Appendix A: Channel cross-sections

This appendix reproduces the full set of channel cross-section profiles introduced in Chapter 4. The plots illustrate the complexity of channel form changes produced by the downstream staging of bed material over time. All of the extracted profiles are coincident with the location of the 1999 sounding lines, so plots for that date preserve actual bed elevations more accurately than for the earlier dates (which necessarily include greater interpolation). The plots reveal the magnitude of vertical and lateral instability that occurs along the river. The greatest changes are typically found within wandering reaches, and are especially large where an avulsion has occurred. Upstream of Agassiz-Rosedale (cross-sections numbered 104 or larger), the comparison is limited to the 1952 and 1999 surveys only. It should be realized that spatial limitations of the 1952 soundings preclude a completely reliable estimate of the actual channel bed along the complete width of some profiles.

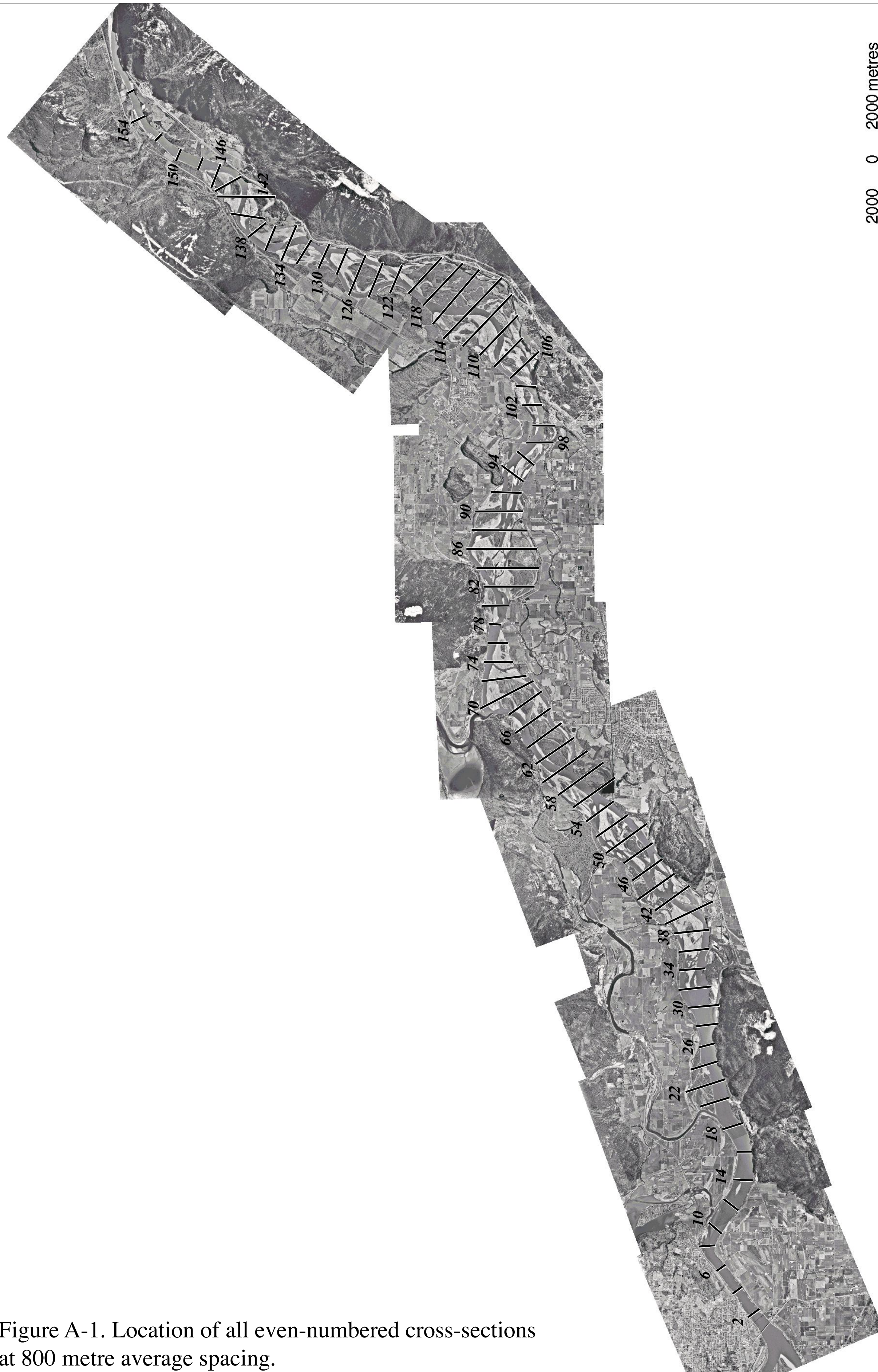

Figure A-1. Location of all even-numbered cross-sections at 800 metre average spacing.

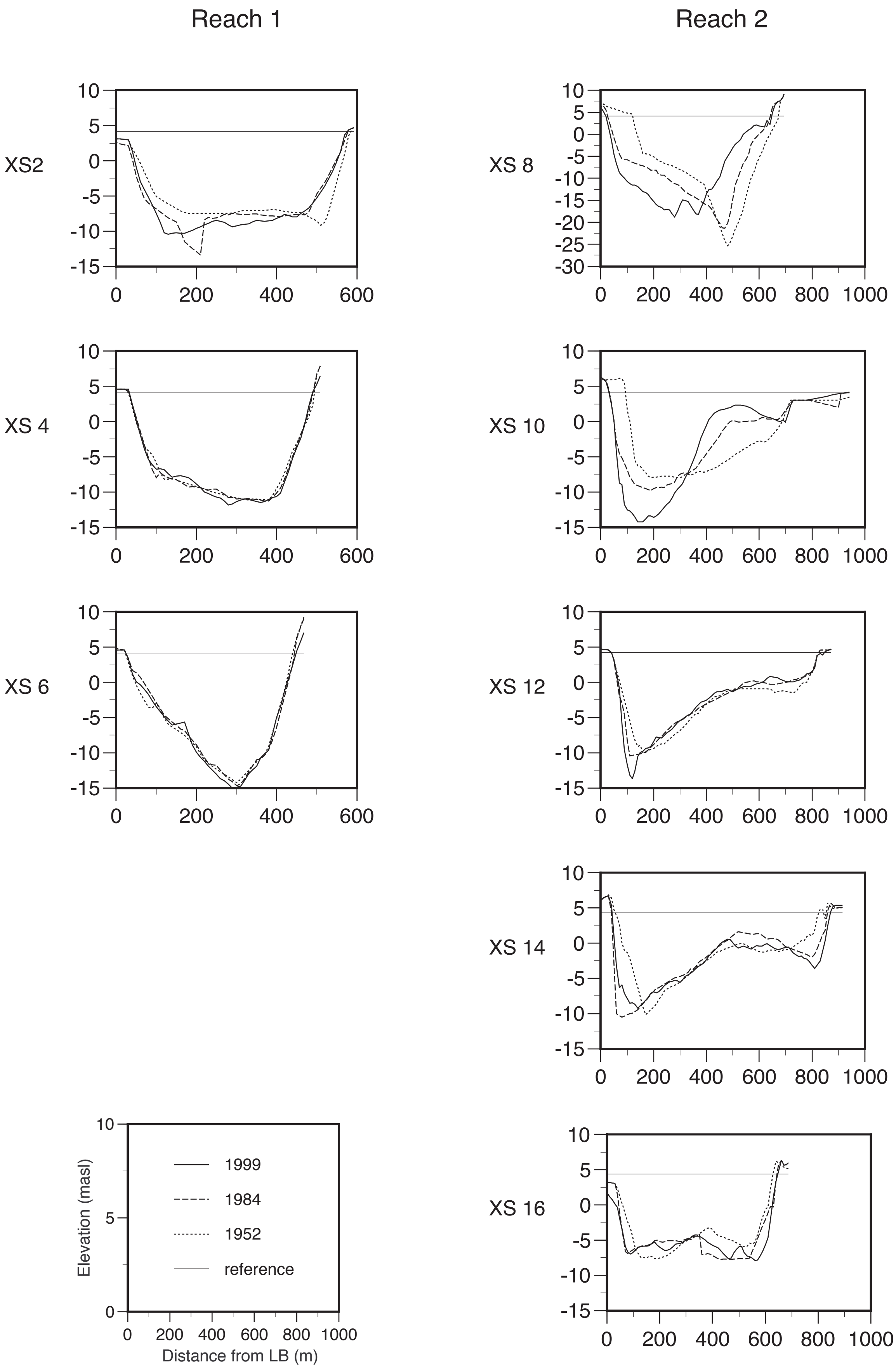

Figure A-2. Channel cross-section profiles for 1952, 1984 and 1999, reaches 1 and 2.
The reference line represents the water level at bankfull discharge.

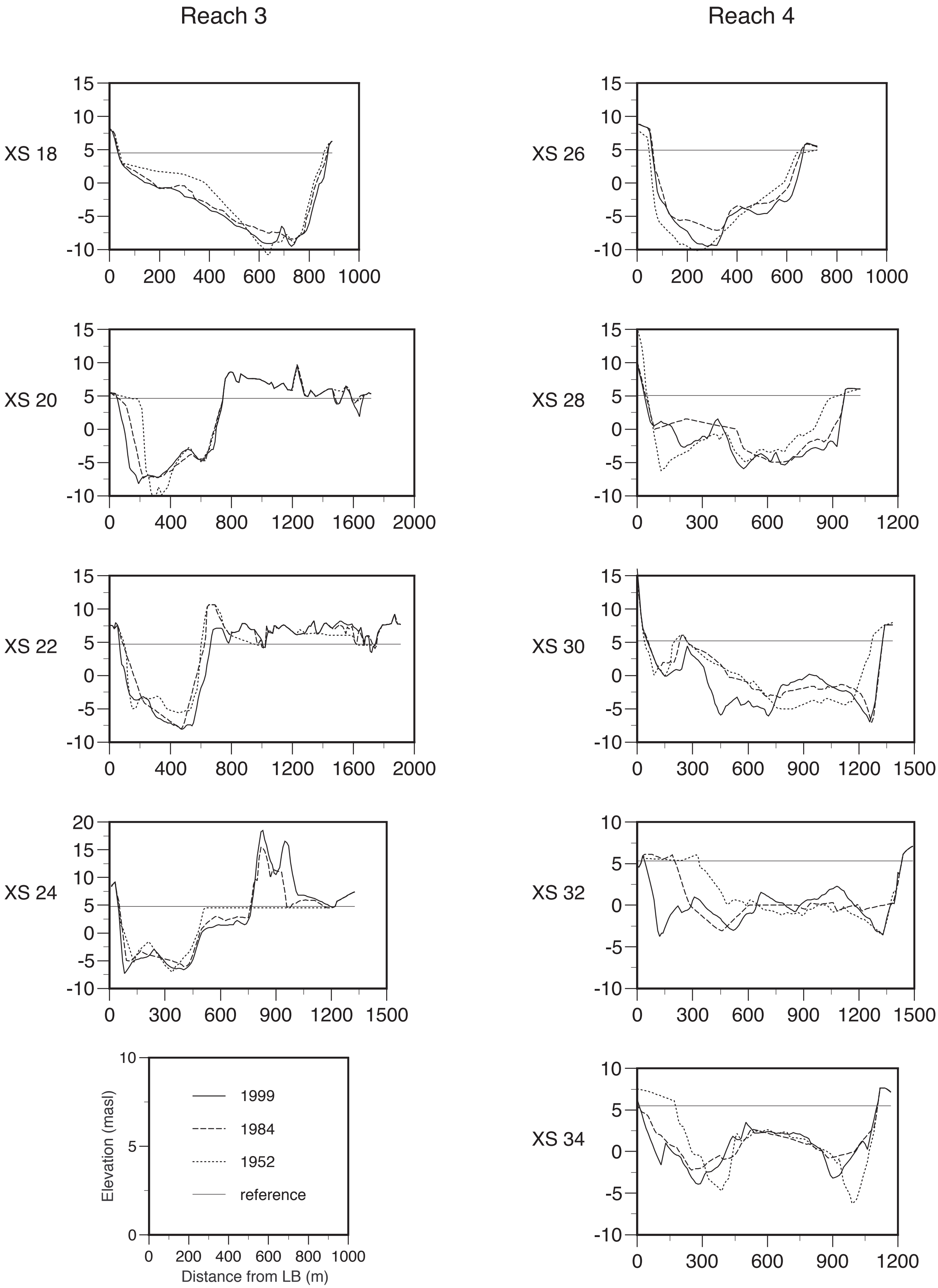

Figure A-3. Channel cross-section profiles for 1952, 1984 and 1999, reaches 3 and 4.

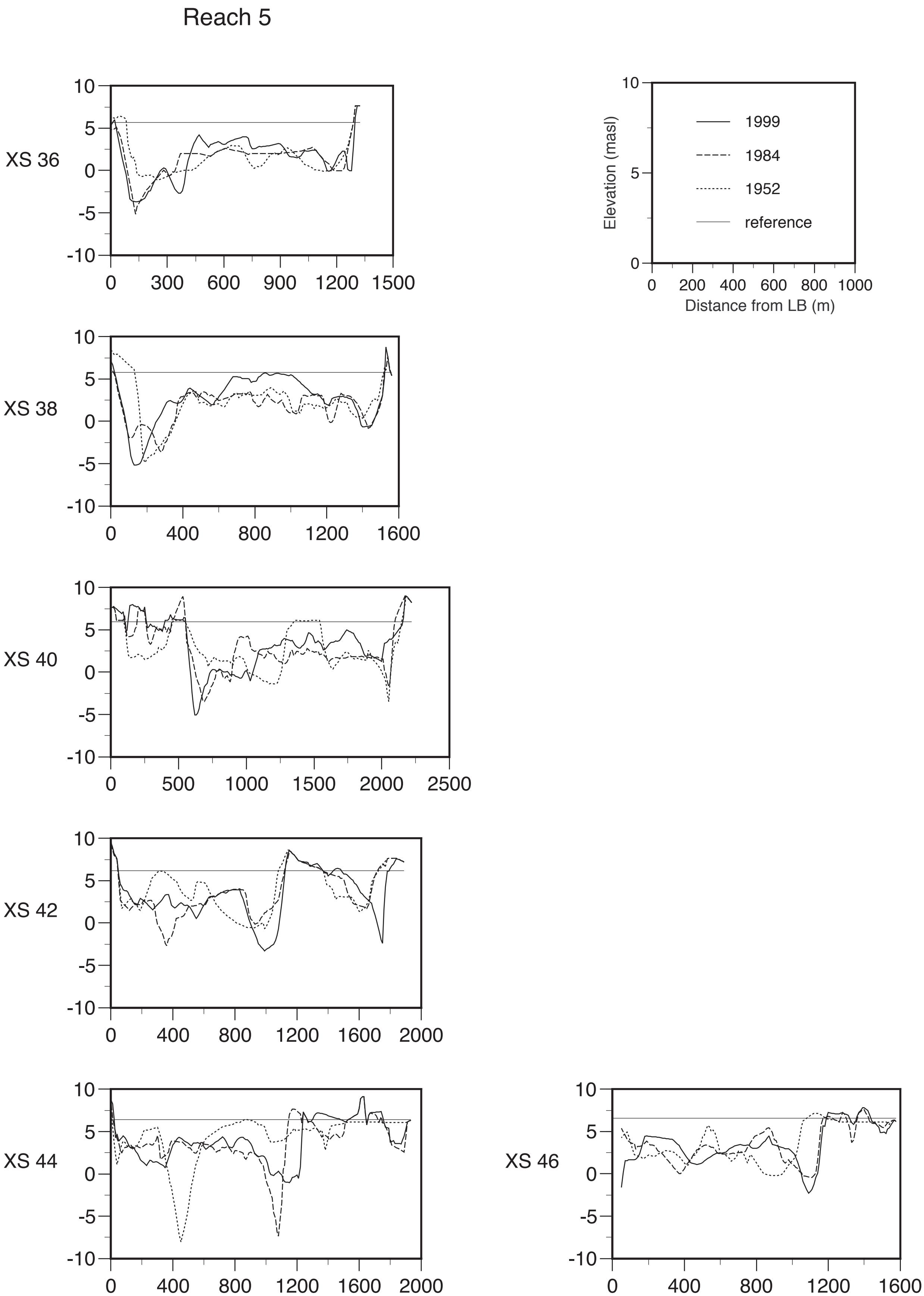

Figure A-4. Channel cross-section profiles for 1952, 1984 and 1999, reach 5.

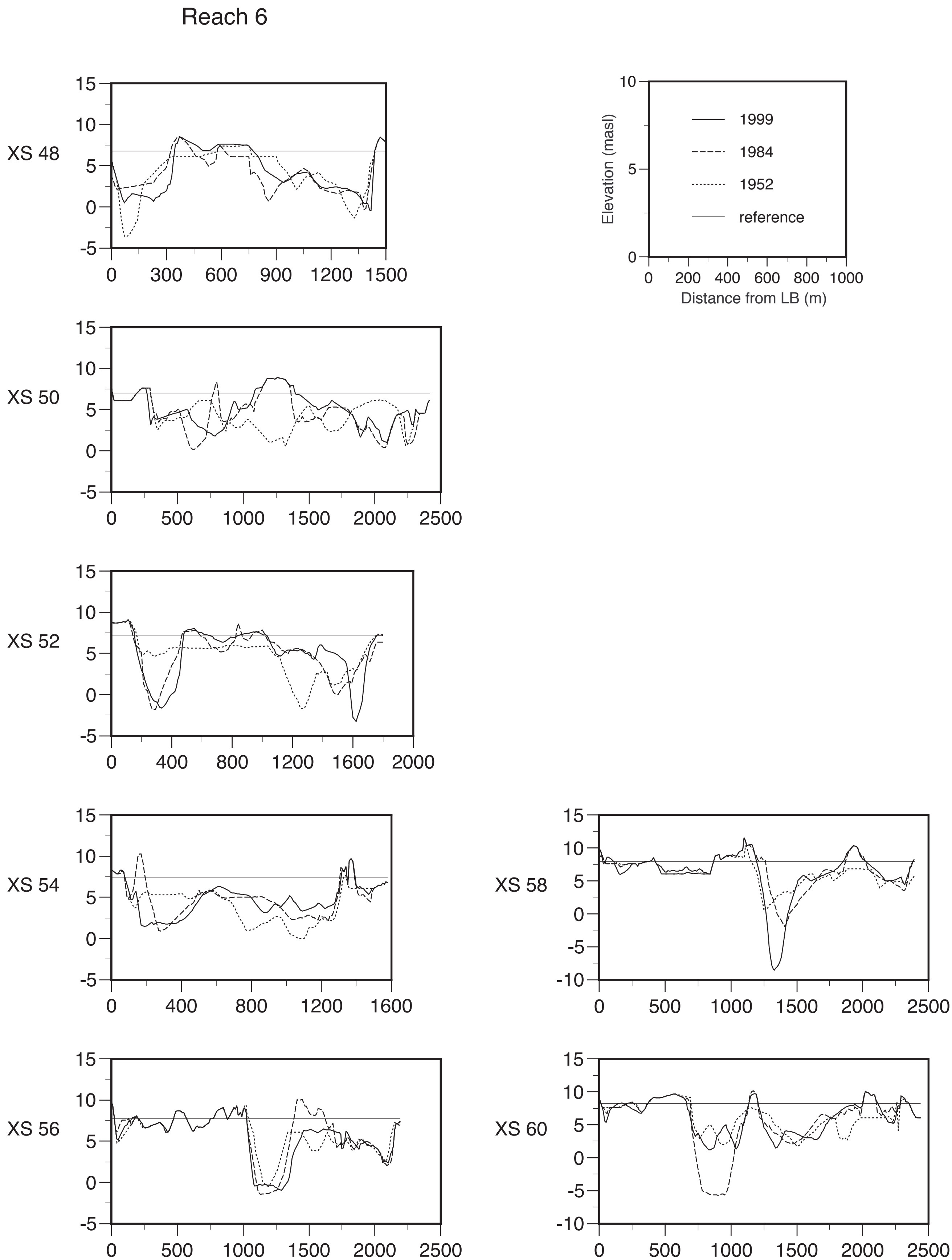

Figure A-5. Channel cross-section profiles for 1952, 1984 and 1999, reach 6.

Reach 7

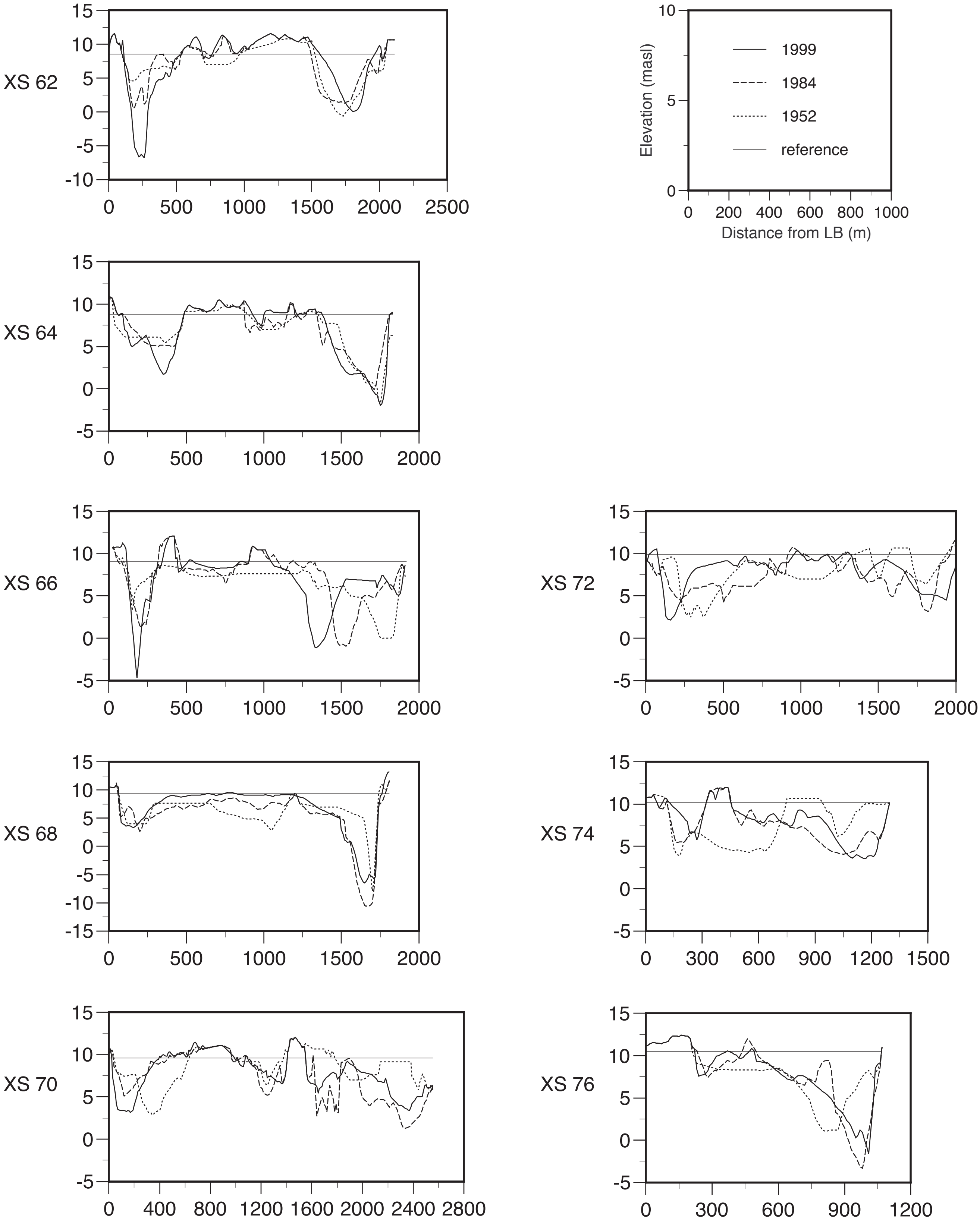

Figure A-6. Channel cross-section profiles for 1952, 1984 and 1999, reach 7.

Reach 8

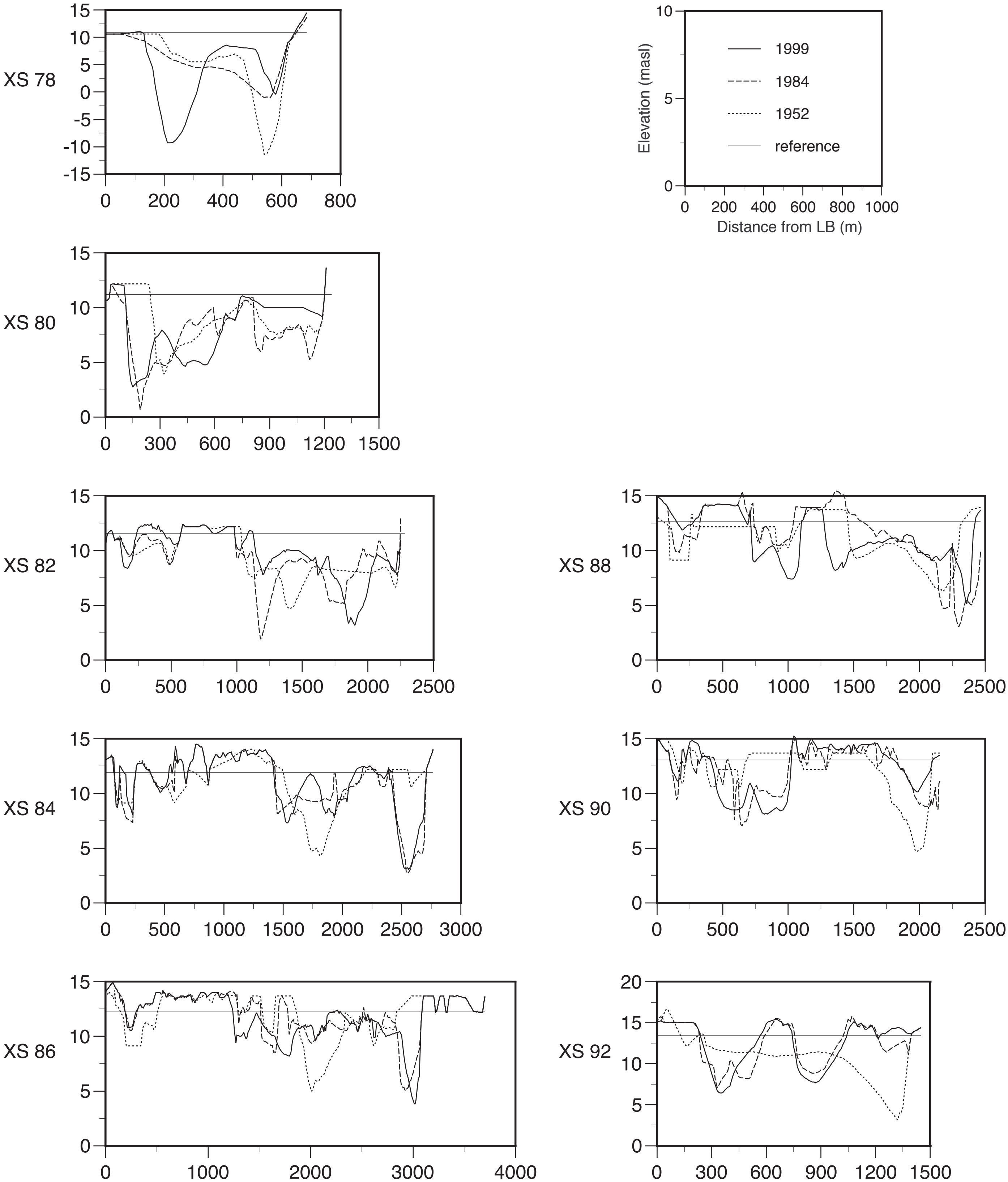

Figure A-7. Channel cross-section profiles for 1952, 1984 and 1999, reach 8.

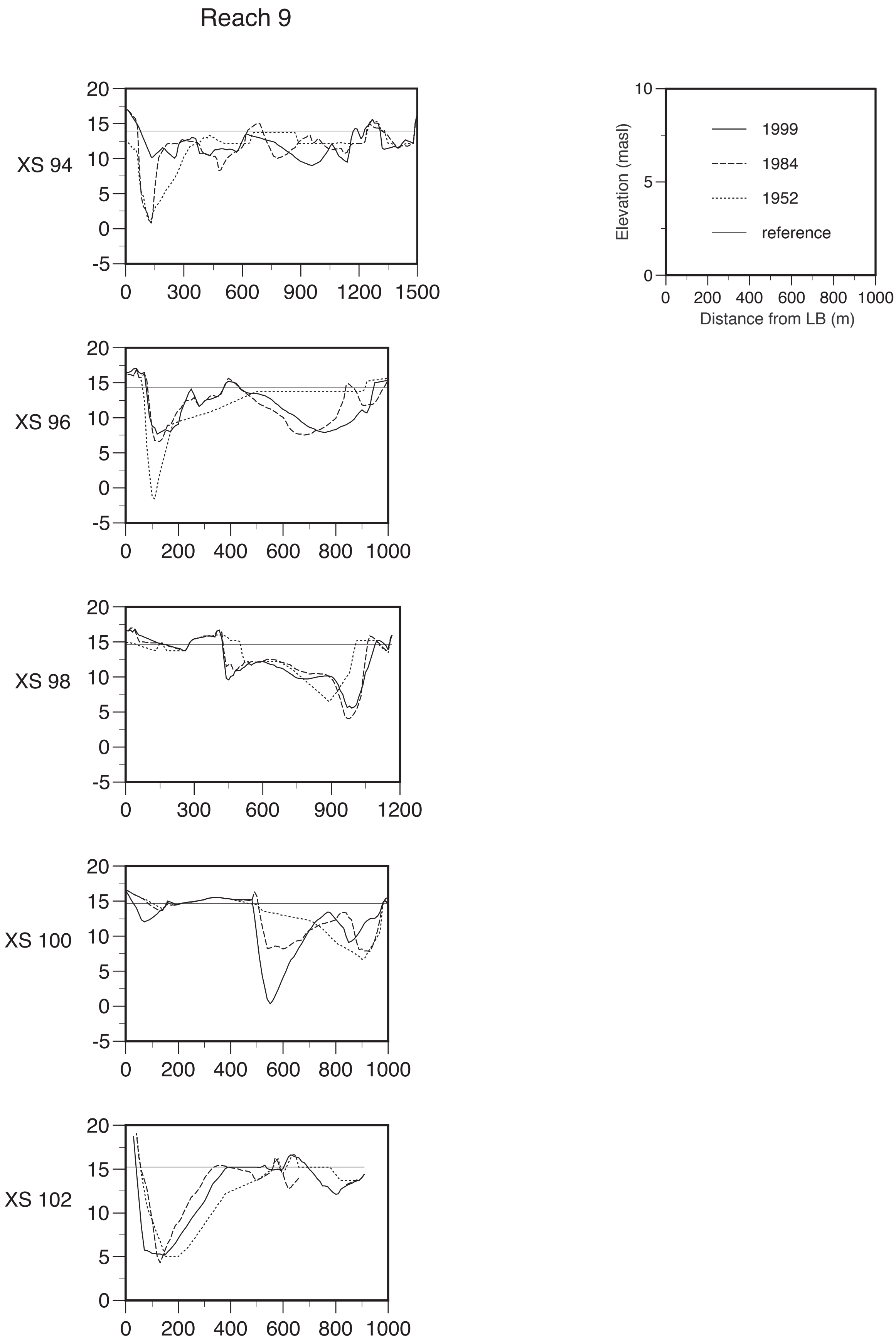

Figure A-8. Channel cross-section profiles for 1952, 1984 and 1999, reach 9.

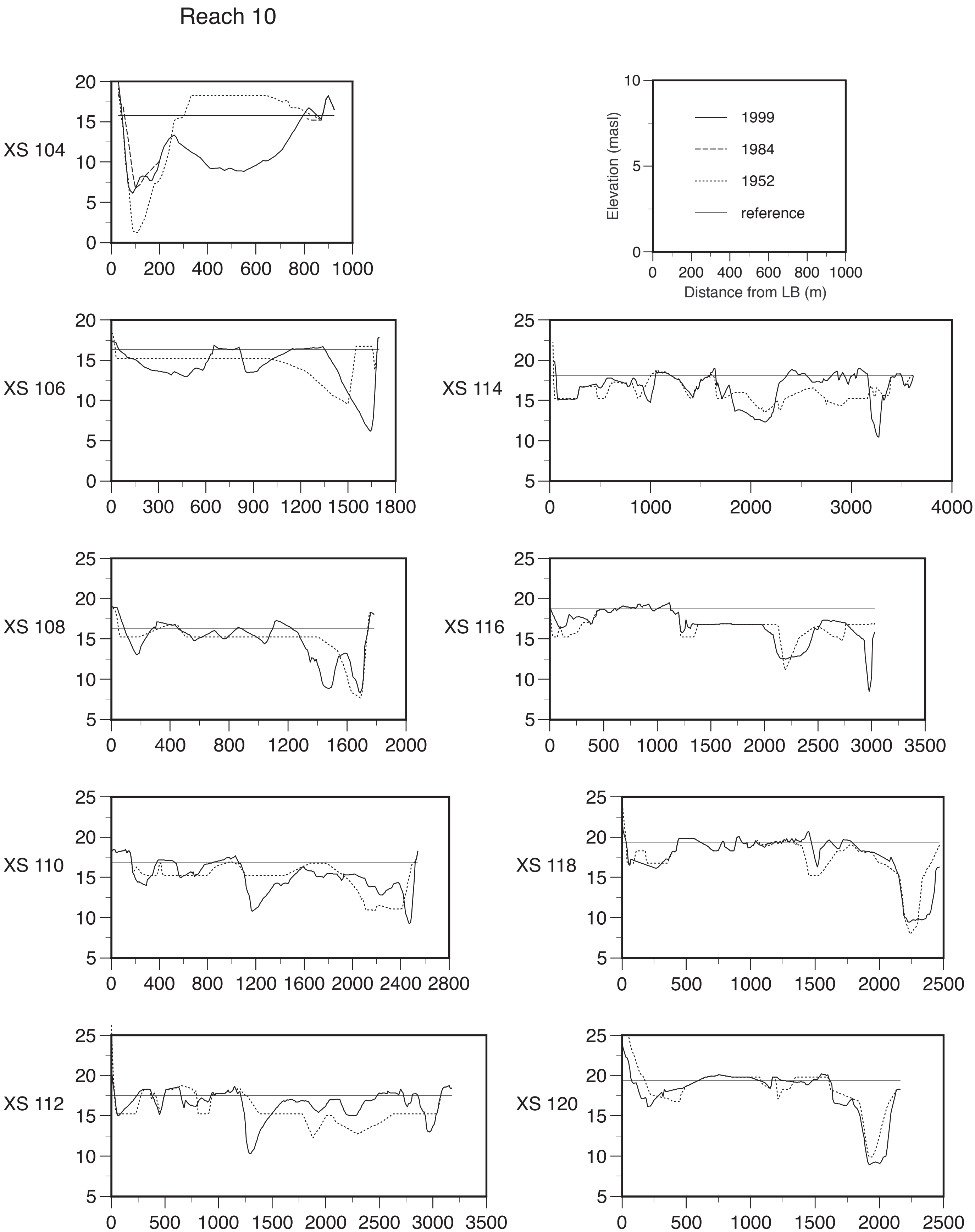

Figure A-9. Channel cross-section profiles for 1952 and 1999, reach 10.

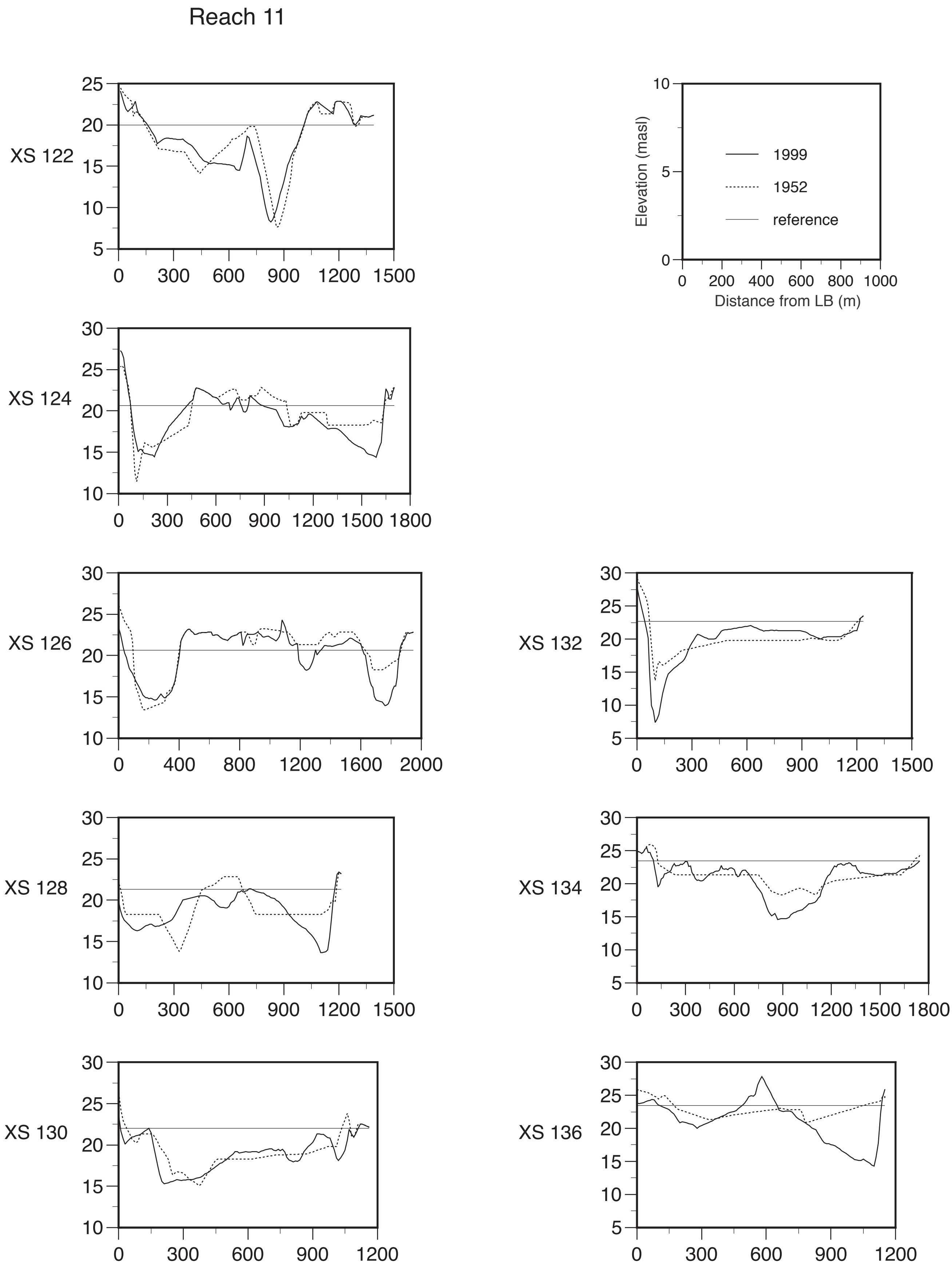

Figure A-10. Channel cross-section profiles for 1952 and 1999, reach 11.

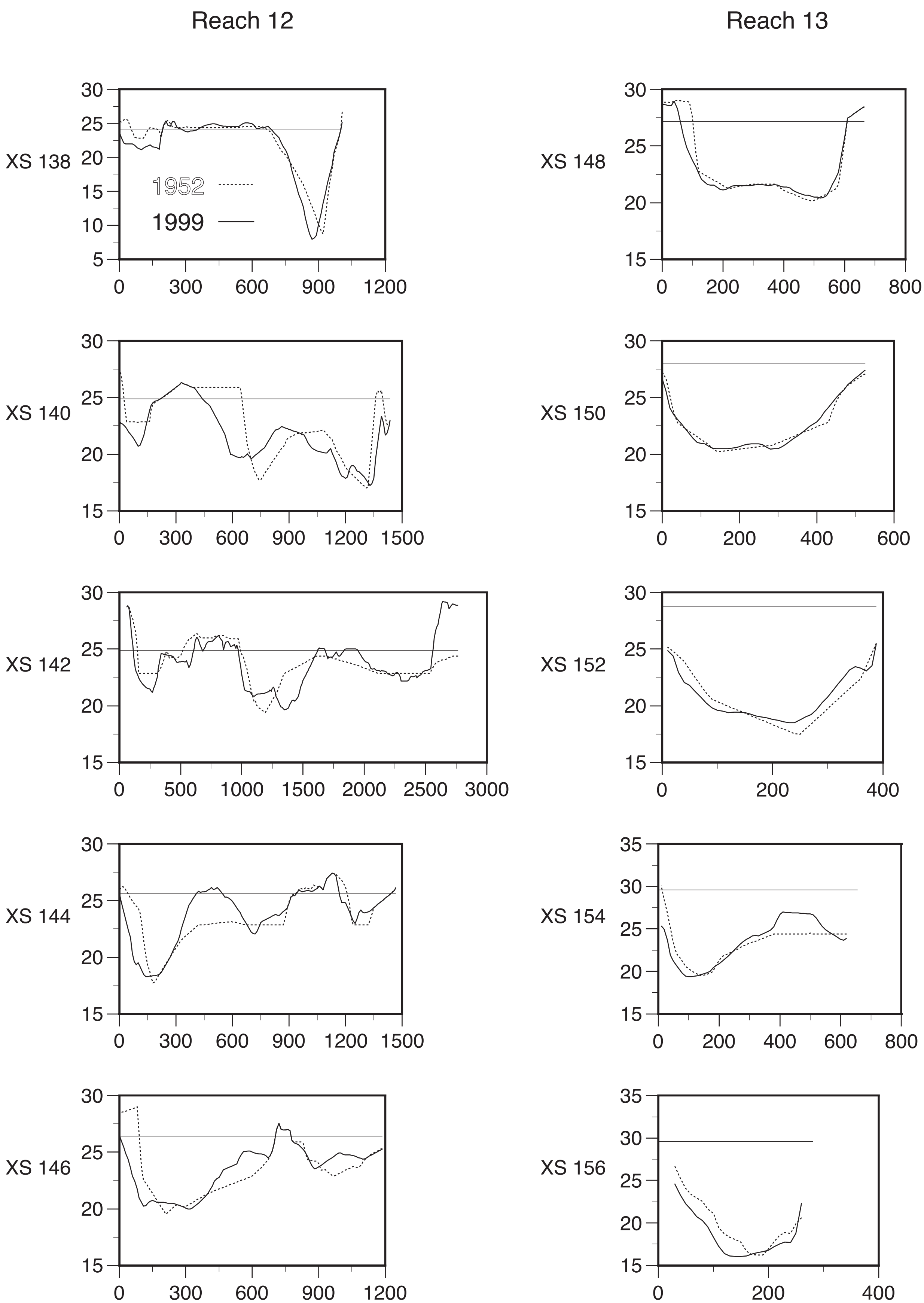

Figure A-11. Channel cross-section profiles for 1952 and 1999, reaches 12 and 13.

Appendix B: Calculating the gravel budget

This appendix describes in detail the procedures used to convert surfaces of differences to coarse sand and gravel volumes for individual computing cells. These computing steps are used to derive the period sediment budget esimates presented in Chapter 5 and to illustrate patterns of aggradation and degradation along the entire gravel reach. Calculations are provided for two 1-km computing cells, to contrast a simple case (minimal bank and island changes, no gravel removals) with a complex case (includes bank and island changes, gravel removals). In the simple case, volumetric changes from the surfaces of difference are simply proportioned into sand and gravel fractions according to the location of the computing cell (see Fgure 5-4). In these cells, addition of the period sediment budgets very nearly produces the same result as the sediment budget derived from the direct surface of difference. In the complex case, the treatment of overbank wash material (which is not incorporated into sediment budget calculations) introduces a bias such that the period budgets and the direct budget do not necessarily add. Consequently, the unadjusted budget (gross volumetric changes) is the preferred figure for examing bed level changes within the gravel reach.

B.1 Computation of unadjusted volumetric changes and bed level changes

The gravel budget requires information on the net difference between scour and fill of the channel bed, changes in storage along island and floodplain deposits and removals of gravel from each reach by dredging/mining. Volumetric changes between any two surveys were initially calculated in Arc/Info GIS using the command CUTFILL, which simply subtracts one cell value from another and writes this information to a third file. First, each topographic model was "clipped" to correspond with a polygon coverage known as a "replace" coverage which contains one of two numeric codes (0 or 1). The replace coverage serves as a mask which is used to replace interpolated elevations with a no-data value where the modeling is known to be weak or otherwise should not be included (because it is outside the region of interest: for example, lower Vedder Canal; several of the prominent sloughs).

The same mask was used for all 3 modeled surfaces to ensure that the same areas exactly are included or excluded from the computations. Since the 1984 survey covers a shorter reach of the river than the other two surveys, a separate mask was used to compare the 1952 and 1999 surveys upstream of Agassiz Bridge. Polygons that were classified as stable island and flood-plain surfaces on *all* dates were assigned the nodata value. This was done to ensure that the computing areas for 1952-84, 1984-99 and 1952-99 are exacly the same, and that they correspond so far as possible with the region that has formed the active channel within the past 50 years. The comparison area from Mission to Agassiz is 55.4 million m^2. Upstream of Agassiz, the comparison area is 33.6 million m^2.

The next step was to use CUTFILL to compute the difference between surveys. This was done in 25x25 m[1] *grid cells* over the entire domain (the dimensions are comparable with the resolution of the surveys - see Chapter 5). Because the same coordinate system was used for all surveys, the grid cells correspond exactly from survey to survey and can be superimposed for intersurvey comparisons. There are 88,660 cells in the Mission-Agassiz reach, and an additional 53,735 cells upstream of Agassiz. Volumetric differences for 1952-84, 1984-99,1952-99 (Mission to Agassiz) and 1952-99 (Agassiz to Laidlaw) were then computed as the product of polygon area and interpolated change in elevation, and aggregated into new polygon coverages corresponding with the 1-km *computing cells* along the river (as shown in Figure 5-1) and the data were exported to a spreadsheet. In the spreadsheet, the volumetric differences were divided by the area of cell in order to arrive at an estimate of the change in bed level. This determines simply that an individual computing cell was higher or lower in elevation, on average, at the end of one survey period compared with another, irrespective of whether the elevation change could be attributed to gravel, coarse sand or fine sand, or whether a portion of the change involved the addition to or loss of channel bank, which would change the currently active channel zone.

The results of these calculations are presented in Table B-9 as *unadjusted bed level changes*. Since no adjustments have been made to the observed volumetric differences they are consistent between periods, and they sum properly to the reported reach average when appropriately weighted by cell area.

B.2 Computation of bed material changes and associated bed level changes

In this section, a detailed explanation is given of the procedures followed to arrive at the results reported in Tables B-5 to B-8, and summarized in the text (Tables B-1 to B-4).

1. Construction of the sediment budget in Chapter 5 is based on 20x20m grid cells following modifications given in Ham and Church (2003). The following discussion is based on original calculations in Church et al. (2001) using somewhat larger grid cells. This difference may alter the magnitude of some error specifications but does not change the context of the text.

The initial topographic models are the same ones used in the previous calculations. However, a procedure is now introduced to classify the 25x25 m grid cells within the study reach. Each cell is classified according to the type of morphological change that occurred in the cell between successive surveys. These changes were determined from planimetric mapping for the years 1949, 1983 and 1999 from available air photography. The dates do not correspond exactly with the timing of the bathymetic surveys so small coding errors remain possible. Successive maps were overlaid (e.g. 1949 to 1983) and the grid cells were coded as one of 6 possible types of channel change transitions[2] based on the interpreted channel maps, as follows:

1. channel scour/ fill (water, bar, bar-edge on both dates)

2. bank erosion (island or floodplain at earlier date; water or bar-edge at later date)

3. bank deposition (water or bar-edge at earlier date; island or floodplain at later date)

4. floodplain stripping (island or floodplain at earlier date; bar at later date)

5. floodplain recovery (bar at earlier date; island or floodplain at later date), and

6. stable island/ floodplain (island or floodplain on both dates)

These codes are mutually exclusive and they include all mapped polygons for each intersurvey comparison (i.e. every overlay polygon is classified as 1 of 6 transitions only and there are no unclassified overlay polygons remaining).

Polygons that were classified as stable island and floodplain surfaces between two dates were assigned the nodata value. This means that the computing areas vary between comparisons (48.9 million m^2 in 1952-84; 46.1 million m^2 in 1984-99; and 49.5 million m^2 in 1952-99 in the Mission-Agassiz reach). The comparison area for the unadjusted difference calculations is larger (55.4 million m^2) since the area of stable island/ floodplain surfaces that was excluded from those calculations is smaller; that is, the stable area common to all 3 mapping dates is much smaller than the stable area between either the 1952-84, 1984-99 or 1952-99 periods. The 1952-99 comparison may seem surprising: it indicates that there are areas along the river (amounting to 10.7% of the total active area) that constituted island or floodplain in both 1952 and 1999, but changed within the intervening period.

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2. It should be noted that this coding is more complex than that presented in Chapter 5, but is fundamentally identical since floodplain stripping is equivalent to bank erosion and floodplain recovery is equivalent to bank deposition (i.e. the data are reduced in exactly the same manner). The extra codes are retained to remain faithful to the original presentation of this material.

At this point, the original elevation difference maps were overlaid with the channel change maps to produce a new summary coverage wherein each individual cell recording elevation change was additionally coded with a channel change (transition) attribute. Individual cells were sometimes divided into more than one smaller cell depending on mapping boundaries but each individual ‘cell piece’ was coded with only a single transition code. An additional database field, ‘volume’, was also added to the summary overlay coverage where volume was calculated as the product of the cell area and the average computed elevation difference. Volumes were subsequently summarized for each channel change transition type along each 1-km computing cell and the data were imported into a spreadsheet for further analysis. Those calculations followed individual components of the sediment budget, as allowed by the grid cell coding, and excluded from the calculations of the bed material budget some portions of the sediments eroded or deposited. The excluded sediments were fine sands and silts deposited on or removed from floodplain and island surfaces when they were eroded or deposited. This material is judged not to form part of the "bed material". The adjustment is the source of the apparent discrepancies in the bed elevation changes reported in Table B-9 under "bed level change from sediment budget".

It is worth emphasis that, although we have preferred the available sum of 1952-1984 and 1984-1999 sediment budgets for estimating the total sediment budget in the Agassiz-Mission reach, the appropriate results for estimating bed level change remain the direct 1952-1999 survey differences. The actual surveys are not biased by coincident sediment scour/fill. In what follows, it must be realised that the selection of input data for summary presentations differs between the preferred estimates of the sediment budget, and those that lead to the estimates of bed level changes.

B.3 Some example calculations

Upon close examination of the different columns presented in Table B-9, it becomes obvious that the bed-level changes reported for some reaches do not change appreciably between the two calculations, while for others, the differences appear to be surprisingly large. In order to make the procedures more transparent, some sample calculations will be given for selected computing cells along the river. We give one example of a "simple cell", one in which there were negligible bankline changes so that the computing areas were the same for all inter-survey comparisons, and in which exchange of wash material was, accordingly, small. The summary numbers in both bed elevation change exercises should be consistent and very similar to each other.

We give a second example of a "complex cell", one in which significant bankline changes have occurred so that floodplain/island areas have been created or destroyed, or there has been significant floodplain stripping and/or recovery. In this case, significant wash material deposits will have been present, leading to systematic differences in the sediment volume recorded between the unadjusted and bed material calculations, thence to different results. In the case of the bed material calculations, furthermore, results may not sum between periods because the observed wash material adjustments may differ amongst the periods due to compensating erosion and deposition.

B.3.1 Simple cell

We first review the calculations for a reach in which the computed bed-level changes remain essentially the same between the two analyses and, in addition, there has been no known sand and gravel removal. A suitable reach for this review is cell 2, located near the downstream end of the study reach at Mission, where the volumetric and bed level changes are as reported in Table B-1. In this comparison, we compare the unadjusted bed level changes with bed level changes estimated from the sediment budget for the full period 1952-1999. (In the main report, the preferred sediment budget is based on an adjusted sum of the 1952-1984 and 1984-1999 budgets. Taking account of the sum procedure would complicate the comparison given here, but would not change the principles to be demonstrated.)

Table B-1. Volume and bed level changes in cell 2. Negative values indicate degradation (erosion volume exceeds deposition volume).

Period	1952-84	1984-99	1952-99
unadjusted volume (m^3 bulk measure - see Table B-9)	**-248,206**	**49,631**	**-199,846**
unadjusted bed level change (m)	-0.50	0.10	-0.40
sediment budget (m^3 bulk measure - see Table B5-B7	-248,434	48,847	-206,728
bed material level change (m)	-0.50	0.10	-0.41

In the sediment budget calculations the direct sum of the 1952-84 and 1984-99 bed material elevation changes (-0.40 m) does not equal the summary value for 1952-99 (-0.41 m) partly because the areas over which the individual period data are calculated are not exactly the same in each case. The sum does, however, correspond with the unadjusted result for 1952-1999.

Furthermore, the result for cell 2 based on the sum of component sediment budgets (Table B-8) is also -0.40 m.

To further review how these data were derived, we need to examine the raw summary data from the GIS. In the case of the unadjusted bed level changes, the volume results are simply the sum of the interpolated elevation differences recorded between two successive surveys in each grid cell (there are n = 813 grid cells in computing cell 2) multiplied by the area of a grid cell (625 m^2). The mean bed level change is, then, simply $\Delta V/A$, as given in equation (1).

In the case of Tables B5-7, the total volumes are based on additions of gravel and sand whose proportions are determined by the location within the channel, but also by the type of transition observed between the two survey dates. Raw (GIS-calculated) volumes for each transition type (sums over the number of grid cells tagged with the particular transition type code) are given in Table B-2. Differences between the bolded intersurvey period totals given in Tables B-1 and B-2 derive only from roundoff errors (due chiefly to transforming small elevation differences into large volumes via multiplication by large areas), and from the slightly different no-data areas.

The sediment budget tables (B5-7) are broken into different sections according to the summary treatment of the transitional changes. Values that are found in these tables are italicized in the following discussion for emphasis.

Table B-2. Volume changes (m^3 bulk measure) in cell 2 by transition type

Transition	1	2	3	4	5	Total volume
1952 - 84	-248,529	-3,888	1,098	0	1,261	**-250,058**
1984 - 99	48,434	2,258	-884	0	0	**49,809**
1952 - 99	-212,425	3,076	5,828	0	1,282	**-202,239**

The first major section of the tables summarizes the *bed changes*, which are based on the transition 1 (active channel scour/fill) volume. The volumetric calculations are straightforward in this case. This material is simply divided into *channel gravel* and *channel sand* according to the percentage of gravel in the bed and lower banks. All of this material is bed material and is counted in the *total sand+gravel* column at the end of the table.

The next major section of the table, *bank changes*, summarizes bank erosion and deposition (transitions 2 and 3). The calculations are considerably more complex because there is a 1-3 metre layer of sands and silts on island and floodplain surfaces that must be removed, or estimates of bed material transfer rates will be inflated. McLean (1990) estimated bank erosion volumes by multiplying eroded areas by the thickness of the basal gravel layer as estimated from direct field measurement, though this depth had to be extrapolated when islands were completely eroded. Deposition thickness was estimated using similar procedures. These depths have now been estimated within the GIS by subtracting the volume of overbank (sand and silt) deposits from the total observed volumetric change under island and floodplain surfaces. Appropriate thicknesses of sand and silt were obtained from Figure 4-11. That figure was constructed by overlaying the channel map for 1999 with the 1999 survey to identify island/floodplain areas, then spatially averaging island/floodplain elevations for each reach and plotting them as a function of distance upstream from Mission. Separate exercises were conducted for old floodplain, recently established floodplain, and old bar tops. Best-fit exponential lines are shown to average scatter or anomalies that may be present due to insufficent elevation data (i.e. a young island polygon may have few or no spot heights).

It is assumed that the difference in elevation between old bar and young island surfaces represents the thickness of recent overbank deposition, estimated as 0.84 metres, or half the maximum observed depth since newly deposited island surfaces will be under various stages of construction at the time of observation. The difference between old bar and old islands, 3 metres on average, is taken to represent the thickness of eroded overbank deposits. (Our earlier sediment budget estimates adopted values of 1 m and 2 metres respectively, following McLean (1990)). In general, the deposition thickness is considerably less than the erosion thickness, a difference likely attributable to age (eroded sediments may be considerably older than deposited sediments where vertical accretion rates are limited). Boniface (1985) and McLean (1990) found an association between overbank thickness and the age of vegetation along island and floodplain surfaces on Fraser River. The thickness of overbank sands may require further confirmation through direct field sampling, though the sampling requirements over such a large area may be prohibitive. An alternative method would be to estimate the erosional and depositional age of island and floodplain deposits based upon the historic mapping that has been completed. Polygons of different ages could be overlaid with elevation data to test whether an age-thickness relation can be determined from existing data.

The conventions just described do not lead to a simple adjustment for erosion and deposition volumes. For example, removing 3 metres of sand from a polygon observed to be eroded, multiplied by the erosional area, may result in a larger volume to be subtracted than the total eroded volume calculated by the GIS. In such cases, the total erosional volume observed is assigned to sand. Similar adjustments are made for transitions coded as stripping (island to bar) which is an erosional sediment transfer, and re-vegetation (bar to island) which is a depositional sediment transfer. (These two transitions were ignored in previous sediment budget estimates.) Where the product of the stripping area and the 3 m overbank thickness was found to be smaller than the stripping volume recorded by the GIS, gravel was also assumed to have been eroded. Similarly, measured revegetation volumes in excess of 0.84 m times the revegated area were assumed to have resulted from additional gravel deposition.

Accordingly, bank erosion (island or floodplain at the earlier date) is assumed to include 3 m of overbank sands above the basal gravel layer. The area of bank erosion is multiplied by 3 m and compared to the measured volumetric change. In the example of cell 2, 3 m times the eroded area of 15,337 m^2 in the period 1952-84 exceeds the 3888 m^3 measured volume, so all of the eroded volume is considered to be overbank sand. The remainder (in this case 0) would be considered to be channel sand and gravel (the value 0 is entered at *erosion, sub 3m*). Bank deposition is computed in a similar manner, except that only the top 0.84 metres of sediment is overbank sand. In this example, the product of 0.84 and the depositional area of 464 m^2 is less than the total measured volume, so there is 390 m^3 of overbank sand and 709 m^3 of bed material sand and gravel: the value 709 is entered at *deposition sub 0.84m*. *Bank total* represents the difference between erosion and deposition of bed material in the banks. This total is divided into *bank gravel* and *bank sand* using the same gravel fraction as in the bed. These values are also included in the *total sand+gravel* column at the end of the table.

The total volume change of overbank sand (390 m^3 – 3888 m^3) is then multiplied by 0.3 to estimate the fraction that is coarser than 0.177 mm (the fraction is defined from analyzed samples of overbank sands obtained from along the river, but not necessarily from cell 2). This value (-1050 m^3) is entered as *O/B sand >0.177* and is also included in the *total sand+gravel* column. **The remaining 2449 m^3 of fine overbank sands is considered wash material and is discarded from sediment budget calculations.** In cells where there has been significant bank erosion and deposition over time, this elimination of wash material represents a considerable adjustment which means that the bed-level changes computed from the sediment budget and based on bed material change (Tables B5-7) are systematically different than the unadjusted bed level changes reported in Table B-9.

The final major section of the sediment budget tables summarizes transitions 4 and 5, *vegetation stripping and recovery*. In this example, there was no measured stripping of sand (top 3 m of surface) or gravel (volume below 3 m). The recovery volume was measured as 1261 m^3 and the recovery area was 1403 m^2. Since only the top 0.84 metres is considered O/B sands, this material is subdivided into 1179 m^3 of O/B sands and the remaining 82 m^3 is considered bed material (recovery sub 0.84 m). The bed material volume is subdived into sand and gravel using the percentage of gravel in the bed and banks. These volumes are found in the *gravel* and *sand* columns and are included in *total sand+gravel*. The overbank sand volume is again multiplied by 0.3 to estimate the coarse sand fraction. This value (354 m^3) is enterd into the *O/B sand >0.177* mm column. The remaining 825 m^3 is also considered wash material and is not introduced into the bed material budget.

The sediment budget also includes a column for overbank sands on stable island and floodplain surfaces (*stable fldpln total sand*). These volumes summarize transition 6 but are not included in sediment budget calculations. The volumes are simply presented as a reflection of measurement errors as volumetric changes are expected to have been minimal on these surfaces (though strictly speaking, some wash material may be deposited or removed). The errors are greatest along the floodplain (areas outside the main channel banks) where the data are less dense and are maximum at the margins of the survey data where the topographic modeling is subject to interpolation errors, as we would expect.

The final term required for the sediment budget is the volume of gravel removed from each reach by dredging or mining activities (V_d). These volumes are included as a positive term in the budget (i.e. they are added to each reach as a depositional volume) as it is assumed that this volume represents material that would have remained in each reach had it not been removed. Weatherly and Church (1999) found that an average of 130,000 m^3 has been removed from the gravel reach between 1964 and 1998 at a variety of different sites, although the records are incomplete prior to 1974 (when the industry became regulated). It is not possible to provide an accurate estimate of earlier removals, though total amounts were probably small except during 1949-52 (approximately) when river gravels were used to repair and upgrade channel dykes. The incomplete knowledge of gravel removal volumes represents a negative bias in the sediment budget (meaning transport estimates represent a minimum) although the magnitude of this bias remains unknown. Gravel removals are incorporated into the sediment budget by plotting the locations of individual documented removals on the base map to determine the affected reach in each case.

These quantities are recorded in the sediment budget tables under *gravel removals* and *sand removals*. As there were no known removals in computing cell 2, a value of 0 is entered in both columns.

The summary of all gravel and coarse sand volumetric changes in given in the columns *gravel sum*, *sand sum* and *total sand+gravel*. The *gravel sum* includes gravel eroded or deposited within the bed (transition 1), channel banks (transitions 2 and 3) and associated with vegetation stripping and recovery (transitions 4 and 5), as well as gravel removed by mining. The *sand sum* includes the sand fraction associated with the gravel erosion and deposition (all transitions) as well as the coarse fraction of overbank sands asociated with bank erosion and deposition (transitions 2 and 3) and vegetation stripping and recovery (transition 4 and 5). Sand volumes removed by mining are also included. The bed-level changes are subsequently calculated as the *total sand and gravel* volume change calculated for each cell, divided by the active channel area of the cell (cell width x length).

As reported earlier, the sediment budget total (-248 434 m^3) compares very well with the direct survey difference total (-248 206 m^3) because most of the material exchange occurs within the channel bed (transition 1) and only a small fraction is 'lost' as overbank wash material. In this example, the 2449+825 m^3 of wash material excluded from final calculations occurs entirely within stable floodplain surfaces and so was not included in the direct survey calculation. In addition, an equivalent volume of coarse sand was eroded outside the channel bed (transitions 2-5) as was deposited so no bias is introduced as a result of the assumed 3 m overbank sand erosion thickess or 0.84 m sand deposition thickness.

B.3.2 Complex cell

We now review a case in which the reported bed-level changes are very large. A suitable computing cell for this comparison is Cell 33 where the gross sediment budget shows an apparent bed-level change of +9 cm (aggradation), compared to the direct (unadjusted) survey comparison which shows a change of –70 cm (degradation) between 1952 and 1984. There have been historic sand and gravel removals from this reach, however, which are included in the sediment budget results as a depositional term. If this volume is removed from the sediment budget calculations, there was an apparent bed change of **–**5 cm, still much smaller than the direct survey comparison.

Net volumetric changes for all periods in cell 33 are given in Table B-3 (in this table, gravel and sand removals have been included in the sediment budget figures in order to make the change "equivalent" to that detected from the unadjusted survey). The raw data values that are used in the sediment budget calculations are given in the Table B-4. As before, the highlighted figures, constituting the unadjusted survey differences (Table B-9) and the unprocessed data for the sediment budget, are equivalent to within roundoff error associated with the different calculations used to construct them and to different masking areas.

Table B-3. Volume and bed level changes in cell 33. Negative values indicate degradation (erosion volume exceeds deposition volume).

Period	1952 - 84	1984 - 99	1952 - 99
unadjusted volume (m^3 bulk measure) - Table B-9	**-774,442**	**257,554**	**-516,040**
unadjusted bed level change (m)	-0.70	0.23	-0.47
sediment budget (m^3 bulk measure) - Tables B5-7	-102,368	298,668	103,187
bed material level change (m)	-0.09	0.27	0.09

The large discrepancy between the sediment budget figures (that is, –102 368 m^3 in 1952-84) compared with the direct survey (-774 442 m^3) can be attributed to the treatment of the overbank wash material. In this example, there was a net loss of 604 137 m^3 of wash material associated with bank changes, and a further loss of 2659 m^3 of wash material asociated with vegetation and recovery processes that was ignored in the sediment budget calculations. If this total (606 796 m^3) had been included, the figure reported in Table B-5 would be –709 164 m^3, or –787 529 m^3 if the degradation on stable island/bar surfaces is considered (which would largely account for the slightly different no-data regions used).

Table B-4. Volume changes (m^3 bulk measure) in cell 33 by transition type

Transition	1	2	3	4	5	6	Total volume
1952 - 84	216,334	-986,290	57,215	-7,880	11,457	-78,365	**-787,529**
1984 - 99	315,408	-44,615	10,143	-13,899	-7,428	-34,090	**225,518**
1952 - 99	422,775	-740,827	143,473	-357,358	33,339	-64,586	**-563,184**

B.3.3 Summary difference

Between Mission and Agassiz during the period 1952-84, the total volume of wash material eliminated from bank changes was 8.04 million m^3 (erosional volume). This volume is in fact negative for all computing periods and reflects the observation that bank erosion volumes consistently exceed bank deposition volumes. The total volume of wash material eliminated from the bed material budget due to vegetation stripping and recovery changes was 0.57 million m^3 (depositional volume). Since these wash material losses are included in the unadjusted survey difference comparison (Table B-9) the unadjusted bed-level changes are smaller or more negative for most computing cells.

There remains the question which is the more appropriate set of figures to use to establish trends of bed level change along the river. The overbank changes are large, and tend to decrease apparent aggradation if included (since they are mainly degradational), but they should not have any material impact on raising the level of the channel bed since these sediments are found on island and floodplain surfaces above the normal channel zone. Their removal should increase the channel conveyance in the very highest floods (those that wash over the floodplain and island surfaces). It appears most prudent to adopt the unadjusted results (direct survey) for differences in channel bed elevation for examining potentially significant changes within the channel.

It remains to ask why those numbers do not even sum from survey to survey. The reason for this is the changing mask that is used from survey to survey in the sediment budget calculations. This adjusts the marginal areas where most overbank sediment adjustments occur, so that overbank sediments are not considered on the basis of equivalent areas from survey to survey. The directly differenced 1952-99 volumes and elevation changes, then, do not equal the sum of the component intersurvey changes.

Table B-5. Sediment budget - 1952 to 1984

				bed changes (deposition)				bank changes					
Cell	river km	length (m)	width (m)	channel change	% sand	channel gravel	channel sand	erosion (sub 3m)	deposition (sub 0.84m)	bank total	bank gravel	bank sand	O/B sand (>0.177 mm)
1	85.5	820	560	-100,534	95	-5,027	-95,507	0	32	32	2	30	-474
2	86.3	1,000	500	-248,529	95	-12,426	-236,102	0	709	709	35	673	-1,050
3	87.3	1,000	450	-175,697	95	-8,785	-166,912	0	0	0	0	0	733
4	88.3	950	400	200,598	95	10,030	190,568	0	0	0	0	0	658
5	89.3	990	640	401,184	95	20,059	381,125	-252,736	21,408	-231,328	-11,566	-219,762	-52,962
6	90.3	1,000	750	360,947	95	18,047	342,900	-85,891	401	-85,490	-4,274	-81,215	-46,266
7	91.3	1,000	750	299,529	80	59,906	239,623	0	0	0	0	0	-13,523
8	92.3	1,150	730	362,126	80	72,425	289,700	0	0	0	0	0	-20,822
9	93.4	1,000	660	-514,343	80	-102,869	-411,474	-265	0	-265	-53	-212	-25,085
10	94.4	1,090	750	-375,085	60	-150,034	-225,051	-6,879	0	-6,879	-2,752	-4,128	-38,578
11	95.5	1,070	1,090	128,009	60	51,204	76,806	-52,915	0	-52,915	-21,166	-31,749	-25,036
12	96.6	1,000	670	-261,367	40	-156,820	-104,547	-43,845	0	-43,845	-26,307	-17,538	-47,817
13	97.6	1,030	680	-513,685	30	-359,579	-154,105	0	0	0	0	0	291
14	98.6	1,000	600	668,194	30	467,736	200,458	-79,570	15,881	-63,688	-44,582	-19,107	-43,895
15	99.6	1,000	960	783,569	30	548,498	235,071	-296,759	4,835	-291,923	-204,346	-87,577	-88,496
16	100.6	1,000	1,270	260,992	30	182,694	78,298	-49,205	0	-49,205	-34,444	-14,762	-55,087
17	101.6	1,030	1,240	330,118	30	231,083	99,035	-63,669	0	-63,669	-44,568	-19,101	-111,532
18	102.7	1,100	1,220	902,639	30	631,848	270,792	-286,261	0	-286,261	-200,383	-85,878	-133,401
19	103.8	1,260	1,160	-80,800	30	-56,560	-24,240	-47,390	15,221	-32,170	-22,519	-9,651	-132,185
20	105.0	1,250	1,320	-428,619	30	-300,033	-128,586	0	29,878	29,878	20,915	8,963	-107,467
21	106.3	1,020	1,440	-489,820	30	-342,874	-146,946	-424,686	0	-424,686	-297,281	-127,406	-160,053
22	107.3	1,020	1,270	-683,645	30	-478,551	-205,093	-126,687	0	-126,687	-88,681	-38,006	-128,066
23	108.3	1,030	1,220	-32,258	30	-22,580	-9,677	0	130,883	130,883	91,618	39,265	-8,610
24	109.3	1,040	1,390	786,657	30	550,660	235,997	-23,062	113,377	90,315	63,220	27,094	-108,207
25	110.4	1,160	1,100	652,772	30	456,940	195,832	-16,201	0	-16,201	-11,341	-4,860	-31,088
26	111.5	1,010	990	439,874	30	307,912	131,962	0	151	151	106	45	-56,022
27	112.5	1,020	1,040	-284,617	30	-199,232	-85,385	0	0	0	0	0	1,386
28	113.6	1,070	920	104,520	30	73,164	31,356	0	16,431	16,431	11,502	4,929	-16,146
29	114.6	1,020	730	216,242	30	151,369	64,872	0	13,956	13,956	9,769	4,187	5,583
30	115.6	1,020	1,040	716,395	30	501,477	214,919	0	17,320	17,320	12,124	5,196	-14,688
31	116.7	1,220	830	-189,112	30	-132,378	-56,734	-107,594	59,308	-48,285	-33,800	-14,486	-64,052
32	117.9	1,120	1,170	173,546	30	121,482	52,064	-13,255	0	-13,255	-9,278	-3,976	-386,156
33	119.0	1,240	890	216,334	30	151,434	64,900	-113,981	47,959	-66,022	-46,215	-19,807	-258,916
34	120.2	1,020	590	36,853	30	25,797	11,056	0	107	107	75	32	-22,921
35	121.3	1,020	700	-345,990	30	-242,193	-103,797	-182,773	0	-182,773	-127,941	-54,832	-57,715
36	122.3	1,010	1,190	-273,608	30	-191,526	-82,083	0	0	0	0	0	-48,234
37	123.3	1,060	1,240	-504,086	30	-352,861	-151,226	-94,723	0	-94,723	-66,306	-28,417	-198,377
38	124.4	1,020	1,520	1,293,146	30	905,203	387,944	-91,678	0	-91,678	-64,175	-27,503	-353,132
39	125.4	1,010	1,370	395,271	30	276,689	118,581	0	204,832	204,832	143,382	61,449	-119,268
40	126.4	1,020	980	1,401,122	30	980,786	420,337	0	108,252	108,252	75,776	32,476	-83,846
41	127.4	1,090	800	307,202	30	215,042	92,161	0	38,033	38,033	26,623	11,410	-136,823
42	128.5	910	700	1,046,079	30	732,255	313,824	-188,325	1,390	-186,935	-130,855	-56,081	-198,457
43	129.4	1,130	560	125,003	30	87,502	37,501	0	0	0	0	0	-57,924
R1-43		1,047	932	7,107,126		4,716,912	2,390,214	-2,648,349	840,364	-1,807,985	-1,037,684	-770,301	-3,443,725

vegetation stripping and recovery											
stripping (sub 3m)	recovery (sub 0.84m)	gravel	sand	O/B sand (>0.177 mm)	stable fldpln total sand	gravel removal	sand removal	gravel sum (m3)	sand sum (m3)	total s+g (m3)	Cell
0	0	0	0	0	-16346	0	0	-5,025	-95,952	-100,977	1
0	82	4	78	354	81982	0	0	-12,387	-236,047	-248,434	2
0	0	0	0	31	382517	0	0	-8,785	-166,147	-174,932	3
0	179	9	170	89	451433	0	0	10,039	191,485	201,524	4
0	19,748	987	18,760	3,109	195258	0	0	9,480	130,270	139,750	5
0	200	10	190	261	-144377	0	0	13,783	215,870	229,653	6
0	0	0	0	0	-73944	0	0	59,906	226,100	286,006	7
0	0	0	0	0	-117652	0	0	72,425	268,879	341,304	8
0	0	0	0	0	-87721	0	0	-102,922	-436,771	-539,692	9
0	0	0	0	-149	-88750	0	0	-152,786	-267,905	-420,691	10
0	0	0	0	1,593	26887	0	0	30,038	21,614	51,652	11
0	0	0	0	23,478	-46176	0	0	-183,127	-146,424	-329,551	12
0	94,199	65,939	28,260	92,819	19020	0	0	-293,640	-32,736	-326,376	13
0	1,027	719	308	3,264	324611	0	0	423,873	141,029	564,901	14
0	0	0	0	0	38580	0	800	344,152	59,797	403,949	15
0	0	0	0	-4,599	-78922	0	0	148,251	3,850	152,101	16
0	35	25	11	31	-32128	0	0	186,539	-31,556	154,983	17
0	0	0	0	0	-75759	0	0	431,465	51,513	482,978	18
0	12,875	9,012	3,862	18,505	-38107	5,880	2,520	-64,186	-141,188	-205,374	19
0	15,896	11,127	4,769	35,430	19633	0	0	-267,991	-186,891	-454,883	20
-8,863	0	-6,204	-2,659	48,807	12282	53,200	22,800	-593,158	-365,457	-958,615	21
0	0	0	0	-8,995	-33999	0	0	-567,232	-380,160	-947,392	22
0	0	0	0	9,526	-62370	0	0	69,037	30,504	99,541	23
0	40,583	28,408	12,175	33,671	-51273	0	0	642,288	200,730	843,019	24
0	12,641	8,849	3,792	10,883	9399	0	0	454,448	174,559	629,007	25
0	425	298	128	349	46980	0	0	308,315	76,462	384,777	26
0	44,612	31,229	13,384	16,799	191822	0	0	-168,003	-53,816	-221,820	27
0	69,609	48,726	20,883	24,493	326883	457,100	195,900	590,492	261,415	851,907	28
0	31,922	22,346	9,577	34,822	447114	379,120	162,480	562,604	281,521	844,125	29
0	104,875	73,413	31,463	22,210	209817	32,200	13,800	619,214	272,899	892,113	30
0	0	0	0	10,847	-75833	0	0	-166,178	-124,424	-290,602	31
0	70,507	49,355	21,152	34,237	-17498	0	0	161,559	-282,680	-121,122	32
0	7,375	5,163	2,213	-1,139	-78365	107,100	45,900	217,481	-166,849	50,632	33
0	50,040	35,028	15,012	9,690	13593	107,100	45,900	168,000	58,769	226,769	34
0	0	0	0	482	104236	0	0	-370,134	-215,862	-585,996	35
0	0	0	0	1,468	141639	0	0	-191,526	-128,848	-320,374	36
0	0	0	0	8,042	30169	0	0	-419,166	-369,978	-789,144	37
0	0	0	0	7,908	351280	82,950	35,550	923,978	50,767	974,745	38
0	152,594	106,816	45,778	108,802	416288	136,850	58,650	663,737	273,993	937,730	39
0	0	0	0	16,933	250877	2,660	1,140	1,059,222	387,039	1,446,261	40
0	0	0	0	0	319283	0	0	241,665	-33,253	208,412	41
0	21,859	15,301	6,558	4,936	194176	0	0	616,702	70,780	687,482	42
0	0	0	0	2,485	81843	0	0	87,502	-17,939	69,564	43
-8,863	751,285	506,560	235,863	571,472	3,568,385	1,364,160	585,440	5,549,947	-431,037	5,118,910	R1-43

Table B-6. Sediment budget - 1984 to 1999

				bed changes (deposition)				b						vegetation stripping and recovery											
Cell	river km	length (m)	width (m)	channel change	% sand	channel gravel	channel sand	erosion (sub 3m)	deposition (sub 0.84m)	bank total	bank gravel	bank sand	O/B sand (>0.177 mm)	stripping (sub 3m)	recovery (sub 0.84m)	gravel	sand	O/B sand (>0.177 mm)	stable fldpln total sand	gravel removal	sand removal	gravel sum (m3)	sand sum (m3)	total s+g (m3)	Cell
1	85.5	820	560	-22,001	95	-1,100	-20,901	0	0	0	0	0	21	0	0	0	0	0	37886	0	0	-1,100	-20,881	-21,981	1
2	86.3	1,000	500	48,434	95	2,422	46,013	0	0	0	0	0	412	0	0	0	0	0	69016	0	0	2,422	46,425	48,847	2
3	87.3	1,000	450	29,274	95	1,464	27,811	0	0	0	0	0	443	0	0	0	0	-6	87300	0	0	1,464	28,248	29,712	3
4	88.3	950	400	9,152	95	458	8,694	0	0	0	0	0	-244	0	0	0	0	0	-71420	0	0	458	8,451	8,908	4
5	89.3	990	640	86,017	95	4,301	81,716	0	0	0	0	0	-1,261	0	0	0	0	1,144	-106127	0	0	4,301	81,599	85,899	5
6	90.3	1,000	750	204,127	95	10,206	193,920	0	0	0	0	0	-395	0	0	0	0	147	-9552	0	0	10,206	193,673	203,880	6
7	91.3	1,000	750	-124,984	80	-24,997	-99,987	0	0	0	0	0	-1,197	0	0	0	0	0	-75390	0	0	-24,997	-101,184	-126,181	7
8	92.3	1,150	730	-289,179	80	-57,836	-231,343	0	0	0	0	0	-1,669	0	0	0	0	0	-39111	0	0	-57,836	-233,012	-290,847	8
9	93.4	1,000	660	-135,699	80	-27,140	-108,560	0	301	301	60	241	-120	0	0	0	0	0	77195	0	0	-27,080	-108,439	-135,519	9
10	94.4	1,090	750	-363,972	60	-145,589	-218,383	0	0	0	0	0	247	0	0	0	0	-266	6850	0	0	-145,589	-218,402	-363,991	10
11	95.5	1,070	1,090	-550,419	60	-220,168	-330,251	0	0	0	0	0	-5,720	0	0	0	0	733	-4715	0	0	-220,168	-335,238	-555,406	11
12	96.6	1,000	670	-293,271	40	-175,963	-117,309	0	0	0	0	0	-9,067	0	0	0	0	2,351	49001	0	0	-175,963	-124,024	-299,987	12
13	97.6	1,030	680	-367,234	30	-257,063	-110,170	0	0	0	0	0	-1,468	0	0	0	0	2,735	250044	0	0	-257,063	-108,903	-365,966	13
14	98.6	1,000	600	-668,195	30	-467,736	-200,458	0	0	0	0	0	-2,936	0	0	0	0	0	-56121	0	0	-467,736	-203,394	-671,130	14
15	99.6	1,000	960	-1,204,732	30	-843,313	-361,420	0	0	0	0	0	956	0	0	0	0	0	-15424	0	0	-843,313	-360,463	-1,203,776	15
16	100.6	1,000	1,270	-161,564	30	-113,095	-48,469	-348,458	0	-348,458	-243,920	-104,537	-80,715	0	0	0	0	0	-15522	0	0	-357,015	-233,721	-590,737	16
17	101.6	1,030	1,240	-531,573	30	-372,101	-159,472	-60,475	0	-60,475	-42,332	-18,142	-31,820	0	0	0	0	-1,253	-66325	0	0	-414,434	-210,688	-625,122	17
18	102.7	1,100	1,220	437,808	30	306,466	131,342	0	20,134	20,134	14,094	6,040	9,454	0	0	0	0	153	-108211	0	0	320,560	146,990	467,550	18
19	103.8	1,260	1,160	542,142	30	379,499	162,643	0	92,724	92,724	64,907	27,817	34,489	0	112,506	78,755	33,752	16,588	100797	3,400	3,400	526,560	278,688	805,248	19
20	105.0	1,250	1,320	258,259	30	180,781	77,478	0	12,304	12,304	8,613	3,691	7,030	0	0	0	0	2,528	126498	0	0	189,394	90,727	280,121	20
21	106.3	1,020	1,440	689,290	30	482,503	206,787	-91,006	19,403	-71,603	-50,122	-21,481	-82,467	0	10,373	7,261	3,112	-17,540	10914	23,750	23,750	463,392	112,161	575,553	21
22	107.3	1,020	1,270	631,570	30	442,099	189,471	-16,803	5,844	-10,959	-7,671	-3,288	-21,691	0	0	0	0	-1,273	129872	0	0	434,428	163,219	597,647	22
23	108.3	1,030	1,220	158,074	30	110,652	47,422	0	3,287	3,287	2,301	986	5,719	0	17,547	12,283	5,264	13,214	154885	0	0	125,235	72,605	197,841	23
24	109.3	1,040	1,390	241,775	30	169,243	72,533	0	0	0	0	0	10,932	0	0	0	0	15,625	115806	0	0	169,243	99,090	268,332	24
25	110.4	1,160	1,100	56,401	30	39,480	16,920	0	0	0	0	0	-187	0	0	0	0	161	36843	0	0	39,480	16,894	56,374	25
26	111.5	1,010	990	-447,120	30	-312,984	-134,136	0	0	0	0	0	-19,708	0	0	0	0	-33,779	27948	14,000	6,000	-298,984	-181,623	-480,607	26
27	112.5	1,020	1,040	-28,473	30	-19,931	-8,542	0	0	0	0	0	7,824	0	0	0	0	6,157	-8789	0	0	-19,931	5,439	-14,492	27
28	113.6	1,070	920	-108,179	30	-75,725	-32,454	0	0	0	0	0	26,728	0	0	0	0	6,802	19275	449,400	192,600	373,675	193,676	567,351	28
29	114.6	1,020	730	-148,174	30	-103,722	-44,452	0	11,369	11,369	7,958	3,411	45,468	0	0	0	0	39,858	-72517	204,085	87,465	108,321	131,749	240,070	29
30	115.6	1,020	1,040	-175,358	30	-122,750	-52,607	-39,021	36,359	-2,663	-1,864	-799	40,365	0	0	0	0	26,321	-78315	0	0	-124,614	13,280	-111,334	30
31	116.7	1,220	830	1,417,532	30	992,272	425,259	0	117,528	117,528	82,270	35,258	31,672	0	0	0	0	84,006	128670	0	0	1,074,542	576,196	1,650,738	31
32	117.9	1,120	1,170	881,837	30	617,286	264,551	0	0	0	0	0	3,512	0	0	0	0	11,776	23119	0	0	617,286	279,839	897,124	32
33	119.0	1,240	890	315,408	30	220,785	94,622	0	0	0	0	0	-10,342	0	0	0	0	-6,398	-34090	105,000	45,000	325,785	122,882	448,668	33
34	120.2	1,020	590	90,340	30	63,238	27,102	0	0	0	0	0	3,574	0	0	0	0	-562	-38905	105,000	45,000	168,238	75,114	243,352	34
35	121.3	1,020	700	693,193	30	485,235	207,958	-341,979	40,393	-301,586	-211,110	-90,476	-58,502	0	46,616	32,631	13,985	10,890	-266647	0	0	306,756	83,855	390,611	35
36	122.3	1,010	1,190	212,755	30	148,929	63,827	0	12,360	12,360	8,652	3,708	23,074	0	0	0	0	16,546	-136145	0	0	157,580	107,155	264,735	36
37	123.3	1,060	1,240	924,250	30	646,975	277,275	0	0	0	0	0	-11,555	0	0	0	0	3,325	-68285	0	0	646,975	269,045	916,020	37
38	124.4	1,020	1,520	260,841	30	182,589	78,252	-26,535	0	-26,535	-18,575	-7,961	-83,763	0	0	0	0	-46,438	-62165	0	0	164,014	-59,910	104,104	38
39	125.4	1,010	1,370	467,752	30	327,426	140,326	-130,469	0	-130,469	-91,328	-39,141	-67,089	0	0	0	0	776	191254	0	0	236,098	34,872	270,970	39
40	126.4	1,020	980	101,701	30	71,191	30,510	0	0	0	0	0	2,610	0	0	0	0	-4,055	73985	30,891	13,239	102,082	42,305	144,387	40
41	127.4	1,090	800	366,506	30	256,554	109,952	0	18,005	18,005	12,603	5,401	2,102	0	0	0	0	1,885	117490	0	0	269,158	119,340	388,498	41
42	128.5	910	700	-43,149	30	-30,204	-12,945	0	0	0	0	0	2,133	0	0	0	0	-9,538	52307	0	0	-30,204	-20,350	-50,554	42
43	129.4	1,130	560	-132,050	30	-92,435	-39,615	0	216	216	151	65	-10,561	0	0	0	0	-638	-19223	0	0	-92,284	-50,749	-143,033	43
R1-43		1,047	932	3,329,109		2,678,200	650,909	-1,054,745	390,226	-664,520	-465,314	-199,206	-243,709	0	187,043	130,930	56,113	141,975	533,958	935,526	416,454	3,279,342	822,536	4,101,878	R1-43

Table B-7. Sediment budget - 1952 to 1999

				bed changes (deposition)				bank changes						vegetation stripping and recovery											
Cell	river km	length (m)	width (m)	channel change	% sand	channel gravel	channel sand	erosion (sub 3m)	deposition (sub 0.84m)	bank total	bank gravel	bank sand	O/B sand (>0.177 mm)	stripping (sub 3m)	recovery (sub 0.84m)	gravel	sand	O/B sand (>0.177 mm)	stable fldpln total sand	gravel removal	sand removal	gravel sum (m3)	sand sum (m3)	total s+g (m3)	Cell
1	85.5	820	560	211,549	95	10,577	200,971	0	0	0	0	0	-614	0	0	0	0	0	36884	0	0	10,577	200,357	210,935	1
2	86.3	1,000	500	-212,425	95	-10,621	-201,804	0	3,774	3,774	189	3,585	1,539	0	0	0	0	385	160869	0	0	-10,433	-196,295	-206,728	2
3	87.3	1,000	450	-138,423	95	-6,921	-131,501	0	0	0	0	0	3,003	0	0	0	0	187	474337	0	0	-6,921	-128,311	-135,233	3
4	88.3	950	400	214,113	95	10,706	203,407	0	0	0	0	0	336	0	0	0	0	124	374000	0	0	10,706	203,868	214,574	4
5	89.3	990	640	647,982	95	32,399	615,583	-385,394	18,436	-366,957	-18,348	-348,609	-57,690	0	22,135	1,107	21,028	3,912	92310	0	0	15,158	234,223	249,381	5
6	90.3	1,000	750	616,443	95	30,822	585,621	-140,568	5,861	-134,707	-6,735	-127,972	-47,147	0	1,300	65	1,235	255	-206303	0	0	24,152	411,993	436,145	6
7	91.3	1,000	750	190,202	80	38,040	152,162	0	0	0	0	0	-18,880	0	0	0	0	0	-159655	0	0	38,040	133,281	171,322	7
8	92.3	1,150	730	98,039	80	19,608	78,431	0	0	0	0	0	-26,630	0	0	0	0	0	-194702	0	0	19,608	51,801	71,408	8
9	93.4	1,000	660	-660,880	80	-132,176	-528,704	0	0	0	0	0	-21,441	0	0	0	0	0	-19508	0	0	-132,176	-550,144	-682,320	9
10	94.4	1,090	750	-747,228	60	-298,891	-448,337	0	0	0	0	0	-36,934	0	0	0	0	-295	-88669	0	0	-298,891	-485,566	-784,457	10
11	95.5	1,070	1,090	-354,298	60	-141,719	-212,579	-37,115	0	-37,115	-14,846	-22,269	-53,855	0	0	0	0	6,325	15991	0	0	-156,565	-282,377	-438,943	11
12	96.6	1,000	670	-454,937	40	-272,962	-181,975	-147,606	0	-147,606	-88,564	-59,042	-63,090	0	0	0	0	57,901	-119326	0	0	-361,526	-246,205	-607,731	12
13	97.6	1,030	680	-884,660	30	-619,262	-265,398	0	0	0	0	0	161	0	325,202	227,641	97,561	90,312	32890	0	0	-391,620	-77,364	-468,984	13
14	98.6	1,000	600	2,270	30	1,589	681	-86,011	28,139	-57,871	-40,510	-17,361	-45,375	0	0	0	0	2,090	247751	0	0	-38,921	-59,965	-98,886	14
15	99.6	1,000	960	-422,890	30	-296,023	-126,867	-268,413	5,627	-262,786	-183,950	-78,836	-94,763	0	0	0	0	0	2523	0	800	-479,973	-299,666	-779,639	15
16	100.6	1,000	1,270	-185,308	30	-129,716	-55,592	-359,511	0	-359,511	-251,658	-107,853	-102,039	0	0	0	0	6,332	-92297	0	0	-381,373	-259,153	-640,526	16
17	101.6	1,030	1,240	-91,051	30	-63,735	-27,315	-262,956	25	-262,930	-184,051	-78,879	-124,607	0	475	332	142	-15,766	-71071	0	0	-247,454	-246,425	-493,879	17
18	102.7	1,100	1,220	1,260,942	30	882,660	378,283	-222,423	6,297	-216,126	-151,288	-64,838	-119,605	0	42,146	29,503	12,644	1,207	-211167	0	0	760,874	207,691	968,565	18
19	103.8	1,260	1,160	641,236	30	448,865	192,371	-144,461	70,491	-73,970	-51,779	-22,191	-100,531	0	205,073	143,551	61,522	34,859	-53626	9,280	5,920	549,918	171,950	721,868	19
20	105.0	1,250	1,320	-554,629	30	-388,241	-166,389	-29,784	142,155	112,371	78,660	33,711	-59,064	0	179,128	125,389	53,738	77,167	32614	0	0	-184,191	-60,836	-245,028	20
21	106.3	1,020	1,440	153,483	30	107,438	46,045	-556,338	0	-556,338	-389,437	-166,902	-181,216	0	95,433	66,803	28,630	-21,326	14298	76,950	46,550	-138,246	-248,220	-386,465	21
22	107.3	1,020	1,270	-99,232	30	-69,463	-29,770	-156,481	0	-156,481	-109,537	-46,944	-111,388	0	0	0	0	763	-16984	0	0	-178,999	-187,339	-366,338	22
23	108.3	1,030	1,220	55,668	30	38,968	16,700	0	233,184	233,184	163,228	69,955	7,807	0	0	0	0	44,379	-14404	0	0	202,196	138,842	341,038	23
24	109.3	1,040	1,390	337,295	30	236,106	101,188	0	336,505	336,505	235,554	100,952	-42,181	0	289,676	202,773	86,903	59,815	18585	0	0	674,433	306,676	981,110	24
25	110.4	1,160	1,100	615,157	30	430,610	184,547	0	1,922	1,922	1,345	577	-37,196	0	69,339	48,537	20,802	32,927	4774	0	0	480,492	201,656	682,148	25
26	111.5	1,010	990	-485,984	30	-340,189	-145,795	0	120,714	120,714	84,500	36,214	-22,857	0	26,215	18,351	7,865	15,396	80192	14,000	6,000	-223,339	-103,178	-326,516	26
27	112.5	1,020	1,040	-509,062	30	-356,343	-152,719	0	35,049	35,049	24,534	10,515	6,231	0	137,533	96,273	41,260	45,534	189090	0	0	-235,536	-49,179	-284,715	27
28	113.6	1,070	920	-311,694	30	-218,186	-93,508	0	39,137	39,137	27,396	11,741	1,568	0	265,349	185,745	79,605	75,515	323218	906,500	388,500	901,455	463,421	1,364,876	28
29	114.6	1,020	730	-163,540	30	-114,478	-49,062	0	86,116	86,116	60,282	25,835	26,214	0	206,033	144,223	61,810	114,943	346041	583,205	249,945	673,232	429,684	1,102,916	29
30	115.6	1,020	1,040	159,772	30	111,840	47,931	-76,002	88,401	12,400	8,680	3,720	-9,711	0	383,606	268,524	115,082	121,679	118424	32,200	13,800	421,244	292,501	713,745	30
31	116.7	1,220	830	24,556	30	17,189	7,367	-64,061	1,092,806	1,028,745	720,122	308,624	30,756	0	91,458	64,021	27,437	83,613	49696	0	0	801,331	457,797	1,259,128	31
32	117.9	1,120	1,170	377,290	30	264,103	113,187	-118,351	31,804	-86,547	-60,583	-25,964	-135,243	0	361,280	252,896	108,384	-56,994	-25396	0	0	456,416	3,370	459,786	32
33	119.0	1,240	890	422,775	30	295,943	126,833	-188,083	111,885	-76,198	-53,339	-22,859	-156,347	0	14,518	10,162	4,355	-101,561	-64586	212,100	90,900	464,866	-58,679	406,187	33
34	120.2	1,020	590	37,113	30	25,979	11,134	0	1,506	1,506	1,055	452	-4,498	0	54,960	38,472	16,488	18,476	-20979	212,100	90,900	277,605	132,952	410,558	34
35	121.3	1,020	700	207,766	30	145,436	62,330	-670,594	168,859	-501,735	-351,215	-150,521	-97,788	-607	15,100	10,145	4,348	3,386	3429	0	0	-195,634	-178,245	-373,879	35
36	122.3	1,010	1,190	-310,584	30	-217,409	-93,175	0	42,466	42,466	29,726	12,740	12,397	0	0	0	0	37,625	471	0	0	-187,682	-30,413	-218,095	36
37	123.3	1,060	1,240	171,849	30	120,295	51,555	-148,886	45,754	-103,131	-72,192	-30,939	-67,254	0	0	0	0	-9,628	-226429	0	0	48,103	-56,267	-8,164	37
38	124.4	1,020	1,520	1,137,869	30	796,508	341,361	-465,399	147,344	-318,055	-222,638	-95,416	-227,481	0	87,724	61,406	26,317	-92,397	284057	82,950	35,550	718,226	-12,066	706,160	38
39	125.4	1,010	1,370	866,941	30	606,859	260,082	0	371,641	371,641	260,149	111,492	-238,732	0	328,727	230,109	98,618	64,041	448670	136,850	58,650	1,233,967	354,152	1,588,118	39
40	126.4	1,020	980	783,557	30	548,490	235,067	-75,356	693,724	618,368	432,858	185,510	-40,923	0	114,806	80,364	34,442	16,358	326967	33,551	14,379	1,095,263	444,833	1,540,095	40
41	127.4	1,090	800	261,622	30	183,135	78,487	0	175,435	175,435	122,805	52,631	-76,481	0	113,985	79,790	34,196	-10,626	490230	0	0	385,729	78,206	463,935	41
42	128.5	910	700	338,282	30	236,798	101,485	-131,340	243,269	111,929	78,350	33,579	-135,780	0	174,737	122,316	52,421	5,940	244002	0	0	437,463	57,645	495,108	42
43	129.4	1,130	560	-93,424	30	-65,397	-28,027	0	35,895	35,895	25,127	10,769	-45,456	0	0	0	0	2,404	53771	0	0	-40,270	-60,311	-100,581	43
44	130.5	1,180	520	-390,032	30	-273,022	-117,010	-12,950	105,789	92,839	64,987	27,852	-377	0	0	0	0	8,995	-75418	140,000	60,000	-68,035	-20,540	-88,575	44
45	131.7	1,220	690	-45,203	30	-31,642	-13,561	-463,188	1,682	-461,506	-323,054	-138,452	-107,282	0	0	0	0	-99,632	-63097	238,105	102,045	-116,591	-256,881	-373,473	45
56	132.9	1,020	1,300	-482,396	30	-337,677	-144,719	0	176,610	176,610	123,627	52,983	-82,518	0	207,596	145,317	62,279	131,291	-44132	0	0	-68,733	19,317	-49,416	56
47	133.9	1,460	1,140	-580,913	30	-406,639	-174,274	0	0	0	0	0	-33,689	0	0	0	0	37,782	87977	0	0	-406,639	-170,182	-576,821	47
48	135.4	1,070	1,650	1,305,994	30	914,196	391,798	0	190,007	190,007	133,005	57,002	-114,884	0	446,921	312,845	134,076	122,769	-67225	109,900	47,100	1,469,946	637,861	2,107,807	48
49	136.5	1,280	1,050	315,063	30	220,544	94,519	0	299,617	299,617	209,732	89,885	-108,526	0	515,565	360,896	154,670	143,056	204927	37,800	16,200	828,971	389,803	1,218,775	49
50	137.8	1,070	790	-53,093	30	-37,165	-15,928	0	17,656	17,656	12,359	5,297	-28,485	0	150,281	105,197	45,084	77,435	135966	0	0	80,391	83,403	163,794	50
51	138.8	1,000	620	-207,303	30	-145,112	-62,191	0	2,662	2,662	1,863	799	-36,874	0	13,454	9,418	4,036	110,155	-84329	0	0	-133,831	15,925	-117,906	51
52	139.8	1,000	1,040	-781,575	30	-547,102	-234,472	0	0	0	0	0	-769	0	0	0	0	31,566	-176325	0	0	-547,102	-203,676	-750,778	52
53	140.8	1,070	880	-721,558	30	-505,091	-216,468	0	1,984	1,984	1,389	595	-4,884	0	0	0	0	-194,899	-326662	0	0	-503,702	-415,655	-919,357	53
54	141.9	1,190	900	-618,554	30	-432,988	-185,566	0	0	0	0	0	-10,624	0	0	0	0	-14,349	-301991	0	0	-432,988	-210,538	-643,526	54
55	143.1	1,020	900	122,399	30	85,679	36,720	-1,516	5,159	3,643	2,550	1,093	3,656	0	82,750	57,925	24,825	24,180	-149845	0	0	146,155	90,474	236,628	55
56	144.1	1,110	780	-349,942	30	-244,959	-104,982	-10,689	51,568	40,879	28,616	12,264	11,724	0	139,596	97,717	41,879	38,725	-121231	0	0	-118,627	-390	-119,017	56
57	145.2	1,360	770	-1,092,998	30	-765,099	-327,899	-135,860	18,693	-117,167	-82,017	-35,150	-61,841	0	71,965	50,375	21,589	59,822	-212443	0	0	-796,740	-343,479	-1,140,219	57
58	146.6	1,020	820	-595,731	30	-417,012	-178,719	-100,066	0	-100,066	-70,046	-30,020	-57,172	0	0	0	0	-49,576	-182815	0	0	-487,058	-315,487	-802,545	58
59	147.6	1,800	820	-488,271	30	-341,789	-146,481	-182,151	107,581	-74,570	-52,199	-22,371	-46,046	-100,147	4,148	-67,199	-28,800	-157,310	-191463	0	0	-461,187	-401,007	-862,194	59
60	149.4	1,100	810	-60,472	30	-42,331	-18,142	-14,201	4,373	-9,828	-6,880	-2,948	-36,381	0	240,573	168,401	72,172	72,838	194970	0	0	119,191	87,539	206,730	60
61	150.5	1,080	670	59,718	30	41,803	17,915	-7,370	0	-7,370	-5,159	-2,211	-16,191	0	33,064	23,145	9,919	-11,668	100055	0	0	59,788	-2,235	57,553	61
62	151.6	1,040	480	-15,015	30	-10,511	-4,505	0	0	0	0	0	-1,482	0	0	0	0	-5,118	-104334	0	0	-10,511	-11,104	-21,615	62
63	152.6	1,010	420	199,631	30	139,741	59,889	0	0	0	0	0	13	0	0	0	0	3,025	10721	0	0	139,741	62,927	202,669	63
64	153.6	1,160	440	-111,716	30	-78,201	-33,515	0	0	0	0	0	529	0	1,400	980	420	7,157	15635	0	0	-77,221	-25,408	-102,629	64
65	154.8	1,430	400	-187,476	30	-131,233	-56,243	0	0	0	0	0	277	-9,200	64,435	38,665	16,571	-2,036	-7737	0	0	-92,568	-41,431	-134,000	65
R1-17		1,008	747	-2,171,501		-1,828,285	-343,216	-1,687,573	61,862	-1,625,711	-788,473	-837,237	-688,025	0	349,112	229,146	119,966	151,764	486,024	0	800	-2,387,613	-1,595,948	-3,983,561	R1-17
18-43		1,073	1,053	5,325,024		3,727,517	1,597,507	-3,047,558	4,322,360	1,274,802	892,361	382,441	-1,824,759	-607	3,256,825	2,279,352	976,865	563,494	2,394,956	2,299,686	1,001,094	9,198,917	2,696,642	11,895,559	18-43
44-65		1,168	813	-4,779,443		-3,345,610	-1,433,833	-927,992	983,383	55,391	38,774	16,617	-731,825	-109,346	1,971,748	1,303,681	558,720	334,211	-1,358,797	525,805	225,345	-1,477,351	-1,030,764	-2,508,115	44-65
total		1,088	892	-1,625,921		-1,446,379	-179,542	-5,663,123	5,367,605	-295,518	142,662	-438,179	-3,244,609	-109,953	5,577,685	3,812,179	1,655,552	1,049,469	1,522,184	2,825,491	1,227,239	5,333,953	69,930	5,403,883	total

Table B-8. Sediment volume changes and bed level changes in individual subreaches between Agassiz and Mission - 1952-99 as sum of 1952-84 and 1984-99 budgets

				bed changes (deposition)				b						vegetation stripping and recovery											
Cell	river km	length (m)	width (m)	channel change	% sand	channel gravel	channel sand	erosion (sub 3m)	deposition (sub 0.84m)	bank total	bank gravel	bank sand	O/B sand (>0.177 mm)	stripping (sub 3m)	recovery (sub 0.84m)	gravel	sand	O/B sand (>0.177 mm)	stable fldpln total sand	gravel removal	sand removal	gravel sum	sand sum	total sand+gravel	Cell
1	85.5	820	560	-122,536	95	-6,127	-116,409	0	32	32	2	30	-454	0	0	0	0	0	21,540	0	0	-6,125	-116,832	-122,958	1
2	86.3	1,000	500	-200,095	95	-10,005	-190,090	0	709	709	35	673	-637	0	82	4	78	354	150,999	0	0	-9,965	-189,622	-199,587	2
3	87.3	1,000	450	-146,422	95	-7,321	-139,101	0	0	0	0	0	1,177	0	0	0	0	25	469,817	0	0	-7,321	-137,899	-145,220	3
4	88.3	950	400	209,750	95	10,487	199,262	0	0	0	0	0	415	0	179	9	170	89	380,013	0	0	10,496	199,936	210,432	4
5	89.3	990	640	487,201	95	24,360	462,841	-252,736	21,408	-231,328	-11,566	-219,762	-54,223	0	19,748	987	18,760	4,252	89,131	0	0	13,781	211,868	225,649	5
6	90.3	1,000	750	565,074	95	28,254	536,820	-85,891	401	-85,490	-4,274	-81,215	-46,661	0	200	10	190	409	-153,929	0	0	23,989	409,543	433,533	6
7	91.3	1,000	750	174,545	80	34,909	139,636	0	0	0	0	0	-14,720	0	0	0	0	0	-149,334	0	0	34,909	124,916	159,825	7
8	92.3	1,150	730	72,947	80	14,589	58,357	0	0	0	0	0	-22,490	0	0	0	0	0	-156,763	0	0	14,589	35,867	50,456	8
9	93.4	1,000	660	-650,042	80	-130,008	-520,034	-265	301	36	7	29	-25,205	0	0	0	0	0	-10,526	0	0	-130,001	-545,210	-675,211	9
10	94.4	1,090	750	-739,057	60	-295,623	-443,434	-6,879	0	-6,879	-2,752	-4,128	-38,331	0	0	0	0	-414	-81,900	0	0	-298,374	-486,307	-784,681	10
11	95.5	1,070	1,090	-422,410	60	-168,964	-253,446	-52,915	0	-52,915	-21,166	-31,749	-30,755	0	0	0	0	2,326	22,172	0	0	-190,130	-313,624	-503,754	11
12	96.6	1,000	670	-554,638	40	-332,783	-221,855	-43,845	0	-43,845	-26,307	-17,538	-56,884	0	0	0	0	25,829	2,826	0	0	-359,090	-270,448	-629,538	12
13	97.6	1,030	680	-880,918	30	-616,643	-264,276	0	0	0	0	0	-1,177	0	94,199	65,939	28,260	95,554	269,064	0	0	-550,703	-141,638	-692,341	13
14	98.6	1,000	600	-1	30	-1	0	-79,570	15,881	-63,688	-44,582	-19,107	-46,830	0	1,027	719	308	3,264	268,490	0	0	-43,864	-62,365	-106,229	14
15	99.6	1,000	960	-421,163	30	-294,814	-126,349	-296,759	4,835	-291,923	-204,346	-87,577	-87,540	0	0	0	0	0	23,156	0	800	-499,161	-300,666	-799,827	15
16	100.6	1,000	1,270	99,428	30	69,599	29,828	-397,663	0	-397,663	-278,364	-119,299	-135,802	0	0	0	0	-4,599	-94,444	0	0	-208,765	-229,871	-438,636	16
17	101.6	1,030	1,240	-201,456	30	-141,019	-60,437	-124,144	0	-124,144	-86,901	-37,243	-143,352	0	35	25	11	-1,222	-98,453	0	0	-227,895	-242,244	-470,138	17
18	102.7	1,100	1,220	1,340,448	30	938,313	402,134	-286,261	20,134	-266,127	-186,289	-79,838	-123,946	0	0	0	0	153	-183,969	0	0	752,024	198,503	950,528	18
19	103.8	1,260	1,160	461,342	30	322,940	138,403	-47,390	107,944	60,554	42,388	18,166	-97,696	0	125,381	87,767	37,614	35,092	62,690	9,280	5,920	462,374	137,499	599,874	19
20	105.0	1,250	1,320	-170,361	30	-119,252	-51,108	0	42,183	42,183	29,528	12,655	-100,437	0	15,896	11,127	4,769	37,957	146,131	0	0	-78,597	-96,164	-174,761	20
21	106.3	1,020	1,440	199,471	30	139,629	59,841	-515,693	19,403	-496,290	-347,403	-148,887	-242,520	-8,863	10,373	1,057	453	31,267	23,196	76,950	46,550	-129,766	-253,296	-383,062	21
22	107.3	1,020	1,270	-52,074	30	-36,452	-15,622	-143,490	5,844	-137,646	-96,352	-41,294	-149,757	0	0	0	0	-10,268	95,873	0	0	-132,804	-216,941	-349,745	22
23	108.3	1,030	1,220	125,816	30	88,071	37,745	0	134,169	134,169	93,919	40,251	-2,890	0	17,547	12,283	5,264	22,740	92,516	0	0	194,273	103,109	297,382	23
24	109.3	1,040	1,390	1,028,432	30	719,902	308,530	-23,062	113,377	90,315	63,220	27,094	-97,275	0	40,583	28,408	12,175	49,296	64,533	0	0	811,531	299,820	1,111,351	24
25	110.4	1,160	1,100	709,172	30	496,421	212,752	-16,201	0	-16,201	-11,341	-4,860	-31,275	0	12,641	8,849	3,792	11,044	46,242	0	0	493,928	191,452	685,381	25
26	111.5	1,010	990	-7,246	30	-5,072	-2,174	0	151	151	106	45	-75,730	0	425	298	128	-33,430	74,928	14,000	6,000	9,331	-105,161	-95,830	26
27	112.5	1,020	1,040	-313,090	30	-219,163	-93,927	0	0	0	0	0	9,210	0	44,612	31,229	13,384	22,956	183,033	0	0	-187,934	-48,377	-236,312	27
28	113.6	1,070	920	-3,660	30	-2,562	-1,098	0	16,431	16,431	11,502	4,929	10,582	0	69,609	48,726	20,883	31,295	346,157	906,500	388,500	964,166	455,092	1,419,258	28
29	114.6	1,020	730	68,067	30	47,647	20,420	0	25,325	25,325	17,728	7,598	51,051	0	31,922	22,346	9,577	74,680	374,597	583,205	249,945	670,926	413,270	1,084,196	29
30	115.6	1,020	1,040	541,037	30	378,726	162,311	-39,021	53,679	14,658	10,261	4,397	25,677	0	104,875	73,413	31,463	48,531	131,502	32,200	13,800	494,599	286,179	780,778	30
31	116.7	1,220	830	1,228,420	30	859,894	368,526	-107,594	176,836	69,243	48,470	20,773	-32,380	0	0	0	0	94,853	52,837	0	0	908,364	451,772	1,360,135	31
32	117.9	1,120	1,170	1,055,383	30	738,768	316,615	-13,255	0	-13,255	-9,278	-3,976	-382,645	0	70,507	49,355	21,152	46,012	5,621	0	0	778,845	-2,842	776,003	32
33	119.0	1,240	890	531,742	30	372,219	159,523	-113,981	47,959	-66,022	-46,215	-19,807	-269,258	0	7,375	5,163	2,213	-7,538	-112,455	212,100	90,900	543,267	-43,967	499,300	33
34	120.2	1,020	590	127,192	30	89,035	38,158	0	107	107	75	32	-19,346	0	50,040	35,028	15,012	9,128	-25,312	212,100	90,900	336,237	133,883	470,121	34
35	121.3	1,020	700	347,203	30	243,042	104,161	-524,751	40,393	-484,358	-339,051	-145,307	-116,217	0	46,616	32,631	13,985	11,372	-162,411	0	0	-63,378	-132,007	-195,385	35
36	122.3	1,010	1,190	-60,853	30	-42,597	-18,256	0	12,360	12,360	8,652	3,708	-25,160	0	0	0	0	18,014	5,494	0	0	-33,946	-21,694	-55,639	36
37	123.3	1,060	1,240	420,164	30	294,115	126,049	-94,723	0	-94,723	-66,306	-28,417	-209,932	0	0	0	0	11,367	-38,116	0	0	227,809	-100,933	126,876	37
38	124.4	1,020	1,520	1,553,987	30	1,087,791	466,196	-118,213	0	-118,213	-82,749	-35,464	-436,895	0	0	0	0	-38,530	289,115	82,950	35,550	1,087,992	-9,143	1,078,849	38
39	125.4	1,010	1,370	863,022	30	604,116	258,907	-130,469	204,832	74,363	52,054	22,309	-186,357	0	152,594	106,816	45,778	109,579	607,541	136,850	58,650	899,836	308,865	1,208,701	39
40	126.4	1,020	980	1,502,823	30	1,051,976	450,847	0	108,252	108,252	75,776	32,476	-81,236	0	0	0	0	12,879	324,861	33,551	14,379	1,161,303	429,344	1,590,648	40
41	127.4	1,090	800	673,709	30	471,596	202,113	0	56,037	56,037	39,226	16,811	-134,721	0	0	0	0	1,885	436,772	0	0	510,822	86,087	596,909	41
42	128.5	910	700	1,002,929	30	702,051	300,879	-188,325	1,390	-186,935	-130,855	-56,081	-196,324	0	21,859	15,301	6,558	-4,601	246,484	0	0	586,497	50,431	636,928	42
43	129.4	1,130	560	-7,047	30	-4,933	-2,114	0	216	216	151	65	-68,486	0	0	0	0	1,847	62,620	0	0	-4,782	-68,688	-73,470	43
R1-43		1,047	932	10,436,235		7,395,112	3,041,123	-3,703,095	1,230,590	-2,472,505	-1,502,999	-969,506	-3,687,434	-8,863	938,328	637,489	291,976	713,447	4,102,343	2,299,686	1,001,894	8,829,289	391,499	9,220,788	R1-43

Table B-9. Summary of bed level changes

Cell	river km	length (m)	width (m)	sediment budget s+g totals (m3) 1952-84	sediment budget s+g totals (m3) 1984-99	sediment budget s+g totals (m3) 1952-99	bed level changes from sediment budget (m) 1952-84 gross	1952-84 net	1984-99 gross	1984-99 net	1952-99 gross	1952-99 net	unadjusted computing cell sediment totals (m3) 1952-84	1984-99	1952-99	unadjusted bed level changes (m) 1952-84	1984-99	1952-99	Cell
1	85.5	820	560	-100,977	-21,981	210,935	-0.220	-0.220	-0.048	-0.048	0.459	0.459	-100,982	-22,846	-123,262	-0.220	-0.050	-0.268	1
2	86.3	1,000	500	-248,434	48,847	-206,728	-0.497	-0.497	0.098	0.098	-0.413	-0.413	-248,206	49,631	-199,846	-0.496	0.099	-0.400	2
3	87.3	1,000	450	-174,932	29,712	-135,233	-0.389	-0.389	0.066	0.066	-0.301	-0.301	-169,949	32,125	-138,247	-0.378	0.071	-0.307	3
4	88.3	950	400	201,524	8,908	214,574	0.530	0.530	0.023	0.023	0.565	0.565	205,223	9,628	214,765	0.540	0.025	0.565	4
5	89.3	990	640	139,750	85,899	249,381	0.221	0.221	0.136	0.136	0.394	0.394	17,332	86,566	104,025	0.027	0.137	0.164	5
6	90.3	1,000	750	229,653	203,880	436,145	0.306	0.306	0.272	0.272	0.582	0.582	101,487	203,257	305,296	0.135	0.271	0.407	6
7	91.3	1,000	750	286,006	-126,181	171,322	0.381	0.381	-0.168	-0.168	0.228	0.228	239,210	-131,502	107,209	0.319	-0.175	0.143	7
8	92.3	1,150	730	341,304	-290,847	71,408	0.407	0.407	-0.346	-0.346	0.085	0.085	257,196	-278,019	-21,186	0.306	-0.331	-0.025	8
9	93.4	1,000	660	-539,692	-135,519	-682,320	-0.818	-0.818	-0.205	-0.205	-1.034	-1.034	-627,247	-122,440	-750,539	-0.950	-0.186	-1.137	9
10	94.4	1,090	750	-420,691	-363,991	-784,457	-0.515	-0.515	-0.445	-0.445	-0.960	-0.960	-514,339	-371,404	-887,294	-0.629	-0.454	-1.085	10
11	95.5	1,070	1,090	51,652	-555,406	-438,943	0.044	0.044	-0.476	-0.476	-0.376	-0.376	6,423	-555,117	-550,623	0.006	-0.476	-0.472	11
12	96.6	1,000	670	-329,551	-299,987	-607,731	-0.492	-0.492	-0.448	-0.448	-0.907	-0.907	-410,063	-177,186	-588,059	-0.612	-0.264	-0.878	12
13	97.6	1,030	680	-326,376	-365,966	-468,984	-0.466	-0.466	-0.523	-0.523	-0.670	-0.670	-109,601	-129,438	-239,962	-0.156	-0.185	-0.343	13
14	98.6	1,000	600	564,901	-671,130	-98,886	0.942	0.942	-1.119	-1.119	-0.165	-0.165	479,478	-686,196	-208,245	0.799	-1.144	-0.347	14
15	99.6	1,000	960	403,949	-1,203,776	-779,639	0.421	0.420	-1.254	-1.254	-0.812	-0.813	184,886	-1,208,731	-1,023,126	0.193	-1.259	-1.066	15
16	100.6	1,000	1,270	152,101	-590,737	-640,526	0.120	0.120	-0.465	-0.465	-0.504	-0.504	-12,636	-858,392	-871,675	-0.010	-0.676	-0.686	16
17	101.6	1,030	1,240	154,983	-625,122	-493,879	0.121	0.121	-0.489	-0.489	-0.387	-0.387	-135,705	-705,023	-841,638	-0.106	-0.552	-0.659	17
18	102.7	1,100	1,220	482,978	467,550	968,565	0.360	0.360	0.348	0.348	0.722	0.722	160,795	488,709	650,620	0.120	0.364	0.485	18
19	103.8	1,260	1,160	-205,374	805,248	721,868	-0.141	-0.146	0.551	0.546	0.494	0.483	-488,358	1,021,551	534,755	-0.334	0.699	0.366	19
20	105.0	1,250	1,320	-454,883	280,121	-245,028	-0.276	-0.276	0.170	0.170	-0.149	-0.149	-610,742	411,773	-197,794	-0.370	0.250	-0.120	20
21	106.3	1,020	1,440	-958,615	575,553	-386,465	-0.653	-0.704	0.392	0.360	-0.263	-0.347	-1,369,817	376,211	-991,946	-0.933	0.256	-0.675	21
22	107.3	1,020	1,270	-947,392	597,647	-366,338	-0.731	-0.731	0.461	0.461	-0.283	-0.283	-1,286,141	633,499	-652,453	-0.993	0.489	-0.504	22
23	108.3	1,030	1,220	99,541	197,841	341,038	0.079	0.079	0.157	0.157	0.271	0.271	104,095	355,341	459,277	0.083	0.283	0.365	23
24	109.3	1,040	1,390	843,019	268,332	981,110	0.583	0.583	0.186	0.186	0.679	0.679	662,651	379,536	1,043,804	0.458	0.263	0.722	24
25	110.4	1,160	1,100	629,007	56,374	682,148	0.493	0.493	0.044	0.044	0.535	0.535	585,877	70,079	656,732	0.459	0.055	0.515	25
26	111.5	1,010	990	384,777	-480,607	-326,516	0.385	0.385	-0.481	-0.501	-0.327	-0.347	240,579	-627,957	-388,073	0.241	-0.628	-0.388	26
27	112.5	1,020	1,040	-221,820	-14,492	-284,715	-0.209	-0.209	-0.014	-0.014	-0.268	-0.268	-180,594	24,471	-155,358	-0.170	0.023	-0.146	27
28	113.6	1,070	920	851,907	567,351	1,364,876	0.865	0.202	0.576	-0.076	1.387	0.071	222,421	25,536	248,916	0.226	0.026	0.253	28
29	114.6	1,020	730	844,125	240,070	1,102,916	1.134	0.406	0.322	-0.069	1.481	0.362	425,933	175,917	602,769	0.572	0.236	0.810	29
30	115.6	1,020	1,040	892,113	-111,334	713,745	0.841	0.798	-0.105	-0.105	0.673	0.629	872,268	51,984	924,983	0.822	0.049	0.872	30
31	116.7	1,220	830	-290,602	1,650,738	1,259,128	-0.287	-0.287	1.630	1.630	1.243	1.243	-514,872	2,058,537	1,545,543	-0.508	2.033	1.526	31
32	117.9	1,120	1,170	-121,122	897,124	459,786	-0.092	-0.092	0.685	0.685	0.351	0.351	-956,898	985,241	29,730	-0.730	0.752	0.023	32
33	119.0	1,240	890	50,632	448,668	406,187	0.046	-0.093	0.407	0.271	0.368	0.094	-774,442	257,554	-516,040	-0.702	0.233	-0.468	33
34	120.2	1,020	590	226,769	243,352	410,558	0.377	0.123	0.404	0.155	0.682	0.179	24,917	101,439	126,605	0.041	0.169	0.210	34
35	121.3	1,020	700	-585,996	390,611	-373,879	-0.821	-0.821	0.547	0.547	-0.524	-0.524	-875,244	281,358	-594,489	-1.226	0.394	-0.833	35
36	122.3	1,010	1,190	-320,374	264,735	-218,095	-0.267	-0.267	0.220	0.220	-0.181	-0.181	-436,094	363,877	-71,105	-0.363	0.303	-0.059	36
37	123.3	1,060	1,240	-789,144	916,020	-8,164	-0.600	-0.600	0.697	0.697	-0.006	-0.006	-1,256,236	1,005,861	-247,977	-0.956	0.765	-0.189	37
38	124.4	1,020	1,520	974,745	104,104	706,160	0.629	0.552	0.067	0.067	0.455	0.379	-5	-170,009	-168,767	0.000	-0.110	-0.109	38
39	125.4	1,010	1,370	937,730	270,970	1,588,118	0.678	0.536	0.196	0.196	1.148	1.006	804,739	294,303	1,101,161	0.582	0.213	0.796	39
40	126.4	1,020	980	1,446,261	144,387	1,540,095	1.447	1.443	0.144	0.100	1.541	1.493	1,327,349	118,942	1,446,287	1.328	0.119	1.447	40
41	127.4	1,090	800	208,412	388,498	463,935	0.239	0.239	0.446	0.446	0.532	0.532	-141,212	414,296	273,621	-0.162	0.475	0.314	41
42	128.5	910	700	687,482	-50,554	495,108	1.079	1.079	-0.079	-0.079	0.777	0.777	242,224	-51,493	191,446	0.380	-0.081	0.301	42
43	129.4	1,130	560	69,564	-143,033	-100,581	0.110	0.110	-0.226	-0.226	-0.159	-0.159	-9,553	-167,133	-177,065	-0.015	-0.264	-0.280	43
44	130.5	1,180	520			-88,575					-0.144	-0.470			-273,294			-0.445	44
45	131.7	1,220	690			-373,473					-0.444	-0.848			-1,197,032			-1.422	45
46	132.9	1,020	1,300			-49,416					-0.037	-0.037			62,930			0.047	46
47	133.9	1,460	1,140			-576,821					-0.347	-0.347			-573,753			-0.345	47
48	135.4	1,070	1,650			2,107,807					1.194	1.105			1,964,607			1.113	48
49	136.5	1,280	1,050			1,218,775					0.907	0.867			1,240,039			0.923	49
50	137.8	1,070	790			163,794					0.194	0.194			290,414			0.344	50
51	138.8	1,000	620			-117,906					-0.190	-0.190			58,133			0.094	51
52	139.8	1,000	1,040			-750,778					-0.722	-0.722			-681,223			-0.655	52
53	140.8	1,070	880			-919,357					-0.976	-0.976			-1,380,013			-1.466	53
54	141.9	1,190	900			-643,526					-0.601	-0.601			-702,185			-0.656	54
55	143.1	1,020	900			236,628					0.258	0.258			316,235			0.344	55
56	144.1	1,110	780			-119,017					-0.137	-0.137			-902			-0.001	56
57	145.2	1,360	770			-1,140,219					-1.089	-1.089			-1,146,574			-1.095	57
58	146.6	1,020	820			-802,545					-0.960	-0.960			-1,064,131			-1.272	58
59	147.6	1,800	820			-862,194					-0.584	-0.584			-1,337,854			-0.906	59
60	149.4	1,100	810			206,730					0.232	0.232			294,549			0.331	60
61	150.5	1,080	670			57,553					0.080	0.080			-3,015			-0.004	61
62	151.6	1,040	480			-21,615					-0.043	-0.043			-36,630			-0.073	62
63	152.6	1,010	420			202,669					0.478	0.478			210,538			0.496	63
64	153.6	1,160	440			-102,629					-0.201	-0.201			-89,452			-0.175	64
65	154.8	1,430	400			-134,000					-0.234	-0.234			-145,882			-0.255	65
R1-43		1,047	932	5,118,910	4,101,878	7,911,998	0.121	0.075	0.097	0.065	0.187	0.109	-4,063,858	4,014,332	-37,220	-0.096	0.095	-0.001	R1-43
R44-65		1,168	813			-2,508,115					-0.120	-0.156			-4,194,495			-0.195	R44-65
Total		1,088	892			5,403,883					0.086	0.021			-4,231,715			-0.067	Total