Report on 2005 Field Season

Monitoring the Effectiveness and Validating Response to the Road Related Mitigation Practices Implemented on the Pike's Peak Highway

Third Year

Submitted by:

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March 7, 2006

Executive Summary

Monitoring the Effectiveness and Validating Response to the Road Related Mitigation Practices Implemented on the Pike's Peak Highway

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This report describes the third year's monitoring effort to determine effectiveness and validate response to road related mitigation practices implemented on the Pike's Peak highway as part of the Settlement Agreement between the Sierra Club and the United States Department of Agriculture – Forest Service in Sierra Club v. Venneman, Civil Action No. 98-M-662 (D. Colo.). The effectiveness-monitoring plan has been designed to determine how well the mitigation practices implemented contribute to meeting their objectives and focuses on the 14 mile-long, 300 foot-wide highway corridor (150 feet each side of highway centerline) starting at mile marker 7 and continuing to the summit. Validation monitoring documents how the properly implemented intervention practices affect the riparian, wetland and aquatic system of catchments within the influence of the Pike's Peak highway.

The objectives for the third year of monitoring were to re-measure the various features surveyed the first two years and to continue to locate, identify, and establish baseline surveys for sites not previously surveyed. Highway improvements continued in 2005 with 1.8 miles of highway paved starting at Glen Cove and moving uphill. This year, approximately 1425 tons of roadbase was added to the unimproved highway sections, two-thirds of which was applied to the switchbacks and the balance distributed (not evenly) over the remaining length of highway. A diversion wall installed above Glen Cove intercepts all runoff from the alpine zone of Ski Creek and diverts it into Glen Cove Creek.

Precipitation measurements at all gauges indicated 2005 was drier than 2003 and 2004 (both in storm intensity and total volume) and that, when compared to the mean monthly estimates from the Oregon State Climate Map, 2005 was drier than average except in the month of August. This was the first full year the snotel site at Glen Cove was in operation and recorded 30.7 inches of precipitation for the water year.

Thirteen cut slope and 29 fill slopes sites were monitored in 2005. This year instead of surveying the fill captured in silt fences with the total station we excavated the sediment into graduated buckets and measured fill volumes, directly. Seven (three treated) of the thirteen cut slope sites captured sediment in the spring but only three (one treated) captured sediment generated from summer precipitation. Two upper cut slope silt fences captured material in the spring (both treated) with no summer accumulation in the upper silt fences at all. Twenty two of the 29 sites required cleaning in the spring of which eight were classified as treated with 3 of these sites capturing sediment in both upper and lower fences (one treated). Nine fill slope sites (five treated) captured sediment generated from summer precipitation and all in the upper silt fence.

Re-surveys of the eleven road cross section sites surveyed in 2005 show both increases and decreases in road surface elevations of the cross sections. The addition of roadbase to the surface in some cases increased the width of the road (e.g. 044RX) as well as the elevation.

Re-surveys of the twenty drainage ditches show the nine of treated sites generally experience less annual variation in cross sectional area than the eleven untreated sites. One treated site, 092DD, in Basin 3 was surveyed after being prepped for shot-crete application and should not be compared with the other sites.

This year marked the completion for the baseline surveys of all known and identified conveyance channels. In addition to the 79 conveyance channels previously surveyed, an additional 34 channels were surveyed in 2005. Several of the conveyance channel surveys were made below rock weirs where currently there is no channel. Except for channels below velocity dissipators and rock weirs, most of the conveyance channels do not need to be re-surveyed until the end of the monitoring term.

Seventeen rock weirs in Basins 1 and 2 were monitored in 2005 to determine their effectiveness in trapping sediment both from winter and summer runoff. Three additional weirs were surveyed in Basin 3 as a result of the highway improvement effort in 2005. The large sediment pond in Basin 2 was surveyed in the spring and fall to determine winter/summer contributions and an initial survey was made of the small sediment pond created below the Ski Creek diversion wall.

Two new stream sites were established this year in response to the diversion wall built on Ski Creek to divert all alpine runoff into Glen Cove Creek. The diversion on Ski Creek will increase the water yield and likely the peaks of both Glen Cove and South Catamount creeks so we established monitoring sites just above the confluence on each of the streams and named them GLEN1 and SCAT3, respectively. Baseline conditions were described for the various parameters in 2005 at each site including planview, slope, cross sections, pebble counts and grab samples, and vegetation cover.

Included with this report are two data DVD’s containing all survey data (field and post processing) plus digital photographs (recommended viewing) for all sites.

Acknowledgements

Many thanks go out to all the people and agencies that cooperated in this effort, and there were quite a few.

Special thanks go out to the US Forest Service's Pike's Peak Ranger District, Rocky Mountain Research Station and Manitou Experimental Forest personnel for all the logistical, technical, laboratory and financial assistance. Also, to the City of Colorado Springs and the Pike's Peak Highway crew who shared their invaluable knowledge of the highway and their time.

My personal thanks to SI International, Inc., METI Inc., the US Forest Service Inventory and Monitoring Institute, Black Creek Hydrology, LLC, Levi Howell, and Khoa van Phung for a successful third year.

Introduction

This report describes the third year's monitoring effort to determine effectiveness of road restoration practices and to validate response to road related mitigation practices implemented on the Pike's Peak highway as part of the Settlement Agreement between the Sierra Club and the United States Department of Agriculture – Forest Service in Sierra Club v. Venneman, Civil Action No. 98-M-662 (D. Colo.). The five major objectives of the road mitigation work are to:

- Stabilize road surface materials, cut slopes and fill slopes
- Reduce runoff velocities and dissipate erosive energy
- Collect runoff in armored ditches and conveyance channels
- Reduce erosion and sediment deposition in drainage channels
- Retain sediment in traps and ponds to reduce downstream sedimentation.

The effectiveness-monitoring plan was designed to determine how well the implemented mitigation practices contribute to meeting these objectives and focuses on the 14 mile-long, 300 foot-wide highway corridor (150 feet each side of highway centerline) starting at mile marker seven and continuing to the summit. Validation monitoring documents how the properly implemented intervention practices affect the riparian, wetland and aquatic system of catchments within the influence of the Pike's Peak highway.

The objectives in the third year of monitoring were to re-measure sites established in 2003 and 2004 and to continue to locate, identify, and establish baseline surveys for features that were not installed in prior years. The monitoring plan calls for replicating "like" conditions for each feature measured, whether they're treated or untreated, control or impacted. Comparisons made, over time, of the relative change observed within a particular treatment type or control, against the relative change observed between treatment types will allow for separation of natural (expected) change from change observed as a result of some disturbance or treatment. What follows in this report is simply a description of the monitoring effort in 2005 and a presentation of the data collected without any comparative analysis.

Site Location and Identification

A proposed 15 year monitoring study not only requires the initial identification of suitable sites, but the ability to relocate them, as well. Location of each cut and fill slope, road cross section, conveyance channel and drainage ditch, rock weir and sediment trap, precipitation gauge, and stream site were identified as a waypoint using a handheld Garmin ETrex Vista Global Positioning unit (GPS) which recorded latitude, longitude, and altitude. Each waypoint was given a unique code to distinguish it in the field as well a as provide an easy identifier for post processing convenience. The naming convention used for the effectiveness monitoring was a 5 character alpha-numeric code starting with three digits followed by two letters (e.g. 001RW, 007FS, etc.) where the numbers are sequential and the letters signify feature type (CS = Cut Slope, RX = Road Cross Section, etc.). The validation monitoring sites use a similar five character naming convention except the first four letters identify the stream and the last digit signifies the reach (e.g. OILC1 = Oil Creek, Reach 1; SVRY2 = Severy Creek, Reach 2; etc.). Appendix A has complete listing of all the sites including Site ID, Latitude, Longitude, Altitude, and Feature Description. It should be noted that while GPS technology is very good, accuracy is still dependent upon the available satellite constellation at the specific time of need and these coordinates should get one reasonably close to the desired feature but not necessarily to within one foot of a control point.

Every site has at least three Temporary Bench Marks (TBM's) or control points for use as relative reference points in order to repeatedly complete spatially similar three dimensional surveys. The TBM's consist of three foot lengths of 0.5 inch rebar pounded into the ground and topped with plastic yellow caps. Aluminum nursery tags wired to the rebar identify the individual TBM's. Sites close in proximity may share TBM's so that every site may not have three unique control points, but every site has at least three points with which to register the survey. We are in the process of establishing a highway control point map that spatially ties all of the effectiveness monitoring sites into the Knight-Piesold highway survey. As of September 2005, we have completed the traverse of the highway in the subalpine zone.

Data

Data loggers and digital cameras make it easy to collect large quantities of data in a relatively short amount of time. It is not the intent of this report to produce hardcopy reproductions of every piece of data or image collected to date. Instead, pertinent and/or interesting examples will be presented in the body of this report while all relevant figures, tables, and charts will be contained in an appendix. All the data is available on ## DVD's so that interested parties might have access to it.

Data on the DVD's is organized in hierarchical directories by monitoring type (effective or validation), by site or feature type, and by photo or survey type. File types encountered in the survey data include MS Excel 2002, Trimble Geomatics Office (TGO) 1.61, AutoDesks AutoCad 2004, and text files. Precipitation data was collected with a HOBO data logger and converted to MS Excel 2002 files. The TGO software is based on MS Access 2000 with surveying applications built in so if you have MS Access (or MS Excel) you do not need TGO to be able to read the raw survey data files. All photos are formatted as .jpg files and can be read by most operating systems.

Photograph location is defined by the directory it is located in (e.g. 102CS_06292005 contains photos of cut slope ID number 102CS taken on June 29, 2005.). Please note that cross section photos in the validation monitoring section have a photo board in them identifying cross section and bank (e.g. AL on the photo board denotes Cross Section A, Left Bank; BR denotes Cross Section B, Right Bank; etc.).

Effectiveness Monitoring

The objective of effectiveness monitoring is to assess the effectiveness of the intervention techniques in meeting their intended purpose. By installing silt fences on cut and fill slopes, permanent cross sections on drainage ditches, conveyance channels, and road surfaces and establishing baseline surveys of sediment traps, we hope to document , over time, the direct effects of the various mitigation practices implemented to stabilize those features.

Precipitation Gauges

Three Onset tipping bucket rain gauges with HOBO event data loggers were installed at approximate elevations of 10,000, 11,500, and 13,000 feet a.s.l. to index precipitation over the elevational range of the highway. Each gauge was mounted on top of a pressure treated six foot 4”x 4” post buried two feet into the ground. Hose clamps and silicone caulk were used to secure the gauges to the post, plumb and level. Rain gauge 075RG was located just uphill from the Halfway Picnic point near mile marker ten which is at the upper end of Priority Basin 2, in the subalpine zone. Rain gauge 076RG was located near the Severy Creek trailhead at the transition between the subalpine and the alpine zones. Rain gauge 077RG is located near the Devil’s Playground well into the alpine. Table 1 contains the specific coordinates and precipitation totals for each gauge.

Table 1. Location, precipitation accumulation, and dates of operation for 3 rain gauges.

Gauge ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Total (in)	Dates of Operation - 2005
075RG	N38 53.797	W105 03.890	10,109	9.11	5/02 – 9/29
076RG	N38 52.582	W105 03.970	11,810	11.92	5/02 – 9/29
077RG	N38 51.783	W105 03.999	13,069	8.79	5/02 – 9/29

The data loggers record a date-time stamp for each tip of the rain gauge bucket (1 tip = 0.01 inches) from which volume, duration, and intensity (or rate) of each storm event can be determined. For our purposes, a storm event is defined as a series of tips where the time interval between successive tips is less than or equal to 60 minutes. A comparison of the monthly recorded precipitation volumes for all three rain gauges from 2003 to 2005, as well as estimated long-term mean monthly precipitation derived from the Oregon State Climate map (Figure 1) shows that May, June and July of 2005 were much drier than the two previous years and well below the average. Figure 2 displays maximum 30 and 60 minute intensity and total storm volume for all events recorded in 2005. Once again the lowest elevation gauge recorded the highest 30 minute storm intensity at 0.55 inches on August 20, but that was the only storm recorded at any gauge to exceed 0.5 inches in 30 minutes. In general, 2005 storm intensity and magnitude was less at all three gauges than in the previous two years. Appendix B contains a complete listing of storm event tabulations for each rain gauge in 2005.

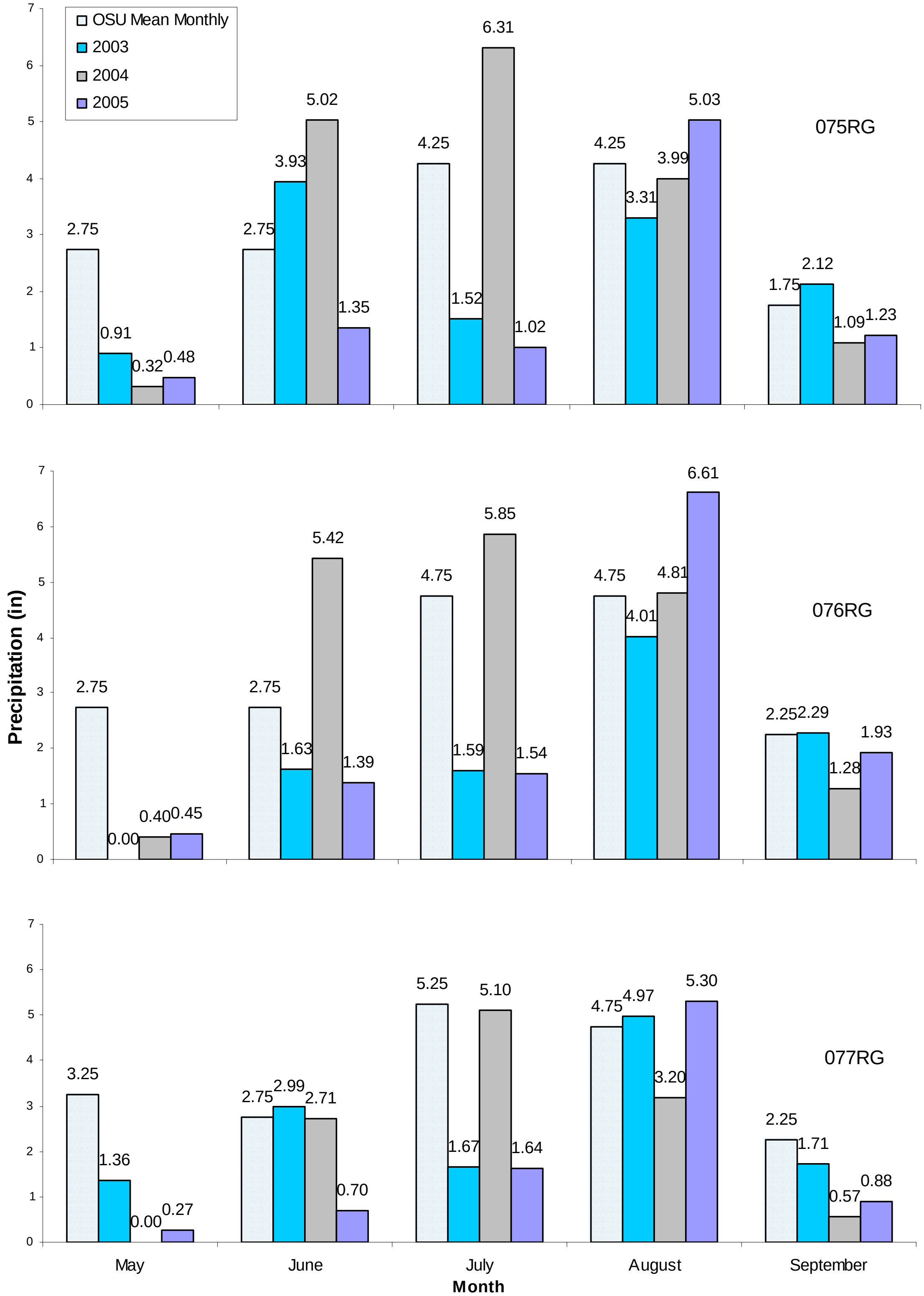


Figure 1. Comparison of monthly precipitation for 2003, 2004, 2005 and the long term monthly mean as predicted by Oregon State Climate model for the 3 the rain gauges on the Pike's Peak Highway.

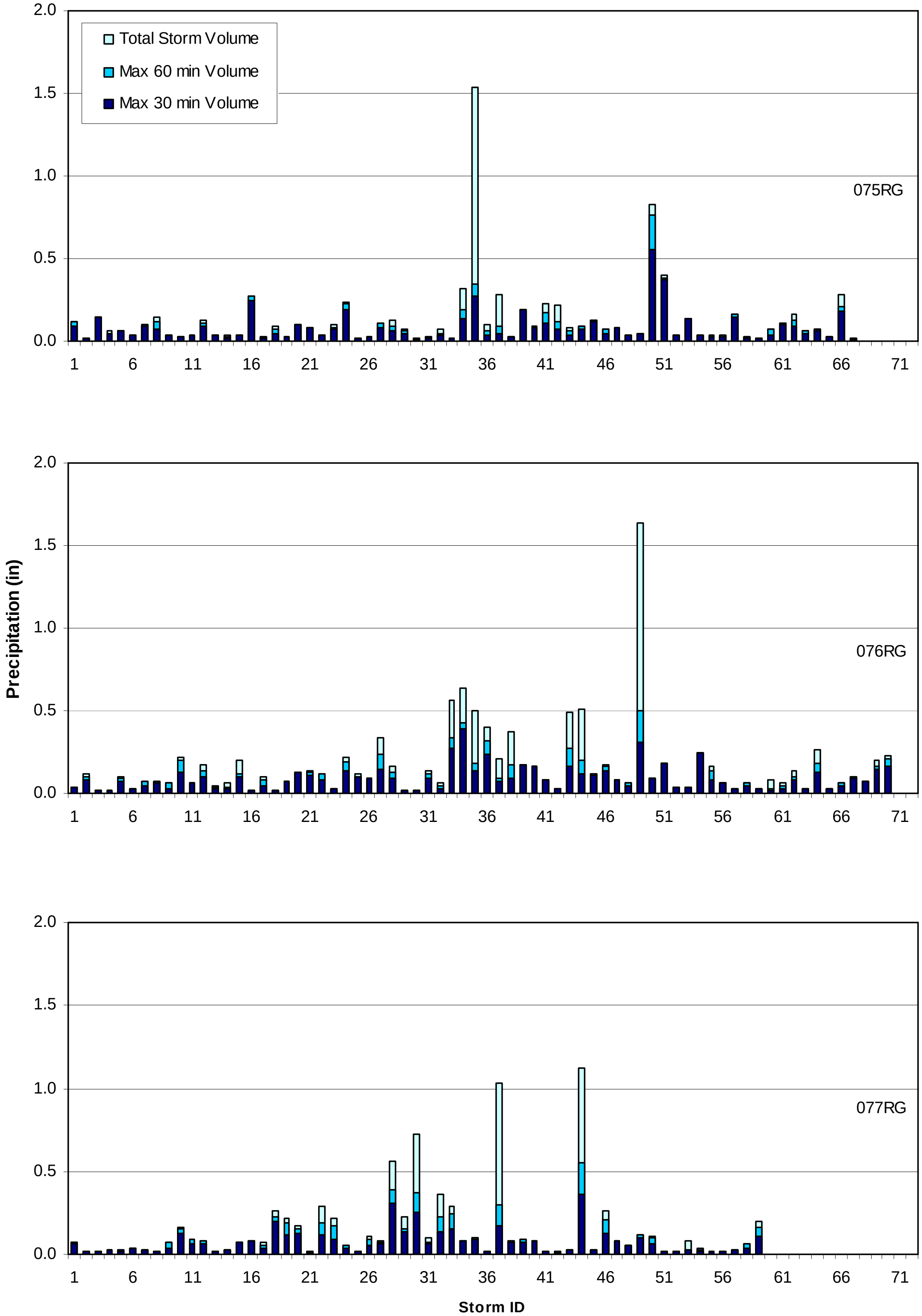


Figure 2. Maximum 30 and 60 minute intensity and total storm volume for the 3 rain gauges on Pike's Peak, 2005.

For water year 2005 (October 1, 2004 to September 30, 2005), the NRCS installed and operated snotel site 05l11s near Glen Cove. For the total water year this site recorded 30.7 inches of precipitation of which 18.5 inches fell between October and April, and 12.2 inches fell from May through September. The snotel site is spatially located between rain gauges 075RG and 076RG and compares well with monthly summer precipitation captured at the 3 rain gauges as shown in Figure 3.

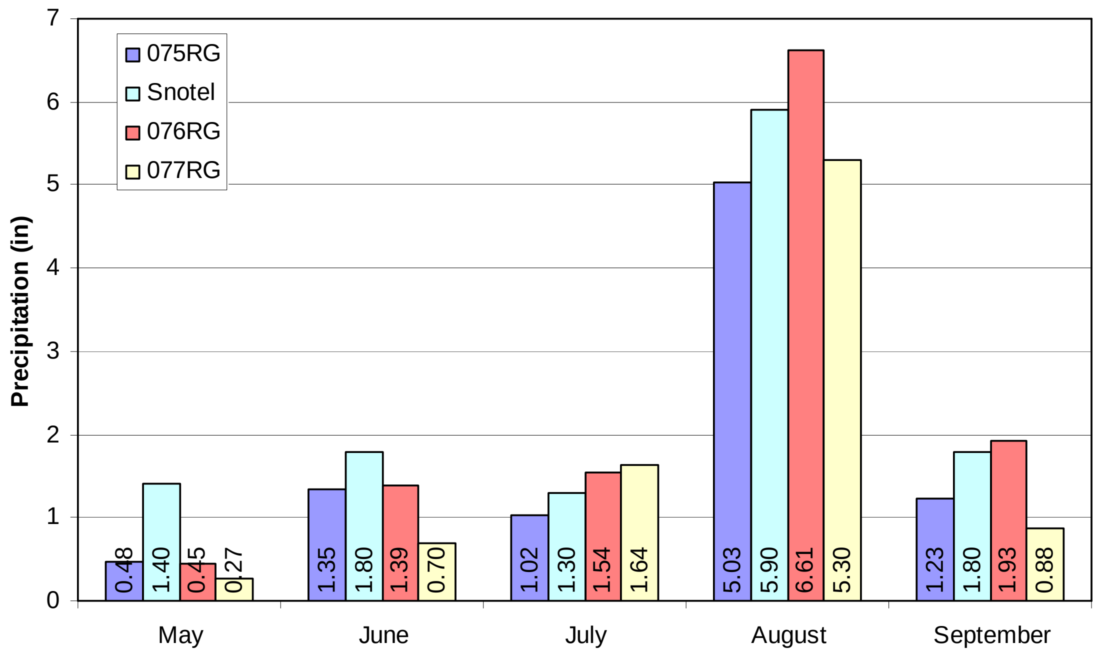


Figure 3. Comparison of 2005 monthly summer precipitation recorded at the Glen Cove Snotel site (05l11s) and the three rain gauges 075RG, 076RG, 077RG.

Cut and Fill Slopes

Stability on cut and fill slopes, and erosion reduction, may be achieved by reestablishing natural vegetation or through the use of geo-synthetic erosion control netting to “armor” the slopes, or by installing various types of structures to keep storm drainage off the slopes entirely. The best monitoring approach is to determine the effectiveness of these practices in reducing cut and fill slope erosion and subsequent sediment transport. Silt fencing installed at the base of the cut or fill slope captures the sediment eroded from the slope. Comparing the rate of eroded material being trapped, over time, at the base of treated and untreated cut and fill slopes is the best measure of the effectiveness of the mitigation practice in reducing erosion.

In 2005, thirteen cut slope and 29 fill slope sites were monitored for stability using silt fences to capture eroding material as described by Nankervis (2004). In 2005, we began using graduated buckets to measure volume of material captured by the silt fences. This reduces field surveying time and eliminates the need for data reduction in the office as material is measured directly as it is excavated (Figure 3). An added benefit of this technique is that it can potentially increase sampling frequency as small amounts of material can be measured more efficiently with the bucket than with the survey method. Once again, the most part all the silt fences remained intact and functional and only required minimal maintenance or repair. Photographs of all sites are on the data DVD's.

Figure 3. Graduated buckets used to measure excavated material from silt fence sites.

Cut Slopes

A summary of the 2005 cut slope site surveys is presented in Table 2. Two of the cut slope sites, 087CS and 090CS, are located in the section of highway treated in 2005. Both these sites are near retaining walls, products from previous cut slope treatments. Initial visits of the cut slope sites occurred from May through June where fences were excavated and repaired/replaced as needed. For the remainder of the field season, cut slope sites were visited on a weekly basis and excavated when sediment accumulated. Seven (three treated) of the thirteen sites required cleaning in the spring of which only two sites, 011CS and 185CS, had material accumulate in the upper fence. Three cut slope sites captured sediment generated from summer precipitation, all of which accumulated in the lower silt fences, and only 192CS is a treated site (197CS is in Basin 2 but no fiber-matrix had been applied to the slope). 197CS is the only site to accumulate sediment in the summer but not the spring.

Table 2. Summary of cut slope monitoring survey dates and total volumes for Upper and Lower silt fence accumulation in 2005.

Site ID	Basin	Year Treated	Date - Volume (ft^3) U / L	Date - Volume (ft^3) U / L
011CS*	1	2001	May05 - 1.0 / 1.7	
045CS	7	N/A	June14 - 0.0 / 1.5	
049CS	7	N/A	June14 - 0.0 / 3.0	Sept28 - 0.0 / 1.2
059CS	7	N/A	June14 - 0.0 / 0.0	
078CS	7	?	June14 - 0.0 / 0.0	
087CS	3	2005	June16 - 0.0 / 0.0	
090CS	3	2005	June19 - 0.0 / 0.0	
102CS	6	N/A	June29 - 0.0 / 0.5	
123CS	6	N/A	June30 - 0.0 / 0.0	
141CS	6	N/A	June30 - 0.0 / 1.9	
185CS*	2	2003	June08 - 1.3 / 1.5	
192CS	2	2003	June09 - 0.0 / 2.4	Sept02 - 0.0 / 1.1
197CS	2	2003	June09 - 0.0 / 0.0	Sept02 - 0.0 / 0.9

*Grab samples taken but laboratory analysis of particle size distribution not available yet. Results will be reported in next year.

Fill Slopes

A summary of the fill slope monitoring sites for 2005 are listed in Table 3. Two of the fill slope sites, 093FS and 098FS, are located in the section of highway treated in 2005 and now have road pavement and shot-creted ditches above them. Initial visits of the fill slope sites occurred from May through June where fences were excavated and repaired/replaced as needed. For the remainder of the field season, fill slope sites were visited on a weekly basis and excavated when sediment accumulated. Twenty two of the 29 sites required cleaning in the spring of which eight were classified as treated (093FS and 098FS were treated in August 2005). Only three sites, 039FS, 088FS, and 101FS, had material accumulate in the lower silt fence of which only 039FS is treated. Nine fill slope sites (five treated including the recently treated 093FS) captured sediment generated from summer precipitation. All nine fill slope sites that captured sediment in the summer also capture material in the spring. No lower fill slope silt fences captured any sediment from summer precipitation.

Highway Surface Stabilization

Initially, this phase of the monitoring plan was going to look at the effectiveness of several different kinds of treatments with respect to stabilizing the road surface. Since road stabilization has been narrowed down to one option (paving with asphalt) there was little need to implement a study design matrix containing one treatment. However, we did measure several sites in unpaved reaches of the road and stratify these reaches by slope; less than 10% and greater than 10% road slope. Table 4 lists the sites, Priority Basins and survey dates of all road cross section measured in 2005.

Table 3. Summary of fill slope monitoring survey dates and total volumes for Upper and Lower silt fence accumulation in 2005.

Site ID	Basin	Year Treated	Date - Volume (ft^3) U / L	Date - Volume (ft^3) U / L
001FS	1	2001	May25 - 0.0 / 0.0	
007FS	1	2001	May25 - 0.0 / 0.0	
039FS*	1	2001	May31 - 6.2 / 1.0	
043FS	7	N/A	June14 - 0.7 / 0.0	
048FS	7	N/A	June14 - 3.3 / 0.0	Sept03 - 2.7 / 0.0
052FS	7	N/A	June14 - 2.3 / 0.0	Sept03 - 1.7 / 0.0
055FS	7	N/A	June14 - 5.2 / 0.0	Sept03 - 9.7 / 0.0
074FS	7	N/A	June14 - 4.6 / 0.0	
079FS	7		June16 - 4.6 / 0.0	
083FS	7		June16 - 0.0 / 0.0	
086FS	7		June16 - 8.0 / 0.0	
088FS	7		June16 - 11.0 / 1.0	Sept03 - 12.9 / 0.0
093FS	3	2005	June20 - 3.2 / 0.0	Sept03 - 3.6 / 0.0
098FS	3	2005	June23 - 8.5 / 0.0	
101FS	3	N/A	July01 - 9.0 / 5.4	
103FS	6	N/A		
105FS	6	N/A	June30 - 5.1 / 0.0	
124FS	6	N/A	June30 - 2.2 / 0.0	
128FS	6	N/A	June27 - 5.4 / 0.0	
177FS	2	2003	May18 - 0.0 / 0.0	
183FS	2	2003	June02 - 0.0 / 0.0	
186FS	2	2003	June08 - 2.8 / 0.0	Sept02 - 1.7 / 0.0
187FS	2	2003	June08 - 2.3 / 0.0	
193FS	2	2003	June01 - 1.7 / 0.0	
194FS	2	2003	June01 - 1.9 / 0.0	Sept28 - 1.3 / 0.0
196FS*	2	2003	June01 - 5.1 / 0.0	Sept03 - 8.6 / 0.0
198FS	2	2003	June08 - 0.0 / 0.0	
203FS	2	2003	June02 - 1.9 / 0.0	Sept02 - 3.2 / 0.0
204FS	2	2003	June08 - 1.0 / 0.0	

*Grab samples taken but laboratory analysis of particle size distribution not available yet. Results will be reported in next year.

Five cross sections (labeled A-E) were resurveyed for each road reach. Like all other sites in this study, we used a resection to locate the survey instrument relative to the previously established permanent monuments to insure measuring the same cross section as in the prior survey. The same protocol is used to measure all cross sections, regardless of monitoring site, in this study. A tape stretched between end points guides the surveyor as they measure cross section topography moving left to right (facing downslope). Each road cross section was measured from the edge of the drainage ditch to the edge of the fill slope.

When calculating the geometry of the road cross sections, two things were done to the data to promote consistency and comparability between successive surveys. The first was to add two reference points, one or two foot in elevation above the left and right endpoints of the survey, to provide a reference elevation for cross sectional area calculations and graphing purposes. It makes the graphs easier to see and accounts for the

Table 4. Summary of road cross section monitoring sites measured in 2005.

Site ID	Basin	Slope Category	Slope	Survey Date
044RX	7	Class 1	0.0751	July14
047RX	7	Class 2	0.1007	July15
050RX	7	Class 2	0.1038	July16
056RX	7	Class 2	0.1049	July17
060RX*	7	Class 2	0.1006	July18
062RX	7	Class 1	0.0971	July19
072RX	7	Class 1	0.0966	July20
154RX	3	Class 2	0.1032	July31
156RX	6	Class 2	0.1022	July30
158RX	6	Class 1	0.0483	July14
160RX	6	Class 1	0.0268	July30

*Only road reach without a corresponding drainage ditch survey

crown and any other undulations in the road surface. The second is a procedure applied to all cross sections surveyed with a total station in this monitoring study and that is a correction to align all points in the cross section to the left pin-right pin vector (i.e. cross section end points). Even though we use a tag line between the end points to guide the cross section survey, directly positioning the prism over the tape for each and every shot is impossible and so by correcting the northing and easting coordinates of each internal cross section shot to match the vector between the left and right end pins, we get a true measure of distance. This correction typically is very small but is necessary when comparing measurements over time. With the arbitrary end point elevations and vector corrections made, road geometry calculations and graphs of all road cross sections were done. Appendix C contains a tabulation of all road cross section geometry and (overlay) graphs for each reach of the surveys done this year. Photographs of all sites are on the data DVD's.

Volumetric differences were calculated for all cross sections by calculating the average change in area for the five cross sections per reach and multiplying by the length of the road reach measured. A summary of volumetric change measured for each road reach between 2003, 2004, and 2005 sorted by slope class, is listed in Table 5 (negative numbers indicate elevation reduction since 2003). On a reach averaged basis, only 056RX lost material since 2004 while some, such as 044RX not only gained elevation but width as well (Figure 4). This is a result of the addition of 1425 tons of gravel to the road in 2005 (personal communication Jack Glavan), of which approximately 954 tons were placed on the switchbacks and 470 tons distributed over the rest of the highway, excluding the 1.8 miles of mitigation above Glen Cove. The values in Table 5 reflect the average cross sectional area differences for each road reach over the original width as surveyed in 2003. Since we stop road cross section surveys at the crest of the fill slope, we do not know how much gravel has been added to increase the width of the road (as in the case of 044RX) as the road extends, in some cases, well beyond the bounds of the original survey.

Table 5. Summary of volumetric change in road surface cross section area from 2003, 2004 and 2005.

Road Cross Section Identifier	Average Area Difference 2003-04 (ft^2)	Average Area Difference 2003-05 (ft^2)	Reach Length (ft)	Volumetric Difference 2003-04 (cubic yards)	Volumetric Difference 2003-05 (cubic yards)	Slope	Slope Class
044RX	2.15	4.56	243.6	19.4	41.1	0.0751	1
062RX	0.04	0.59	257.8	0.4	5.6	0.0971	1
072RX	-1.15	1.54	218.9	-9.3	12.5	0.0966	1
158RX	-2.31	-1.91	214.4	-18.3	-15.2	0.0483	1
160RX	-1.54	0.03	225.1	-12.9	0.2	0.0268	1
047RX	2.81	2.83	223.2	23.3	23.4	0.1007	2
050RX	-1.46	3.32	302.2	-16.4	37.1	0.1038	2
056RX	-1.52	-4.78	201.0	-11.3	-35.6	0.1049	2
060RX	1.19	1.23	198.4	8.8	9.1	0.1006	2
154RX	-2.80	-2.71	229.7	-23.8	-23.1	0.1032	2
156RX	1.70	21.05	192.9	19.4	150.4	0.1022	2

Armoring Drainage Channels

The effectiveness monitoring for this phase focuses on measuring cross sections in roadside drainage ditches and conveyance channels to determine if the implemented mitigation practices reduce erosion and deposition in these features. The current mitigation treatments differ from what was initially planned. For example, instead of armoring drainage ditches, all reaches except those meeting the criteria stated in the latest Forest Service Design Review (Burke 2002) will be lined with shot-crete, which in Basins 2 and 3 is virtually the entire length of the road. We would expect little deposition and no erosion in ditches lined with shot-crete, so post-construction monitoring will be limited to ditches lined with erosion control fabric or ditches left untreated. Instead of relying solely on energy dissipating devices for erosion control in conveyance channels, where possible, completely removing the energy from the conveyance channels, as in Basin 2, is preferred.

Drainage Ditches

A summary of the 20 drainage ditch monitoring sites surveyed in 2005 are listed in Table 6. Sixteen of the sites were established in 2003 and 4 more sites in Basin 2 were established in 2004. Ten of the sites are associated with some treatment; the six ditches in Basins 1 and 2 are lined with erosion control blankets and are the only drainage ditches in these basins not lined with shot-crete. Three ditches in Basin 7 are adjacent to road surfaces paved with recycled asphalt but have no other treatment applied to the ditch. A fourth ditch, 092DD, was adjacent to recycled asphalt but was shot-creted as part of the 1.8 miles of highway improvement in 2005. In fact, the 2005 survey of 092DD was done after the ditch was graded and prepped for shot-crete. The ditches in Basin 7 will provide the longest measure of erosion as Basin 7 is currently the last basin scheduled for construction (USDA Forest Service 2000).

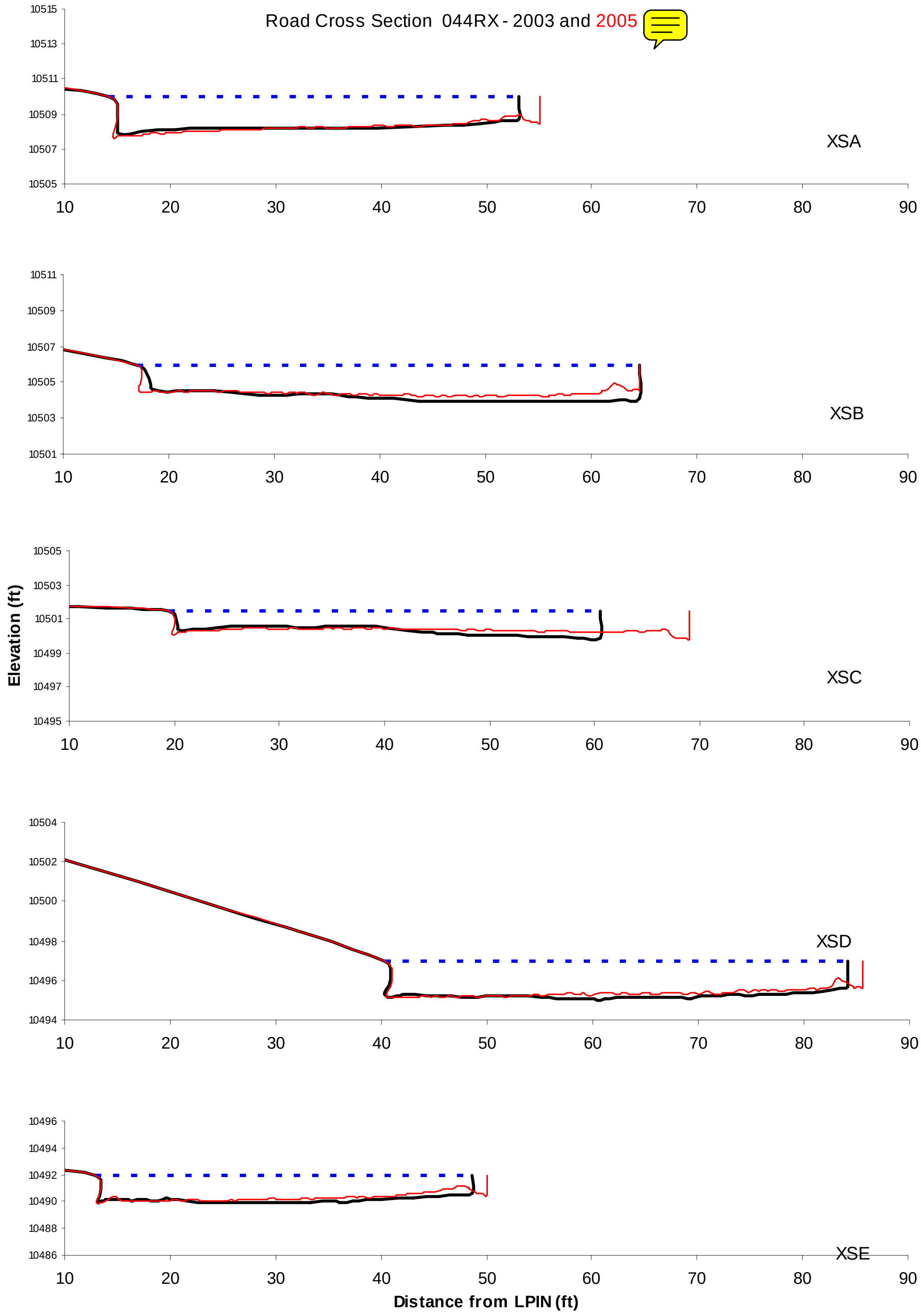


Figure 4. Comparison of 2003 and 2005 road cross section surveys at 044RX.

Similar to the road cross section surveys, there are five cross sections (labeled A-E) per drainage ditch monitoring site. The cross section end points are monumented on the cut slope side with rebar and on the road side with either a temporary or permanent marker.

Table 6. Summary of drainage ditch monitoring sites surveyed in 2005.

Site ID	Basin #	Year Treated	Treatment Type	Survey Date
005DD*	1	2001	Erosion Control Fabric	July06
010DD*	1	2001	Erosion Control Fabric	July07
042DD	7	N/A	N/A	July14
046DD	7	N/A	N/A	July15
051DD	7	N/A	N/A	July16
057DD	7	N/A	N/A	July17
061DD	7	N/A	N/A	July19
071DD	7	N/A	N/A	July20
080DD*	7	?	Recycled Asphalt	July26
082DD*	7	?	Recycled Asphalt	July29
085DD*	7	?	Recycled Asphalt	July26
092DD**	3	2005	Shot-crete	July30
107DD	3	N/A	N/A	July31
155DD	6	N/A	N/A	July30
157DD	6	N/A	N/A	July14
159DD	6	N/A	N/A	July30
182DD	2	2003	Erosion Control Fabric	July07
188DD	2	2003	Erosion Control Fabric	July07
195DD	2	2003	Erosion Control Fabric	July07
205DD	2	2003	Erosion Control Fabric	July14

*Drainage ditch sites not associated with road cross section surveys
**Surveyed after graded and prepped for shot-crete

The procedure for surveying and relocating these cross sections is the same as for the road cross section sites. Using a tape stretched across the cross section as a guide, we survey as many verticals as needed to define the shape of the ditch. Post processing involves correcting the internal, channel defining shots to the left and right vector of cross section end points. We used surveyed "top of ditch" points as our reference for calculating the channel geometry. Appendix D contains a tabulation of channel geometry for all drainage ditch monitoring sites and (overlay) graphs of each cross section. Photographs of all drainage ditch sites are on the data DVD's.

The average and range of the cross sectional area differences between 2003 and 2005 surveys (or 2004 and 2005 for the four ditches established in 2004) for the 5 cross sections measured at each drainage ditch site are presented in Figure 5. Treated sites are on the left side of the graph and the untreated sites are to the right. Values less than 0 indicate scour and values greater than 0 indicate deposition in the cross sections. If you discount drainage ditch 092DD in the treated sites because of the preparation for shot-crete, there is little change in the treated ditches compared to the variation in the untreated sites. It should be noted relative to the discussion of drainage ditch maintenance in Nankervis (2005) that the only ditch in the untreated category that has definitely not been graded in the last three years is site 057DD (personal communication Levi Howell).

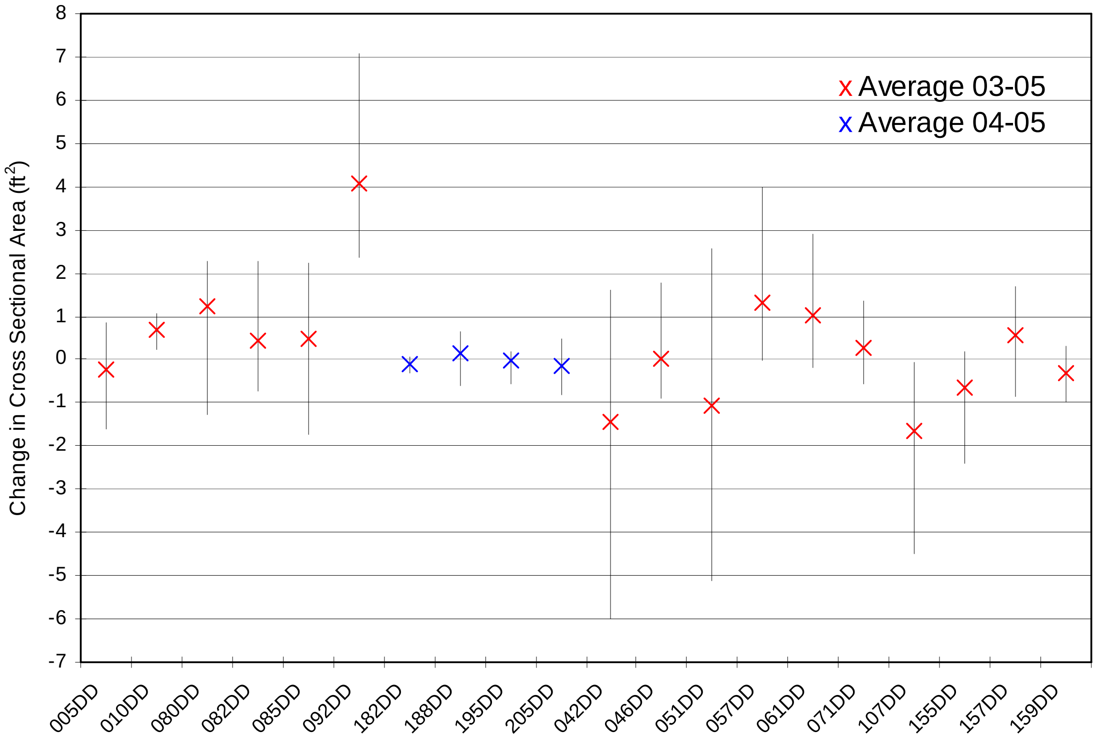


Figure 5. Average and range of cross sectional area differences from drainages ditches surveyed in 2003, 2004, and 2005 (treated sites on left, untreated on right).

Conveyance Channels

This year marked the completion for the baseline surveys of all known and identified conveyance channels. In addition to the 79 conveyance channels surveyed in 2003 and 2004, an additional 34 channels were surveyed in 2005 (Table 7). Each channel had a series of three cross sections (labeled A-C) located within the 150 foot boundary of the highway corridor. Left and right cross section end points were monumented with rebar, providing a minimum of 6 fixed points by which to relocate future surveys. A tape stretched between the left and right end points was used as a tag line to guide the cross section survey and enough verticals were taken to describe the features of the channel. Post processing was similar to that of the drainage ditches where all points in the cross section were corrected to the left-right end point vector and “top of bank” reference points were used to calculate channel geometry. Photographs of all conveyance channels surveyed in 2005 are on the data DVD’s. Appendix E contains tabulations of all channel geometry calculations and graphs of each cross section.

Individual conveyance channels contribute varying quantities of sediment downslope to the streams and reservoir below. Some of these channels likely have been in existence since the road was created and some have developed as recently as 2005. Some conveyance channel sites below rock weirs surveyed in 2005 are not “channels” yet but potentially could become channels in the future. Another site that is not a conveyance channel yet is 232CC, below the snotel site at Glen Cove. This potential channel parallels Glen Cove Creek and may be the result of a spring that has emerged, possibly from the diverted flow from Ski Creek. This site encompasses Glen Cove Creek and contains five cross sections instead of three.

Table 7. Summary of conveyance channel monitoring sites visited in 2005.

Site ID	Basin #	Year Treated	Treatment Type	Survey Date
100CC	5	N/A	N/A	Aug02
106CC	5	N/A	N/A	Aug08
108CC	5	N/A	N/A	Aug09
109CC	5	N/A	N/A	Aug14
110CC	5	N/A	N/A	Aug14
111CC	5	N/A	N/A	Aug05
112CC	5	N/A	N/A	Aug15
113CC	5	N/A	N/A	Aug18
114CC	5	N/A	N/A	Aug18
115CC	5	N/A	N/A	Aug05
116CC	5	N/A	N/A	Aug18
117CC	5	N/A	N/A	Aug18
118CC	5	N/A	N/A	Aug18
119CC	5	N/A	N/A	Aug18
184CC*	1	2003	Curb	Jun02
214CC	5	N/A	N/A	Aug20
215CC	5	N/A	N/A	Aug20
216CC	1	2001	Curb, Rock Weir	May18
217CC	1	2001	Curb, Rock Weir	May18
218CC	1	2001	Rock Weir	May23
219CC	1	2001	Rock Weir	May25
220CC	1	2001	Rock Weir	May25
221CC	1	2001	Rock Weir	May30
222CC	1	2001	Rock Weir	May30
223CC	1	2001	Rock Weir	May30
224CC	2	2003	Rock Weir, Asphalt Ditch	May31
225CC	2	2003	Rock Weir, Fabric	May31
226CC	2	2003	Rock Weir, Curb	Jun01
227CC	2	2003	Rock Weir, Curb	Jun01
228CC	2	2003	Rock Weir	Jun02
229CC	2	2003	Rock Weir	Jun09
230CC	2	2003	Rock Weir	Jun09
231CC	2	2003	Rock Weir	Jun09
232CC	7	N/A	N/A	Jun23
235CC	5	2005	Rock Weir	Sep01

*Channel below sediment pond 199RW was surveyed in 2004, as well.

Sediment Ponds and Traps

In May and September 2005, 17 rock weirs in Basins 1 and 2 were surveyed to determine their effectiveness in trapping sediment derived from winter snowmelt and summer rain events. Three rock weirs installed in Basin 3 in the 2005 highway improvement effort were surveyed to determine baseline volumes. Volume of sediment captured by each structure is determined by comparing two grid surveys of each basin and calculating fill volume differences from the DTM's. Winter accumulation is determined by comparing the May 2005 survey volume to the September 2004 volume and the summer contribution is determined by comparing the September and May 2005 surveys. To determine effectiveness in trapping sediment, we installed silt fences below the rock weirs to capture any material that might pass over, under, or through the structure. These fences were surveyed in the same manner as the cut and fill slope silt fences this year using the graduated bucket methodology. In 2004, rip-rap was added to several rock weirs at the terminus of the drainage ditches to dissipate energy as storm drainage scoured and piped through (under) the weirs (Figure 7) which altered the discharge location requiring us to extend the silt fences below these weirs. This also changed the void volume of the weirs so, for the purpose of calculating sediment accumulation, the area in each weir covered by the rip-rap is excluded in the sediment calculation.

Figure 7. Example of rip-rap velocity dissipator in rock weir 161RW.

A summary of survey location, dates and sediment volume accumulated in the weir and associated silt fences is presented in Table 8. No weirs were cleaned out in 2005. The negative values for several weirs are likely the result of over-winter settling in the basin or perhaps piping through the gravel apron, though relatively little piping occurred this year as just four fences captured material and only one as a function of summer runoff.

Table 8. Summary of sediment trap monitoring sites (and associated silt fence) sediment volumes in 2005.

Site ID	Basin #	Year Built	Survey Date 2005	Winter (Fence) Sediment Volume (ft^3)	Summer (Fence) Sediment Volume (ft^3)
002RW	1	2001	May17 , Sep24	24.20	27.70
003RW	1	2001	May11 , Sep22	-22.30	15.80
006RW	1	2001	May03 , Sep22	-7.20	15.00
008RW	1	2001	May10 , Sep22	1.00	20.40
009RA	1	2001	May10 , Sep22	0.00	39.90
152RW	2	2003	May10 , Sep27	2.50	5.60
153RW	2	2003	May17 , Sep24	-2.90	82.10
161RW	2	2003	May03 , Sep23	2.20	3.50
162RW	2	2003	May03 , Sep19	0.80 (1.0)*	4.20
176RW	2	2003	May04 , Sep23	4.50	-3.50
178RW	2	2003	May04 , Sep23	5.40	0.20
179RW	2	2003	May11 , Sep23	3.20	-1.00
180RW	2	2003	May18 , Sep22	1.40	3.80
181RW	2	2003	May23 , Sep22	15.60	4.70
200RW	2	2003	May04 , Sep20	0.05 (1.1)	0.20 (0.5)
201RW	2	2003	May03 , Sep23	5.00	-1.80
202RW	2	2003	May10 , Sep20	3.20 (0.8)*	6.90
233RW	3	2005	Aug31		
234RW	3	2005	Sep01		
236RW	3	2005	Sep01		

*Grab samples taken but laboratory analysis of particle size distribution not available yet. Results will be reported in next year.

The rock weirs are designed to act as small detention ponds, collecting storm drainage and releasing the water gradually while allowing the sediment to filter or settle out. Since all the weirs are located where the highway has been paved, sediment sources are limited to a few un-paved drainage ditches, cut slopes, and hill slopes. The weirs established in 2005 have collected very fine material and seem to hold water longer than the weirs in Basins 1 and 2 as shown in Figure 8.

Figure 8. Storm runoff in rock weir 236RW on August 20th (left) is still present on September 1, 2005 (right).

This was the second year the large sediment pond in Basin 2 (199RW) was in operation and the first year for a smaller sediment pond established in Basin 3 just below the Ski Creek diversion wall. Unlike the rock weirs which drain relatively small sections of road, these ponds collect storm drainage from extended lengths of highway using a network of shot-crete drainage ditches and culverts. The large pond diverts storm runoff from Crystal Creek (North Fork) into the Ski Creek basin. Water entering199RW, is filtered through a gravel-encased perforated standpipe, and discharged through a culvert downstream. The monitoring effort for the pond includes 5 cross sections to estimate volumetric changes in sediment accumulation, suspended sediment samples taken above the pond where the shot-crete conveyance channel ends and at the outlet (pipe) during storm runoff to measure effectiveness in capturing sediment, and 3 cross sections in the channel below the pond outlet (184CC) to measure changes in channel dimension.

Road runoff enters and exits the smaller pond (237RW) via shot-creted drainage ditches that drain from Severy and Ski Creek drainages into Glen Cove Creek. The pond actually is part of Ski Creek just below the diversion wall built in 2004 and water can also be introduced into the pond if it overtops the diversion. A stand pipe at the base of the pond can spill excess water under the highway and into Ski Creek (Figure 9.). The monitoring effort for the pond includes 3 cross sections to estimate volumetric changes in sediment accumulation. Graphs and summaries of sediment pond surveys are in Appendix F.

Figure 9. Sediment pond 237RW below Ski Creek diversion wall.

The September 2005 survey was the baseline for 237RW but May and September surveys for 199RW show an average winter LOSS of sediment over the five cross sections of 68.5 ft^2 and an average summer LOSS of sediment of 5.32 ft^2. In fact, the pond probably did not lose any sediment and with the lack of rainfall in 2005 in-pond erosion was minimal, if any, so settling would have to account for the LOST material plus any sediment that may have been introduced over the course of the year.

To measure the sediment capturing effectiveness of 199RW, we took 2 suspended sediment grab samples on August 13 and September 8, 2005. Laboratory results are pending and will be provided in the next report. Photographs of all sites are contained on the data DVD's.

Validation Monitoring

The objective of validation monitoring is to document the effect road mitigation practices have on the aquatic, wetland, and riparian communities that are within the influence of the Pike's Peak Highway. By monitoring features in both reference (non-highway influenced) and impaired streams, relative (converging or diverging) changes observed in these features over time between the 2 groups would be attributed to the road mitigation practices. The nine streams identified as either impacted or non-impacted by the presence and maintenance of the Pikes Peak Highway by ERO Resources Corporation (1999) are: North Catamount, South Catamount, Oil, and Boehmer Creeks as reference or non-impacted streams; and Ski, Severy, East Fork of Beaver, North Fork of Crystal, and West Fork of Beaver Creeks as stream systems impacted by the highway.

None of the original 17 stream sites were surveyed in 2005 after establishing the baseline in 2003 and developing the protocol for resurveying in 2004. However, two new sites were established this year in response to the diversion wall built on Ski Creek to divert all alpine runoff into Glen Cove Creek. Glen Cove Creek is a tributary to South Catamount Creek, which was consider a "reference" stream. The diversion on Ski Creek will increase the water yield and likely the peaks of both Glen Cove and South Catamount creeks so we established monitoring sites just above the confluence on each of the streams and named them GLEN1 and SCAT3, respectively.

Stream Channel Surveys

Baseline conditions were described for the various parameters in 2005 at each site including planview, slope, cross sections, pebble counts and grab samples, and vegetation cover. The same equipment and methodology described by Nankervis (2004) was employed for 2005 surveys.

Planview

The planview (or pattern) of left and right edge water, thalweg, and cross section location for each stream reach measured is presented in Appendix G. This perspective of the stream reach will provide a general index to lateral channel adjustment or migration over time.

Cross Sections

Five cross sections per reach were established to document changes in active channel geometry. Cross section end points were monumented with rebar capped with yellow plastic to provide ten permanent reference locations per reach to maintain continuity in monitoring over the course of the study. A tape was stretched between the two cross section endpoints to act as a tagline to align the survey. Top of bank, or bankfull, elevation identified at each cross section is used as a reference for calculating the active channel dimensions which are presented in Appendix H along with graphs of each cross section. Consistently monitoring channel dimensions at the same location provides an excellent measure of both lateral and vertical channel adjustment within each reach. Photographs of left and right bank and upstream and downstream views at each cross section, with photograph ID board, are contained on the data DVD.

Slope

Left and right edge of water and thalweg were surveyed over the length of each reach. Slope was calculated by dividing the change in elevation by the total distance measured for each feature. No attempt was made to normalize distance to a consistent feature (e.g. thalweg) so the total distance measured at each reach can vary by feature. Summary of slopes between cross sections A and E and graphs of all reaches are presented in Appendix I. These measurements, particularly the thalweg, will be useful in detecting vertical channel adjustment (erosion/deposition) over time.

Particle Size Distribution

Pebble Counts

Pebble counts (300 particles) in each reach were done to characterize the bed material of the active channel using the Bevenger and King Pebble Count Procedure (Bevenger and King, 1995). A tabulation of the 15^{th}, 35^{th}, 50^{th}, 84^{th}, and 95^{th} percentile and graphs of the distributions are presented in Appendix J. Comparing the particle size distributions from successive pebble count surveys, to document trends in the percent fines between control and impacted sites, will be useful in defining one aspect of the in-channel impact of the reduction in sediment supply or discharge.

Grab Samples

Grab samples were taken from bars at each site. Laboratory analysis is still pending so the results will be presented in the next report.

Vegetation

Vegetation photo points were established at the top of the left and right banks at each cross section to document changes in species composition and percent cover over time. Vegetation was grouped into general categories of moss, grass, sedge, forb, or shrub to document presence, and percent cover estimated for the top of bank area 1.5 feet on either side of the cross section. A tape stretched between the cross section end pins was used to determine the distance from the left bank pin for the top of bank as well as the camera position. A pocket rod was used to indicate the three foot transect of interest at the top of bank and an ID board was used to indicate cross section and bank ID (AL = Cross Section A, Left Bank; DR = Cross Section D, Right Bank) for the photograph. All photographs were taken with an Olympus Stylus 400 digital camera and our field procedures generally follow those outlined in the Photo Point Monitoring Handbook (Hall 2002). Appendix K provides a tabulation of the data recorded and photographs taken at each site. Photographs taken of the same site, from the same location, should provide good documentation of trends in specie composition and percent cover over time.

References

Bevenger, Gregory S. and Rudy M. King. 1995 A Pebble Count Procedure for Assessing Watershed Cumulative Effects. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Research Paper RM-RP-319. Fort Collins, CO 17pp.

Hall, F.C. 2002. Photo point monitoring handbook: Part A-Field procedures. USDA Forest Service, Pacific Northwest Research Station, PNW-GTR-526. Portland, OR 48pp.

Nankervis, J.M. 2004. Monitoring effectiveness and validating response to the road related mitigation practices implemented on the Pike’s Peak Highway. Blue Mountain Consultants, Berthoud, CO. Unpublished Report 22 pp plus Appendices.

Nankervis, J.M. 2005. Monitoring effectiveness and validating response to the road related mitigation practices implemented on the Pike’s Peak Highway. Blue Mountain Consultants, Berthoud, CO. Unpublished Report 29 pp plus Appendices.

USDA Forest Service. 2000. Decision notice and finding of no significant impact – Pikes Peak Highway drainage, erosion, and sediment control plan. Pike and San Isabel National Forests and Cimarron Comanche National Grassland. Pueblo, Colorado. 16 pp.

Appendix A

Site Locations for
Effectiveness and Validation Monitoring

2005

Site Locations for Effectiveness and Validation Monitoring 2005

Datum WGS 84

Site ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Feature Description
001FS	N38 55.211	W105 02.238	9410	Fill Slope
002RW	N38 55.224	W105 02.264	9410	Rock Weir/Apron
003RW	N38 55.200	W105 02.258	9416	Rock Weir/Apron
004CC	N38 55.132	W105 02.278	9431	Conveyance Channel
005DD	N38 55.087	W105 02.415	9447	Drainage Ditch
006RW	N38 55.109	W105 02.482	9415	Rock Weir/Apron
007FS	N38 55.094	W105 02.520	9414	Fill Slope
008RW	N38 55.075	W105 02.554	9417	Rock Weir/Apron
009RA	N38 55.046	W105 02.655	9443	Rock Weir/Apron
010DD	N38 54.907	W105 02.734	9457	Drainage Ditch
011CS	N38 54.909	W105 02.730	9459	Cut Slope
012CC	N38 54.748	W105 03.060	9528	Conveyance Channel
013CC	N38 54.730	W105 03.068	9525	Conveyance Channel
014CC	N38 54.691	W105 03.089	9519	Conveyance Channel
015CC	N38 54.603	W105 03.174	9547	Conveyance Channel
016CC	N38 54.602	W105 03.111	9525	Conveyance Channel
017CC	N38 54.510	W105 03.246	9565	Conveyance Channel
018CC	N38 54.472	W105 03.298	9576	Conveyance Channel
019CC	N38 54.457	W105 03.384	9599	Conveyance Channel
020CC	N38 54.345	W105 03.383	9637	Conveyance Channel
021CC	N38 54.299	W105 03.461	9668	Conveyance Channel
022CC	N38 54.288	W105 03.552	9692	Conveyance Channel
023CC	N38 54.272	W105 03.583	9701	Conveyance Channel
024CC	N38 54.289	W105 03.638	9715	Conveyance Channel
025CC	N38 54.258	W105 03.697	9744	Conveyance Channel
026CC	N38 54.232	W105 03.643	9752	Conveyance Channel
027CC	N38 54.183	W105 03.652	9771	Conveyance Channel
028CC	N38 54.149	W105 03.714	9818	Conveyance Channel
029CC	N38 54.145	W105 03.816	9856	Conveyance Channel
030CC	N38 54.134	W105 03.828	9855	Conveyance Channel
031CC	N38 54.130	W105 03.829	9861	Conveyance Channel
032CC	N38 54.159	W105 03.836	9858	Conveyance Channel
033CC	N38 54.106	W105 03.854	9886	Conveyance Channel
034CC	N38 54.037	W105 03.896	9940	Conveyance Channel
035CC	N38 53.909	W105 04.000	10060	Conveyance Channel
036CC	N38 53.866	W105 03.875	10126	Conveyance Channel
037CC	N38 53.821	W105 03.855	10217	Conveyance Channel
038CC	N38 53.759	W105 03.787	10254	Conveyance Channel
039FS	N38 54.910	W105 02.812	9455	Fill Slope
040CC	N38 54.914	W105 02.789	9464	Conveyance Channel
041CP	N38 53.807	W105 03.893	10072	Road Survey Control Point
042DD	N38 53.719	W105 03.746	10161	Drainage Ditch
043FS	N38 53.726	W105 03.764	10180	Fill Slope
044RX	N38 53.726	W105 03.763	10183	Road Cross Section
045CS	N38 53.657	W105 03.868	10266	Cut Slope
046DD	N38 53.658	W105 03.868	10268	Drainage Ditch
047RX	N38 53.658	W105 03.868	10268	Road Cross Section
048FS	N38 53.651	W105 03.880	10275	Fill Slope

Site Locations for Effectiveness and Validation Monitoring 2005

Site ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Feature Description
049CS	N38 53.592	W105 04.020	10406	Cut Slope
050RX	N38 53.593	W105 04.020	10404	Road Cross Section
051DD	N38 53.593	W105 04.021	10397	Drainage Ditch
052FS	N38 53.593	W105 04.021	10401	Fill Slope
053CC	N38 53.560	W105 04.127	10478	Conveyance Channel
054CC	N38 53.579	W105 04.148	10448	Conveyance Channel
055FS	N38 53.612	W105 04.095	10445	Fill Slope
056RX	N38 53.614	W105 04.096	10442	Road Cross Section
057DD	N38 53.613	W105 04.095	10445	Drainage Ditch
058CC	N38 53.513	W105 04.057	10512	Conveyance Channel
059CS	N38 53.353	W105 04.222	10697	Cut Slope
060RX	N38 53.354	W105 04.219	10691	Road Cross Section
061DD	N38 53.221	W105 04.381	10808	Drainage Ditch
062RX	N38 53.216	W105 04.381	10805	Road Cross Section
063CC	N38 53.223	W105 04.394	10803	Conveyance Channel
064CC	N38 53.448	W105 04.155	10634	Conveyance Channel
065CC	N38 53.382	W105 04.192	10679	Conveyance Channel
066CC	N38 53.336	W105 04.243	10701	Conveyance Channel
067CC	N38 53.297	W105 04.299	10736	Conveyance Channel
068CC	N38 53.251	W105 04.305	10841	Conveyance Channel
069CC	N38 53.019	W105 04.287	10989	Conveyance Channel
070CC	N38 52.956	W105 04.276	11028	Conveyance Channel
071DD	N38 52.972	W105 04.285	11017	Drainage Ditch
072RX	N38 52.972	W105 04.285	11015	Road Cross Section
073ST	N38 52.879	W105 04.311	11062	Sediment Trap
074FS	N38 52.927	W105 04.272	11053	Fill Slope
075RG	N38 53.797	W105 03.890	10109	Precipiatation Gauge
076RG	N38 52.582	W105 03.970	11810	Precipiatation Gauge
077RG	N38 51.783	W105 03.999	13069	Precipiatation Gauge
078CS	N38 53.331	W105 04.275	10478	Cut Slope
079FS	N38 52.882	W105 04.382	11254	Fill Slope
080DD	N38 52.865	W105 04.391	11256	Drainage Ditch
081CC	N38 52.943	W105 04.415	11194	Conveyance Channel
082DD	N38 52.787	W105 04.376	11284	Drainage Ditch
083FS	N38 52.777	W105 04.362	11288	Fill Slope
084CC	N38 52.796	W105 04.471	11360	Conveyance Channel
085DD	N38 52.786	W105 04.410	11313	Drainage Ditch
086FS	N38 52.602	W105 04.390	11447	Fill Slope
087CS	N38 52.435	W105 04.432	11542	Cut Slope
088FS	N38 52.388	W105 04.549	11590	Fill Slope
089CC	N38 52.391	W105 04.555	11580	Conveyance Channel
090CS	N38 52.366	W105 04.540	11604	Cut Slope
091CC	N38 52.402	W105 04.414	11643	Conveyance Channel
092DD	N38 52.432	W105 04.204	11781	Drainage Ditch
093FS	N38 52.399	W105 04.401	11642	Fill Slope
094CC	N38 52.540	W105 04.069	11873	Conveyance Channel
095CC	N38 52.452	W105 04.205	11787	Conveyance Channel
096CC	N38 52.379	W105 04.217	11746	Conveyance Channel
097CC	N38 52.381	W105 04.310	11678	Conveyance Channel
098FS	N38 52.265	W105 03.995	12242	Fill Slope

Site Locations for Effectiveness and Validation Monitoring 2005

Site ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Feature Description
099CC	N38 52.131	W105 04.046	12319	Conveyance Channel
100CC	N38 52.133	W105 03.936	12353	Conveyance Channel
101FS	N38 52.097	W105 03.875	12390	Fill Slope
102CS	N38 51.641	W105 04.063	12963	Cut Slope
103FS	N38 51.491	W105 04.021	12950	Fill Slope
104CC	N38 51.444	W105 03.894	12923	Conveyance Channel
105FS	N38 51.062	W105 03.694	13083	Fill Slope
106CC	N38 52.082	W105 03.858	12251	Conveyance Channel
107DD	N38 52.044	W105 03.824	12312	Drainage Ditch
108CC	N38 51.994	W105 03.769	12362	Conveyance Channel
109CC	N38 52.027	W105 03.825	12393	Conveyance Channel
110CC	N38 52.062	W105 03.914	12448	Conveyance Channel
111CC	N38 52.051	W105 03.992	12511	Conveyance Channel
112CC	N38 52.049	W105 03.933	12531	Conveyance Channel
113CC	N38 52.002	W105 03.873	12577	Conveyance Channel
114CC	N38 51.956	W105 03.840	12601	Conveyance Channel
115CC	N38 51.977	W105 03.995	12692	Conveyance Channel
116CC	N38 51.940	W105 04.080	12736	Conveyance Channel
117CC	N38 51.925	W105 04.141	12777	Conveyance Channel
118CC	N38 51.912	W105 04.177	12797	Conveyance Channel
119CC	N38 51.914	W105 04.032	12850	Conveyance Channel
120CC	N38 51.823	W105 04.090	12876	Conveyance Channel
121CC	N38 51.439	W105 03.804	12877	Conveyance Channel
122CC	N38 51.347	W105 03.789	12920	Conveyance Channel
123CS	N38 51.361	W105 03.782	12920	Cut Slope
124FS	N38 51.362	W105 03.788	12931	Fill Slope
125CC	N38 51.238	W105 03.806	12986	Conveyance Channel
126CC	N38 51.158	W105 03.789	13031	Conveyance Channel
127CC	N38 51.032	W105 03.697	13064	Conveyance Channel
128FS	N38 50.930	W105 03.732	13072	Fill Slope
129CC	N38 50.897	W105 03.662	13068	Conveyance Channel
130CC	N38 50.900	W105 03.177	13183	Conveyance Channel
131CC	N38 50.940	W105 03.382	13088	Conveyance Channel
132CC	N38 50.840	W105 03.274	13217	Conveyance Channel
133CC	N38 50.768	W105 03.213	13282	Conveyance Channel
134CC	N38 50.671	W105 03.035	13401	Conveyance Channel
135CC	N38 50.285	W105 02.872	13677	Conveyance Channel
136CC	N38 50.299	W105 02.931	13624	Conveyance Channel
137CC	N38 50.260	W105 02.755	13733	Conveyance Channel
138CC	N38 50.221	W105 02.605	13805	Conveyance Channel
139CC	N38 50.774	W105 03.110	13370	Conveyance Channel
140CC	N38 50.730	W105 03.195	13327	Conveyance Channel
141CS	N38 51.043	W105 03.690	13103	Cut Slope
152RW	N38 54.912	W105 02.837	9444	Rock Weir/Apron
153RW	N38 54.741	W105 03.066	9457	Rock Weir/Apron
154RX	N38 52.040	W105 03.817	12112	Road Cross Section
155DD	N38 51.245	W105 03.803	12917	Drainage Ditch
156RX	N38 51.244	W105 03.799	12922	Road Cross Section
157DD	N38 51.074	W105 03.684	13100	Drainage Ditch
158RX	N38 51.074	W105 03.683	13099	Road Cross Section

Site Locations for Effectiveness and Validation Monitoring 2005

Site ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Feature Description
159DD	N38 51.610	W105 04.072	13091	Drainage Ditch
160RX	N38 51.611	W105 04.072	13066	Road Cross Section
161RW	N38 54.720	W105 03.055	9516	Rock Weir/Apron
162RW	N38 54.887	W105 02.854	9518	Rock Weir/Apron
163RA	N38 54.665	W105 03.115	9528	Rock Weir/Apron
175CC	N38 55.104	W105 02.532	9437	Conveyance Channel
176RW	N38 54.146	W105 03.795	9838	Rock Weir
177FS	N38 55.302	W105 02.224	9323	Fill Slope
178RW	N38 54.142	W105 03.821	9839	Rock Weir
179RW	N38 54.127	W105 03.852	9851	Rock Weir
180RW	N38 54.055	W105 03.903	9906	Rock Weir
181RW	N38 54.025	W105 03.918	9919	Rock Weir
182DD	N38 54.895	W105 02.860	9430	Drainage Ditch
183FS	N38 54.675	W105 03.109	9453	Fill Slope
184CC	N38 54.708	W105 03.363	9308	Conveyance Channel
185CS	N38 54.536	W105 03.246	9532	Cut Slope
186FS	N38 54.524	W105 03.242	9538	Fill Slope
187FS	N38 54.281	W105 03.658	9711	Fill Slope
188DD	N38 54.075	W105 03.892	9894	Drainage Ditch
189CC	N38 54.073	W105 03.886	9887	Conveyance Channel
190CC	N38 54.095	W105 03.869	9871	Conveyance Channel
191CC	N38 54.117	W105 03.854	9855	Conveyance Channel
192CS	N38 54.183	W105 03.677	9786	Cut Slope
193FS	N38 54.821	W105 02.983	9507	Fill Slope
194FS	N38 54.811	W105 03.004	9506	Fill Slope
195DD	N38 54.827	W105 02.983	9505	Drainage Ditch
196FS	N38 54.872	W105 02.900	9497	Fill Slope
197CS	N38 54.364	W105 03.383	9640	Cut Slope
198FS	N38 54.497	W105 03.254	9560	Fill Slope
199RW	N38 54.688	W105 03.389	9326	Sediment Pond
200RW	N38 55.261	W105 02.246	9418	Rock Weir
201RW	N38 54.805	W105 03.021	9522	Rock Weir
202RW	N38 54.619	W105 03.132	9450	Rock Weir
203FS	N38 54.603	W105 03.139	9517	Fill Slope
204FS	N38 54.273	W105 03.572	9707	Fill Slope
205DD	N38 54.022	W105 03.927	9983	Drainage Ditch
206CC	N38 54.689	W105 03.097	9506	Conveyance Channel
207CC	N38 51.664	W105 04.062	12962	Conveyance Channel
208CC	N38 52.754	W105 04.445	11172	Conveyance Channel
209CC	N38 52.647	W105 04.411	11365	Conveyance Channel
210CC	N38 54.059	W105 03.916	9849	Conveyance Channel
211CC	N38 54.130	W105 03.844	9853	Conveyance Channel
212CC	N38 53.149	W105 04.311	10893	Conveyance Channel
213CC	N38 50.964	W105 03.391	13046	Conveyance Channel
214CC	N38 50.234	W105 02.661	13198	Conveyance Channel
215CC	N38 50.356	W105 02.792	13375	Conveyance Channel
216CC	N38 55.263	W105 02.236	9289	Conveyance Channel
217CC	N38 55.255	W105 02.232	9284	Conveyance Channel
218CC	N38 55.226	W105 02.268	9359	Conveyance Channel
219CC	N38 55.202	W105 02.262	9371	Conveyance Channel

Site Locations for Effectiveness and Validation Monitoring 2005

Site ID	Latitude (hddd°mm.mmm)	Longitude (hddd°mm.mmm)	Altitude (ft)	Feature Description
220CC	N38 55.108	W105 02.482	9411	Conveyance Channel
221CC	N38 55.107	W105 02.482	9305	Conveyance Channel
222CC	N38 55.070	W105 02.554	9319	Conveyance Channel
223CC	N38 55.048	W105 02.657	9394	Conveyance Channel
224CC	N38 54.878	W105 02.852	9493	Conveyance Channel
225CC	N38 54.917	W105 02.840	9441	Conveyance Channel
226CC	N38 54.796	W105 03.010	9431	Conveyance Channel
227CC	N38 54.706	W105 03.053	9480	Conveyance Channel
228CC	N38 54.746	W105 03.078	9431	Conveyance Channel
229CC	N38 54.140	W105 03.788	9774	Conveyance Channel
230CC	N38 54.028	W105 03.912	9902	Conveyance Channel
231CC	N38 54.050	W105 03.908	9910	Conveyance Channel
232CC	N38 52.583	W105 04.557	11399	Conveyance Channel
233RW	N38 52.383	W105 04.560	11074	Rock Weir
234RW	N38 52.502	W105 03.924	11915	Rock Weir
235CC	N38 52.504	W105 03.920	11928	Conveyance Channel
236RW	N38 52.185	W105 04.066	12177	Rock Weir
237RW	N38 52.398	W105 04.393	11219	Rock Weir
BHMR1	N38 48.951	W105 03.040	11885	Boehmer Creek 1
BHMR2	N38 49.061	W105 03.027	11995	Boehmer Creek 2
EBVR1	N38 49.832	W105 03.612	12156	East Fork Beaver Creek 1
EBVR2	N38 49.907	W105 03.598	12190	East Fork Beaver Creek 2
GLEN1	N38 54.457	W105 04.690	9519	Glen Cove Creek 1
NCAT1	N38 54.746	W105 05.994	9415	North Catamount Creek 1
NCAT2	N38 54.402	W105 06.106	9519	North Catamount Creek 2
NCRY1*	N38 54.418	W105 03.199	9453	North Fork Crystal Creek 1 & 2
OILC1	N38 48.449	W105 06.511	10505	Oil Creek 1
SCAT1	N38 55.035	W105 04.112	9368	South Catamount Creek 1
SCAT2	N38 54.974	W105 04.181	9345	South Catamount Creek 2
SCAT3	N38 54.316	W105 04.899	9412	South Catamount Creek 3
SKIC1	N38 54.975	W105 04.078	9418	Ski Creek 1
SKIC2	N38 53.767	W105 03.987	10035	Ski Creek 2
SVRY1	N38 52.467	W105 03.039	10732	Severy Creek 1
SVRY2	N38 52.472	W105 03.339	10926	Severy Creek 2
WBVR1	N38 48.181	W105 05.710	10726	West Fork Beaver Creek 1
WBVR2	N38 48.349	W105 05.591	10698	West Fork Beaver Creek 2

* North Fork Crystal Creek 2 (NCRY2) is located 200 ft upstream from NCRY1

Appendix B

Summary of Storm Events for 3 Rain Gauges

075RG
076RG
077RG

2005

Summary of Storms Measured at 075RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
03May05 07:56:39.0	03May05 08:41:59.0	12	0.12	0.756	03May05 08:19:19.0	0.159	9	12	1
27May05 15:04:17.0	27May05 15:21:19.0	2	0.02	0.284	27May05 15:12:48.0	0.070	2	2	2
29May05 15:30:14.5	29May05 15:57:11.5	15	0.15	0.449	29May05 15:43:43.0	0.334	15	15	3
29May05 18:22:02.5	29May05 19:28:07.0	6	0.06	1.101	29May05 18:55:04.7	0.054	5	5	4
29May05 20:48:15.5	29May05 20:57:52.0	6	0.06	0.160	29May05 20:53:03.7	0.375	6	6	5
02Jun05 18:37:39.5	02Jun05 18:44:31.5	4	0.04	0.114	02Jun05 18:41:05.5	0.350	4	4	6
03Jun05 17:20:38.0	03Jun05 17:57:28.0	10	0.1	0.614	03Jun05 17:39:03.0	0.163	9	10	7
09Jun05 18:36:45.5	09Jun05 20:01:23.5	15	0.15	1.411	09Jun05 19:19:04.5	0.106	7	12	8
10Jun05 00:39:59.0	10Jun05 00:58:01.0	4	0.04	0.301	10Jun05 00:49:00.0	0.133	4	4	9
10Jun05 02:41:49.5	10Jun05 02:46:56.0	3	0.03	0.085	10Jun05 02:44:22.8	0.352	3	3	10
10Jun05 11:01:01.5	10Jun05 11:11:27.5	4	0.04	0.174	10Jun05 11:06:14.5	0.230	4	4	11
10Jun05 14:09:54.0	10Jun05 15:44:46.5	13	0.13	1.581	10Jun05 14:57:20.2	0.082	9	11	12
11Jun05 21:29:30.5	11Jun05 21:33:12.5	4	0.04	0.062	11Jun05 21:31:21.5	0.649	4	4	13
12Jun05 01:47:14.0	12Jun05 02:57:56.0	4	0.04	1.178	12Jun05 02:22:35.0	0.034	2	3	14
15Jun05 13:42:00.0	15Jun05 13:48:04.0	4	0.04	0.101	15Jun05 13:45:02.0	0.396	4	4	15
21Jun05 14:25:55.0	21Jun05 15:21:15.0	27	0.27	0.922	21Jun05 14:53:35.0	0.293	25	27	16
21Jun05 16:40:17.0	21Jun05 17:12:10.5	3	0.03	0.532	21Jun05 16:56:13.8	0.056	2	3	17
23Jun05 17:04:20.0	23Jun05 18:25:01.0	9	0.09	1.345	23Jun05 17:44:40.5	0.067	5	7	18
24Jun05 19:39:45.5	24Jun05 19:41:37.5	3	0.03	0.031	24Jun05 19:40:41.5	0.964	3	3	19
28Jun05 20:16:39.0	28Jun05 20:42:26.0	10	0.1	0.430	28Jun05 20:29:32.5	0.233	10	10	20
02Jul05 14:33:26.0	02Jul05 14:42:16.0	8	0.08	0.147	02Jul05 14:37:51.0	0.543	8	8	21
06Jul05 19:23:16.0	06Jul05 19:51:34.0	4	0.04	0.472	06Jul05 19:37:25.0	0.085	4	4	22
14Jul05 21:22:10.5	14Jul05 22:58:32.0	10	0.1	1.606	14Jul05 22:10:21.2	0.062	7	8	23
15Jul05 14:47:51.0	15Jul05 15:58:26.5	24	0.24	1.177	15Jul05 15:23:08.7	0.204	19	23	24
17Jul05 13:19:56.5	17Jul05 13:27:15.0	2	0.02	0.122	17Jul05 13:23:35.7	0.164	2	2	25
23Jul05 16:45:51.0	23Jul05 17:04:38.5	3	0.03	0.313	23Jul05 16:55:14.8	0.096	3	3	26
24Jul05 14:26:06.5	24Jul05 15:11:09.5	11	0.11	0.751	24Jul05 14:48:38.0	0.147	8	11	27
24Jul05 20:01:17.0	24Jul05 22:29:09.5	13	0.13	2.465	24Jul05 21:15:13.2	0.053	6	9	28
25Jul05 16:26:02.5	25Jul05 17:37:37.0	7	0.07	1.193	25Jul05 17:01:49.7	0.059	5	6	29
25Jul05 22:15:01.5	25Jul05 22:54:30.5	2	0.02	0.658	25Jul05 22:34:46.0	0.030	1	2	30
26Jul05 22:54:06.0	26Jul05 23:40:52.0	3	0.03	0.779	26Jul05 23:17:29.0	0.038	2	3	31
27Jul05 17:45:22.0	27Jul05 19:01:34.5	7	0.07	1.270	27Jul05 18:23:28.2	0.055	4	5	32
03Aug05 16:29:15.0	03Aug05 16:47:57.5	2	0.02	0.312	03Aug05 16:38:36.2	0.064	2	2	33
03Aug05 18:25:03.0	03Aug05 22:02:19.0	32	0.32	3.621	03Aug05 20:13:41.0	0.088	14	19	34

Summary of Storms Measured at 075RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
04Aug05 02:26:46.0	04Aug05 13:22:43.0	154	1.54	10.932	04Aug05 07:54:44.5	0.141	27	35	35
04Aug05 15:38:57.0	04Aug05 17:12:29.0	10	0.1	1.559	04Aug05 16:25:43.0	0.064	4	6	36
04Aug05 18:14:16.0	04Aug05 22:48:11.0	28	0.28	4.565	04Aug05 20:31:13.5	0.061	5	9	37
05Aug05 16:06:42.5	05Aug05 16:19:50.5	3	0.03	0.219	05Aug05 16:13:16.5	0.137	3	3	38
09Aug05 20:21:53.0	09Aug05 20:39:09.5	19	0.19	0.288	09Aug05 20:30:31.2	0.660	19	19	39
10Aug05 16:43:12.5	10Aug05 17:15:54.5	9	0.09	0.545	10Aug05 16:59:33.5	0.165	8	9	40
11Aug05 13:03:12.0	11Aug05 15:41:51.0	23	0.23	2.644	11Aug05 14:22:31.5	0.087	11	17	41
11Aug05 17:15:12.0	11Aug05 20:21:07.0	22	0.22	3.099	11Aug05 18:48:09.5	0.071	7	12	42
11Aug05 21:28:22.0	11Aug05 22:45:02.5	8	0.08	1.278	11Aug05 22:06:42.2	0.063	4	6	43
12Aug05 17:59:40.0	12Aug05 18:37:23.5	9	0.09	0.629	12Aug05 18:18:31.7	0.143	7	9	44
13Aug05 18:33:18.5	13Aug05 19:04:06.5	13	0.13	0.513	13Aug05 18:48:42.5	0.253	12	13	45
13Aug05 23:03:17.5	13Aug05 23:58:44.0	7	0.07	0.924	13Aug05 23:31:00.8	0.076	5	7	46
14Aug05 15:07:45.0	14Aug05 15:34:54.5	8	0.08	0.453	14Aug05 15:21:19.7	0.177	8	8	47
16Aug05 15:29:04.5	16Aug05 15:49:34.0	4	0.04	0.342	16Aug05 15:39:19.2	0.117	4	4	48
19Aug05 17:32:22.5	19Aug05 17:49:03.0	5	0.05	0.278	19Aug05 17:40:42.7	0.180	5	5	49
20Aug05 10:56:41.5	20Aug05 12:28:03.0	83	0.83	1.523	20Aug05 11:42:22.2	0.545	55	76	50
20Aug05 15:25:01.5	20Aug05 16:54:01.0	40	0.40	1.483	20Aug05 16:09:31.2	0.270	37	38	51
22Aug05 20:21:53.0	22Aug05 20:31:04.5	4	0.04	0.153	22Aug05 20:26:28.7	0.261	4	4	52
23Aug05 17:57:57.5	23Aug05 18:25:54.5	14	0.14	0.466	23Aug05 18:11:56.0	0.301	14	14	53
06Sep05 13:31:49.0	06Sep05 13:51:40.5	4	0.04	0.331	06Sep05 13:41:44.7	0.121	4	4	54
06Sep05 23:11:04.0	06Sep05 23:50:02.0	4	0.04	0.649	06Sep05 23:30:33.0	0.062	3	4	55
07Sep05 18:53:38.0	07Sep05 19:27:11.5	4	0.04	0.559	07Sep05 19:10:24.7	0.072	3	4	56
08Sep05 13:24:49.0	08Sep05 14:01:28.0	16	0.16	0.611	08Sep05 13:43:08.5	0.262	15	16	57
08Sep05 15:43:17.0	08Sep05 16:14:57.5	3	0.03	0.528	08Sep05 15:59:07.2	0.057	2	3	58
08Sep05 19:31:36.5	08Sep05 19:35:23.0	2	0.02	0.063	08Sep05 19:33:29.7	0.318	2	2	59
09Sep05 22:25:39.5	09Sep05 23:23:06.5	7	0.07	0.958	09Sep05 22:54:23.0	0.073	4	7	60
14Sep05 16:13:37.5	14Sep05 17:12:49.5	11	0.11	0.987	14Sep05 16:43:13.5	0.111	10	11	61
22Sep05 03:59:37.5	22Sep05 05:57:03.5	16	0.16	1.957	22Sep05 04:58:20.5	0.082	9	13	62
22Sep05 17:59:44.5	22Sep05 18:33:47.0	6	0.06	0.567	22Sep05 18:16:45.7	0.106	5	6	63
27Sep05 20:47:02.5	27Sep05 21:18:23.0	7	0.07	0.522	27Sep05 21:02:42.7	0.134	6	7	64
28Sep05 02:11:11.0	28Sep05 02:26:01.5	3	0.03	0.247	28Sep05 02:18:36.2	0.121	3	3	65
28Sep05 04:18:53.5	28Sep05 06:45:36.5	28	0.28	2.445	28Sep05 05:32:15.0	0.115	18	21	66
28Sep05 14:34:58.5	28Sep05 15:10:01.0	2	0.02	0.584	28Sep05 14:52:29.8	0.034	1	2	67

Summary of Storms Measured at 076RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
03May05 08:03:06.0	03May05 08:14:24.5	4	0.04	0.188	03May05 08:08:45.2	0.212	4	4	1
03May05 09:29:03.0	03May05 10:36:57.0	12	0.12	1.132	03May05 10:03:00.0	0.106	8	10	2
09May05 14:17:57.0	09May05 14:18:45.5	2	0.02	0.013	09May05 14:18:21.2	1.485	2	2	3
27May05 15:30:32.0	27May05 15:36:35.5	2	0.02	0.101	27May05 15:33:33.7	0.198	2	2	4
29May05 15:35:46.5	29May05 16:38:09.0	10	0.1	1.040	29May05 16:06:57.7	0.096	7	9	5
29May05 18:25:26.5	29May05 18:34:08.5	3	0.03	0.145	29May05 18:29:47.5	0.207	3	3	6
02Jun05 18:33:36.5	02Jun05 19:14:11.5	7	0.07	0.676	02Jun05 18:53:54.0	0.103	5	7	7
04Jun05 10:15:15.5	04Jun05 10:55:35.0	7	0.07	0.672	04Jun05 10:35:25.2	0.104	6	7	8
04Jun05 13:32:40.5	04Jun05 14:27:08.5	6	0.06	0.908	04Jun05 13:59:54.5	0.066	3	6	9
10Jun05 08:33:13.5	10Jun05 09:36:51.0	22	0.22	1.060	10Jun05 09:05:02.2	0.207	13	20	10
10Jun05 11:21:11.5	10Jun05 11:30:25.0	6	0.06	0.154	10Jun05 11:25:48.2	0.390	6	6	11
10Jun05 16:16:48.0	10Jun05 19:12:31.5	17	0.17	2.929	10Jun05 17:44:39.7	0.058	10	14	12
11Jun05 21:55:24.5	11Jun05 23:12:58.0	5	0.05	1.293	11Jun05 22:34:11.2	0.039	3	4	13
12Jun05 08:46:49.0	12Jun05 10:11:12.5	6	0.06	1.407	12Jun05 09:29:00.8	0.043	3	4	14
21Jun05 14:43:40.5	21Jun05 17:19:15.5	20	0.2	2.593	21Jun05 16:01:28.0	0.077	10	12	15
21Jun05 18:49:27.5	21Jun05 18:53:55.0	2	0.02	0.074	21Jun05 18:51:41.2	0.269	2	2	16
23Jun05 17:06:28.5	23Jun05 18:20:25.5	10	0.1	1.232	23Jun05 17:43:27.0	0.081	5	8	17
24Jun05 13:49:06.5	24Jun05 14:09:21.5	2	0.02	0.337	24Jun05 13:59:14.0	0.059	2	2	18
24Jun05 19:33:17.0	24Jun05 19:50:00.5	7	0.07	0.279	24Jun05 19:41:38.7	0.251	7	7	19
28Jun05 20:16:22.0	28Jun05 20:39:43.0	13	0.13	0.389	28Jun05 20:28:02.5	0.334	13	13	20
06Jul05 19:09:06.5	06Jul05 20:29:42.5	14	0.14	1.343	06Jul05 19:49:24.5	0.104	11	13	21
14Jul05 20:57:09.0	14Jul05 21:56:48.5	12	0.12	0.994	14Jul05 21:26:58.7	0.121	8	12	22
14Jul05 22:57:20.5	14Jul05 23:22:25.0	3	0.03	0.418	14Jul05 23:09:52.7	0.072	3	3	23
15Jul05 14:34:19.0	15Jul05 15:55:23.0	22	0.22	1.351	15Jul05 15:14:51.0	0.163	14	19	24
23Jul05 16:39:06.0	23Jul05 17:54:00.5	12	0.12	1.248	23Jul05 17:16:33.2	0.096	10	10	25
24Jul05 14:41:17.0	24Jul05 15:07:24.5	9	0.09	0.435	24Jul05 14:54:20.7	0.207	9	9	26
24Jul05 19:54:17.0	24Jul05 22:58:41.5	34	0.34	3.073	24Jul05 21:26:29.2	0.111	15	24	27
25Jul05 16:20:54.5	25Jul05 17:42:01.0	16	0.16	1.352	25Jul05 17:01:27.7	0.118	9	13	28
25Jul05 22:24:16.5	25Jul05 22:36:45.5	2	0.02	0.208	25Jul05 22:30:31.0	0.096	2	2	29
26Jul05 02:35:17.0	26Jul05 02:51:03.5	2	0.02	0.263	26Jul05 02:43:10.2	0.076	2	2	30
26Jul05 21:45:47.0	26Jul05 23:06:41.0	14	0.14	1.348	26Jul05 22:26:14.0	0.104	9	12	31
27Jul05 17:10:54.0	27Jul05 18:27:50.5	6	0.06	1.282	27Jul05 17:49:22.2	0.047	3	5	32
03Aug05 19:24:58.0	03Aug05 21:53:53.5	56	0.56	2.482	03Aug05 20:39:25.7	0.226	27	34	33
04Aug05 02:31:32.5	04Aug05 04:40:50.5	64	0.64	2.155	04Aug05 03:36:11.5	0.297	39	43	34
04Aug05 05:44:38.5	04Aug05 10:27:36.5	50	0.5	4.716	04Aug05 08:06:07.5	0.106	14	18	35

Summary of Storms Measured at 076RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
04Aug05 11:28:51.5	04Aug05 13:16:05.5	40	0.4	1.787	04Aug05 12:22:28.5	0.224	24	32	36
04Aug05 14:26:42.0	04Aug05 17:20:59.5	21	0.21	2.905	04Aug05 15:53:50.8	0.072	7	9	37
04Aug05 18:40:42.0	04Aug05 22:35:24.0	37	0.37	3.912	04Aug05 20:38:03.0	0.095	9	17	38
05Aug05 16:11:34.5	05Aug05 16:26:39.5	17	0.17	0.251	05Aug05 16:19:07.0	0.676	17	17	39
09Aug05 20:14:45.0	09Aug05 20:31:38.0	16	0.16	0.281	09Aug05 20:23:11.5	0.569	16	16	40
10Aug05 16:50:46.5	10Aug05 17:17:19.0	8	0.08	0.442	10Aug05 17:04:02.7	0.181	8	8	41
11Aug05 00:23:31.5	11Aug05 00:45:08.5	3	0.03	0.360	11Aug05 00:34:20.0	0.083	3	3	42
11Aug05 12:51:54.5	11Aug05 16:36:56.5	49	0.49	3.751	11Aug05 14:44:25.5	0.131	16	27	43
11Aug05 17:42:39.0	11Aug05 23:55:20.0	51	0.51	6.211	11Aug05 20:48:59.5	0.082	12	20	44
12Aug05 18:02:00.0	12Aug05 18:33:06.0	12	0.12	0.518	12Aug05 18:17:33.0	0.232	11	12	45
13Aug05 22:49:58.0	13Aug05 23:59:27.0	17	0.17	1.158	13Aug05 23:24:42.5	0.147	14	16	46
14Aug05 15:06:49.5	14Aug05 15:33:56.0	8	0.08	0.452	14Aug05 15:20:22.7	0.177	8	8	47
16Aug05 15:29:37.0	16Aug05 16:11:25.5	6	0.06	0.697	16Aug05 15:50:31.2	0.086	5	6	48
20Aug05 10:52:12.0	20Aug05 16:55:10.0	164	1.64	6.049	20Aug05 13:53:41.0	0.271	31	50	49
22Aug05 20:25:54.5	22Aug05 20:46:15.5	9	0.09	0.339	22Aug05 20:36:05.0	0.265	9	9	50
23Aug05 17:54:26.5	23Aug05 18:14:41.0	18	0.18	0.337	23Aug05 18:04:33.7	0.534	18	18	51
25Aug05 15:45:54.5	25Aug05 15:58:10.5	4	0.04	0.204	25Aug05 15:52:02.5	0.196	4	4	52
04Sep05 19:10:40.0	04Sep05 19:21:52.5	4	0.04	0.187	04Sep05 19:16:16.2	0.214	4	4	53
06Sep05 13:22:44.5	06Sep05 13:43:10.0	25	0.25	0.340	06Sep05 13:32:57.2	0.734	25	25	54
06Sep05 22:43:27.0	06Sep05 23:53:04.5	16	0.16	1.160	06Sep05 23:18:15.7	0.138	8	14	55
07Sep05 18:34:48.5	07Sep05 18:54:47.5	6	0.06	0.333	07Sep05 18:44:48.0	0.180	6	6	56
08Sep05 01:11:36.0	08Sep05 01:33:42.0	3	0.03	0.368	08Sep05 01:22:39.0	0.081	3	3	57
08Sep05 13:25:03.0	08Sep05 13:57:14.0	6	0.06	0.536	08Sep05 13:41:08.5	0.112	5	6	58
08Sep05 15:34:30.0	08Sep05 15:58:45.0	3	0.03	0.404	08Sep05 15:46:37.5	0.074	3	3	59
08Sep05 19:28:36.0	08Sep05 22:23:25.0	8	0.08	2.914	08Sep05 20:56:00.5	0.027	2	3	60
09Sep05 22:16:24.5	09Sep05 23:20:37.0	6	0.06	1.070	09Sep05 22:48:30.7	0.056	3	5	61
15Sep05 08:05:58.5	15Sep05 09:36:22.5	14	0.14	1.507	15Sep05 08:51:10.5	0.093	8	10	62
22Sep05 02:23:37.0	22Sep05 02:29:42.5	3	0.03	0.102	22Sep05 02:26:39.8	0.295	3	3	63
22Sep05 04:04:08.0	22Sep05 05:55:47.5	26	0.26	1.861	22Sep05 04:59:57.7	0.140	13	18	64
22Sep05 13:22:27.0	22Sep05 13:36:43.0	3	0.03	0.238	22Sep05 13:29:35.0	0.126	3	3	65
22Sep05 17:40:58.0	22Sep05 18:26:04.0	6	0.06	0.752	22Sep05 18:03:31.0	0.080	5	6	66
27Sep05 20:44:12.5	27Sep05 21:23:50.5	10	0.1	0.661	27Sep05 21:04:01.5	0.151	9	10	67
28Sep05 02:06:36.0	28Sep05 02:26:11.5	7	0.07	0.327	28Sep05 02:16:23.7	0.214	7	7	68
28Sep05 03:28:25.5	28Sep05 05:25:16.0	20	0.2	1.947	28Sep05 04:26:50.7	0.103	15	16	69
28Sep05 08:41:02.5	28Sep05 10:11:24.0	23	0.23	1.506	28Sep05 09:26:13.2	0.153	16	21	70

Summary of Storms Measured at 077RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
03May05 09:41:49.5	03May05 10:27:18.0	7	0.07	0.758	03May05 10:04:33.7	0.092	6	7	1
04May05 10:11:09.0	04May05 10:15:03.5	2	0.02	0.065	04May05 10:13:06.3	0.307	2	2	2
27May05 15:58:40.0	27May05 16:02:10.5	2	0.02	0.058	27May05 16:00:25.2	0.342	2	2	3
28May05 09:26:11.0	28May05 09:56:03.5	3	0.03	0.498	28May05 09:41:07.2	0.060	3	3	4
29May05 16:38:55.5	29May05 17:18:33.0	3	0.03	0.660	29May05 16:58:44.2	0.045	2	3	5
04Jun05 13:25:00.5	04Jun05 13:29:17.5	4	0.04	0.071	04Jun05 13:27:09.0	0.560	4	4	6
10Jun05 11:36:47.0	10Jun05 11:43:16.0	3	0.03	0.108	10Jun05 11:40:01.5	0.278	3	3	7
10Jun05 16:37:14.0	10Jun05 16:45:17.0	2	0.02	0.134	10Jun05 16:41:15.5	0.149	2	2	8
12Jun05 11:44:39.5	12Jun05 12:44:28.5	7	0.07	0.997	12Jun05 12:14:34.0	0.070	4	7	9
21Jun05 14:24:25.0	21Jun05 15:32:21.5	16	0.16	1.132	21Jun05 14:58:23.3	0.141	13	15	10
21Jun05 16:36:24.5	21Jun05 17:25:54.5	9	0.09	0.825	21Jun05 17:01:09.5	0.109	6	9	11
23Jun05 16:56:54.5	23Jun05 17:54:28.0	8	0.08	0.959	23Jun05 17:25:41.2	0.083	6	8	12
24Jun05 13:55:29.5	24Jun05 14:19:38.5	2	0.02	0.402	24Jun05 14:07:34.0	0.050	2	2	13
26Jun05 19:58:41.5	26Jun05 20:06:15.0	3	0.03	0.126	26Jun05 20:02:28.2	0.238	3	3	14
28Jun05 20:16:26.0	28Jun05 20:42:50.5	7	0.07	0.440	28Jun05 20:29:38.2	0.159	7	7	15
05Jul05 14:36:13.0	05Jul05 15:01:40.5	8	0.08	0.424	05Jul05 14:48:56.8	0.189	8	8	16
06Jul05 19:16:57.0	06Jul05 20:36:37.5	7	0.07	1.328	06Jul05 19:56:47.2	0.053	4	5	17
14Jul05 20:58:40.5	14Jul05 23:05:37.5	26	0.26	2.116	14Jul05 22:02:09.0	0.123	20	23	18
15Jul05 14:29:40.5	15Jul05 16:02:08.0	22	0.22	1.541	15Jul05 15:15:54.3	0.143	12	19	19
23Jul05 16:38:42.5	23Jul05 17:42:34.5	17	0.17	1.064	23Jul05 17:10:38.5	0.160	13	15	20
24Jul05 14:52:03.5	24Jul05 15:27:22.0	2	0.02	0.588	24Jul05 15:09:42.7	0.034	1	2	21
24Jul05 20:03:30.0	24Jul05 22:50:51.5	29	0.29	2.789	24Jul05 21:27:10.7	0.104	12	19	22
25Jul05 16:18:48.5	25Jul05 17:37:48.5	22	0.22	1.317	25Jul05 16:58:18.5	0.167	9	17	23
25Jul05 22:09:53.5	25Jul05 22:47:58.5	5	0.05	0.635	25Jul05 22:28:56.0	0.079	4	5	24
26Jul05 02:43:35.5	26Jul05 03:04:22.0	2	0.02	0.346	26Jul05 02:53:58.8	0.058	2	2	25
26Jul05 21:13:06.5	26Jul05 23:34:27.0	11	0.11	2.356	26Jul05 22:23:46.8	0.047	5	9	26
27Jul05 16:54:24.5	27Jul05 18:07:52.5	8	0.08	1.224	27Jul05 17:31:08.5	0.065	6	7	27
03Aug05 18:05:29.0	03Aug05 22:34:12.0	56	0.56	4.479	03Aug05 20:19:50.5	0.125	31	39	28
04Aug05 02:34:11.5	04Aug05 04:31:08.0	23	0.23	1.949	04Aug05 03:32:39.7	0.118	14	15	29
04Aug05 07:40:49.5	04Aug05 13:14:09.0	72	0.72	5.555	04Aug05 10:27:29.3	0.130	25	37	30
04Aug05 14:51:03.0	04Aug05 17:15:18.0	10	0.1	2.404	04Aug05 16:03:10.5	0.042	6	7	31
04Aug05 18:41:32.0	04Aug05 21:38:59.0	36	0.36	2.958	04Aug05 20:10:15.5	0.122	14	23	32
05Aug05 16:04:07.5	05Aug05 17:40:43.0	29	0.29	1.610	05Aug05 16:52:25.2	0.180	15	24	33
09Aug05 20:10:37.5	09Aug05 20:28:35.5	8	0.08	0.299	09Aug05 20:19:36.5	0.267	8	8	34

Summary of Storms Measured at 077RG - 2005

DateTime Start	DateTime End	Storms (tips)	Storm Volume (in)	Duration (hr)	MedianTime	Ave Rate (in/hr)	Max Tips 30 min	Max Tips 60 min	Storm ID
10Aug05 16:42:08.0	10Aug05 17:22:20.5	10	0.1	0.670	10Aug05 17:02:14.2	0.149	9	10	35
11Aug05 00:19:55.0	11Aug05 00:31:20.0	2	0.02	0.190	11Aug05 00:25:37.5	0.105	2	2	36
11Aug05 13:26:54.0	11Aug05 23:54:32.0	103	1.03	10.461	11Aug05 18:40:43.0	0.098	17	30	37
12Aug05 18:06:09.5	12Aug05 18:37:47.5	8	0.08	0.527	12Aug05 18:21:58.5	0.152	7	8	38
13Aug05 23:17:44.5	14Aug05 00:13:06.0	9	0.09	0.923	13Aug05 23:45:25.2	0.098	7	9	39
14Aug05 15:14:59.5	14Aug05 15:32:58.0	8	0.08	0.300	14Aug05 15:23:58.7	0.267	8	8	40
15Aug05 14:59:11.5	15Aug05 15:16:22.5	2	0.02	0.286	15Aug05 15:07:47.0	0.070	2	2	41
16Aug05 15:31:35.5	16Aug05 16:17:41.5	2	0.02	0.768	16Aug05 15:54:38.5	0.026	1	2	42
20Aug05 11:01:02.5	20Aug05 11:13:00.5	3	0.03	0.199	20Aug05 11:07:01.5	0.150	3	3	43
20Aug05 13:42:04.0	20Aug05 19:30:55.5	112	1.12	5.814	20Aug05 16:36:29.7	0.193	36	55	44
22Aug05 20:37:35.5	22Aug05 20:48:32.0	3	0.03	0.182	22Aug05 20:43:03.7	0.165	3	3	45
23Aug05 18:07:44.0	23Aug05 20:20:54.0	26	0.26	2.219	23Aug05 19:14:19.0	0.117	13	21	46
04Sep05 19:01:57.5	04Sep05 19:23:37.5	8	0.08	0.361	04Sep05 19:12:47.5	0.222	8	8	47
05Sep05 17:33:21.0	05Sep05 17:44:05.5	5	0.05	0.179	05Sep05 17:38:43.2	0.279	5	5	48
06Sep05 13:19:29.0	06Sep05 13:57:52.5	12	0.12	0.640	06Sep05 13:38:40.8	0.188	10	12	49
06Sep05 22:47:09.0	06Sep05 23:50:07.0	11	0.11	1.049	06Sep05 23:18:38.0	0.105	6	10	50
07Sep05 18:47:05.0	07Sep05 18:56:00.0	2	0.02	0.149	07Sep05 18:51:32.5	0.135	2	2	51
08Sep05 15:31:44.5	08Sep05 15:47:48.0	2	0.02	0.268	08Sep05 15:39:46.2	0.075	2	2	52
08Sep05 19:19:45.5	08Sep05 22:27:20.5	8	0.08	3.126	08Sep05 20:53:33.0	0.026	3	3	53
09Sep05 22:23:12.0	09Sep05 23:29:03.5	4	0.04	1.098	09Sep05 22:56:07.7	0.036	2	3	54
22Sep05 02:27:19.0	22Sep05 02:35:01.5	2	0.02	0.128	22Sep05 02:31:10.3	0.156	2	2	55
22Sep05 07:08:04.0	22Sep05 07:19:53.0	2	0.02	0.197	22Sep05 07:13:58.5	0.102	2	2	56
27Sep05 20:51:26.5	27Sep05 21:09:18.5	3	0.03	0.298	27Sep05 21:00:22.5	0.101	3	3	57
28Sep05 02:02:43.0	28Sep05 03:02:18.0	6	0.06	0.993	28Sep05 02:32:30.5	0.060	4	6	58
28Sep05 11:23:34.0	28Sep05 12:50:52.0	20	0.2	1.455	28Sep05 12:07:13.0	0.137	11	16	59

Appendix C

Road Cross Sections
Cross Section Geometry and Graphs

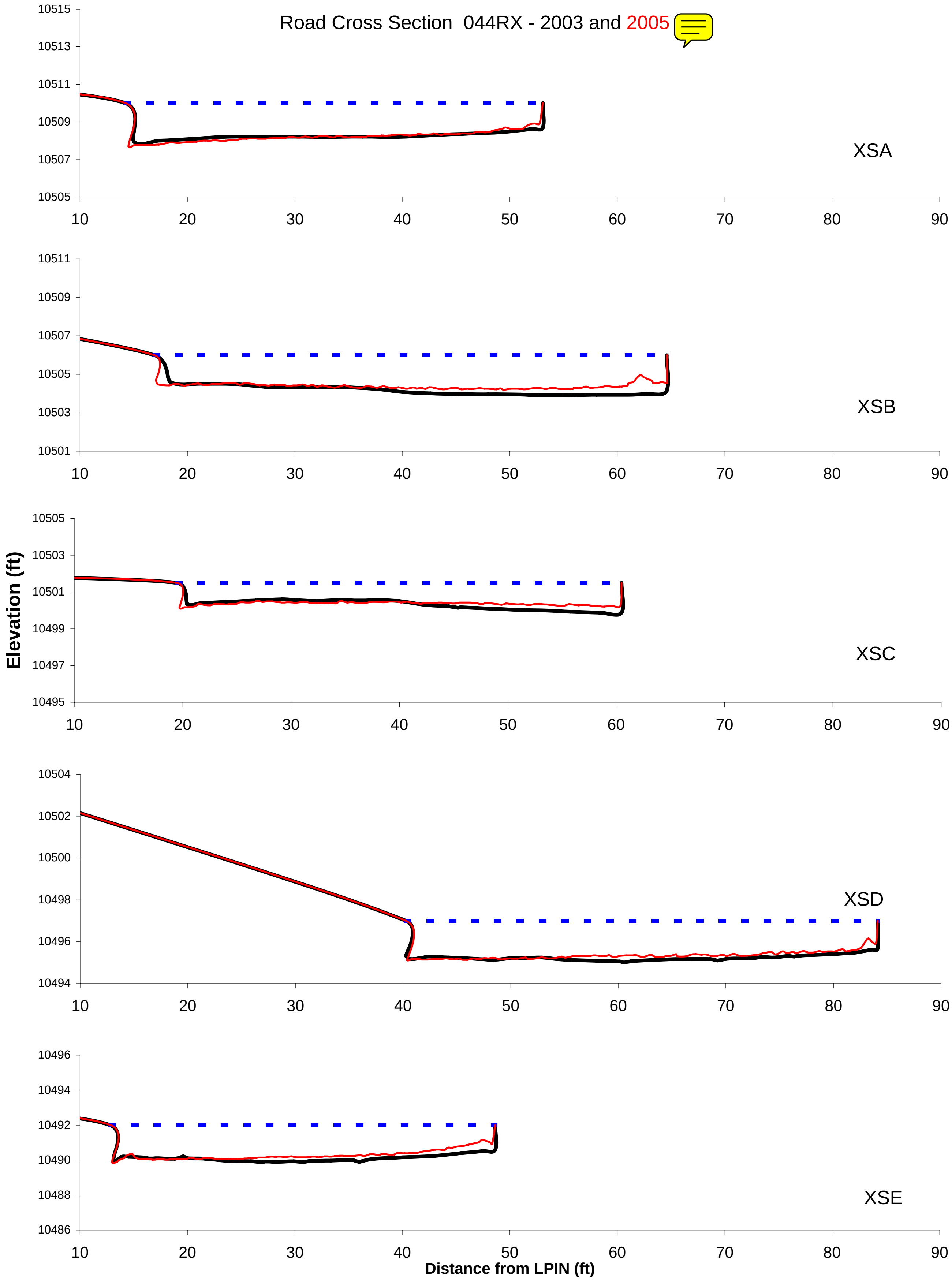
2005

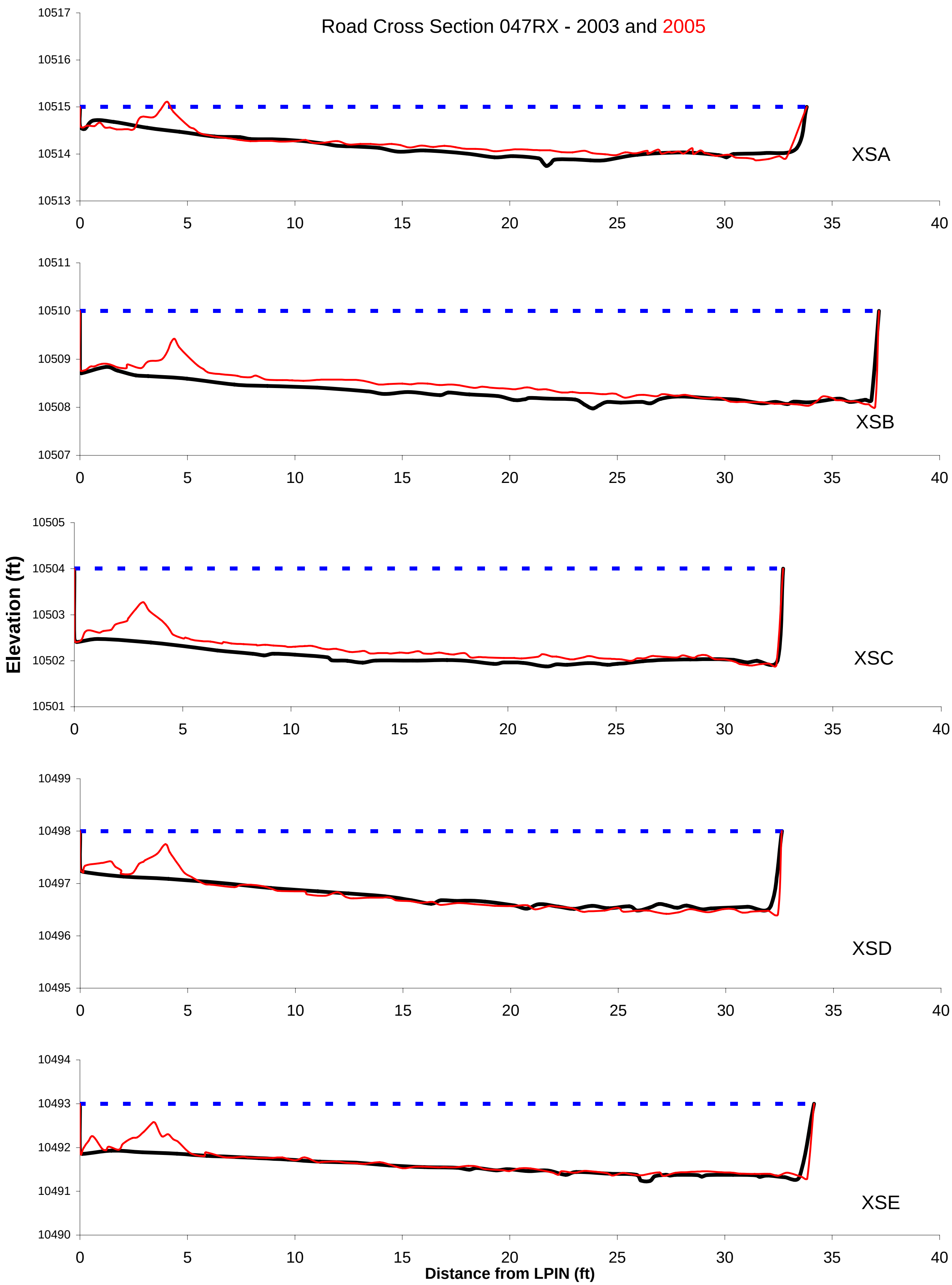
Geometry of Road Cross Sections 2005

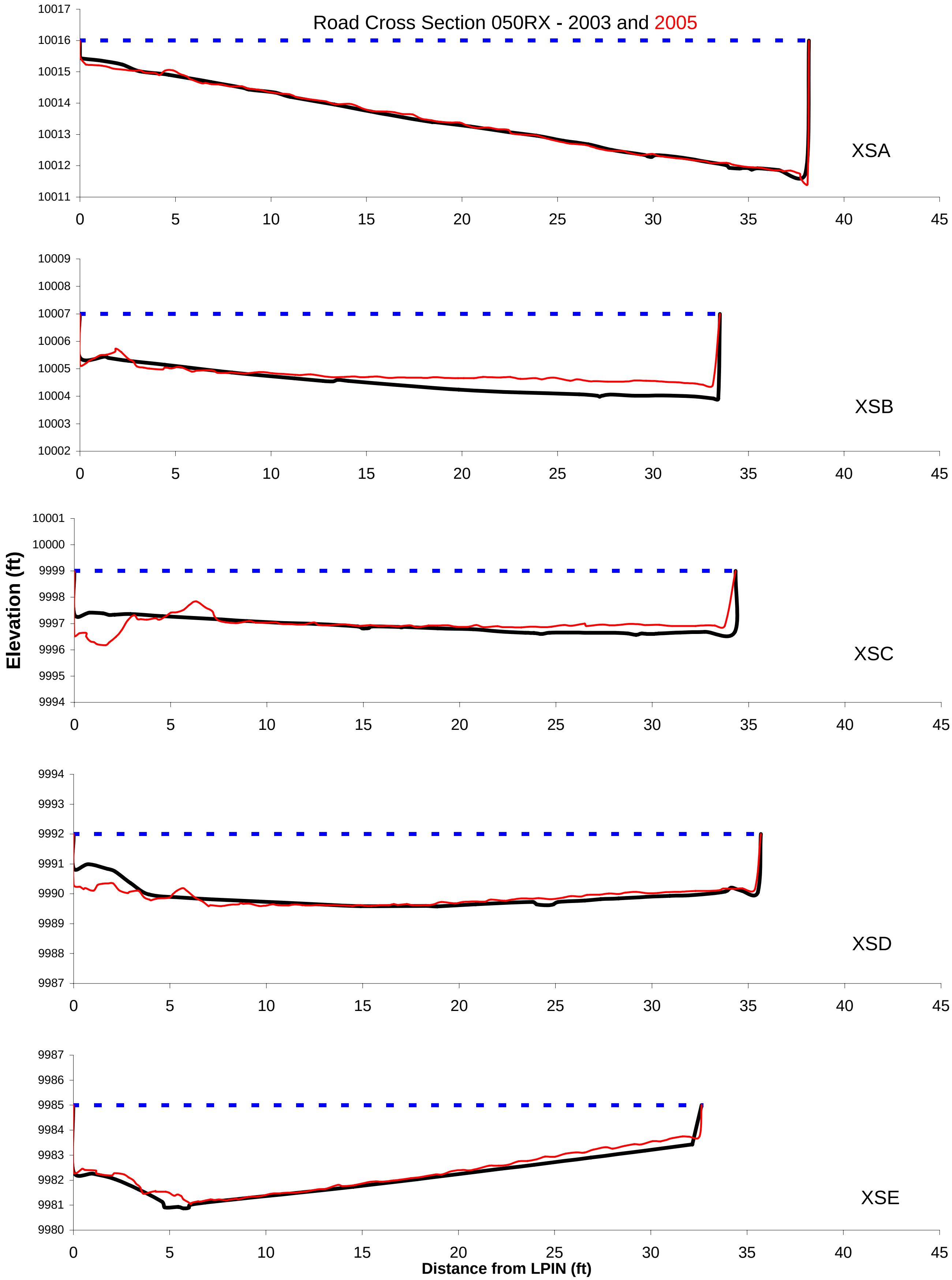
Road Cross Section Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Area Differences 2003-2004 (ft^2)	Area Differences 2003-2005 (ft^2)
044RX	14Jul05	A	38.8	68.85	1.77	2.29	-0.64	-1.25
044RX	14Jul05	B	47.7	77.21	1.62	1.81	0.48	9.08
044RX	14Jul05	C	41.0	46.15	1.12	1.35	-0.82	2.65
044RX	14Jul05	D	43.9	72.43	1.65	1.86	6.05	5.51
044RX	14Jul05	E	35.8	60.81	1.70	2.11	5.67	6.80
047RX	15Jul05	A	33.8	26.35	0.78	1.14	2.39	2.13
047RX	15Jul05	B	37.2	57.60	1.55	1.99	4.84	5.05
047RX	15Jul05	C	32.7	56.97	1.74	2.10	5.29	5.36
047RX	15Jul05	D	32.6	40.32	1.24	1.58	0.93	-0.22
047RX	15Jul05	E	34.2	46.31	1.36	1.70	0.62	1.84
050RX	16Jul05	A	38.2	97.47	2.55	4.58	-0.61	-0.11
050RX	16Jul05	B	33.5	74.22	2.22	2.58	-1.11	9.27
050RX	16Jul05	C	34.3	69.38	2.02	2.83	-1.63	2.45
050RX	16Jul05	D	35.7	76.02	2.13	2.42	-3.98	-0.15
050RX	16Jul05	E	32.6	88.99	2.73	3.96	0.01	5.12
056RX	17Jul05	A	39.8	84.14	2.11	3.27	-0.64	-6.52
056RX	17Jul05	B	34.9	107.00	3.07	4.36	-1.54	-7.19
056RX	17Jul05	C	28.0	60.74	2.17	3.28	-1.85	-2.89
056RX	17Jul05	D	30.3	84.45	2.79	3.56	-1.90	-4.69
056RX	17Jul05	E	29.1	62.20	2.13	2.68	-1.67	-2.63
060RX	18Jul05	A	29.6	61.57	2.08	2.71	1.61	1.19
060RX	18Jul05	B	30.8	49.96	1.62	2.20	-0.17	2.05
060RX	18Jul05	C	30.0	68.66	2.29	2.83	-0.15	-1.00
060RX	18Jul05	D	30.5	36.93	1.21	1.67	2.47	3.22
060RX	18Jul05	E	32.1	68.28	2.12	2.37	2.21	0.70
062RX	19Jul05	A	35.9	54.42	1.52	2.19	0.75	0.07
062RX	19Jul05	B	32.9	37.06	1.13	1.67	0.02	2.27
062RX	19Jul05	C	36.2	58.33	1.61	2.00	2.13	2.18
062RX	19Jul05	D	33.9	26.98	0.80	1.44	-1.06	-0.51
062RX	19Jul05	E	39.0	60.51	1.55	1.84	-1.65	-1.06
072RX	20Jul05	A	37.6	76.83	2.04	2.62	-0.11	0.34
072RX	20Jul05	B	31.9	78.24	2.45	3.03	-2.04	-0.75
072RX	20Jul05	C	36.2	90.69	2.51	3.19	-2.25	3.25
072RX	20Jul05	D	34.7	85.21	2.45	3.01	-2.06	2.03
072RX	20Jul05	E	36.0	75.39	2.09	2.91	0.73	2.83
154RX	31Jul05	A	27.2	44.29	1.63	2.04	-3.00	-5.60
154RX	31Jul05	B	29.1	56.73	1.95	2.44	-2.76	-1.01
154RX	31Jul05	C	29.2	43.26	1.48	1.83	-4.13	-0.98
154RX	31Jul05	D	29.9	57.17	1.91	2.24	-1.57	-0.25
154RX	31Jul05	E	30.0	42.65	1.42	1.76	-2.53	-5.74
156RX	30Jul05	A	35.5	28.16	0.79	1.56	-0.62	12.58
156RX	30Jul05	B	35.9	40.72	1.14	2.59	2.55	21.16
156RX	30Jul05	C	32.9	39.83	1.21	2.26	1.89	25.21
156RX	30Jul05	D	32.0	34.91	1.09	1.68	2.81	24.98
156RX	30Jul05	E	33.7	44.36	1.32	2.43	1.88	21.33
158RX	14Jul05	A	48.8	53.77	1.10	1.55	-3.97	-2.21
158RX	14Jul05	B	44.0	85.95	1.96	2.36	-2.36	-4.28
158RX	14Jul05	C	47.1	79.95	1.70	2.07	-1.58	-1.32
158RX	14Jul05	D	42.9	93.77	2.19	2.59	-2.40	-1.29
158RX	14Jul05	E	43.3	92.76	2.14	2.52	-1.25	-0.47

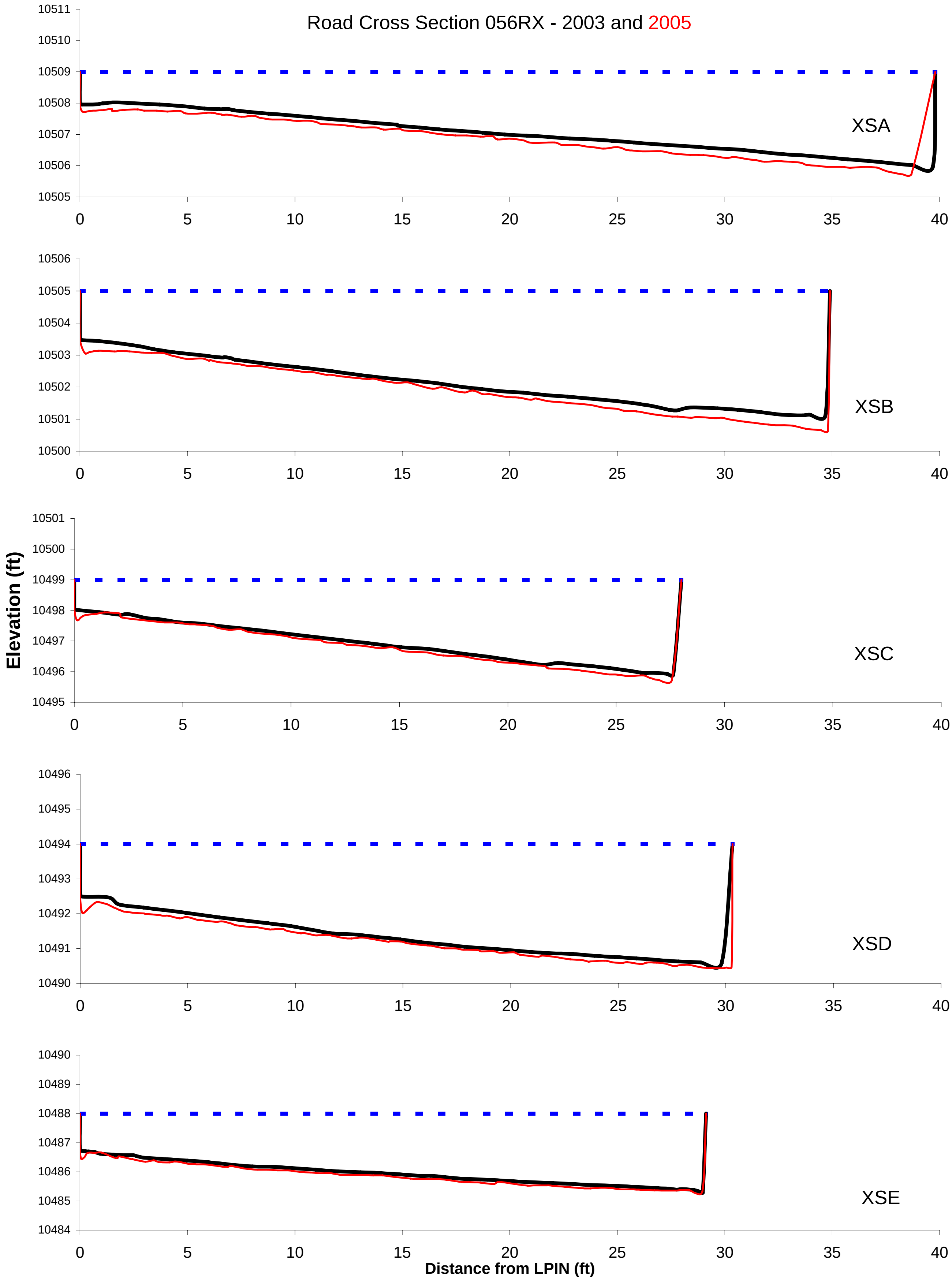
Geometry of Road Cross Sections 2005

Road Cross Section Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Area Differences 2003-2004 (ft^2)	Area Differences 2003-2005 (ft^2)
160RX	30Jul05	A	36.7	59.69	1.62	1.86	-1.16	0.22
160RX	30Jul05	B	38.9	59.21	1.52	2.08	-0.91	2.07
160RX	30Jul05	C	39.9	33.91	0.85	1.37	-1.69	0.00
160RX	30Jul05	D	38.0	51.03	1.34	1.74	-1.23	0.60
160RX	30Jul05	E	38.7	63.73	1.65	2.01	-2.73	-2.76


Road Cross Section 044RX - 2003 and 2005
XSA
10515
10513
10511
10509
10507
10505
10
20
30
40
50
60
70
80
90
XSB
10511
10509
10507
10505
10503
10501
XSC
10505
10503
10501
10499
10497
10495
XSD
10504
10502
10500
10498
10496
10494
XSE
10496
10494
10492
10490
10488
10486
Elevation (ft)
Distance from LPIN (ft)


Road Cross Section 047RX - 2003 and 2005
XSA
10517
10516
10515
10514
10513
XSB
10511
10510
10509
10508
10507
XSC
10505
10504
10503
10502
10501
XSD
10499
10498
10497
10496
10495
XSE
10494
10493
10492
10491
10490
0 5 10 15 20 25 30 35 40
Elevation (ft)
Distance from LPIN (ft)


Road Cross Section 050RX - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)



Road Cross Section 056RX - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
10511
10510
10509
10508
10507
10506
10505
10506
10505
10504
10503
10502
10501
10500
10501
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10499
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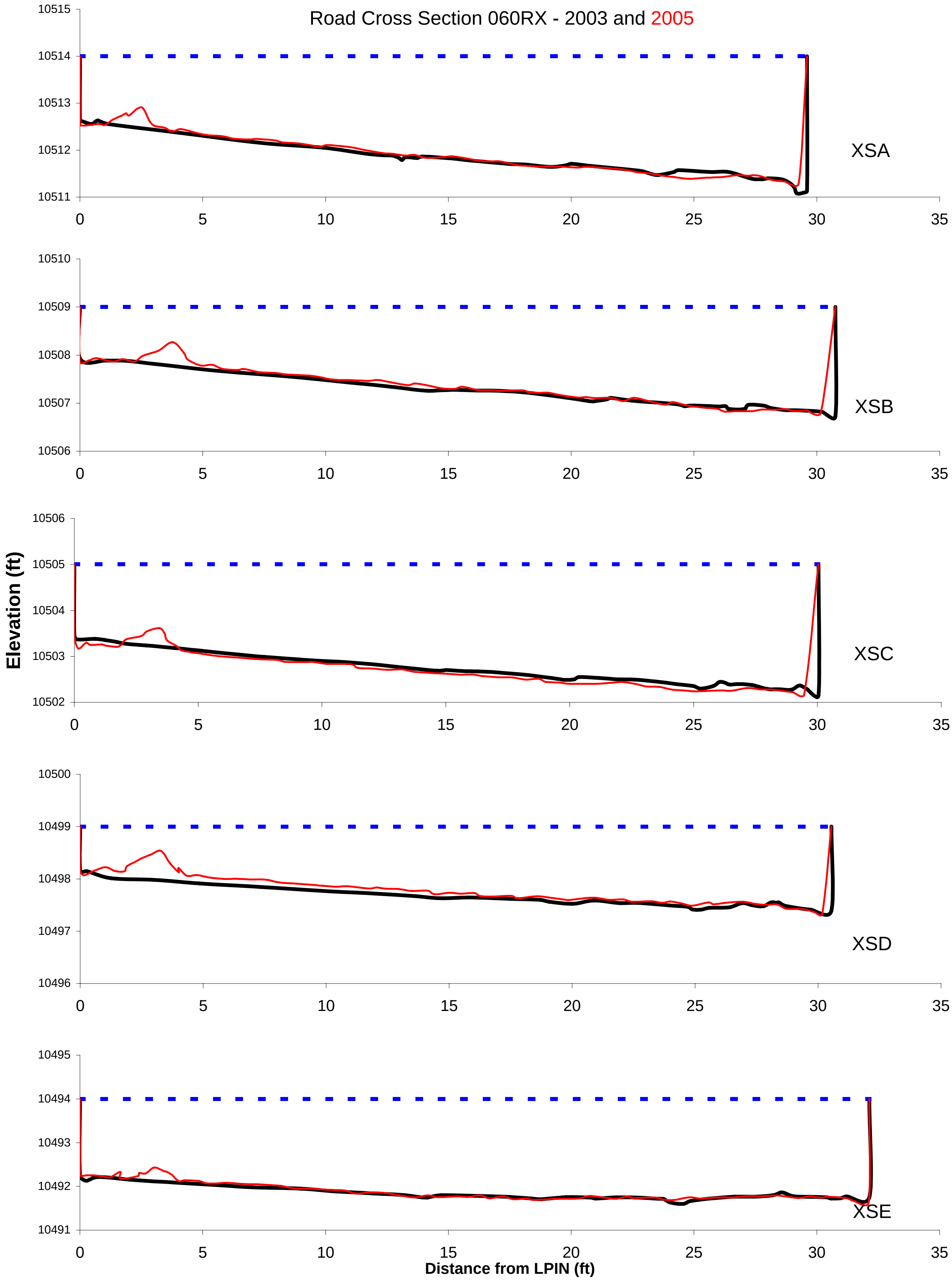
10488
10487
10486
10485
10484
0
5
10
15
20
25
30
35
40



Road Cross Section 060RX - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
10515
10514
10513
10512
10511
10510
10509
10508
10507
10506
10505
10504
10503
10502
10500
10499
10498
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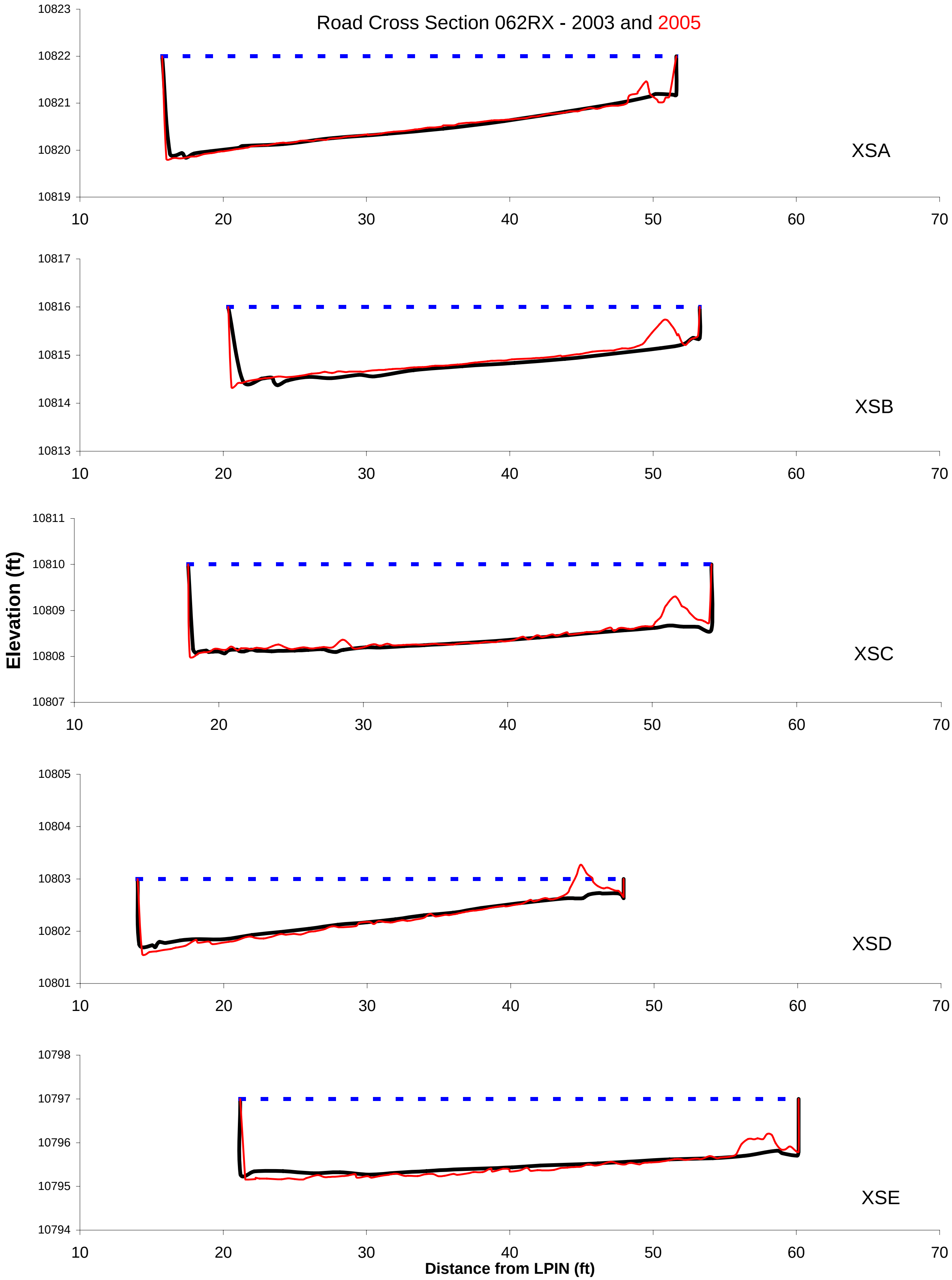
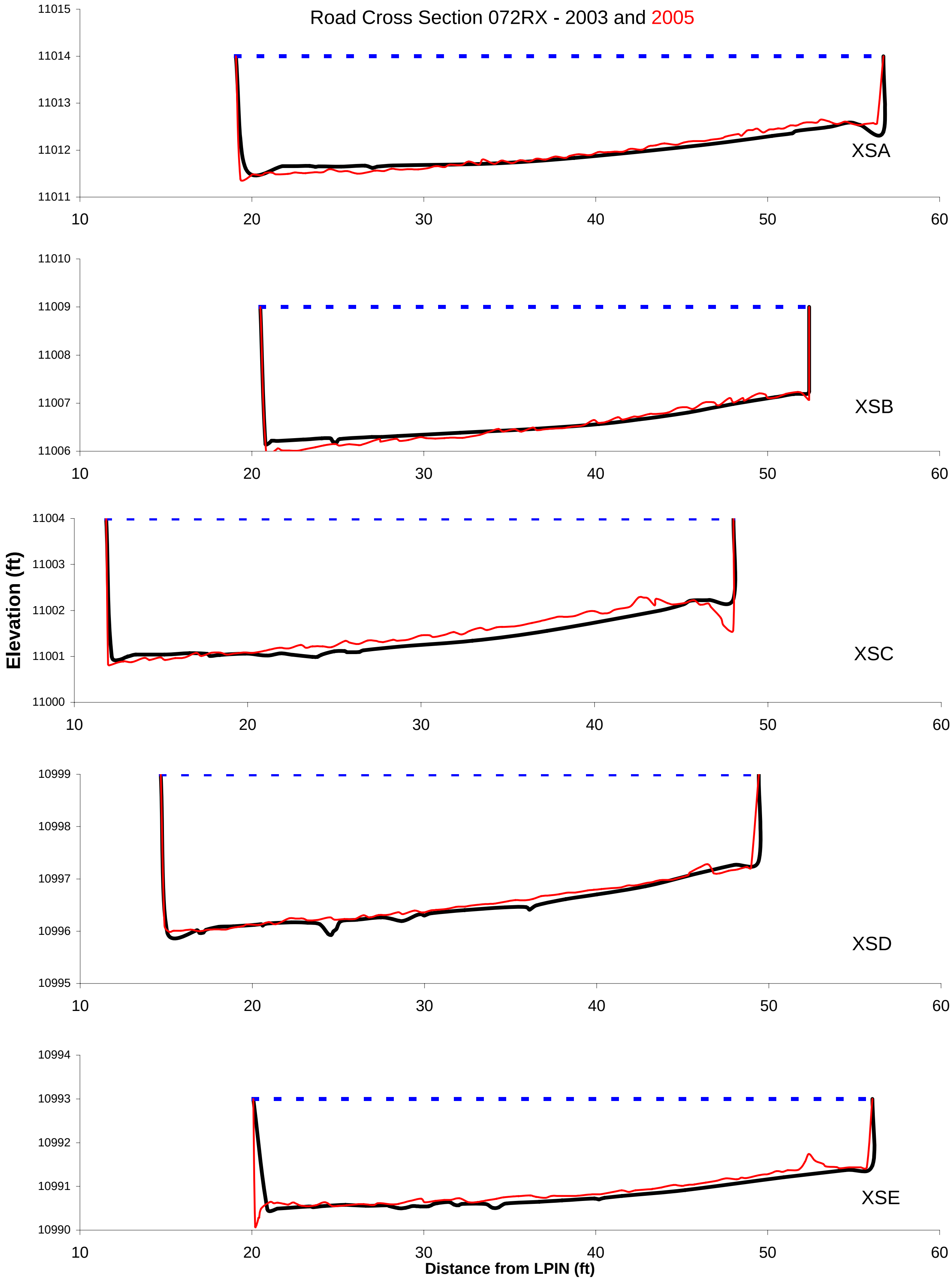
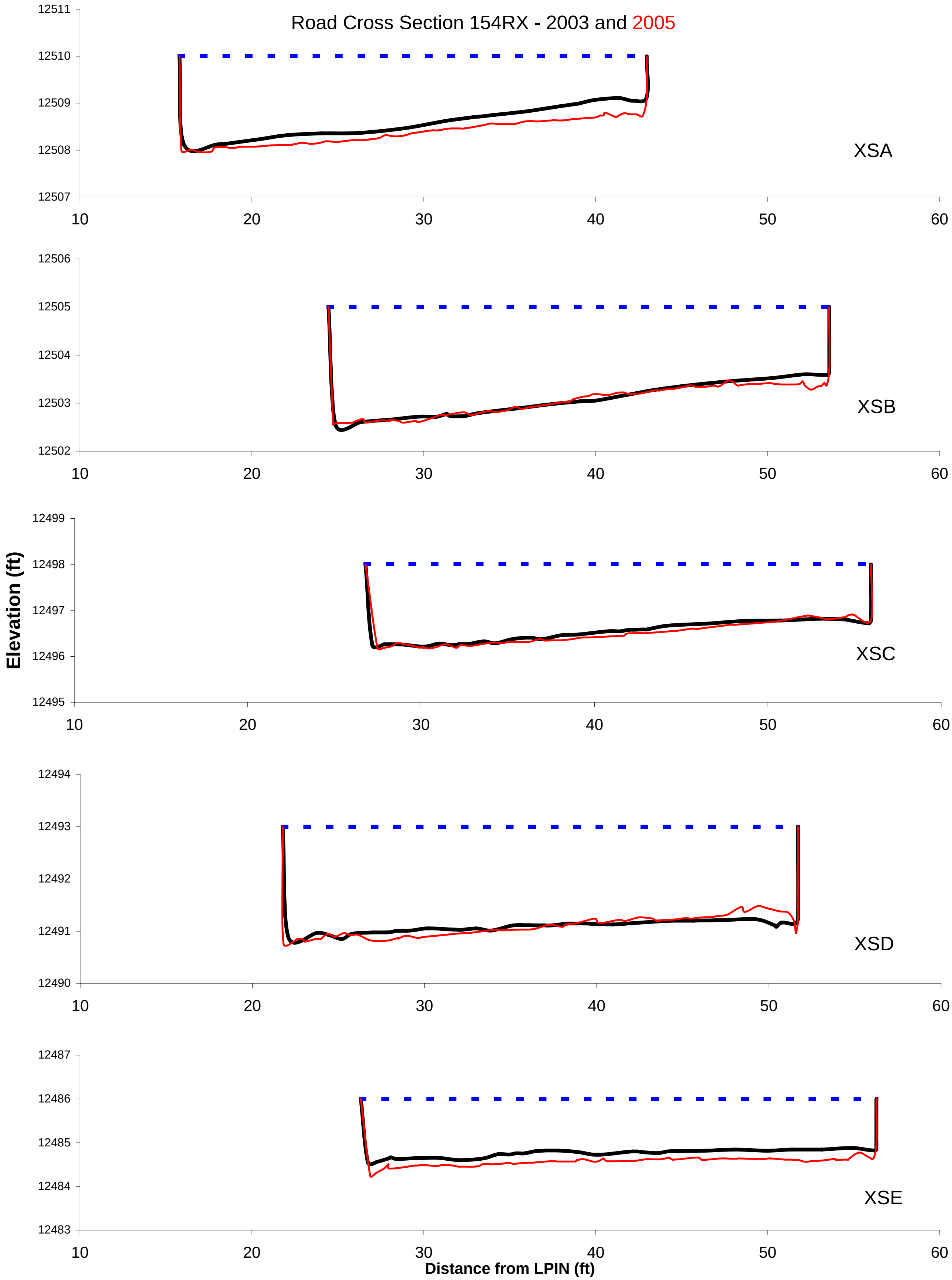
10496
10495
10494
10493
10492
10491
0
5
10
15
20
25
30
35


Road Cross Section 062RX - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10823
10822
10821
10820
10819
10817
10816
10815
10814
10813
10811
10810
10809
10808
10807
10805
10804
10803
10802
10801
10798
10797
10796
10795
10794
10
20
30
40
50
60
70


Road Cross Section 072RX - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)


Road Cross Section 154RX - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
12511
12510
12509
12508
12507
12506
12505
12504
12503
12502
12499
12498
12497
12496
12495
12494
12493
12492
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12490
12487
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12485
12484
12483
10
20
30
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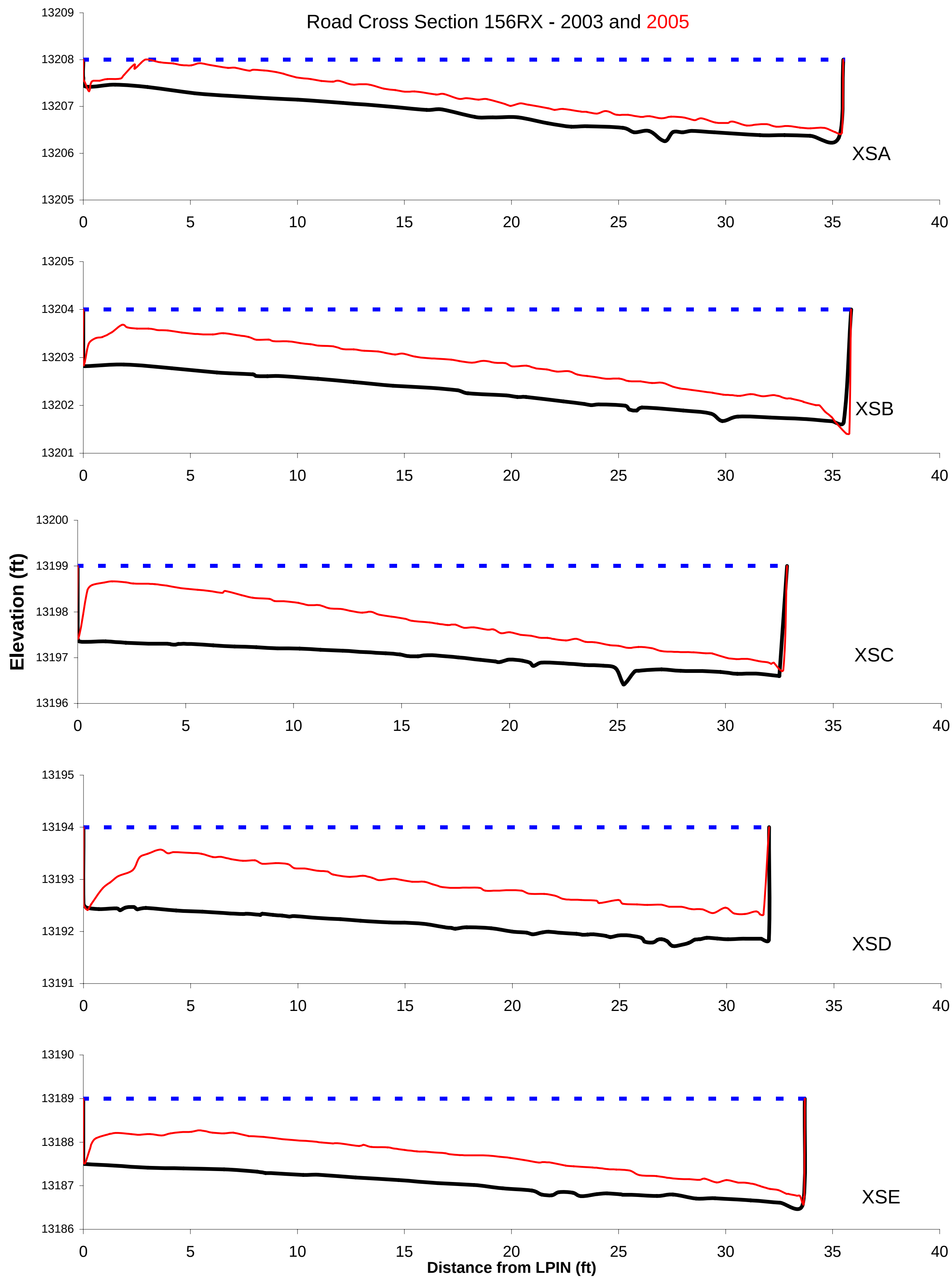
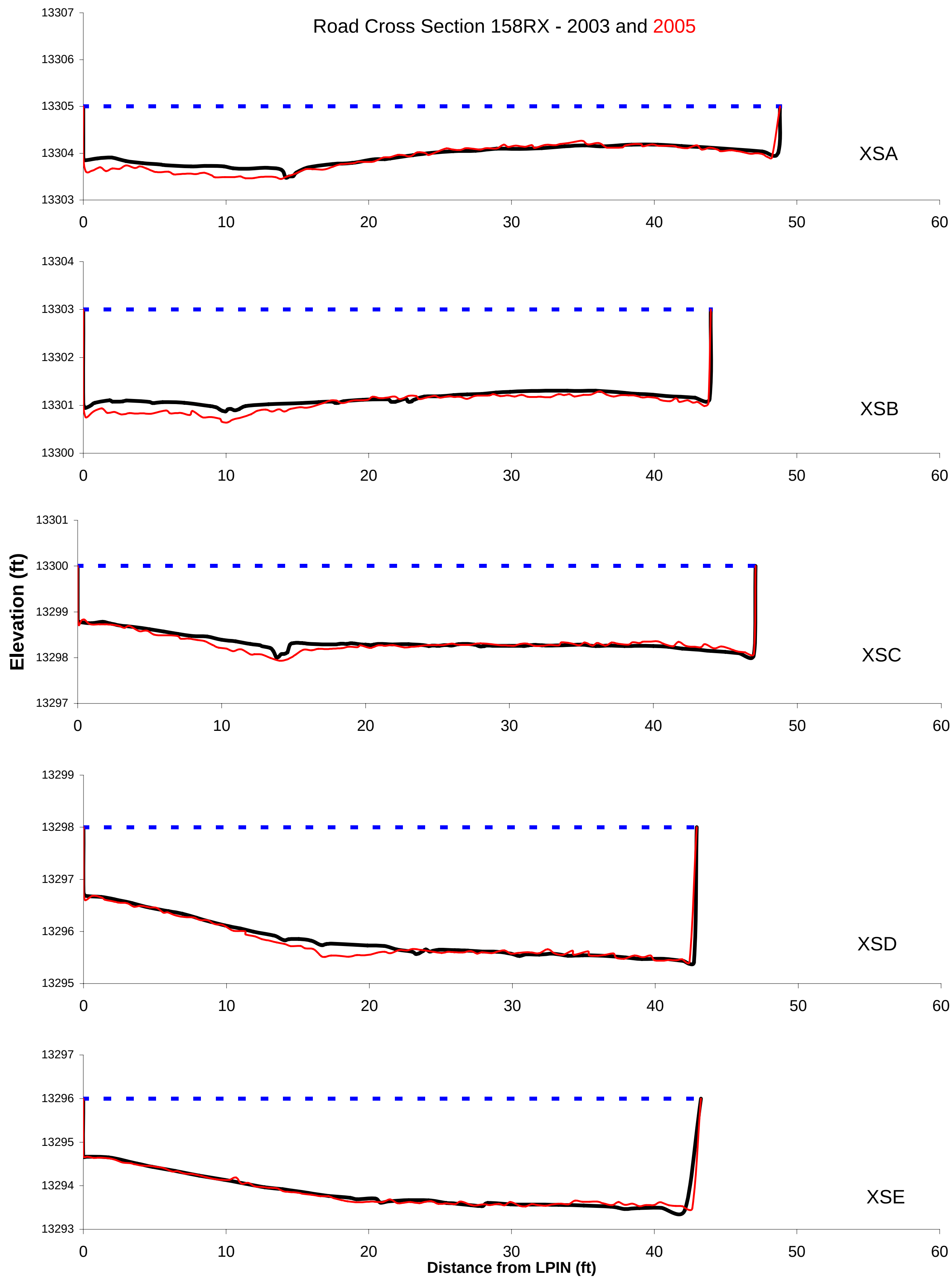


Road Cross Section 156RX - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
13209
13208
13207
13206
13205
13204
13203
13202
13201
13200
13199
13198
13197
13196
13195
13194
13193
13192
13191
13190
13189
13188
13187
13186
0
5
10
15
20
25
30
35
40



Road Cross Section 158RX - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
13307
13306
13305
13304
13303
13302
13301
13300
13299
13298
13297
13296
13295
13294
13293
0
10
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30
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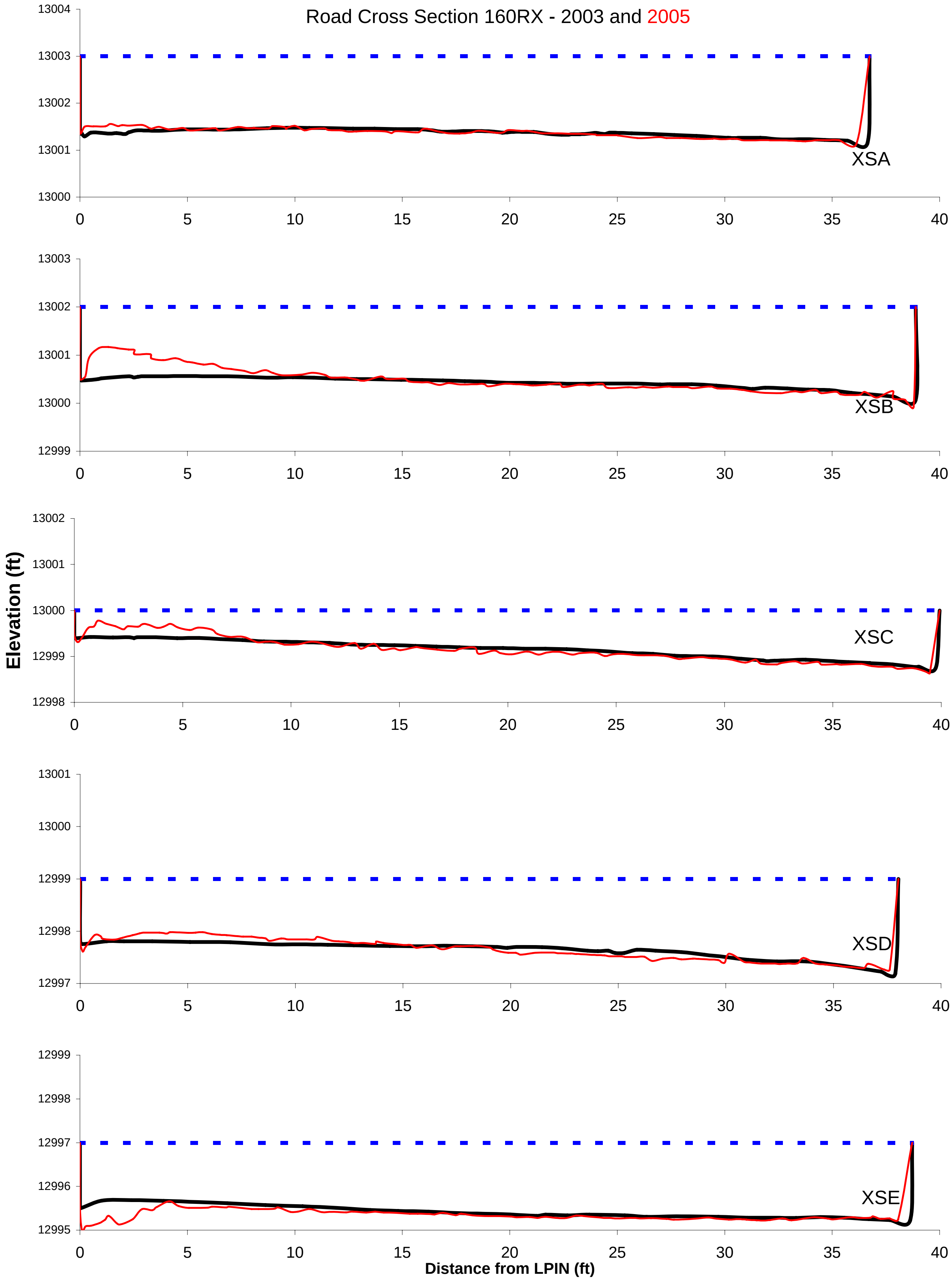
60



Road Cross Section 160RX - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
13004
13003
13002
13001
13000
12999
12998
12997
12996
12995
0
5
10
15
20
25
30
35
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Appendix D

Drainage Ditches
Cross Section Geometry and Graphs

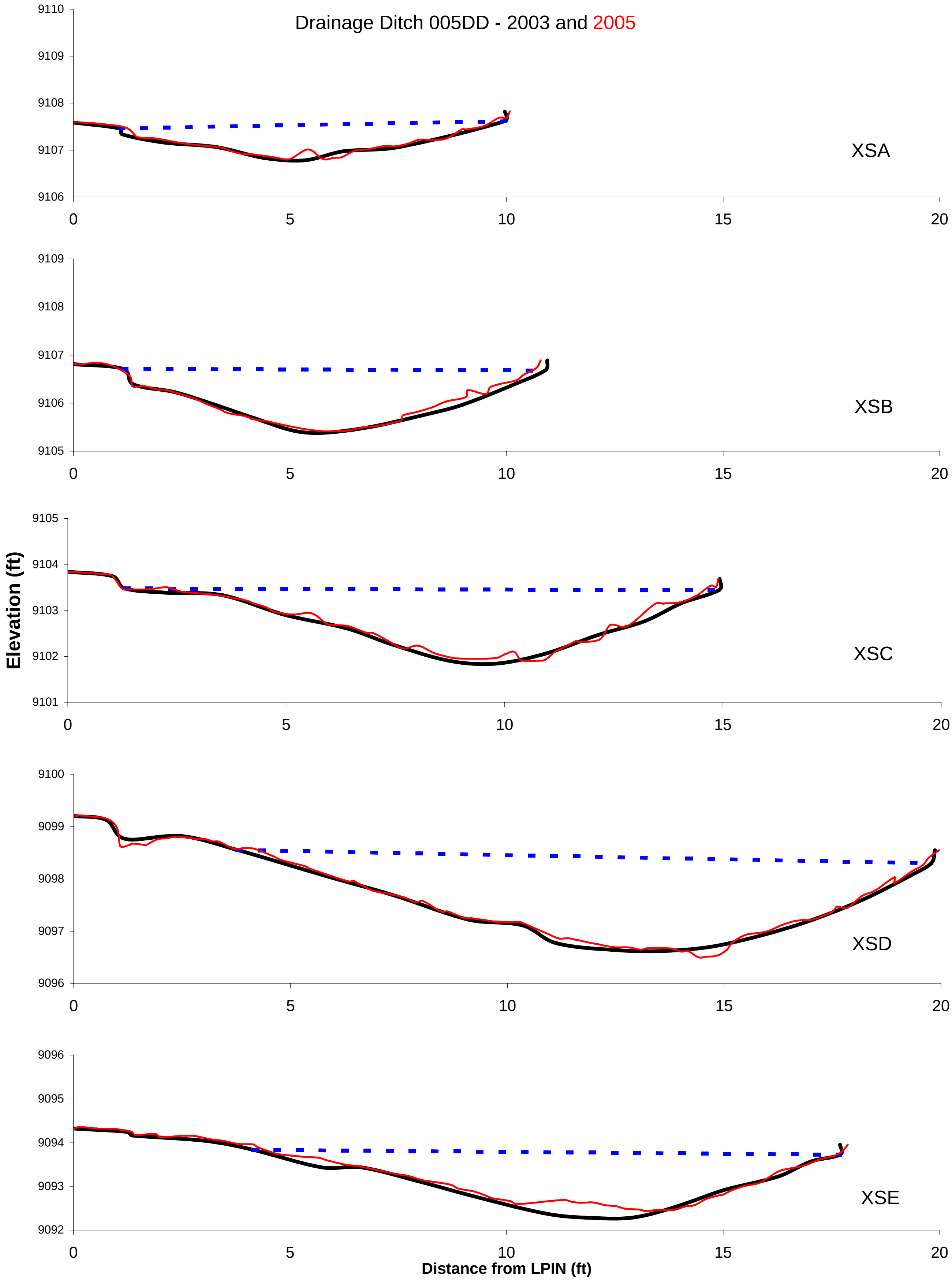
2005

Channel Geometry of Drainage Ditches 2005

Drainage Ditch Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio	Area Difference 2003-2005 (ft^2)	Area Difference 2004-2005 (ft^2)
005DD	06Jul05	A	8.9	4.13	0.47	0.78	9.22	0.45	18.97	-0.25	0.07
005DD	06Jul05	B	9.4	6.99	0.74	1.23	10.09	0.69	12.61	0.84	0.79
005DD	06Jul05	C	13.5	10.67	0.79	1.61	14.41	0.74	16.97	0.16	0.54
005DD	06Jul05	D	16.4	18.79	1.15	2.01	17.37	1.08	14.27	-1.61	-0.74
005DD	06Jul05	E	13.6	11.30	0.83	1.42	14.09	0.80	16.39	-0.24	0.70
010DD	07Jul05	A	8.7	5.31	0.61	1.23	9.73	0.55	14.35	0.87	0.57
010DD	06Jul05	B	7.6	6.10	0.81	1.50	8.28	0.74	9.41	0.48	-0.01
010DD	07Jul05	C	7.4	5.13	0.70	1.22	7.95	0.64	10.54	0.22	-0.01
010DD	06Jul05	D	7.2	4.35	0.60	0.99	7.76	0.56	12.03	0.89	0.26
010DD	07Jul05	E	6.1	4.99	0.82	1.23	6.87	0.73	7.51	1.06	0.87
042DD	14Jul05	A	6.6	2.02	0.31	0.77	7.39	0.27	21.26	-0.90	-0.56
042DD	14Jul05	B	7.2	4.90	0.68	1.47	8.44	0.58	10.53	-1.99	-0.39
042DD	14Jul05	C	9.2	10.17	1.10	1.89	10.60	0.96	8.34	1.62	1.75
042DD	14Jul05	D	27.1	45.38	1.68	2.85	30.72	1.48	16.17	-6.01	0.36
042DD	14Jul05	E	7.3	11.60	1.58	2.67	9.58	1.21	4.63	0.07	0.20
046DD	15Jul05	A	2.9	1.45	0.51	0.81	3.56	0.41	5.62	-0.64	-0.02
046DD	15Jul05	B	4.5	2.65	0.58	1.13	5.33	0.50	7.77	-0.90	0.35
046DD	15Jul05	C	5.9	2.63	0.45	0.97	6.40	0.41	13.09	-0.04	0.27
046DD	15Jul05	D	5.7	3.41	0.60	1.18	6.71	0.51	9.54	1.79	0.37
046DD	15Jul05	E	7.9	6.40	0.81	1.55	9.10	0.70	9.72	-0.05	0.17
051DD	16Jul05	A	5.7	3.95	0.69	1.21	7.00	0.56	8.29	-0.47	0.77
051DD	16Jul05	B	7.1	7.09	1.00	1.81	8.54	0.83	7.15	-2.49	-1.99
051DD	16Jul05	C	5.6	4.66	0.83	1.61	7.70	0.60	6.78	2.55	1.31
051DD	16Jul05	D	7.8	7.01	0.90	1.86	9.81	0.71	8.58	0.27	-0.72
051DD	16Jul05	E	10.7	15.14	1.41	2.29	12.93	1.17	7.62	-5.11	-1.63
057DD	17Jul05	A	10.2	3.72	0.37	1.28	11.18	0.33	27.77	0.59	1.13
057DD	17Jul05	B	7.9	4.19	0.53	1.23	8.76	0.48	14.82	1.01	0.44
057DD	17Jul05	C	9.8	9.59	0.98	1.84	11.66	0.82	10.01	3.99	0.68
057DD	17Jul05	D	5.5	3.34	0.61	0.98	7.87	0.42	8.91	1.03	0.56
057DD	17Jul05	E	7.3	5.83	0.80	1.45	8.36	0.70	9.13	-0.01	-0.23
061DD	19Jul05	A	3.6	0.77	0.22	0.49	3.78	0.20	16.47	1.87	1.54
061DD	19Jul05	B	9.2	2.46	0.27	0.48	9.85	0.25	34.66	2.89	0.87
061DD	19Jul05	C	10.7	3.52	0.33	1.01	11.38	0.31	32.29	0.58	-0.11
061DD	19Jul05	D	8.7	2.88	0.33	0.90	9.25	0.31	26.34	-0.09	-0.33
061DD	19Jul05	E	6.0	2.04	0.34	0.70	6.47	0.32	17.35	-0.18	2.14
071DD	20Jul05	A	5.9	0.52	0.09	0.38	6.17	0.08	66.05	1.37	0.69
071DD	20Jul05	B	3.9	1.28	0.33	0.79	4.76	0.27	12.00	0.34	0.54
071DD	20Jul05	C	4.8	1.51	0.31	0.69	5.40	0.28	15.34	0.08	0.50
071DD	20Jul05	D	4.2	1.90	0.45	0.71	4.90	0.39	9.45	0.17	0.66
071DD	20Jul05	E	5.2	2.88	0.55	1.02	5.94	0.48	9.52	-0.57	-0.12
080DD	26Jul05	A	9.1	5.43	0.60	0.90	9.93	0.55	15.25	2.12	1.11
080DD	26Jul05	B	11.4	13.40	1.17	1.96	13.37	1.00	9.73	1.83	2.27
080DD	26Jul05	C	10.2	12.08	1.18	2.32	12.18	0.99	8.64	2.26	0.04
080DD	26Jul05	D	11.3	16.24	1.43	2.27	13.34	1.22	7.89	1.26	1.20
080DD	26Jul05	E	11.5	18.14	1.58	2.90	13.67	1.33	7.26	-1.27	-1.51
082DD	29Jul05	A	9.5	8.40	0.89	1.38	11.00	0.76	10.64	2.30	1.39
082DD	29Jul05	B	6.3	4.59	0.73	1.24	7.47	0.61	8.68	-0.27	1.43
082DD	29Jul05	C	7.3	7.04	0.96	1.64	8.49	0.83	7.64	0.52	0.41
082DD	29Jul05	D	7.4	6.61	0.89	1.50	8.61	0.77	8.27	0.43	0.52
082DD	29Jul05	E	6.2	4.77	0.77	1.18	7.46	0.64	7.96	-0.72	0.00
085DD	26Jul05	A	22.6	28.67	1.27	2.08	24.51	1.17	17.75	-1.75	0.23
085DD	26Jul05	B	10.2	8.46	0.83	1.63	11.73	0.72	12.35	2.25	1.55
085DD	26Jul05	C	10.2	8.45	0.83	1.26	10.92	0.77	12.19	-0.66	-0.15
085DD	26Jul05	D	9.4	5.89	0.63	1.24	11.12	0.53	14.91	1.56	0.64
085DD	26Jul05	E	11.2	9.11	0.81	1.70	12.22	0.75	13.74	0.99	0.55

Channel Geometry of Drainage Ditches 2005

Drainage Ditch Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio	Area Difference 2003-2005 (ft^2)	Area Difference 2004-2005 (ft^2)
092DD	30Jul05	A	5.0	1.39	0.28	0.50	5.24	0.26	18.24	2.61	1.44
092DD	30Jul05	B	5.9	2.58	0.43	0.95	6.32	0.41	13.65	2.34	1.11
092DD	30Jul05	C	9.3	5.84	0.63	1.17	10.10	0.58	14.92	7.08	4.96
092DD	30Jul05	D	7.8	3.57	0.46	1.07	8.52	0.42	17.16	5.49	4.85
092DD	30Jul05	E	8.0	4.17	0.52	1.24	8.71	0.48	15.45	2.79	2.23
107DD	31Jul05	A	10.9	6.56	0.60	1.49	11.90	0.55	18.05	-1.75	0.64
107DD	31Jul05	B	8.8	8.06	0.92	1.81	9.86	0.82	9.50	-1.39	0.95
107DD	31Jul05	C	10.4	10.21	0.98	1.95	11.99	0.85	10.65	-4.49	-0.98
107DD	31Jul05	D	8.3	5.99	0.72	3.25	16.79	0.36	11.50	-0.08	0.77
107DD	31Jul05	E	9.9	8.95	0.90	1.63	11.10	0.81	10.96	-0.45	-0.36
155DD	30Jul05	A	4.3	1.05	0.25	0.48	4.45	0.24	17.51	0.18	-0.62
155DD	30Jul05	B	5.3	2.40	0.45	0.80	5.70	0.42	11.82	0.02	-1.07
155DD	30Jul05	C	6.0	2.83	0.47	0.84	6.47	0.44	12.80	-0.44	-0.79
155DD	30Jul05	D	5.8	3.20	0.55	1.21	6.55	0.49	10.41	-0.67	-1.11
155DD	30Jul05	E	9.1	7.95	0.88	1.80	10.24	0.78	10.37	-2.40	-4.58
157DD	14Jul05	A	2.5	0.80	0.32	0.44	2.79	0.29	7.84	0.86	2.97
157DD	14Jul05	B	6.9	3.33	0.48	1.03	7.46	0.45	14.20	1.66	1.43
157DD	14Jul05	C	8.3	3.17	0.38	0.94	8.80	0.36	21.66	-0.52	1.80
157DD	14Jul05	D	4.3	1.64	0.38	0.71	4.58	0.36	11.21	1.70	0.88
157DD	14Jul05	E	6.8	2.81	0.41	0.80	7.26	0.39	16.47	-0.84	-0.18
159DD	30Jul05	A	4.0	1.54	0.39	0.66	4.42	0.35	10.27	-0.35	-0.49
159DD	30Jul05	B	3.8	1.23	0.32	0.58	4.14	0.30	11.97	0.31	-0.15
159DD	30Jul05	C	4.4	1.97	0.45	0.69	4.78	0.41	9.77	-0.99	0.15
159DD	30Jul05	D	7.3	4.16	0.57	1.32	8.01	0.52	12.95	-0.66	-1.34
159DD	30Jul05	E	5.6	2.35	0.42	0.83	5.94	0.40	13.44	0.02	0.78
182DD	07Jul05	A	7.5	1.56	0.21	0.46	7.69	0.20	36.12		-0.32
182DD	07Jul05	B	6.2	5.88	0.94	1.66	7.47	0.79	6.62		-0.02
182DD	07Jul05	C	9.4	7.87	0.84	1.75	10.41	0.76	11.24		0.05
182DD	07Jul05	D	10.9	4.17	0.38	1.08	11.61	0.36	28.38		-0.02
182DD	07Jul05	E	7.9	2.53	0.32	0.69	8.20	0.31	24.57		-0.13
188DD	07Jul05	A	17.3	6.75	0.39	0.96	17.60	0.38	44.16		0.65
188DD	07Jul05	B	8.4	4.73	0.56	1.15	9.09	0.52	15.03		-0.61
188DD	07Jul05	C	8.4	2.51	0.30	0.61	8.64	0.29	28.46		0.14
188DD	07Jul05	D	15.3	9.81	0.64	1.45	15.81	0.62	23.72		0.48
188DD	07Jul05	E	13.7	4.82	0.35	0.66	14.00	0.34	38.79		-0.50
188DD	07Jul05	F	12.6	8.13	0.64	1.22	13.06	0.62	19.68		0.14
188DD	07Jul05	G	8.0	3.35	0.42	0.95	8.45	0.40	18.92		0.45
188DD	07Jul05	H	8.2	3.64	0.44	0.99	8.82	0.41	18.68		0.25
195DD	07Jul05	A	12.1	7.23	0.60	1.29	12.59	0.57	20.36		0.18
195DD	07Jul05	B	13.6	6.74	0.50	1.05	14.11	0.48	27.39		-0.55
195DD	07Jul05	C	8.6	3.65	0.42	0.76	9.15	0.40	20.25		0.05
195DD	07Jul05	D	8.7	3.51	0.40	0.86	9.06	0.39	21.69		0.08
195DD	07Jul05	E	5.3	2.31	0.44	0.80	5.86	0.39	12.01		0.10
205DD	14Jul05	A	17.5	10.42	0.59	1.18	17.76	0.59	29.47		0.14
205DD	14Jul05	B	13.2	9.72	0.74	1.39	13.56	0.72	17.84		-0.81
205DD	14Jul05	C	10.1	6.74	0.66	1.16	10.55	0.64	15.26		0.48
205DD	14Jul05	D	11.4	9.34	0.82	1.45	11.99	0.78	13.96		-0.05
205DD	14Jul05	E	17.1	15.79	0.92	1.93	17.97	0.88	18.50		-0.53


Drainage Ditch 005DD - 2003 and 2005
9110
9109
9108
9107
9106
XSA
9109
9108
9107
9106
9105
XSB
9105
9104
9103
9102
9101
XSC
9100
9099
9098
9097
9096
XSD
9096
9095
9094
9093
9092
XSE
0
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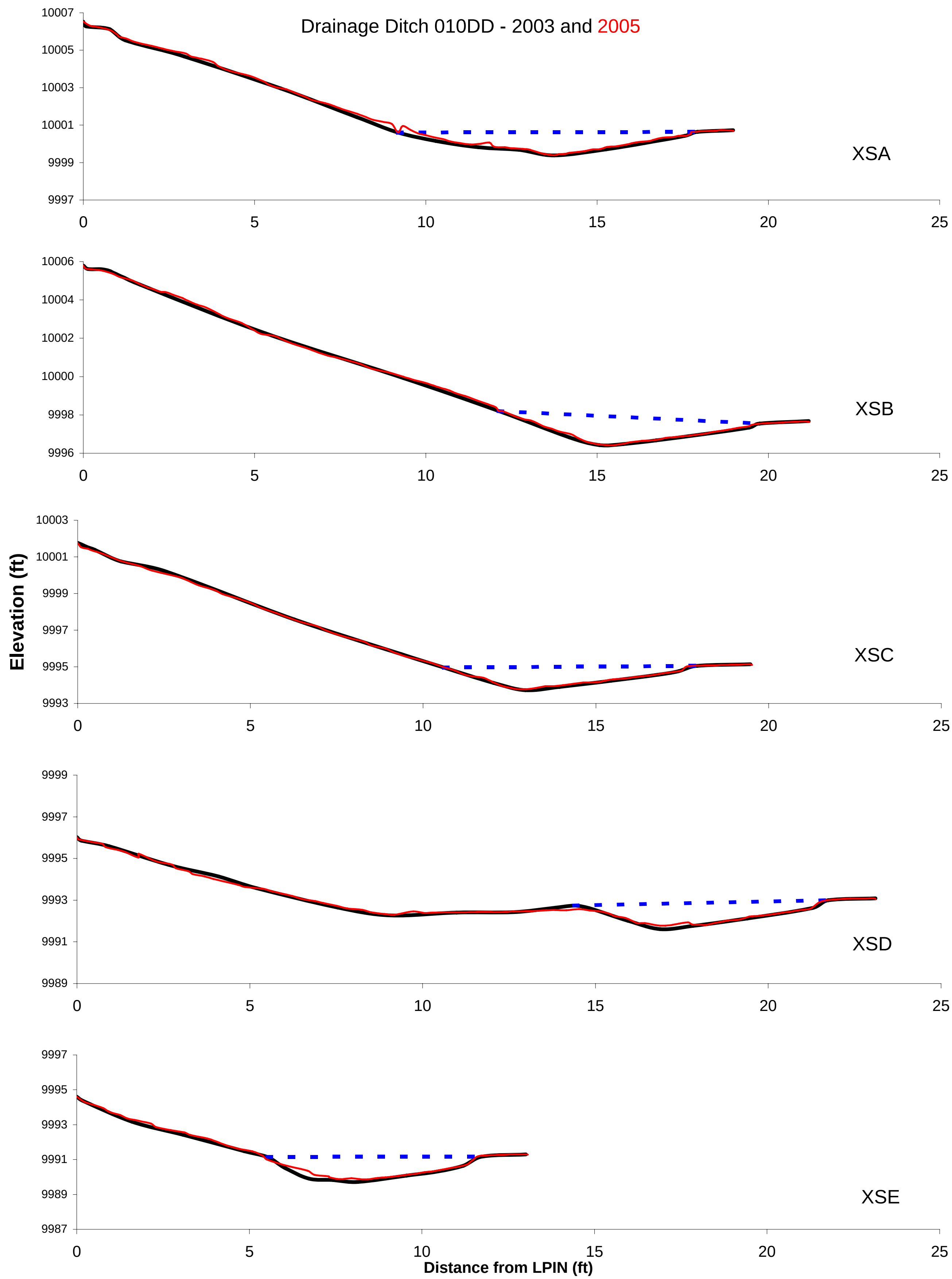
Elevation (ft)
Distance from LPIN (ft)


Drainage Ditch 010DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10007
10005
10003
10001
9999
9997
10006
10004
10002
10000
9998
9996
10003
10001
9999
9997
9995
9993
9999
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9989
9987
0
5
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15
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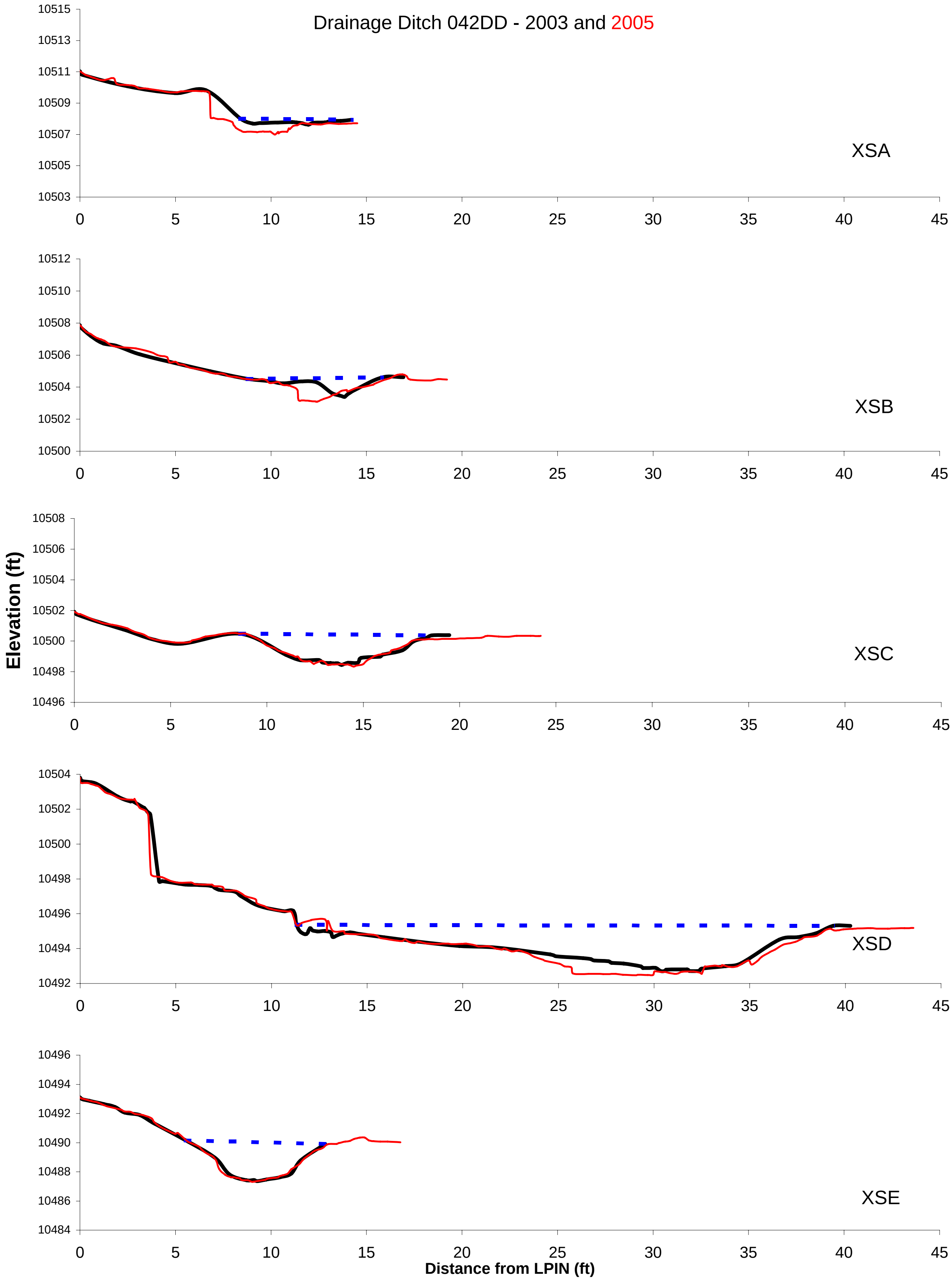
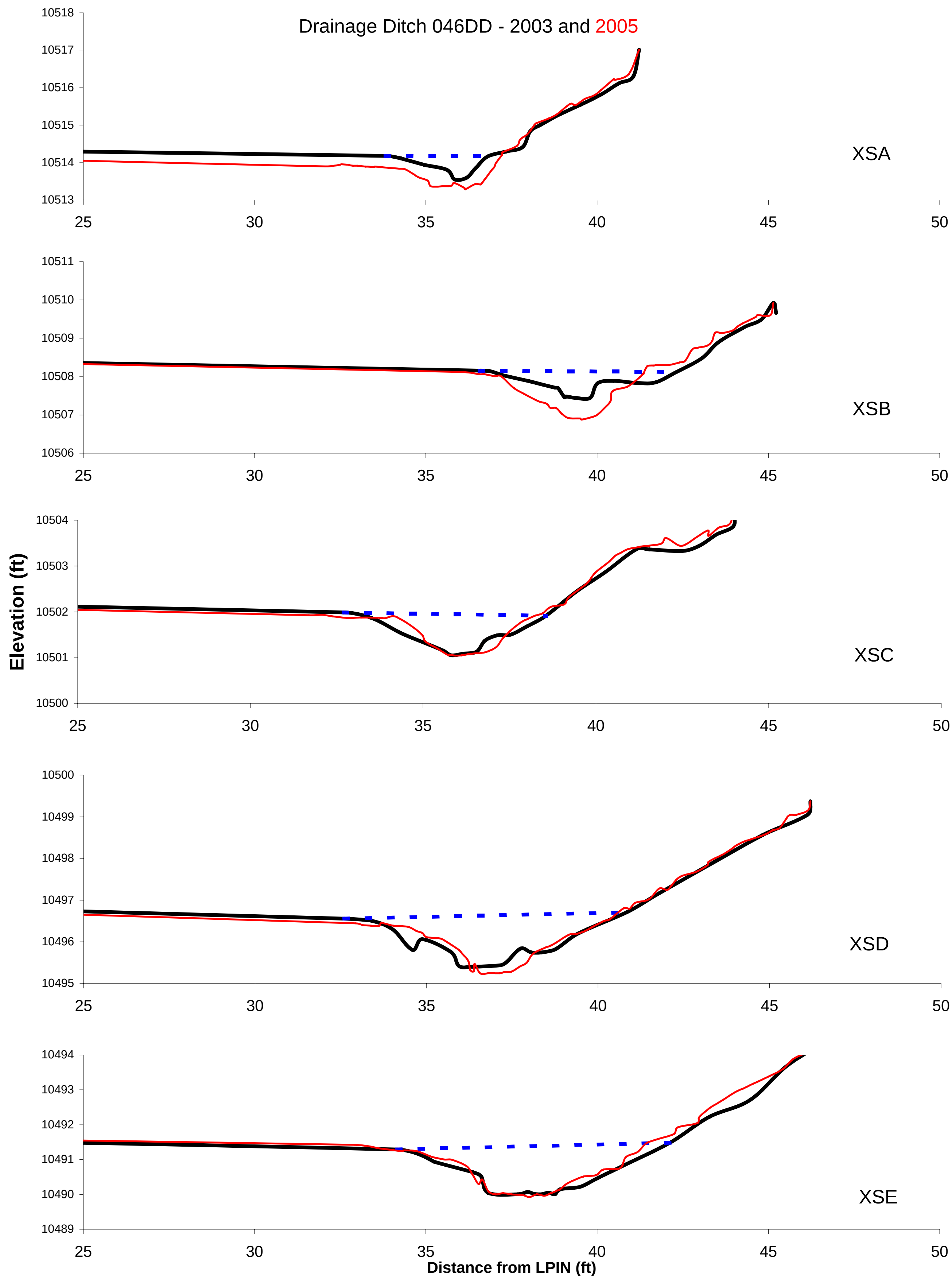
25



Drainage Ditch 042DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)



Drainage Ditch 046DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10518
10517
10516
10515
10514
10513
10511
10510
10509
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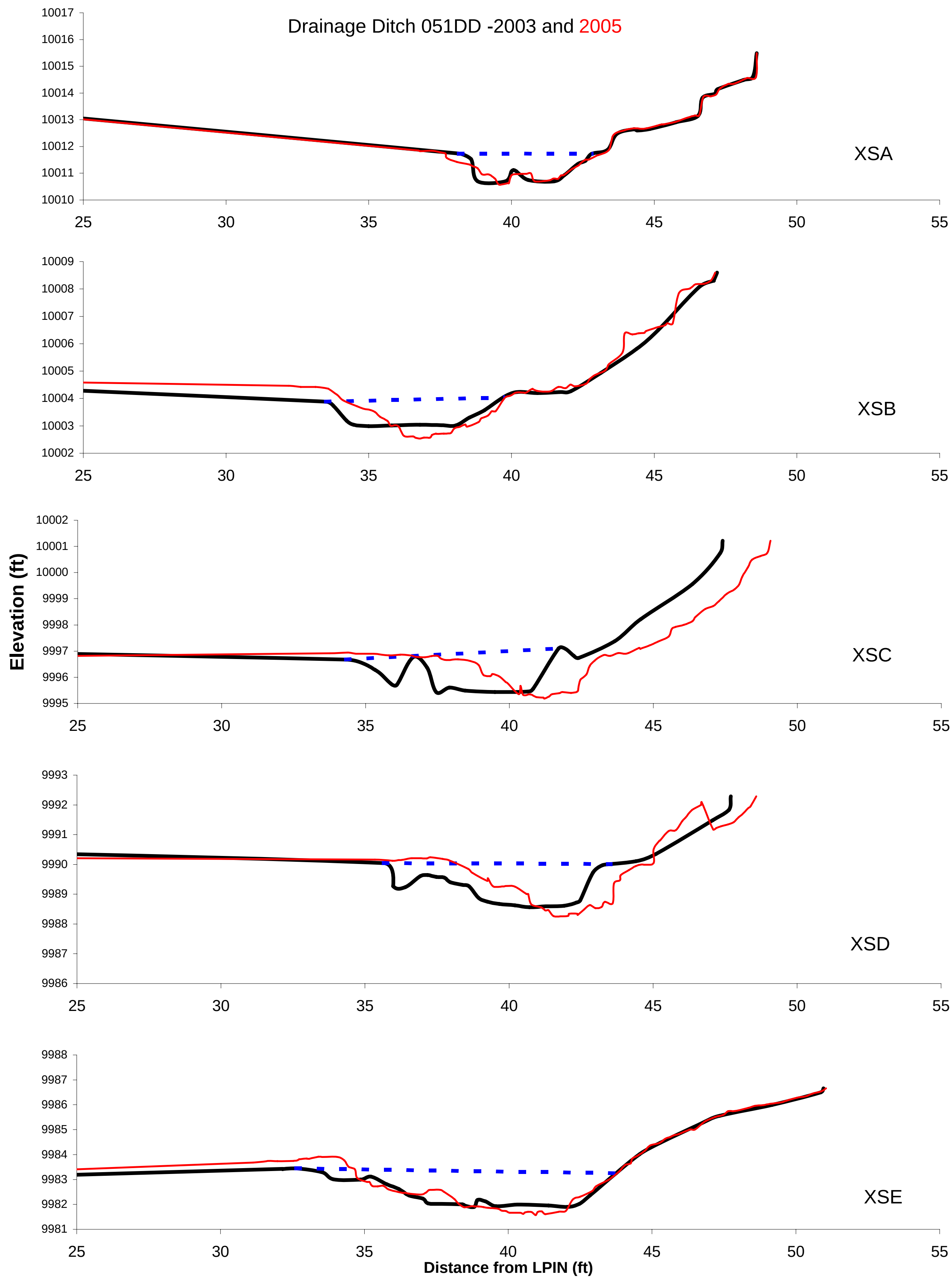
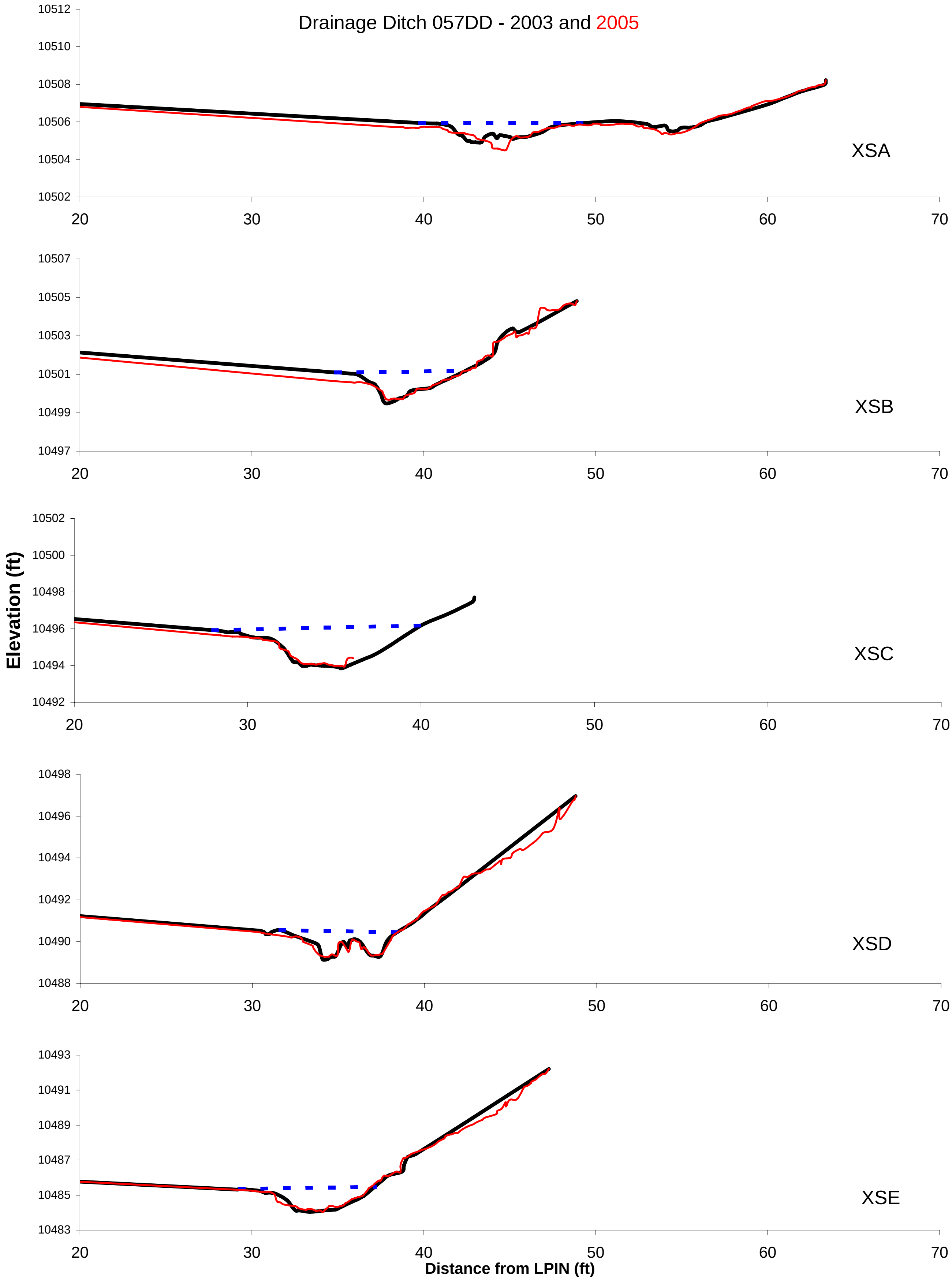
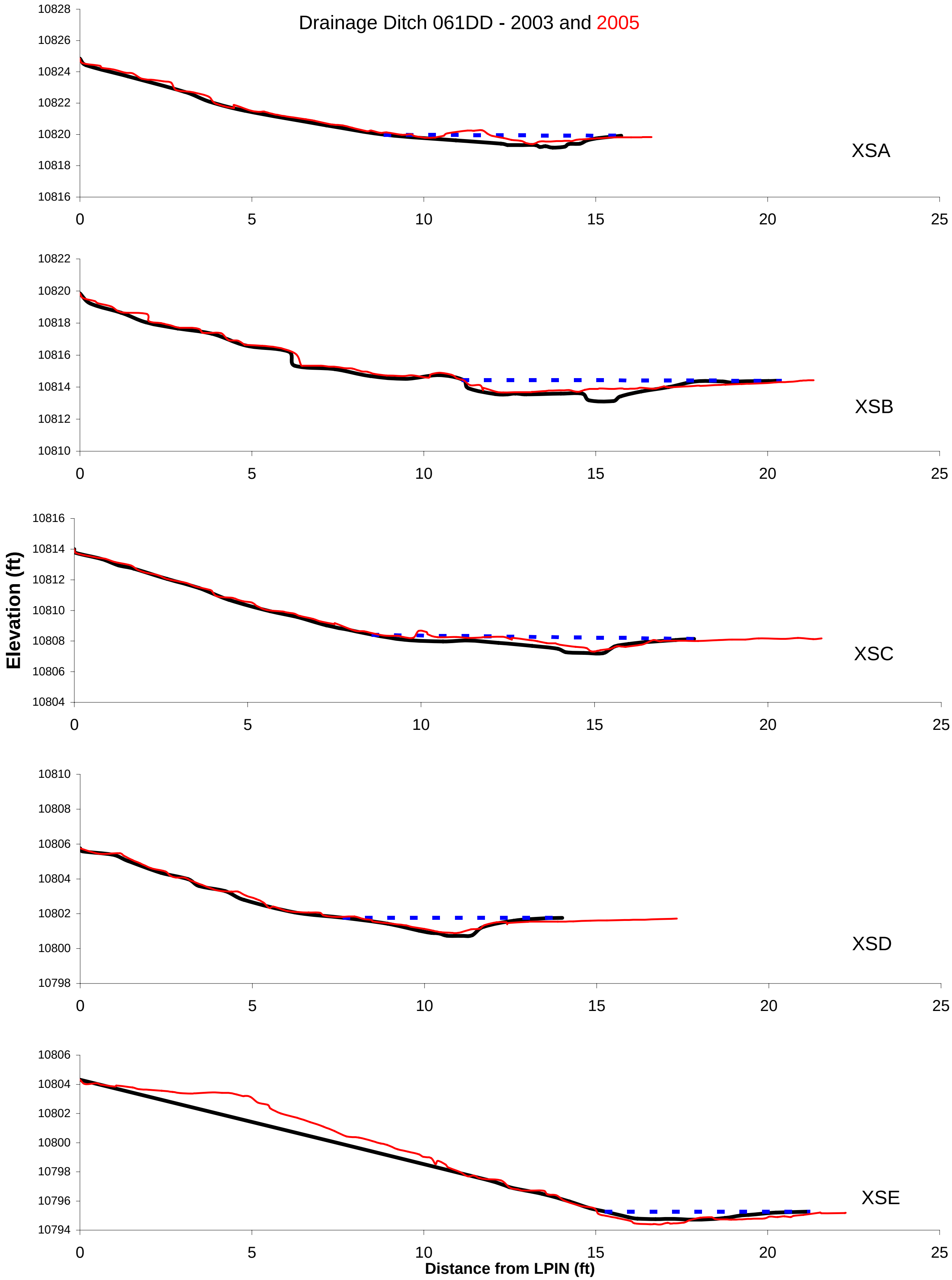
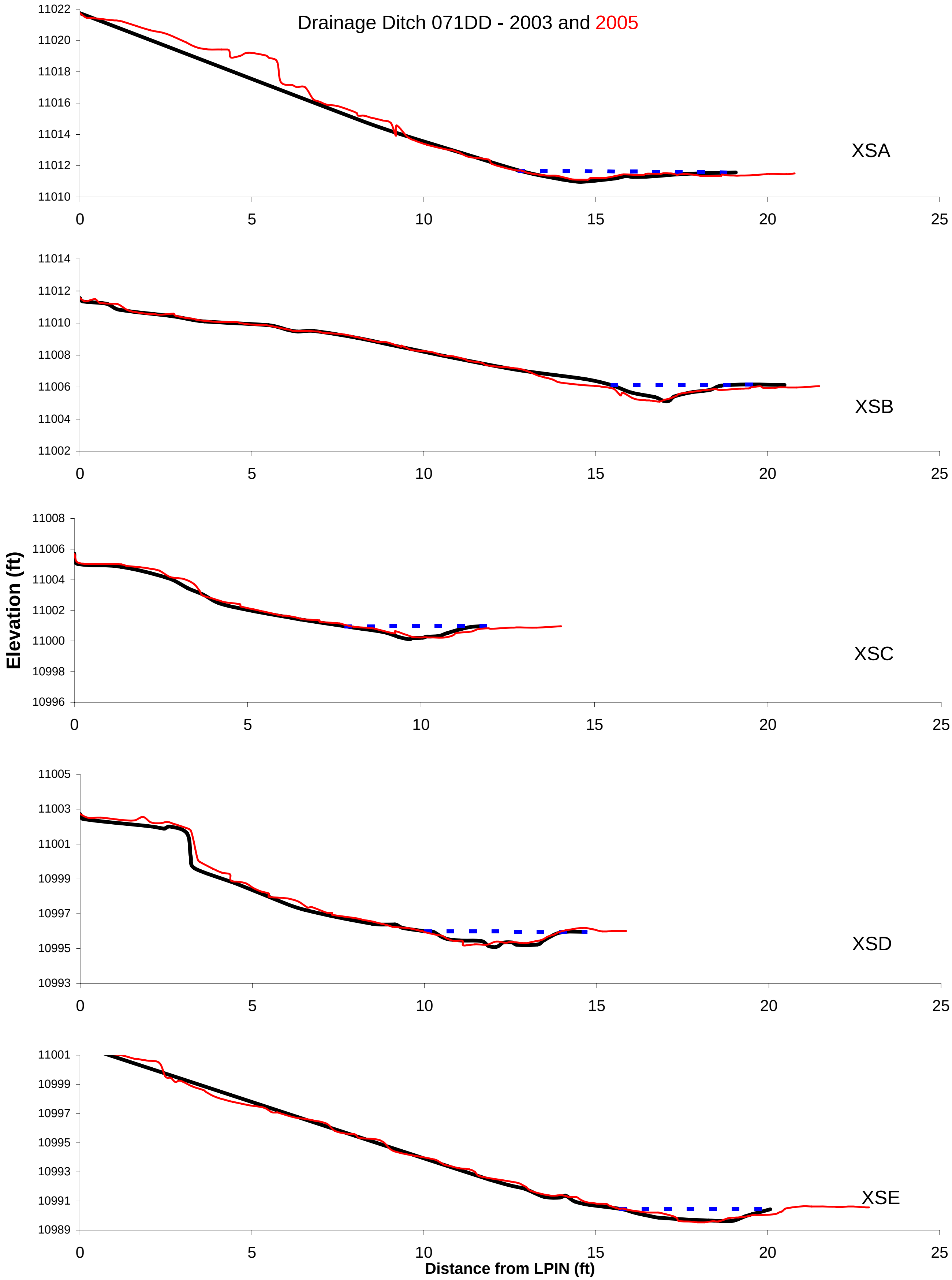
45
50

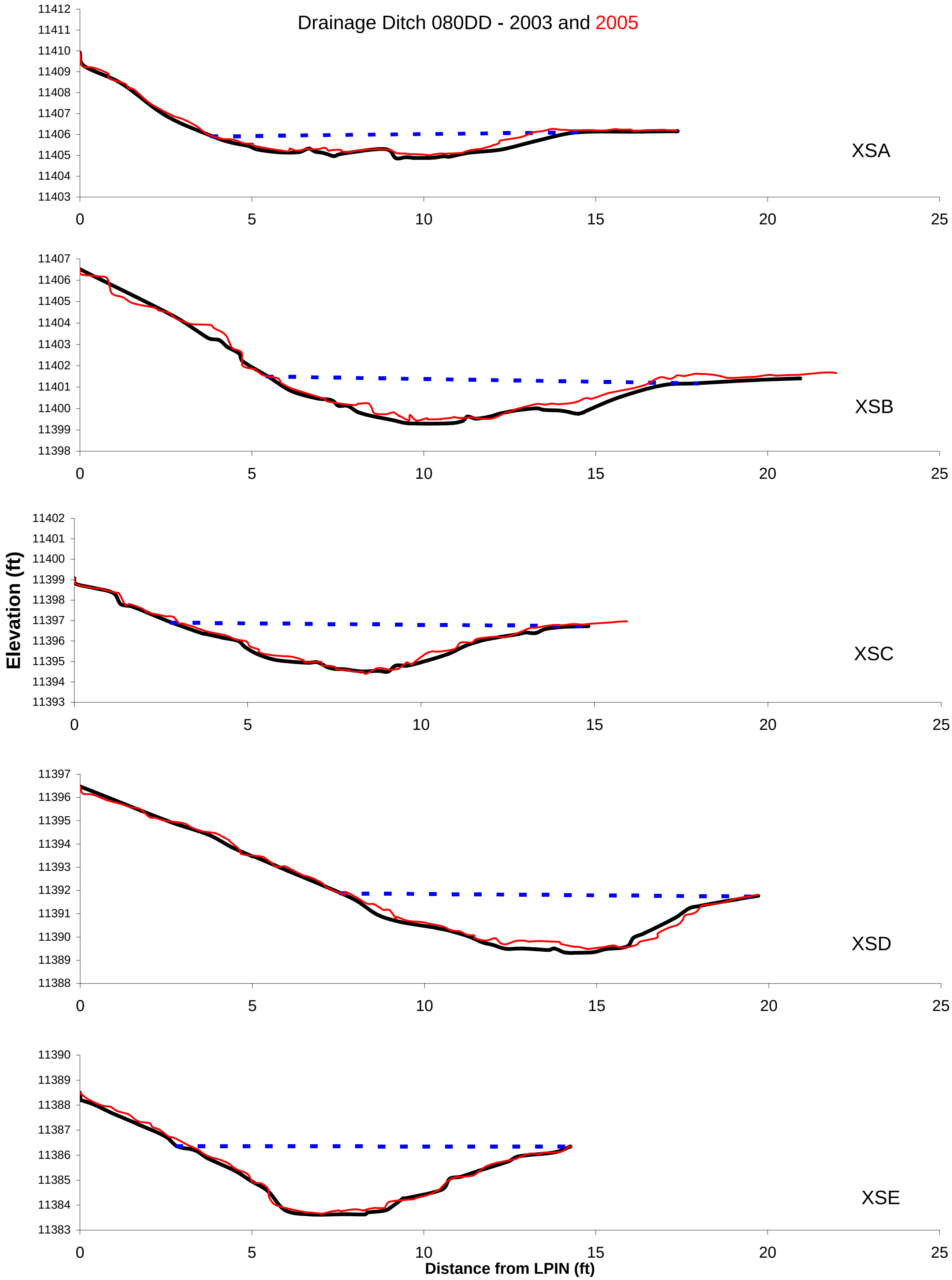


Drainage Ditch 051DD -2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10017
10016
10015
10014
10013
10012
10011
10010
10009
10008
10007
10006
10005
10004
10003
10002
10001
10000
9999
9998
9997
9996
9995
9993
9992
9991
9990
9989
9988
9987
9986
9985
9984
9983
9982
9981
25
30
35
40
45
50
55

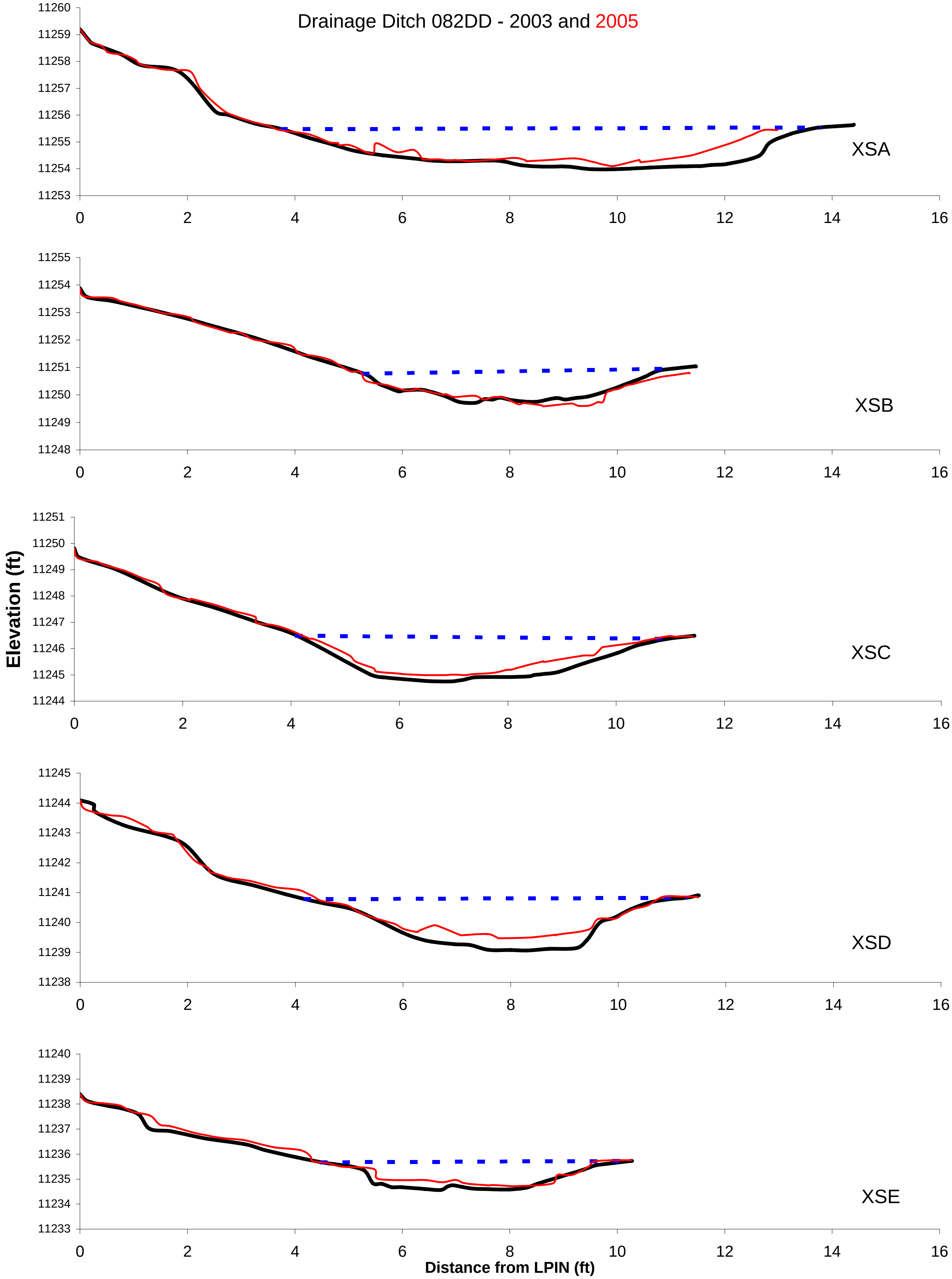

Drainage Ditch 057DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10512
10510
10508
10506
10504
10502
10507
10505
10503
10501
10499
10497
10502
10500
10498
10496
10494
10492
10498
10496
10494
10492
10490
10488
10493
10491
10489
10487
10485
10483
20
30
40
50
60
70

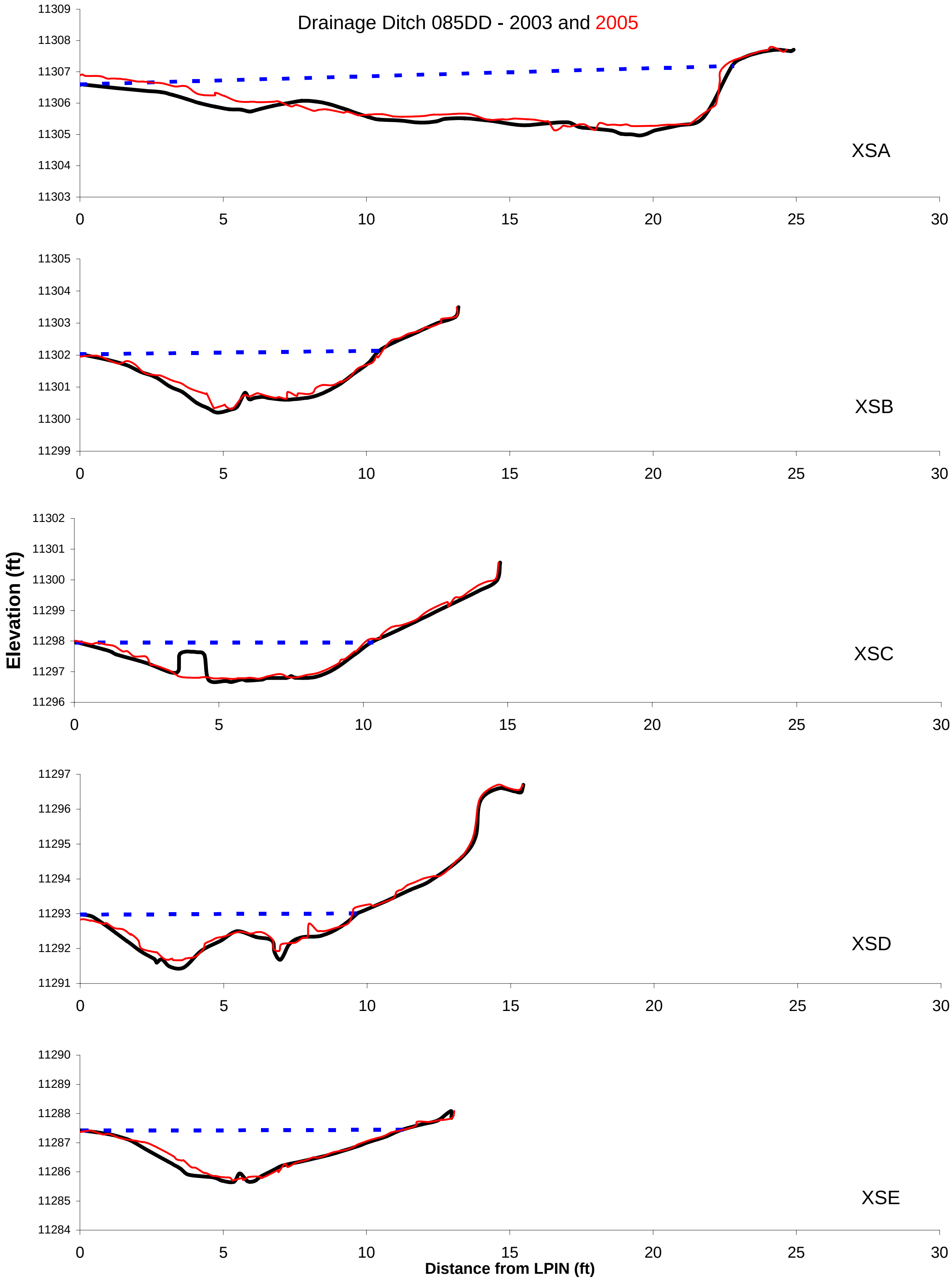

Drainage Ditch 061DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
10828
10826
10824
10822
10820
10818
10816
10822
10820
10818
10816
10814
10812
10810
10816
10814
10812
10810
10808
10806
10804
10810
10808
10806
10804
10802
10800
10798
10806
10804
10802
10800
10798
10796
10794
0
5
10
15
20
25

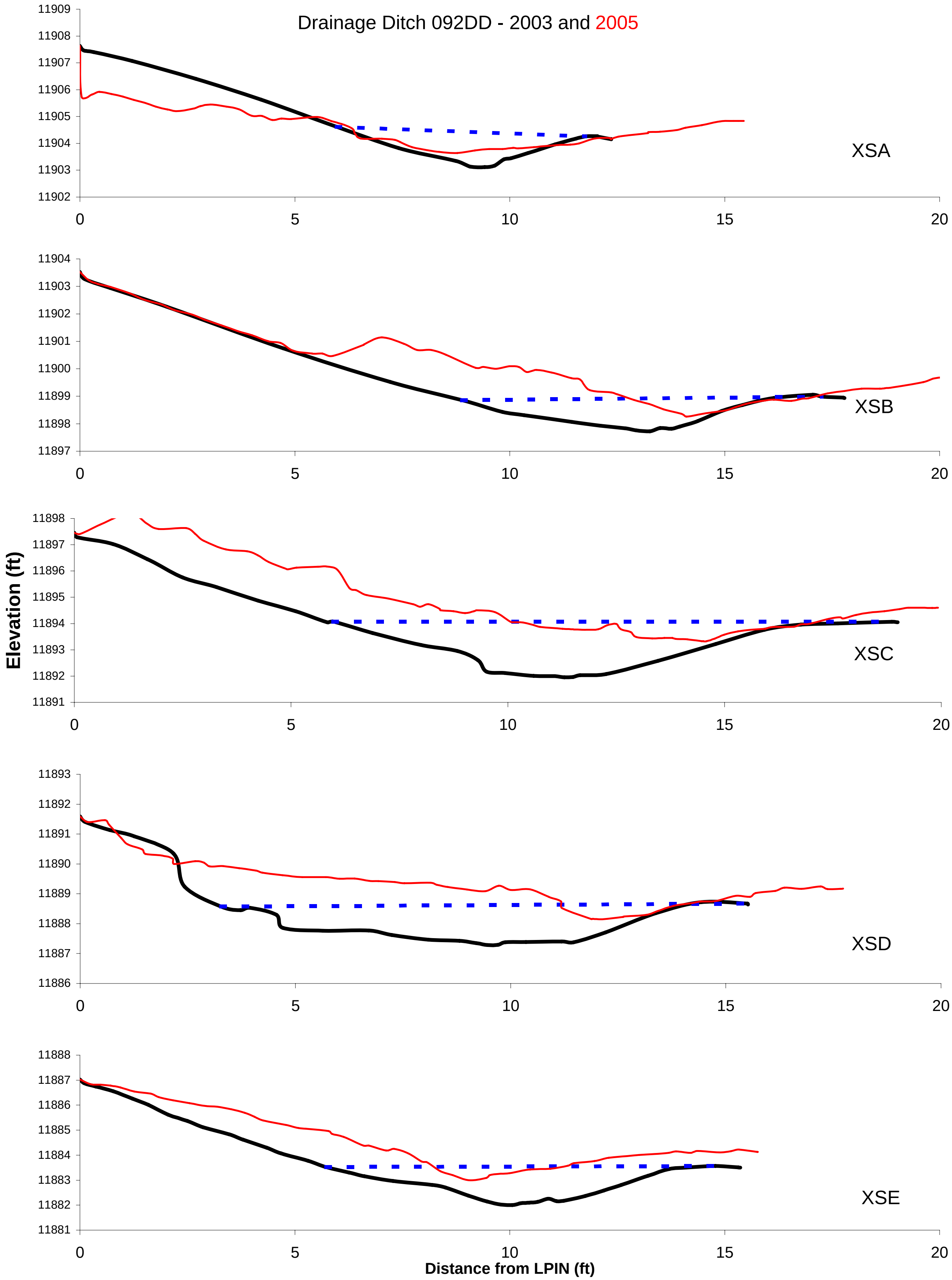

Drainage Ditch 071DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
11022
11020
11018
11016
11014
11012
11010
11014
11012
11010
11008
11006
11004
11002
11008
11006
11004
11002
11000
10998
10996
11005
11003
11001
10999
10997
10995
10993
11001
10999
10997
10995
10993
10991
10989
0
5
10
15
20
25



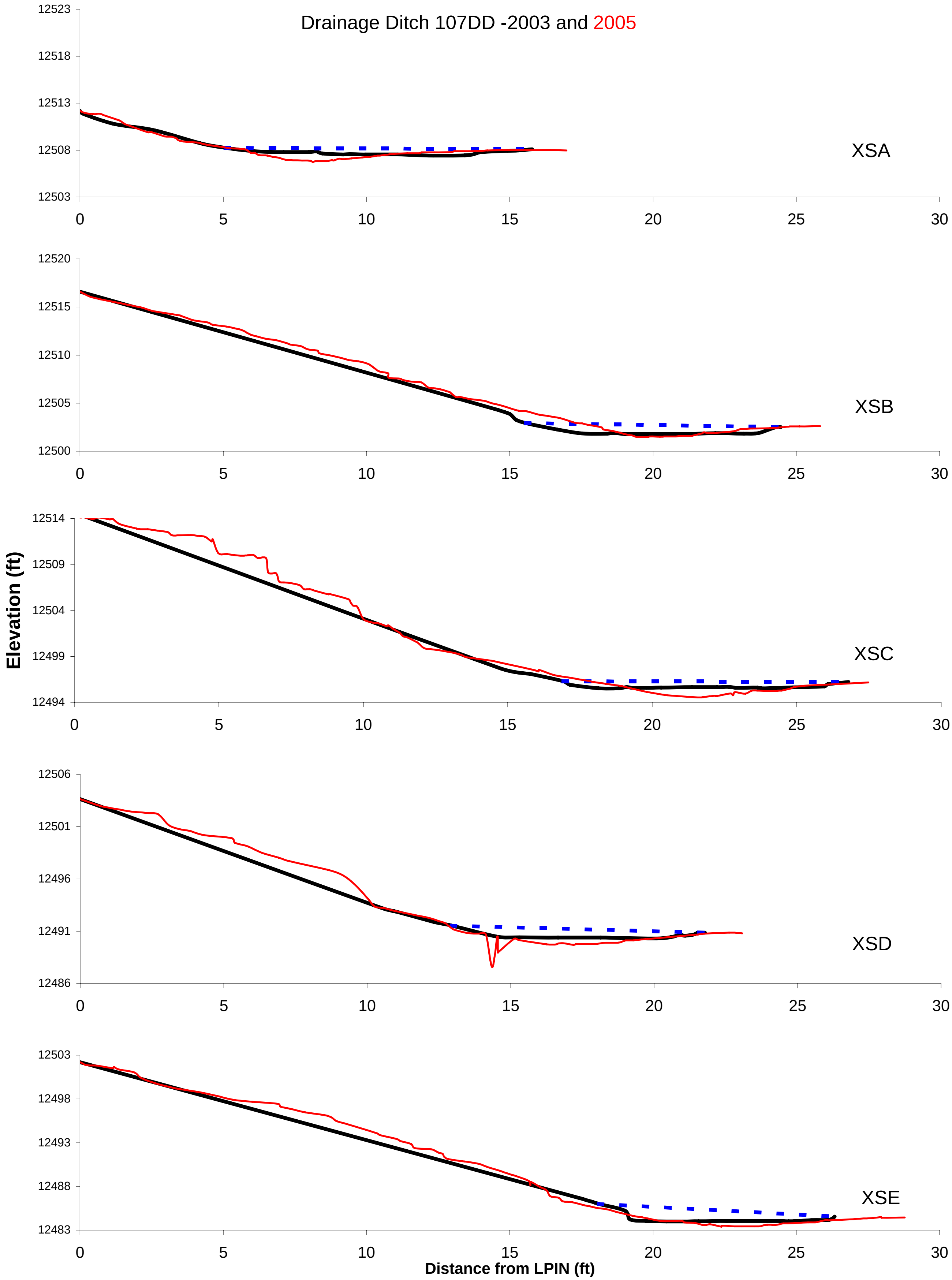
Drainage Ditch 080DD - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
11412
11411
11410
11409
11408
11407
11406
11405
11404
11403
0
5
10
15
20
25

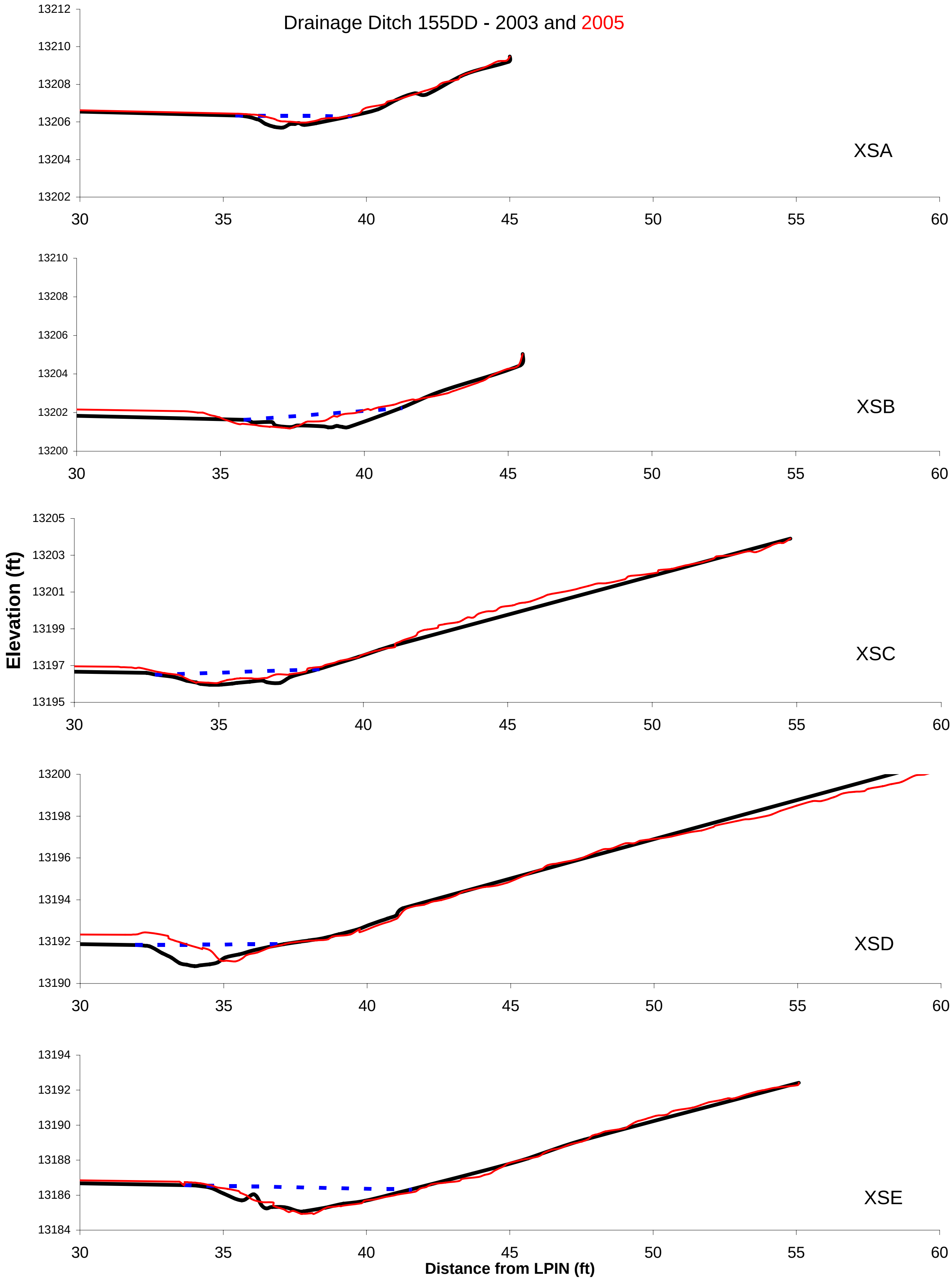

Drainage Ditch 082DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)


Drainage Ditch 085DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
11309
11308
11307
11306
11305
11304
11303
11305
11304
11303
11302
11301
11300
11299
11302
11301
11300
11299
11298
11297
11296
11297
11296
11295
11294
11293
11292
11291
11290
11289
11288
11287
11286
11285
11284
0
5
10
15
20
25
30

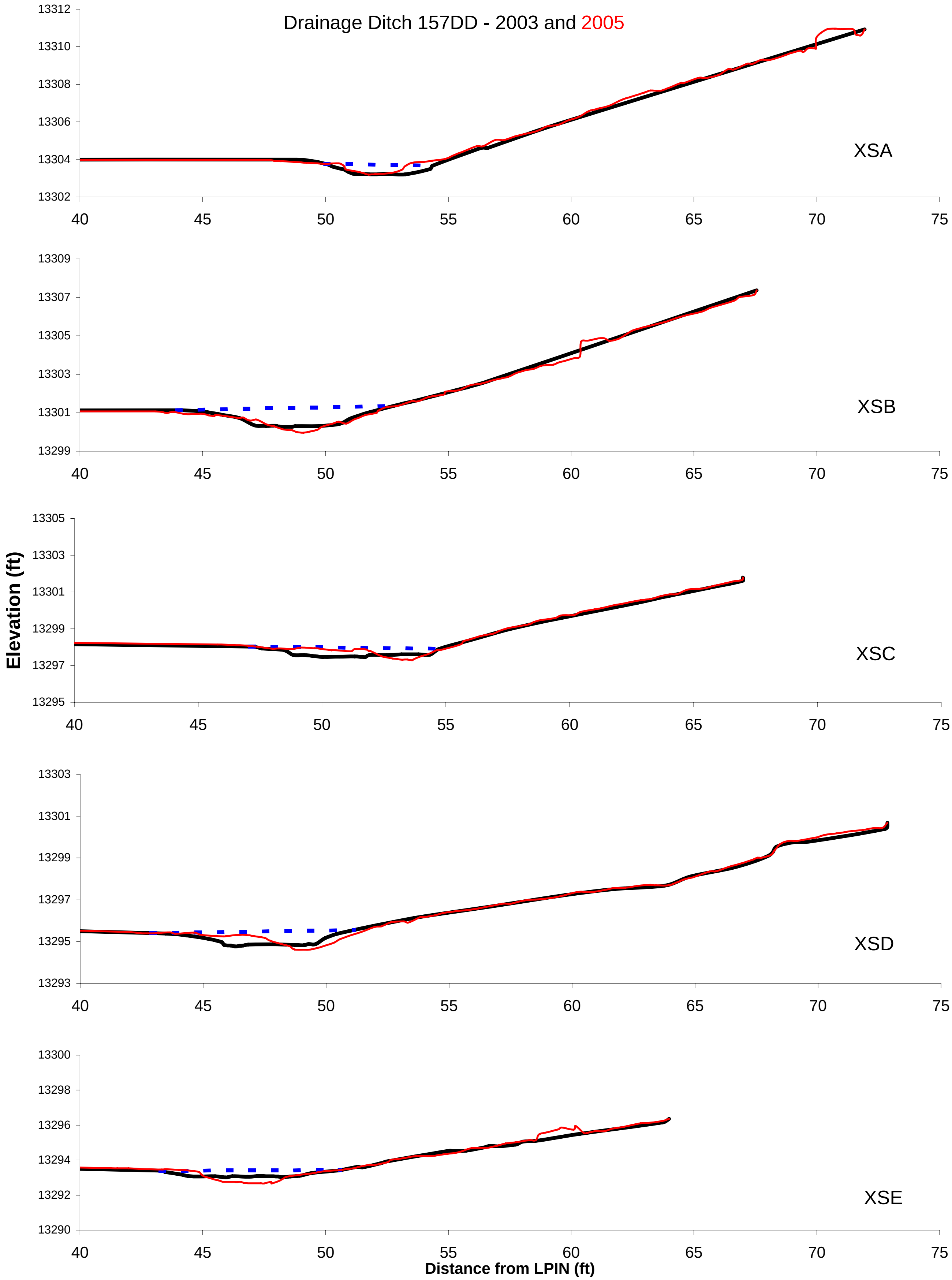


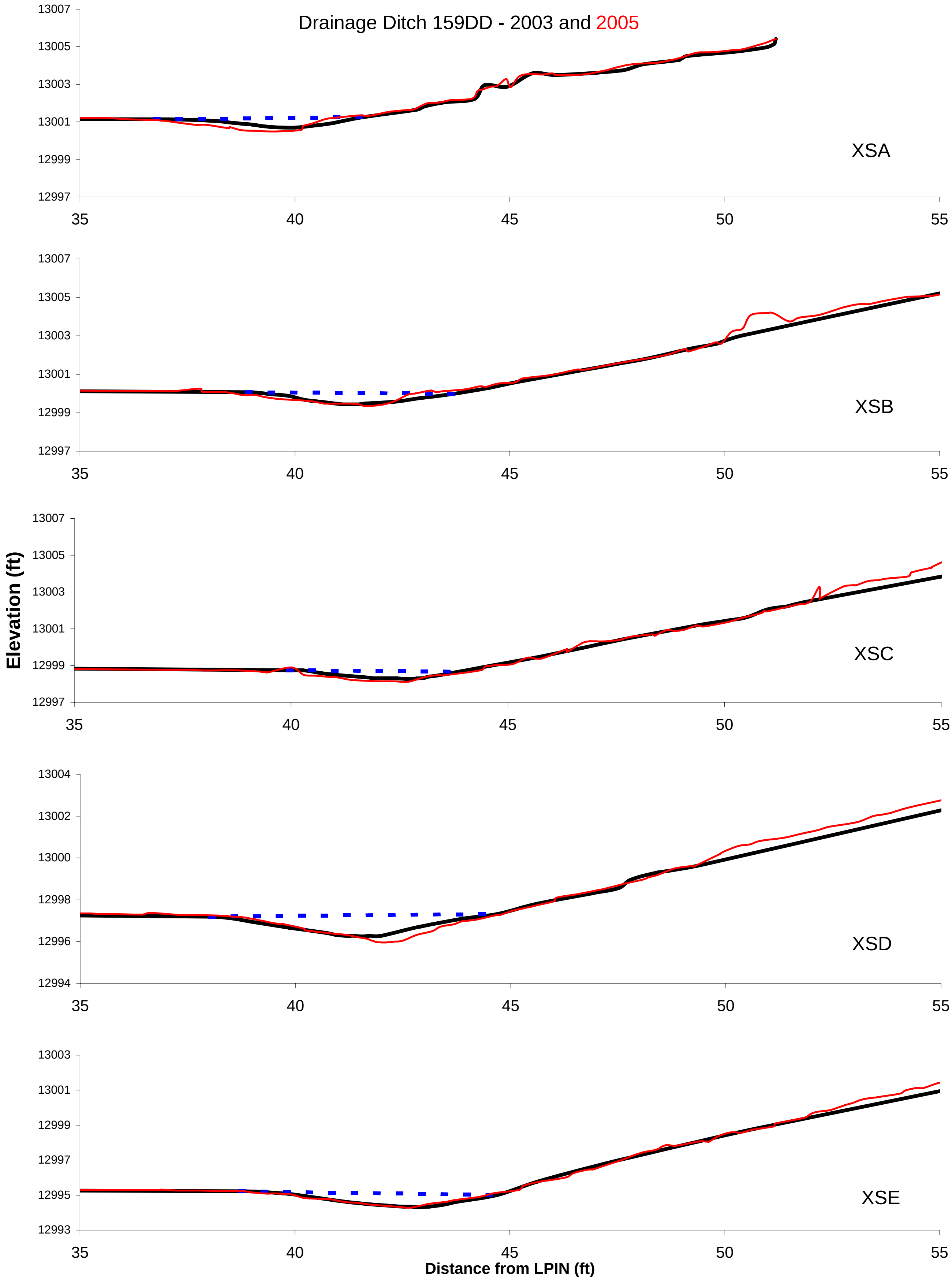
Drainage Ditch 092DD - 2003 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
11909
11908
11907
11906
11905
11904
11903
11902
11904
11903
11902
11901
11900
11899
11898
11897
11898
11897
11896
11895
11894
11893
11892
11891
11893
11892
11891
11890
11889
11888
11887
11886
11888
11887
11886
11885
11884
11883
11882
11881
0
5
10
15
20

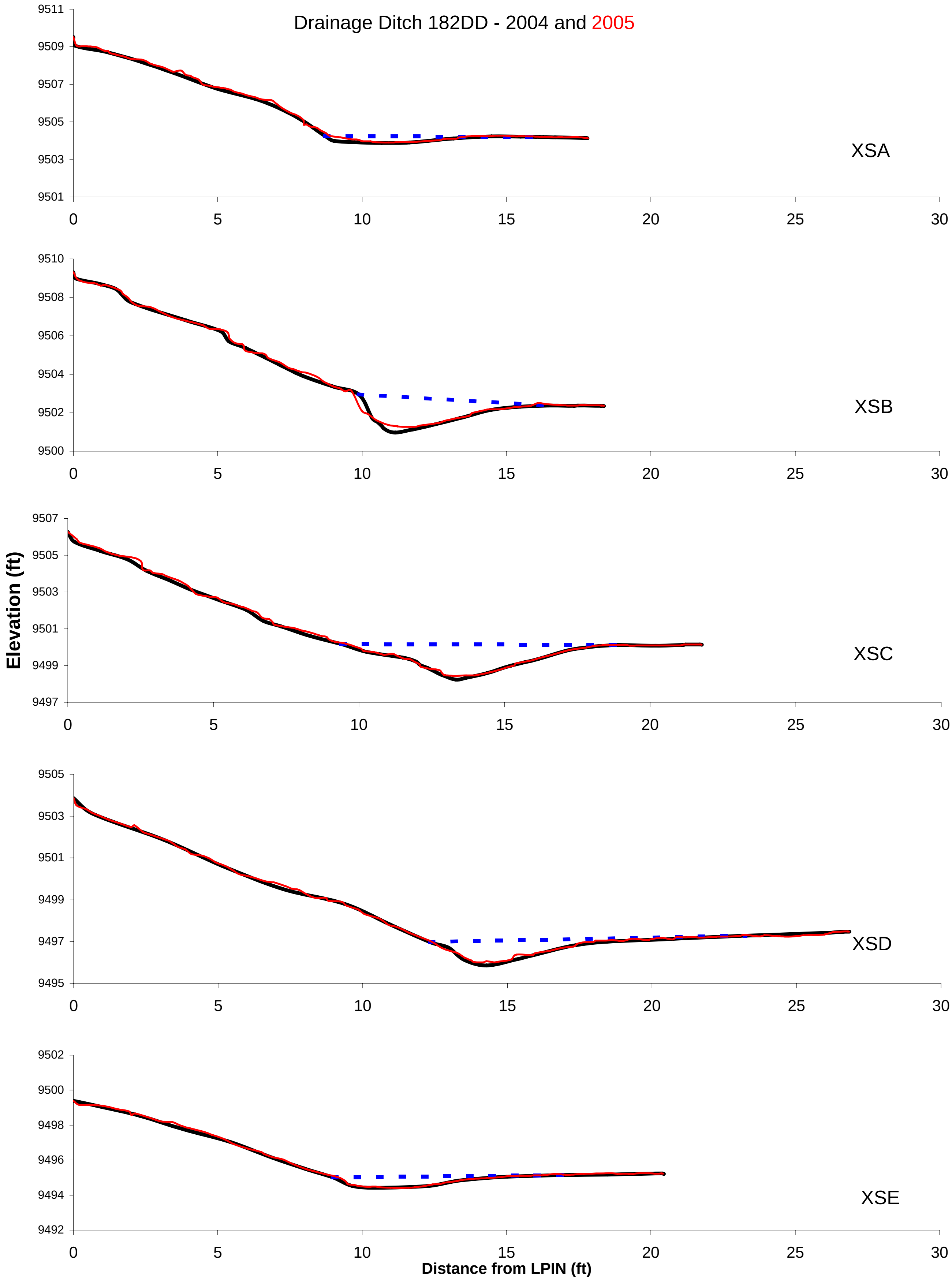

Drainage Ditch 107DD -2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
12523
12518
12513
12508
12503
12520
12515
12510
12505
12500
12514
12509
12504
12499
12494
12506
12501
12496
12491
12486
12503
12498
12493
12488
12483
0
5
10
15
20
25
30



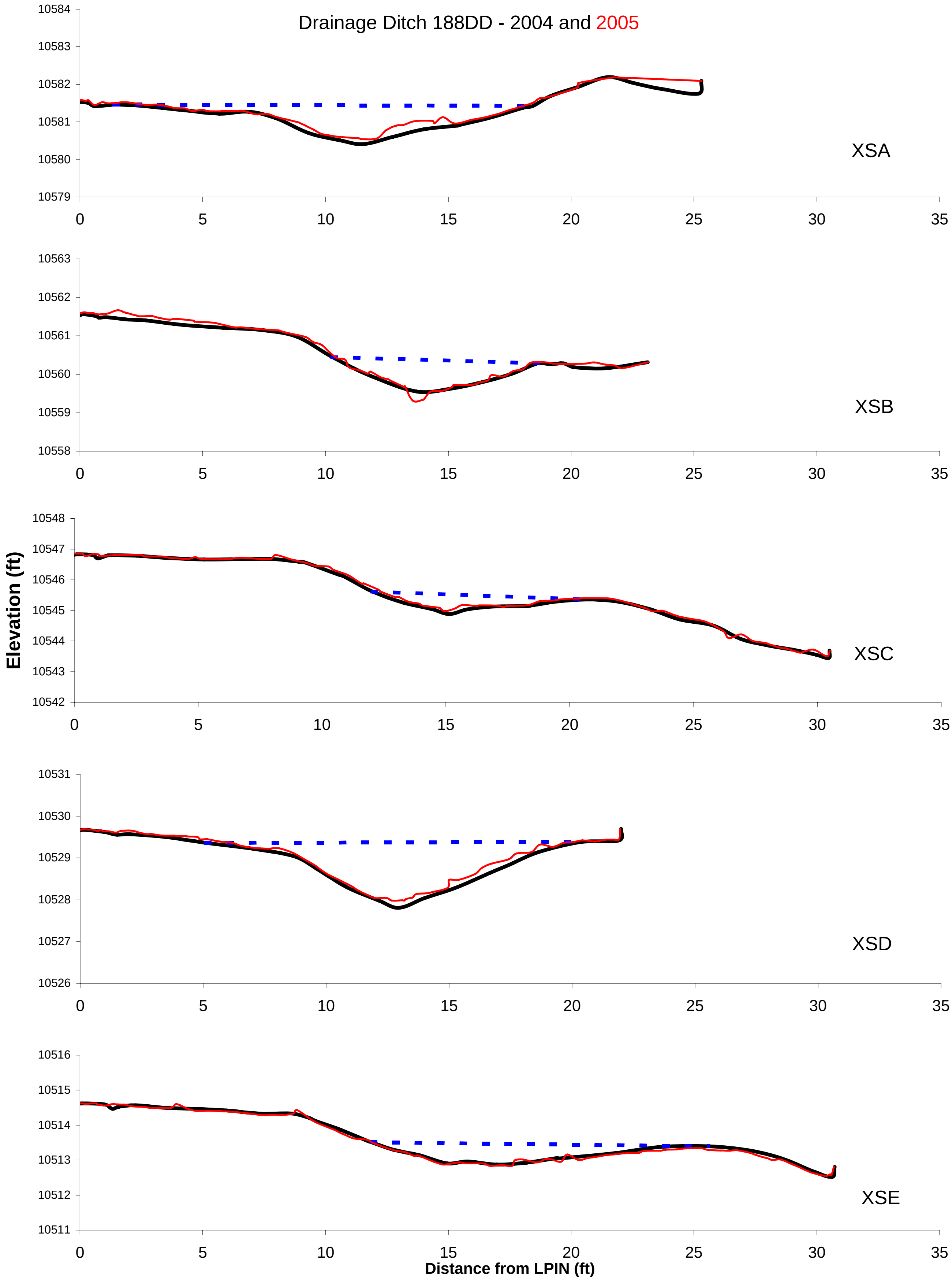
Drainage Ditch 155DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
13212
13210
13208
13206
13204
13202
13200
13205
13203
13201
13199
13197
13195
13198
13196
13194
13192
13190
13188
13186
13184
30
35
40
45
50
55
60


Drainage Ditch 157DD - 2003 and 2005
XSA
13312
13310
13308
13306
13304
13302
XSB
13309
13307
13305
13303
13301
13299
XSC
13305
13303
13301
13299
13297
13295
XSD
13303
13301
13299
13297
13295
13293
XSE
13300
13298
13296
13294
13292
13290
40 45 50 55 60 65 70 75
Elevation (ft)
Distance from LPIN (ft)

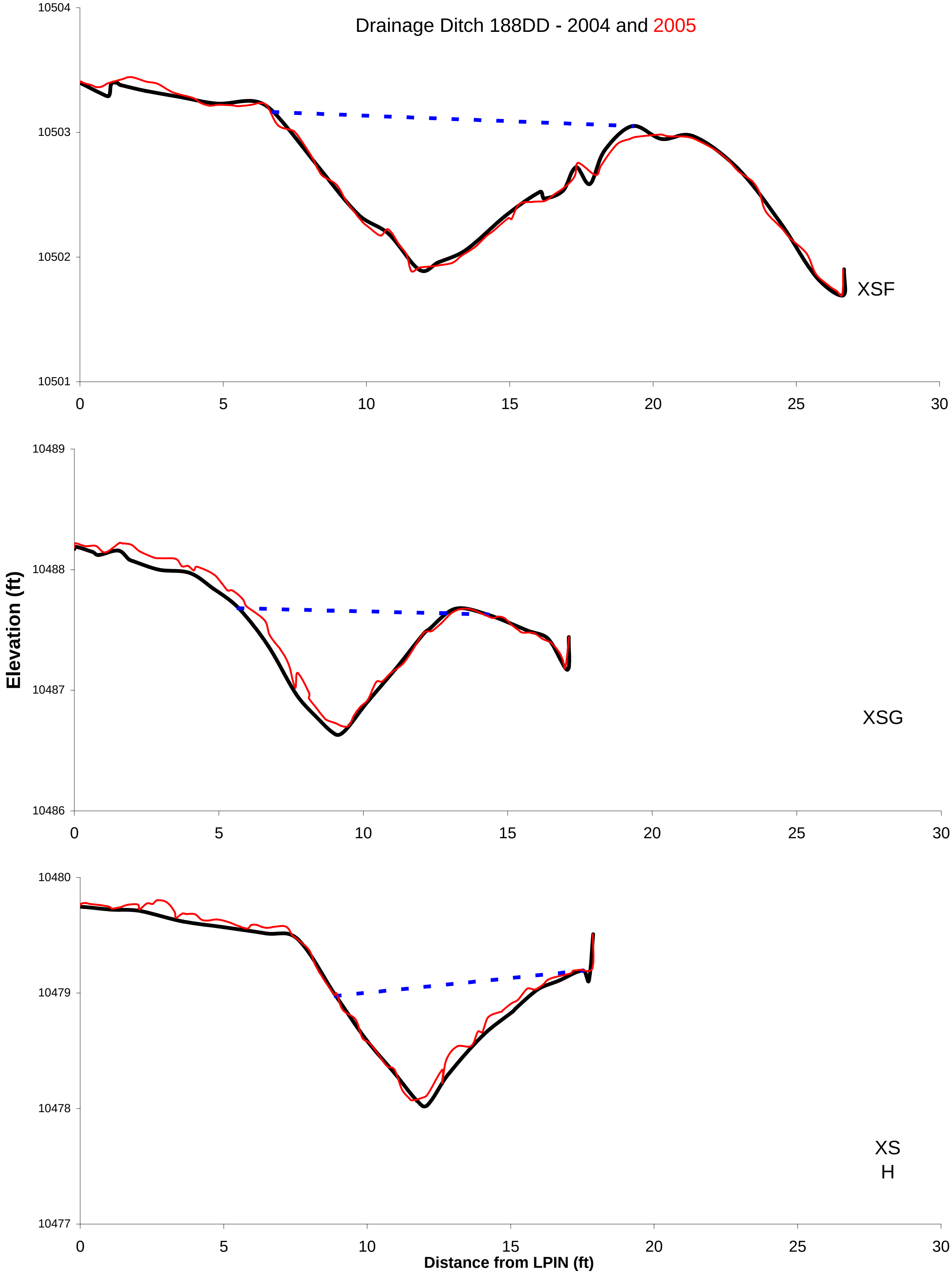

Drainage Ditch 159DD - 2003 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
13007
13005
13003
13001
12999
12997
13004
13002
13000
12998
12996
12994
12995
12993
35
40
45
50
55



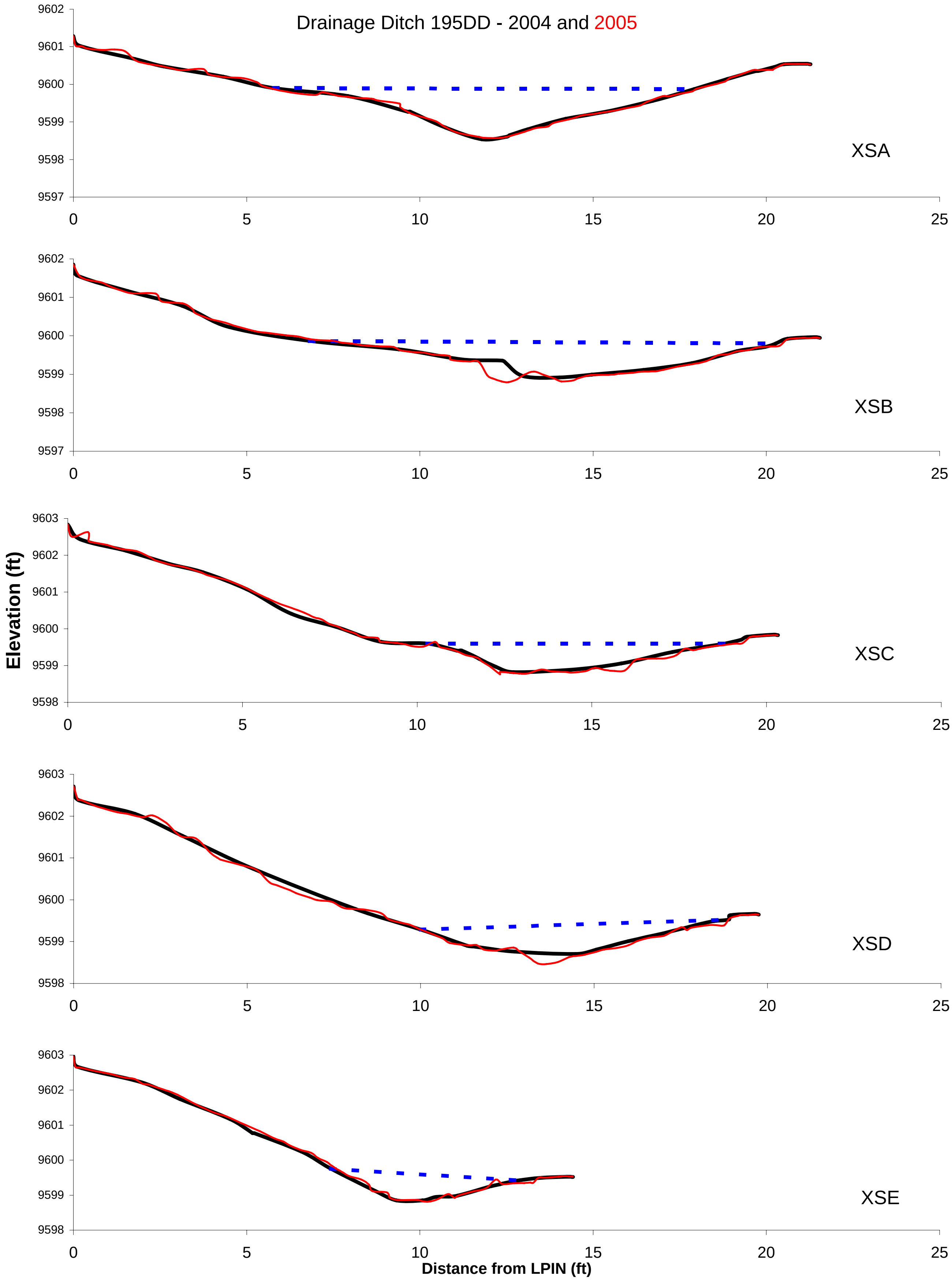
Drainage Ditch 182DD - 2004 and 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)
9511
9509
9507
9505
9503
9501
9510
9508
9506
9504
9502
9500
9507
9505
9503
9501
9499
9497
9505
9503
9501
9499
9497
9495
9502
9500
9498
9496
9494
9492
0
5
10
15
20
25
30



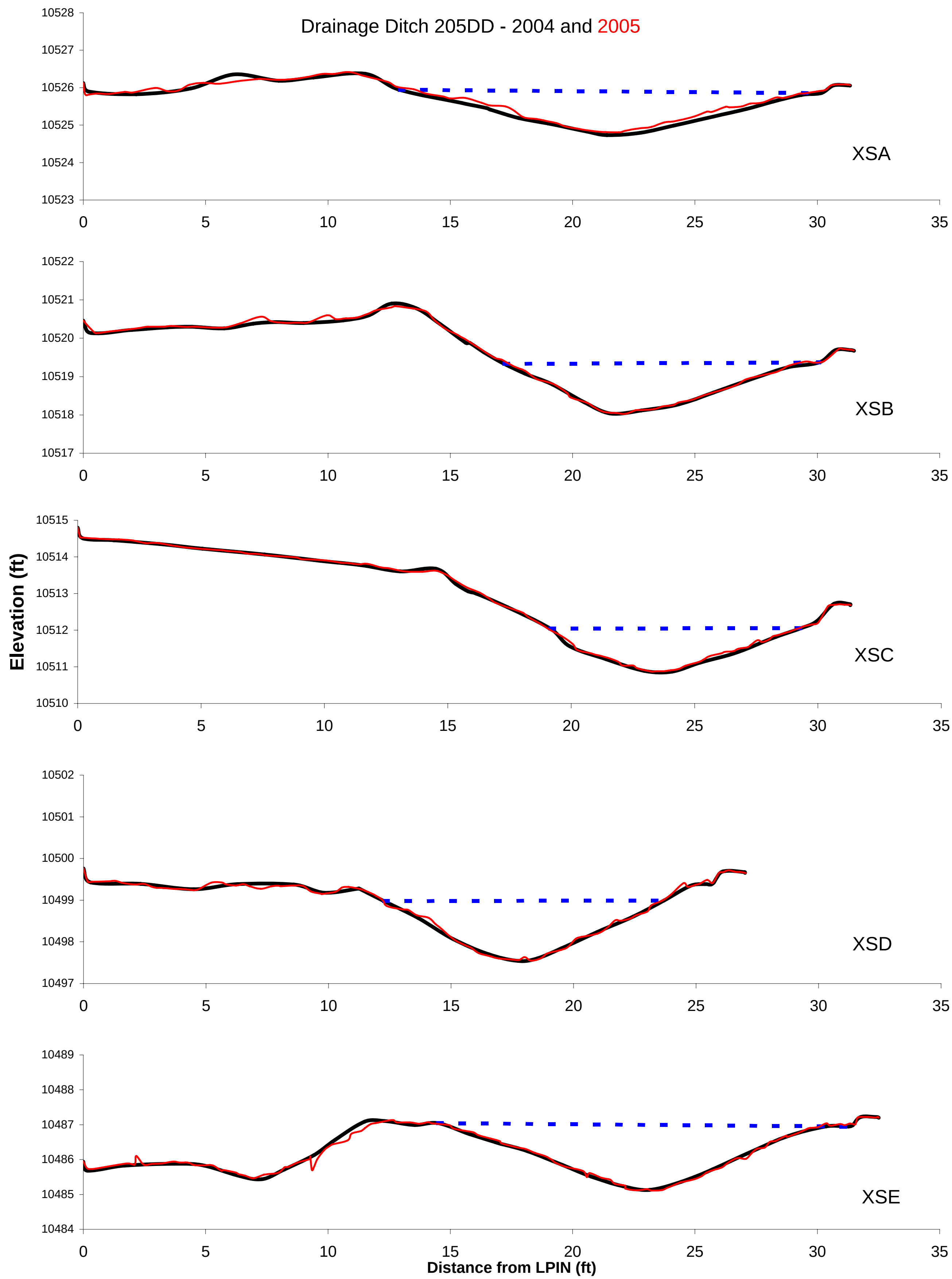
Drainage Ditch 188DD - 2004 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE



Drainage Ditch 188DD - 2004 and 2005
10504
10503
10502
10501
0
5
10
15
20
25
30
XSF
10489
10488
10487
10486
XSG
Elevation (ft)
10480
10479
10478
10477
XS
H
Distance from LPIN (ft)



Drainage Ditch 195DD - 2004 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
9597
9598
9599
9600
9601
9602
9603
0
5
10
15
20
25


Drainage Ditch 205DD - 2004 and 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
10528
10527
10526
10525
10524
10523
10522
10521
10520
10519
10518
10517
10515
10514
10513
10512
10511
10510
10502
10501
10500
10499
10498
10497
10489
10488
10487
10486
10485
10484
0
5
10
15
20
25
30
35

Appendix E

Conveyance Channels
Cross Section Geometry and Graphs

2005

Channel Geometry of Conveyance Channels 2005

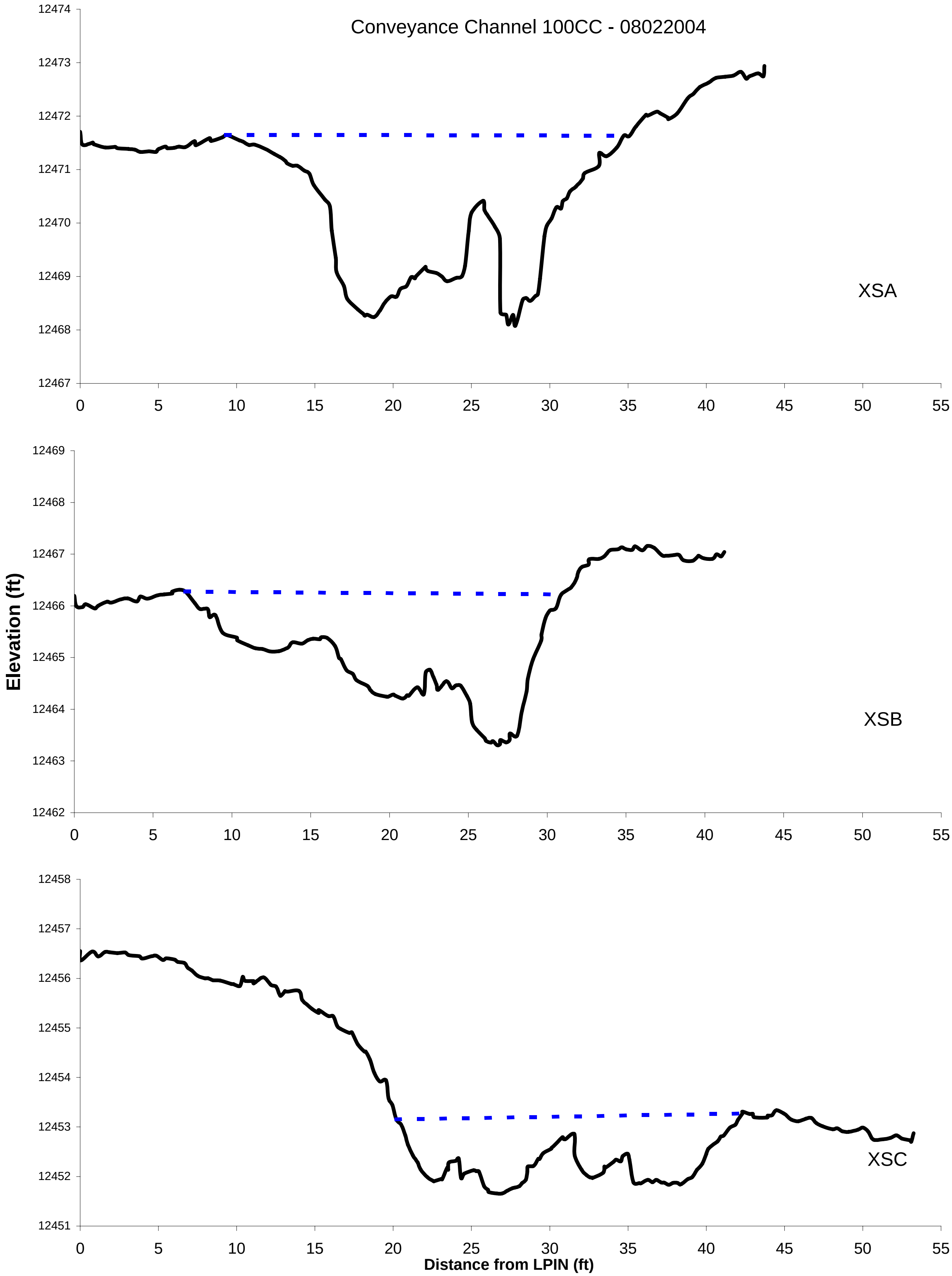
Conveyance Channel Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio
100CC	02Aug05	A	25.4	44.21	1.74	3.56	31.25	1.41	14.61
100CC	02Aug05	B	23.8	34.37	1.44	2.93	26.88	1.28	16.54
100CC	02Aug05	C	22.1	22.05	1.00	1.53	24.81	0.89	22.17
106CC	08Aug05	A	33.7	71.86	2.13	4.36	44.05	1.63	15.80
106CC	08Aug05	B	42.6	63.14	1.48	2.83	51.32	1.23	28.81
106CC	08Aug05	C	48.3	36.68	0.76	1.75	53.67	0.68	63.57
108CC	09Aug05	A	16.8	9.81	0.58	1.69	20.77	0.47	28.69
108CC	09Aug05	B	37.2	41.98	1.13	2.40	45.23	0.93	32.97
108CC	09Aug05	C	31.4	28.66	0.91	2.01	37.01	0.77	34.45
109CC	14Aug05	A	7.9	13.82	1.75	2.75	11.11	1.24	4.49
109CC	14Aug05	B	5.2	4.62	0.89	1.43	7.57	0.61	5.88
109CC	14Aug05	C	10.0	10.17	1.01	2.08	12.85	0.79	9.89
110CC	14Aug05	A	8.7	3.59	0.41	0.94	10.48	0.34	21.04
110CC	14Aug05	B	16.0	12.39	0.77	1.79	20.07	0.62	20.72
110CC	14Aug05	C	11.5	7.76	0.67	1.80	13.68	0.57	17.04
111CC	05Aug05	A	18.4	22.97	1.25	2.49	22.03	1.04	14.75
111CC	05Aug05	B	9.0	4.08	0.45	0.88	11.11	0.37	19.75
111CC	05Aug05	C	15.6	12.62	0.81	1.52	20.01	0.63	19.20
112CC	15Aug05	A	11.0	8.69	0.79	1.71	12.43	0.70	13.88
112CC	15Aug05	B	11.6	12.96	1.12	2.02	12.93	1.00	10.34
112CC	15Aug05	C	13.2	8.74	0.66	1.63	17.56	0.50	20.04
113CC	18Aug05	A	11.9	6.62	0.56	1.10	12.56	0.53	21.38
113CC	18Aug05	B	12.6	6.45	0.51	1.02	13.29	0.49	24.70
113CC	18Aug05	C	9.8	3.86	0.39	0.67	10.04	0.38	24.87
114CC	18Aug05	A	8.5	9.45	1.11	1.61	10.90	0.87	7.65
114CC	18Aug05	B	10.6	11.21	1.06	1.87	13.83	0.81	9.99
114CC	18Aug05	C	7.1	5.02	0.71	1.35	9.56	0.53	9.92
115CC	05Aug05	A	30.9	36.86	1.19	2.34	36.42	1.01	25.87
115CC	05Aug05	B	11.4	15.88	1.39	2.54	14.40	1.10	8.24
115CC	05Aug05	C	12.2	12.60	1.04	1.97	15.31	0.82	11.72
116CC	18Aug05	A	13.0	13.05	1.01	2.08	15.35	0.85	12.92
116CC	18Aug05	B	14.0	15.23	1.09	1.83	16.40	0.93	12.81
116CC	18Aug05	C	18.3	18.57	1.01	2.37	22.63	0.82	18.08
117CC	18Aug05	A	15.3	14.13	0.92	1.70	19.21	0.74	16.58
117CC	18Aug05	B	21.3	14.00	0.66	1.60	24.61	0.57	32.50
117CC	18Aug05	C	27.0	21.30	0.79	1.51	33.47	0.64	34.17
118CC	18Aug05	A	51.7	156.64	3.03	5.14	71.83	2.18	17.04
118CC	18Aug05	B	54.7	161.25	2.95	5.13	74.17	2.17	18.55
118CC	18Aug05	C	47.5	93.60	1.97	3.85	57.23	1.64	24.15
119CC	18Aug05	A	13.8	30.74	2.22	4.19	18.37	1.67	6.23
119CC	18Aug05	B	13.0	19.77	1.52	2.38	16.96	1.17	8.58
119CC	18Aug05	C	26.1	23.07	0.88	1.64	30.40	0.76	29.52
184CC	02Jun05	A	27.6	69.12	2.50	4.77	31.33	2.21	11.03
184CC	02Jun05	B	40.9	130.96	3.20	5.56	45.34	2.89	12.76
184CC	02Jun05	C	22.7	87.44	3.85	7.00	27.90	3.13	5.88
214CC	20Aug05	A	18.5	19.83	1.07	1.65	21.24	0.93	17.19
214CC	20Aug05	B	20.5	13.33	0.65	1.68	26.57	0.50	31.39
214CC	20Aug05	C	15.5	9.53	0.61	1.31	18.84	0.51	25.27

Channel Geometry of Conveyance Channels 2005

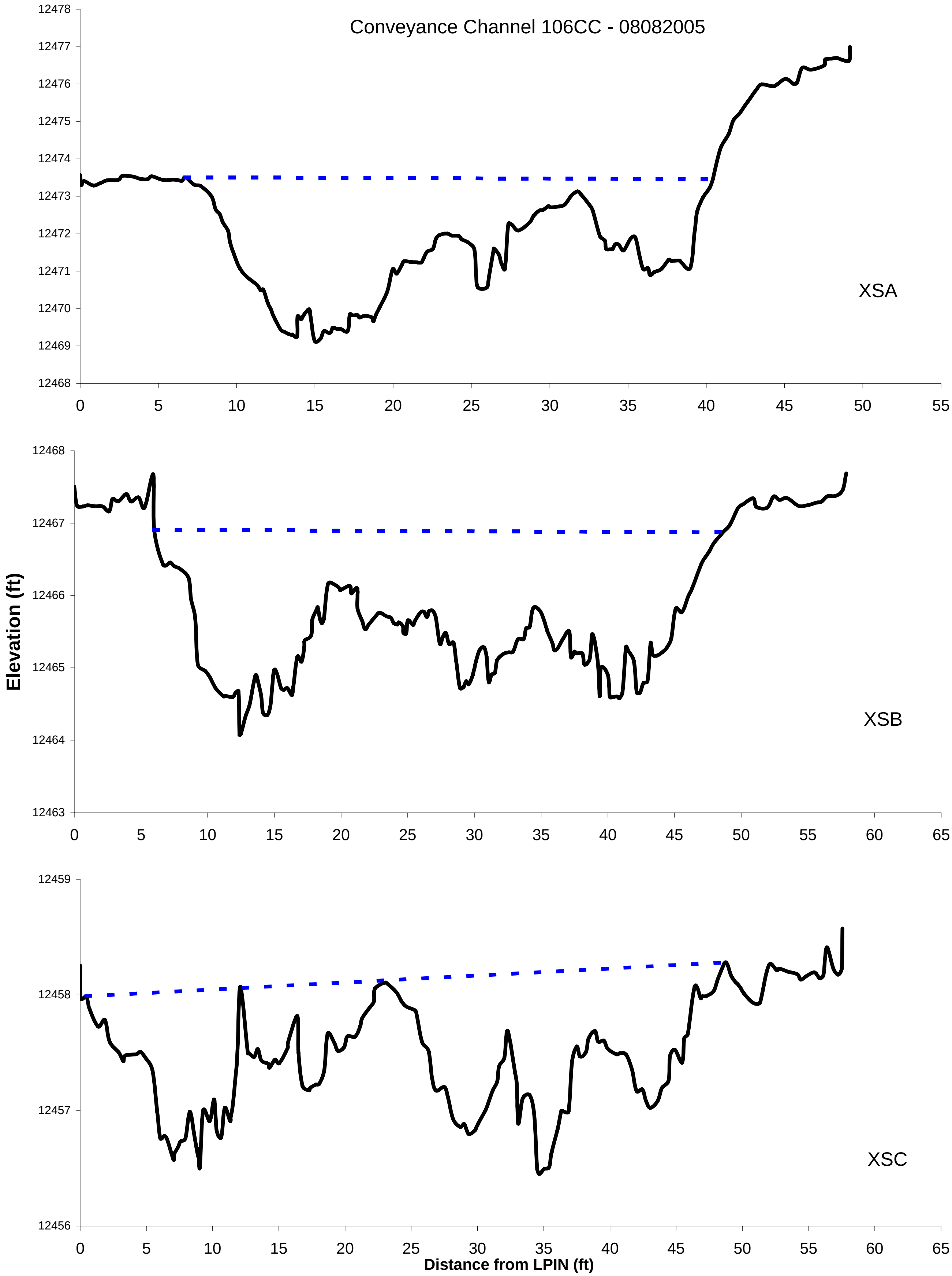
Conveyance Channel Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio
215CC	20Aug05	A	18.8	19.14	1.02	1.90	22.55	0.85	18.55
215CC	20Aug05	B	21.2	21.70	1.02	1.85	25.27	0.86	20.81
215CC	20Aug05	C	48.2	55.77	1.16	2.40	54.42	1.02	41.71
216CC	18May05	A	8.9	1.87	0.21	0.34	9.07	0.21	42.44
216CC	18May05	B	13.1	1.88	0.14	0.26	13.30	0.14	90.49
216CC	18May05	C	10.4	4.93	0.47	0.87	11.42	0.43	22.12
217CC	18May05	A	12.8	1.60	0.13	0.25	12.92	0.12	101.85
217CC	18May05	B	10.8	2.23	0.21	0.50	11.14	0.20	52.66
217CC	18May05	C	12.8	2.85	0.22	0.43	13.02	0.22	57.96
218CC	25May05	A	22.3	5.01	0.22	0.44	22.64	0.22	99.00
218CC	25May05	B	29.5	16.89	0.57	1.62	30.55	0.55	51.36
218CC	25May05	C	26.5	11.49	0.43	1.07	27.43	0.42	61.09
219CC	25May05	A	22.5	6.13	0.27	0.55	22.83	0.27	82.28
219CC	25May05	B	12.0	2.77	0.23	0.48	12.22	0.23	51.99
219CC	25May05	C	9.0	4.12	0.46	0.84	9.29	0.44	19.78
220CC	25May05	A	16.6	4.76	0.29	0.46	16.70	0.29	57.62
220CC	25May05	B	16.0	7.96	0.50	1.50	17.45	0.46	32.23
220CC	25May05	C	27.3	11.98	0.44	1.51	28.85	0.42	62.22
221CC	30May05	A	20.2	11.32	0.56	1.67	23.08	0.49	35.93
221CC	30May05	B	8.5	1.13	0.13	0.28	8.81	0.13	64.54
221CC	30May05	C	9.6	1.45	0.15	0.28	9.88	0.15	63.94
222CC	30May05	A	28.1	13.53	0.48	2.81	42.13	0.32	58.57
222CC	30May05	B	10.3	5.05	0.49	0.79	10.79	0.47	20.81
222CC	30May05	C	27.9	11.21	0.40	0.73	28.84	0.39	69.41
223CC	30May05	A	28.5	10.14	0.36	0.78	29.21	0.35	80.31
223CC	30May05	B	36.7	10.33	0.28	0.58	37.13	0.28	130.76
223CC	30May05	C	31.2	9.84	0.32	0.62	32.75	0.30	98.83
224CC	31May05	A	12.2	2.09	0.17	0.31	12.75	0.16	71.03
224CC	31May05	B	12.3	2.97	0.24	0.47	12.65	0.24	50.51
224CC	31May05	C	8.3	1.01	0.12	0.54	8.67	0.12	67.75
225CC	31May05	A	12.1	8.12	0.67	2.05	14.00	0.58	18.17
225CC	31May05	B	24.0	12.57	0.52	0.99	25.79	0.49	45.77
225CC	31May05	C	15.7	7.91	0.50	1.66	17.76	0.45	31.13
226CC	01Jun05	A	31.9	21.47	0.67	1.15	32.72	0.66	47.35
226CC	01Jun05	B	13.6	4.93	0.36	0.94	14.50	0.34	37.43
226CC	01Jun05	C	13.5	5.17	0.38	1.28	14.46	0.36	35.04
227CC	01Jun05	A	23.8	4.20	0.18	0.40	24.28	0.17	134.94
227CC	01Jun05	B	19.0	3.13	0.16	0.28	19.29	0.16	115.27
227CC	01Jun05	C	21.9	4.13	0.19	0.41	22.29	0.19	115.51
228CC	02Jun05	A	9.4	6.33	0.68	1.63	10.82	0.59	13.89
228CC	02Jun05	B	21.5	15.81	0.73	1.07	22.61	0.70	29.28
228CC	02Jun05	C	23.8	38.04	1.60	2.99	26.22	1.45	14.90
229CC	09Jun05	A	5.5	1.28	0.23	0.39	5.62	0.23	23.47
229CC	09Jun05	B	21.3	5.05	0.24	0.45	21.86	0.23	90.27
229CC	09Jun05	C	19.9	5.44	0.27	0.52	20.34	0.27	72.82
230CC	09Jun05	A	23.4	8.74	0.37	0.79	24.06	0.36	62.73
230CC	09Jun05	B	19.8	4.41	0.22	0.45	20.14	0.22	88.60
230CC	09Jun05	C	19.0	9.92	0.52	1.86	21.37	0.46	36.47

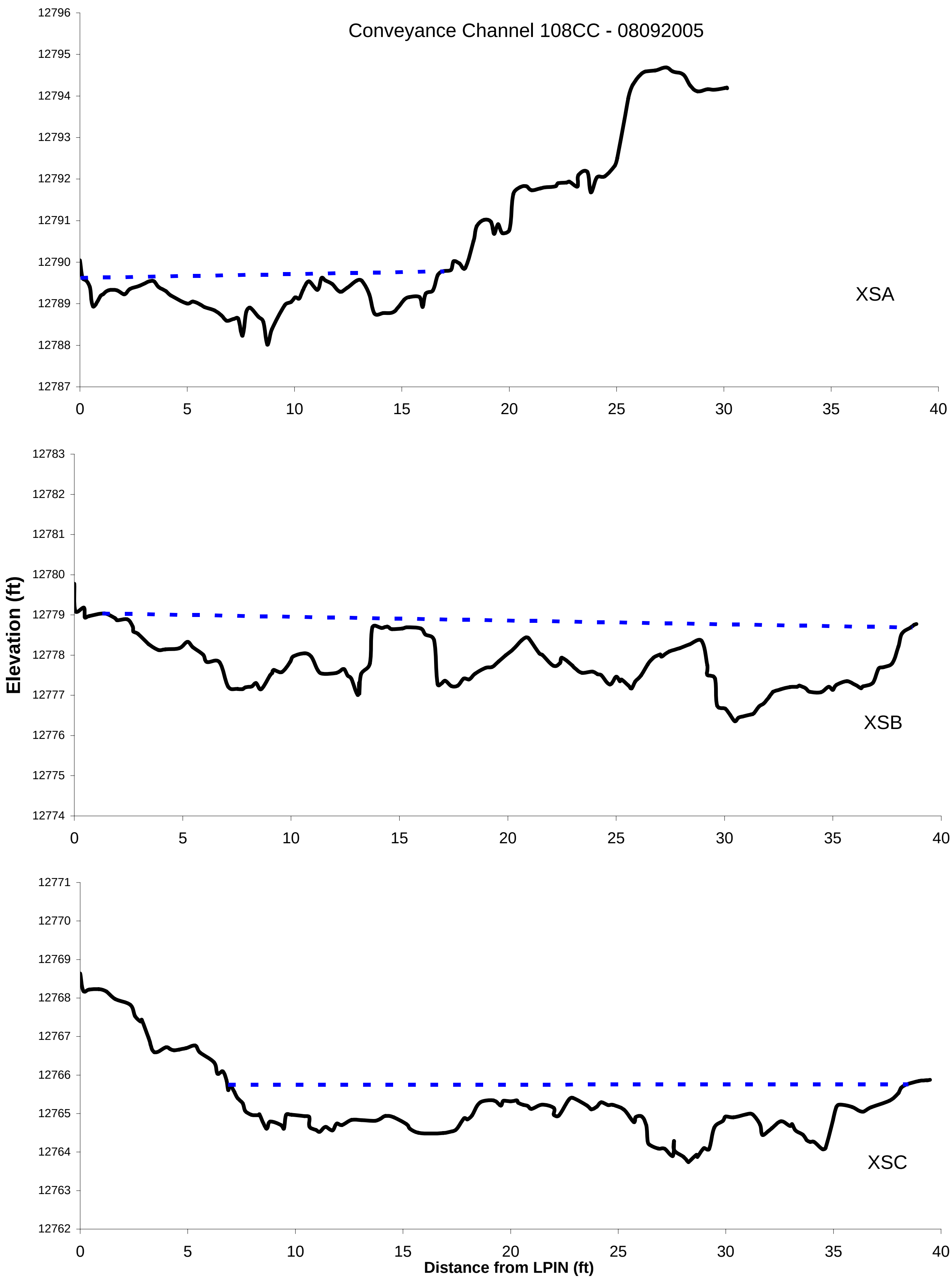
Channel Geometry of Conveyance Channels 2005

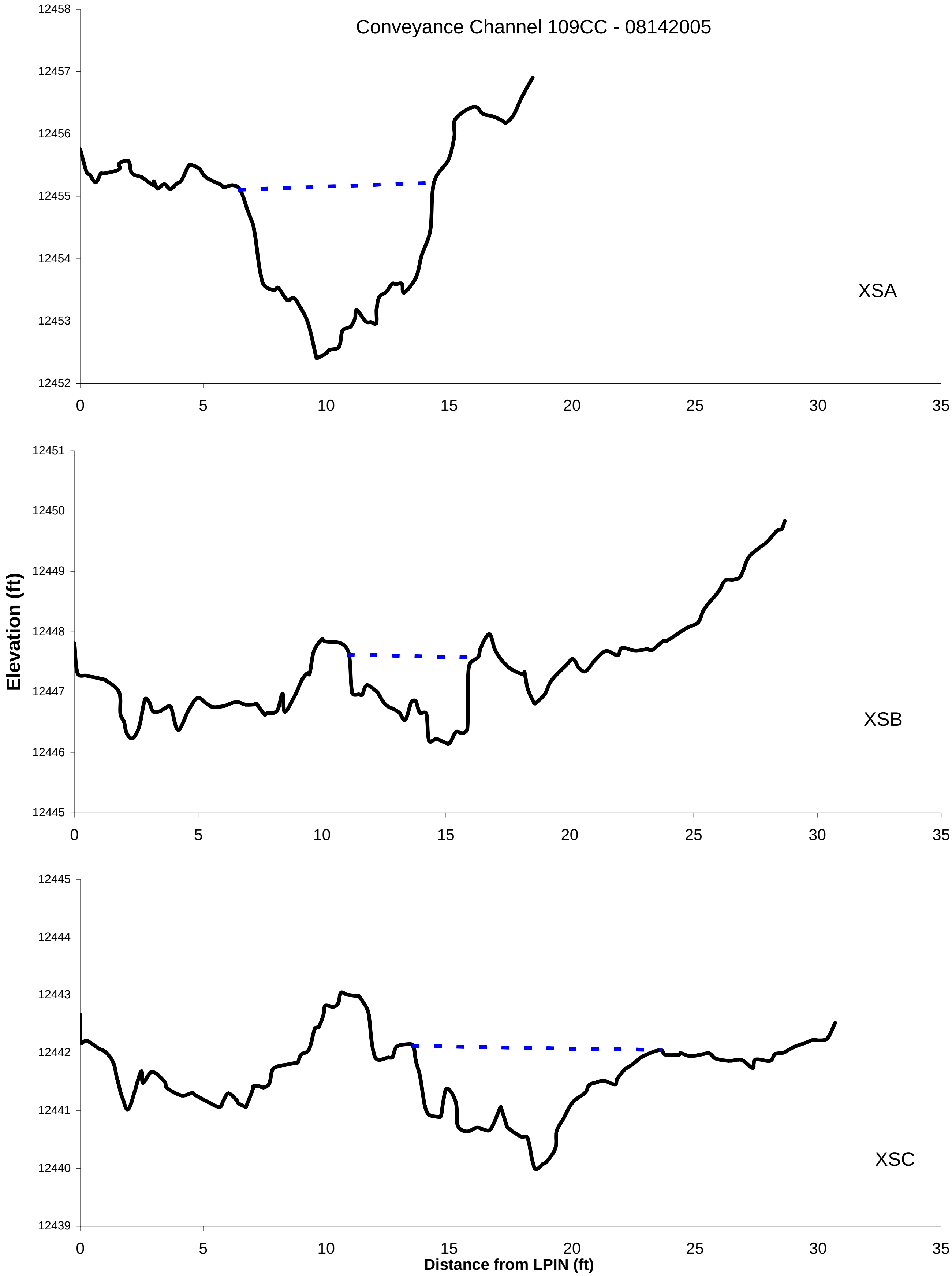
Conveyance Channel Identifier	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio
231CC	09Jun05	A	31.8	8.81	0.28	0.66	33.11	0.27	114.80
231CC	09Jun05	B	32.2	7.89	0.24	0.60	33.36	0.24	131.77
231CC	09Jun05	C	26.3	7.36	0.28	0.53	26.58	0.28	94.11
232CC	23Jun05	A	7.5	6.87	0.91	1.88	9.85	0.70	8.28
232CC	23Jun05	B	8.7	7.32	0.84	1.79	10.96	0.67	10.28
232CC	23Jun05	C	23.4	23.36	1.00	1.89	24.84	0.94	23.41
232CC	23Jun05	Dl	12.0	5.81	0.48	0.71	12.48	0.47	24.87
232CC	23Jun05	Dr	2.6	1.89	0.73	1.22	4.79	0.39	3.56
232CC	23Jun05	E	46.0	27.96	0.61	1.20	48.63	0.57	75.59
235CC	01Sep05	A	21.8	26.36	1.21	2.38	27.74	0.95	18.10
235CC	01Sep05	B	18.7	27.52	1.47	2.81	20.66	1.33	12.68
235CC	01Sep05	C	8.5	11.72	1.38	2.54	12.39	0.95	6.12

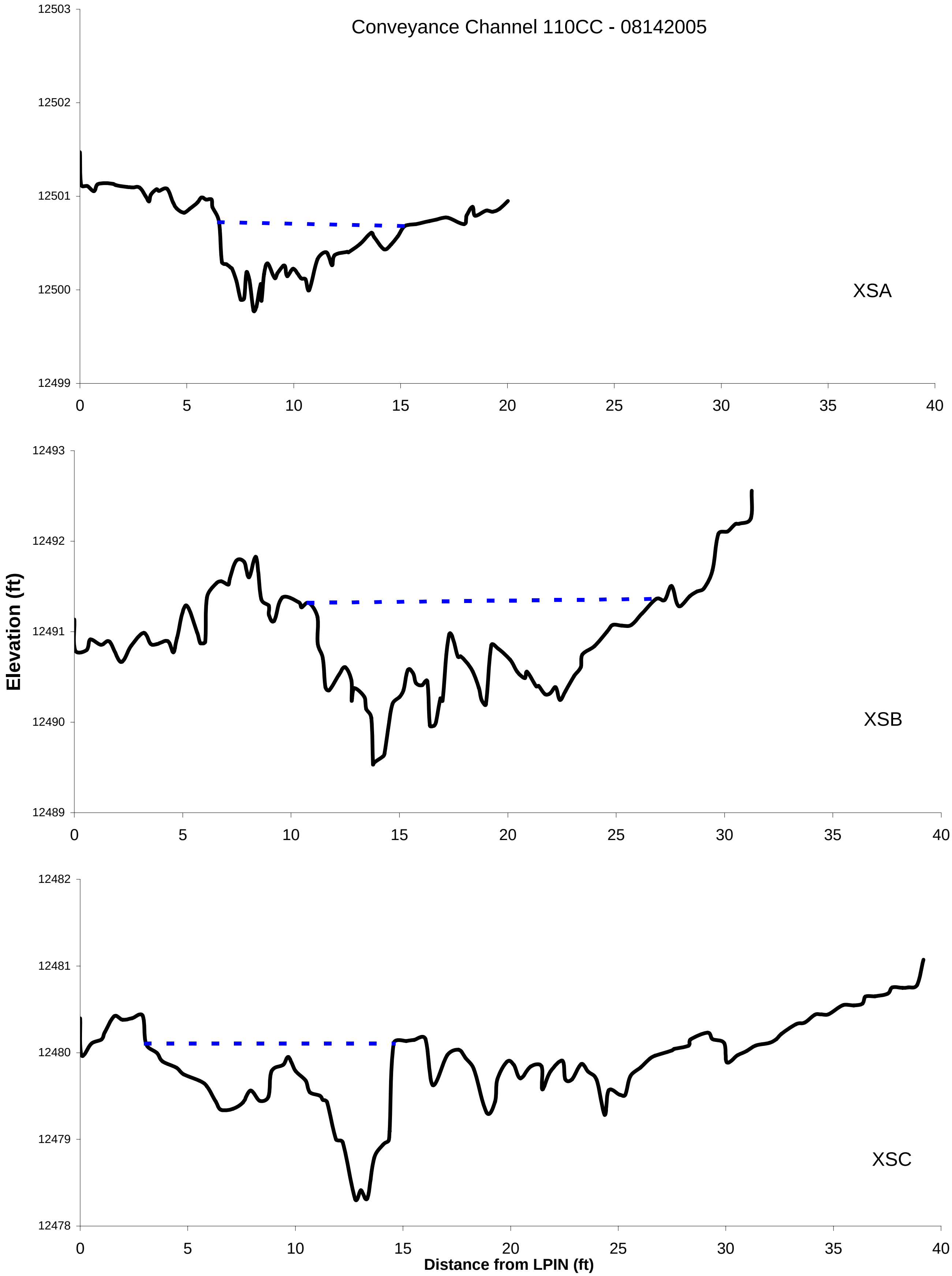


Conveyance Channel 100CC - 08022004
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12474
12473
12472
12471
12470
12469
12468
12467
12466
12465
12464
12463
12462
12458
12457
12456
12455
12454
12453
12452
12451
0
5
10
15
20
25
30
35
40
45
50
55

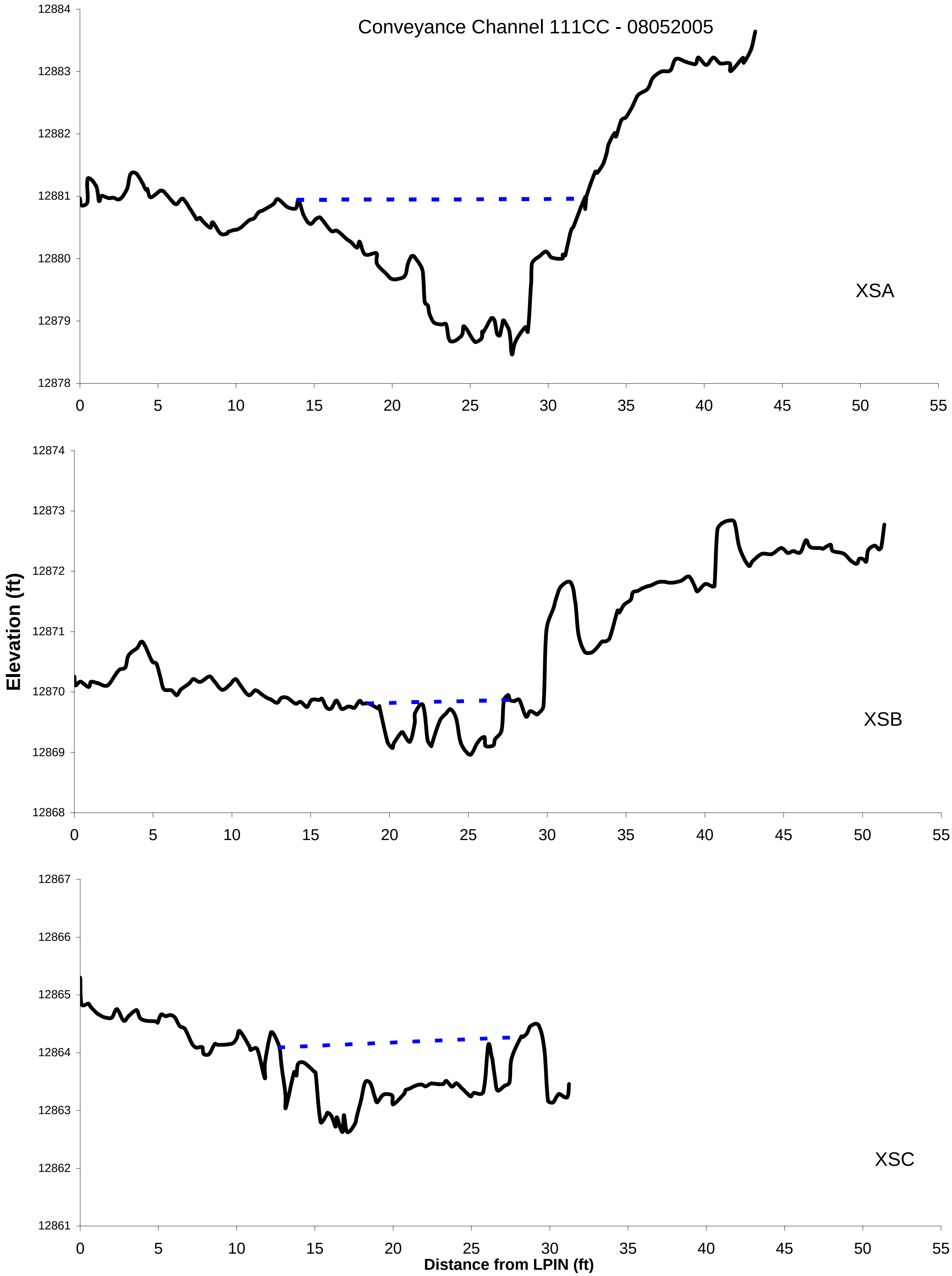

Conveyance Channel 106CC - 08082005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12478
12477
12476
12475
12474
12473
12472
12471
12470
12469
12468
12467
12466
12465
12464
12463
12459
12458
12457
12456
0
5
10
15
20
25
30
35
40
45
50
55
60
65


Conveyance Channel 108CC - 08092005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12796
12795
12794
12793
12792
12791
12790
12789
12788
12787
12783
12782
12781
12780
12779
12778
12777
12776
12775
12774
12771
12770
12769
12768
12767
12766
12765
12764
12763
12762
0
5
10
15
20
25
30
35
40

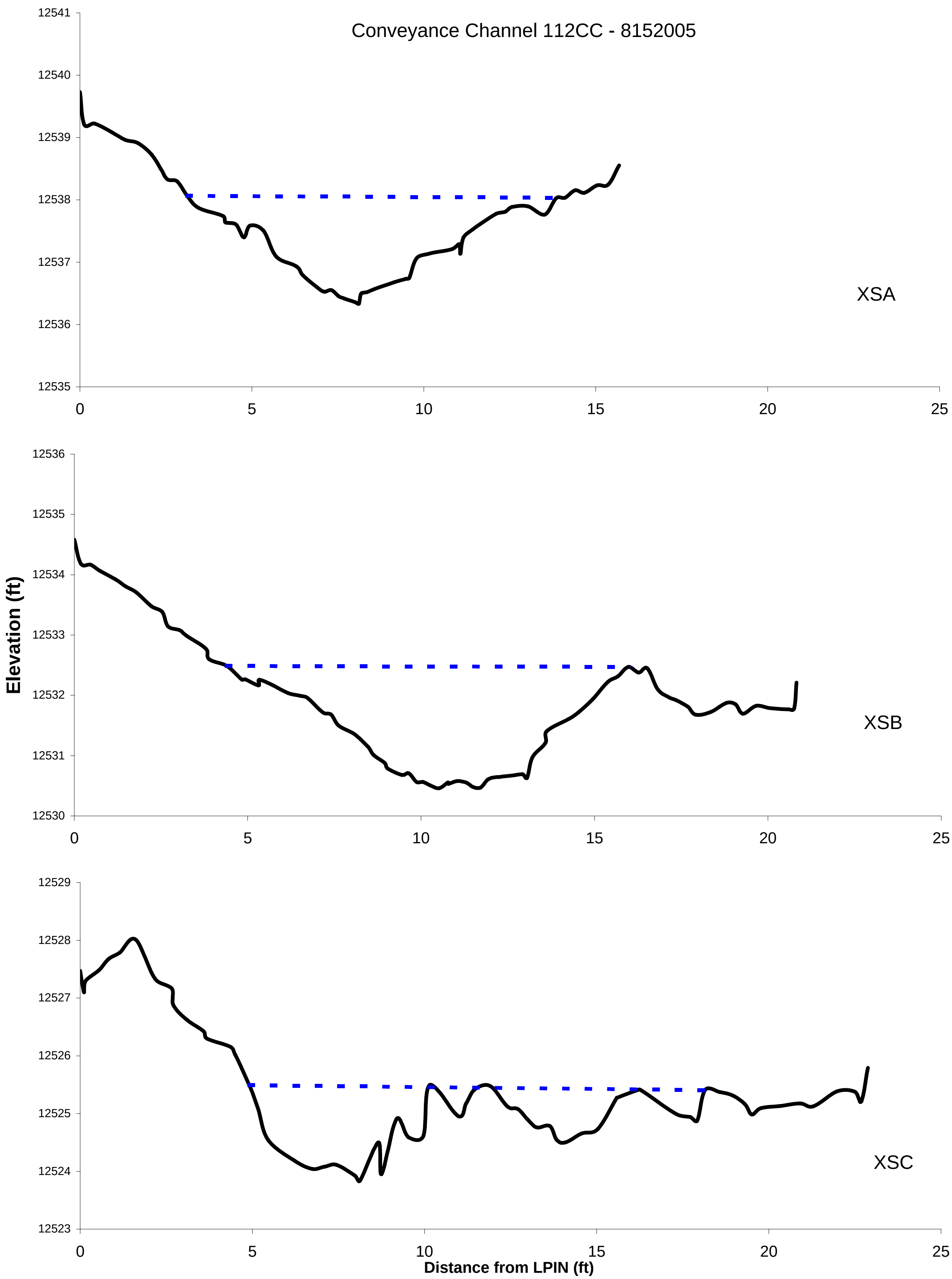

Conveyance Channel 109CC - 08142005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
12458
12457
12456
12455
12454
12453
12452
12451
12450
12449
12448
12447
12446
12445
12444
12443
12442
12441
12440
12439
0
5
10
15
20
25
30
35



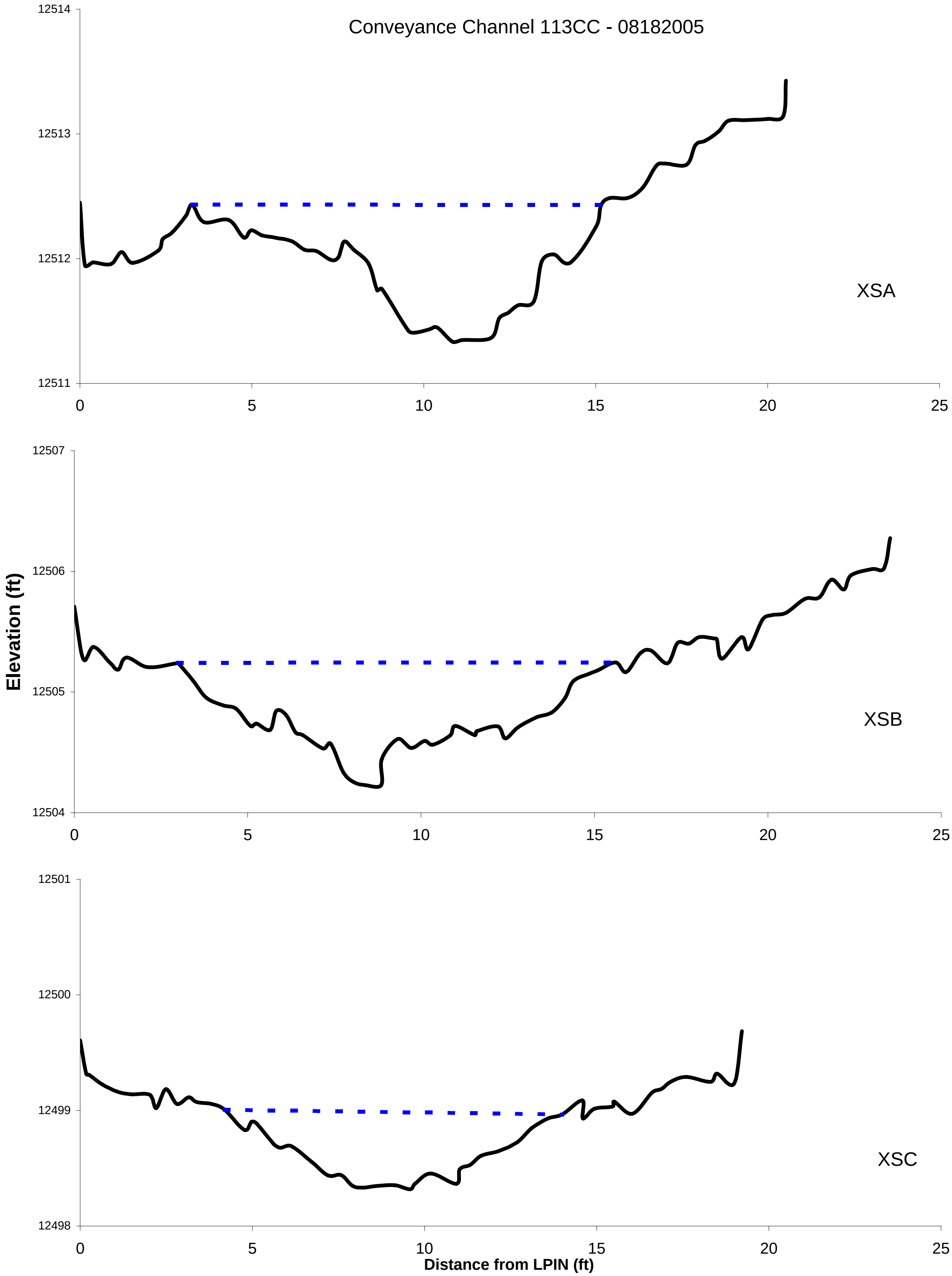
Conveyance Channel 110CC - 08142005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12503
12502
12501
12500
12499
12493
12492
12491
12490
12489
12482
12481
12480
12479
12478
0
5
10
15
20
25
30
35
40

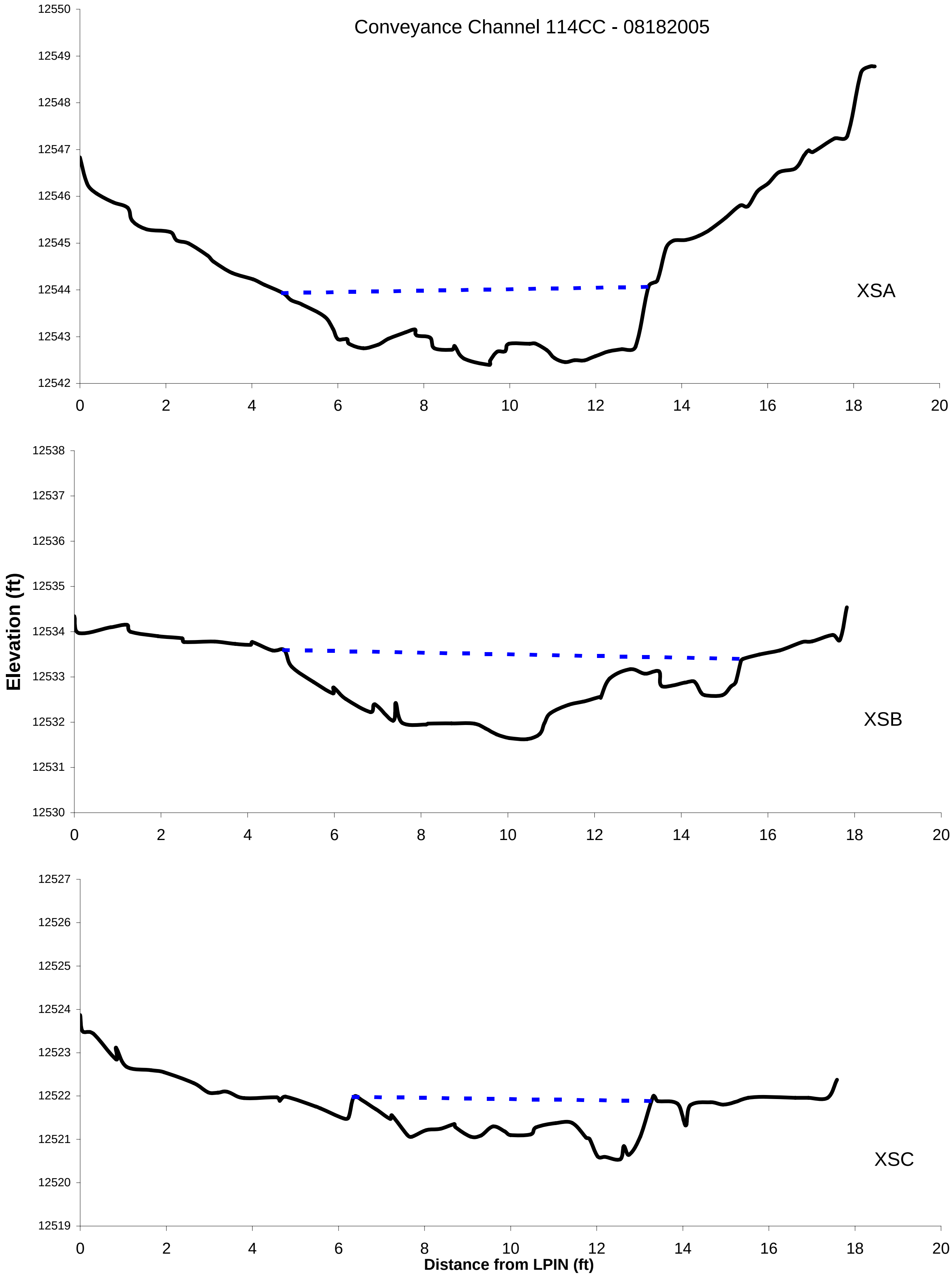


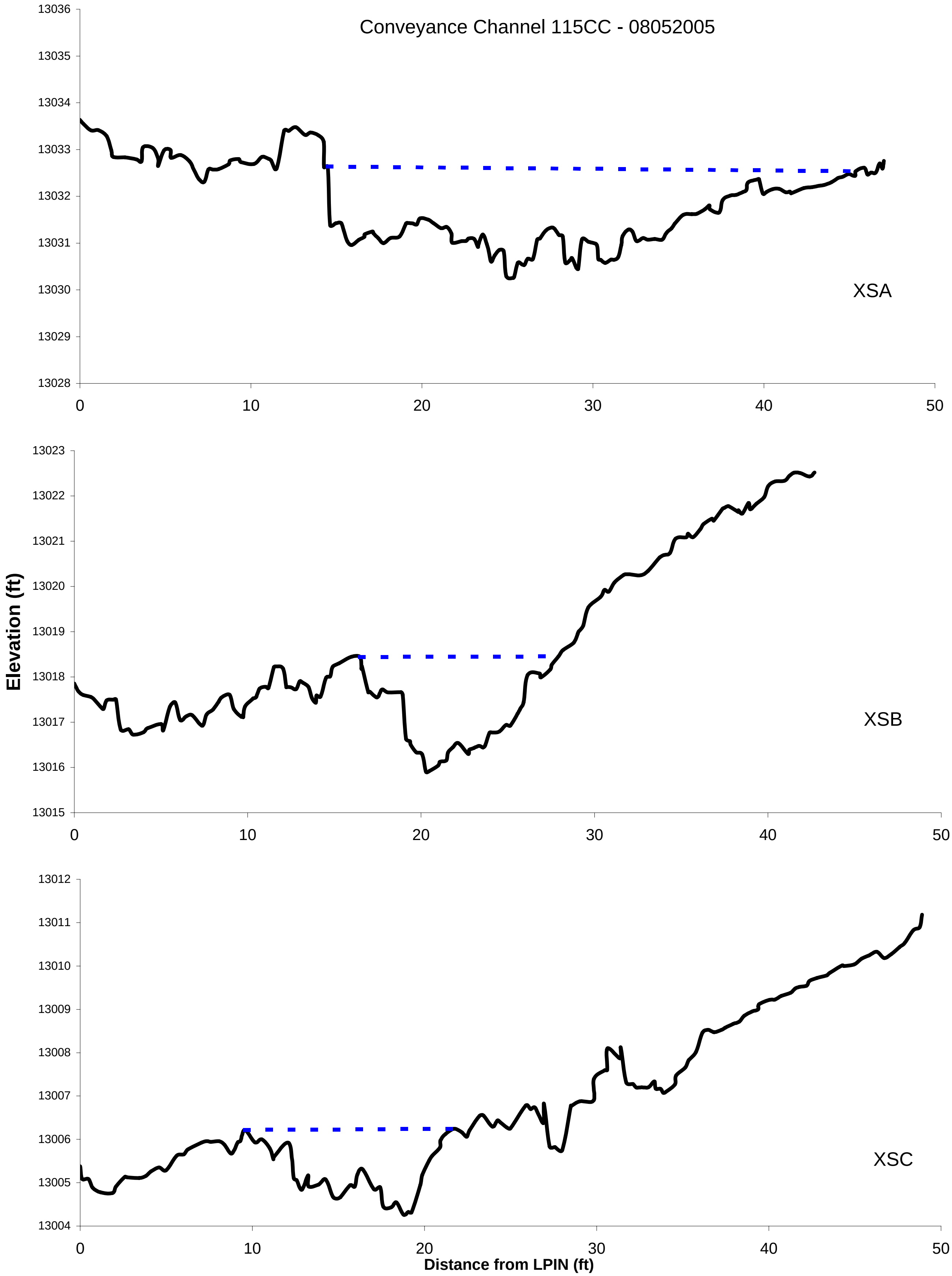
Conveyance Channel 111CC - 08052005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12884
12883
12882
12881
12880
12879
12878
12874
12873
12872
12871
12870
12869
12868
12867
12866
12865
12864
12863
12862
12861
0
5
10
15
20
25
30
35
40
45
50
55



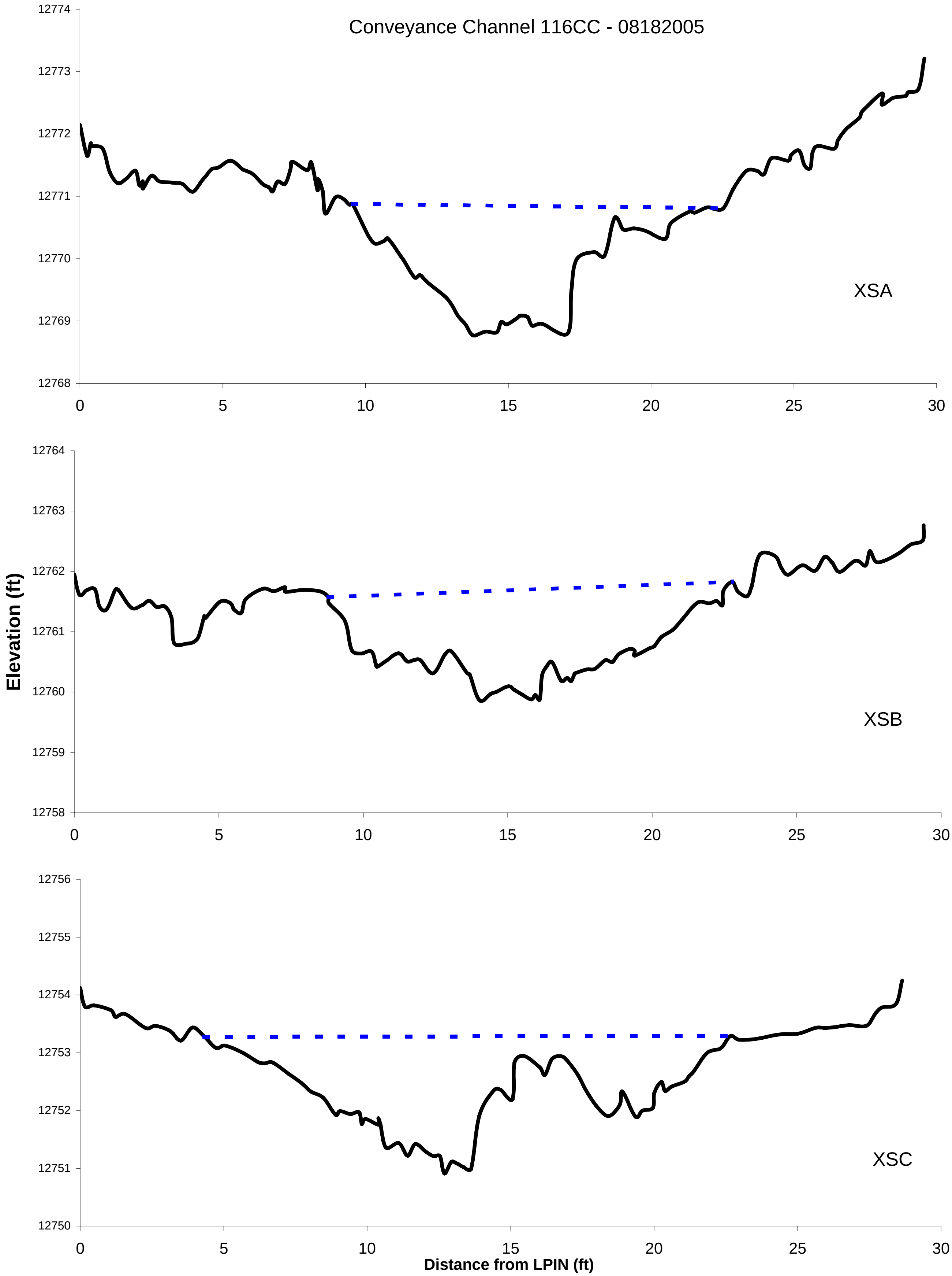
Conveyance Channel 112CC - 8152005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
12541
12540
12539
12538
12537
12536
12535
12534
12533
12532
12531
12530
12529
12528
12527
12526
12525
12524
12523
0
5
10
15
20
25

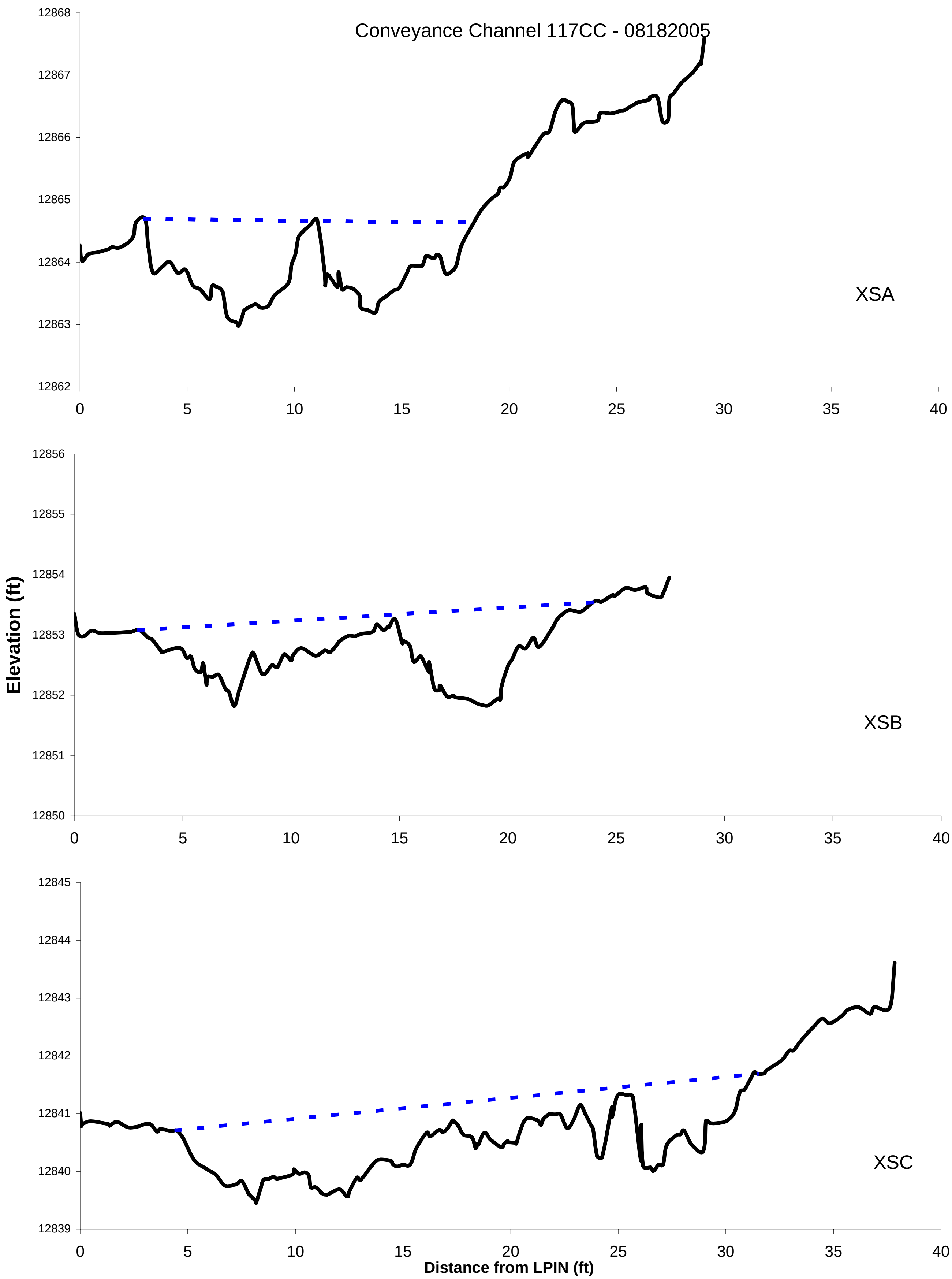

Conveyance Channel 113CC - 08182005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12514
12513
12512
12511
12507
12506
12505
12504
12501
12500
12499
12498
0
5
10
15
20
25


Conveyance Channel 114CC - 08182005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12550
12549
12548
12547
12546
12545
12544
12543
12542
12538
12537
12536
12535
12534
12533
12532
12531
12530
12527
12526
12525
12524
12523
12522
12521
12520
12519
0
2
4
6
8
10
12
14
16
18
20

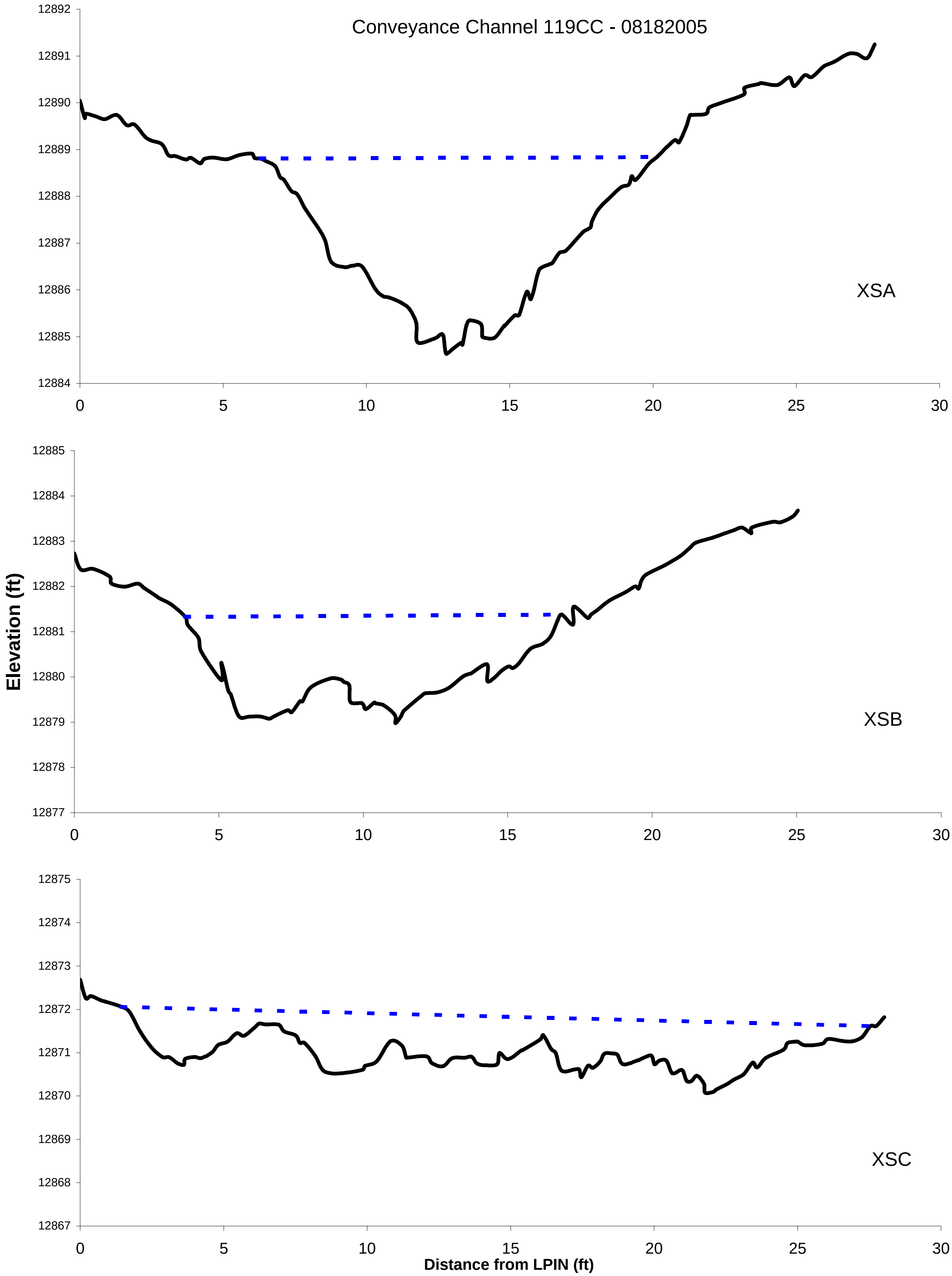


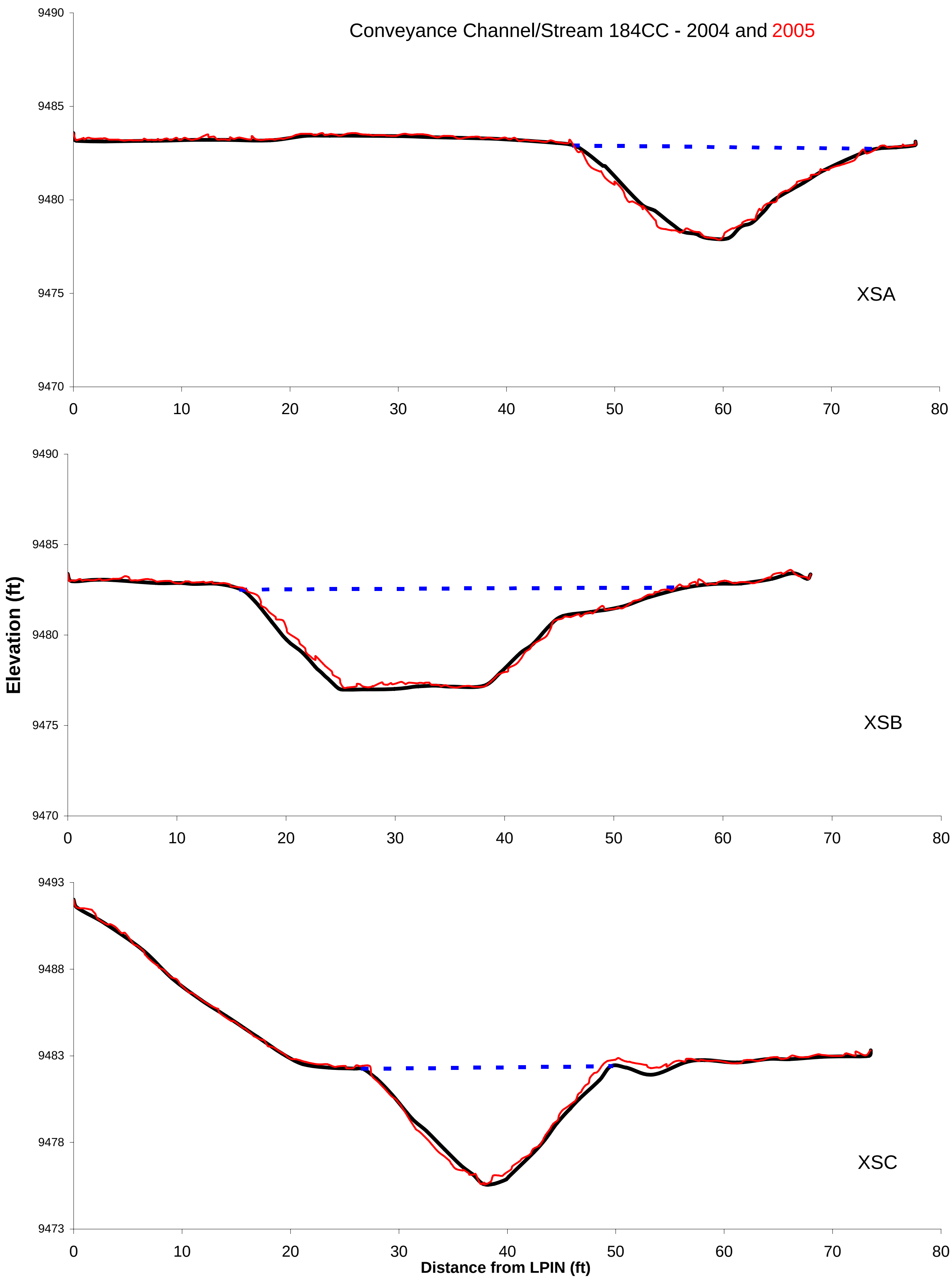
Conveyance Channel 115CC - 08052005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
13036
13035
13034
13033
13032
13031
13030
13029
13028
13023
13022
13021
13020
13019
13018
13017
13016
13015
13012
13011
13010
13009
13008
13007
13006
13005
13004
0
10
20
30
40
50

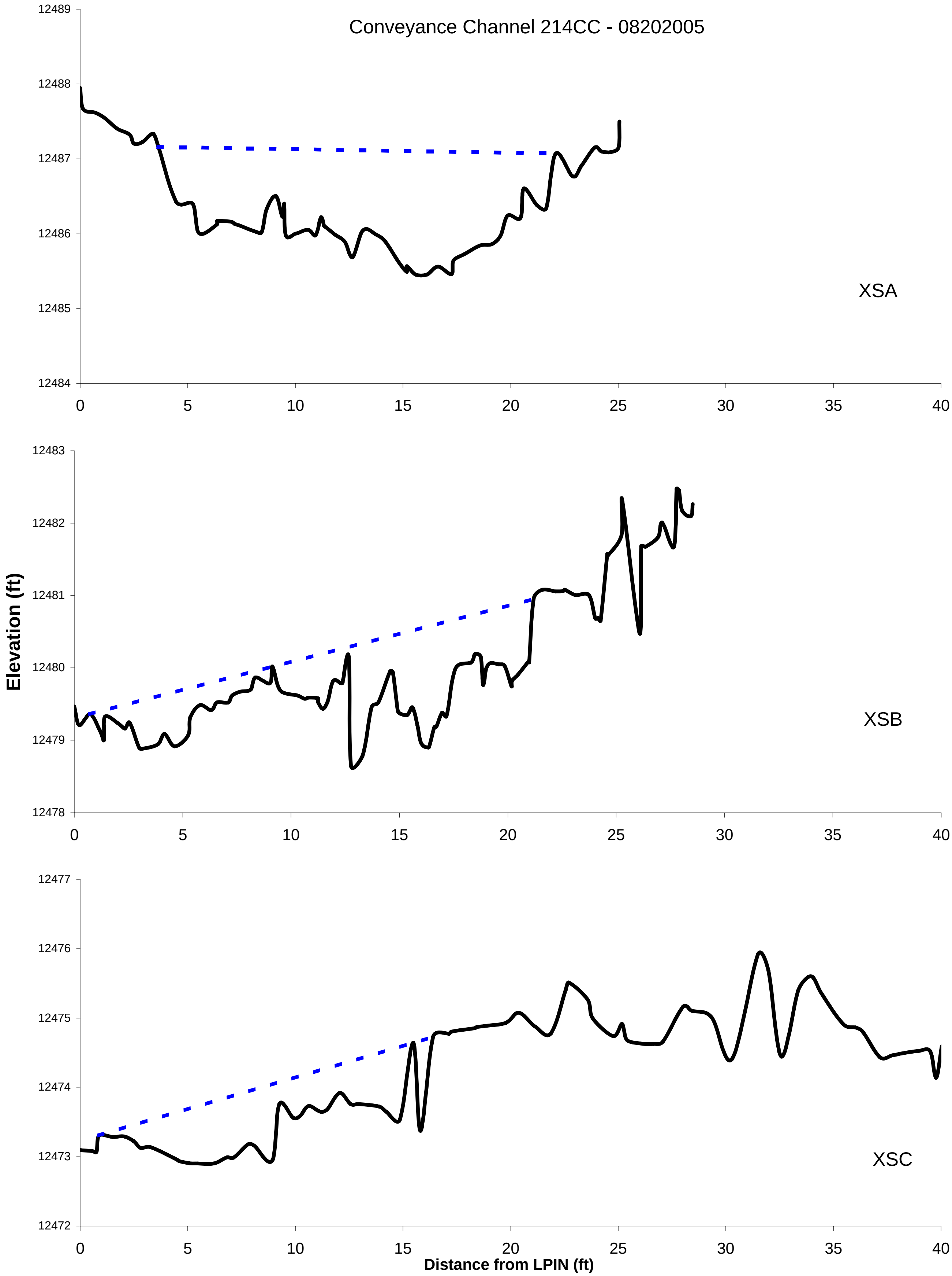

Conveyance Channel 116CC - 08182005
Elevation (ft)
XSA
XSB
XSC
Distance from LPIN (ft)
12774
12773
12772
12771
12770
12769
12768
12764
12763
12762
12761
12760
12759
12758
12756
12755
12754
12753
12752
12751
12750
0
5
10
15
20
25
30

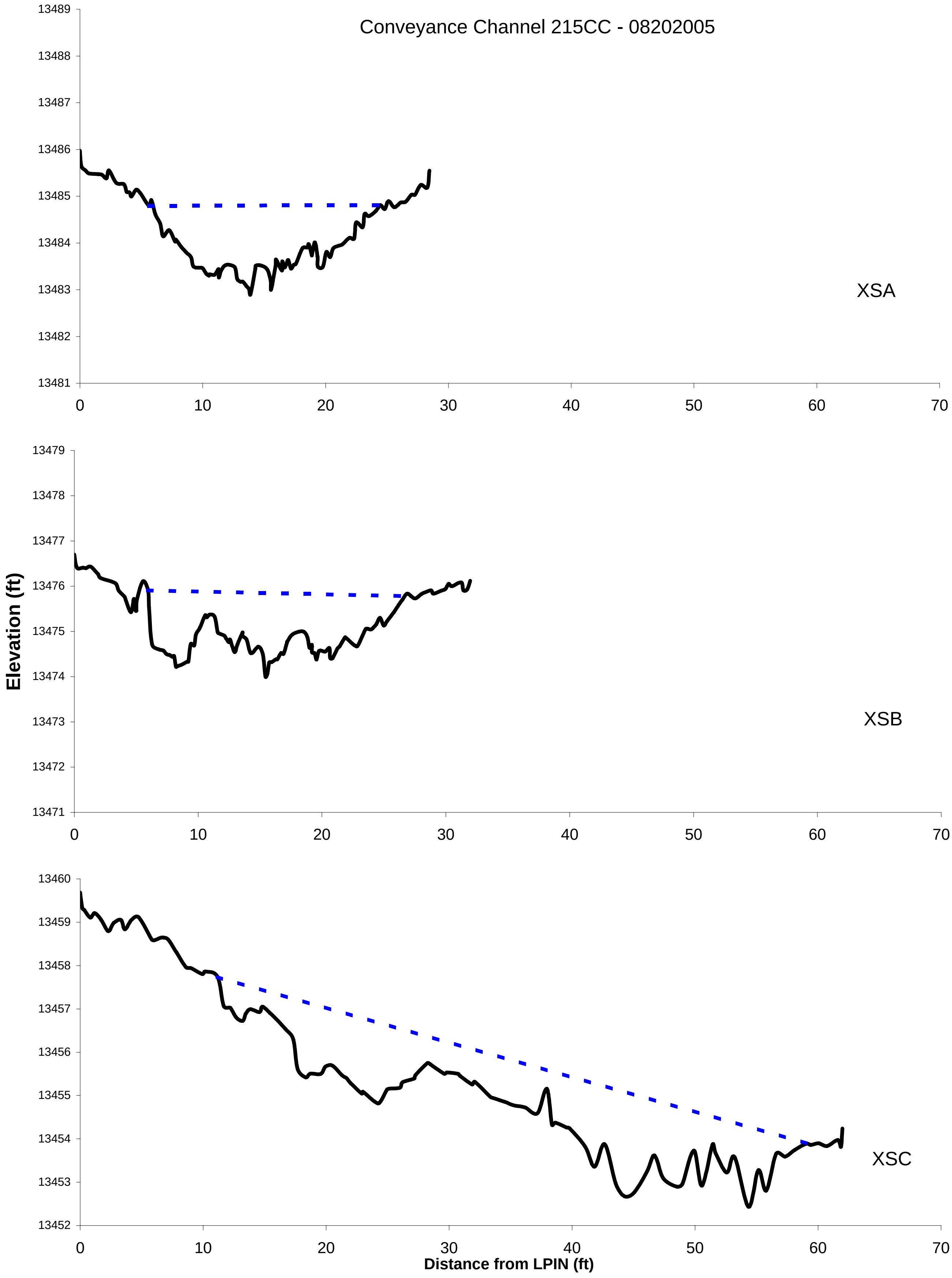

Conveyance Channel 117CC - 08182005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12868
12867
12866
12865
12864
12863
12862
12856
12855
12854
12853
12852
12851
12850
12845
12844
12843
12842
12841
12840
12839
0
5
10
15
20
25
30
35
40

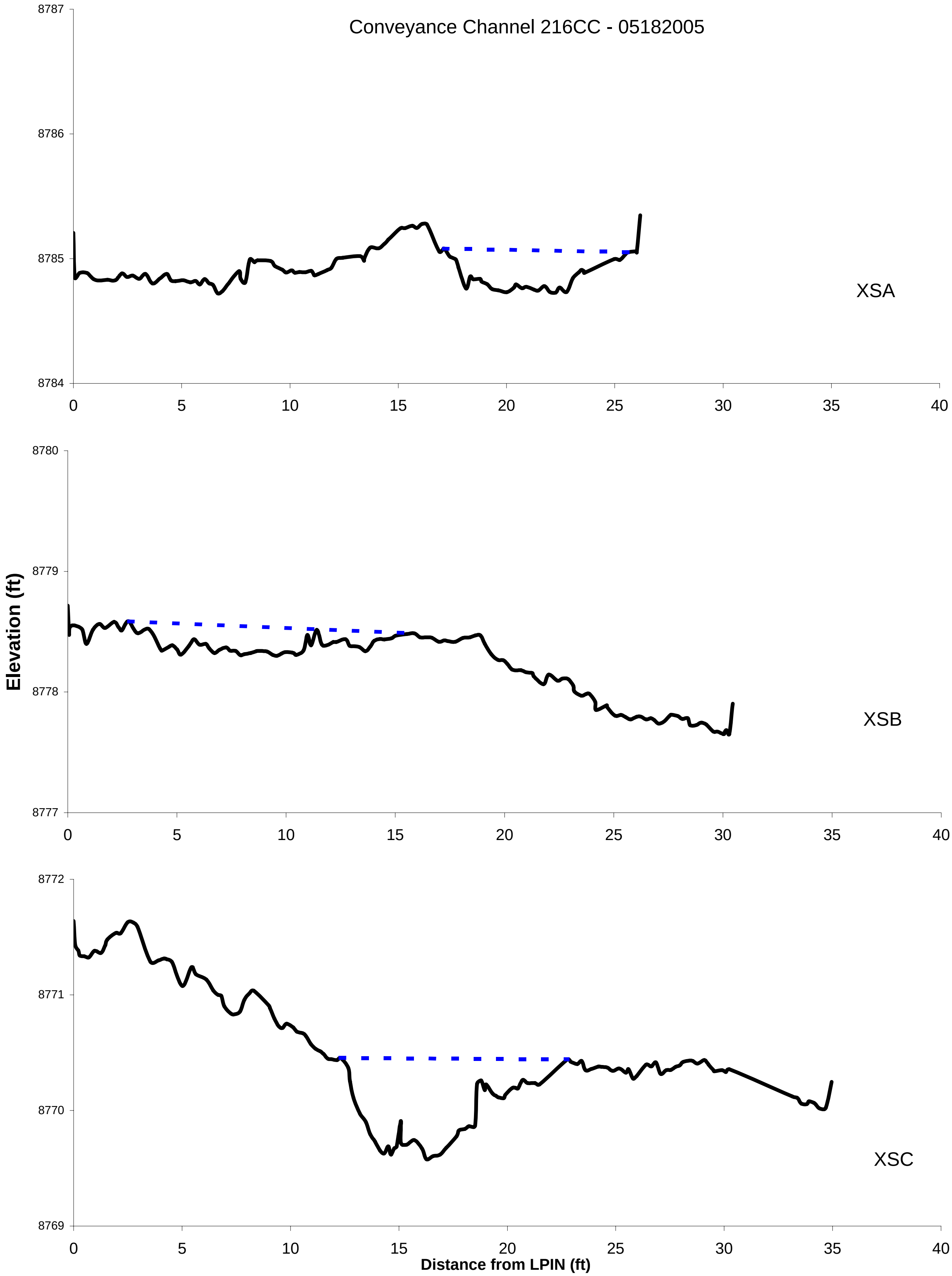

Conveyance Channel 118CC - 08182005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12893
12892
12891
12890
12889
12888
12887
12886
12885
12884
12883
12882
12881
12880
12879
12878
12877
12876
12874
12873
12872
12871
12870
12869
12868
12867
12866
0
10
20
30
40
50
60
70

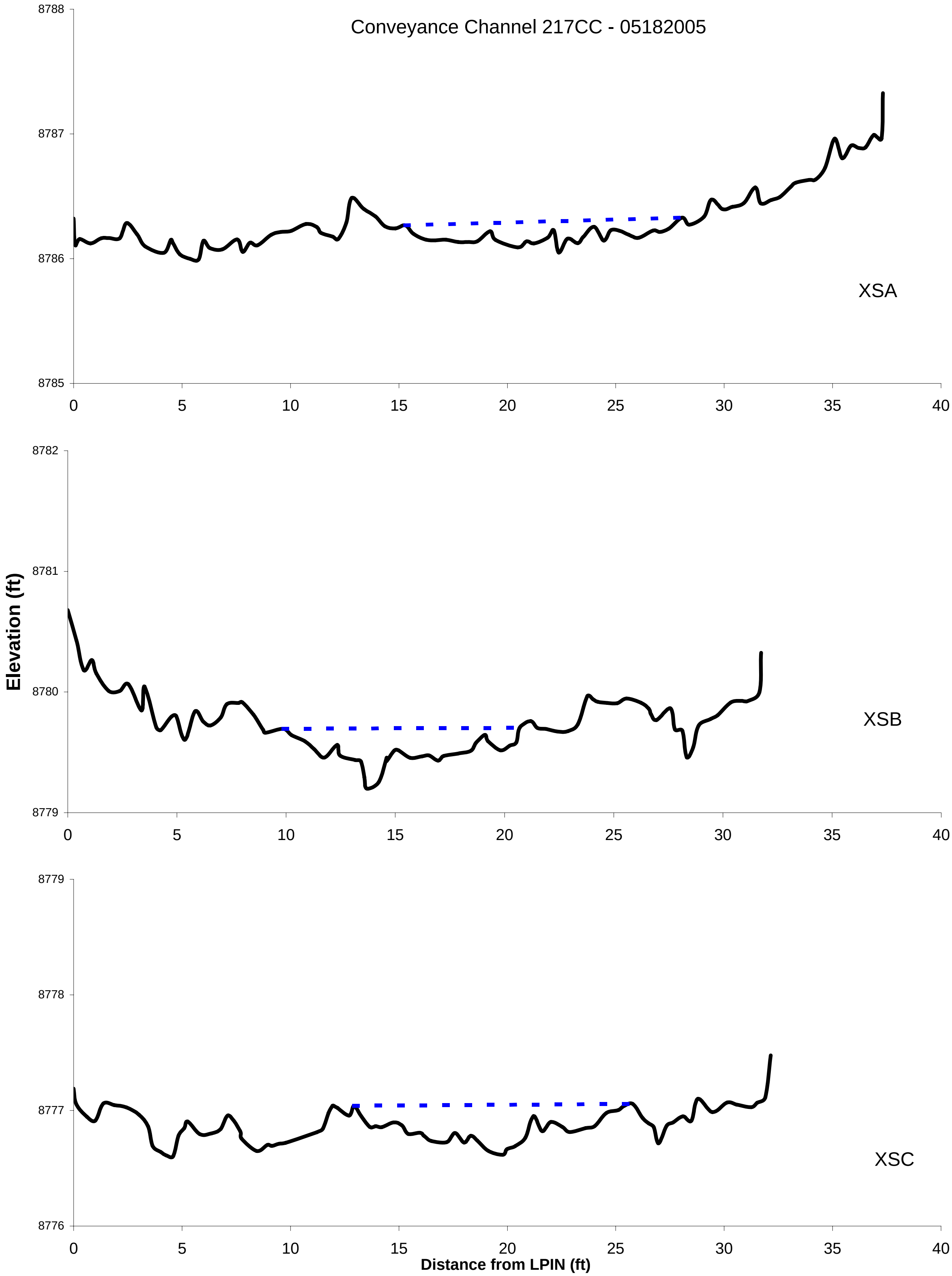

Conveyance Channel 119CC - 08182005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12892
12891
12890
12889
12888
12887
12886
12885
12884
12883
12882
12881
12880
12879
12878
12877
12875
12874
12873
12872
12871
12870
12869
12868
12867
0
5
10
15
20
25
30


Conveyance Channel/Stream 184CC - 2004 and 2005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)

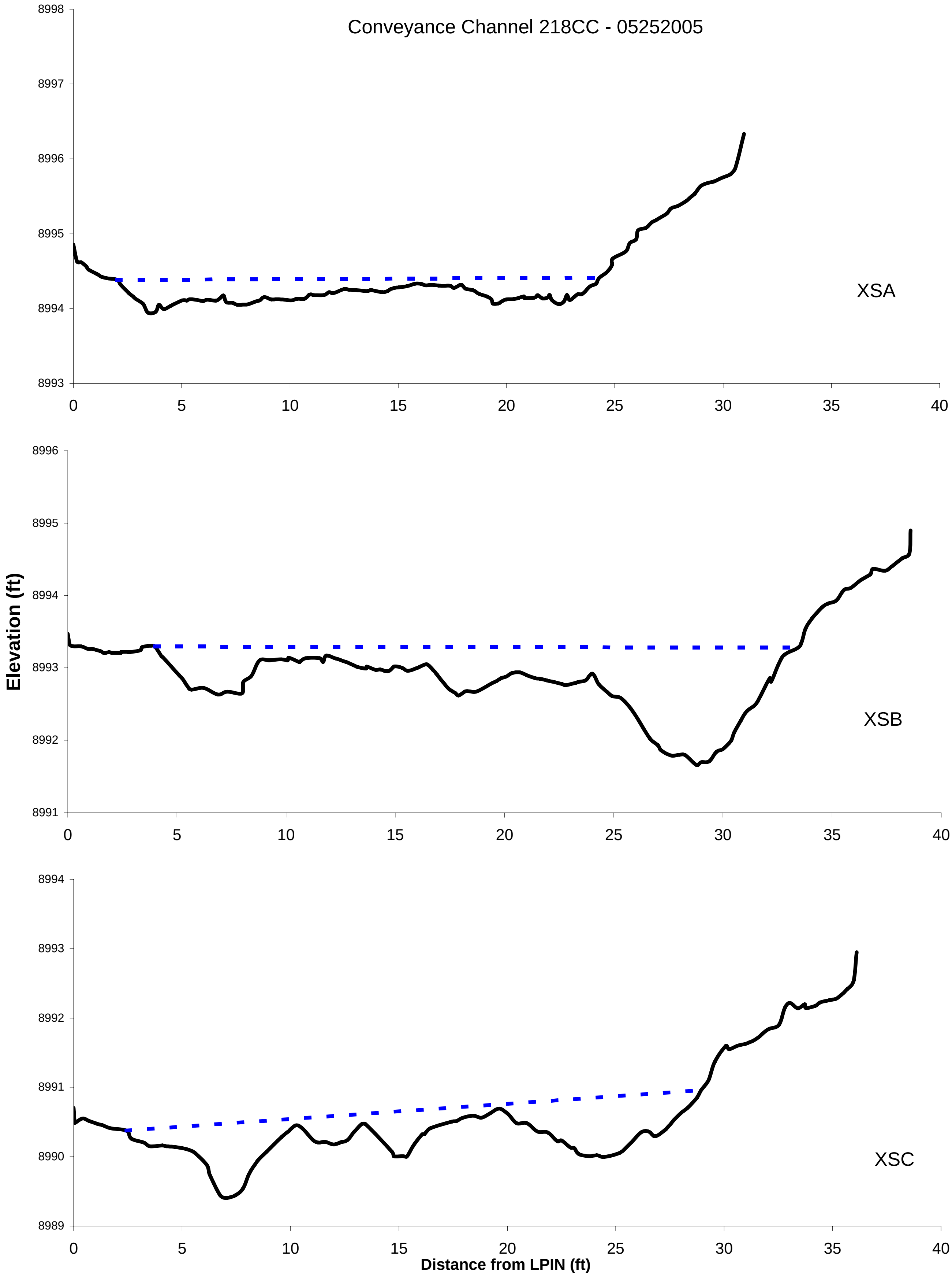

Conveyance Channel 214CC - 08202005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
12489
12488
12487
12486
12485
12484
12483
12482
12481
12480
12479
12478
12477
12476
12475
12474
12473
12472
0
5
10
15
20
25
30
35
40


Conveyance Channel 215CC - 08202005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)

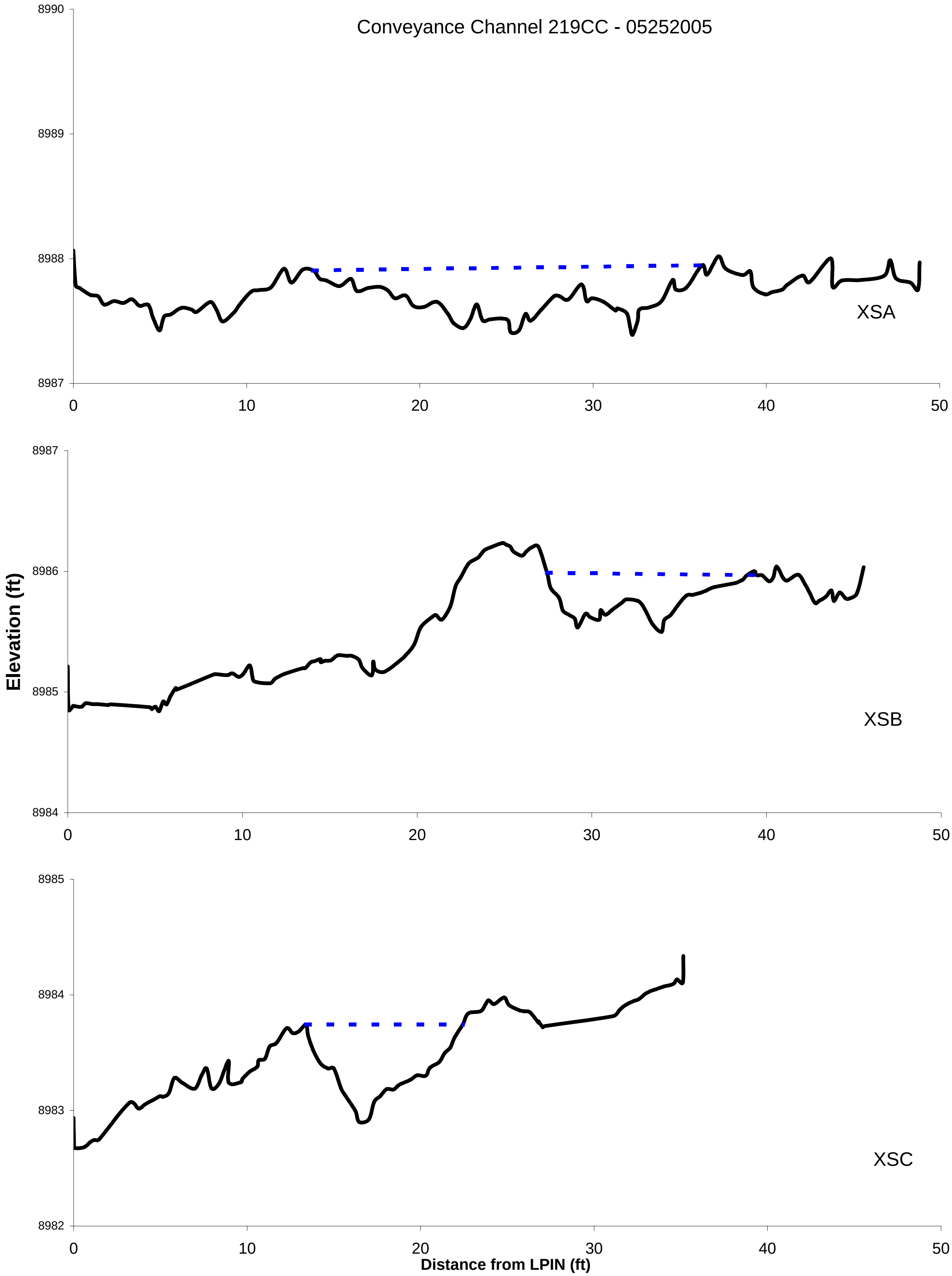

Conveyance Channel 216CC - 05182005
8787
8786
8785
8784
0 5 10 15 20 25 30 35 40
XSA
8780
8779
8778
8777
0 5 10 15 20 25 30 35 40
XSB
Elevation (ft)
8772
8771
8770
8769
0 5 10 15 20 25 30 35 40
XSC
Distance from LPIN (ft)

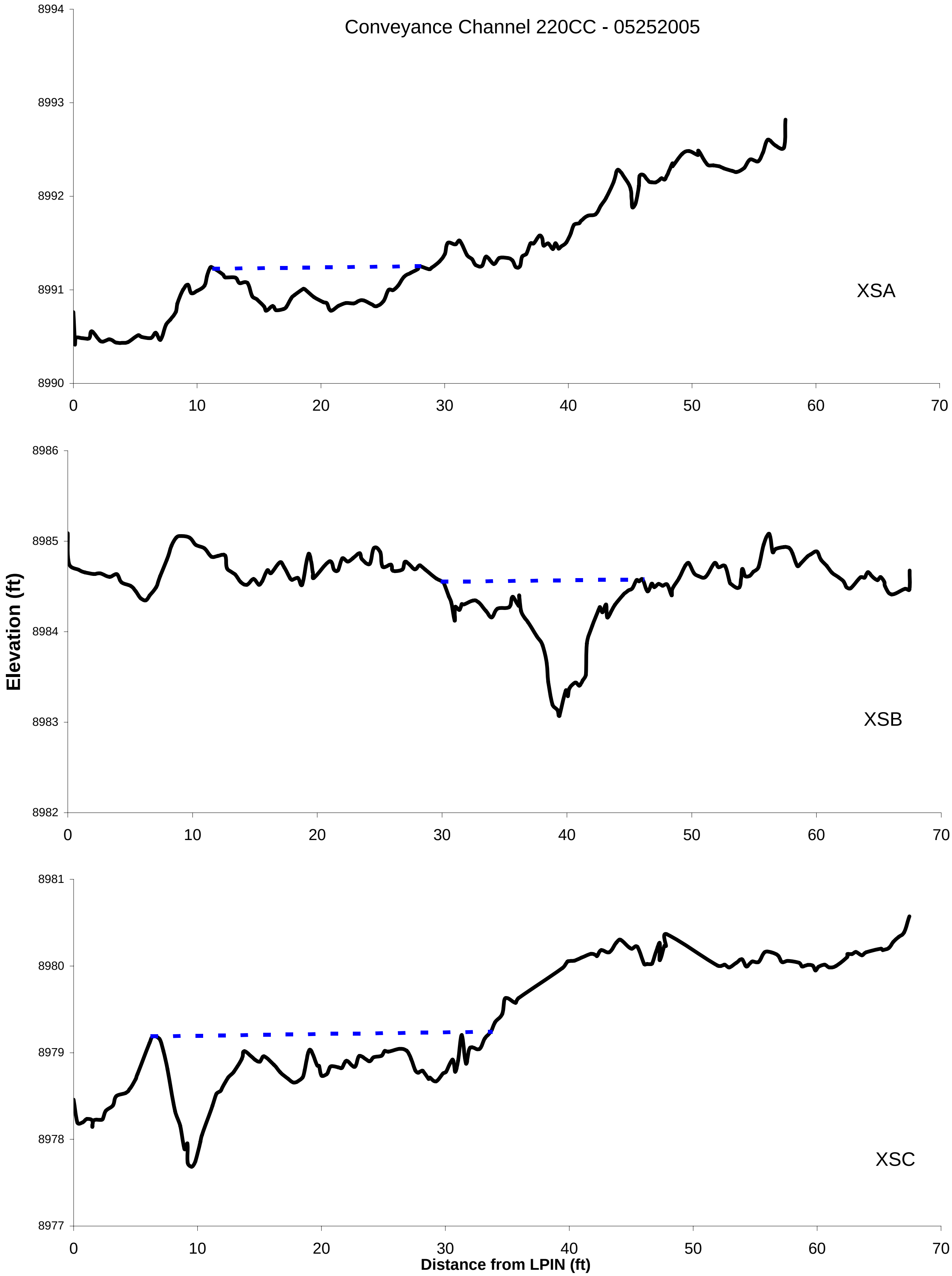


Conveyance Channel 217CC - 05182005
8788
8787
8786
8785
XSA
8782
8781
8780
8779
XSB
8779
8778
8777
8776
XSC
0
5
10
15
20
25
30
35
40
Elevation (ft)
Distance from LPIN (ft)

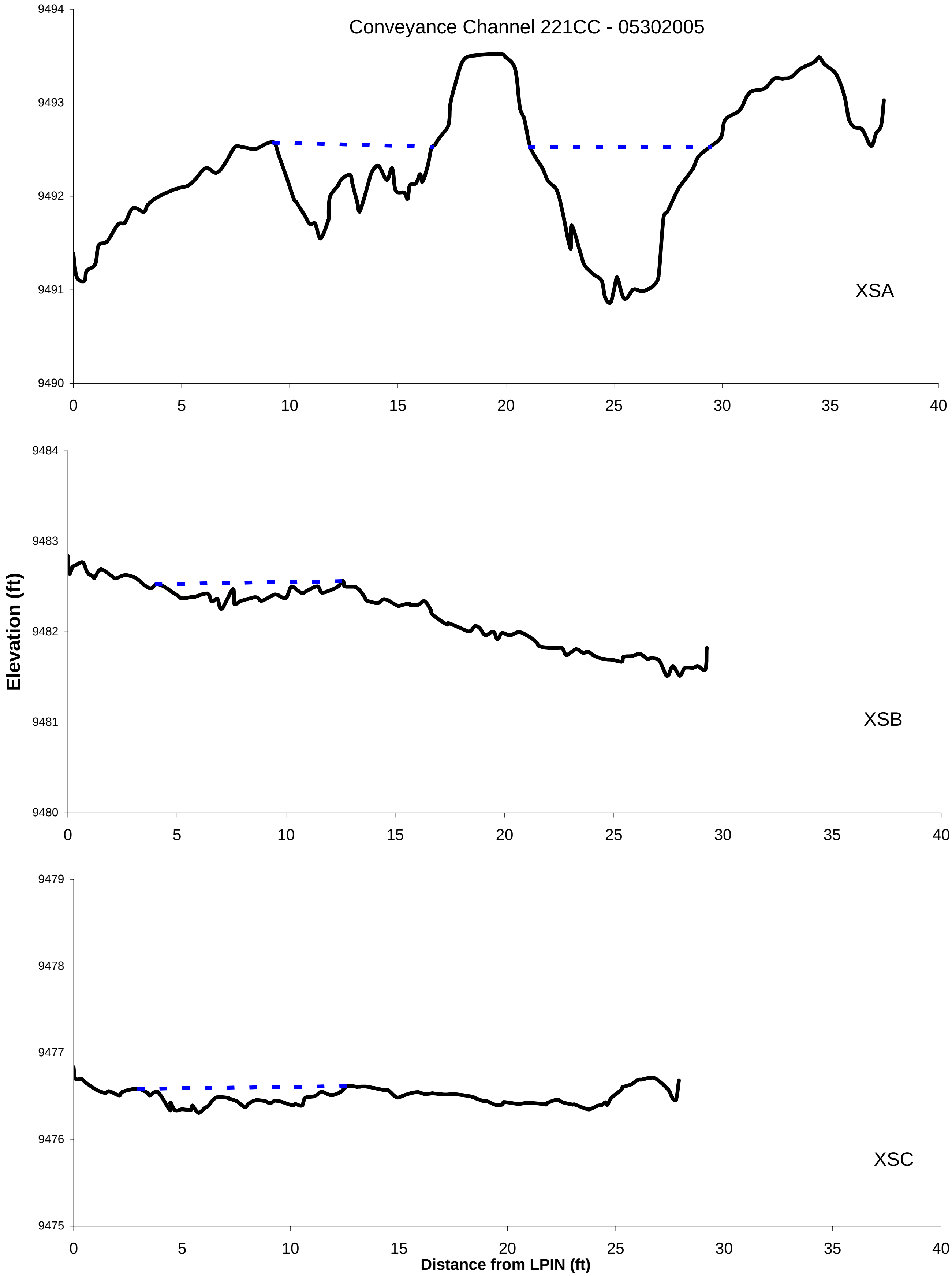


Conveyance Channel 218CC - 05252005
Elevation (ft)
8998
8997
8996
8995
8994
8993
XSA
0
5
10
15
20
25
30
35
40
8996
8995
8994
8993
8992
8991
XSB
0
5
10
15
20
25
30
35
40
8994
8993
8992
8991
8990
8989
XSC
0
5
10
15
20
25
30
35
40
Distance from LPIN (ft)

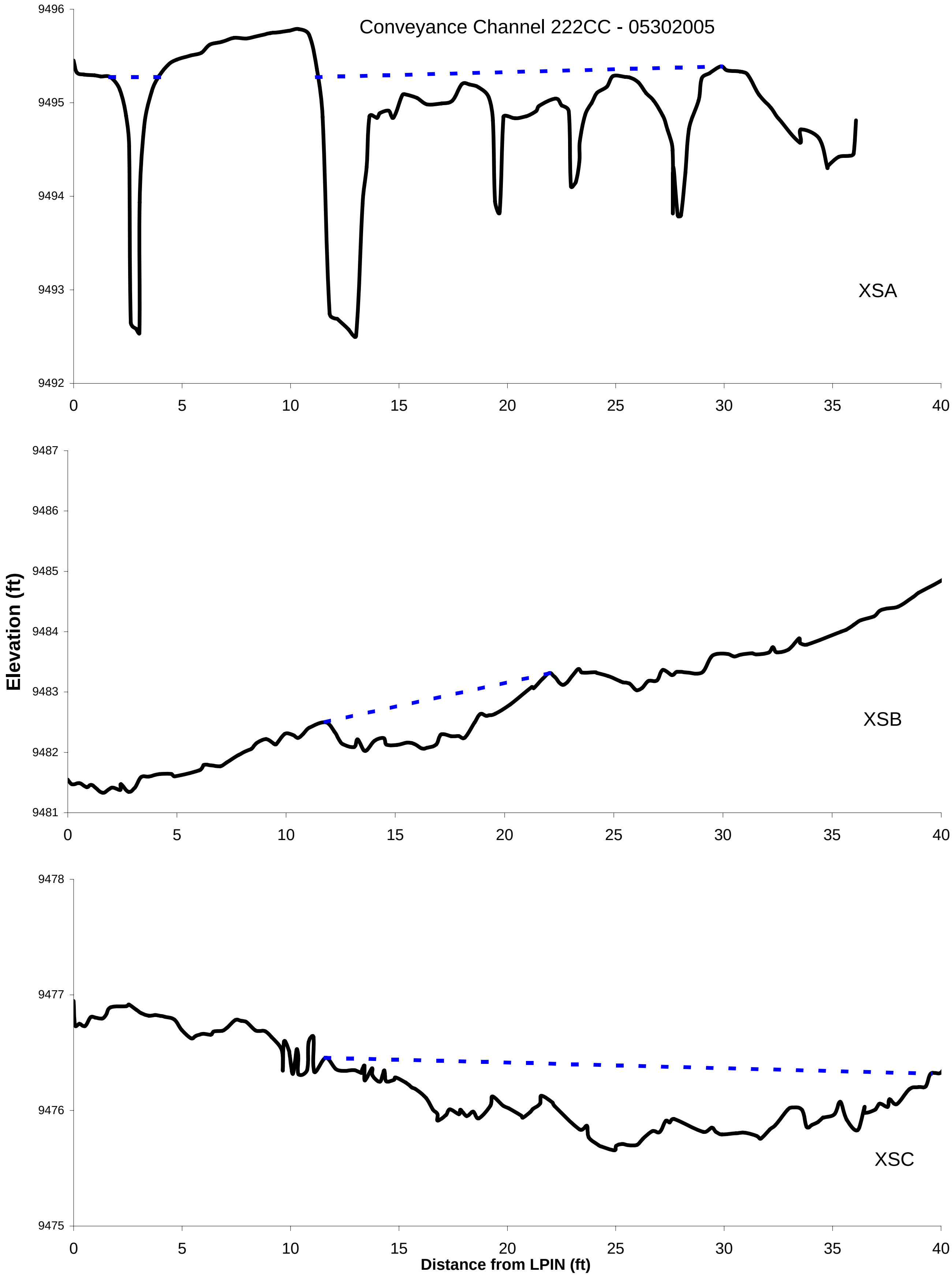

Conveyance Channel 219CC - 05252005
Elevation (ft)
8990
8989
8988
8987
0
10
20
30
40
50
XSA
8987
8986
8985
8984
0
10
20
30
40
50
XSB
8985
8984
8983
8982
0
10
20
30
40
50
XSC
Distance from LPIN (ft)

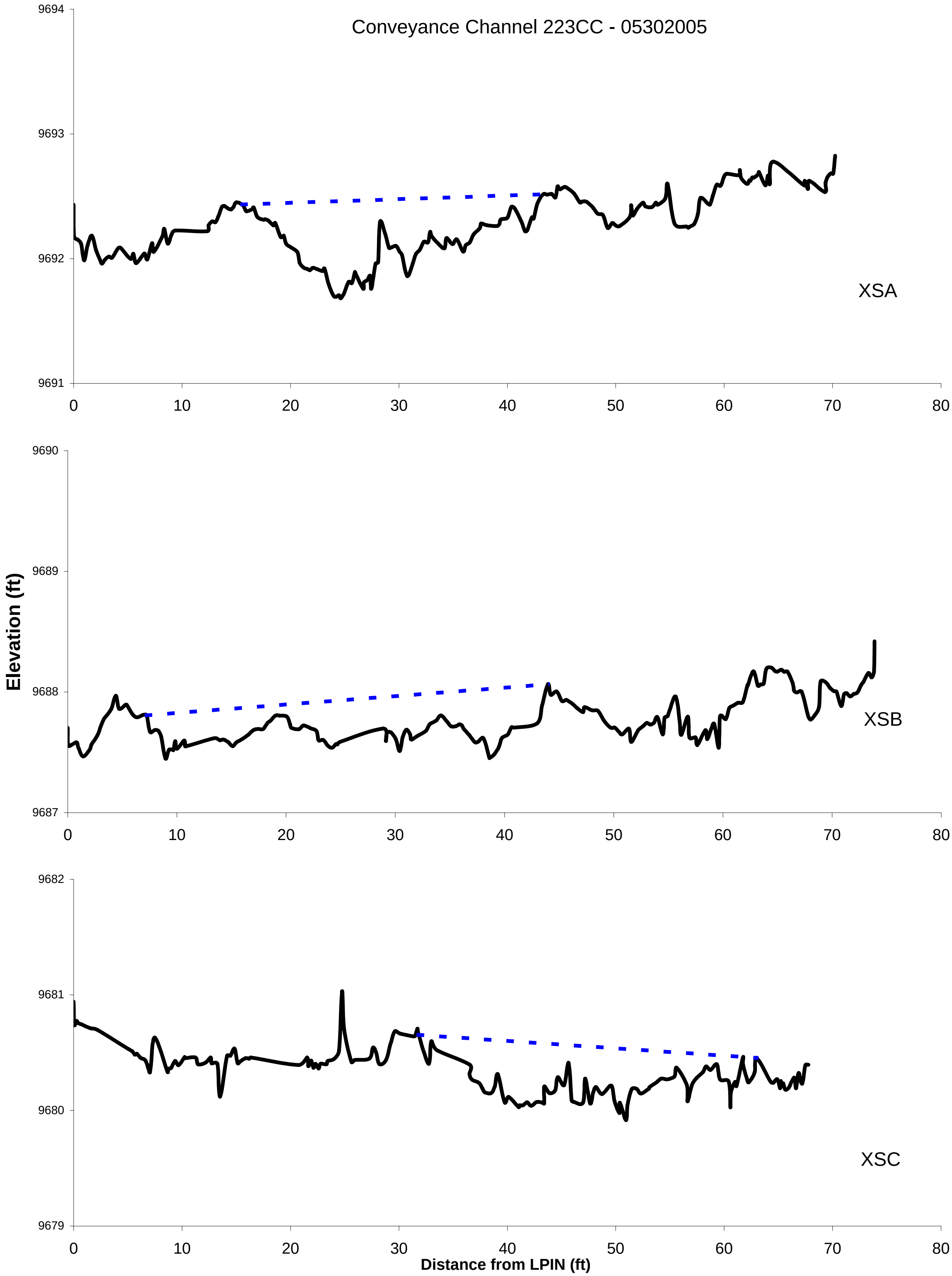


Conveyance Channel 220CC - 05252005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
8994
8993
8992
8991
8990
8986
8985
8984
8983
8982
8981
8980
8979
8978
8977
0
10
20
30
40
50
60
70

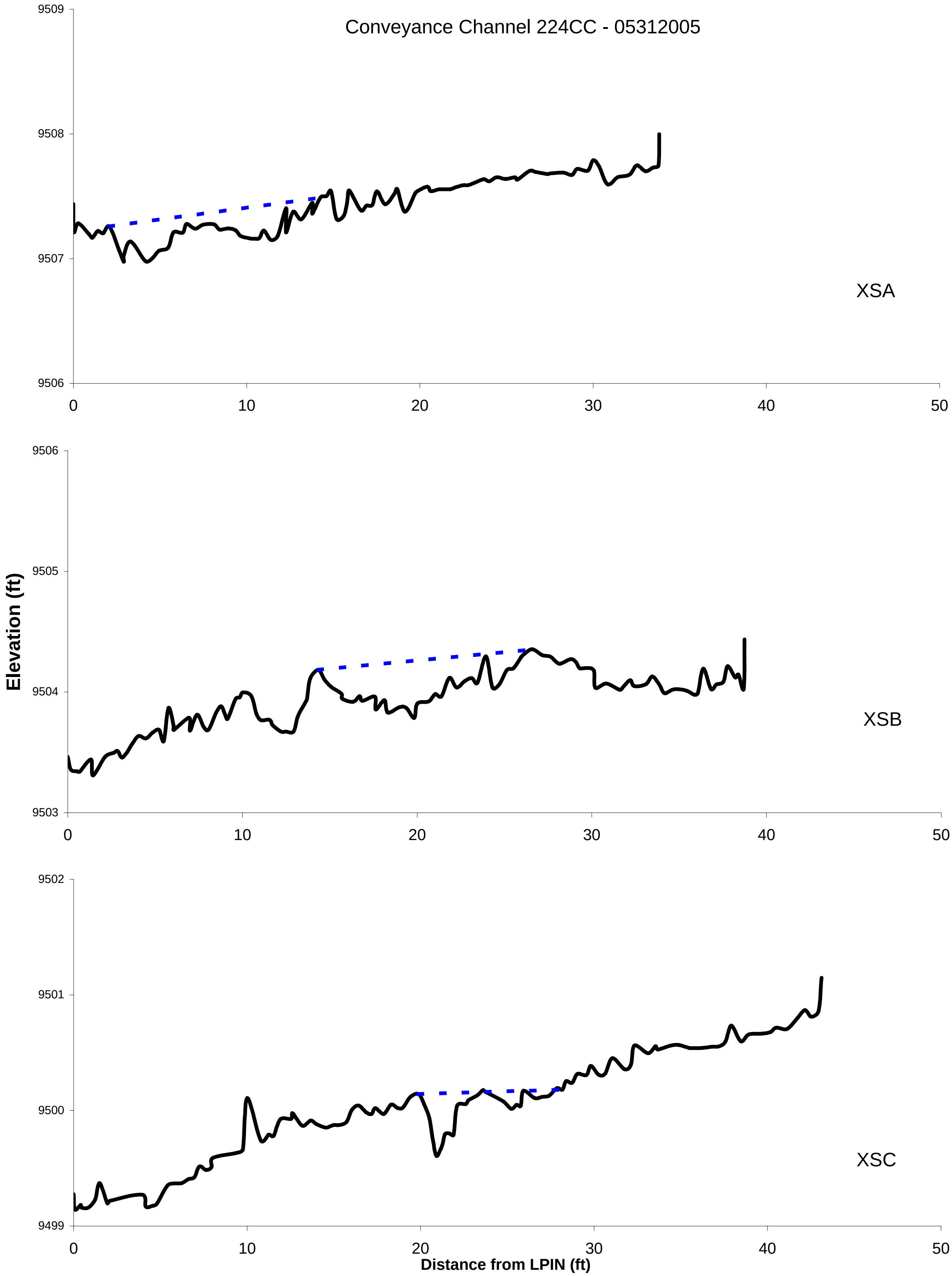


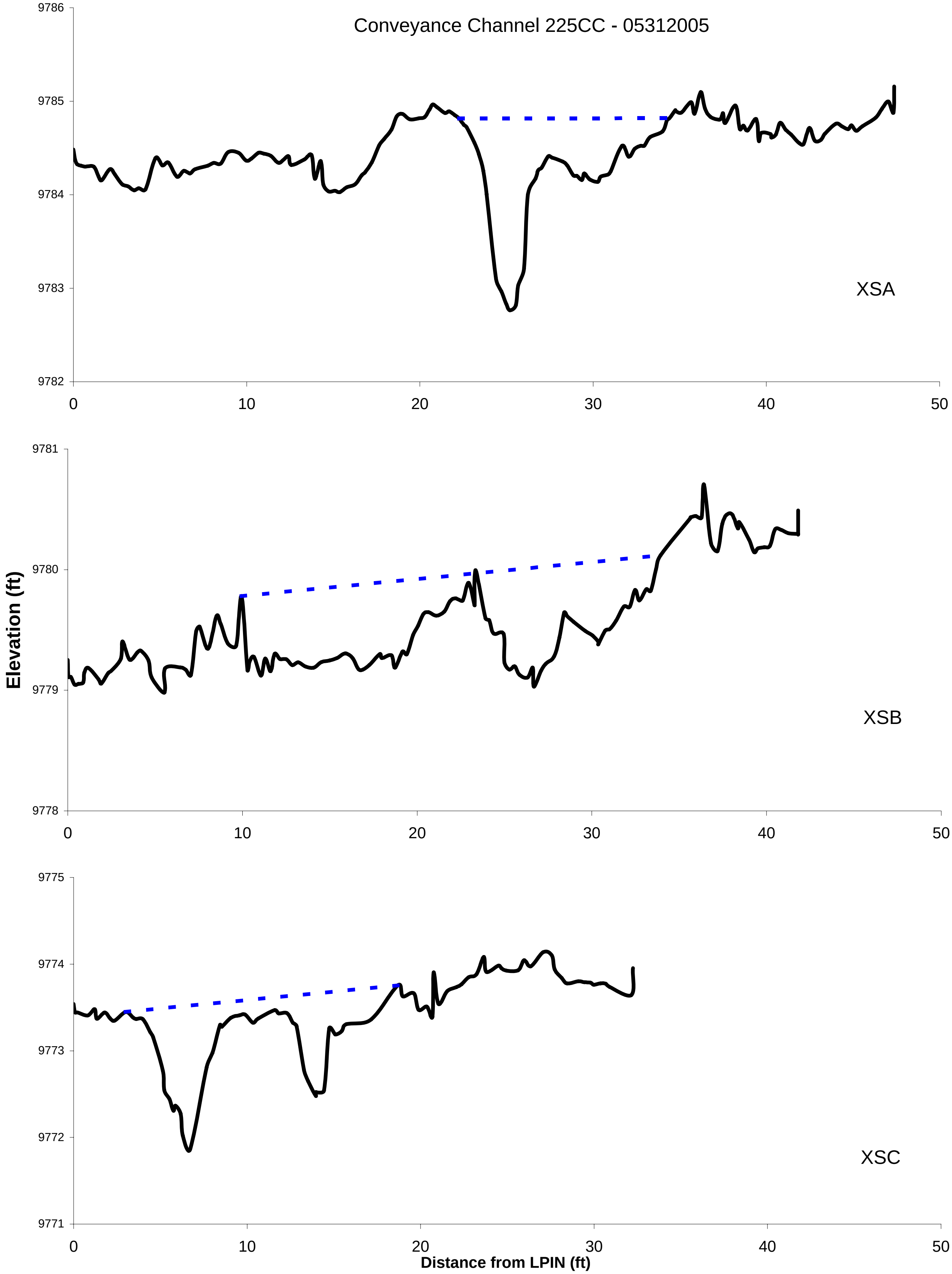
Conveyance Channel 221CC - 05302005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
9494
9493
9492
9491
9490
9484
9483
9482
9481
9480
9479
9478
9477
9476
9475
0
5
10
15
20
25
30
35
40

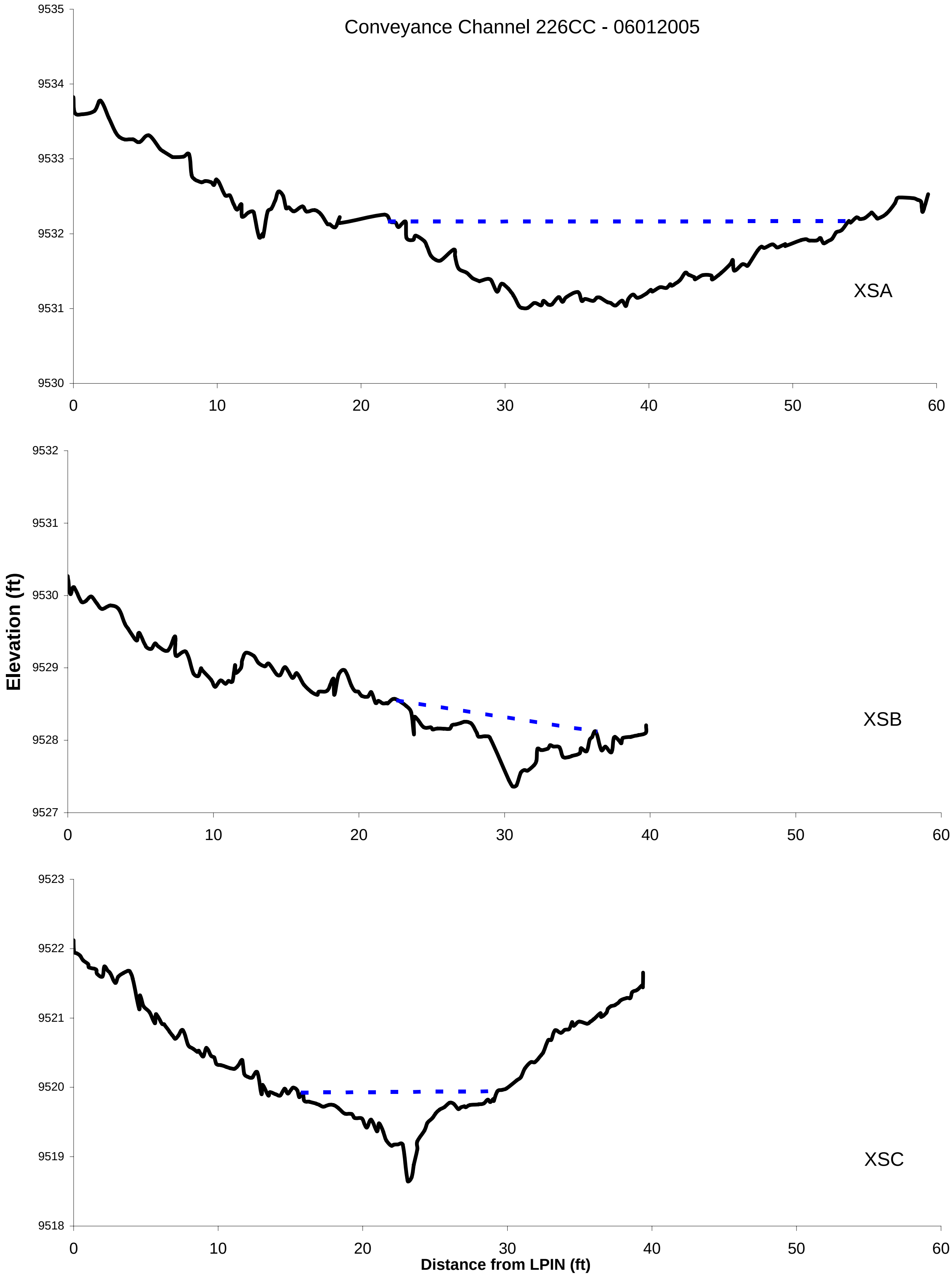

Conveyance Channel 222CC - 05302005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
9496
9495
9494
9493
9492
9487
9486
9485
9484
9483
9482
9481
9478
9477
9476
9475
0
5
10
15
20
25
30
35
40



Conveyance Channel 223CC - 05302005
Elevation (ft)
9694
9693
9692
9691
XSA
9690
9689
9688
9687
XSB
9682
9681
9680
9679
XSC
0
10
20
30
40
50
60
70
80
Distance from LPIN (ft)


Conveyance Channel 224CC - 05312005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
9509
9508
9507
9506
9505
9504
9503
9502
9501
9500
9499
0
10
20
30
40
50


Conveyance Channel 225CC - 05312005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
9786
9785
9784
9783
9782
9781
9780
9779
9778
9775
9774
9773
9772
9771
0
10
20
30
40
50


Conveyance Channel 226CC - 06012005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
9535
9534
9533
9532
9531
9530
9529
9528
9527
9523
9522
9521
9520
9519
9518
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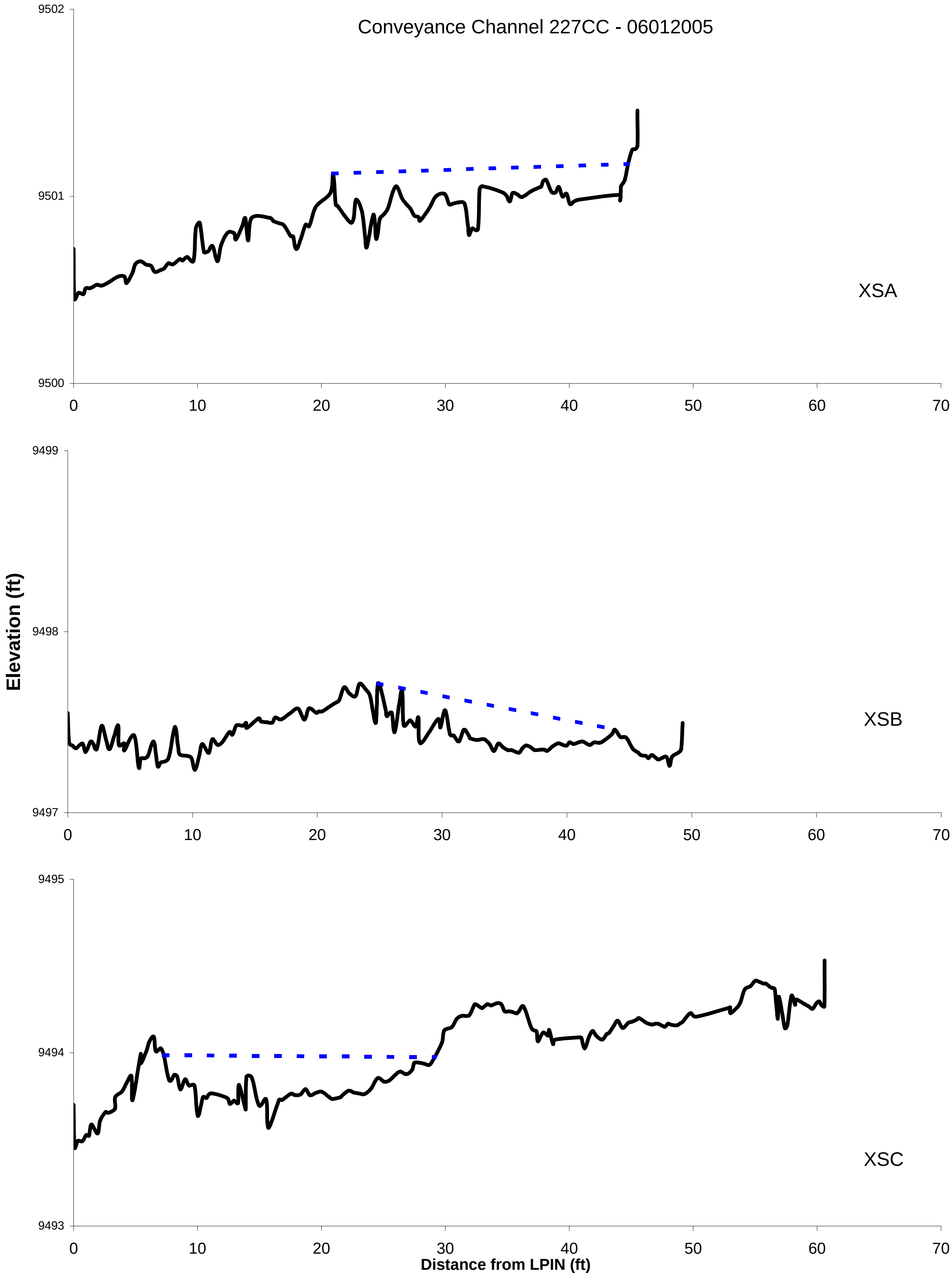
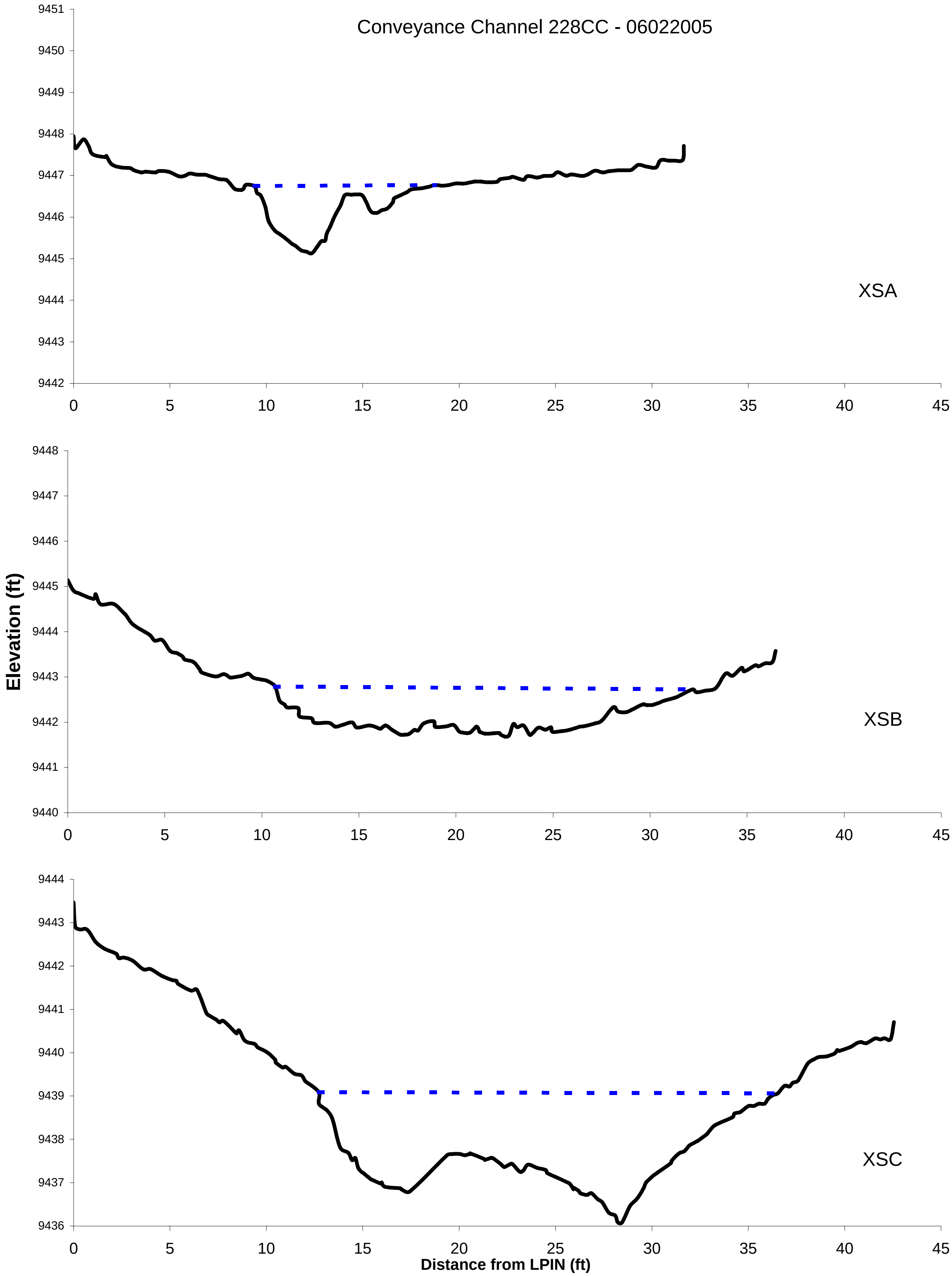
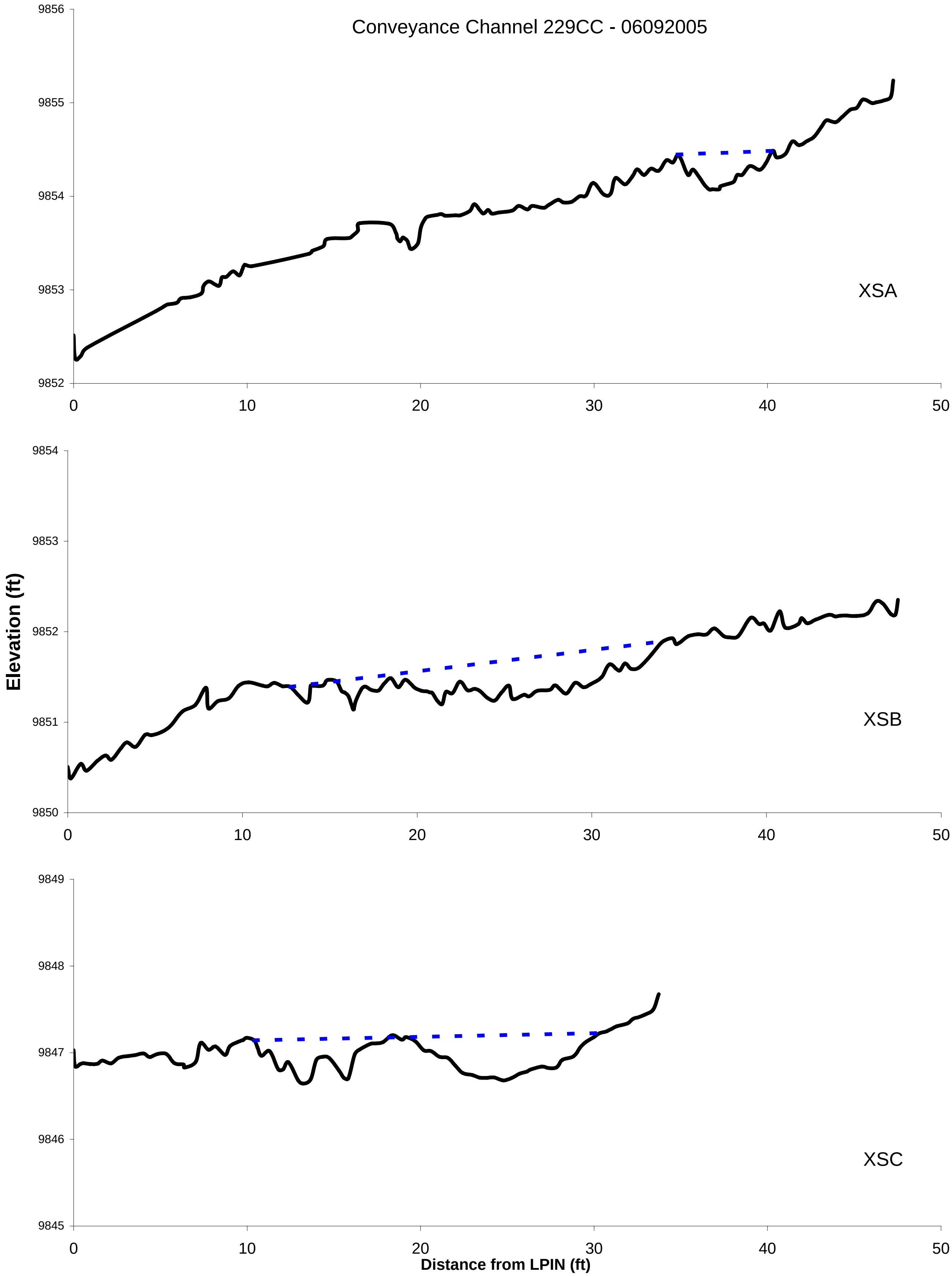
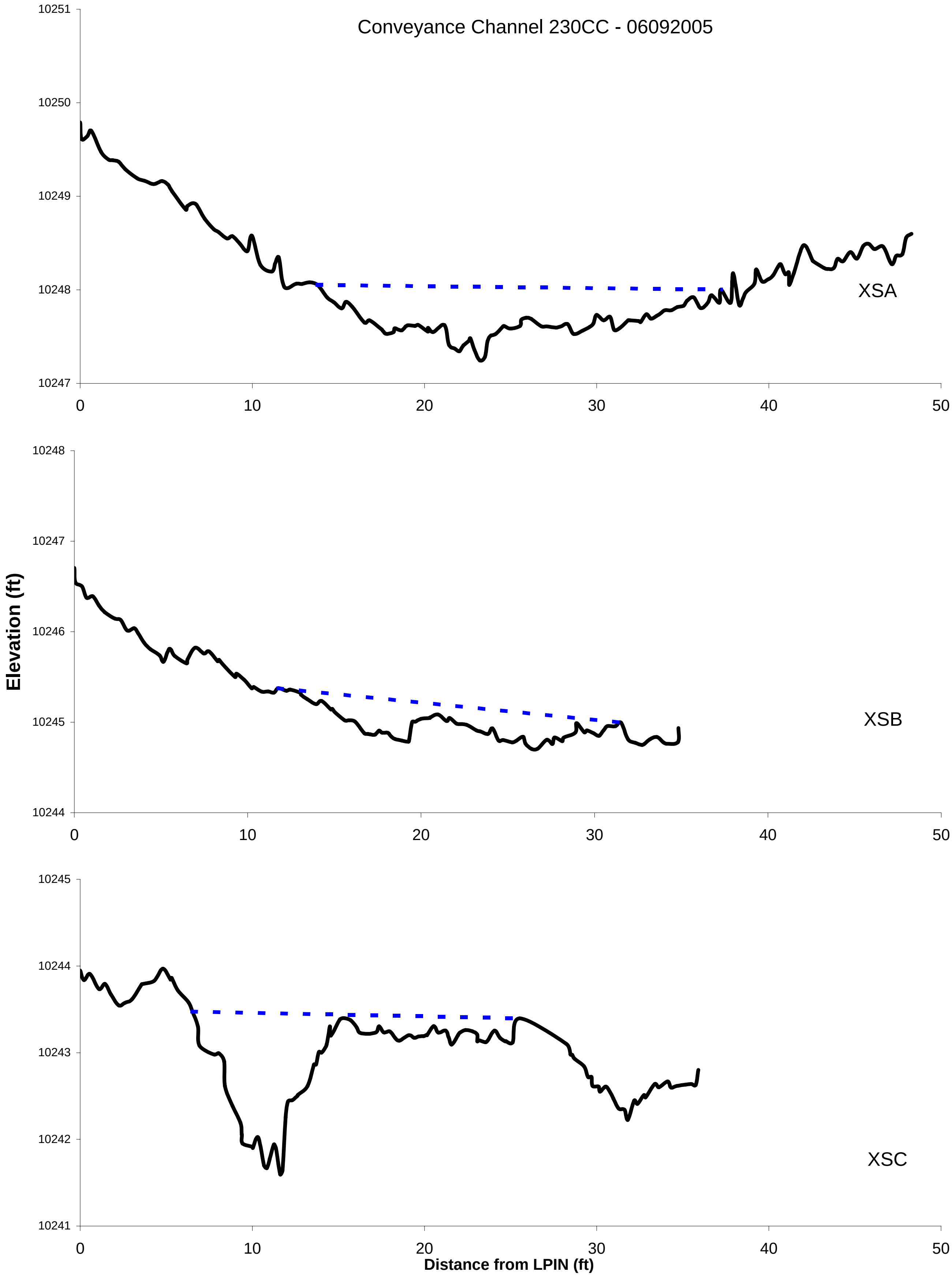
10
20
30
40
50
60

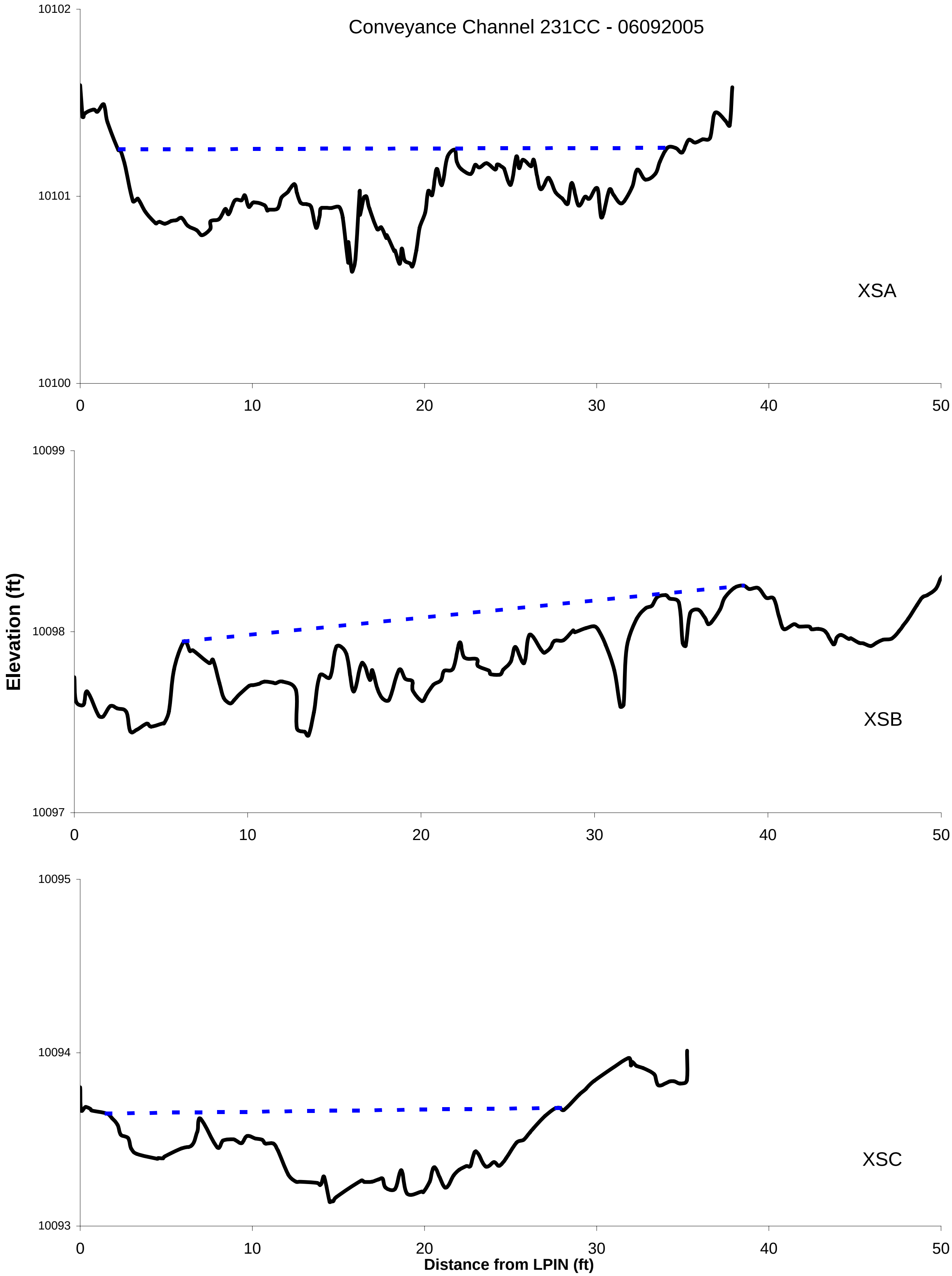

Conveyance Channel 227CC - 06012005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
9502
9501
9500
9499
9498
9497
9495
9494
9493
0
10
20
30
40
50
60
70


Conveyance Channel 228CC - 06022005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
9451
9450
9449
9448
9447
9446
9445
9444
9443
9442
9441
9440
9439
9438
9437
9436
0
5
10
15
20
25
30
35
40
45

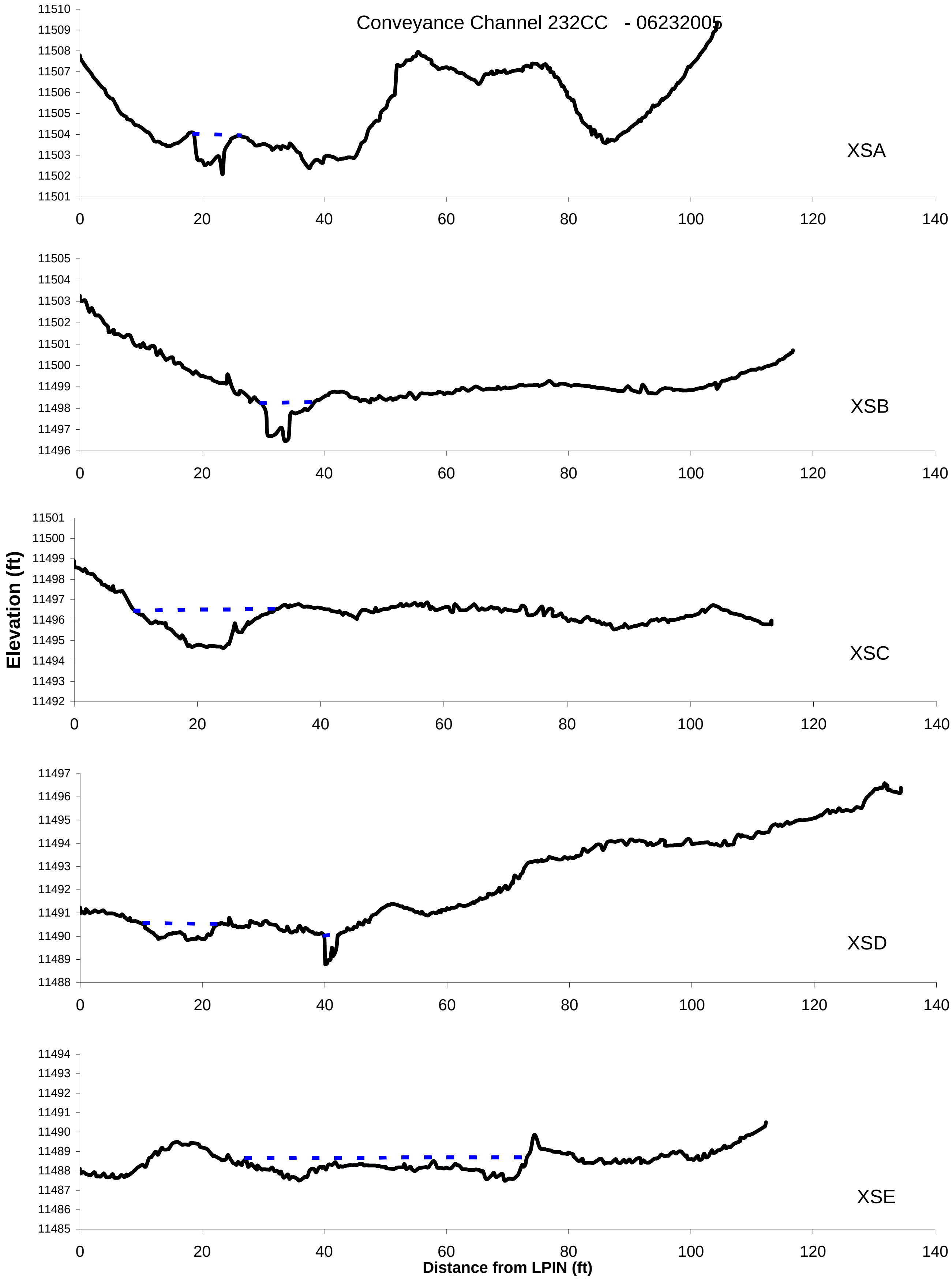


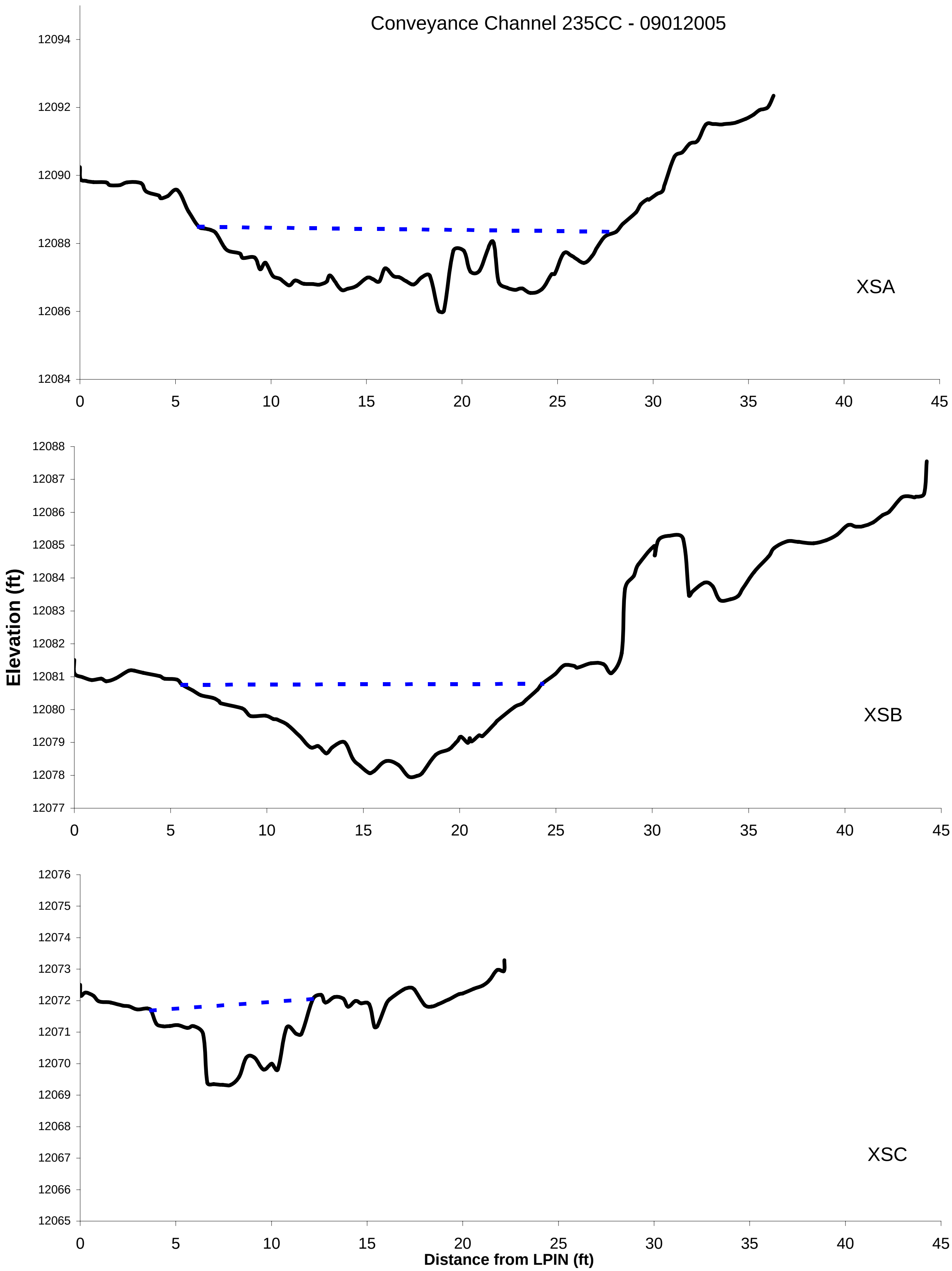
Conveyance Channel 229CC - 06092005
Elevation (ft)
9856
9855
9854
9853
9852
0
10
20
30
40
50
XSA
9854
9853
9852
9851
9850
XSB
9849
9848
9847
9846
9845
XSC
Distance from LPIN (ft)


Conveyance Channel 230CC - 06092005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
10251
10250
10249
10248
10247
10246
10245
10244
10243
10242
10241
0
10
20
30
40
50



Conveyance Channel 231CC - 06092005
Elevation (ft)
10102
10101
10100
XSA
10099
10098
10097
XSB
10095
10094
10093
XSC
0
10
20
30
40
50
Distance from LPIN (ft)


Conveyance Channel 232CC - 06232005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)



Conveyance Channel 235CC - 09012005
XSA
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)
12094
12092
12090
12088
12086
12084
12088
12087
12086
12085
12084
12083
12082
12081
12080
12079
12078
12077
12076
12075
12074
12073
12072
12071
12070
12069
12068
12067
12066
12065
0
5
10
15
20
25
30
35
40
45

Appendix F

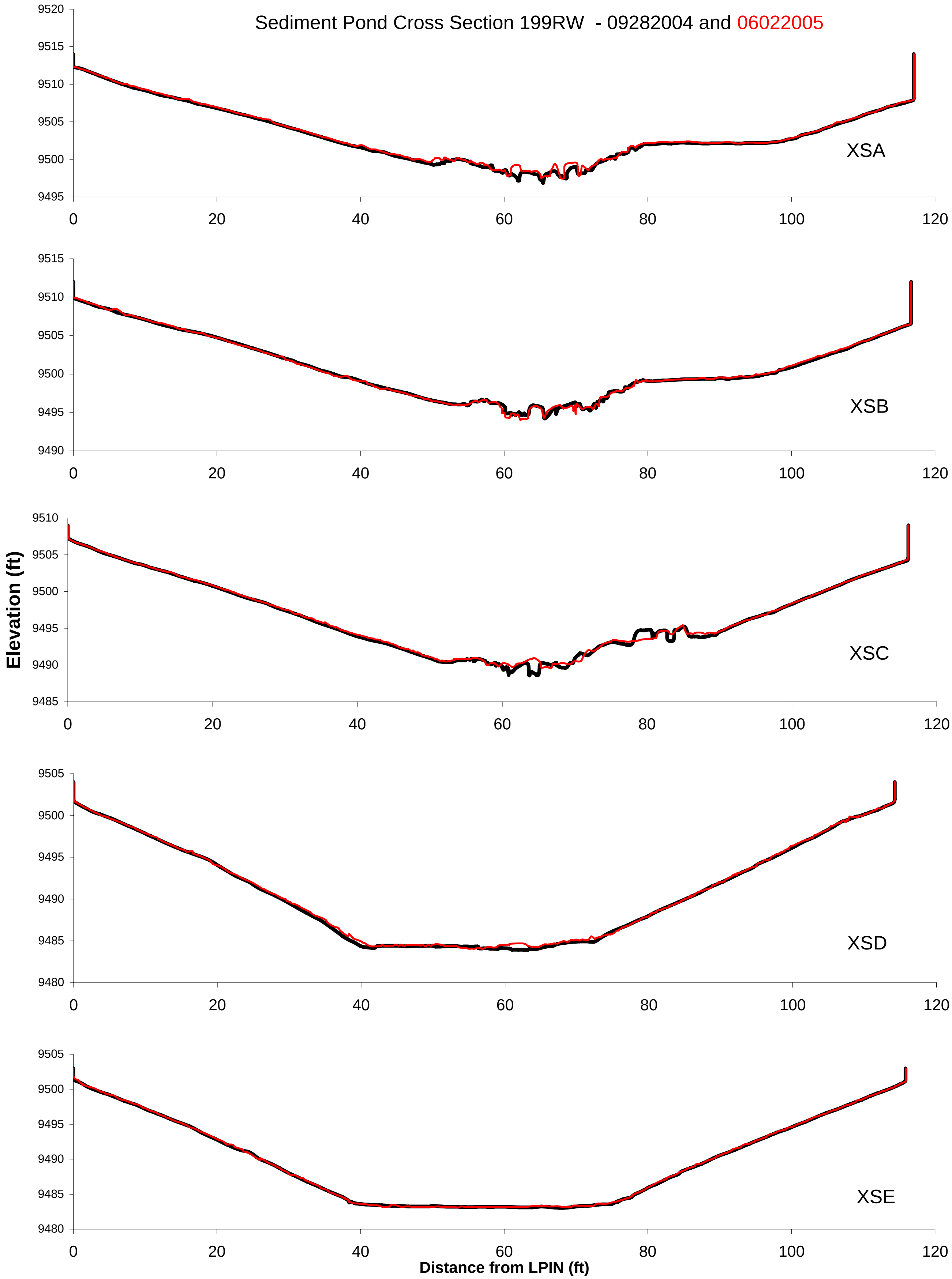
Sediment Pond Cross Section Geometry and Graphs

2005

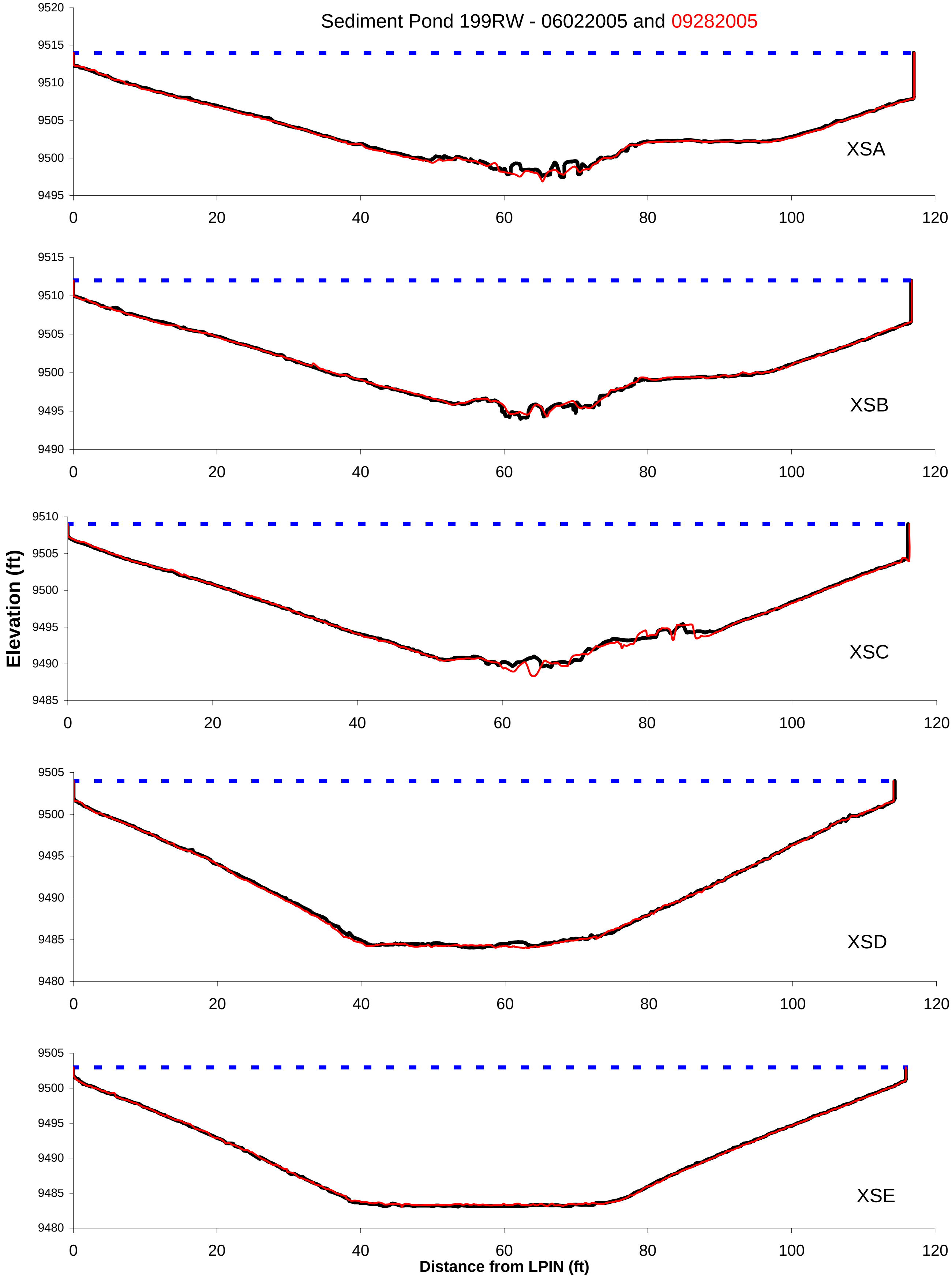
Summary of Cross Section Geometry for Sediment Ponds 199RW and 273RW - 2005

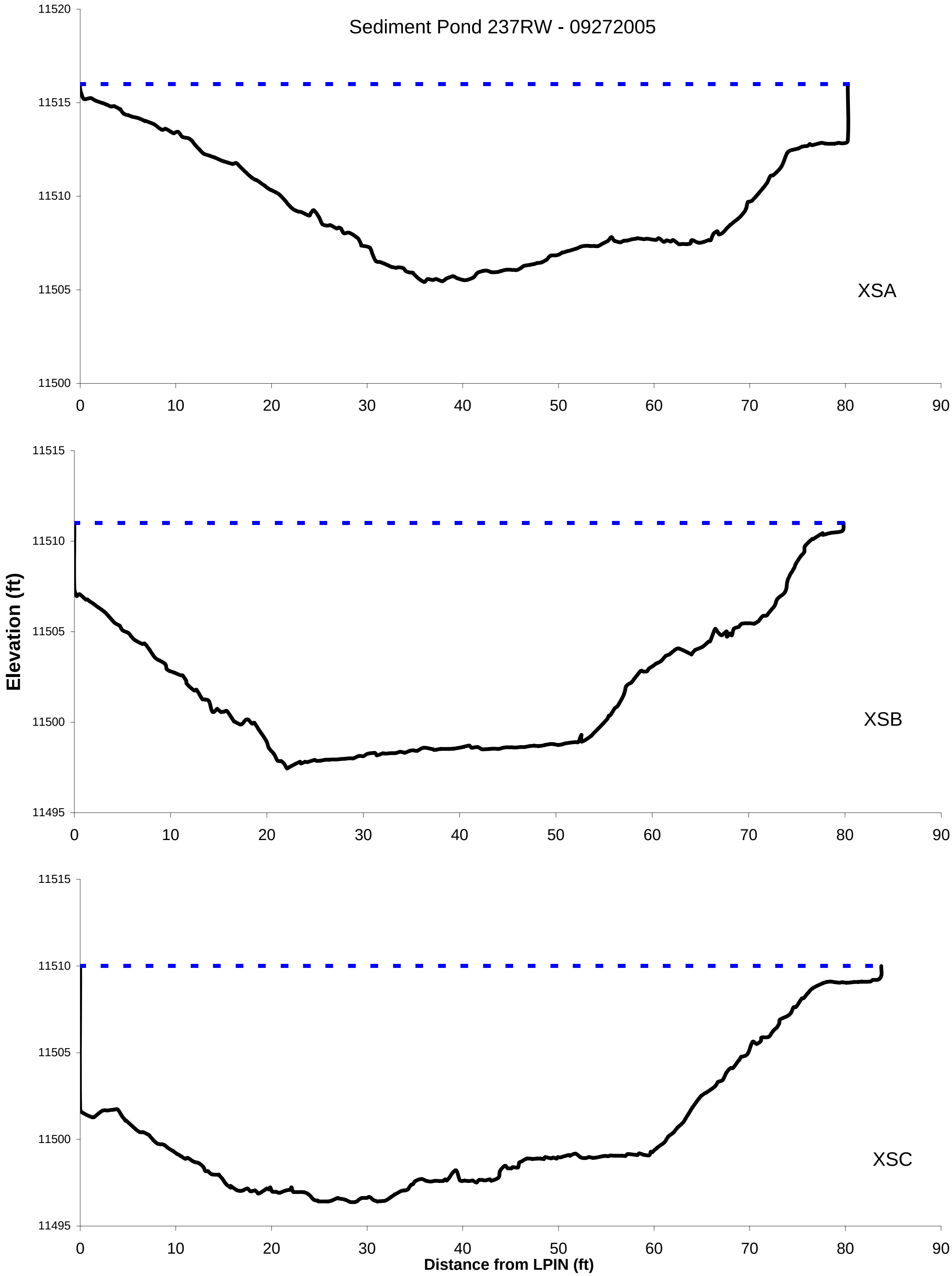
Site	Date	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Area Difference* (ft^2)
199RW	28Sep04	A	117.04	1244.55	10.63	17.05	136.60	9.11	-2.15
199RW	28Sep04	B	116.69	1176.54	10.08	16.66	134.81	8.73	-5.74
199RW	28Sep04	C	116.10	1311.68	11.30	19.33	140.85	9.31	6.27
199RW	28Sep04	D	114.20	1372.55	12.02	19.04	124.10	11.06	11.76
199RW	28Sep04	E	115.88	1522.44	13.14	19.89	127.18	11.97	18.97
199RW	02Jun05	A	117.03	1235.18	10.55	16.48	141.02	8.76	9.37
199RW	02Jun05	B	116.69	1300.75	11.15	17.97	140.55	9.25	-124.21
199RW	02Jun05	C	116.05	1424.43	12.27	19.41	133.90	10.64	-112.75
199RW	02Jun05	D	114.19	1482.48	12.98	19.95	130.04	11.40	-109.94
199RW	02Jun05	E	115.91	1527.26	13.18	19.92	129.23	11.82	-4.82
199RW	28Sep05	A	117.11	1249.83	10.67	17.09	133.16	9.39	-14.65
199RW	28Sep05	B	116.75	1297.87	11.12	17.70	133.15	9.75	2.88
199RW	28Sep05	C	116.23	1433.22	12.33	20.52	140.95	10.17	-8.79
199RW	28Sep05	D	114.02	1490.66	13.07	20.00	128.58	11.59	-8.18
199RW	28Sep05	E	115.91	1525.12	13.16	19.95	130.05	11.73	2.15
273RW	27Sep05	A	80.26	534.77	6.66	10.58	88.75	6.03	
273RW	27Sep05	B	79.87	738.49	9.25	13.55	93.06	7.94	
273RW	27Sep05	C	83.75	805.74	9.62	13.63	99.87	8.07	

*Difference in cross sectional area between successive surveys (e.g. Sep2004-Jun2005, Jun2005-Sep2005).



Sediment Pond Cross Section 199RW - 09282004 and 06022005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
9520
9515
9510
9505
9500
9495
9490
9485
9480
0
20
40
60
80
100
120


Sediment Pond 199RW - 06022005 and 09282005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
9520
9515
9510
9505
9500
9495
9490
9485
9480
0
20
40
60
80
100
120

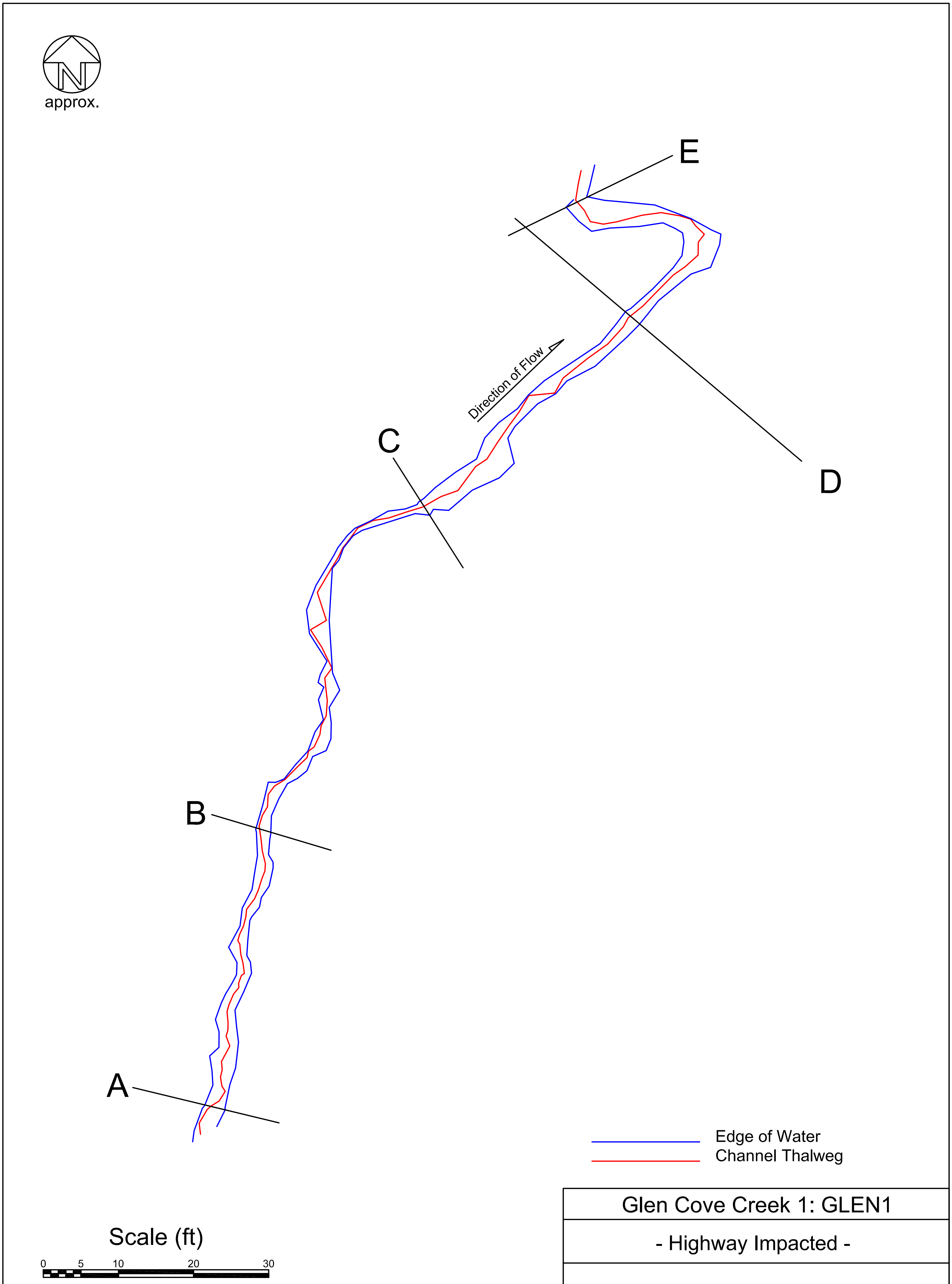


Sediment Pond 237RW - 09272005
11520
11515
11510
11505
11500
0
10
20
30
40
50
60
70
80
90
XSA
11515
11510
11505
11500
11495
XSB
XSC
Elevation (ft)
Distance from LPIN (ft)

Appendix G

Planview
Plots of Stream Reach Surveys

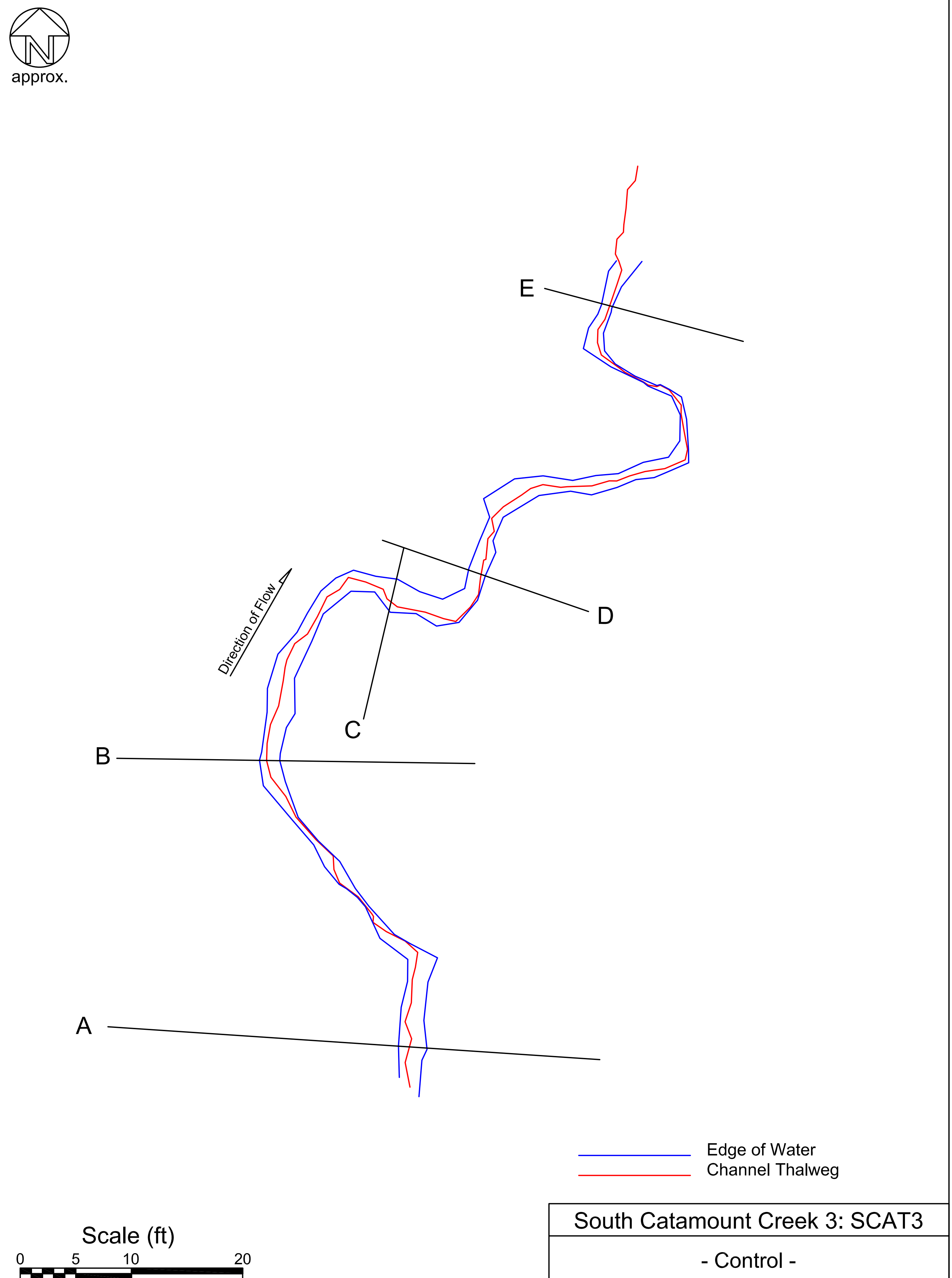
2005



Glen Cove Creek 1: GLEN1

- Highway Impacted -

October 2005



South Catamount Creek 3: SCAT3

- Control -

October 2005

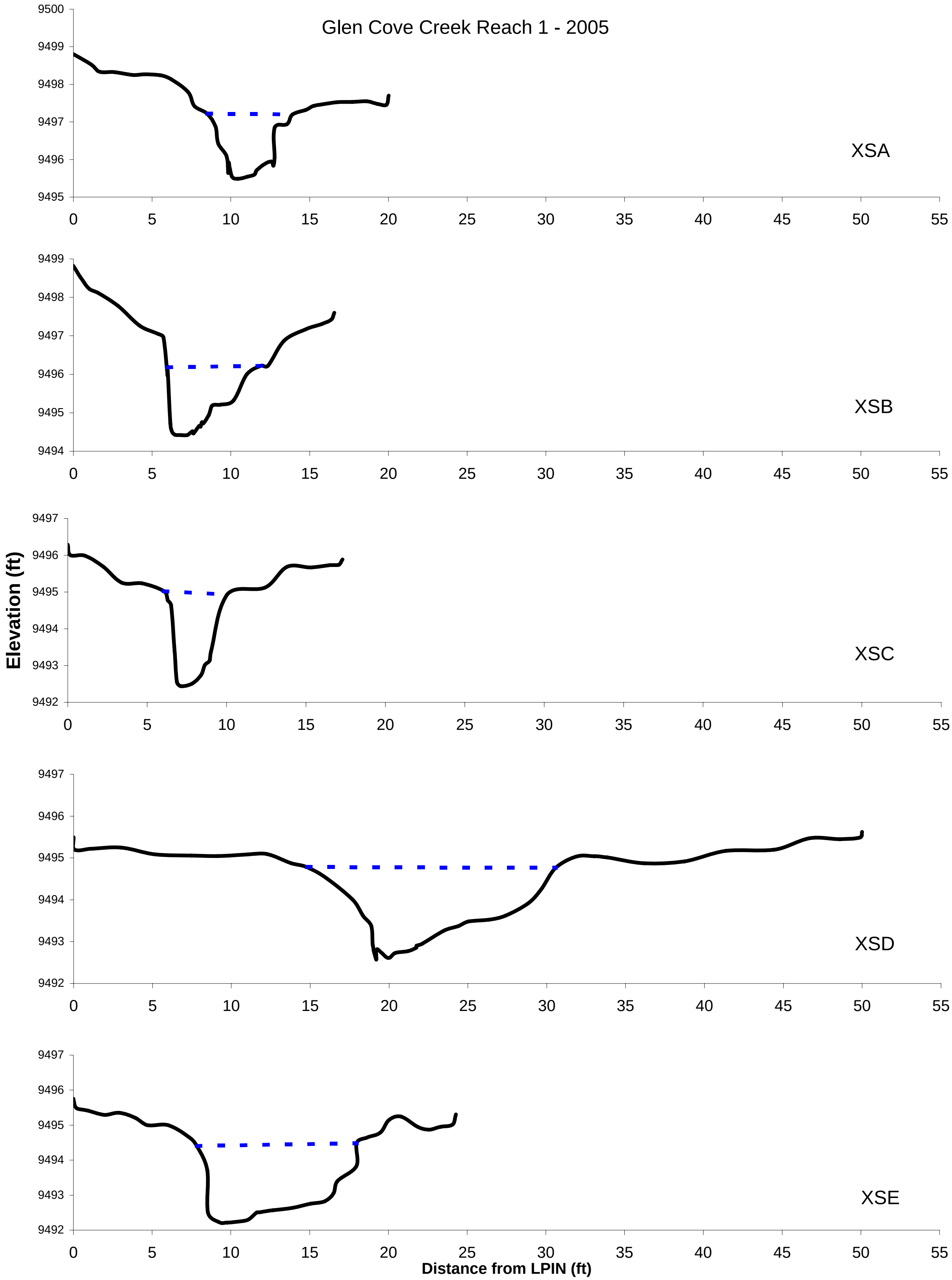
Appendix H

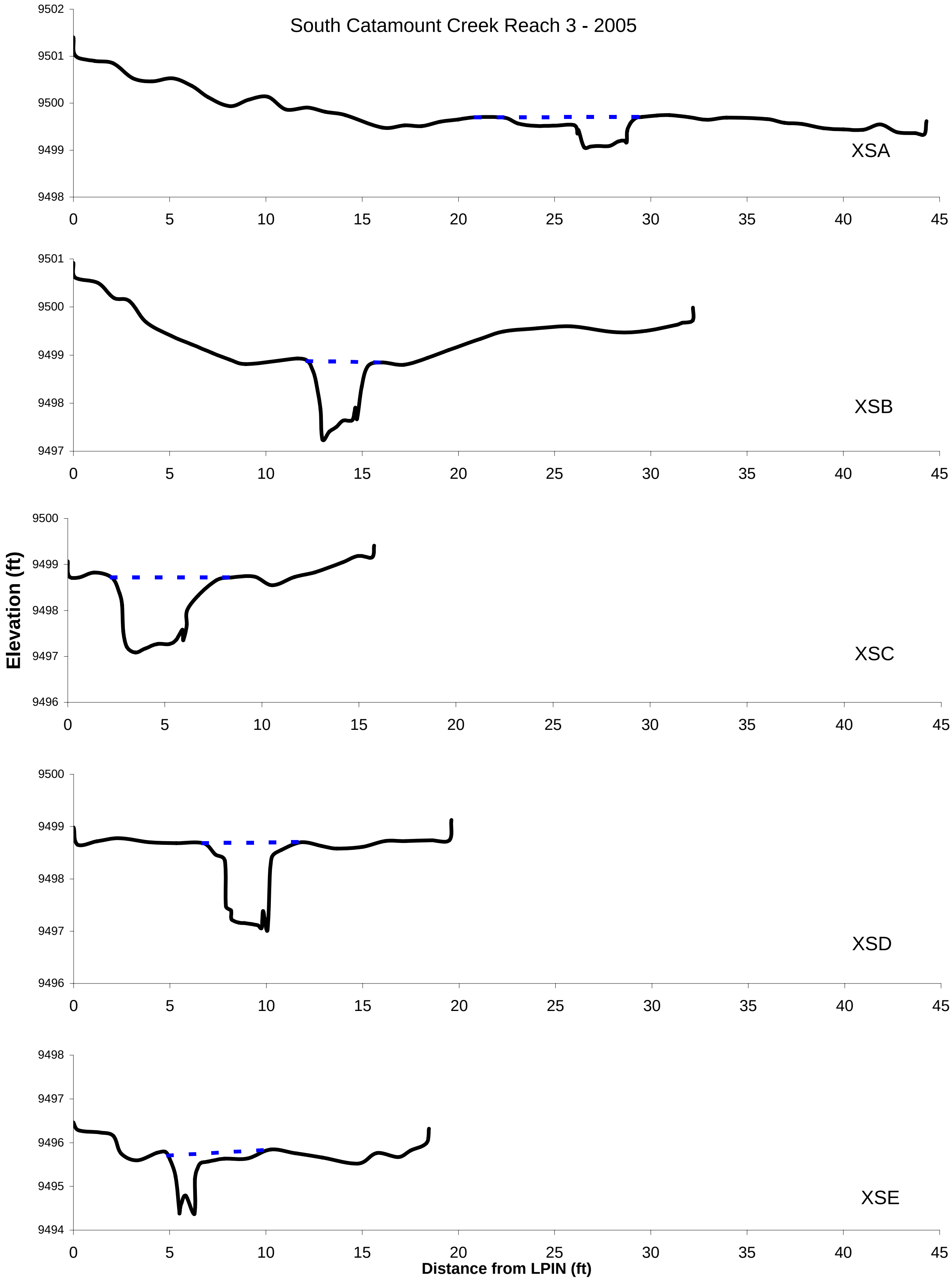
Stream Cross Sections
Cross Section Geometry

2005

Summary of Stream Channel Geometry 2005

Stream	Identifier /Reach	Cross Section	Width (ft)	Cross Sectional Area (ft^2)	Mean Depth (ft)	Maximum Depth (ft)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Width /Depth Ratio
Clen Cove Creek	GLEN1	A	5.4	5.63	1.04	1.73	7.92	0.71	5.22
Clen Cove Creek	GLEN1	B	5.9	6.24	1.05	1.77	7.98	0.78	5.66
Clen Cove Creek	GLEN1	C	4.0	6.35	1.60	2.56	7.11	0.89	2.49
Clen Cove Creek	GLEN1	D	15.8	18.46	1.17	2.21	17.17	1.07	13.48
Clen Cove Creek	GLEN1	E	10.1	16.84	1.66	2.21	12.64	1.33	6.10
South Catamount Ck	SCAT3	A	8.6	2.15	0.25	0.64	9.25	0.23	34.67
South Catamount Ck	SCAT3	B	3.9	3.08	0.79	1.62	6.06	0.51	4.88
South Catamount Ck	SCAT3	C	6.2	5.49	0.89	1.63	8.10	0.68	6.91
South Catamount Ck	SCAT3	D	5.1	3.85	0.76	1.67	7.80	0.49	6.73
South Catamount Ck	SCAT3	E	5.3	1.80	0.34	1.37	7.58	0.24	15.78


Glen Cove Creek Reach 1 - 2005
Elevation (ft)
Distance from LPIN (ft)
XSA
XSB
XSC
XSD
XSE
9500
9499
9498
9497
9496
9495
9494
9493
9492
0
5
10
15
20
25
30
35
40
45
50
55



South Catamount Creek Reach 3 - 2005
XSA
XSB
XSC
XSD
XSE
Elevation (ft)
Distance from LPIN (ft)

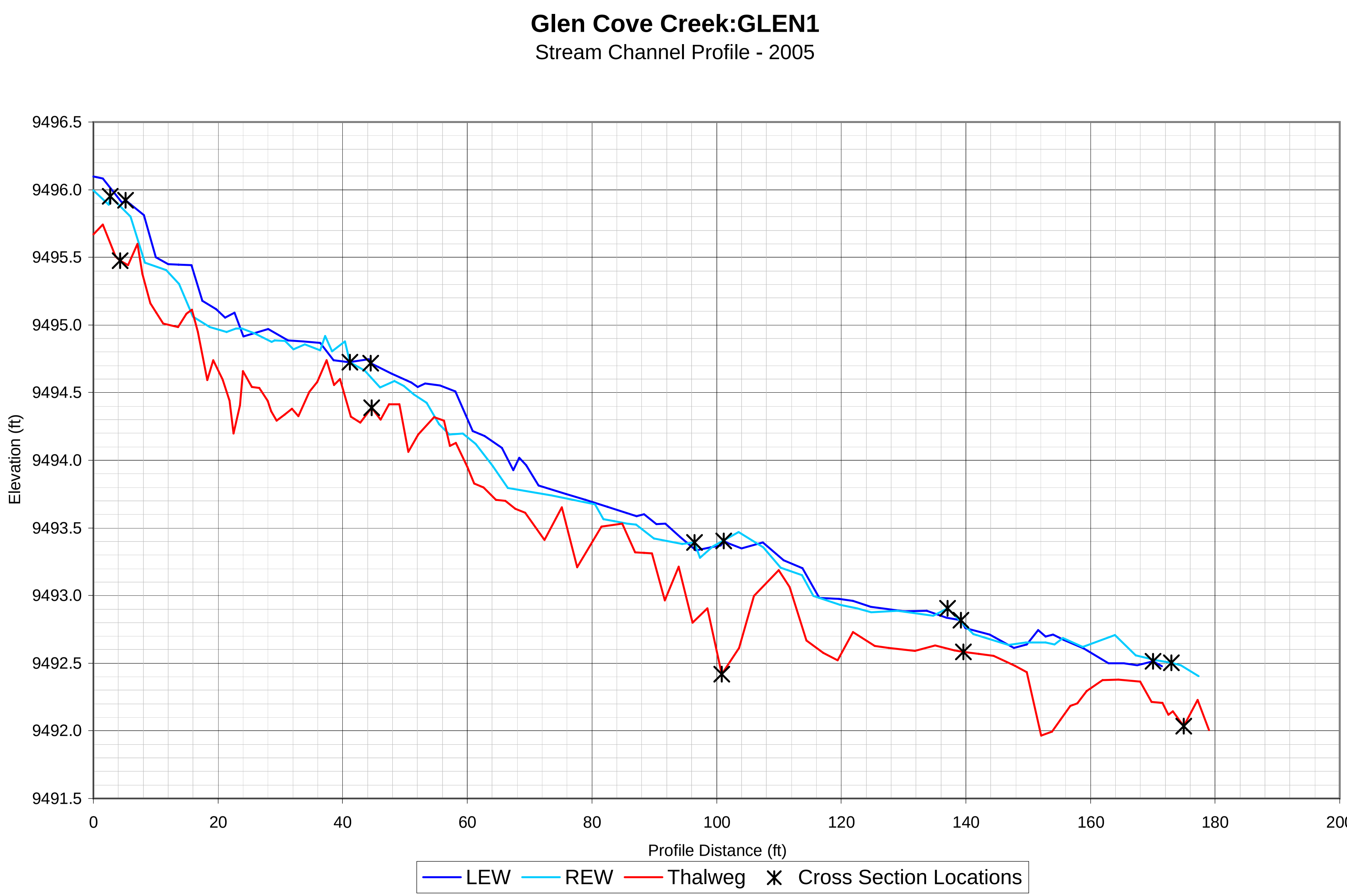
Appendix I

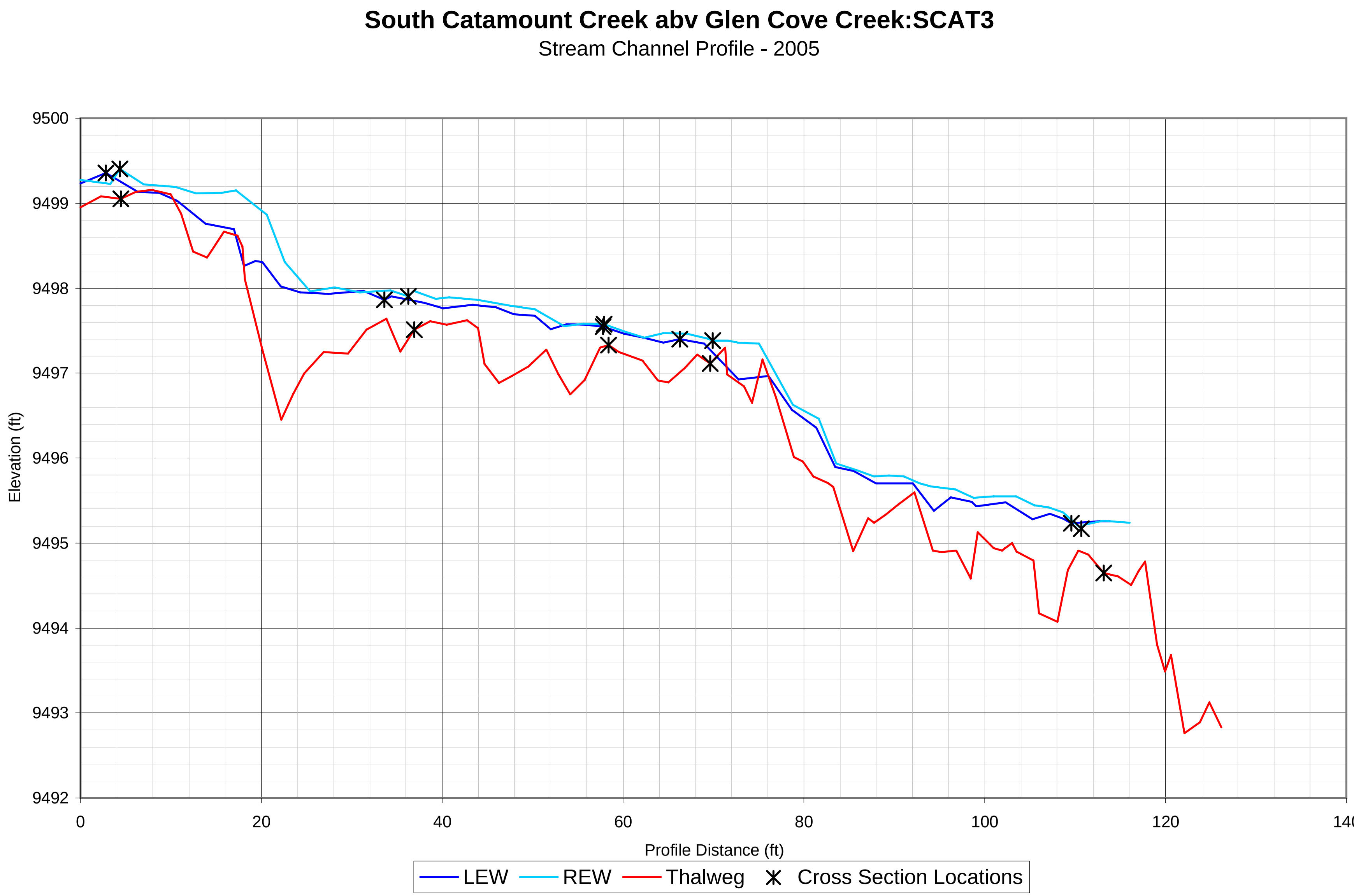
Stream Slopes
Summary and Graphs

2005

Summary of Slopes for each Stream Reach 2005

For 2005			From Cross Section A to E		
Stream	Reach	Feature	Distance (ft)	Elevation Change (ft)	Slope
Glen Cove Creek	GLEN1	LWSE	170	3.41	0.0207
Glen Cove Creek	GLEN1	RWSE	173	3.45	0.0202
Glen Cove Creek	GLEN1	Thalweg	175	3.44	0.0202
South Catamount Creek	SCAT3	LWSE	110	4.12	0.0386
South Catamount Creek	SCAT3	RWSE	111	4.23	0.0398
South Catamount Creek	SCAT3	Thalweg	113	4.40	0.0405


Glen Cove Creek:GLEN1
Stream Channel Profile - 2005
Elevation (ft)
9496.5
9496.0
9495.5
9495.0
9494.5
9494.0
9493.5
9493.0
9492.5
9492.0
9491.5
0
20
40
60
80
100
120
140
160
180
200
Profile Distance (ft)
LEW
REW
Thalweg
Cross Section Locations


South Catamount Creek abv Glen Cove Creek:SCAT3
Stream Channel Profile - 2005
Elevation (ft)
9500
9499
9498
9497
9496
9495
9494
9493
9492
0
20
40
60
80
100
120
140
Profile Distance (ft)
LEW
REW
Thalweg
Cross Section Locations

Appendix J

Stream Pebble Counts
Particle Size Distributions and Graphs

2005

Summary of Particle Size Distributions From Pebble Counts 2005

Stream	Reach	Particle Size Distribution					
		D15	D35	D50	D84	D95	D100
Glen Cove Creek	GLEN1	0.267	1.51	4.44	18	119	600
South Catamount Creek	SCAT3	0.878	3.40	4.98	10	139	320

Pebble Count Worksheet

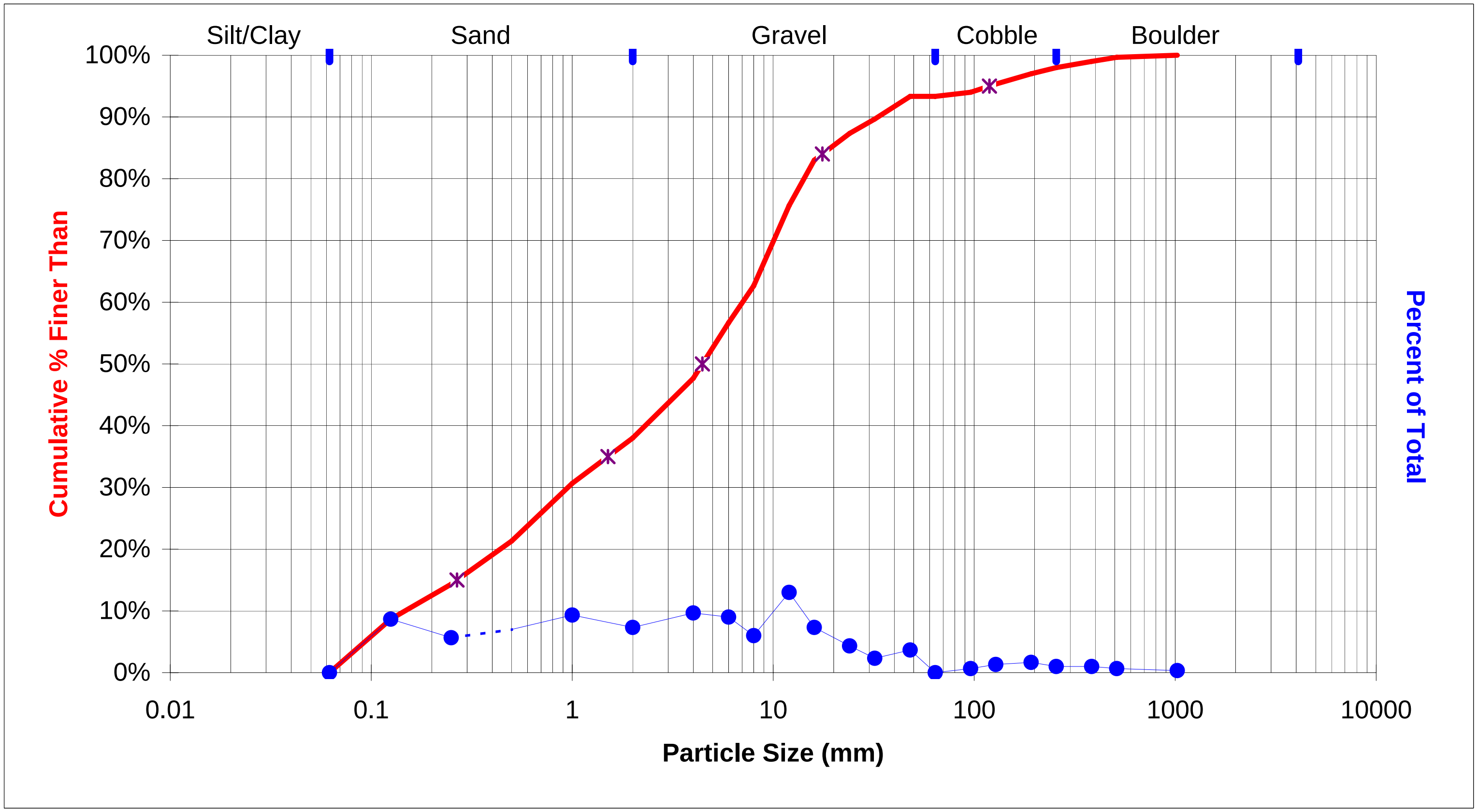
Particle Size (mm)	% finer than	Total Count
<0.062	0%	0
0.062 - 0.125	9%	26
0.125 - 0.25	14%	17
0.25 - 0.5	21%	21
0.5 - 1.0	31%	28
1 - 2	38%	22
2 - 4	48%	29
4 - 6	57%	27
6 - 8	63%	18
8 - 12	76%	39
12 - 16	83%	22
16 - 24	87%	13
24 - 32	90%	7
32 - 48	93%	11
48 - 64	93%	0
64 - 96	94%	2
96 - 128	95%	4
128 - 192	97%	5
192 - 256	98%	3
256 - 384	99%	3
384 - 512	100%	2
512 - 1024	100%	1
1024 - 2048		
2048 - 4096		

COMMENTS: New reach established just upstream from confluence with South Catamount Ck because of the transbasin diversion installed in Ski Ck-this reach is impacted by highway runoff

STREAM NAME: Glen Cove Creek
ID NUMBER: GLEN1
DATE: 10/1/2005
CREW: J.Nankervis, S. Belz, K. Phung

Particle Size Distribution (mm)

D15	D35	D50	D84	D95	Lpart	Year
0.27	1.51	4.44	17.6	119.1	600.0	2005



Pebble Count Worksheet

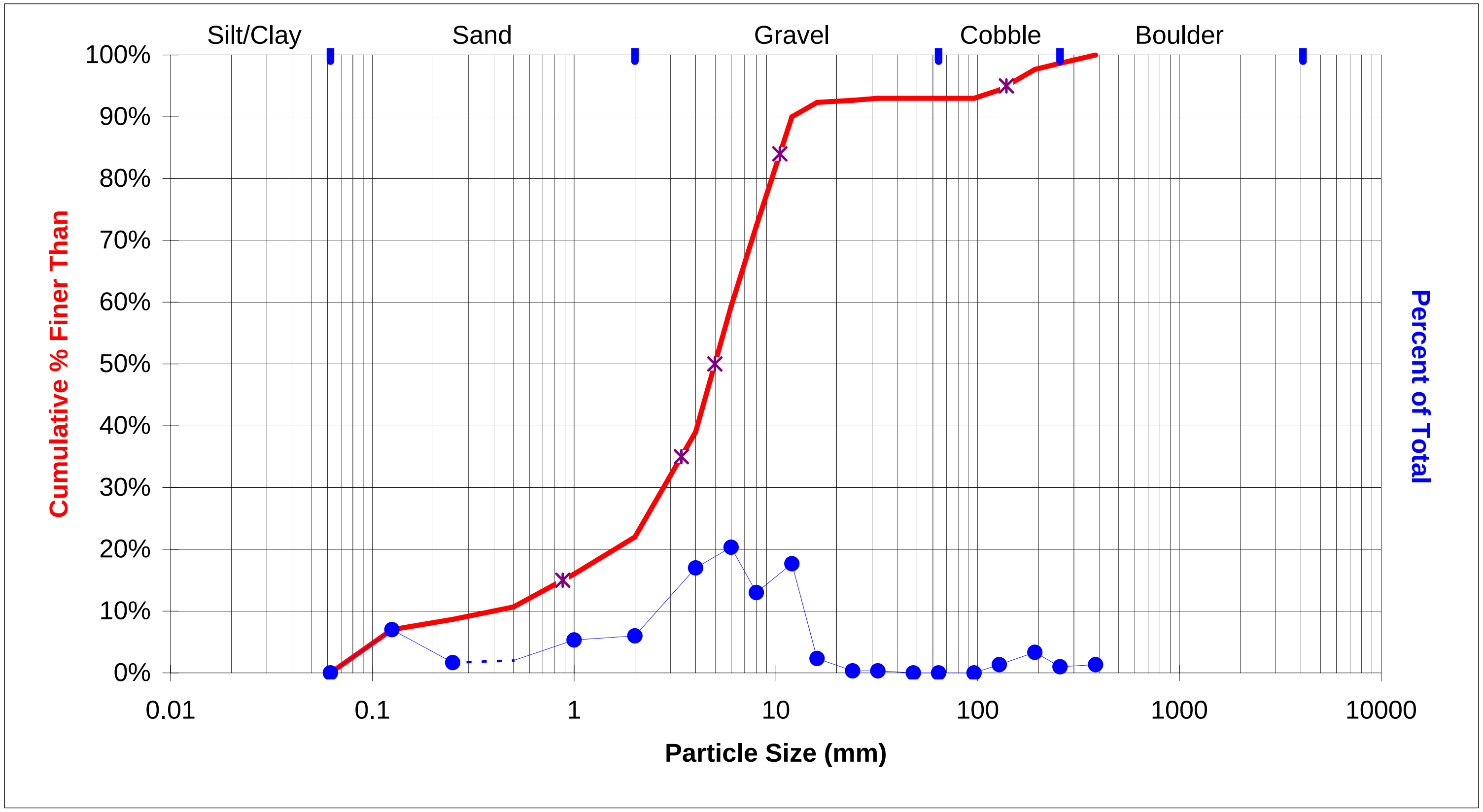
Particle Size (mm)	% finer than	Total Count
<0.062	0%	0
0.062 - 0.125	7%	21
0.125 - 0.25	9%	5
0.25 - 0.5	11%	6
0.5 - 1.0	16%	16
1 - 2	22%	18
2 - 4	39%	51
4 - 6	59%	61
6 - 8	72%	39
8 - 12	90%	53
12 - 16	92%	7
16 - 24	93%	1
24 - 32	93%	1
32 - 48	93%	0
48 - 64	93%	0
64 - 96	93%	0
96 - 128	94%	4
128 - 192	98%	10
192 - 256	99%	3
256 - 384	100%	4
384 - 512		
512 - 1024		
1024 - 2048		
2048 - 4096		

COMMENTS: New reach established just upstream from confluence with Glen Cove Ck because of the transbasin diversion installed in Ski Ck-this reach is unimpacted by highway runoff

STREAM NAME: South Catamount Creek
ID NUMBER: SCAT3
DATE: 10/1/2005
CREW: J.Nankervis, S. Belz, K. Phung

Particle Size Distribution (mm)

D15	D35	D50	D84	D95	Lpart	Year
0.88	3.40	4.98	10.5	138.8	320.0	2005



Appendix K

Riparian Vegetation
Description and Bank Photographs

2005

Summary of Riparian Vegetation Description and Photo Points 2005

					Photo Points			
Site	Date	Camera	Cross Section	Bank	Bank - Distance from LPIN (ft)	Camera - Distance from LPIN (ft)	Percent Cover	Comments
GLEN1	100105	Olympus Stylus 400	A	Left	8.5	12.9	55	sedge,grass
GLEN1	100105	Olympus Stylus 400	A	Right	13.0	8.5	60	sedge,grass,shrub
GLEN1	100105	Olympus Stylus 400	B	Left	6.3	9.5	0	bare
GLEN1	100105	Olympus Stylus 400	B	Right	11.5	5.7	70	sedge,grass,shrub
GLEN1	100105	Olympus Stylus 400	C	Left	5.9	9.9	40	sedge
GLEN1	100105	Olympus Stylus 400	C	Right	9.3	5.0	30	sedge,forb
GLEN1	100105	Olympus Stylus 400	D	Left	15.1	19.9	5	grass,shrub
GLEN1	100105	Olympus Stylus 400	D	Right	31.1	27.2	5	grass,shrub,tree
GLEN1	100105	Olympus Stylus 400	E	Left	8.0	5.5	60	sedge,grass,shrub
GLEN1	100105	Olympus Stylus 400	E	Right	19.7	16.0	65	grass,shrub
SCAT3	100105	Olympus Stylus 400	A	Left	26.0	29.4	60	sedge
SCAT3	100105	Olympus Stylus 400	A	Right	29.2	25.2	85	grass
SCAT3	100105	Olympus Stylus 400	B	Left	12.1	16.0	40	sedge
SCAT3	100105	Olympus Stylus 400	B	Right	15.5	12.7	50	sedge
SCAT3	100105	Olympus Stylus 400	C	Left	3.3	6.8	50	sedge,grass
SCAT3	100105	Olympus Stylus 400	C	Right	6.8	3.1	40	sedge,grass
SCAT3	100105	Olympus Stylus 400	D	Left	8.2	11.6	75	sedge
SCAT3	100105	Olympus Stylus 400	D	Right	10.8	8.1	70	sedge,grass
SCAT3	100105	Olympus Stylus 400	E	Left	5.1	8.2	50	sedge,grass,shrub
SCAT3	100105	Olympus Stylus 400	E	Right	6.5	3.8	60	sedge,grass,shrub

Glen Cove Creek 1: GLEN1 2005

Left | Right

01 GLEN1_010.JPG

XSA

02 GLEN1_011.JPG

03 GLEN1_012.JPG

XSB

04 GLEN1_013.JPG

05 GLEN1_018.JPG

XSC

06 GLEN1_019.JPG

07 GLEN1_024.JPG

XSD

08 GLEN1_025.JPG

09 GLEN1_030.JPG

XSE

10 GLEN1_031.JPG

South Catamount Creek 3: SCAT3 2005

Left

Right

01 SCAT3_010.JPG

XSA

02 SCAT3_009.JPG

03 SCAT3_012.JPG

XSB

04 SCAT3_011.JPG

05 SCAT3_024.JPG

XSC

06 SCAT3_025.JPG

07 SCAT3_018.JPG

XSD

08 SCAT3_017.JPG

09 SCAT3_030.JPG

XSE

10 SCAT3_031.JPG