Summary
8/9/13 4:01:46 PM -07'00'

Differences exist between documents.

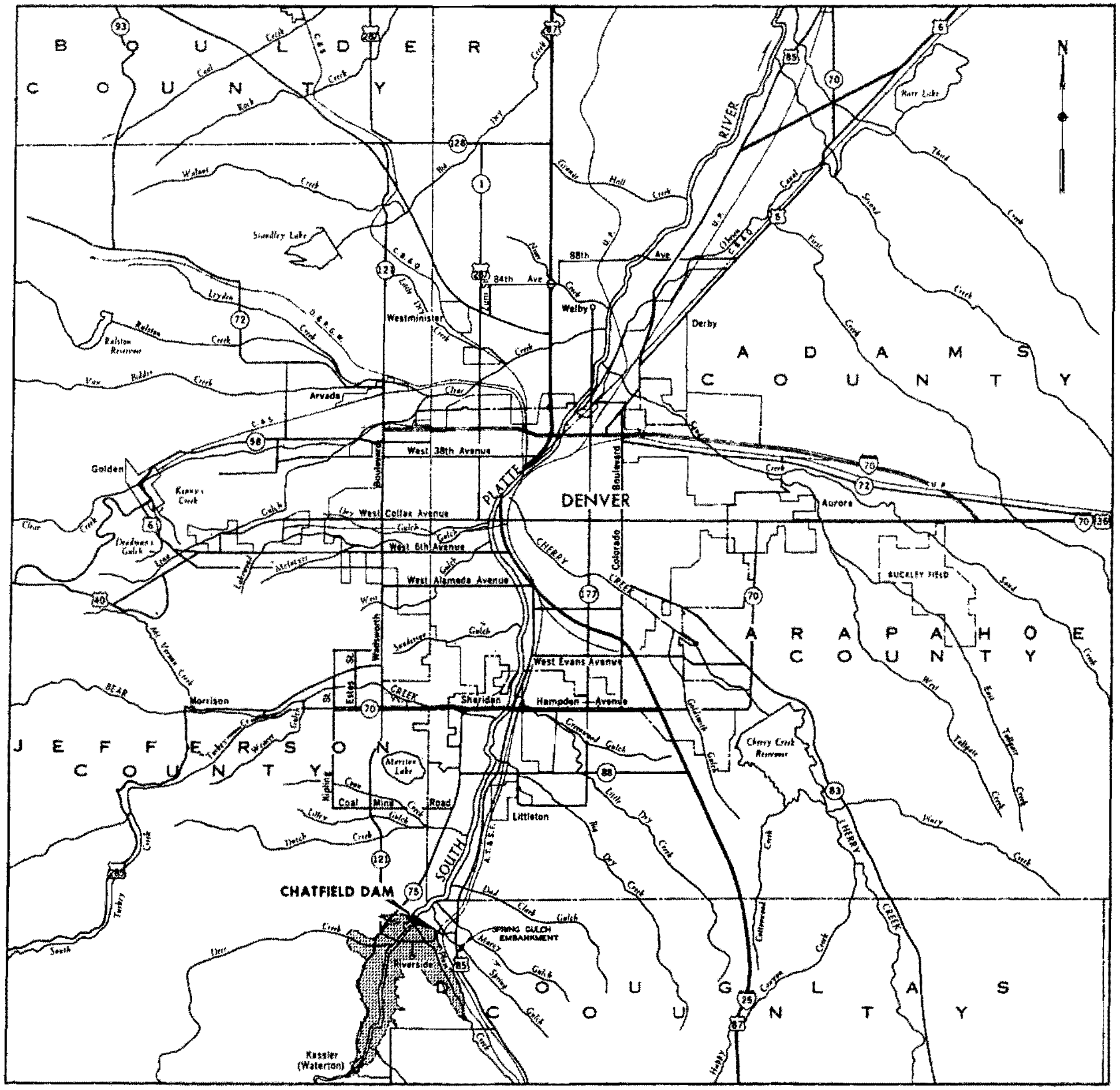
New Document:	Old Document:
FinalEIS	Appendices
87 pages (6.09 MB)	119 pages (7.35 MB)
8/9/13 5:00:32 PM -07'00'	8/9/13 5:00:22 PM -07'00'
Used to display results.	

Get started: first change is on page 35.

No pages were deleted

How to read this report

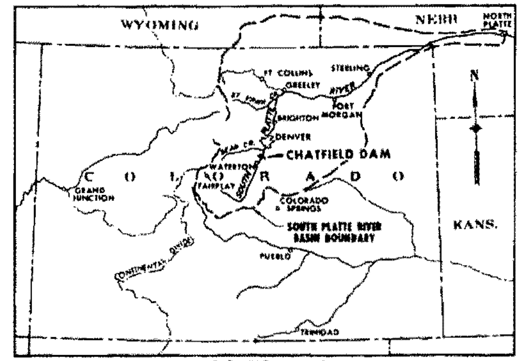
Highlight indicates a change.
~~Deleted~~ indicates deleted content.
 indicates pages were changed.
 indicates pages were moved.



VICINITY MAP

SCALE IN FEET

8000 0 8000 16000 24000



LOCATION MAP

NO SCALE

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SOUTH PLATTE RIVER, COLORADO

CHATFIELD DAM AND RESERVOIR

EARTHWORK – STAGE III

VICINITY AND LOCATION MAPS

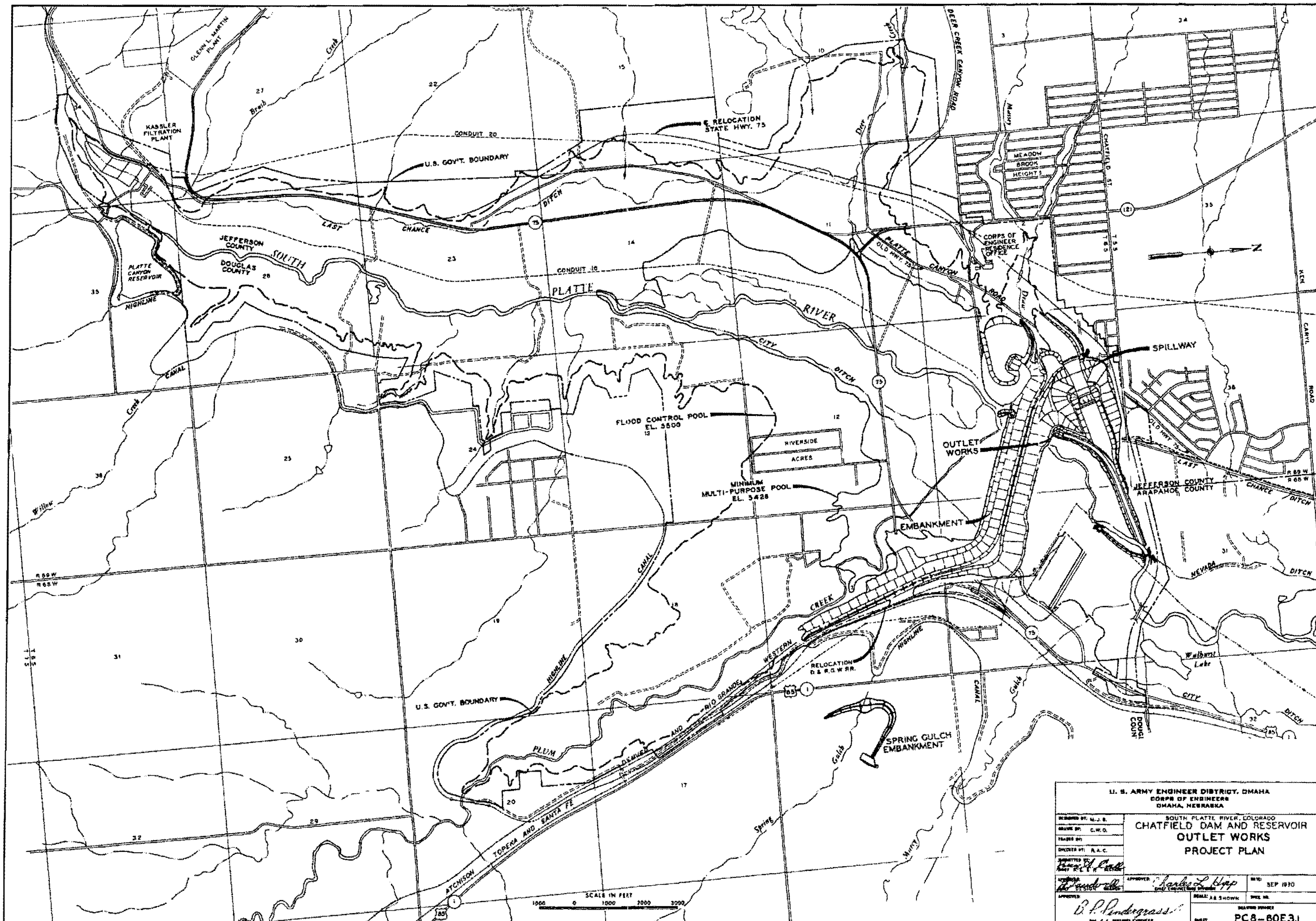
DESIGNED BY: R. J. M.
CHECKED BY: C. V. J.

DATE: JAN. 1970

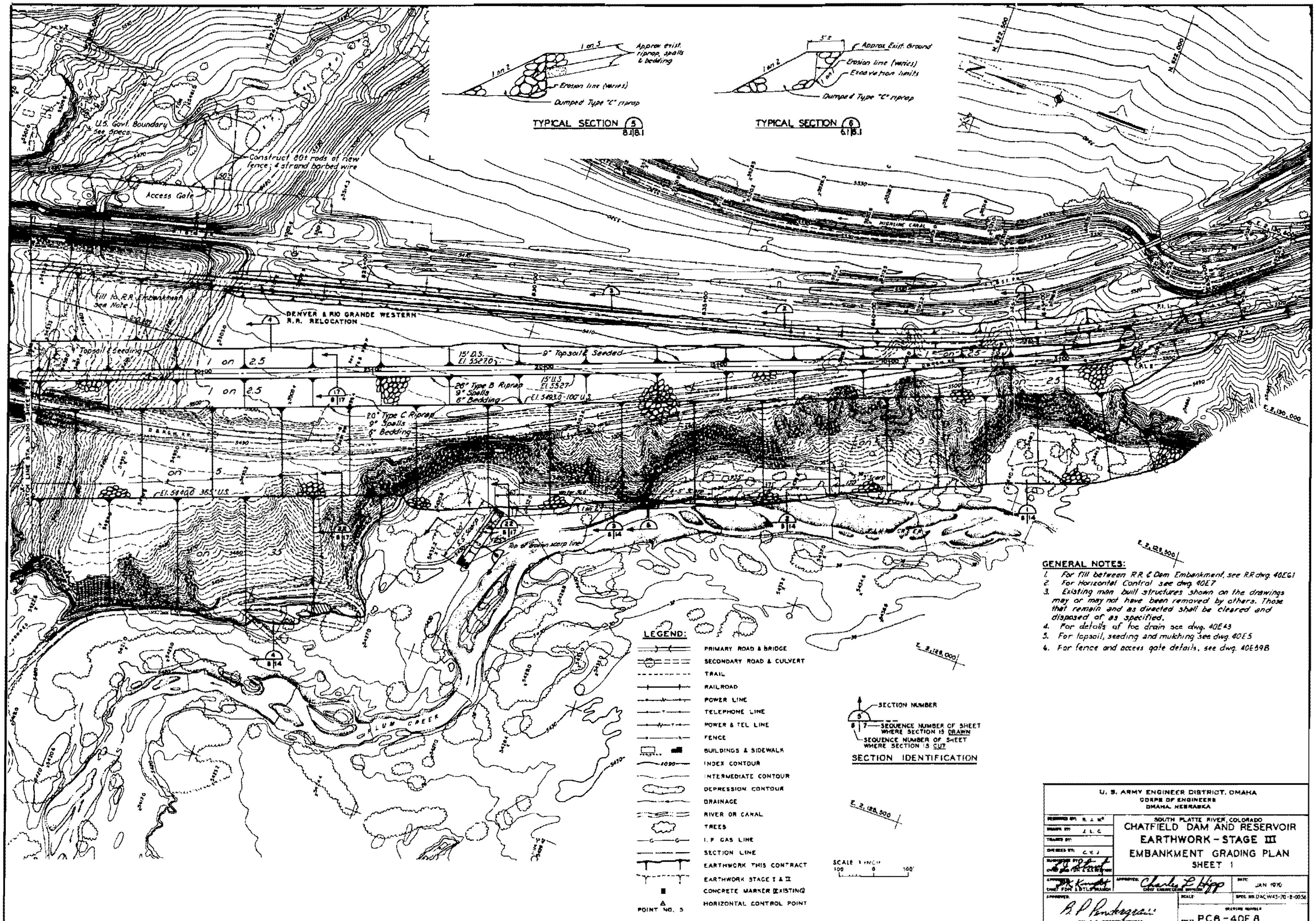
SCALE AS SHOWN

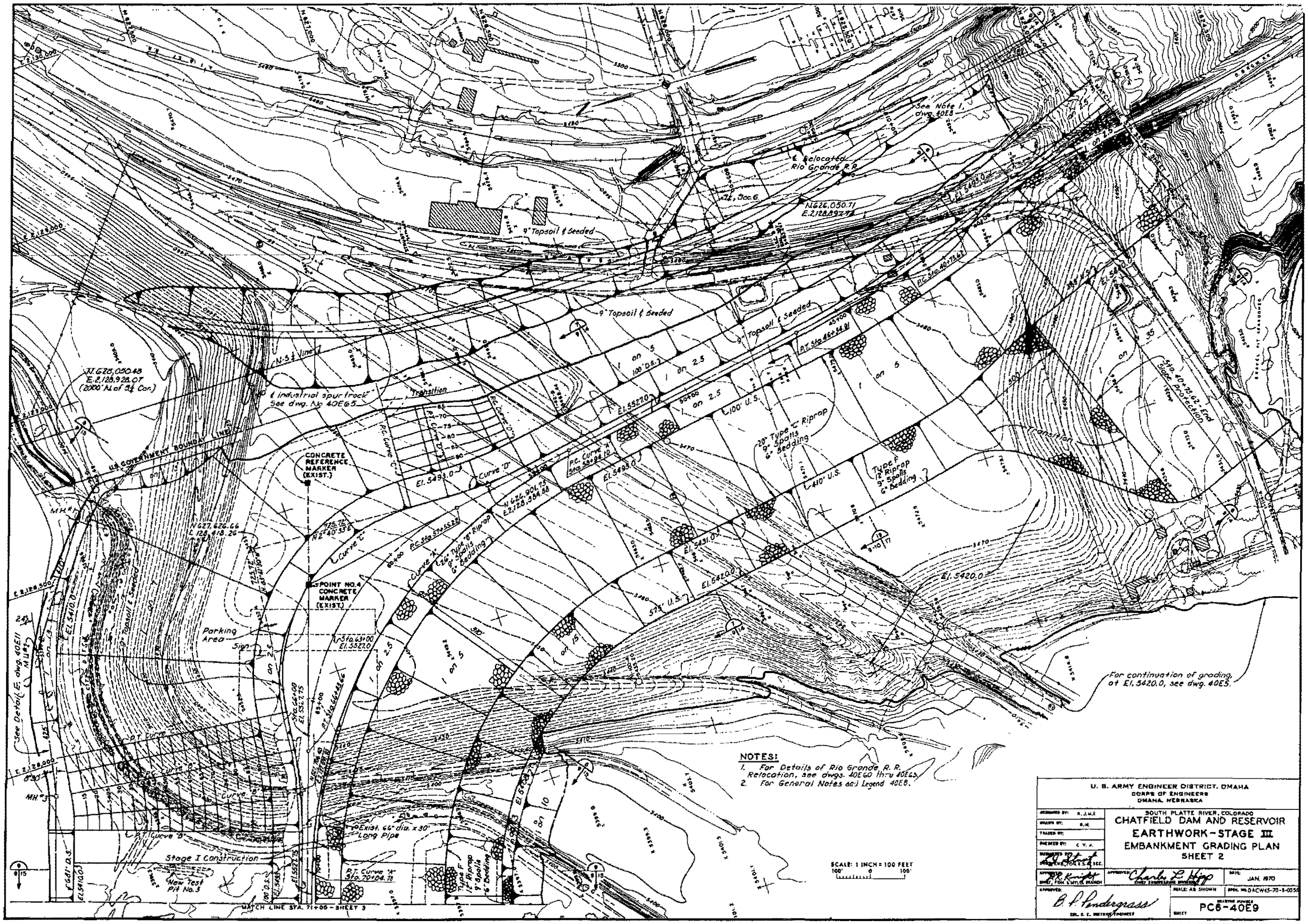
SHEET PC6 – 40E1

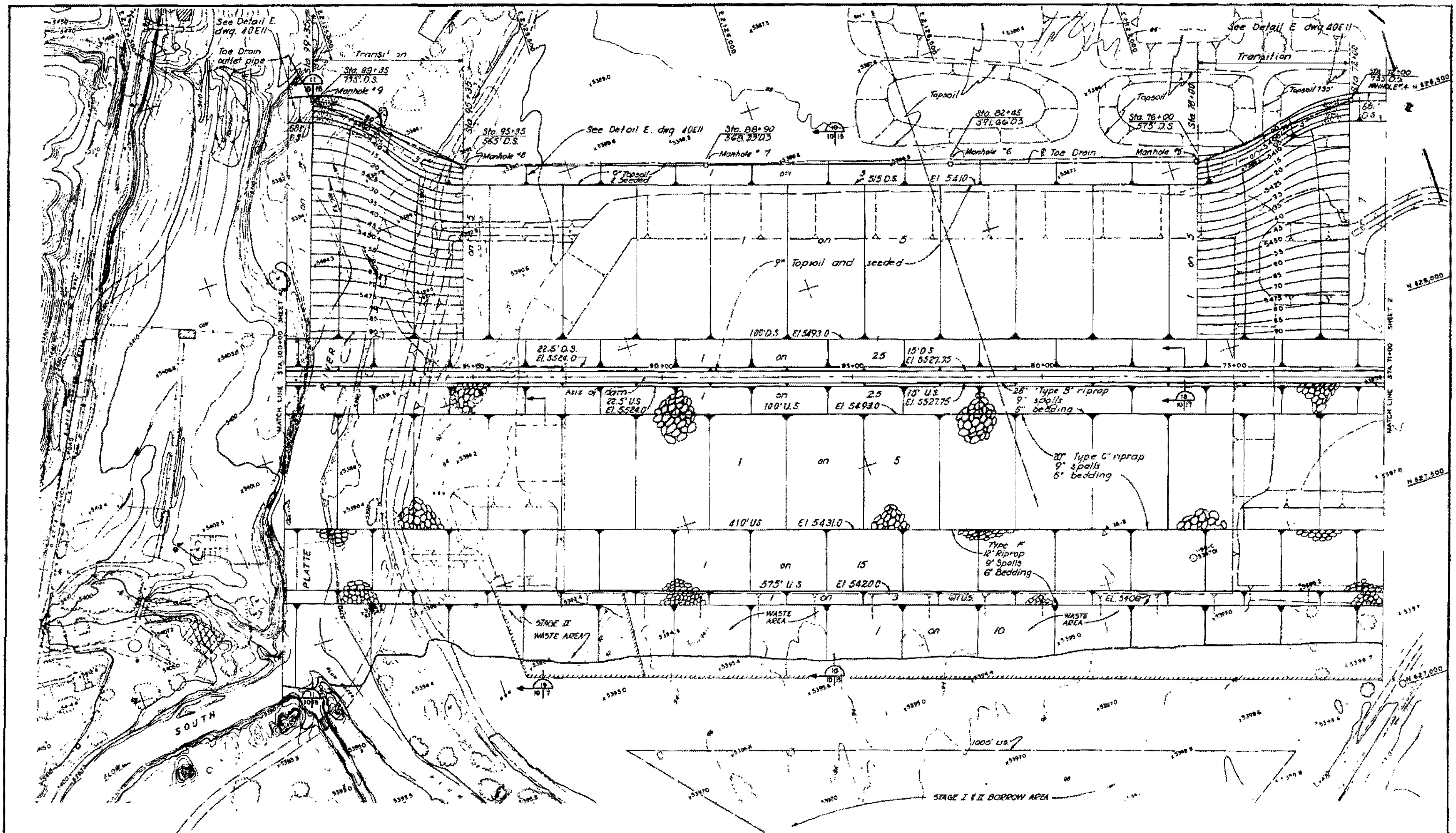
CHATFIELD RE-ALLOCATION STUDY PLATE A-1



CHATFIELD RE-ALLOCATION STUDY PLATE A-2


TYPICAL SECTION 5 8.1|8.1
1 on 3
1 on 2
Approx exist. riprap, spalls & bedding
Erosion line (varies)
Dumped Type "C" riprap
TYPICAL SECTION 6 6.1|6.1
5' ±
Approx Exist Ground
Erosion line (varies)
Excavation limits
Dumped Type "C" riprap
U.S. Govt. Boundary see Specs.
Construct 80± rods of new fence; 4 strand barbed wire
Access Gate
Fill to R.R. Embankment see Note 1
DENVER & RIO GRANDE WESTERN R.R. RELOCATION
HIGHLINE CANAL
Topsoil Seeding
1 on 2.5
15' D.S. El. 5527.0
9" Topsoil & Seeded
15' U.S. El. 5527
26" Type B Riprap 9" Spalls 6" Bedding
El. 5493.0 - 100' U.S.
20" Type C Riprap 9" Spalls 6" Bedding
1 on 5
El. 5490.0 - 365' U.S.
1 on 35
Top of erosion scarp line
PLUM CREEK
E. 2,130,000
E. 2,129,500
E. 2,129,000
E. 2,128,500
N. 822,500
N. 822,000
GENERAL NOTES:
1. For fill between R.R. & Dam Embankment, see R.R. dwg. 40E61
2. For Horizontal Control see dwg. 40E7
3. Existing man built structures shown on the drawings may or may not have been removed by others. Those that remain and as directed shall be cleared and disposed of as specified.
4. For details of toe drain see dwg. 40E43
5. For topsoil, seeding and mulching see dwg. 40E5
6. For fence and access gate details, see dwg. 40E59B
LEGEND:
PRIMARY ROAD & BRIDGE
SECONDARY ROAD & CULVERT
TRAIL
RAILROAD
POWER LINE
TELEPHONE LINE
POWER & TEL LINE
FENCE
BUILDINGS & SIDEWALK
INDEX CONTOUR
INTERMEDIATE CONTOUR
DEPRESSION CONTOUR
DRAINAGE
RIVER OR CANAL
TREES
I.P. GAS LINE
SECTION LINE
EARTHWORK THIS CONTRACT
EARTHWORK STAGE I & II
CONCRETE MARKER (EXISTING)
HORIZONTAL CONTROL POINT
POINT NO. 5
SECTION NUMBER
SEQUENCE NUMBER OF SHEET WHERE SECTION IS DRAWN
SEQUENCE NUMBER OF SHEET WHERE SECTION IS CUT
SECTION IDENTIFICATION
SCALE 1 INCH
100 0 100'
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA
SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EARTHWORK - STAGE III
EMBANKMENT GRADING PLAN
SHEET 1
JAN 1970
PC8 - 40E 8


NOTES:
1. For Details of Rio Grande R.R. Relocation, see dwgs. 40E60 thru 40E63.
2. For General Notes and Legend 40E8.
For continuation of grading, at El. 5420.0, see dwg. 40E5.
U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA
SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EARTHWORK-STAGE III
EMBANKMENT GRADING PLAN
SHEET 2
JAN. 1970
PC6-40E9
SCALE: 1 INCH = 100 FEET
MATCH LINE STA. 71+00 - SHEET 3
Relocated Rio Grande R.R.
9" Topsoil & Seeded
U.S. GOVERNMENT BOUNDARY LINE
CONCRETE REFERENCE MARKER (EXIST.)
POINT NO. 4 CONCRETE MARKER (EXIST.)
Parking Area
Stage I Construction
New Test Pit No. 3
Exist. 66" dia. x 30' Long Pipe
Transition



NOTE:
1. For General Notes and Legend, see dwg. 40E8.

SCALE 1 INCH = 100 FEET

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

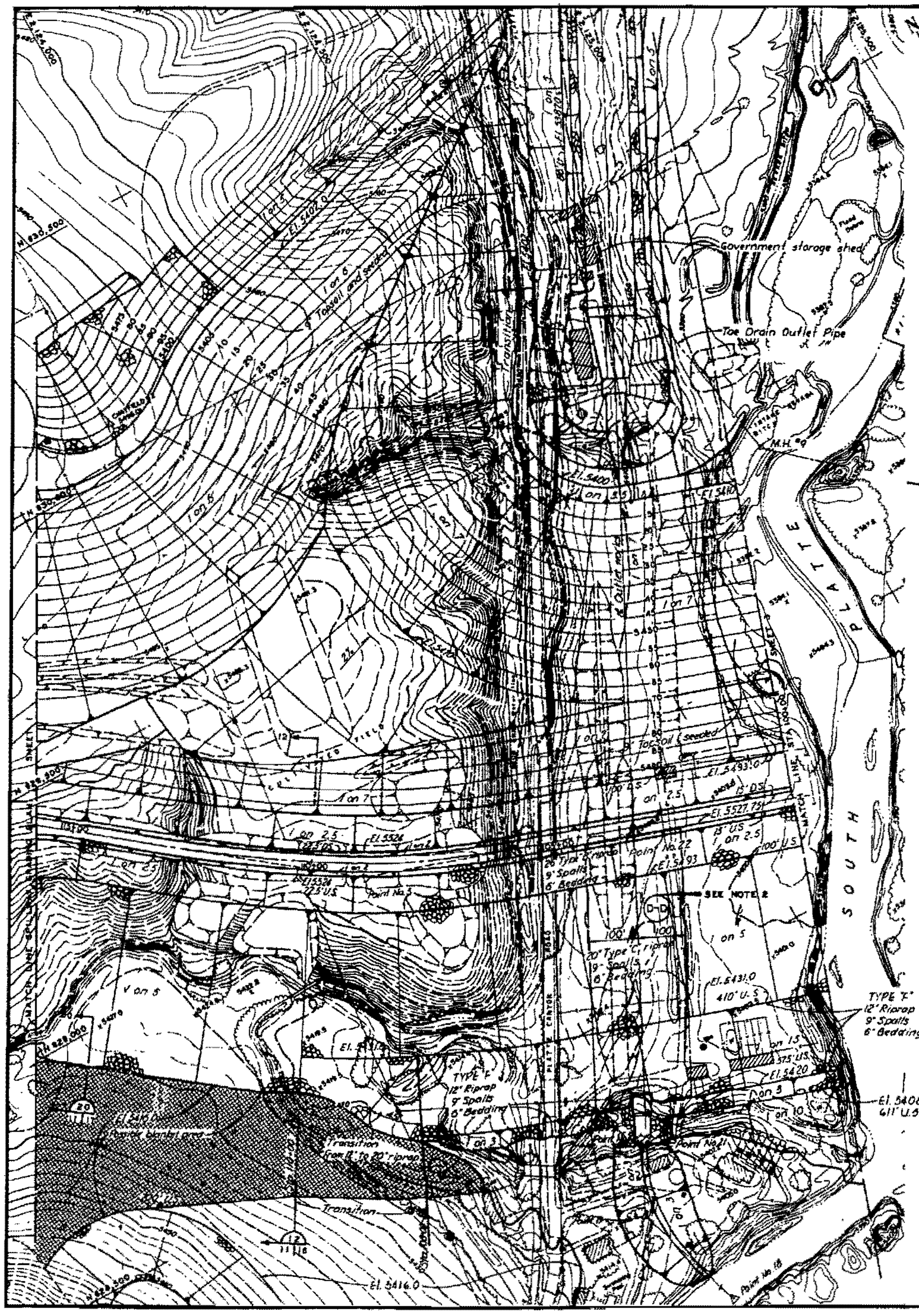
SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EARTHWORK - STAGE III
EMBANKMENT GRADING PLAN
SHEET 3

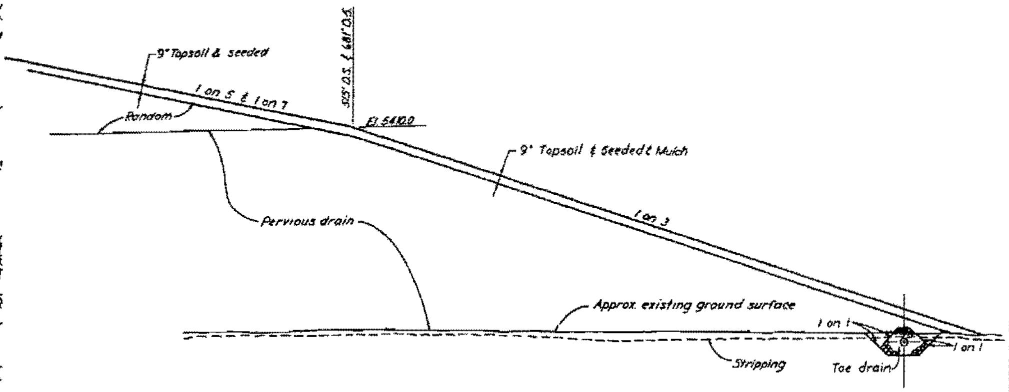
DESIGNED BY: R.J.M.
DRAWN BY: R.L.M.
CHECKED BY: C.K.J.

JAN. 1970

DACW45-70-B-0056

PC6 - 40E10





DETAIL E/11

NOTES:

1. For General Notes and Legend, see dwg 40E8.
2. Area D-D is construction area for Service Bridge by others, see section 1 area use, for coordination of work.
3. For grading of the Downstream Outlet Works channel, see Dwg. E 23.1 P/35.

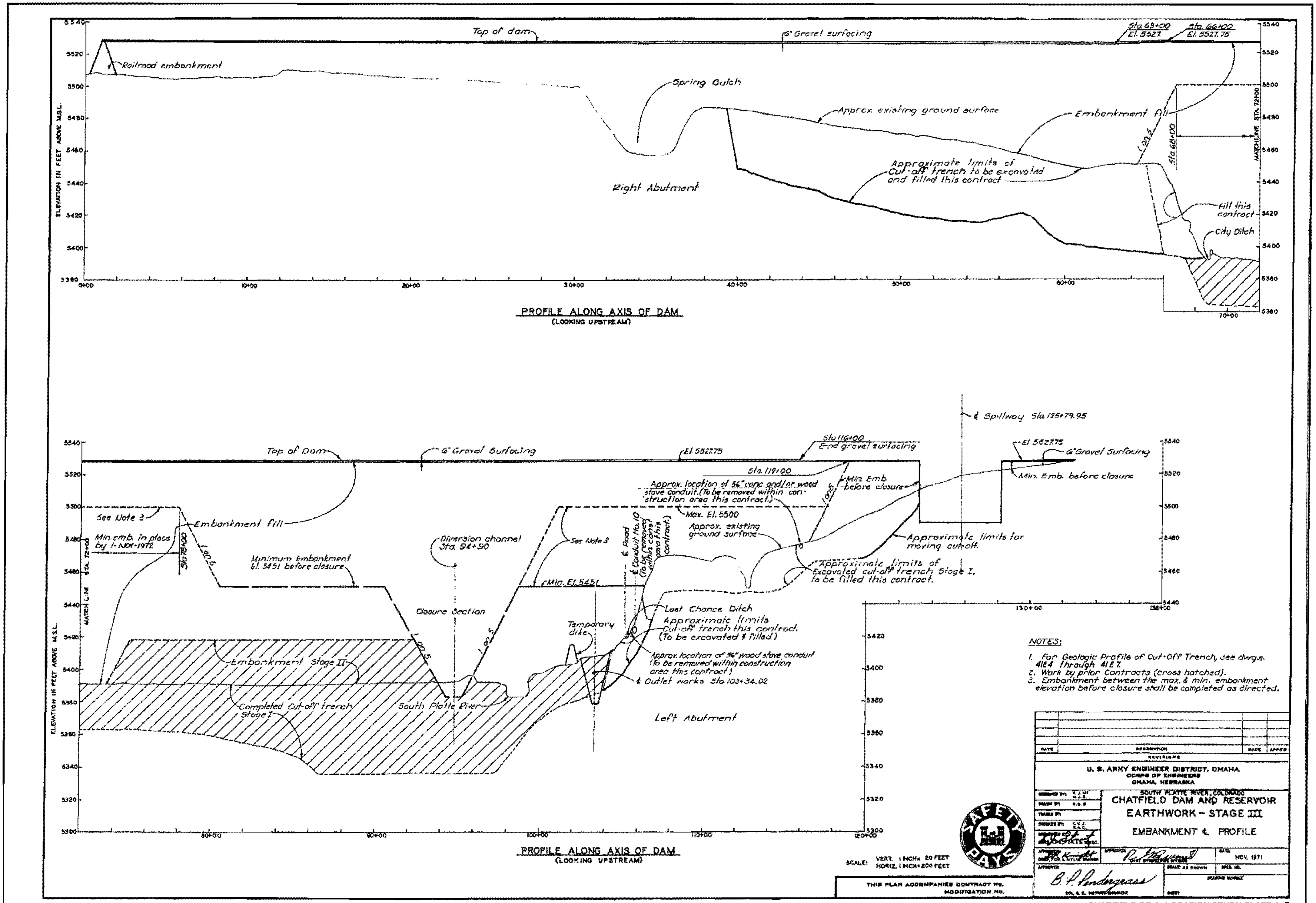
SCALE 1 INCH = 100 FEET
100 0 100

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

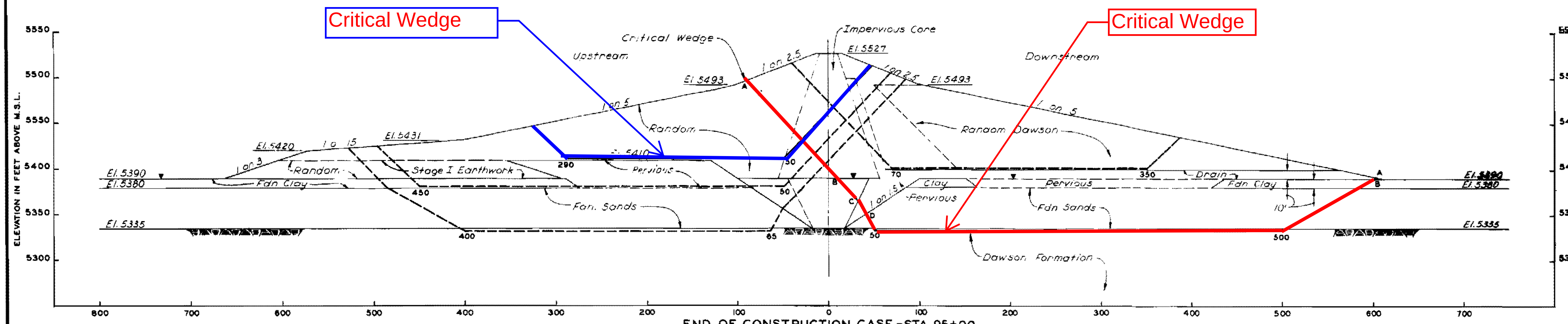
DESIGNED BY: R. J. Mc
DRAWN BY: J. N. W.
TRACED BY:
CHECKED BY: C. V. J.

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EARTHWORK STAGE III
EMBANKMENT GRADING PLAN
SHEET 4

APPROVED: Charles L. Hipp
DATE: JAN. 1970
APPROVED: B. P. Pendergrass
SCALE AS SHOWN
SPEC. NO. DACW45-70-B-0056
DRAWING NUMBER PC6-40E11



CHATFIELD RE-ALLOCATION STUDY PLATE A-7



END OF CONSTRUCTION CASE - STA. 95+00

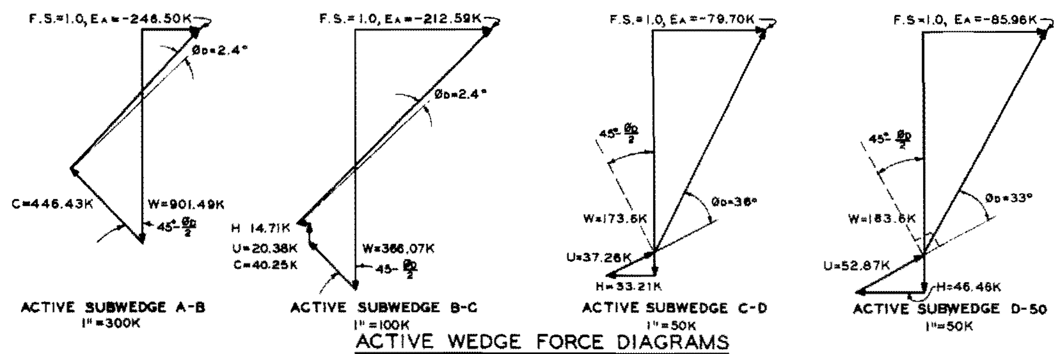
SCALE: 1 INCH = 50 FEET

FACTORS OF SAFETY UPSTREAM				
ELEVATION OF FAILURE PLANE	ACTIVE WEDGE DISTANCE FROM EMB. ℄	PASSIVE WEDGE DISTANCE FROM EMB. ℄	FACTORS OF SAFTY	
			NORMAL	EARTHQUAKE
5410	50	290	2.62	1.82*
5390	50	450	2.71	1.84
5335	65	400	2.64	1.75

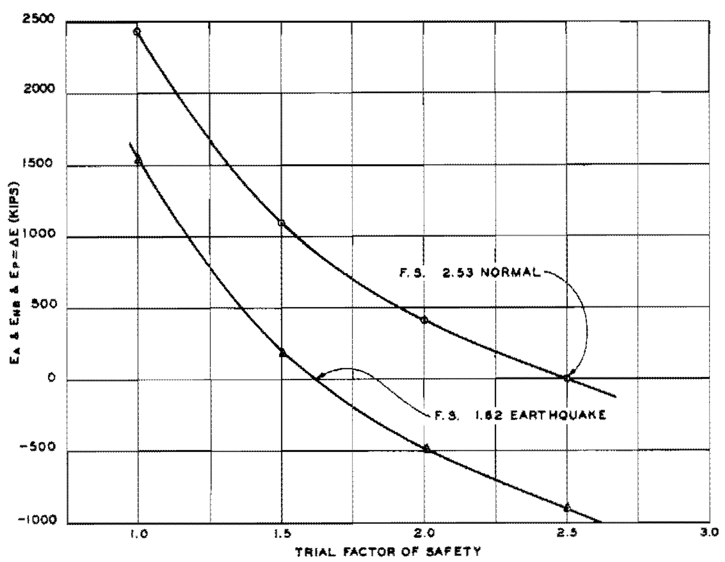
* CRITICAL

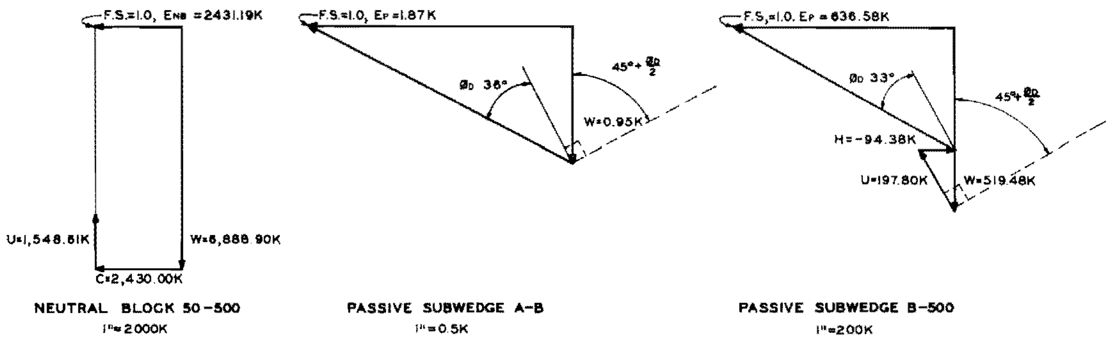
FACTORS OF SAFETY DOWNSTREAM				
ELEVATION OF FAILURE PLANE	ACTIVE WEDGE DISTANCE FROM EMB. ℄	PASSIVE WEDGE DISTANCE FROM EMB. ℄	FACTORS OF SAFETY	
			NORMAL	EARTHQUAKE
5400	70	350	2.67	1.90
5335	50	500	2.53	1.62*

*CRITICAL



ACTIVE WEDGE FORCE DIAGRAMS





NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

NOTES:

1. Net Hydrostatic Force is perpendicular to vertical sides of subwedge or block.
2. Seismic coefficient = 0.1g
3. Wedges and force diagrams shown are for a trial F.S. = 1.0. Failure surfaces and force diagrams are slightly different for other trial F.S.'s due to ϕ_D and c
4. All stability computations performed by RCA 301 Computer - Program No. 41-R3-1302C.
5. Critical wedge shown by solid line.

NOMENCLATURE

W = WEIGHT OF WEDGE OR BLOCK
H = NET HYDROSTATIC FORCE
U = UPLIFT ON FAILURE PLANE
C = (COHESION ÷ TRIAL F.S.) × LENGTH OF PLANE
ϕ_D = ARCTAN TAN ϕ ÷ TRIAL F.S.
F.S. = SHEAR STRENGTH ASSUMED / SHEAR STRENGTH NEEDED FOR EQUILIBRIUM

ADOPTED SHEAR STRENGTH						
MATERIAL	IN PLACE WEIGHT	SAT'D. WEIGHT	SUBM. WEIGHT	UNCONSOLIDATED UNDRAINED - "Q"		
	#/FT³	#/FT	#/FT	TAN Ø	Ø	COH - T/SF
EMBANKMENT						
Impervious	120.0	126.0	63.6	0.042	2.4	1.50
Random	120.0	126.0	63.6	0.042	2.4	1.50
Pervious	130.0	136.0	73.6	0 73	36.1	0 0
Dawson FM.	120.0	126.0	63.6	0.00	0	2.0
FOUNDATION						
Clay		118.0	55.6	0.00	0	0.28
Sand		125.0	62.6	0 65	33.0	0 00
Dawson	130.0	135 0	72.6	0.00	0	2 70

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	MADE	APPR'D

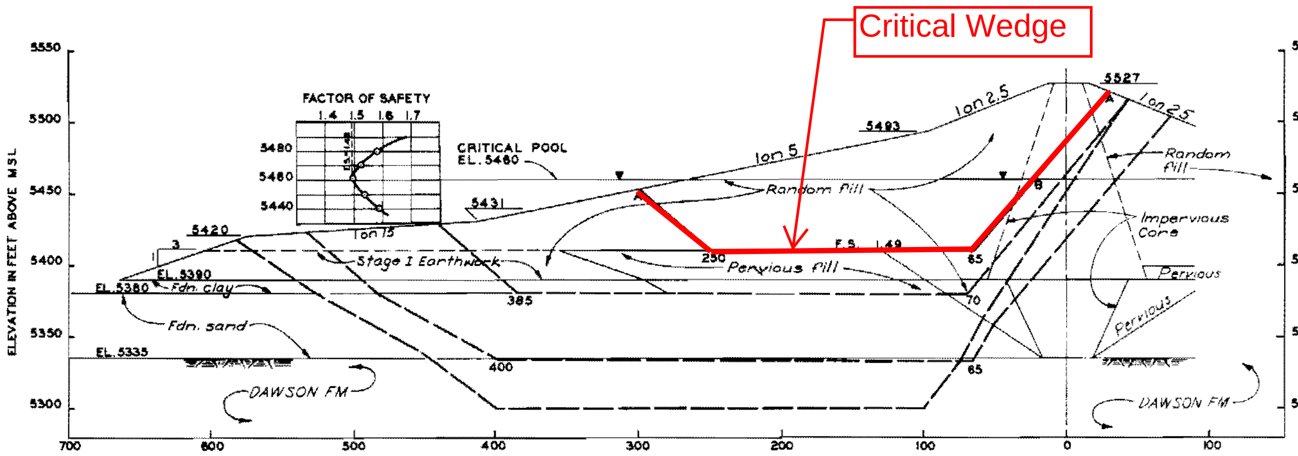
REVISIONS

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
STABILITY ANALYSIS
END OF CONSTRUCTION CASE
STA. 95+00

DESIGNED BY: L G S
DRAWN BY: R G S
TRACED BY:
CHECKED BY: L G S
SUBMITTED BY: CHIEF, EMB., FDN. & GEOL. SEC.
APPROVED: CHIEF, EMB., FDN. & GEOLOGY BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
APPROVED: COL. C. E., DISTRICT ENGINEER
DATE: DEC. 1968
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.



PARTIAL POOL STA. 95+00

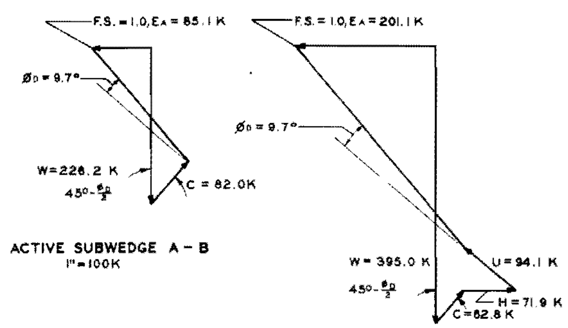
SCALE: 1 INCH = 50 FEET

ELEV. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTORS OF SAFETY POOL ELEVATIONS 5420		5431		5440		5450		5460		5470		5480	
			NORM.	E. Q.	NORM.	E. Q.	NORM.	E. Q.	NORM.	E. Q.	NORM.	E. Q.	NORM.	E. Q.	NORM.	E. Q.
5410	65	250					1.59	1.12	1.53	1.08	1.49*	1.04	1.52	1.04	1.58	1.05
5380	70	385					1.96	1.31	1.95	1.28	1.94	1.25				
5335	65	400					2.09	1.31	2.12	1.30	2.18	1.30	"R" STRENGTH			
5300	100	400	1.78	1.12	1.74	1.08	1.76	1.08	1.79	1.07	1.84	1.07	"S" STRENGTH			

* Critical

ADOPTED DESIGN VALUES FOR EMBANKMENT STABILITY									
MATERIAL	IN PLACE WEIGHT #/FT.³	SAT'D WEIGHT #/FT.³	SUBM. WEIGHT #/FT.³	CONSOLIDATED UNDRAINED "R" TANØ	Ø	COH-T/SF	CONSOLIDATED DRAINED "S" TANØ	Ø	COH-T/SF
EMBANKMENT									
Impervious	120.0	126.0	63.6	0.17	9.7	0.50	0.45	24.3	0.0
Random	120.0	126.0	63.6	0.17	9.7	0.50	0.45	24.3	0.0
Pervious	130.0	136.0	73.6	0.73	36.1	0.00	0.73	36.1	0.0
Dawson Fm.	120.0	126.0	63.6	0.20	11.3	0.40	0.41	22.3	0.0
FOUNDATION									
Clay		118.0	55.6	0.15	8.5	0.30	0.38	20.8	0.0
Sand		125.0	62.6	0.65	33.0	.00	0.65	33.0	0.0
Dawson	130.0	135.0	72.6	0.35	19.3	0.40	0.27*	15.0*	0.0*

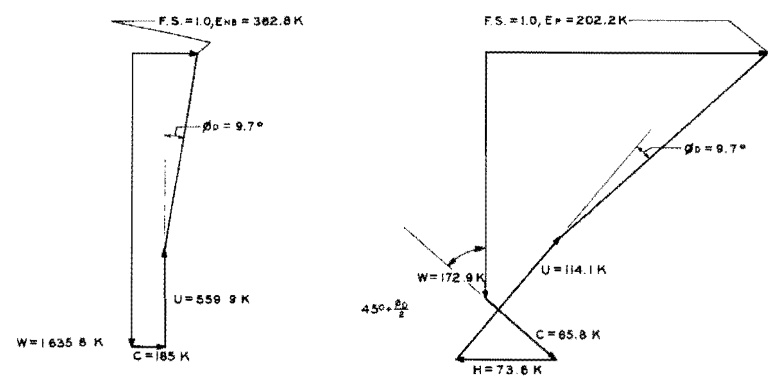
* Used in lieu of 'S' strength



ACTIVE SUBWEDGE A – B
1" = 100K

ACTIVE SUBWEDGE B – 65
1" = 100 K

ACTIVE WEDGE FORCE DIAGRAMS



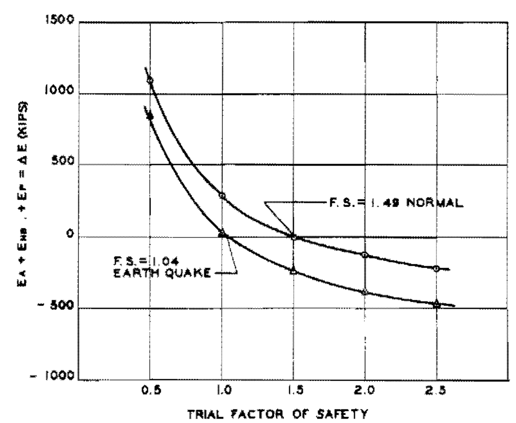
NEUTRAL BLOCK 65 – 250
1" = 400K

PASSIVE WEDGE A = 250
1" = 50K

NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

NOTES:
For notes see plate B-73

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.



NOMENCLATURE

- W = WEIGHT OF WEDGE OR BLOCK
- H = NET HYDROSTATIC FORCE
- U = UPLIFT ON FAILURE PLANE
- C = (COHESION ÷ TRIAL F.S.) × LENGTH OF PLANE
- $Ø_D$ = ARCTAN TAN Ø ÷ TRIAL F.S.
- F.S. = $\frac{\text{SHEAR STRENGTH ASSUMED}}{\text{SHEAR STRENGTH NEEDED FOR EQUILIBRIUM}}$

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

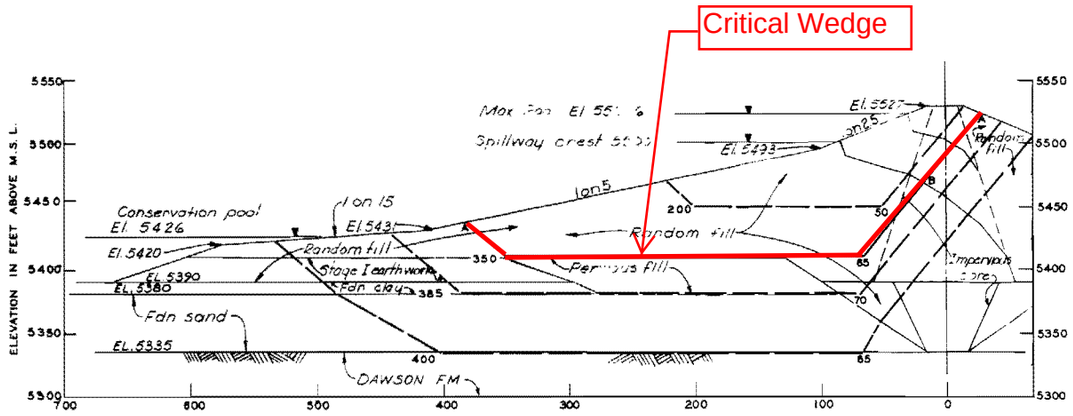
DATE	DESCRIPTION	MADE	APPR'D
REVISIONS			

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: L.G.S
DRAWN BY: J.M.F
TRACED BY:
CHECKED BY: L.G.S
SUBMITTED BY: [illegible] CHIEF, EMB. FDN. & S. SEC.
APPROVED: [illegible] CHIEF, FDN'S MTL'S BRANCH
APPROVED: [illegible] CHIEF, ENGINEERING DIVISION
APPROVED: [illegible] COL. C. E., DISTRICT ENGINEER

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
STABILITY ANALYSIS
PARTIAL POOL CASE
STA. 95+00

DATE: DEC 1968
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

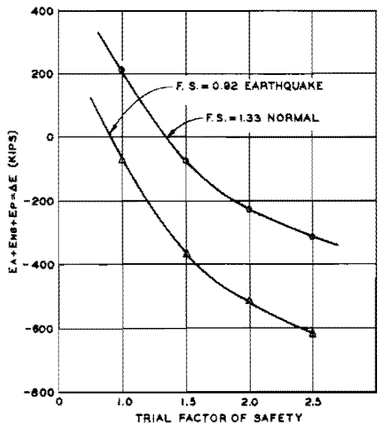


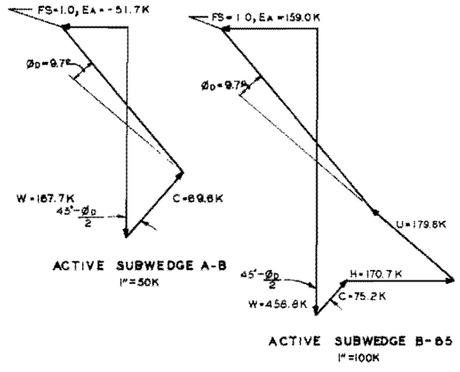
SUDDEN DRAWDOWN STA. 95+00

SCALE: 1 INCH = 50 FEET

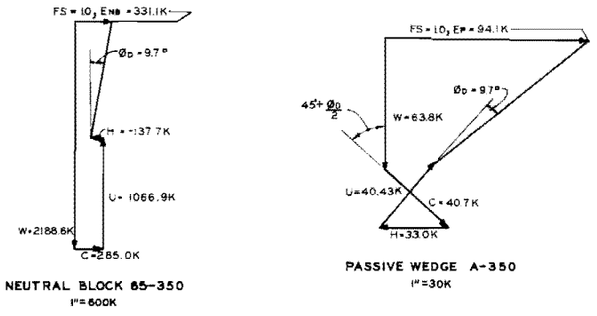
FACTORS OF SAFETY						
EL. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTORS OF SAFETY CREST NORMAL	CREST E.Q.	MAX. NORMAL	MAX. E.Q.
5450	50	200	1.57	1.12	1.50	–
5410	65	350	1.33*	0.92	1.23	–
5380	70	385	1.56	1.05	1.47	–
5335	65	400	1.78	1.14	1.68	–
Req'd F.S.			1.20	1.0	1.0	–

*Critical





ACTIVE WEDGE FORCE DIAGRAMS



NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

ADOPTED SHEAR STRENGTHS						
MATERIAL	IN PLACE WEIGHT #/FT³	SAT'D WEIGHT #/FT³	SUBM WEIGHT #/FT³	CONSOLIDATED UNDRAINED "R" TAN Ø	Ø	COH. T/SF
EMBANKMENT						
Impervious	120.0	126.0	63.6	0.17	9.7	0.50
Random	120.0	126.0	63.6	0.17	9.7	0.50
Pervious	130.0	136.0	73.6	0.73	36.1	0.00
Dawson FM.	120.0	126.0	63.6	0.20	11.3	0.40
FOUNDATION						
Clay		118.0	55.6	0.15	8.5	0.30
Sand		125.0	62.6	0.65	33.0	0.00
Dawson	130.0	135.0	72.6	0.35	19.3	0.40

NOMENCLATURE

W = WEIGHT OF WEDGE OR BLOCK
H = NET HYDROSTATIC FORCE
U = UPLIFT ON FAILURE PLANE
C = (COHESION + TRIAL F.S.) × LENGTH OF PLANE
Øp = ARCTAN TAN Ø ÷ TRIAL F.S.
F.S. = SHEAR STRENGTH ASSUMED / SHEAR STRENGTH NEEDED FOR EQUILIBRIUM

NOTE:
1. For notes, see plate B-73

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	MADE	APPRD
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

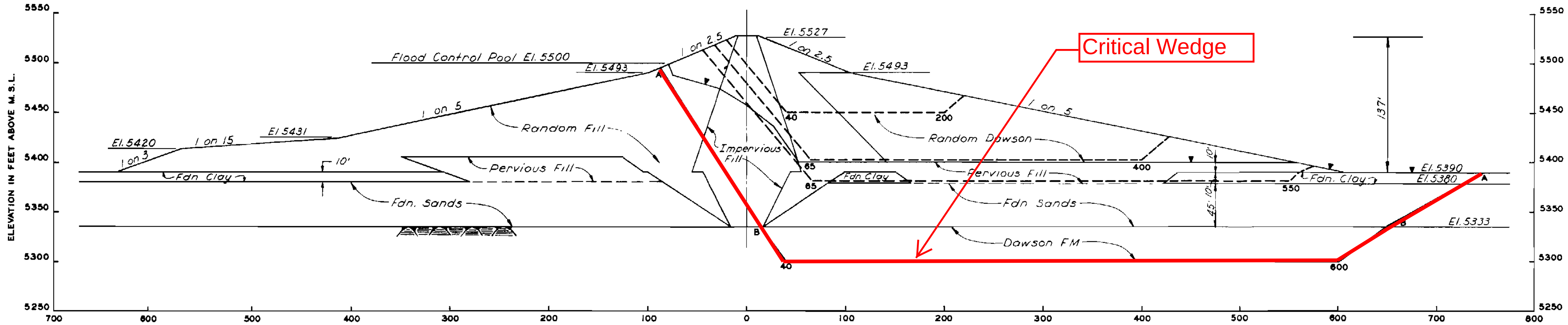
SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION

STABILITY ANALYSIS
SUDDEN DRAWDOWN CASE
STA. 95+00

DESIGNED BY: L G S
DRAWN BY: R G B
TRACED BY:
CHECKED BY: L G S
SUBMITTED BY: CHIEF, ENGINEERING SECTION
APPROVED: CHIEF, ENGINEERING DIVISION
APPROVED: CHIEF, ENGINEERING DIVISION
DATE: DEC. 1965
APPROVED: COL. U. S. ARMY, DISTRICT ENGINEER
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

SAFETY DAYS

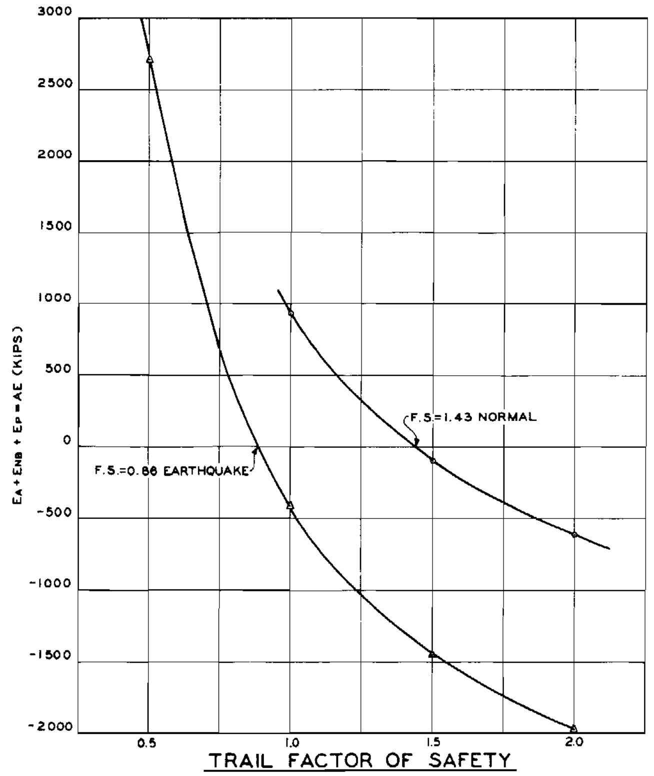


STEADY SEEPAGE STA. 95+00

SCALE: 1 INCH = 50 FEET

EL. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTORS OF SAFETY R. STRENGTH NORMAL	R. STRENGTH E.Q.	S. STRENGTH NORMAL	S. STRENGTH E.Q.	AVERAGE NORMAL	AVERAGE E.Q.
5450	40 65	200 315	1.82	1.32	1.84	1 34	1 83	1 83
5400	65 85	400 565	1.63	1.13	2.13	1.48	1.88	1.31
5380	65	550	2.49	1 68	2.73	1.84	2.61	1 76
5300	40	600	1.98	1.26	* 1 43	0.86		

* Critical



APOPTED SHEAR STRENGTHS									
MATERIAL	IN PLACE WEIGHT #/FT.³	SAT'D. WEIGHT #/FT.³	SUBM. WEIGHT #/FT.³	CONSOLIDATED UNDRAINED - "R" TAN Ø	Ø	COH-T/SF	CONSOLIDATED DRAINED - "S" TAN Ø	Ø	COH-T/SF
EMBANKMENT									
Impervious	120 0	126.0	63.6	0.17	9.7	0.50	0.45	24.3	0.0
Random	120 0	126 0	63.6	0.17	9.7	0.50	0.45	24.3	0 0
Pervious	130.0	136.0	73.6	0.73	36.1	0.00	0.73	36.1	0.0
Dawson FM.	120.0	126.0	63.6	0.20	11.3	0.40	0 41	22.3	0.0
FOUNDATION									
Clay		118.0	55 6	0.15	8 5	0.30	0.38	20.8	0.0
Sand		125.0	62.6	0.65	33.0	00	0.65	33.0	0.0
Dawson	130.0	135 0	72.6	0.35	19.3	0.40	0.27*	15.0*	0.0 *

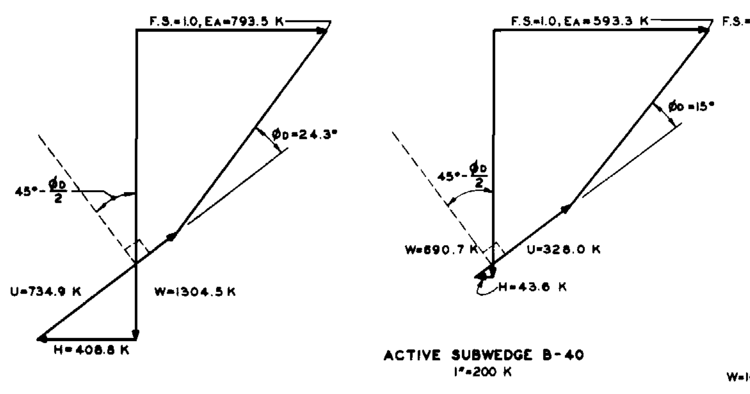
* Used in lieu of "s" strength

NOMENCLATURE

W = WEIGHT OF WEDGE OR BLOCK
H = NET HYDROSTATIC FORCE
U = UPLIFT ON FAILURE PLANE
C = (COHESION + TRIAL F.S.) x LENGTH OF PLANE
ϕ_D = ARCTAN TAN Ø + TRIAL F.S.
F.S. = SHEAR STRENGTH ASSUMED / SHEAR STRENGTH NEEDED FOR EQUILIBRIUM

NOTE:
1. For notes, see plate B-73

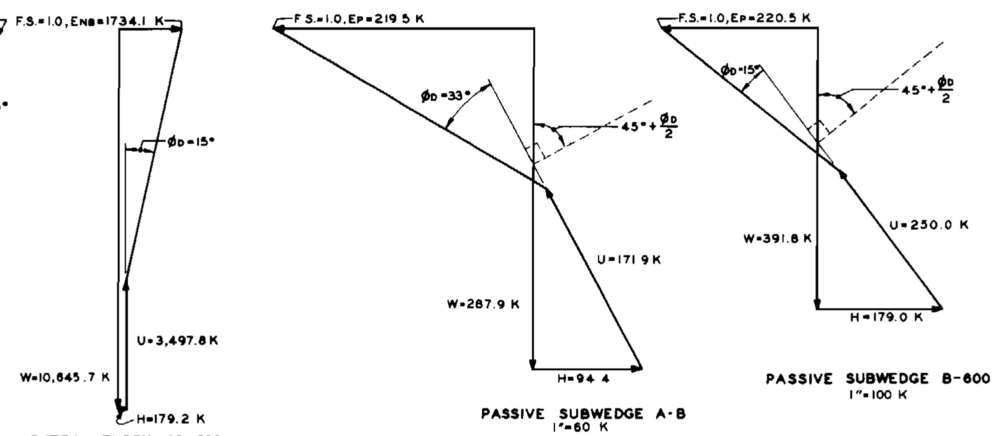
THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.



ACTIVE SUBWEDGE A-B
1"=300 K

ACTIVE SUBWEDGE B-40
1"=200 K

ACTIVE WEDGE FORCE DIAGRAMS



NEUTRAL BLOCK 40-600
1"=2000 K

PASSIVE SUBWEDGE A-B
1"=60 K

PASSIVE SUBWEDGE B-600
1"=100 K

NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

DATE	DESCRIPTION	MADE	APPR'D

REVISIONS

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

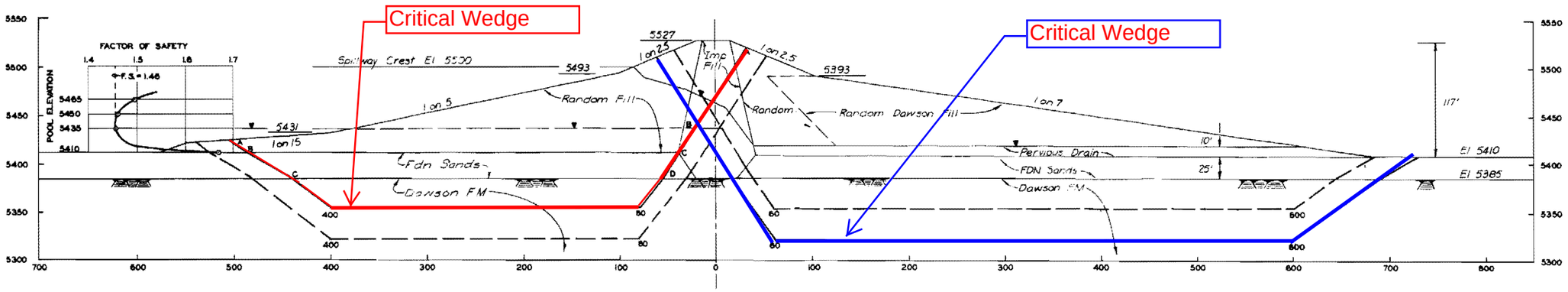
DESIGNED BY: L. G. S.
DRAWN BY: R. H.
TRACED BY:
CHECKED BY: L. G. S.
SUBMITTED BY: [illegible]
CHIEF, EMB., FDN. & S.A. SEC.
APPROVED: B.K. Knight
CHIEF, FDN & MTLS. BRANCH
APPROVED: Charles L. Hipp
CHIEF ENGINEERING DIVISION
APPROVED: [illegible]
COL. C. E., DISTRICT ENGINEER

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
STABILITY ANALYSIS
STEADY SEERAGE CASE
STA. 95+00

DATE: DEC 1968
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

CHATFIELD RE-ALLOCATION STUDY PLATE B-4



PARTIAL POOL AND STEADY SEEPAGE - "S" STRENGTHS

OUTLET WORKS STA. 104 + 35

SCALE: 1 INCH = 50 FEET

50' 0 50'

FACTORS OF SAFETY UPSTREAM
PARTIAL POOL - "S" STRENGTH

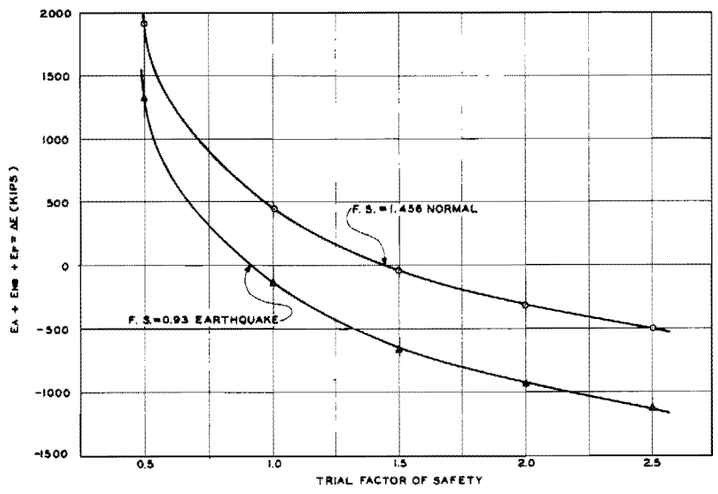
EL. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTORS OF SAFETY							
			POOL ELEVATION							
			5465		5450		5435		5410	
			NORM	E.Q.	NORM	E.Q.	NORM	E.Q.	NORM	E.Q.
5353	80	400	1.495	0.88	1.460	0.90	#1.456	#0.93	1.67	1.08
5320	100	400	1.57	0.90	1.51	0.91	—	—	1.64	1.05
Req'd. F.S.			1.50	1.0						

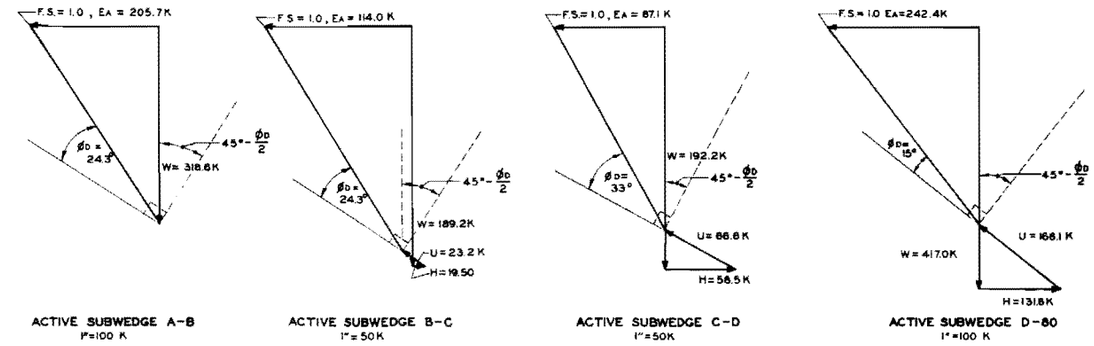
* Critical

FACTORS OF SAFETY DOWNSTREAM
STEADY SEEPAGE - "S" STRENGTH

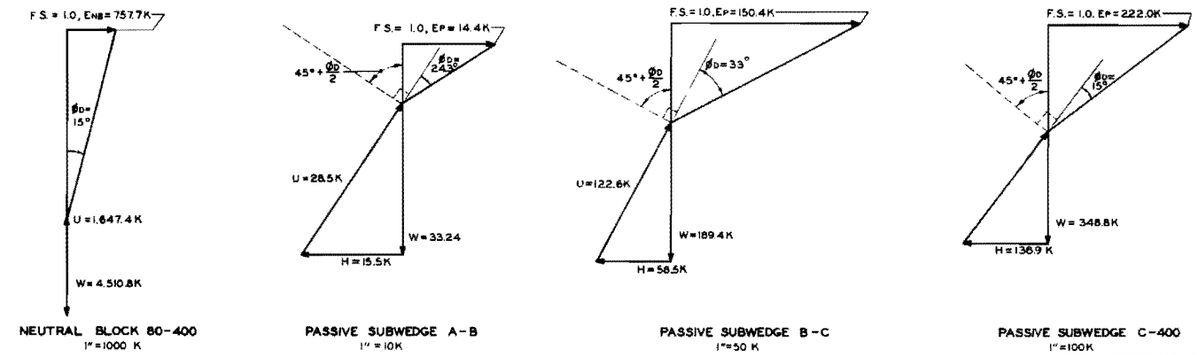
EL. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTORS OF SAFETY	
			NORMAL	E.Q.
5353	60	600	1.62	0.96
5320	60	600	1.58 *	0.92 *
Req'd. F.S.			1.50	1.0

* Critical





ACTIVE WEDGE FORCE DIAGRAMS



NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

ADOPTED SHEAR STRENGTH

MATERIAL	IN PLACE WEIGHT		SAT'D WEIGHT		SUBM. WEIGHT		CONSOLIDATED DRAINED - "S"		
	#/FT³	T/FT³	#/FT³	#/FT³	#/FT³	T/FT³	TAN ϕ	ϕ	COH. T/SF
EMBANKMENT									
Impervious	120.0	0.060	126.0	0.063	63.6	.0318	0.45	24.3	0.0
Random	120.0	0.060	126.0	0.063	63.6	.0318	0.45	24.3	0.0
Pervious	130.0	0.065	136.0	0.068	73.6	.0368	0.73	36.1	0.0
Dawson FM	120.0	0.060	126.0	0.065	63.6	.0318	0.41	22.3	0.0
FOUNDATION									
Clay			118.0	0.059	55.6	.0278	0.38	20.8	0.0
Sand			125.0	0.063	62.6	.0313	0.65	33.0	0.0
Dawson	130.0		135.0	0.0675	72.6	.0363	0.27*	15.0*	0.0*

* Used in lieu of "s" strength

NOMENCLATURE

W = WEIGHT OF WEDGE OR BLOCK
H = NET HYDROSTATIC FORCE
U = UPLIFT ON FAILURE PLANE
C = (COHESION + TRIAL F.S.) x LENGTH OF PLANE
ϕ_D = ARCTAN TAN ϕ ÷ TRIAL F.S.
F.S. = SHEAR STRENGTH ASSUMED / SHEAR STRENGTH NEEDED FOR EQUILIBRIUM

Note:
1. For notes refer to Plate B-73

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	MADE	APP'D
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

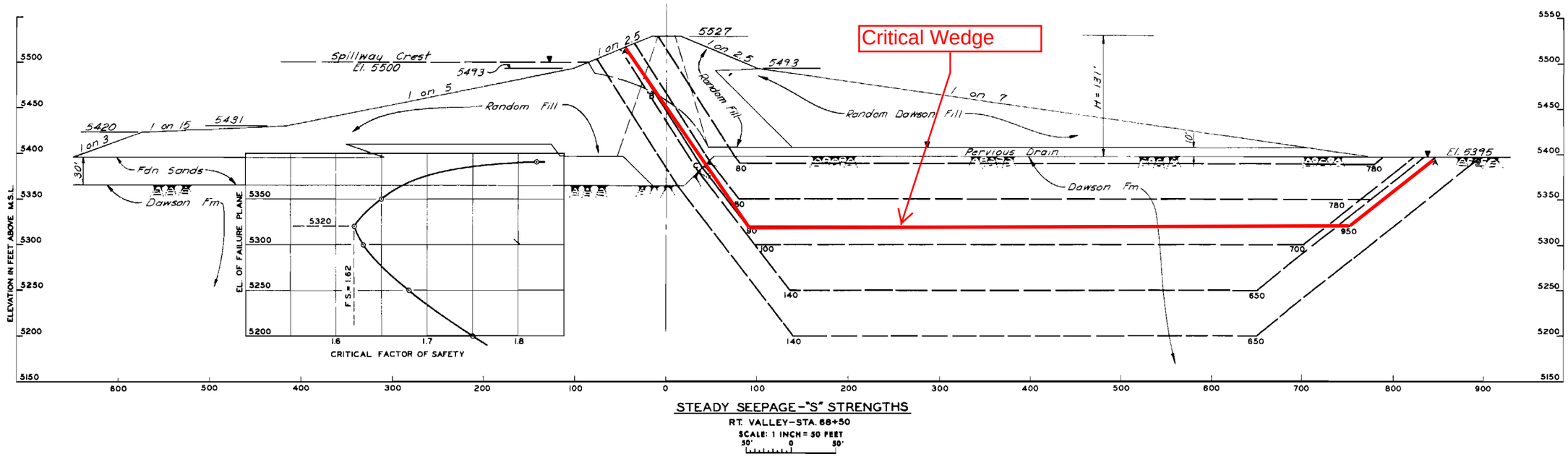
SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
STABILITY ANALYSIS
PARTIAL POOL AND STEADY SEEPAGE CASES
OUTLET WORKS - STA. 104+35

DESIGNED BY: L G S
DRAWN BY: J F P
TRACED BY:
CHECKED BY: L G S
SUBMITTED BY: [signature] CHIEF, ENGINEERING SECTION
APPROVED: [signature] CHIEF, FOUNDATION & MATERIALS BRANCH
APPROVED: [signature] DIRECT ENGINEERING DIVISION
DATE: DEC 1968
APPROVED: [signature] COL. C. E., DISTRICT ENGINEER
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

THIS PLAN ACCOMPANIES CONTRACT NO.
MODIFICATION NO.

SAFETY DAY

CHATFIELD RE-ALLOCATION STUDY PLATE B-5



STEADY SEEPAGE – "S" STRENGTHS

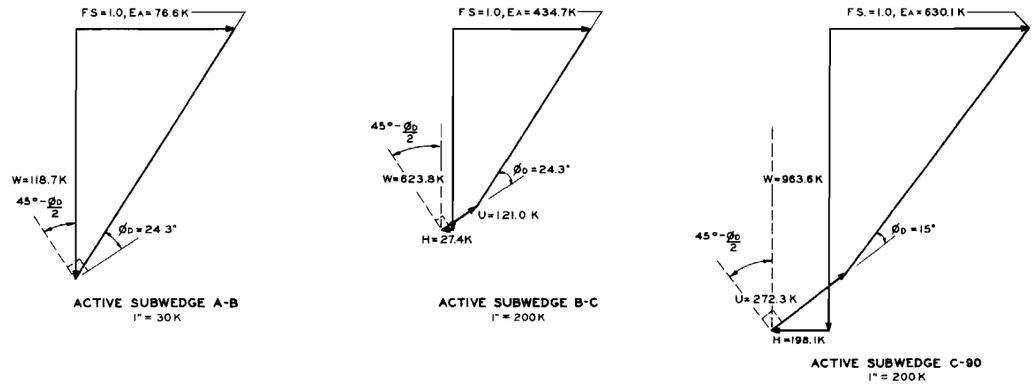
RT. VALLEY – STA. 68+50

SCALE: 1 INCH = 50 FEET

50' 0 50'

EL. OF FAILURE PLANE	ACTIVE WEDGE	PASSIVE WEDGE	FACTOR OF SAFETY NORM.	FACTOR OF SAFETY E.Q
5390	80	780	1.82	1.12
5350	80	780	1.65	0.97
5320	90	750	1.62*	0.94*
5300	100	700	1.63	0.94
5250	140	650	1.68	0.97
5200	140	650	1.75	0.98
Regd. factor of Safety			1.50	1.0

*Critical

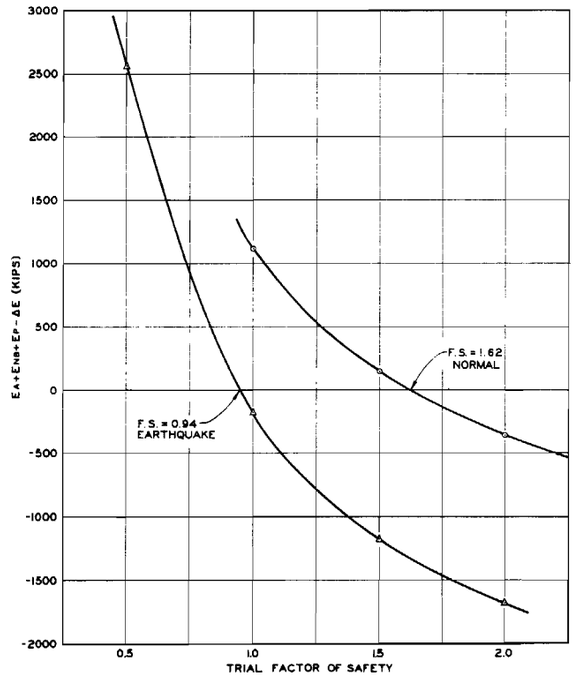


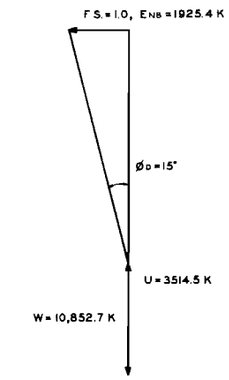
ACTIVE SUBWEDGE A-B
1" = 30K

ACTIVE SUBWEDGE B-C
1" = 200K

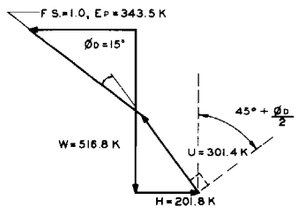
ACTIVE SUBWEDGE C-90
1" = 200K

ACTIVE WEDGE FORCE DIAGRAMS





NEUTRAL BLOCK 90 – 750
1" = 2,000K



PASSIVE WEDGE A – 750
1" = 200K

NEUTRAL BLOCK AND PASSIVE WEDGE FORCE DIAGRAMS

NOMENCLATURE

W = WEIGHT OF WEDGE OR BLOCK
H = NET HYDROSTATIC FORCE
U = UPLIFT ON FAILURE PLANE
C = (COHESION + TRIAL F.S.) × LENGTH OF PLANE
ϕ_D = ARCTAN TAN ϕ ÷ TRIAL F.S.
F.S. = SHEAR STRENGTH ASSUMED / SHEAR STRENGTH NEEDED FOR EQUILIBRIUM

NOTE:
1 For NOTES, see Plate B-73

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	MADE	APP'D
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

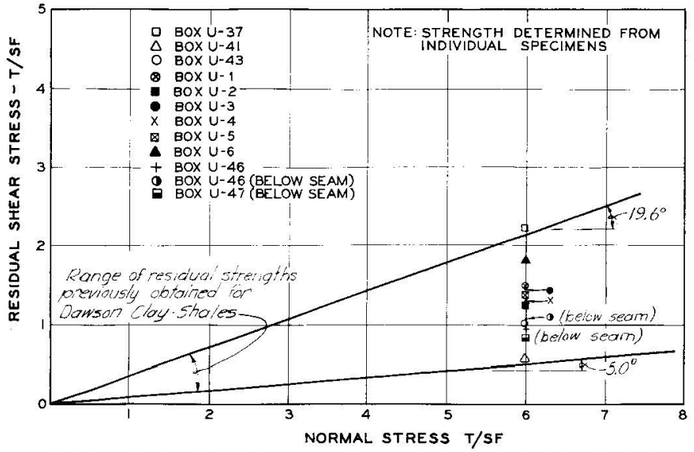
DESIGNED BY: L G S
DRAWN BY: E J G
TRACED BY:
CHECKED BY: L G S
SUBMITTED BY: CHIEF, ENGINEERING DIVISION
APPROVED: CHIEF, FDN & MTLS BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
APPROVED: DIST. U. S. ENGINEER

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
STABILITY ANALYSIS
STEADY SEEPAGE CASE
RIGHT VALLEY – STA. 68+50

DATE: DEC. 1968
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

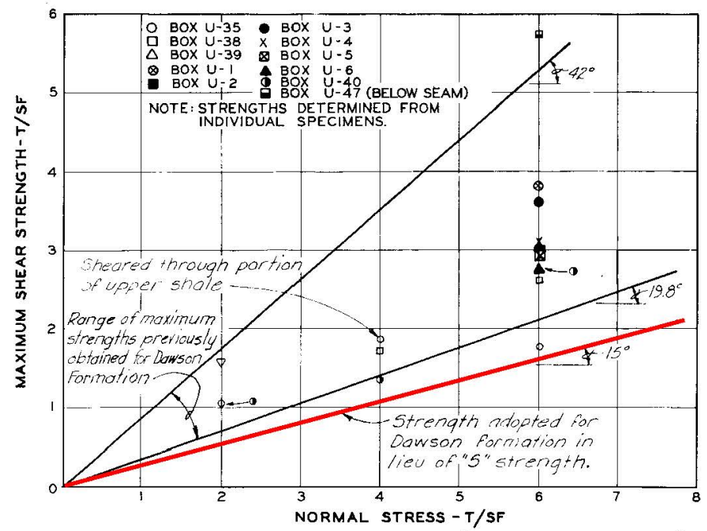
THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.

SAFETY DAYS



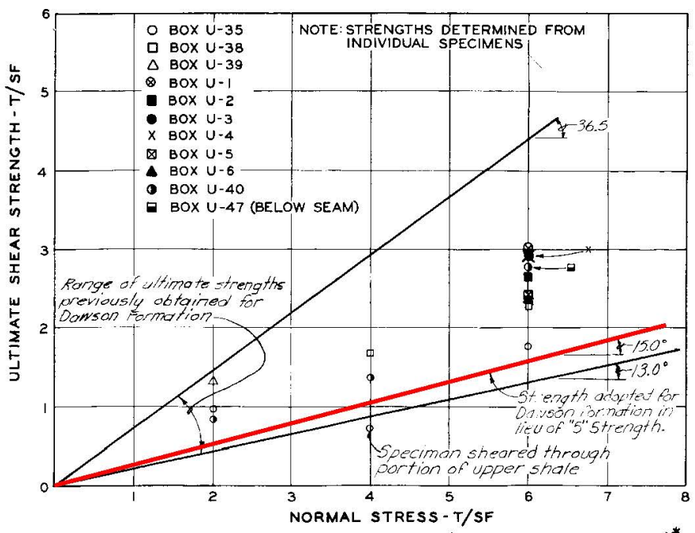
SUMMARY OF RESIDUAL DIRECT SHEAR TESTS ON SOFT SEAM

FIGURE 1



SUMMARY OF DIRECT SHEAR TESTS (MAXIMUM STRENGTH) ON SOFT SEAM MATERIAL.

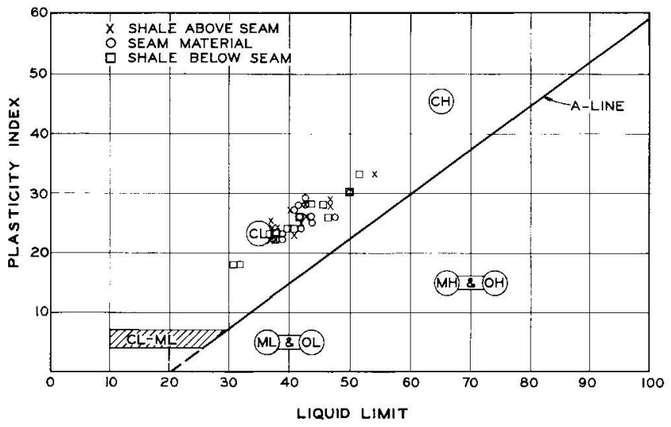
FIGURE 2



SUMMARY OF DIRECT SHEAR TESTS (ULTIMATE STRENGTH)* ON SOFT SEAM MATERIAL.

FIGURE 3

*NOTE: ULTIMATE STRENGTH IS THAT AFTER HORIZONTAL DEFORMATION OF 0.5 INCH IN DIRECT SHEAR.



PLASTICITY CHART

FIGURE 4

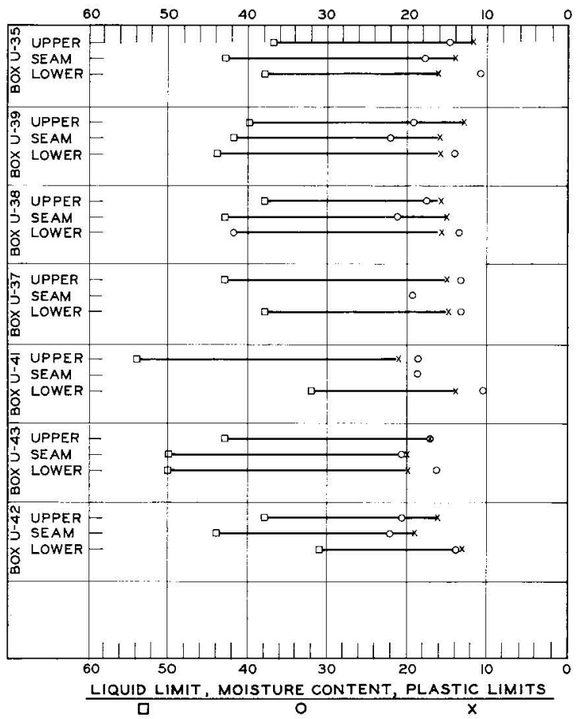


FIGURE 5

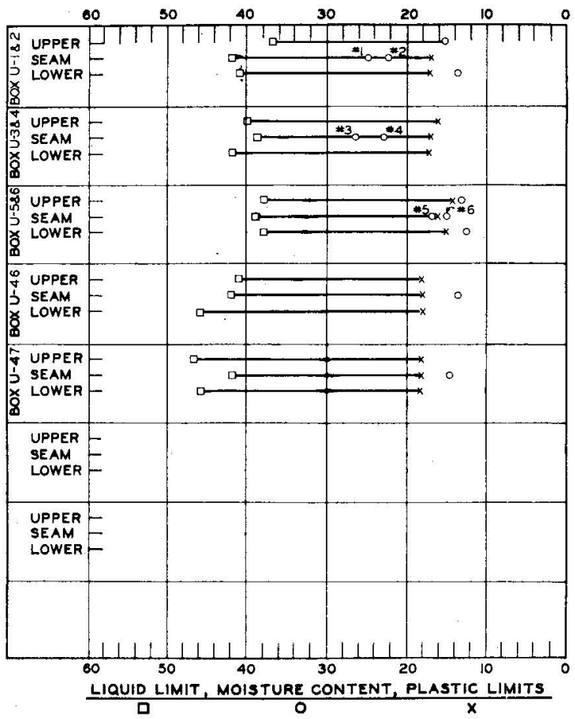


FIGURE 6

MOISTURE AND ATTERBERG LIMITS RELATIONSHIPS

NOTE:

1. Residual Tests on Boxes U-46 and U-47 were performed on precut samples; all other tests were performed on undisturbed samples.

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
EMBANKMENT AND EXCAVATION
UNDISTURBED DAWSON FORMATION
SUMMARIES OF DIRECT SHEAR TESTS
(RESIDUAL AND NORMAL) ON SOFT SEAM
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA.
OCT. 1970

STILLING BASIN TERMINAL

MONOLITH 28 TERMINAL

MONOLITH 18 TERMINAL

INTAKE STRUCTURE TERMINAL

TW1 TW2 TW3 TW4 TW5 TW6 TW7 TW8 TW9

PZ-1 PZ-3 PZ-4 PZ-5 PZ-6 PZ-7 PZ-8

95-2 95-3 95-4

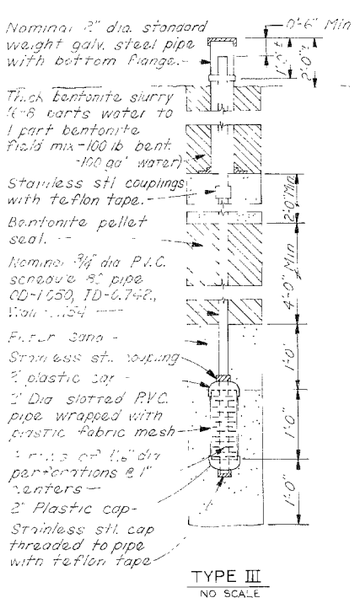
EMBANKMENT HYDROSTATIC PRESSURE CELLS			
NO.	STATION	RANGE	NO. OF CELLS
498	55 + 00	℄	1
499 A, B	55 + 00	30' D. S.	2
500 A, B	68 + 90	190' U. S.	2
501 A, B	68 + 90	75' U. S.	2
502 A, B	68 + 90	℄	2
503 A, B	68 + 90	55' D. S.	2
504 A, B	68 + 90	195' D. S.	2
505 A, B	68 + 90	400' D. S.	2
536	68 + 85	185' U. S.	1
538	68 + 85	85' U. S.	1
541	68 + 85	125' D. S.	1
506 A, B, C	81 + 20	200' U. S.	3
507 A, B, C	81 + 20	℄	3
508 A, B	81 + 20	195' D. S.	2
509 A, B	81 + 20	395' D. S.	2
510	93 + 00	200' U. S.	1
511	93 + 00	75' U. S.	1
512A, B, C, D	93 + 00	℄	4
513	93 + 00	50' D. S.	1
514	93 + 00	200' D. S.	1
515	93 + 00	400' D. S.	1
516	102 + 54	400' U. S.	1
517	102 + 54	200' U. S.	1
518	102 + 54	80' U. S.	1
519 A, B, C	102 + 54	℄	3
520 A, B	102 + 54	120' D. S.	2
521	102 + 54	300' D. S.	1
522	102 + 54	550' D. S.	1

DAWSON SANDSTONE & OVERBURDEN (TYPE III)		
No.	Station	Range
559	60+00	470'D. S.
567	68+80	300'D. S.
560	68+80	770'D. S.
569	76+50	300'D. S.
566	81+10	300'D. S.
557	81+10	590'D. S.
556	81+10	600'D. S.
568	85+50	300'D. S.
570	85+50	590'D. S.
555	85+50	620'D. S.
551S	87+50	750'D. S.
551D	87+50	750'D. S.
561	92+90	300'D. S.
564	93+02	580'D. S.
565	93+02	590'D. S.
563	99+47	353'D. S.
558	101+35	720'D. S.
562	101+92	443'D. S.
554	102+00	250'D. S.

EMBANKMENT - FOUNDATION PORE PRESSURE (TYPE I)		
No.	Station	Range
41	68+90	25'U. S.
483	68+90	200'D. S.
	74+00	25'U. S.
	79+00	25'U. S.
529	81+20	215'U. S.
484	81+20	200'D. S.
	82+50	25'U. S.
	83+00	℄
	88+00	25'U. S.
	93+00	25'U. S.
485	93+00	195'D. S.
	102+00	25'U. S.
	102+00	℄
486	102+54	25'U. S.
185	108+65	90'U. S.

EMBANKMENT - FOUNDATION PORE PRESSURE (TYPE II)		
No.	Station	Range
537	68+85	130'U. S.
539	68+85	100'D. S.
540	68+85	150'D. S.
542	81+15	75'U. S.
543	81+15	75'D. S.

EMBANKMENT-FOUNDATION PIEZOMETERS		
No.	Station	Range
95-2	93+00	100' D.S
95-3	81+20	C.L.
95-4	81+20	100' D.S.



TYPE III
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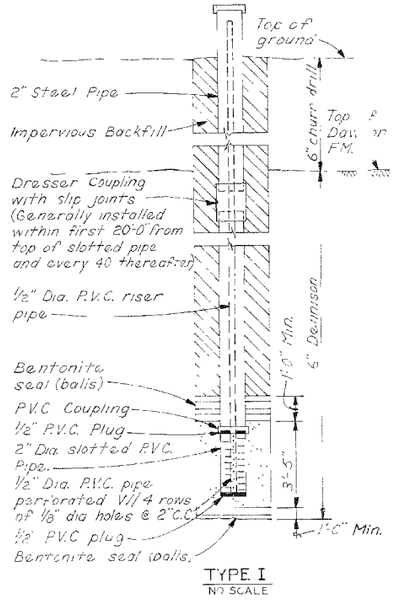
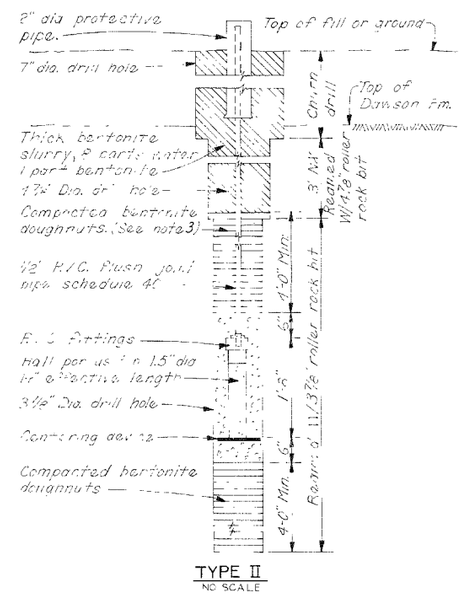


TYPE I
NO SCALE

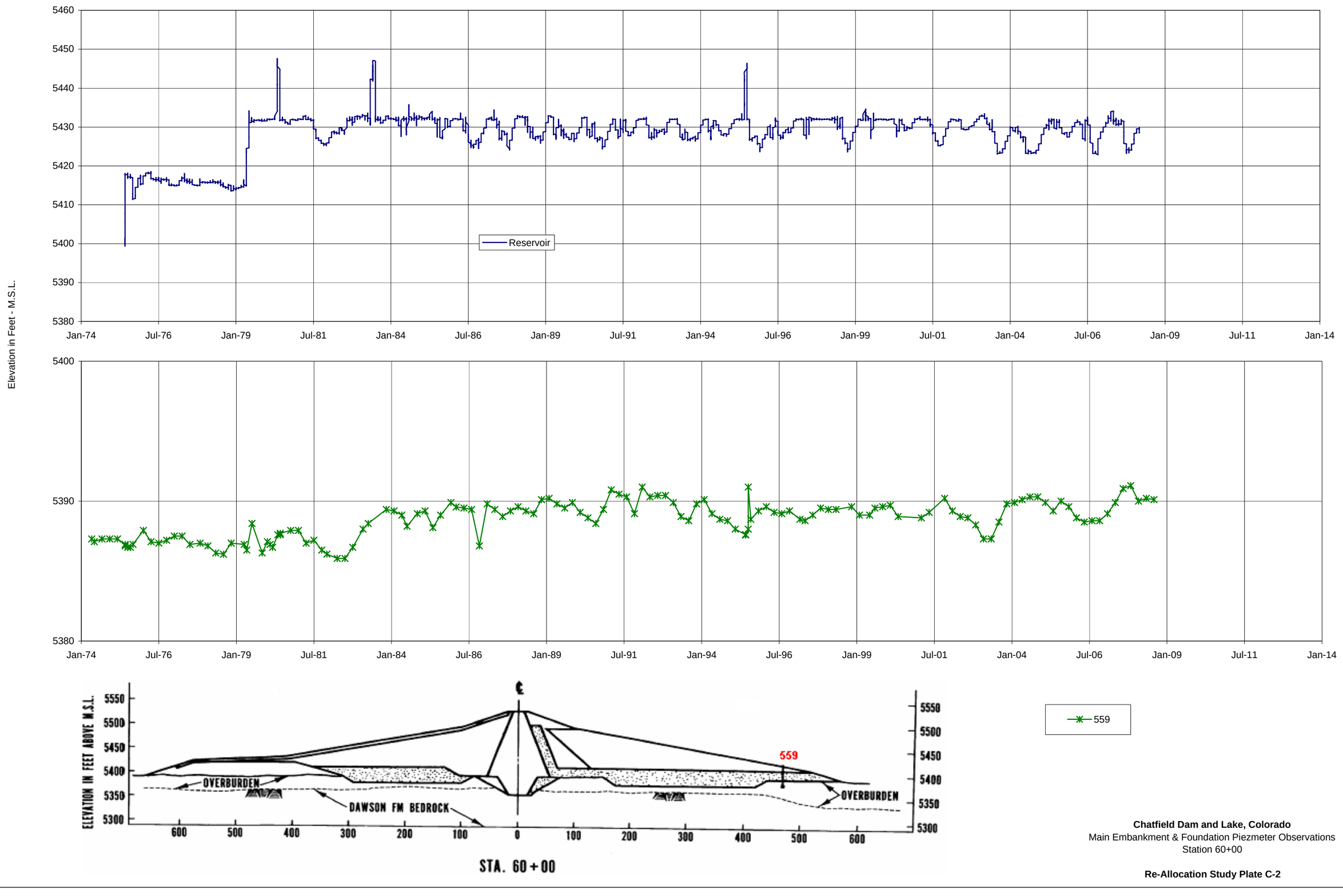


TYPE II
NO SCALE

LEGEND:

- □ Embankment Hydrostatic Pressure Cells
- △ Dawson Sandstone & Overburden (Type III)
- ○ Embankment-Foundation Pore Pressure (Type I)
- ● Embankment-Foundation Pore Pressure (Type II)
- ■ Terminal Wells/Boxes for Hydrostatic Pressure Cells

DESIGNED BY:	SOUTH PLATTE RIVER
DRAWN BY:	CHATFIELD LAKE, COLORADO
CHECKED BY:	EMBANKMENT
SUBMITTED BY: CHIEF SECTION	PIEZOMETER LOCATION PLAN
RECOMMENDED: CHIEF DESIGN BRANCH	APPROVED: CHIEF ENGINEERING DIVISION — DATE:
APPROVED: COL. C. E. DISTRICT ENGINEER	SCALE: AS SHOWN — SPEC. NO. DACA45 — DRAWING NUMBER — SHEET

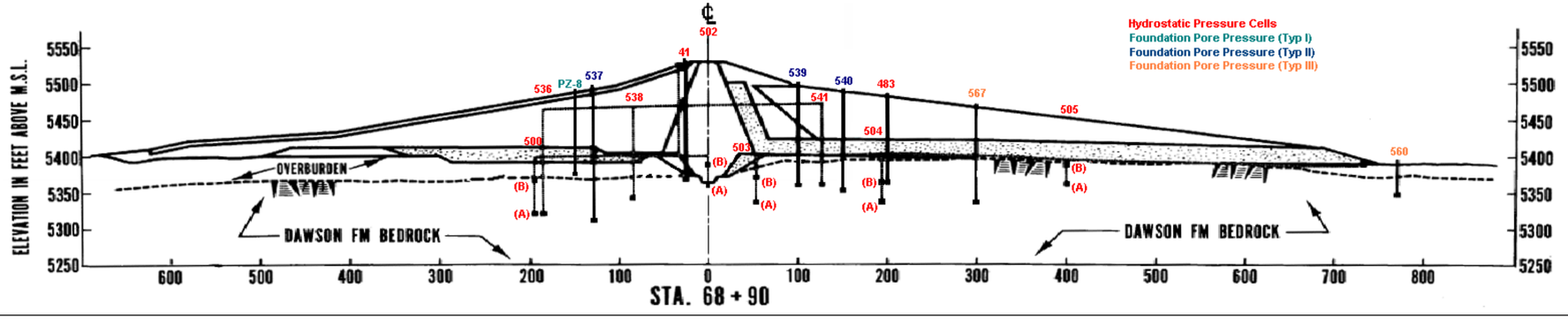


Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 60+00

Re-Allocation Study Plate C-2

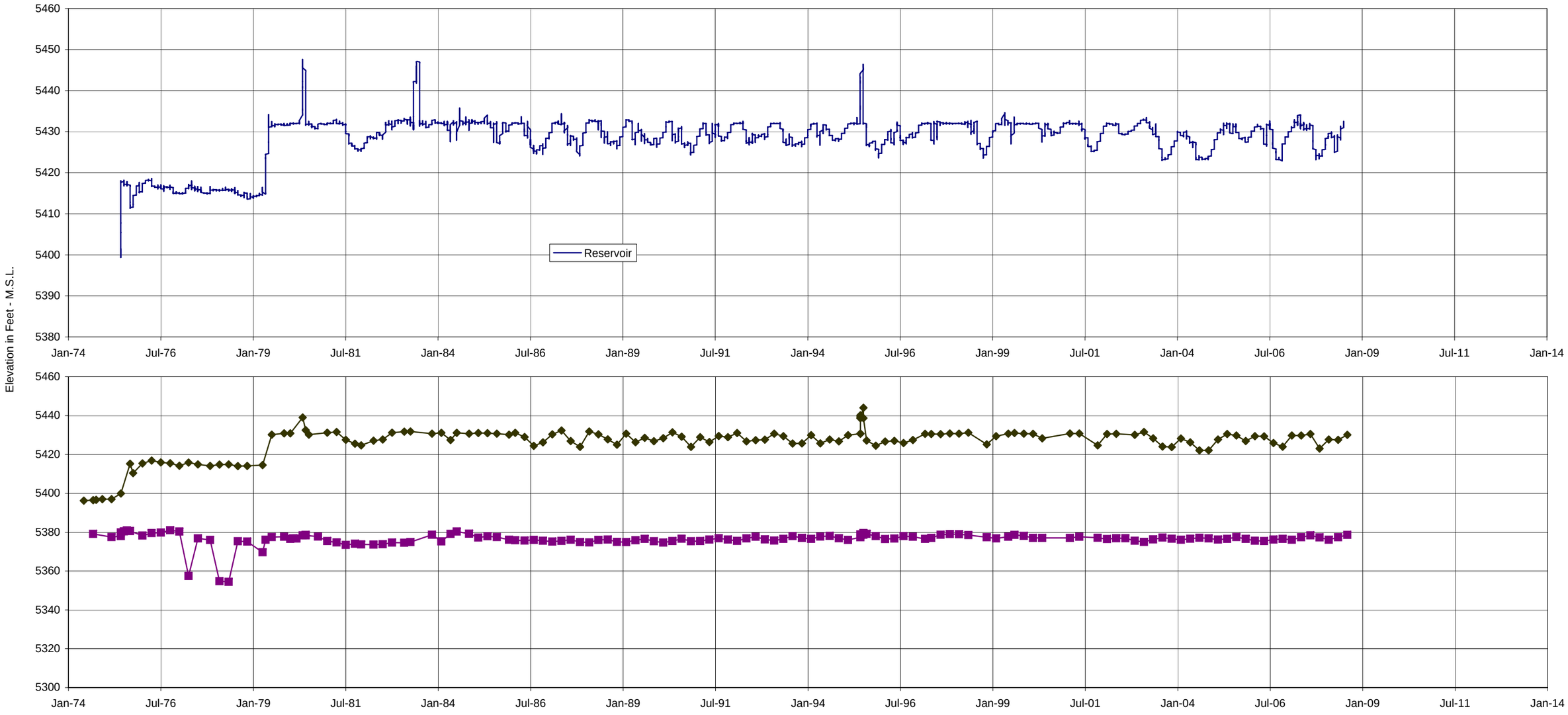
Elevation in Feet - M.S.L.

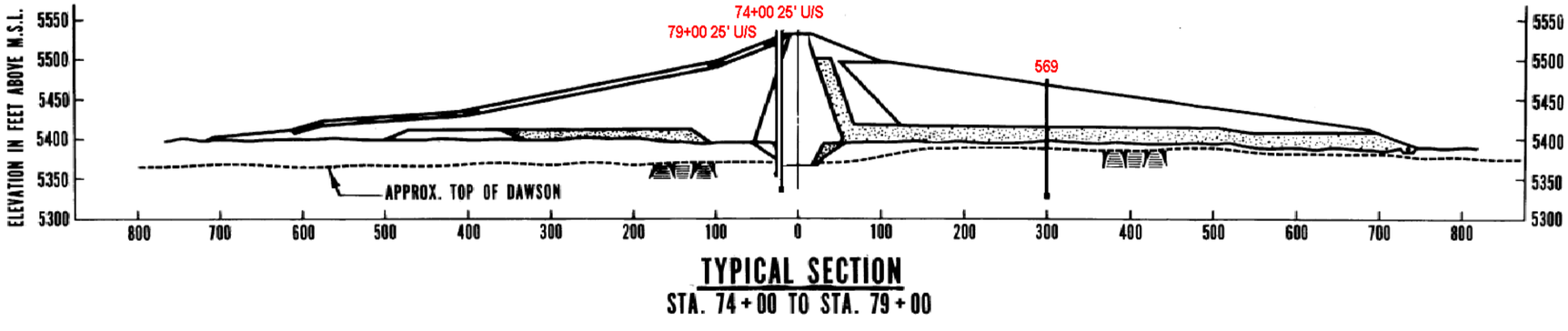
Reservoir



Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 68+90

Re-Allocation Study Plate C-3





TYPICAL SECTION
STA. 74+00 TO STA. 79+00

79+00/25US — 569

NOTE: Piez 74+00 25' U/S was found plugged & was abandoned in July 1972

Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 79+00

Re-Allocation Study Plate C-4

Elevation in Feet - M.S.L.

Reservoir

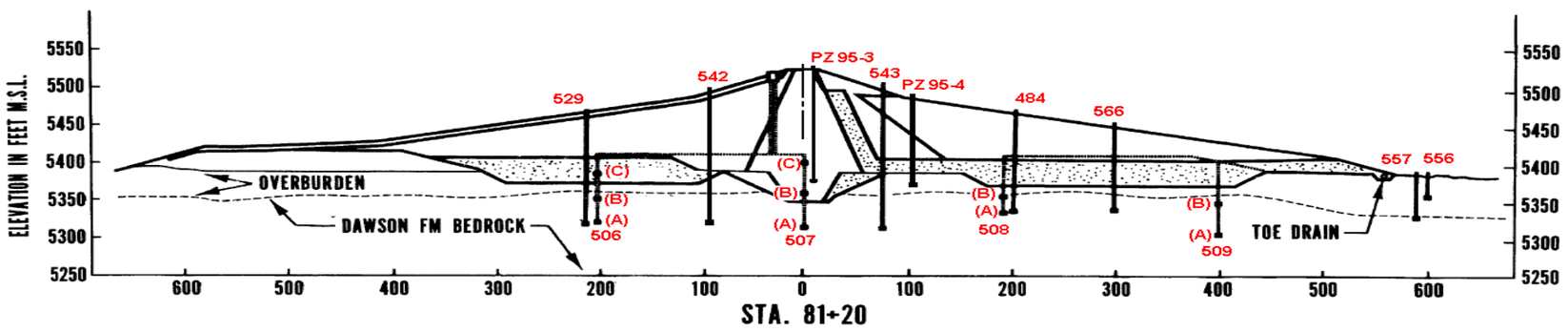
5460 5450 5440 5430 5420 5410 5400 5390 5380

Jan-74 Jul-76 Jan-79 Jul-81 Jan-84 Jul-86 Jan-89 Jul-91 Jan-94 Jul-96 Jan-99 Jul-01 Jan-04 Jul-06 Jan-09 Jul-11 Jan-14

5480 5460 5440 5420 5400 5380 5360 5340 5320 5300

Jan-74 Jul-76 Jan-79 Jul-81 Jan-84 Jul-86 Jan-89 Jul-91 Jan-94 Jul-96 Jan-99 Jul-01 Jan-04 Jul-06 Jan-09 Jul-11 Jan-14

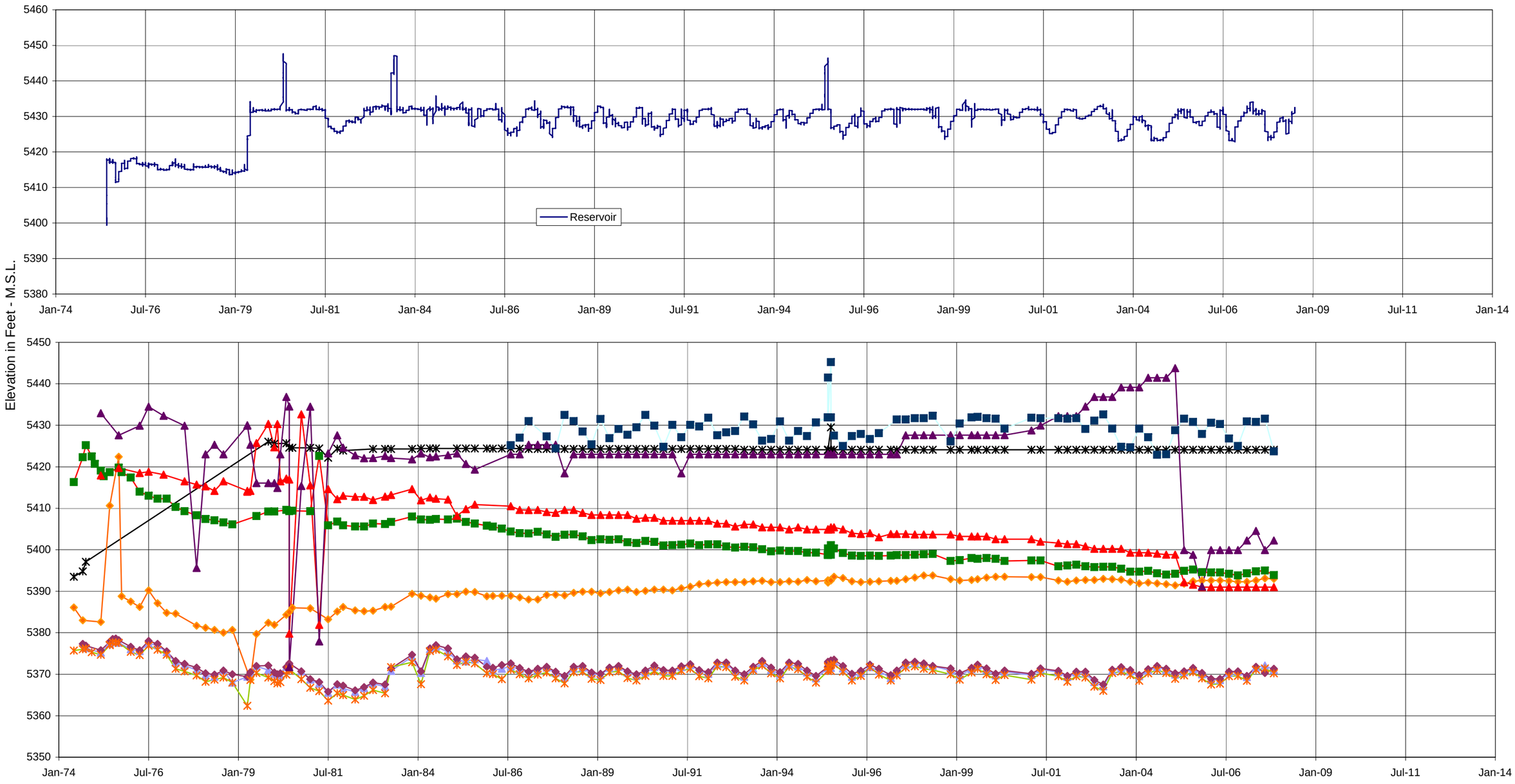
506A 506B 506C 507C
529 484 566 557
556 95-03 95-04

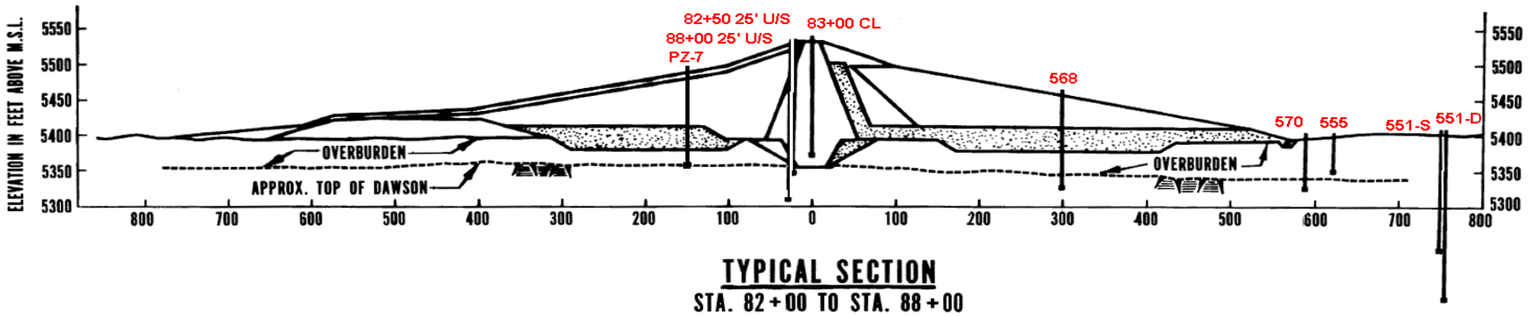


NOTE: Piez. 543 Reading discontinued Aug 1994 due to sounder cable broke and lodged in pipe.

Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 81+20

Re-Allocation Study Plate C-5



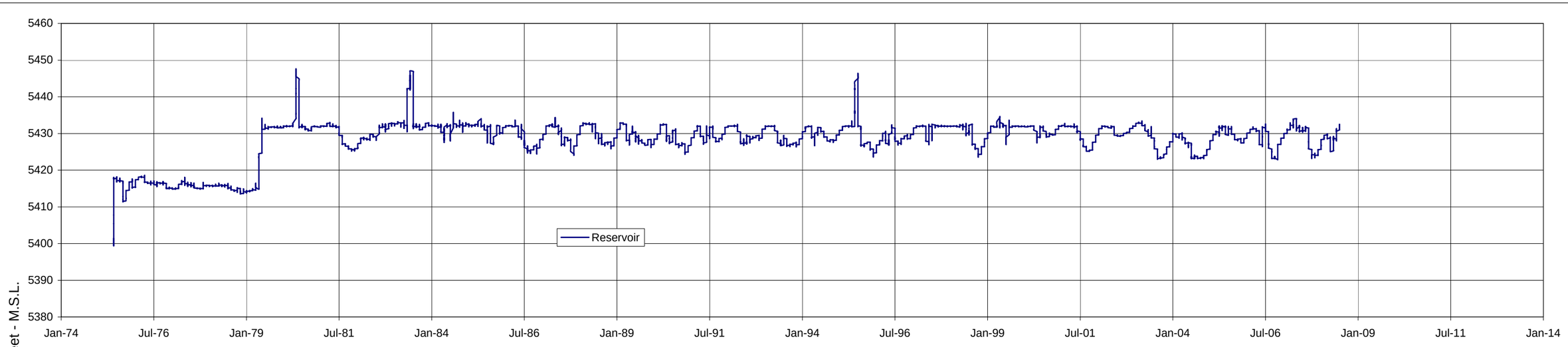


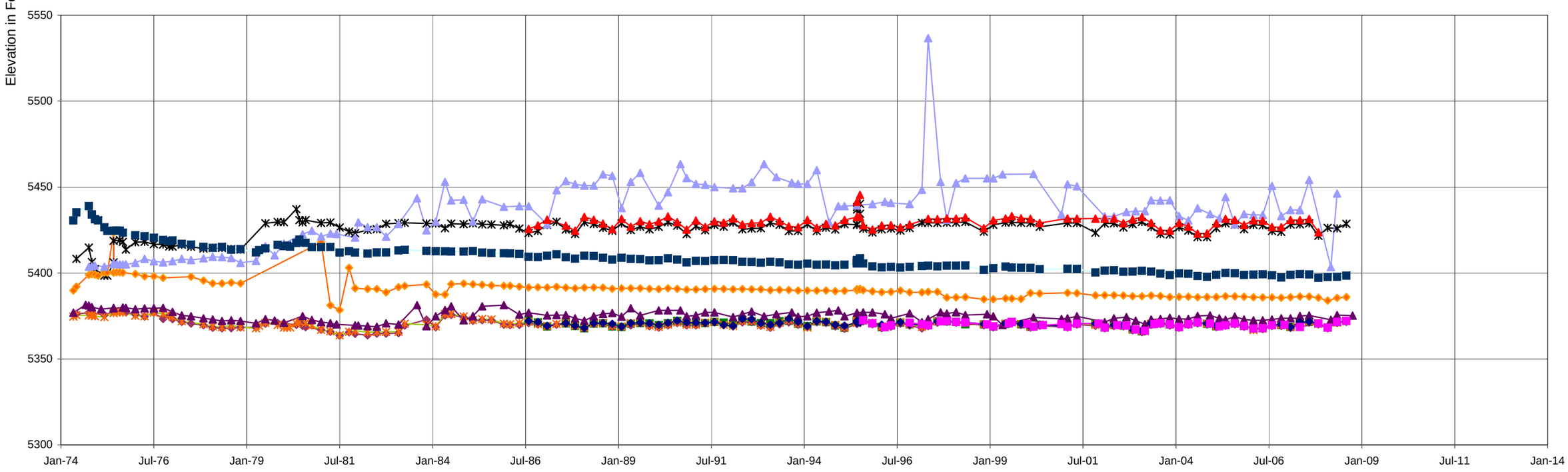
TYPICAL SECTION
STA. 82+00 TO STA. 88+00

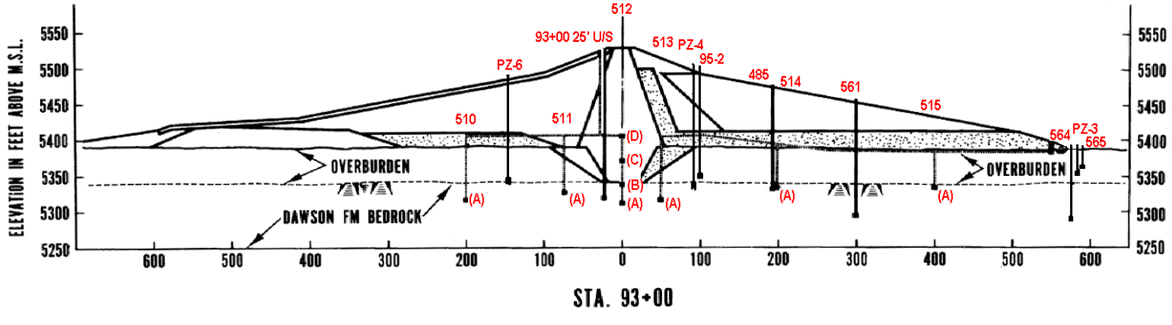
82+50/25US
83+00/CTR
88+00/25US
568
570
555
551-S
551-D
PZ-7

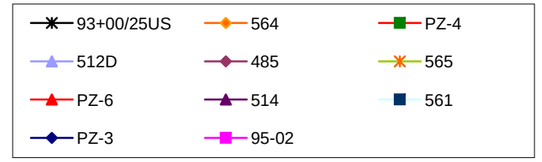
Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 82+00

Re-Allocation Study Plate C-6



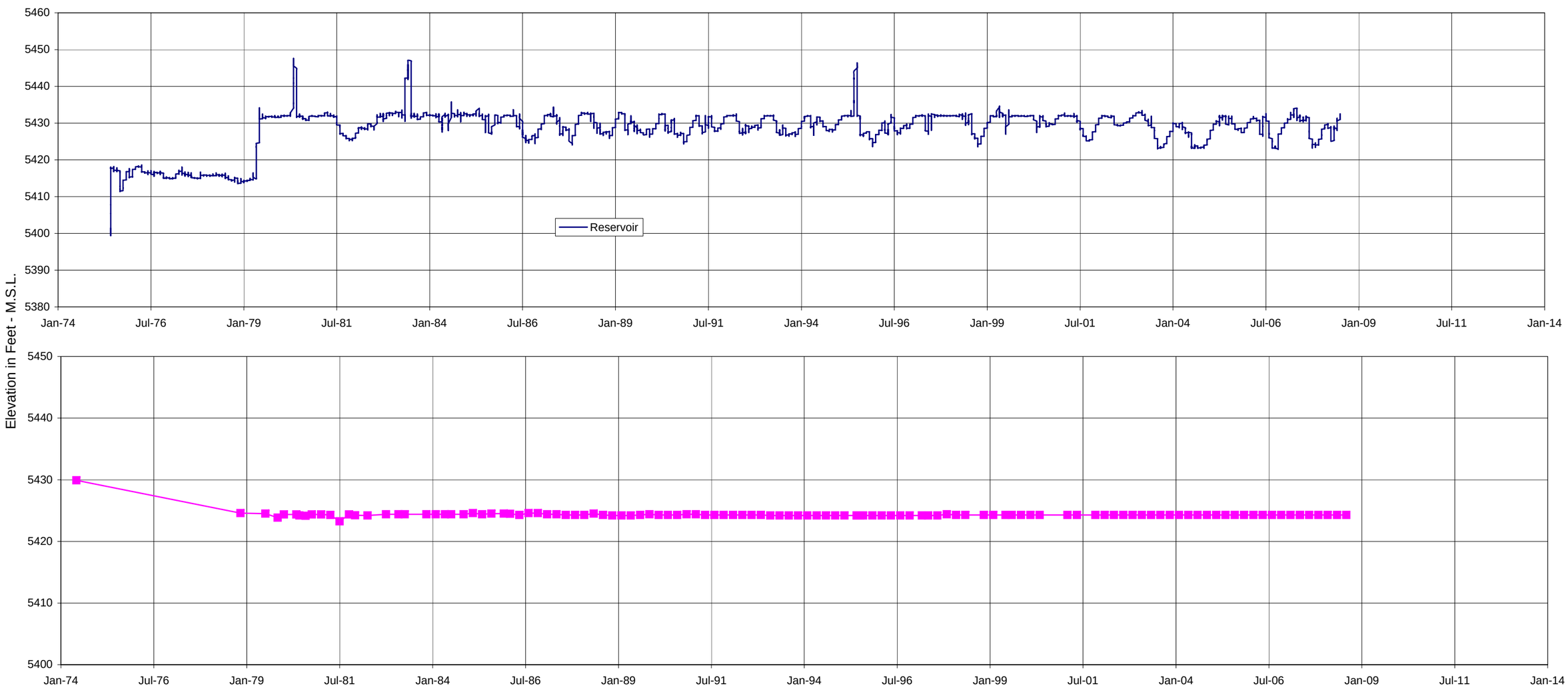


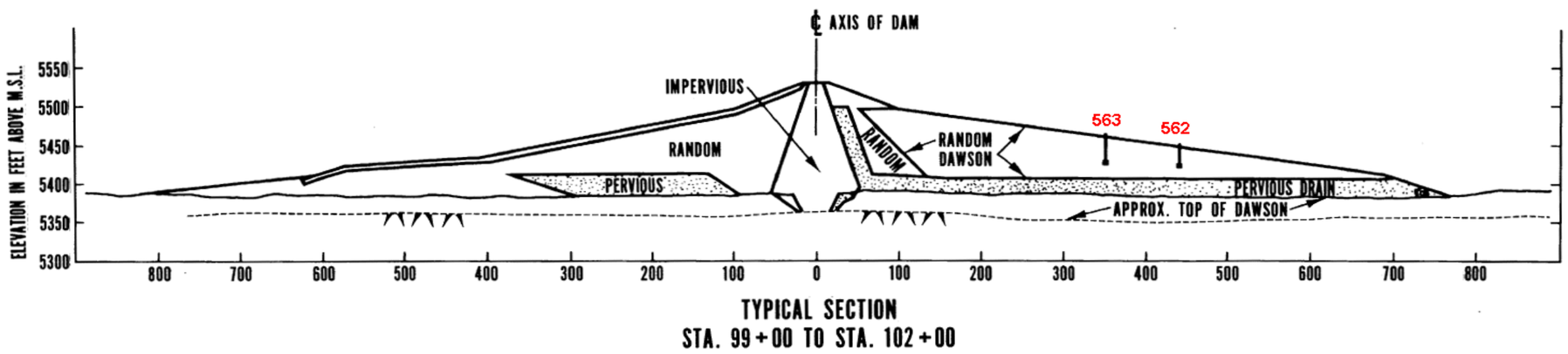




Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezometer Observations
Station 93+00

Re-Allocation Study Plate C-7



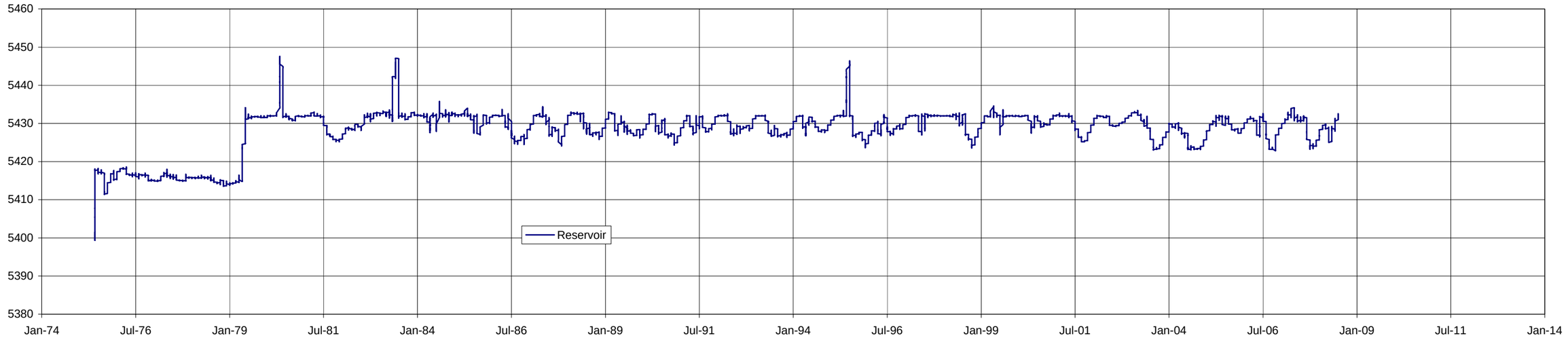


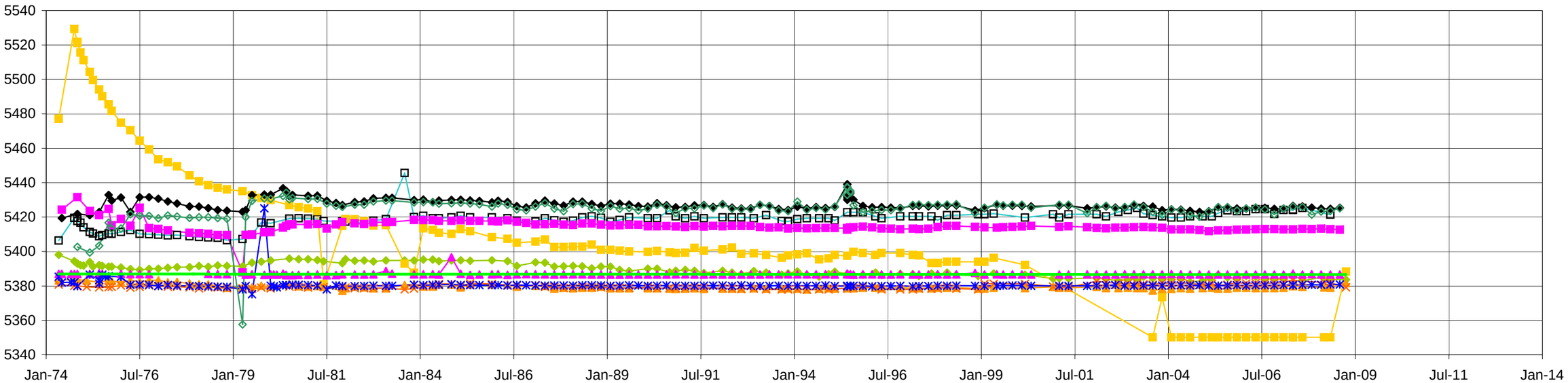
TYPICAL SECTION
STA. 99+00 TO STA. 102+00

Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 99+00

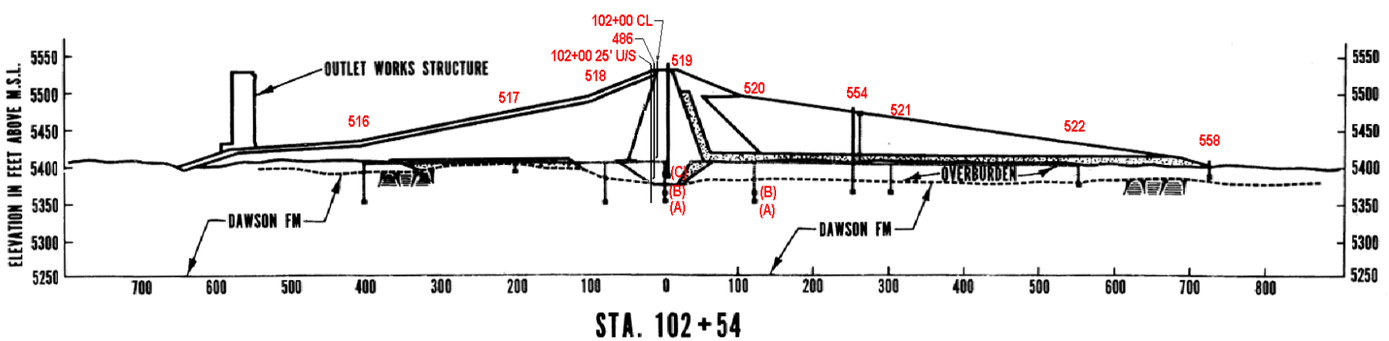
Re-Allocation Study Plate C-8

Elevation in Feet - M.S.L.





519C
520A
520B
521
522
102+00/25US
102+00/CTR
558
554
486
Poly. (558)

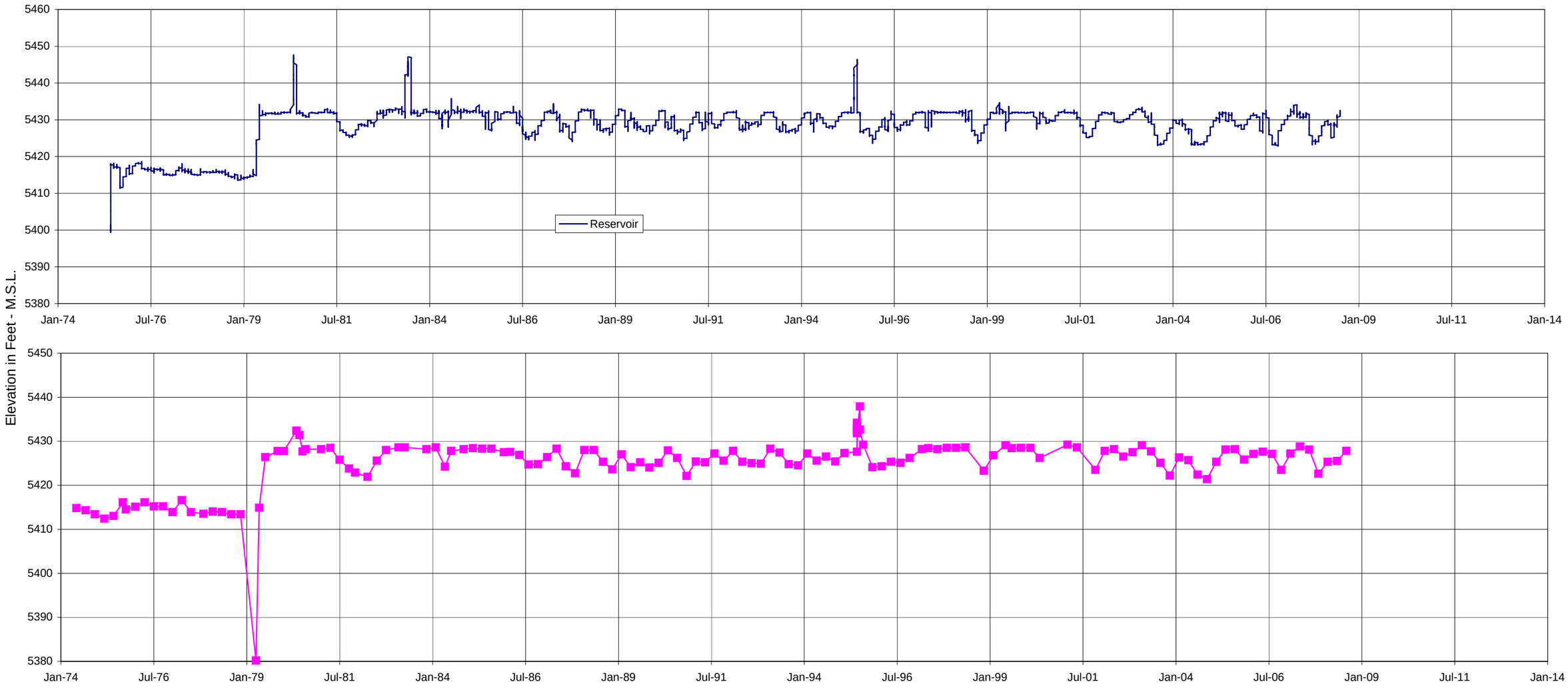


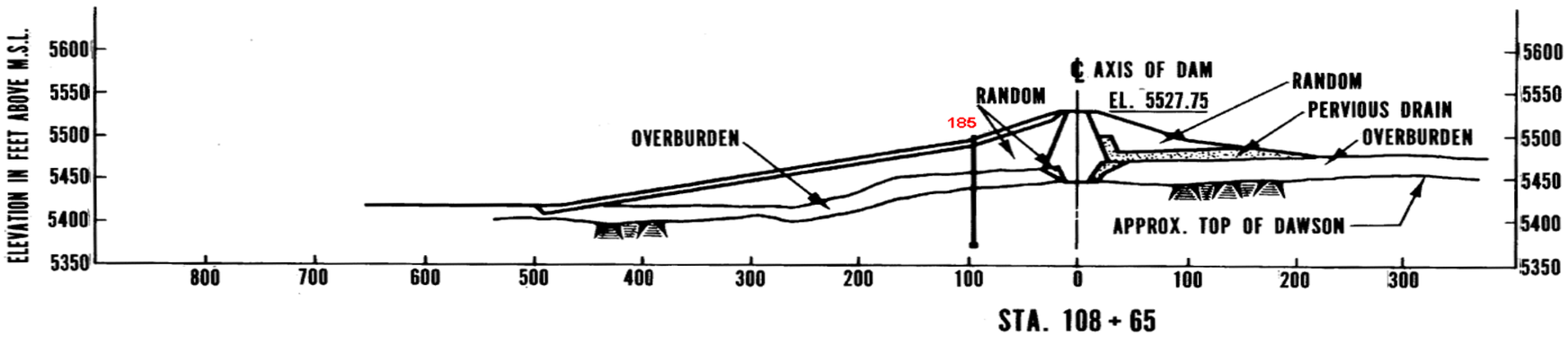
STA. 102+54

NOTE: Piez. 519A discontinued in May 1985 due to erratic behavior.
Piez. 519B discontinued in Aug 1995 due to difficulty in obtaining readings.
Piez 516 discontinued in Aug 1995 due to erratic behavior.

Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezmeter Observations
Station 102+54

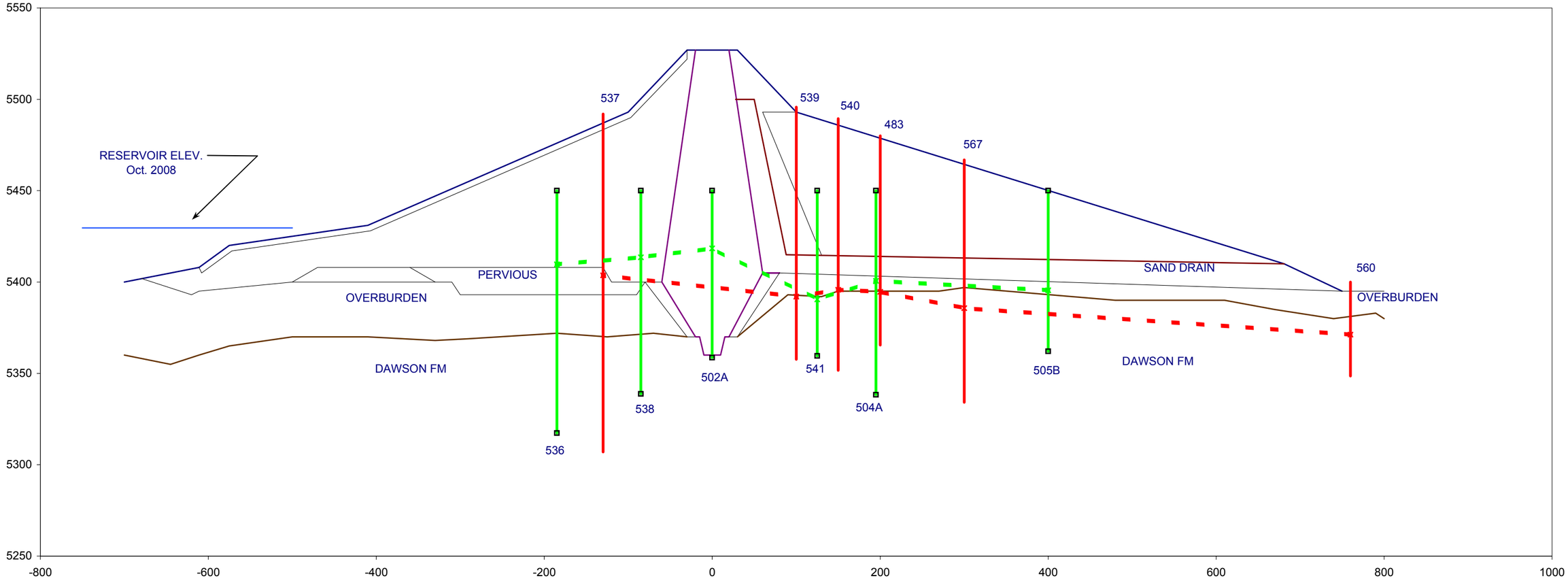
Re-Allocation Study Plate C-9





Chatfield Dam and Lake, Colorado
Main Embankment & Foundation Piezometer Observations
Station 108+65

Re-Allocation Study Plate C-10



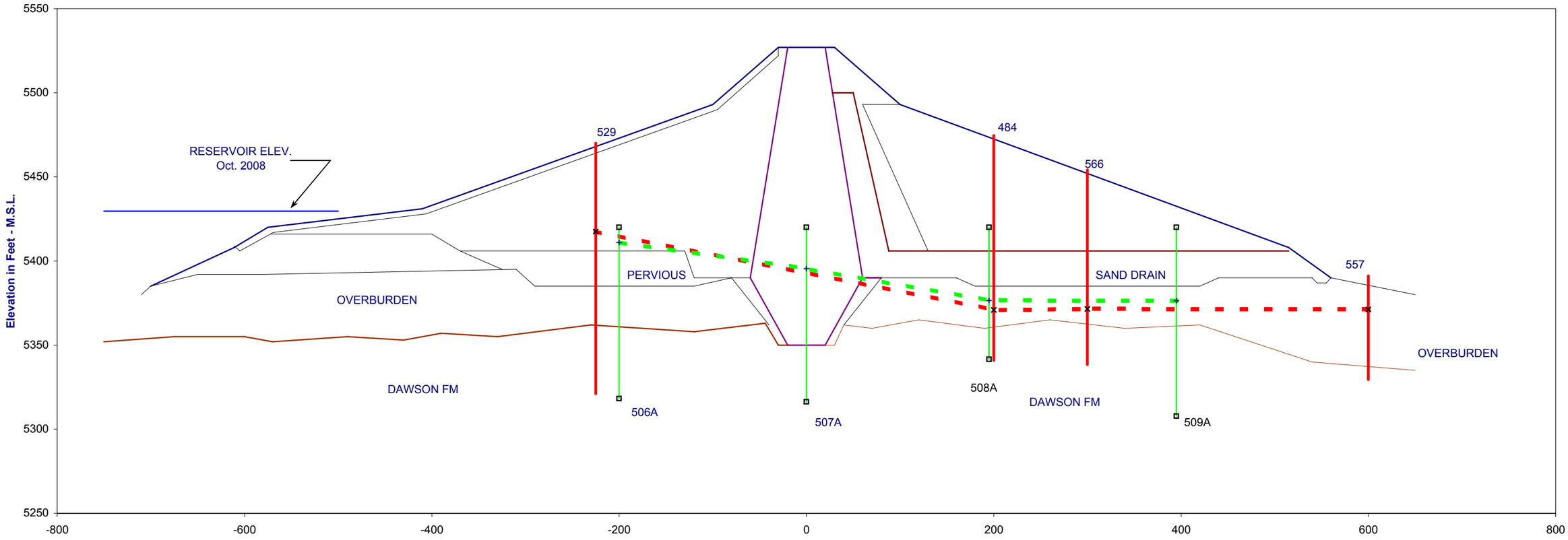
Embankment Station 68+80 to 68+90

Open Tube - May 2008 Data Res. El.(5431.15)

Pressure Cell - Oct 2008 Data Res. El.(5429.61)

Chatfield Dam and Lake, CO
Foundation Piezometer Observations
Station 68+80 to 68+90

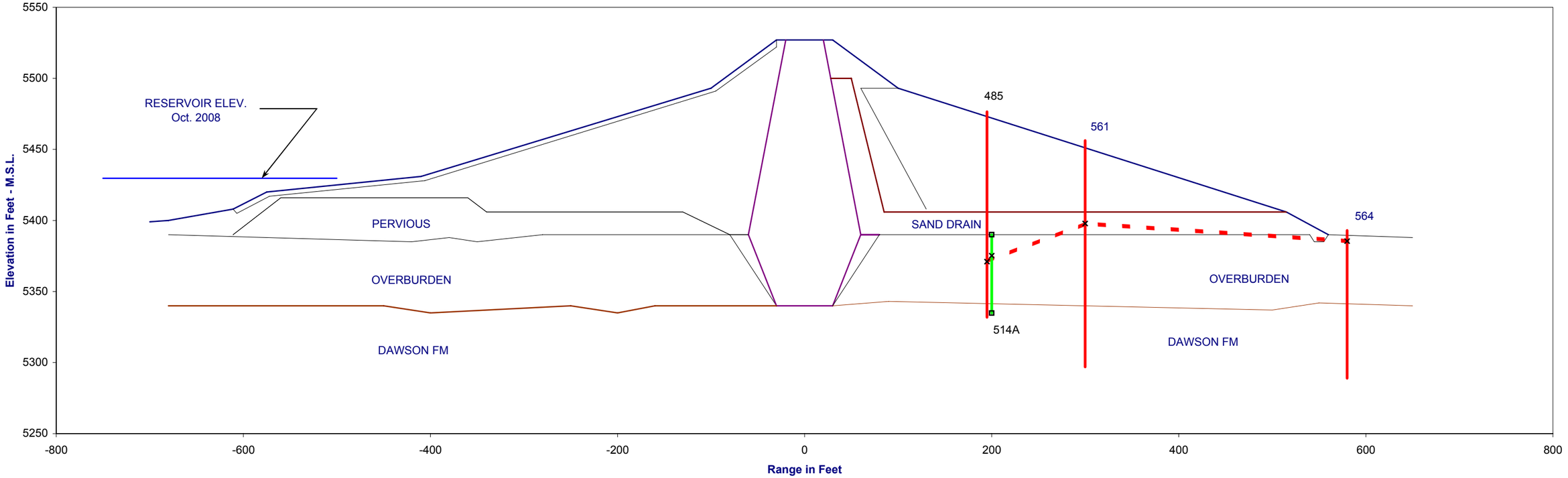
RE-ALLOCATION STUDY PLATE C-11



Embankment Station 81+10 to 81+20
Open Tube - May 2008 Data Res. El. (5431.15)
Pressure Cell - Oct 2008 Data Res. El.(5429.61)

Chatfield Dam and Lake, CO
Foundation Piezometer Observations
Station 81+10 to 81+20

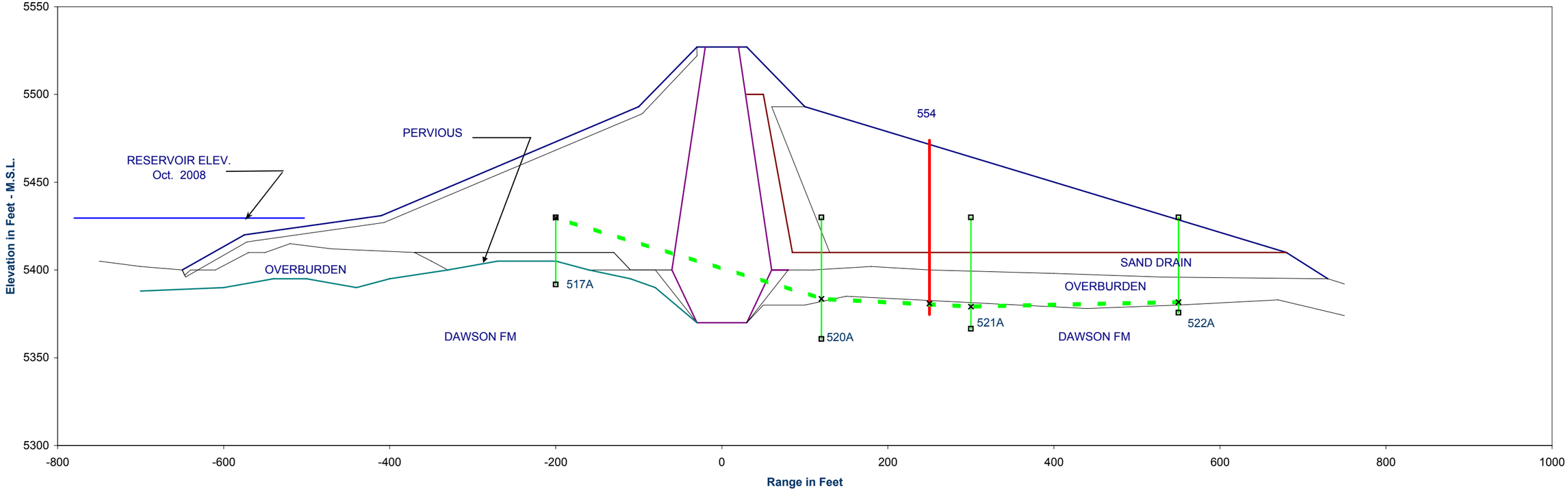
RE-ALLOCATION STUDY PLATE C-12



Embankment Station 92+90-93+02
Open Tube - May 2008 Data Res. El. (5431.15)
Pressure Cell - Oct 2008 Data Res. El.(5429.61)

Chatfield Dam and Lake, CO
Foundation Piezometer Observations
Station 93+00

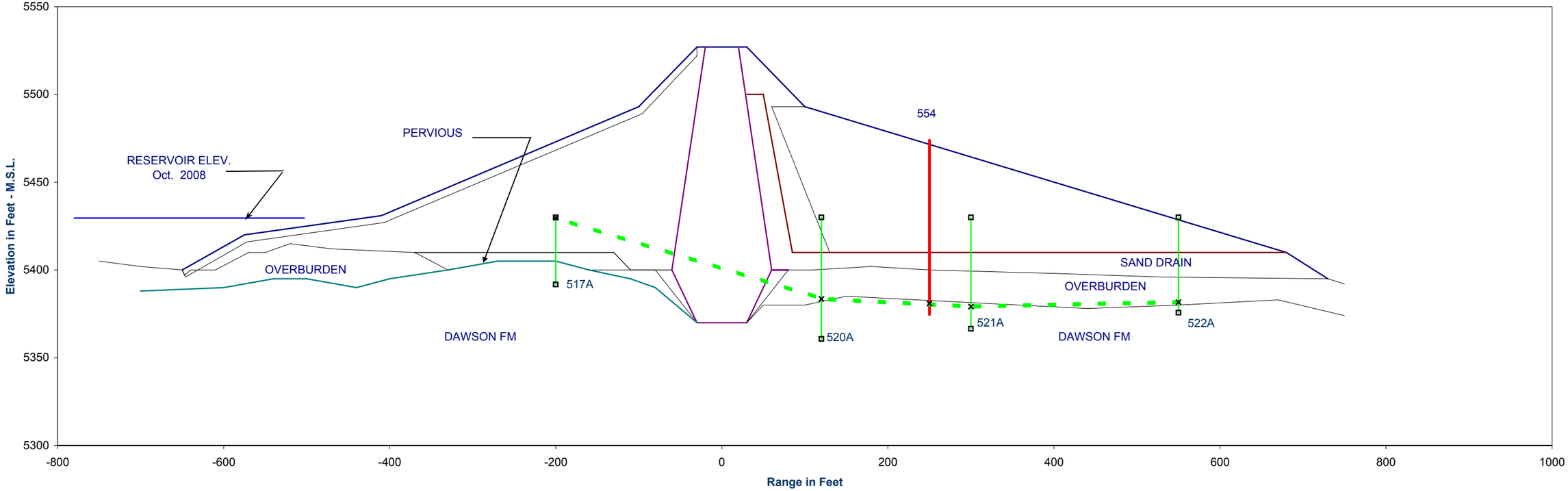
RE-ALLOCATION STUDY PLATE C-13



Embankment Station 101+35-102+00
Open Tube - May 2008 Data Res. El. (5431.15)
Pressure Cell - Oct 2008 Data Res. El.(5429.61)

Chatfield Dam and Lake, CO
Foundation Piezometer Observations
Station 101+35 to 102+00

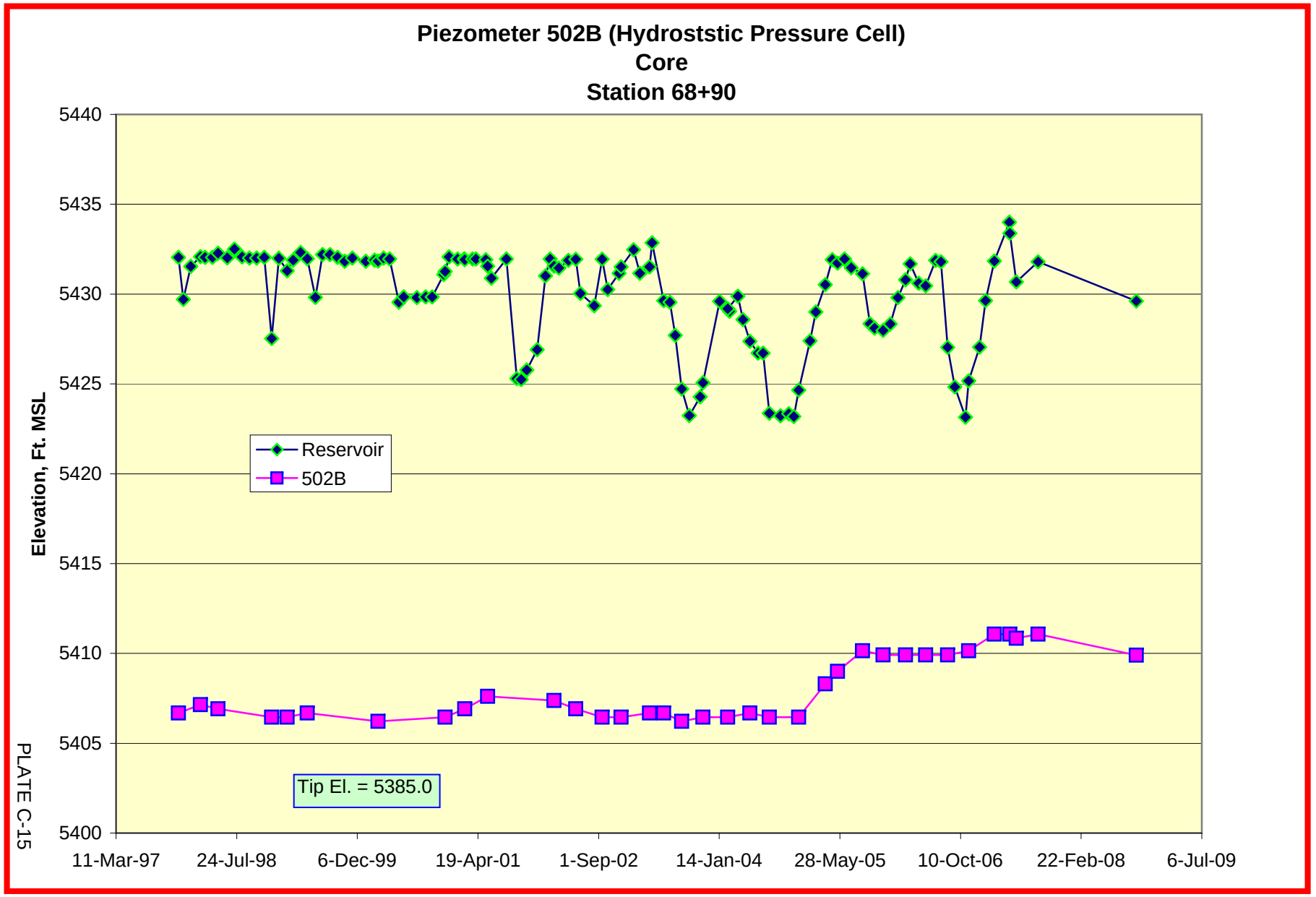
RE-ALLOCATION STUDY PLATE C-14

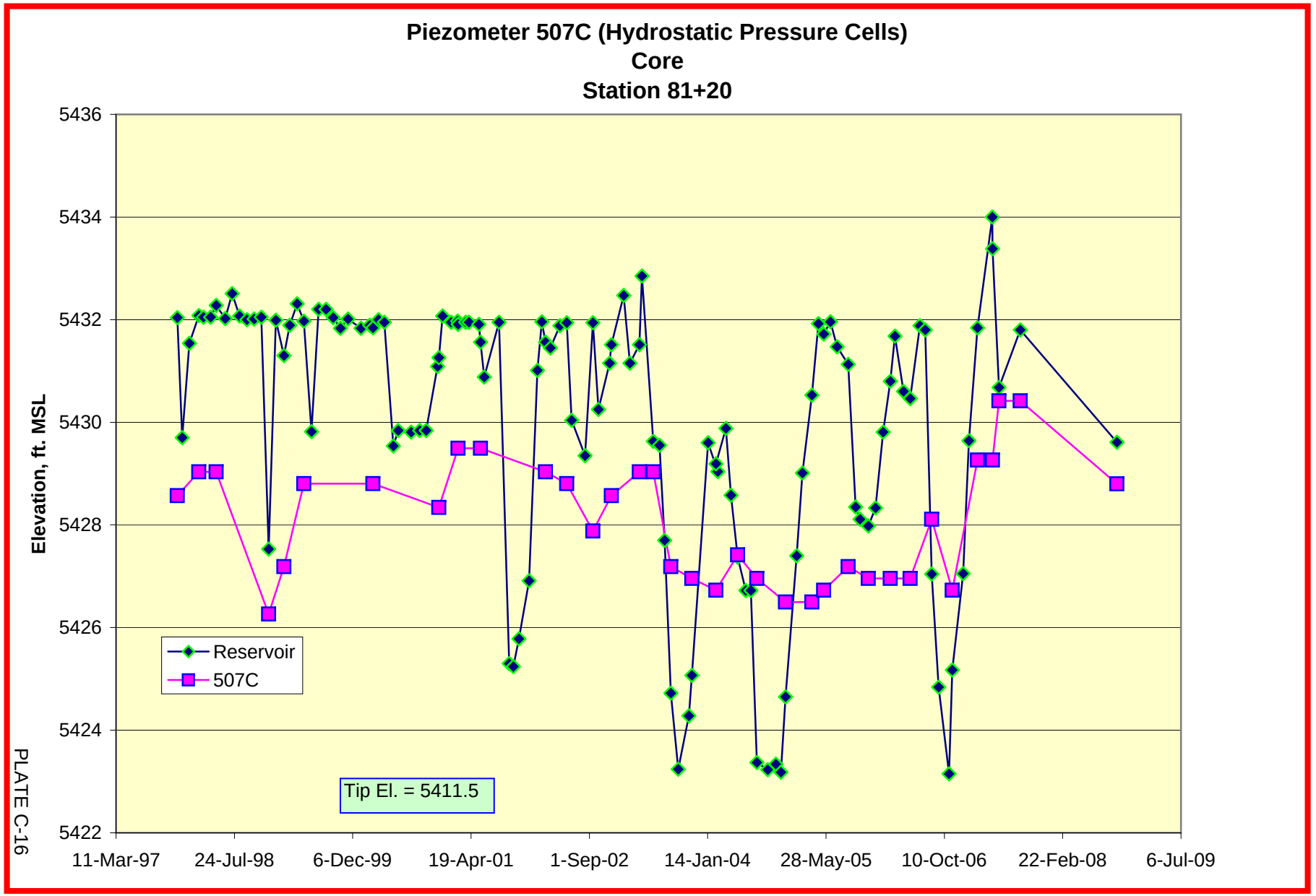


Embankment Station 101+35-102+00
Open Tube - May 2008 Data Res. El. (5431.15)
Pressure Cell - Oct 2008 Data Res. El.(5429.61)

Chatfield Dam and Lake, CO
Foundation Piezometer Observations
Station 101+35 to 102+00

RE-ALLOCATION STUDY PLATE C-14


Piezometer 502B (Hydroststic Pressure Cell)
Core
Station 68+90
Elevation, Ft. MSL
5440
5435
5430
5425
5420
5415
5410
5405
5400
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
Reservoir
502B
Tip El. = 5385.0
PLATE C-15


Piezometer 507C (Hydrostatic Pressure Cells)
Core
Station 81+20
Elevation, ft. MSL
5436
5434
5432
5430
5428
5426
5424
5422
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
Reservoir
507C
Tip El. = 5411.5
PLATE C-16

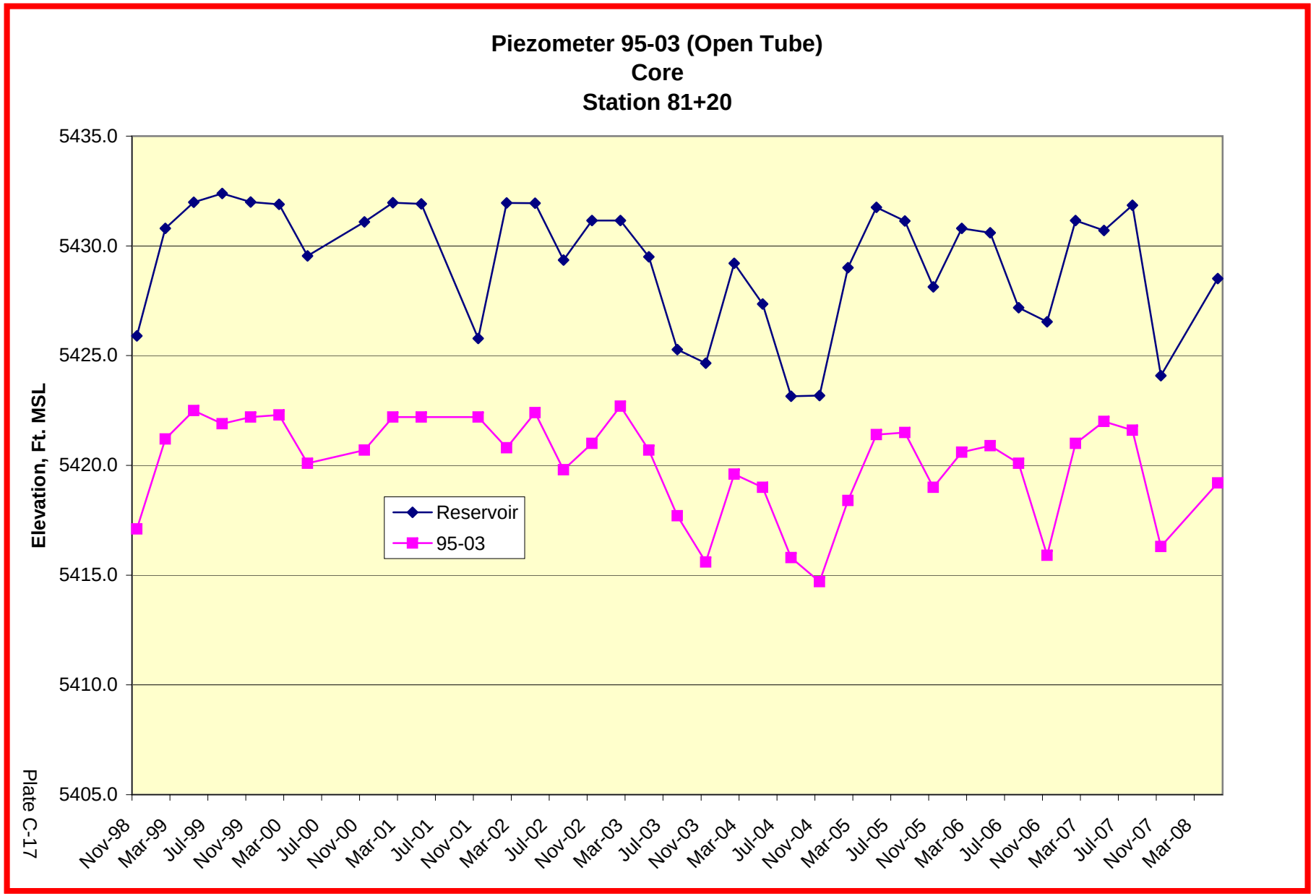

Piezometer 95-03 (Open Tube)
Core
Station 81+20
Elevation, Ft. MSL
5435.0
5430.0
5425.0
5420.0
5415.0
5410.0
5405.0
Reservoir
95-03
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08

Plate C-17

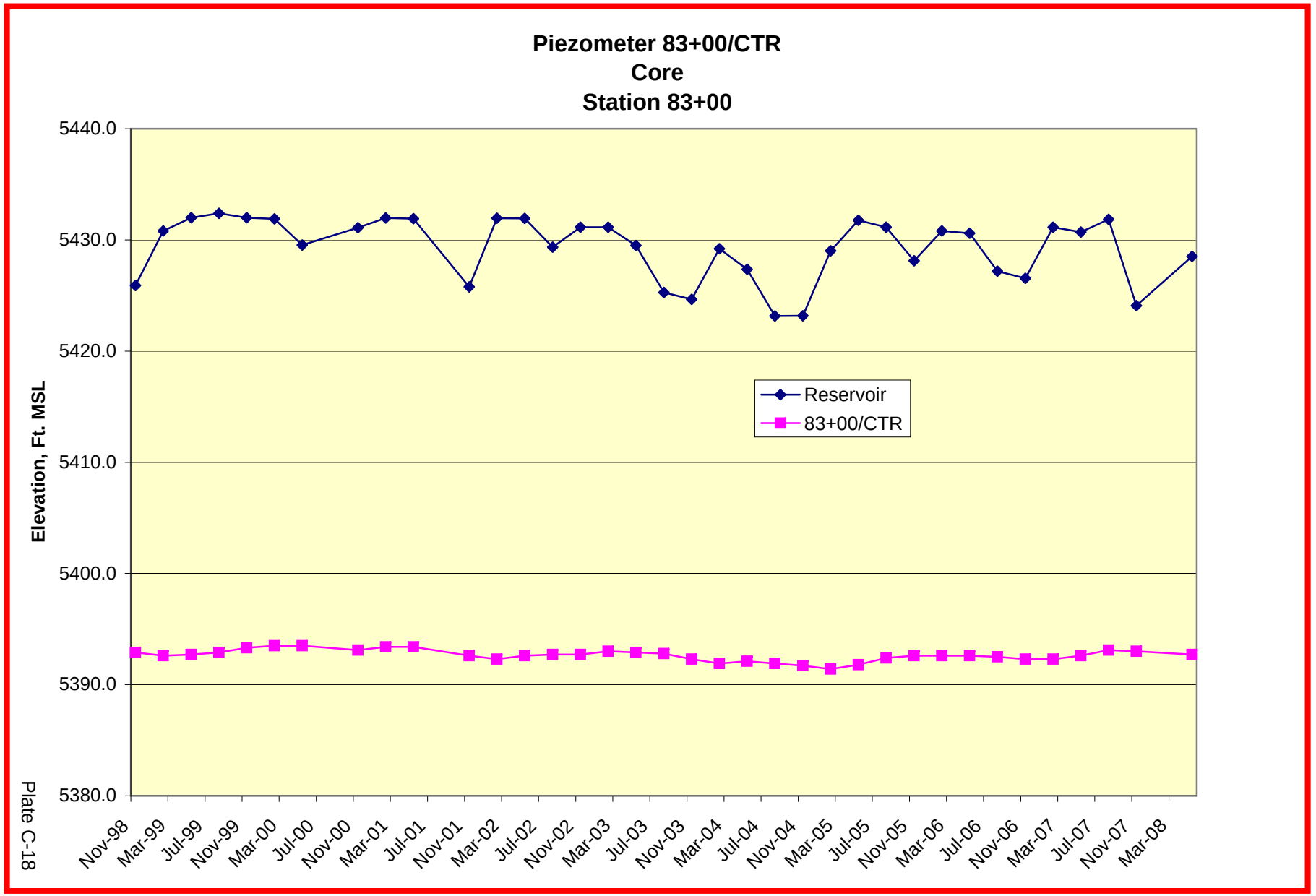

Piezometer 83+00/CTR
Core
Station 83+00
Elevation, Ft. MSL
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
Reservoir
83+00/CTR
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08

Plate C-18

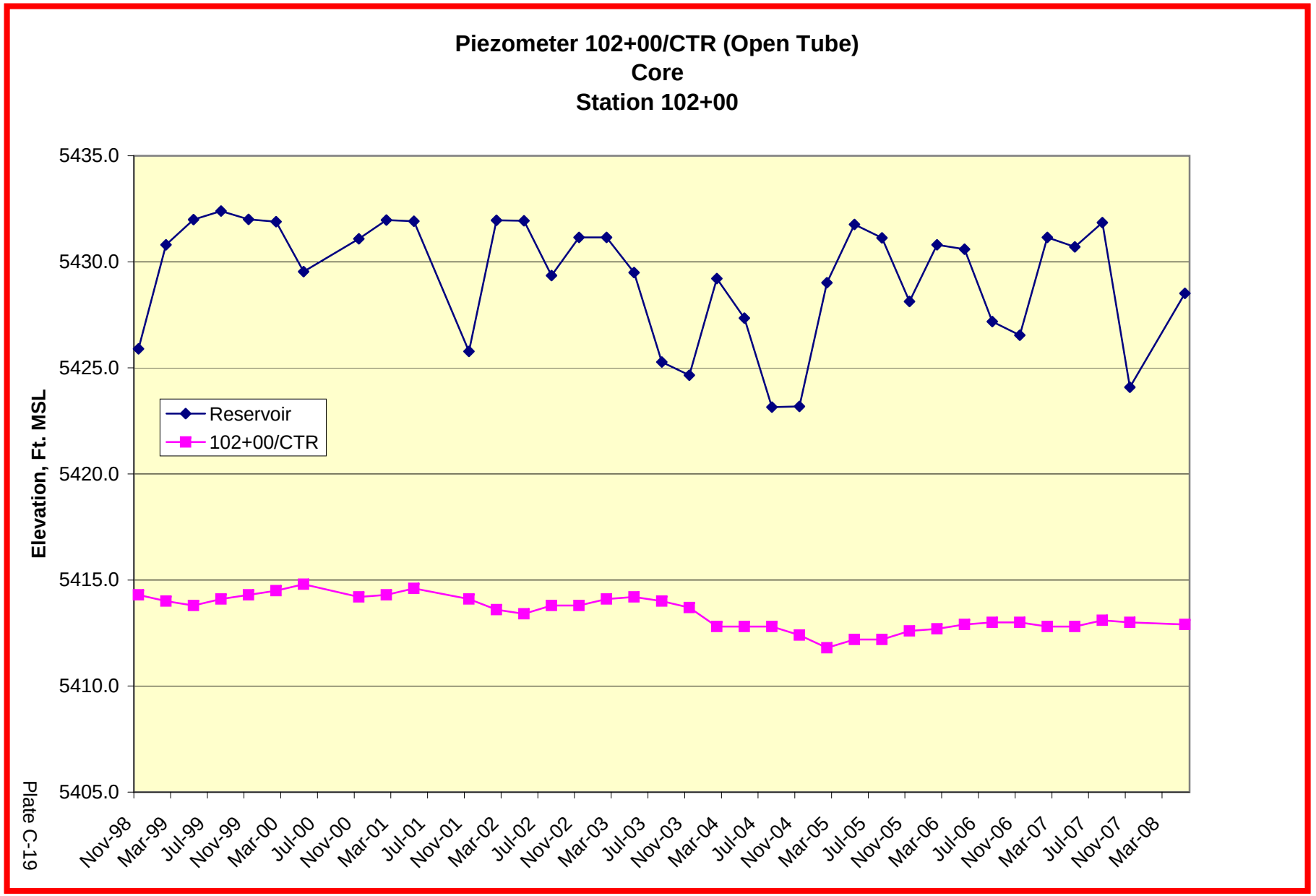

Piezometer 102+00/CTR (Open Tube)
Core
Station 102+00
Elevation, Ft. MSL
5435.0
5430.0
5425.0
5420.0
5415.0
5410.0
5405.0
Reservoir
102+00/CTR
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08

Plate C-19

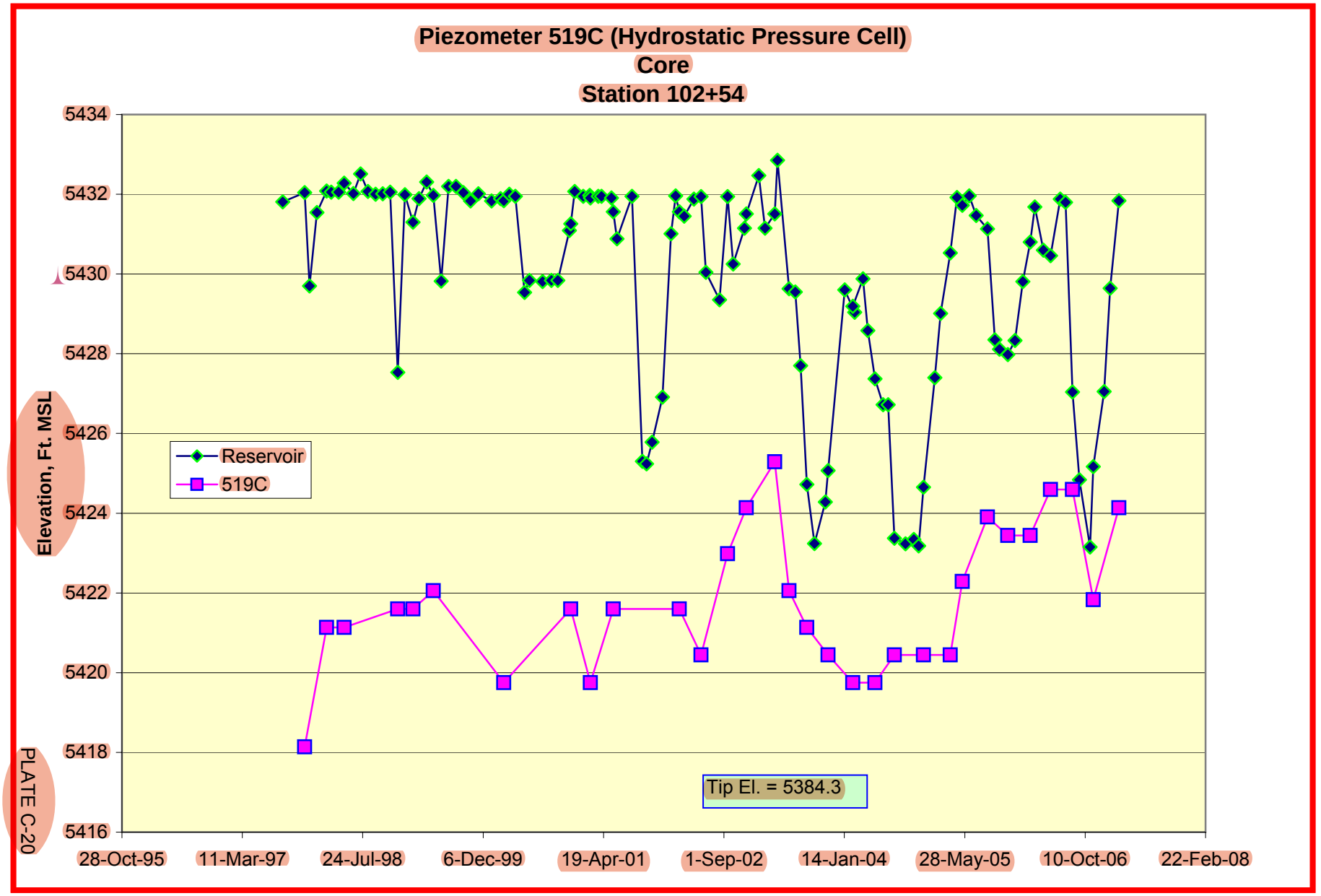
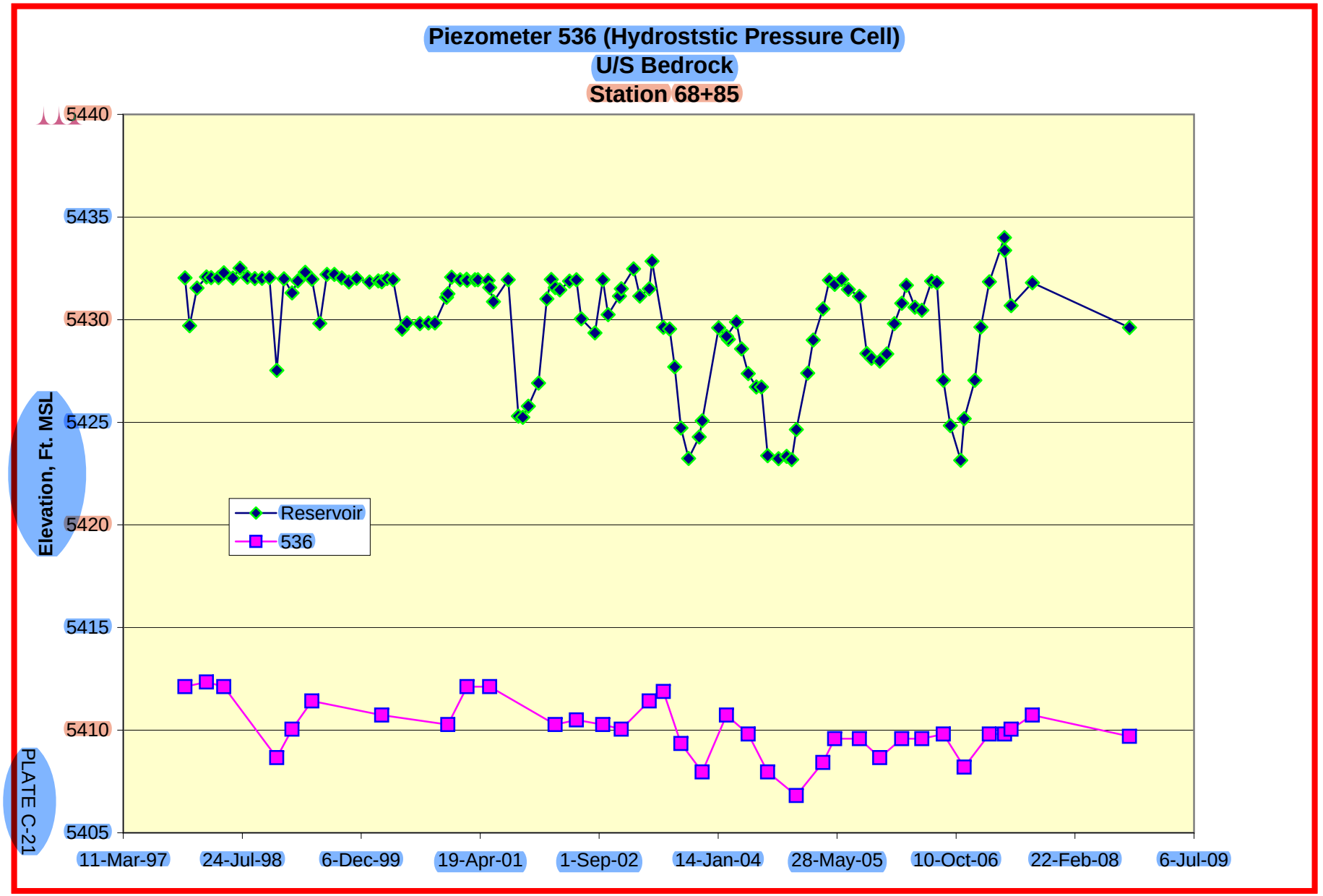
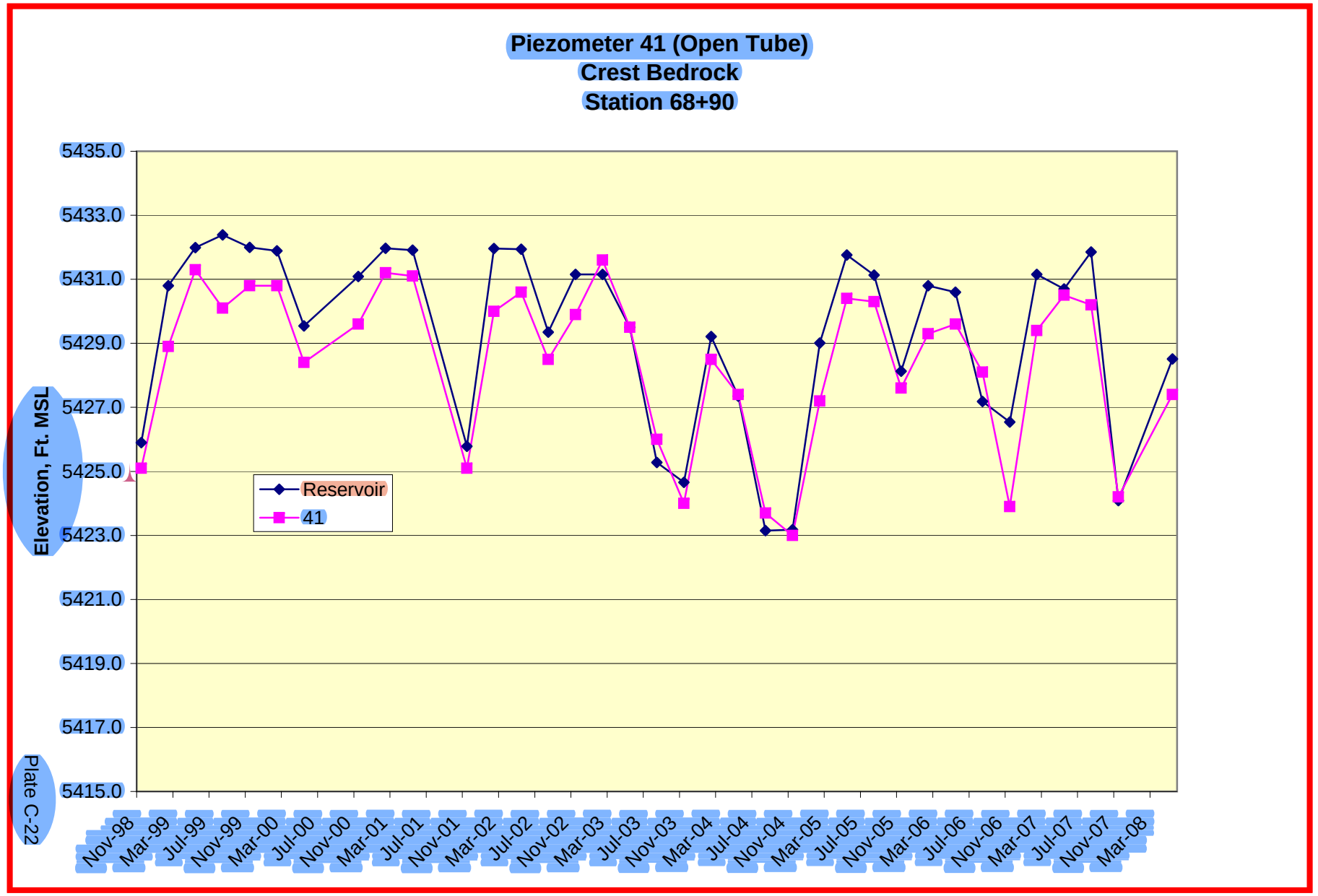
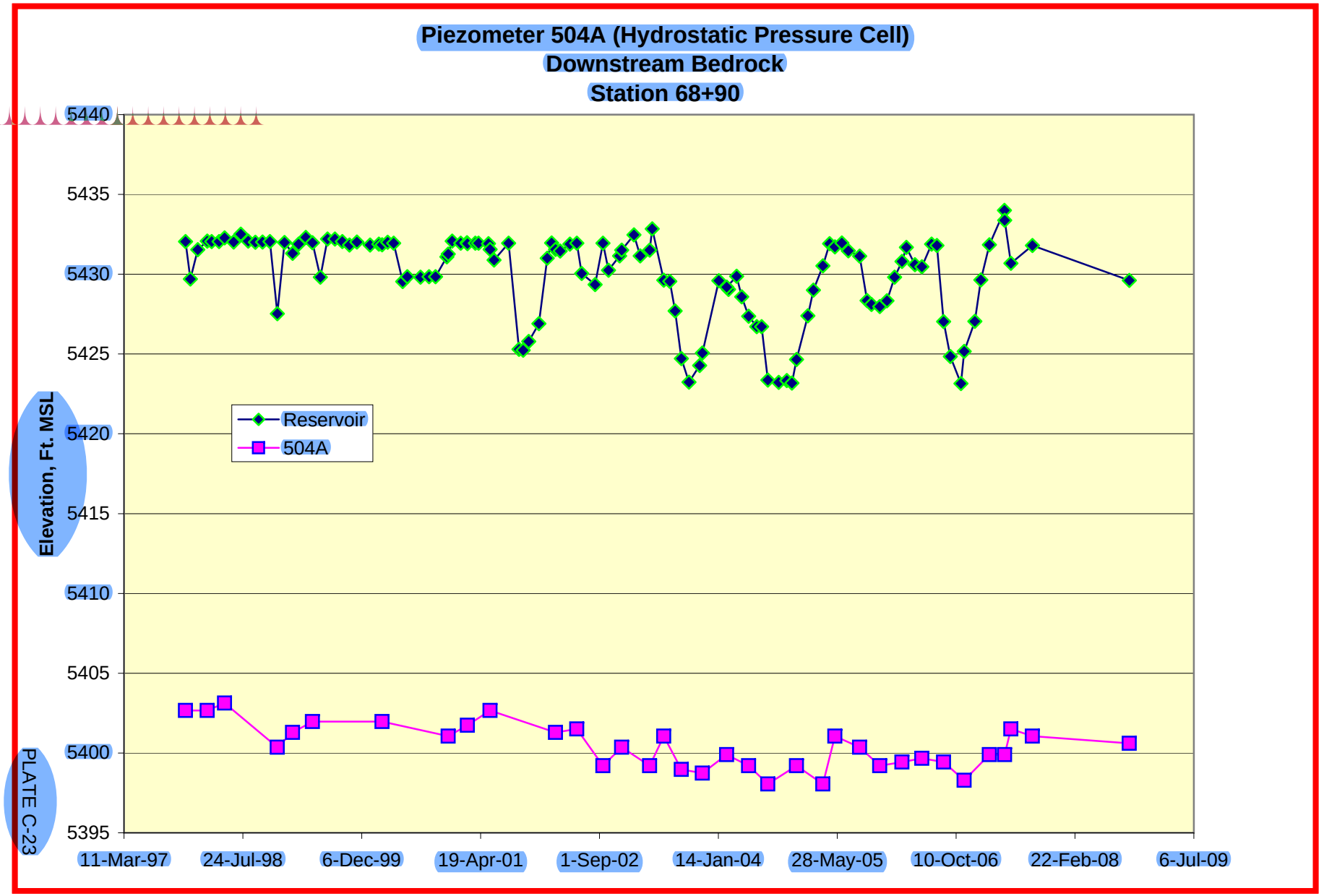
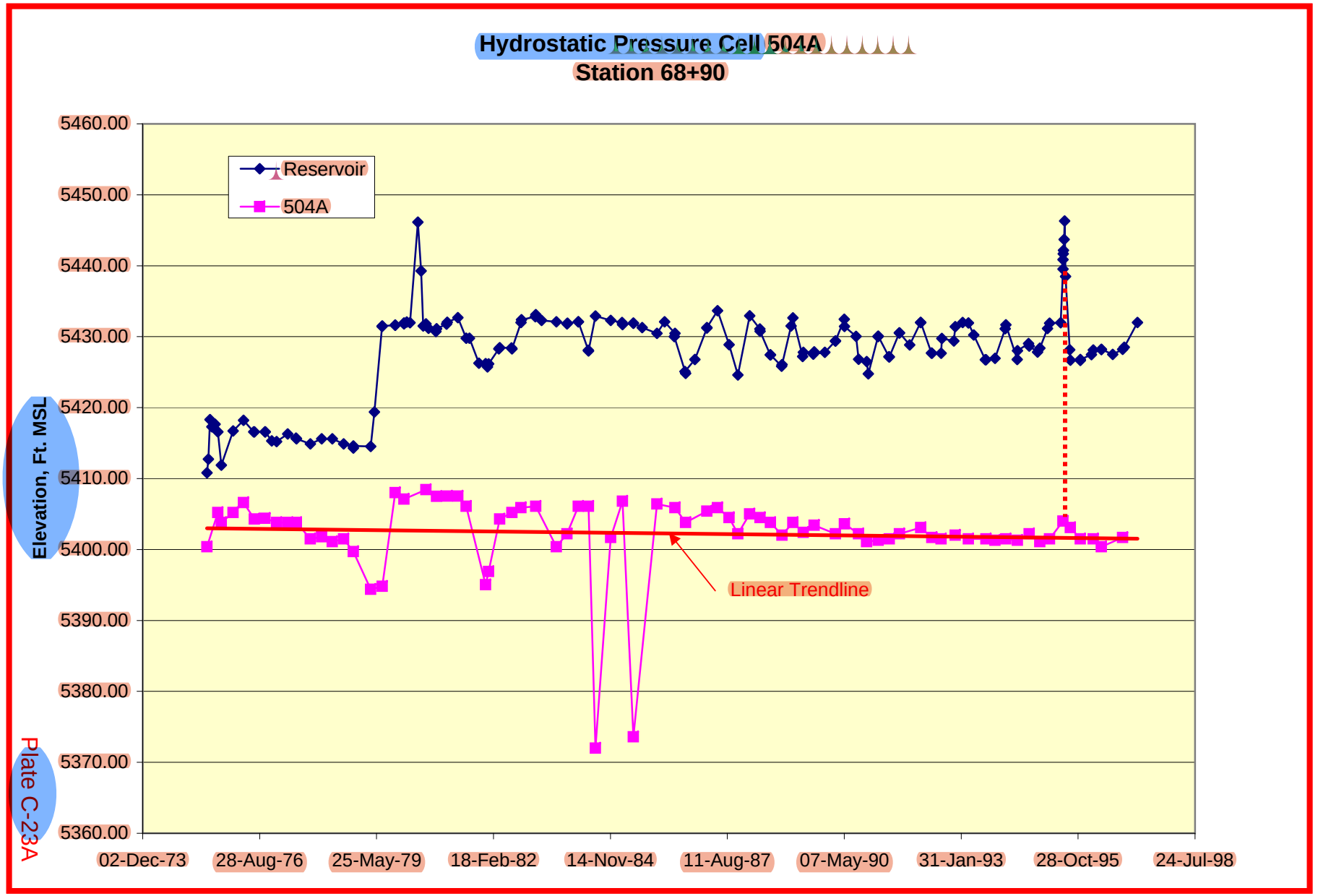

Piezometer 519C (Hydrostatic Pressure Cell)
Core
Station 102+54
Elevation, Ft. MSL
5434
5432
5430
5428
5426
5424
5422
5420
5418
5416
Reservoir
519C
Tip El. = 5384.3
28-Oct-95
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08

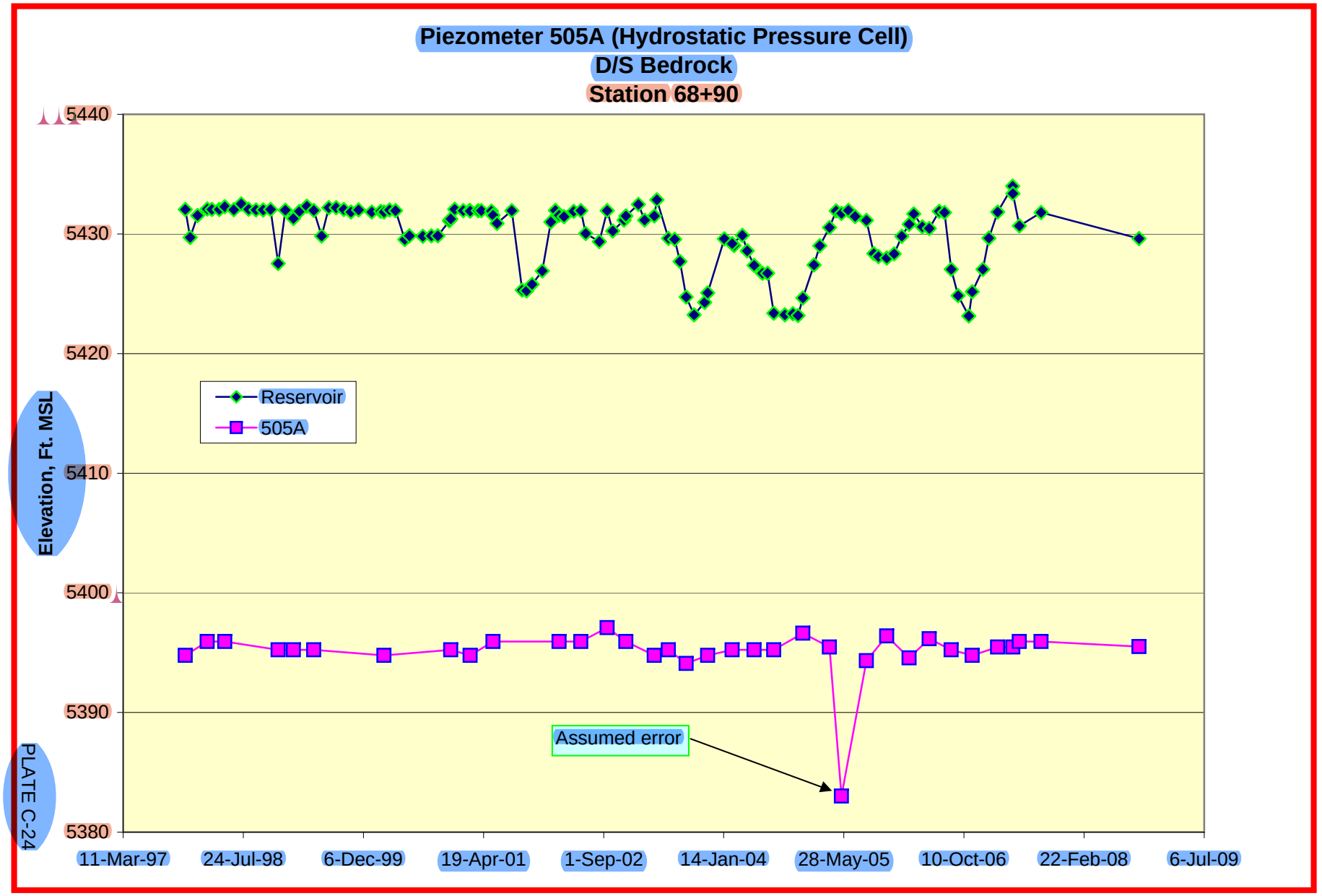
PLATE C-20

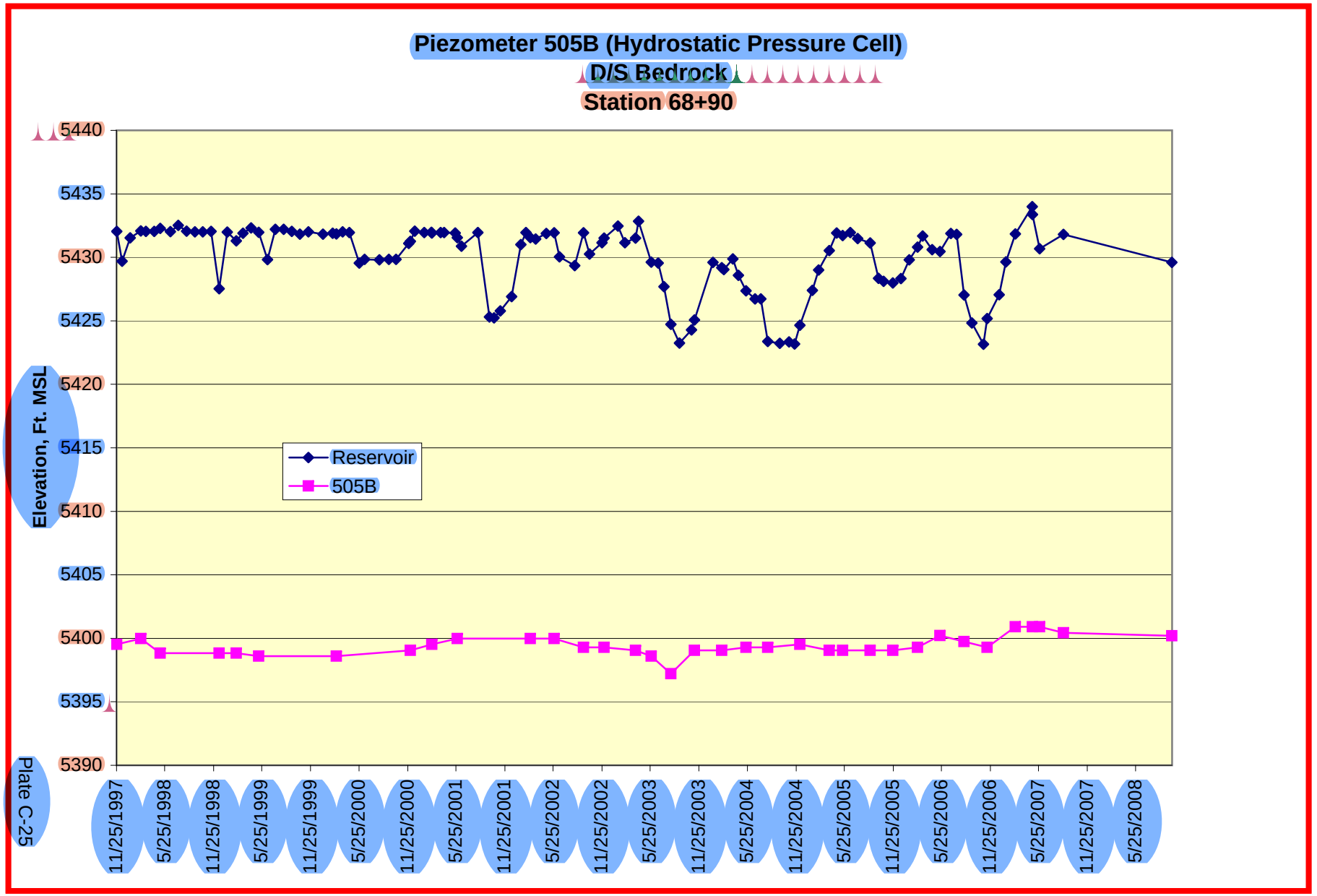

Piezometer 536 (Hydroststic Pressure Cell)
U/S Bedrock
Station 68+85
Elevation, Ft. MSL
5440
5435
5430
5425
5420
5415
5410
5405
Reservoir
536
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
PLATE C-21

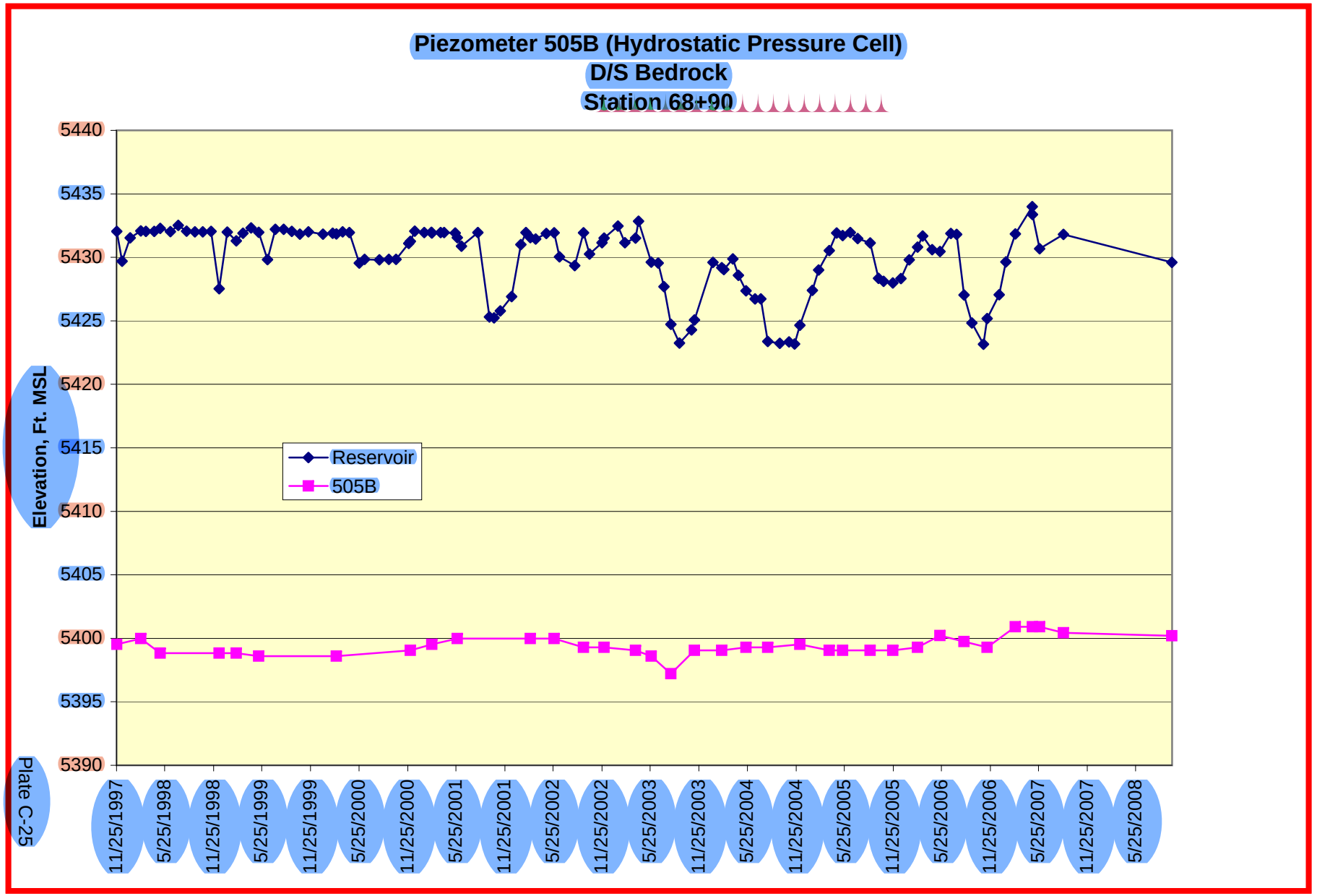

Piezometer 41 (Open Tube)
Crest Bedrock
Station 68+90
Elevation, Ft. MSL
5435.0
5433.0
5431.0
5429.0
5427.0
5425.0
5423.0
5421.0
5419.0
5417.0
5415.0
Reservoir
41
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-22

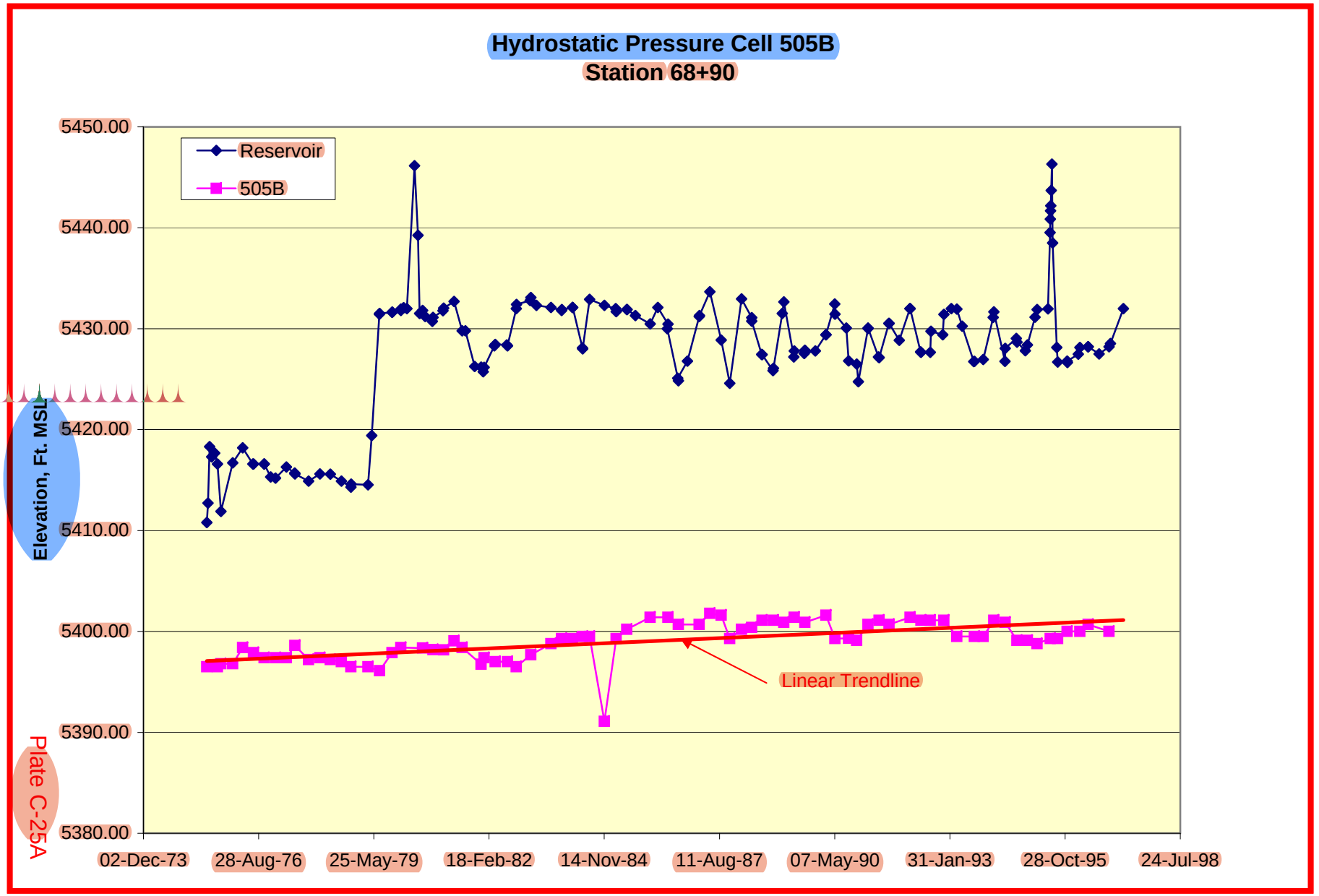

Piezometer 504A (Hydrostatic Pressure Cell)
Downstream Bedrock
Station 68+90
Elevation, Ft. MSL
5440
5435
5430
5425
5420
5415
5410
5405
5400
5395
Reservoir
504A
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
PLATE C-23


Hydrostatic Pressure Cell 504A
Station 68+90
Reservoir
504A
Linear Trendline
Elevation, Ft. MSL
5460.00
5450.00
5440.00
5430.00
5420.00
5410.00
5400.00
5390.00
5380.00
5370.00
5360.00
02-Dec-73
28-Aug-76
25-May-79
18-Feb-82
14-Nov-84
11-Aug-87
07-May-90
31-Jan-93
28-Oct-95
24-Jul-98
Plate C-23A


Piezometer 505A (Hydrostatic Pressure Cell)
D/S Bedrock
Station 68+90
5440
5430
5420
5410
5400
5390
5380
Elevation, Ft. MSL
Reservoir
505A
Assumed error
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
PLATE C-24


Piezometer 505B (Hydrostatic Pressure Cell)
D/S Bedrock
Station 68+90
Elevation, Ft. MSL
5440
5435
5430
5425
5420
5415
5410
5405
5400
5395
5390
Reservoir
505B
11/25/1997
5/25/1998
11/25/1998
5/25/1999
11/25/1999
5/25/2000
11/25/2000
5/25/2001
11/25/2001
5/25/2002
11/25/2002
5/25/2003
11/25/2003
5/25/2004
11/25/2004
5/25/2005
11/25/2005
5/25/2006
11/25/2006
5/25/2007
11/25/2007
5/25/2008
Plate C-25


Piezometer 505B (Hydrostatic Pressure Cell)
D/S Bedrock
Station 68+90
Elevation, Ft. MSL
5440
5435
5430
5425
5420
5415
5410
5405
5400
5395
5390
Reservoir
505B
11/25/1997
5/25/1998
11/25/1998
5/25/1999
11/25/1999
5/25/2000
11/25/2000
5/25/2001
11/25/2001
5/25/2002
11/25/2002
5/25/2003
11/25/2003
5/25/2004
11/25/2004
5/25/2005
11/25/2005
5/25/2006
11/25/2006
5/25/2007
11/25/2007
5/25/2008
Plate C-25


Hydrostatic Pressure Cell 505B
Station 68+90
Reservoir
505B
Linear Trendline
Elevation, Ft. MSL
5450.00
5440.00
5430.00
5420.00
5410.00
5400.00
5390.00
5380.00
02-Dec-73
28-Aug-76
25-May-79
18-Feb-82
14-Nov-84
11-Aug-87
07-May-90
31-Jan-93
28-Oct-95
24-Jul-98
Plate C-25A

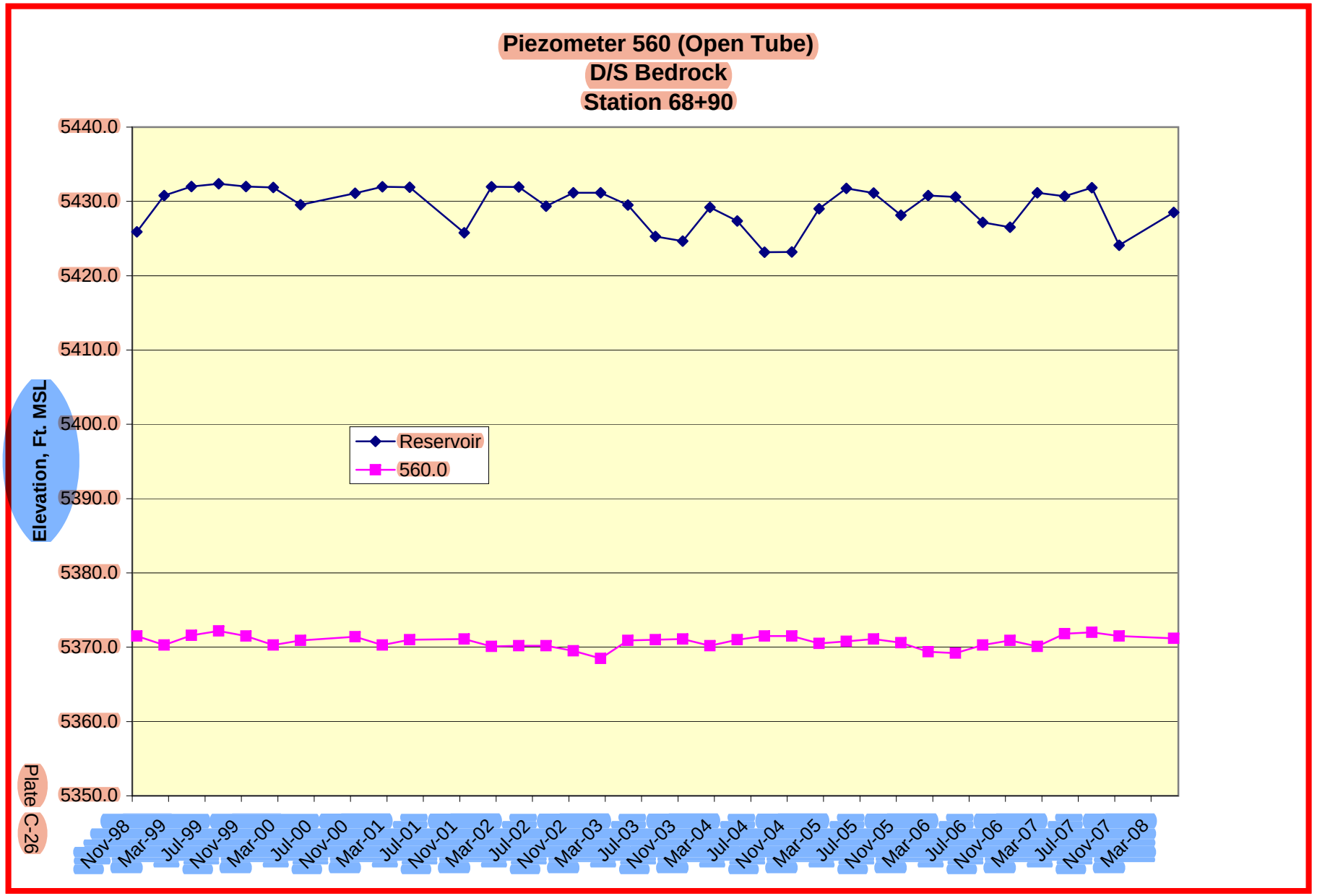

Piezometer 560 (Open Tube)
D/S Bedrock
Station 68+90
Elevation, Ft. MSL
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
5370.0
5360.0
5350.0
Reservoir
560.0
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08

Plate C-26

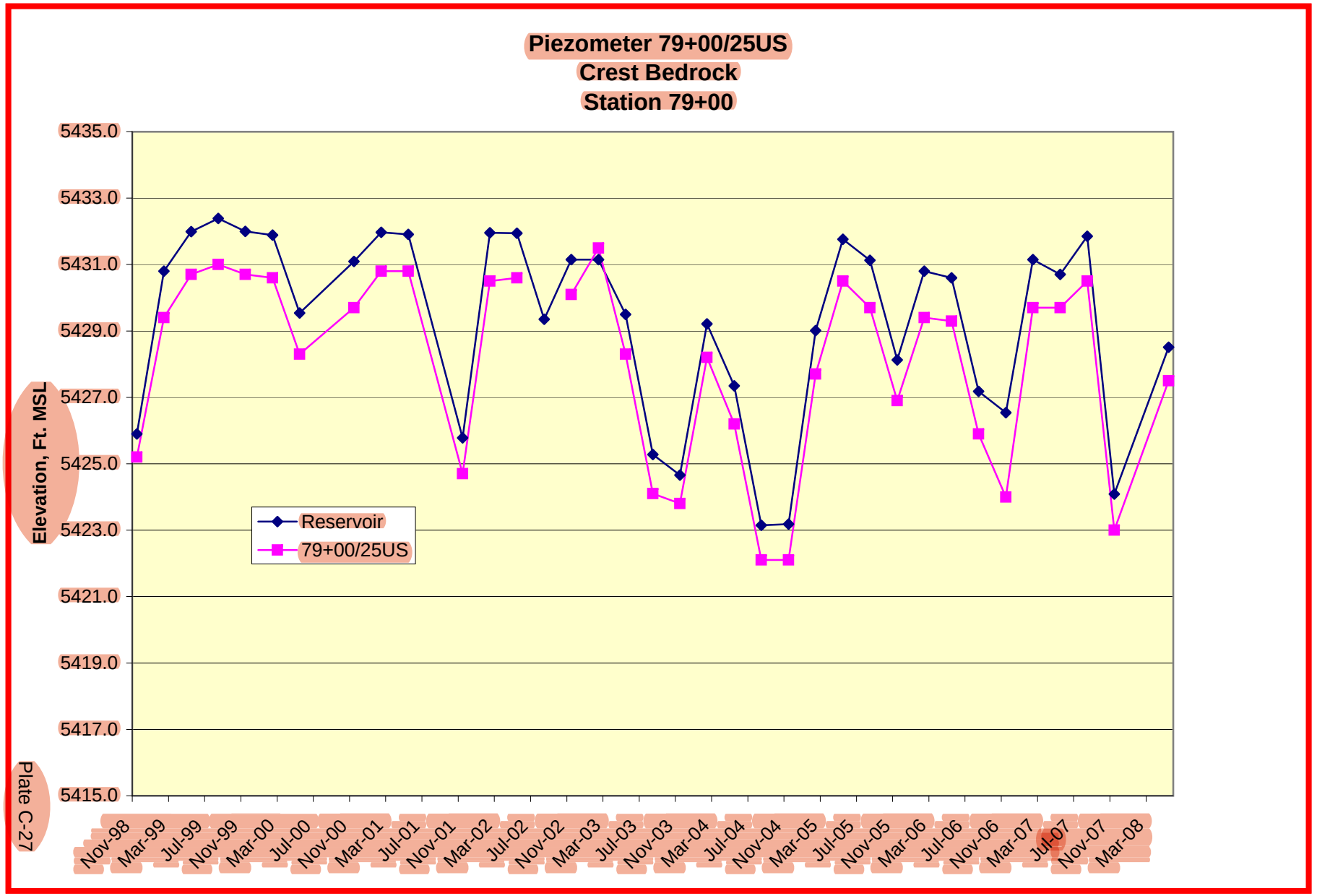
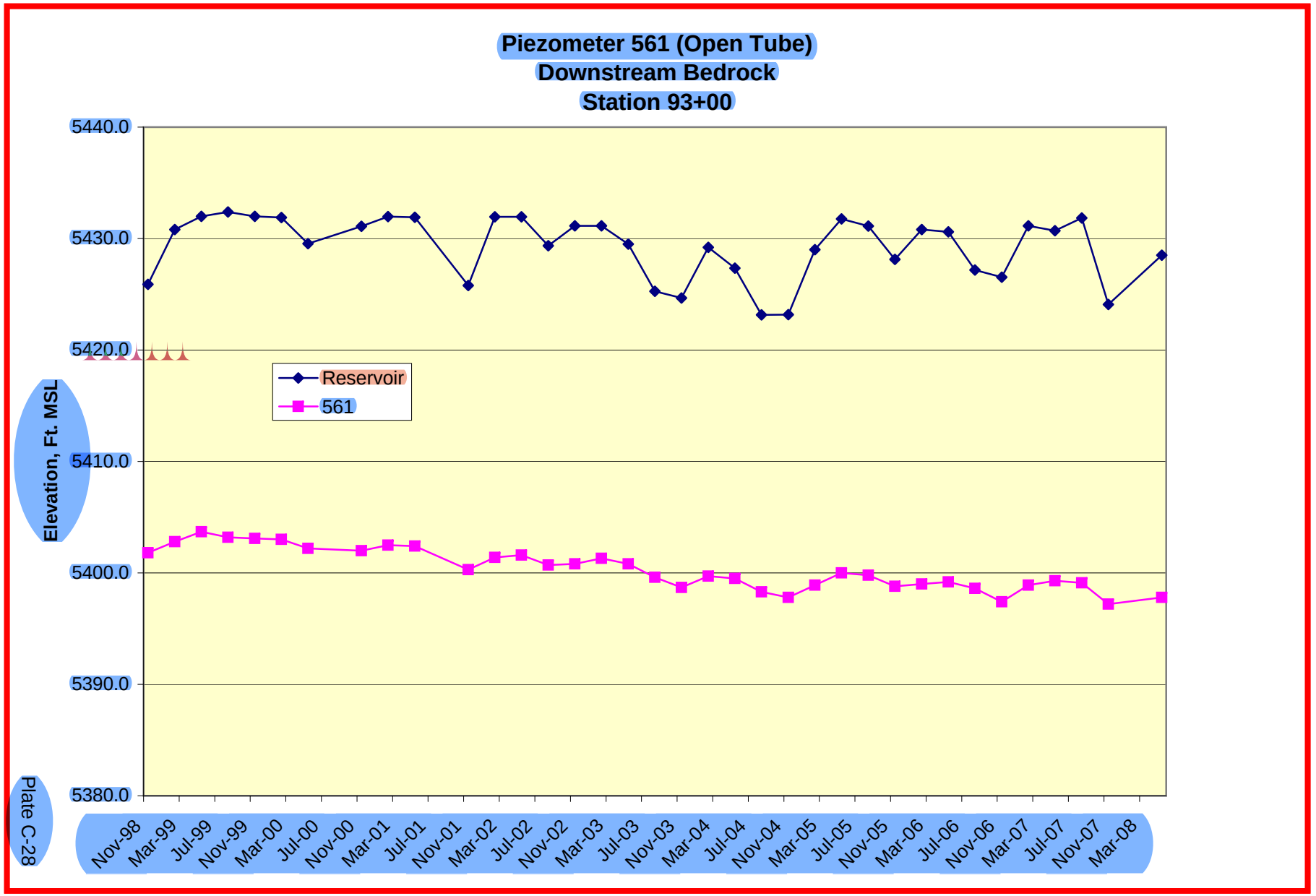
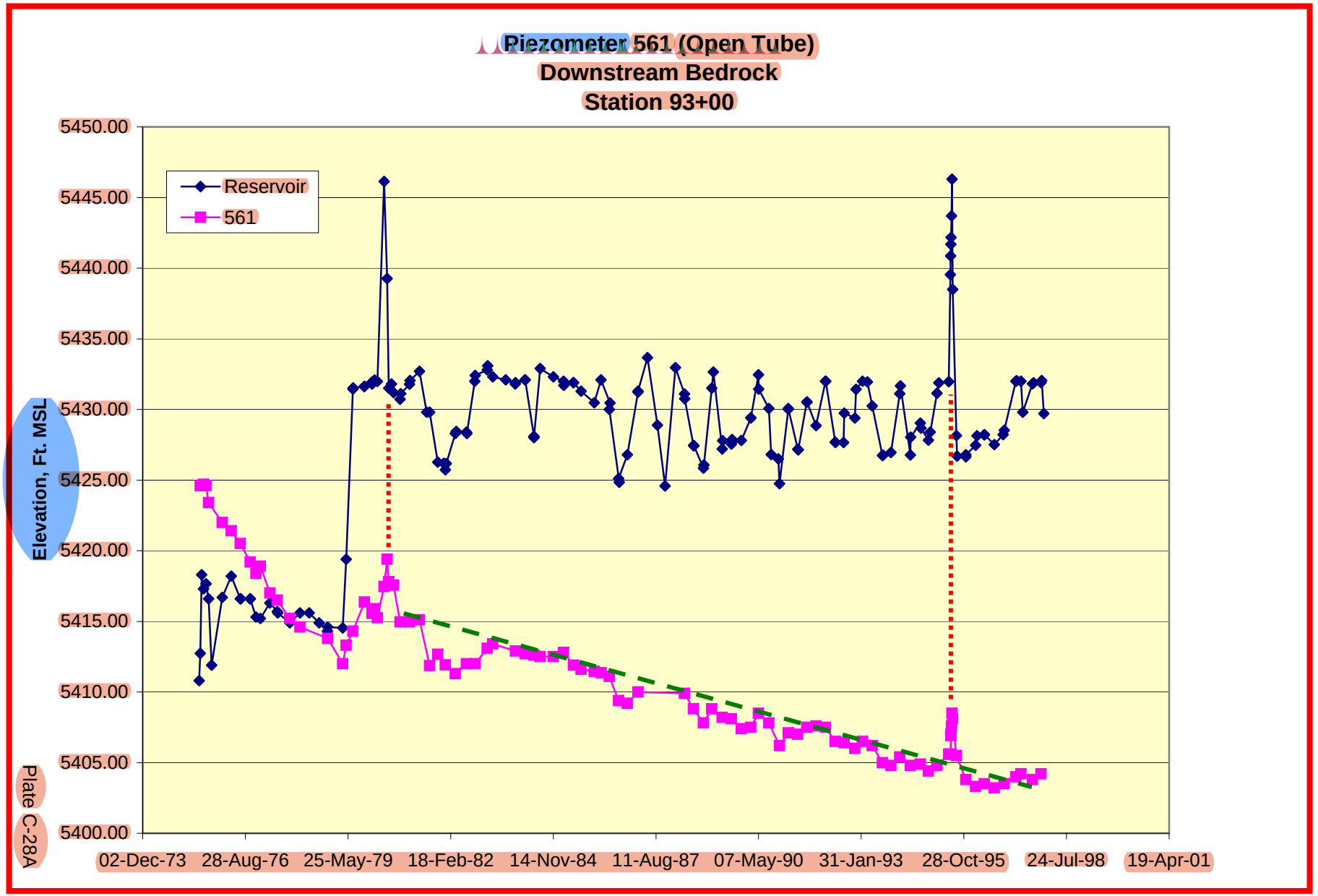
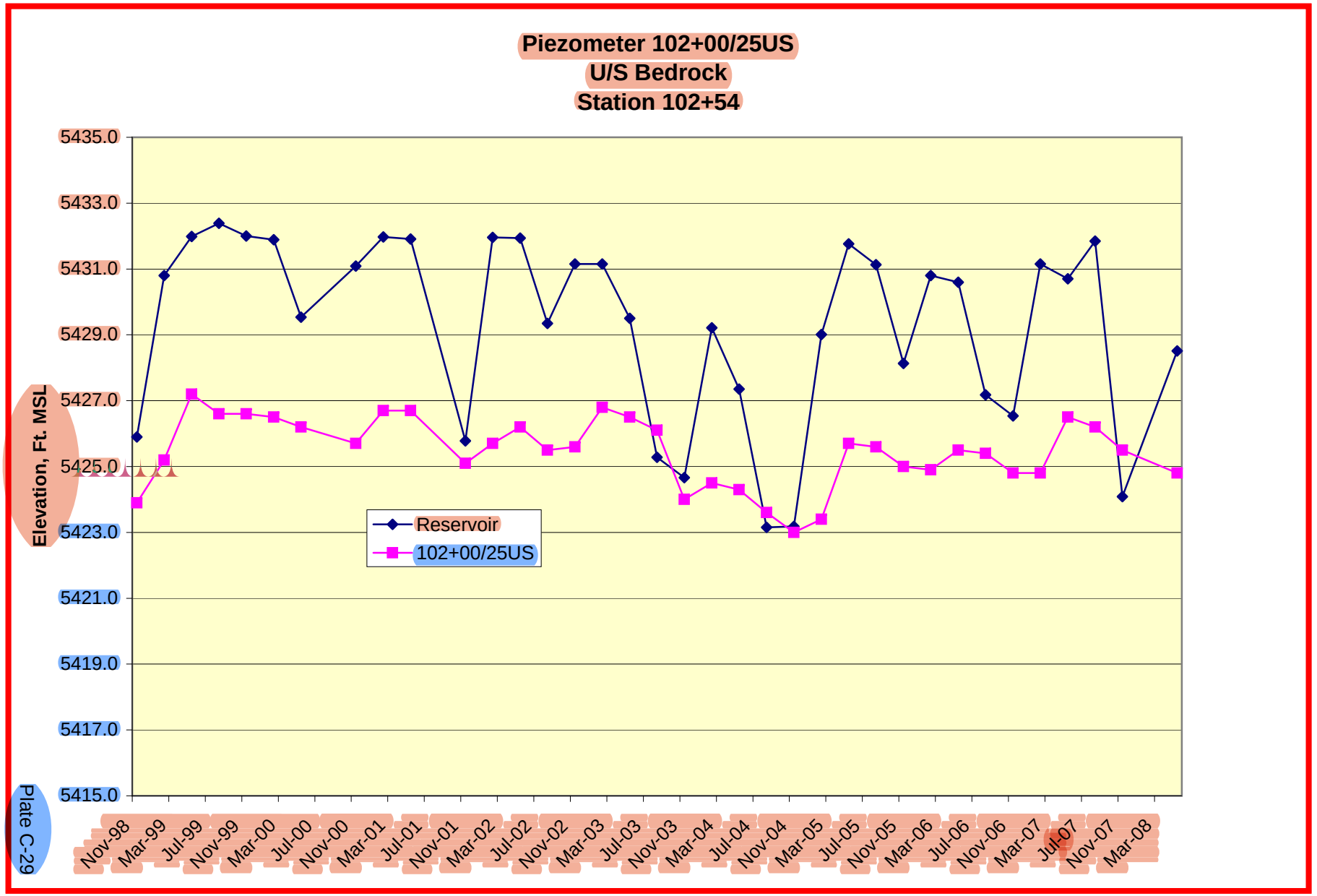

Piezometer 79+00/25US
Crest Bedrock
Station 79+00
Elevation, Ft. MSL
5435.0
5433.0
5431.0
5429.0
5427.0
5425.0
5423.0
5421.0
5419.0
5417.0
5415.0
Reservoir
79+00/25US
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08

Plate C-27


Piezometer 561 (Open Tube)
Downstream Bedrock
Station 93+00
Elevation, Ft. MSL
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
Reservoir
561
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-28


Piezometer 561 (Open Tube)
Downstream Bedrock
Station 93+00
Reservoir
561
Elevation, Ft. MSL
5450.00
5445.00
5440.00
5435.00
5430.00
5425.00
5420.00
5415.00
5410.00
5405.00
5400.00
02-Dec-73
28-Aug-76
25-May-79
18-Feb-82
14-Nov-84
11-Aug-87
07-May-90
31-Jan-93
28-Oct-95
24-Jul-98
19-Apr-01
Plate C-28A


Piezometer 102+00/25US
U/S Bedrock
Station 102+54
Elevation, Ft. MSL
5435.0
5433.0
5431.0
5429.0
5427.0
5425.0
5423.0
5421.0
5419.0
5417.0
5415.0
Reservoir
102+00/25US
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
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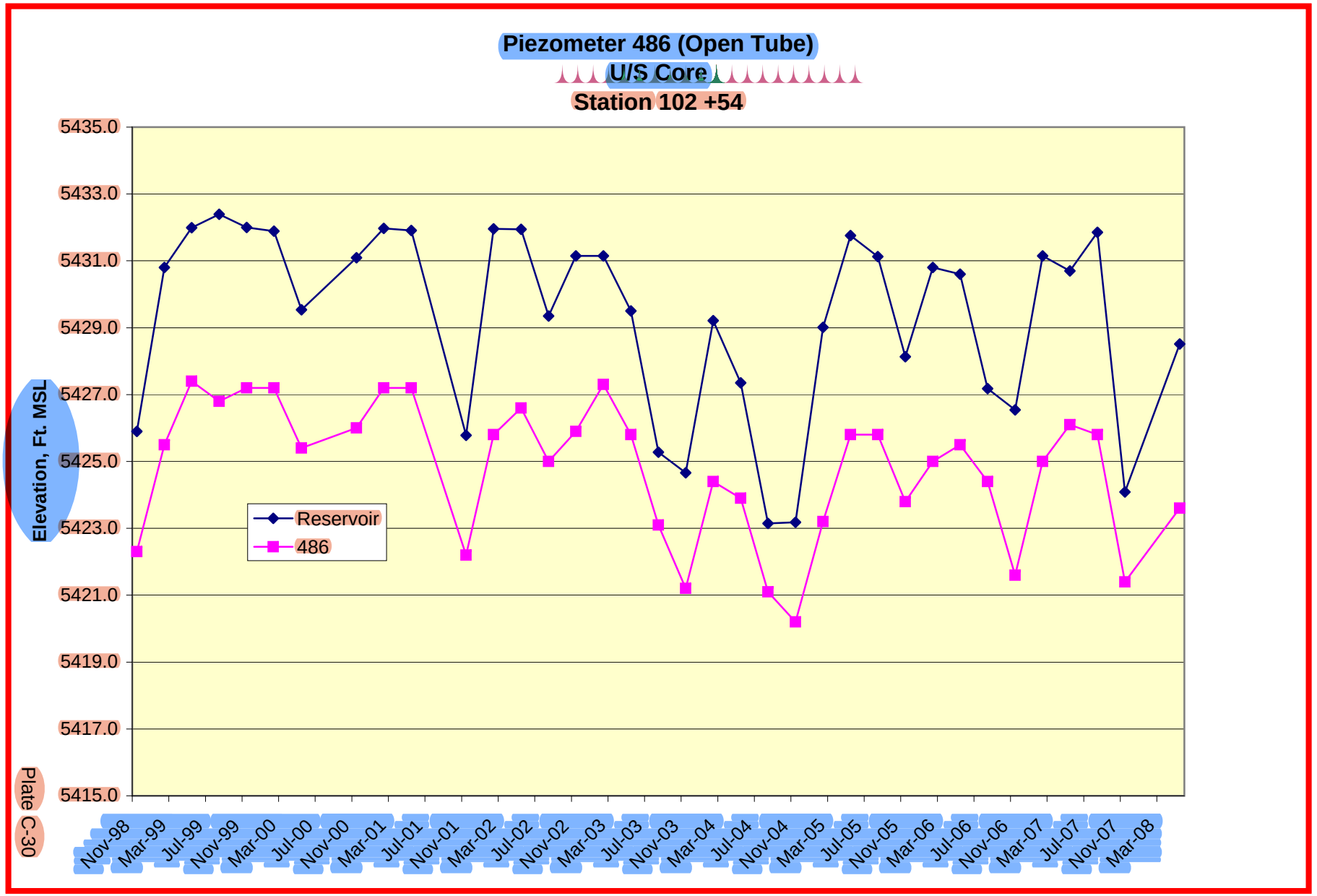
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-29


Piezometer 486 (Open Tube)
U/S Core
Station 102 +54
Elevation, Ft. MSL
5435.0
5433.0
5431.0
5429.0
5427.0
5425.0
5423.0
5421.0
5419.0
5417.0
5415.0
Reservoir
486
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
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Nov-05
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Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-30

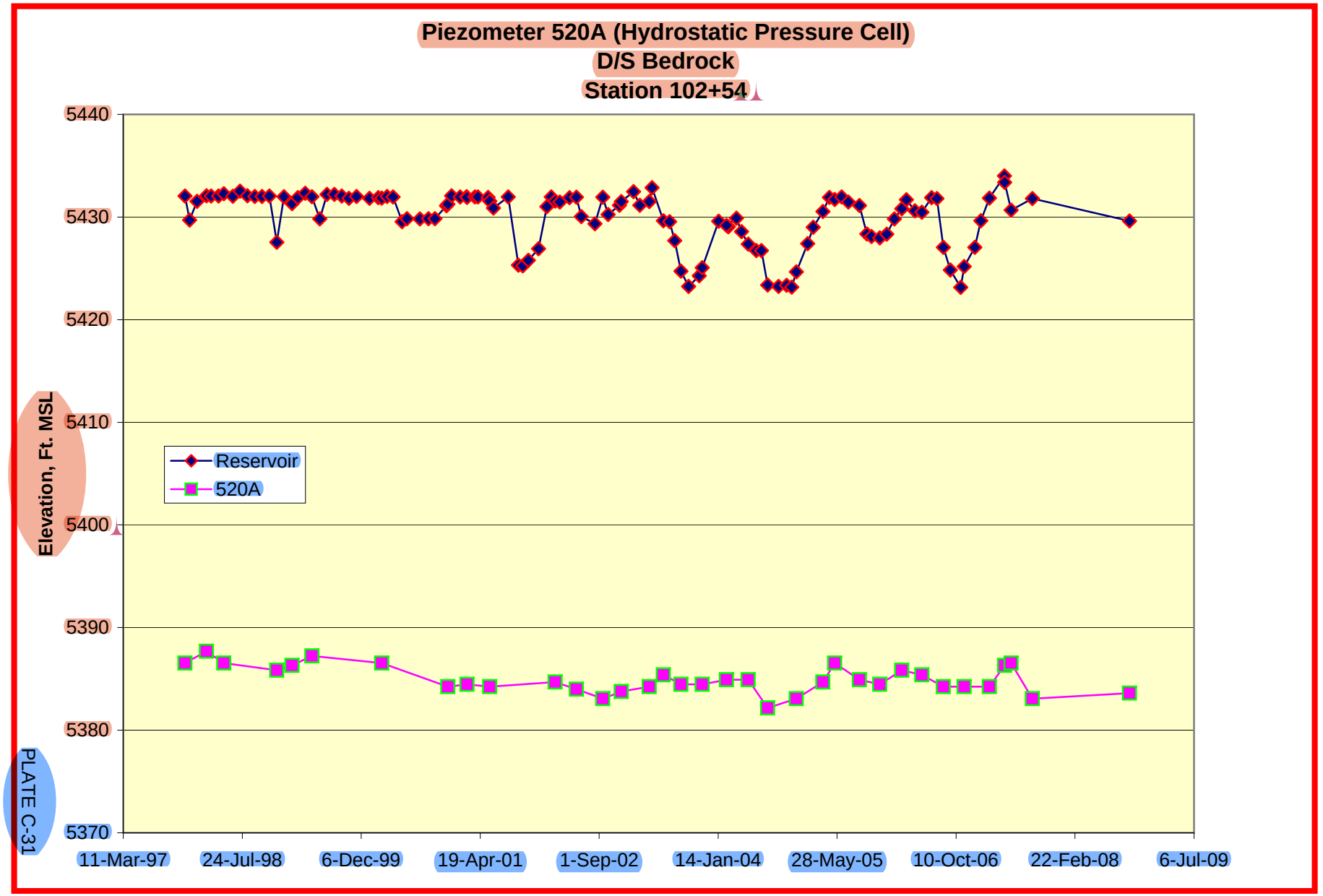
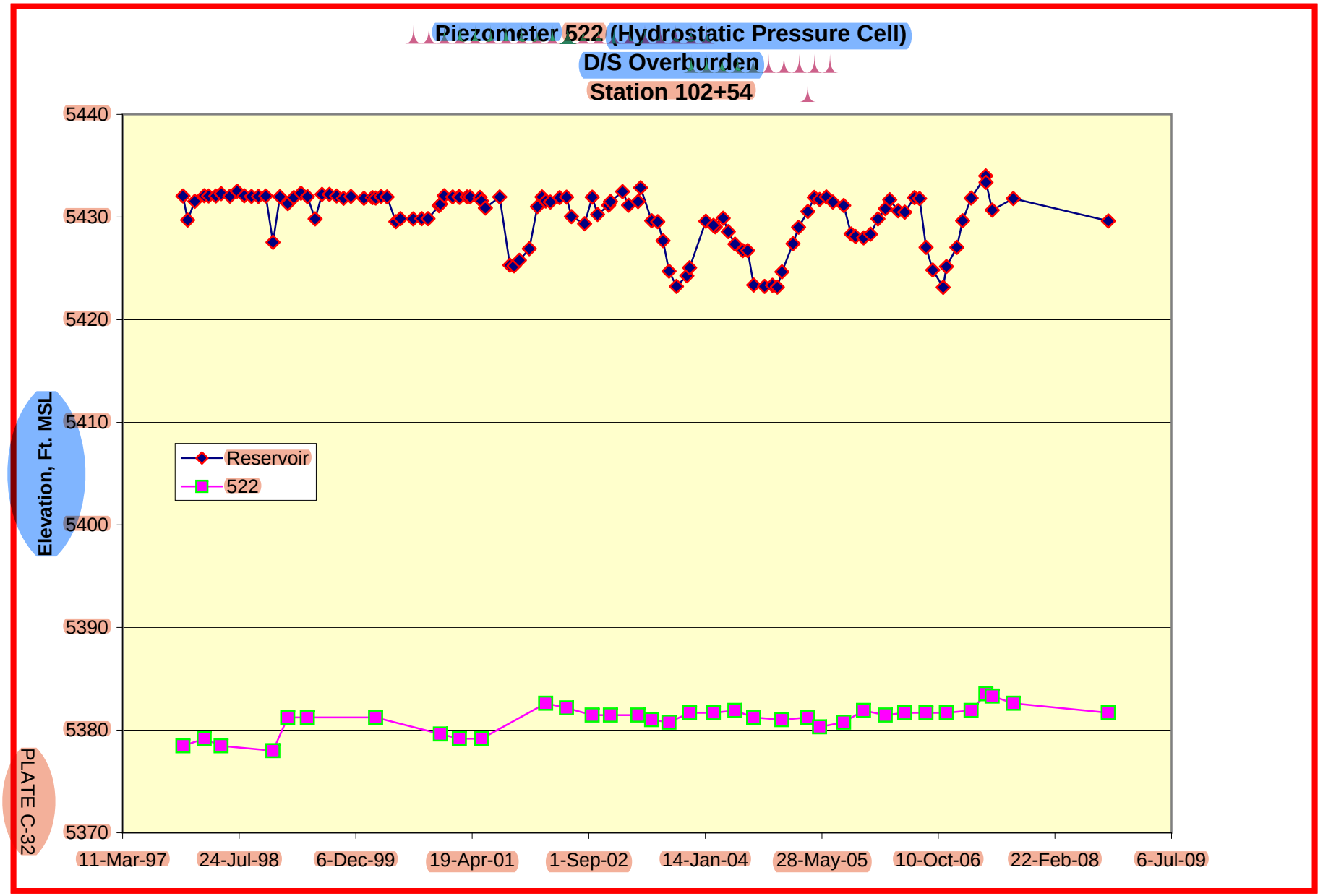
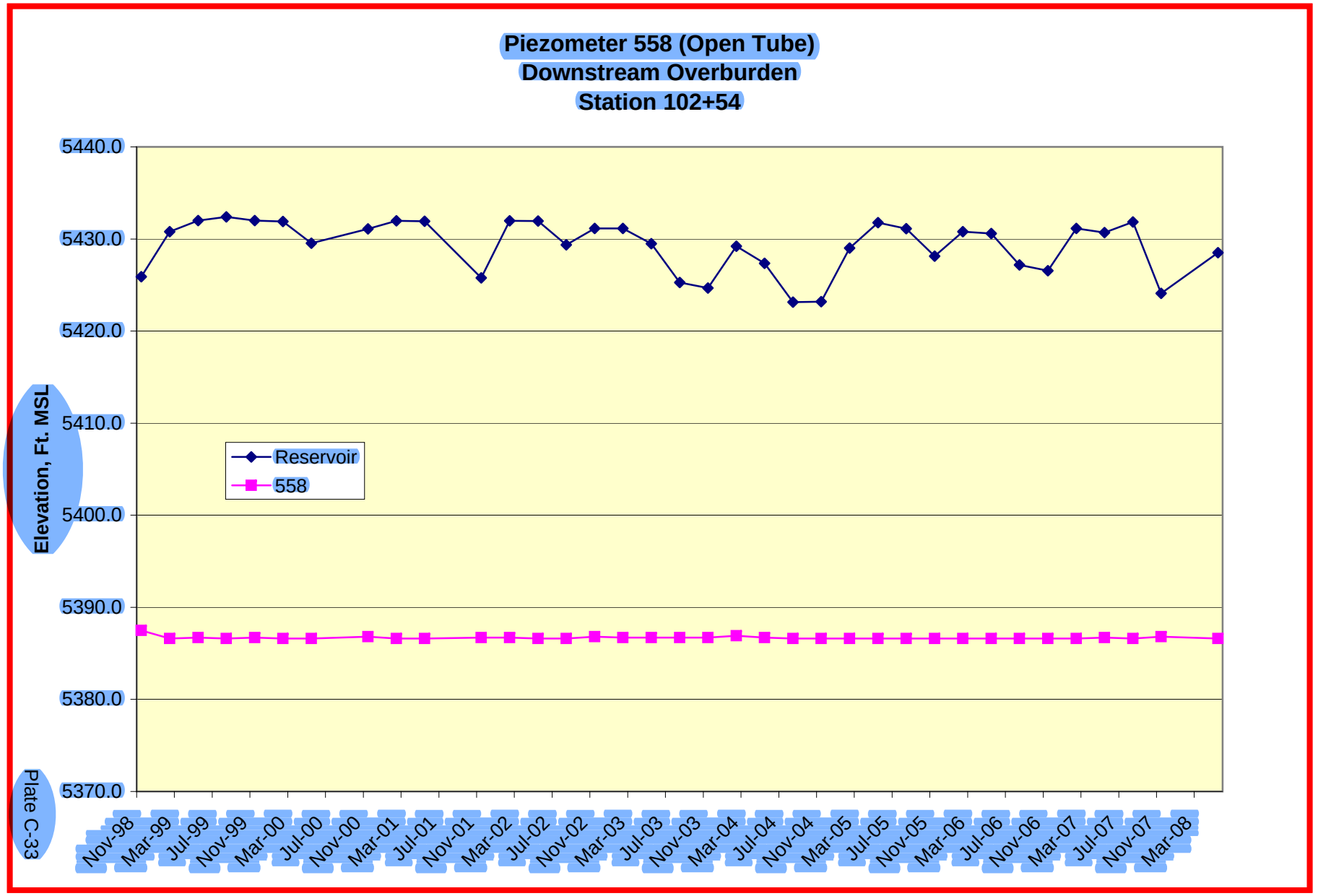
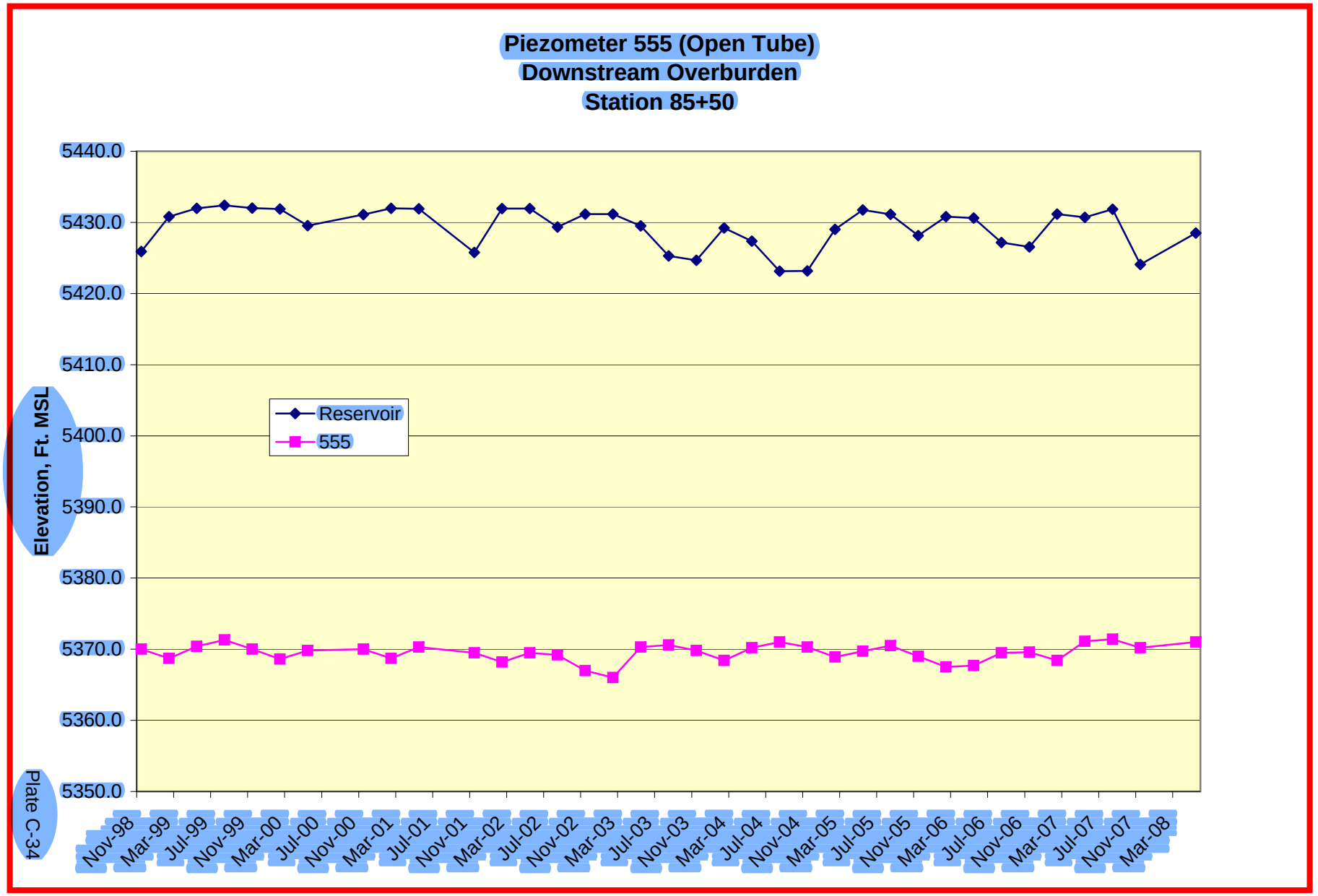

Piezometer 520A (Hydrostatic Pressure Cell)
D/S Bedrock
Station 102+54
Elevation, Ft. MSL
5440
5430
5420
5410
5400
5390
5380
5370
Reservoir
520A
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09

PLATE C-31


Piezometer 522 (Hydrostatic Pressure Cell)
D/S Overburden
Station 102+54
Elevation, Ft. MSL
5440
5430
5420
5410
5400
5390
5380
5370
Reservoir
522
11-Mar-97
24-Jul-98
6-Dec-99
19-Apr-01
1-Sep-02
14-Jan-04
28-May-05
10-Oct-06
22-Feb-08
6-Jul-09
PLATE C-32


Piezometer 558 (Open Tube)
Downstream Overburden
Station 102+54
Elevation, Ft. MSL
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
5370.0
Reservoir
558
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-33


Piezometer 555 (Open Tube)
Downstream Overburden
Station 85+50
Elevation, Ft. MSL
5440.0
5430.0
5420.0
5410.0
5400.0
5390.0
5380.0
5370.0
5360.0
5350.0
Reservoir
555
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
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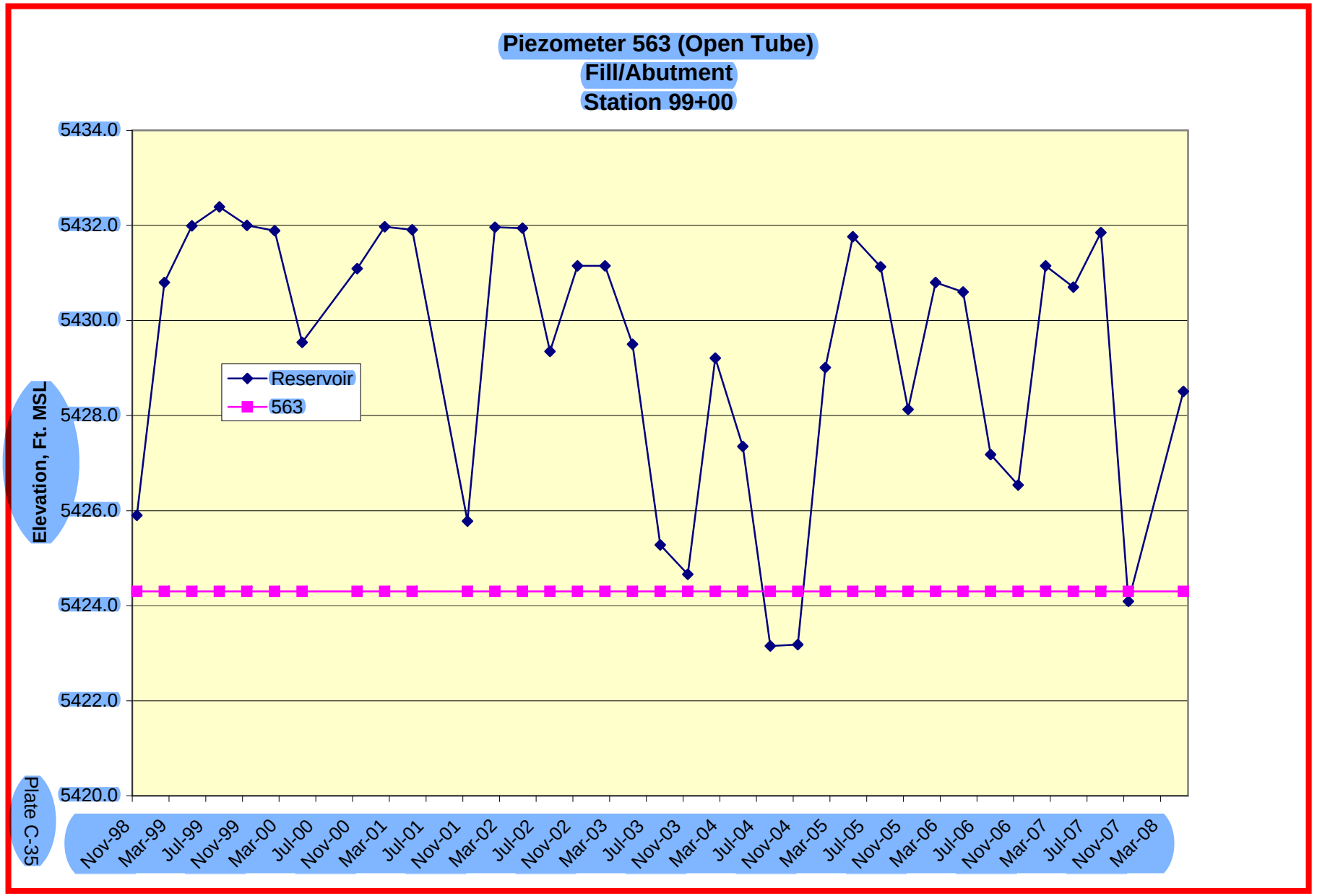
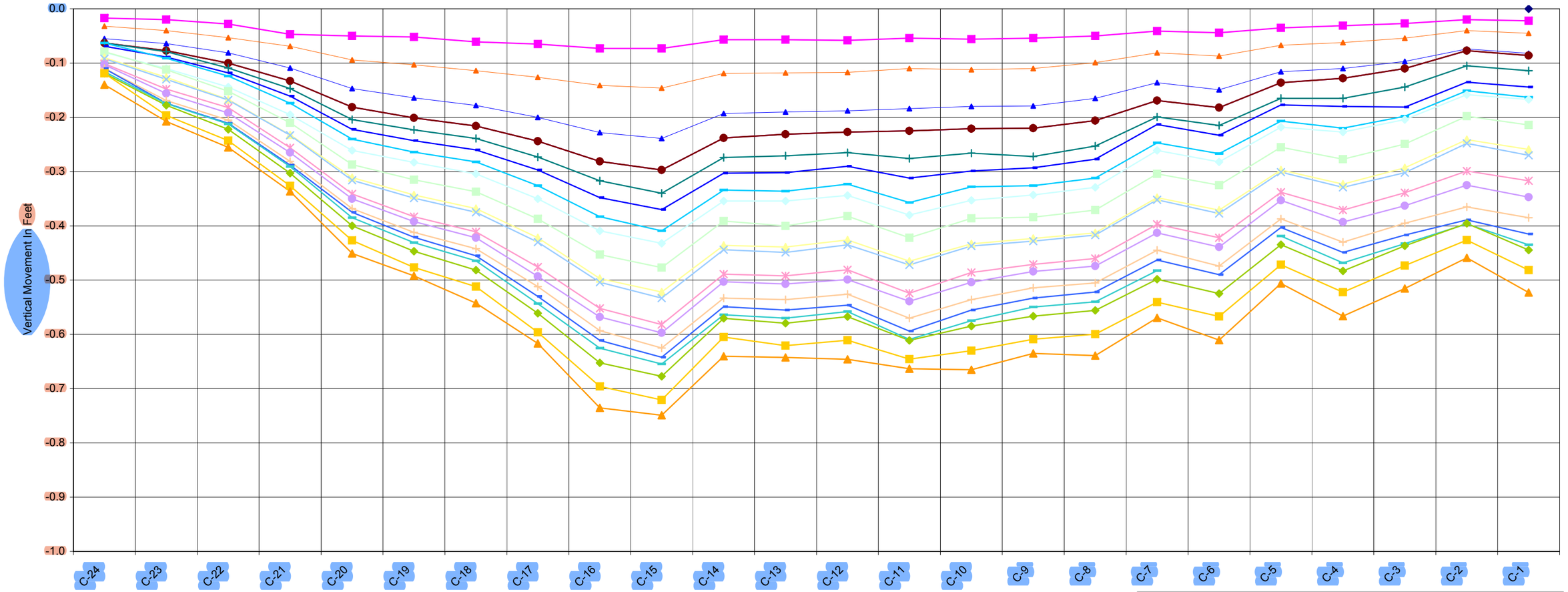
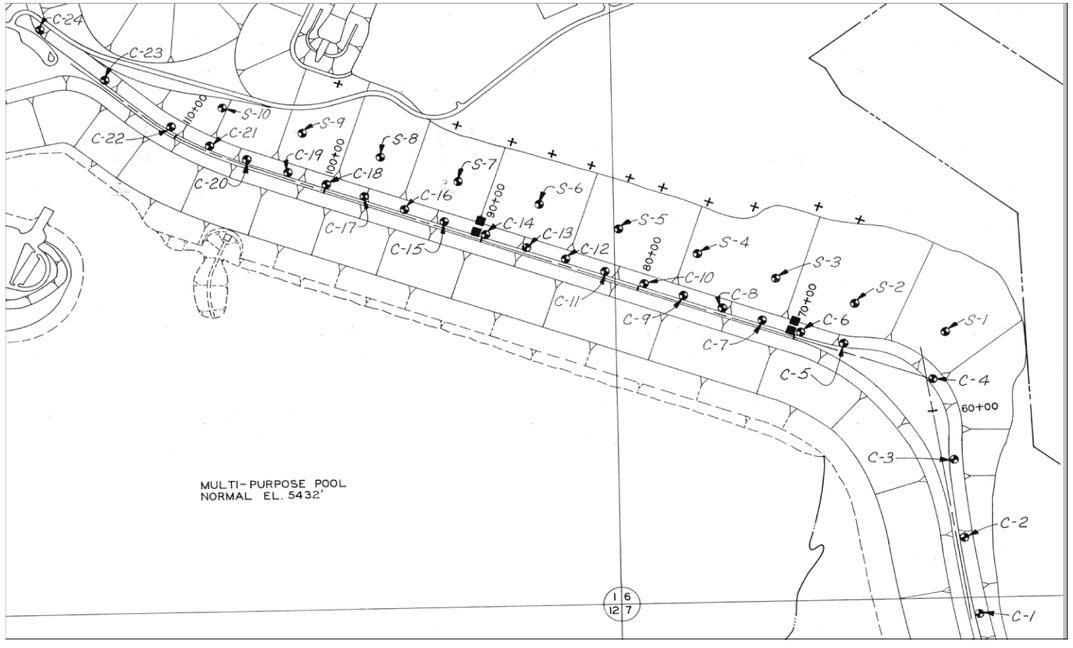
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-34

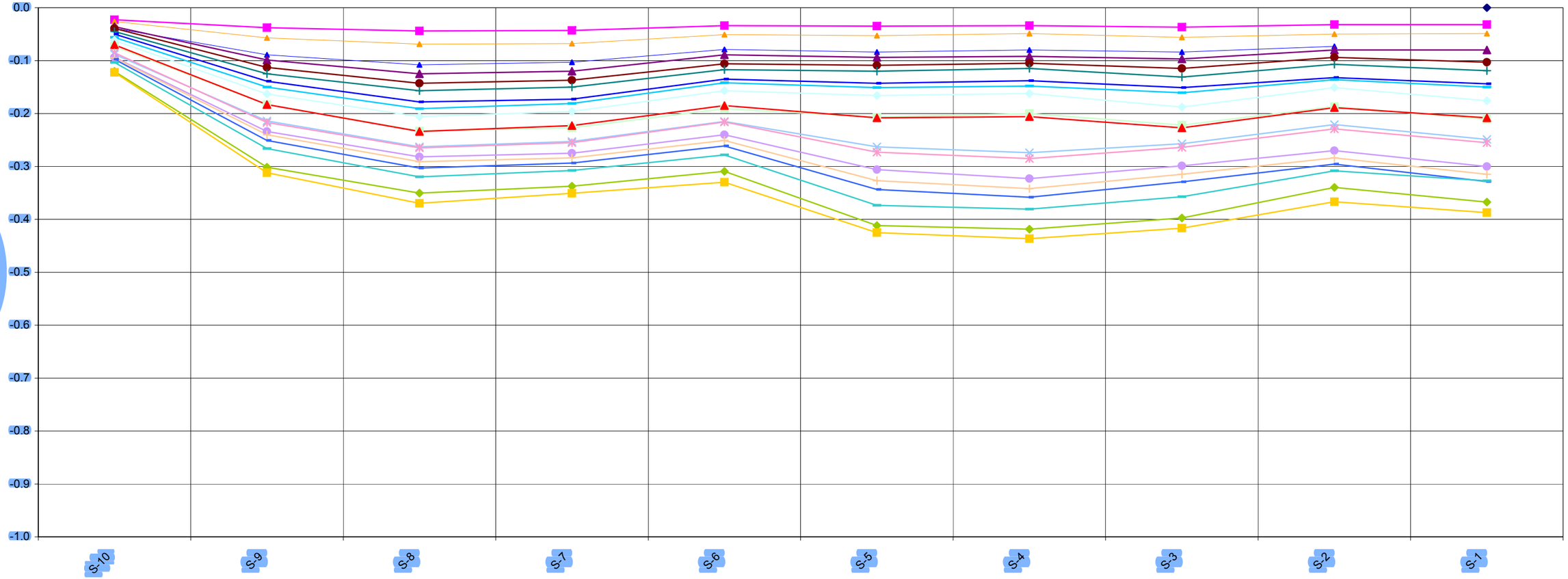

Piezometer 563 (Open Tube)
Fill/Abutment
Station 99+00
Elevation, Ft. MSL
5434.0
5432.0
5430.0
5428.0
5426.0
5424.0
5422.0
5420.0
Reservoir
563
Nov-98
Mar-99
Jul-99
Nov-99
Mar-00
Jul-00
Nov-00
Mar-01
Jul-01
Nov-01
Mar-02
Jul-02
Nov-02
Mar-03
Jul-03
Nov-03
Mar-04
Jul-04
Nov-04
Mar-05
Jul-05
Nov-05
Mar-06
Jul-06
Nov-06
Mar-07
Jul-07
Nov-07
Mar-08
Plate C-35

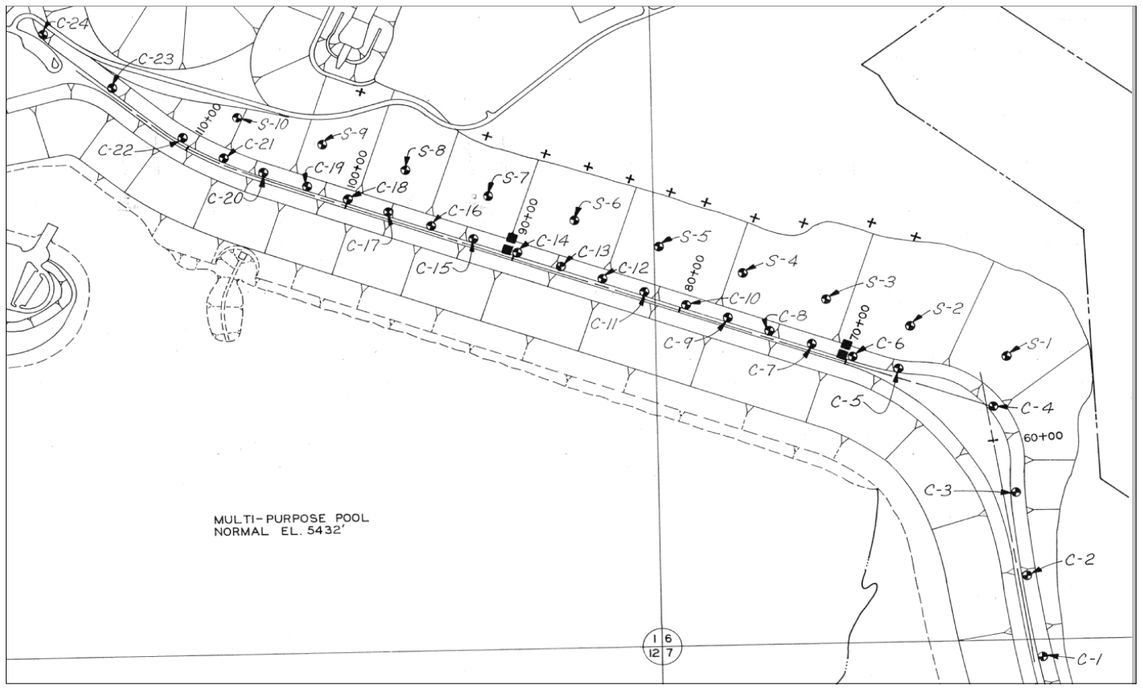




Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest Movement Markers
Vertical Movement

Re-Allocation Study Plate D-1



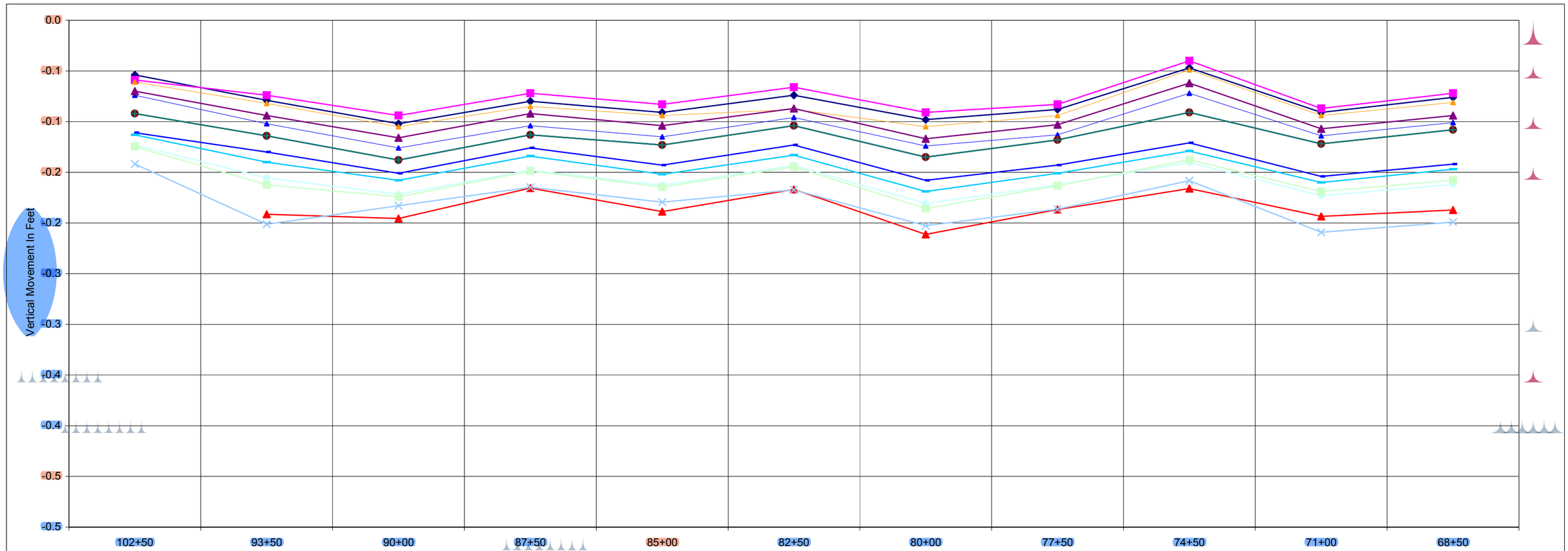


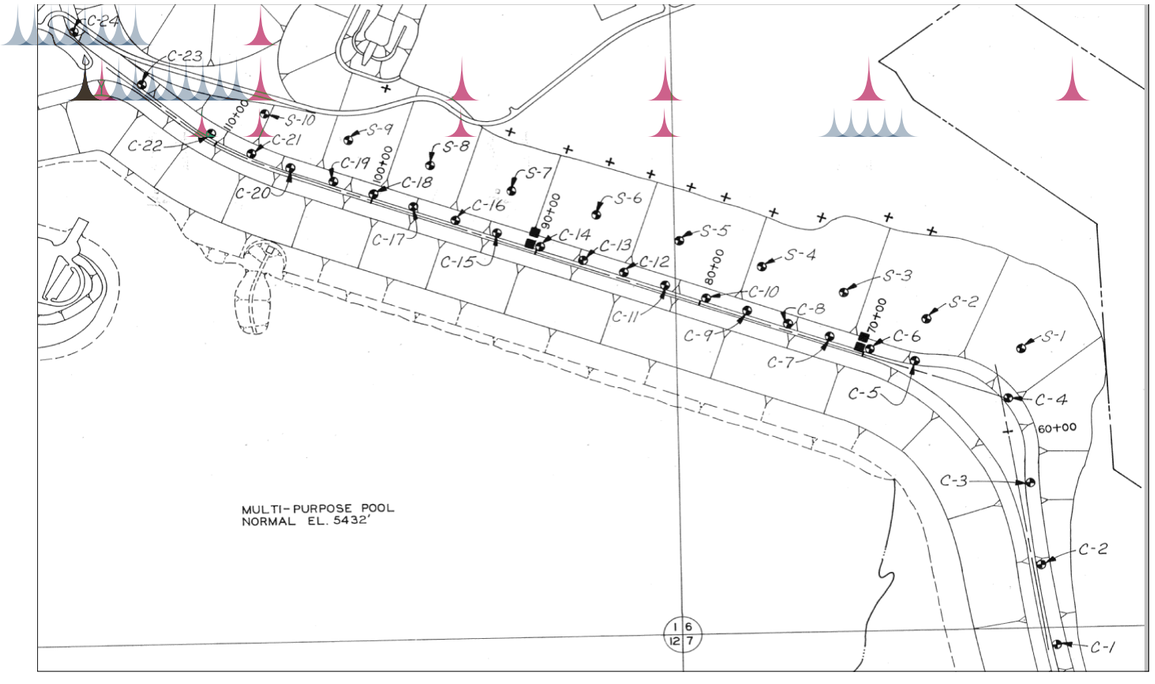
1-Nov-75 1-Jun-76 1-Jan-77 1-Mar-78 1-Jul-79
1-Aug-80 1-Jul-81 1-Sep-82 1-Apr-83 1-Jul-85
1-Sep-87 1-Jun-88 1-Jul-91 1-Jun-92 1-Apr-93
1-Mar-94 1-Oct-96 1-Jul-00 1-May-03 1-Feb-07

Notes:
1. Marker S-10 was found damaged and was reset August 1987.

Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Slope Movement Markers
Vertical Movement

Re-Allocation Study Plate D-2





Notes:
1. 77+50 damaged and reset 8-24-71
2. 102+50 Initial 1974

Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Toe Movement Markers
Vertical Movement

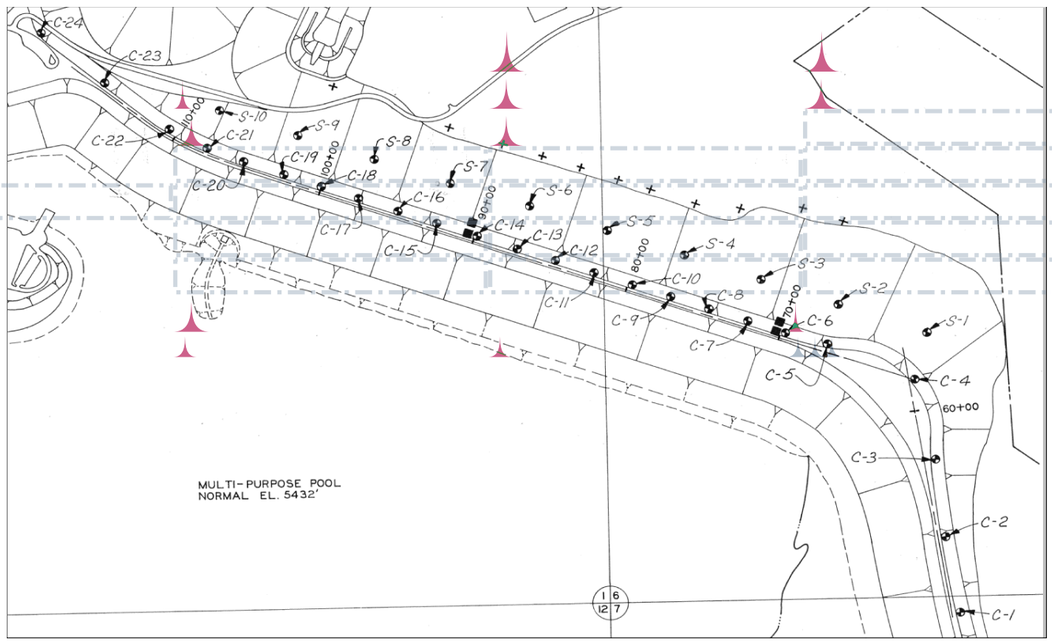
Re-Allocation Study Plate D-3

Movemeny in feet

0.000
-0.100
-0.200
-0.300
-0.400
-0.500
-0.600
-0.700
-0.800

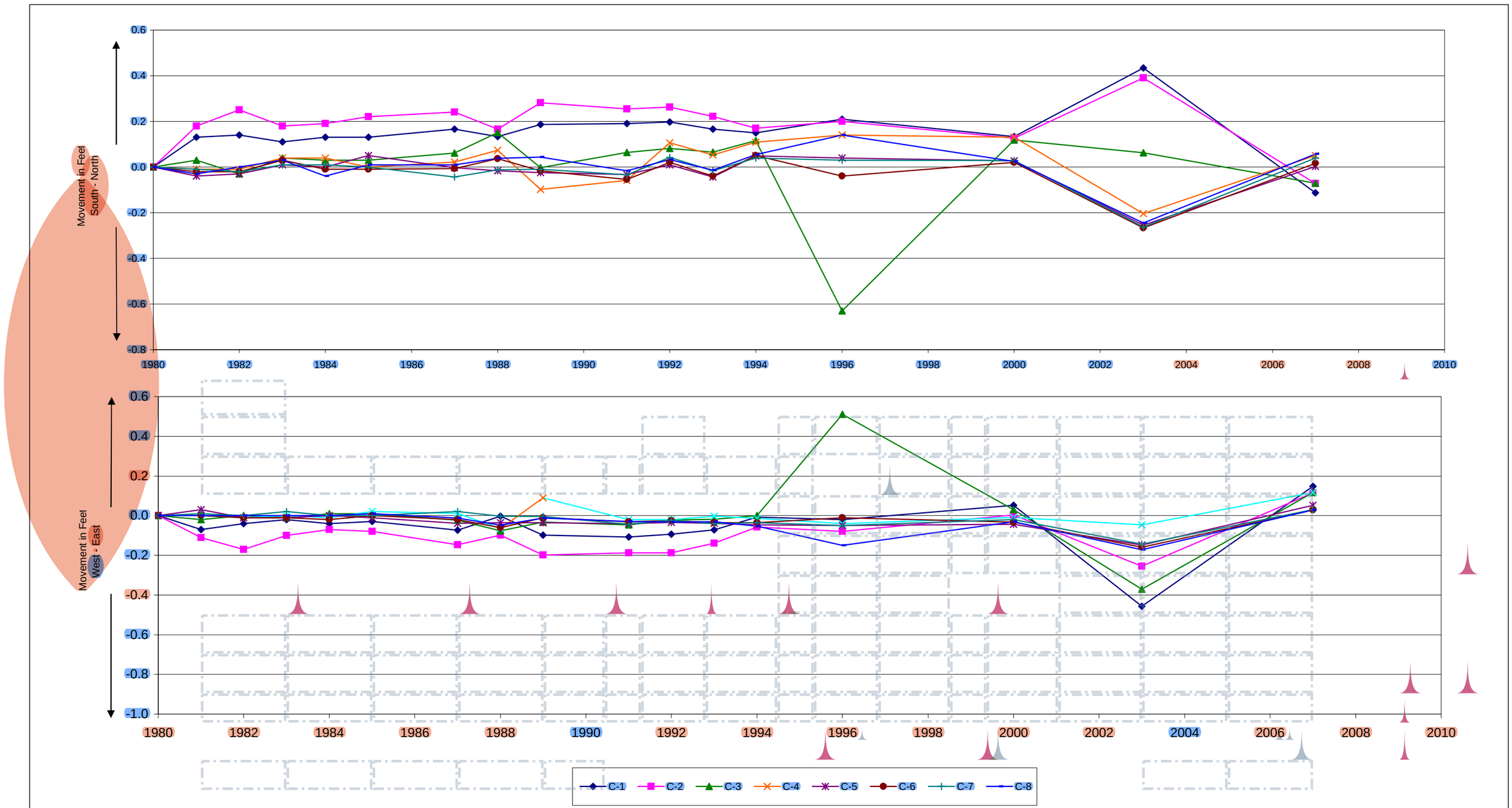
1975
1980
1985
1990
1995
2000
2005
2010

C-11
C-15
C-16
S-3
S-4
S-5
Toe-80+00
Toe-90+00
Toe-93+50



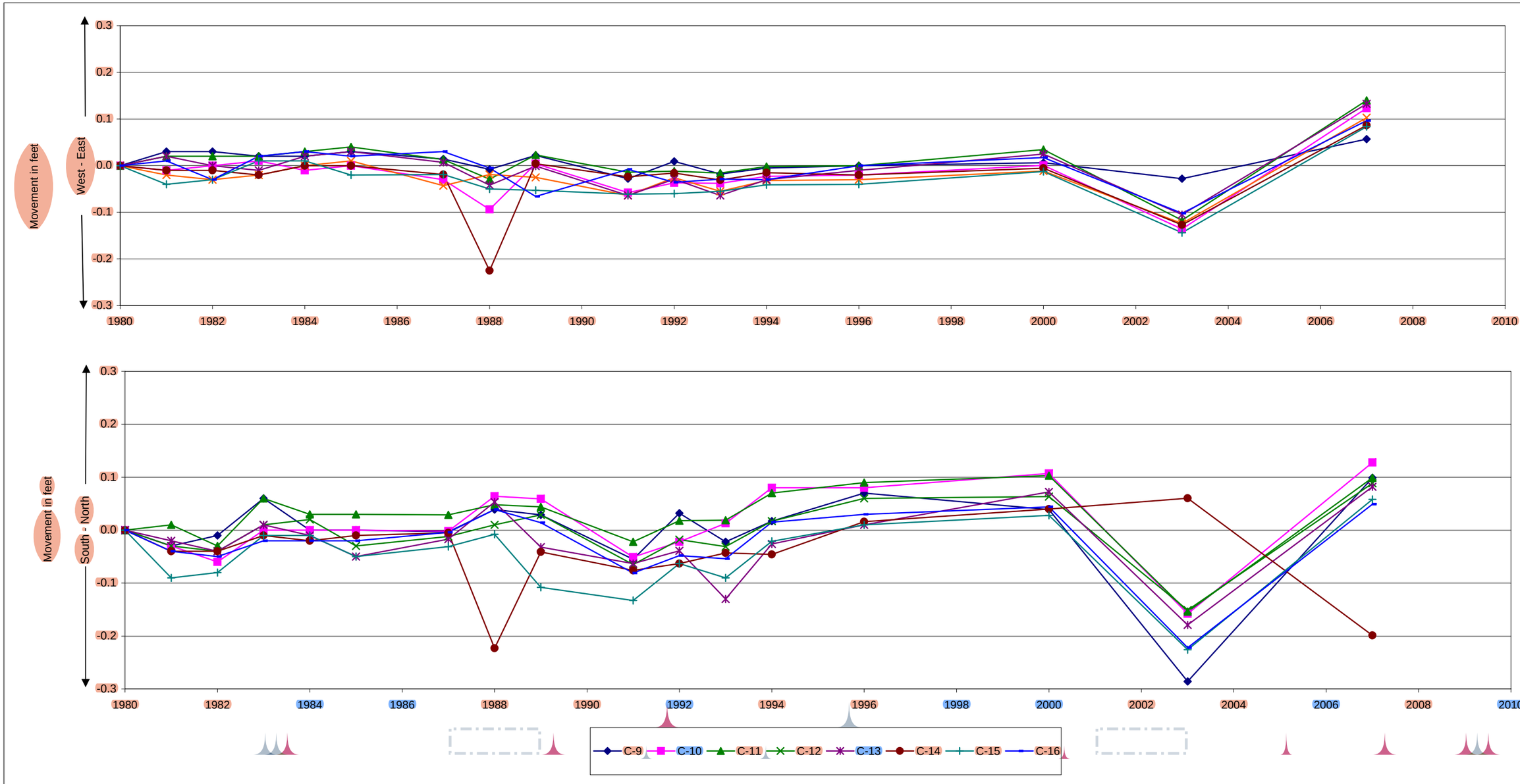
Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest, Slope and Toe Movement Markers
Vertical Movement vs. Time Plot

Re-Allocation Study Plate D-4



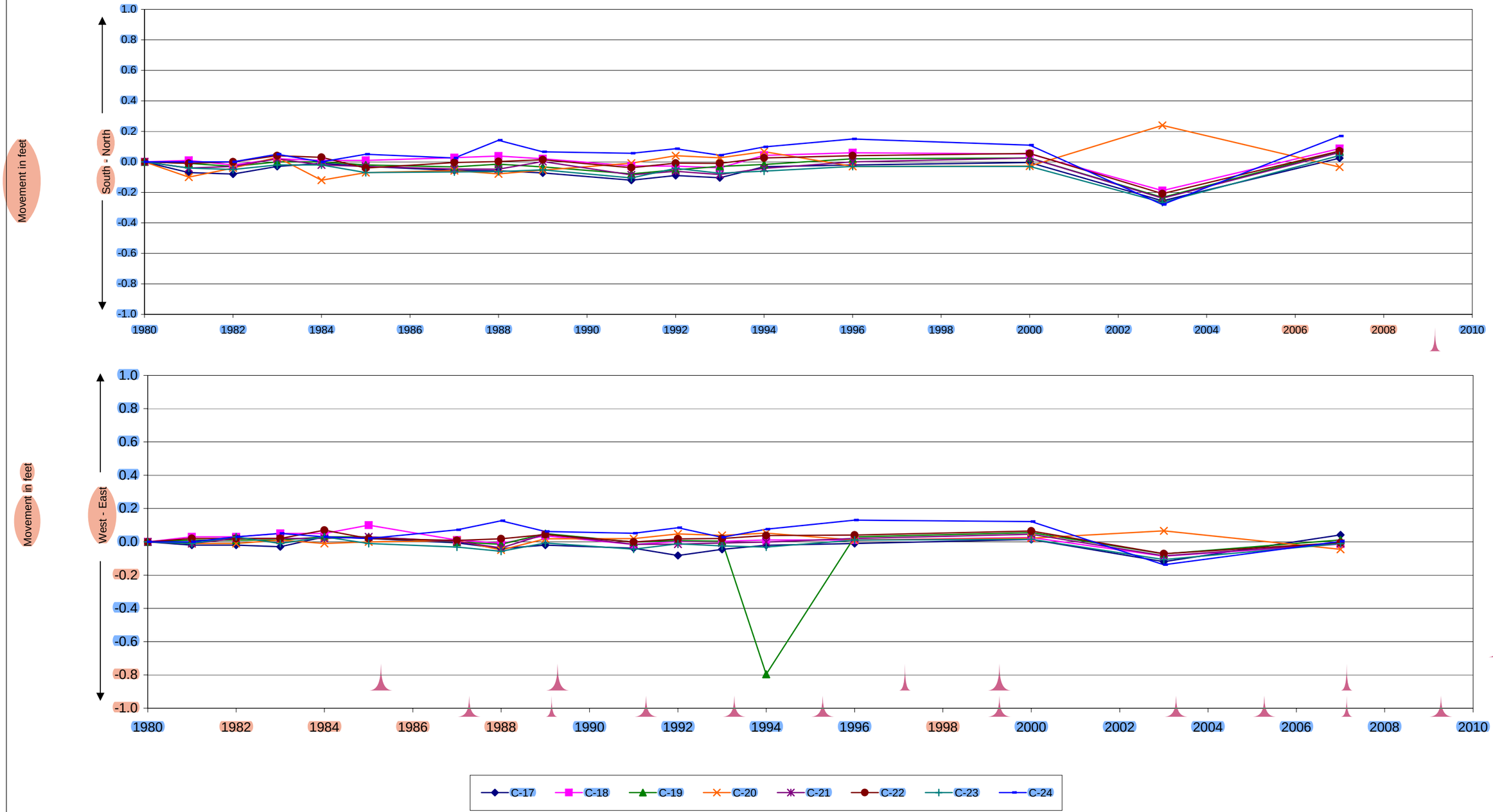
Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest, Slope, and Toe Movement Markers
Horizontal Movement vs Time Plot Crest Markers 1-

Re-Allocation Study Plate D-5



Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest, Slope, and Toe Movement Markers
Horizontal Movement vs. Time Plot Crest Markers 9-16

Re-Allocation Study Plate D-6



Chatfield Dam and Lake, CO

Embankment & Foundation Movement

Crest, Slope, and Toe Movement Markers

Horizontal Movement vs Time Plot Crest Makers 17-24

Re-Allocation Study Plate D-7

Movement in feet

South - North

1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0

1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

Movement in feet

West - East

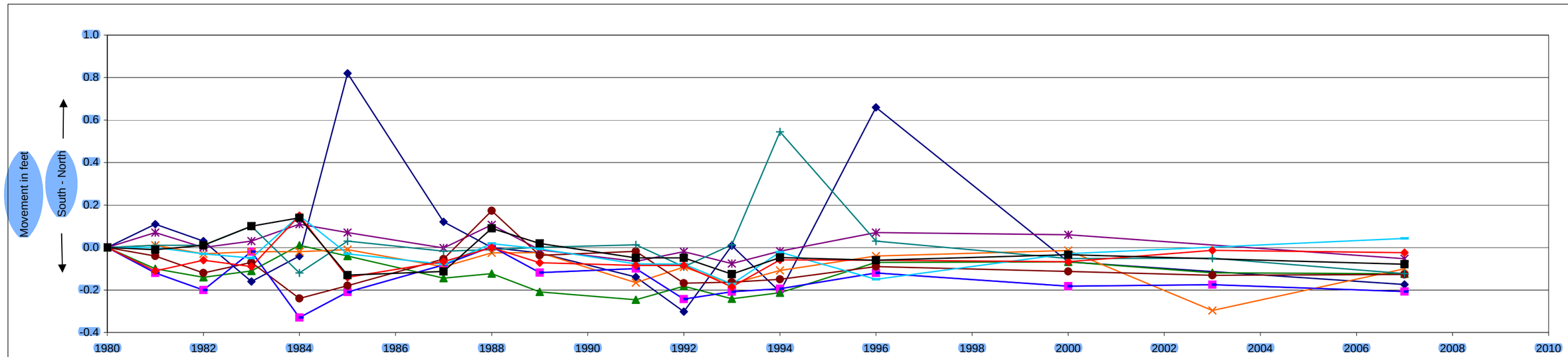
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0

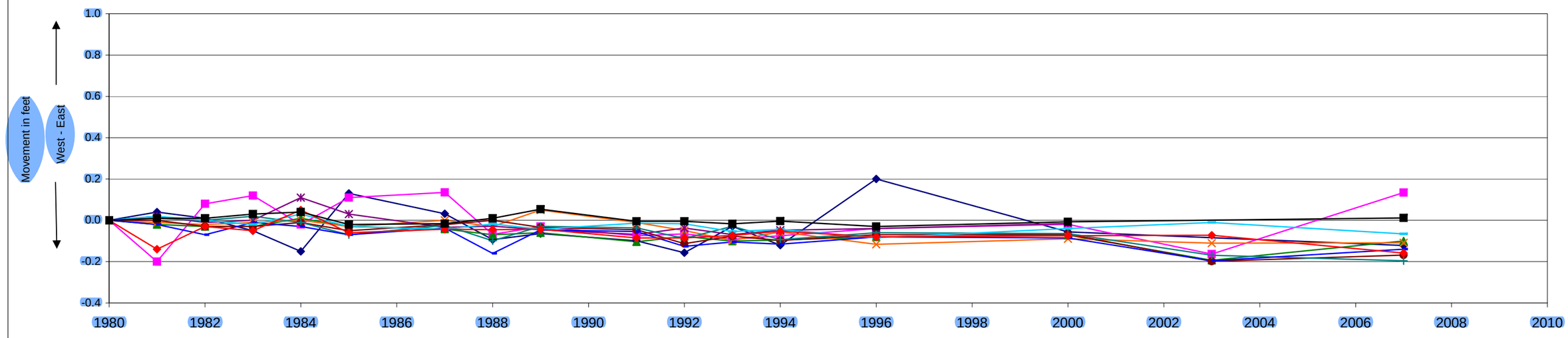
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010

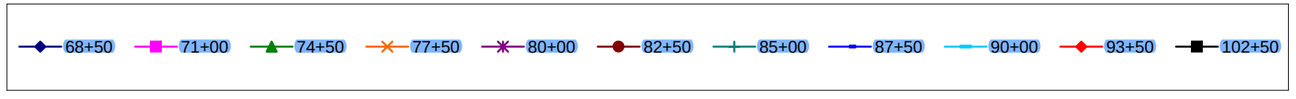
S-1 S-2 S-3 S-4 S-5 S-6 S-7 S-8 S-9 S-10

Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest, Slope, and Toe Movement Markers
Horizontal Movement vs. Time Plot

Re-Allocation Study Plate D-8

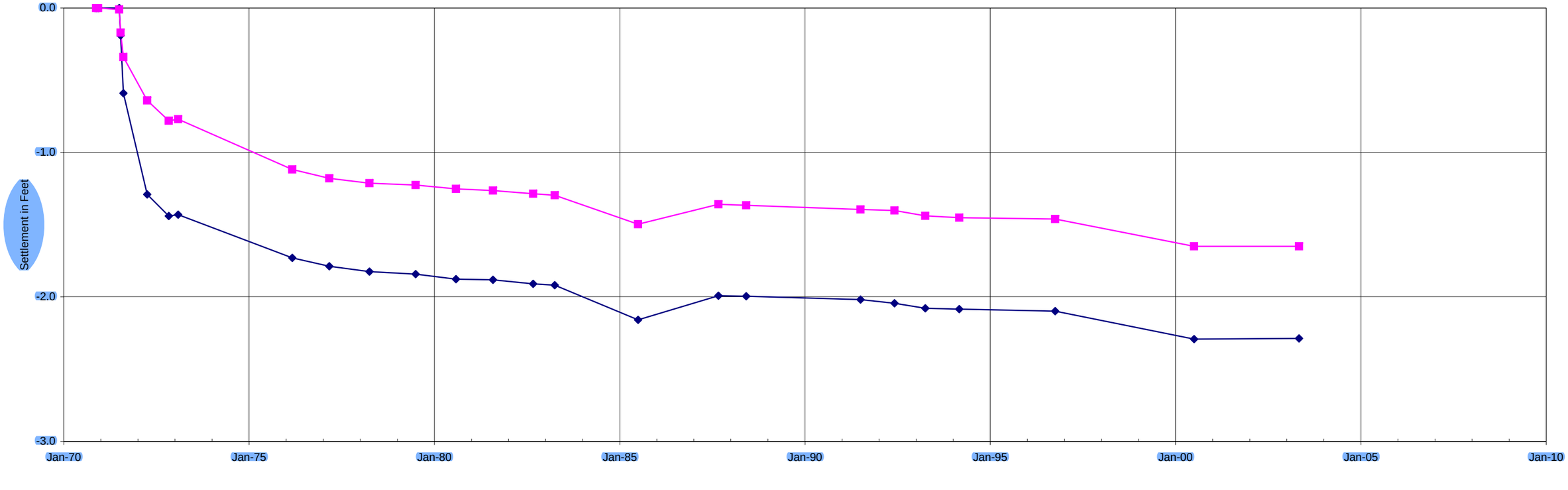


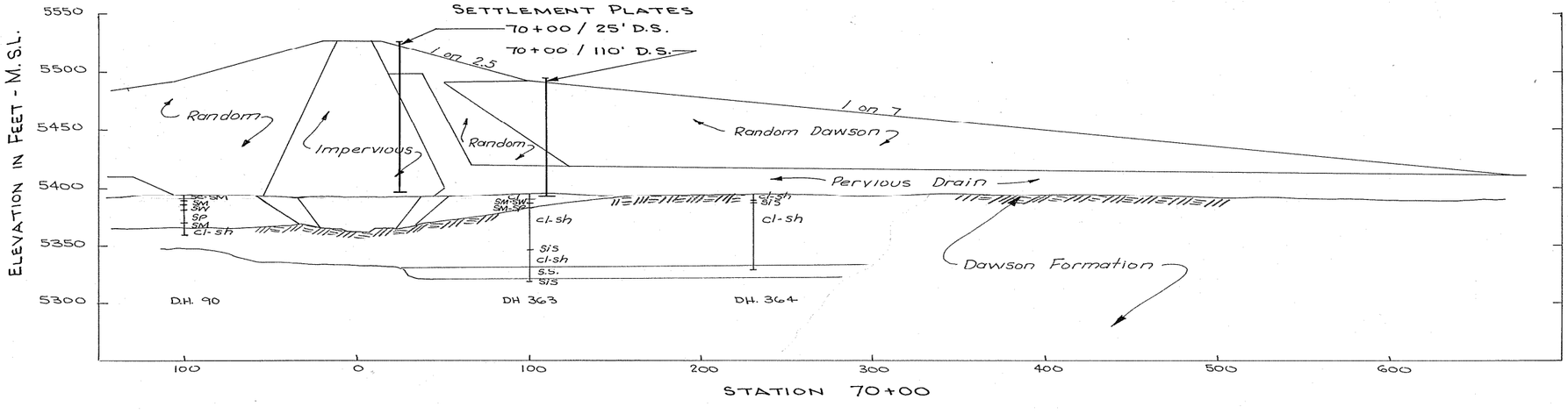




Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Crest, Slope, and Toe Movement Markers
Horizontal Movement vs. Time Plot Toe Markers

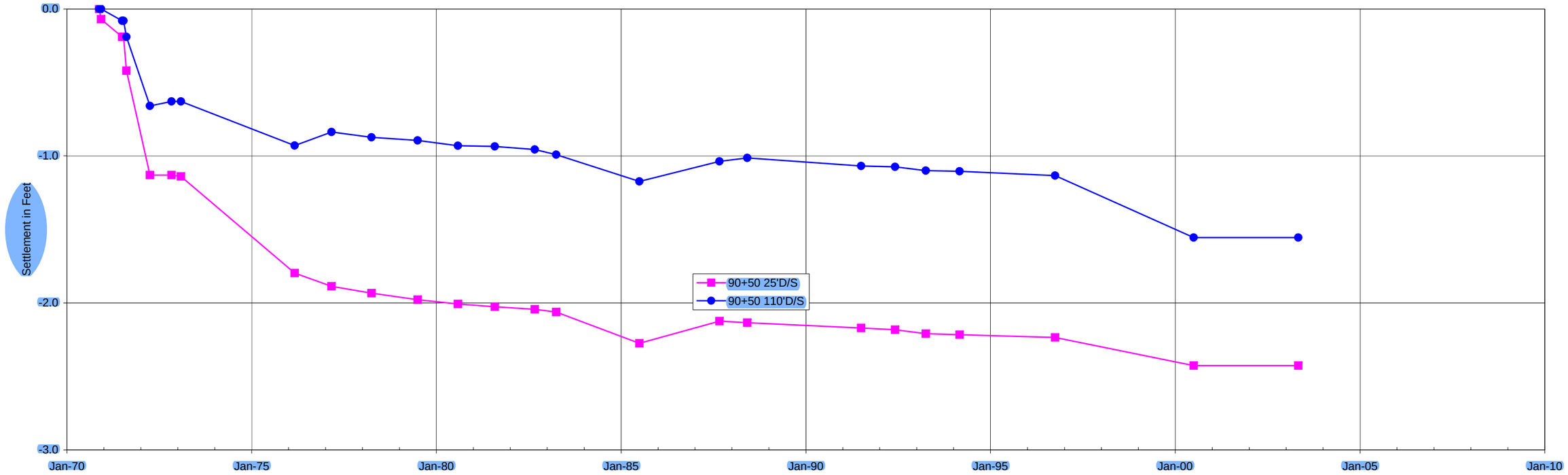
Re-Allocation Study Plate D-9

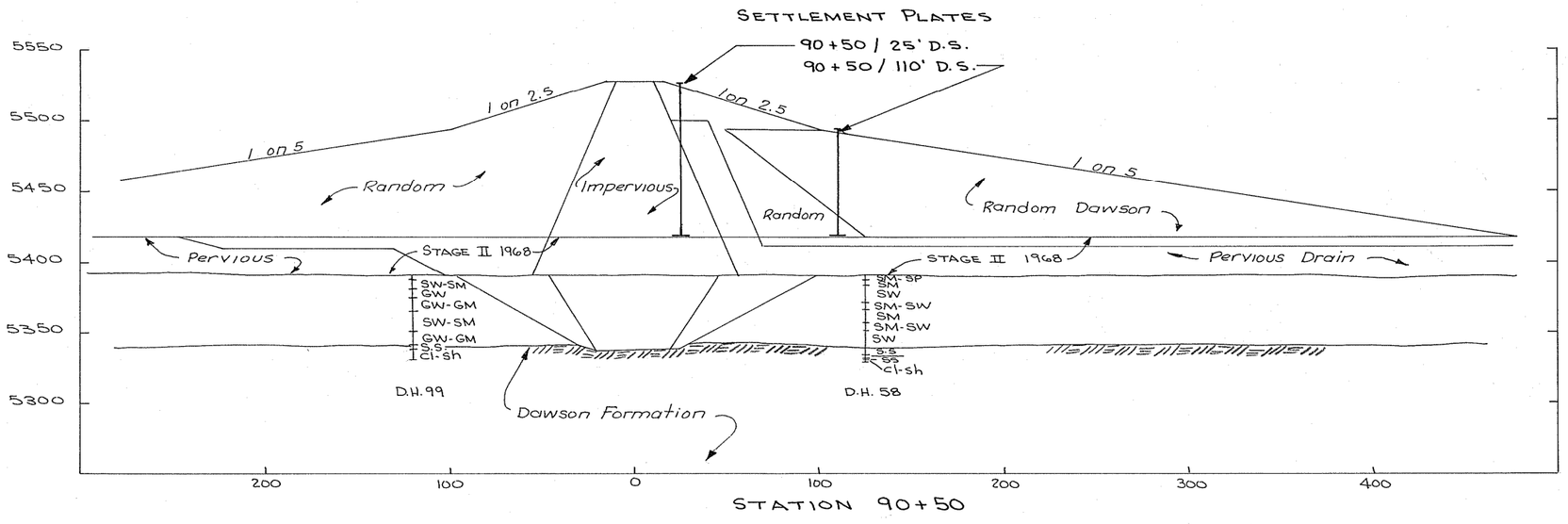




Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Settlement Gages - Sta. 70+00
Vertical Movement

Re-Allocation Study Plate D-10





Chatfield Dam and Lake, CO
Embankment & Foundation Movement
Settlement Gages - Sta. 90+00
Vertical Movement

Re-Allocation Study Plate D-11

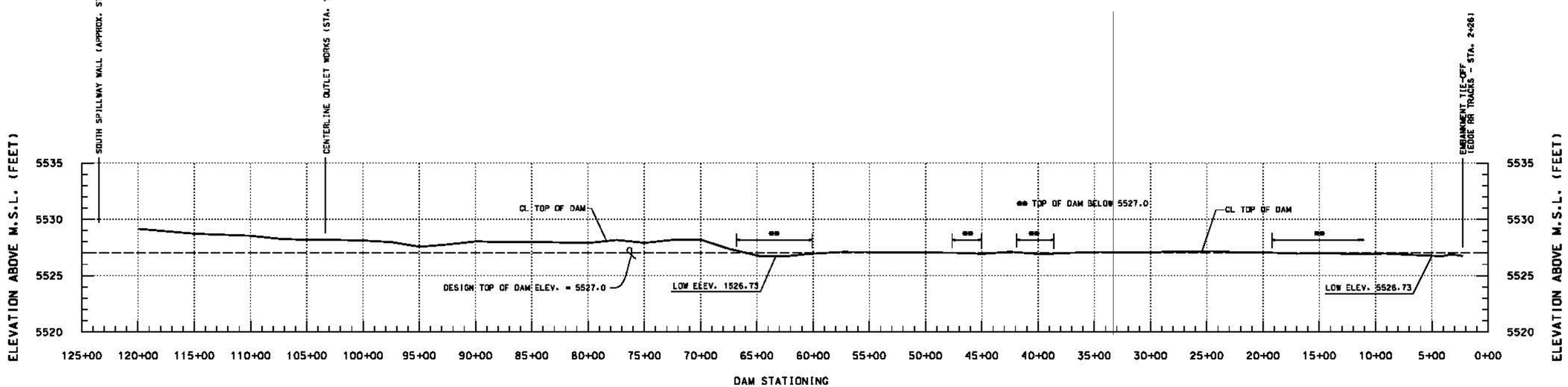
PLAN VIEW - CHATFIELD DAM

1000' 0 1000'

SCALE: 1" = 2000' (WHEN PRINTED AT 11X17')

NOTES:

1. STATIONING SHOWN IS APPROXIMATELY EQUIVALENT TO DAM STATIONING. TOP OF DAM SURVEY WAS VISUALLY LINED UP WITH SEPT 2007 AERIAL PHOTOGRAPH OF DAM. STATIONING WAS ESTIMATED BASED ON CENTERLINE OF OUTLET WORKS.
2. TOP OF DAM SURVEY WAS CONDUCTED MAY 2007.
3. VERTICAL DATUM IS 1929 NGVD.
4. VERTICAL CONTROL FOR SURVEY WAS CONTROL POINT "WEST".



TOP OF DAM PROFILE

500' 0 500'

5' 0 5'

HOR. SCALE: 1" = 1000' (WHEN PRINTED AT 11X17')
VER. SCALE: 1" = 10' (WHEN PRINTED AT 11X17')

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR

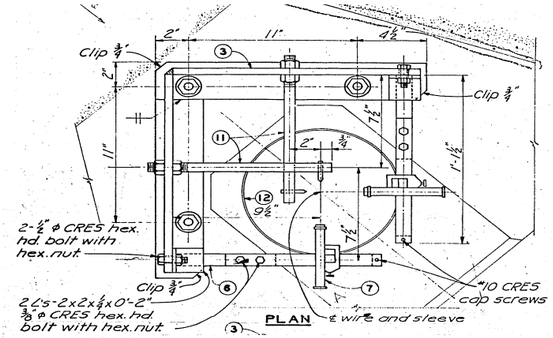
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA DISTRICT

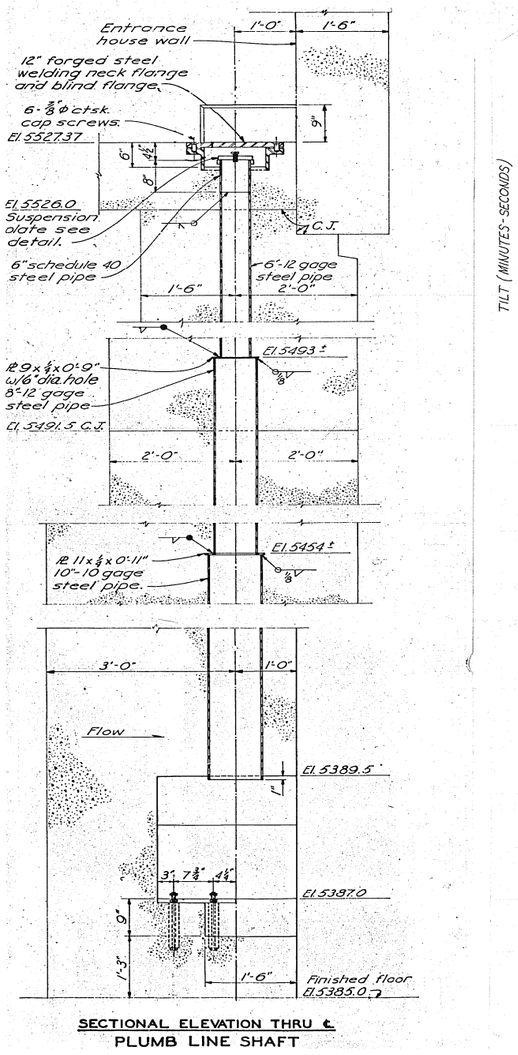
DESIGNED BY:
DRN BY: B.J.L.
CHD BY: M.T.K.
SUBMITTED BY:
FILE NAME:
SIZE:
PLOT SCALE:
DATE: 20 OCT 2008
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:
PLOT DATE:

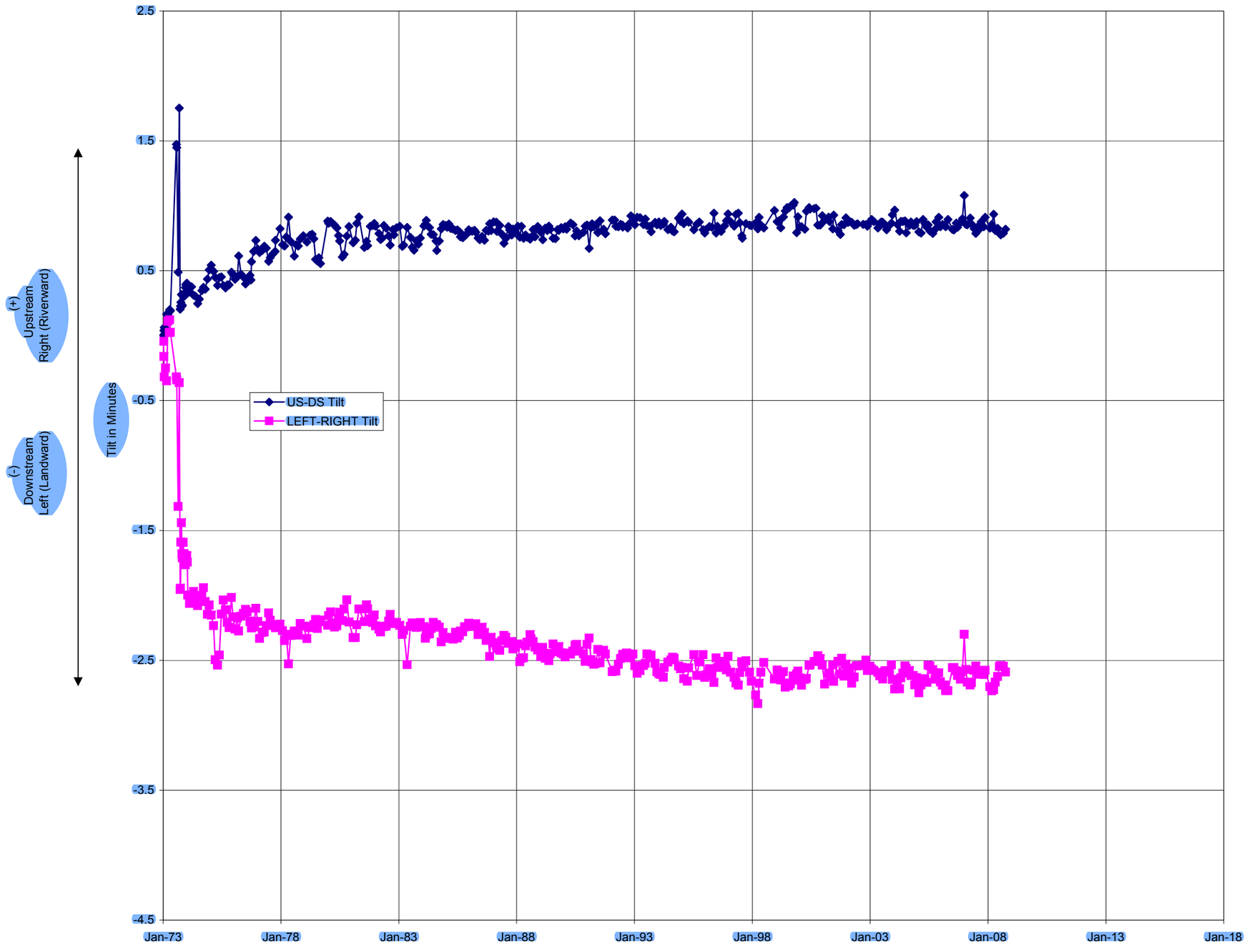
CHATFIELD DAM AND LAKE, COLORADO

TOP OF DAM SURVEY
MAY 2007

SHEET IDENTIFICATION NUMBER
D-12

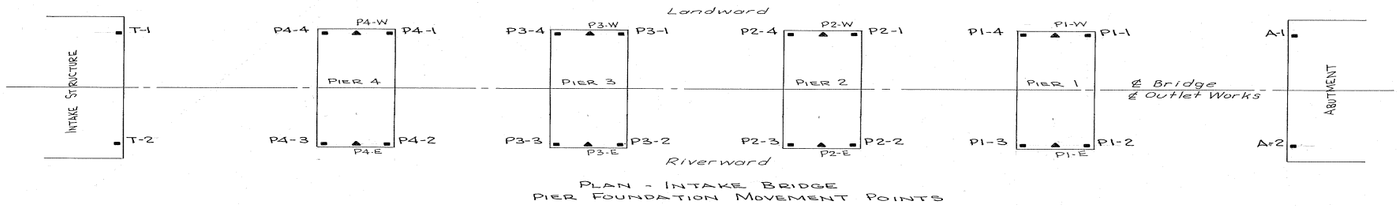




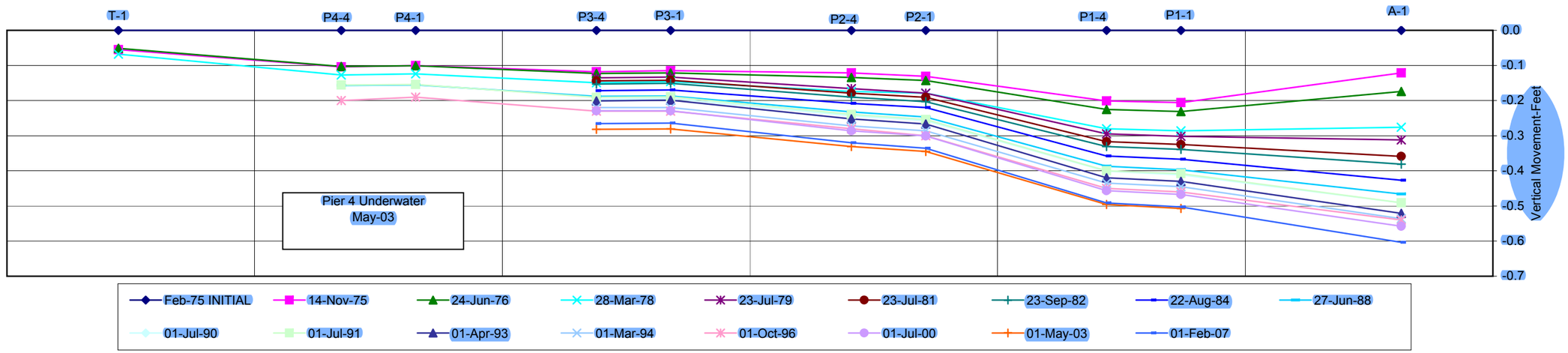


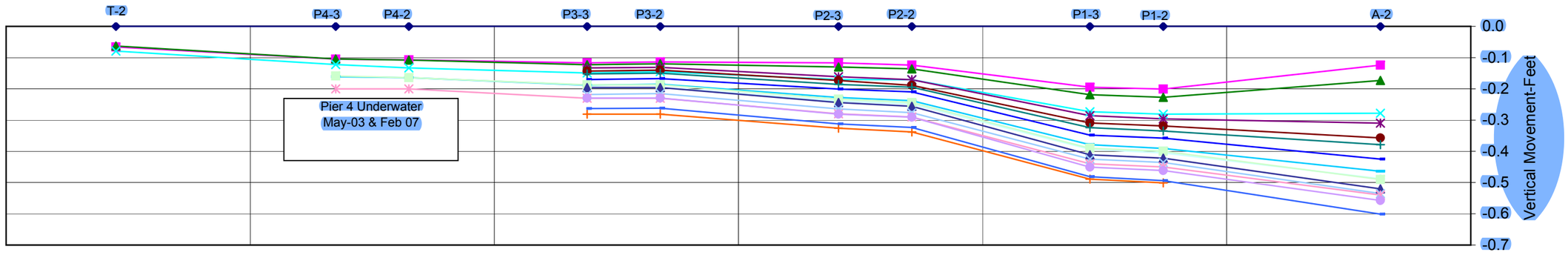
Chatfield Dam and Lake, Colorado
Outlet Works - Intake Structure
Plumbline Tilt

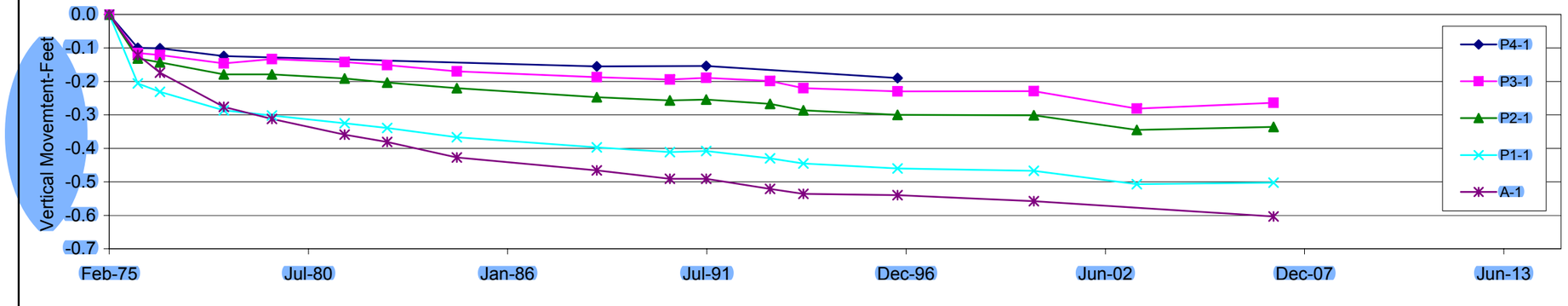
Re-Allocation Study Plate D-13



PLAN - INTAKE BRIDGE
PIER FOUNDATION MOVEMENT POINTS

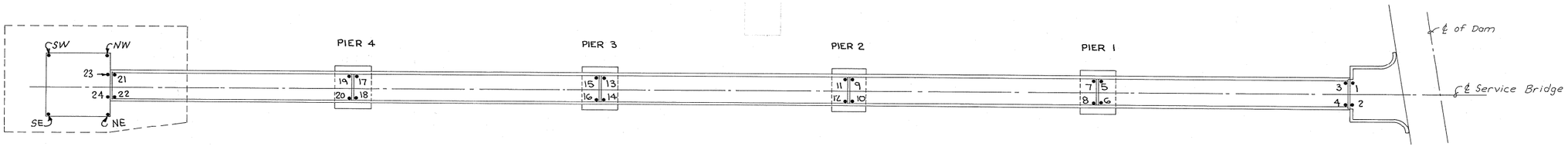


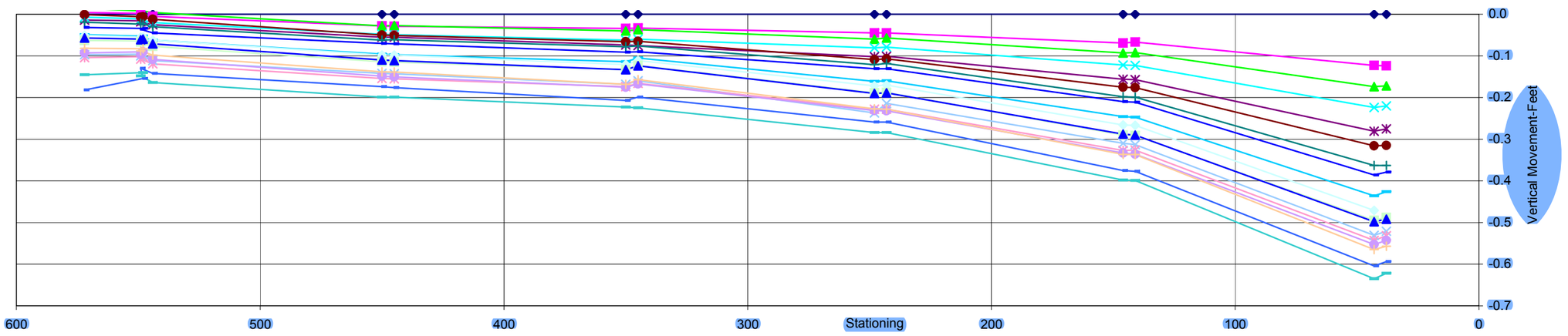


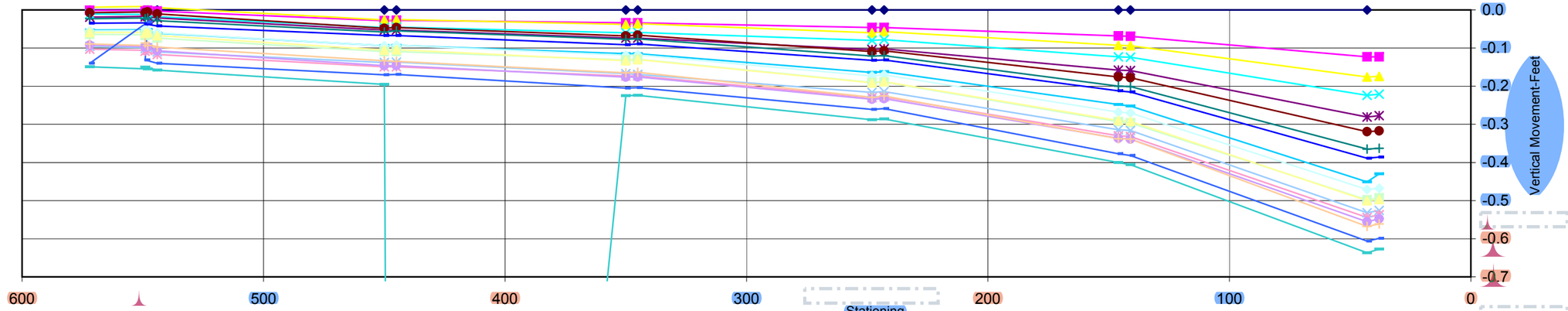


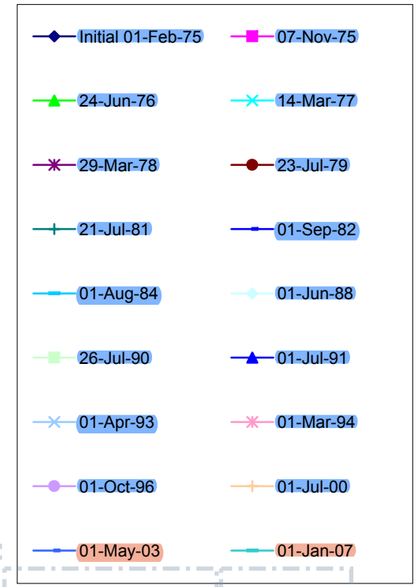
Chatfield Dam and Lake, CO
Outlet Works Movement
Intake Bridge Piers & Tower
Verical Movement

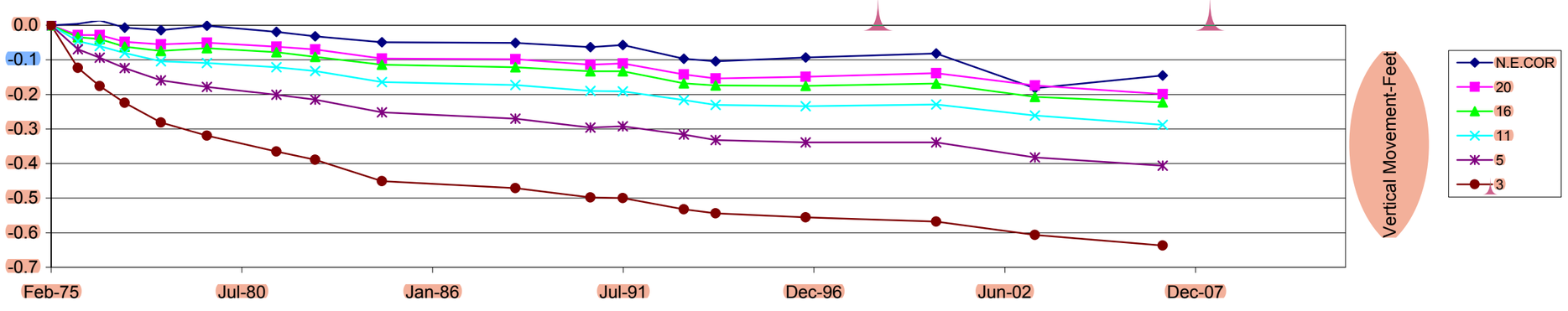
Re-Allocation Study Plate D-14





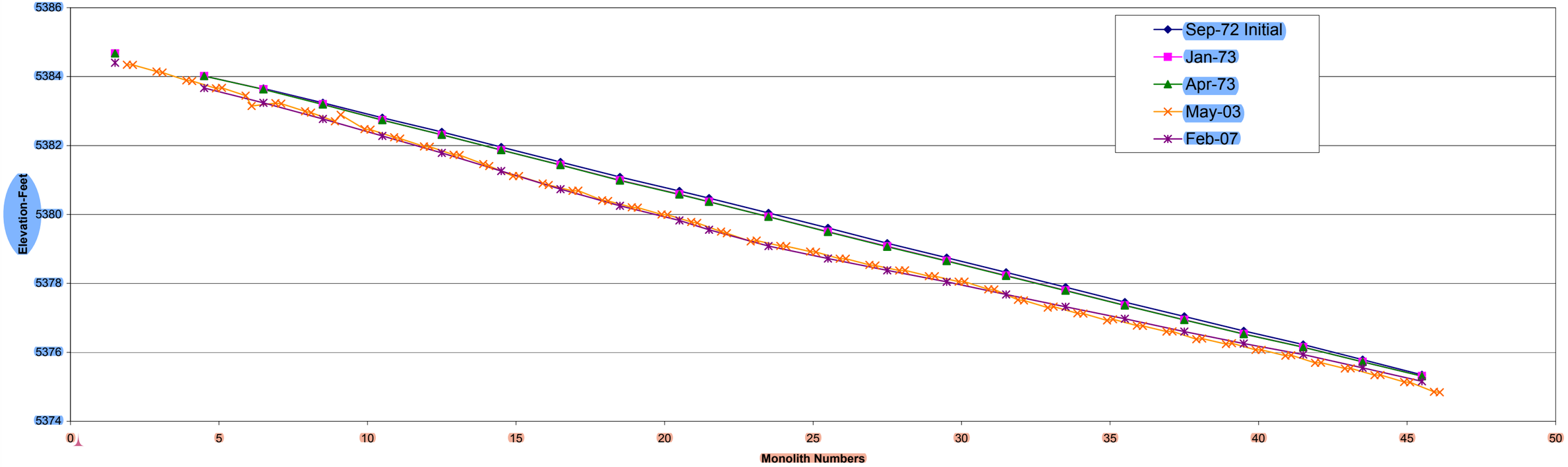


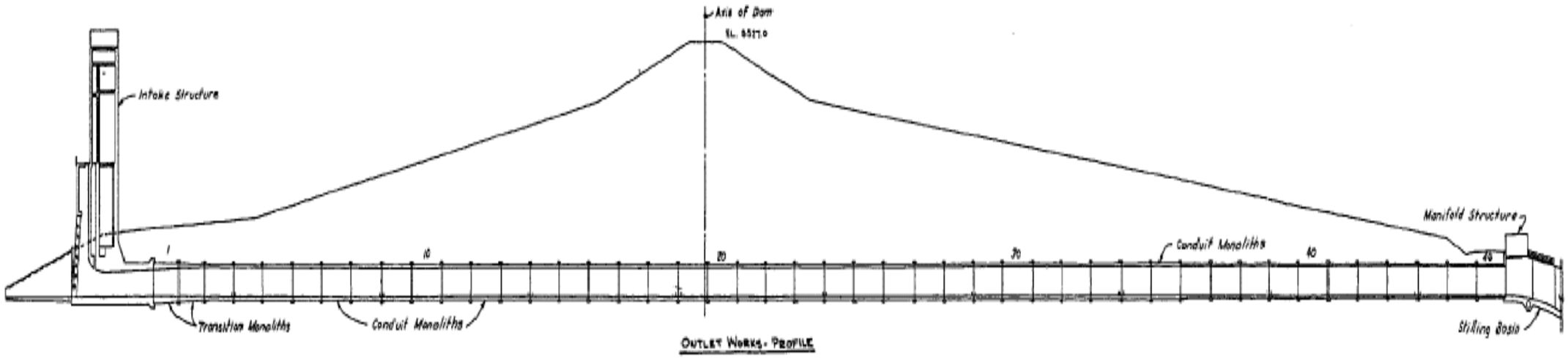




Chatfield Dam and Lake, CO
Outlet Works Movement
Intake Bridge Deck & Tower Vertical Movement

Re-Allocation Study Plate D-15

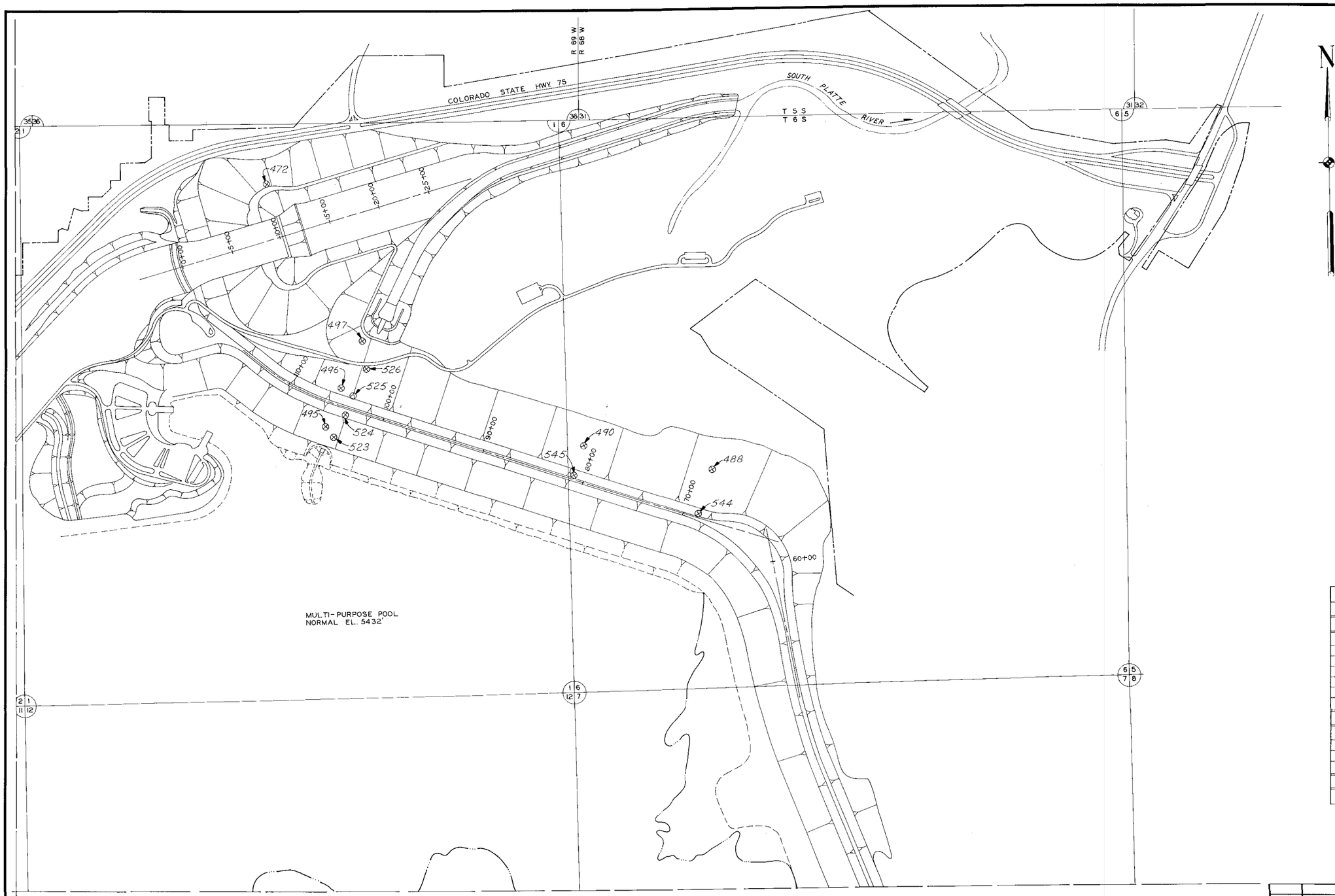




OUTLET WORKS - PROFILE

Chatfield Dam
Outlet Works - Wet Conduit
Vertical Movement Profile

Re-Allocation Study Plate D-16



INCLINOMETERS		
EMBANKMENT		
NO.	STATION	RANGE
544	68 + 80	17' D. S.
488	68 + 80	500' D. S.
545	81 + 20	17' D. S.
490	81 + 20	350' D. S.
495	104 + 78.1	232' U. S.
496	104 + 53.9	167.2' D. S.
497	104 + 21.2	667.5 D. S.
OUTLET WORKS		
523	-2 + 92 (U. S.)	9.5' Left
524	-0 + 68 (U. S.)	9.5' Left
525	1 + 00 (D. S.)	9.5' Left
526	4 + 36 (D. S.)	9.5' Left
SPILLWAY SLOPE		
472	10 + 60	500' Left

DATE	DESCRIPTION	MADE	APPR'D
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

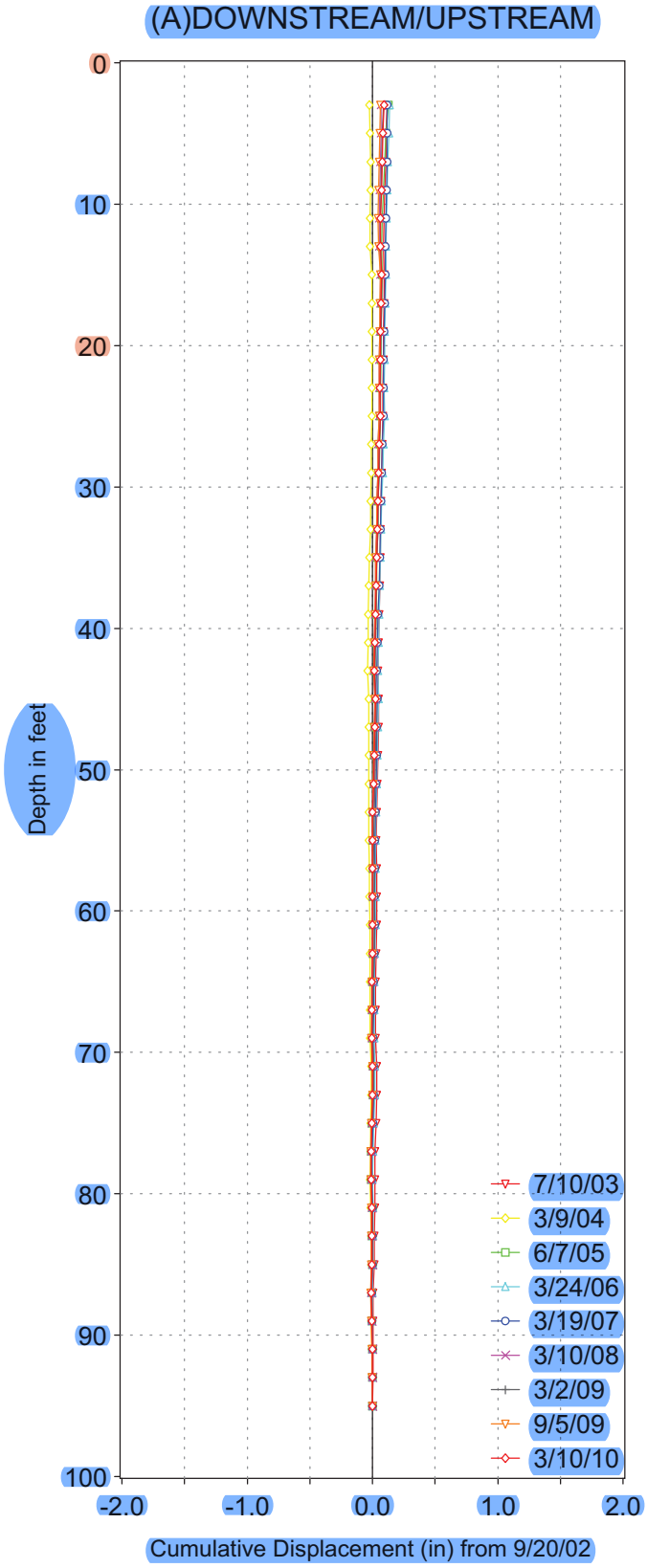
DESIGNED BY:
DRAWN BY: J. L. C.
CHECKED BY:
SUBMITTED BY:
CHIEF SECTION
RECOMMENDED:
CHIEF DESIGN BRANCH
APPROVED:
COL. C. E., DISTRICT ENGINEER

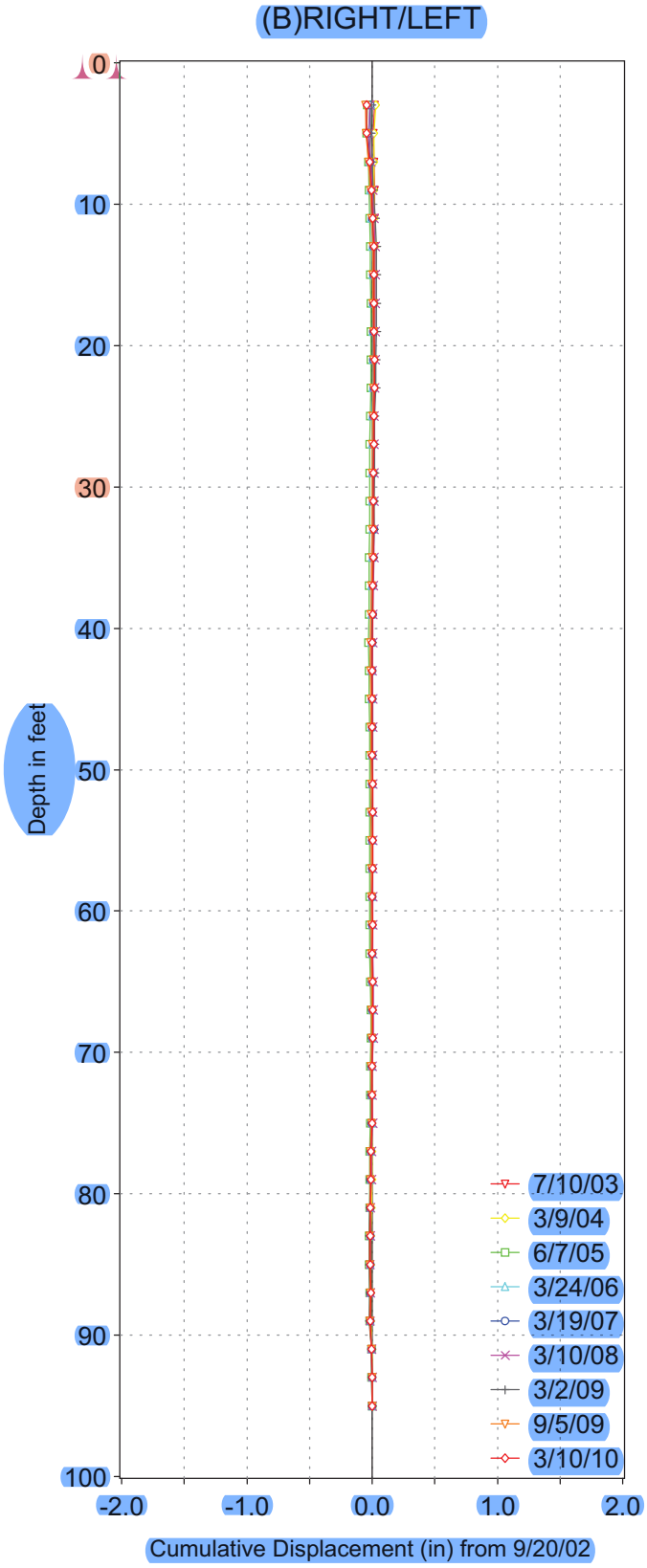
SOUTH PLATTE RIVER
CHATFIELD LAKE, COLORADO
EMBANKMENT AND SPILLWAY
INCLINOMETERS
LOCATION PLAN

APPROVED: DATE:
CHIEF ENGINEERING DIVISION
SCALE: AS SHOWN SPEC. NO. DACA45
DRAWING NUMBER
SHEET 1

THIS PLAN ACCOMPANIES CONTRACT No. DACA45 MODIFICATION No.

U.S. GOVERNMENT PRINTING OFFICE: 1976-641-151





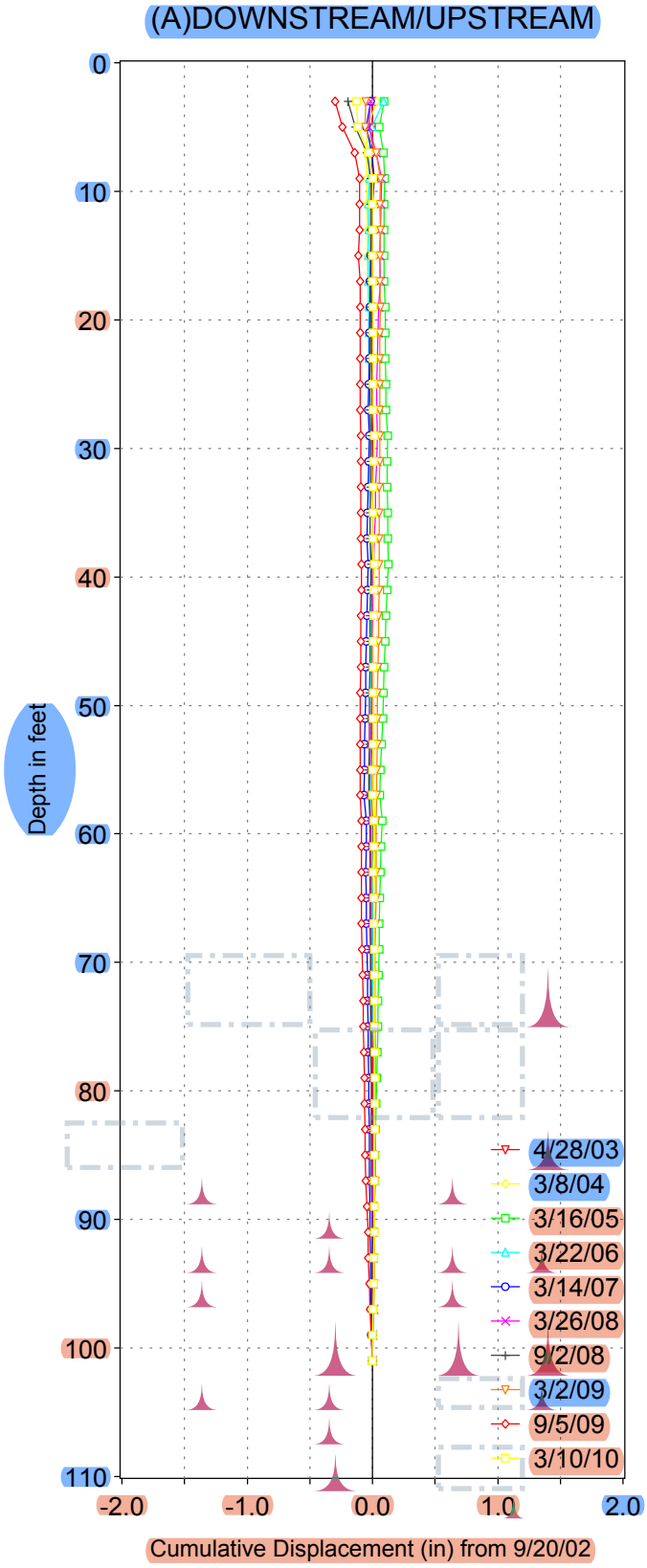
US Army Corps of Engineers®

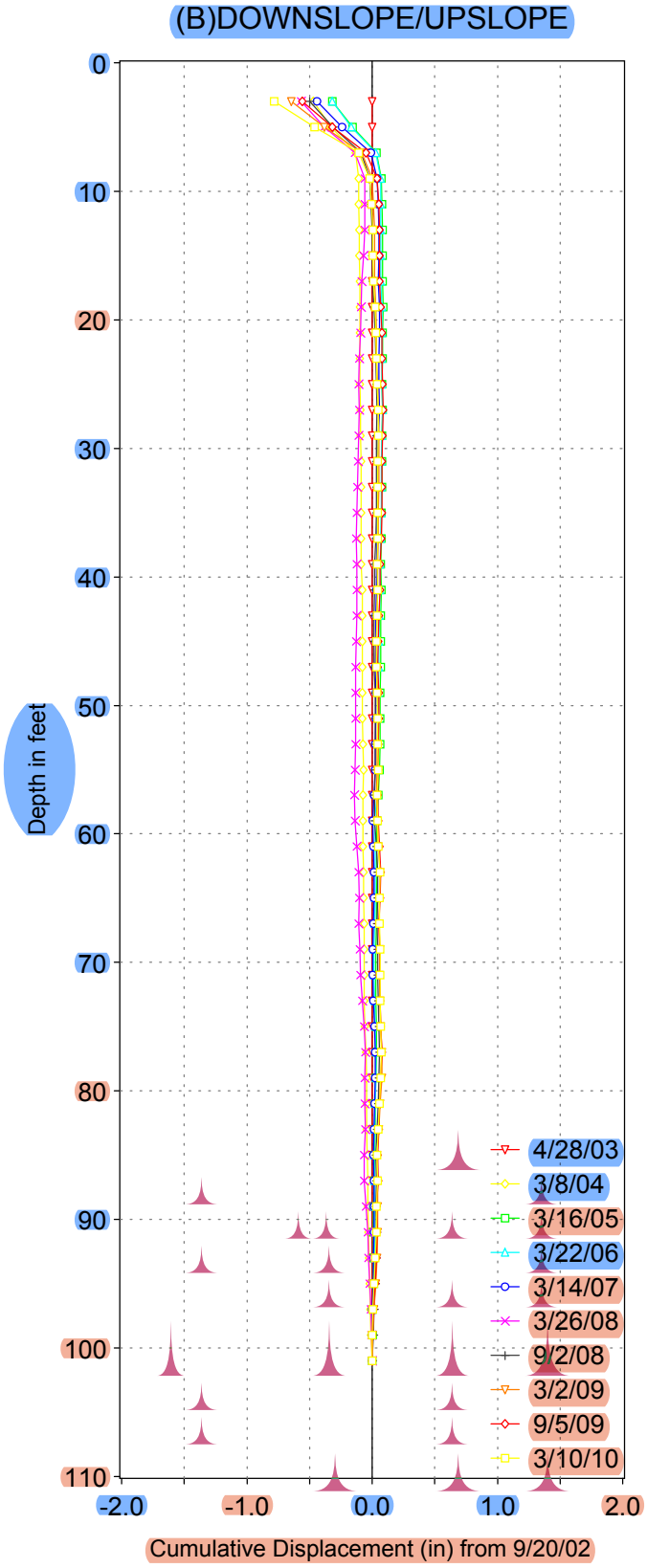
Chatfield Dam and Lake, CO

Inclinometer 497, Sta. 104+21, 668' DS

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-18**





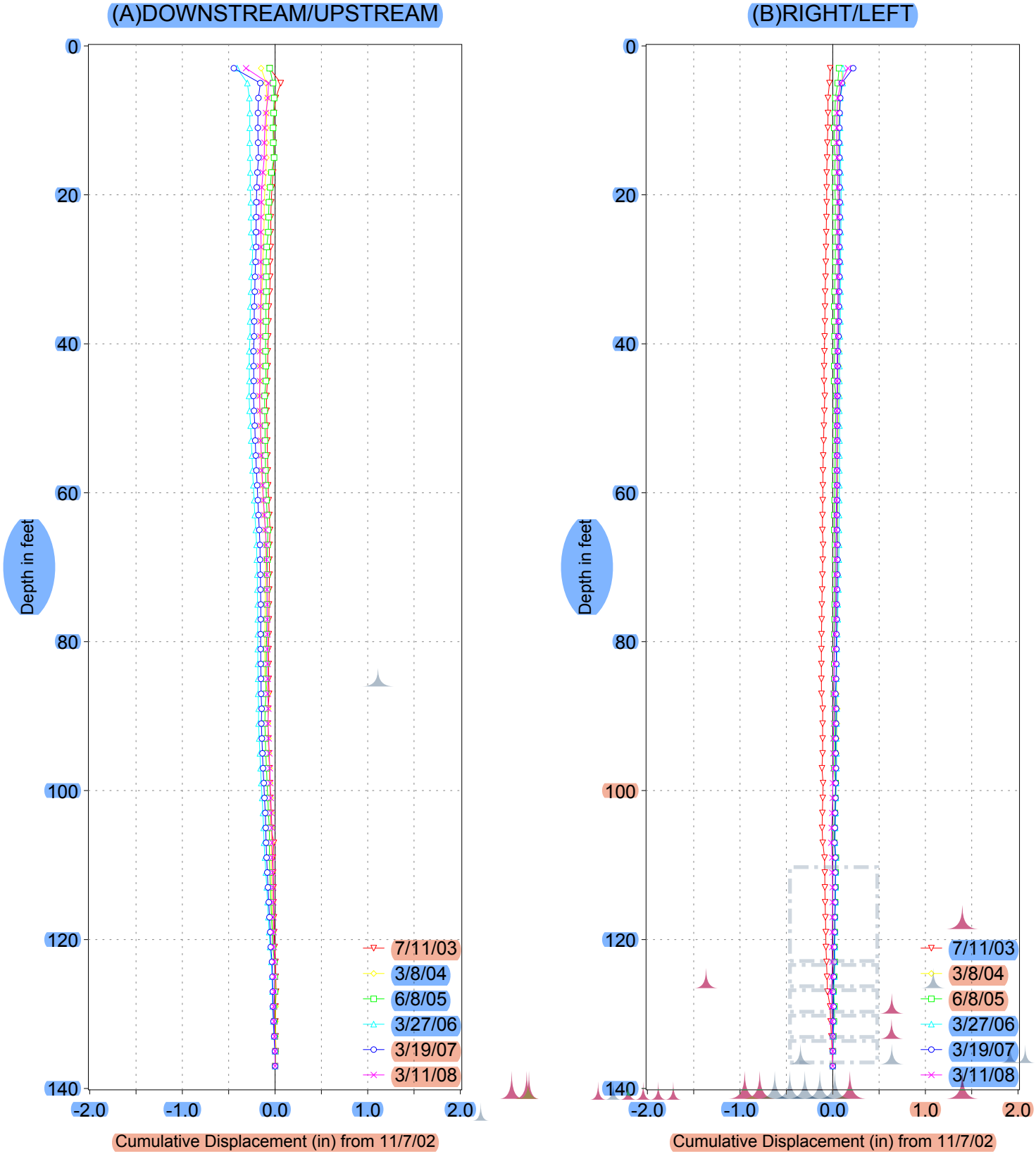
US Army Corps of Engineers®

Chatfield Dam and Lake, CO

Inclinometer 472, Spillway Sta. 10+60, 500' Left

Cumulative Displacement 2002-Present

Reallocation Study **Plate D-19**



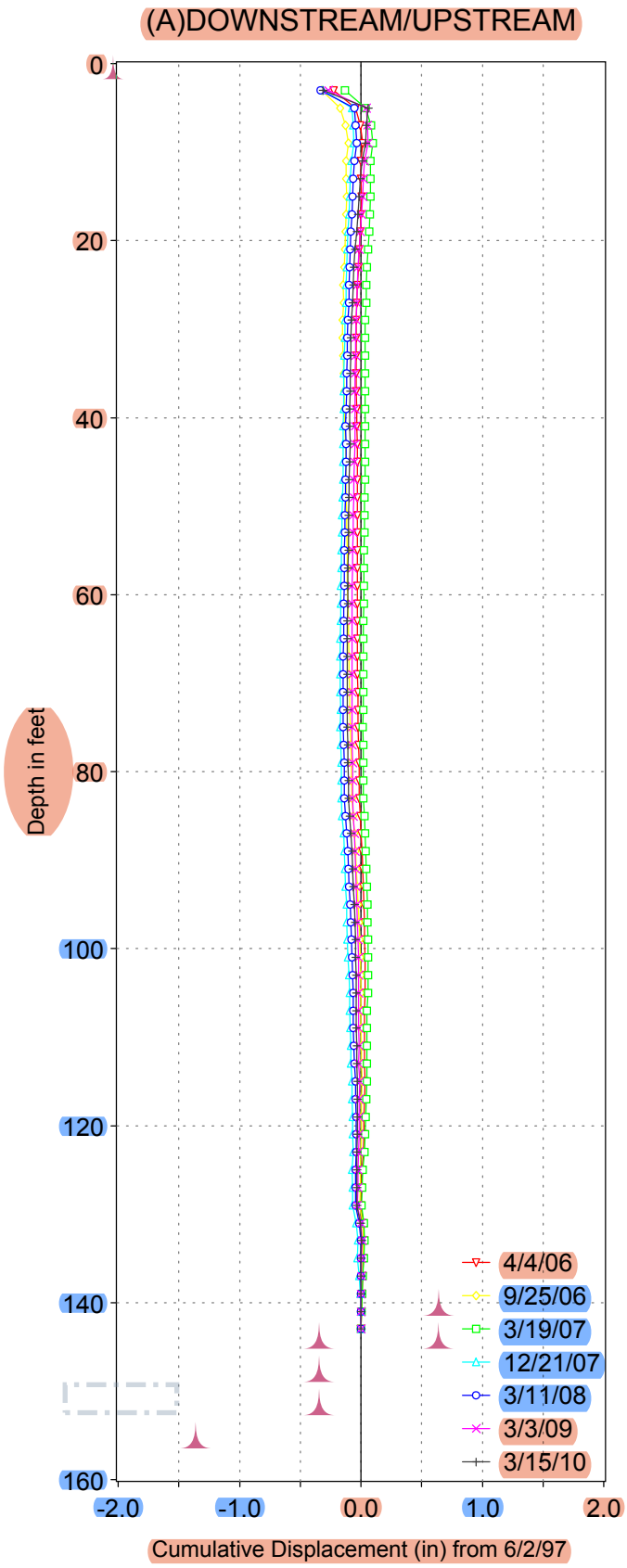
US Army Corps of Engineers®

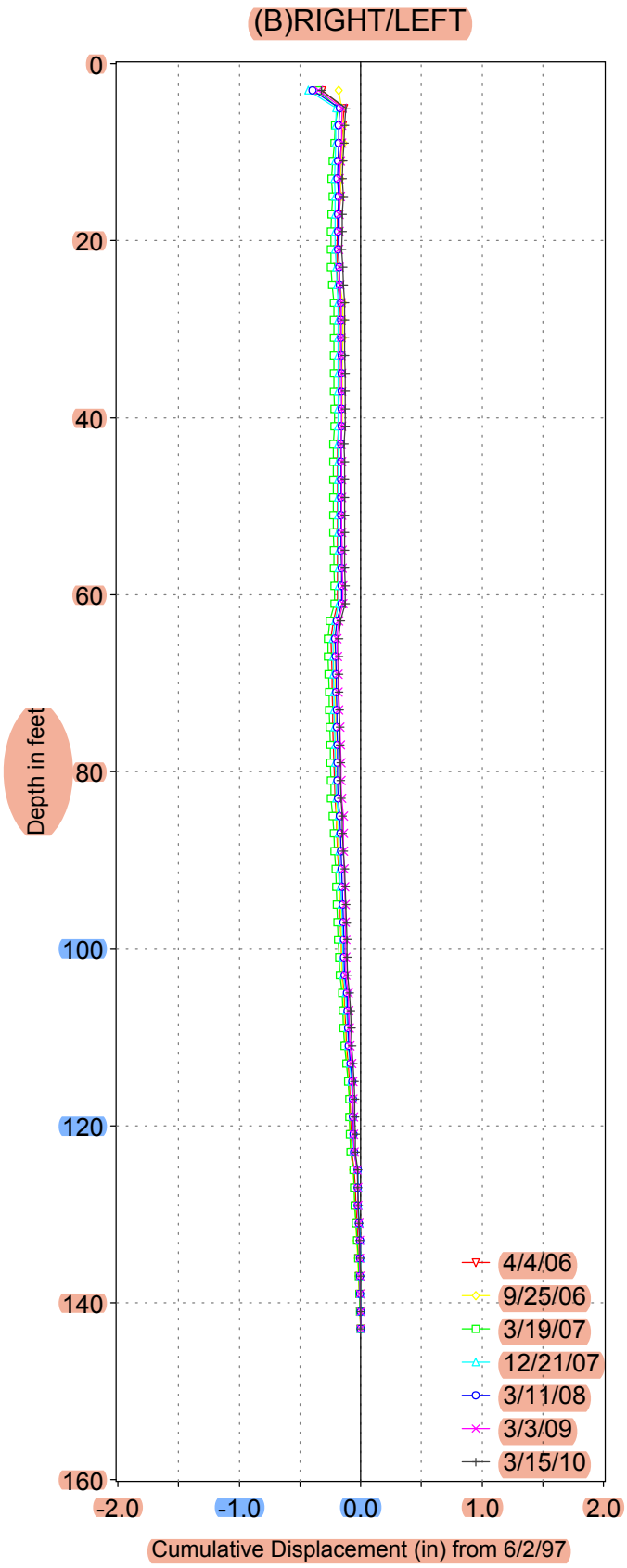
Chatfield Dam and Lake, CO

Inclinometer 488, Sta. 68+90, 500' DS

Cumulative Displacement 2002 - Present

Realloction Study **Plate D-20**





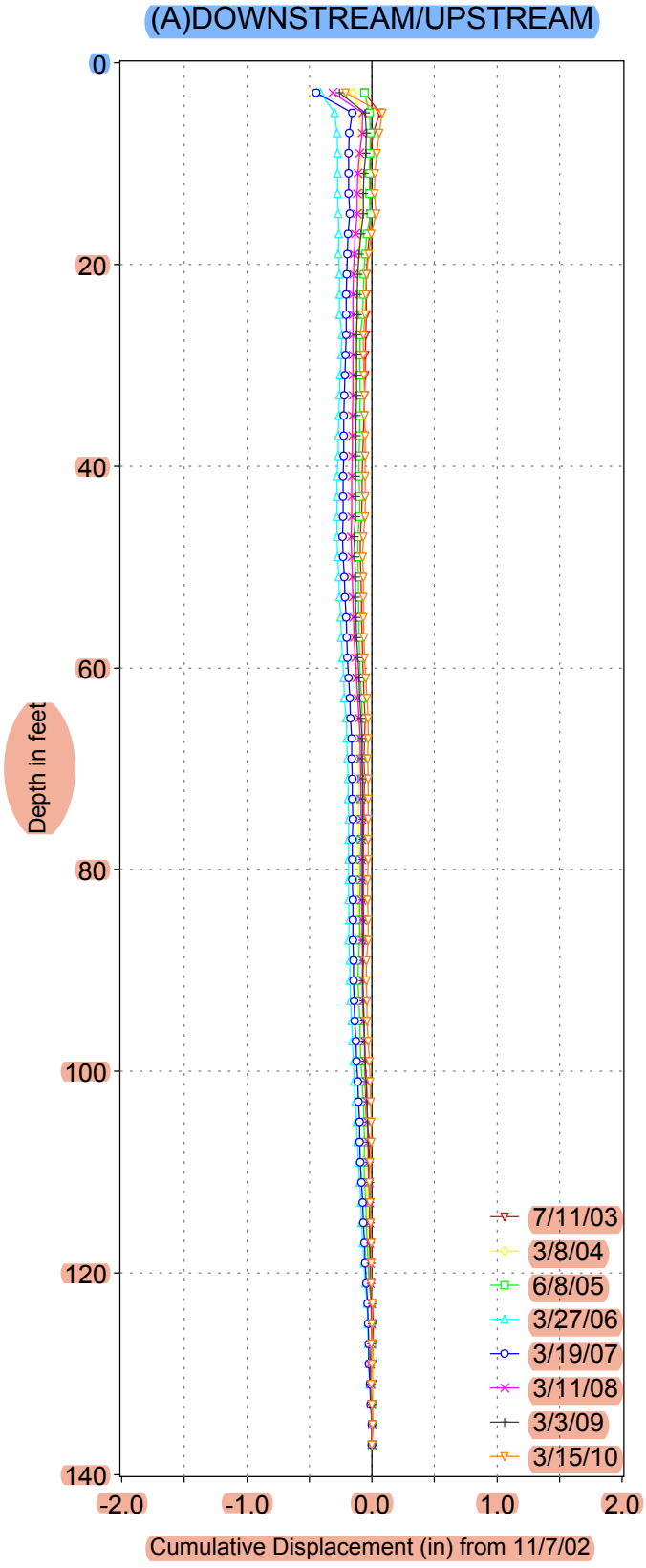
US Army Corps of Engineers®

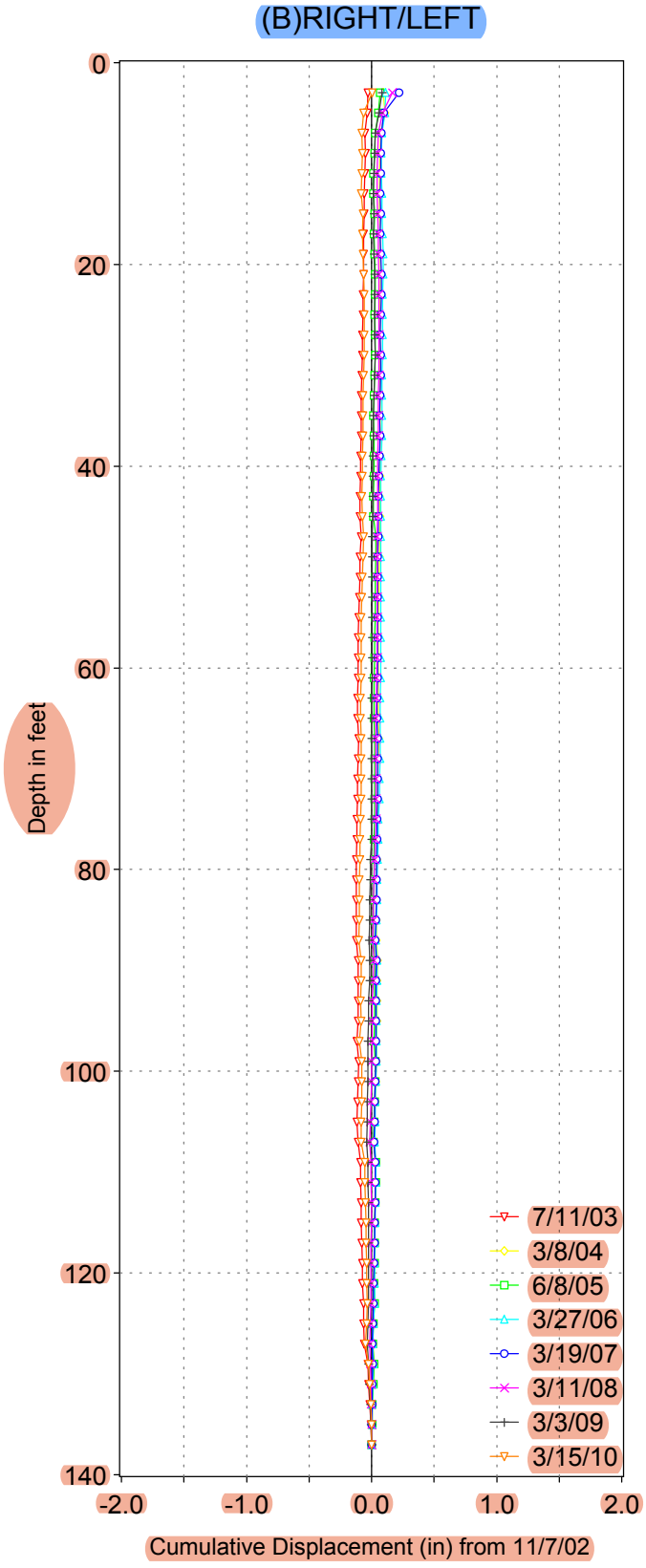
Chatfield Dam and Lake, CO

Inclinometer 490, Sta. 81+20, 350' DS

Cumulative Displacement 97 - Present

Reallocation Study **Plate D-21**





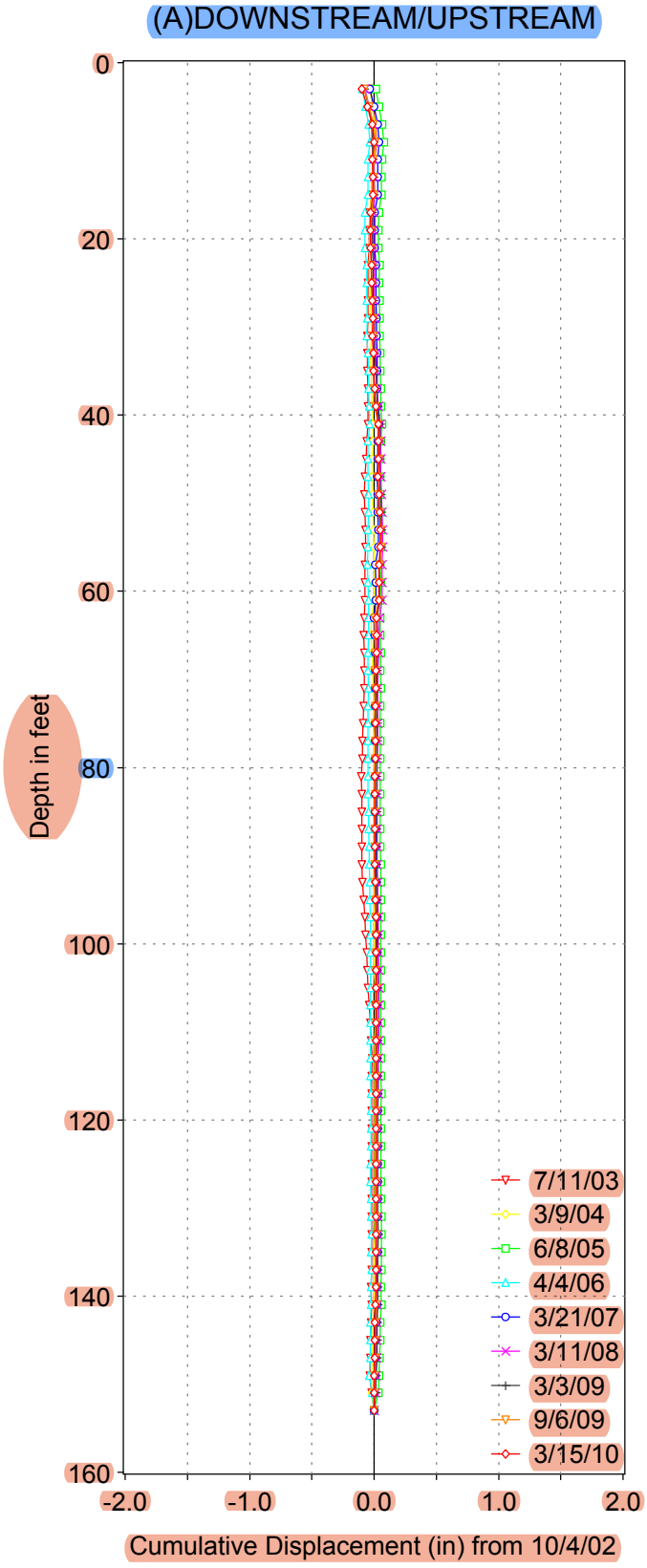
US Army Corps of Engineers®

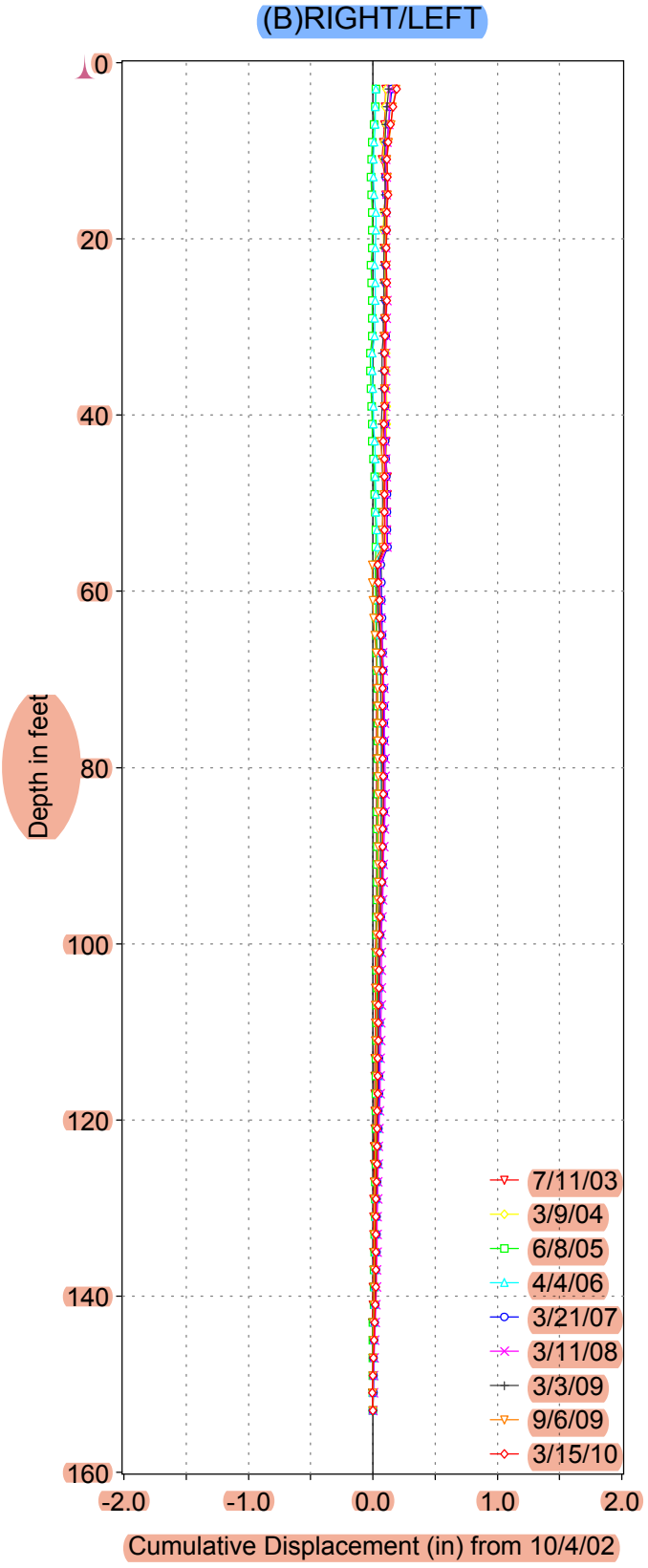
Chatfield Dam and Lake, CO

Inclinometer 488, Sta. 68+90, 500' DS

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-22**





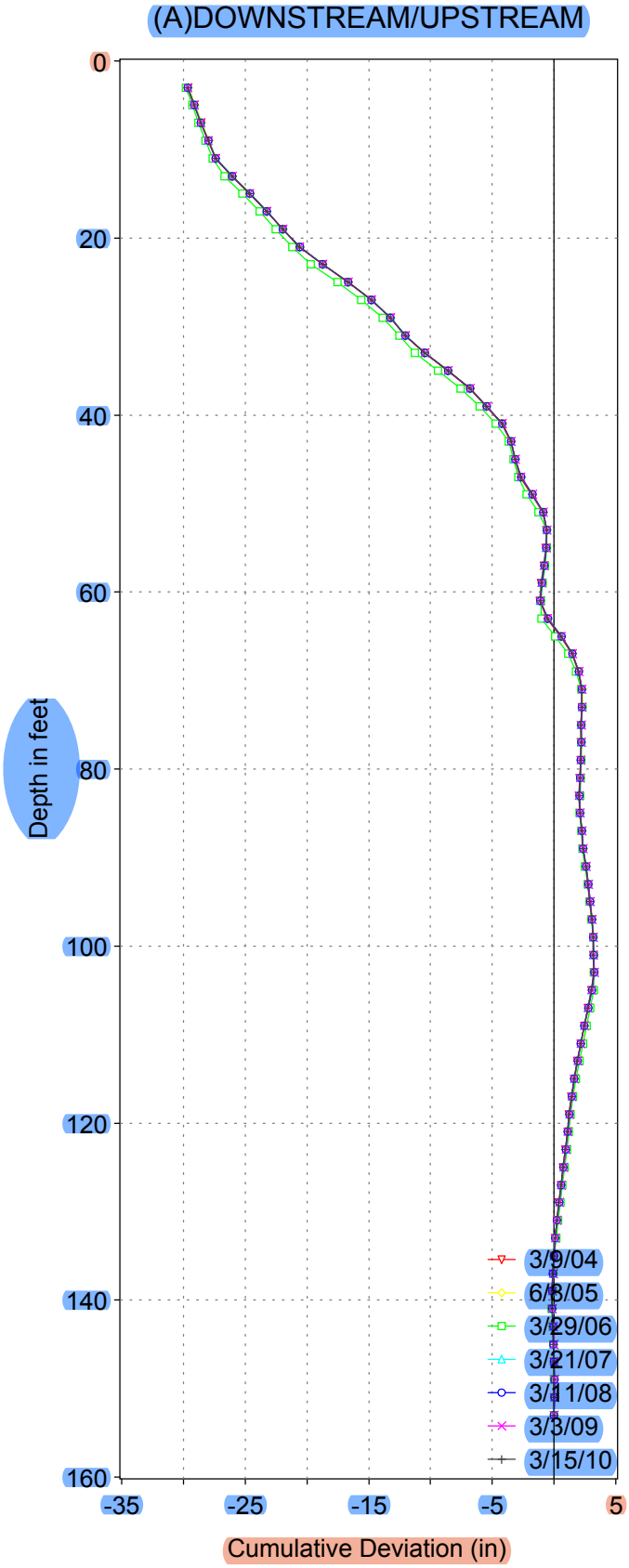
US Army Corps of Engineers®

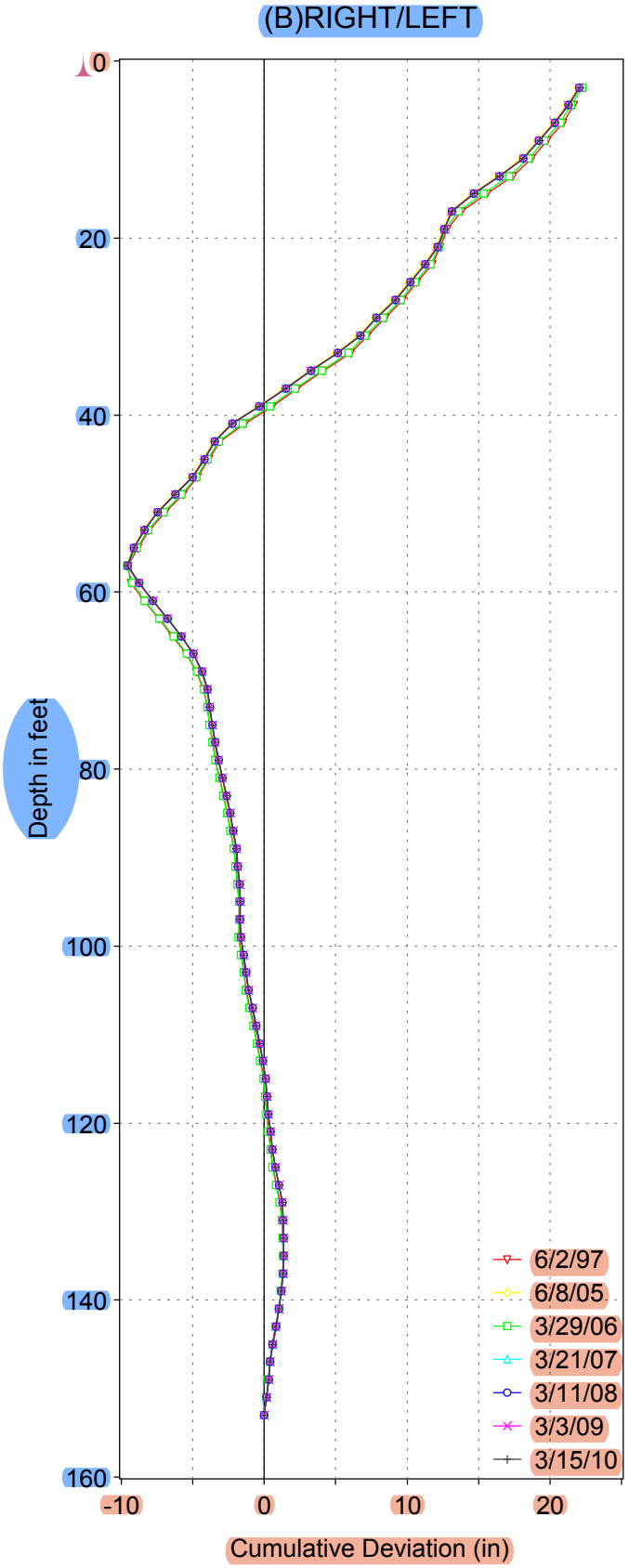
Chatfield Dam and Dam, CO

Inclinometer 496, Sta. 104+54, 167' DS

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-23**





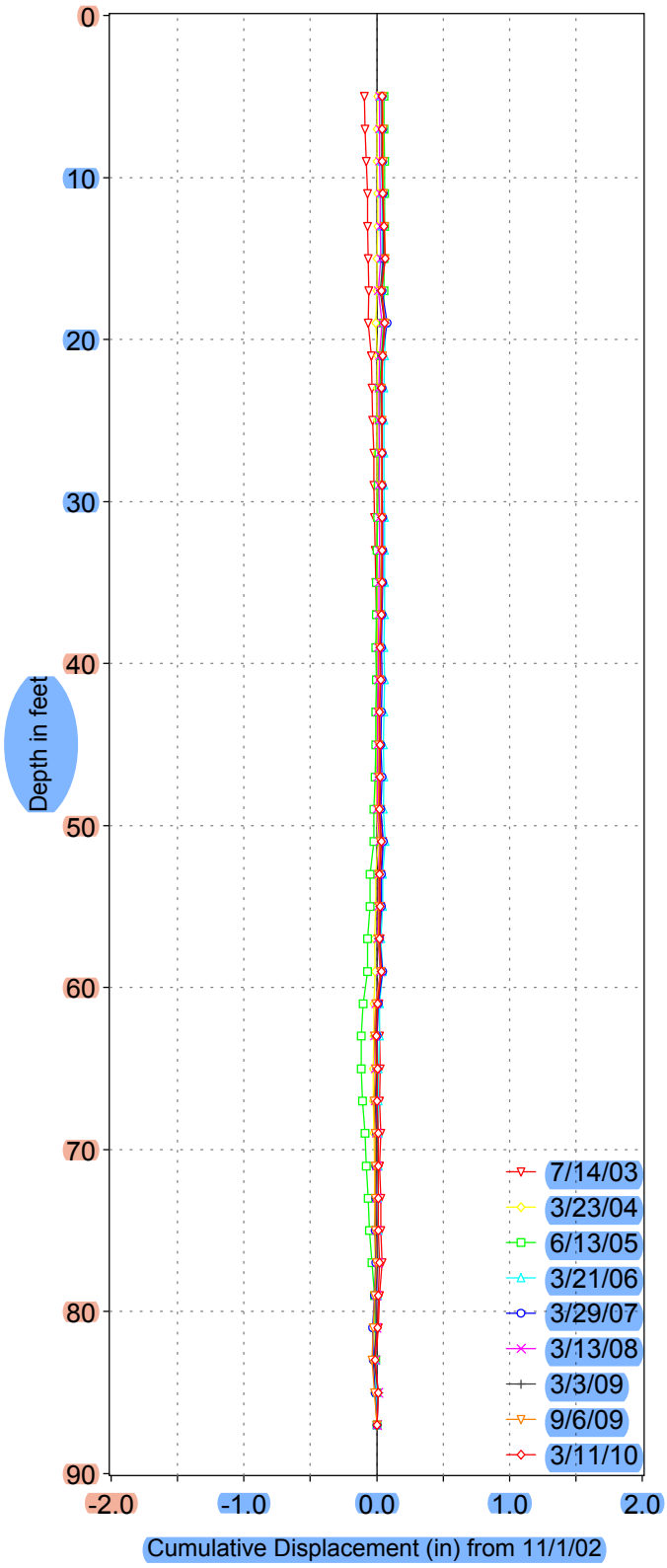
US Army Corps of Engineers®

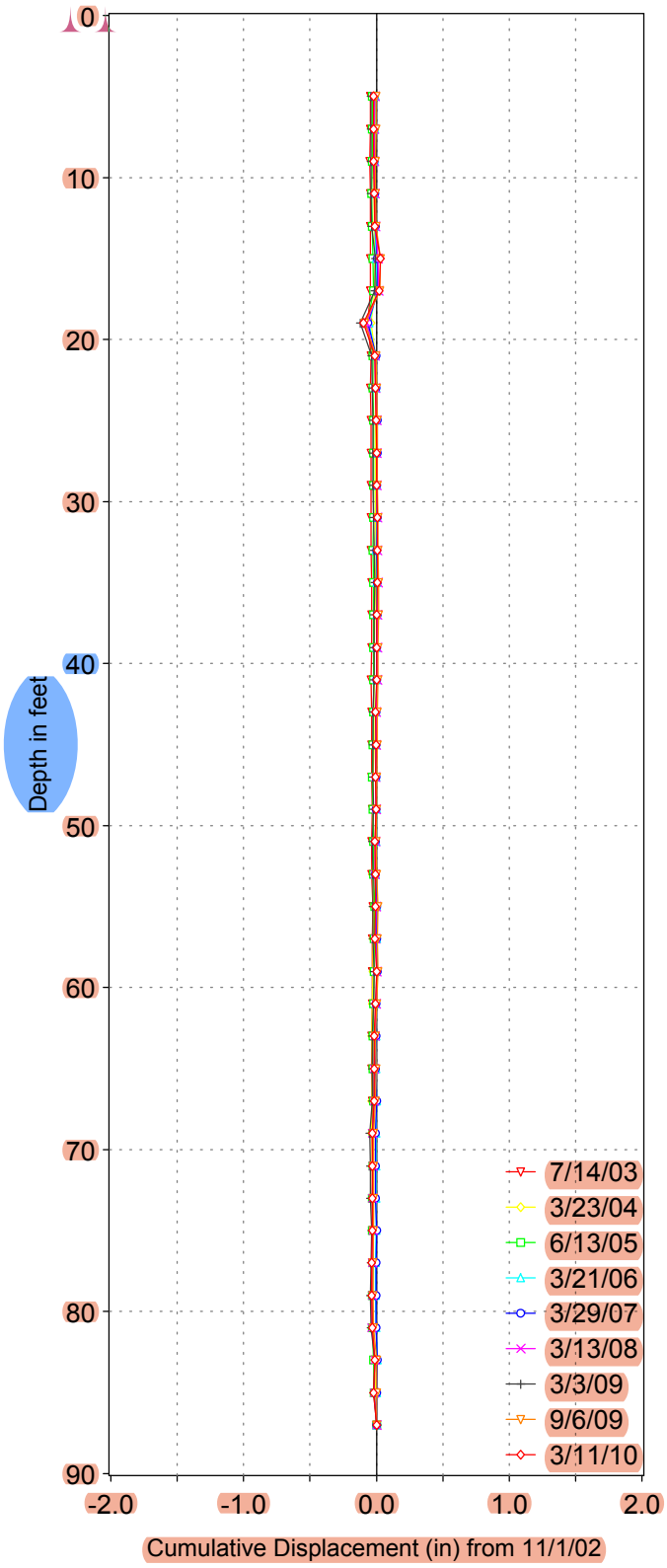
Chatfield Dam and Lake, CO

Inclinometer 496, Sta. 104+54, 167' DS

Cumulative Deviation

Reallocation Study **Plate D-23A**





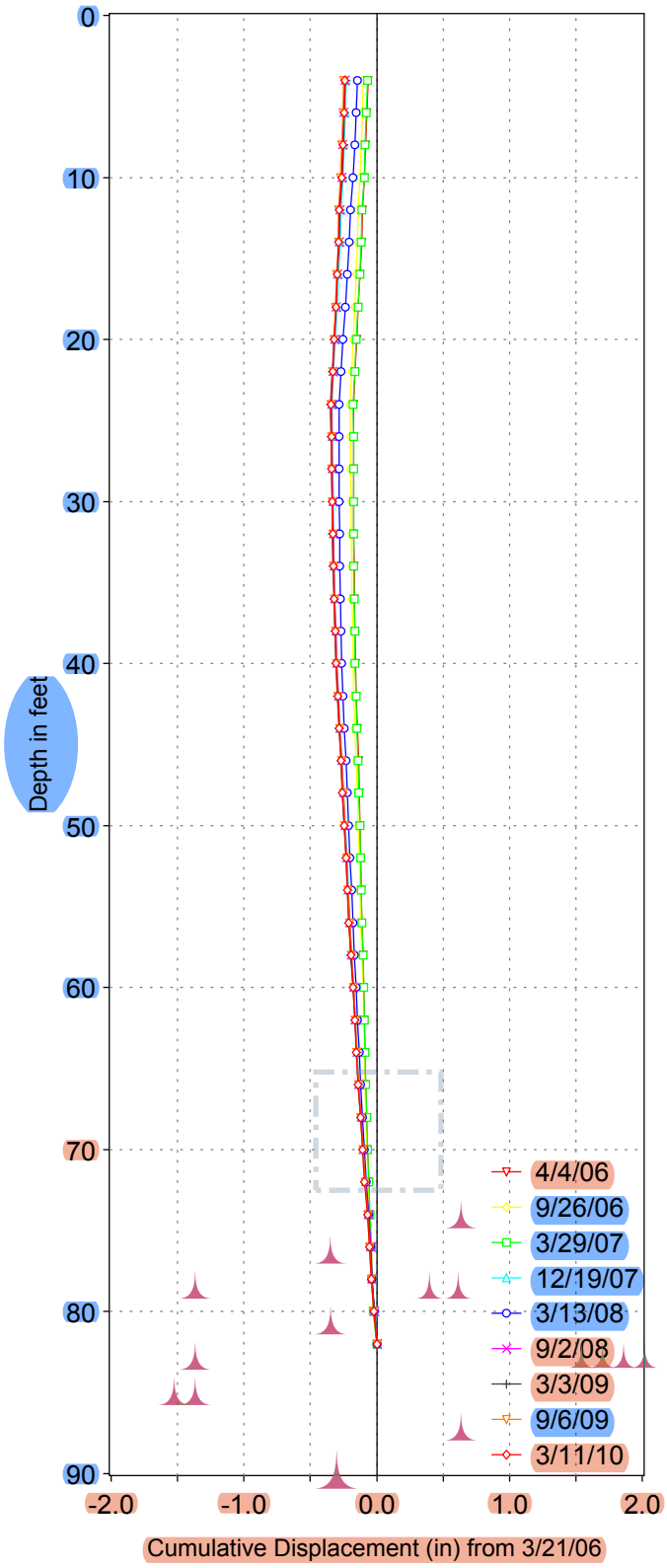
US Army Corps of Engineers®

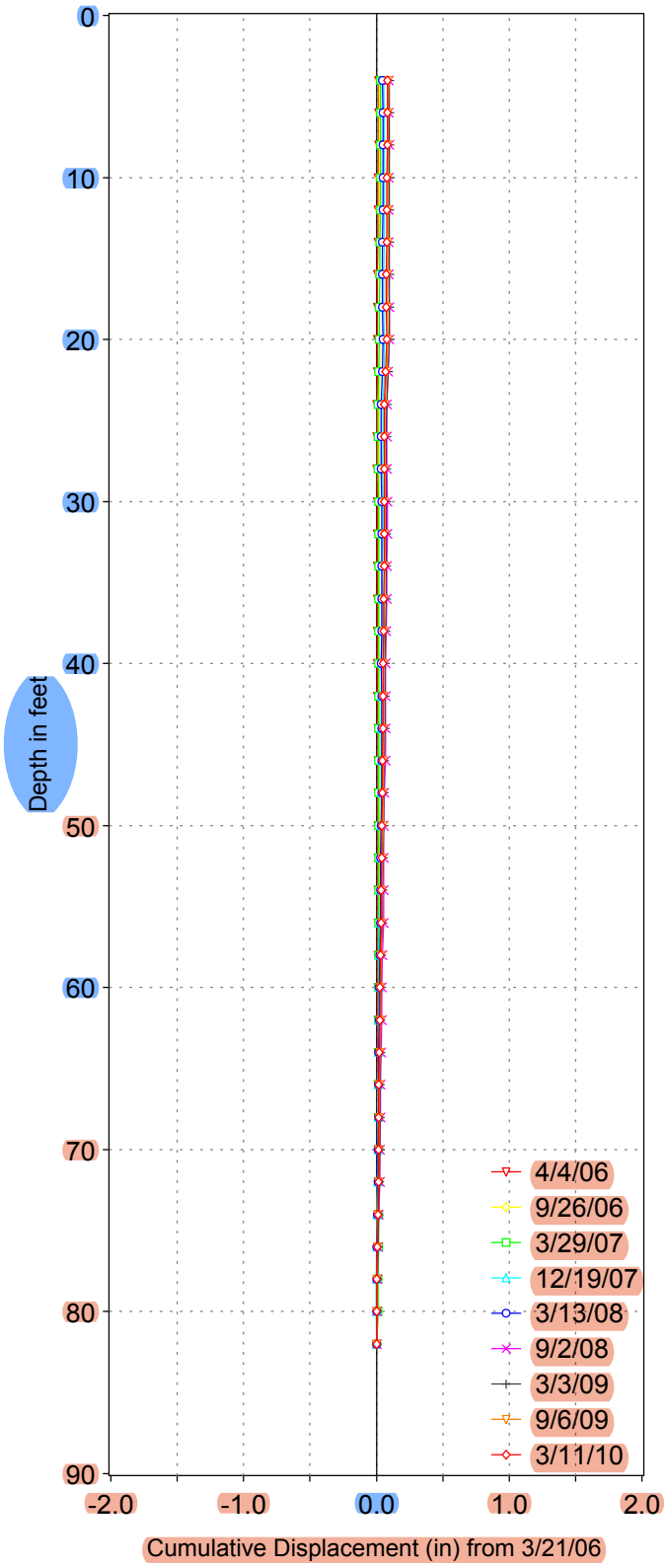
Chatfield Dam and Lake, CO

Inclinometers 523, Outlet Works Sta. 2+92, 9.5' LEFT

Cumulative Displacement 2002 - Present

Realloction Study **Plate D-24**





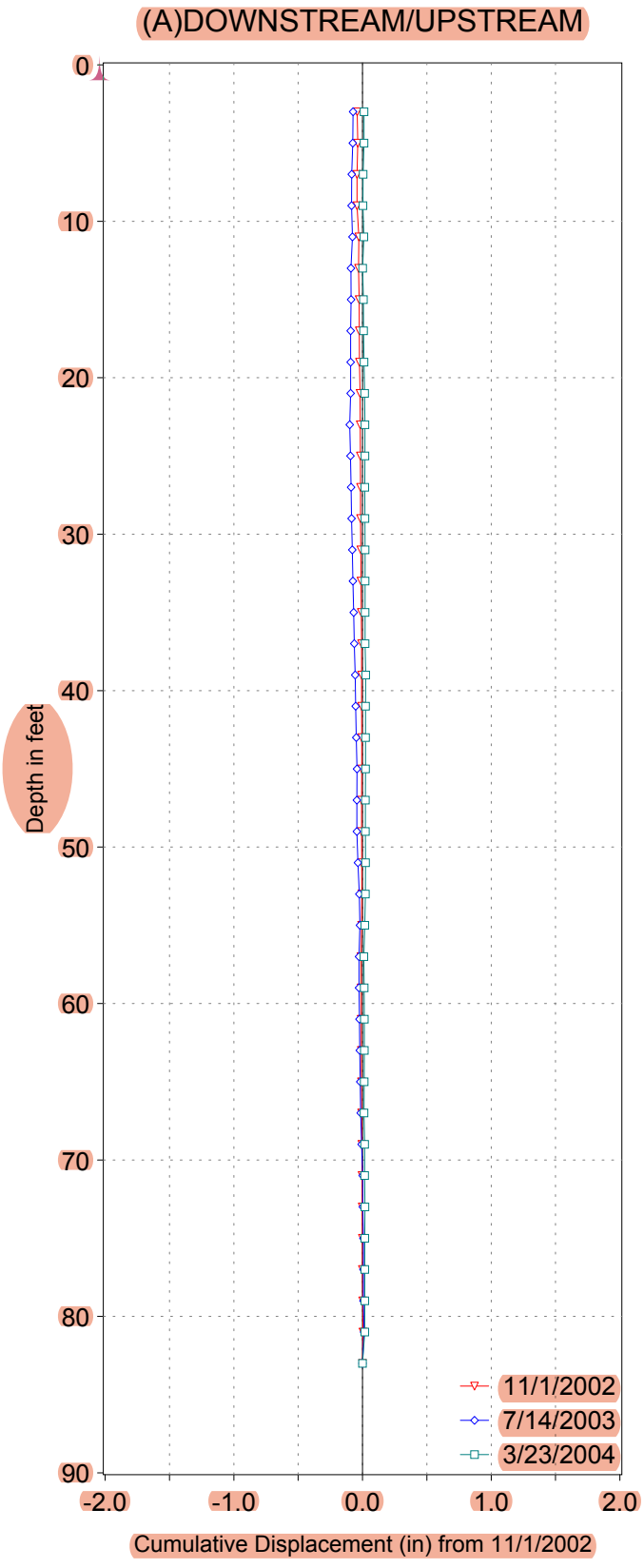
US Army Corps of Engineers®

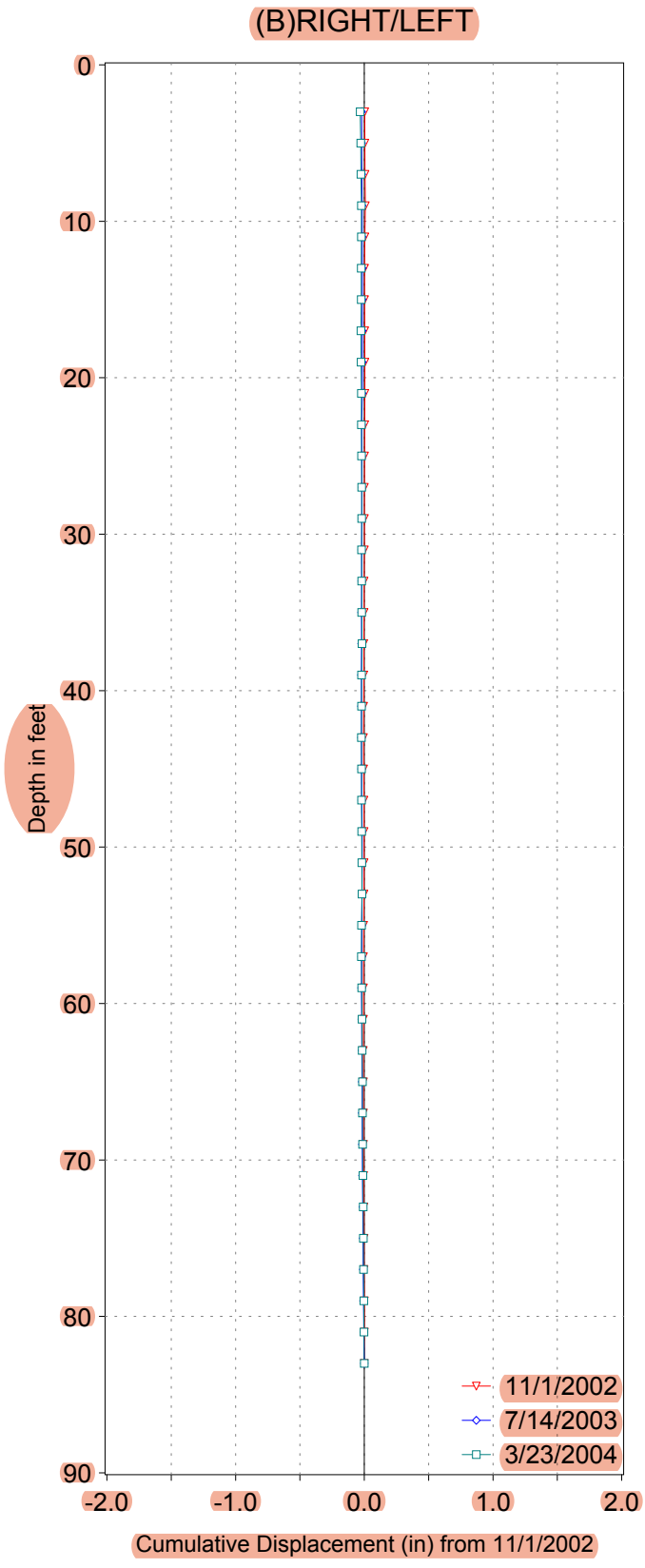
Chatfield Dam and Lake, CO

Inclinometer 524, Outlet Works Sta. 0+68, 9.5' Left

Cumulative Displacement 2006 - Present

Reallocation Study **Plate B-25**





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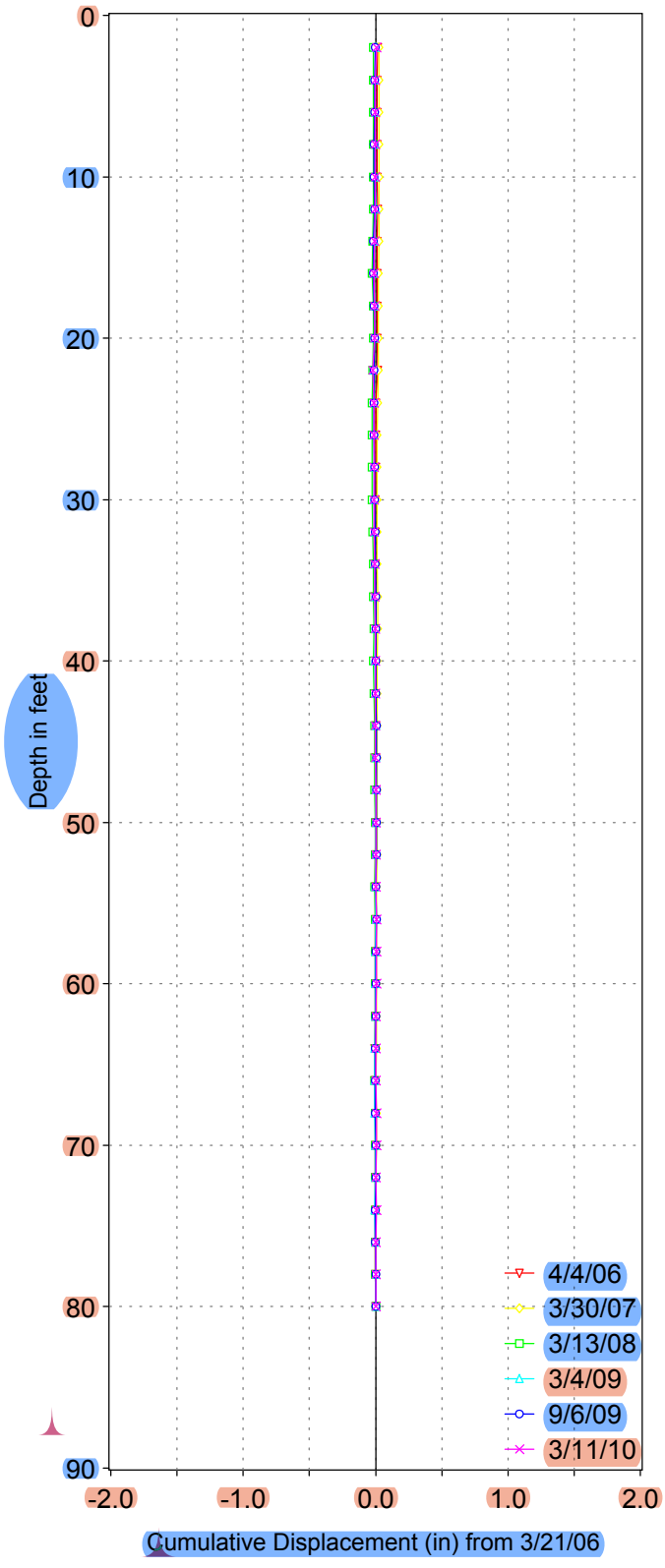
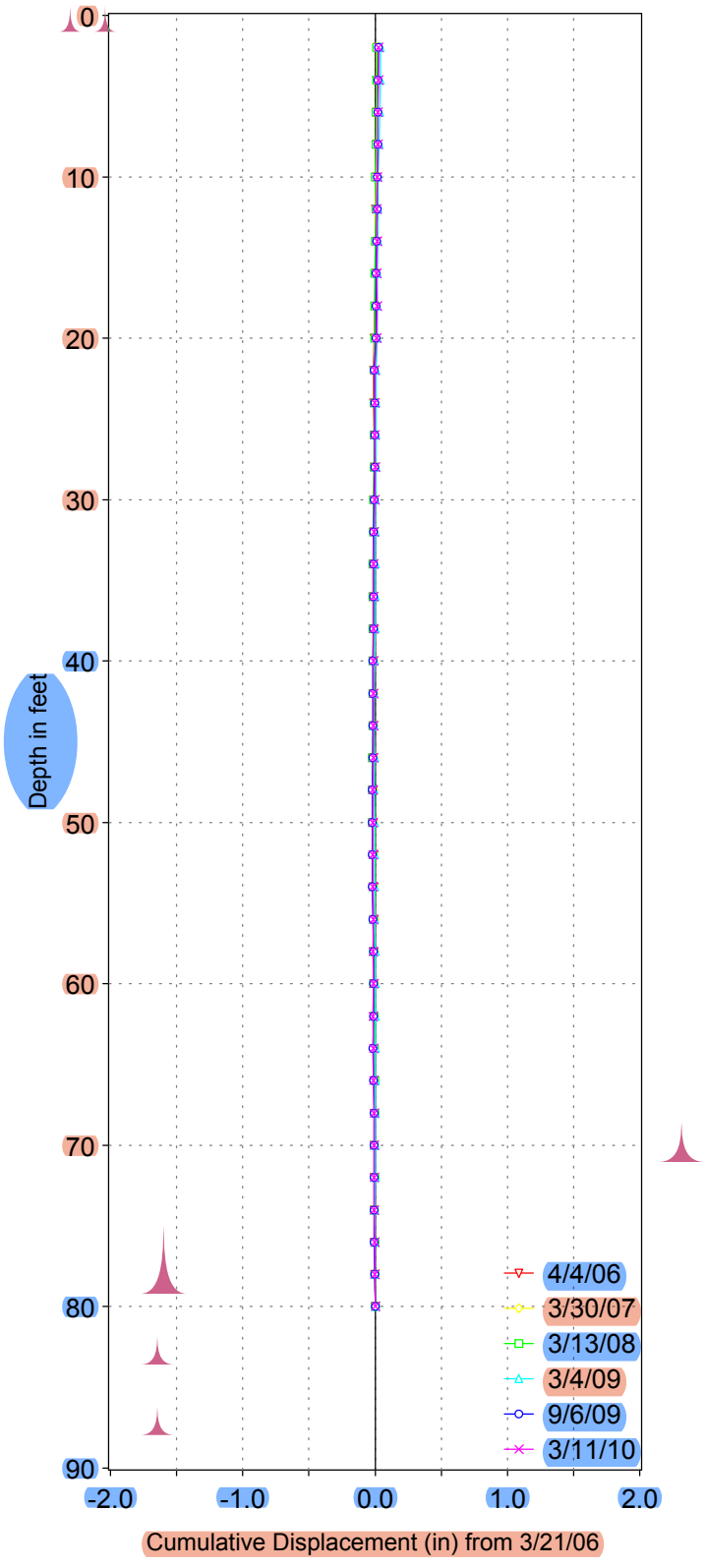
Chatfield Dam and Lake, CO

Inclinometer 525, Outlet Works Sta. 1+00, 9.5' Left

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-26**





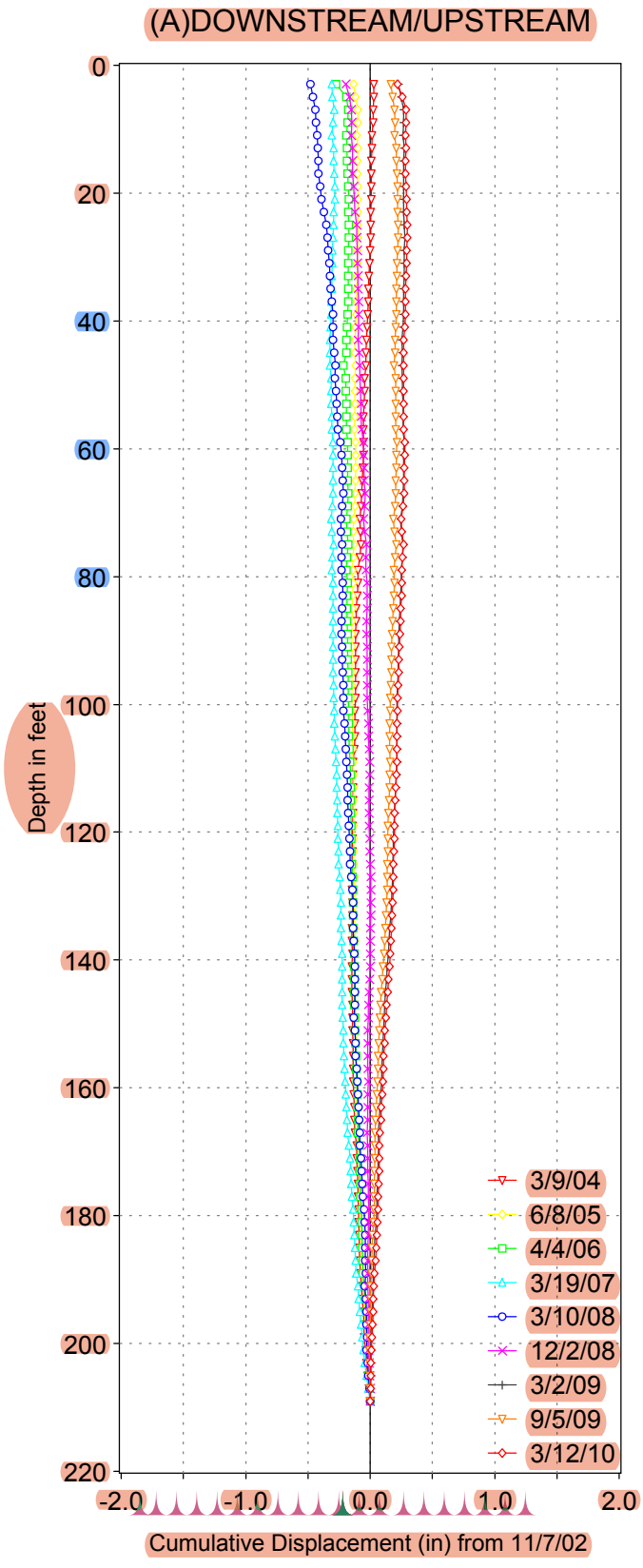
US Army Corps of Engineers®

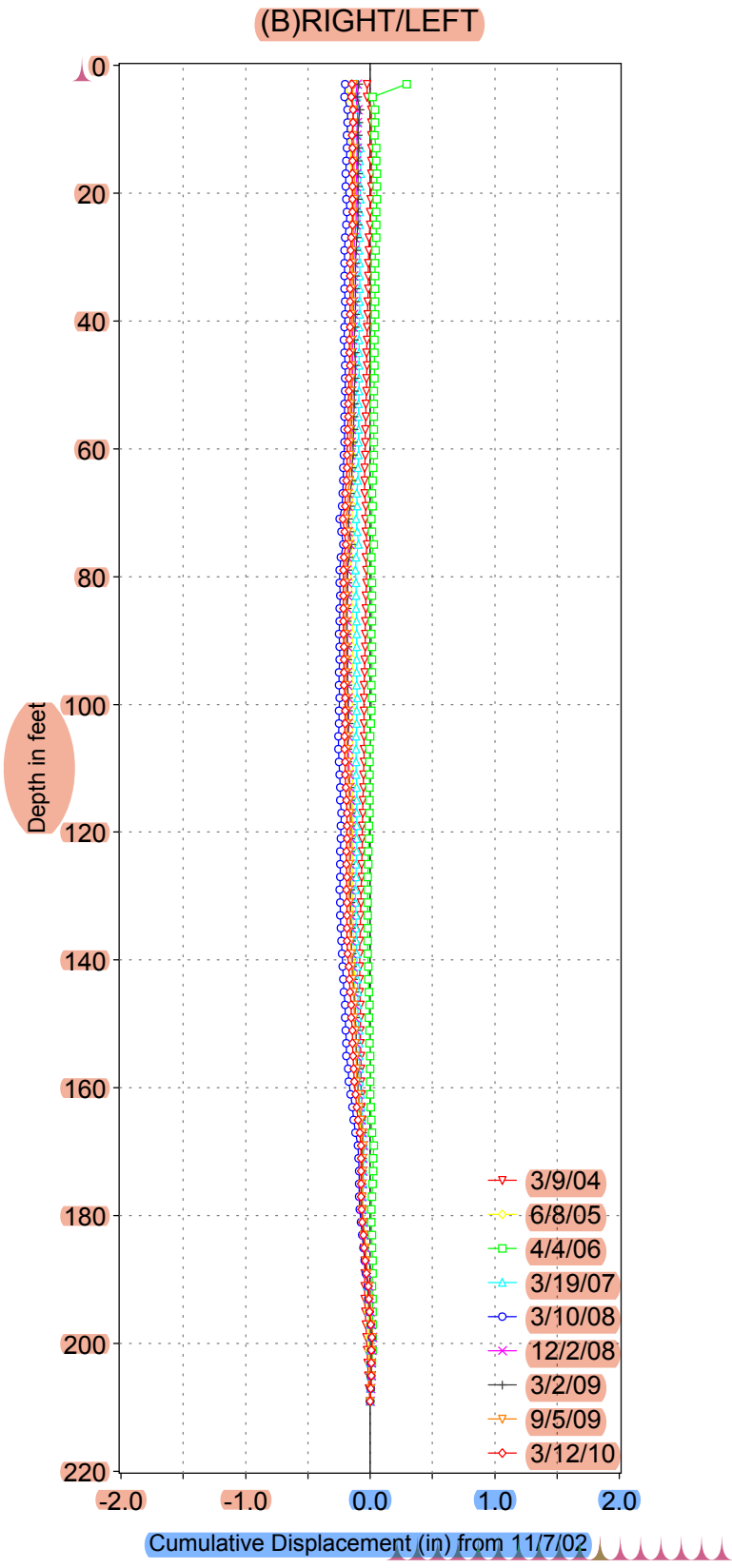
Chatfield Dam and Lake, CO

Inclinometer 526, Outlet Works Sta. 4+36, 9.5' Left

Cumulative Displacement 2006 - Present

Reallocation Study **Plate D-27**





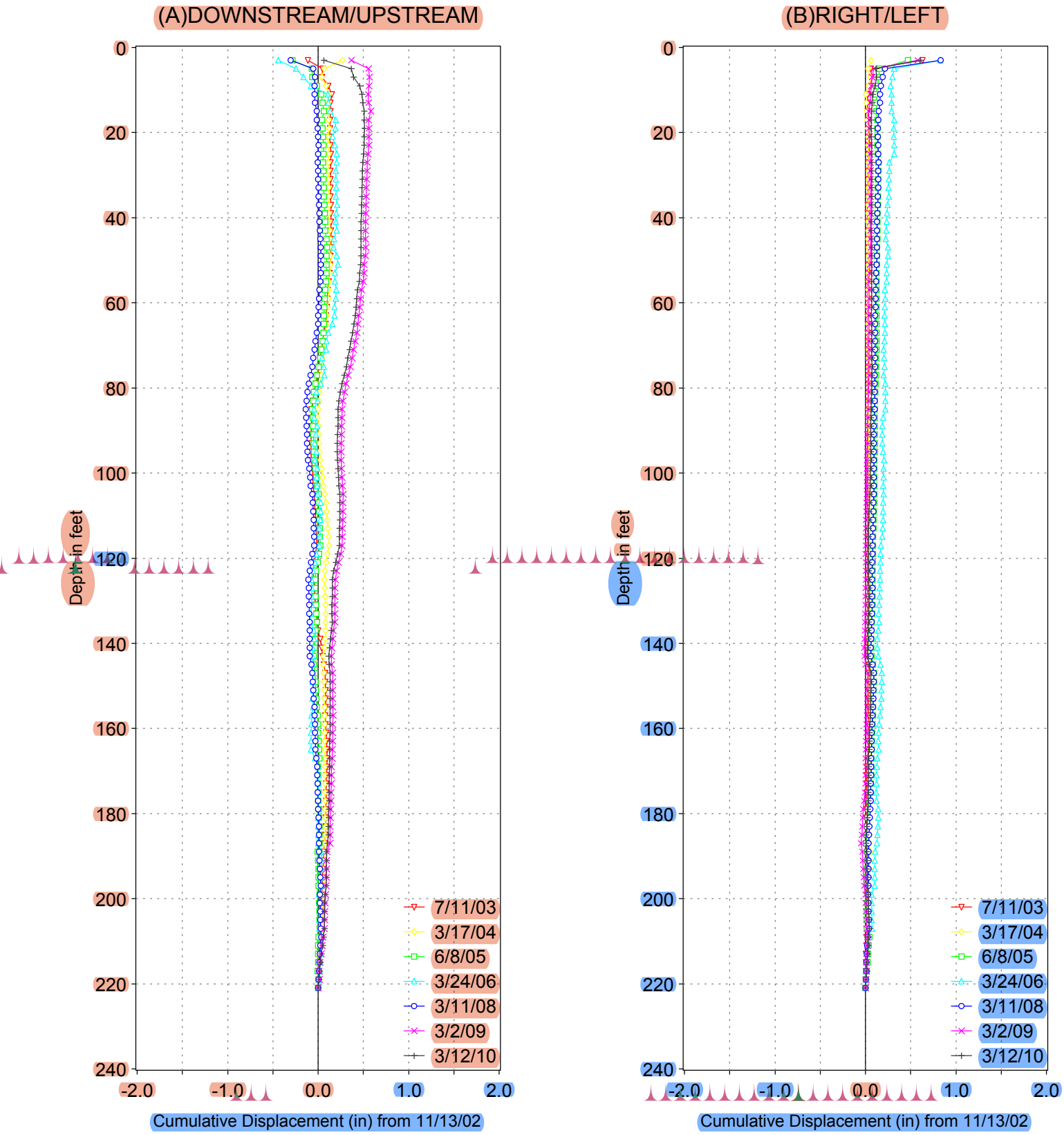
US Army Corps of Engineers®

Chatfield Dam and Lake, CO

Inclinometer 544, Sta. 68+80, 17' D.S.

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-28**



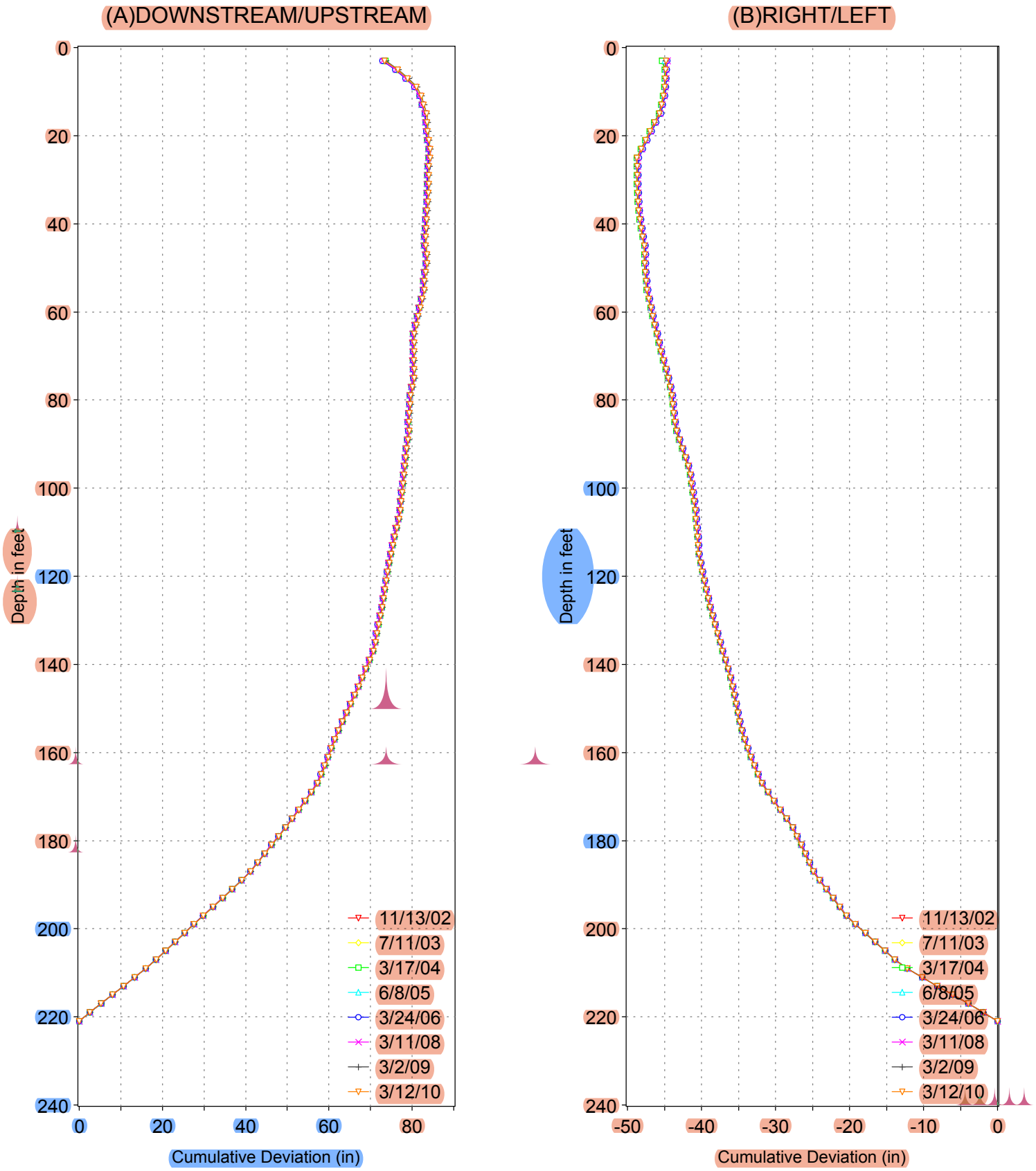
US Army Corps of Engineers®

Chatfield Dam and Lake, CO

Inclinometer 545, Sta. 81+10, 17' DS

Cumulative Displacement 2002 - Present

Reallocation Study **Plate D-29**



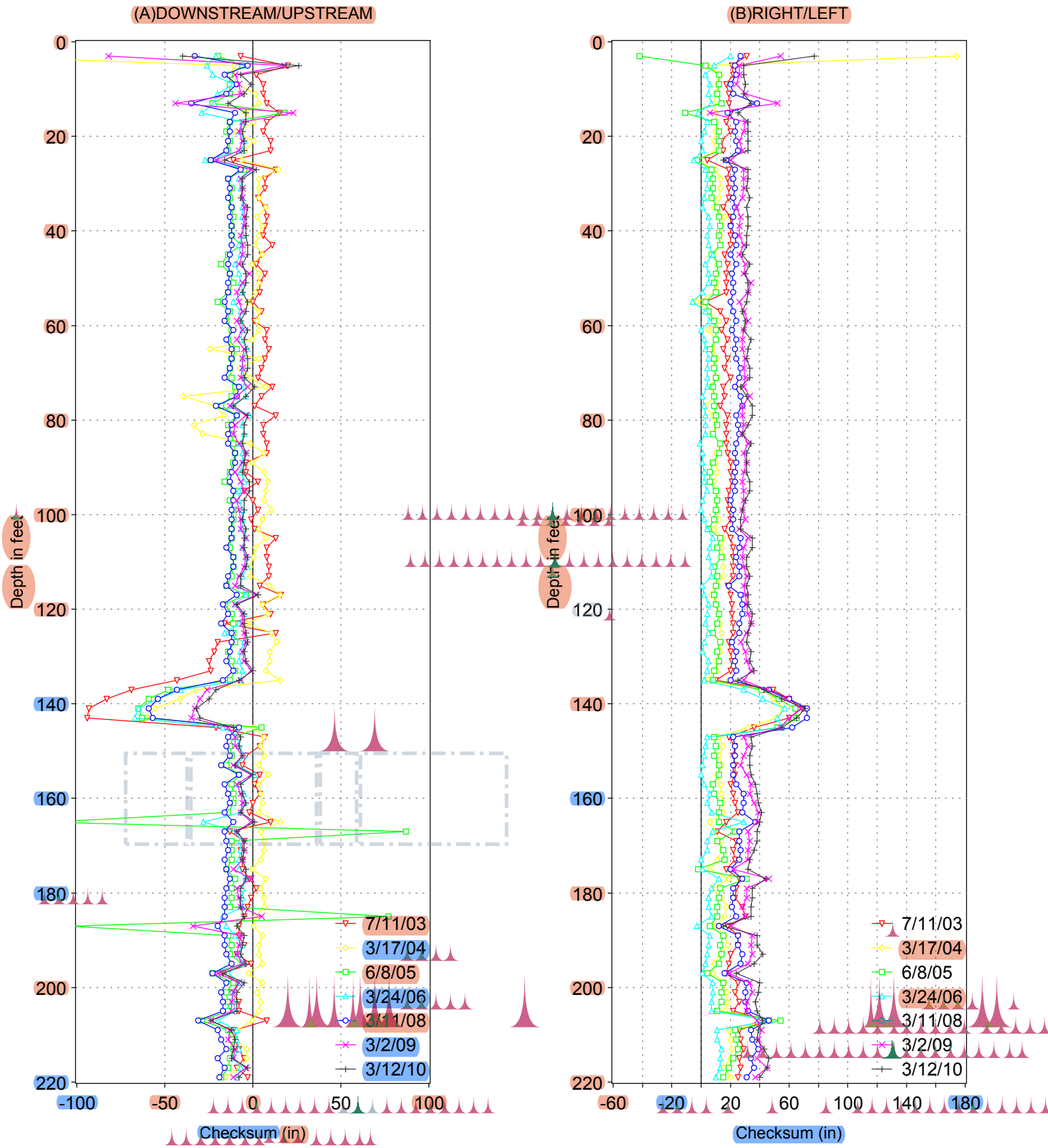
US Army Corps of Engineers®

Chatfield Dam and Lake, Co

Inclinometer 545, Embankment Sta. 81+10, 17' DS

Cumulative Deviation 2002 - Present

Reallocation Study **Plate D-30**



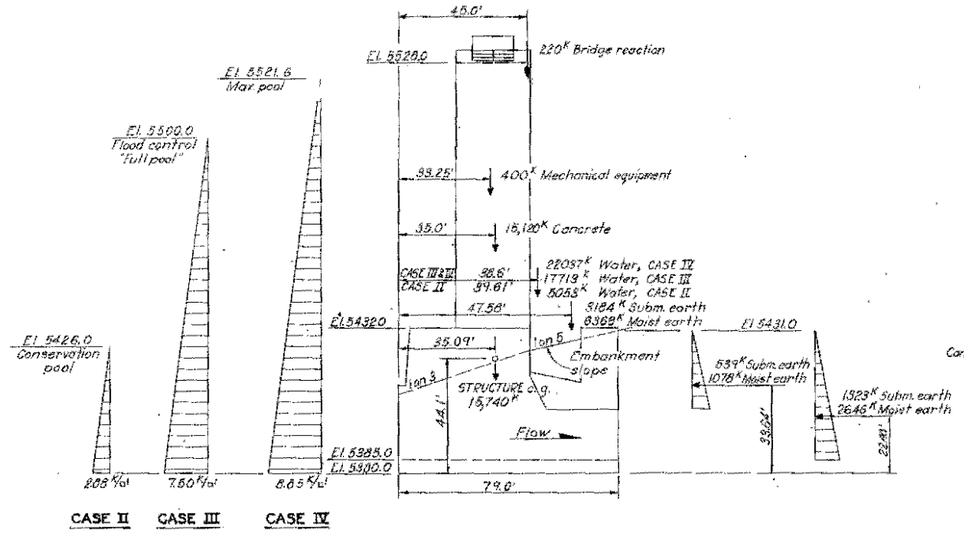
US Army Corps of Engineers®

Chatfield Dam and LAke,CO

Inclinometer 545, Sta. 81+10, 17' DS

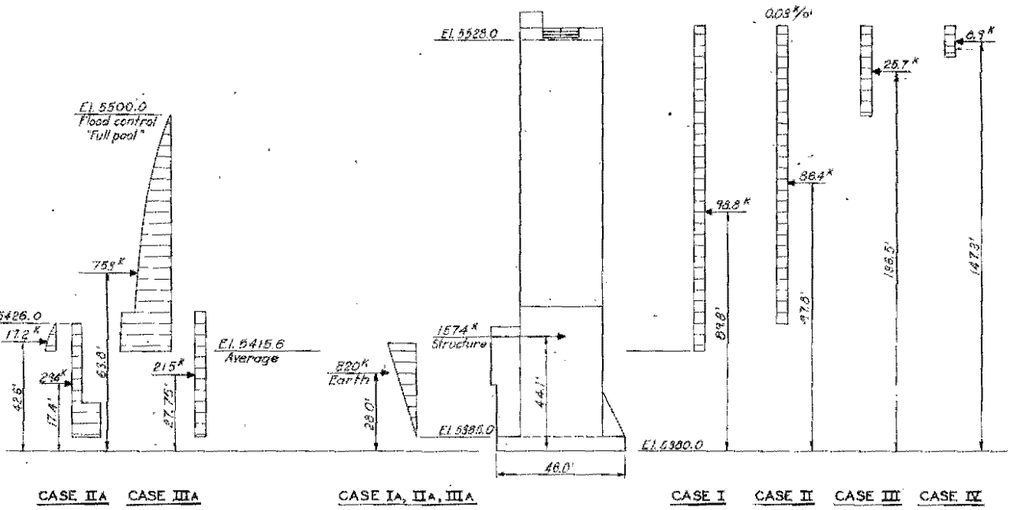
Checksum 2002 - Present

Reallocation Study **Plate D-31**



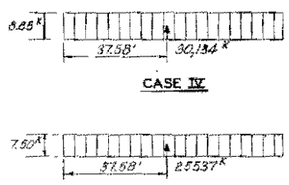
HORIZONTAL WATER PRESSURES

HORIZONTAL EARTH PRESSURES

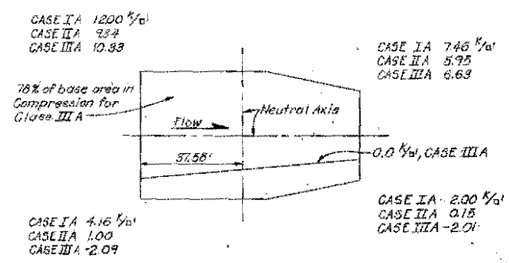


EARTHQUAKE FORCES

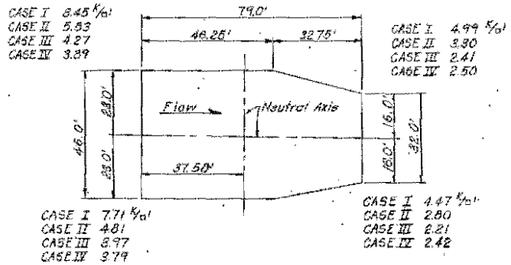
WIND PRESSURES



UPLIFT PRESSURES



FOUNDATION PRESSURES
DUE TO EARTHQUAKE



FOUNDATION PRESSURES
DUE TO WIND

LOADING CONDITIONS:

CASE I CONSTRUCTION CONDITION
- a. Reservoir empty
- b. Dead load of structure, incl. bridge & equip.
- c. Earth loads
- d. Wind load on side above backfill

CASE II NORMAL OPERATING CONDITIONS
- a. Reservoir at El. 5425, Conservation Pool
- b. All gates open
- c. Dead load of structure
- d. Earth loads
- e. Wind load on side above water surface
- f. Full uplift on base

CASE III FULL FLOOD CONDITION
- a. Reservoir at El. 5500, Full Pool
- b. Emergency gates closed
- c. Dead load of structure
- d. Earth loads
- e. Wind load above water surface
- f. Full uplift on base

CASE IV MAXIMUM FLOOD CONDITION
Same as Case III except pool at El. 5521.6

Case IA, IIA, OR IIIA
Same as Case I, II, or III, except earthquake is substituted for wind.

SHEAR-FRICTION FORMULA:
Sliding safety factor = $\frac{fV + sA}{H}$

CASE I	7.56	CASE IA	6.36
CASE II	13.64	CASE IIA	7.73
CASE III	13.08	CASE IIIA	6.33
CASE IV	13.00		

Allowable bearing pressure = 12.0 k.s.f.

THIS DRAWING HAS BEEN REDUCED TO THREE-EIGHTHS THE ORIGINAL SCALE.

DATE	DESCRIPTION	MADE	APPRD
	REVISIONS		

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: R. W. A.
DRAWN BY: L. J. S.
TRACED BY:
CHECKED BY: O. F. S.
SUBMITTED BY: Chief, Design Section
APPROVED: Chief, Civil Design Branch
APPROVED: Chief Engineering Division
APPROVED: Col. C. E., District Engineer

SOUTH PLATTE RIVER, COLORADO
CHATFIELD DAM AND RESERVOIR
OUTLET WORKS
INTAKE TOWER STABILITY ANALYSES

DATE: JUNE 1967
SCALE: AS SHOWN
SPEC. NO.
DRAWING NUMBER
SHEET

THIS PLAN ACCOMPANIES CONTRACT No.
MODIFICATION No.