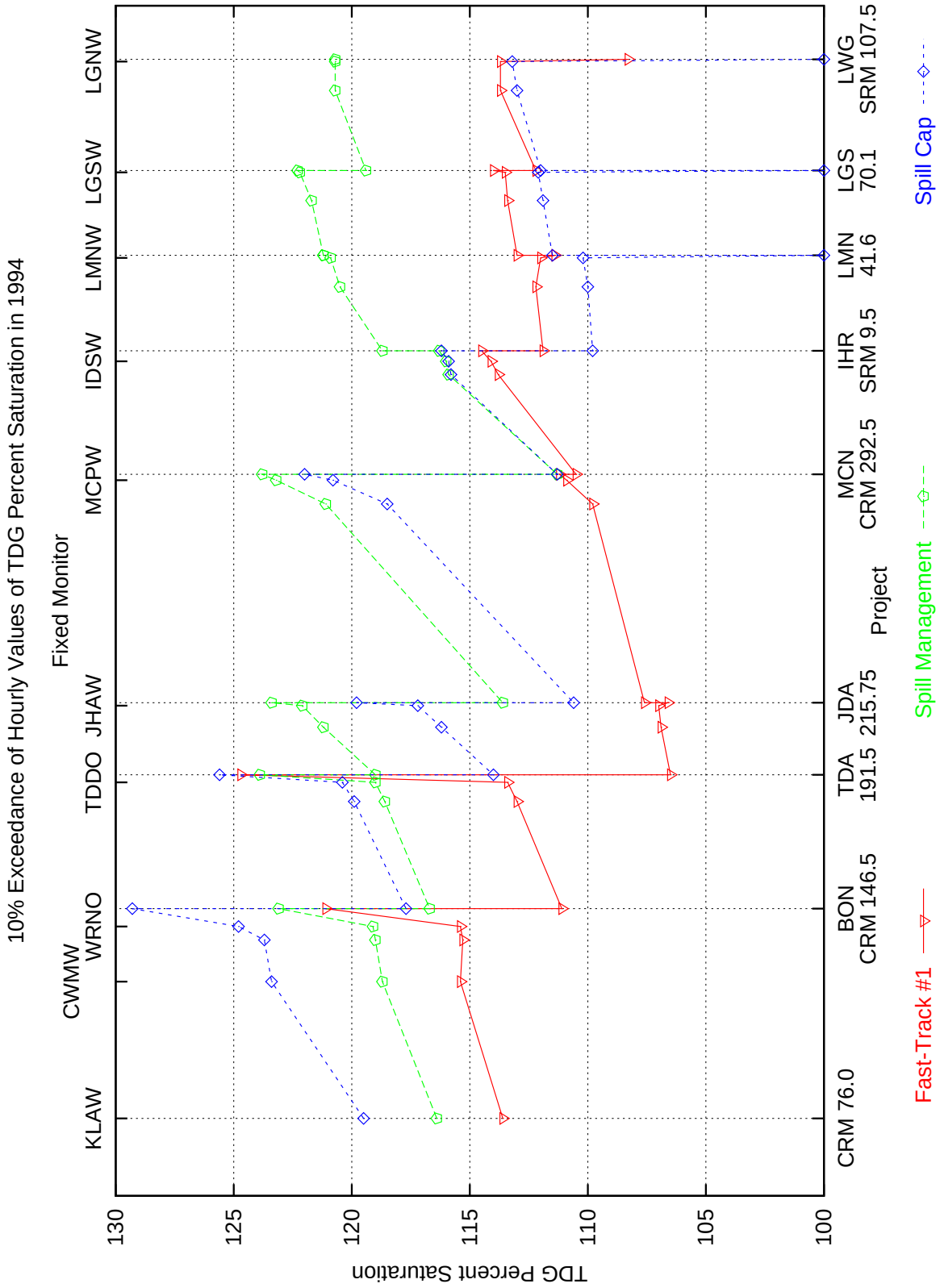

Figure 1.62: Comparison of the 10% exceedance of of TDG Percent Saturation of MASS1 time series output: Low Flow Season (1994)

Table 1.29: 25% exceedance of TDG percent saturation of MASS1 time series output: low flow season (1994)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	100.0	118.0	100.0
LGS-sp	SRM 70.1	107.4	119.4	100.0
LMN-sp	SRM 41.6	100.0	119.5	100.0
IHR-sp	SRM 9.5	112.0	114.0	113.9
MCN-sp	CRM 292.5	104.3	121.2	119.5
JDA-sp	CRM 215.75	103.7	121.1	115.0
TDA-sp	CRM 191.5	122.4	122.0	123.7
BON-sp	CRM 146.5	117.7	121.3	126.3
LWG-fms	SRM 106.75	109.0	118.0	106.5
LGS-fms	SRM 69.5	111.4	119.4	108.2
LMN-fms	SRM 40.75	110.1	118.9	107.4
IHR-fms	SRM 6.0	111.3	113.9	113.8
MCN-fms	CRM 290.5	108.1	121.0	118.5
JDA-fms	CRM 214.75	104.3	120.2	113.0
TDA-fms	CRM 189.0	108.5	117.4	118.7
BON-fms	CRM 140.5	112.6	117.7	122.3
LGS-fb	SRM 70.1	110.3	116.5	108.0
LMN-fb	SRM 41.6	111.4	118.5	108.7
IHR-fb	SRM 9.5	109.7	116.9	107.4
MCN-fb	CRM 292.5	108.2	108.7	108.7
JDA-fb	CRM 215.75	104.2	110.4	107.7
TDA-fb	CRM 191.5	104.0	117.4	110.5
BON-fb	CRM 146.5	107.6	114.6	115.8
TID-fb	CRM 76.0	110.9	115.0	117.0

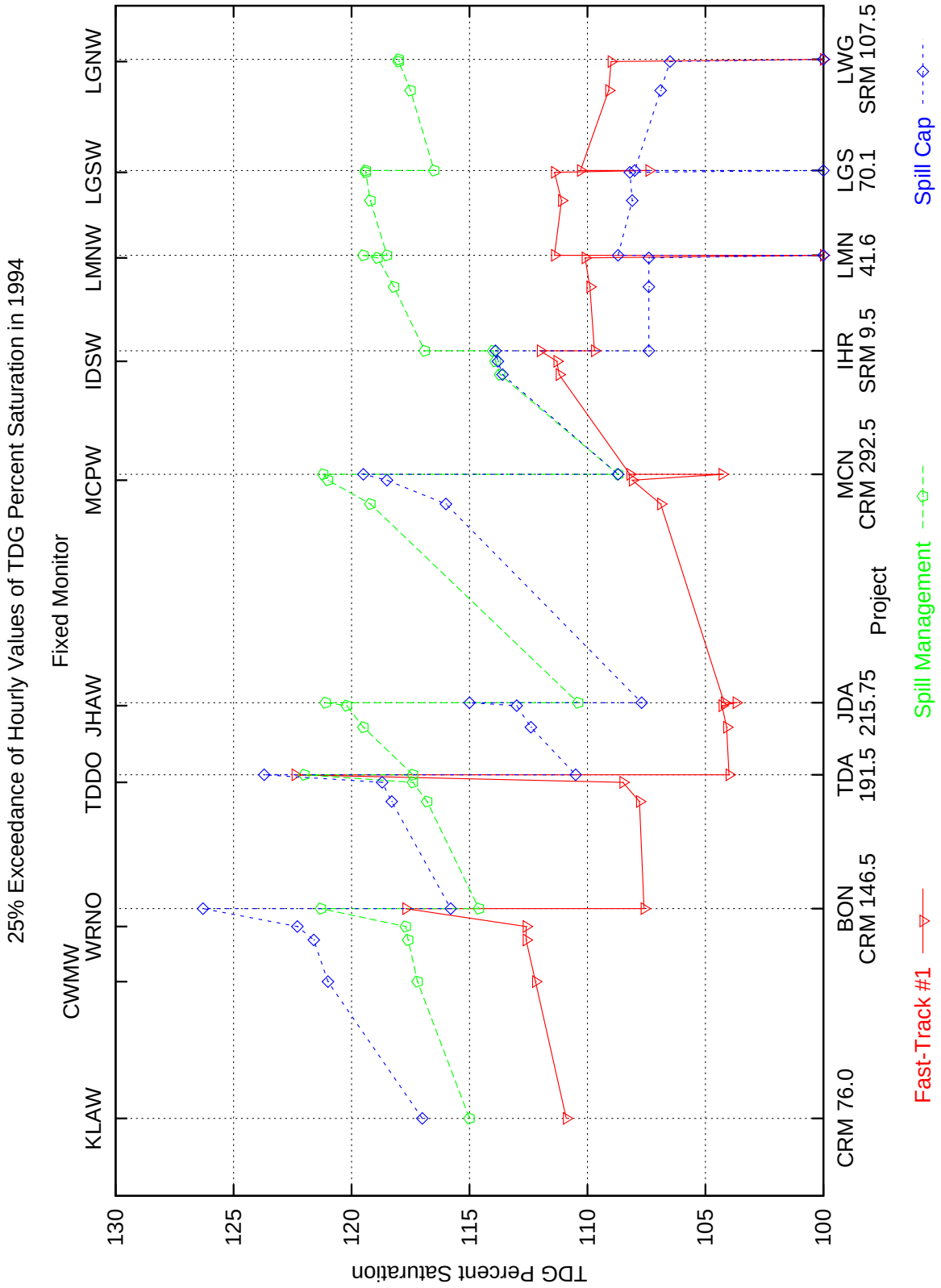

Figure 1.63: Comparison of the 25% exceedance of of TDG Percent Saturation of MASS1 time series output: Low Flow Season (1994)

Table 1.30: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: low flow season (1994)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	115.2	121.5	100.0
LGS-sp	SRM 70.1	115.2	122.7	101.2
LMN-sp	SRM 41.6	116.0	121.9	101.3
IHR-sp	SRM 9.5	115.1	116.6	116.6
MCN-sp	CRM 292.5	115.7	124.2	123.8
JDA-sp	CRM 215.75	107.5	123.8	121.0
TDA-sp	CRM 191.5	125.0	124.4	126.0
BON-sp	CRM 146.5	127.2	123.4	129.9
LWG-fms	SRM 106.75	114.5	121.5	113.5
LGS-fms	SRM 69.5	114.1	122.7	112.4
LMN-fms	SRM 40.75	112.7	121.4	111.0
IHR-fms	SRM 6.0	114.8	116.5	116.4
MCN-fms	CRM 290.5	112.7	123.7	122.4
JDA-fms	CRM 214.75	107.5	122.7	118.2
TDA-fms	CRM 189.0	113.6	119.6	120.9
BON-fms	CRM 140.5	119.3	119.5	125.0
LGS-fb	SRM 70.1	112.4	119.5	112.2
LMN-fb	SRM 41.6	113.1	121.6	111.9
IHR-fb	SRM 9.5	112.3	119.0	110.0
MCN-fb	CRM 292.5	110.8	111.5	111.5
JDA-fb	CRM 215.75	107.9	113.7	110.9
TDA-fb	CRM 191.5	106.8	119.7	115.6
BON-fb	CRM 146.5	111.7	117.1	118.1
TID-fb	CRM 76.0	116.3	116.8	120.1

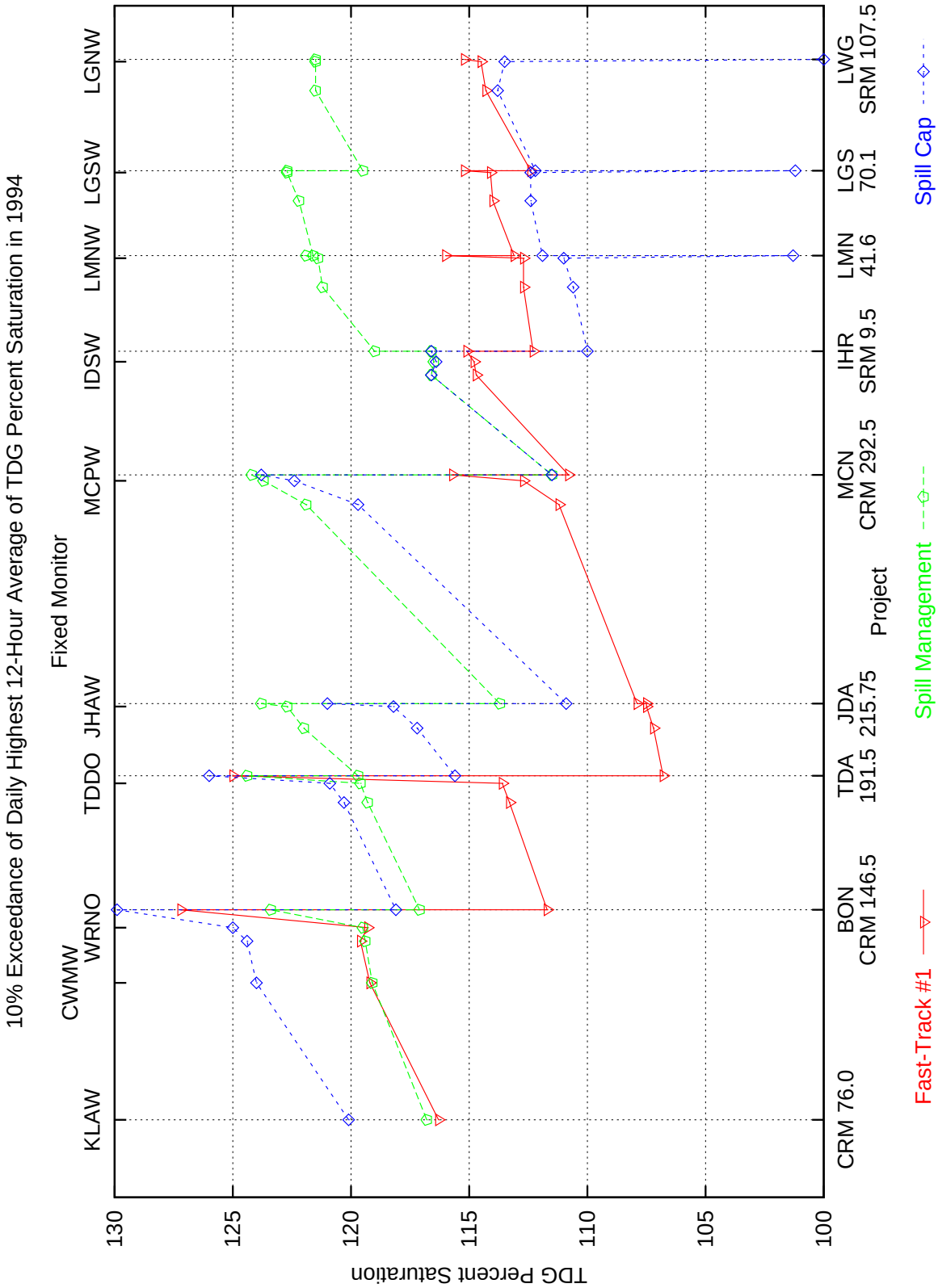

Figure 1.64: Comparison of the 10% exceedance of Daily Highest 12-Hour Average of TDG Percent Saturation of MASS1 time series output: Low Flow Season (1994)

Table 1.31: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: low flow season (1994)

Location	Project	River Mile	Operations		Spill Management		Spill-Cap	
			Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	4	2.4	27	16.2	0	0.0
> 120	LGS	SRM 70.1	0	0.0	47	28.1	0	0.0
	LMN	SRM 41.6	3	1.8	39	23.4	1	0.6
	IHR	SRM 9.5	0	0.0	4	2.4	3	1.8
	MCN	CRM 292.5	0	0.0	79	47.3	67	40.1
	JDA	CRM 215.75	0	0.0	66	39.5	32	19.2
	TDA	CRM 191.5	89	53.3	97	58.1	132	79.0
	BON	CRM 146.5	47	28.1	69	41.3	136	81.4
FMS	LWG	SRM 106.75	0	0.0	27	16.2	0	0.0
> 120	LGS	SRM 69.5	0	0.0	45	26.9	0	0.0
	LMN	SRM 40.75	0	0.0	35	21.0	0	0.0
	IHR	SRM 6.0	0	0.0	4	2.4	3	1.8
	MCN	CRM 290.5	0	0.0	75	44.9	50	29.9
	JDA	CRM 214.75	0	0.0	53	31.7	4	2.4
	TDA	CRM 189.0	0	0.0	13	7.8	29	17.4
	BON	CRM 140.5	13	7.8	13	7.8	132	79.0
Forebay	LGS	SRM 70.1	0	0.0	58	34.7	0	0.0
> 115	LMN	SRM 41.6	4	2.4	92	55.1	0	0.0
	IHR	SRM 9.5	0	0.0	62	37.1	0	0.0
	MCN	CRM 292.5	0	0.0	1	0.6	1	0.6
	JDA	CRM 215.75	0	0.0	12	7.2	0	0.0
	TDA	CRM 191.5	0	0.0	100	59.9	21	12.6
	BON	CRM 146.5	0	0.0	43	25.7	65	38.9
	TID	CRM 76.0	27	16.2	50	29.9	103	61.7

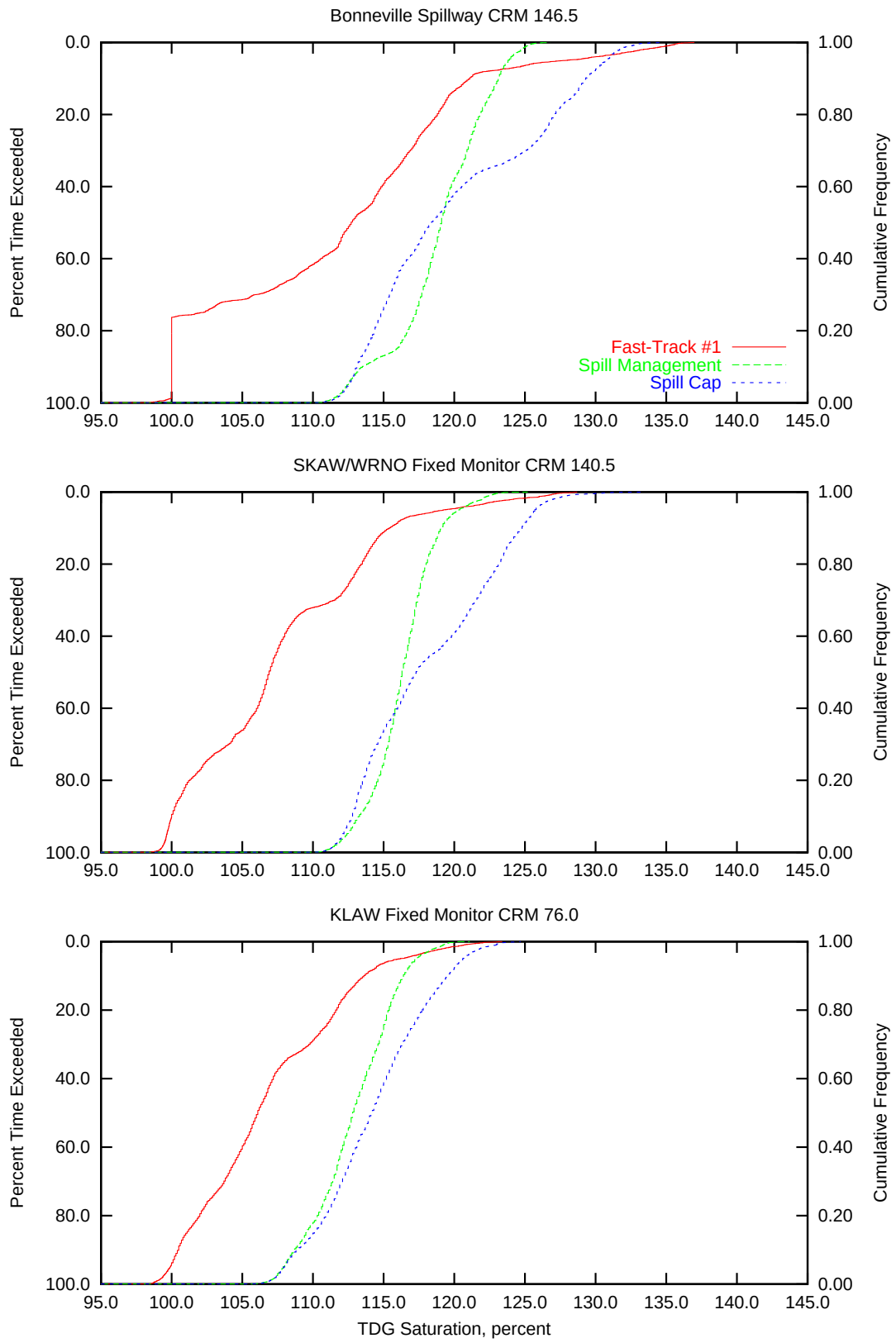

Figure 1.65: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a low flow (1994) season.

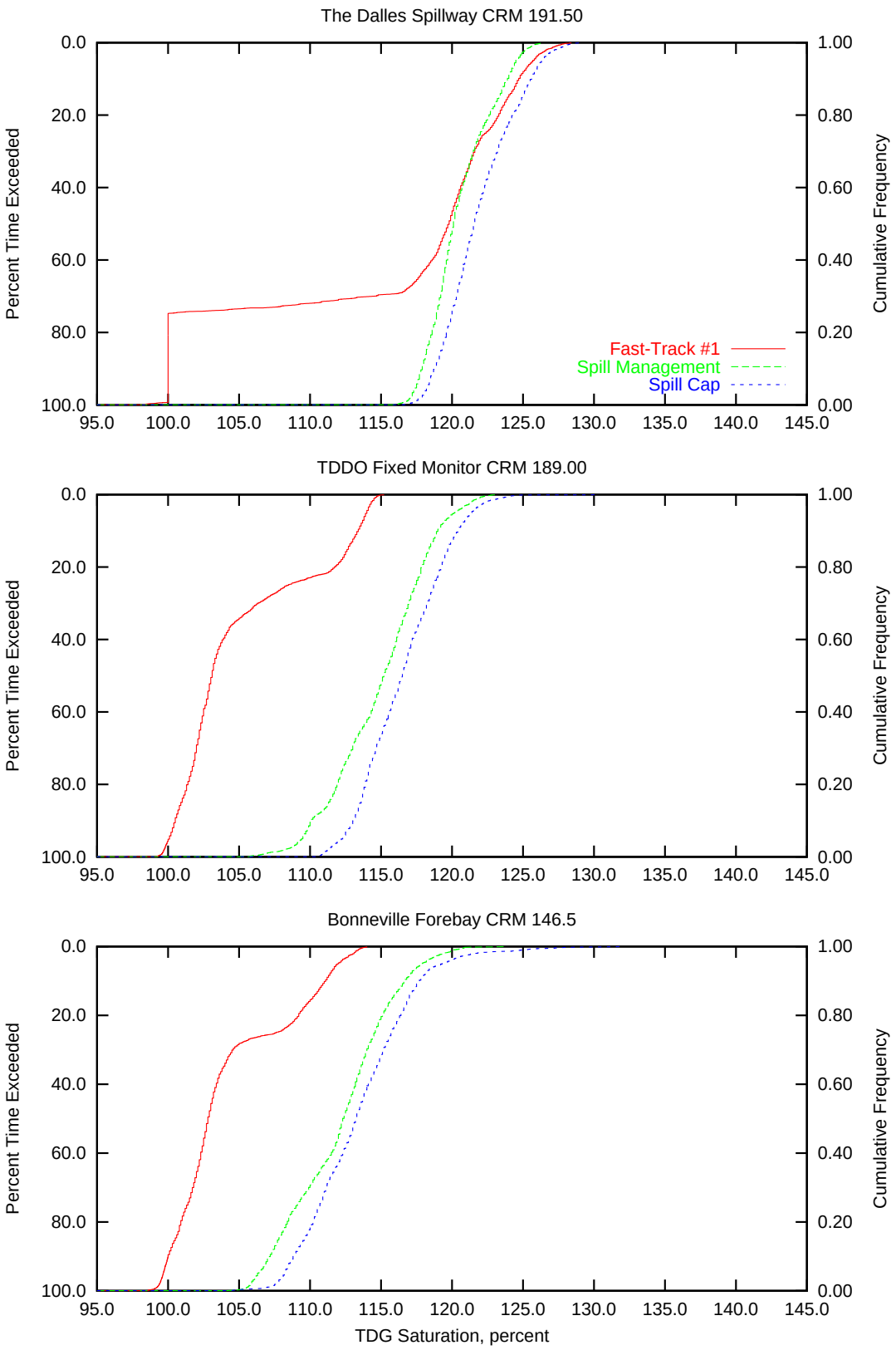

Figure 1.66: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a low flow (1994) season.

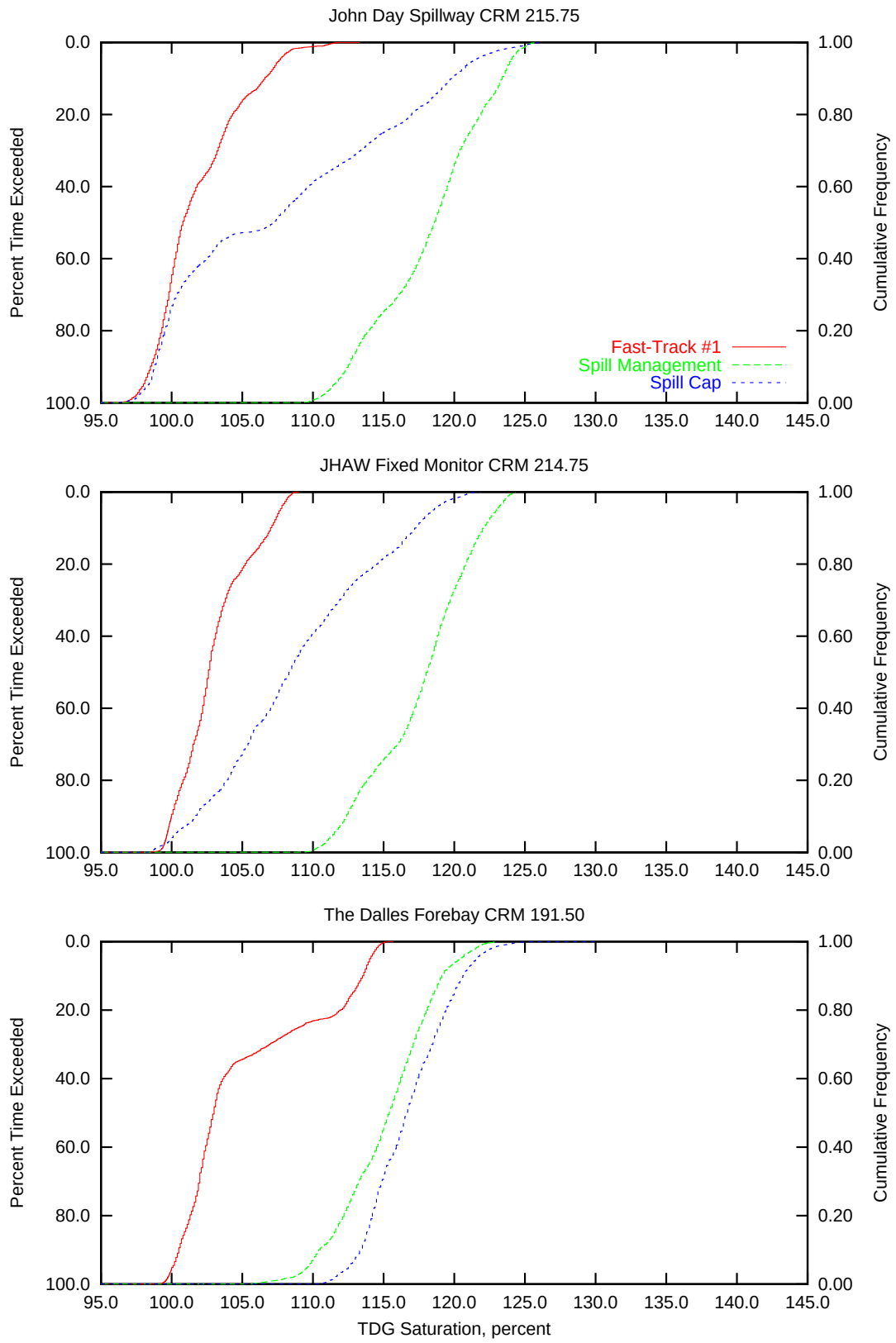

Figure 1.67: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a low flow (1994) season.

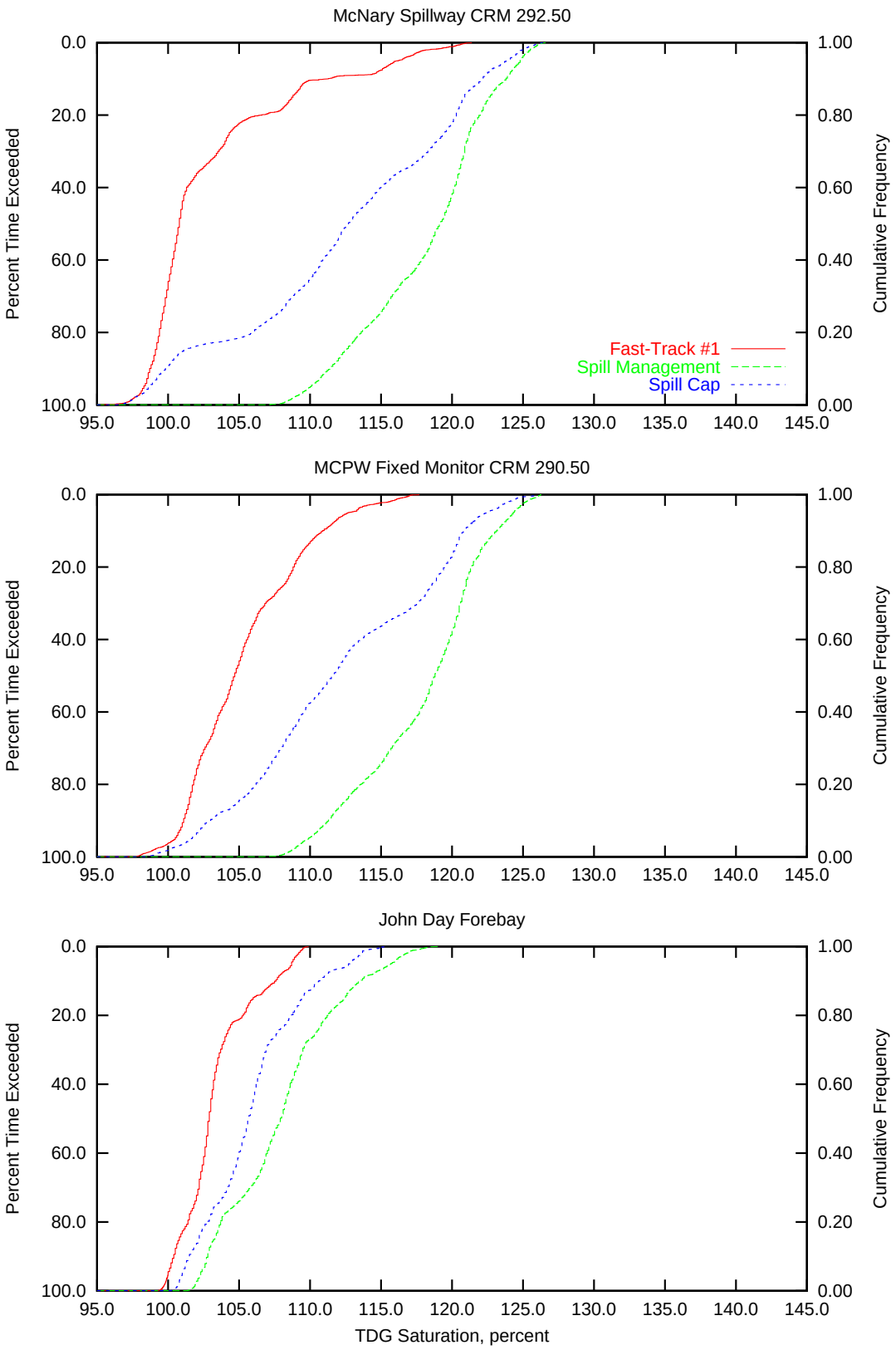

Figure 1.68: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a low flow (1994) season.

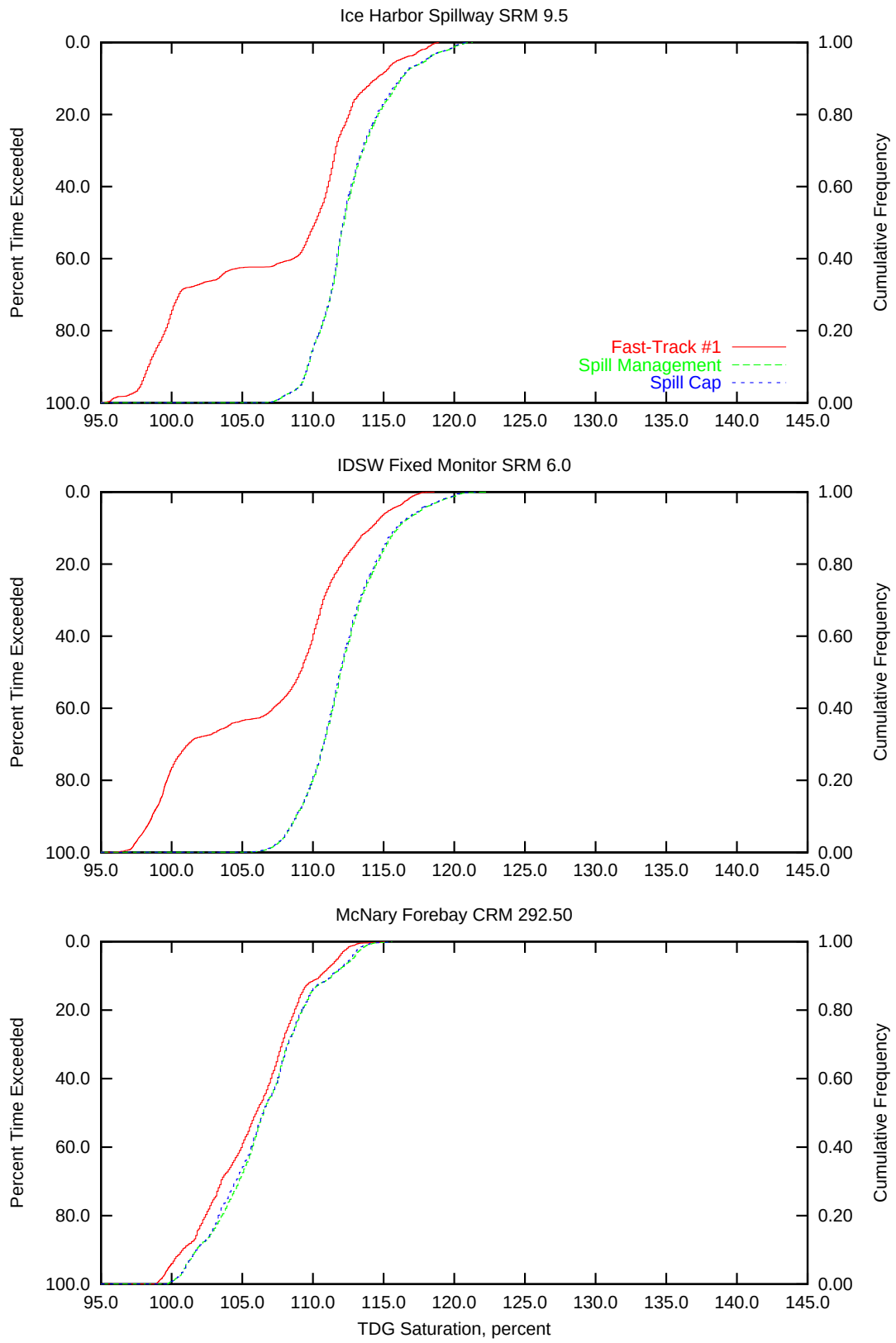

Figure 1.69: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a low flow (1994) season.

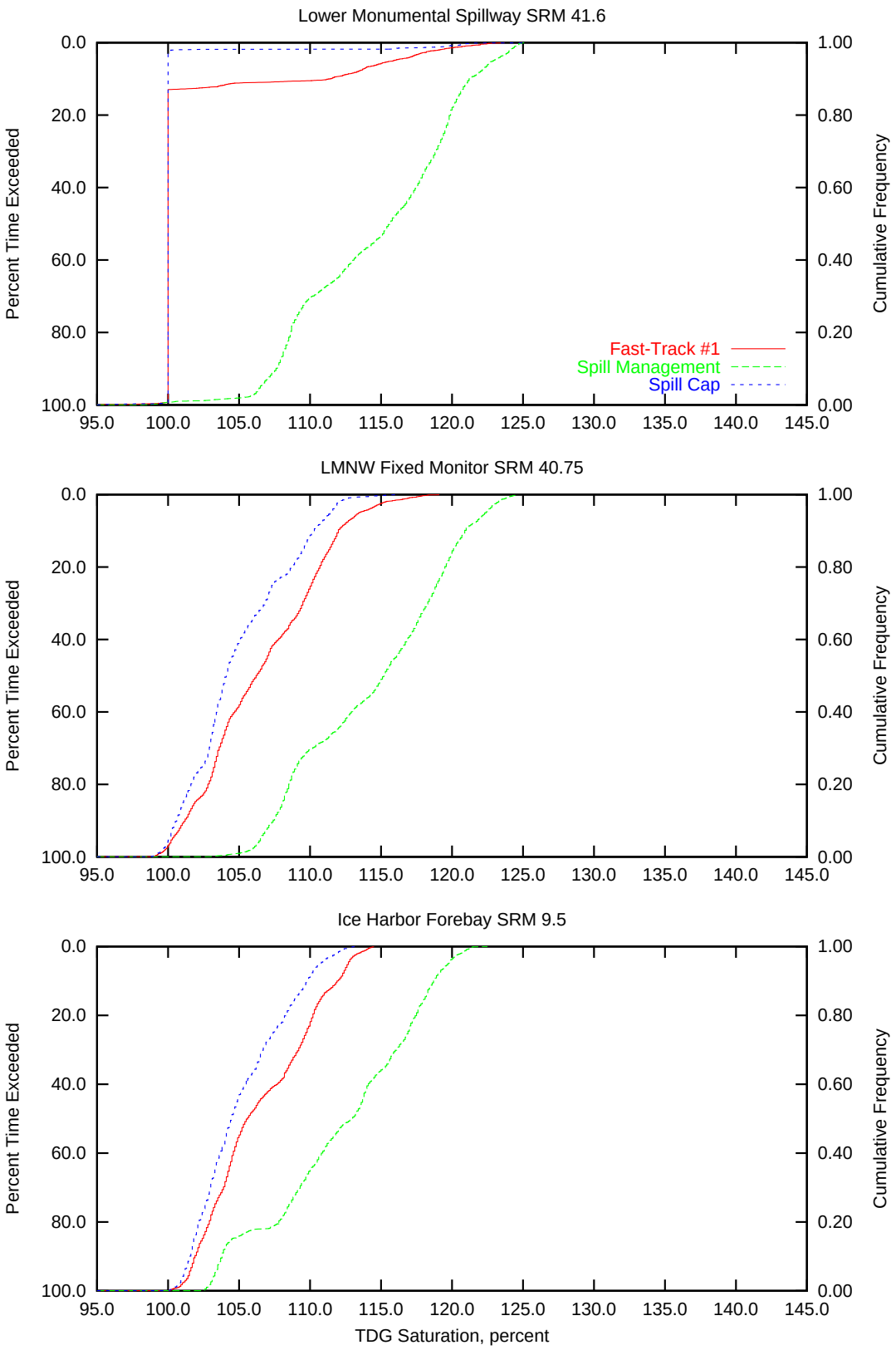

Figure 1.70: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a low flow (1994) season.

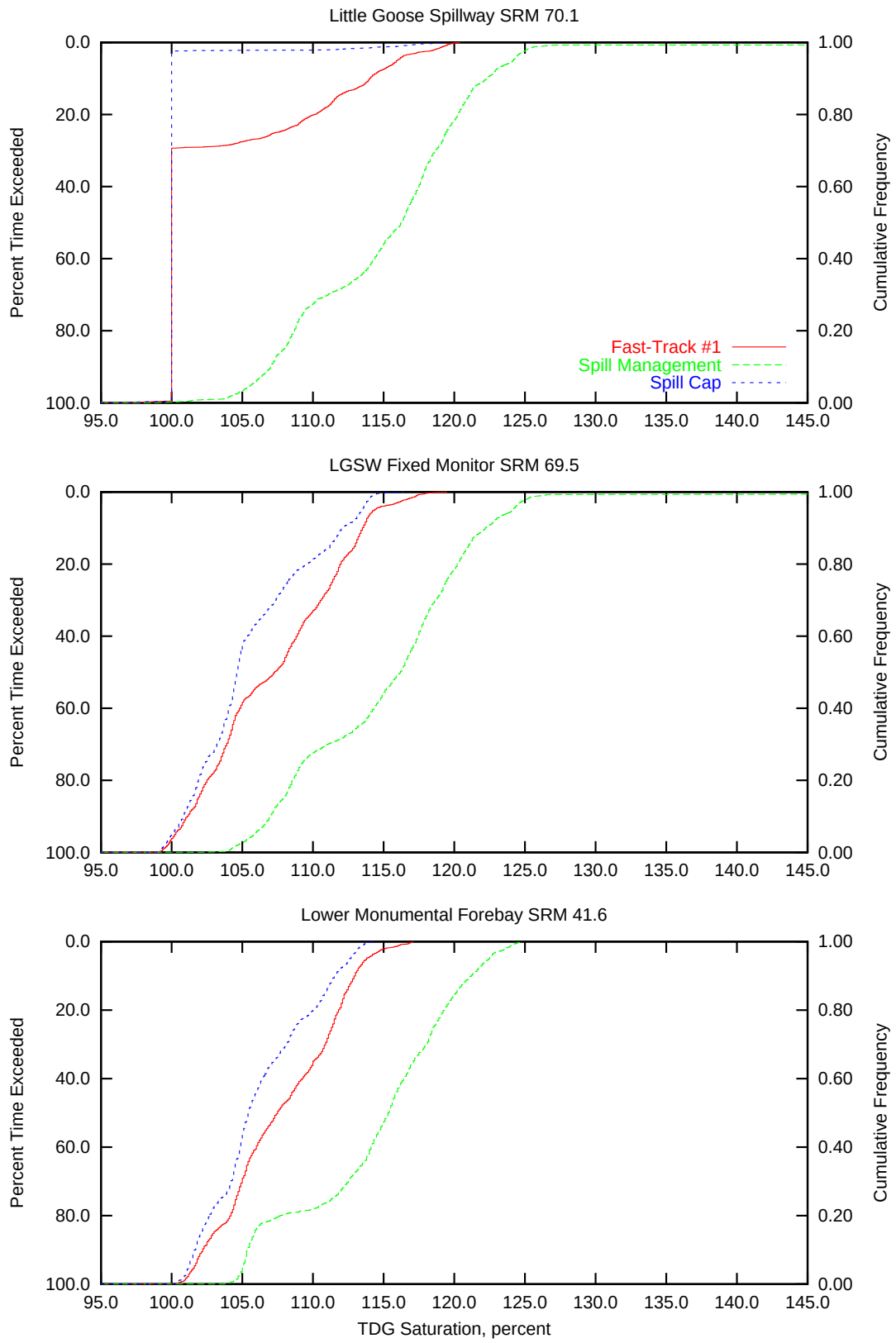

Figure 1.71: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a low flow (1994) season.

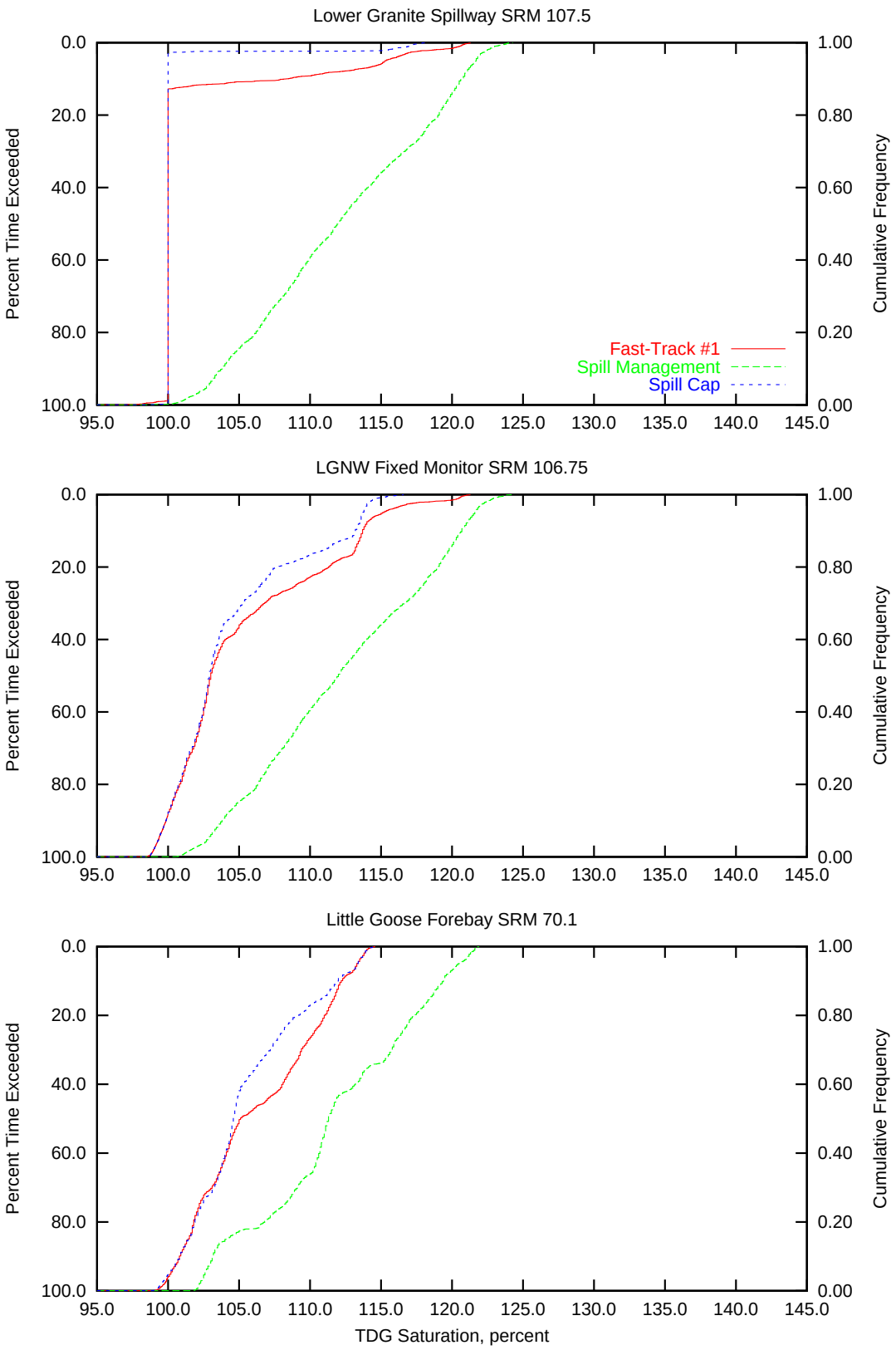

Figure 1.72: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a low flow (1994) season.

1.3.4 Medium/High Flow Year (1996)

Table 1.32: 10% exceedance of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	123.2	122.9	121.1
LGS-sp	SRM 70.1	126.1	123.9	123.3
LMN-sp	SRM 41.6	127.3	126.4	126.6
IHR-sp	SRM 9.5	118.5	120.2	118.4
MCN-sp	CRM 292.5	129.9	129.3	129.3
JDA-sp	CRM 215.75	121.2	120.4	123.6
TDA-sp	CRM 191.5	125.2	123.5	125.1
BON-sp	CRM 146.5	135.5	136.0	136.0
LWG-fms	SRM 106.75	118.5	121.1	115.1
LGS-fms	SRM 69.5	125.4	123.0	120.8
LMN-fms	SRM 40.75	124.6	122.5	121.8
IHR-fms	SRM 6.0	119.8	120.5	119.2
MCN-fms	CRM 290.5	126.7	126.1	126.0
JDA-fms	CRM 214.75	119.1	118.6	120.4
TDA-fms	CRM 189.0	122.5	118.7	122.0
BON-fms	CRM 140.5	127.6	125.4	126.9
LGS-fb	SRM 70.1	117.2	119.9	114.3
LMN-fb	SRM 41.6	123.5	121.5	120.0
IHR-fb	SRM 9.5	123.1	121.9	121.3
MCN-fb	CRM 292.5	118.3	118.7	118.1
JDA-fb	CRM 215.75	118.0	117.5	117.4
TDA-fb	CRM 191.5	117.8	117.5	118.3
BON-fb	CRM 146.5	120.0	116.8	119.9
TID-fb	CRM 76.0	123.6	121.8	123.3

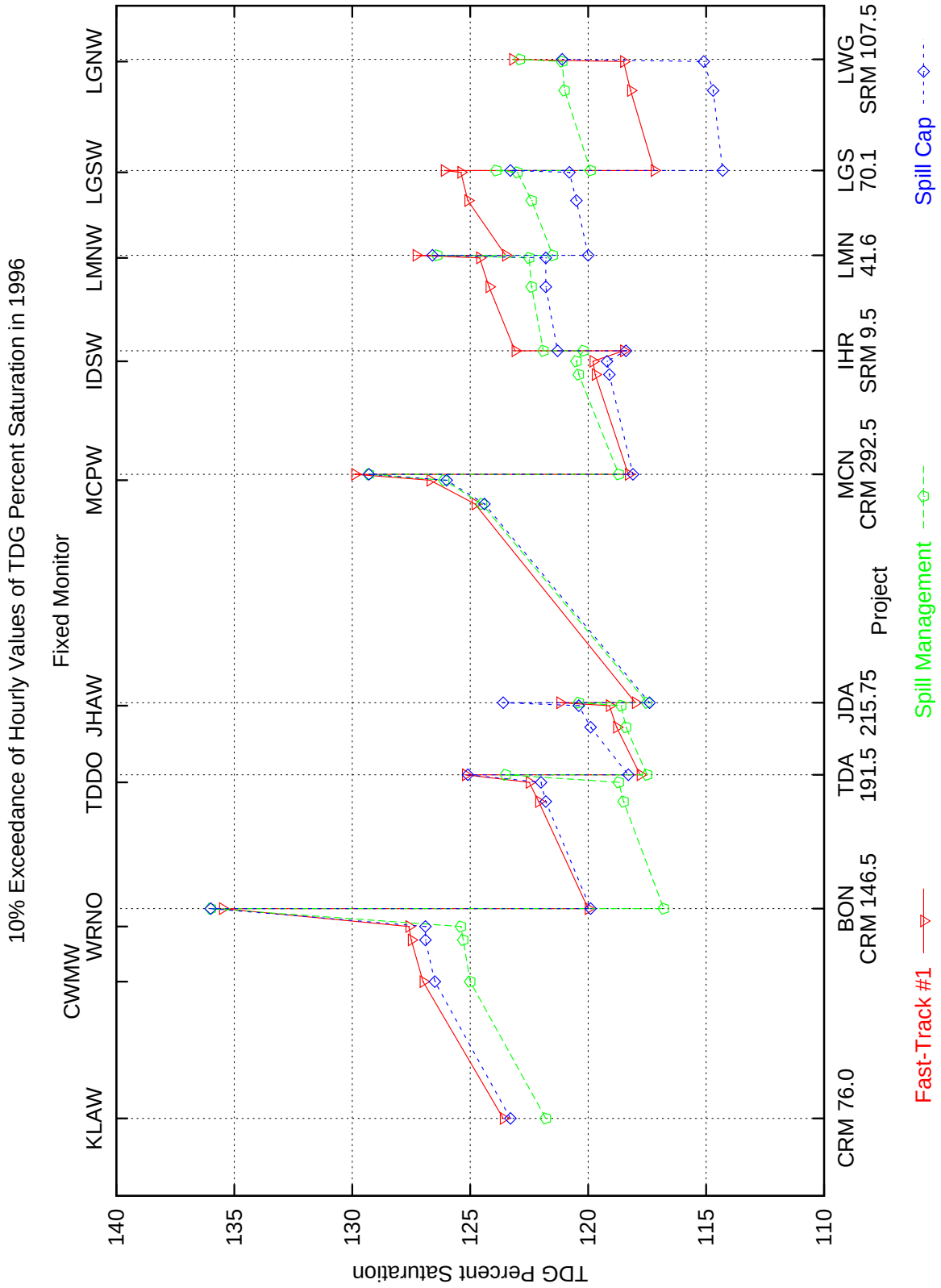

Figure 1.73: Comparison of the 10% exceedance of of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.33: 25% exceedance of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	118.2	120.5	116.3
LGS-sp	SRM 70.1	120.5	121.5	117.2
LMN-sp	SRM 41.6	121.1	121.1	120.2
IHR-sp	SRM 9.5	114.3	118.0	115.9
MCN-sp	CRM 292.5	122.6	122.9	122.9
JDA-sp	CRM 215.75	114.8	119.4	120.1
TDA-sp	CRM 191.5	123.1	121.0	123.4
BON-sp	CRM 146.5	132.3	129.4	129.3
LWG-fms	SRM 106.75	113.6	119.2	111.3
LGS-fms	SRM 69.5	119.2	120.9	114.2
LMN-fms	SRM 40.75	118.5	120.2	114.7
IHR-fms	SRM 6.0	115.3	117.9	115.7
MCN-fms	CRM 290.5	119.8	120.2	119.8
JDA-fms	CRM 214.75	113.0	117.7	117.3
TDA-fms	CRM 189.0	118.7	116.5	120.2
BON-fms	CRM 140.5	123.5	119.8	122.3
LGS-fb	SRM 70.1	112.7	118.1	108.9
LMN-fb	SRM 41.6	117.9	119.9	113.3
IHR-fb	SRM 9.5	116.9	118.0	113.4
MCN-fb	CRM 292.5	114.8	115.4	115.0
JDA-fb	CRM 215.75	112.9	114.6	114.4
TDA-fb	CRM 191.5	112.5	116.1	115.8
BON-fb	CRM 146.5	117.0	114.7	117.9
TID-fb	CRM 76.0	118.5	115.8	118.3

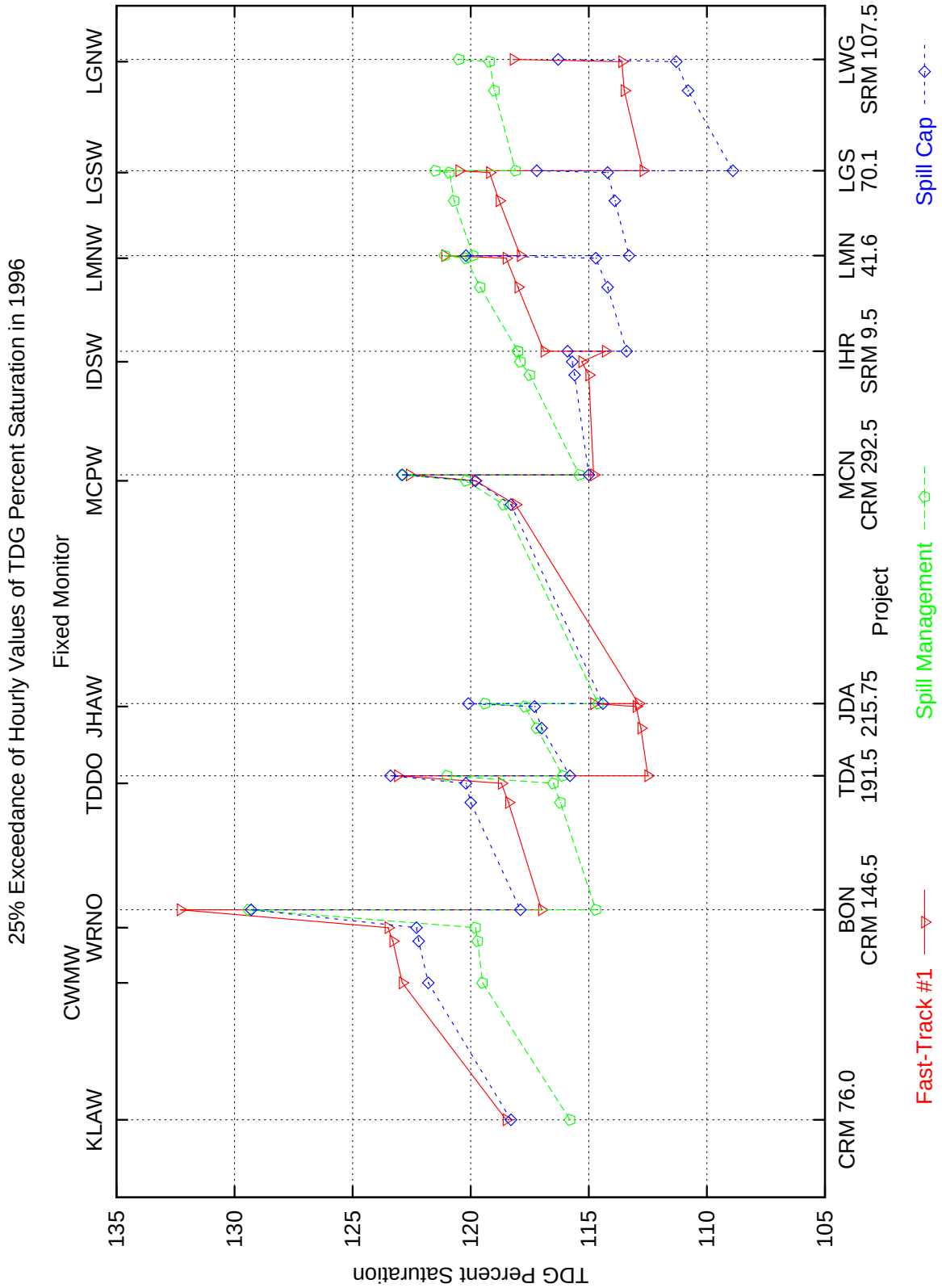

Figure 1.74: Comparison of the 25% exceedance of of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.34: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	124.7	123.5	122.0
LGS-sp	SRM 70.1	127.4	124.8	124.4
LMN-sp	SRM 41.6	128.5	128.1	128.2
IHR-sp	SRM 9.5	119.5	120.6	119.5
MCN-sp	CRM 292.5	131.9	131.2	131.2
JDA-sp	CRM 215.75	122.0	120.7	124.8
TDA-sp	CRM 191.5	125.5	123.7	125.4
BON-sp	CRM 146.5	136.4	136.5	136.5
LWG-fms	SRM 106.75	119.5	122.0	116.2
LGS-fms	SRM 69.5	126.8	123.6	122.1
LMN-fms	SRM 40.75	125.5	123.3	122.8
IHR-fms	SRM 6.0	120.7	121.0	119.7
MCN-fms	CRM 290.5	128.8	128.2	128.0
JDA-fms	CRM 214.75	119.6	118.9	121.2
TDA-fms	CRM 189.0	122.8	119.0	122.7
BON-fms	CRM 140.5	128.2	126.0	127.3
LGS-fb	SRM 70.1	118.2	120.2	114.8
LMN-fb	SRM 41.6	124.6	121.8	120.7
IHR-fb	SRM 9.5	124.1	122.8	121.5
MCN-fb	CRM 292.5	118.7	119.3	118.5
JDA-fb	CRM 215.75	118.3	118.2	118.0
TDA-fb	CRM 191.5	118.3	118.1	119.2
BON-fb	CRM 146.5	120.6	117.2	120.5
TID-fb	CRM 76.0	124.9	122.4	123.4

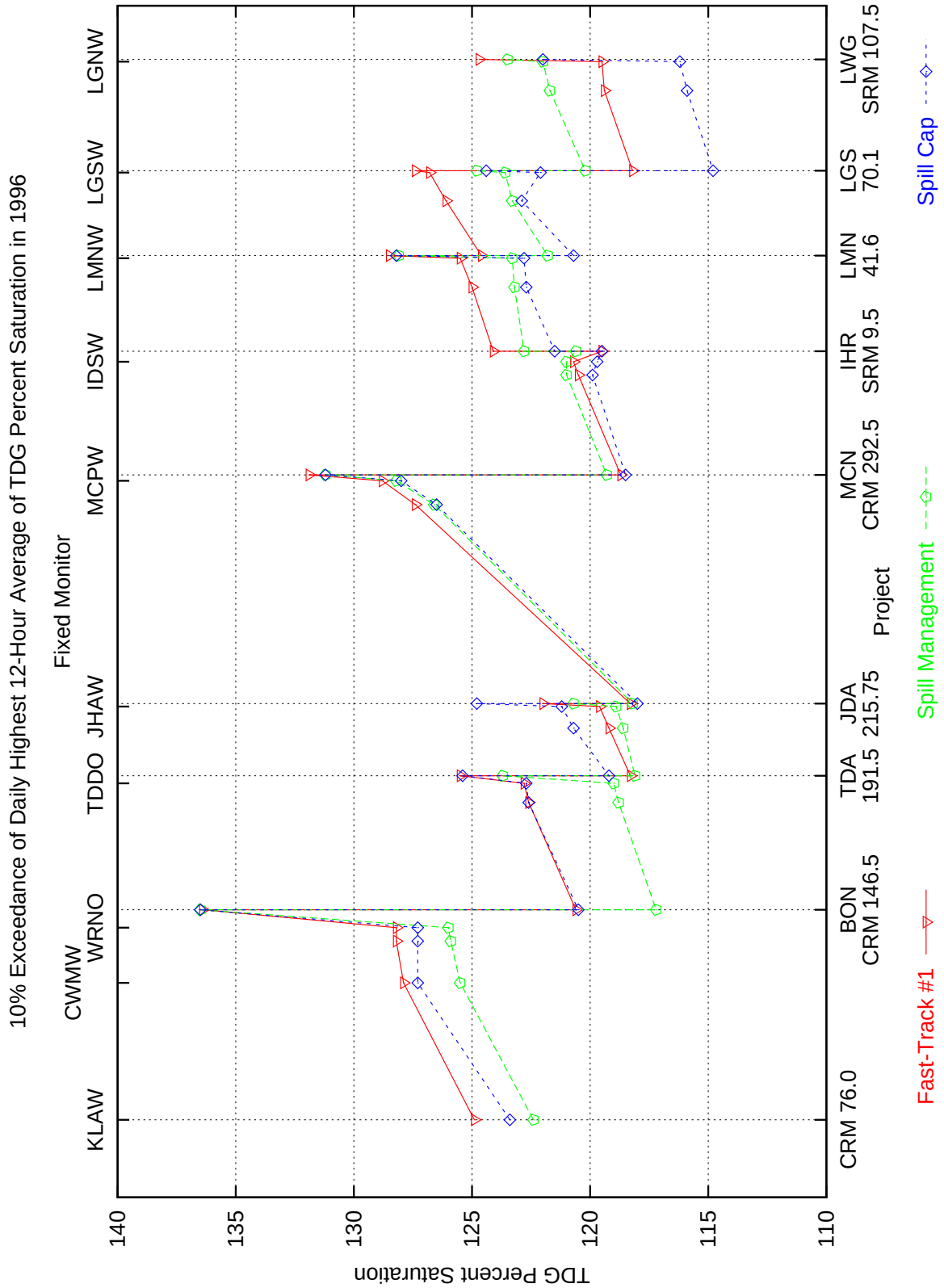

Figure 1.75: Comparison of the 10% exceedance of Daily Highest 12-Hour Average of TDG Percent Saturation of MASS1 time series output: Medium Flow Season (1996)

Table 1.35: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: medium flow season (1996)

Location	Project	River Mile	Operations		Spill Management		Spill-Cap	
			Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	38	22.8	67	40.1	24	14.4
> 120	LGS	SRM 70.1	55	32.9	108	64.7	36	21.6
	LMN	SRM 41.6	54	32.3	83	49.7	47	28.1
	IHR	SRM 9.5	13	7.8	26	15.6	15	9.0
	MCN	CRM 292.5	60	35.9	78	46.7	73	43.7
	JDA	CRM 215.75	24	14.4	32	19.2	76	45.5
	TDA	CRM 191.5	130	77.8	62	37.1	133	79.6
	BON	CRM 146.5	121	72.5	74	44.3	166	99.4
FMS	LWG	SRM 106.75	14	8.4	38	22.8	11	6.6
> 120	LGS	SRM 69.5	53	31.7	91	54.5	21	12.6
	LMN	SRM 40.75	41	24.6	62	37.1	23	13.8
	IHR	SRM 6.0	19	11.4	25	15.0	16	9.6
	MCN	CRM 290.5	43	25.7	45	26.9	43	25.7
	JDA	CRM 214.75	14	8.4	6	3.6	33	19.8
	TDA	CRM 189.0	37	22.2	10	6.0	56	33.5
	BON	CRM 140.5	70	41.9	44	26.3	86	51.5
Forebay	LGS	SRM 70.1	33	19.8	106	63.5	16	9.6
> 115	LMN	SRM 41.6	62	37.1	145	86.8	38	22.8
	IHR	SRM 9.5	56	33.5	107	64.1	36	21.6
	MCN	CRM 292.5	46	27.5	57	34.1	51	30.5
	JDA	CRM 215.75	35	21.0	42	25.1	42	25.1
	TDA	CRM 191.5	35	21.0	88	52.7	74	44.3
	BON	CRM 146.5	73	43.7	46	27.5	113	67.7
	TID	CRM 76.0	91	54.5	55	32.9	127	76.0

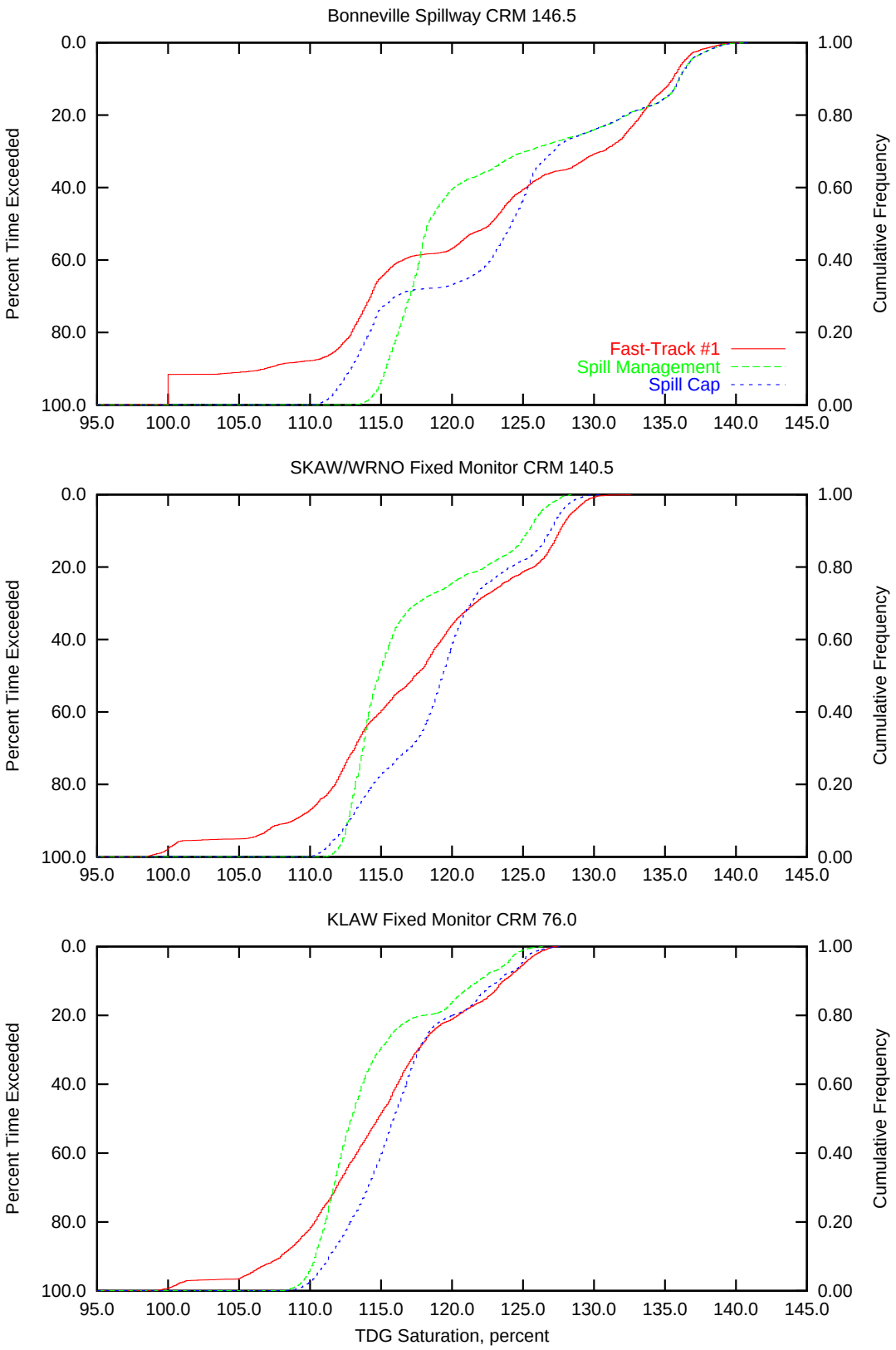

Figure 1.76: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a medium flow (1996) season.

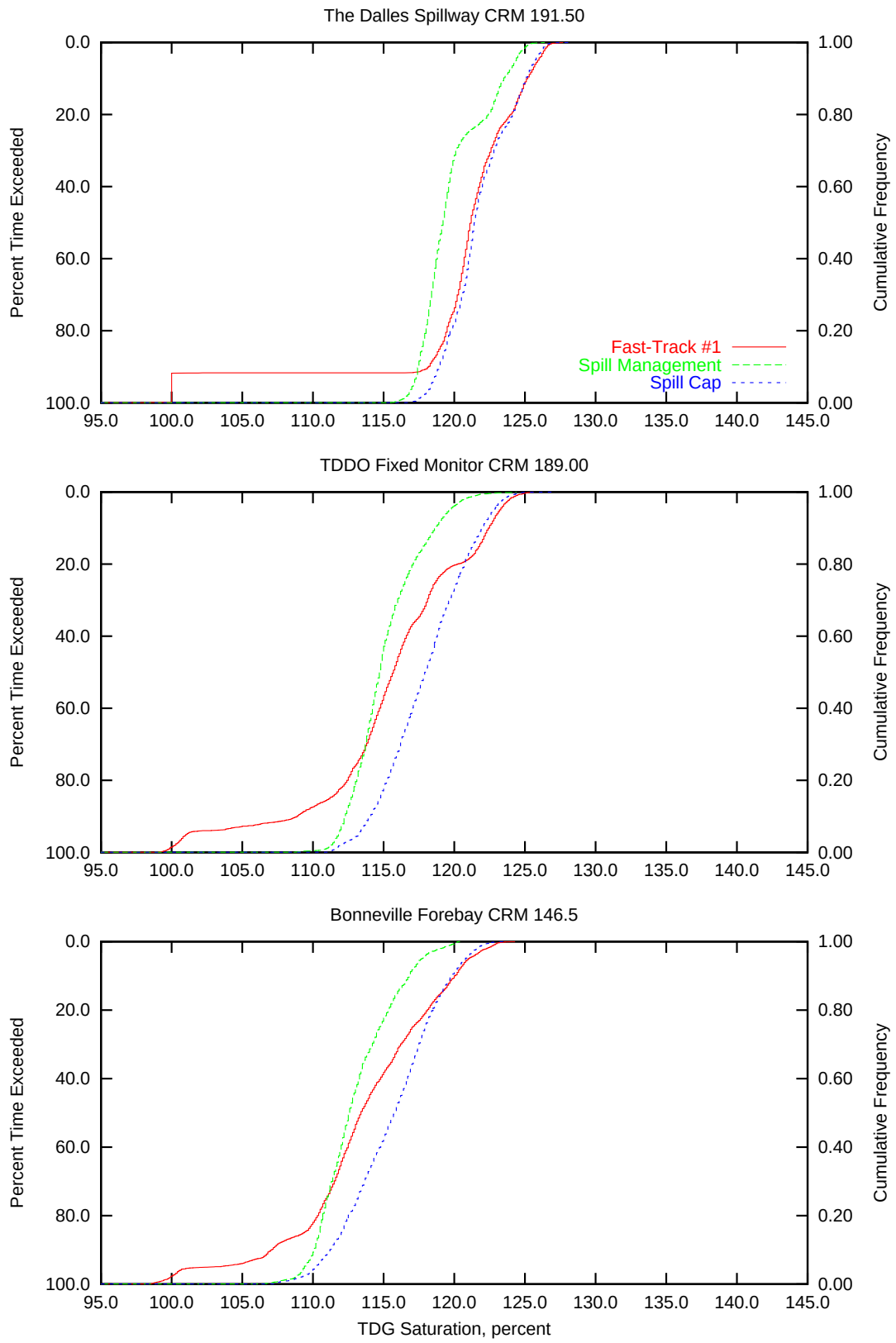

Figure 1.77: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a medium flow (1996) season.

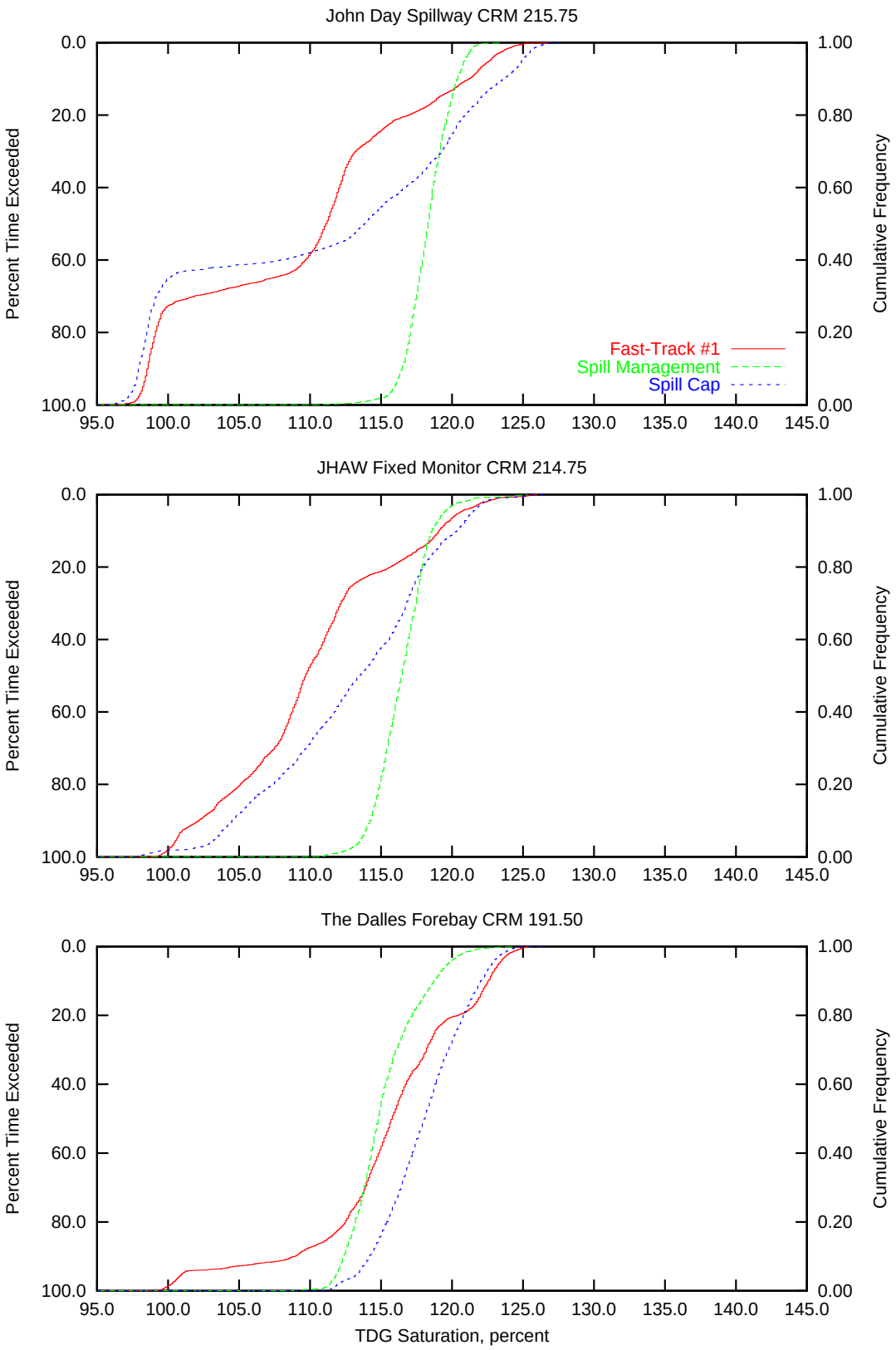

Figure 1.78: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a medium flow (1996) season.

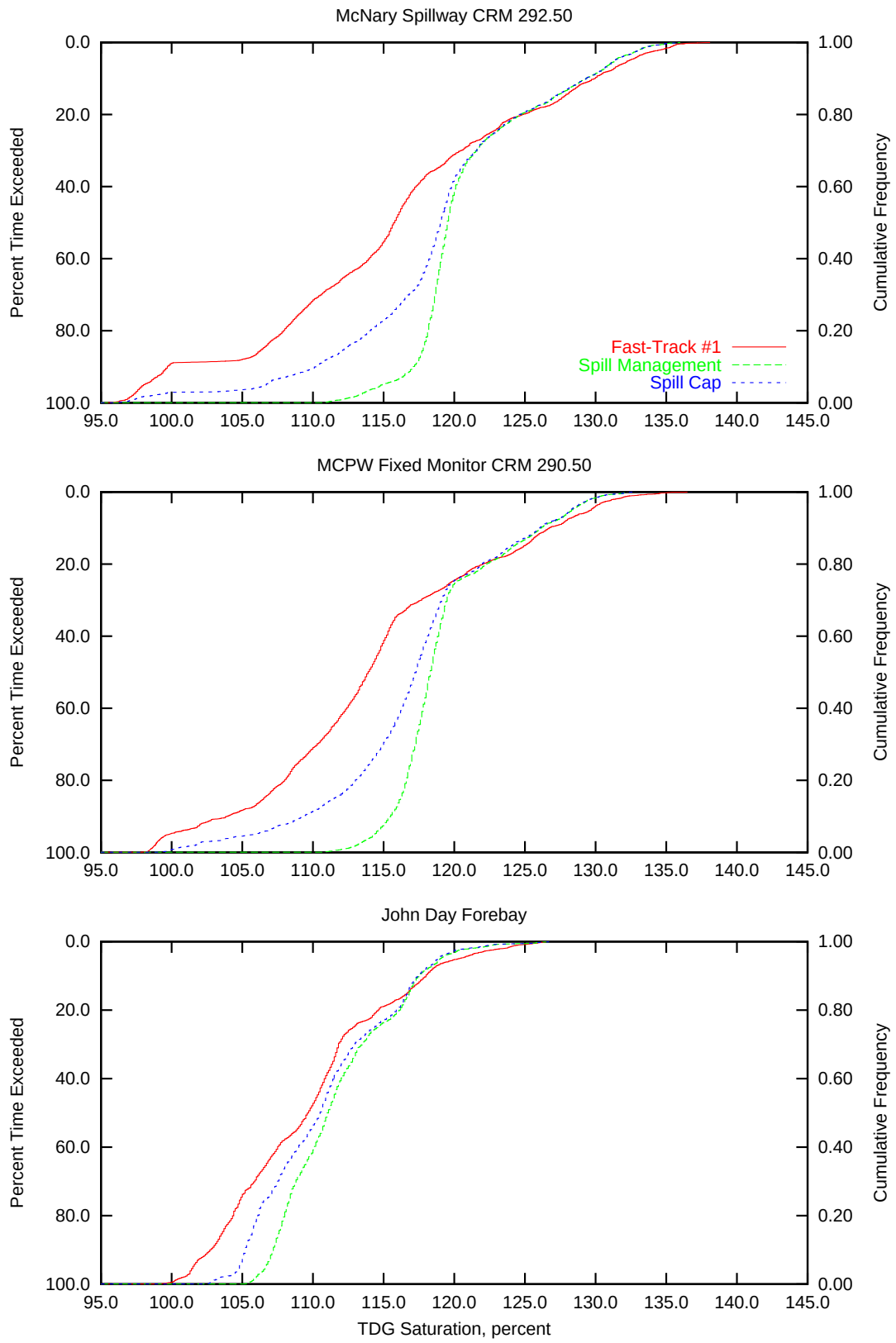

Figure 1.79: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a medium flow (1996) season.

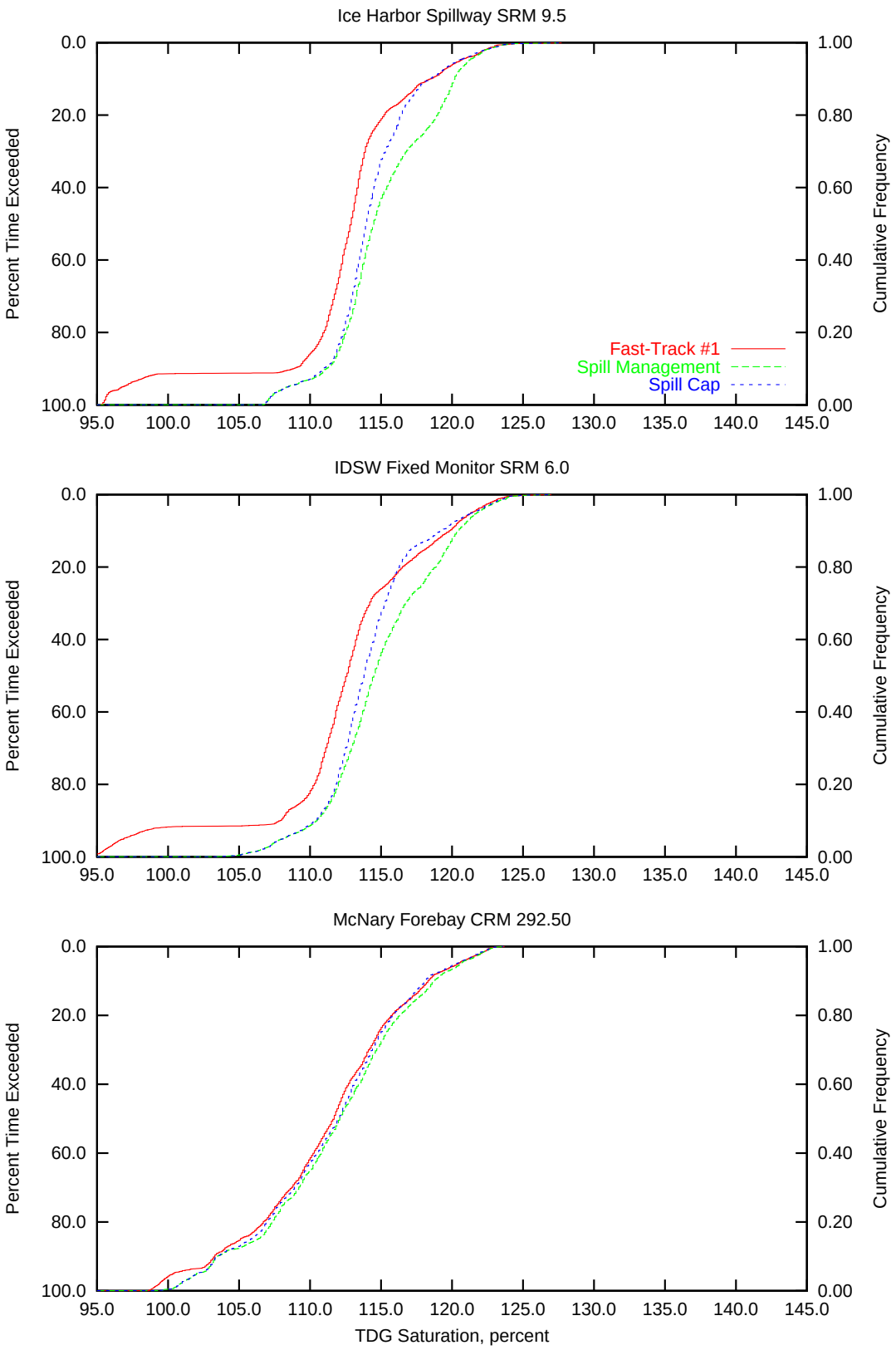

Figure 1.80: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a medium flow (1996) season.

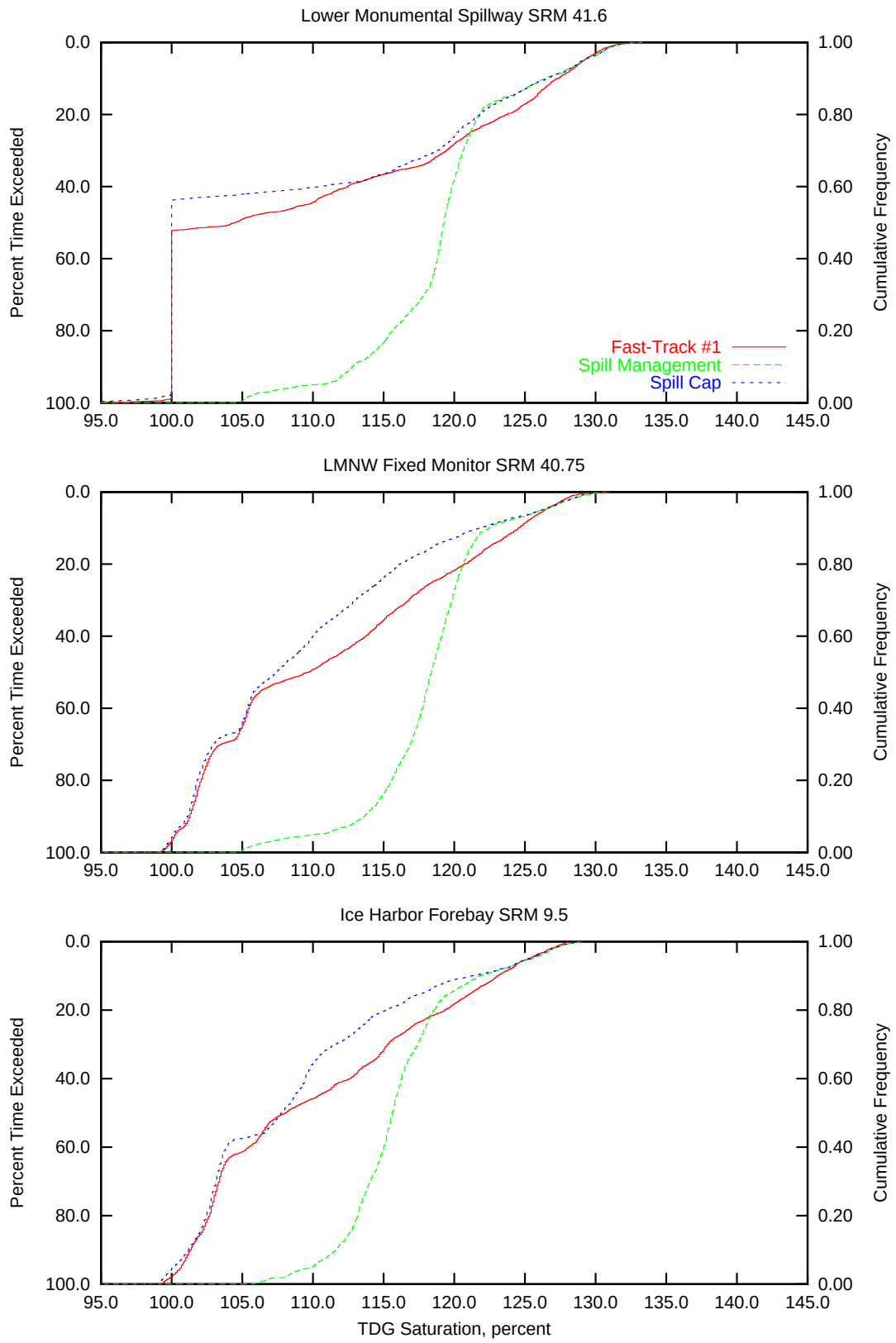

Figure 1.81: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a medium flow (1996) season.

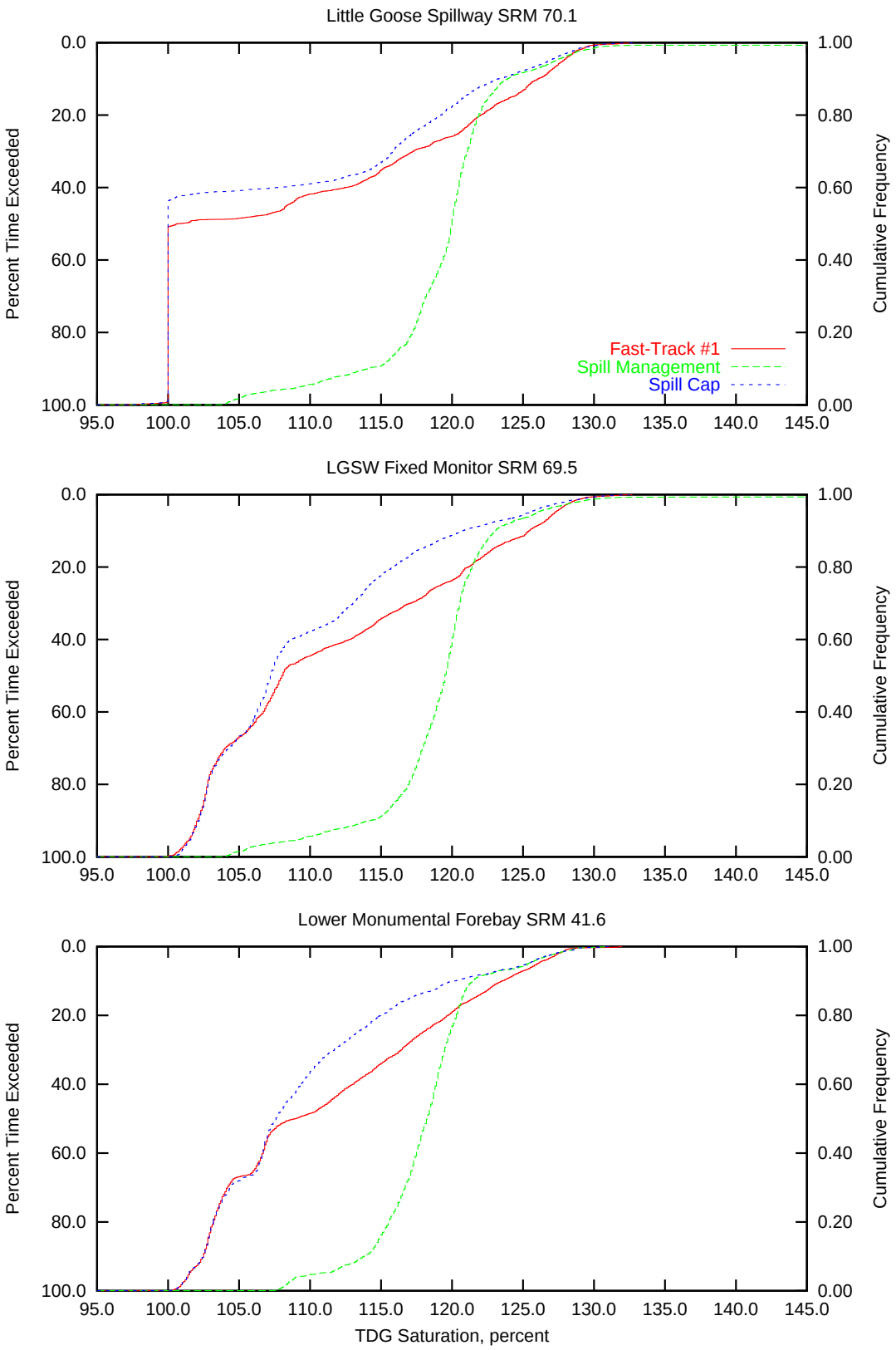

Figure 1.82: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a medium flow (1996) season.

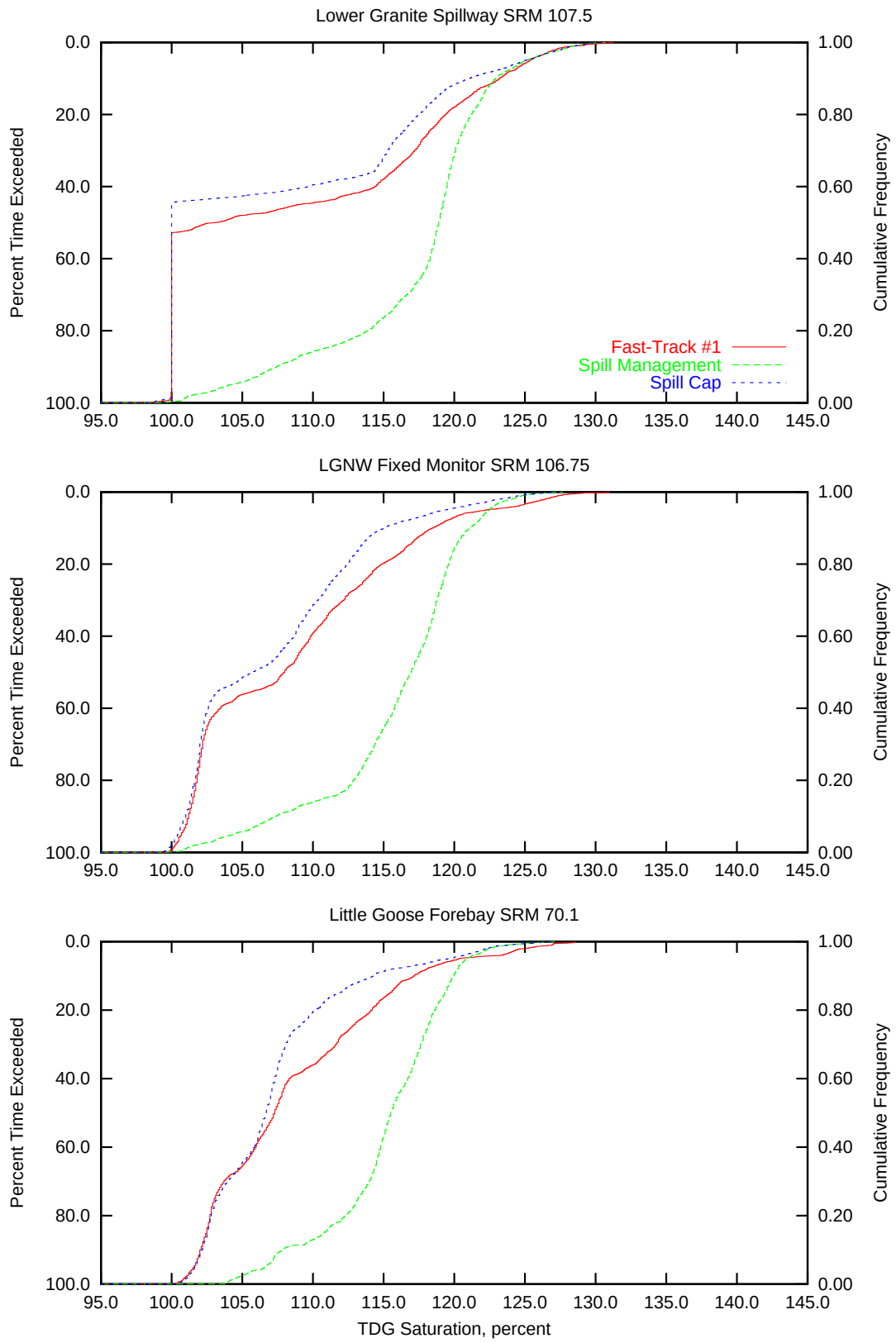

Figure 1.83: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a medium flow (1996) season.

1.3.5 High Flow Year (1997)

Table 1.36: 10% exceedance of TDG percent saturation of MASS1 time series output: high flow season (1997)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	124.6	125.2	125.2
LGS-sp	SRM 70.1	126.2	126.4	126.2
LMN-sp	SRM 41.6	128.2	128.7	128.7
IHR-sp	SRM 9.5	120.4	120.1	119.6
MCN-sp	CRM 292.5	136.1	137.6	137.5
JDA-sp	CRM 215.75	127.0	124.9	125.8
TDA-sp	CRM 191.5	126.2	125.0	125.5
BON-sp	CRM 146.5	133.3	133.7	133.7
LWG-fms	SRM 106.75	118.9	120.3	119.7
LGS-fms	SRM 69.5	125.1	125.0	124.8
LMN-fms	SRM 40.75	125.3	125.6	125.5
IHR-fms	SRM 6.0	121.2	121.0	120.9
MCN-fms	CRM 290.5	132.2	134.1	134.1
JDA-fms	CRM 214.75	125.4	124.8	125.0
TDA-fms	CRM 189.0	125.3	123.9	124.2
BON-fms	CRM 140.5	126.4	125.7	126.3
LGS-fb	SRM 70.1	118.1	119.7	119.2
LMN-fb	SRM 41.6	124.3	124.2	124.3
IHR-fb	SRM 9.5	124.5	125.0	124.9
MCN-fb	CRM 292.5	122.2	122.5	122.2
JDA-fb	CRM 215.75	124.5	124.8	124.8
TDA-fb	CRM 191.5	123.8	123.4	123.6
BON-fb	CRM 146.5	123.0	121.8	122.2
TID-fb	CRM 76.0	123.3	123.3	123.8

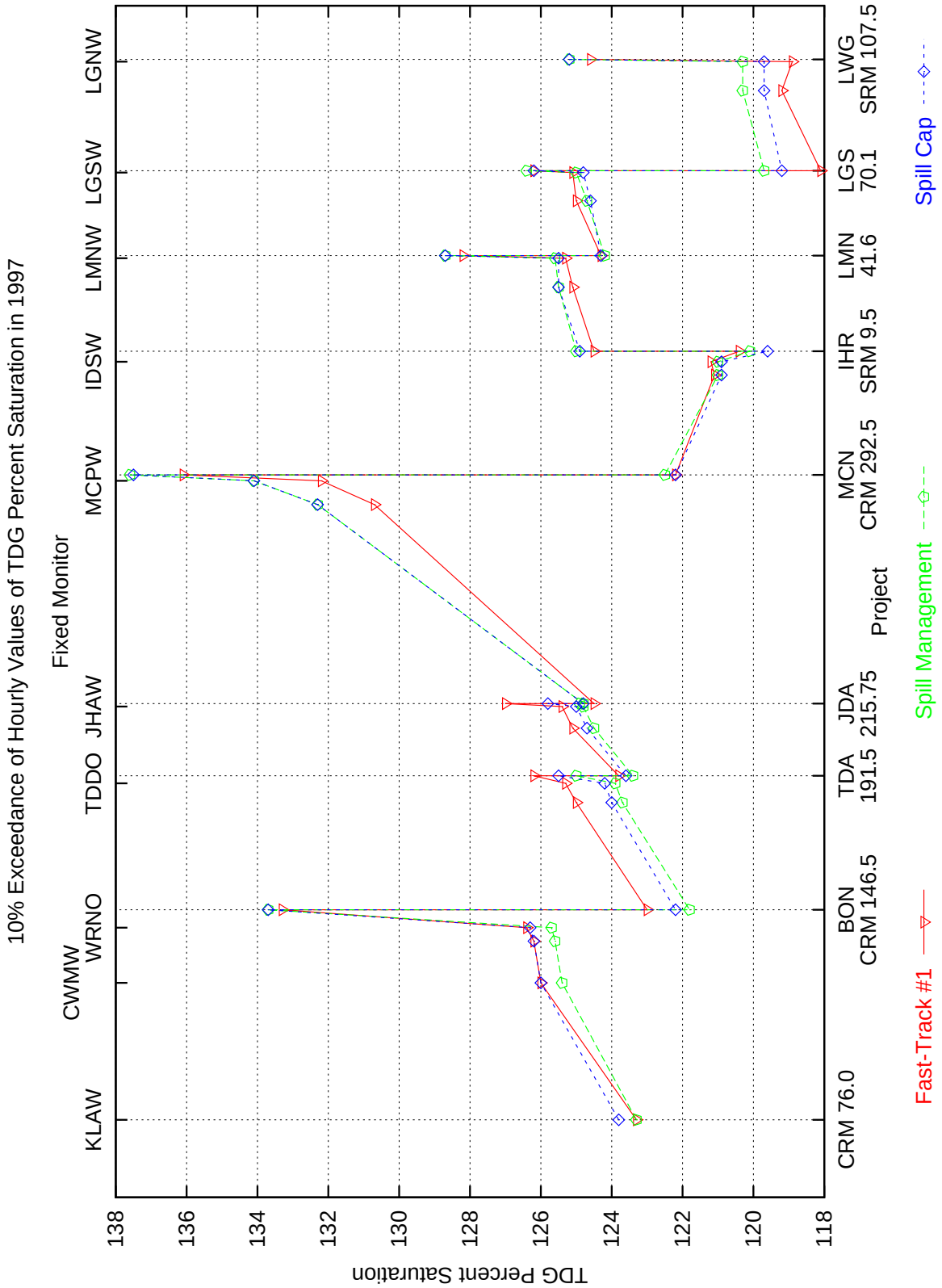

Figure 1.84: Comparison of the 10% exceedance of of TDG Percent Saturation of MASS1 time series output: High Flow Season (1997)

Table 1.37: 25% exceedance of TDG percent saturation of MASS1 time series output: high flow season (1997)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	119.3	121.2	120.8
LGS-sp	SRM 70.1	122.0	121.6	121.6
LMN-sp	SRM 41.6	125.0	125.6	125.6
IHR-sp	SRM 9.5	117.2	118.7	116.8
MCN-sp	CRM 292.5	129.3	131.2	131.2
JDA-sp	CRM 215.75	122.8	119.8	123.2
TDA-sp	CRM 191.5	124.0	123.1	124.1
BON-sp	CRM 146.5	128.1	129.0	129.1
LWG-fms	SRM 106.75	112.7	119.0	114.7
LGS-fms	SRM 69.5	119.7	120.9	119.6
LMN-fms	SRM 40.75	120.1	121.6	121.4
IHR-fms	SRM 6.0	117.6	118.8	117.5
MCN-fms	CRM 290.5	125.8	127.8	127.7
JDA-fms	CRM 214.75	120.5	120.5	121.8
TDA-fms	CRM 189.0	122.4	120.4	122.2
BON-fms	CRM 140.5	123.0	123.1	123.9
LGS-fb	SRM 70.1	112.4	117.9	115.0
LMN-fb	SRM 41.6	119.0	120.2	118.8
IHR-fb	SRM 9.5	119.3	119.9	119.7
MCN-fb	CRM 292.5	118.9	119.4	119.0
JDA-fb	CRM 215.75	119.4	121.0	120.9
TDA-fb	CRM 191.5	119.3	119.3	120.1
BON-fb	CRM 146.5	120.5	118.4	120.0
TID-fb	CRM 76.0	119.8	120.3	120.9

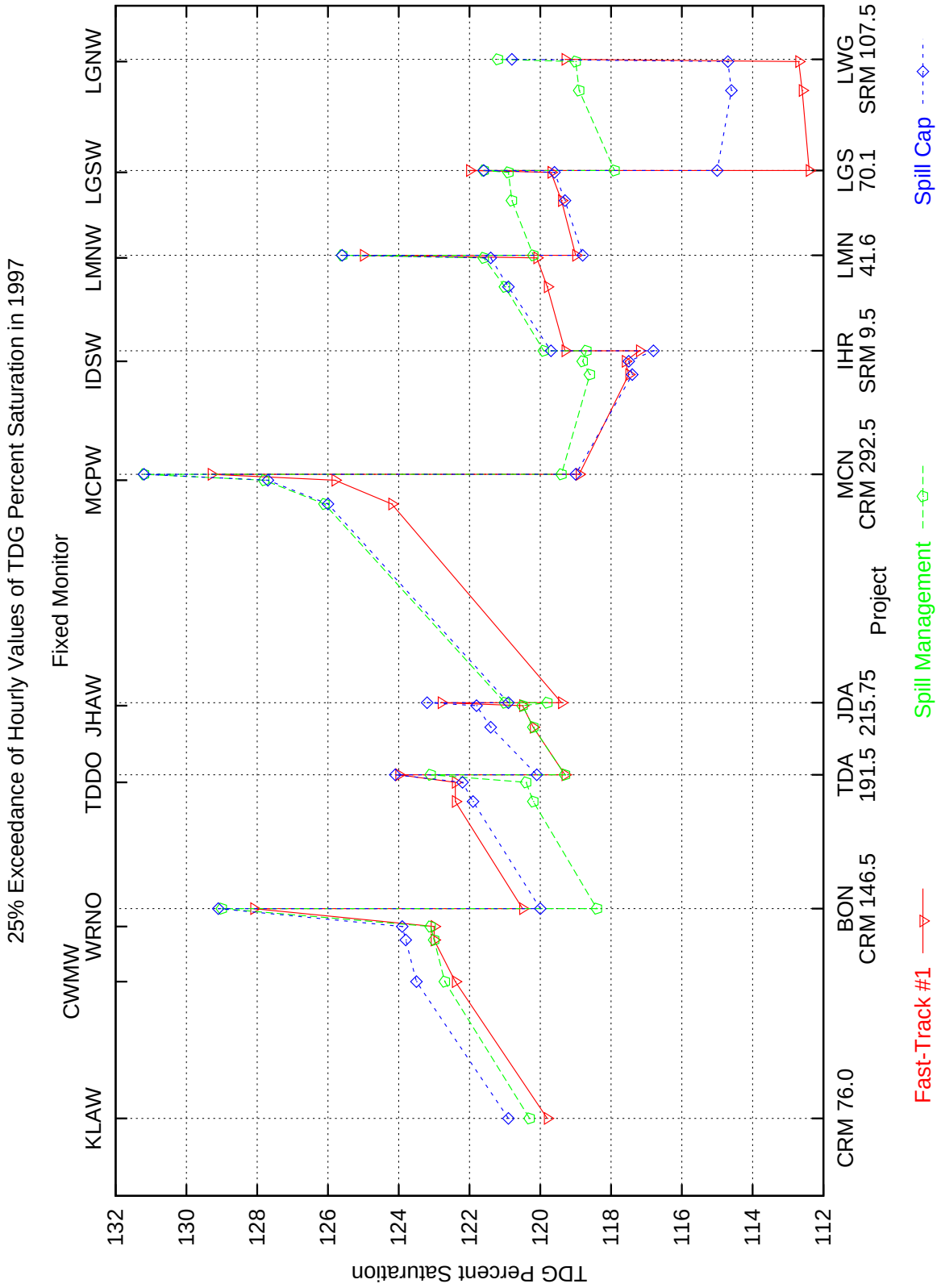

Figure 1.85: Comparison of the 25% exceedance of of TDG Percent Saturation of MASS1 time series output: High Flow Season (1997)

Table 1.38: 10% exceedance of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: high flow season (1997)

Location	River Mile	Operations	Spill Management	Spill-Cap
LWG-sp	SRM 107.5	126.9	125.7	125.8
LGS-sp	SRM 70.1	126.8	127.5	127.0
LMN-sp	SRM 41.6	129.0	129.4	129.4
IHR-sp	SRM 9.5	121.7	120.7	120.7
MCN-sp	CRM 292.5	137.3	138.7	138.7
JDA-sp	CRM 215.75	127.4	125.2	126.0
TDA-sp	CRM 191.5	126.7	125.4	126.0
BON-sp	CRM 146.5	134.0	134.4	134.4
LWG-fms	SRM 106.75	122.8	120.7	120.5
LGS-fms	SRM 69.5	126.0	126.4	125.8
LMN-fms	SRM 40.75	126.2	126.6	126.6
IHR-fms	SRM 6.0	122.0	121.8	121.8
MCN-fms	CRM 290.5	133.4	134.5	134.5
JDA-fms	CRM 214.75	125.8	125.2	125.6
TDA-fms	CRM 189.0	125.8	124.4	124.7
BON-fms	CRM 140.5	126.8	126.4	127.0
LGS-fb	SRM 70.1	120.5	120.1	120.0
LMN-fb	SRM 41.6	125.1	125.2	125.2
IHR-fb	SRM 9.5	125.4	125.9	125.9
MCN-fb	CRM 292.5	123.0	123.2	123.1
JDA-fb	CRM 215.75	125.1	126.2	126.1
TDA-fb	CRM 191.5	124.7	124.1	124.4
BON-fb	CRM 146.5	123.5	122.2	122.5
TID-fb	CRM 76.0	124.1	124.2	124.4

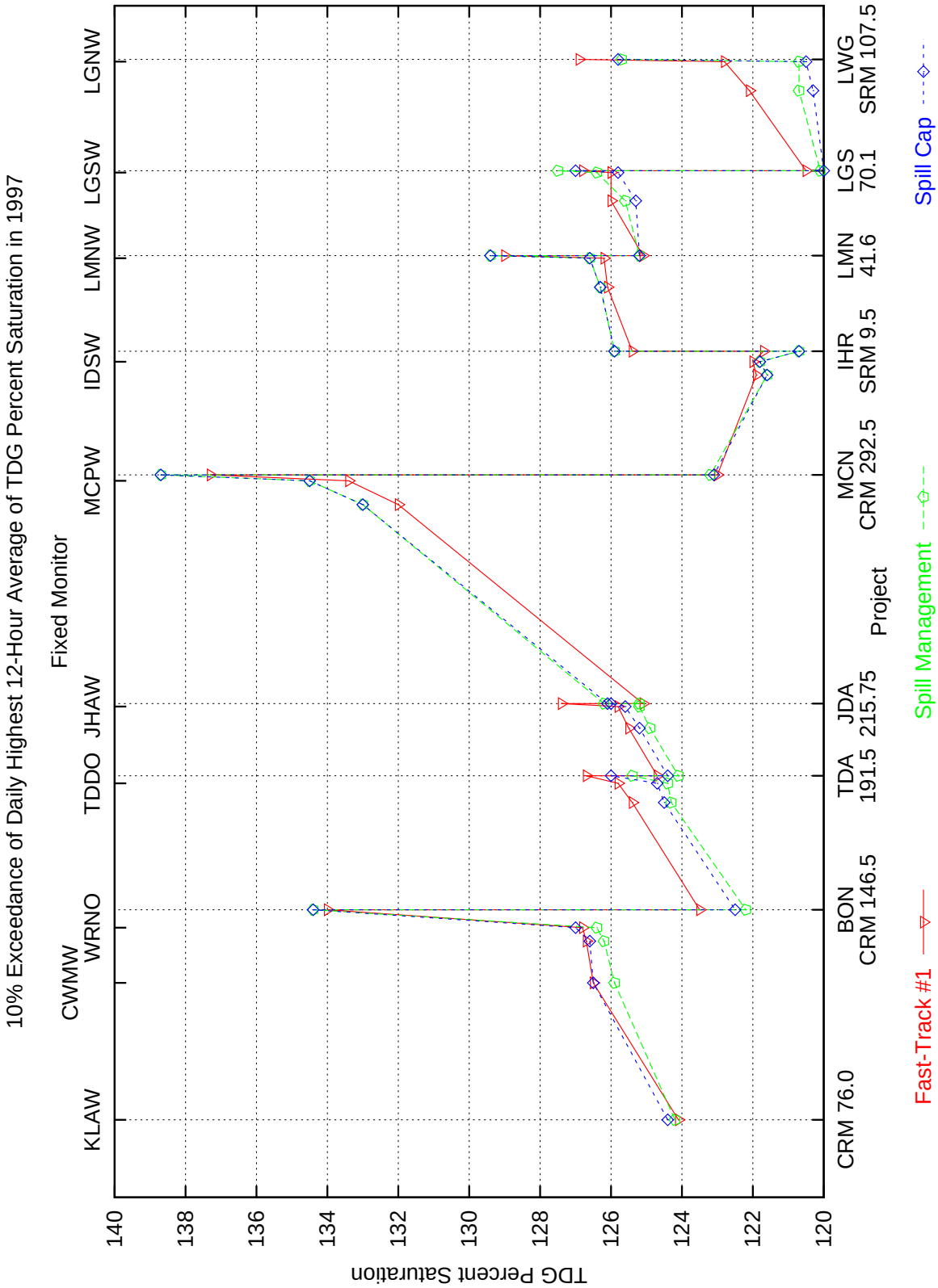

Figure 1.86: Comparison of the 10% exceedance of Daily Highest 12-Hour Average of TDG Percent Saturation of MASS1 time series output: High Flow Season (1997)

Table 1.39: Percentage of exceeding the water quality waiver of daily highest 12-hour average of TDG percent saturation of MASS1 time series output: high flow season (1997)

Location	Project	River Mile	Operations		Spill Management		Spill-Cap	
			Days	%	Days	%	Days	%
Spillway	LWG	SRM 107.5	47	28.1	72	43.1	53	31.7
> 120	LGS	SRM 70.1	60	35.9	89	53.3	59	35.3
	LMN	SRM 41.6	64	38.3	66	39.5	72	43.1
	IHR	SRM 9.5	29	17.4	25	15.0	19	11.4
	MCN	CRM 292.5	71	42.5	80	47.9	79	47.3
	JDA	CRM 215.75	57	34.1	44	26.3	98	58.7
	TDA	CRM 191.5	116	69.5	83	49.7	129	77.2
	BON	CRM 146.5	111	66.5	71	42.5	156	93.4
FMS	LWG	SRM 106.75	23	13.8	33	19.8	23	13.8
> 120	LGS	SRM 69.5	51	30.5	74	44.3	45	26.9
	LMN	SRM 40.75	53	31.7	52	31.1	51	30.5
	IHR	SRM 6.0	32	19.2	31	18.6	30	18.0
	MCN	CRM 290.5	68	40.7	70	41.9	69	41.3
	JDA	CRM 214.75	45	26.9	46	27.5	62	37.1
	TDA	CRM 189.0	66	39.5	47	28.1	74	44.3
	BON	CRM 140.5	68	40.7	61	36.5	77	46.1
Forebay	LGS	SRM 70.1	37	22.2	116	69.5	45	26.9
> 115	LMN	SRM 41.6	62	37.1	139	83.2	61	36.5
	IHR	SRM 9.5	63	37.7	108	64.7	62	37.1
	MCN	CRM 292.5	67	40.1	69	41.3	67	40.1
	JDA	CRM 215.75	67	40.1	70	41.9	68	40.7
	TDA	CRM 191.5	68	40.7	97	58.1	83	49.7
	BON	CRM 146.5	83	49.7	66	39.5	115	68.9
	TID	CRM 76.0	105	62.9	69	41.3	123	73.7

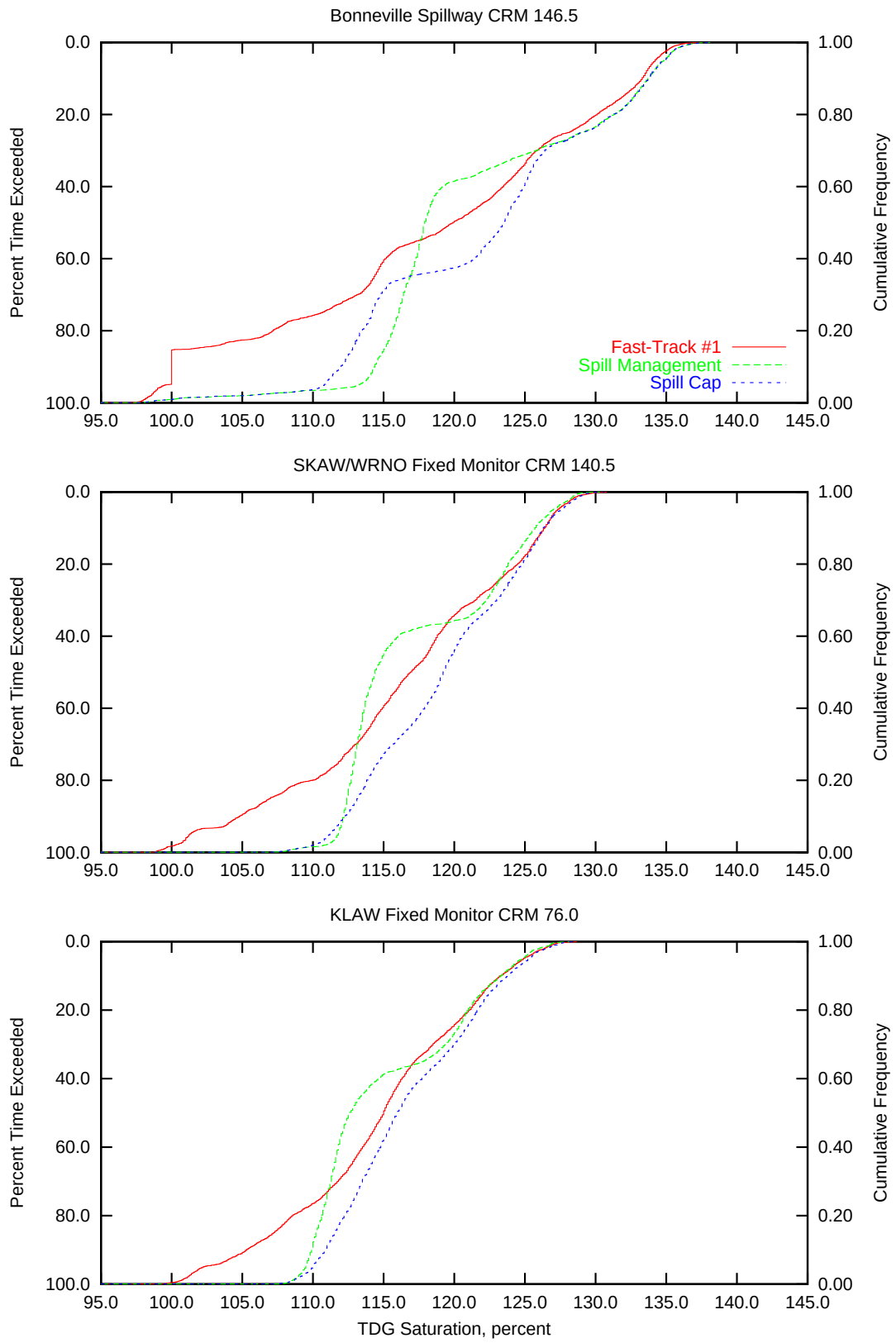

Figure 1.87: Comparision of simulated TDG saturation cumulative frequency distributions for locations in the tidal reach during a high flow (1997) season.

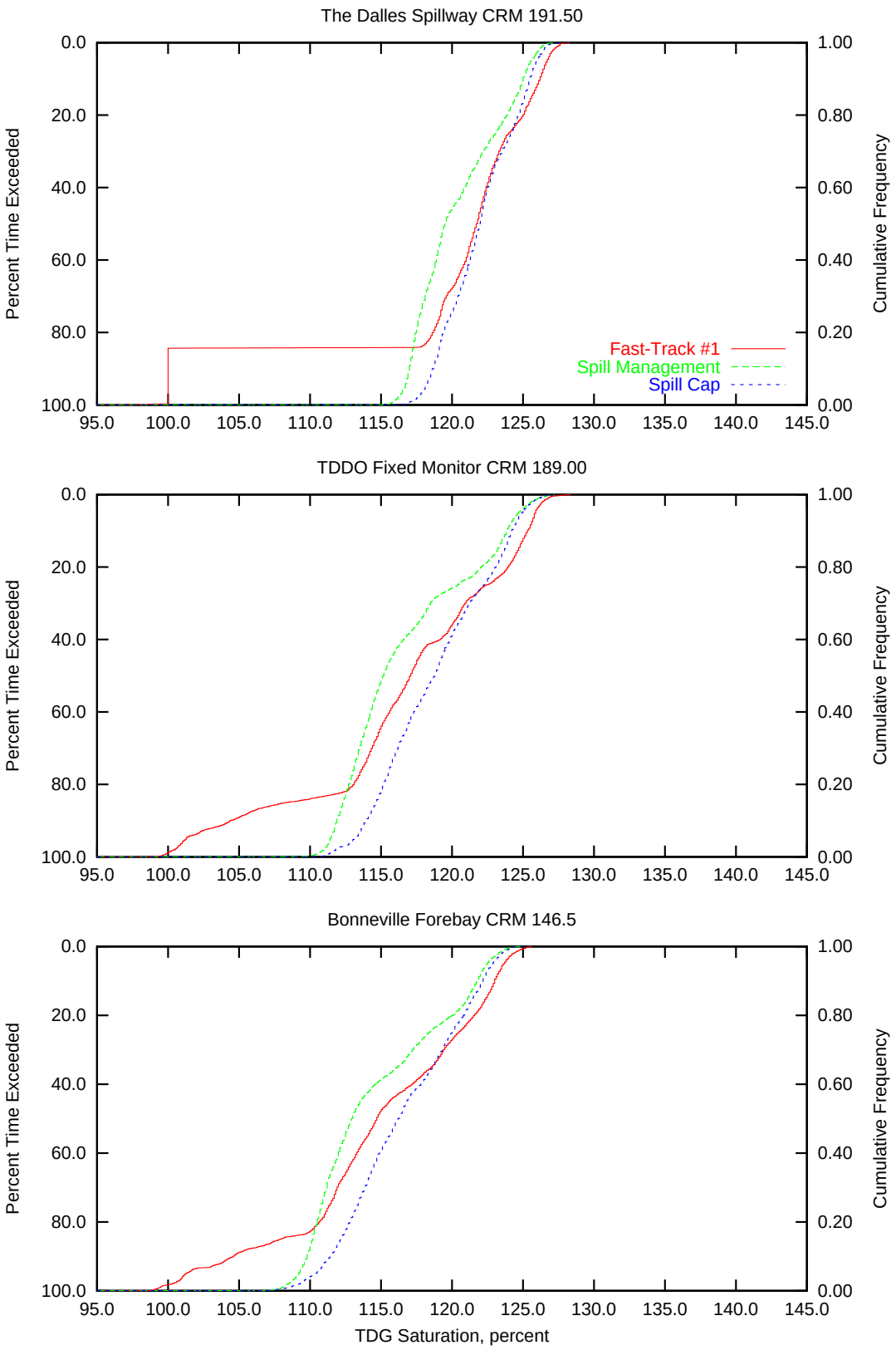

Figure 1.88: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Bonneville pool during a high flow (1997) season.

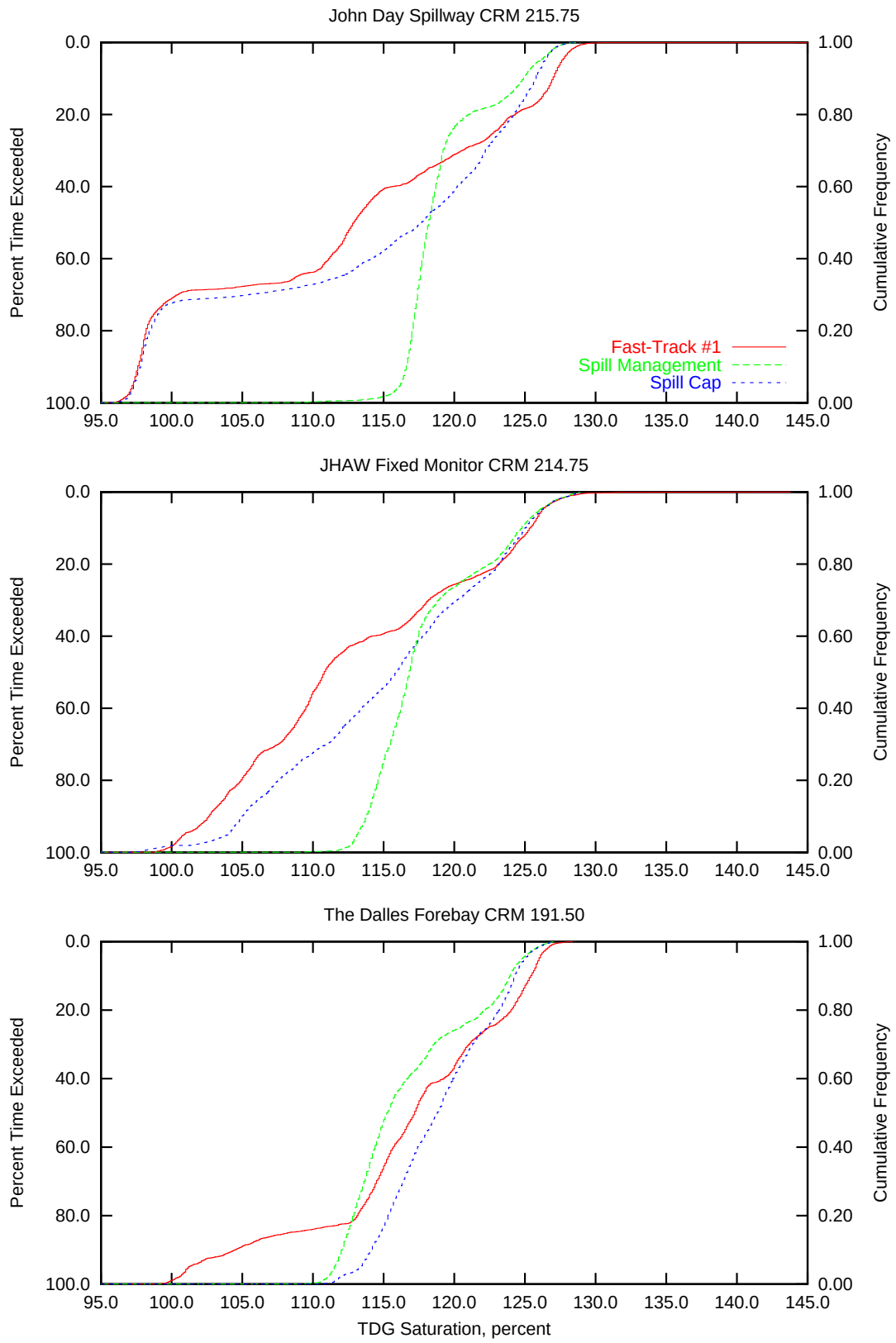

Figure 1.89: Comparision of simulated TDG saturation cumulative frequency distributions for locations in The Dalles pool during a high flow (1997) season.

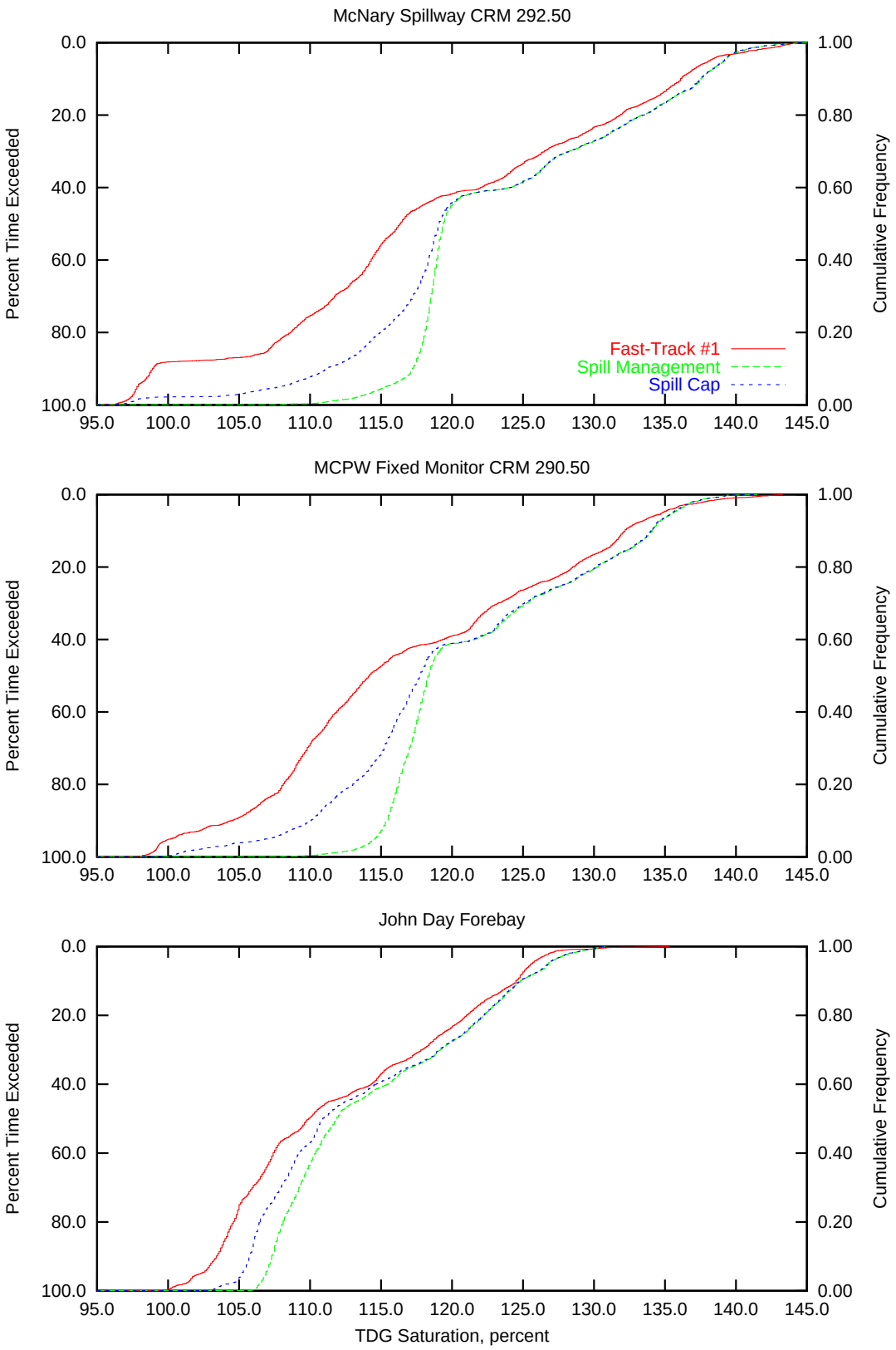

Figure 1.90: Comparision of simulated TDG saturation cumulative frequency distributions for locations in John Day pool during a high flow (1997) season.

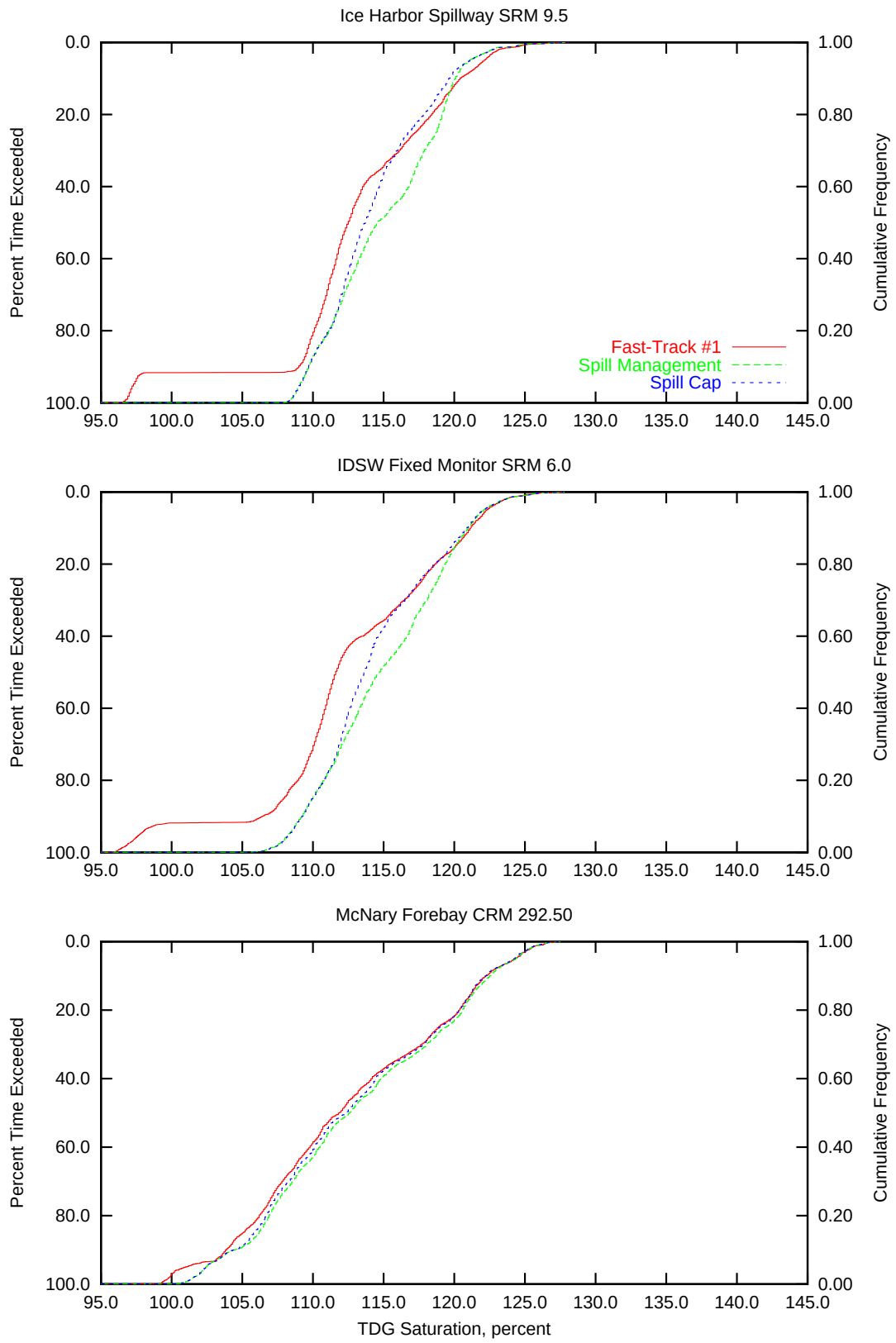

Figure 1.91: Comparision of simulated TDG saturation cumulative frequency distributions for locations in McNary pool during a high flow (1997) season.

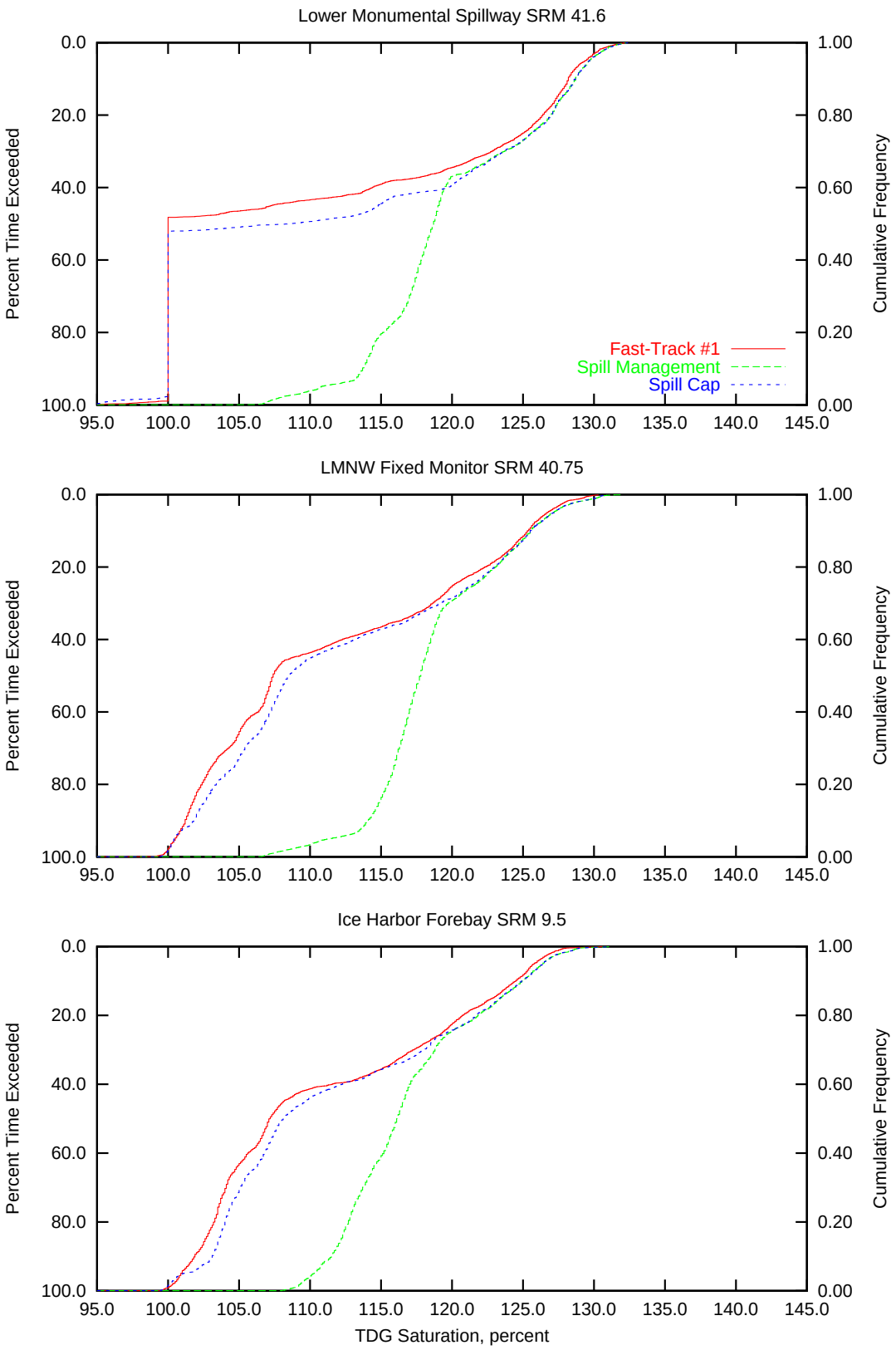

Figure 1.92: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Ice Harbor pool during a high flow (1997) season.

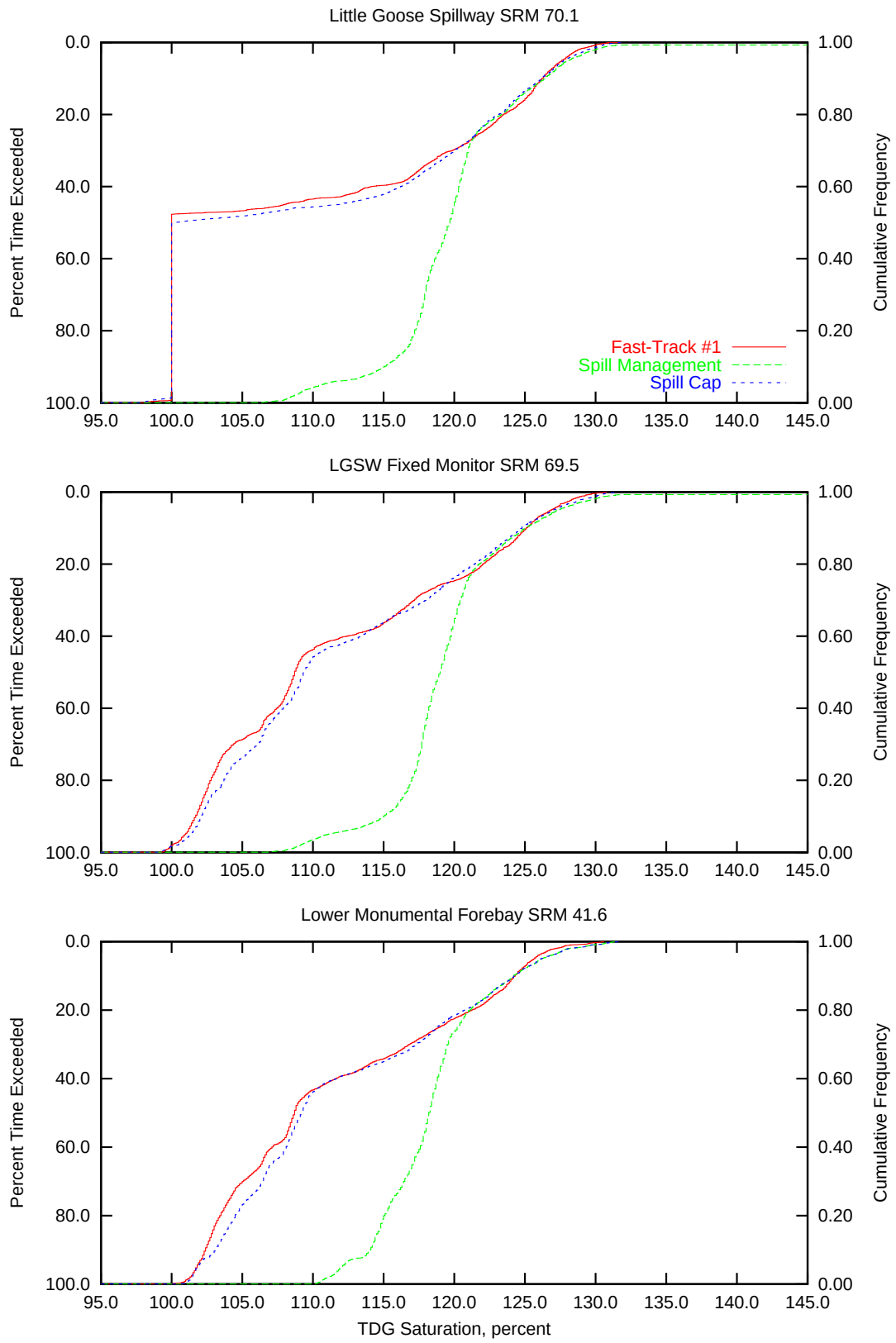

Figure 1.93: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Lower Monumental pool during a high flow (1997) season.

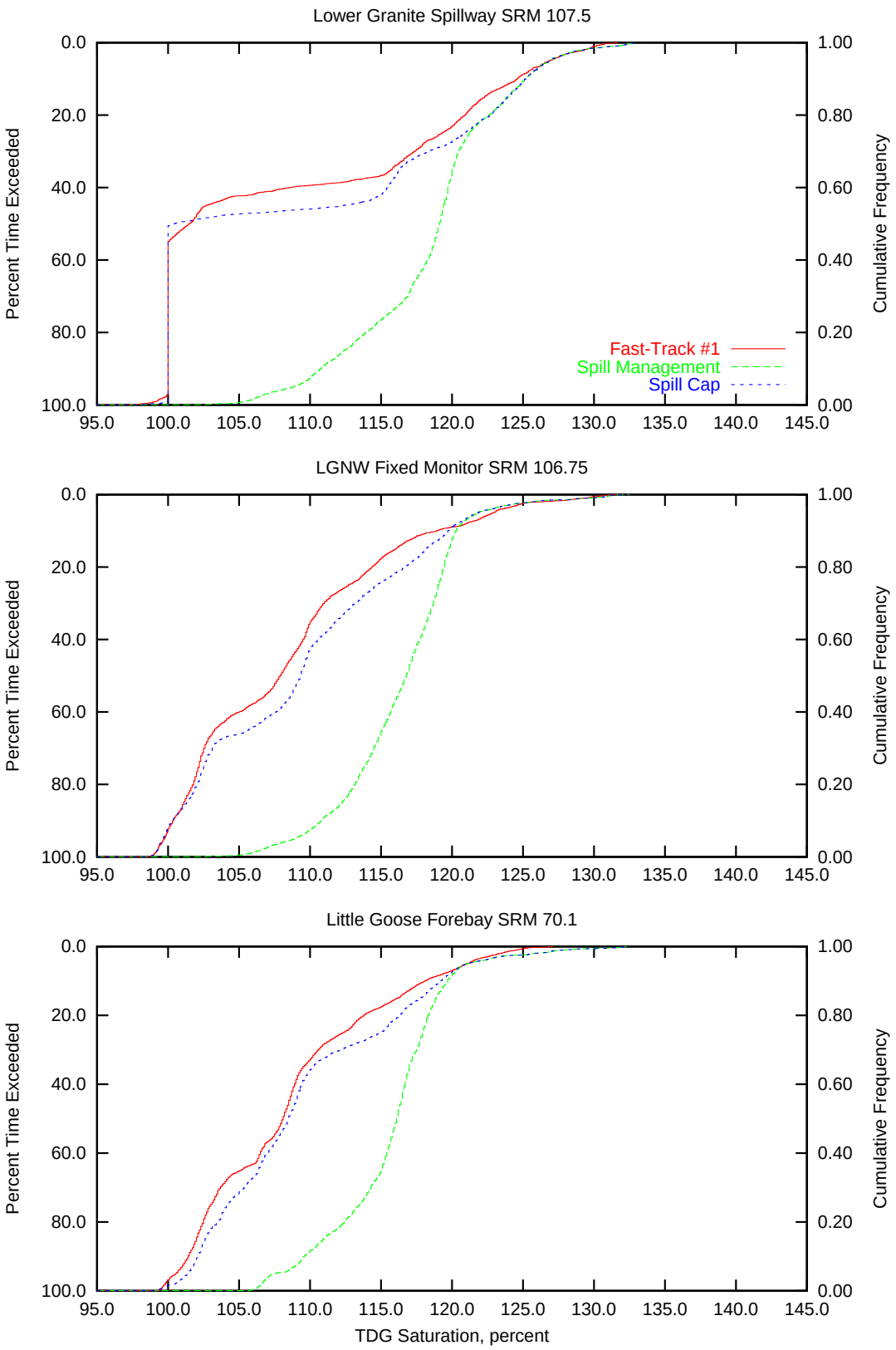

Figure 1.94: Comparision of simulated TDG saturation cumulative frequency distributions for locations in Little Goose pool during a high flow (1997) season.