Glacial geology and geomorphology of Weardale.

Edwin Neville Moore

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Volume II

by

Edwin Neville Moore

A thesis submitted for the degree of Doctor of Philosophy of the University of Durham April, 1994.

Weardale 1:10,560 series

Field Map Extracts:-

MAPS	1.	NZ.13.SW	Bedburn confluence South
	2.	NZ.13.SW	Harperley
	3.	NZ.13.SW	Bedburn confluence North
	4.	NZ.13.NW	Bradley
	5.	NZ.03.NE	Wolsingham East
	6.	NZ.03.NE	Wolsingham West
	7.	NA.03.NW	Frosterley
	8.	NZ.03.NW	Rogerley
	9.	NY.93.NE	Stanhope to Eastgate
	10.	NY.93.NW	Eastgate to Brotherlee
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	13.	NY.83.NE	Wearhead

Glacial Geology and Geomorphology of Weardale

Volume II

Field Techniques

This volume includes a selection of the original field maps completed during the survey. The sequence of maps included embrace the main terraces and associated morphological features of the Dale. These features have been mapped on the O.S., 1:10,560 series. Detail was later transferred to O.S. maps, 1:25,000 series (Vol.1., Figs. 10.1 - 10.11). The area originally covered embraced all sheets NY84/94, NY83/93, and N213.

1. Aims and Objectives in the field.

The primary aim of the study was to assess the extent and nature of Devensian glacial process in the Dale. This necessitated detailed morphological mapping of the area covered by Pennine Till. This cover extended from the head of the Dale at Killhope Cross (GR.799.433) to the Scars (GR.136.319), below the Bedburn confluence at Witton-le-Wear, a distance of some 42 kilometres. No erratics had previously been found in any remnant of till on interfluves around the Dale, to the west of High Stoop, Tow Law (GR.164.403) in the north, or of Five Pikes (Gr.013.369) in the south.

The current survey acquired access to many exposures of till which cap the interfluves above Coal Measures strata. To the north of the Dale this strata forms the slopes and interfluves to the west of the Waskerley Beck. South of the Wear, Coal Measures cap the interfluves from the Ayhope to the Harthope and the Wear. These beds finally form the underlying strata to the east of the Bedburn.

Exposures in till confirmed a presence of Pennine ice at Inkerman, Tow Law. East of this location, at Stonefoot Hill, at Sunniside, and Dowfold Hill, Crook, tills included erratics which had been derived from Lake District and Scottish sources. South of the Dale, erratics of Lake District and Vale of Eden origin were also found in tills to the east of the Bedburn drainage.

These exposures, along with examination of glaciofluvial deposits, confirmed the area of the Dale around Witton-le-Wear as being one where ice flows had merged.

Mapping of the Dale to the west of Witton-le-Wear embraced an area of some 630 sq. km. At Greenfoot, Stanhope the interfluves are at a distance apart of some 14 kilometres (i.e. from Horseshoe Hill, (GR.985.499) in the north, to Raven Seat, (GR.970.233) on Harnisha Hill to the south).

The extent of this area of field study necessitated locating a base within the Dale. The original mapping was

completed using White House Farm, Eastgate, as this base. (thanks are recorded to Mr and Mrs W. Rippon who allowed siting of a caravan at this location). Later studies were completed after taking up residence in the Dale at Witton-le-Wear.

2. Mapping

Mapping embraced a study of the river terraces, glaciofluvial forms, till morphology, as well as meltwater channels left by deglaciation. The extent of the study area necessitated an aerial photographic study of the Dale. The University of Durham stereoscopic aerial photographic cover of the Dale proved invaluable as a source of supplementary evidence, both for, and after, the acquisition of field data (eg. The Greenly Hills moraine - see Vol. 1. Ch. 5). Stereoscopic survey also aided identification of morphological features which were concealed by topography, or vegetative cover at ground level. Features identified on these photographs were mapped subsequent to a ground survey which included a geological survey of surficial deposits and sold strata.

Levelling of features e.g. meltwater channels and paired terraces was carried out with the use of a quick-set level. Slopes which were difficult of access (e.g. The gorge at Greenly Hills moraine (see Vol. I. Ch. 5)) were measured by clinometer. An aneroid checked at hourly intervals to

known spot heights, was utilised for recording heights of features on higher fells above 450 m O.D.

Meltwater channels were mapped which would include those formed by marginal and sub-marginal flow, as well as larger ice-directed channels, (cf. Mannerfelt, 1945, 1949; Sissons, 1958, 1960a, 1960b, 1961a; Derbyshire, 1961; Clapperton, 1968; Price, 1973). Channels are listed according to location, height of incision and gradient of floor (see Vol. 1 Ch.7).

3. Further Objectives

A Quaternary field survey necessitated defining the following objectives:-

a) An assessment of the quality of solid strata in the Dale and to what extent the degree of weathering was derived from Quaternary process. Exposures of solid strata were fractured to provide clean sections for examination of rock quality, and for the presence of open, or iron-stained joints.

   These observations were later correlated with details of the quality of solid strata encountered by exploratory boring for the Kielder Tunnels Project.

b) A Fabric analysis of all exposures of basal till.

Clasts in the diamict were hand sectioned for field identification. Where further identification was required, thin sections of the rocks were prepared, then analysed with a petrological microscope (cf. Bridgland, 1986). A minimum of fifty clasts were examined at each till exposure. A total count of only 50 gives a standard error of some 13.9% (Bridgland, 1986). However such counts may still be considered viable if correlated with data from neighbouring locations. Records were taken of parent lithology, size and 'a' axis orientation. Similar records were taken of large gritstone boulders (1-3 m across) deposited in scattered trains across several interfluves to the Dale.

c) Recording of sedimentary content and structures in glaciofluvial deposits. Detail of Weardale glacial sediments (at depth) was provided by access to borehole data from the Blue Circle factory, and the Kielder Tunnels project. (kindly see acknowledgements Vol.1). Road construction also provided detailed sedimentology of glacial kames, terrace gravels, and sections through tills and solifluction deposits (e.g. Willow Green Ch. 5). Excavation for bridge pillars at Broadwood, Frosterley and at the A.68 Bypass Witton-le-Wear provided further details of sand and gravel sequences in the Quaternary terraces. Details of the glaciofluvial content of kames was also provided by

extraction of these deposits for track surfacing.

Sampling of slope deposits for evidence of mass movement found inclusions of these deposits within the older gravel terraces of the Dale.

Consequently older terrace gravels are defined as those which include interdigitated, and thus contemporary with, soliflucted deposits from adjacent slopes. Borehole details reveal their sedimentology to also include ablation till, boulders, and silts suggesting derivation from valley sandurs. Artifacts included on their surface suggest these terraces formed dry sites by Mesolithic times when they became utilised by man.

Incision of the older gravels occurred with rapid run off as a result of deforestation in Iron Age/Romano - British times. Lower terrace levels so formed are capped by silt. Reworking of former gravels also occurred with deposition of a terrace of mineral rich s diments, notably fluorspar, as a result of anthropogenic 'flash flooding'. This resulted from the North Pennine orefield practice of hydrological mining termed 'hushing'. This practice was very active during the operations of the London Lead Company 1762-1844.

d) An evaluation of the nature and effects of periglacial processes during the Quaternary in the Dale.

Deposits which include masses of sharp angular fragmented debris orientated downslope were assigned to a derivation by frost process. These were found in localities where exposures of strata, and inclined boring for the Kielder Tunnels, revealed clay-filled open joints. Such joints were also examined in detail thanks to access to the experimental tunnel at Rogerley Quarry (kindly see acknowledgements). Joints were also examined at valley quarries and at surface exposures.

Paraglacial processes were also operative in the Dale. These appear to have provided the spreads of slumped deposits from reworking of the basal till. Such deposits are reddish sandy clays. In contrast to the blue-grey basal tills they lack an argillaceous content and show evidence of oxidation and deep weathering.

Patterned ground is of limited occurrence in the Dale. Sampling occurred at the limited localities.

Lithology, size and orientation of block fabric in Felsenmeer were recorded. Orientation of 'a' and 'b' axes were taken by prismatic compass. Dips, where

applicable, were taken with a clinometer.

e) Recording of glaciotectonic structures.

Glacial geological investigations encountered evidence for glaciotectonic disturbance of strata. Greenly Hills form an apparent push moraine (see Ch.5). Extensive glacial rafting was also found in Westphalian strata, both within the Wear valley, and across both interfluves to the Dale. The presence or absence of permafrost in the Westphalian beds appears to have contributed to the extent of strata rafted, and determined the degree of disturbance at the location of extraction, as well as in the included beds. Analysis of structures on the interfluve, necessitated comparisons with other glaciotectonic disturbances observed in similar beds at locations north of the interfluve. At the latter permafrost appears to have been absent (see Vol. 1. Ch.6). Thanks are recorded for access to sites where the rate of open-cast coal extraction can result in several hectares being extracted and infilled within one week.

4. Analysis of the Data.

Analysis of the data has been presented by:-

1. Tabulation of data recording the quality of solid rock strata.

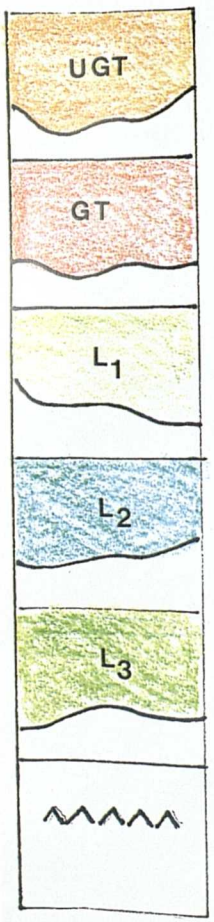
2. Plotting of polar scattergrams and modal azimuths of stone content in basal till.
3. Plotting of polar scattergrams and modal azimuths of blocks scattered across interfluves and in Felsenmeer of the Dale.
4. Geological sections showing the nature of till, glaciofluvial, and sandur deposits of the Dale.
5. Geological sections of glaciotectonic rafts.
6. Tabulation of meltwater channels based on location, height, average gradient, and incision.
7. Plotting of all data onto a geomorphological map of the Dale. Details are also recorded on the O.S. 1:25,000 series (Vol.1 10.1-10).

The analysis is based on an acquisition of field data. Such data lacks an accuracy of refinement by further laboratory studies. However the correlation of that data presents a hypothesis which it is hoped may serve as a challenge to further detailed explorations.

Extracts from the original field maps are to be found in the subsequent pages.

Key to 1:10,560 Field Maps

Grid Squares. 1km Square.



Upper Gravel Terrace = Sandur Level 1

Lower Gravel Terrace = Sandur Level 2

Holocene silt capped Terrace. Level 1 (upper)

Holocene silt capped Terrace. Level 2

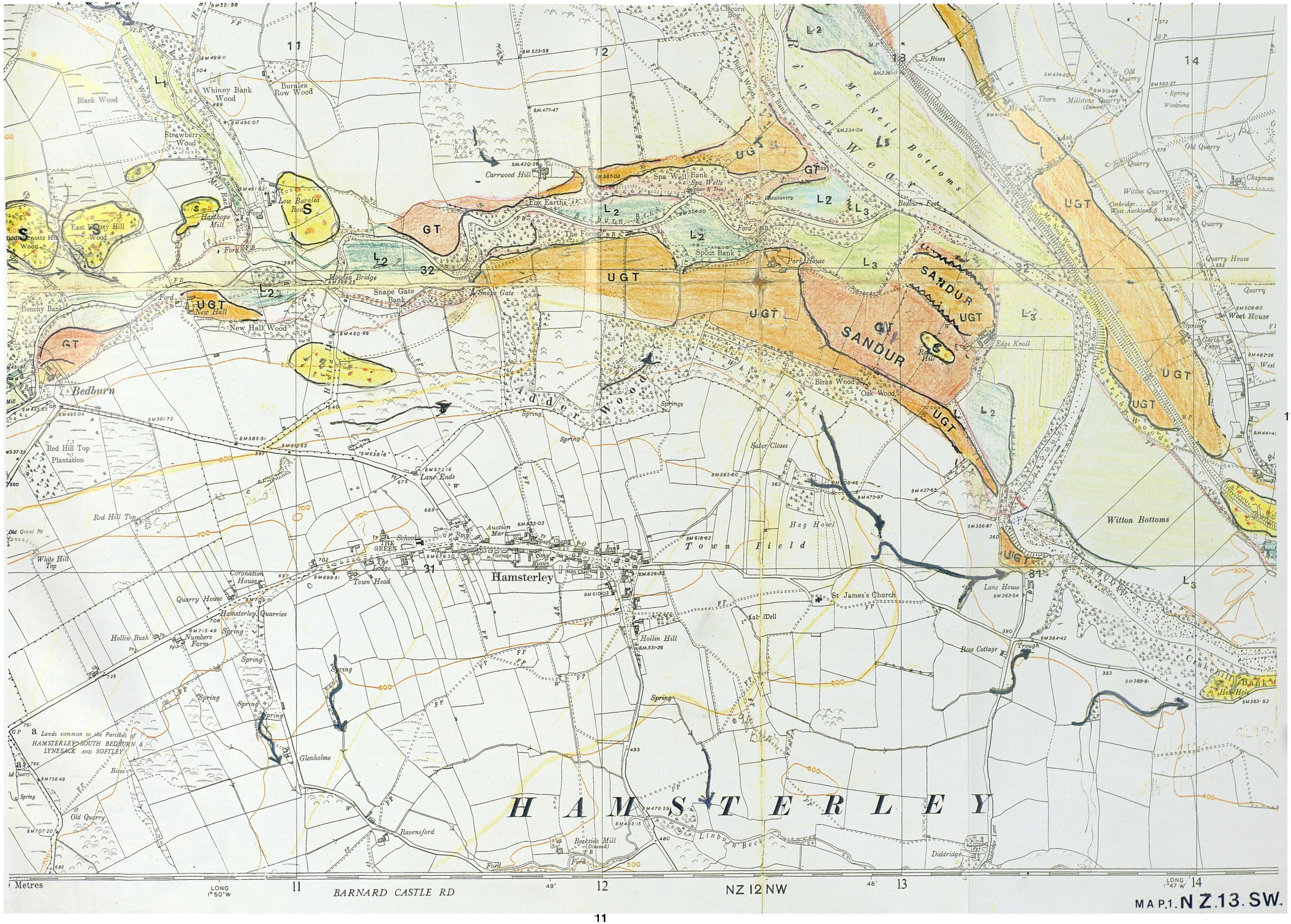
Holocene silt capped Terrace. Level 3 (lower)

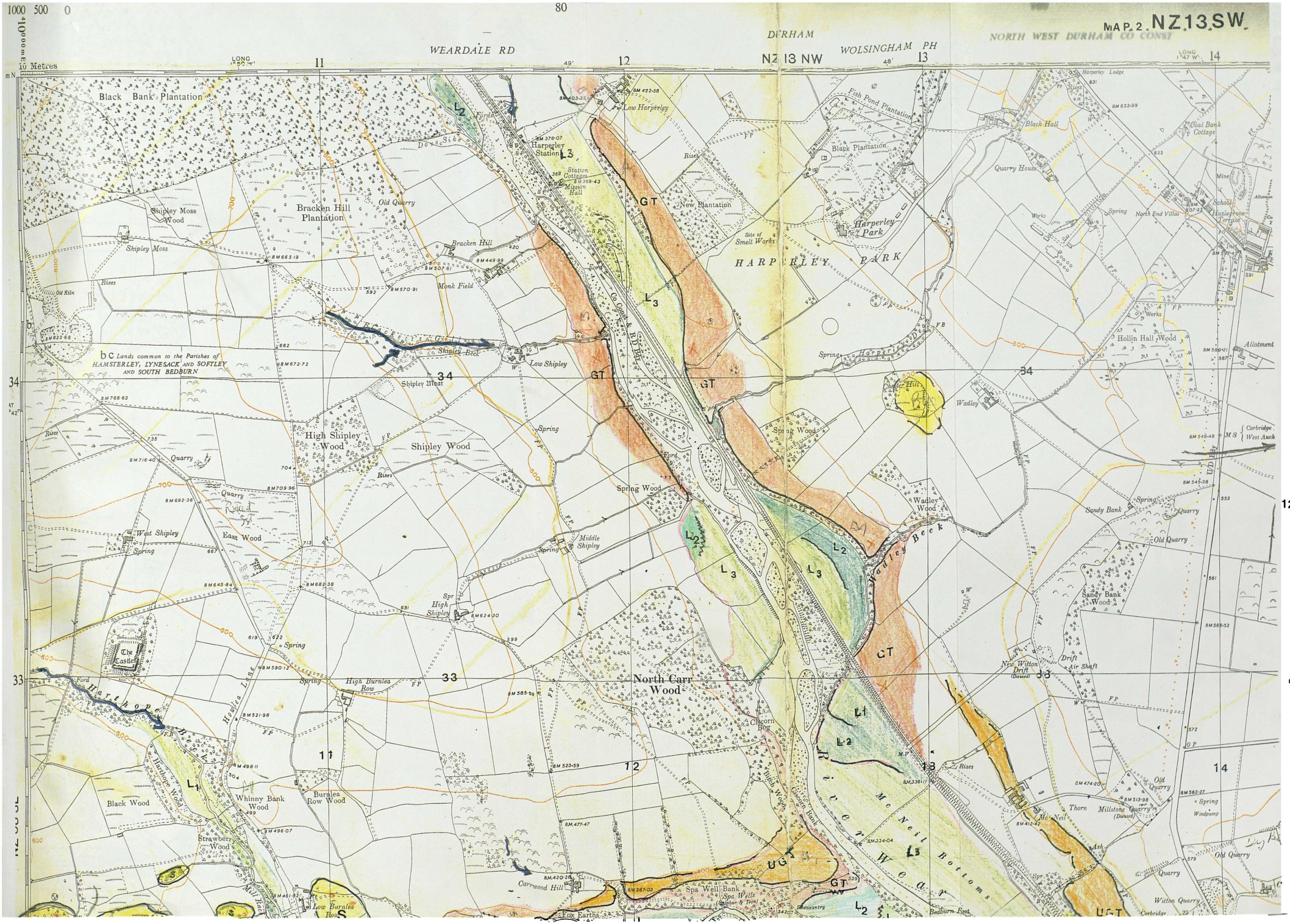
Merged break of slope at terrace rear

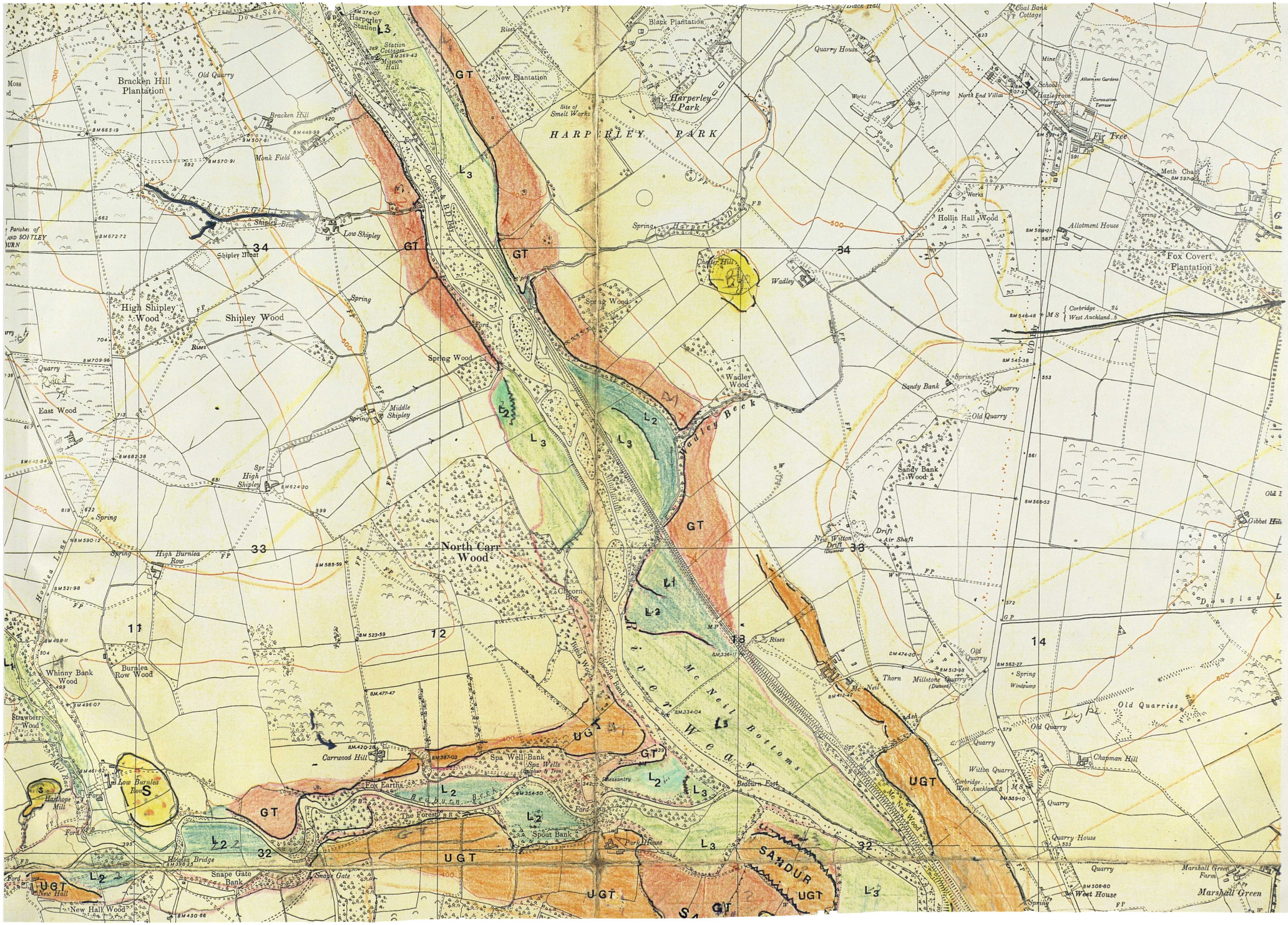
Glacial kame of sand and gravel

Glacially moulded till

Glacial meltwater channels


MAP.1. NZ.13.SW.
HAMSTERLEY
Hamsterley
NZ 12 NW
BARNARD CASTLE RD
Metres
LONG 1° 50' W
LONG 1° 47' W
11
12
13
14
31
32
S
L1
L2
L3
GT
UGT
SANDUR
River Wear
Mc Neil Bottoms
Bedburn Beck
Black Wood
Whinny Bank Wood
Burnlea Row Wood
Strawberry Wood
Low Burnlea
Hartshope Mill
East Knotty Hill Wood
Carrwood Hill
Fox Earths
Spa Well Bank
Spa Wells
The Forest
Spout Bank
Park House
Bedburn Foot
Snape Gate Bank
Snape Gate
New Hall
New Hall Wood
Benchy Bank
Bedburn
Adder Wood
Birks Wood
Oak Wood
Edge Knoll
Red Hill Top Plantation
Red Hill Top
White Hill Top
Lane Ends
Auction Mart
The Green
School
Town Head
Coronation House
Quarry House
Hamsterley Quarries
Hollin Bush
Numbers Farm
Hollin Hill
Town Field
Hag Howl
St James's Church
Lady Well
Lane House
Rose Cottage
Witton Bottoms
Old Quarry
Quarry
Millstone Quarry (Disused)
Witton Quarry
Quarry House
West House
Garth Farm
Glenholme
Ravensford
Beckside Mill (Disused)
Linburn Beck
Diddridge
Hell Hole
Crake Hill Bank
Lands common to the Parishes of HAMSTERLEY, SOUTH BEDBURN & LYNESACK AND SOFTLEY


MAP 2. NZ 13 SW
NORTH WEST DURHAM CO CONST
DURHAM
WEARDALE RD
WOLSINGHAM PH
NZ 13 NW
Black Bank Plantation
Shipley Moss Wood
Bracken Hill Plantation
Shipley Moss
Old Quarry
Bracken Hill
Monk Field
Shipley Beck
Low Shipley
Shipley Moat
High Shipley Wood
Shipley Wood
Quarry
West Shipley
East Wood
Spring
Middle Shipley
Spr High Shipley
The Castle
High Burnlea Row
Harthope Beck
Hawlea Lane
Black Wood
Whinny Bank Wood
Burnlea Row Wood
Strawberry Wood
Low Burnlea Row
North Carr Wood
Cicorn Bog
Carrwood Hill
Fox Earths
Spa Well Bank
Spa Wells (Sulphur & Iron)
Chalybeate
Low Harperley
Harperley Station
Station Cottage
Mission Hall
Ford
Do Sike
Co Const & RD Hill
New Plantation
Site of Smelt Works
HARPERLEY PARK
Harperley Park
Fish Pond Plantation
Black Plantation
Black Hall
Quarry House
Harperley Lodge
Coal Bank Cottage
Mine
Allotment
Hazlegrove Terrace
North End Villas
Hollin Hall Wood
Chester Hill
Wadley
Spring Wood
Wadley Beck
Wadley Wood
Sandy Bank
Sandy Bank Wood
New Witton Drift (Disused)
Drift Air Shaft
Millstone Quarry (Disused)
Old Quarry
Windpump
Witton Quarry
Corbridge
West Auckland
River Wear
McNeil Bottoms
Bedburn Fell
Chessantry
Rises
Spring
Works
Ford
FP
GT
UG
L1
L2
L3
bc Lands common to the Parishes of HAMSTERLEY, LYNESACK AND SOFTLEY AND SOUTH BEDBURN


MAP 3 NZ 13 SW
13
Bracken Hill Plantation
Old Quarry
Harperley Station
Station Cottages
Mission Hall
New Plantation
Site of Smelt Works
Harperley Park
HARPERLEY PARK
Black Plantation
Quarry House
Coal Bank Cottage
Fir Tree
Meth Chap
Hollin Hall Wood
Allotment House
Fox Covert Plantation
Bracken Hill
Monk Field
Shipley Beck
Low Shipley
Shipley Moat
Parishes of AND SOUTLEY URN
Chester Hill
Wadley
Spring Wood
High Shipley Wood
Shipley Wood
Spring
Middle Shipley
East Wood
Quarry
Wadley Wood
Wadley Beck
Sandy Bank
Sandy Bank Wood
Old Quarry
Gibbet Hill
North Carr Wood
High Burnlea Row
Clicorn Bog
New Witton Drift (Disused)
Drift
Air Shaft
Rises
Old Quarries
Whinny Bank Wood
Burnlea Row Wood
Strawberry Wood
Carrwood Hill
Spa Well Bank
(Spa Wells (Sulphur & Iron))
Fox Earths
Low Burnlea Top
Hardhope Mill
Redburn Beck
The Forest
Spout Bank
Pheasantry
Bedburn End
Park House
McNeil Bottoms
McNeil Wood
Thorn
Millstone Quarry (Disused)
Mc Neil
Ash
Chapman Hill
Witton Quarry
Quarry House
Marshall Green Farm
Marshall Green
West House
Hesleden Bridge
Snape Gate
Snape Gate Bank
New Hall
New Hall Wood
Windpump
Spring
Ford
Rises
Quarry
Old Quarry
Douglas
Corbridge
West Auckland
Saxdur
UGT
GT
L1
L2
L3
11
12
13
14
32
33
34

MAP 4. NZ13.NW

14

al Edition on National Sheet Lines)

160 240 C

DURHAM

NZ 04 SE 53' 08 WEARDALE RD 52' 09 LONG 1°51'W 41000 540

WOLSINGHAM NORTH MOOR

Reservoir Spring Sheepfold Sand Pits (Disused) Rises Spring Redmires Old Quarry Rises Old Quarries Spring Houselop Beck

Old Quarry Rises Old Quarry Old Quarry Dodd Hill Spring Rises Castle Hill House Houselop Bridge Stone

Tank Old Quarry Thistlewood Farm Thistlewood Lane Dodd Hill Lane Thistlewood Quarry Quarry Spring Sandy Carr Spring

Old Quarry Rises Sandy Carr Gannister & Firestone Quarries Lanchester...7 Wolsingham...2 M S P Spring

Boat Hill House Thistlewood House Thistlewood Hall Old Quarry Redgate Grange Old Quarries Spring Spring

Low Doctor Pasture Trough Plane Tree House Spring Spring Rises Mount Pleasant Spring

Holywood Hall (Durham County Somewhere) Redgate Villa Redgate Quarry (Disused) Red Gate Redgate Hank Old Quarry Redgate Quarry Lanchester...8 Wolsingham...1 Lodge Redgate House Redgate Hall Stone Bdy FUNDAMENTAL BENCH MARK

Ford Lodge Low Redgate Hank Rises Spring

Holwell Farm Grosvenor House Heartwell Plantation Old Quarries Spring Greenwell Hill Old Quarries Old Quarry

UPPER TOWN WOLSINGHAM Old Workhouse School Bowlees Spring Spring Spring

Demesne Mill Demesne Weir Wolsingham Bridge St Mary & St Stephen's Church St Ann's School St Thomas's R.C. School Dunskins Spring

Thus Works Attwood Terrace Ward Terrace Durham Road Farm Old MS Wolsingham Durham Spring

Wolsingham Steel Works Rise of Wear Mill Dam Weardale Hotel Brick Works The Butts Spring

Wolsingham Bridge Gas Depot Flood Plain Cross Scotch Isle Gallows Gate

Clough Gill Spring Old Quarries Old Quarries Crook Lane

Bella Side Old Quarry Rises

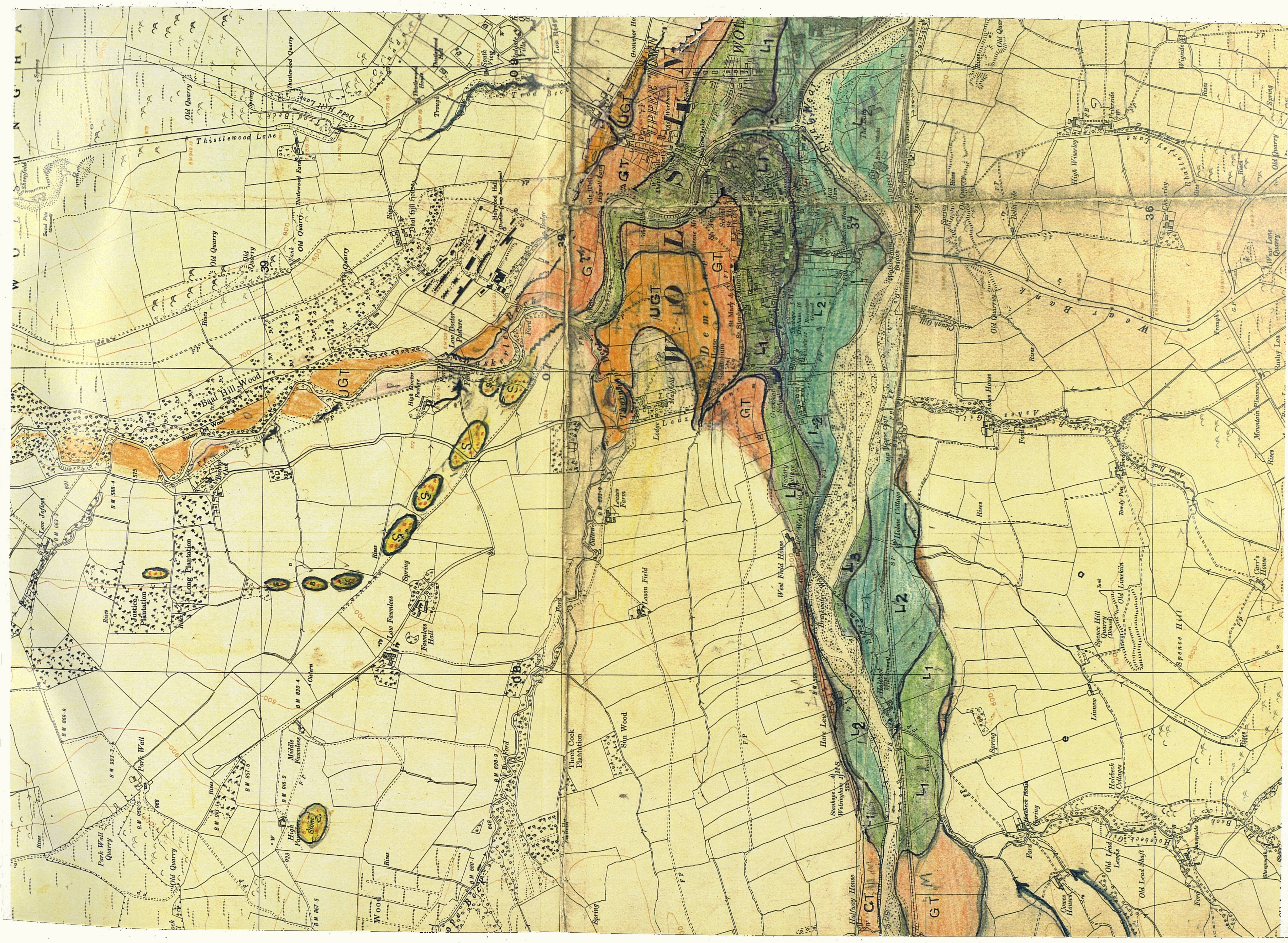
High Wiserley Wiserley Hall Wiserley Ford Low Wiserley Ford

Fairside Fords Ford

15

MAP 5. NZ 03 NE.

MAP.6.NZ03.NE


Thistlewood Lane
Bael Hill Wood
UGT
GT
L1
L2
L3
S
CT
GTM
Spence Hill
High Fawnlees
Low Fawnlees
West Fold House
Halfway House
Thirt Cock Plantation
Sun Wood
Park Wall Quarry
Old Quarry


Fatherley Hill
Fatherley Hill Currick
Old Quarries
Old Quarry
Thornhope Quarry
Bradley Currick
Rogerley High Plantation
Coal Drift
Old Quarry
Township Plantation
Intake Plantation
Brake House
Shake Hole
Old Quarry
High Barn
Wiserley Hill
Old Shaft (Lead)
Old Level (Lead)
Rogerley Quarry
Kirk Stile
Old Quarries
Kiln House
Frosterley
Church (Site of)
School
Wesleyan Meth. Chap.
Hall
Bishopley House
Old Quarry
New Frosterley Quarry (Disused)
Old Quarry
Willow Green
Newlands Hall
West Newlands
Bishopley Junction
Broadwood
Broadwood Quarry (Disused)
Otters Pool
Landieu
Thornhope Beck
Thornhope House
Sheepfold
Ladley Wood
Old Quarry
Old Shaft (Lead)
Ladley
Old Quarry
Old Quarry
Springs
Green Bank
School
East Bridge End
New Houses
North Bishopley Quarry
Harehope Quarry (Disused)
Bishopley Limekiln
Main House
Old Lead Drifts
Old Quarry
Old Lead Shaft
Old Limekiln
White Kirkley
Bishopley Crag Quarries (Disused)
Old Quarry
West Biggins
East Biggins
Old Lead Level
North Rigg
Old Quarry
Old Lead Shafts
Old Quarry
Rises
Springs
Trough
Tank
Tanks
Pp
Pond
Batts
Br
Ford
Dry Burn
Thorn Hope Burn
Willow Burn
Green Burn
River Wear
UGT
GT
BENCH
L2
D
A
L
E
V
37
38
39
03
04
30
NZ 03 NE
1000
900
800
700
600
500
400
300
200
100

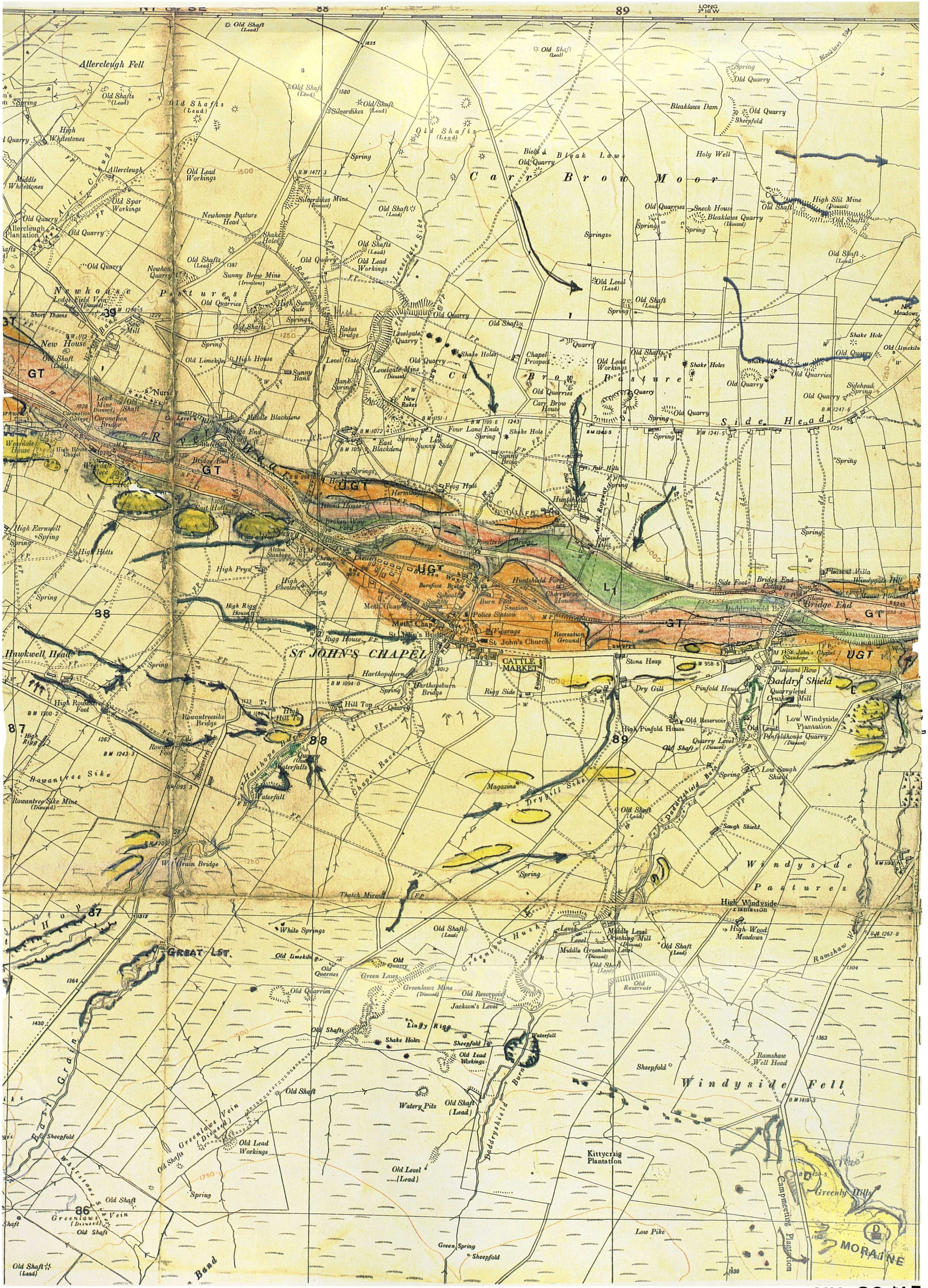
MAP 7. NZ. 03. NW.

NORTH WEST DURHAM CO CONST
WEARDALE RD
NY 94 SE
STANHOPE PH
96
97
98
99
Bewdley Plain
Allerton Riggs
East Bewdley
West Bewdley
Hall Plantation
Green Head
Spain's Field
Laverock Seat
High Farm
Harrowbank House
Old Quarries
Shake Hole
Thrush Nest
Warm Wells
Old Quarry
Brock Bank
Sweet Wells
Guy's Close
Broad Meadows
Eweclose Spring
Greenfoot Plantation
Greenfoot Cottage
Greenfoot House
Greenfoot Quarry
Golden Lands
St. John's Chapel 7 Stanhope
Allerton Bridge
STANHOPE
East Gate House
Eastgate
St John's Chapel
White House
UGT
L1
L2
D
UG
River
Eastgate Station
Whitehouse Plantation
West Softley Plantation
East Softley Plantation
Horsley Burn Waterfall
Aller Gill House
Aller Gill
Horsley Hall
Square Plantation
Hag Top
Long Plantation
High Horsley
Old Limekiln
Birkshaw
Old Quarries
Newlandside Quarry
Newlandside Hall
Crookleys Plantation
Quarry Hill
Thimbley Hill
Scurfield House
Moor House
Shield Ash
Cowburn Rigg
Old Clay Pit
High House
West Newlandside
Horsley Head
Hothill Quarry (Disused)
Mary Knott's Quarry (Disused)
Snape Gate
Holly Well
Shake Holes
Old Shafts (Lead)
Springs
Rises
38
39
19
MAP 9. NY.93.NE.

20

MAP. 10. NY.93.NW.

MAP. 11. NY.93.NW



MAP.12. NY. 83. NE

22

MAP.13.NY.83.NE

23