



EIS 869

AB019517

Muswellbrook environmental study. [Volume 2], Technical
report

NSW DEPT PRIMARY INDUSTRIES
AB019517



VOLUME 2

G. SUMMERHAYES
GEOLOGICAL SURVEY

*ENVIRONMENTAL
GEOLOGY
SUBSECTION*

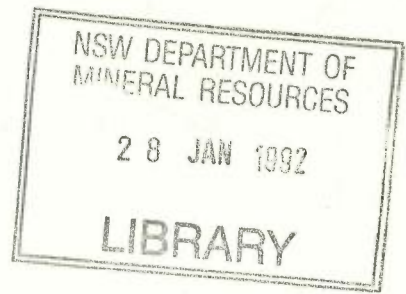
NSW DEPARTMENT OF
MINERAL RESOURCES
28 JAN 1982
LIBRARY



Muswellbrook Environmental Study



Technical Report



Muswellbrook Environmental Study

Technical Report

Prepared For THE MUSWELLBROOK SHIRE COUNCIL

By JACKSON TEECE CHESTERMAN WILLIS & PARTNERS April 1981

(i)

INTRODUCTION

This environmental study has been carried out as required under Section 57 of the Environmental Planning and Assessment Act 1979. It provides the information and suggests policies upon which a new plan for the Shire should be based.

The study is in two volumes containing eighteen chapters and is supported by a number of appendices and reports.

Volume 1, chapters 1 and 2, summarise the study and its major recommendations. Volume 2, chapters 3 to 18, describes relevant aspects of the natural and man-made environment and examines the issues that must be addressed in the plan.

The form and content of this study has been influenced to a large extent by the 'Study Specifications' issued by the Department of Environment and Planning on the 2nd January, 1981. Matters required to be investigated, assessed and reported included:-

- "1. Measures proposed to be taken to protect the present and future urban areas of the Shire of Muswellbrook from any adverse effects of mining.
2. To set aside appropriate land for residential, commercial, industrial, recreational and community purposes.
3. Measures proposed to be taken to protect the natural and man-made environment of the Shire of Muswellbrook.
4. The establishment of a road system and infrastructure that adequately serves the needs of industry, residents and through traffic.
5. The protection of agricultural, recreational, scenic, natural and mineral resources of the Shire of Muswellbrook.

(ii)

6. The environmental effects associated with industrial growth, including air, water, noise and visual pollution.
7. The cumulative effects of urban and industrial growth on the towns, villages and rural areas and, in particular, the effects on the Hunter River, agriculture and social structure.
8. The resolution of conflicts that may arise from competition for resources such as water and land.
9. The provision of community facilities and services to meet demand, including the provision of essential social services and public infrastructure.
10. The identification of areas of co-operation between State and Local Government in order to properly manage and administer the financing of infrastructure, services, facilities and land acquisition.
11. Social impacts and opportunities to broaden the industrial and employment base of the sub-region to lessen over-reliance on mining and power generation.
12. The provision of a variety of housing forms, suitable for temporary accommodation and family housing.
13. The adequacy of the transportation network to meet increased demands in an environmentally acceptable manner. "

Following gazettal of the above specifications, a number of studies and investigations were carried out in order to obtain adequate background data and information. These included:

- . Muswellbrook Social Survey - Dec. 1980. Jackson Teece Chesterman Willis and Partners Pty. Limited
- . Muswellbrook Community Impact Study - Dec. 1980. Gutteridge Haskins and Davey Pty. Limited.

(iii)

- . Introduction to Expected Growth and Augmentation of Utilities -
Dec. 1980. Gutteridge Haskins and Davey Pty. Limited.
- . Implications of Coal Related Growth to Council Finances -
Jan. 1981. Gutteridge Haskins and Davey Pty. Limited.
- . Muswellbrook Land Use and Floor Space Survey - Dec. 1980.
Jackson Teece Chesterman Willis and Partners Pty. Limited.
- . Historic Buildings and Sites Surveys - Muswellbrook Historic
Society. Jackson Teece Chesterman Willis and Partners Pty.
Limited, Planning Workshop Pty. Limited.
- . Acoustical Impact Assessment. Louis A. Challis and Associates
Pty. Limited.
- . Wind and Air Quality Assessment. Accent Designs.
- . Upper Hunter Industrial Survey - March 1981. Jackson Teece
Chesterman Willis and Partners Pty. Limited.
- . Upper Hunter Sub-regional Study. A Report to the Department of
Environment and Planning - March 1981.
Jackson Teece Chesterman Willis and Partners Pty. Limited and
Gutteridge Haskins and Davey Pty. Limited.

In addition to these studies information was sought from a number of
Government Departments, private organisations, consultants and academics.
These included:

- . N.S.W. Department of Environment and Planning
- . N.S.W. Department of Mineral Resources
- . Water Resources Commission of N.S.W.
- . Electricity Commission of N.S.W.
- . State Rail Authority of N.S.W.
- . N.S.W. Department of Lands
- . N.S.W. Department of Main Roads
- . N.S.W. Housing Commission

(iv)

- . N.S.W. Department of Education
- . N.S.W. Department of Youth and Community Services
- . Combined Coal Proprietors Association
- . Joint Coal Board of N.S.W.
- . State Pollution Control Commission
- . Hunter District Water Board
- . Hunter Valley Research Foundation
- . John Collins - University of Newcastle
- . Sinclair Knight and Partners
- . James B. Croft and Associates

The assistance of the above is gratefully appreciated.

(xii)

TABLES cont'd	Page	
8.0	Population in the Upper Hunter	94
8.1	New Construction Employment 1981-1991 by Project and Primary Urban Orientation	98
8.2	Projected New Production Employment, 1981-1991, by Project and Primary Urban Orientation	99
8.3	Coal Mining Employment	100
8.4	Net Residential Impact of New Basic Workforce in the Upper Hunter	102
8.5	Residential Location of 80 Per Cent of the Construction Workforce (Temporary Accommodation)	102
8.6	Type 2 Multipliers Assumed for Forecasting Employment Opportunities	105
8.7	Changes in Employment by Area of Residence - Upper Hunter 1981-1991	105
8.8	Population Forecasts	107
9.0	The Demand for Extra Dwellings in Muswellbrook	109
9.1	Basic Land Requirements for Extra Dwellings in Muswellbrook	109
9.2	The Muswellbrook Trade Area. The Percentage of Retail Expenditure Captured by Muswellbrook	111
9.3	Forecast Retail Expenditure in Muswellbrook - 1986	112
9.4	Net Rentable Floorspace Requirements in Muswellbrook (1980 prices)	112
11.0	Demand for Land in Muswellbrook	127
11.1	Retail and Office Floorspace (m ²) and Estimated Retail Floorspace to 1986	128
11.2	Supply and Demand for Residential Lots	149
11.3	Land Release and Infrastructure Programme	150
11.4	Potential Floor Space and Parking Supply	161
11.5	Open Space Requirements 1983-1991 - Muswellbrook	168
11.6	Cost Distribution of Augmentation - Muswellbrook	170
11.7	Cost Distribution of Augmentation - Denman	177

(xi)

TABLES

Title	Page
3.0 Average and Median Rainfall for Muswellbrook	9
3.1 Highest and Lowest Recorded Monthly and Yearly Rainfall at Muswellbrook	9
3.2 Cumulative Total of Minimum Rainfall Recorded in Consecutive Periods at Muswellbrook Commencing in the Month Indicated	9
3.3 Mean Temperatures at Muswellbrook	9
3.4 Minimum Number of Inversion Days	14
4.0 Population Distribution and Age Structure	30
4.1 Labour Force Distribution	31
4.2 Sector of Employment	32
4.3 Household Income	33
4.4 Motor Vehicle Ownership	33
4.5 Land Use and Ownership	36
4.6 Agricultural Land Use in the Upper Hunter 1977-78 Percent of Hunter S.D. Totals	37
4.7 Agricultural Production in the Muswellbrook Shire 1978-79 Season	37
4.8 Daily Traffic Volumes (AADT)	43
5.0 Floorspace Distribution in Muswellbrook Town Centre October 1980	53
5.1 Number of Establishments in Denman Town Centre (Ogilvie Street)	62
6.0 Listing of Historic Homesteads in the Muswellbrook Shire	72
7.0 Muswellbrook Shire: Mining and Power Generation Activities	84

(v)

TABLE OF CONTENTS

	Page
3.0 THE NATURAL ENVIRONMENT	1
3.1 Geographical setting	1
3.2 Topography	1
3.3 Geology	4
3.4 Soils and Erosion	4
3.5 Climate: Rainfall. Temperature. Frosts. Evaporation. Wind. Air inversions.	
3.6 Hydrology: River system and catchment areas. Catchment hydrology and flow variations. Flood mitigation. Water quality.	15
3.7 Vegetation and Wildlife: Vegetation. Wildlife.	20
3.8 Acoustic Environment: Background noise levels. Conclusions.	23
4.0 POPULATION CHARACTERISTICS AND ECONOMIC ACTIVITY	29
4.1 Population Characteristics: Population distribution and age structure. Employment. Household income/motor vehicle ownership. Summary.	29
4.2 Economic Activity: Agriculture. Coal mining and power generation. Transportation. Recreation and tourism. Commerce/retailing.	36
5.0 THE URBAN AREAS	49
5.1 Muswellbrook: Housing. Commercial areas. Shopping patterns. Social and cultural facilities. Active recreation facilities. Water supply and sewerage. Roads. Land ownership.	49

(vi)

	Page
5.2 Denman:	62
Land use. Social and cultural facilities.	
Active recreation facilities.	
6.0 HERITAGE, LANDSCAPE AND TOWNSCAPE	67
6.1 A Brief History	67
6.2 Landscape	73
6.3 Townscape	83
7.0 COAL RELATED PROJECTS	
7.1 Firm Proposals	86
7.2 Possible Projects	90
8.0 POPULATION FORECASTS	94
Introduction. Increases in basic employment in the Upper Hunter. Residential location associated with the new basic labour force. Multipliers and their consequences for employment. Population forecasts.	
9.0 DEMAND FOR HOUSING AND LAND	108
9.1 Housing and Land	108
9.2 Retail Floor Space	111
9.3 Industrial Land	114
10.0 SOCIAL CHANGES AND DEMAND FOR FACILITIES AND SERVICES	117
Existing population structure. Expected growth and change. Demand for social facilities and services.	
11.0 URBAN DEVELOPMENT	126
11.1 Introduction	126
11.2 The Likely Scale of Growth	127
11.3 Muswellbrook: Environmental Protection of Urban Area	130

(vii)

	Page
11.4 Muswellbrook: Structure	137
11.5 Muswellbrook: Residential Development	143
11.6 Muswellbrook: Town Centre	151
11.7 Muswellbrook: Industrial Areas	166
11.8 Muswellbrook: Open Space	167
11.9 Muswellbrook: Water Supply and Sewerage	168
11.10 Denman	171
12.0 TRANSPORTATION	178
12.1 Rail Transport: Current and future railway prospects for Muswellbrook. Possible options for railway relocation.	178
12.2 Road Transport	196
12.3 Recommendations - Transport	198
13.0 WATER RESOURCES	201
Total water requirements. Potential conflicts. Cost of water resource development.	
14.0 RURAL INDUSTRIES	208
14.1 The impact of Coal Mining on Agriculture: Prime agricultural land. Major issues.	
14.2 Recommendations	212
15.0 TOURISM AND RECREATION	213
16.0 IMPACTS ON LANDSCAPE, VIEWS, HERITAGE AND WILDLIFE	217
16.1 Landscape and Visual Considerations	217
16.2 Heritage: Landscape. Archeology. Settlement patterns. Historic buildings/precincts and townscapes. Summary.	219

	Page
16.3	Vegetation and Wildlife: 228 Vegetation. Wildlife.
16.4	Recommendaions 230
17.0	AIR QUALITY 231
17.1	Dust Deposition 231
17.2	Suspended Dust Concentrations 231
17.3	Dust Control Measures 233
17.4	Other Effects of Dust 234
17.5	Summary and Recommendations 234
18.0	NOISE AND VIBRATION IMPACTS 238
18.1	Description of the Area 236
18.2	Possible Changes in the Acoustical Environment 238
18.3	Acoustical Criteria for Acceptable Residential Amenity 240
18.4	Blast Vibration and Noise Criteria 243
18.5	Modelling of Future Acoustical Environment 244
18.6	Possible Main Northern Railway Line Deviation 249
18.7	Possible Deviation of the New England Highway 249
18.8	Conclusions 250
18.9	Recommendations 251
	BIBLIOGRAPHY 254
	STUDY TEAM 258

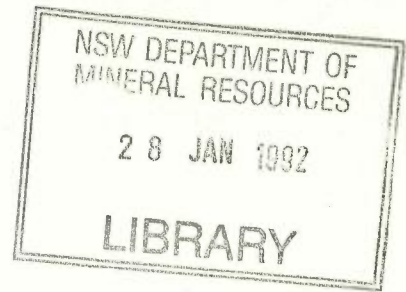
LIST OF FIGURES

Title	Page
3.0 Location Plan	1
3.1 Topography	3
3.2 Geology	4
3.3 Mining Authorisations and Geology	6
3.4 Soils	7
3.5 Wind Roses	12
3.6 Hunter Regional Water Catchments	16
3.7 Flood Mitigation Works	18
3.8 Vegetation	21
3.9 Location of Noise Measurement Areas	24
3.10 Suggested Criteria for Acceptability	25
- Day-time Noise	
3.11 Suggested Criteria for Acceptability	26
- Night-time Noise	
4.0 Generalised Land Use	38
4.1 Coal Related Projects	40
4.2 Road and Rail Network	44
4.3 District Recreation and Tourism	46
5.0 Generalised Land Use - Muswellbrook	50
5.1 Existing Zoning - Muswellbrook	51
5.2 Business Area - Muswellbrook Town Centre	52
5.3 Social and Cultural Facilities - Muswellbrook Environs	55
5.4 Social and Cultural Facilities - Muswellbrook Town Centre	56
5.5 Recreational Facilities - Muswellbrook Environs	57
5.6 Land Ownership - Muswellbrook	60
5.7 Land Use - Denman	63
5.8 Social and Cultural Facilities - Denman	65
5.9 Recreation Facilities - Denman	66

(x)

FIGURES cont'd

	Page
6.0 Historic Buildings and Sites	69
6.1 Landscape Units	74
6.2 View Corridors Visual Catchments	77
6.3 Townscape - Muswellbrook Town Centre	79
7.0 Coal Related Projects	85
11.0 Potential Conflicts - Muswellbrook Environs	129
11.1 Recommended Action - Muswellbrook Environs	135
11.2 Constraints - Town of Muswellbrook	138
11.3 Structure Plan - Town of Muswellbrook	140
11.4 Medium Density Potential 1981-86	144
11.5 Residential Development Potential	145
11.6 Phasing Plan - Case A	147
11.7 Phasing Plan - Case B	148
11.8 Development Opportunities - Muswellbrook Town Centre	152
11.9 Constraints to Development - Muswellbrook Town Centre	155
11.10 Distribution of Floor Space - Muswellbrook Town Centre	159
11.11 Denman Constraints	172
11.12 Denman Structural Plan	174
12.0 Rail Network - Muswellbrook	179
12.1 Railway Relocation Options	187
12.2 Recommended Railway Bypass Route	190
18.0 Night-time Noise Impact of Mines and Transportation Routes	237
18.1 Night-time Impact of Mines and Proposed Railway Deviations	246
18.2 Night-time Impact of Mines and Proposed Railway, Highway Deviations	247



Muswellbrook Environmental Study

Technical Report

Prepared For THE MUSWELLBROOK SHIRE COUNCIL

By JACKSON TEECE CHESTERMAN WILLIS & PARTNERS April 1981

(i)

INTRODUCTION

This environmental study has been carried out as required under Section 57 of the Environmental Planning and Assessment Act 1979. It provides the information and suggests policies upon which a new plan for the Shire should be based.

The study is in two volumes containing eighteen chapters and is supported by a number of appendices and reports.

Volume 1, chapters 1 and 2, summarise the study and its major recommendations. Volume 2, chapters 3 to 18, describes relevant aspects of the natural and man-made environment and examines the issues that must be addressed in the plan.

The form and content of this study has been influenced to a large extent by the 'Study Specifications' issued by the Department of Environment and Planning on the 2nd January, 1981. Matters required to be investigated, assessed and reported included:-

- "1. Measures proposed to be taken to protect the present and future urban areas of the Shire of Muswellbrook from any adverse effects of mining.
2. To set aside appropriate land for residential, commercial, industrial, recreational and community purposes.
3. Measures proposed to be taken to protect the natural and man-made environment of the Shire of Muswellbrook.
4. The establishment of a road system and infrastructure that adequately serves the needs of industry, residents and through traffic.
5. The protection of agricultural, recreational, scenic, natural and mineral resources of the Shire of Muswellbrook.

(ii)

6. The environmental effects associated with industrial growth, including air, water, noise and visual pollution.
7. The cumulative effects of urban and industrial growth on the towns, villages and rural areas and, in particular, the effects on the Hunter River, agriculture and social structure.
8. The resolution of conflicts that may arise from competition for resources such as water and land.
9. The provision of community facilities and services to meet demand, including the provision of essential social services and public infrastructure.
10. The identification of areas of co-operation between State and Local Government in order to properly manage and administer the financing of infrastructure, services, facilities and land acquisition.
11. Social impacts and opportunities to broaden the industrial and employment base of the sub-region to lessen over-reliance on mining and power generation.
12. The provision of a variety of housing forms, suitable for temporary accommodation and family housing.
13. The adequacy of the transportation network to meet increased demands in an environmentally acceptable manner. "

Following gazettal of the above specifications, a number of studies and investigations were carried out in order to obtain adequate background data and information. These included:

- . Muswellbrook Social Survey - Dec. 1980. Jackson Teece Chesterman Willis and Partners Pty. Limited
- . Muswellbrook Community Impact Study - Dec. 1980. Gutteridge Haskins and Davey Pty. Limited.

(iii)

- . Introduction to Expected Growth and Augmentation of Utilities -
Dec. 1980. Gutteridge Haskins and Davey Pty. Limited.
- . Implications of Coal Related Growth to Council Finances -
Jan. 1981. Gutteridge Haskins and Davey Pty. Limited.
- . Muswellbrook Land Use and Floor Space Survey - Dec. 1980.
Jackson Teece Chesterman Willis and Partners Pty. Limited.
- . Historic Buildings and Sites Surveys - Muswellbrook Historic
Society. Jackson Teece Chesterman Willis and Partners Pty.
Limited, Planning Workshop Pty. Limited.
- . Acoustical Impact Assessment. Louis A. Challis and Associates
Pty. Limited.
- . Wind and Air Quality Assessment. Accent Designs.
- . Upper Hunter Industrial Survey - March 1981. Jackson Teece
Chesterman Willis and Partners Pty. Limited.
- . Upper Hunter Sub-regional Study. A Report to the Department of
Environment and Planning - March 1981.
Jackson Teece Chesterman Willis and Partners Pty. Limited and
Gutteridge Haskins and Davey Pty. Limited.

In addition to these studies information was sought from a number of
Government Departments, private organisations, consultants and academics.
These included:

- . N.S.W. Department of Environment and Planning
- . N.S.W. Department of Mineral Resources
- . Water Resources Commission of N.S.W.
- . Electricity Commission of N.S.W.
- . State Rail Authority of N.S.W.
- . N.S.W. Department of Lands
- . N.S.W. Department of Main Roads
- . N.S.W. Housing Commission

(iv)

- . N.S.W. Department of Education
- . N.S.W. Department of Youth and Community Services
- . Combined Coal Proprietors Association
- . Joint Coal Board of N.S.W.
- . State Pollution Control Commission
- . Hunter District Water Board
- . Hunter Valley Research Foundation
- . John Collins - University of Newcastle
- . Sinclair Knight and Partners
- . James B. Croft and Associates

The assistance of the above is gratefully appreciated.

(xiii)

TABLES cont'd	Page
12.0 Mines In and Around Muswellbrook	183
12.1 Coal Transport Task by Rail in Muswellbrook Area 1980-2000	183
12.2 Average and Peak Daily Laden Unit Coal Train Flows by Line Section	184
12.3 Railway Relocation Options	186
12.4 Total Average and Peak Daily Southbound Train Flows by Line Section, Options and Key Year	189
12.5 Costs by Option	191
12.6 Key Travel Distance	191
13.0 Effects of Variation of Requirement	206
13.1 Effects of Alternative Levels of Requirements	207
14.0 Interaction Between Agriculture and Surface Mining	209

(xiv)

APPENDICES

1. Community Facility and Services Development Programme
2. Muswellbrook Social Survey - 1980 - Questionnaire
3. Muswellbrook Floor Space and Land Use Survey - 1980
4. Residential Development - Discussion Paper
5. Industrial Survey Questionnaire
6. Muswellbrook Historical Society - Survey of Historic Buildings
7. Summary of Impacts from Environmental Impact Statements

SUPPORTING DOCUMENTS

1. Water Quality in the Hunter River Valley -
The Impact of Natural Processes and the Likely Influence
of Future Industrial Development on Water Resources
2. Muswellbrook Community Impact Study
3. Hunter Regional Leisure Plan
4. Hunter Tourist Development Plan
5. Noise Assessment Reports

The Natural
Environment

3

3.0 THE NATURAL ENVIRONMENT

The natural systems of Muswellbrook Shire form the parameters within which future development will take place. To modify these systems may lead to imbalances that will require careful planning, management and incur substantial costs to the community.

The purpose of this chapter is therefore to identify those aspects of the natural environment that must be respected in the Shire's future development.

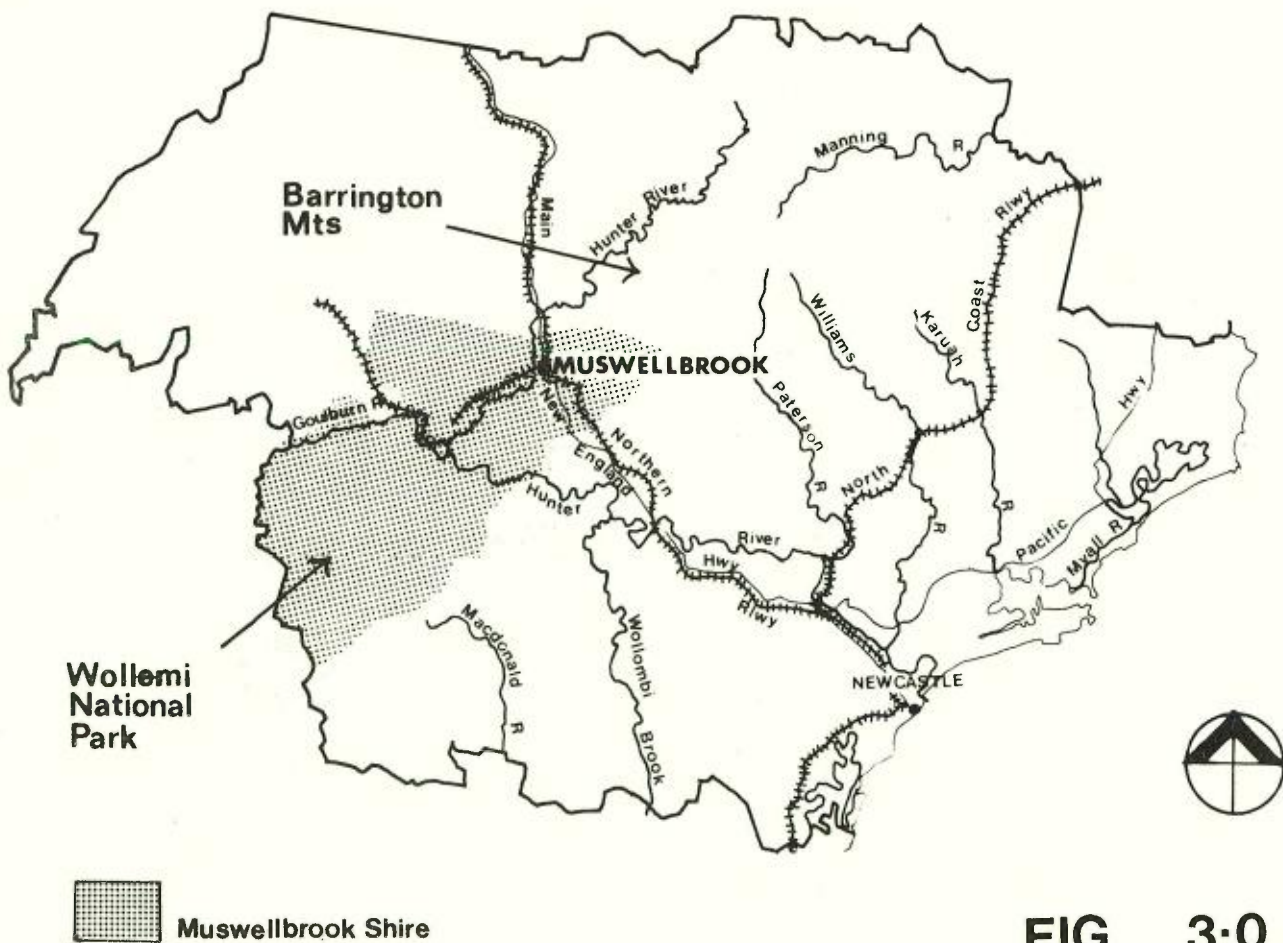
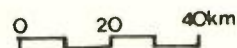


FIG. 3-0



3.1 GEOGRAPHICAL SETTING

The Muswellbrook Shire is located in the Upper Hunter region some 120 kilometres inland from Newcastle (see Figure 3.0). The Shire is dissected by the Hunter River which flows from the upper reaches of the Barrington Mountains past Muswellbrook and Denman where it joins the Goulburn River and then easterly to the coast. To the west of the valley, the countryside is undulating with Wybong and Sandy Creeks the major water source in the area. Similarly, undulating hills dominate the landscape between Muswellbrook and Singleton, broken only by Lake Liddell. The Wollemi National Park, comprising heavily vegetated mountainous terrain, is located in the south-western portion of the Shire. Together, Muswellbrook, Scone, Singleton, Merriwa and Murrurundi Shires form the major rural hinterland for their regional centre, Newcastle.

3.2 TOPOGRAPHY

The topography of the Shire can be divided into the following basic components:

- 1) Land less than 150 metres ^{about sea level} in height which mainly consists of the Hunter and Goulburn River floodplains, associated tributaries and the gentle rolling hills surrounding the floodplain.
- 2) Gently undulating country generally less than 900 metres in height.
- 3) Steep cliffs and rugged mountains above 900 metres in height.

As can be seen from Figure 3.1, the floodplain divides the Shire into three distinct areas. Firstly, the south which forms part of the Great Dividing Range and is therefore characterised by a very rugged landscape of steep valley walls and peaks rising to over 1,300 metres. Secondly, the north which is undulating countryside and, thirdly, the east which is a combination of undulating hills and quite rugged terrain.

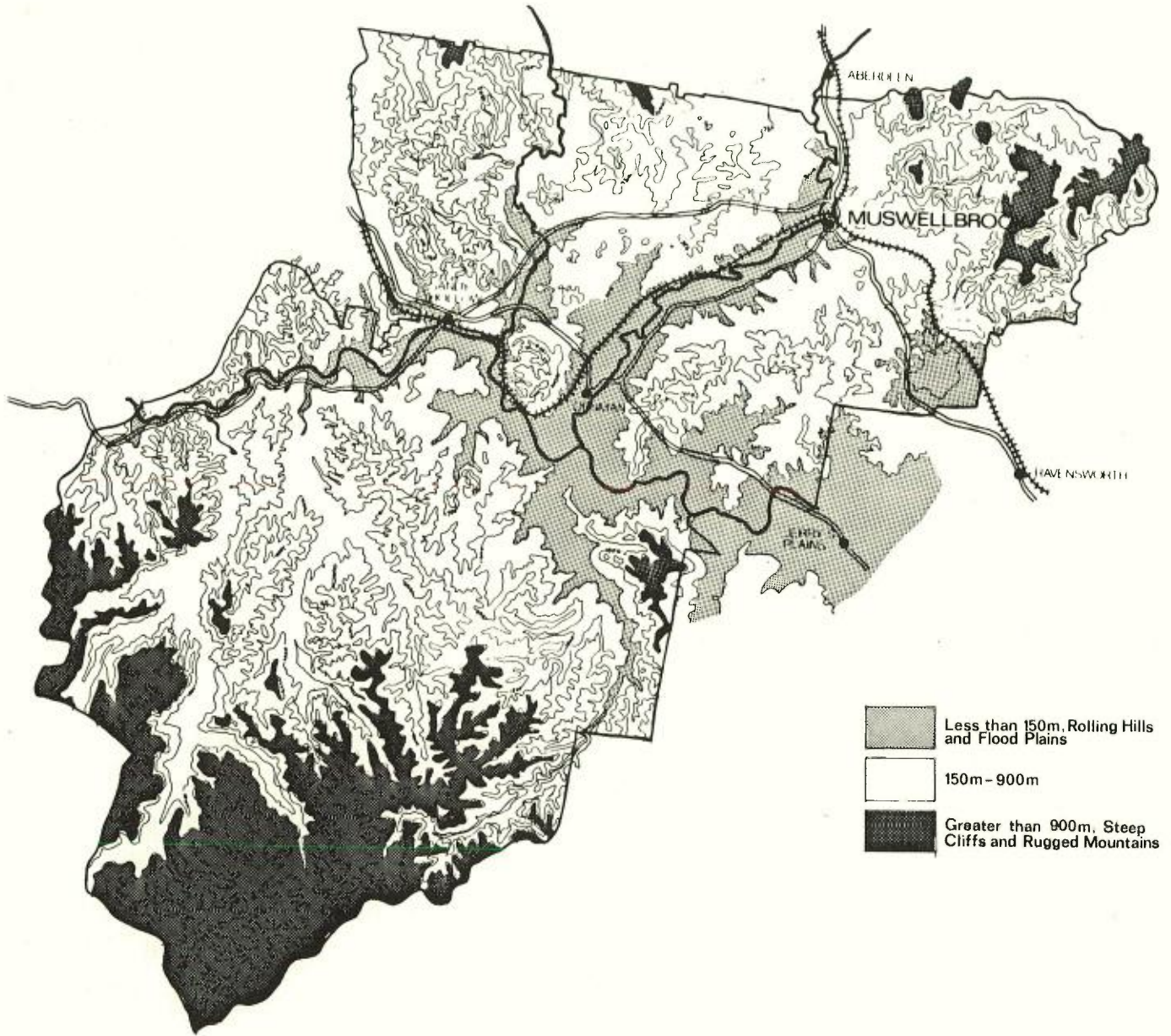


FIG. 3.1
TOPOGRAPHY



3.3 GEOLOGY

The main geological features of the Shire of Muswellbrook are indicated in Figure 3.2. The southern half of the Shire consists primarily of Narrabeen Group sandstone, interspersed with Singleton Coal Measures. These Singleton Coal Measures also occur in large quantities in the north, extending in a band from Denman to Jerry's Plains. Muswellbrook itself is located on a reserve of Greta Coal Measures approximately 16 kilometres in length and 3 kilometres wide (see cross section AA). East of the town the area has been subject to significant folding and faulting, resulting for example in the Greta measures approaching the surface near Muswellbrook. Generally speaking, these resources are of the low ash coking coal variety with some seams having a relatively high sulphur content.

The Singleton Coal Measures, however, are of two types known as the Wollombi and Wittingham measures. The Wollombi contain few seams of economic importance although in the future they may yield some steaming coals. The Wittingham, however, are particularly viable to mine by open cut methods since they contain about 15 seams of steaming and coking coals, often up to 25 metres thick.

The relationship between the various mining areas and the geology of Muswellbrook can be seen in Figure 3.3.

3.4 SOILS AND EROSION

Broadly speaking, three types of soil characterise the Shire. These are illustrated in Figure 3.4 and are as follows:

- 1) Floodplain alluvials. Very fertile soils of prime agricultural value. Dairy farming and stud farms are the predominant land use in these areas.
- 2) Skeletals which are generally unsuitable for agriculture. These are common in the southern portion of the Shire. Beef cattle grazing is the major current land use.
- 3) Solonetzic and podsols having low natural fertility but suitable for improved pasture. Found mainly in the north of the Shire and in scattered pockets, they are generally used for grazing and, in some instances, vineyards.

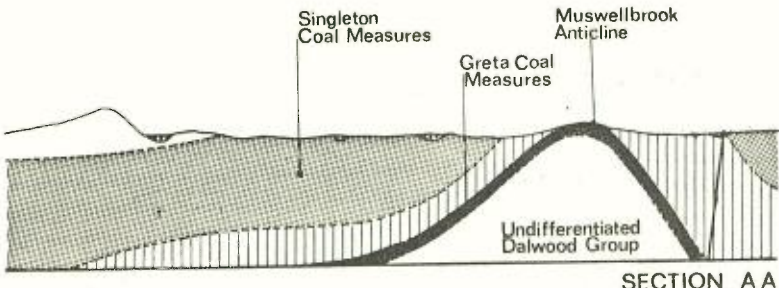
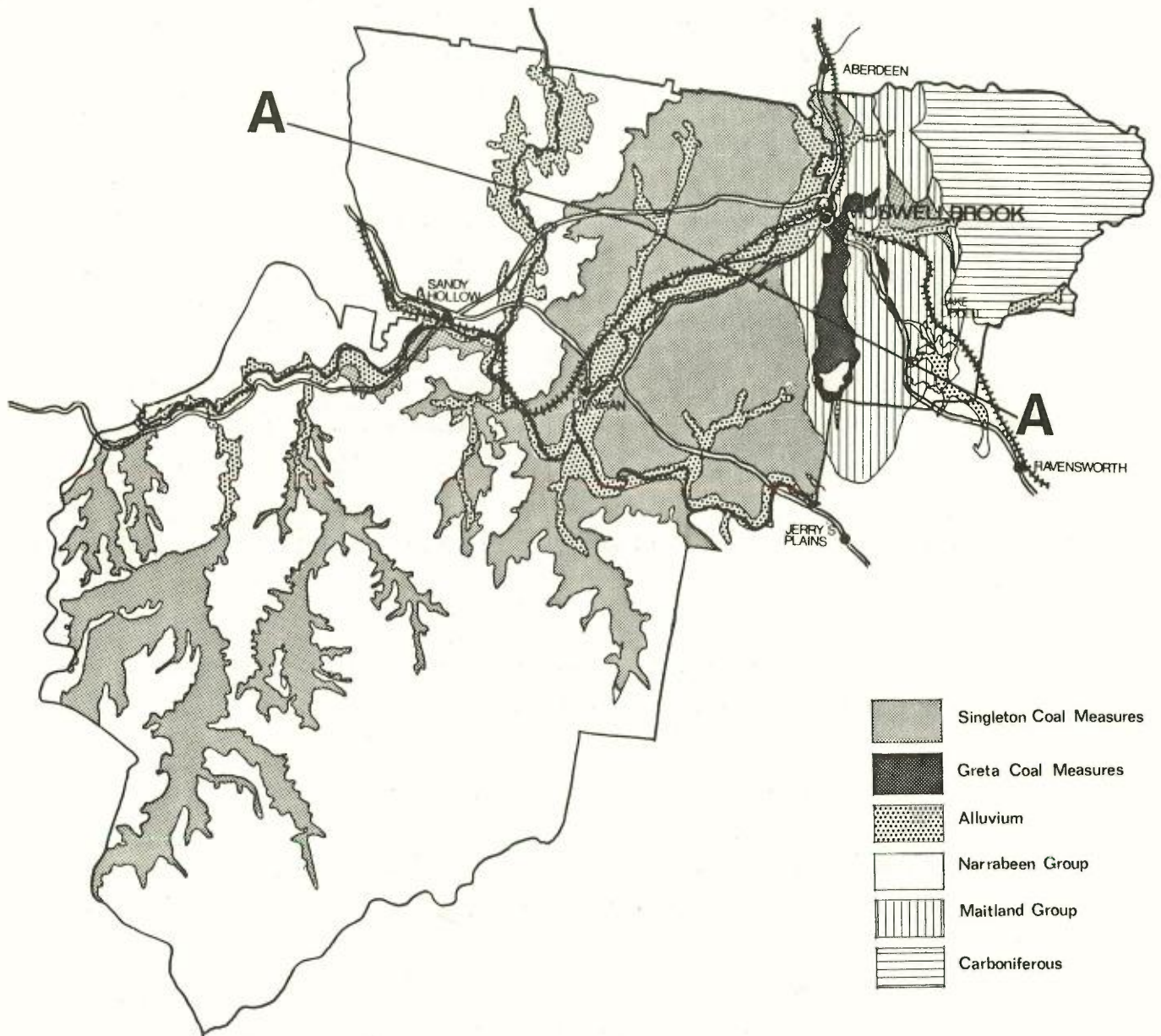
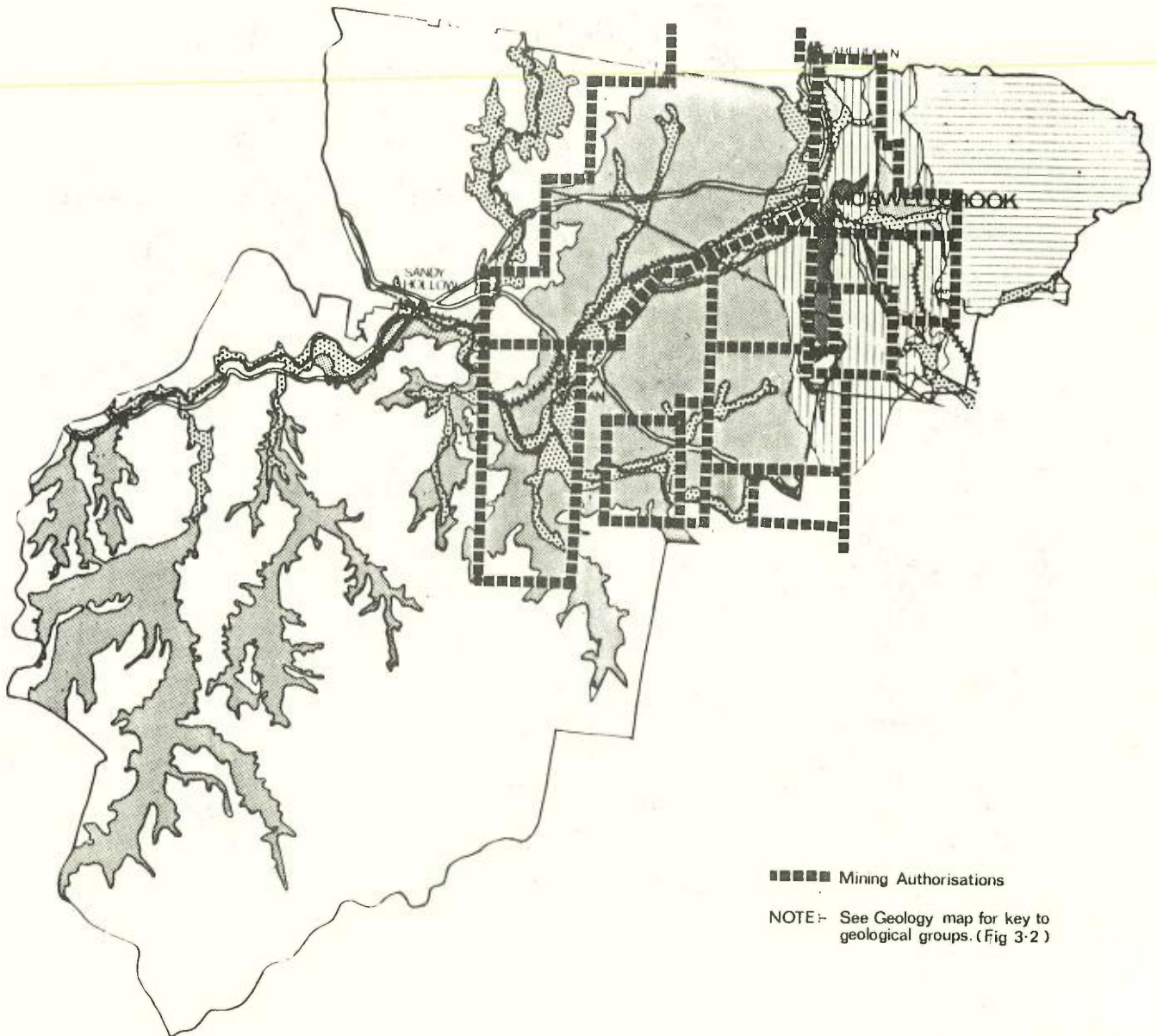


FIG. 3-2
GEOLOGY





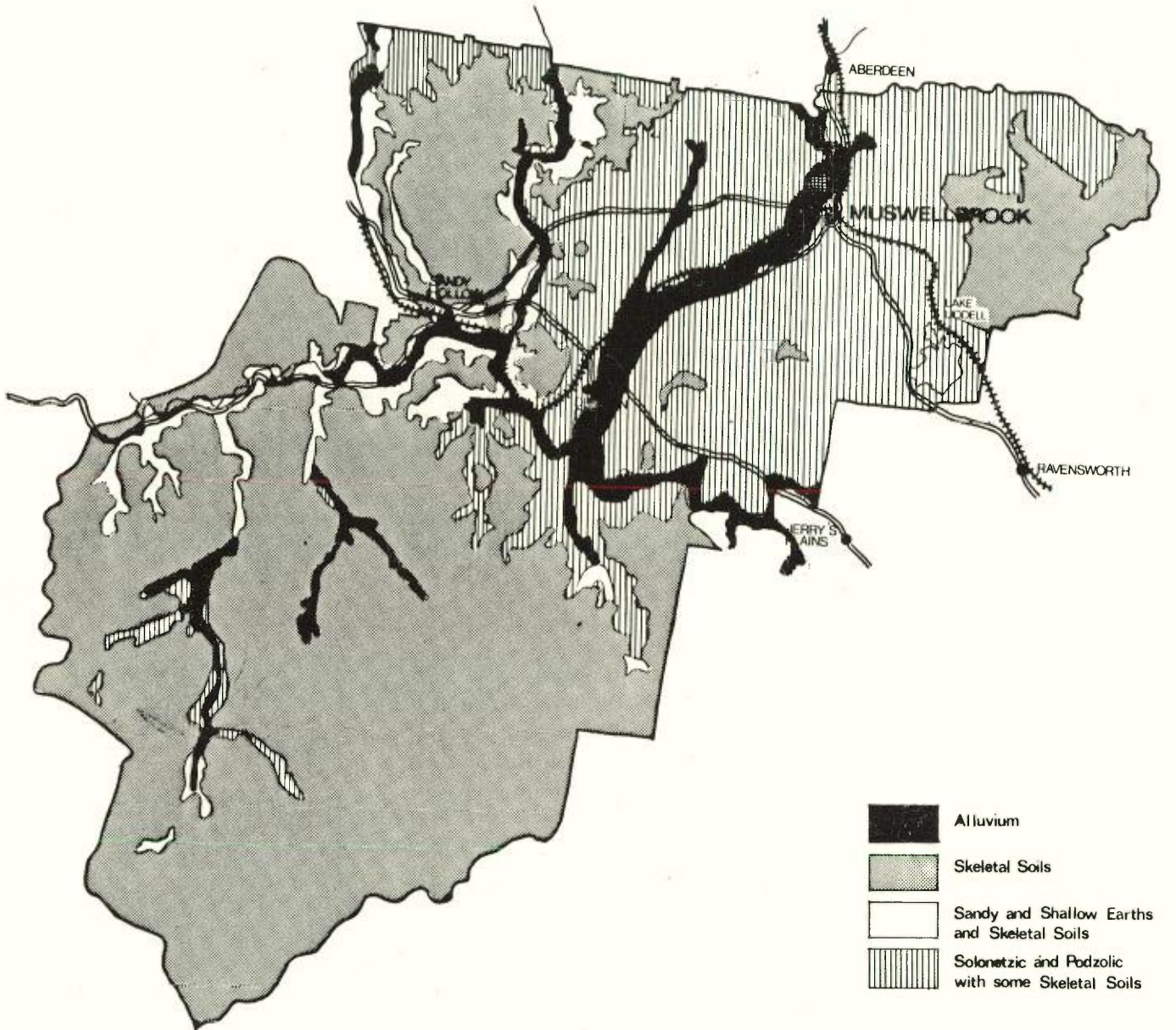
■ ■ ■ ■ Mining Authorisations





NOTE:- See Geology map for key to geological groups. (Fig 3-2)



FIG. 3-3
MINING AUTHORIZATIONS
AND GEOLOGY





-  Alluvium
-  Skeletal Soils
-  Sandy and Shallow Earths and Skeletal Soils
-  Solonchic and Podzolic with some Skeletal Soils



**FIG. 3-4
SOILS**



From a mining viewpoint, the ability of certain soils to withstand stockpiling is an important consideration. Solonetzic and podsollic soils, for example, are generally suitable for stockpiling. Sandy or gravelly soils, such as skeletal and alluvials, are not as suitable.

Soil erosion has been a problem in the Hunter Valley since European settlement and can be attributed to over-clearing and over-grazing. The extensive clearing of indigenous flora has led to widespread sheet erosion, while gully erosion has been prevalent along most drainage courses. Erosion is particularly noticeable on undulating and hilly areas with slopes between 5 and 18 degrees.

3.5 CLIMATE

The Upper Hunter Valley Region is characterised by a warm, temperate climate. Seasonal variations in conditions produce hot summers and cool to mild winters with occasional severe frosts.

Rainfall

The annual median rainfall for Muswellbrook is 612mm, although variations from this figure can be extreme. Table 3.0 indicates the average and median rainfall, while Table 3.1 indicates the minimum and maximum recorded monthly and yearly rainfalls.

The driest months of the year usually occur from May to September. However, monthly median rainfall generally exceeds 25mm in all months of the year. Heavy rain may occur at any time of the year but the months experiencing the highest rainfall occur between December and March. Rainfall in the summer months is frequently in the form of high intensity, short duration storms.

Low rainfall conditions lasting six months or more occur on occasions throughout the region. An indication of such conditions occurring at Muswellbrook is given in Table 3.2 which lists the minimum recorded cumulative rainfalls commencing in any month of the year and continuing for up to 12 months. Although rainfall during the first six months of any recorded period exceeded 100mm on only seven occasions, the 12 month cumulative total exceeded 280mm on all but two occasions.

Table 3.0: Average and Median Rainfall for Muswellbrook (MM)

Rainfall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean	70	64	54	45	42	51	45	40	41	48	52	66	618
Median	57	44	41	35	27	35	35	32	31	42	44	59	612

Source: Bureau of Meteorology

Table 3.1: Highest and Lowest Recorded Monthly and Yearly Rainfall (mm) at Muswellbrook

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Minimum	0	0	3	0.5	0	0	0	0	3	2	0	1	271
Maximum	241	378	250	192	262	258	194	213	172	132	205	225	1108

Source: Water Resources Commission of New South Wales

Table 3.2: Cumulative Total of Minimum Rainfall Recorded in Consecutive Periods at Muswellbrook Commencing in the Month Indicated (mm)

No. of Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0	0	0	1	0	0	0	0	3	2	0	1
2	3	2	13	8	8	10	6	17	11	11	22	21
3	36	37	24	22	16	21	22	25	23	49	50	45
4	60	38	38	48	25	34	31	35	67	76	72	64
5	61	53	64	71	38	54	40	77	83	96	75	100
6	97	79	80	117	58	101	83	103	103	157	111	107
7	123	133	127	145	114	137	120	122	170	181	119	122
8	161	164	156	156	148	147	140	190	200	182	133	176
9	207	188	167	181	157	166	208	219	231	224	214	209
10	229	238	191	233	177	234	237	257	253	252	234	231
11	248	271	274	261	245	263	280	271	279	285	252	248
12	271	308	333	317	274	307	295	299	319	307	284	286

Source: Water Resources Commission of New South Wales

Table 3.3: Mean Temperatures at Muswellbrook (degrees C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean maximum	28.4	28.6	27.6	24.9	19.9	17.8	17.4	19.1	20.0	25.3	25.9	29.1
Mean	22.2	22.7	20.9	17.3	13.2	11.1	9.6	11.7	12.9	17.6	19.1	22.0
Mean minimum	16.1	16.7	14.1	9.7	6.5	4.5	1.8	4.2	5.8	9.9	12.2	14.9

Source: Water Resources Commission of New South Wales

10

Comparisons with rainfall figures for Liddell Power Station and Singleton and Scone indicate that towns in the valley closer to Newcastle have slightly higher average rainfalls than Muswellbrook.

The discussion above does not raise the issue of periods of drought and flooding. The Hunter region has experienced lengthy periods of drought conditions, most obvious being the period 1978-81, while periods of flooding have also been fairly common over the years. Floods are discussed in Section 3.7.

Temperature

Mean temperatures recorded at Muswellbrook range from 10 degrees C in July to 23 degrees C in February. In winter, particularly when there are light winds and clear skies, low overnight temperatures occur. In July, temperatures lower than minus 2 degrees C are sometimes experienced. Temperatures above 33 degrees C are common between October and April, resulting from north-westerly winds bringing hot dry air from central Australia. Table 3.3 illustrates the recorded mean annual temperature range.



Frosts

Air and ground frosts occur in the Muswellbrook Shire. The mean number of frost days is 27 per year. Most of these occur between May and September with the most severe in July. The frost free period begins in October and is also the period of highest rainfall which produces the new season growth.

Evaporation

The average annual evaporation measured at the Liddell Station is 1,295mm. The highest monthly evaporation rate usually occurs between November and January while the lowest evaporation occurs in May and June. A water deficit (that is, evaporation is greater than precipitation) exists in the region in all months of the year producing an annual deficit of 530mm with the largest deficits occurring between November and March.

Wind



The available wind records of relevance to the Shire, and particularly to Muswellbrook itself, are from Liddell Power Station, Jerry's Plains, Sandy Hollow, Scone and Muswellbrook. The Muswellbrook data, however, is only based on four years of records. Nevertheless, when analysed in conjunction with the information for Liddell and Scone, a fairly accurate assessment can be made. Wind roses for the stations are shown on fig. 3.5.

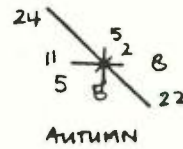
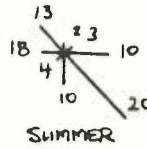
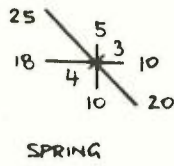
The wind roses indicate that the predominant directions of winds are influenced by the major river valley systems. For Liddell, most winds in summer blow from the south-east, with some from the east, south and north-west. By winter, most winds come from the north-west and west. This corresponds with the north-west/south-east alignment of the valley floor. Winds from the north, north-east and south-west occur infrequently.

Wind directions at Scone are slightly different from Liddell. In summer most winds blow from the south, with some from the south-east, south-west, west and north-west. Southerlies prevail again in autumn, with some from the west, north-west and south-west. By winter, westerlies and north-westerlies prevail, while in spring the north-westerlies and southerlies predominate. These directions reflect the north-south alignment of the river valley floors.

The prevalent wind directions at Muswellbrook are different to those experienced at Liddell and Scone. Throughout the year, most winds blow from either the south or north. In summer, the southerlies are particularly common while in autumn and spring both northerlies and southerlies prevail. There are also some winds from the north-west and south-east during the year.

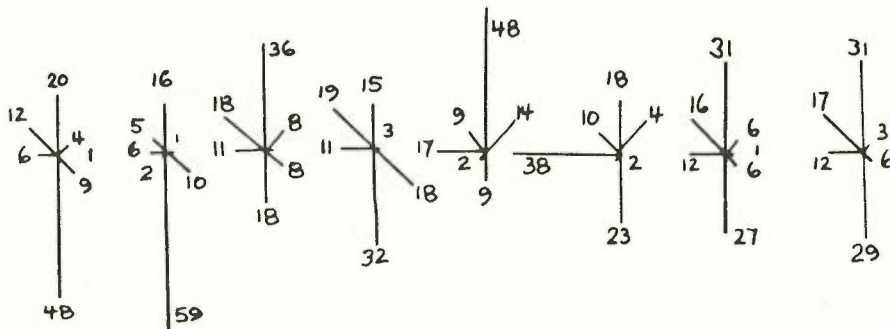
The local topography has been shown from the existing Wind Rose Data, to materially influence the wind directions within the Muswellbrook region. The south-easterly windfronts moving up the Hunter River basin from the

RECORDINGS FOR LIDDELL POWER STATION

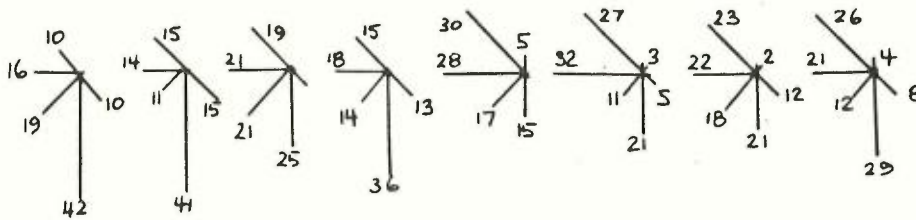


JANUARY APRIL JULY OCTOBER
9am 3pm 9am 3pm 9am 3pm 9am 3pm

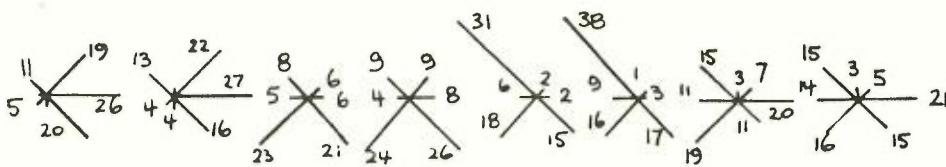
MUSWELLBROOK



SCONE



SANDY HOLLOW



JERRY'S PLAINS

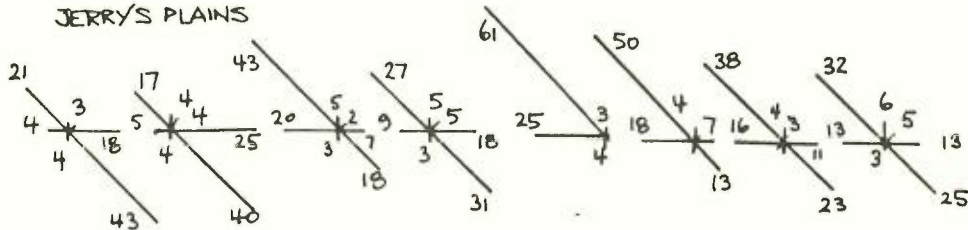


FIG. 3.5
WIND ROSES

direction of Singleton are influenced by the terrain to divide into two major windpaths. One such path transports some 30% of this low level windfront air mass in the Hunter River basin up into the Goulburn Valley. The remainder of the windfront, due to the proximity of the elevated peaks of the Mount Royal Range, is translated in a southerly direction through the Muswellbrook region and up into the valley system above Scone.

Due to the constraint of the river basin about Muswellbrook, such air masses in this progression through the region, generate an increase in local velocities and an inherent increase in fine grained turbulence. Such turbulence would tend to maintain the dust particles for longer periods in the Muswellbrook area and improve the opportunity both for their capture by the recording gauges, as well as being visible.

Preliminary observations within the Muswellbrook township would suggest that the dust already in the area, which is being continually stirred up by transient vehicles, is the dust which is being maintained in the turbulent air mechanisms generated by the passage of the local windfront - not that which is thought to enter the region from the Liddell Station.

Air Inversions

Inversion development is dependent upon a number of climatic conditions including the cooling of the ground surface and moisture content of the air. Both surface level and upper air inversions occur in the Upper Hunter Valley.

Surface level inversions develop because of the different rates of cooling between the land surface and the air at night. As the land cools more rapidly than the overlying air, the blanket of air in contact with the ground is also cooled. Consequently on calm, clear nights, a temperature

inversion will develop 90 per cent of the time. The surface inversions will exist between 100 and 500 metres from the ground. They are broken up by the reheating of the land surface, one to two hours after sunrise.

The effect of surface inversions is to prohibit the dispersion of gases and particulate matter into higher levels of the atmosphere. The introduction of pollutants such as smoke and dust may cause the inversion to persist longer as the incoming solar radiation after sunrise is scattered and absorbed by the foreign matter in the air. Surface inversions also significantly increase noise transmission.

Although the effects of inversions are commonly observed in the Upper Hunter Valley, measured data on the development, duration, frequency, persistence and height of these phenomena are not available. A study of inversions for the Hunter Valley has recently been commissioned by the State Pollution Control Commission. The Department of Geography, University of Newcastle, is carrying out the study and preliminary results will be not available until mid 1981.

Because fog is a characteristic of a surface inversion, where condensation of moisture has occurred, the number of fog days can be taken as a minimum indication. Table 3.4 presents data from fog recording stations at Williamtown and Jerrys Plains.

Table 3.4: Minimum Number of Inversion Days

<u>Locality</u>	<u>Number of Fog Days</u>
Jerrys Plains	29 per year
Williamtown	35 per year

Upper air inversions can last for a number of days depending upon the meteorological conditions. Their geographical distribution is wider and more pronounced than the surface inversions, although their potential adverse effects are not so pronounced.

3.6 HYDROLOGY

River System and Catchment Areas

The Hunter rises in the Mount Royal Range and the high plateau of the Barrington Tops at elevations of over 1,500 metres and flows south-west to Denman, where it joins the Goulburn River. The Goulburn River originates in the Merriwa Plateau within the Great Dividing Range, on the western extremity of the catchment. The Liverpool Range forms the northern boundary of the catchment and is the watershed between the coastal Hunter River system and the inland Namoi River system. From the Goulburn River junction, the Hunter flows in a south-easterly direction towards Newcastle. Upstream of Singleton the catchment area of the Hunter is 16,446km². The major catchment areas are shown in Figure 3.6.

Catchment Hydrology and Flow Variations

Two major rainfall mechanisms exist and often result in flooding in the Hunter Valley. They are inland depressions (usually during late summer and autumn) and coastal cyclonic rains affecting mainly the coastal catchments (usually between February and September). These two rainfall mechanisms account for the strong seasonality of flood events.

Hunter River flows have been measured at Singleton since 1891 and Muswellbrook since 1906. The highest recorded flood occurred in February 1955, which reached a height of 14.57 metres at Singleton and 12.31 metres at Maitland. The earliest recorded flood at Maitland occurred in 1820 and more than 80 have been recorded.

Flooding may occur at any time of the year, although the months from January to August account for nearly 90% of the total and include all major floods. February, March, June and July are the most common for flooding whilst spring and early summer have been relatively free. It has also been common for more than one flood to occur in a single year. For example, there were five exceeding 8 metres in 1950 at Singleton.

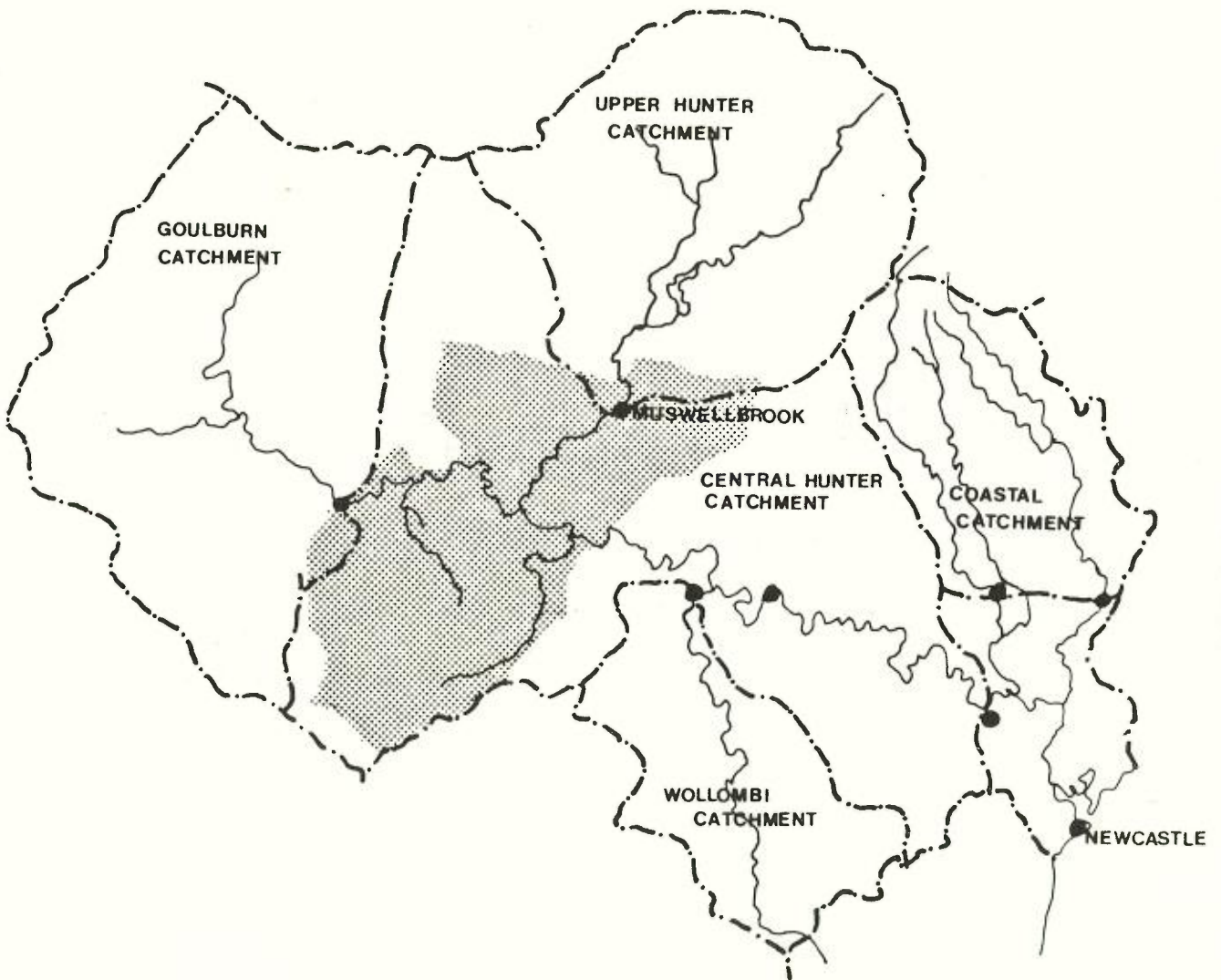
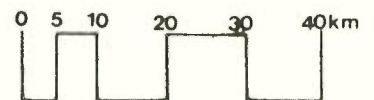


FIG. 3-6
HUNTER REGIONAL WATER CATCHMENTS



SOURCE: Hunter River Flood Plain Management Study
Prepared for Dept. Public Works, Govt. of N.S.W.

Some 15 urban centres, including Muswellbrook, Denman, Singleton and Maitland, are affected by flooding to a varying degree of severity. These problems are aggravated by natural levees and backswamp areas which result in the delayed drainage of cultivated areas. The river channel and floodplain in the upper reaches are highly susceptible to erosion which contributes to the vast quantities of infertile sand and debris deposited on the floodplain in the lower reaches.

All major streams have ceased to flow on a number of occasions. Over 70 years of records, the Hunter River at Singleton has ceased flowing for a total of 597 days. The longest continuous period of zero flow was 138 days which occurred from 24 May to 8 October 1940 (Water Resources Commission). The lowest flow over any 12 month period at Singleton occurred from November 1939 to October 1940 inclusive when the total flow was only about three per cent of the mean annual flow. More detail is provided in Supporting Document 1.

Flood Mitigation

Although inundation of land can cause problems in the Upper Hunter, the major problem appears to be loss of land due to riverbank erosion. European settlement has significantly affected the stability of the river regime. As development is centred on the existing river course, any change will have a significant effect as changes in river location can threaten towns, permanent ways, property boundaries and cause a loss of alluvial soil. It has been estimated that over a section of 51 miles of the Hunter, between Glenbawn Dam and Alcheringa, 613 acres of alluvial land were destroyed between 1945 and 1955.

For this reason, investment in channel stabilisation has been extensive particularly since the 1955 flood. Under the Hunter Valley Flood Mitigation Act, expenditure on improvement works has been in the order of \$15 million.

The main objectives of these works have been the protection of structures (for example, bridges) and urban settlements, conservation of arable lands, maintenance of flood protection through preventing the loss of natural levees, control of debris, preservation of riverbank facilities (for example, pumps) and the preservation of viability of holdings which rely on joint use of the river flat and high lands.

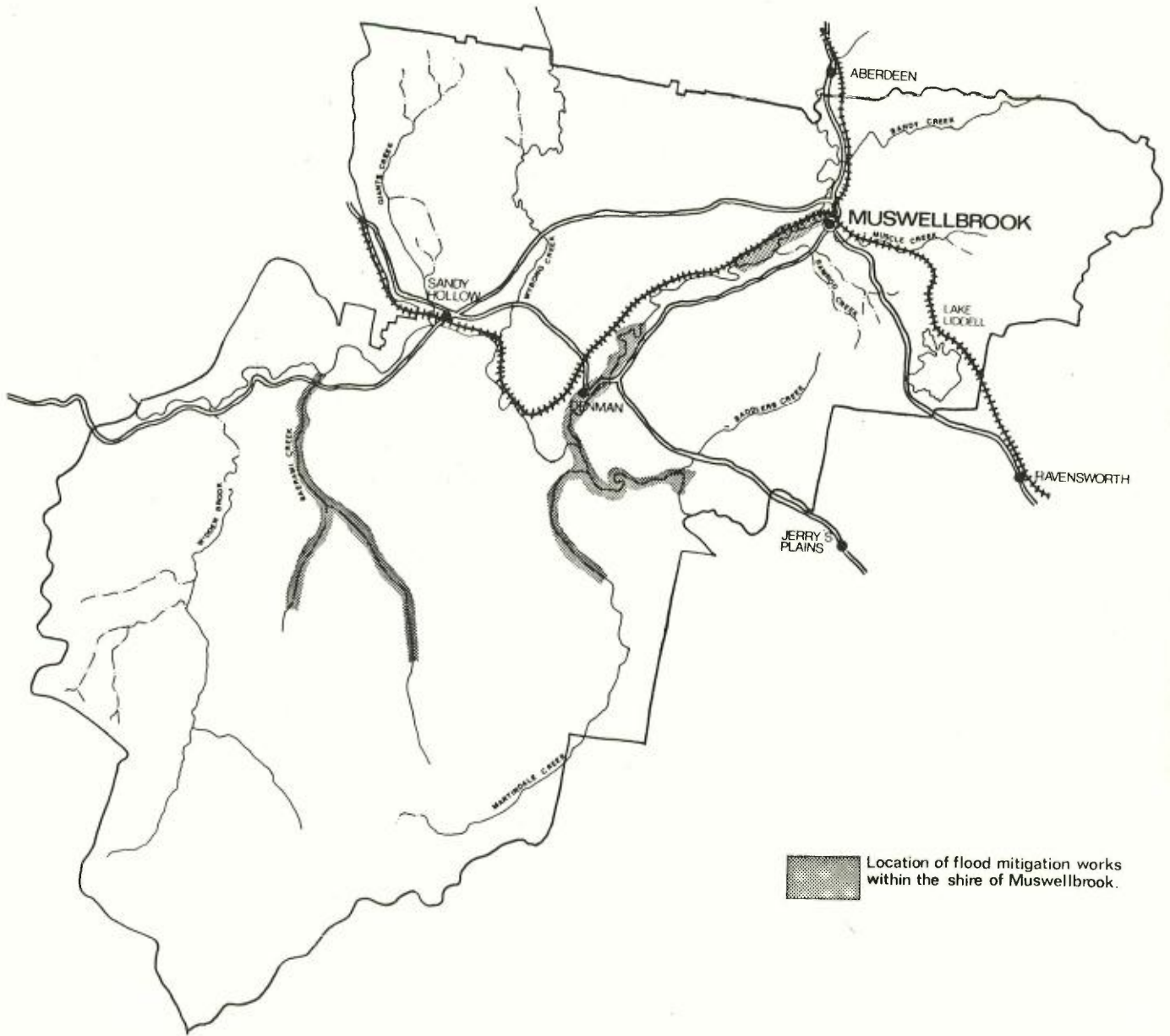


FIG. 3-7
FLOOD MITIGATION WORKS



SOURCE: Hunter River Flood Plain Management Study
Prepared for Dept. of Planning, 1988

Four major types of works have been undertaken:

- i) River Improvement or River Control: The enhancement of particular characteristics of streamflow by modification of its channel.
- ii) Bank Stabilisation: The prevention of bank slumping and erosion by the establishment of a rock toe or dense vegetation reinforced in early growth stages by fencing.
- iii) River Training: The confinement of a river within a selected width and along a chosen course.
- iv) Stream Clearing or De-snagging: The removal from the stream channel of vegetation having an undesirable accelerative and diversionary effect on flow. By this removal local scouring velocities are reduced.

The location of the works undertaken to date is shown in Figure 3.7.

Water Quality

Salinity levels of the Hunter River are normally in the range of 250 to 500 milligrams per litre (mg/l), while water from the alluvium is slightly more saline. It is higher again in the alluvium in the contributory creeks and particularly high during periods of low flow reflecting the contribution of saline inflows from the marine sediments and probably the coal seams as well.

The Hunter River falls into Class 2 "medium salinity" water of the classification of irrigation water given in the Australian Water Resources Commission Technical Paper No.7 (1974). This water is suitable for irrigation provided a moderate level of leaching occurs. The various creeks, however, are classified as "very high salinity" and are unsuitable for irrigation under normal soil conditions.

Supporting Document 1 deals with water quality within the Hunter Valley in more detail.

3.8 VEGETATION AND WILDLIFE

Vegetation

Approximately 40% of the Hunter Region is covered by native vegetation. The most common types are rainforest and eucalypts including Wet and Dry Sclerophyll Forests and Sub-Alpine and Savannah Woodlands. Much is woodland of little timber value.

The clearing of vegetation reflects the spread of agriculture along valley floors and gentler slopes to uncover the arable land. Most of the gentle slopes beside the valley floor have been cleared but still retain their open Savannah Woodland characteristics with native pastures and scattered wooded areas, while the valley floor is cleared and intensively farmed. Dense forests occur on the steeper slopes and ridges surrounding the valley, particularly in the south-west of the Shire, most of which is included in the Wollemi National Park (see Figure 3.8).

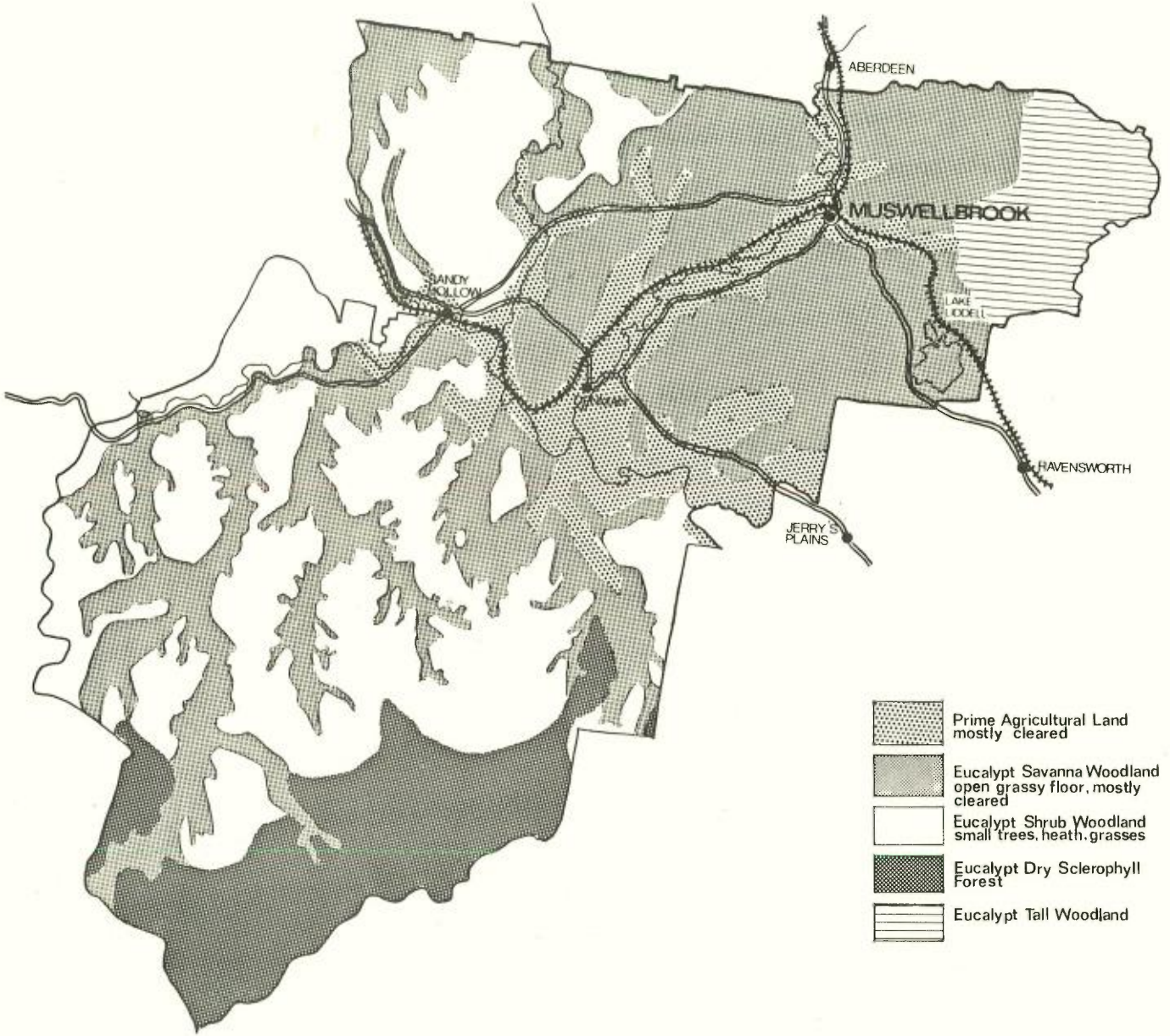
The distribution of tree species is closely related to the slope and drainage of the land. The lower and middle slopes are dominated by Eucalypts and the upper slopes by Box. Casuarinas predominate within the watercourses.






Wildlife

Extensive clearing and prolonged grazing and agricultural activities within the Shire have either destroyed or severely modified wildlife habitats, resulting in little protection for small mammals. The predominant mammals are introduced domestic animals and wild animals including the fox, brown hare and European rabbit.

Numerous kangaroos exist throughout the Shire and koalas in the wooded areas. Other native animals include the common Brushtail Possum, Red-Necked Wallaby and Echidna.

The Hunter River and Lake Liddell lend support to a diversity of waterbirds. A total of 164 species of birds might be expected in the area. Many of the woodland and forest species are only found in a few local habitats and in smaller number than might be expected in a less disturbed environment.



-  Prime Agricultural Land mostly cleared
-  Eucalypt Savanna Woodland open grassy floor, mostly cleared
-  Eucalypt Shrub Woodland small trees, heath, grasses
-  Eucalypt Dry Sclerophyll Forest
-  Eucalypt Tall Woodland



**FIG. 3·8
VEGETATION**



The most commonly observed waterbirds include the Straw-Necked Ibis, Black Duck and Maned Duck, while the most common grass and cropland species are the Galah and Starling. The common open woodland and woodland species are Magpie, Jacky Winter and Eastern Rosella.

The unnatural rise and fall of the Hunter River, due to water release from dams combined with the lower water temperature, resulting from upstream impoundments, is likely to have affected the abundance and species composition of fish populations in the river. The most common fish are the Catfish, Mullet, Eel and the introduced Mosquito fish.

The discharge of effluent from Muswellbrook sewerage treatment plant, together with irrigation drainage, has probably increased the nutrient levels in the river resulting in profuse growth of filamentous green algae. This can result in de-oxygenation of the water and deterioration of fish abundance.

3.9 ACOUSTIC ENVIRONMENT

This section is a summary of a report prepared by Louis A. Challis and Associates Pty Limited on behalf of the Muswellbrook Shire Council and the Department of Environment and Planning.

Stage 1 of the two-stage report (refer supporting document 5), is concerned with an acoustical evaluation related to the existing and predicted noise levels in and around the township of Muswellbrook.

Stage 2 is summarised in Chapter 18 and includes an assessment of the predicted noise levels resulting from mining developments and transportation routes and their planning implications.

Background Noise Levels

Noise levels were monitored and recorded for five areas in and around Muswellbrook. These are indicated on figure 3.9. The degree of "acceptability" or "acoustical amenity" is described under the following categories and are illustrated on figures 3.10 and 3.11.

- . clearly acceptable
- . normally acceptable
- . normally unacceptable
- . clearly unacceptable

Area A: North Muswellbrook

At the present levels of traffic flows on the Highway, residential amenity would be likely to be "normally acceptable" to "clearly acceptable" at distances greater than 100m from the Highway. At such distances, the degree of residential amenity would be determined by proximity to either the Muswellbrook Power Station or the other mines and industries within the area.

The cumulative effects of likely future traffic flows and mining development in this area will determine the extent of buffer zones which should be created to ensure a degree of residential acoustical amenity.

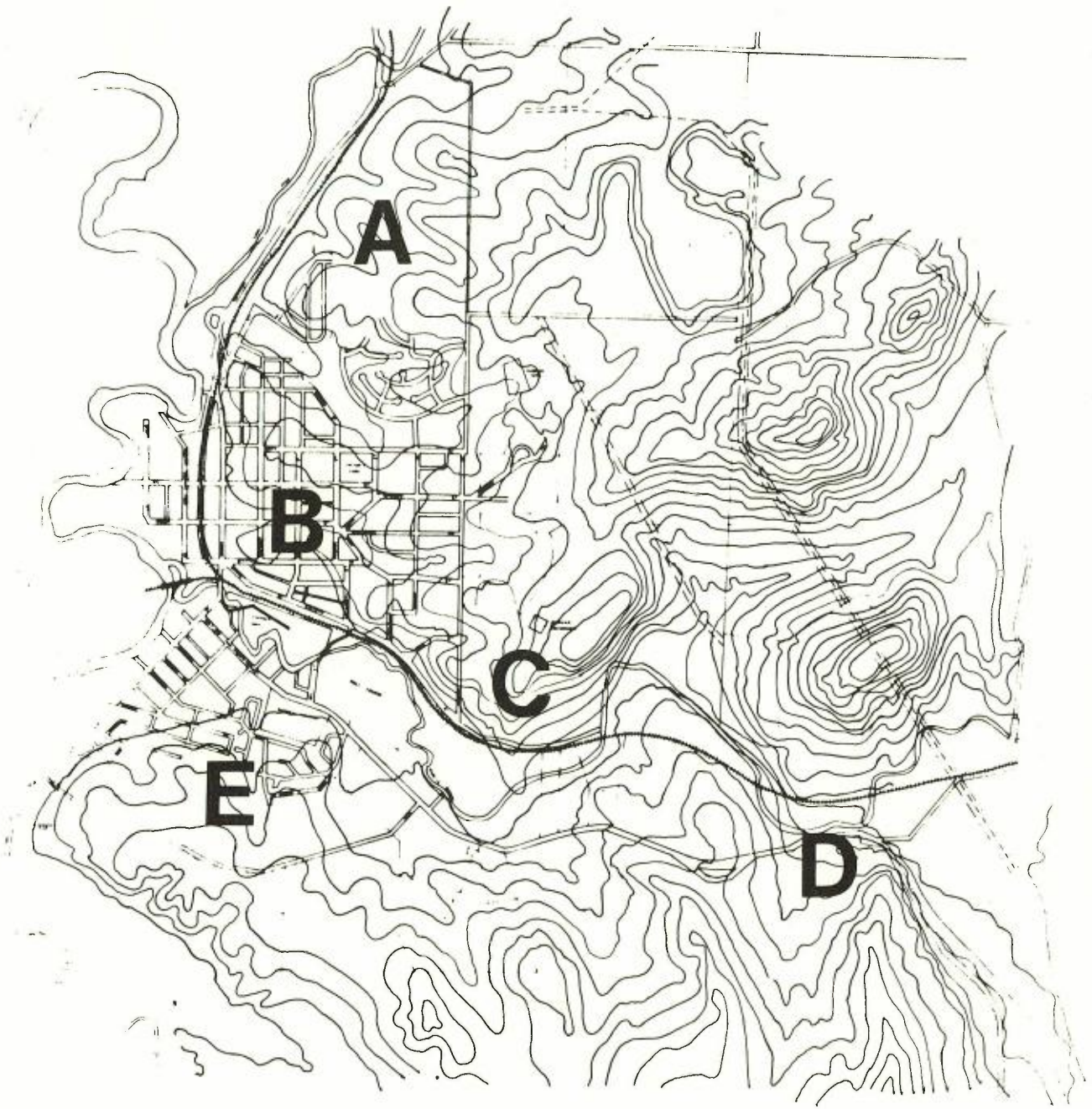
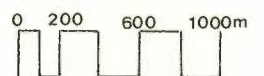


FIG. 3-9
LOCATION OF NOISE
MEASUREMENT AREAS



SUGGESTED CRITERIA FOR ACCEPTABILITY
DAY TIME

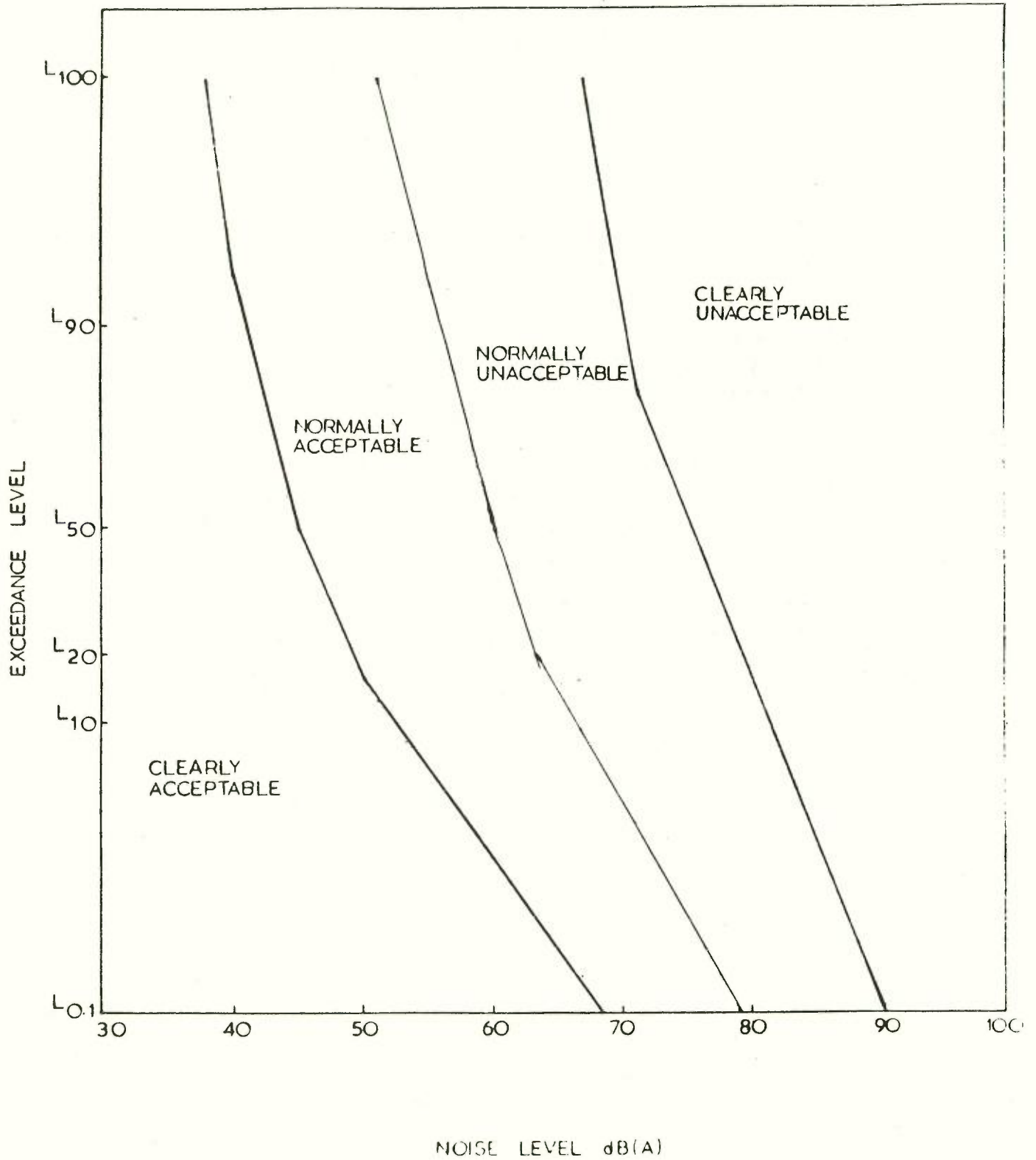


FIG. 3-10

SUGGESTED CRITERIA FOR ACCEPTABILITY
NIGHT TIME

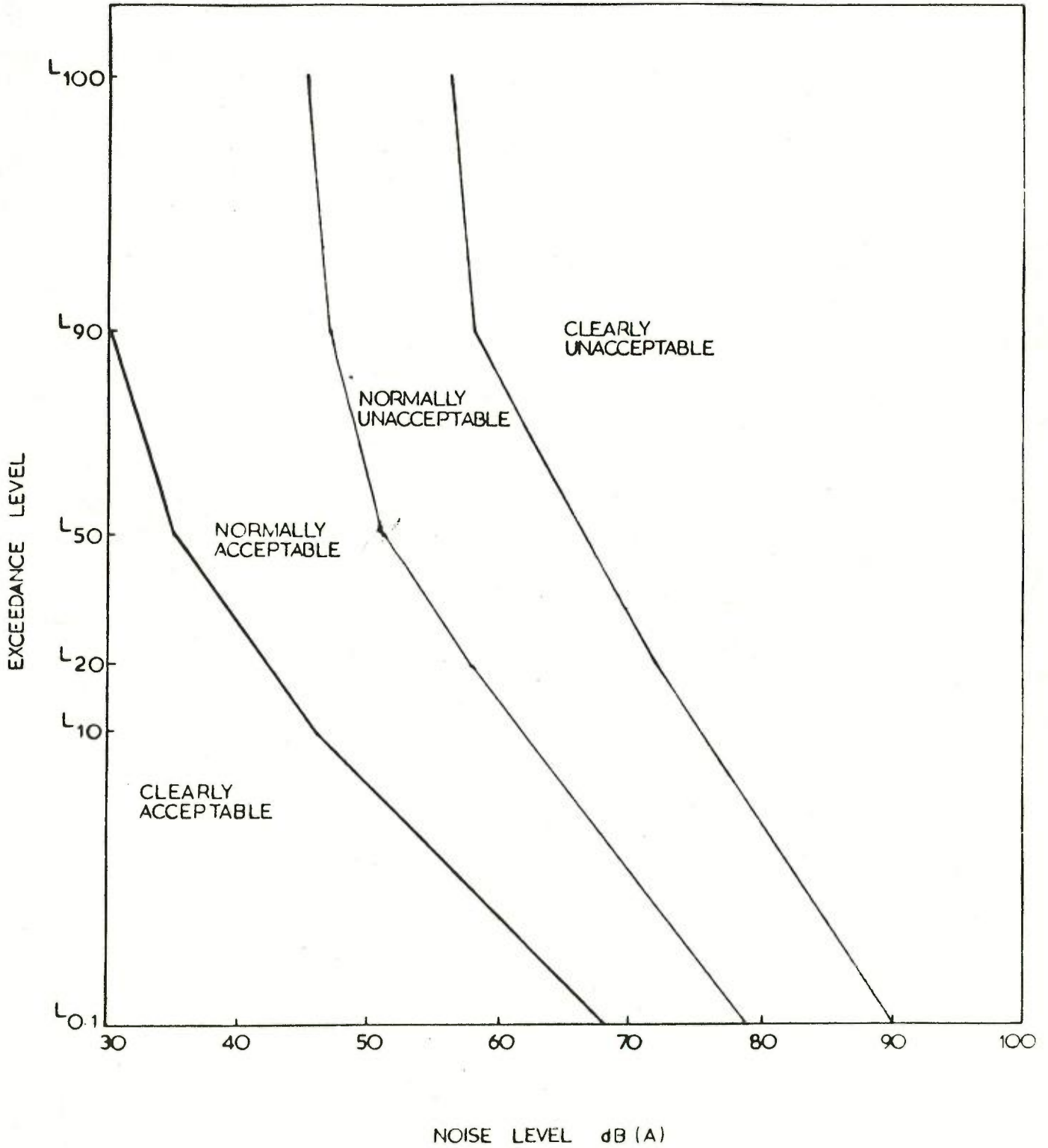


FIG. 3-11

Area B: Muswellbrook Township

These areas are considered "normally acceptable" at night, at positions further than 100 metres from the Highway. This comes as a result of the additional screening provided by the buildings fronting onto the Highway. Whilst local traffic tends to predominate in Brook Street (which is possibly the busiest street in the township apart from the Highway), the Highway traffic is of greater significance in the fringe areas. Thus the future levels of acoustical amenity in such areas are likely to be largely dependent on traffic flows on the Highway, increases in rail traffic and, in particular, on the numbers of heavy vehicles at night.

Area C: East Muswellbrook

The measurements conducted in the vicinity of the railway line are not considered representative of the normal situation, as the size of coal trains was limited to six waggons as a result of industrial action. Notwithstanding the results indicate that the maximum levels resulting from trains would be likely to result in significant levels of annoyance at nominal distances up to 100 metres from the track. In the absence of rail traffic, the acoustical environment would be "normally acceptable" during the day, with the Highway traffic some 500 metres away being the dominant factor.

Area D: Adjacent Black Hill

At the present levels of traffic flows on the Highway, the night-time acoustical amenity would appear to be acceptable at distances greater than about 50 metres from the Highway.

Area E: South Muswellbrook

The acoustical amenity is generally "normally acceptable" in the central and southern sectors of Muswellbrook. The major noise controlling factors tend to be the New England Highway, the Main Northern Railway Line and, to a lesser extent, the Denman Road. Local activities resulting from building construction and local traffic also constitute significant factors during the day.

Conclusions

Supporting Document 5 contains the results of a limited series of background noise level measurements in and around the township of Muswellbrook. The results have been presented in the form of statistical data and are related to two suggested sets of criteria for "acceptability" of acoustic environment.

The existing residential areas within the township and in the northern and southern sectors currently experience an acoustical amenity that could be described as "normally acceptable" in all areas except those typically within 50 to 100 metres of the New England Highway or the Main Northern Railway Line.

Future residential subdivisions as proposed in Chapter 11 are currently "clearly acceptable" or "normally acceptable" in terms of their acoustical environment, except for those areas nominally closer than 100 metres from the main northern line or the New England Highway.

Population Characteristics
& Economic Activity

4

4.0 POPULATION CHARACTERISTICS AND ECONOMIC ACTIVITY

The purpose of this chapter is to describe the characteristics of the present population and their economic activities.

The Shire developed around a rural and primary industry base but, by the turn of the century, coal mining at Muswellbrook had begun, with limited associated industrial development. The 1950's and 1960's saw a general rural decline throughout New South Wales which was felt in the Upper Hunter region with decreased productivity and a marked slowing in population growth rates when compared to urban areas.

This decline coincided with developments within the district which have added a significant industrial component to its social and economic structure, notably the construction of the Liddell Power Station and associated coal mines. The proposed expansion of coal mining and associated industrial activity surrounding Muswellbrook will undoubtedly alter the social and economic structure of the Shire during the 1980's and 1990's. These changes are explained in greater detail in later chapters.

4.1 POPULATION CHARACTERISTICS

Muswellbrook, with a population of 7,805 (1976 Census), is the major service town in the Shire, providing a range of retail, business, service and recreational facilities to the surrounding rural population. Denman, 25 kilometres south-west of Muswellbrook, is a localised service centre with some 808 persons (1976 Census). The remaining small villages scattered throughout the Shire, such as Sandy Hollow, Martindale and Hollydeen, are local convenience centres used by surrounding farm dwellers.

The following description of the social characteristics of the Shire's population is based on the 1976 Census and a social survey undertaken in 1980 during the preparation of this Study (see Appendix 3).

Population Distribution and Age Structure:

In 1976 the population of the Shire was 11,518 persons, 68% of whom lived in Muswellbrook, 7% in Denman and 25% in the surrounding rural areas and villages. Population distribution and age structure are shown in Table 4.0. The Shire has been grouped into four major areas - Denman, Muswellbrook, South Muswellbrook (south of the Main Northern Railway Line) and rural areas.

Table 4.0: Population Distribution and Age Structure

Location	Age Groups												Total
	0-4		5-15		16-24		25-44		45-59		Over 60 yrs.		
	yrs.	%	yrs.	%	yrs.	%	yrs.	%	yrs.	%	60 yrs.	%	
Denman	71	9	166	20	135	17	187	23	150	19	98	12	800
Muswellbrook	414	10	849	20	677	16	1,076	25	702	16	529	12	4,240
South Muswellbrook	389	11	874	20	508	14	1,050	30	400	11	335	9	3,550
Rural	304	10	829	28	336	12	805	28	367	13	266	10	2,900
Total Shire	1,176		2,716		1,654		3,117		1,618		1,228		11,518
Percentage of Total Population	10%		23%		14%		27%		14%		10%		
Sydney S.D.	8%		18%		15%		28%		17%		14%		

Source: 1976 Census

Note: Percentage column is proportion of each area's population.

The table indicates the relatively young population of Muswellbrook Shire, particularly the 0-4 year olds (10% of total population) and 5-15 year olds (23% of total population). The largest age group, the 25-44 year olds, form the parent group of these children and suggests a predominance of families within the community. South Muswellbrook and the rural areas particularly have a high proportion of family groups. Denman and Muswellbrook have an older population with 19% and 16% respectively of 45-59 year olds and 12% over 60 years.

Employment

Table 4.1 indicates that the workforce participation rate is high, with over two-thirds of working age adults employed.

Table 4.1: Labour Force Distribution

Location	Employed				Unemployed				Not in labour force (over 15 years)				Total
	Male	%	Female	%	Male	%	Female	%	Male	%	Female	%	
Denman	241	41	95	16	8	.1	2	.1	57	9	185	31	588
Muswellbrook	1,198	40	548	18	74	.2	33	.1	284	9	827	28	2,964
South Muswellbrook	978	41	409	17	36	.1	35	.1	177	7	731	31	2,366
Rural	866	47	412	22	26	.1	14	.1	116	6	418	22	1,852
Total	3,283		1,464		144		84		634		2,161		7,770
Percentage of Total Labour Force	42%		19%		2%		1%		8%		28%		
Sydney S.D.	37%		22%		2%		1%		10%		28%		

Source: 1976 Census

This is comparable to the Sydney Statistical Division (S.D.) particularly for male participation rates. The rural area has the highest male and female participation rates reflecting, perhaps, the role of women as partners in the farm or workers on the property. However, the proportion of employed females in Denman, Muswellbrook and South Muswellbrook is below the Sydney averages, consequently increasing the proportion of women not in the workforce, particularly in Denman and South Muswellbrook. Unemployment in 1976 was comparable to Sydney and was related to the population distribution throughout the Shire.

The type of employment in which the population is engaged is indicated in Table 4.2. The employed population is primarily involved in agriculture (18.4% of total workforce) while wholesale/retail (13.5%), mining (9.9%), electricity/gas/water (10.2%) and community services (9.0%) provide the remaining major sectors of employment. Although agriculture is dominant, the large proportion of other sectors such as mining and electricity/gas/water perhaps reflects the changing nature of local industry.

Muswellbrook provides the largest labour force (66% of total Shire), primarily engaged in wholesaling/retailing, mining, electricity/gas/water production and community services. Denman only contributes 7% of the total Shire workforce, with most jobs in public administration, wholesaling/retailing, manufacturing and agriculture. The rural area, with 27% of the Shire's workforce, is overwhelmingly engaged in agriculture, with some manufacturing and community services.

Table 4.2: Sector of Employment

Sector	Denman		Muswell- brook-		South Muswell- brook		Rural		Total	
		%		%		%		%		%
Agriculture	40	12	39	2	29	2	764	60	872	18.4
Mining	12	4	220	12	187	13	52	4	471	9.9
Manufacturing	43	13	146	8	81	6	110	8	380	8.0
Electricity/gas/ water	5	1	212	12	240	17	29	2	486	10.2
Construction	18	5	124	7	88	6	37	3	267	5.6
Wholesale/retail	61	18	288	16	220	16	70	5	639	13.5
Transport/storage	16	5	80	5	82	6	27	2	205	4.3
Communications	4	1	38	2	51	4	8	0	101	2.1
Finance	14	4	107	6	26	2	10	0	157	3.3
Public Administration	65	19	91	5	52	4	43	3	251	5.3
Community Services	35	10	186	11	134	10	74	6	429	9.0
Entertainment/ Recreation	13	4	114	6	105	7	15	1	247	5.2
Other	9	3	102	6	87	6	39	3	237	5.0
Total	336		1,747		1,382		1,277		4,742	
Percentage of Total Employed	7		37		29		27			

Source: 1976 Census

The Social Survey¹ suggested that workplace locations were distributed as follows: Town of Muswellbrook (45%), rest of Shire (30%), Ravensworth/Liddell/Bayswater (17%) and elsewhere (8%).

1 Refer Appendices 1 and 2

Household Income/Motor Vehicle Ownership

Household income refers to the total gross income of each household. Table 4.3 indicates that low to middle income earners formed the largest income groups in the Shire. Households earning over \$15,000 per annum were significantly less than the Sydney S.D. although Muswellbrook and South Muswellbrook contained a higher proportion of high income earners. Denman and the rural area greatly affect the overall Shire total, due to the concentration of household incomes less than \$5,000 per annum and \$5,000 to \$9,000 per annum.

Table 4.3: Household Income

Location	<u>No. of Households</u>								Total
	Less than \$5,000 pa	%	\$5,000 - \$9,000 pa	%	\$9,000 - \$15,000	%	Over \$15,000	%	
Denman	56	23	56	23	64	27	36	15	238
Muswellbrook	122	13	200	22	294	32	212	23	920
South Muswellbrook	180	13	270	20	390	29	322	24	1,334
Rural	152	20	256	33	164	21	116	15	772
Total Households	510		782		912		686		3,264
Percentage of Total Households	16		24		28		21		
Sydney S.D.	15.5		21		27.3		26.1		

Source: 1976 Census

Motor vehicle ownership is high with the majority of residents having two cars per household. Three car ownership is also high, particularly in Denman and the rural area. Table 4.4 outlines motor vehicle ownership throughout the Shire.

Table 4.4: Motor Vehicle Ownership

Location	<u>Number of Vehicles per Household</u>					Total
	None	1	2	3 or more	Not stated	
Denman	36	106	60	30	6	238
Muswellbrook	166	734	338	72	24	1,334
South Muswellbrook	112	508	222	50	28	920
Rural	22	392	258	86	14	772
Total Households	336	1,740	878	238	72	3,264
Percentage of Total Households	10	53	27	8	2	
Sydney S.D.	20.5	47.3	22	5.6	4.6	

Source: 1976 Census

Summary

Several important social characteristics emerge from the census information for each area within the Shire:

Muswellbrook

- . Young families.
- . Low female participation in workforce.
- . Stable population, although more recent movement into South Muswellbrook.
- . Majority of household incomes \$9,000 to \$15,000 per annum.
- . Mostly one or two car households.
- . Mainly employed in wholesale/retail, electricity/water/gas/mining.

Denman

- . Evenly distributed age structure.
- . Low female participation in workforce.
- . Stable population.
- . Household incomes are low.
- . High proportion of two and three car households.
- . Mainly employed in public administration and wholesale/retail.

Rural

- . Higher proportion of 5-15 year olds and 25-44 year olds.
- . High female participation in workforce.
- . Relatively stable population.
- . Mostly \$5,000 to \$9,000 per annum household income.
- . Primarily two and three car households.
- . Overwhelmingly employed in agriculture.

The Muswellbrook Social Survey² provides a current view of the population but as only preliminary analysis has been completed, characteristics for the total Shire only can be considered. The following social characteristics are revealed from the survey analysis and present a picture of a fairly stable and self-contained community.

- . The majority of residents in the Shire own or are purchasing homes.
- . Most residents have immediate relatives living in Muswellbrook or Muswellbrook Shire. Few had close relatives in Singleton and Maitland although Sydney, Newcastle and other areas outside the Hunter Valley rated highly.
- . Respondents considered that close friends mostly live in Muswellbrook town and Shire. Few nominated Sydney, Singleton, Maitland or Newcastle as residence of close friends.
- . Families were the dominant household type in the survey with few communal or single dwellers in the survey sample.
- . 94% of total respondents were Australian born and 3% English born, compared to New South Wales where the proportion of Australian born residents is 81%. The Shire has a dominant Australian born population.
- . Only a small proportion of total respondents had moved into the Shire since June 1976, these being from Sydney, Newcastle and other areas within Australia.
- . Major location of employment of those interviewed were Muswellbrook town, Muswellbrook Shire and Ravensworth/Liddell/Bayswater areas.
- . Sector of employment showed agriculture and mining to be the major employers in the Shire.
- . Only 2% of the total interviewees considered themselves to be unemployed. This included both registered unemployed and housewives presently seeking employment.

4.2 ECONOMIC ACTIVITY AND LAND USE

Land use within the Shire is set out in Table 4.5. It can be seen that a fairly high proportion (33%) is in government ownership. A total of 71,000 hectares (21%), mostly grazing land, is covered by mining authorisations.

Table 4.5: Land Use and Ownership

<u>Use</u>	<u>Area (ha)</u>	<u>% of Total Shire</u>
Wollemi National Park	96,068	28
Nature Reserves	3,500	1
Liddell Power Station	13,000	4
Prime Agricultural Land	20,615	6
Urban Areas	720	0.01
Vacant and grazing	206,302	61
<u>Total Shire</u>	<u>340,455</u>	<u>100</u>
Authorisations	71,200	21

Agriculture

The main agricultural activities within the Shire range from beef cattle grazing on native pastures to intensive cultivation and dairying on the river flats - Table 4.6. Unreliable rainfall, soil erosion and low fertility outside the Hunter River alluviums make the district generally unsuitable for cultivation. The usual pattern therefore is one dominated by grazing activities with localised areas of croplands on the floodplains.

Sheep, beef and dairy cattle are the most important grazing activities in the district. Milk production, although relatively small in terms of live-stock numbers, is the largest single contributor to the district productivity. Smaller scale intensive developments include horse breeding and pig production.

The main crops in the district are grains, especially wheat. Market gardening is important on the prime soils of the river flats. More recently, several new vineyards have developed around Muswellbrook and Denman.

Table 4.6: Agricultural Land Use in the Upper Hunter 1977-78
Percent of Hunter S.D. Totals

Shire	<u>% Hectares</u>					<u>% Head of Livestock</u>			
	Vine- yards	Fruit	Vege- tables	Grain	Pasture	Sheep	Beef Cattle	Dairy Cattle	Pigs
Denman (Muswellbrook)	27.8	10.0	2.2	8.5	5.2	2.4	8.1	15.6	3.7
Scone	4.1	8.4	2.1	10.0	22.6	31.6	21.7	9.8	51.7
Singleton	22.1	31.5	27.8	2.3	10.3	1.9	11.3	19.6	1.8

Source: Australian Bureau of Census and Statistics

Notes: 1) 1976-77 figures.

2) Includes area under sown grasses and clover and crops and grasses cut for hay.

Approximately 43% of the Shire's land area is used for agricultural purposes (1978-1979 Agricultural Census). Table 4.6 indicates the importance in terms of production of the various agricultural activities, while Figure 4.0 indicates the location of these broad activities within the Shire.

Activities of particular regional significance include grapes (54% of Hunter Valley production), lucerne (40%), maize, barley and oats (around 22%) dairy cattle (16%) and horses (15%).

The alluvial river flats contain soils of high natural fertility and high phosphorus content. They are generally loams of good structure and texture and are free draining. Much of the river flats are irrigated and intensively farmed. Uses include winter cereals; permanent improved pasture for milk production, or beef cattle fattening; lucerne for commercial hay production; inter grain crops (wheat, oats and barley); summer crops such as maize, sorghum and soy beans and grapes and vegetables.

Some 160 dairies in the Shire supply whole milk to the Muswellbrook Oak Factory, producing approximately 136,000 litres of milk per day for the Sydney, Newcastle and local markets. This represents approximately 16% of the total Hunter region animal production.

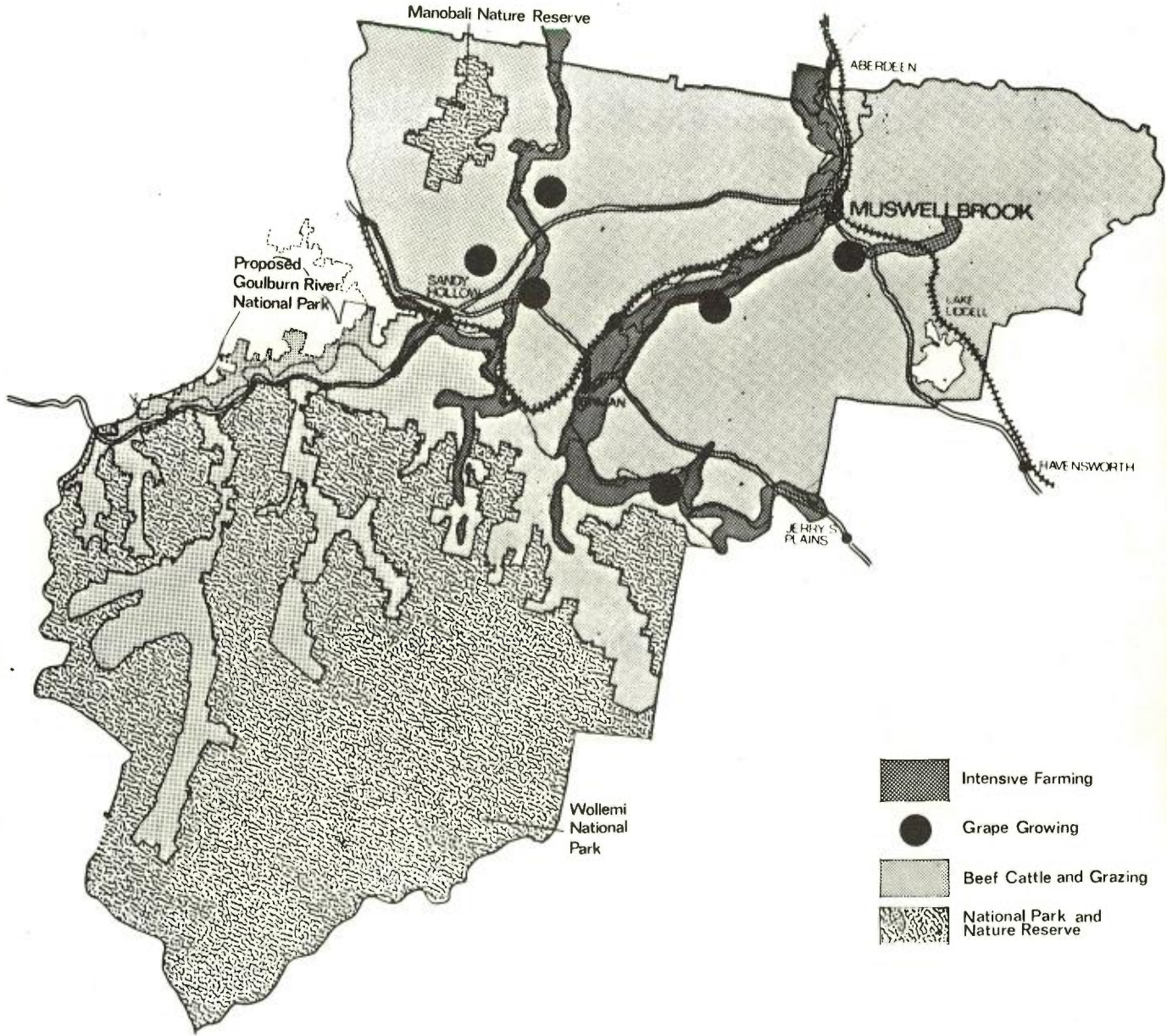


FIG. 4-0
GENERALIZED LAND USE



The alluvial flats around Muswellbrook have long been recognised as a major source of lucerne production, producing 40% of the Hunter Region's crop. Although a proportion of this is for local consumption, the majority is sold to other farming areas.

Land on the lower slopes is mainly used for improved pasture, grain growing (wheat, oats, maize, barley and sorghum for both local and statewide markets), and grapes. It is also suitable for irrigation.

Away from the river, beef cattle grazing on the less fertile undulating areas is the dominant agricultural use, with large areas of native pastures with some winter cropping. Vineyards are also extending into the more fertile areas on this undulating land.

Table 4.7: Agricultural Production in the Muswellbrook Shire 1978-79 Season

Agricultural type	No. of livestock/ production	Percentage of total Hunter Region 1978-79 production
Sheep	11,822	2
Dairy cattle	16,755	16
Beef cattle	45,142	9
Pigs	1,725	4
Horses	2,173	15
Wheat	5,424 tonnes	5
Oats	1,213 tonnes	20
Maize	1,392 tonnes	23
Barley	2,090 tonnes	22
Sorghum	805 tonnes	3
Lucerne	15,005 tonnes	40
Grass and pasture	1,318 tonnes	7
Grapes	9,469 tonnes	54
Vegetables	387 tonnes	2

Source: 1978-79 Agricultural Census, A.B.S.

Coal Mining and Power Generation

Existing coal mining and power generation activities in the Shire have been identified on Figure 4.1 and a brief description follows.

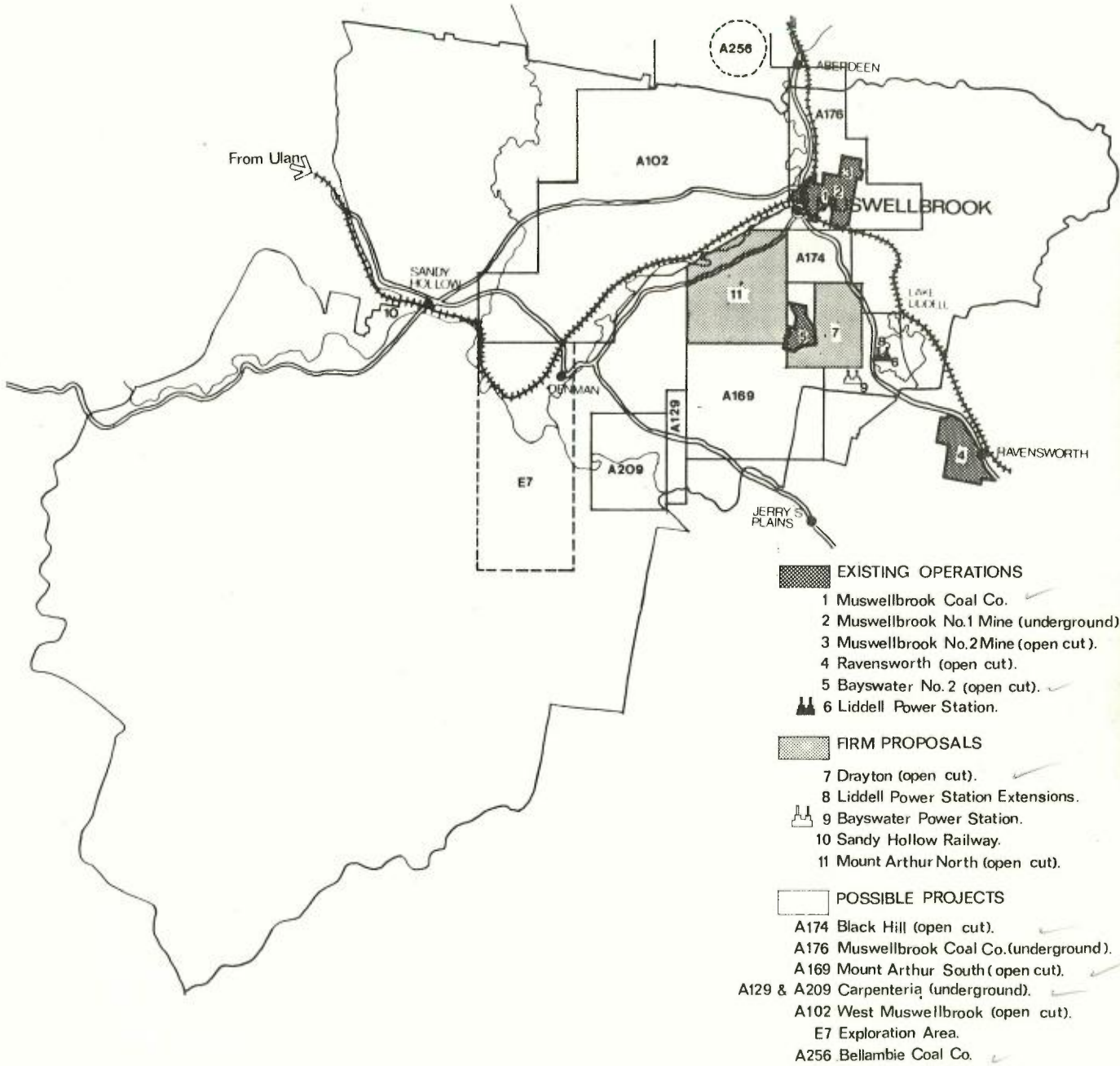


FIG. 4-1
COAL RELATED PROJECTS



Liddell Power Station

The power station is located off the New England Highway approximately 16 kilometres south-east of Muswellbrook and 25 kilometres to the north-east of Singleton. The station was constructed in the 1960's, together with Lake Liddell which is used for power generation and also recreational activities. Owned by the Electricity Commission of New South Wales, the station has a capacity of 2,000 MW, with coal being supplied by Ravensworth No.2 colliery, the Liddell State Mine and eventually the proposed Mt. Arthur North mine.

The station presently employs about 750 men, with a further 100 apprentices undergoing training for work in new power stations. Some further contract construction jobs have been created as a result of the upgrading of station plants during 1980-1982.

Bayswater No.2

An open cut mine owned by Bayswater Colliery Co. presently producing 0.8 million tonnes per annum. Expansion of the existing mine in A171 is intended, with construction beginning in 1982 and new production in 1983. Production will increase to approximately 1.5 mtpa, all of which will be for export. A new mine in A172 (about 12 kilometres south of A171) may begin operations in the early 1990's but few details of this project are known.

The existing mine is located about 9 kilometres immediately south of Muswellbrook, between the Drayton mine and the proposed Whites Creek mine. Expansion of the existing mine will begin in 1982 with a construction workforce of 50, rising to a peak of 100 in 1983-1986. The permanent workforce will expand by 50 in 1983, peaking at 200 in 1987-91.

Muswellbrook No.1

Owned by the Muswellbrook Coal Co., this small underground mining operation is immediately under the township of Muswellbrook. Its closure is expected in 1981 due to the depletion of the coal resources, together with the adverse environmental effects on the town. These include traffic noise, coal dust deposition and evidence of mine subsidence.

Currently employing around 40 men, it is anticipated that these employees will be transferred to the company's new operations to the north of the town. Production level is around 0.6 mtpa.

Muswellbrook No.2 and No.3

Also owned by Muswellbrook Coal Co., these mines are located approximately 3 to 4 kilometres north-east of the township respectively. Current production level is approximately 0.6 mtpa and it is likely that increased production from 1983-84 will bring total production to some 1.3 mtpa. The mines have adverse environmental effects from their open cut operations, together with problems of heavy road transport through the township.

The existing workforce is approximately 50 men, increasing slightly between 1984-1991.

Authorisations

As well as existing mines, many Authorisations to drill for coal have been granted by the New South Wales Department of Mineral Resources and approximately 21% or 71,200 hectares of land in the Shire is affected (refer Figure 4.1).

Transportation

Approximately 4.3% of the Shire's workforce is engaged in transportation/storage activities (refer Table 4.8). With predicted increases in the industrial sector, this proportion is likely to increase. A brief description of the present transportation system follows.

Muswellbrook is located on the New England Highway, 49 kilometres north of Singleton. The road is generally of high standard, with two lane construction in short sections developed into four lanes. It is used by both tourists passing through the town, heavy vehicles for deliveries and coal transportation and by local Shire residents travelling through to Maitland, Newcastle and Sydney. Denman Road and the Denman-Jerry's Plains Road are of less importance but nevertheless do carry heavy vehicles and considerable local traffic. Denman Road connects Denman to Muswellbrook and is the major link for Denman and many rural residents to services and facilities of Muswellbrook. Heavy vehicle use, however, has resulted in a poor road surface and inadequate road

alignment. The Jerry's Plains Road acts as an alternative route to the New England Highway from south of Singleton, connecting to Muswellbrook via Edderton Road and Denman Road. This route avoids the bridge at Singleton which has a height limit unsuitable for heavy vehicles. It receives heavy traffic from quarries near Jerry's Plains and coal trucks from the Buchanan-Lemington mine. Existing traffic volumes taken from the Mt. Arthur North Environmental Impact Statement are shown in Table 4.8 below.

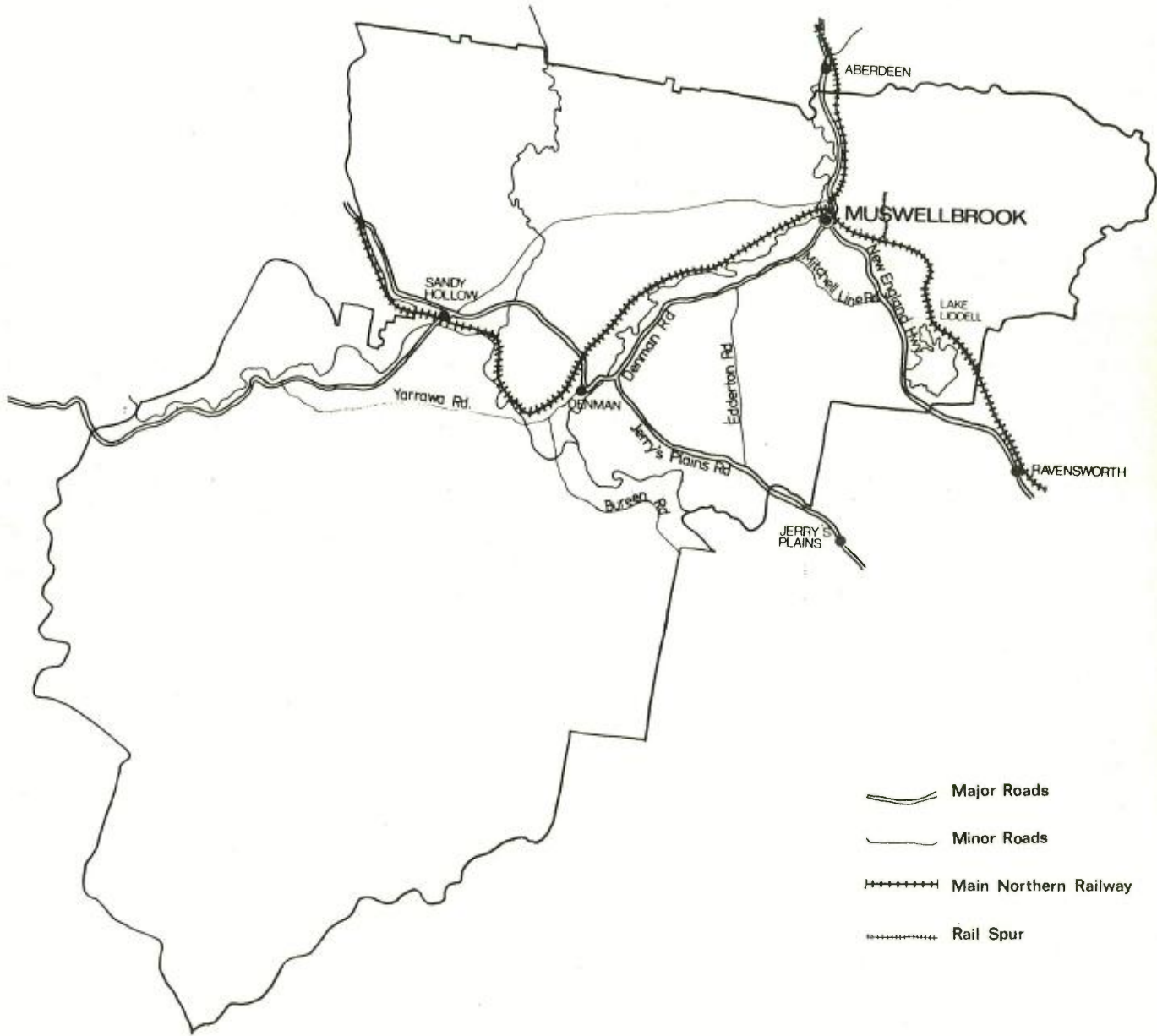
Table 4.8: Daily Traffic Volumes (AADT)

Location	Count Station	1972	1976
New England Highway:			
. rural section	5.039	3810	5600
. urban fringe	5.244	4720	7680
. at junction with Denman Road	5.245	6030	8420
Denman Road:			
. west of Edderton Road	5.073	1040	1270
. at junction with New England Highway	5.477	5400	9690
Edderton Road:			
. at junction of Denman to Jerry's Plains Road	5.696	250	440

Source: Department of Main Roads

Existing traffic volumes are low to moderate in relation to the standards of these roads with noticeable increases around the outskirts of Muswellbrook. The most noticeable feature is the increase in volumes on the town end of Denman Road (Sydney Street) and the urban fringe of the New England Highway.

Figure 4.2 shows the location of Muswellbrook in the Upper Hunter Valley and the railway lines that serve it. The Main Northern Railway was opened to Muswellbrook from Newcastle in 1869. It was not connected to Sydney until the completion of the Hawkesbury River Bridge in 1889. The Merriwa Branch from Muswellbrook was opened in 1915-20. As early as 1911, a railway was proposed from Sandy Hollow, on the Merriwa Branch, to Gulgong and Maryvale to carry agricultural produce from the north-west of New South Wales to Newcastle. This railway, which was commenced in 1936, will be completed as far as Ulan, for the large scale carriage of coal in 1983.







-  Major Roads
-  Minor Roads
-  Main Northern Railway
-  Rail Spur



FIG. 4-2
ROAD & RAIL NETWORK



South of Muswellbrook a number of spur lines have been completed in recent years to serve coal mining:

- i) from Whittingham to Mt. Thorley for Mt. Thorley and Warkworth mines;
- ii) from Newdell Junction to Newdell sidings from Newdell and Liddell mines; and
- iii) from St. Heliers to Muswellbrook No.3 mine.

Muswellbrook is served by two or three passenger trains per day in each direction. The most important is the six-days-a-week Northern Tablelands Daylight Express. On four nights a week it is served by the North Mail and sporadically during the week by middle-of-the-day passenger trains to and from Newcastle.

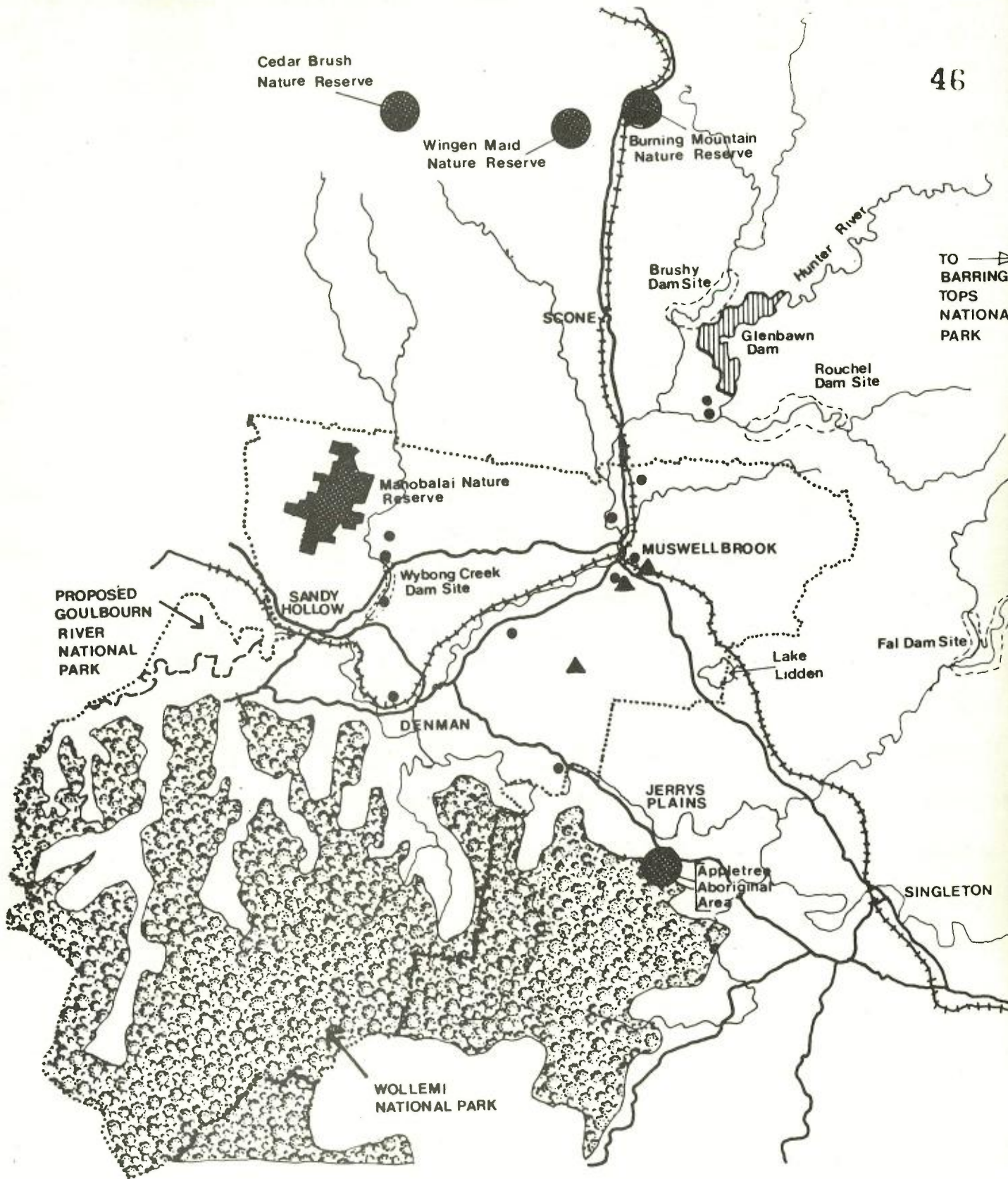
The Main Northern Railway has virtually no interstate freight traffic. It is sustained by the largely agricultural activity of the Northern Tablelands and Northwest Slopes of New South Wales. In recent years coal mining activity north of the Hunter Valley has added to traffic. Coal is currently hauled through Muswellbrook from northern mines such as Gunnedah and beyond. A total of 62 train movements occur on average in each 24 hour period from Monday to Saturday while on Sunday the traffic flow is considerably lower. More detail is provided in the paper prepared by R. Travers Morgan in Appendix 4.

No major airfields exist in the Muswellbrook Shire although a service to the Shire is provided by Scone and Maitland airports. Both are classified by the Department of Transport as Class C aerodromes as their runway length is 1,500 metres or less.

Recreation and Tourism

A wide range of recreational facilities are available in Muswellbrook and Denman and are discussed in Chapter 5.

At a district level a variety of recreational attractions can be found within a reasonable drive from Muswellbrook (see Figure 4.3). These have been identified in the Mt. Arthur North Environmental Impact Statement and include the following:









-  National Parks & Scenic Areas
-  Nature Reserves
-  Water Recreation Areas
-  Proposed Dam Site
-  Vineyards
-  State Forests & Nurseries

FIG 4-3
DISTRICT RECREATION
AND TOURISM



SOURCE: Mt. Arthur, North Coal Project E.I.

- . The Barrington Tops National Park with an area of 16,000 hectares is 50 kilometres east-north-east of Muswellbrook and forms part of a southern extension of the New England Plateau along the Mount Royal Ranges. This park is considered a wilderness area with limited access and contains a great diversity of plant communities from sub-alpine woodlands, grasslands and swamps to hardwoods, beech forests and warm temperate rain forests set in rugged terrain. The area is dissected by fast running creeks.

- . Wollemi National Park covers an area of 450,000 hectares extending from the Hunter River between Denman and Singleton south into the Blue Mountains and west to Rylestone. The park is largely a wilderness area with many species of native fauna and flora. It contains many aboriginal relics and traces of their culture such as hand stencils, cave drawings and grinding grooves. These can be seen in the Appletree Aboriginal Area situated on the northern boundary of the Wollemi National Park, 20 kilometres west of Singleton.

- . A small State Forest, No.975, lies south-east of Muswellbrook between the New England Highway and the Main Northern Railway and a State Nursery is located near Muswellbrook.

- . There are four nature reserves within the general area. Burning Mountain, Wingen Maid and Cedar Brush Nature Reserve are situated close to each other and are about 20 kilometres north of Scone. The Manobali Nature Reserve is situated about 30 kilometres west of Muswellbrook. The nature reserves provide a protected area for flora and fauna and are important as an education tool as well as providing a pleasant recreation area.

- . Glenbawn Dam and Lake Liddell provide outlets for power boats, sailing and fishing. Lostock Dam and proposed Water Resources dams at the Wybong Creek, Brushby, Rouchel Brook and Fal sites will add to the recreation resource, although permitted uses of the water bodies are not known at present.

- . Grape growing and wine making is expanding to the point where many of the Hunter's best wines are being produced in the Shire. There are currently some 14 vineyards in the Upper Hunter region, with many recently planted areas in the Denman area.

The historical and architectural heritage of the Shire is discussed in Chapter 6. As yet few of the historic buildings are open to the public but it is anticipated that the efforts of the local historical societies to restore old buildings such as Merton, will improve this situation in time.

Many of the roads in the Shire, particularly the Jerry's Plains-Denman-Muswellbrook, the Denman-Sandy Hollow, Ulan and the Sandy Hollow-Merriwa Roads, offer the motorist extremely scenic views of the surrounding river valley landscape and are recreational and tourist attractions in themselves.

The tourist industry in the Shire generates modest but steady revenues. As the area lacks tourist attractions of mass appeal, business is largely dependent on short term accommodation for travellers and visitors. The present outlook is for continuing slow growth. The extent to which mining and industrial development can be developed for tourist appeal will affect this future growth potential.

Throughout the year there are a number of annual events which attract large numbers of inter-regional visitors. The main events include:

- . Muswellbrook Rodeo (March)
- . Muswellbrook Agricultural Show (April)
- . Muswellbrook Art Exhibition (April)
- . Muswellbrook Picnic Races (May)
- . Muswellbrook Art Prize and Purchase Exhibition (July)
- . Upper Hunter Wine Festival - Denman (October)

Commerce/Retailing

Approximately 13.5% of the Shire's workforce is engaged in wholesale and retail activities. Some growth in this sector is anticipated (refer Chapter 9, Section 9.3). These activities are an important source of jobs for women, young people and those looking for part-time or casual employment.

The Urban Areas

5

5.0 THE URBAN AREAS

5.1 MUSWELLBROOK

The town of Muswellbrook, with 68% of the Shire's population, is the major centre for retail, business and recreational services within the Shire. Located as it is on the New England Highway approximately half-way between Newcastle and Tamworth, the town attracts considerable passing trade from through travellers.

A Land Use Survey was conducted in October 1980¹ which identified all the various land uses in the town (see Figure 5.0). The limits of this survey are the town boundary as defined prior to amalgamation with Denman Shire. An existing zoning map is reproduced on Figure 5.1 for comparison purposes.

Housing

There are some 2,050 detached dwelling houses in Muswellbrook, as well as 110 residential flats and 28 aged persons' units. The past year has seen an increased interest in the construction of flats and townhouses due to the increased demand for this type of residential accommodation. Older established housing tends to be located east of the railway line bounded by Dumaresq, Market, Dalahenty and George Streets and west of the railway line towards the river. Historically the town has grown from this central core north to the new North Muswellbrook subdivision and east towards the Muswellbrook Common. The largest area of recent growth has occurred in South Muswellbrook.

Commercial Areas

A floor space survey of the town centre was also conducted in October 1980. A total of 15 blocks and some 200 establishments were surveyed (see Figure 5.2). Table 5.0 presents floor space distribution within the town centre, identifying the range of land use activities within each block. The Australian Standard Industrial Classification (A.S.I.C.) has been used to categorise activities. Retailing forms the largest activity group within

1 Jackson Teece Chesterman Willis - refer Appendix 3.

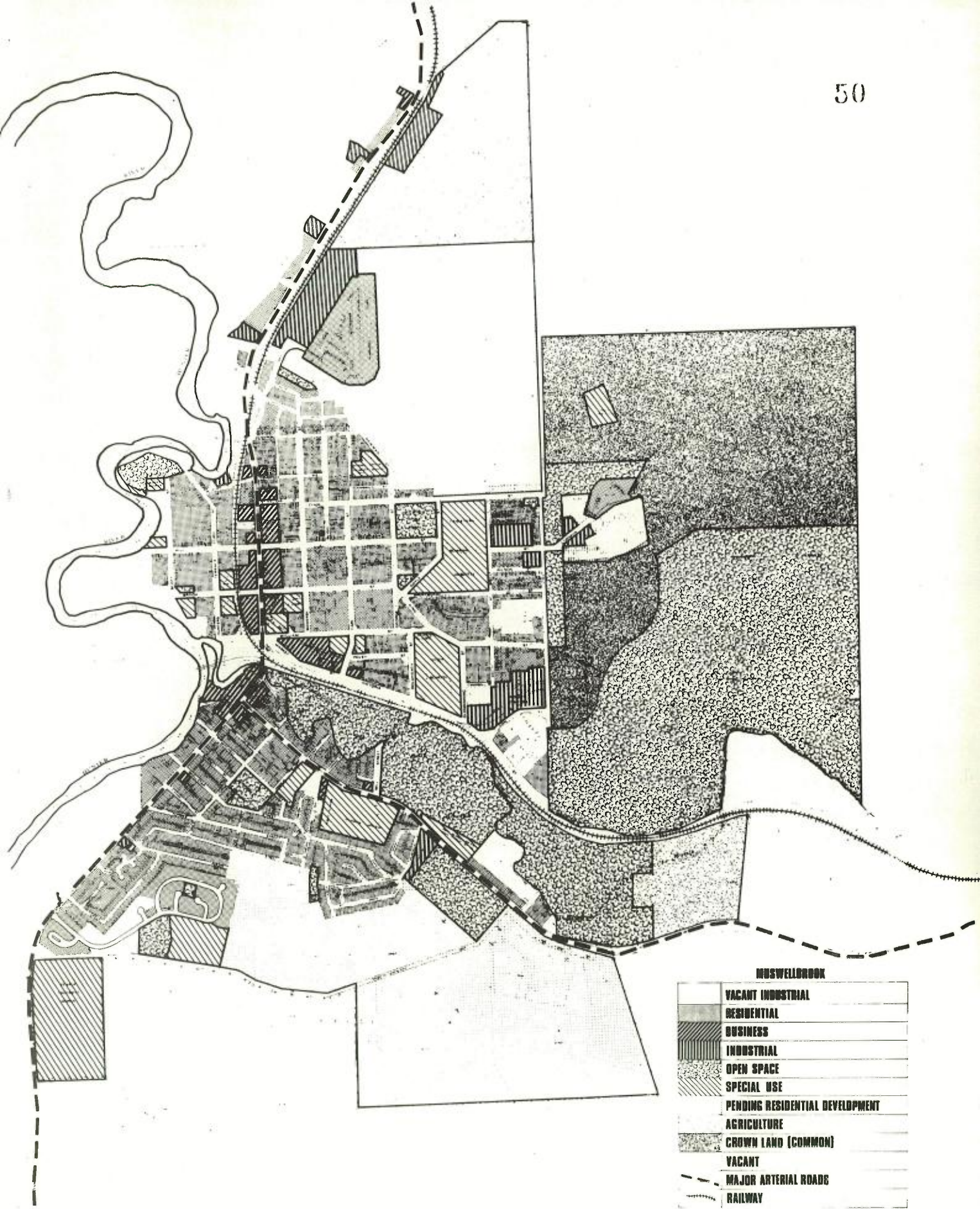
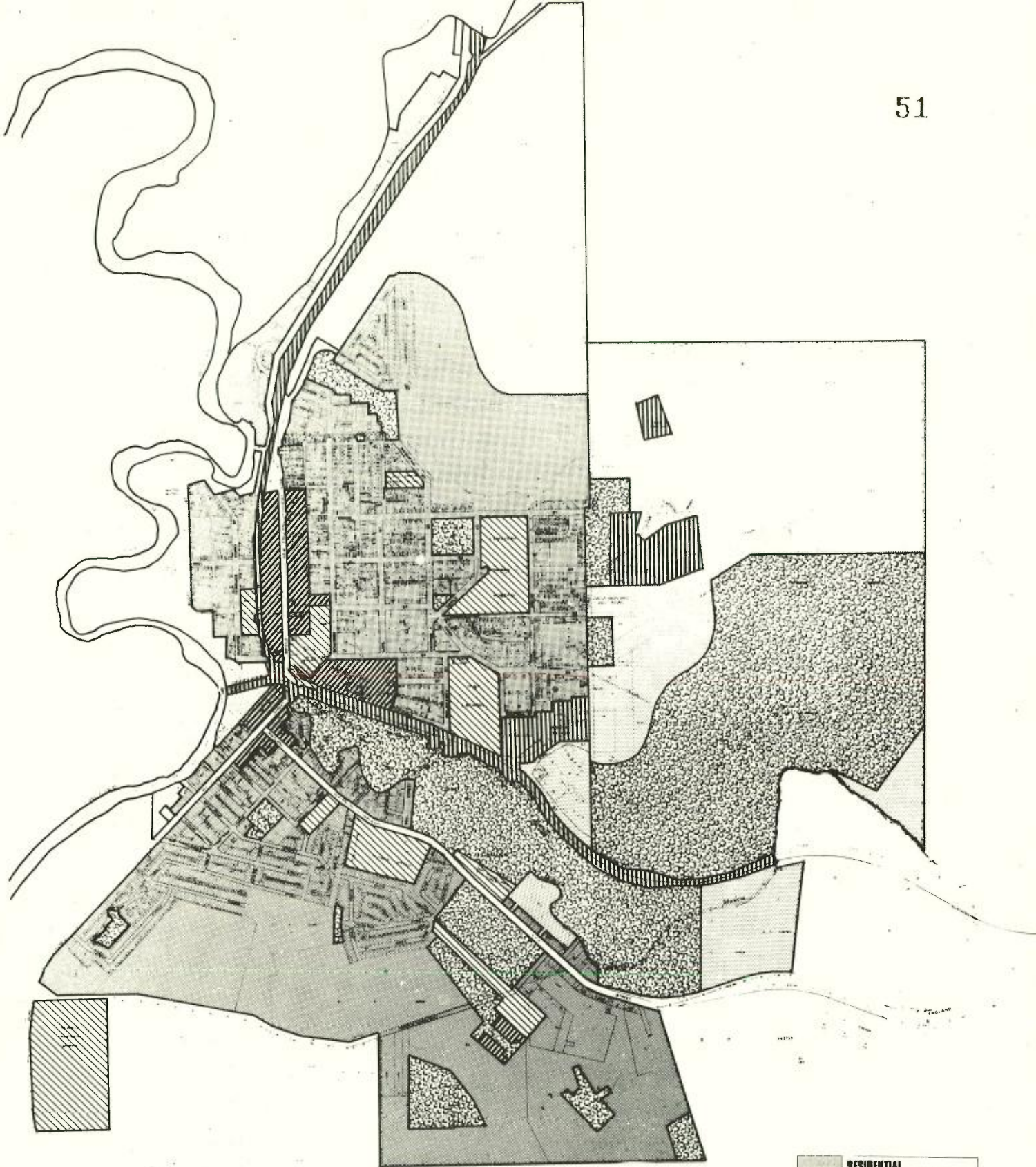


FIG 5-0
MUSWELLBROOK
GENERALISED LAND USE



	RESIDENTIAL
	BUSINESS
	INDUSTRIAL
	OPEN SPACE
	SPECIAL USE
	NON-URBAN



FIG 5-1
MUSWELLBROOK
EXISTING ZONING

0 200 400 600 800 1000m

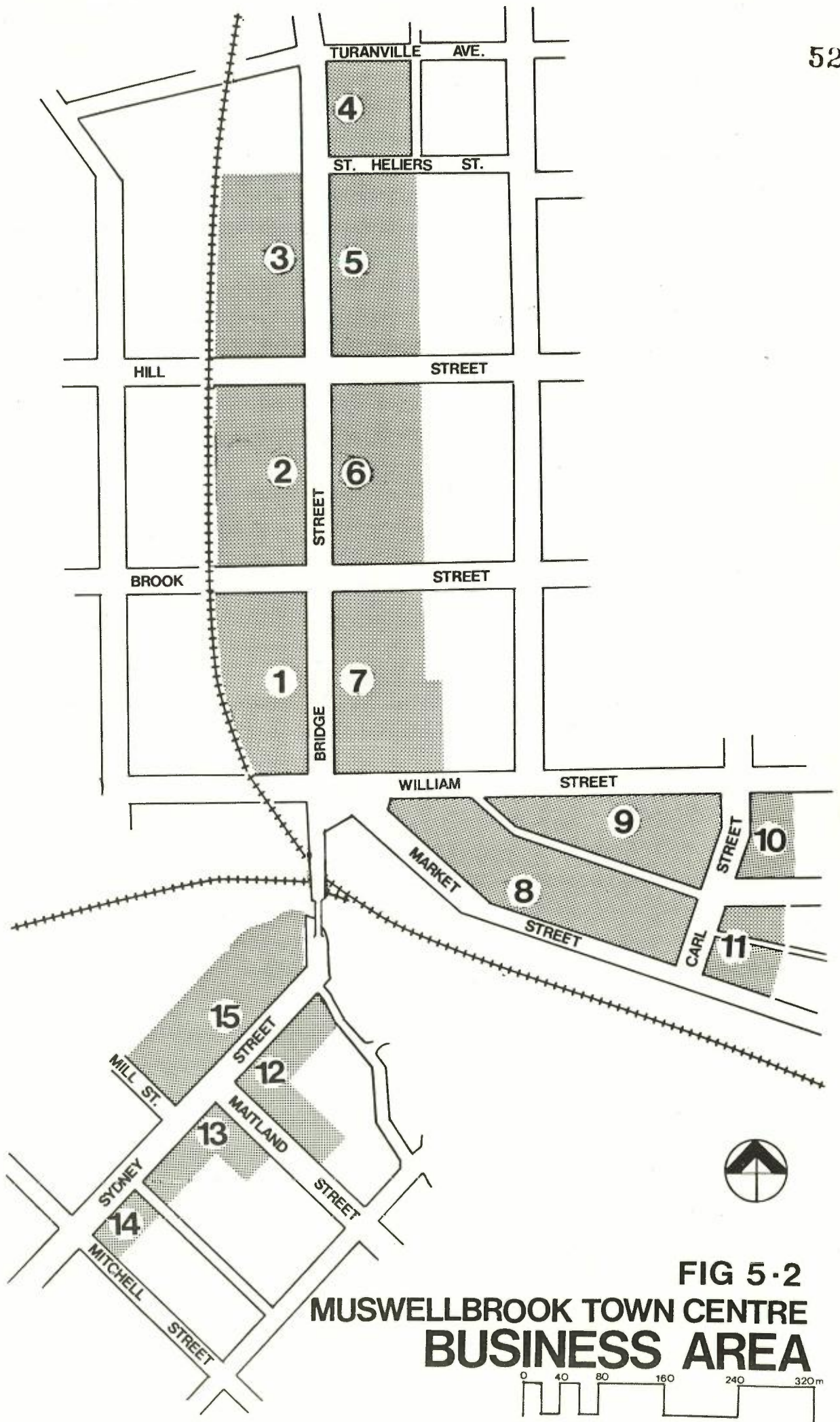
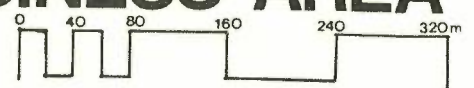


FIG 5-2
MUSWELLBROOK TOWN CENTRE
BUSINESS AREA



the centre, with some 101 retail establishments occupying 24% of the total town centre floorspace. Consumer goods form the largest retail floorspace component, although "other retail" (motor vehicle dealers, specialty shops etc.) have a greater number of establishments. This high proportion of "other retail" reflects the traditionally small, specialised nature of shopping in Muswellbrook and the absence of larger variety food and department stores. "Social" floorspace forms a considerable component of the town centre, occupying 11,750m². The total of 18 clubs, hotels and restaurants within the town centre is high, indicating that most residents prefer to utilise local recreational facilities.

Table 5.0 Floorspace Distribution in Muswellbrook Town Centre - October 1980

Block No.	Activity in m ²											Total Floorspace Block
	Food	Clothing	Household	Other Retail ¹	Total Retail	Commercial/Office	Public ²	Social ³	Vacant	Residential	Other Non Retail ⁴	
1	2,045	721	437	1,353	4,556	851	-	1,247	1,975	903	276	9,808
2	344	369	179	1,223	2,115	1,105	2,190	2,023	206	492	2,049	9,280
3	-	-	-	241	241	-	-	-	238	926	861	2,266
4	-	-	-	-	-	-	-	-	-	875	321	1,196
5	68	-	-	-	68	65	-	1,617	-	597	269	2,616
6	290	194	388	400	1,272	1,900	473	951	-	476	493	5,565
7	258	225	195	2,358	3,036	2,307	1,796	755	573	229	112	8,808
8	299	-	1,490	344	2,133	1,474	637	1,023	141	1,903	1,657	8,968
9	-	-	-	-	-	926	-	-	-	447	173	1,546
10	-	-	-	-	-	180	-	-	-	-	-	180
11	-	-	-	-	-	-	-	-	-	471	522	993
12	328	-	-	-	328	181	-	970	-	766	450	2,695
13	131	120	-	156	407	-	-	-	-	466	197	1,070
14	-	-	-	-	-	-	-	-	-	636	-	636
15	211	-	-	-	211	111	-	3,164	-	436	296	4,218
Total Floor-space Activity	3,974	1,629	2,689	6,075	14,367	9,100	4,196	11,750	3,133	9,623	7,676	59,845

1 Includes variety stores which comprise food, clothing and household goods.

2 "Public" floorspace is area denoted for public use such as town halls, libraries, churches, church halls etc.

3 "Social" floorspace includes clubs, hotels and restaurants.

4 Predominantly motor vehicle uses.

Source: 1980 Landuse Survey

Shopping Patterns

Existing shopping patterns within the Shire appear to be centred on Muswellbrook. The Social Survey sought to identify existing shopping patterns by asking residents to nominate shopping centres and the proportion of shopping done in each centre for a particular range of goods. Food shopping is primarily done in Muswellbrook with 86% of respondents doing the majority of their food shopping there. A small proportion of food expenditure does go to Denman, primarily by Denman residents. Similarly, 71% of respondents do 51-100% of their furniture and large household goods shopping in Muswellbrook (79% do some shopping for these goods in Muswellbrook). However, some escape expenditure does occur to Newcastle with 12% of respondents shopping for household goods at this centre.

Clothing, however, experiences a higher proportion of escape expenditure. Seventeen percent of respondents do some shopping for clothing at Newcastle, 8% at Sydney and 5% at Maitland.

Residents use of business services such as legal, finance and real estate are concentrated on Muswellbrook with 86% of respondents using the town for these services and the majority of Denman residents using Denman local business services. Personal services which include doctors and dentists follow a similar pattern with 75% of respondents using the services of Muswellbrook. However, both Scone and Denman do capture a considerable proportion of users within the Shire.

Social and Cultural Facilities

The land use survey identified the social, educational and cultural facilities available to Muswellbrook residents. A complete inventory of these is detailed in Appendix 1 and their locations are shown in Figures 5.3 and 5.4. The significant findings are:

- . The eight schools in the town are well distributed.
- . Cultural and welfare facilities are limited and social facilities relate primarily to adult entertainment, such as licensed clubs and hotels.

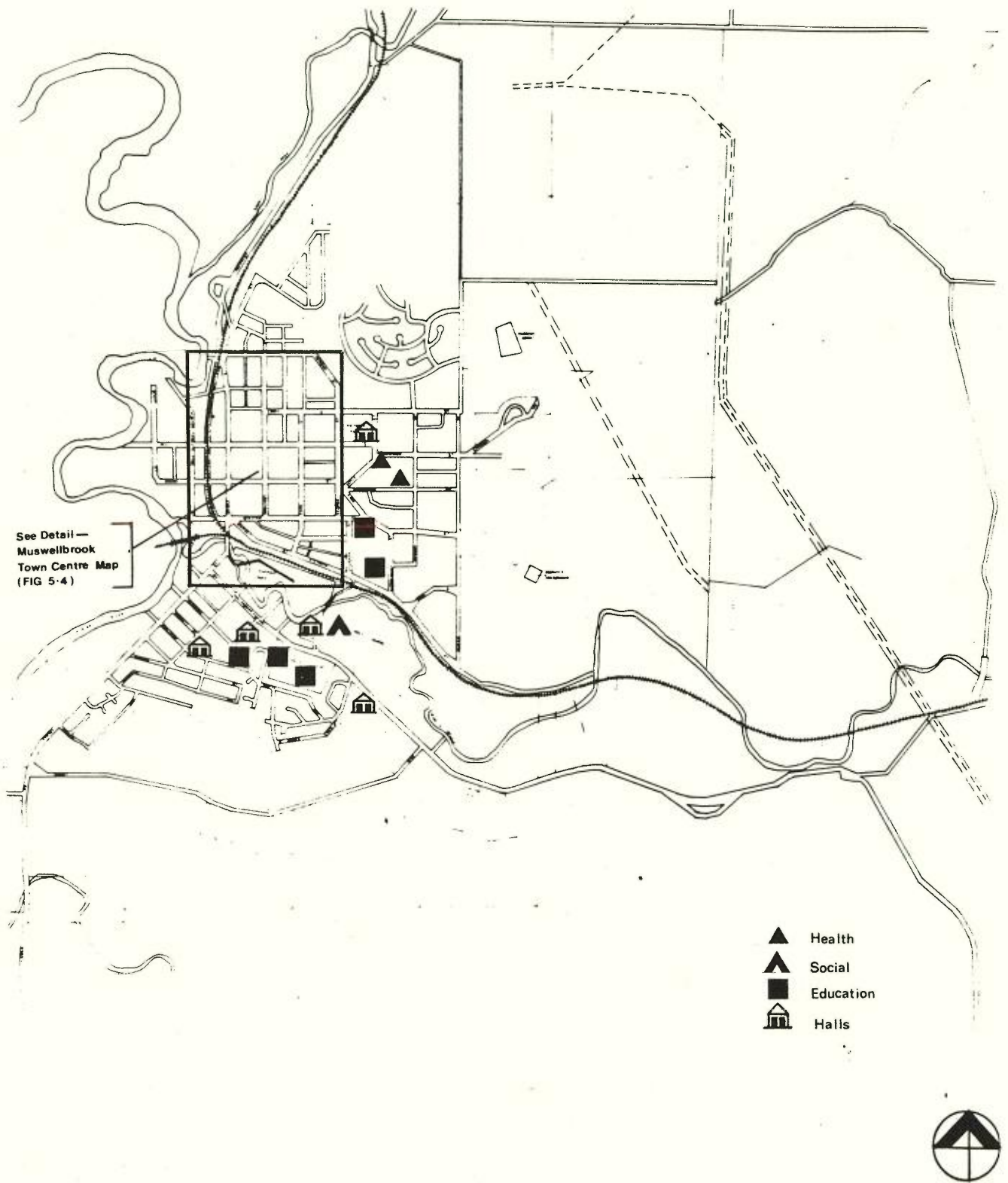


FIG 5-3
MUSWELLBROOK ENVIRONS
SOCIAL & CULTURAL FACILITIES

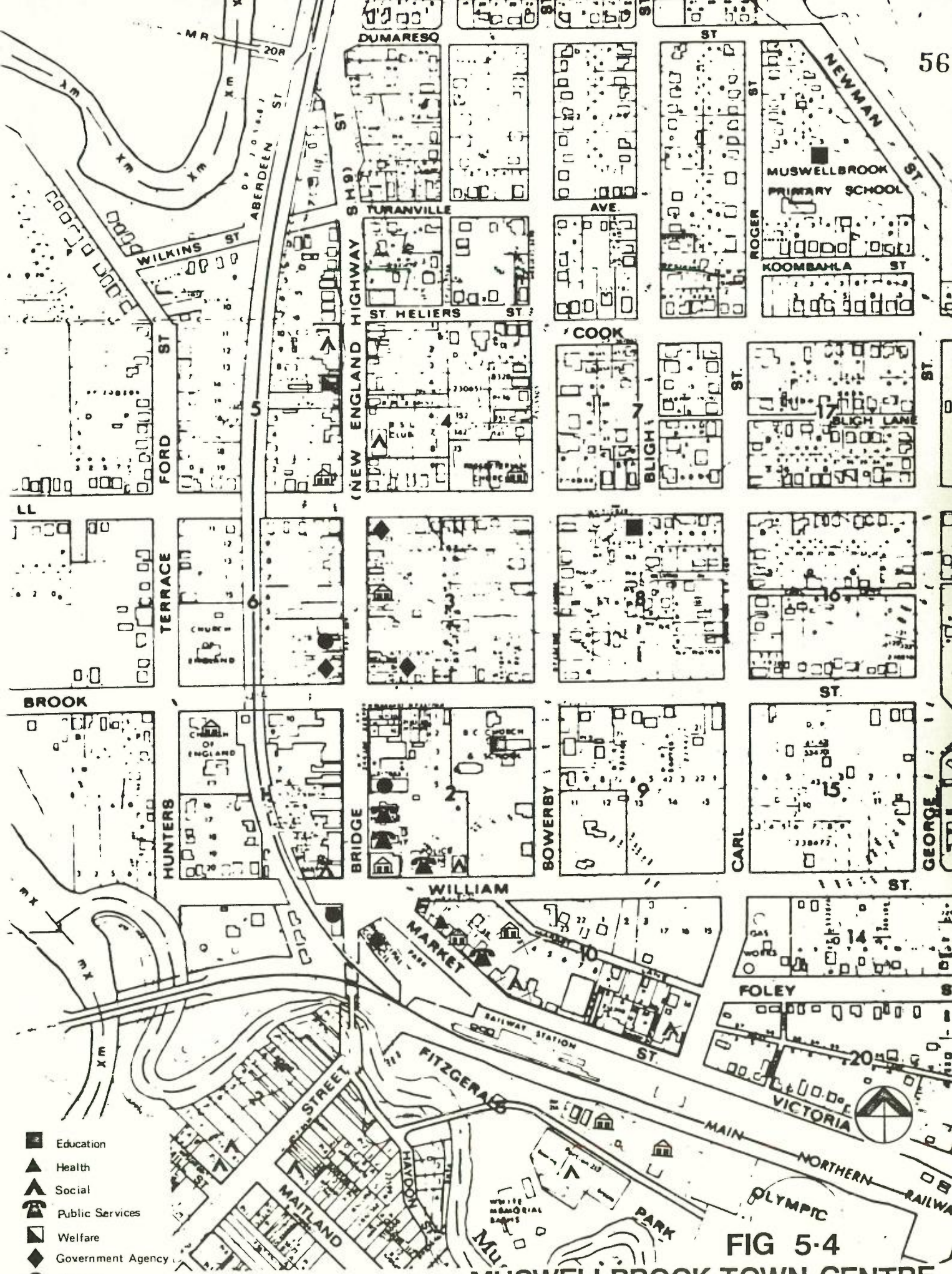
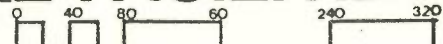


FIG 5-4
MUSWELLBROOK TOWN CENTRE
SOCIAL & CULTURAL FACILITIES



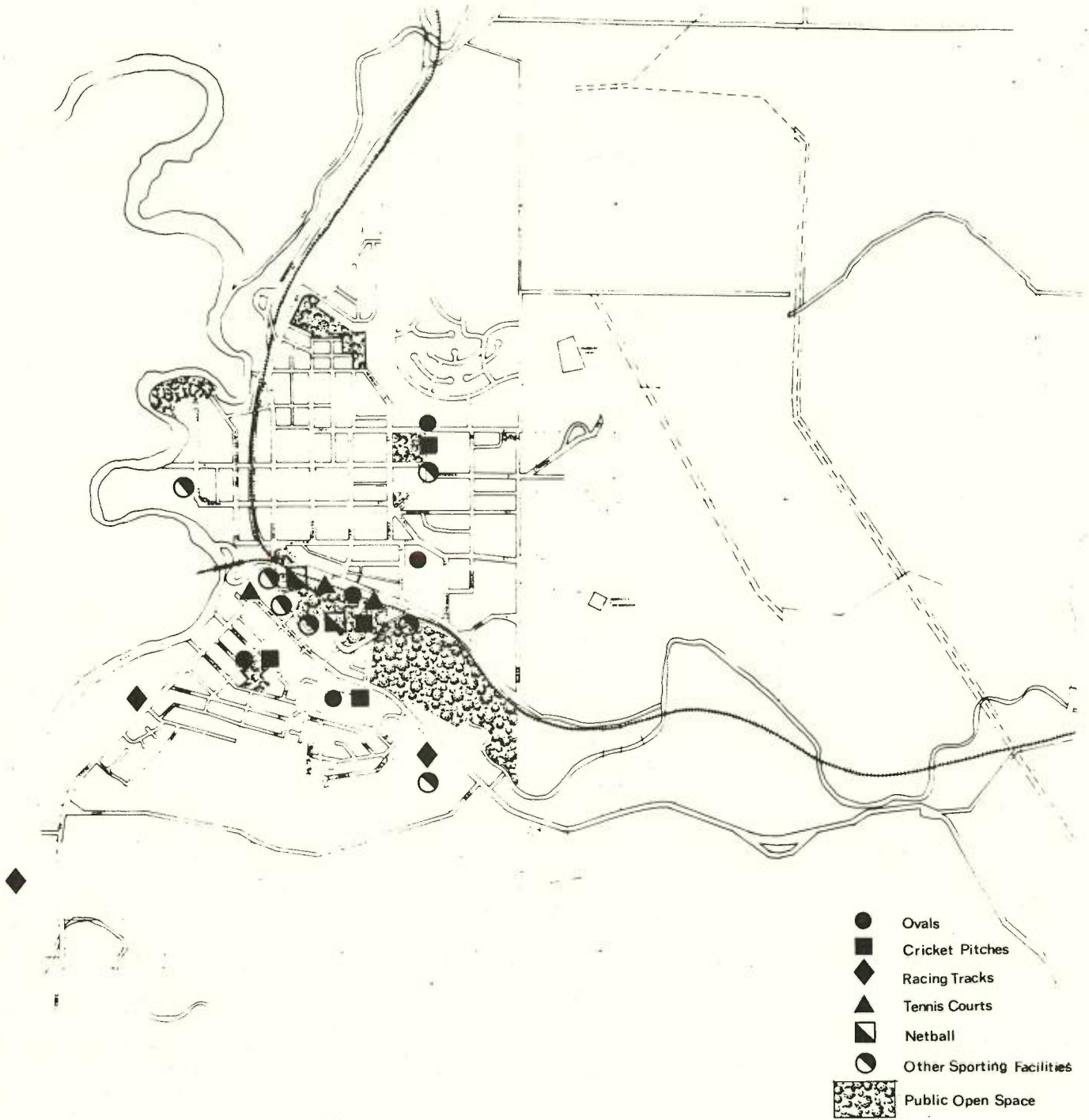
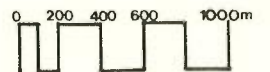


FIG 5-5
MUSWELLBROOK ENVIRONS
RECREATIONAL FACILITIES



- . Teenage and family entertainment opportunities are limited to the Plaza Cinema in Bridge Street.
- . The town is served by some 20 halls and function rooms.
- . Licensed club membership is high. The four clubs were contacted seeking information on total club membership for December 1980. Total membership was 8,850 which is greater than the 1976 census population of 7,805 persons. The popularity of licensed clubs can be attributed perhaps to the lack of other social meeting places within the community.

Active Recreation Facilities

Participation in active sporting activities is high. The Hunter Valley Leisure Plan and the Muswellbrook Social Survey both identified team sports (tennis, squash, cricket, football) as the most popular activities. The high sporting involvement can be attributed to the high proportion of young families within the Shire and the trend is expected to continue as the population increases. This is further reinforced by the high proportions of younger respondents who stated they were involved in active sport.

Sporting facilities in Muswellbrook are concentrated in Olympic Park, located between North and South Muswellbrook (see Figure 5.5 and Appendix 1). Few new facilities close to local schools and residential areas have developed in North and South Muswellbrook. The central location of facilities within the older part of the town has encouraged full utilisation and enables easy access for family groups, who perhaps use a range of recreational facilities. There is a wide range of outdoor recreational facilities but a limited number of indoor facilities.

Water Supply and Sewerage

Water is drawn from the bed load of the Hunter River, treated and pumped to storage on the high ground east of the town. There are five reservoirs of varying sizes having a total storage of 21.4 million litres. The whole urban area is served by reticulation from the one location. Refer to Supporting Document 2 - Gutteridge Haskins and Davey Report - Muswellbrook Community Impact Study - December 1980.

Usage of water in Muswellbrook is high. Including industrial usage, the year round average daily consumption is 727 litres/capita, with average daily demand during the peak summer period of 1,188 litres/capita. The peak day usage is 1,894 litres/capita.

At the moment, storage is adequate for two days summer period demand and it is estimated that current storage will suffice for no more than 12,500 population. Capacity is thus expected to be reached before 1985.

There has been periodic overloading of the sewerage trunk system. New areas in North and South Muswellbrook have been pumped to avoid critical points. A new main is being developed around the eastern edge of town. The southern portion from a new pumping station on the Highway is in operation and part of the northern systems is under construction.

The treatment plant has a capacity of 10,000 population and has been augmented by a Pasveer Channel with a population equivalent of 2,000. When the new trunk line is complete, the sewerage system will have the capacity to serve a population similar to the water supply and will reach its maximum prior to 1985. Refer to Supporting Document 2 for the location of existing urban utilities.

Roads

The condition and width of roads and associated traffic volumes within the urban centre of Muswellbrook are described in the G.H.D. Report³. The New England Highway forms the main artery of the town and passes through its commercial centre. Works have commenced to improve the Highway at the southern entrance to town and to construct a median from the south to the Bell Street intersection.

The poor condition of Denman Road and the restricted railway underpass (low height and prone to flooding) have been identified as the major deficiencies in the urban road system, while the varying conditions of the secondary road system and the need to connect these roads to new residential areas, will also require attention as the town grows⁴.

3 Gutteridge Haskins and Davey Pty Ltd "Muswellbrook Shire Community Impact Study" 1980

4 Ibid

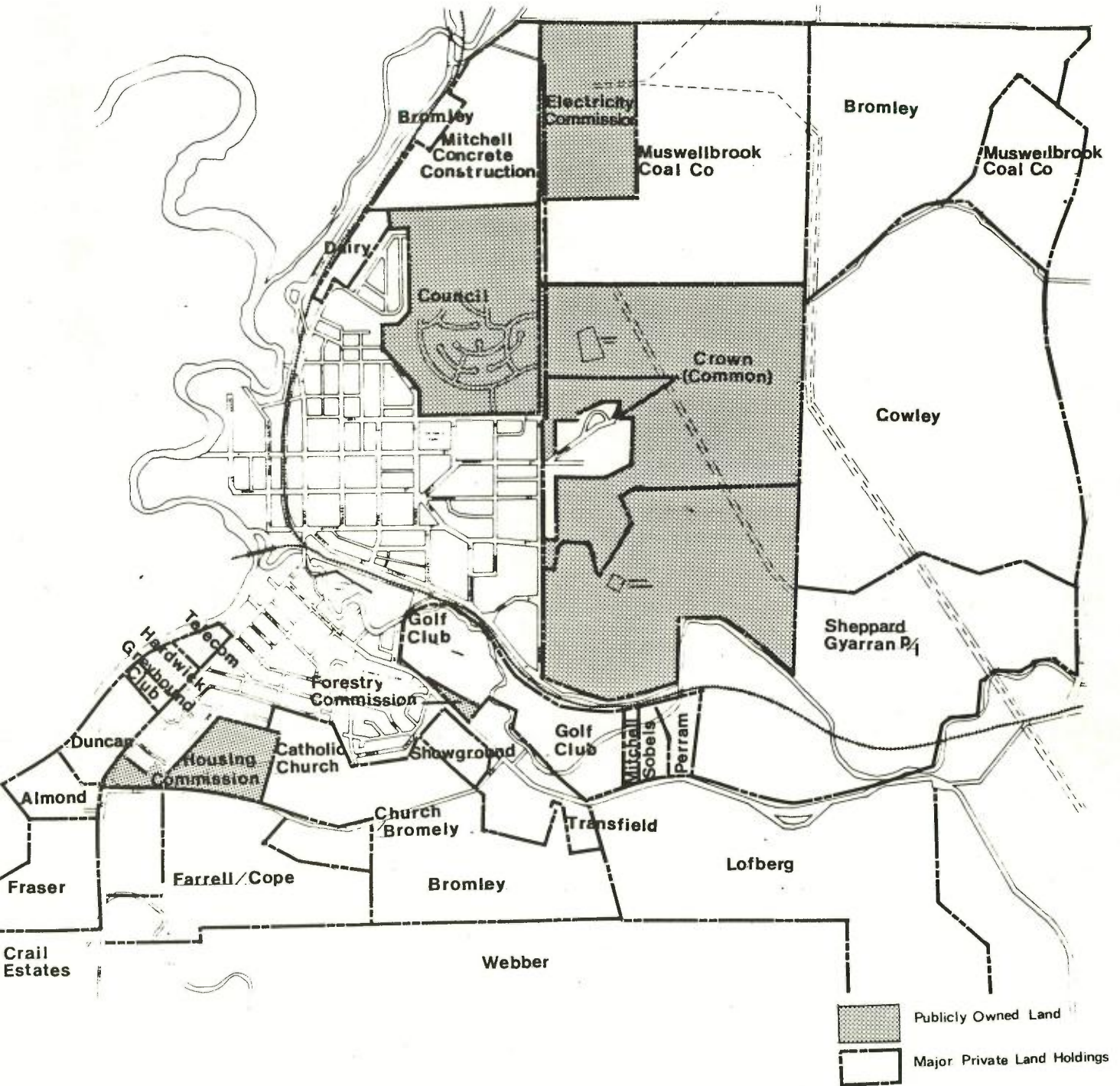
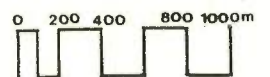


FIG 5-6
MUSWELLBROOK
LAND OWNERSHIP



Land Ownership

Figure 5.6 indicates the owners of land surrounding the existing urban areas of the town. As can be seen, most of the land is held in quite large parcels. Significant areas of publicly owned land exist to the north (Council and the Electricity Commission), to the east (New South Wales Department of Lands) and to the south (New South Wales Housing Commission). Land owned by Bromley, also to the south of town, has recently been resumed by the New South Wales State Government.

5.2 DENMAN

Denman is the only other town in the Shire with a significant population and offering a range of services to the surrounding rural areas.

Land Use

A land use survey of Denman was conducted in November 1980 (Figure 5.7). At that time there were 280 detached houses and 11 flats. Most of the development is located east of the railway line in the area bounded by Kenilworth, Palace, South and Virginia Streets. New development has occurred on the western side of the railway, although as yet this only consists of one block of housing. Other new housing is concentrated in the north of the town. Here land is being subdivided and a group of six town houses has been constructed. The older established housing is usually on large lots while throughout the town and particularly on the extremities there are a large number of vacant lots.

The commercial area of Denman is concentrated in Ogilvie Street, primarily between Paxton and Palace Streets. Table 5.1 lists the number of establishments in Ogilvie Street by land use category. The town centre reflects the service role of the town. The small number of stores caters for the daily needs of the community. For other goods, residents must travel to Muswellbrook or another larger town. The large number of "non retail" uses primarily provides supplies and services for the rural areas around the town. A list of all businesses in the town is included in Appendix 3.

The major industrial activities include the new concrete sleeper factory, a farm machinery depot and fodder storage sheds, while there are two caravan parks located in the town.

Table 5.1

Number of Establishments in Denman Town Centre (Ogilvie Street)

		House-	Other	Total	Community/		Motor	Other	
Food	Clothing	hold	Retail	Retail	Office	Public	Social	Non	Total
							Vehicles	Retail	
5	3	2	3	13	5	4	2	6	32

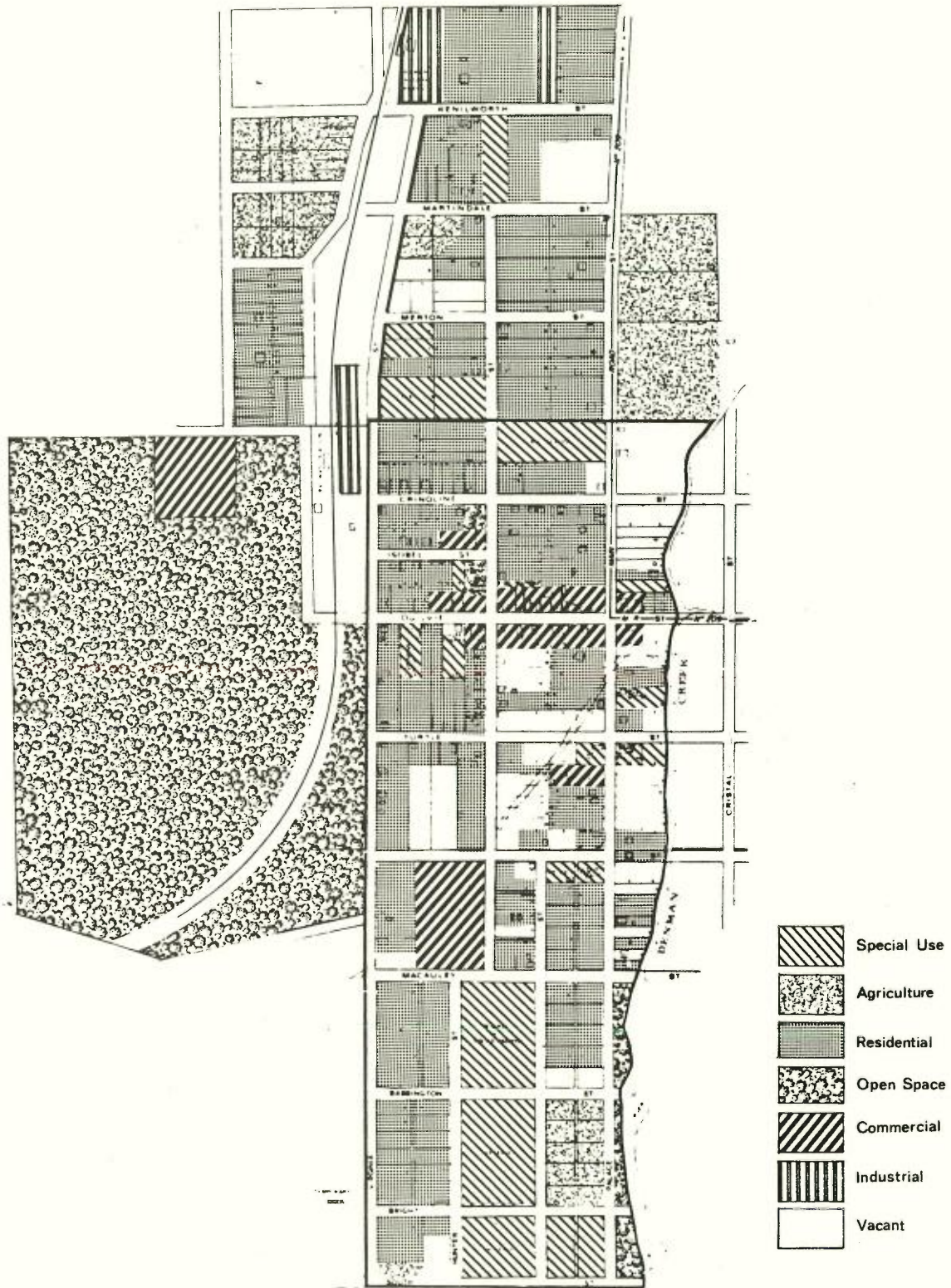
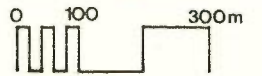


FIG 5-7
DENMAN LAND USE



Social and Cultural Facilities

Facilities are clustered in and around the main shopping area in Ogilvie Street. (For a full list see Appendix 1.) The range is small, with few halls or meeting places available for public use. As in Muswellbrook, welfare and cultural facilities are limited, while social facilities are based primarily on adult entertainment in licensed clubs and hotels (for example, the Denman R.S.L. Club has 1,000 members while only about 500 adults live in the town itself). See Figure 5.8.

Active Recreation Facilities

Denman is well served with a variety of active recreational facilities, most of which are located at the central recreation area. Facilities include ovals, tennis courts, a golf course, bowling green, swimming pool and a sprint horse racecourse (see Appendix 1 and Figure 5.9).

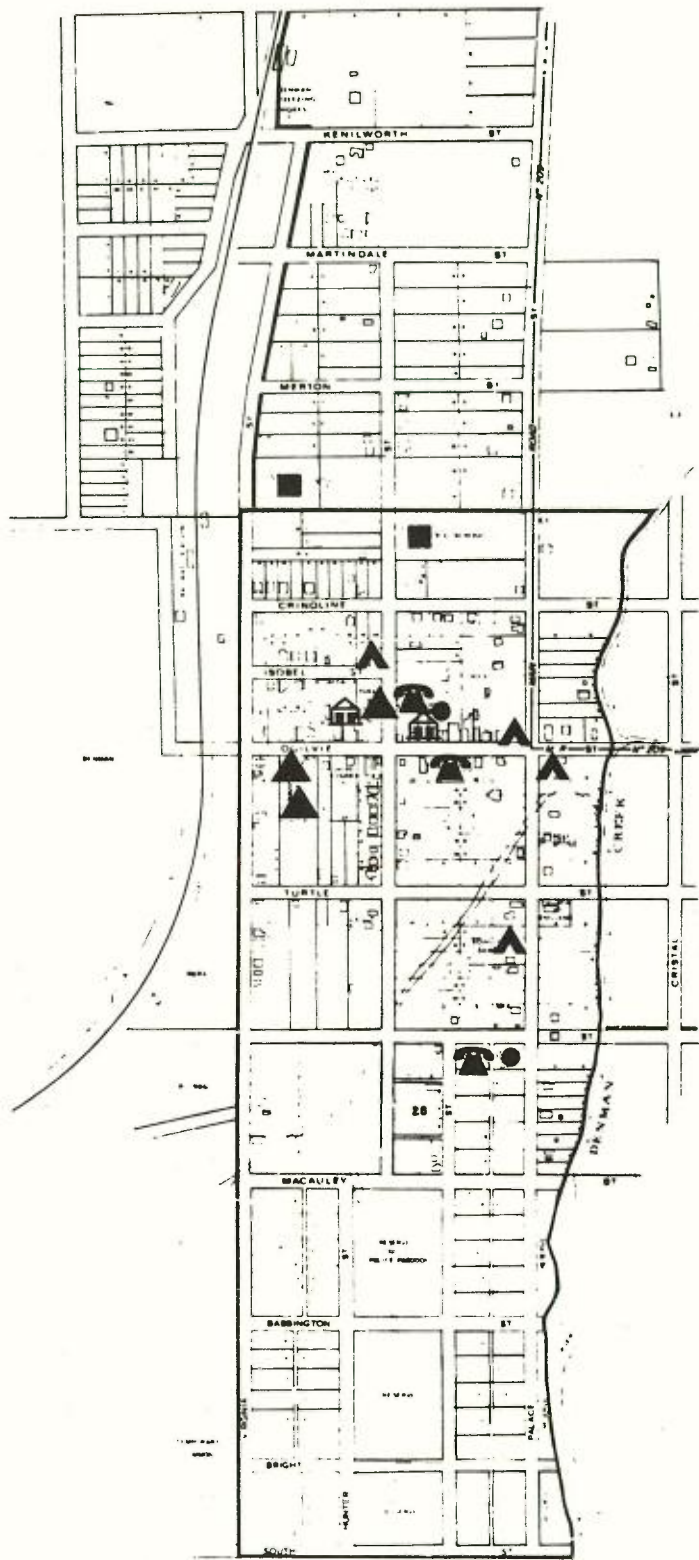
Water Supply and Sewerage

Water is pumped from a bore on the river bank at a maximum of 2,000 litres per hour and direct from the river at 90,000 litres per hour⁵. Storage is for 1.0 million litres which is less than twice the average consumption. Peak consumption is thus provided from both storage and pumping direct from the river. Not only is storage inadequate, it is at a relatively low level so that new housing to the west of the village even now lacks sufficient water pressure.

The sewerage system⁶ reticulates to a trunk line running along the spine of the village to treatment at its southern end. Treatment is in a Pasveer Channel with a population equivalent of 1,000. Any development of vacant lots or new development would imply augmenting of the existing systems.

5 Ibid

6 Ibid

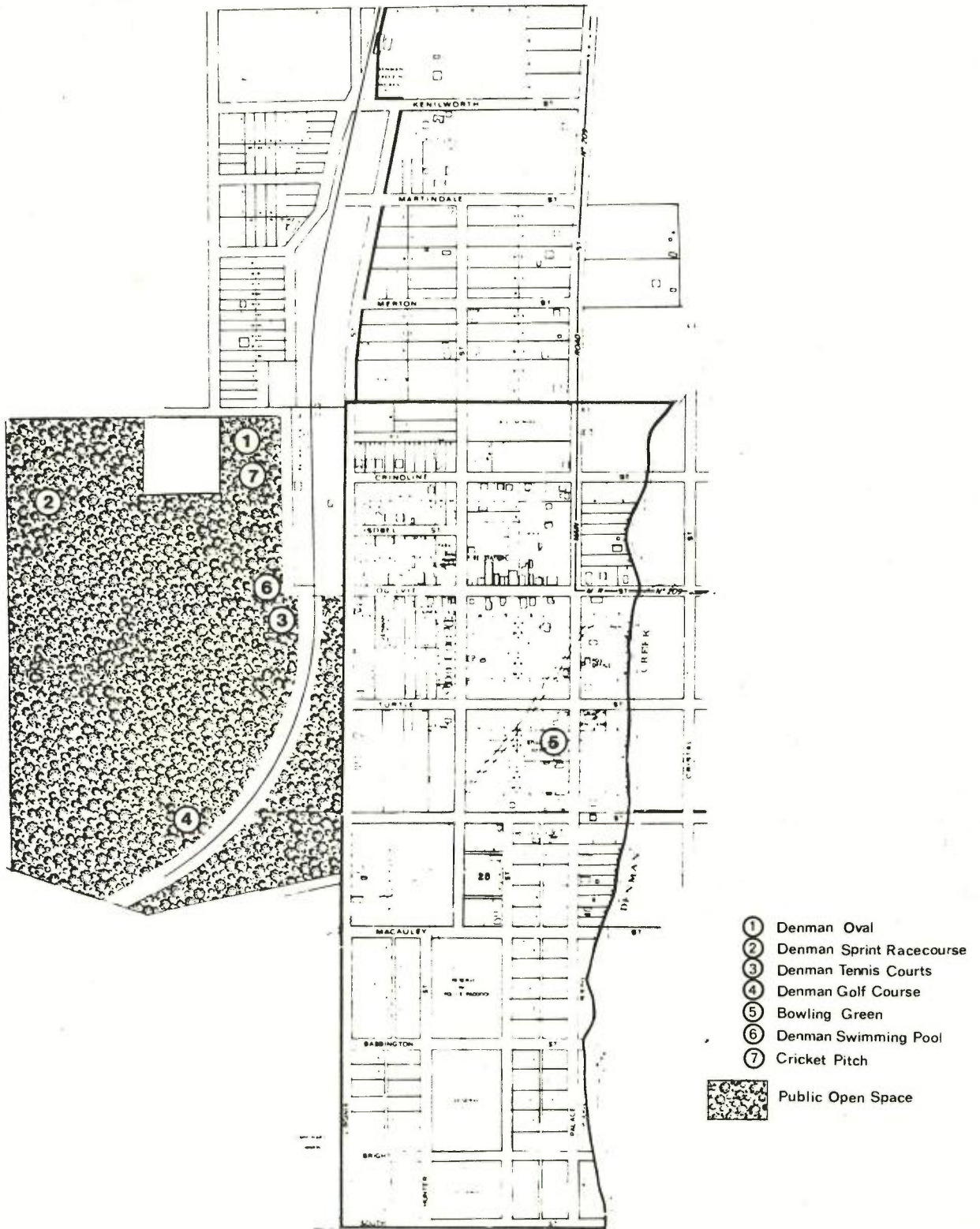


- Education
- ▲ Health
- 🏠 Halls
- ▲ Social
- 🏠 Public Services
- Cultural



**FIG 5-8
DENMAN
SOCIAL & CULTURAL FACILITIES**





- ① Denman Oval
 - ② Denman Sprint Racecourse
 - ③ Denman Tennis Courts
 - ④ Denman Golf Course
 - ⑤ Bowling Green
 - ⑥ Denman Swimming Pool
 - ⑦ Cricket Pitch
-  Public Open Space



**FIG 5-9
RECREATION FACILITIES**



Heritage,
Landscape, & Townscape

6

6.0 HERITAGE, LANDSCAPE AND TOWNSCAPE

6.1 A BRIEF HISTORY

The Hunter River was discovered in 1797 by Lieutenant John Shortland. The conflict between the potential of the area as a source of natural resources - coal and timber, and the desire to take advantage of the good farming land, the pleasant climate and the easy river access that the valley offered began almost immediately. The valley was reserved in 1801 for mineral exploration and this effectively prevented any settlement for almost 20 years. However in 1819, Governor Macquarie was persuaded that development of the valley was desirable. On his recommendation orders for land grants were issued by Lord Bathurst (then Secretary of State for the Colonies) to two English spinsters, Sarah and Elizabeth Jenkins. They selected land at a tributary of the Hunter called Muscle Brook, the grants of land being about three miles east of Muswellbrook. However neither woman ever sailed to Australia and the title deeds were sold instead.

The Upper Hunter Valley remained unexplored until 1824, when Henry Dangar first crossed the Muscle Brook. Only aborigines had lived in the area prior to this and there had been no contact by white men. Following Dangar's expedition, there was a scramble for land in the area and within a year all the river frontages in the Muswellbrook district had been taken. The large pastoral estates on the Hunter Valley alluvial plain were immediately established and they provided butter, cheese and tobacco for the Sydney market. The first wine growing, too, was begun during this period. The valley soils were fertile and easily cultivated. It was quickly found that although the alluvial plain was arable, it was also vulnerable to drying out. The shallow soil of the open forest country of the surrounding foothills held moisture and gave better crop yields. Settlement therefore quickly moved away from the alluvial flood plain.

In 1829 the first overland road was constructed up the Hunter Valley, crossing the river at Muswellbrook. Muswellbrook was therefore established as a river crossing settlement, and became from its inception, a service centre for the surrounding homesteads.

The reserve for the town of Muswellbrook had been set aside by Dangar in the original subdivision in 1824, as part of a 3890 acre church/school estate. The

town was gazetted in 1833 and a street plan drawn up. The surveyor at the time, Surveyor Dixon, noted that "There was good sound building land" to the east of the Great North Road while the "... rich alluvial soil, although not fit for building, was well suited for gardens etc....". Dixon laid out the town in six square sections, 10 chains by 10 chains each subdivided into 20, 1 x 5 chain, 1/2 acre lots. On the west of Hunter Terrace 2½ acre portions were laid out as small farming lots. Dixon noted that these portions were on the flood plain of the Hunter.

The first lots were auctioned in 1834 and the first buildings were apparently of drop log or split slab construction. The earliest stone buildings date from the 1840s, but with the exception of Weidmann Cottage and the Presbyterian Sunday School, neither these nor any earlier buildings have survived. In 1842 a private town was built on the southern side of Muscle Creek by Chief Justice Forbes (owner of Skellatar) and connected to the main town by a bridge. The two were merged almost immediately when the inhabitants of South Muswellbrook petitioned the Government to extend the privileges of the Government town to the private town, and by 1860 the form of the town as we know it was well established. Loxton House and the Royal Hotel still survive from this period.

The Railway arrived in 1869, its alignment cutting the town off from the river, though at the same time providing a new focus for commercial activity at Market Street. The business section developed rapidly after this, the main section of Bridge Street being built during the late 1880s to early 1890s.

From then, expansion was slow, and the town changed little until the improvements in road transport and the growth of traffic on the highway shifted the emphasis from the railway precinct to Main Street. Mining however, became more and more important as time went on and by the 1930s the town had changed in role from a rural service town to that of a predominantly mining town.

This process has accelerated in the last 3-4 years. Muswellbrook is now not only changing role, but changing scale. New people with different attitudes, ways of life, are moving in. The town is growing up - and out, the expansion creates demands on, and partially threatens, the existing landscape, townscape and many of the remaining buildings of historic or architectural significance.

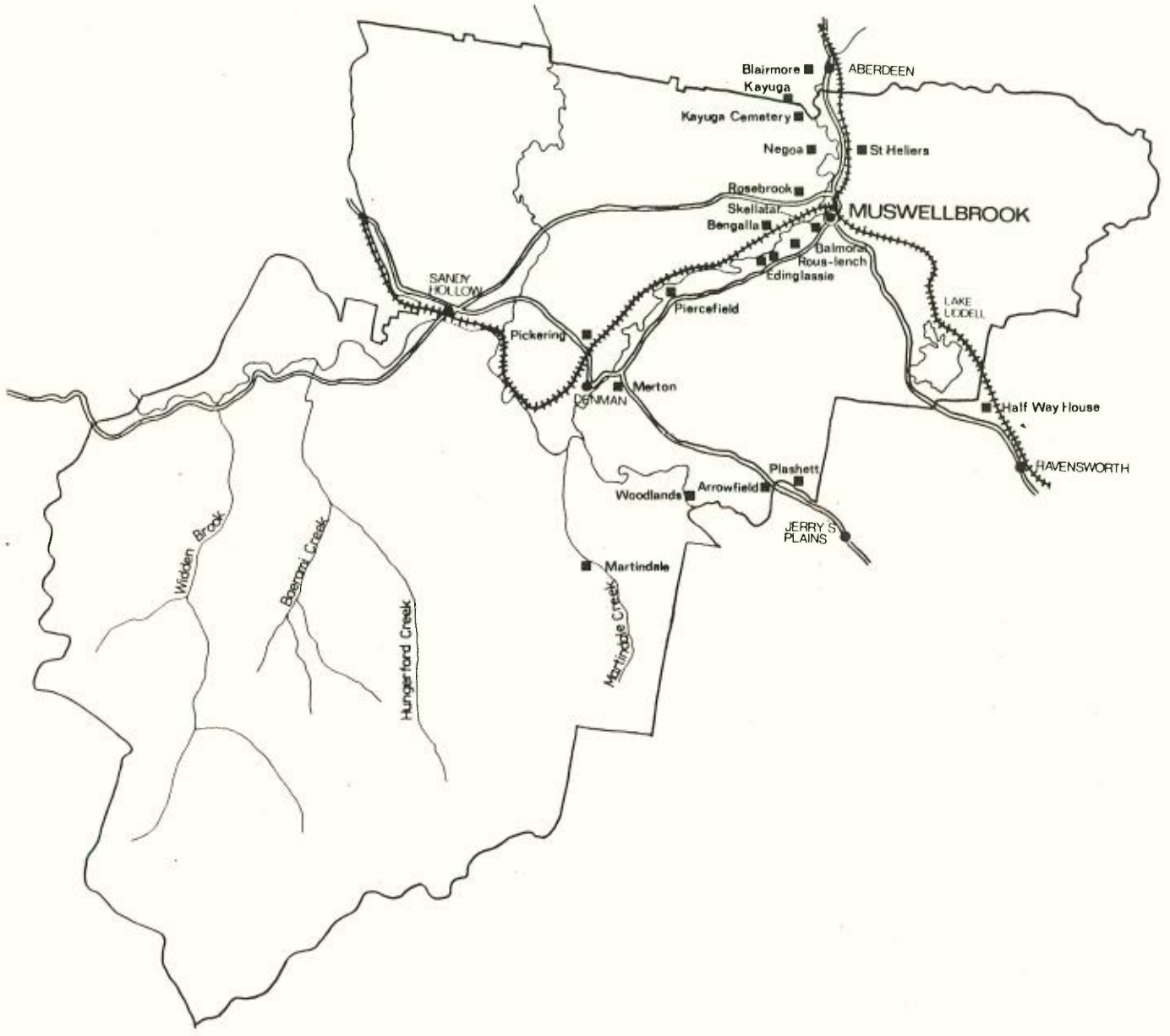


FIG. 6-0
HISTORIC BUILDINGS & SITES



SOURCE: Mount Arthur North Coal Project EIS
Heritage Survey Planning Workshop

A preliminary investigation¹ of Muswellbrook Shire's early development reveals a marked settlement pattern of historic properties along the Hunter River corridor. Fig. 6.0 illustrates the location of historic buildings throughout the Shire. The fact that historic settlement relates closely to the river flats is no coincidence for the early settlers clearly knew where the best land was located and sought the most attractive elevated ground upon which to site their residence.

The early settlement of Muswellbrook commenced in the Jerrys Plain area and moved west and east towards the area where the existing township of Muswellbrook now stands.

The first property developed in this area was Edinglassie, which was settled in 1826 and comprised a holding of some 30,000 acres, covering much of the Mount Arthur North lease area. Adjoining properties, averaging 20,000-30,000 acres, developed around Edinglassie on both sides of the Hunter River to establish what was to become the nucleus of a group of unusually elegant large homesteads.

Most of the buildings are Victorian, constructed in the 1880s and later, although there is evidence of earlier colonial buildings from the 1820s on these properties. The former Edinglassie, now known as Rouse Lench (on district maps) shows the more typical architectural style of buildings constructed during the 20s and 30s. These buildings and their siting on the elevated terraces overlooking the rich alluvial Hunter River flats form quite a coherent and relatively high quality rural grouping. Although they have not all been closely examined, they appear generally to be in good condition.

The Edinglassie group are a significant element of the total historic rural heritage outside individual townships in the Shire. Their presence as part of the rural texture of the valley, with its lush green pastures, planted field rows, meandering river, irrigated fields and farm animals contributes to the rich man made pastoral image of the Hunter Valley that can be found in only a few agriculturally rich pockets in New South Wales. The southern tablelands, and southern and northern river valleys where there is similar high quality rural property, lacks the truly majestic scale of wide valley floor and high rugged mountain range backdrop that characterises the Upper Hunter landscape. This

¹ Mt. Arthur North Coal Project EIS. Heritage Survey by Planning Workshop Pty Ltd

pastoral identity needs to be preserved within the framework of a broader valley management plan to ensure the preservation of the Hunter Valley's natural and man-made environment.

Taken as individual buildings, the Edinglassie group are not of major historic significance. Their heritage value lies in their coherence as an historic group forming part of a pattern of development along the Hunter River. It is the architectural, historical and social importance of the total complex of buildings and property holdings that needs to be carefully considered in relation to mining and/or urban development.

It should be noted that the National Trust listing for these buildings is "Classified Listing" for Edinglassie and Balmoral. Rouse Lench is also classified "With the Curtilage" of Edinglassie. However, there is no recorded listing for the other buildings on the current National Trust Register. It is understood that rural buildings in Muswellbrook are currently being reviewed by the Trust's Historic Building Committee and it is possible that other buildings such as Balmoral could then be included.

A listing of historic homesteads in the Shire prepared by the Muswellbrook Historical Society is presented in Table 6.0.

Table 6.0: Listing of Historic Homesteads in the Muswellbrook Shire

Homestead	Year Built	Classification by National Trust
Negoa	1836	
St. Heliers	1900	Recorded
Rosebrook	1830	
Bengalla	1877	
Skellatar	1883	Recorded
Balmoral	1857	Classified
Edinglassie	1880's	Classified
Piercefield	1860	
Pickering	1898	Recorded
Merton	1826	Recorded
Woodlands	1833	
Martindale	1860's	Recorded
Arrowfield	1850's	Recorded
Strowan	1860	
Half Way House	1843	Recorded
Ravensworth	1832	Classified
Rous Lench	1842	Recorded

Source: Muswellbrook Historical Society

6.2 LANDSCAPE

The Hunter and Goulburn Rivers meet in the Muswellbrook Shire. The two rivers meander along a flat, fertile floodplain, creating a Y-shaped valley floor that has been cut into a rugged, wooded, steeply rolling landscape. The towns of Muswellbrook, Denman and Sandy Hollow lie on the riverbank and expand into the foothills that contain the river valley. Three broad land types can be identified and are illustrated on Figure 6.1. The land types are the flat alluvial valley floors, predominantly cleared and cultivated; the rounded hills and valleys associated with these and the steep ridges; and the rolling hills and open valleys which surround the floodplain on the south and north-east corners of the Shire.

Landscape Units

For the purposes of a visual evaluation and discussion, the Shire has been divided into a number of landscape units, each with a distinctive combination of landform, drainage pattern and land use. The boundaries between units are always at ridges, so that each is either a complete visual catchment in itself or is formed by the grouping of a number of visual catchments. Figure 6.1 identifies the four visual catchments within the Shire. These are:

- Unit 1 The Hunter Range
- Unit 2 Sandy Hollow
- Unit 3 Bells Mountain Spur and
- Unit 4 Hunter/Goulburn River Valleys

The river valley catchment can be broken into three sub units, each basically an arm of the 'Y' meeting at Denman.

Unit 1: The Hunter Range

The Hunter Range occupies almost half the Shire and lies on the western side of the alluvial river flat. Most of its area is within the Wollemi National Park. It is a rugged, fissured landscape (carved out of the Triassic Sandstone) with deep cliff walls and mountain peaks (Mount Monundilla and Mount Coriaday) that rise over 1,000 metres above the valley floor.

The hillsides are covered with box, gum and ironbark and a vigorous shrub undergrowth. The gentle lower slopes have been cleared to form a chain of grazing pastures that follow the roads beside the creeks as they flow on their way to the Goulburn River. The experience of the area is of a series of intimate rural valleys set amidst an untouched and steeply sloping mountain range.

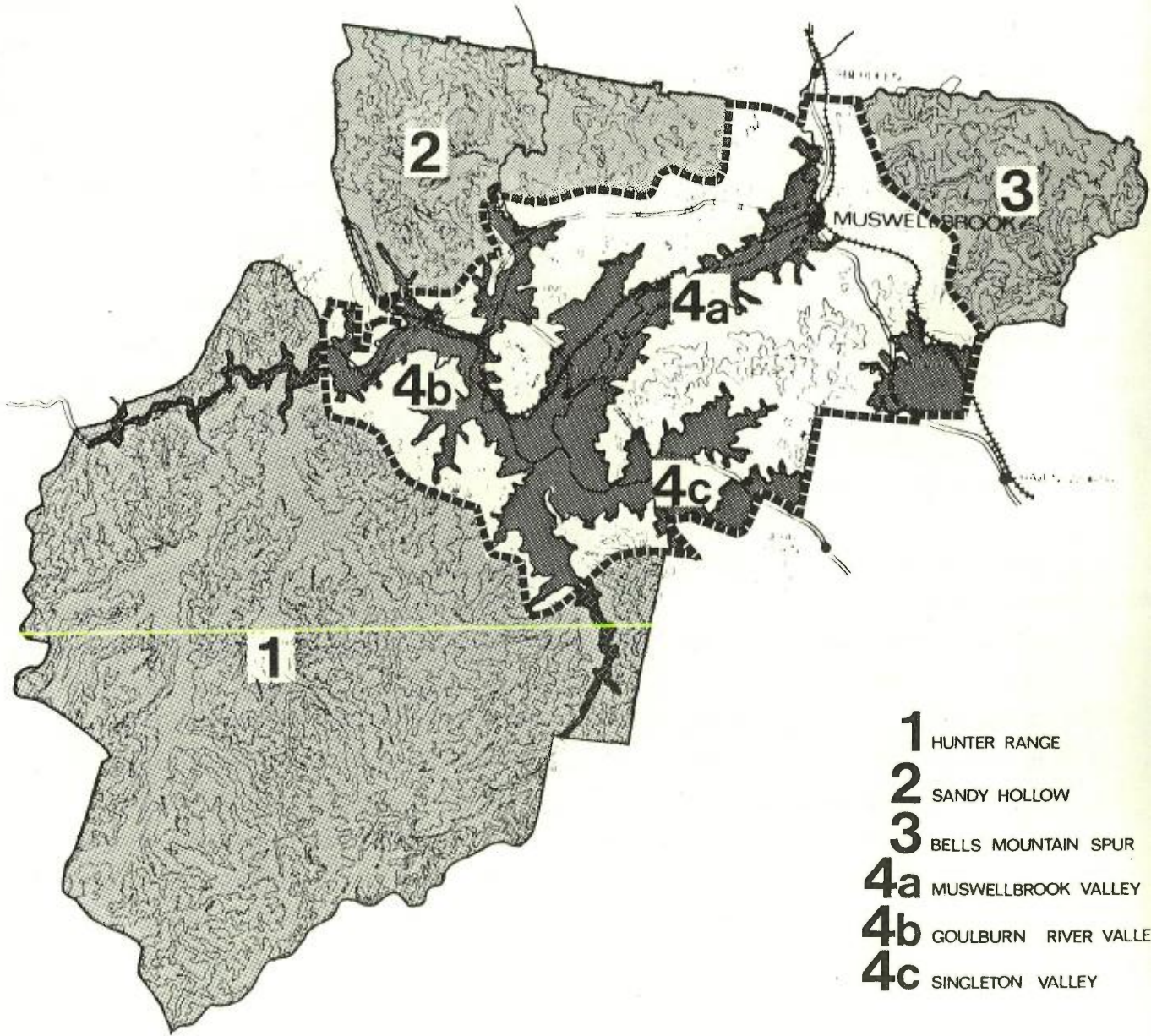


FIG. 6-1
LANDSCAPE UNITS



Landscape value: High - a natural unspoilt landscape with varied and interesting terrain and healthy vegetation. It is one of the largest remaining sections of vacant crown land in New South Wales and its size makes it an effective, long standing reservoir of botanic and faunal communities.

Unit 2: Sandy Hollow

The Sandy Hollow unit lies on the west side of the Goulburn River Valley. It is an undulating landscape of rounded hills and occasional rocky sandstone outcrops that becomes steeper and more rugged towards the west where the unit adjoins the Hunter Range.

The steeper slopes have remained in their natural state - a dry sclerophyll forest growing in a soil that is not fertile enough to support a rich undergrowth. The gentler hills have been cleared, settled and farmed - wheat, sheep and cattle grazing and the occasional study farm. The village of Sandy Hollow nestles within these hills, protected by one of the steeper rocky outcrops.

Landscape Value: Medium - generally the landscape is smaller in scale, less vegetated, more affected by man and with neither the level of contrast nor the degree of harmony of the Hunter Range unit.

Unit 3: Bell's Mountain Spur

The Bell's Mountain Spur lies on the north-eastern edge of the Shire. The unit is stoney and steep, the slopes rising directly from the valley floor. The hill-sides remain uncleared - a dry sclerophyll forest similar to the vegetation at Sandy Hollow, while small farms derive a meagre living from the narrow strip of cleared flat land at their base.

Landscape Value: Low. The least attractive of the three mountainous units that encircle the river valley. Poor soil quality, erosion and man's own neglect (falling down fences, etc.) combine to create a degraded landscape.

Unit 4: Hunter/Goulburn River Valleys

The Y-shaped river valley forms a distinct landscape unit. The foothills of the surrounding mountains contain a fertile alluvial floodplain within which the rivers flow and the ridges of these foothills broadly define the landscape unit.

On the alluvial plain lie the historic houses, the vineyards and wineries and the towns of Muswellbrook and Denman - (Denman at the confluence of the two rivers and Muswellbrook where Muscle Creek meets the Hunter River).

These key scenic elements, along with the overall views to the foothill ridges and the peaks of the surrounding mountains, combine to form a scenic corridor of great visual, tourist and heritage significance. This corridor, that can be viewed from the Denman Road and Jerry's Plains Road, is described in Figure 6.2.

The three arms of the river valley form three separate sub units, each slightly different and with its own character:

a) The Goulburn River Valley.

The Goulburn River Valley unit has the most intimate scale of the three river valleys. Like the other two, it consists of a flat valley floor, substantially cleared and farmed, enclosed by a range of foothills whose lower slopes have been cleared and farmed and beyond which can be seen the ridge of the distant mountains.

The land is used as grazing pasture and held in large holdings. The overall impression is of rich, well cared for agricultural land with occasional stands of trees.

Landscape Value: High.

b) The Muswellbrook Valley Unit.

The Muswellbrook river valley unit is the most developed and settled of the three valleys. It contains the town of Muswellbrook as well as the vineyards and historic houses that line the Denman Road.

Like the other valleys, it consists of a flat alluvial floodplain surrounded by low rolling foothills with occasional steeper and more rocky escarpments in the east. The land has been cleared and is used agriculturally - intensive farming on the floodplain - vineyards, dairying and crop farming and grazing on the foothills. The town of Muswellbrook and the historic houses that also lie on the floodplain will be described later.

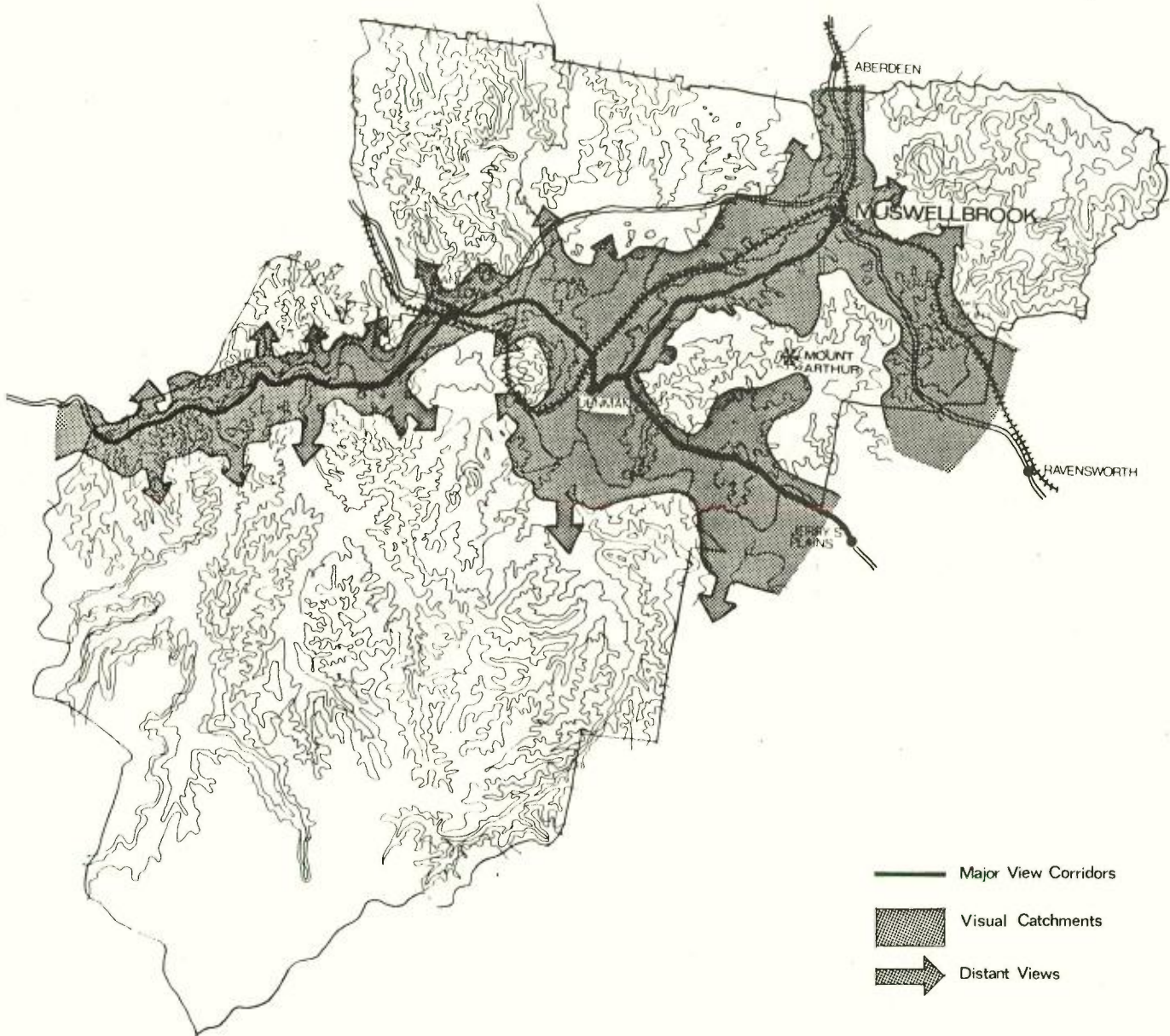


FIG. 6-2
VIEW CORRIDORS
VISUAL CATCHMENTS



The overall impression is of an idealized pastoral valley rich and fertile and well cared for with scattered rural settlements and individual homesteads.

Landscape Value: Very high.

c) The Singleton Valley unit.

The most rugged and untouched of the three valley units - with the steepest terrain and a combination of intimate and distant views that creates a landscape of great contrasts and harmonies.

Landscape Value: Very high.

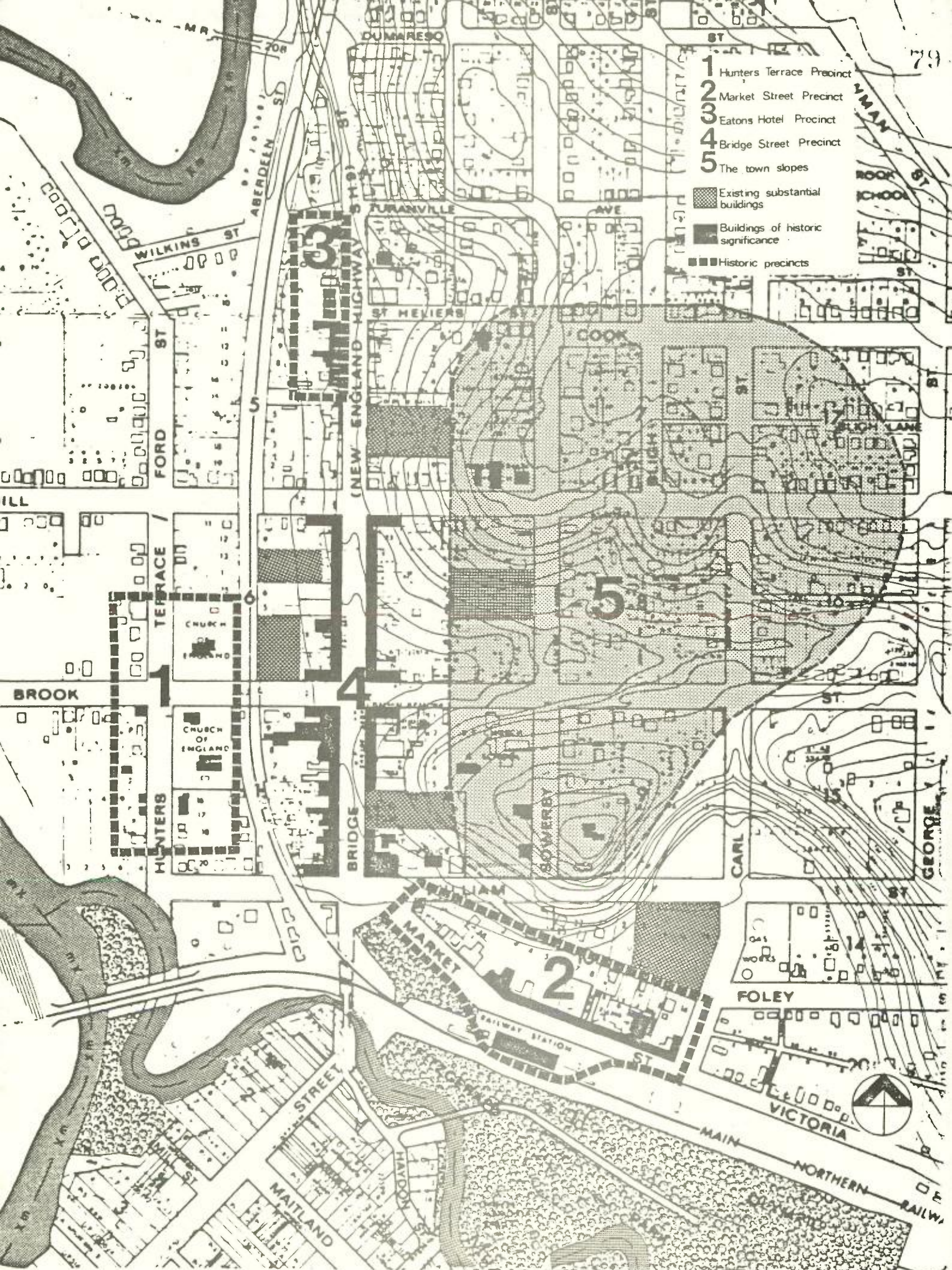
6.3 TOWNSCAPE

Muswellbrook has several precincts and streetscapes of value or potential, the most important of which have been identified below and are located on Figure 6.3. The following numbered sections relate to the diagrams.

1. Hunters Terrace Precinct

The most historic area of the town, dominated by the fine Anglican Church, Rectory and Bell Tower and set amongst mature trees. Important buildings in the precinct comprise:

- . St. Albans Church of England, Bell Tower, fence and grounds.
1864-9. Designed by Sir Gilbert Scott, documented by Blakett and supervised by Horbury Hunt. This building provides the focal point for the area and is in excellent condition, though the grounds and fence need attention.
- . Fences and Bell Tower, 1880's. Classified by National Trust.
- . Church of England Rectory.
1881, probably Horbury Hunt. In good condition and recorded by the National Trust.
- . Church of England Sunday School Residence.
Probably 1860's. National Trust recorded.



- 1 Hunters Terrace Precinct
 - 2 Market Street Precinct
 - 3 Eatons Hotel Precinct
 - 4 Bridge Street Precinct
 - 5 The town slopes
- Existing substantial buildings
 - Buildings of historic significance
 - Historic precincts

MUSWELLBROOK TOWN CENTRE TOWNSCAPE

FIG 6-3



. Church of England Sunday School.

1874 Horbury Hunt. Built using brick windows and other materials from the old St. Albans Church. National Trust recorded.

. Brighton Villa and Stables and the old Shire Council Chambers.

Although these buildings are not important in their own right, they complement the major buildings and make an overall contribution to the character of the precinct.

2. Market Street Precinct

A cluster of exceptionally interesting buildings of diverse style and character and in various states of repair, grouped around the 'square' in front of the station. This area represents a real opportunity to create a new urban space to complement the main street. The existing wide verandahs over the pavement already create the basis for a coherent and consistent character.

. Foleys Shops - a rare survivor of earlier rural commercial buildings.

. Terrace House, 38-40 Market Street - three attached houses with Flemish bond brickwork. Cast iron columns and galvanised iron roofing.

. Muswellbrook Hotel - 1869. Fine lacework balconies out over the footpath.

. Railway Station - 1860. A sturdy venacular brick building with timber columns and balustrade. National Trust Recorded.

3. Eatons Hotel Precinct

A small but valuable group of large hotels, small cottages and small commercial buildings. The overhanging verandahs and fine lacework create a fine atmosphere to the area.

. Eaton Hotel - 1866. Brick and timber with cast iron verandah posts and lace. The original building was later extended with the addition of the verandah balcony over the footpath. In good condition. On the National Trust Classified list.

4. Bridge Street Precinct

The main shopping street. These two blocks create the image of Muswellbrook. There has been little intrusion of new development and while few buildings are individually outstanding, they combine to create an environment of consistent scale and with a high level of visual richness and variety. The small group immediately south of Hill Street forms an earlier historic interlude in an otherwise more Victorian street. Some of the buildings in the street are of particular interest.

. Loxton House - 1856. Two storey sandstone house with cast iron lace verandah supported on timber columns. It acts as the focus for this little grouping and was restored in 1980. National Trust listed.

. Weedmann's Cottage - c.1840-50. Important contribution to the streetscape. Fair condition but marred by unsympathetic timber additions. Listed by the Heritage Commission to be preserved.

. Campbell's Store - 1870. The tower on the corner provides the focus for the main shopping street. It was extended relatively sympathetically a number of times and has been well maintained and painted appropriately.

. Post Office - 1883-5. Stucco brick, timber columns, cast iron balusters. National Trust recorded.

5. The Town Slopes

The old residential part of the town with good quality old houses, fine avenues of jacarandas and straight streets undulating over steeply sloping terrain and vistas out towards the western hills and the river valley. The whole area should be carefully managed as it would be very vulnerable to the intrusion of unsympathetic new development. The Catholic and Presbyterian Churches make valuable contributions to the character of the area and create a grander scale to Sowerby Street.

. St. Johns Presbyterian Church - 1913. Built by W.L. Pender. Good condition, National Trust recorded.

- . Old Presbyterian Church - (now Sunday School). Hill Street. 1842.
Rendered stone. National Trust recorded.

- . Presbyterian Manse - 1877. J. Pender. Fair condition. National
Trust recorded.

- . St. James Catholic Church - 1911-1912. James Hicky. Good condition.
National Trust recorded.

- . Roman Catholic Presbytery.

- . Sowerby Street North and Hill Street - a wide jacaranda lined street
with old timber verandahed houses creating a particularly charming
and gracious streetscape.

- . Bligh Street, north of Hill Street - similar in character to Sowerby
Street.

Coal Related Projects

7

7.0 COAL RELATED PROJECTS

The purpose of this chapter is to identify the nature, location and magnitude of developments likely to occur within the Shire having a significant effect or impact on the Shire and its community. Developments outside the Shire, also having an impact, are dealt with in the Upper Hunter Sub-Regional Study. (Also refer Tables 8.2 and 8.3.)

In the past the most significant activities in Muswellbrook's economy have been based on the rural sector and, to a limited extent, coal mining. However, with the growth in demand for the State's coal resources, coal mining and power generation will undoubtedly become the Shire's principal economic base for the future.

The main generators of change over the next ten years and probably well into the next century will therefore be:

- a) Coal mining, both open cut and underground.
- b) Power generation.
- c) Infrastructure construction related to coal mining and power stations.

In fact, of the known and potential development projects for the Shire (refer Table 7.0 and Fig.7.0) nearly all are coal related.

Preliminary estimates indicate that some \$1.35 billion will be invested in mines alone. This, together with over \$900 million on power stations and around \$60 to \$100 million on roads, rail and services etc., will result in a rapid population build-up and unprecedented level of demand for land, housing, community services, facilities and utilities.

Of the projects listed in Table 7.0, a total of \$2.35 billion will be injected into the Shire in capital works projects. These will create some 250 to 3,025 new construction jobs between 1981 and 1986 and between 50 to 2,650 production jobs from 1981 to 1991

Table 7.0

Muswellbrook Shire: Mining and Power Generation Activities

Coal Related Projects	Timing	Cost \$M	Peak Production		
			Tonnes/ Year	M.Watts (Peak Capacity)	Peak Production Workforce
<u>Existing Operation</u>					
Muswellbrook Coal Co.					
No.1 Mine U/G	1981	N/A	0.6		40
No.2 Mine O/C	To - 1990	20	0.6		60
Ravensworth O/C	1972 -	80- 90 ¹	5		250
Bayswater No.2 O/C	1981-1990	400	1.5		200
Liddell Power Station	Indefinite	50		2,000	600
<u>Firm Proposals</u>					
Drayton O/C	1981-2005	150	3.3		420
Bayswater Power Station	1985 -	900		2,640	570
Sandy Hollow Railway	1981-1982	58	-	-	20
Liddell Power Station Extension	1980-1982	50 ²	-	-	50
Mt. Arthur North O/C	1983-2004	400	9.7		1,267
<u>Possible Projects</u>					
Black Hill O/C	1982-1992	45	.75		259
Muswellbrook Coal Co. U/G	N/A	N/A	N/A		N/A
Mt. Arthur South O/C	1984-2004	200	6.5		600
Carpentaria U/G	1985 -	40	N/A		150
Authorisation 102 O/C	1988-2044	400	N/A		1,190
Authorisation 256 O/C	1988 -	N/A	10.0 (Est.)		450 (Est.)

1 At present day figures

2 Source - Development Projects in New South Wales
Department of Industrial Development and Decentralisation

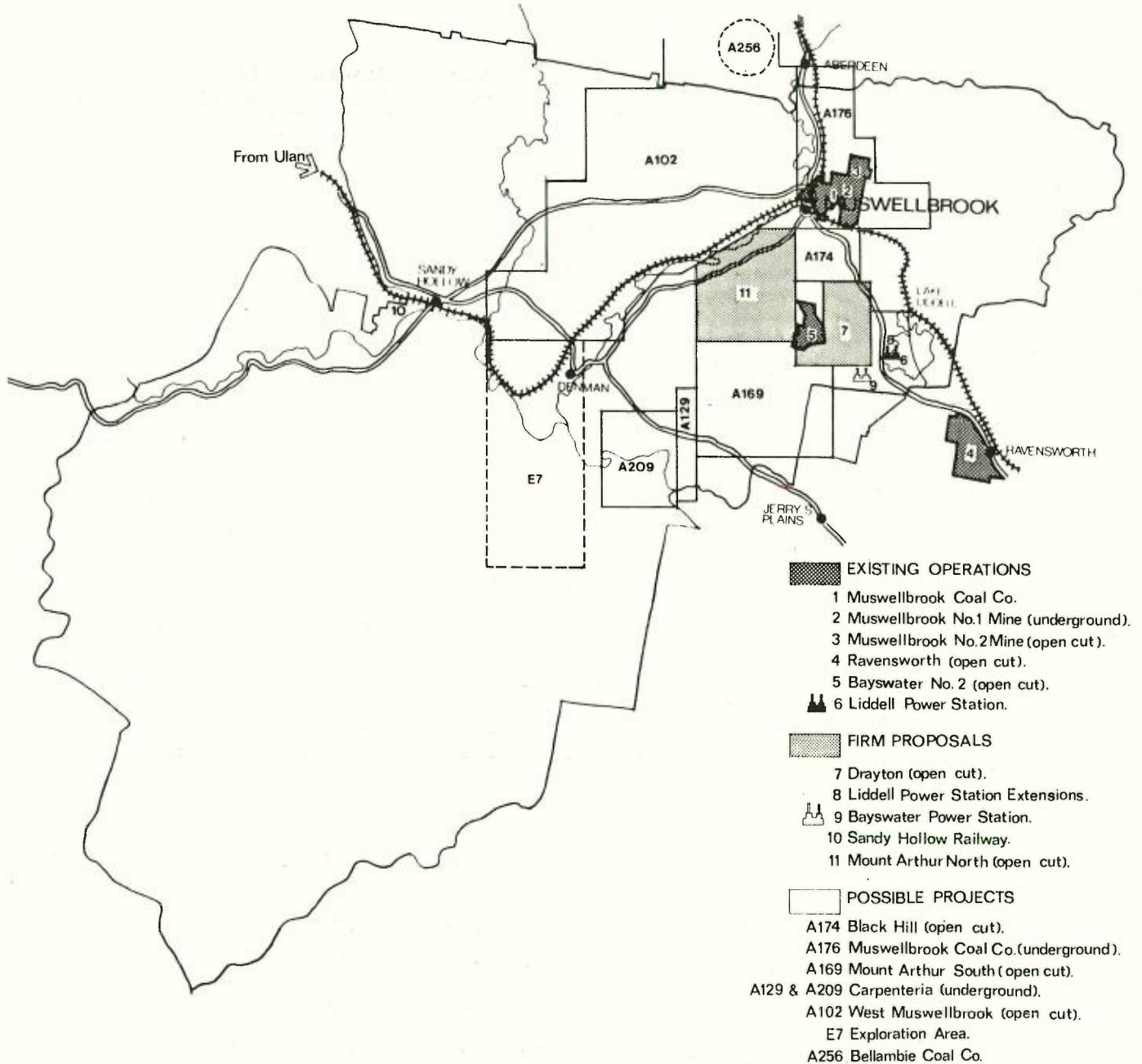


FIG. 7-0
COAL RELATED PROJECTS



7.1 FIRM PROPOSALS

Drayton Co-Venture

Found within Authorisation No.173 and approximately 9 kilometres south-east of Muswellbrook and 4 kilometres west of Lake Liddell, this open cut mining development will be run by a consortium of organisations comprising Theiss Bros. Pty Ltd, the Shell Company of Australia Ltd. and other partners. A total of 167 million tonnes of reserves have been identified, of which approximately 70 million tonnes is intended to be mined in two pits, that is:

East Pit	-	50.98 million tonnes
West Pit	-	18.26 million tonnes

It is proposed that mining operations will commence on the western side of the pits and proceed towards their western extremities. The mine life is planned for 24 years commencing in 1983, after which additional reserves may be investigated.

Consent for the Drayton Mine has been granted. Construction is therefore due to commence and the first coal production could be around 1982-3.

At peak production (say 1993), some 3.3 mtpa is expected to be extracted. Since the Drayton development is contingent on the production of high quality steaming coal and its subsequent sale on the international market, the transportation of coal will be largely by rail. A rail spur and balloon loop will be constructed linking the mine with the main northern railway, some 123 kilometres from the port of Newcastle.

The construction workforce for the project is estimated at 250 and a production workforce of 420.

Direct environmental effects on urban areas are minimum because of the mine's location at a distance from Muswellbrook. However, significant effects will be felt at the Antienne rural subdivision.

Liddell Power Station

The Liddell Power Station is located near the New England Highway approximately 16 kilometres south-east of Muswellbrook and 25 kilometres to the north-east of Singleton, on the shores of Lake Liddell (see Figure 7.0).

Liddell is a coal-burning station of 2,000 MW capacity, owned by the Electricity Commission of New South Wales and constructed in the early 1960's.

It has an indefinite life and it is understood that it is to be upgraded in the near future to extend its useful life. Coal supplies from the Ravensworth No. 2 colliery, the Liddell State Mine holding and eventually from the Mt. Arthur North mines will ensure long-term power generation.

The station presently employs 750 men, with a further 100 apprentices undergoing training for work in new power stations. Some further contract construction jobs have been created as a result of the upgrading of certain station plants during 1980 to 1982.

Bayswater Power Station

The power station site is located near the New England Highway approximately 16 kilometres south-east of Muswellbrook and 25 kilometres to the north-west of Singleton, adjacent to the Liddell Power Station (see Figure 7.0). The station is to be constructed by the Electricity Commission of New South Wales and will comprise four coal burning 600 MW generating units. Coal supplies for the station will initially be obtained from deposits to the south and west of the Ravensworth No.2 open cut mine and subsequently from the Mt. Arthur Authorisation Area.

The first two units will be available for full operational service in 1985 and 1986, while the second pair of units is expected to be operational in 1986-87. The power station has an indefinite life, as it will probably be replaced if required at some time in the distant future.

The coal supplying the station will be transported by conveyors from both the Ravensworth No.2 area and the Mt. Arthur North mines. The first stage of the project (Units 1 and 2) will require up to 3.5 million tonnes of coal per annum. On completion of Units 3 and 4, 7 million tonnes per annum will be required.

Construction is expected to start in 1981 with construction workforce rising to a peak in 1984 of 2,300, decreasing to only 100 by 1987. Permanent workforce will begin with 50 in 1981, rising to a stable workforce of about 570 in 1986.

Output from Units 1 and 2 will connect to transmission lines from Liddell Power Station. A new line will be required for Units 3 and 4.

Due to the site's proximity to the New England Highway and Liddell Power Station and to the coal supply utilising conveyors, no major road or rail improvements will be required. Light traffic volumes will increase along the highway as a result of the new workforce but the highway interchange serving Liddell Power Station will be upgraded to provide access to the new station.

Sandy Hollow - Ulan Railway

The line will connect the Ulan coalfields with Sandy Hollow, thus allowing coal to be transported by rail via Muswellbrook to Newcastle. The line is approximately 25 kilometres west of Muswellbrook. The Sandy Hollow-Ulan Railway will be constructed for Ulan Coal Mines Limited to transport coal from Ulan via Sandy Hollow and Muswellbrook to Newcastle for export. The railway easement has largely been constructed, requiring the construction of several bridges and the laying of lines etc. The Sandy Hollow-Muswellbrook line will also be upgraded.

Total coal reserves in the Ulan region have not been estimated but are thought to be at least 400 million tonnes. The proposal is to initially transport 4 million tonnes of coal annually, rising to about 8 million tonnes. The rail line will have a capacity of up to 20-25 million tonnes per annum.

The major impact that the proposal will have on the Shire of Muswellbrook will be an increase in the number of coal trains travelling through the Shire (Sandy Hollow-Denman-Muswellbrook-Singleton). This is estimated at six train units each hauling approximately 3,200 tonnes each day, resulting in twelve movements per day (both directions). No time restrictions will be operating. Further reference is made to rail traffic in Chapter 12.

A construction workforce of about 300 between 1980-1983 is anticipated, some of whom will reside in the Shire of Muswellbrook, particularly at Denman.

Mt. Arthur North

This project is located approximately 6 kilometres south-west of Muswellbrook along the Denman Road and within Authorisation No.168. The proposal is a large open cut mining project by the Electricity Commission of New South Wales. It is anticipated that some 412 million tonnes of reserves will eventually be recovered. However, the project as it presently stands will extract 210 million tonnes of raw coal from three open cut pits known as:

Ramrod Creek Mine	-	41 million tonnes
Whites Creek Mine	-	133 million tonnes
Glen Munro Mine	-	36 million tonnes

It is proposed that mining operations will commence in the northern pits which are closest to Muswellbrook town (that is, Ramrod and Whites Creek) with later development (around 1990) in the southern pit (Glen Munro) which is a further 3 kilometres from town.

The current proposal is expected to operate over the period 1983-2004. Proposals for subsequent extraction of the remaining open cut coal reserves will be forthcoming.

This will be one of the largest open cut mining operations in Australia. At peak production it will have an output of around 9.7 million tonnes per annum, 7.7 mtpa of which will be bound for Liddell and Bayswater Power Stations, 1.0 mtpa to other power stations and a further 1.0 mtpa for export.

Only a small proportion of coal will be moved by rail, that is, that coal bound for export and for power stations other than Liddell and Bayswater. The remainder of the coal will be transported by overland conveyors.

The total project workforce will vary from 260 in 1983 to 1,267 in 2000 AD. The construction workforce will vary from 150 in 1981 to 500 in 1983, then decrease to 150 in 1986.

A Development Application has been received for this project and an environmental impact statement is currently being reviewed.

7.2 POSSIBLE PROJECTS

Black Hill Coal Mine

This open cut coal mining project is located within Authorisation No.174, approximately 2 kilometres south-east of Muswellbrook town. It is proposed by Mount Sugarloaf Collieries Pty Ltd and is currently the subject of a draft Environmental Impact Statement being reviewed by the Department of Environment and Planning. The following information has been provided by the mining company is preliminary:- That some 65 million tonnes of reserve exists. However, only approximately 9.0 million tonnes of coal has open cut potential.

Mining would be carried out approximately 1½ to 2 kilometres from the southernmost edge of Muswellbrook town during the day and approximately 3½ to 3 kilometres during the night.

The proposal is a relatively small operation in comparison to the adjacent Mt. Arthur North Mines and nearby Drayton Mines. At peak production it may have an output of 0.75 mtpa. The coal is to be exported to Japan and will therefore be conveyed approximately 2.5 kilometres to the Drayton rail loop and transported to Newcastle by rail for export.

Construction workforce figures are estimated at 50 in 1984, 200 in 1985 and 50 in 1986. Production workforce figures range from 180 in 1984 to 259 in 1994.

Because of its proximity to the urban areas of Muswellbrook, this particular mining proposal has the potential to create significant adverse environmental effects.

Muswellbrook No.2 - Extension

Located approximately 3 kilometres north-east of the town of Muswellbrook, this will be an extension to an existing mine operated by Muswellbrook Coal Co. Current production level is around 0.6 mtpa.

Proposals for the mine's future are at a preliminary stage. At the moment it seems that increased production from around 1983/4 will arise from underground operations from the existing pit, bringing total production to approximately 1.3 mtpa.

The existing workforce is approximately 50 men. Construction workforce would be around 20-50 from 1983-85 and production workforce at 20-60 from 1984-1991.

Mt. Arthur South

This project is located approximately 12 to 14 kilometres south-west of Muswellbrook and 10 kilometres west of the Bayswater Power Station. It is a proposal for a large scale open cut mining development by the Electricity Commission of New South Wales within Authorisation Area 169. Since the project is at a preliminary stage, details are not known. However, it is likely to be similar in scale to the Mt. Arthur North project (depending upon proven resources).

It is anticipated that operations as currently proposed will commence in 1984 and continue over a 20 year period.

It is understood that the project may consist of 4 small open cut mines providing around 200 million tonnes of coal over the 20 year period. The majority of the coal will be railed via the Mt. Arthur North rail loop to Newcastle, with production beginning in 1984 and rising to about 4 mtpa by 1987. This may increase to about 6.5 mtpa by 1990.

Construction workforce estimates are currently around 500 from 1982-86 and production workforce at 600 between 1984 to 2004.

Carpentaria

Currently at the exploration stage, this proposal will probably be an underground mine development within Authorisation 129. The proponent is Carpentaria Exploration Co. Pty Ltd, a subsidiary of Mt. Isa Mines. Mining may begin in 1985 with a production of about 0.5 mtpa, rising to about 2.0 mtpa by 1988. Transportation of the coal, which is presumed to be of export quality, would be by rail.

A second rail loop further south of the Drayton Loop, a spur line connecting also with Mt. Arthur South or a spur line connecting across to the Denman rail line might be possibilities to handle the transportation of the coal.

Major effects of this particular mine could be related to its proximity to prime agricultural land, vineyards and areas of scenic value.

Authorisation 102

Authorisation 102 is held by the Department of Mineral Resources and Development. It occupies a large area of some 515 square kilometres. At the present moment reconnaissance drilling is being undertaken with a view to extracting some one billion tonnes of coal by open cut.

The authorisation has been investigated with a view towards supplying coal for coal/oil processing. Some four billion tonnes of reserves have been identified but, as yet, a decision on the future of the proposal has not been made.

If it proceeds, coal will either be processed on site or sent by rail to another location, for example, Newcastle, for processing. A critical aspect of the proposal would seem to be the availability of water for processing. A102 is close to and visible from Muswellbrook and careful consideration will need to be given to noise, dust and vibration effects.

Authorisation 256

In Scone Shire, this authorisation is approximately 2 to 3 kilometres west of Aberdeen. A large open cut mining operation within Authorisation 256, expected to produce around 4.0 mtpa by the late 1980's. The proponent is Bellambie Coal Co.

This authorisation is west of the Hunter River and its alluvial plain and was previously part of the Department of Mineral Resources Authorisation 102. From preliminary discussions with the Department of Mineral Resources, it is possible that the operation would supply coal for coal liquefaction and that any transportation system designed to cater for A102 would also cater for A256. Estimates for workforce based on a scale of operations similar to that of Mt.Arthur North are - construction 1984-88/9 around 200-250 and production 1988/9 from 50-450 depending on rate of extraction.

Its major impacts appear to be on the town of Aberdeen and on the transportation system of Muswellbrook.

Population Forecasts

8

8.0 POPULATION FORECASTS

The population forecasts below are interim projections. They are currently being revised for the Upper Hunter Sub-Region Study. No significant modifications are anticipated.

Introduction

In the first half of the 1970's, the population level in the Upper Hunter was fairly constant. The population of Muswellbrook Shire (including Denman) was 11,771 in 1971 and 11,520 in 1976. The combined population of Muswellbrook, Scone and Singleton Shires was 31,153 in 1971 and 31,261 in 1976.

The geographical breakdown of the population in the Upper Hunter in 1976 and 1981 is estimated as follows:

Table 8.0: Population in the Upper Hunter

	1976 (Census)	1980 (Dec.)
Muswellbrook	7,805	8,707
Denman	808	897
Balance Shire	2,907	3,056
Muswellbrook Shire	11,520	12,660
Scone	3,424	3,480
Aberdeen	1,133	1,186
Balance Shire	2,825	2,878
Scone Shire	7,382	7,544
Singleton	7,917	8,813
Balance Shire	4,442	4,504
Singleton Shire	12,359	13,317
Total Population	31,261	33,521

A number of population forecasts have been produced in recent years¹²³⁴. Each forecast has been higher than the previous one, as the magnitude of the resources boom has become increasingly apparent. These forecasts are in turn higher than previous ones, although in part this is due to some variations in assumptions⁵.

It should be said that it is quite unlikely that the growth to 1986 predicted in this report will be fully achieved in practice. However, the growth predicted to 1991 does represent a feasible target.

The forecasting approach adopted here is briefly as follows. It is anticipated that the growth of the Upper Hunter region will depend on coal mining and power generation (basic employment) and the effects that flow from these developments (multiplier effects). The rest of the local economy will be stable, except for some reduction in agricultural activities as a result of the mining.

The increases in the permanent production workforce and in the largely temporary construction employees are forecast to 1991. These increases are distributed to towns and rural areas in the Hunter Region and employment multipliers forecast for these areas. The forecast increases in population are based on population employment ratios appropriate to the Region.

1. Hunter Regional Planning Committee 'Hunter Regional Plan' Discussion Papers Nos. 1,2,3, 1977 and 1978.
2. James B. Croft and Associates 'The Impact of Coal Mining Development in the Upper Hunter on the Municipality of Muswellbrook' 1978.
3. Department of Environment and Planning (DEP) 'Hunter Region Population Projection 1981 to 2001', August 1980.
4. Gutteridge, Haskins and Davey Pty Ltd 'Muswellbrook Shire. Introduction to Expected Growth and Augmentation of Utilities'. December 1980.
5. The DEP are currently revising their forecasts but the revisions will not be available until after this report is finalised.

Increases in Basic Employment in the Upper Hunter

A 'basic' worker is defined here as someone who is directly employed on a major project exporting goods or services outside the Hunter Region. This excludes workers involved in the provision of materials to these projects, for example, who would be included in the multiplier process. Also excluded by this definition of basic worker are workers in local engineering firms who are exporting their goods or services⁶.

Tables 8.1 and 8.2 show the projected employment levels in construction and production respectively by major development⁷. They have been developed by the Department of Environment and Planning (DEP) following discussions with the N.S.W. Coal Colliery Proprietors' Association, Gutteridge Haskins and Davey Pty Ltd and ourselves and they are based on numerous environmental impact statements and newspaper articles. To summarise, the construction workforce in the Upper Hunter is expected to increase sharply to around 4,000 by 1983-84 and to fall sharply thereafter. The production workforce is projected to rise rapidly to around 8,000 by 1986 and to 9,000 by 1989.

To what extent will these projections be fulfilled? It was anticipated seven years ago, for example, that the Mt. Thorley Mine would be producing within three years but production is only just starting.

The deposits in the Upper Hunter are large and accessible. Production is relatively cheap. The seams do not have a high sulphur content which makes coal in some other countries unattractive. Also the proposed mines are much closer to a seaport than are most of the proposed mines in Queensland.

Although there is some doubt about the size of the market⁸, the most authoritative local study⁹ argues strongly that the market will not constrain the

6. The arbitrary and crude nature of the distinction between basic and non basic workers constitutes a limitation on the precision of this procedure compared with more detailed input-output analysis. However, as shown below, we have been able to draw on some useful research on input-output relationships in the Hunter Region.
7. The tables include employment on Glennies Creek Dam which might be excluded from a strict definition of base employment.
8. National Times, February 1, 'Japan May Not Want All the Coal It Claims', Business Review Section, Page 8.
9. Joint Coal Board, 'Prospective Expansion Black Coal Industry, Australia - New South Wales' October 1980.

development of the Hunter Region's coal resources. Shortages of skilled manpower may be a more significant constraint. Also the rail and port systems may constrain the rate of development. In general the logistics of bringing so many large projects on stream in the same period are so great that some slips in timing are likely.

On the other hand, many of the projections in Tables 8.1 and 8.2 represent firm commitments. The very large projects (Bayswater Power Station and the Mt. Arthur North Mine) especially are likely to proceed on time. Further, some developments not yet anticipated may occur in the second half of the 1980's.

On balance then the figures in Tables 8.1 and 8.2 are probably on the high side in the early 1980's but realistic for the later years. Thus they represent reasonable figures for planning purposes.

Elsewhere in the report (Chapter 14) the impact of mining on agriculture is described. Although it is not easy to quantify precisely the implications for employment, there is little doubt that employment in agriculture and related sectors will be affected. We have assumed that 25 per cent of the jobs in agriculture in the Muswellbrook and Denman Shires in 1976 will have disappeared by 1986 (this is 218 jobs). Furthermore, there will be a loss of jobs which service agriculture, which is put here at $0.50 \times 218 = 109$ jobs. Note that these jobs refer specifically to Muswellbrook Shire rather than to the whole of the Upper Hunter. The population forecasts are not sensitive with regard to these assumptions.

Table 8.1: New Construction Employment, 1981-1991 by Project & Primary Urban Orientation

Project	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91
Muswellbrook Mines	-	-	20	50	20	-	-	-	-	-	-
Blackhill	-	-	50	100	50	25	-	-	-	-	50
Mt Arthur North	150	400	500	500	300	150	-	-	-	-	-
Bayswater	-	50	100	75	-	-	-	-	-	-	-
Drayton	200	250	150	-	-	-	-	-	-	-	-
Bayswater Power Station	360	940	1600	2300	1800	625	100	-	-	-	-
West Muswellbrook Mines ¹	-	-	-	-	-	150	150	-	-	-	-
Sub Total - Muswellbrook	710	1640	2420	3025	2250	1050	250	-	-	-	50
Mt Arthur South	-	100	500	300	150	50	-	-	-	-	-
Mt Ogilvy	-	-	-	-	50	100	50	50	50	-	-
Denman/Sandy Hollow Railway	310	15	-	-	-	-	-	-	-	-	-
Sub Total - Denman	310	115	500	300	200	150	50	50	50	-	-
Newdell/Howick North	-	-	50	-	-	-	-	-	-	-	-
Foybrook	-	-	-	-	-	50	-	-	-	-	-
Hunter Valley No. 1	100	100	20	20	-	-	-	-	-	-	-
Howick South	-	50	100	100	50	-	-	50	-	-	-
Hunter No. 1	-	-	20	50	75	50	-	-	-	-	-
Sub Total - Mus'k and Sing'n	100	150	190	170	125	100	-	50	-	-	-
Glendell	150	100	-	-	-	-	-	-	-	-	-
Glennies Creek	-	-	50	100	100	50	-	-	-	-	-
Glennies Creek Dam	50	150	50	-	-	-	-	-	-	-	-
Rixs Creek	100	100	50	50	-	-	-	-	-	-	-
Buchanan - Lemington	160	-	-	-	-	-	-	-	-	-	-
Hunter Valley No. 2	-	-	75	200	50	-	-	-	-	-	-
Miners Federation	-	100	100	50	-	-	-	-	-	-	-
Wambo	30	30	40	60	60	-	-	-	-	-	-
Warkworth	200	100	20	-	-	-	-	-	-	-	-
Mt Thorley	200	150	100	-	-	-	-	-	-	-	-
Bulga	-	-	-	200	150	100	-	-	-	-	-
Saxonvale	100	100	100	100	100	-	-	-	-	-	-
Mitchells Flat	-	-	50	100	50	-	-	-	-	-	-
Great Greta	-	-	-	-	-	-	-	-	-	-	-
Sub Total - Singleton	990	930	635	860	510	150	-	-	-	-	-
TOTAL	2110	2835	3745	4355	3085	1450	300	100	50	-	50

1 Authorisation areas 102 and 256.

Table 8.2: Projected New Production Employment, 1981-1991, by Project & Primary Urban Orientation

Project	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91
Muswellbrook Mines	-	-	-	20	40	60	60	60	60	60	60
Blackhill	-	-	-	180	180	180	180	180	180	180	180
Mt Arthur North	-	-	260	640	780	910	980	1140	1160	1170	1190
Bayswater	-	-	50	100	100	100	100	100	100	100	100
Drayton	50	200	270	330	340	360	400	400	420	400	400
Bayswater Power Station	-	-	20	200	470	570	570	570	570	570	570
West Muswellbrook Mines	-	-	-	-	-	-	150	150	150	150	150
Sub Total - Muswellbrook	50	200	600	1470	1910	2180	2440	2600	2640	2630	2650
Mt Arthur South	-	-	-	100	400	600	600	600	600	600	600
Mt Ogilvy	-	-	-	-	-	-	-	50	150	150	150
Denman/Sandy Hollow Railway	20	20	20	20	20	20	20	20	20	20	20
Sub Total - Denman	20	20	20	120	420	620	620	670	770	770	770
Newdell/Howick North	-	-	110	150	150	150	150	150	150	150	150
Foybrook	-	-	-	-	-	110	110	110	110	110	110
Ravensworth	35	35	35	35	-260	-260	-260	-260	-260	-260	-260
Hunter Valley No. 1	-	80	200	410	410	410	410	410	410	410	410
Howick South	-	-	-	-	110	110	110	220	220	220	220
Hunter No. 1	-	-	-	-	-	120	120	120	120	120	120
Sub Total - Mus'k and Sing'n	35	115	345	595	410	640	640	750	750	750	750
Glendell	-	-	400	450	520	520	520	520	520	520	520
Glennies Creek Dam	-	-	10	160	260	370	430	490	550	550	550
Rixs Creek	-	-	75	150	150	150	150	150	150	150	150
Buchanan - Lemington	15	200	300	400	400	400	400	400	400	400	400
Hunter Valley No. 2	-	-	-	100	230	230	230	230	230	230	230
Miners Federation	-	-	100	350	350	350	350	350	350	350	350
Wambo	210	210	220	220	270	320	320	370	370	370	370
Warkworth	190	220	350	490	340	540	540	540	540	540	540
Mt Thorley	85	200	300	300	300	300	300	300	300	300	300
Bulga	-	-	-	85	200	300	300	300	300	300	300
Saxonvale	-	100	300	500	730	900	900	900	900	900	900
Mitchells Flat	-	-	-	100	175	175	175	175	175	175	175
Great Greta	30	30	30	30	30	30	30	30	30	30	30
Sub Total - Singleton	530	960	2085	3335	3955	4585	4645	4755	4815	4815	4815
TOTAL	635	1295	3050	5520	6695	8025	8345	8775	8975	8965	8985

Residential Location Associated with the New Basic Labour Force.

In 1980, Muswellbrook town housed 79% of persons who worked in coal mining in the Shire and 25% of the coal mining workforce of Singleton Shire. A full breakdown of the residential location of mine employees is given in Table 8.3

Table 8.3: Coal Mining Employment*

Residence	Place of Residence-May 1980					
	Muswellbrook L.G.A.		Singleton L.G.A.		Total	
	No.	%	No.	%	No.	%
Scone	10	3.7	-	-	10	0.5
Aberdeen	4	1.5	-	-	4	0.1
Muswellbrook	211	79.0	486	25.2	697	31.8
Denman	6	2.2	-	-	6	0.2
Ravensworth	-	-	18	0.9	18	0.8
Singleton	25	9.4	729	37.8	754	34.4
Bulga	-	-	1	0.0	1	0.0
Broke	-	-	2	0.1	2	0.1
Cessnock	-	-	585	30.3	585	26.7
Kurri	-	-	38	1.9	38	1.7
Maitland	-	-	60	3.1	60	2.7
Rural	11	4.1	9	0.5	20	0.9
TOTAL	267	100.0	1928	100.0	2195	100.0

* Excludes Liddell State Mine (190) and Swamp Creek Mine (110) employees

Note: Unplaced 'other' category (386 employees) has been distributed by the existing weighting of each place of residence.

Source: N.S.W.C.C.P.A. Survey, May, 1980.

Although Table 8.3 is a useful guide to possible future residential locations of workers, there are some complications. Chief amongst these is the scarcity of land for housing in Muswellbrook which has created land prices in Muswellbrook which are approximately twice as high as those in Aberdeen and nearly three times those in Scone. As more people from the mines seek to locate in Muswellbrook others will capitalise on their property assets and seek a more rural environment in Scone. Estate agents in Muswellbrook and Scone have

confirmed this tendency. We have therefore assumed that for every three workers associated with the increase in basic workforce who locate in Muswellbrook, one other working resident of Muswellbrook and his family will relocate in Aberdeen or Scone 10, 11

Other factors which are changing and must be taken into account in forecasting residential location are:

- i) the locations of mines are moving northwards,
- ii) land in Denman, which is close to the Mount Arthur South Coal Mine, is available and cheap,
- iii) for people working between Singleton and Muswellbrook, Singleton will tend to be preferred because more land is available there and it is closer to the coast, and
- iv) the high level of activity in the lower Hunter will reduce the availability of manpower from those areas.

Taking these factors into account, it is assumed that the net effect of the increased employment in the Upper Hunter (allowing for some existing households to relocate in Aberdeen and Scone) would be of the order shown in Table 8.4. What this shows is that for every 100 new workers in the Muswellbrook-Denman area, an estimated 17 more would live in Scone, 10 in Aberdeen, 50 in Muswellbrook town etc.

- 10 The implications of this assumption, which are worked out below, are consistent with the planning assumptions for Scone Shire.
- 11 Given current land values, a household can save around \$14,000 in house price by moving from Muswellbrook to Scone less the costs of moving. This would provide an additional annual income of the order of \$1,000. This would, of course, be offset by the costs of travelling to and from Muswellbrook.

Table 8.4: Net Residential Impact of New Basic Workforce in the Upper Hunter

In Percentage Terms

Area of Employment

Area of Residence	Area of Employment		
	Muswellbrook/Denman	Muswellbrook/Singleton	Singleton
	%	%	%
Scone	17	6	1
Aberdeen	10	3	1
Muswellbrook (town)	50	20	5
Denman	12	3	3
Muswellbrook (rural)	3	3	3
Singleton Shire	8	50	57
Lower Hunter	-	15	30
Total	100	100	100

Elsewhere in this report (Appendix 4) the residential location of the construction workforce has been considered in some detail. The grave shortage of accommodation in the region makes it inevitable that most of this workforce (assumed to be 80 per cent) will have to be accommodated in temporary accommodation. This suits the needs of much of the construction workforce anyway. It is assumed that the other 20 per cent of the construction workforce will seek accommodation (probably rented accommodation) in the places and proportions shown in Table 8.5.

The location of the other 80 per cent of the construction workforce will be somewhat different as special hostels and camps will be developed, some in rural areas (including mine authorisation areas). The forecast location of this workforce is shown in Table 8.5.

Table 8.5: Residential Location of 80 per cent of the Construction Workforce (Temporary Accommodation)

Area of Residence	Area of Employment		
	Muswellbrook/Denman	Muswellbrook/Singleton	Singleton
Muswellbrook (town)	40	33	-
Muswellbrook (rural)	40	33	-
Singleton (shire)	20	33	100

Multipliers and their Consequences for Employment

There are two forms of multiplier. One arises because a firm purchases locally produced and distributed equipment and materials. The second arises because some of the money going to local firms and to employers is re-spent on locally produced foods and services. These expenditures are called 'indirect' and 'induced' expenditures respectively (whereas the original expenditure is described as 'direct').

Thus the two multipliers, both of which apply with a time lag, are:

$$\text{Type 1} \quad \frac{\text{Direct} + \text{Indirect Effects}}{\text{Direct Effects}}$$

$$\text{Type 2} \quad \frac{\text{Direct} + \text{Indirect} + \text{Induced Effects}}{\text{Direct Effects}}$$

The most sophisticated way to measure multipliers is through an input-output table which is a matrix representing all the transactions in an economy - national, regional or local. Such input-output tables have been estimated for Muswellbrook¹² and for the Hunter Region as a whole^{13,14}.

For coal mining in Muswellbrook McCaulden estimated a type 1 employment multiplier of 1.58 and type 2 multiplier of 2.51. For construction, McCaulden estimated a type 1 multiplier of 1.45 and a type 2 multiplier of 2.27.

On the other hand, the Unisearch report, based on a refinement of the H.V.R.F. study estimated the following multipliers for the Hunter Region as a whole:

	<u>Type 1</u>	<u>Type 2</u>
Coal mining	1.45	2.43
Power stations	1.53	2.42
Building and construction	1.48	2.60

12 G. McCalden 'Muswellbrook: An Urban Case Study Part II: Function and Economic Structure', Hunter Valley Research Foundation, Monograph No.31, Newcastle 1969.

13 Hunter Valley Regional Foundation, 'Input-Output Study for Hunter Region'.

14 Unisearch Ltd. 'Report on the Hunter Valley Input-Output Study', June 1980.

To clarify these multipliers, the Unisearch results suggest that for every 100 persons employed directly in coal mining, a further 45 men will be employed in the Hunter Region in providing equipment and materials to these mines. And for every 145 persons thus employed, a further 100 or so will be employed in providing goods and services of all kinds to them, including public services.

There are two special uncertainties regarding these multipliers. One is the relevance of an average figure estimated for a particular year to an incremental situation a few years later. If economies of scale (or unused capacity) exist, the average figure will exceed the incremental. On the other hand, if the economy of an area grows it will produce more locally and its multiplier will increase. The similarity between the Muswellbrook and the regional multipliers is therefore most surprising because multipliers are expected to be significantly lower in smaller areas which provide fewer services.

An industrial land use survey carried out in 1980-81 (Jackson Teece Chesterman Willis & Partners Pty Ltd) (see Section 9.3) suggested that because of the shortage of homes and land there would not be a large increase in local industry in Muswellbrook as a result of the mining developments. However, significant retail developments are anticipated in Muswellbrook (Section 9.2).

Alternatively on the assumption that the employment multiplier will be similar to an income multiplier, a multiplier can be calculated with the following formula:

$$M = \frac{1}{T(1-MPFC) + (1-T)(1-(MPC-MPI))}$$

where M is the multiplier

T is the tax rate

MPFC is the marginal proportion of the tax income generated which will be re-spent locally

MPC is the marginal propensity to consume

and MPI is the marginal propensity to import.

Imputing plausible figures for an economy the size of Muswellbrook's,

$$M = \frac{1}{(0.25(1-0.4) + 0.75(1 - (0.9-0.6)))} = 1.48$$

It should be stressed that these figures, though plausible, have no firm local data base and are only indicative.

In the light of these various pieces of evidence, the following type 2 multipliers have been adopted in this report. They are assumed to occur without delays, although this is not strictly realistic. However, no multiplier is allowed for any construction workers, even those looking for standard accommodation. Although some construction workers will remain in Muswellbrook after the particular development is completed and will become part of the labour force supply, the object of the exercise here is to forecast the increase in jobs available (the demand for labour) in Muswellbrook.

Table 8.6: Type 2 Multipliers Assumed for Forecasting Employment Opportunities
(Refers only to increases in basic employment)

Scone	1.35
Aberdeen, Denman	1.25
Muswellbrook (town)	1.60
Muswellbrook (rural)	1.10
Singleton (shire)	1.60

The implications of the various assumptions are shown in Table 8.8 which summarises the forecast impacts. This shows that by 1986, there could be approximately 5,600 extra workers living in Singleton Shire, 4,436 in Muswellbrook Shire and 838 in Scone Shire. If the construction programmes proceed on schedule, the great majority of new jobs by 1986 would be permanent ones.

Table 8.7 Changes in Employment by Area of Residence - Upper Hunter 1981 to 1991¹

Area of Residence	Agriculture Related Employment			Permanent Base Employment			Temporary Construction Employment (20% Permanent accom.)			Temporary Construction Employment (80% Temporary accom.)			Multiplier Employment			Total Increase in Jobs by Residence		
	83	86	91	83	86	91	83	86	91	83	86	91	83	86	91	83	86	91
Scone	ne	ne	ne	147	548	674	102	41	2	-	-	-	51	192	236	300	782	912
Aberdeen	ne ²	ne	ne	93	345	413	62	25	1	-	-	-	23	96	103	178	456	517
Muswellbrook (town)	-54	-109	-109	583	1757	2091	306	125	5	984	409	16	350	1054	1255	2169	3326	3258
Denman	-25	-50	-50	146	492	566	75	31	2	-	-	-	37	123	141	233	596	659
Muswellbrook (rural)	-84	-168	-168	91	241	269	22	8	-	984	409	16	9	24	27	1022	514	144
Singleton (Shire)	ne	ne	ne	1417	3157	3386	690	231	-	1025	337	8	850	1894	2031	3982	5619	5425

1. The figures are estimated precisely on the basis of the assumptions made in the study. It is proper statistical practice only to round the final results - this is done below.

Population Forecasts

The previous sections have resulted in an estimate of the increase in jobs by residential location in the Upper Hunter. Some of these jobs will be taken up by local people. In this case other people will migrate into the area to take up existing jobs not occupied by local people. For the purposes of these forecasts it is immaterial whether the increase in jobs is taken up by local people or by migrants. The net increase in population will depend upon the net increase in jobs.

The additional population resulting from the increase in jobs depends therefore on the participation rate (the proportion of the population seeking work) and the unemployment rate¹⁵. The lower the participation rate and the greater the unemployment rate, the higher will be the population to employment ratio.

Traditionally crude participation rates in the Hunter Region have tended to be low because of the lack of jobs available to females and because of the relatively large household sizes. In 1976, the crude labour force participation rate¹⁶ was 42.4 per cent in Muswellbrook, compared with 43.2 per cent for Singleton, 44.6 per cent for Scone and 44.9 per cent for New South Wales as a whole. Given the high male component in mining, a crude participation of 42 per cent is assumed for permanent migrants into the Upper Hunter¹⁷.

On the assumption that there is a 4 per cent unemployment rate amongst the migrating population (since it is implausible to suppose that the average unemployment rate in Muswellbrook will be much lower than elsewhere in New South Wales in the long run), the ratio of population to permanently employed persons would be $\frac{1}{.42 \times .96} = 2.48$

- 15 It is assumed that there is no change to the current participation rate and unemployment rate of the existing population.
- 16 The crude participation rate relates numbers seeking employment to the whole population rather than just to those of working age.
- 17 The DEP Report (op. cit. October 1980) assumed a medium crude participation rate of 55.20 for males and 29.75 for females.

In the population forecasts shown in Table 8.8, it is assumed that the 2.48 ratio applies to the permanent base employment, the multiplier employment and to 20 per cent of the construction workforce¹⁸. Eighty per cent of the temporary construction workforce is assumed to be single.

Table 8.8 Population Forecasts¹

	Population in Permanent Dwellings				Population in Temporary Accommodation			Total Population		
	Jan 81	83	86	91	83	86	91	83	86	91
Muswellbrook(town)	8700	11600	15900	16700	984	409	16	12600	16300	16700
Denman	900	1500	2400	2500	-	-	-	1500	2400	2500
Muswellbrook(rural)	3100	3100	3300	3400	984	409	16	4100	3700	3400
TOTAL	12700	16200	21600	22600	1968	818	32	18200	22400	22600
Scone	3500	4200	5400	5700	-	-	-	4200	5400	5700
Aberdeen	1200	1600	2300	2400	-	-	-	1600	2300	2400
Scone (rural) ²	2900	2900	2900	2900	-	-	-	2900	2900	2900
TOTAL	7600	8700	10600	11000				8700	10600	11000
Singleton Shire	13300	20600	26400		1025	337	8	21600	26700	26700

1 Rounded to nearest hundred.

2 Assumed to stay constant - not analysed in this report.

18 Strictly, if a temporary worker is accompanied by a wife who works locally, she is already implicitly included in the forecast population figures but the simplified assumption in the text is not numerically significant.

Demand For Housing
& Land

9

9.0 DEMAND FOR HOUSING AND LAND

9.1 HOUSING AND LAND

In 1976, there were 2,478 dwellings in Muswellbrook of which 2,198 (88.7%) were separate dwellings. Of the total dwellings, 2,278 were occupied (including those with owner temporarily absent). The occupancy rate averaged 3.8 persons per dwelling.

Between September 1975 and June 1980, 179 dwellings were completed. Of these, 127 were separate dwellings and 52 were flats.

The demand for new dwellings in Muswellbrook depends on:

- i) the increase in permanent households,
- ii) vacancy rates in these new dwellings,
- iii) any fall in the occupancy rate in existing dwellings and
- iv) the rate at which existing buildings are demolished and replaced.

Point i) is the overwhelming factor, of course.

Because of the shortage of land and the tendency towards smaller households, it is assumed for the central case that 25 per cent of new dwellings will be home units or town houses. This is not inconsistent with recent trends in Muswellbrook and in New South Wales but variations in this assumption are also considered. Further it is assumed that the average occupancy rates of new households will be 3.5 persons per separate dwellings and 2.5 persons per home unit or town house. Again this is consistent with current trends. This would mean an average occupancy rate of 3.25 persons per new dwelling.

The occupancy rates of existing households in Muswellbrook are high by New South Wales standards where the average was 3.1 persons per dwelling in 1976. In normal circumstances it would be reasonable to expect the occupancy rates in Muswellbrook to fall by at least 10 per cent by 1986 thus generating a significant impact on housing demand. Given the housing shortage, a reduction in existing occupancy rates of only 5 per cent by 1986 is allowed here.

With regard to point ii), a vacancy rate of 3 per cent is assumed. For point iv), it is assumed that 0.5% of the existing dwelling stock is demolished annually to

make way for units and other developments. This is probably conservative. No allowance is made for dwellings which are obsolete and rebuilt on the same site.

The effects of these four impacts on demand are summarised in Table 9.0.

Table 9.0: The Demand for Extra Dwellings in Muswellbrook

	1983	1986	1991
New households	890	2,215	2,460
Vacancy factor	25	65	75
Lower occupancy rates existing households	30	60	120
Demolition factor	40	80	120
Total	985	2,420	2,775
of which separate dwellings	740	1,815	2,060
of which units and town houses	245	605	695

In order to calculate the land requirements, it is assumed that including roads, neighbourhood shops and local open space, there would be ten separate dwellings per hectare and an average of 25 home units or town houses per hectare. This latter assumption is based on three home units or two town houses per single dwelling lot. Of course such standards are not rigid, although they are reasonable averages. On the basis of these assumptions, the basic land requirements for extra dwellings would be as shown in Table 9.1.

Table 9.1: Basic Land Requirements for Extra Dwellings in Muswellbrook

	<u>Hectares</u>		
	1983	1986	1991
Separate dwellings	74.0	181.5	206.0
Units/town houses	9.8	24.2	27.8
Total	83.8	205.7	233.8

To allow for residential choice, it is desirable that some land over and above that shown in Table 9.1 should be zoned residential. This is particularly so in the early years of what is likely to be a comparatively short boom. This issue is discussed elsewhere (chapter 11.0).

Land requirements would also vary if the proportion of medium density was decreased or increased. If separate dwellings constituted 85 per cent of all new dwellings, the total basic land requirements in 1991 would be approximately 250 hectares. On the other hand, if separate dwellings were only 50 per cent of all new dwellings, the basic land requirements in 1991 would be around 210 hectares. Thus on the densities assumed for single dwellings and for medium density living, the land requirements are not very sensitive to the proportion of flats and town houses. One reason for this is, of course, that occupancy rates are higher in houses than in flats or town houses.

9.2 RETAIL FLOOR SPACE

Data on retail expenditure in Muswellbrook has been provided by Planning Workshop Pty Ltd who recently conducted a retail survey in Muswellbrook. This study estimated that with the development of the major retailing site of nearly 6000m² bounded by Bridge, Brook, Somerby and Hill Streets, Muswellbrook would capture the following retail expenditure:

Table 9.2: The Muswellbrook Trade Area

The Percentage of Retail Expenditure captured by Muswellbrook

From households in	%
Muswellbrook (town)	90
Muswellbrook (rural)	85
Aberdeen	75
Scone (Shire) exc. Aberdeen	15
Denman	50
Merriwa	30

In addition the study estimated that with the major new retail development approximately 8 per cent of retail expenditure in Muswellbrook would come from outside this trade area.

Average household expenditure on retail goods, excluding alcohol, in NSW was an estimated \$5,350 in 1978-79. Allowing for inflation and some small real growth in retail expenditure, average household expenditure in 1980 was \$6,250. If retail expenditure per household grows at 1.5 per cent per annum between 1980 and 1986, retail expenditure would be around \$6,850 (in 1980 prices) per household in NSW in 1986. In order to allow for local income differentials it is assumed that incomes in Muswellbrook will be 5 per cent higher than this average figure and incomes in other areas will be 5 per cent lower.

The forecast retail expenditure in Muswellbrook shown in Table 9.3 is estimated conservatively on the basis of permanent households only.

1. A.B.S. 'Retail Sales for Goods'.

Table 9.3: Forecast Retail Expenditure in Muswellbrook 1986

Area	Forecast Population	Forecast Households	Retail Expenditure per household (%) per annum in 1986	Total Expenditure (\$m) in Muswellbrook
Muswellbrook (town)	15,900	4,540	7,200	29.4
Muswellbrook (rural)	3,300	870	6,500	4.8
Denman	2,400	630	6,500	2.0
Scone Shire (exc. Aberdeen)	8,300	2,180	6,500	2.1
Aberdeen	2,300	610	6,500	3.0
Merriwa	2,275	600	6,500	1.2
Other (+ 8%)	-	-	-	3.4
TOTAL				45.9

In order to convert these figures into floorspace needs, it is necessary to determine a ratio of turnover to floor space. In its study Planning Workshop adopted an average figure for turnover over all commodities of \$2,000 per m² (in 1980 prices) of rentable floor space, which is consistent with figures used in our studies such as the Port Macquarie Town Plan. Accordingly the demand for retail floor space would be as follows:

Table 9.4: Net Rentable Floorspace Requirements in Muswellbrook (1980 prices)

	1986 (a)
Estimated Retail Turnover (\$m)	45.9
Average turnover per m ² (\$)	2,000
Total floorspace required (m ²)	22,950
Existing floorspace (m ²)	14,370
Proposed new floorspace (m ²) 1981	6,000
Deficiency to be met (m ²)	2,580

Table 9.4 suggests that even with the major new development proposed, on standard turnover figures of \$2,000 per m² of rentable floorspace there could be a deficiency of some 2,580m² of retail space in Muswellbrook in 1986. However the situation is not as serious as this suggests. It has been noted above, it is unlikely that the population forecasts will be met fully in practice. Some new shops not currently known about will be developed in Muswellbrook.

And some shoppers will go elsewhere if shops in Muswellbrook become congested and their prices unacceptably high.

In order to ensure that sufficient land is available for retail developments, it will be necessary to convert about $(2,580 \times 1.25)m^2 = 3.23$ hectares of land into retail space. As shown in Chapter 11, this can be achieved largely by consolidation of the existing commercial areas.

9.3 INDUSTRIAL LAND

In 1981, there are approximately 80 hectares zoned for industrial use in Muswellbrook in two main areas - Mitchell Line Road and East Muswellbrook Common Road. Currently some 30 hectares are in industrial use.

A recent industrial survey conducted by JTCW suggests that there is unlikely to be any significant demand for more land in the foreseeable future. Its findings are summarised below and are detailed in the Sub-Region Study¹.

Representatives of 28 firms and the 3 Shire Councils (Muswellbrook, Singleton and Scone) were interviewed. Of the firms interviewed, 18 are in the Upper Hunter and 10 in the Lower Hunter. The questionnaire used is in Appendix 5.

The survey covered the following industrial groups: engineering and steel fabrication, heavy earth moving machinery and off the road tyres and concrete and construction. These groups were chosen because of their central role in the development of the Upper Hunter.

Factors which the interviewed firms perceived as relevant to their locational decisions will be factors which all firms must take into account when deciding whether to locate in the Upper Hunter. These factors will also influence the planning of expansion of firms already located in the area.

The most important factor firms took into account was the anticipated problem of attracting and retaining sufficient skilled and experienced labour if they set up an operation in the Upper Hunter. Firms already located in the region have tried to minimise the impact of this problem, with mixed success.

The scarcity of accommodation in the Upper Hunter is another important factor in locational decisions. Firms are aware of the excess demand in the region's housing market, especially in Muswellbrook.

1 Upper Hunter Sub-Regional Study - A Report to the Department of Environment and Planning - March 1981 - Draft - Unpublished.

Demand for industrial land in this region by engineering and steel fabrication firms is almost non-existent. While skilled and experienced labour remains in scarce supply, it seems that these firms will continue to operate from their present locations and will not consider setting up branch operations in the Upper Hunter. The shortage of housing, especially in Muswellbrook, also features as a reason for not moving into the region.

Suppliers of products which require regular specialised servicing (for example of the road tyres and heavy earthmoving equipment) are obliged to locate near to the mining development. They can minimise the effects of the scarcity of skilled labour in the region by sending appropriate servicing and repair work to centres outside the region. Also, it is likely that outside firms supplying well known products will locate in the Upper Hunter in order to take advantage of the increasing demand for their produce from the mines. Some firms located in the region indicated that they would like to purchase more industrial land. In total this group may require, at most, some 20 hectares of industrial land in the first half of the 1980's in the Upper Hunter, including possibly 10 hectares in Muswellbrook.

Concrete producers require sites near to the point of delivery of their product. Sites upon which producers in the area are already located are of a size sufficient for anticipated expansion. With the increase in demand for concrete in the near future, other producers may come to the region. Firms with one site only - in Muswellbrook or Singleton - may set up a batching plant in the other. Demand from this source for industrial land is not likely to exceed two hectares in Muswellbrook and three hectares in Singleton.

Building firms and firms supplying building materials perceive a good future in the Upper Hunter. Increased residential building and building premises for industrial and mining companies and the public sector will ensure a strong demand for their products. Some of the firms interviewed had made provision for future expansion but had underestimated their needs. Also, these firms prefer to be located near to the market for their product. However, it is not clear how many firms will move into the Upper Hunter and the amount of industrial land demand generated by this group is not expected to exceed 5 hectares in Muswellbrook and 5 in Singleton.

As mentioned above, the survey did not cover activities such as light industry, agriculture related industry and warehousing not associated with mining or construction. However, there are not strong reasons for expecting growth in these areas.

The survey suggests that in the near future the demand for industrial land in the Upper Hunter will not be strong. Despite the huge mining development anticipated for the region, firms will only locate in the area if obliged to do so, for example, to be near to the mining operations they service. Firms consider that locating in the Upper Hunter is not viable in other circumstances since the required labour is not available. In total there may be a demand for some 25 extra hectares of industrial land in Muswellbrook in the first half of the 1980's.

Social Changes & Demand
For Facilities & Services

10

10.0 SOCIAL CHANGES AND DEMAND FOR FACILITIES AND SERVICES

The growth of Muswellbrook Shire will be reflected not only in the increased population and rapid industrial development but also in a change in social structure and attitudes of the community. In determining the likely social changes, information has been collected from the 1976 Census, a social survey of three hundred Muswellbrook households¹, discussions with local community agencies and community spokespersons. While also drawing on experiences of towns with similar rapid growth, the likely scenario for Muswellbrook has been developed (refer to Community Facility Development Programme in Appendix 1).

Existing Population Structure

The population of the Shire has remained constant with 11,771 persons in 1971 and 11,520 in 1976. The characteristics of the existing population are described more fully in Chapter 4 and Appendix 1. However, in summary, the population is generally comprised of stable, young families, the last influx of population arriving with the construction of the Liddell Power Station in the 1960's. Social networks centre on Muswellbrook while activities such as shopping and recreation are Muswellbrook oriented. Taken from the 1976 Census, Muswellbrook residents receive average household incomes of \$9,000 to \$15,000 per annum and are employed in wholesaling/retailing, electricity/water/gas and mining. In Denman and the rural areas, household incomes are much lower with agriculture, wholesaling/retail and public administration being the major sectors of employment. Generally male participation in the workforce is high while female participation is extremely low. The population is predominantly Australian with a small proportion of English born residents.

Expected Growth and Change

Based on population projections, the Shire is expected to house 18,200 persons in 1983, 22,400 persons in 1986 and 22,600 in 1991 (refer to Chapter 8). On the current construction dates of developments, the most significant growth will be experienced in the next three years. With the influx of both permanent and transient employees and their families to the Shire, several major changes will result.

1 Jackson Teece Chesterman Willis & Partners Pty Limited
Refer Appendix 2

1) Accommodation

The accommodation shortage will have serious ramifications for both new and existing residents. Existing housing prices are escalating as the limited supply and high demand from the mining population increases. New permanent employees are in receipt of the high wages offered by mining and power generation industries, much higher than those offered by local industries. Several mining companies, together with the Electricity Commission, are buying land and homes in the Shire for a proportion of its new employees reducing further the availability of housing on the market. Many permanent workers, however, will be forced to live in temporary accommodation and await the provision of permanent housing. Similarly, construction workers will be seeking less permanent accommodation in caravan parks, hotels, hostels and rental accommodation. This type of accommodation is presently limited and already well patronised and, in some cases, over-crowded. This will place stress on families as well as create difficulties for child-rearing. The provision of adequate facilities in caravan parks will be essential (see Appendix 4).

For existing residents the accommodation shortage will provide both benefits and disadvantages. Many will be encouraged to sell their homes for considerably higher prices than when purchased, while those on lower incomes will find difficulty in purchasing local housing. Residents on fixed incomes, such as pensioners and single parents, may find it difficult to obtain reasonably priced rental accommodation, resulting in a further demand for low income and aged housing.

2) Social Needs

New construction workers and possibly permanent employees may be of a more varied ethnic background resulting, perhaps, in a degree of social tension within the predominantly Australian born Muswellbrook community. The varied background of the new population will also attract a cosmopolitan quality to the town which will differ from its existing rural atmosphere. Similarly, many will have different lifestyles and aspirations, expressing demands for facilities and services which are available in metropolitan areas and not presently sought by existing residents.

The incoming population will arrive in Muswellbrook without established family and social networks. Many will seek public and community facilities and services, together with centres for social interaction and entertainment. Active recreation is likely to be popular due to the young age of many new employees and their families. However, as shown in Appendix 1, the availability of these facilities and services is limited in the Shire while those available are unlikely to cope with the high demand. A number of factors, including shiftwork, lack of female work, absence of social networks and public transport are likely to result in the social isolation of a number of women in the community.

The initiatives taken by various companies to widen the employment base of the Shire and to encourage apprenticeship schemes is to be supported, particularly if the current problem of high youth unemployment is to be alleviated.

3) Employment Trends

Employment trends within the Shire will add further to the level of social change. As discussed earlier, the high wages earned in mining and electricity production will enable a greater buying capacity for new employees. Housing and rental prices may rise, while the price of local goods and services may increase as demand exceeds the presently limited supply. This will be felt most by low and fixed income earners.

High male participation in the workforce will grow as male labour is attracted to the mining and power generation industries. Opportunities for female and youth employment will be limited and unless measures are taken to encourage training and employment in mining industries and widen the employment base, unemployment will rise further.

This will be intensified by the attraction of employees away from agriculture, retailing and rural service industries to the higher remuneration offered by mining companies. No longer will local employment be primarily agriculturally oriented but rather a new employment base will grow. The social implications of this change for existing residents are likely to be great.

For the farming community, historically the backbone of the Muswellbrook Shire, the population growth of the Shire, together with the purchase of farming land for mining developments, is likely to force their relocation or retirement. The agricultural quality of the community will no longer be predominate while movement of the rural population to urban areas may increase. The social effect on long established farmers, such as social isolation and likely unemployment, together with the loss of agricultural production in the area, may have further ramifications in the long term.

4) Community Character

Perhaps more importantly, Muswellbrook will no longer display the qualities and lifestyles of a rural town due to the increased urban, industrialised workforce within the Shire. The town will no longer be comprised of long term residents but rather a more shifting population will predominate. Facilities and services, such as shopping centres, schools and sports ovals, may be inaccessible or overused for both new and existing residents. For existing residents this may be difficult to accept while new residents, expecting a rural quality of life and atmosphere, may be similarly disillusioned.

Demand for Social Facilities and Services

The following programme has been developed in light of the existing facilities and services within the Shire together with the impact of social changes and increased population on the community. Further reference should be made to Appendix 1 which details an inventory of facilities and services, utilisation rates and community demands.

1) Neighbourhood Centre - Community Hall

The demand is high for a multi-purpose activity centre not only for functions and meetings but also for group activities, skill classes and support-counselling groups. The centre would fulfill the needs of playgroups seeking accommodation, teenagers seeking activities and skill classes, groups seeking small meeting rooms and activities. Flexibility of use is the most important aspect of this centre accommodating as many uses as possible.

2) Sporting Complex

The Social Survey strongly recommended the need for additional sporting facilities within the community and this is further reinforced by the high utilisation of existing sporting facilities. The sporting complex should provide a multi-purpose indoor centre which would be used for a range of indoor activities such as basketball and gymnastics while also providing function space for large presentation dinners, school functions and dances. The survey of existing function facilities within the Shire indicated the need for a large, modern hall which would cater for these needs. The indoor sporting complex at Denman also should be completed as soon as possible as demand for this facility is high in the community.

3) Tourist and Community Information Centre

The lack of an information network within the Muswellbrook Shire has been strongly noted by several community agencies and individuals. Particularly as new residents move into the area, a strong need exists for a centre which provides information on the range of services, facilities and groups available to residents of the Shire. The centre would act as a meeting place for rural residents, new families in the area and transient employees. The centre should also extend its services to meet the growing needs of the tourist trade visiting the Shire, providing information on places of historic, scenic and cultural interest. The centre could be run on a voluntary basis.

4) Community Space Specifically for Transient and Semi-Permanent Residents

After discussions with several community agencies, particularly the co-ordinators of the Hillside Park Children's Activity Group, it appears there is a growing need for community facilities within caravan parks. Due to the accommodation shortage within the Shire, many of the transient and new residents may have to live in caravan parks. Their use of facilities within the community appears limited often due to the isolated nature of the park and lack of public transport within the community. Therefore, Council should encourage caravan park

developers to provide community space as a condition of development consent. This would provide a meeting place for pre-school children in the park, mothers and families. Also additional open space and outdoor play areas should be available for these semi-permanent residents.

5) Aged Housing and Care

Many of the needs identified relate to the new and young residents moving into the Shire but a need also exists for care and housing of existing residents, particularly the aged. Already, Home Help, Meals-On-Wheels and the Senior Citizens Association are well established but with increased housing and living costs expected in the Shire, aged residents will require reasonably priced accommodation. This will include self-contained units, hostel accommodation and full nursing care, depending on the needs of each resident. At present aged accommodation is available at Scone and a Nursing Home is operating in Tindale Street, Muswellbrook, but these are insufficient to cope with the demands of the community.

The development of this facility as a joint Muswellbrook Hospital, Muswellbrook Shire Council and Muswellbrook community project should be further investigated.

Its role as a sub-regional facility, providing for aged residents in Scone, Muswellbrook and Singleton Shires, should also be assessed in order to maximise use and economic feasibility of the project.

6) New Primary Schools and High School

Based on population estimates and discussions with the Department of Education, the Shire will require an additional primary school by 1983 and by 1986 a new primary and high school. Considerable upgrading of schools in both Muswellbrook and Denman will be required by 1986 to cope with the population growth. It is desirable that facilities in the schools be open to community use and further discussions with the Department should be held to determine the full extent of this use.

7) Occasional and Long Day Child Care

Several community agencies and individuals in the Social Survey considered Child Care to be an important need of the community. The existing high proportion of young families within the community and low female participation in the workforce is expected to increase in the next five to ten years. New residents are unable to rely on traditional family networks for social contact and childminding and many agencies fear that mothers may become isolated in their new community. Pressures of child minding and the existing lack of public transport add to the likely growth in this social problem. Already a form of child care, the Playgroup Association of New South Wales, is extremely active in Muswellbrook. Over 150 families are presently members of the Association within the Muswellbrook Shire and numbers are increasing. This may also be extended to include long day care and pre-school facilities as the demand for this facility increases. Child care will provide social contact for mothers while providing them with a few hours of free time for shopping and appointments. It also enables new residents to participate in the service. Many occasional and full day child care centres are presently operating within New South Wales and their methods of operation, fees and management should be investigated.

8) Community Bus Service

Public transport is almost non-existent in both Muswellbrook and Denman. Individuals in the Social Survey and several community agencies considered the lack of public transport to be difficult for many residents. Apparently a community bus service has already been tried in Muswellbrook but perhaps the management and service provided was not suited to the needs of the community. Transport is primarily needed by aged residents to do shopping, visit the Community Health Centre and Senior Citizens Hall. Similarly, mothers with children may find it difficult to do shopping, attend group meetings and playcentres. Caravan park residents also may use this service as often the parks are located away from the main town centre. Many Denman residents also may be finding difficulty in travelling to Muswellbrook. New residents living in areas distant from the main Muswellbrook Centre are more likely to need and use this service.

9) Development of a Senior Citizens' Activity Programme

Muswellbrook Council has budgetted for the construction of a new Senior Citizens' Centre in 1981. The centre will be located on the site of the existing Senior Citizens' Hall and will provide an excellent modern facility for both Senior Citizen and public use. The high membership of the Association although having a limited activity programme, emphasises the demand for this service in the Shire. Therefore, Council should consider the development of a Senior Citizens' Activity Programme encouraging full utilisation of this new facility. The programme may include a range of activities such as craft groups, singing, chess, cards, special interest groups, bus trips and even meals at the centre. The centre should be available each day for use by members while at night the centre may be used by community groups for meetings and functions. Council's Community Development Officer, together with a Senior Citizens' Committee, should develop this programme.

10) Children's Activity Programme

Children's and teenage facilities and services are deficient within the Muswellbrook Shire, particularly as these age groups form a high proportion of the total shire population. The influx of young families into the community in the next ten years will further increase this demand which many community agencies and individuals have already identified. The development of this program could be conducted by Council's Community Development Officer together with the various agencies and groups throughout the Shire. The programme would make use of the many proposed facilities such as the Neighbourhood Centre and Sporting Complex for activity classes, skill classes, after-school care, dances and holiday programmes. The youth of the community should be involved in the formulation of this programme and Council may consider the appointment of a Youth Officer to fully develop this most important social need.

11) Community Information Booklet

The development of a comprehensive community information network is dependent not only upon the Community Information Centre but also the availability of an up-to-date Community Information Booklet. The booklet should cover the total range of facilities and services available within the Shire, the nature of the facility or service and a contact name and telephone number. The booklet should be distributed throughout the Shire, perhaps by postal delivery and be available at shops, government agencies, caravan parks and schools so that existing, new and transient residents have access to this information. The booklet should be regularly revised as names change and new facilities or services are introduced.

12) Appointment of a Social Worker

The growth of the Muswellbrook Shire is likely to bring with it a range of new residents and new social problems. The level of social disruption is difficult to determine but, as in Lithgow, Cessnock and Singleton, Muswellbrook may face growing social pressures. This may include problems such as social isolation of both new and old residents, an increase in single parents and welfare problems. The need for a Community Social Worker is obvious and preferably should be attached to the Upper Hunter Valley Community Health Centre. Currently, counselling and support expertise is lacking within the community and this demand is being met by local services and agencies. These agencies, however, should have the qualified social welfare advice and guidance and not be fully responsible for this social service.

13) Inter-Agency Committee

Local agencies within the Shire should be encouraged to interact and discuss their needs, difficulties and ideas. In this way it is hoped that the community may receive a more co-ordinated service and that funds allocated to the Shire are spent for the full advantage of all interests within the community. It could also act as a catalyst for community projects and ideas, liaising with various government departments seeking guidance and assistance.

Urban Development

11

11.0 URBAN DEVELOPMENT

11.1 INTRODUCTION

This chapter describes structure plans and outlines strategies for the development of land in the towns of Muswellbrook and Denman. Its contents have been organised as follows:

- 11.1 Introduction
- 11.2 The Likely Scale of Growth
- 11.3 Muswellbrook: Environmental Protection
- 11.4 Muswellbrook: Structure
- 11.5 Muswellbrook: Residential Development
- 11.6 Muswellbrook: Town Centre
- 11.7 Muswellbrook: Industrial Areas
- 11.8 Muswellbrook: Open Space
- 11.9 Muswellbrook: Water Supply and Sewerage
- 11.10 Denman

The general strategy for Muswellbrook and Denman is to encourage additive growth in order to more fully utilise existing infrastructure and urban services. The growth projections that have been used are the best available at present. However, there are indications that they may overstate the rate of growth, particularly in early years.

11.2 THE LIKELY SCALE OF MUSWELLBROOK'S GROWTH

The anticipated demand for land for the years 1981-1991 is shown in Table 11.0. It can be seen that in all categories substantial expansion can be expected. In particular there will be a high demand for residential land between 1981 and 1986.

Table 11.0: Demand for Land in Muswellbrook (hectares) to end of period

Category	Existing land in use 1981	Projected		
		1981- 1983	1983- 1986	1986- 1991
Residential	155	84	122	28
Commercial (retail)	11	Not applicable - see Table 11.1		
Industrial	26	10*	15*	-
Public Recreation	21	17	11	1

* Sufficient areas already zoned.

The above table is based on projections made in Chapter 9 and on the land use survey at Appendix 3. Figures quoted are for additional demand by the period stated.

It has been estimated (Chapter 9) that the following numbers of dwellings will be needed.

Year	Total Number of Dwellings	Incremental Increase
1983	985	985
1986	2,420	1,435
1991	2,775	355

It has been calculated (Chapter 9) that a further 9,406m² of retail floor-space will be required by 1986 (see Table 11.1). It is worth noting that the proposal for construction of shops in the Brook Street block will supply some 6,000m² of this space.

Table 11.1: Retail and Office Floorspace (m²) and
 Estimated Retail Floorspace to 1986






	Existing	Estimated Demand 1986	Increase
Retail	14,370	22,950	9,406
Office	9,100		

It is also anticipated that there will be an increase in demand for office accommodation. As there is some vacant space available now and as some of the demand for new office space will be provided above retail floorspace, it is considered unlikely that offices will require a significant additional area of land.

There is presently 80 hectares of zoned industrial land in or near Muswellbrook, 70 hectares located along the Mitchell Line of Road and the remainder in East Muswellbrook, on the Common Road. A variety of non conforming industrial activities are also located throughout the town, particularly along its northern and southern approaches. It is estimated that approximately 26 hectares are currently in use.

Demand for additional industrial land, discussed in Chapter 9, could be in the order of 25 hectares by 1986. It is therefore considered unlikely that more land will need to be zoned in the near future.

Open space in Muswellbrook is heavily utilised (see Appendix 1). It has been estimated that some 50 hectares of additional space will be needed by 1986 in order to maintain the present standard.

-  Existing Town Area
-  Flood Liabile Land
-  Extent of Prepared Open Cut Mines
-  Proposed Industrial Area
-  Proposed Residential yr 2000

- 1 Flood Plain
- 2 Extent of Land Needed for Urban Purposes yr 2000
- 3 Noise & Barriers Created by Railway
- 4 Possible Conflict with Black Hill Mine
- 5 Effect of Mining in A102
- 6 Need to Clean up Old Mining Areas

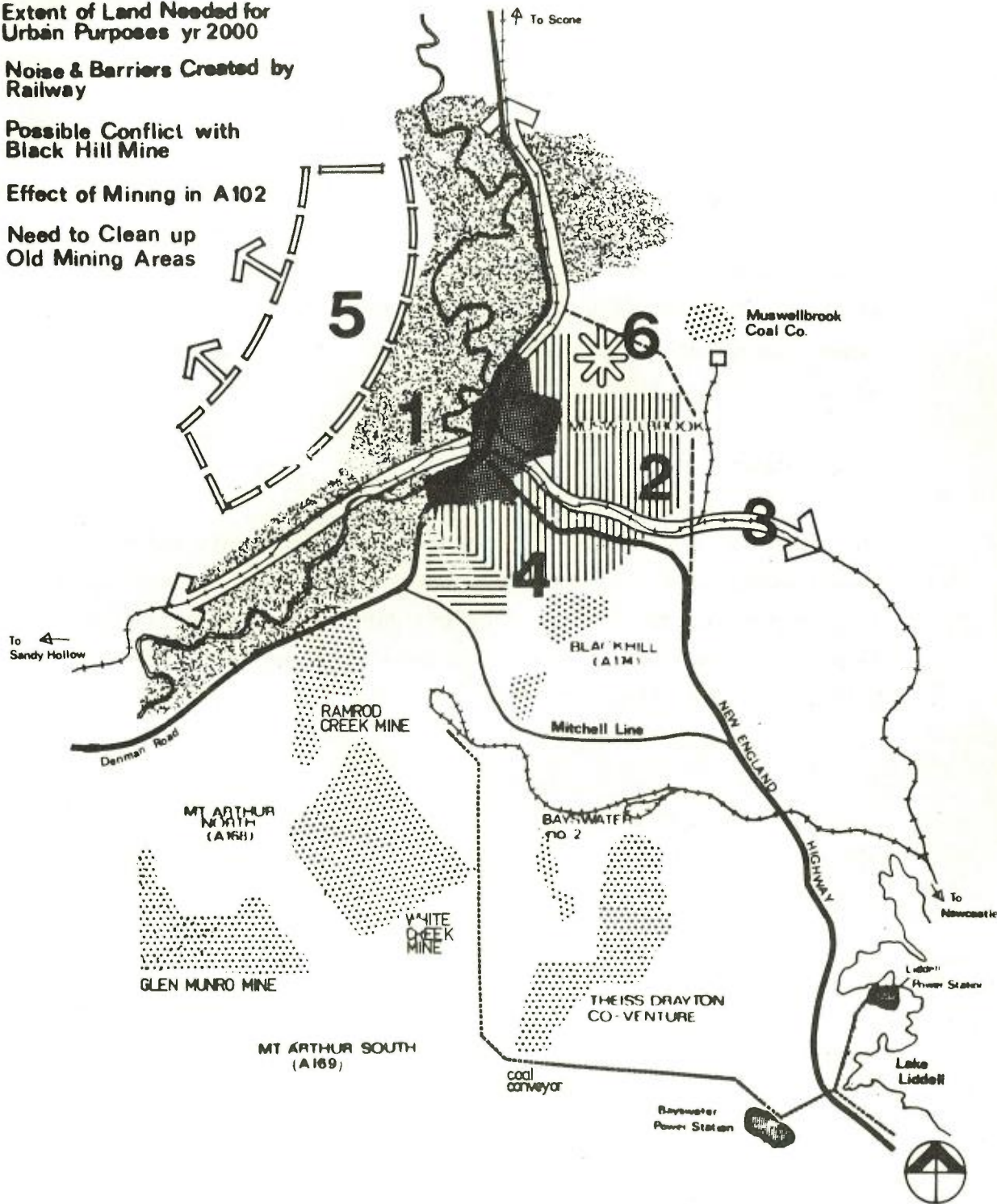


FIG. II-0
MUSWELLBROOK ENVIRONS
POTENTIAL CONFLICTS



11.3 MUSWELLBROOK: ENVIRONMENTAL PROTECTION OF URBAN AREA

In this section the direct effects of coal related development on the town of Muswellbrook and their implications for planning are described. Issues considered are Noise, Atmospheric Pollution, Visual Impact and Traffic Conflicts.

Mining and Related Activities

Figure 11.0 identifies the main open cut mining, power generation and infrastructure proposals which could directly affect the amenity of the Muswellbrook urban area. It also draws attention to the relationship of the New England Highway and the Northern Railway Line, which will experience great increases in traffic to existing and future urban areas.

Future Growth

The future growth of Muswellbrook is likely to result in the town more than doubling its area over the next 20 years. Growth will occur around the existing urban area, east of the Hunter River floodplain where suitable land exists and where urban development will not sterilize coal resources. Within this area there is ample space for the town's population to treble.

Noise

The detailed studies of existing and future potential noise levels, described in Section 3.9 and Chapter 18, conclude that:

- . Muswellbrook is at present a very quiet town.
- . Due to their distance from the town and the nature of the topography, the Mt. Arthur North, Drayton and Muswellbrook Coal Company mines are unlikely to adversely affect existing or future urban areas (except at night under inversion conditions).
- . The proposed Black Hill mine would adversely affect a limited area of future urban land in South Muswellbrook.
- . It will be desirable for blasting operations at all mines to be co-ordinated.

- . Traffic on the Northern and Sandy Hollow Railways will adversely affect a large area of the existing and future town and will constitute a major noise nuisance in the town.
- . Increased traffic on the New England Highway will constitute a further major noise nuisance to the town.
- . Any operations in A.102 will require careful screening to ensure that acceptable noise levels in the town are not exceeded.

Atmospheric Pollution

Studies of existing and future dust levels in the Upper Hunter have been commenced but results are not yet available. The following observations are however relevant:

- . Readings taken in Muswellbrook show that existing dust levels are high. It is thought that fallout onto the town is caused by turbulence at the junction of two major air-streams in the valley.
- . Unnecessary local sources of pollution include the coal dust from Muswellbrook Mines loading point which gets spread widely by vehicle movement, burning coal to the north east of the town and smoke from Council's garbage tip. The problem of dust dispersal by vehicles is discussed in more detail in Chapter 17.

Visual Impact

The town has a very pleasant rural character and existing mining operations are not generally evident from within it or from its approaches. The location of most of the proposed mines is such that existing topography will largely conceal them. The major visual impact of coal related development from existing residents will be the expansion and redevelopment of the town itself. Exceptions to this and likely problems are:

- . The poor condition of mine subsidence and stripped areas to the north and east of the town which will become more evident as the town expands.

i.e. the old open cut.

- . The north east corner of the Ramrod Creek coal mine, where it is currently proposed that the Denman Road be moved in a northerly direction which will have a considerable impact on Edinglassie Rous Lench and their surroundings.
- . The permanent scarring of the north face of Mt. Arthur by the Whites Creek Mine.
- . The possible visual impact of the Black Hill Mine, as yet unassessed.
- . The need for very careful design consideration to be given to any operations in the A102 area, as it is highly visible from the town.
- . That buildings and streetscapes within the town could be damaged by inappropriate development or demolitions which would destroy their character.

Traffic Conflicts

A number of traffic problems are evident in the town of Muswellbrook. These tend to detract from the town's character and to prevent effective planning from occurring. Major problems appear to be:

- . The volume of traffic, particularly heavy through traffic, along Bridge Street and the New England Highway north and south of town. This is creating significant noise, dust and safety problems.
- . The physical and psychological barrier created by the presence of the highway and railway through the town. This has led to the segregation of the community into residents who live north, south or east of the railway and the loss of valuable land in the centre of town which could otherwise be used for important commercial or residential developments.
- . The highway and the railway have also tended to cut the town off from valuable recreation land along the river frontage and to prevent the redevelopment of sites east and west of Bridge Street for commercial and/or community uses which must consolidate the town centre in preference to extending development along the highway.


- . The presence of unsightly rail sidings and goods yards in the centre of town.
- . Lack of adequate off-street parking, in turn creating parking problems for residents living close to the town centre.
- . The absence of a road system or means of providing adequate cross-town movement, which is in part due to the location of the highway and railway which results in expensive bridges and underpasses.
- . The alienation of land along the Hunter River and Muscle Creek, by the Highway and railway, that would otherwise be suitable as an open space corridor or spine through the town.
- . The flooding and poor standard of the road/rail underpass on the corner of Bridge and Market Streets.

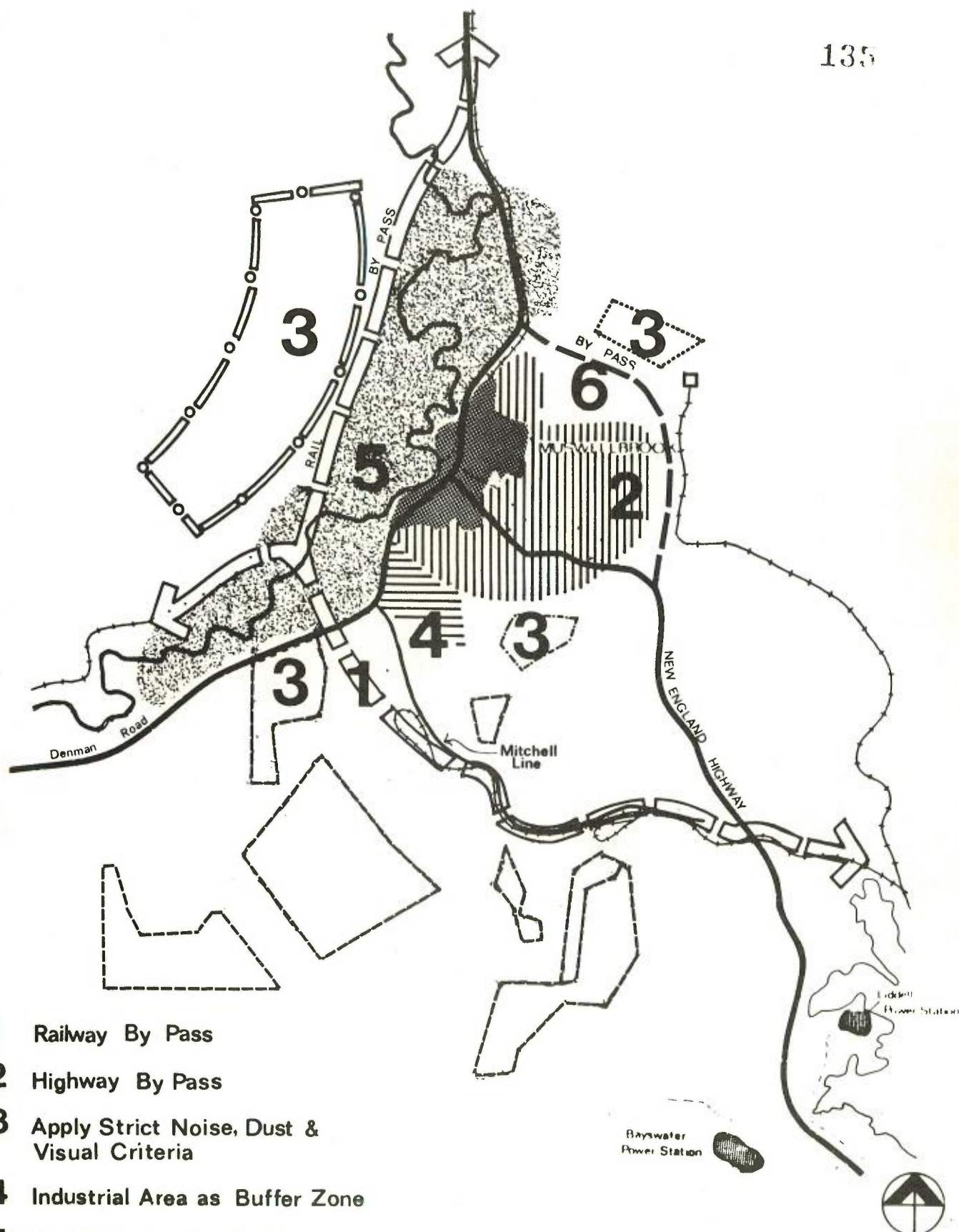
Implications for Planning

The following strategies and procedures are recommended in order to avoid the problems identified above. Reference is made to figure 11.1.

1. Reroute the northern railway line south and west of the town.
This can be largely achieved through the use of coal spur lines, however construction should be advanced to ensure that coal from Ulan and the proposed Bellambie mine does not travel through Muswellbrook. Spur lines should be maintained to serve the Oak factory and the Muswellbrook Coal Company. A goods and passenger station should be constructed near the industrial area, thus further reducing vehicular activity in the town.

Progressive implementations of this strategy should be made a condition of consent to mining proposals.

2. Press for construction of a highway bypass east of the town.
It is not feasible to bypass the town centre by any other route. Further upgrading of the present highway only serves to reinforce an existing unsatisfactory situation which will get much worse.
 3. Impose the following conditions on all mine operators.
 - . Adherence to the noise criteria set out in chapter 18.
 - . Preparation and implementation of a co-ordinated blasting program to Council's satisfaction.
 - . Use of non-dust raising surfaces on all regularly used internal roads and control of dust at sources. 'Dust traps' should be provided at intervals on all internal roads and at entrances and exits from mine sites.
 - . North east corner of Ramrod Creek. Mine to be redesigned to avoid impact on Edinglassie and surrounding areas and the visual impact of proposal to mine to the east of the ridge line should be clearly illustrated to enable its further evaluation.
- 



- 1** Railway By Pass
- 2** Highway By Pass
- 3** Apply Strict Noise, Dust & Visual Criteria
- 4** Industrial Area as Buffer Zone
- 5** No Mining in Alluvial Area
- 6** Restoration of Mined Area

FIG. II-1
MUSWELLBROOK ENVIRONS
RECOMMENDED ACTION



- . The permanent scarring of the northern face of Mt. Arthur should be studied further and proposals put forward for methods of minimising its impact by designing its shape or benching in some way to permit vegetation.
 - . Require that mining lease holders prepare and implement land management programs which ensure that their holdings are not overgrazed and are properly restored.
- ~~Establish limits to the edge of town~~
wot about the cocher!
4. Establish limits to the edge of town - by using the industrial area ridge line to the south and a 200 - 300 metre buffer zone to the proposed highway to the east and north. The width of this buffer should be determined by acoustic and topographic study in association with the highway design.
 5. Support State Government Policy for no mining of alluvial areas and establish a Scenic Protection Zone over this part of the shire.
 6. Develop a joint program with Muswellbrook mines for the restoration of damaged areas N.E. of the town.
 7. Prepare and implement a landscape policy. This should ensure the establishment of large tree species in streets and buffer zones and appropriate plantings in all developments.
 8. Adopt and apply zoning provisions and development control plans which protect the existing urban areas from inappropriate redevelopment.

11.4 MUSWELLBROOK STRUCTURE

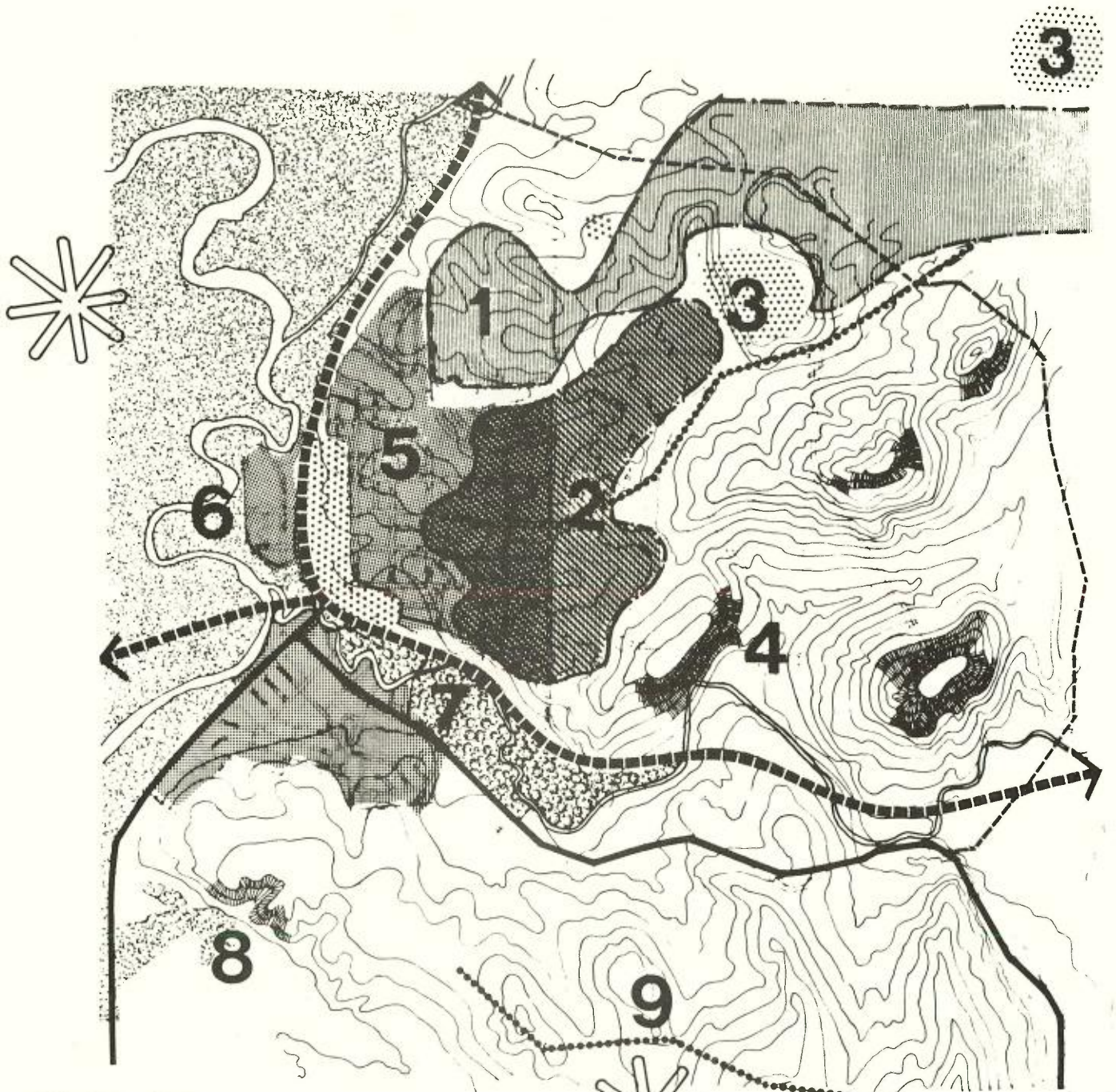
This section briefly describes the main elements of a structure plan for the growth of the town. It is based on a number of studies which were carried out during the preparation of this report and discussions with various Government Departments and organisations¹. Alternative structure plans were investigated. However, after reconciling the anticipated rate of growth within the known constraints to development, it appears that there is really no option but to expand the town in the way suggested in this Chapter. A description of the major constraints and the recommended structure plan follows:

Constraints

The major constraints to the growth of Muswellbrook are shown on Fig 11.2 and are described below:

1. Areas with future underground mining potential. Some of this land has until recently been subject to mineral exploration. Its future development is limited to single storey lightweight construction.
2. Area already undermined, partly under the town and partly under the common. A subsidence problem exists in this area and no new development is possible without clearance.
3. Areas damaged by open cut operations. The blighting effect of open cuts, spoil dumps, subsidence and erosion has sterilized this area for residential development.
4. Muswellbrook East, an area consisting of wooded valleys, steep slopes and creek flats is partly in public ownership. Within it, areas of scenic value and steep slope should not be developed. There is no coal underlying this area and is thus the most suitable area for urban expansion.
5. Existing buildings of the town centre and established residential areas.

1 Refer to the list of studies and organisations in the introduction to this report.






-  Steep Slopes
-  Town Centre
-  Proposed Open Cut
- 1** Potential Undermining
- 2** Undermined-subject to Subsidence
- 3** Existing Open Cut
- 4** Reserved for Public Recreation
- 5** Existing Town
- 6** Flood Liable Land
- 7** Muscle Ck Openspace
- 8** Low Lying Area Ramrod Ck
- 9** Proposed Black Hill Open Cut



FIG. 11-2
TOWN OF MUSWELLBROOK
CONSTRAINTS



6. Flood liable lands unsuitable for development.
7. The Great Northern and Denman Railway Lines which will create increased dust and noise nuisance. As the town expands east, limited crossing points will create difficulties of access to schools, playing fields and other residential areas.
8. Low-lying flat lands at Ramrod Creek separate the southern boundaries of town from extractive industries. This area can be logically developed as an industrial estate.
9. The proposed Black Hill Mine, which may reduce the area available for residential development in the short term.

*Weldon; you can't use back-filled ofc areas for urban housing!
within 100 years! fair enough*

Brief Description of the Structure Plan

The main elements of the structure plan, see Fig 11.3, are briefly described below and are discussed in more detail in sections 11.5 to 11.9.

Residential growth has been allocated to three main areas and in three directions from the existing town. They are:

- . Northern: north of existing town. Growth in this direction is constrained by railway and flood liable land to the west, flood liable land to the north and mining activities to the east.
- . Southern: south of New England Highway and east of Denman Road. Growth in this direction is limited to the west by flood liable land, to the south by low lying areas associated with Ramrod Creek and by the effects of mining activities (of which Black Hill is the closest) and to the east by the New England Highway.

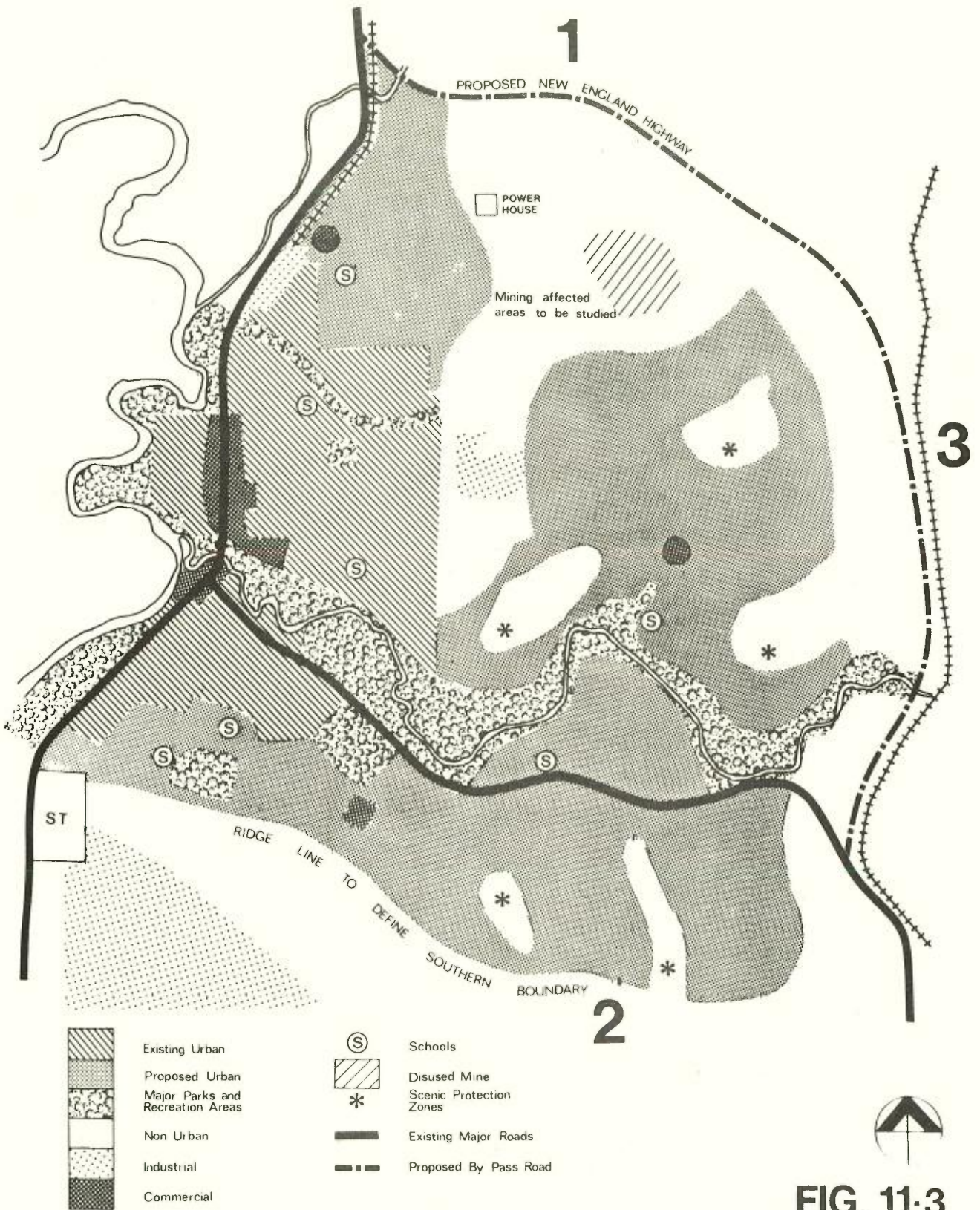


FIG. 11-3
TOWN OF MUSWELLBROOK
STRUCTURE PLAN



- . Eastern: north of the New England Highway and east of the existing town. Growth in this direction is relatively unconstrained. There are no flood liable lands and there is to be no mining in this area. There are some minor constraints due to topography, but these are not substantial.

It is considered that it is unlikely that a suitable development rate can be achieved unless development proceeds on these three fronts.

Allowance has been made within these residential areas for local open space, schools and neighbourhood shopping.

Consolidation of the business area is recommended due to the highly constrained nature of the town centre (see section 11.6).

There are a variety of business functions which should not be encouraged to locate in the retail hub. These include automotive, caravan and boat sales, automotive, agricultural and industrial supplies and similar functions. These functions have been allocated to the areas south of Muscle Creek along Denman Road and to Market Street and, to a lesser extent, to Bridge Street, north of the R.S.L. Club.

It is intended that small neighbourhood centres be established in new development areas. These centres contain neighbourhood functions such as: butcher, grocer, greengrocer, chemist, newsagent etc. and perhaps professional rooms for doctor, dentist and community functions such as child care. Precise locations of these centres will relate to size and distribution of population and should be more fully articulated in development control plans.

Industrial growth has been allocated to the low lying area around Ramrod Creek and the Mitchell Line of Road (see section 11.7). This area can thus act as a buffer zone between residential areas and mining areas to the south.

A major open space corridor is proposed along the low lying areas associated with Muscle Creek and the Hunter River which can provide for both active and passive recreation. The Muscle Creek corridor is well located for easy access from new development to the south and the east. These major areas can be supplemented with lesser corridors associated with water courses and by areas of scenic quality which are too steep for urban development. Consideration should be given also to the reclamation of some of the mine affected areas to the north for open space and playing fields associated with residential development in the north.

11.5 MUSWELLBROOK - RESIDENTIAL DEVELOPMENT

Many of the issues and considerations related to future residential development in Muswellbrook are discussed in Appendix 4. These, along with the historic buildings and precincts' recommendations contained within Chapter 16.0 and the details of servicing requirements in the 'Implications for Coal Related Growth Study'. (Gutteridge Haskins and Davey Pty. Ltd.), form the major part of recommendations to be made to Council on future residential development. In addition to the above, the following discussion on medium density development is considered to be relevant.

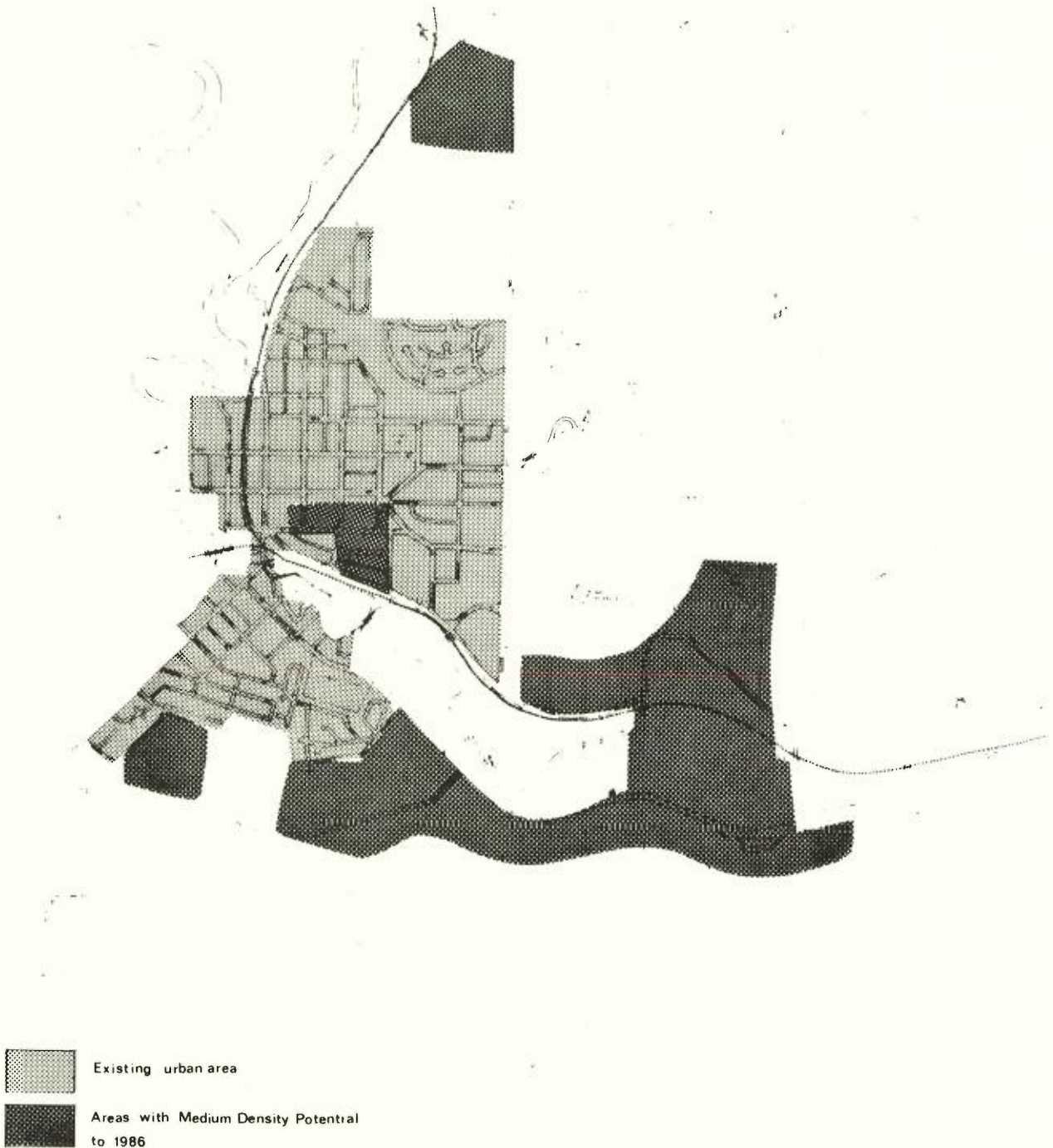
Medium Density Development

It is assumed that medium density can be developed in all areas other than those previously undermined or likely to be undermined. Infrastructure constraints are assumed surmountable by 1986. The areas shown on Figures 11.3 and 11.4 may require a higher than usual density in early years to meet demand for dwelling units, particularly if Black Hill Mine sterilizes substantial amounts of land in South Muswellbrook. A mix of densities is seen as desirable throughout the new development areas provided that the medium density is compatible in scale and character with surrounding low density development. Areas most suitable should be identified in Development Control Plans.

There are few areas within the existing town suitable for redevelopment at a higher density. Figure 11.5 indicates the general character of the existing town and points to areas where redevelopment may take place.

The following notes relate to the numerals on this figure.

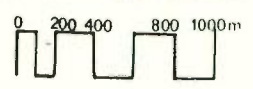
1. Town centre - no residential recommended.
2. Consolidated good quality older residential.
Redevelopment not to be encouraged.
3. Older residential, some steep slopes.
Encourage, perhaps reserve for, medium density
redevelopment.



Existing urban area
Areas with Medium Density Potential to 1986



FIG. 11-4
MEDIUM DENSITY POTENTIAL
1981-1986



1-9 Numbers relate directly to text

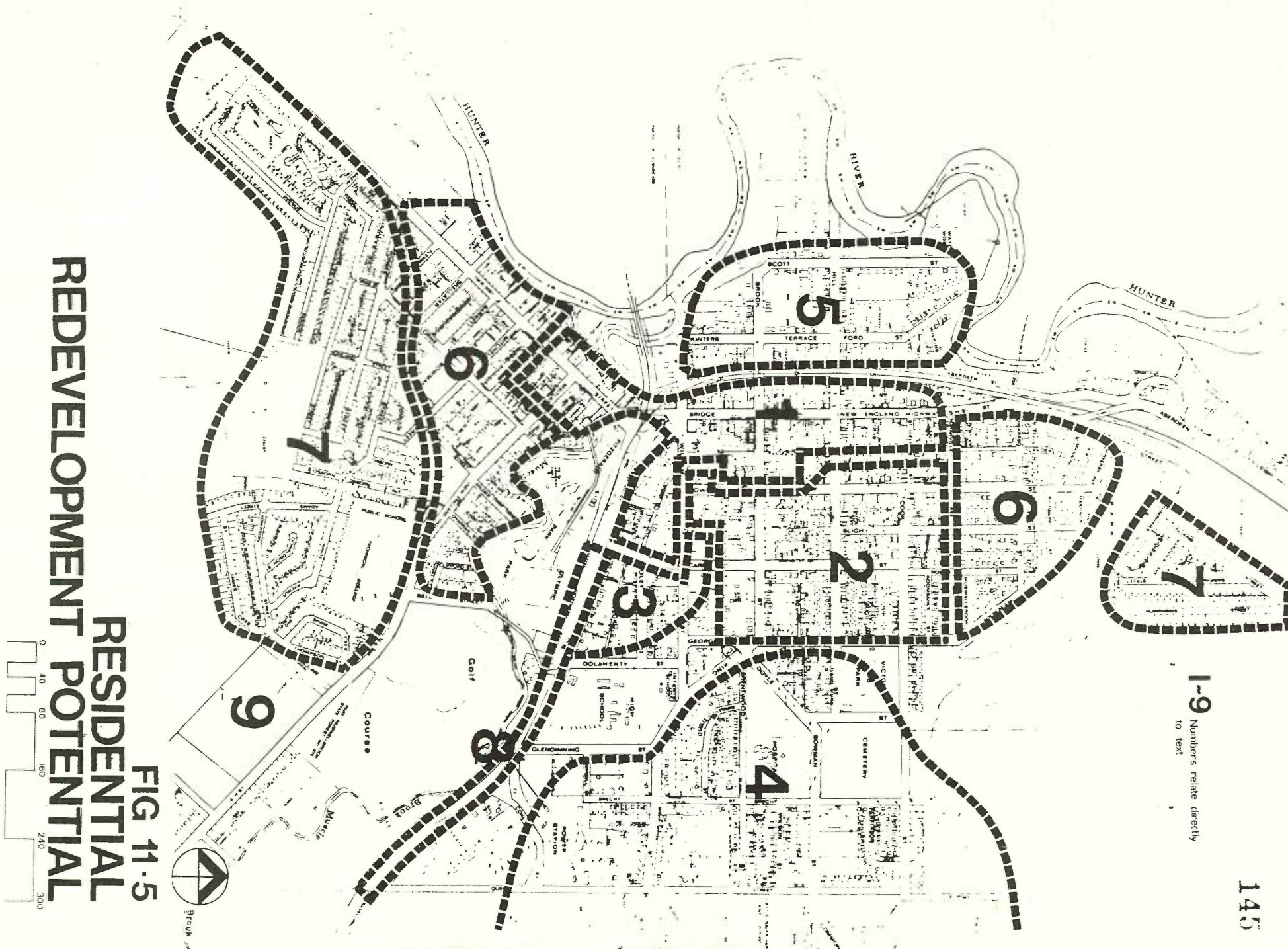


FIG 11-5
RESIDENTIAL
REDEVELOPMENT POTENTIAL

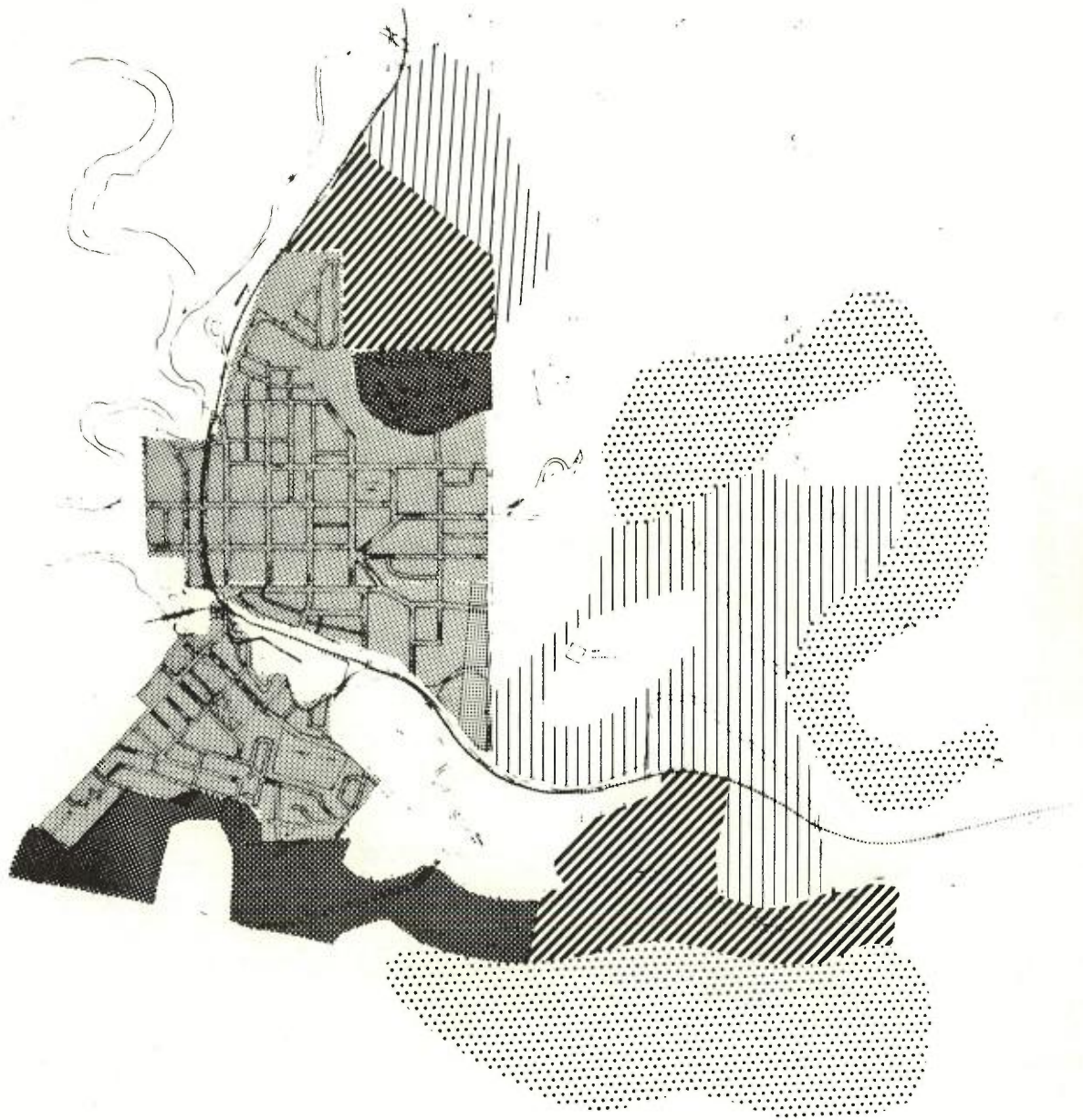
4. Undermined area - further investigation required to ascertain if there are areas sufficiently free from subsidence suitable for medium density. Generally the area is of mixed quality with many buildings suitable for replacement. Do not permit medium density until further investigations are carried out.
5. Flood liable land unsuitable for redevelopment.
6. Areas of varying housing type, quality and character - permit medium density redevelopment subject to general requirement of compatibility with surrounds.
7. New areas unlikely to be redeveloped in the short term.
8. Railway reservation - suitable for medium density redevelopment if railway were relocated with outlook over park and golf course.
9. Showground - suitable for medium density redevelopment if showground could be moved to racetrack.

Development Sequence Strategy

Table 11.2 compares the supply and demand situation in the 1981-1986 period for the two scenarios:

Case A: Mt. Sugarloaf Colliery's Mine at Black Hill proceeds, thereby restricting residential development in South Muswellbrook during the 1981-1986 period.

Case B: South Muswellbrook land not affected by the Black Hill Mine.



Land Developed
By Year

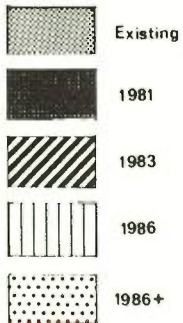
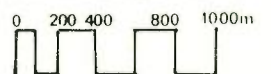
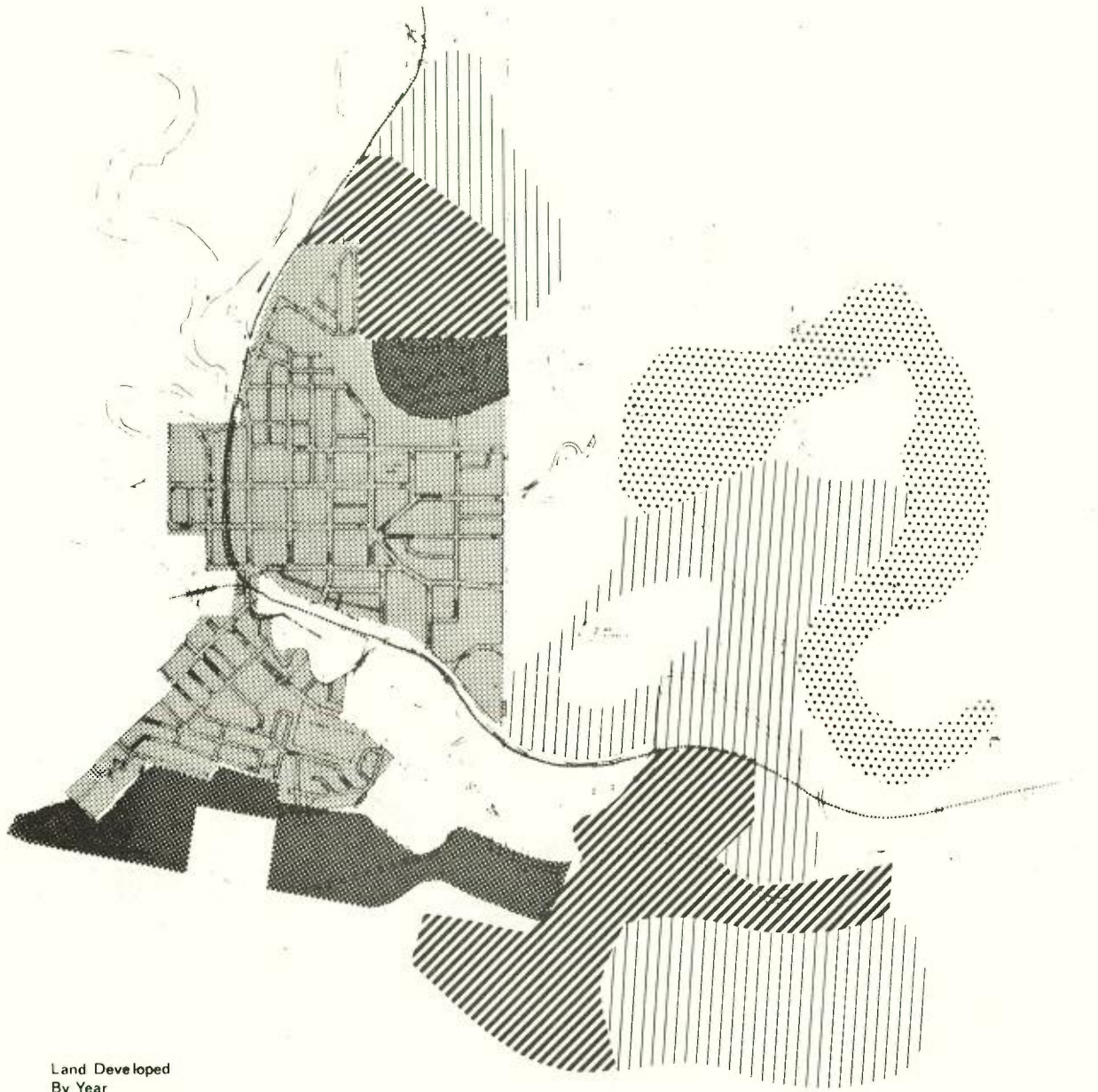


FIG. 11-6
PHASING PLAN
CASE A





Land Developed
By Year






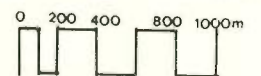
-  Existing
-  1981
-  1983
-  1986
-  1986+



FIG. 11-7
PHASING PLAN
CASE B



It also compares demand for land when the medium density component is increased and shows what percentage of available lots must be developed to satisfy demand.

It can be seen from Table 11.2 that for Case A there is considerable difficulty matching supply with demand particularly during the 1981-1986 period whereas for Case B little difficulty would be expected.

Table 11.2: Supply and Demand for Residential Lots

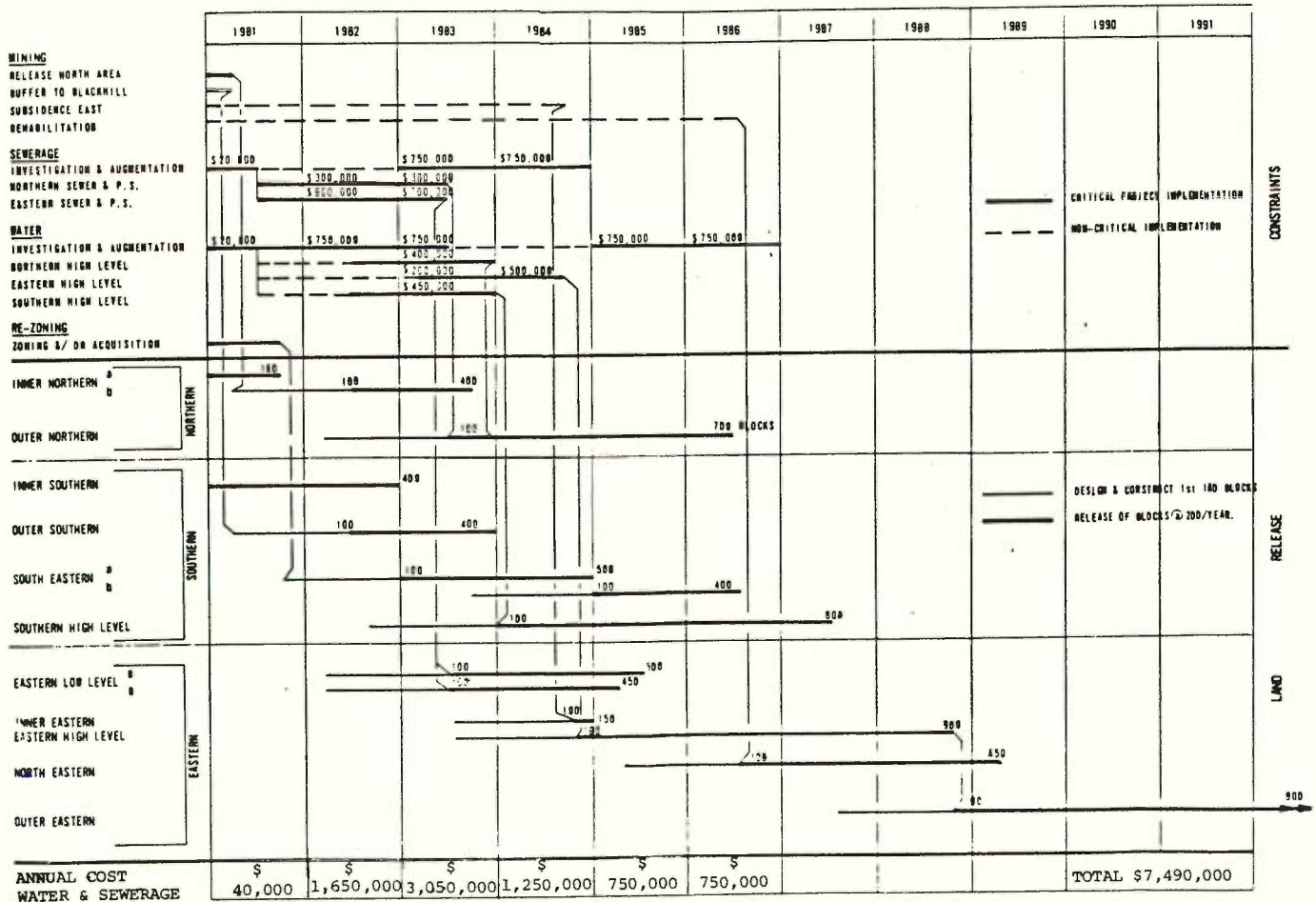
Year	<u>DEMAND</u>		<u>SUPPLY</u>		
	(lots)	CASE A (lots)	% development required	CASE B (lots)	% development required
1981		360		360	
1982		400		700	
1983		<u>950</u>		<u>950</u>	
		1,710		2,010	
		- 280***		- 280	
1983	985	1,430	69	1,730	57
	838*		59		48
	689**		49		40
1984		850		850	
1985		550		950	
1986		<u>300</u>		<u>600</u>	
		1,700		2,400	
		- 280		- 280	
1986	1,435	1,420	100	2,120	68
	1,220*		86		58
	1,005**		71		47

* Equivalent number of lots assuming 25% medium density.
 ** Equivalent number of lots assuming 50% medium density.
 *** 280 lots equivalent to one year's surplus (based on average number of lots/year 1981-1991).

Demand drops off rapidly for the period 1986-1991 and, providing that supply has been kept up during the preceding period, there should be a few problems in providing an adequate and regular supply of lots through to 1991.

Table 11.3 prepared by Gutteridge Haskins and Davey indicates the approximate number of lots which can be produced related to capacity to service land etc. This information has been used in conjunction with the latest population projections to indicate possible phasing plans for the development of residential land for Case A (Figure 11.6) and Case B (Figure 11.7).

TABLE 11.3 Land Release and Infrastructure Programme



Source: Gutteridge Haskins and Davey Pty. Limited - Introduction to Expected Growth and Augmentation of Utilities - December 1980.

11.6 MUSWELLBROOK - TOWN CENTRE

This section discusses the development of the town centre in some detail. Critical issues appear to be:

- . Conflict between heavy through traffic, local traffic and pedestrians.
- . Growth being constrained by topography and flood liability.
- . A conflict exists between the need to provide for expansion and the need to conserve the existing townscape.

Summary

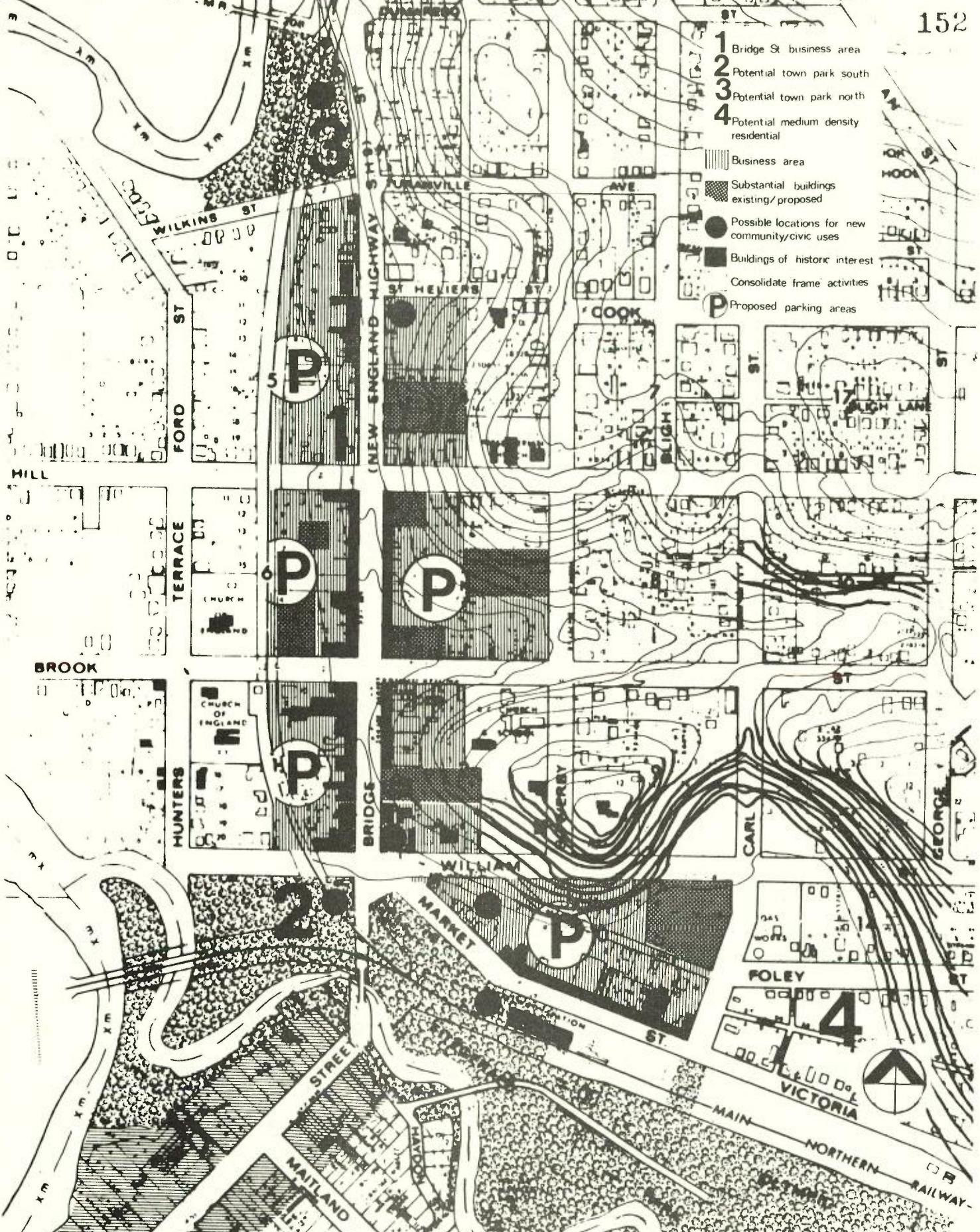
Figure 11.8 summarises the development opportunities outlined in the following section. The numbers on the map refer to the points below:

- 1) Concentrate business area along Bridge Street spine between William and Wilkins Streets as shown. Allow for further growth between Market and William Streets with possibility of further growth on railway land if railway moves and maintain area between rail and Hunter Terrace and William and Hill Streets (excluding church lands) in low density residential as future supply. Allow and encourage frame area uses to continue to cluster on the northern and southern extremities of the business area.

Programme streetscape improvements to Bridge Street with street planting and strategic footpath widening between Hill and William Streets.

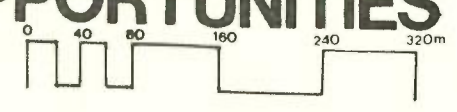
Preserve historic buildings wherever possible and ensure new development is harmonious in scale and character (particularly between Hill and William Streets). Develop continuous awning where possible.

Develop parking areas as shown at rear of Bridge Street using railway corridor as access. Develop through-site connections to Bridge Street.



- 1 Bridge St business area
 - 2 Potential town park south
 - 3 Potential town park north
 - 4 Potential medium density residential
- Business area
 - Substantial buildings existing/proposed
 - Possible locations for new community/civic uses
 - Buildings of historic interest
 - Consolidate frame activities
 - P Proposed parking areas

**MUSWELLBROOK TOWN CENTRE
DEVELOPMENT OPPORTUNITIES**
FIG. 11-8



Identify sites for future commercial development or redevelopment. Consider possibilities of site amalgamation to create commercial landbank.

- 2) Develop continuous park system along banks of Muscle Creek to the Hunter River. This will create an "entrance" to the business centre where Bridge Street crosses Muscle Creek. This area would make an excellent town park, providing a much needed "rest area" adjacent to the business centre.
- 3) Develop northern town park between Bridge Streets and Hunter River providing a green space to this end of town, if and when the railway is relocated.
- 4) Allow medium/high density development in basin area from railway to William Street and consider possibility of medium density on the steep slopes.

Assess possible alternative locations for civic and community buildings. Examine future needs of Council and carefully investigate these sites to select the most appropriate.

It will be necessary for Council to give careful consideration to measures which:

- . Divert heavy traffic around the town.
- . Ensure that adequate well located sites are available to meet future demand for retail and commercial floor space. These should suit both small and large projects.
- . Ensure adequate provision of parking to cope with existing demand and future demand.
- . Manage movement to and from parking areas.
- . Improve pedestrian environment.
- . Improve the image and attractiveness of the town centre for worker and shopper comfort and convenience, preserving and enhancing historic buildings and streetscapes and cultivating street trees for shade and beauty.

Constraints to Town Centre Development

The following descriptions relate to the numerals on Figure 11.9.

1) Flood Liable Land (100 year flood)

Flooding of the Hunter River occurs regularly to much of the land lying west of the railway line limiting the potential for redevelopment. Only under exceptional circumstances are areas to the east of the line affected and then only a small area between Market and Foley Streets. The New England Highway is cut at Muscle Creek by a 1 in 20 year flood level.

2) William Street Escarpment

This escarpment makes north-south travel difficult in this area and limits the development potential of the land. From the ridge and upper slopes, however, pleasant views are afforded of the parklands associated with the Muscle Creek floodplain.

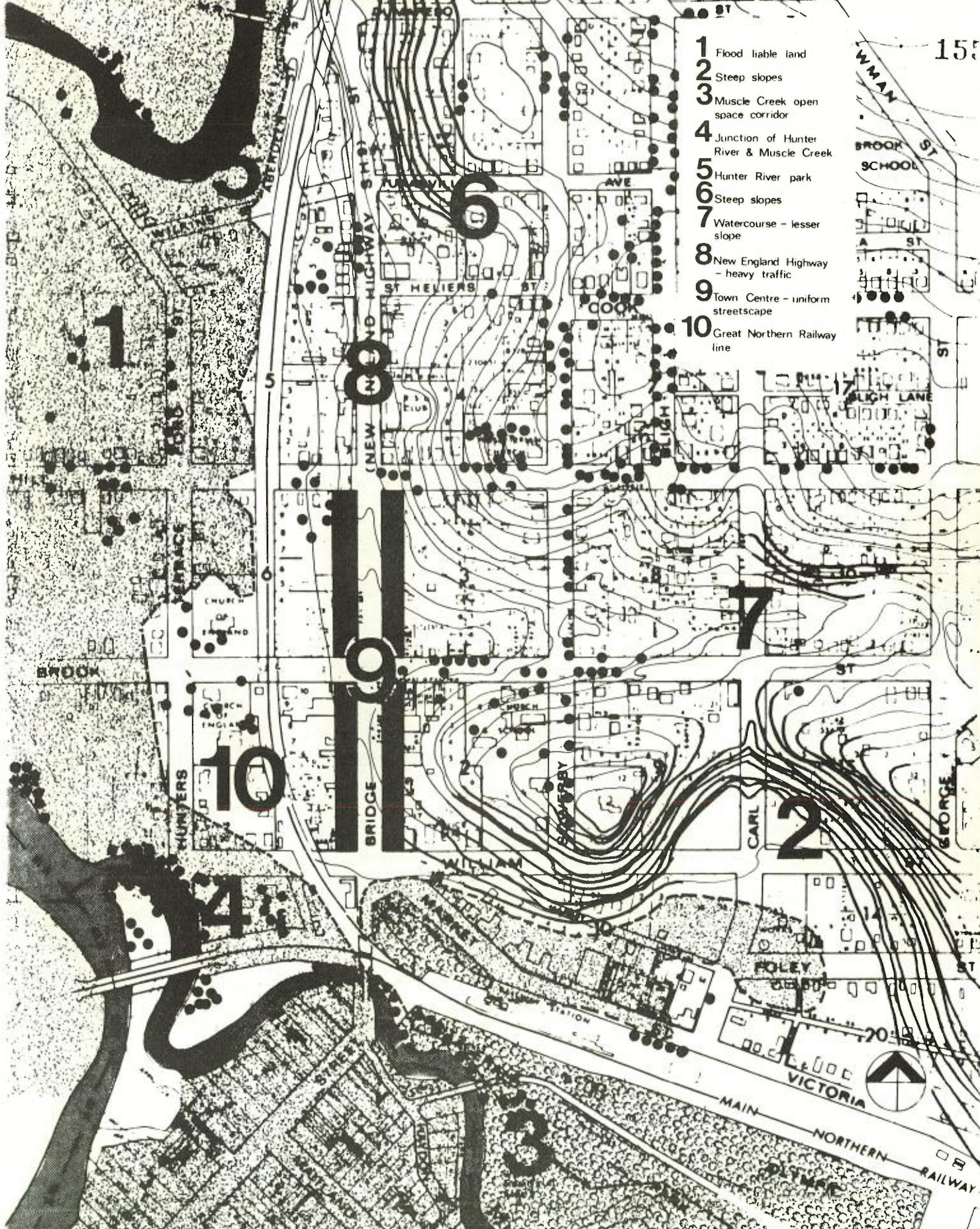
The ridge associated with this steep land effectively separates the Bridge Street business area from the scattered businesses in Market Street and limits the possibility of substantial commercial development in the Market Street area.

3) Olympic Park-Muscle Creek Flood Plain

The Muscle Creek flood plain contains most of the town's recreational resources (Olympic Pool, Bowling Club etc. and further upstream the Golf Course). Unfortunately the access to this resource is poor due to the limited rail crossings (Bridge Street and Bell Street).

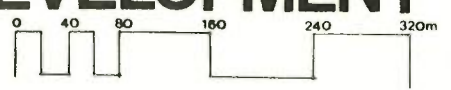
4) Junction of Muscle Creek and Hunter River

The scenic quality of the junction between the Hunter and the creek from which the town draws its name is obscured from view by roads, railway lines and low intensity uses. The opportunity exists, if the railway were to be removed, to create a town park of major significance.



- 1 Flood liable land
- 2 Steep slopes
- 3 Muscle Creek open space corridor
- 4 Junction of Hunter River & Muscle Creek
- 5 Hunter River park
- 6 Steep slopes
- 7 Watercourse - lesser slope
- 8 New England Highway - heavy traffic
- 9 Town Centre - uniform streetscape
- 10 Great Northern Railway line

MUSWELLBROOK TOWN CENTRE
CONSTRAINTS TO DEVELOPMENT
 FIG.11-9



5) Hunter River - Kyuga Road (M.R. 208)

The Hunter River again approaches the town centre at this point and is again separated from it visually and physically by the railway line. The opportunity exists for the establishment of another fine park in this location pending, of course, the removal of the railway.

6) Steep Slopes Down to Bridge Street

The steepness of the landform in the proximity of Bridge Street has constrained the expansion of the business area and will continue to do so. Business premises can effectively only expect to stretch half a block back from Bridge Street before encountering very steep slopes, except in the case of Brook Street.

7) Brook Street

Brook Street follows a watercourse between two spurs and consequently is of substantially lesser slope than other east-west streets. It is consequently the major east-west street and has a generous reservation with a landscaped central median strip. Commercial development has penetrated a little further into the residential area here for this reason.

8) New England Highway

The Highway passes right through the main business area of town causing conflicts between pedestrian and vehicle, local traffic and heavy through traffic. This will be substantially exacerbated by increased heavy vehicle movements associated with coal related development.

9) Townscape - Bridge Street Precinct (between William and Hill Streets)

The main shopping area: These two blocks are of harmonious scale and character. The continuous two storey traditional commercial and retail buildings create an image of Muswellbrook which, whilst not of exceptional quality, contains some significant buildings (see Chapter 6). The best of these buildings should be preserved and new buildings should be of similar scale and character.

Other significant groups of buildings occur in Hunters Terrace, Market Street and Bridge Street North (Eatons Hotel).

10) The Main Northern Railway Line

The main northern railway passes right through the middle of town, half a street block from Bridge Street, limiting the possibility of commercial expansion and strongly separating the town from the river. It is joined by the Sandy Hollow line at the southern end of the main street and then heads east where the severing effect on the town is again in evidence, separating the major part of town from the recreational facilities on Muscle Creek. Dramatically increased rail transport of coal etc. will severely affect the amenity of the existing town and substantially limit opportunities for growth.

Town Centre Development Opportunities

It would appear that there is adequate zoned land in Muswellbrook Town Centre to cope with retail, commercial and parking demand for the next 10 years. Topographic constraints limit the potential for rezoning further land and it would thus be more appropriate to concentrate on management policies.

Opportunities for redevelopment of quite substantial sites (once amalgamated) exist in almost every block. These possibilities are discussed on a block by block basis below and relate to figure 11.10.

Block 1

Highest existing f.s.r. in town, approximately 0.54:1. Predominantly retail use (43%) very high vacancy (23%) substantial but unco-ordinated parking available. High conservation value. This block has very little potential for new development as it contains many fine historic buildings which substantially contribute to the townscape of Muswellbrook. However, much of the vacancy could be taken up for office space when demand increases if these buildings were sensitively restored. This could contribute a further 2,200m² of floor space. Further parking could be provided if the railway were removed (approximately 120 cars).

Block 2

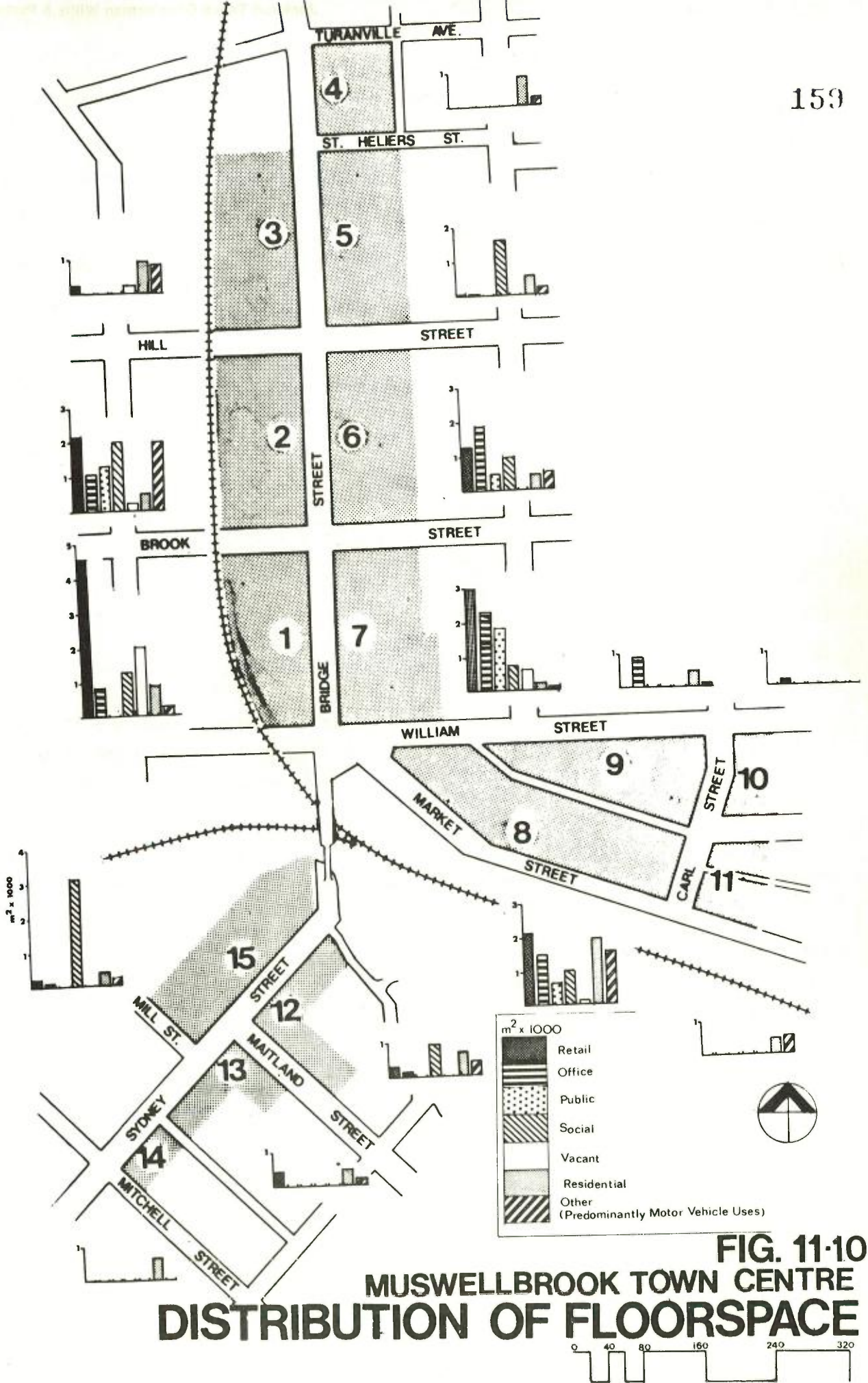
F.s.r. 0.46:1 mixed uses, little vacancy, 24% retail, some historic buildings, car sales site could be redeveloped as could residential properties on Hill Street. It is possible to gain a further 5,000 to 6,000m² of floor space in this block, plus accommodate another 80 cars and a further 120 cars if the railway were removed.

Block 3

Low intensity use, low site cover 0.11:1, 40% residential. High redevelopment potential south of Eaton's Hotel group for mixed retail, commercial development with parking. Possibly some 8,500m² of floor space and 100 cars with further 120 cars if railway were removed. Encourage preservation and rehabilitation of Eaton's Hotel group.

Block 4

Little redevelopment potential due to predominant residential nature of the block and steep slopes.



Block 5

Limited redevelopment potential low f.s.r. 0.11:1, predominantly residential except for R.S.L. Club. Topography constrains development away from Bridge Street.

Block 6

F.s.r. 0.33:1, mixed uses 35% office, 21% social, 20% retail. Approved new development on this block will yield 6,000m² with 200 car spaces. There is still potential for further development in this block to Brook Street and for small scale redevelopment to Bridge Street connecting through to the new shopping centre. Further new development in this block would yield a further 2,400m² and about 50 cars.

Block 7

F.s.r. 0.45:1, predominantly retail (40%) and public with 15% vacancy. There is some redevelopment potential for the arcade, cinema site and vacant land to the rear. Topography makes it difficult but not unfeasible. Potential yield is 3,500m² retail and commercial plus 80-100 cars.

New community or commercial functions are required for the old council buildings where rehabilitation is desirable.

If the church school was to move, then consideration could be given to allowing further business activity to the Brook Street frontage of this site. The rest of this site would seem unsuitable due to its extremely steep nature.

Blocks 8 and 9

Very low f.s.r. 0.3:1 and 0.1:1, mixed development.

Redevelopment should be restrained in this area until absolutely necessary due to poor connection with Bridge Street. If, however, there is an urgent demand for a large amount of floorspace, then this is the place to get it. Sensible site amalgamations here could yield in excess of 7,000m² plus parking for 120 cars. If ever there was a need for structured parking the level change between Market and William Streets would suit admirably. The Market Street historic precinct should be preserved and rehabilitated. The following table summarises the above description.

Table 11.4: Potential Floor Space and Parking Supply

Block	Approx. Existing f.s.r.	Estimated Potential New Floor-space m ²	Estimated Number of New Parking Spaces Possible
1	0.54	2,200	20 (120)
2	0.46	6,000	80 (120)
3	0.11	8,500	100 (120)
4	-	-	-
5	0.11	-	-
6	0.33	2,400*	50
7	0.45	3,500	100
8	0.3	7,000	120
9	0.1		
		29,600	470 (360)

(Additional spaces available if railway is relocated.)

* excluding 6,000m² recently approved

Thus it can be seen that by careful management of land resources there is ample potential for future development within the existing town centre by amalgamating sites and increasing the development intensity. Parking space at grade can be provided for 460-800 cars. There are currently approximately 1,450 car spaces in the town centre (approximately 6.6 car spaces/100m² floor space). At a similar rate this indicates a need to provide a further 225 cars off street.

Commercial floorspace can generally be provided on floors above retail development. Mixed development of this kind should be encouraged. Office buildings without retail at street level should be discouraged particularly in blocks 1, 2, 6 and 7, except to the Brook Street frontage between Bridge and Sowerby Streets.

Council's Role in Managing Town Centre Growth

Council should formulate policies on its role in land management in the Town Centre. The most obvious area where action is required is in regard to parking.

As the centre grows, parking must be provided in an orderly and rational fashion. As indicated earlier, there is ample space to the rear of the properties fronting Bridge Street, particularly on the western side.

Council can involve itself in this in a number of ways. Council could:

- . Designate areas where it believes parking should be provided and depend on private developers to supply it according to a satisfactory parking code.
- . Actively encourage and co-ordinate the provision of spaces by private developers.
- . Collect parking contributions from development and use the money to purchase land and develop car parks on a block by block basis.

Access and egress to and from central block parking areas should be, wherever possible, onto east-west streets to reduce traffic congestion at intersections and maintain flow in Bridge Street.

On a more significant scale Council must decide whether it should play an active role in property amalgamation for commercial development by developing a commercial landbank. Council could, over a period of time, amalgamate sites in strategic locations either leasing the properties to cover costs and/or using them for free parking. Council could then sell at the appropriate time to a developer or major retailer and use the funds derived for providing further parking or further amalgamations.

The benefits derived from such operations include:

- . The ability to direct business expansion into those desired areas which will strengthen the town centre structure.
- . The ability to develop a system of mid block parking areas in an orderly fashion at little cost to the community.

Pedestrian Movement

Consideration should be given with further development to ways in which pedestrian amenity can be improved:

- . Walking distances should be minimised.
- . Shade and shelter should be provided.
- . An interesting environment should be created.
- . Pedestrian/vehicle conflicts should be minimised.

Some means of obtaining these objectives are mentioned below:

- . Arcades and through site links to parking areas should be encouraged.
- . Retail and business areas should be concentrated, as far as possible, to allow one stop shopping. This, in effect, means that Council should restrict uses within the hub area of the town centre. Motor vehicle sales, specialised machinery, motels etc. are not uses which should be encouraged in the centre.
- . Continuous shelter and shade should be provided to the footpaths. Thus awnings, verandahs, etc. should be obligatory, even for bank and institutional buildings.
- . Footpath crossings should be minimised on Bridge Street. Access to parking areas should occur on east-west streets where there are lesser pedestrian concentrations.

Landscaping and Environmental Improvement

There is a need for shade, particularly on the east side of Bridge Street where the strong afternoon westerly sun penetrates right under awnings. Extensive tree planting of heavily canopied deciduous trees will not only provide the shade when needed in summer but also soften the streetscape.

If the railway is relocated, possibilities exist for the establishment of two exceptional town parks at either end of the town centre. At the

southern end a magnificent opportunity exists south of William Street and west of Bridge Street to create a major park running down to Muscle Creek and connecting through to the junction with the Hunter River. This would require quite extensive works but could produce a park of premier quality. At the northern end of town a similar opportunity would exist on relocation of rail for a substantial riverside park between M.R.208 and Wilkins Street. This would define the northern extremity of the town.

General improvements could also be made with the introduction of a well designed co-ordinated set of street furniture (seats, litter bins, public notice boards, etc.).

Railway Relocation

The relocation of the railway would allow the release of approximately seven hectares of flood-free flat land adjacent to the existing business centre. Although little of this land could be used directly for business development, it would aid the functioning of the town centre in a significant number of ways. It could:

- . Improve traffic circulation significantly in the town centre by opening up all east-west streets currently blocked by the rail line or constrained by level crossings.
- . Give substantially better access to parking areas located at the rear of the Bridge Street shopping area.
- . Provide more land for the construction of these parking areas which in turn would allow more efficient redevelopment and greater site cover to shops fronting Bridge Street.
- . Provide access to areas of significant environmental quality which could be developed as town parks to improve the amenity of the town centre.
- . Provide excellent sites for the development of new community and civic functions which would otherwise be required to compete with commercial interests for town centre sites.

- . Provide improved access from the northern parts of town to the south and vice versa. This is particularly significant for northern residents wishing to use the recreational facilities on Muscle Creek and for southern residents wishing to use the town centre.
- . Provide seven hectares of land suited to medium density housing with views across the Muscle Creek floodplain.
- . Allow for the creation of a cycleway connecting northern areas and eastern areas with expanded recreational and community facilities on Muscle Creek.

Civic and Community Buildings

Increased development of the Muswellbrook Town Centre will reduce the number of potential sites available for Council to upgrade or relocate its chamber and offices and locate other civic buildings. It would seem appropriate at this time for Council to formulate a policy on future civic and administrative needs and select a suitable site. Possible sites which should be considered include:

- . Market-William Street area opposite existing chambers.
- . Bridge and William Street corner redevelopment of old Town Hall.
- . Bridge Street just north of R.S.L. Club.

and if the railway were to be relocated:

- . Alongside the railway station perhaps including reuse of the station building.
- . In a potential parkland setting on the south-west corner of William and Bridge Streets.
- . In potential parkland setting between William, Bridge Street, M.R. 208 and the Hunter River.

It is suggested that a thorough investigation should be carried out to compare these (and other) sites in terms of: Relationship to and effects on the town centre, expansion potential, image, convenience, cost, timing and environmental impact.

11.7 MUSWELLBROOK - INDUSTRIAL AREAS

At the present moment it is estimated that there are approximately 40 hectares of industrial land available, all of which can be found in Council's new industrial estate along the Mitchell Line of Road.

The basis of Council's industrial strategy should be to encourage all new industrial development to occur in the industrial estate and to encourage the eventual relocation of a number of industrial developments from other parts of town to this estate.

The prime reasons for this are:

1. Ample land is available in and adjacent to the new industrial estate. This land is visually shielded from residential areas and would be served by the future rail loop. It will also serve as a buffer between the town and extractive industries to the south.
2. The existing industrial area on East Common Road is visually intrusive and will act to separate the existing town from new development to the east.
3. Land more central to the existing town associated with the existing railway would be better used for business uses. These industries could, in some cases, hold up relocation of the railway line or be rendered redundant by relocation of the railway line.
4. Uses associated with the Highway and main roads within the town would be better located out of town, thus removing conflicts between industrial traffic and local traffic.

Thus the industrial strategies may be stated as follows:

1. Encourage new industrial development to locate in the industrial estate on Mitchell Line of Road.

2. Encourage, over time, relocation where possible of industrial development from East Muswellbrook to the new industrial estate. Where this is not feasible, then encourage environmental improvements. Discourage further development in this area or restrict it to non noxious and non intrusive development.
3. Encourage over time relocation of industrial uses adjacent to railway land within Muswellbrook town to relocate to the new industrial estate.

11.8 MUSWELLBROOK - OPEN SPACE

A survey of open space existing in Muswellbrook and Denman was carried out in December 1980 as part of the Land Use Survey¹. The results of that survey show that there are approximately 21.0 hectares of open space in Muswellbrook² (both passive open space and active). Given the current population, this means that Muswellbrook has 2.4 hectares of open space per 1,000 population.

To maintain this level it would be necessary to acquire at least 3.65 hectares per annum during the period 1981-1991.

As established in the social survey (see Appendices 1 and 2) open space, particularly for active recreation, is currently heavily utilised. It is therefore considered that a level of provision similar to the present is necessary to ensure these standards are at least maintained.

- 1 See Survey Questionnaire at Appendix 3 and details of Survey within Appendix 1.
- 2 Of these 21 hectares approximately 8.0 hectares have been assessed as usable active open space and 13.0 hectares as usable passive open space. The Common area in East Muswellbrook, although intended originally for recreational purposes, has been considered as unsuitable because of its mine subsidence problems and unattractive appearance.

At the commonly accepted standard of 2.8 hectares/1,000 population³, there is at present adequate open space. However, since these standards are based on an urban situation and not a rural one, it is considered more appropriate to use a slightly higher figure to project future provision, that is, 3.0 hectares/1,000 population⁴.

Based on this figure, the following table outlines the additional open space requirements.

Table 11.5: Open Space Requirements 1983-1991 - Muswellbrook

	Population	Passive	Active	Total (ha)
Level of Provision (ha/1,000 population)		1.3	1.7	3.0
<u>Existing</u>				
1981	8,707	13.0	8.0	21.0
<u>Required</u>				
1983	12,600	16.4	22.0	38.0
1986	16,300	21.0	28.0	49.0
1991	16,700	22	28.4	50

11.9 MUSWELLBROOK - WATER AND SEWERAGE

(See Table 11.3 for relationship of servicing to lot production.) For a full explanation of needs and costs of engineering infrastructure, see Gutteridge Haskins and Davey "Muswellbrook Community Impact Study" December 1980. The following is a summary of that report.

Muswellbrook Water Supply

Option 1 - provide storage.

Storages of 77+ML and 130+ML in 1986 and 1991 would obviate the need for duplication of the extraction/treatment/delivery system. Cost is approximately \$3.55 million.

3 Sydney Region Open Space Survey 1975 -
New South Wales Department of Environment and Planning

4 Department of Environment and Planning Standards (refer footnote(3) assume a ratio of 1.6 hectares passive to 1.21 hectares active open space for every 2.8 hectares total. The same ratio has been used for Table 11.5.

Option 2 - provide duplicate intake works/treatment etc. and storage for two summer days at a cost of approximately \$3.57 million.

Costs are of similar magnitude but Option 2 allows for staging, that is, enlargement of storage.

Distribution to property boundaries would cost an estimated \$2 million.

Total costs are likely to be upward of \$5.5 million or \$2,750 per block. In the case of Option 1, staging of works could be planned to match development and thus be proportional to the rate of lots developed.

Muswellbrook Sewerage Augmentation

From all reports and descriptions, the existing collection transfer and treatment system is already fully committed and, in some areas, overloaded.

About 640 blocks north of the Newman Street-Cook Street development require service as do the 1,360 blocks needed by the year 1991 which lie to the east of the north-south Queen Street axis. Beyond 1991, there is potential for further expansion and development in the easterly direction.

As the water supply intake is downstream of the northern development areas, and the majority of the development eastward is drained by Muscle Brook, the additional treatment capacity required would logically be provided as an extension to the existing works.

It is considered that all development areas east of the Queen Street axis can and should be gravitated to a major pump station adjacent to Muscle Brook for pumping direct to the treatment works.

Similarly, it is believed that the northern development can mostly be drained to a single pump installation adjacent to the industrial area discharging direct to the Treatment Works. To relieve the load on the "old" town system, discharge from the pump station adjacent to Humphries Street could also be led to the main northern pump station.

Both the main new pump and rising main installation would require "in pipe" treatment to control hydrogen sulphide and odour generation.

In the case of the eastern Muscle Brook installation, there is the possibility of using spare capacity in the twin 300 diameter rising mains recently constructed by Council. There is also potential for utilising development sewage contributions for Council's new pump station adjacent to the New England Highway, at least for a few years.

The cost of the northern and eastern pumping stations and their associated rising mains and odour control facilities would be \$490,000 and \$520,000 respectively.

A Treatment Works augmentation of the extended aeration/oxidation channel variety complete with maturation lagoons, etc. to cater for 7,000 people would cost about \$1,000,000.

Reticulation, carrier mains, etc. would cost an estimated \$1,800,000. Thus the overall cost of providing a sewerage service to the 2,000 new blocks would total about \$3,810,000.

While reticulation expenditure would match the rate of land development, pumping station facilities would be required immediately and the treatment works could be sensibly built in two stages.

Table 11.6: Cost Distribution of Augmentation - Muswellbrook

Year	Cumulative Dwellings	Water (\$'000)		Sewerage (\$'000)		Temporary Carrier & Eastern Pump Station	Total
		Storage	High Level Storage	Northern Pump Station & Carrier	Treatment		
1981	60	-	-	49	-	-	49
1982	190	-	-	343	-	100	443
1983	470	-	-	98	335	-	433
1984	850	-	-	-	335	130	465
1985	1,230	375	-	-	-	260	635
1986	1,500	750	-	-	-	130	880
1987	1,690	375	275	-	-	-	650
1988	1,770	-	275	-	165	-	440
1989	1,830	375	-	-	165	-	540
1990	1,880	750	-	-	-	-	750
1991	1,930	375	-	-	-	-	375
Total Cost		3,000	550	490	1,000	620	5,660

11.10 DENMAN

The Likely Scale of Growth

Population projections indicate the following residential land demand for Denman:

	<u>1981</u>	<u>1983</u>	<u>1986</u>	<u>1991</u>
Cumulative Population	900	1500	2500	2500
Population Increase		<u>600</u>	<u>900</u>	<u>100</u>
Number of Lots Required		<u>171</u>	<u>257</u>	<u>30</u>

Assuming new development is essentially low density, this suggests a need for approximately 450 lots by 1991.

Constraints to Growth

There are a number of physical constraints to the growth of the town of Denman. These are illustrated on Figure 11.11 and are described below.

- 1) Denman is partially built on flood liable land. The low lying flood plains of the Hunter River and Sandy Creek form a major natural constraint to development in the east.
- 2) West of the town the land rises very steeply.
- 3) The recreational areas of Denman Park limit the direction of future development to the north-west and to the Crown lands west of Virginia Street.
- 4) The auto/train conflict at the railway level crossings will be exacerbated by dramatic increase in rail traffic and by the number of new residences created to the west of the line. Grade separation could cost up to \$1 million and could not be justified by the projected population increase.

Increased rail traffic will generate noise nuisance to residential development adjacent to the railway line.

172

2

4

3

1

- 1 Flood Liable Land
- 2 Steep Slopes
- 3 Denman Common
- 4 Railway Line



FIG. 11-11
DENMAN CONSTRAINTS



Structure Plan

This section briefly describes the structure plan for Denman as illustrated at Figure 11.12.

Both water and sewerage systems require attention in Denman. This, however, should not severely constrain development provided that such works be undertaken as a matter of urgency and that development proceed in the two areas identified as areas 3 on the plan. Consideration should be given to buffer zones or noise attenuation mechanisms adjacent to the railway line.

The exaggerated north-south sprawl of the town should not be continued whilst suitable residential land remains close in to the west, particularly since development has begun of some 580 lots on the western side of the railway line by the Lands Department and potential for approximately 450 lots exists further to the south-west.

The existing residential area (that is, area 1 on Figure 11.13) should be consolidated with appropriate infill development. Although there has been some recent medium density residential development, it is not envisaged that a significant demand exists for this form of accommodation other than of a low/medium density nature.

The Denman Town Centre is concentrated on Ogilvie Street, primarily between Paxton and Palace Streets. The town centre is of pleasing character, largely due to the rustic nature of the largely free-standing weatherboard shops with their awnings supported by kerbside posts. Ogilvie Street has a degree of rural charm yet much of the building stock is old and in relatively poor condition. It is likely that some of it at least will need to be replaced in the near future.

Part of the existing shopping area is flood liable, consequently no further development should be permitted in these areas.

The trade area of Denman covers an area extending to Baerami in the west, Merriwa in the north-west, Jerry's Plains in the east and Bureen in the south. This covers approximately 700 households (250 in Denman town).

It is expected that by 1986, the demand for retail floorspace could increase by the order of 2,500m.

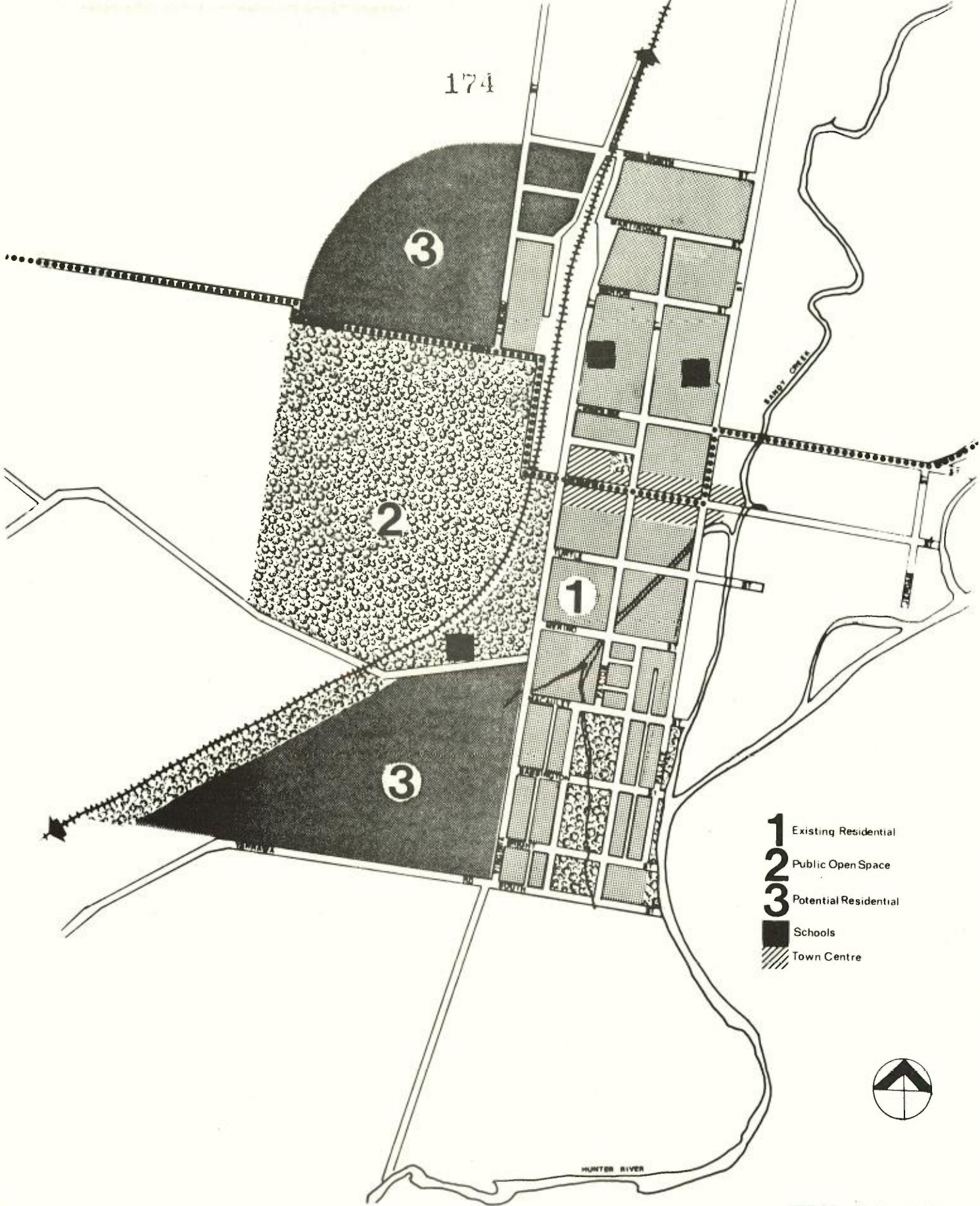


FIG. 11-12
DENMAN STRUCTURE
PLAN

The Retail Core should be contained to Ogilvie Street frontages between Virginia and Palace Streets.

It is recommended that the existing commercial area be maintained as the core to a slightly expanded town centre, that action be taken wherever possible to preserve the weatherboard shop buildings that provide considerable character and that redevelopment be encouraged on infill sites and where the building condition is beyond salvation.

Opportunities for site amalgamations and redevelopment be explored in the area between Paxton and Virginia and Ogilvie and Isobel Streets (for example Winns and Telecom).

There may be a need for small scale neighbourhood shopping facilities with new development. Such centres would consist only of 3 or 4 local shops, perhaps a doctor and day care or similar community facility.

Denman presently has some 30 hectares of land set aside for active and passive recreation (see area 2 on figure 11.12). As the current population is around 850 and the projected population is not expected to exceed 2,500 by 1991, it is considered that ample open space has been provided, particularly for the period 1981-1991. Further opportunities for open space development exist in the southern portion of area 1.

Water and Sewerage

For a full explanation of needs and costs, refer to Gutteridge Haskins and Davey report titled 'Muswellbrook Community Impact Study' December 1980.

Denman Water Supply

Currently, difficulty is being experienced in obtaining full supply from the existing source by extraction direct from the Hunter River.

At the moment, apparently only chlorination of water is provided. Because of present difficulties in obtaining underground water, it is assumed for this evaluation that supply will come from the Hunter and require treatment. Further, because of the potential for interruption to supply by flooding, it is judged prudent to provide six to seven days' storage capacity at average usage (that is, an additional 12 ML - provided by a conventionally roofed membrane lined tank).

The costs involved would be approximately as follows: \$2,030,000.

For the 500 new blocks envisaged, cost would be about \$3,600 per block.

Since the existing scheme is apparently at its limit, expenditure on intake, treatment and storage works would be required at an early date, while gravity mains reticulation could be installed to keep pace with development.

It should be noted that intake, treatment and storage works have been sized to cater for growth and existing supply. Also, as 300 of the existing lots in Denman could be used for building, reticulation costs may be less than indicated.

Denman Sewerage

The existing scheme was designed for 1,000 E.P. and is now operating under full load.

For the development of all the 506 blocks required outside the existing town periphery, a completely independent collection system can be provided, discharging to an augmented treatment system adjacent to the existing plant. Because of relative elevations, it is believed that a satisfactory syphon system could be constructed under the creek separating the treatment plant from new development, thus eliminating a pump station.

Any development of vacant lots in the existing township would imply augmentation/duplication of the existing system but such costs are not considered in this evaluation.

Treatment works for an additional 1,800 people would cost about \$300,000 while the reticulation carriers, etc. would cost about \$540,000.

Thus an overall cost of \$840,000 is envisaged or about \$1,980 per block. Expenditure on the treatment works and carriers would be required immediately, while reticulation would be constructed to keep pace with development.

Table 11.7 indicates the overall costs for water and sewerage augmentation in Denman.

TABLE 11.7 Cost Distribution of Augmentation - Denman

Year	Cumulative Dwellings	Water	Sewerage	Carrier Main	Total
		(\$'000)	(\$'000)		
		Intake Treatment Storage	Treatment		
1981	25	-	30	-	30
1982	60	-	210	-	210
1983	120	480	60	45	585
1984	195	470	-	45	515
1985	285	580	-	-	580
1986	365	-	-	-	-
Total Cost		1,530	300	90	1,920

Transportation

12

12.0 TRANSPORTATION

INTRODUCTION

This chapter deals with the impacts of coal mining and related activities on the transportation system of Muswellbrook Shire. It is in two parts, the first dealing with rail transport which has been prepared by R Travers Morgan Pty Ltd and the second, road transport, prepared by JTCW.

The contents of this chapter form the basis of the recommendations made in Volume 1 under the heading of 'Movement Strategy'.

12.1 RAIL TRANSPORT

CURRENT AND FUTURE RAILWAY PROSPECTS FOR MUSWELLBROOK

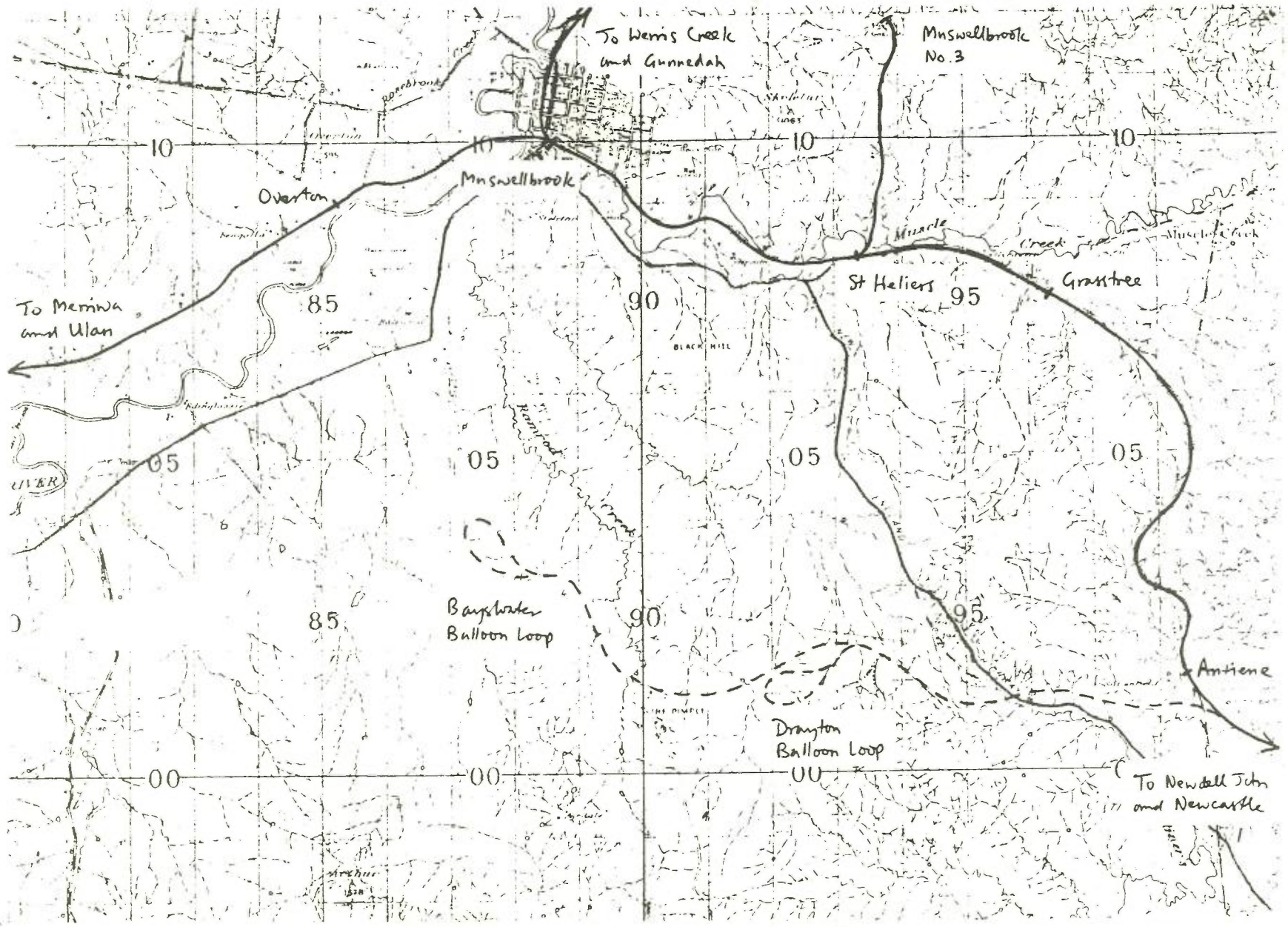
Physical Details

Figure 12.0 shows the location of Muswellbrook in the Upper Hunter Valley and the railway lines that serve it. The Main Northern Railway was opened to Muswellbrook from Newcastle in 1869. It was not connected to Sydney until the completion of the Hawkesbury River Bridge in 1889. The Merriwa Branch from Muswellbrook was opened in 1915-1920. As early as 1911 a railway was proposed from Sandy Hollow, on the Merriwa Branch, to Gulgong and Maryvale to carry agricultural produce from the north-west of New South Wales to Newcastle. This railway, which was commenced in 1936, will be completed as far as Ulan, for the large scale carriage of coal in 1982/83.

South of Muswellbrook a number of spur lines have been completed in recent years to serve coal mining:

- i) from Whittingham to Mt. Thorley for Mt. Thorley and Warkworth mines;
- ii) from Newdell Junction to Newdell sidings for Newdell and Liddell mines; and
- iii) from St. Heliers to Muswellbrook No.3 mine.

It has been proposed recently to assist the development of the Drayton, Mt. Sugarloaf, Mt. Arthur North and South mines, as well as the existing Bayswater mine, that another spur line be constructed from just south of Antienne to 9 kilometres south of Muswellbrook. This spur line could serve a number of



RAIL NETWORK - MUSWELLBROOK

Fig. 12.0

balloon loops, including those for the Drayton and Bayswater mines.

Passenger Traffic

Muswellbrook is served by two or three passenger trains per day in each direction. The most important is the six-days-a-week Northern Tablelands Daylight Express. On four nights a week it is served by the North Mail and sporadically during the week by middle-of-the-day passenger trains to and from Newcastle. For this study a base passenger train flow of three per day in each direction has been adopted.

The SRA propose in the future to replace the Daylight with an Express Passenger Train (XPT) service. As far as can be established, no other changes are envisaged. One major constraint imposed by the introduction of XPT services would be the desire of the SRA to operate them on the most direct route north. Ministerial commitments have been made in the past about reduced travel times between major population centres. In the light of the New South Wales Government's public commitment to improve country passenger train services, it is likely that any relocation of the Main Northern Railway would still have to allow for a railway station in the centre of Muswellbrook.

General Freight Traffic

The Main Northern Railway has virtually no interstate traffic base. It is sustained by the largely agricultural activity of the Northern Tablelands and north-west slopes of New South Wales. In recent years coal mining activity north of the Hunter Valley has added to traffic. At the same time, the SRA has lost a fair proportion of the haulage of less-than-car-load traffic from Sydney and Newcastle to the hinterland. Thus the general freight traffic base of the railway may be regarded as stable with probably few non-mineral growth prospects. The Merriwa Branch is largely wheat only. There may well be additional agricultural traffic on the Merriwa Branch once the Sandy Hollow Railway is completed from Ulan to Gulgong. This traffic would be diverted from other lines and would be dependent on suitable terminal facilities being available in Newcastle.

In recent years it has been proposed that a sub-regional freight centre be developed in Muswellbrook to serve the Merriwa Branch and the mainline as far as Murrurundi. However this may be perceived as a rationalisation measure rather than a traffic growth prospect.

Although the SRA timetables for 17-19 freight train paths in each direction on an average weekday, the current level of activity requires no more than eight per day in each direction. While traffic peaks and troughs undoubtedly occur, these would be dovetailed into the haulage of coal. Thus it is realistic to assume an average daily flow of eight general freight (including wheat) trains in each direction. A maximum of one train in each direction per day is assumed for the Merriwa Branch, notwithstanding changes that may occur as the Sandy Hollow Railway reaches Gulgong.

Coal Traffic

Coal is currently hauled through Muswellbrook from the north (from around Gunnedah and beyond). None is won from Muswellbrook itself, now that the local minehead is served by St. Heliers.

From 1982/83 onwards, coal will be hauled through Muswellbrook, off the Merriwa Branch, from Ulan on the Sandy Hollow Railway.

The bulk of coal haulage from around Muswellbrook will originate from the projected spur line, just south of Antienne, for example, from the Drayton and Bayswater balloon loops. This haulage would be well under way by 1985.

The haulage of coal from the north is currently handled by unit trains to the Newcastle coal loaders and serving a number of rail heads including Newdell/Liddell and Gunnedah. The current train sizes are:

- i) 31 CHS wagons to and from Newdell/Liddell with a nett load of 2356 t and hauled by various combinations of existing mainline and branchline locomotives; and
- ii) 21 CHS wagons to and from Gunnedah with a nett load of 1596 t.

The Gunnedah load is constrained by the severe grades across the Liverpool Range at Ardglen and the lengths of crossing loops north of Muswellbrook.

By 1985, with the introduction of new heavy duty diesel locomotives, unit train loads of 42 CHS wagons with a nett load of 3192 t should be in operation. The severe grades at Ardglen will place an absolute limit of 30-31 CHS wagons on a unit coal train crossing the Liverpool Range.

It is reasonable to expect selective crossing loop lengthening on the Main Northern Railway (to a minimum of 900 m for the longest coal train, if not to 1200m) in the future. Mainline electrification has also been proposed, at least as far as Muswellbrook and tentatively as far as Werris Creek. Electrification will not reduce the number of trains but will reduce the costs of operating them.

Future Coal Mining and Rail Haulage Prospects

It is agreed by all concerned that the forecasting of coal mining prospects is a risky undertaking in the light of rapid changes in world demand for steaming, as well as coking, coal. For this study the yet unpublished, conservative estimates of coal production round Muswellbrook prepared by the Joint Coal Board, the Hunter Valley Research Foundation and others have been adopted.

Table 12.0 shows the major mines or leases around Muswellbrook which will be in production from 1980 onwards.

Table 12.1 shows expected annual coal tonnage flows by rail out of the Muswellbrook area at five yearly intervals from 1980 to 2000. The information in this table is a synthesis of Joint Coal Board and Hunter Valley Research Foundation sources and is thus not official but indicative of the transport task.

On the basis of these annual tonnages and the unit train sizes discussed above, the average daily and peak daily numbers of loaded coal trains have been estimated (Table 12.2), assuming 300 shipping days distributed throughout a full year, based on 7 days-a-week railway operation. On the basis of information presented in the Ulan and Mt. Arthur North Environmental Impact Statements, peak train flows from individual mines would be double the average train flows. However revised SRA operating practices would reduce this peak to average ratio of movements to 1.3. On line sections shared by different flows, the peak to average ratio would be even less. However, a conservative ratio of 1.3 on all line segments has been adopted. Allowing for the empty return of unit trains from the port to the mine, the total daily unit train flows would be double the laden train flows.

Table 12.0: Mines In and Around Muswellbrook

Mine	When in Operation and Rail Despatch Point
Bayswater	Currently in operation, and despatching via Newdell Junction sidings, in the future possibly via extension of the Drayton Spur
Muswellbrook	Currently in operation, despatching via St Heliers
Ulan	Operating by 1983, despatching via Sandy Hollow Railway
Drayton	Operating by 1985, despatching via the Drayton spur
Mt Arthur North & South	Operating by 1985, despatching via extension of the Drayton spur - most production from North mine committed to export, all from South Mine to Bayswater Power Station
Grasstree	Operating by 1990
Mt Sugarloaf	Operating by 1990
Carpentaria	Operating post 1990

Table 12.1: Coal Transport Task By Rail in Muswellbrook Area 1980-2000

Rail Line Section	Annual Coal Tonnage by Rail (mtpa)				
	1980	1985	1990	1995	2000
North of Muswellbrook	0.8	3.5	4.5	5.5	5.5
Ulan-Muswellbrook	-	2.0	5.0	5.5	5.5
Muswellbrook-Antiene	0.9	6.0	10.0	12.0	13.0
Bayswater/Drayton-Antiene ⁽¹⁾	0.9	6.0	12.0	12.0	11.0
Antiene-Newdell Jctn	0.9	12.0	22.0	24.0	24.0

Note: In 1980 Bayswater ships via Newdell.

Table 12.2: Average and Peak Daily Laden Unit Coal Train Flows by Line Section

Rail Line Section	Average and Peak Daily Laden Unit Train Flows									
	1980		1985		1990		1995		2000	
	Av	Pk	Av	Pk	Av	Pk	Av	Pk	Av	Pk
North of Muswellbrook	2	2	5	7	7	9	8	10	8	10
Ulan-Muswellbrook	-	-	2	3	6	7	6	8	6	8
Muswellbrook-Antiene	2	3	8	11	13	17	15	19	16	20
Bayswater/Drayton-Antiene	-	-	7	9	13	15	13	15	12	14
Antiene-Newdell Jctn	2	3	15	20	26	32	28	34	28	34

NOTE: Train numbers have been rounded up from the fractional numbers arrived at by applying the train payloads and peak to average ratios.

POSSIBLE OPTIONS FOR RAILWAY RELOCATION

A number of options were considered for the relocation of the Main Northern Railway away from the centre of Muswellbrook. There were two complementary planning objectives that could be sought:

- i) the reduction of train intrusion by way of noise annoyance and pollution; and
- ii) the removal of the railway and the release of railway land for urban uses.

Against these possible planning gains must be weighed the dislocation of railway users and operations that may occur from either a partial or a total removal of the Main Northern Railway from the centre of Muswellbrook.

Table 12.3 sets out the range of railway relocation options that were considered in the light of these objectives. These options are also illustrated in Figure 12.1.

Option 3 is obviously difficult to construct because of the hilly terrain to the east of Muswellbrook but still requires much of the basic expenditure required for Option 2. It is considered that Option 2 is a superior option and thus 3 has not been considered any further.

Option 4 is a long-term option predicated on the mining of leases to the west of Muswellbrook, which are being considered for coal liquefaction. Development of Option 2 would not preclude eventual development of Option 4. Because of the even greater uncertainty about the development of these leases than those mentioned in Table 12.0, Option 4 has not been considered any further at this stage.

Using the average and peak daily flows of passenger, general freight and coal trains determined earlier, table 12.4 was compiled. This table shows the total average and peak daily southbound train flows by line section, option and key year. Total train flows would be double the southbound train flows.

Table 12.3: Railway Relocation Options

OPTION	DESCRIPTION OF RAILWAY FACILITIES	TRAFFIC CONSEQUENCES
BASE	Main Northern Railway facilities augmented as traffic grows.	Extrapolation of current operations as traffic grows.
1	Extension of Bayswater/Drayton spur to triangular connection with Merriwa Branch at Overton and construction of triangular junction at Muswellbrook.	Diversion of all freight traffic over new route west of Muswellbrook.
2	As for option 1 but with severance of Main Northern Railway from William Street, Muswellbrook to St. Heliers and construction of a new crossing loop and station north of Brook Street, Muswellbrook.	Diversion of all traffic over new route west of Muswellbrook.
3	Upgrading and extension of St. Heliers spur to the Main Northern Railway north of Muswellbrook. Extension of the Bayswater/Drayton spur to the Merriwa Branch and severance of the Main Northern Railway from St. Heliers to north of Muswellbrook.	Diversion of all northern traffic east of Muswellbrook, all Ulan/Merriwa traffic west of Muswellbrook and elimination of rail passenger access to Muswellbrook.
4	Extension of Bayswater/Drayton spur, with a connection from the Merriwa Branch at Overton to north of Muswellbrook and severance of the Main Northern Railway from St. Heliers to north of Muswellbrook.	Diversion of all traffic west of Muswellbrook and elimination of rail passenger access to Muswellbrook unless a new passenger station provided on the spur line.

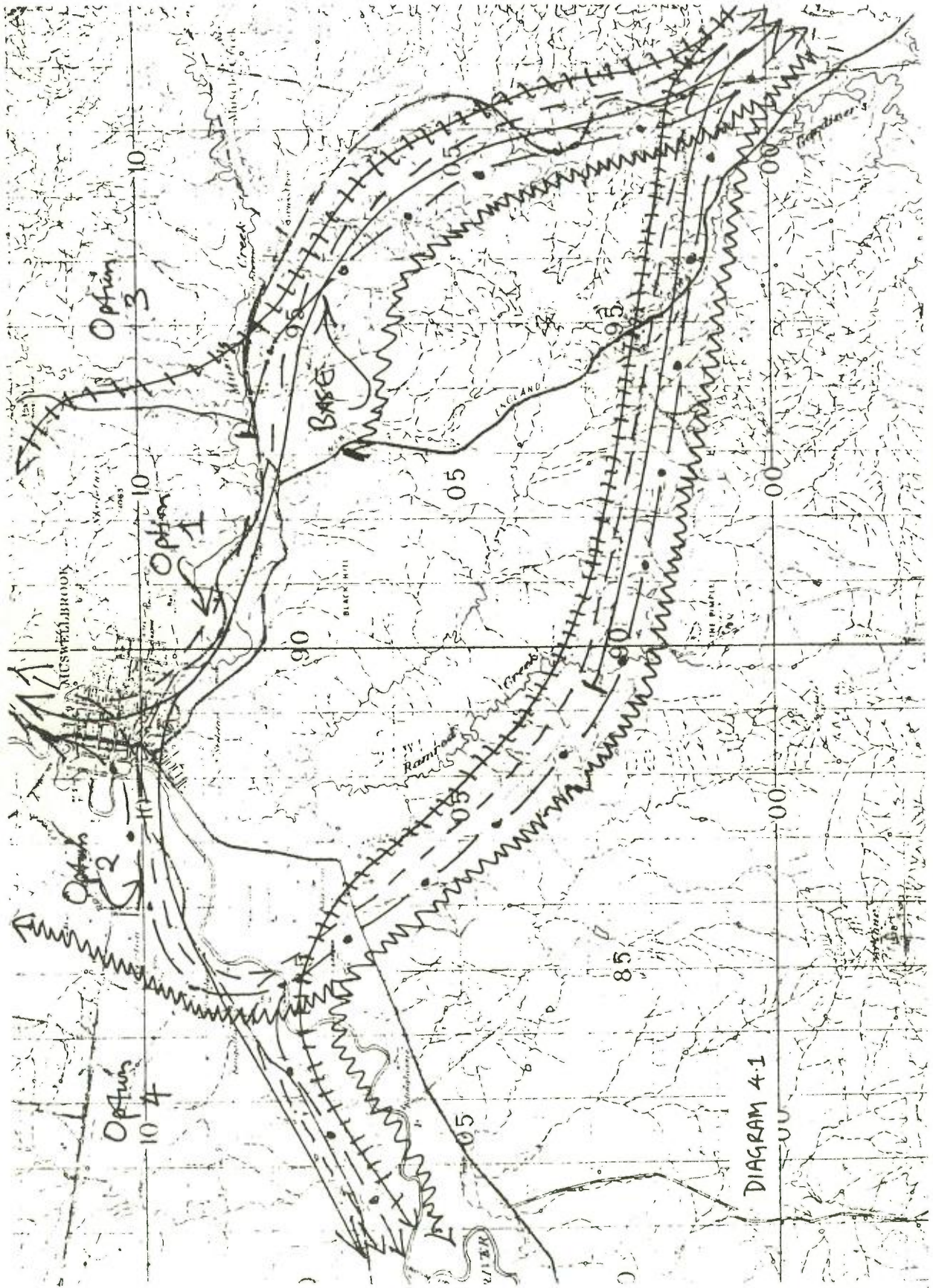


Fig. 12.1

RAILWAY RELOCATION OPTIONS

The train flows from Table 12.4 were used to dimension the railway facilities that would be required over the study period for each option, including BASE. It is clear that at some period in the future some single track sections would have to be duplicated. The basic characteristic of the Main Northern Railway in the vicinity of Muswellbrook is a single line with crossing loop spacings of approximately 6 kilometres. Assuming an average train speed of 40 km/h for unit trains and approximately equal numbers of trains flowing in each direction, the headway between successive southbound trains would be double the section clearing time, that is, 20 minutes. On this basis the traffic levels at which duplication should be considered would be:

- i) 25 trains/day in one direction for a general freight traffic flow; and
- ii) 30 trains/day in one direction if there is a high proportion of scheduled unit trains in the traffic flow.

As well as determining the number of tracks in each line section and the spacing between crossing loops, the ruling gradient and curvature for each new section of line has also been considered. The SRA calls for a compensated 1 in 100 (1%) ruling gradient against the laden traffic flow for new lines. This in turn materially affects the Overton Jctn-Bayswater Section since it has to cross the Hunter River and Ramrod Creek before climbing to Bayswater, a rise of approximately 65 m. Allowing for the resistance to motion due to curves, this section needs to be developed at a grade of 1 in 110 (0.9%), thus adding approximately 3.3 km to the most direct route. If the SRA relaxed its standard to a compensated 1 in 80 ruling gradient, some small reduction in the length of the route maybe possible.

The suggested route, shown in Figure 12.2, departs from the Merriwa Branch near the Overton property by way of a triangular junction. It then crosses the Hunter River and Ramrod Creek, before following Ramrod Creek on the south side in a wide curve towards Bayswater balloon loop. Two crossing loops would be required on the new line at Ramrod and Bayswater plus another at Drayton balloon loop. The length of new construction would be 9.3 kilometres.

Table 12.4: Total Average and Peak Daily Southbound Train Flows by Line Section, Options and Key Year

Line Section		Options	Total Average Peak Daily Southbound Train Flows									
			1980		1985		1990		1995		2000	
No.	Name		Av	Pk	Av	Pk	Av	Pk	Av	Pk	Av	Pk
1.	North of Muswellbrook	A11	13	13	16	18	18	20	19	21	19	21
2.	Merriwa Branch west of Overton Jctn	A11	1	1	3	4	7	8	7	10	7	10
3.	Merriwa Branch east of Overton Jctn	BASE	1	1	3	4	7	8	7	9	7	9
		01	1	1	8	11	14	17	15	20	15	20
		02	1	1	11	14	17	20	18	23	18	23
4.	Muswellbrook - St Heliers	BASE	13	13	18	21	24	27	25	29	25	29
		01	13	13	3	3	3	3	3	3	3	3
		02	13	13	-	-	-	-	-	-	-	-
5.	St Heliers - Antiene	BASE	13	14	19	22	24	28	26	30	27	31
		01	13	14	4	4	4	4	4	4	5	5
		02	13	14	1	1	1	1	1	1	2	2
6.	Overton Jctn - Bayswater	BASE	-	-	-	-	-	-	-	-	-	-
		01	-	-	16	19	22	25	23	27	23	27
		02	-	-	19	22	25	28	26	30	26	30
7.	Bayswater - Antiene	BASE	-	-	7	9	13	15	13	15	12	14
		01	-	-	22	27	33	39	35	41	34	40
		02	-	-	25	30	36	42	38	44	37	43
8.	South of Antiene	A11	13	14	26	31	37	43	39	45	39	45

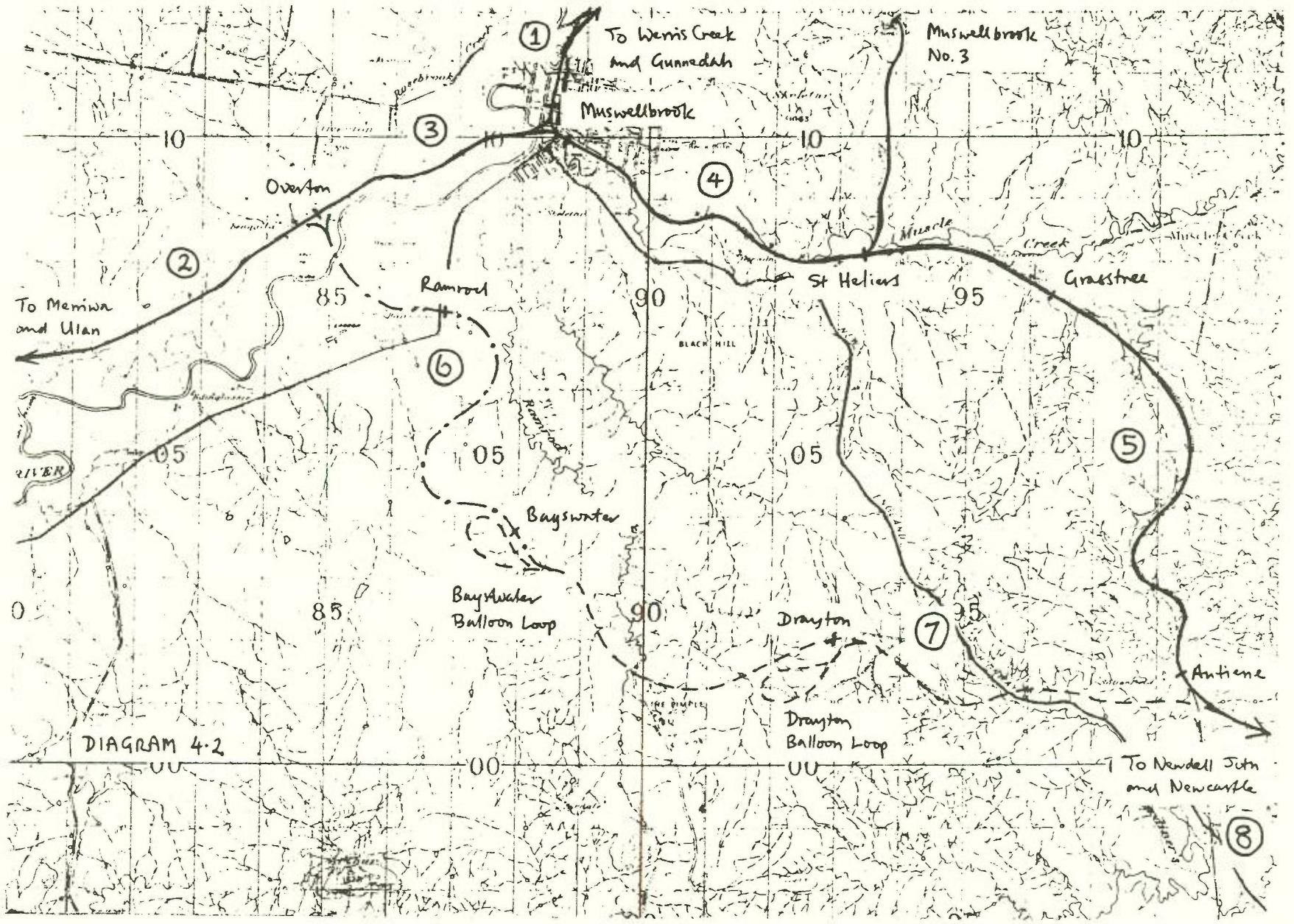


DIAGRAM 4.2

Fig. 12.2

THE RECOMMENDED RAIL BY-PASS ROUTE

Table 12.5 sets out the rough order of expenditure needed for each option on the basis of the train numbers set out in Table 12.4 and the design criteria laid down earlier. The schedule of facilities for each option is detailed on page 194.

Table 12.5: Costs by Option

Level of Facilities	Costs (\$m) By Option (1980 Prices)		
	BASE	01	02
Single track railway	-	14.0	15.5
Duplication	8.3	13.1	13.1
Total	8.3	27.1	28.6

Summary

The prospects for the relocation of the Main Northern Railway out of the centre of Muswellbrook have been examined at a sufficient level of detail to:

- i) be satisfied that relocation is feasible;
- ii) establish the orders of cost difference between development of the existing railway and the western bypass via Bayswater; and
- iii) ascertain the approximate operational impact on the SRA.

Table 12.6 sets out the distances between key locations each side of Muswellbrook, with and without the new route.

Table 12.6: Key Travel Distance

Route	Old Line (km)	New Line (km)
Muswellbrook route to Antiene	16.8	24.4
(Ulan) - Overton to Antiene	21.2	20.9

Any bypass of Muswellbrook, with or without severance of the existing railway, will increase the length of journeys of all trains passing over it from the north of Muswellbrook. As well, it is clear that coal traffic from Ulan will receive a very marginal distance advantage by passing over the new line and will incur the additional operating problem of having to cross an additional summit between Ulan and Newcastle. This problem also affects traffic from the north of Muswellbrook, with the added distance penalty of 7.6 km. Assuming an average speed of 80 km/h end-to-end, passenger trains would take an additional 6 minutes to traverse the new route, as compared to the old one.

Such increases in basic railway operations will incur additional operating costs. It is estimated that a relocation of the Main Northern Railway via Bayswater would increase the SRA's annual trailing tonne kilometrage by an average of 80 m trailing tonne km pa over the 20 years of this study period. Passenger operating parameters would also increase. At current prices it is estimated that this increase in railway operations would amount to some \$0.6m pa. This may be partially offset by increases in distance based revenue.

Another impact on Muswellbrook would be the level of railway traffic if the railway remains where it is or is relocated. From 1990 onwards, average headways of all trains passing through Muswellbrook on the existing railway would be 25-30 minutes throughout the day. Moving through Options 1 and 2 there would be successive restrictions in train numbers.

If freight trains at the very least were not diverted from the centre of Muswellbrook, additional mining activity beyond the estimates in Table 12.2 to the north or west of Muswellbrook would induce more trains than estimated above. For every 1 mtpa of coal shipped from south of the Liverpool Range or from the Sandy Hollow Railway an extra laden train (and its empty return) per day would be expected to pass through Muswellbrook. North of the Liverpool Range, 0.7 mtpa would induce an extra laden train, etc.

Conclusions

The prospects for relocation of the Main Northern Railway away from the centre of Muswellbrook have been briefly examined. The background passenger and general freight train flows, the possible coal mining activity from 1980 to 2000 and the consequential coal train flows in addition to the other railway traffic have been assessed.

A tentative route for a railway from Bayswater, an extension of the proposed Drayton spur from Antienne, to Overton on the Merriwa Branch 3.5 km west of Muswellbrook has been established. Depending on the development options chosen, the nett capital cost difference between continued development of the existing Main Northern Railway and the new route would be \$18.8 to 20.3m by 1990 once duplication of either railway line had been completed to handle the level of traffic expected.

Any new line would be less economical for the SRA to operate: passenger journeys' times in either direction would increase by six minutes; and operating costs could rise by about \$0.6 m pa, although they may be partially offset by increases in distance-based revenue.

Neither the existing railway nor the new one would incur excessive costs for electrification. The basic costs of 25kVAC electrification would be \$3.9m and \$3.8m respectively, omitting a common allowance for the provision of high tension power supplies. It has been assumed that all civil and signalling works for either route would be compatible with ultimate electrification.

Notwithstanding the feasibility of constructing and operating a relocated Main Northern Railway, it is not clear who would be responsible for the capital costs of such an undertaking or for additional operational expenditure and any traveller inconvenience. Offsetting this impact on the SRA and its users would be the benefits to Muswellbrook Shire of the release of some railway land in the centre of the township and the removal of some or all of the intrusion of a relatively intensive railway operation.

SCHEDULE OF CONSTRUCTION ITEMS FOR OPTIONS

A.1 BASE Duplication by 1990

Duplication of 11.8 km of track Muswellbrook - St Heliers (4.8 km) and Grasstree - Antiene (7.0 km) @ \$0.7 m/km including AC immune signalling - \$8.3 m.

A.2 Option 1 Single Track by 1985

- i) New single line bridges across Hunter River and Muscle Creek north of existing Merriwa Branch bridges plus trackwork for loop - say \$2.5 m;
- ii) 1.8 km of embankment from Overton Jctn to Ramrod Loop - say \$2.0 m;
- iii) Overton Jctn works - say \$0.3 m;
- iv) Bridges over Hunter River and Ramrod Creek, allowing for future duplication - say \$2.0 m;
- v) Single line trackwork with modest earthworks for 7.4 km @ \$0.5 m/km - say \$4.0 m;
- i) Three road crossings @ \$0.15 m each - say \$0.5 m;
- vii) Three 1200 m crossing loops (at Ramrod, Bayswater and Drayton) @ \$0.9 m each allowing for AC immune signalling and CTC from Muswellbrook to Antiene - \$2.7 m;
- viii) Total - \$14.0 m.

A.3 Option 2 Single Track by 1985

- i) Same as for Option 1 single track - \$14.0 m;
- ii) New 1200 m crossing loop to the north of old Muswellbrook plus new station and relocated CTC office - say \$1.5 m;
- iii) Total - \$15.5 m.

A.4 Option 1 Duplication by 1990

- i) Same as for Option 1 single track options - \$14.0 m;

- ii) Duplication of 20.3 km of track from Overton Jctn to Antiene, less 3.0 km of existing crossing loop, nett 17.3 km @ \$0.7 m/km including AC immune signalling - \$12.1 m;
- iii) Additional 1.8 km of embankment work - say \$1.0 m;
- iv) Total - \$27.1 m.

A.5 Option 2 Duplication by 1985

- i) Same as for Option 1 Duplication - \$27.1 m;
- ii) Plus crossing loop, etc at Muswellbrook - \$1.5 m;
- iii) Total - \$28.6 m.

A.6 Other Issues

- i) All work would have to be compatible with 25kVAC electrification. On the assumption that basic electrification costs would be proportional to track kilometrage at the rate of \$0.075 m/track km, using Sydney-Melbourne electrification cost estimates, and that power supply cost would be common:
 - BASE \$3.9 m for 52 km
 - Option 1 and 2 \$3.8 m for 51 km.
- ii) There would be a cost to set up any alternative freight handling and minor locomotive maintenance facilities if the Main Northern Railway was severed at Muswellbrook. On the other hand, the SRA would be credited with the value of land and improvements on the current site of the station. While there would be no cost impact on Option 1, for Option 2 a nett cost of, say, \$3.0 m could be involved.

12.2 ROAD TRANSPORT

Impacts on the road system will be substantial over the next 10-20 years as a result of the proposed increase in mining and associated activities and the increase in the population living in the Shire, particularly in Muswellbrook. Urban and rural roads are briefly discussed in the Muswellbrook Community Impact Study. The following is a guide to particular impacts that have been identified and will require further investigation.

(i) Denman Road between Muswellbrook and Mitchell Line of Road

Much of this section of road is presently in a state of poor repair and will need to be upgraded in accordance with NSW Department of Main Roads standards for a nominal design speed of 100 kph. Large increases in traffic (both light vehicles and trucks) will occur along this section as a result of (a) Council's Industrial Estate located on the Mitchell Line of Road, (b) the Mt. Arthur North and South, Bayswater, Drayton and Blackhill mining proposals and (c) increased traffic between Denman and Muswellbrook as a result of the general increase in activities associated with the rapid growth of Denman, Muswellbrook and, to a lesser extent, Sandy Hollow.

It is also worth noting that some of this increased traffic will occur in the early and late hours of the day as a result of shiftworkers travelling to and from the mines.

The residential areas located immediately to the east of this section of the road will be particularly affected by the increase in activity, particularly with respect to increased noise levels.

(ii) New England Highway

a) Muswellbrook - Liddell

Increases in traffic, both light and truck, will occur along the Highway between Muswellbrook and Liddell as a result of Bayswater Power Station, Black Hill and Drayton mines (although most traffic generated by these mines should use the Mitchell Line of Road/Denman Road route) and general increase in traffic as a result of increased growth in the Upper Hunter region, particularly movements between Newcastle-Singleton-Muswellbrook.

197

b) Scone - Muswellbrook

Traffic increases along this section will occur due to increased residential development in Scone with associated journeys to work to Muswellbrook and beyond, and with development of mining activities at Bellambi and possibly in A102 and the possible construction of a coal conversion plant within A102.

Although the highway should not require upgrading in the short-medium term, the Main Road 208 bridge across the Hunter River will require major upgrading if any of the projects to the west of Muswellbrook proceed.

(iii) Other Rural Roads

The Jerry's Plains Road (MR 213) is presently receiving traffic from quarries near Jerry's Plains and coal trucks across the Lemington Bridge from the Buchanan - Lemington mine. This road also serves as an alternative to the New England Highway from south of Singleton connecting to Muswellbrook via Edderton and Denman Roads. The reason for this route being used by heavy vehicles is not so much to avoid heavy traffic on the Highway as to avoid the bridge over the Hunter River at Singleton which has a height limit.

The Edderton Road is in fair condition but the narrow and relatively weak pavement will not hold for the increasing traffic. A section of this road is, however, proposed to be diverted and upgraded as a result of the Mt. Arthur North project.

The Mudgee Road (MR 208) between Muswellbrook and Sandy Hollow is already experiencing increased traffic arising from the upsurge in activity in the area. It has sections of narrow pavement in fair condition which will not stand up to heavy traffic, as well as lengths of gravel which are inadequate for the expected usage. The Hunter River bridge over to Muswellbrook is also inadequate for future requirements.

(iv) Muswellbrook Town Centre

With major trip generating activities proposed for areas to the north and south of Muswellbrook, traffic movements through the town are expected to increase dramatically over the next 20 years. It is estimated that by 1991 there will be approximately 27,000 trips per day from North to South Muswellbrook across a cordon defined by the railway. The existing railway underpass is restricted in height and prone to flooding, while the bypass over the narrow bridge on Bell Street is also deficient.

The underpass can be expected to attract some 18,000-20,000 of the above-mentioned trips, of which 7,000 will be through Highway movement. Given the restricted capacity of the underpass and the expected growth of the Commercial Centre itself (which could generate up to 40,000 trips per day), a bypass to divert through traffic from the town centre will be required by the end of the decade. Such a bypass will alleviate problems of congestion, air pollution, noise, safety and general loss of amenity in the commercial centre.

(v) The Sandy Hollow-Denman Road

As a result of increased activities at Sandy Hollow associated with the construction of the Ulan-Sandy Hollow railway, increased car and truck movements are expected between Sandy Hollow and Denman. However, the existing road is considered adequate for the expected increase in traffic volumes.

RECOMMENDATIONS - TRANSPORT

Rail

R Travers Morgan Pty Ltd have considered the consequences of various relocations of the railway network to the east and west of Muswellbrook as well as the possibility of retaining the present location of the Main Northern Railway and duplicating its capacity. The option most favoured by R Travers Morgan is an extension of the Bayswater/Drayton spur to a triangular connection with Merriwa Branch at Overton and construction of a triangular junction at Muswellbrook. The Main Northern Railway from William Street, Muswellbrook to St. Heliers to be severed and a new crossing loop and station to be constructed north of Brook Street, Muswellbrook.

In considering this option the planning objectives of reducing the negative environmental impacts of the railway on Muswellbrook township and the release of railway land for urban uses can be achieved.

The disadvantages of the proposal are primarily related to the additional costs both in construction of the proposed new lines and the operating costs due to an increase in journey time and length.

It is considered that the benefits of construction of the line cannot be ignored and it is recommended that:

- 1) As a condition of consent all mining projects on the eastern side of the Hunter River be required to utilise an extension of the Mt. Arthur North loop and onto the northern line at Antienne.
- 2) The Drayton/Mt. Arthur North rail loop be constructed in all respects to mainline standards as a condition of consent.
- 3) The line be extended from the Mt. Arthur loop to meet the existing main line at Overton.
- 4) The existing line be severed between the St. Heliers junction and Muswellbrook.
- 5) As a condition of consent any developer or group of developers of mines in the A102 and A256 areas load coal on the western side of the river and relocate the main line to the west of the river.
- 6) A new railway station be constructed to the north of Muswellbrook.

These recommendations relate to the 'Movement Strategy' in Volume 1.

Road

As well as the direct impacts that the major new projects will have on the road transport system in the Shire, the general rapid increase in the population of the Shire (particularly Muswellbrook) and the associated increase in service/commercial/industrial activities that will take place will create increased pressures on the local road network. Further study of these effects, particularly with respect to noise effects and road improvements generally, is required.

Particular issues include the need to create a through traffic north-south bypass and route through Muswellbrook, the need to improve the secondary road system within the town to connect new urban areas with the town centre and to the Highway, the need to upgrade Denman Road, particularly between Muswellbrook and Mitchell Line of Road, the need to upgrade the Mudgee Road and the bridge connection to Muswellbrook and the need to upgrade the Jerry's Plains Road and Edderton Road.

The following recommendations relate to road transport and the 'Movement Strategy' in Volume 1.

- 1) In order to separate light and heavy traffic and protect tourists and residents from conflict with trucks:
 - . Maintain the Jerry's Plains, Denman, Sandy Hollow, Muswellbrook Roads for light traffic by physically restricting the entry of large vehicles from these roads into mining areas.
 - . Press for the upgrading of the New England Highway to four lane width.
- 2) Discontinue upgrading of the Highway through Muswellbrook town and press for early construction of a Muswellbrook bypass to the east of the town.
- 3) Require as a condition of consent to all mining projects on the eastern side of the Hunter River that all heavy vehicles and all coal transport by haul road, conveyor or rail be directed through an extension of the Mt. Arthur North loop and onto the northern line at Antienne.

Water Resources

13

13.0 WATER RESOURCES ?

A preliminary examination of groundwater quality of surface water resources in the Hunter Valley has recently been carried out by D.E.J. Garman and G.L. Muir¹ of the Water Resources Commission of New South Wales. Their conclusions are as follows:

"At present, water quality is generally determined by the geology of the catchment. There are significant deteriorations in surface water quality from the upper to the lower catchments in most tributaries of the Hunter River as well as in the River itself, although the quality of water is generally suitable for town water supply and irrigation.

The mechanisms by which this deterioration occurs are not well understood but may be related to land use and other factors such as direct groundwater accession.

Development of water resources in the Valley should ensure that there is maintenance of present water quality under all flow conditions and there will probably be better quality under regulated flow conditions, especially in the lower reaches of the Hunter River and the tributaries on which storages are constructed.

Mining and power developments are unlikely to affect water quality significantly provided adequate safeguards are maintained."

The following information has been prepared by JTCW based on the data in various EIS' and documents published by the NSW Water Resources Commission.

Total Water Requirements

Based on the expected growth of industrial, rural and urban use of water resources within the Hunter River Basin, the Water Resources Commission of New South Wales has prepared a programme to meet these likely water requirements. Two reports "Preliminary Plan for Development of Water Resources in

1 Refer to paper titled "Water Quality in the Hunter River Valley - The Impact of Natural Processes and the Likely Influence of Future Industrial Development on Water Resources" - Supporting Document 1.

the Hunter River Basin" (January 1979) together with information from the yet to be published "Review of Future Water Requirements and Storage Proposals for the Hunter Valley" (November 1980) detail the water requirements for the Hunter River Basin.

1) Rural Needs

It is anticipated that the total irrigated area in the Hunter River Basin will increase from some 11,500 hectares in 1980 to 14,000 hectares in 1990 and 18,500 hectares in 2005. Corresponding water requirements are 70,000, 84,000 and 111,500 megalitres respectively². Of this, Muswellbrook irrigators use approximately one-third of the total Basin requirements.

2) Power Generation Needs

The Electricity Commission have indicated the need for additional water requirements for power generation in the next twenty years. The Bayswater Power Station will require 18,000 megalitres per annum by 1985 and a further 18,000 megalitres by 1986.

It is expected that surplus flows in the Hunter River will be reduced both in frequency and volume as the surface water resources in the Basin become further developed. For example, Liddell Power Station, which presently diverts an average of 25,000 megalitres per annum from the river, will require an additional 7,000 megalitres per annum from regulated flows in 1985, increasing to 15,000 megalitres in 1986. Requirements would then increase by 3,000 megalitres reaching a maximum of 50,000 megalitres per annum in 1996.

Additional to this, possible further power station development will require 9,000 megalitres in 1990, a further 9,000 megalitres in 1991 and increasing to 50,000 megalitres per annum in 1993 to 1996.

² "Preliminary Plan for Development of Water Resources in the Hunter River Basin" - Water Resources Commission 1979.

3) Mining Needs

The Water Resources Commission is currently planning for an increase in water requirements for coal mining and washing processes. Based on the proposed mining developments in Muswellbrook Shire, an estimated 3,000 megalitres in 1980 will be required, increasing to 7,250 megalitres in 1990 and 11,500 megalitres in 2005.

The Energy Commission of New South Wales has indicated the possible need for additional water supplies to cater for coal conversion plants in the Muswellbrook Shire. Each plant would require 72,000 megalitres per annum, however, this could be reduced to 24,000 megalitres if expensive air cooling equipment were used. As plans for coal conversion plants are tentative, allowance has been made only for one plant commencing in 1990 requiring 72,000 megalitres per annum.

4) Urban Needs

The Commission has allocated 2,000 megalitres per annum in 1985 for Muswellbrook rising to 3,000 megalitres per annum in 1995. An additional 25 megalitres per annum has been included for smaller towns such as Denman. This allocation is based on population estimates from the Premier's Department which suggests a total town population of 21,600 by 2005.

Interpolation with population estimates in Chapter 8 (1991 Muswellbrook population will reach 16,700 persons and 2,500 for Denman), suggests that this allocation will meet the expected population levels.

Total Water Needs

The maximum total water requirements for the Hunter River Basin above Maitland, with allowances for flow maintenance, operation, evaporation and seepage losses, are likely to be:

<u>Total Basin Requirements</u>	<u>Megalitres/Annum</u>
1985	187,500
1990	306,000
1995	389,000
2000	421,500
2005	461,500

Of this, the Muswellbrook Shire would use approximately 55% of the total Basin requirements due to the large proportion of the Basin within the Shire and the concentration of coal mining, power generation and possible coal conversion within the Shire boundaries. However, these requirements could be considerably reduced if various developments, which are large users of water resources, do not occur - for example, coal conversion plants and additional power generation.

Potential Conflicts

The following information has been obtained from a review of various Water Resources Commission documents³. Further details can be found in the paper reproduced as Supporting Document 1.

1) Groundwater

The Water Resources Commission of New South Wales estimates that some 30,000,000 megalitres of water are stored in aquifers within the Hunter River Basin⁴. This resource is generally confined to the alluvium deposits along the Hunter River and its tributaries. Recent assessments indicate that the possible exploitable annual yield could be in the vicinity of 280,000 megalitres per year (refer Table 2, Supporting Document 1).

These groundwaters are particularly valuable for irrigation where withdrawal points are well dispersed and individual withdrawals are relatively small. However, the production rates of wells in these aquifers are not great enough for them to be considered as a potential source of supply for the larger individual requirements which, as will be shown, constitute the greater part of the assessed future water needs in the Basin.

Furthermore, in some parts of the Basin, alluvial groundwaters are replenished from river flows and cannot be regarded as a fully independent resource.

3 Refer 'Preliminary Plan for Development of Water Resources in the Hunter River Basin' (January 1979) and 'Review of Future Water Requirements and Storage Proposals for the Hunter Valley (November 1980) unpublished.

4 Ibid

Several of the major mining developments proposed for the Shire rely on low yield, highly saline on-site aquifers for site water requirements. Developments should adequately safeguard the quality of this groundwater and not permit the flow of used groundwater into higher quality aquifers within the nearby alluviums. In several instances, the high saline aquifers and those within the alluviums intersect and these should be carefully monitored so that valuable aquifers used for irrigation are not contaminated. Also, many of the aquifers used by the mines are of low yield and although the water is to be recycled, additional safeguards should be provided to ensure adequate long-term on-site water resources.

2) Surface Water

Changes could occur in water quality if the various operations were to release acidic or salty waters into the Hunter River. However, stringently controlled management of water on and off mine sites and the on-site treatment and disposal of polluted water, should result in negligible effects. If mines are net users of water, there may be a slight impact on the flow of the Hunter River. Salinity levels in the Hunter are increasing (mostly from agriculture) and all mines must be monitored to assure that they are not contributing to this situation.

It is not envisaged that there will be any discharge of undesirable materials into the Hunter except under severe flood conditions where the sheer volume of water will dilute such discharge to acceptable levels.

Note should be made of the indirect water usage required to service the increased population generated by mine activities (see Chapter 8) and also of

1. the potential deoxygenation of water in the Hunter River due to increased runoff from sewerage treatment works. Consideration must also be given to
2. the possible uses of wastes to increase agricultural productivity (see Mt. Arthur North Environmental Impact Study) and to encourage landscape rehabilitation works.

Why haven't these points been given recognition status
See also Rural Industry recognition - the environmental study is not balanced for all Shire land uses !!

3. Eutrophication of rivers
4. Siltation of rivers due to rural activities

As previously stated, large volumes of water are required for power generation and coal conversion plants. This development can only occur if the dam development programme, as proposed by the Water Resources Commission, is fulfilled. The latest programme released by the Water Resources Commission details requirements for maximum development as well as requirements if developments do not occur. This is shown in Table 13.0. Considerable emphasis has been placed on the irrigation requirements of the Basin even though power generation usage of water appears to be higher.

Table 13.0 Effects of Variation of Requirements

	Assessed Maximum Requirements	Irrigation Development Less Than Projected	No Hunter District Water Board Extractions	Development Less and No Hunter District Water Board Extractions	No Power Development Other Than Bayswater and Liddell	No Coal Conversi
Total 2005 requirements (megalitres)	461 500	440 500	434 500	413 000	383 500	371 500
Operational years for:						
• Glenbawn Dam Enlargement	1989	1989	1989	1989	1989	1993
• Kerrabee Dam	1990	1990	1990	1990	1993	1996
• Rouchel Dam	1995	1995	1995	-	-	-
• Brushy Dam	2001	-	-	-	-	-

Source: "Refinements to Preliminary Hunter Water Plan"
Water Resources Commission of New South Wales 1980.

Cost of Water Resource Development

The Water Resources Commission have estimated the costs of water storage for the Hunter River Basin based on various development stages. If the maximum requirements to 2005 are to be satisfied, after the completion of Glennies Creek Dam, the additional storages needed in turn would be an enlarged Glenbawn Dam on the Hunter River, Kerrabee Dam on the Goulburn River, Rouchel Dam on the

Rouchel Brook and Brushy Dam on the Pages River. The additional storages would be required to be operational by 2001 and would cost about \$250 million at 1980 values. There would be a surplus of supplies of about 23,000 mega-litres per year.

Costs, however, based on alternative levels of water requirement are in Table 13.1 below.

Table 13.1 Effects of Alternative Levels of Requirements

	Assessed Maximum Requirements	Irrigation Development Restricted	No Hunter District Water Board	Irrigation Development Restricted and No Hunter Dis- trict Water Board	No Power Development Other Than Bayswater and Liddell	No Coal Conversion
Capital Cost of Additional Works After Glennies Creek Dam (1980 values)	\$ 250M	\$ 160M	\$ 160M	\$ 95M	\$ 95M	\$ 95M

Source: "Refinements to the Preliminary Hunter Water Plan"
Water Resources Commission of New South Wales 1980

Rural Industries

14

14.0 RURAL INDUSTRIES

The main sources of information on the various rural industries within the Shire are "Working Paper No.5 - Primary Industry", "Working Paper No.16 - Agricultural Land Use" by the New South Wales Planning and Environment Commission and a paper prepared by J. Hunt titled 'The Impact of Coal Mining on the Upper Hunter'¹.

A brief description of rural industry is contained within Chapter 4.0. The purpose of this chapter is to outline the major issues that may arise as a result of change and to identify possible impacts.

The above sources have been used extensively for this purpose and discussions held with Dr. R.G. Woodward of the New South Wales Department of Environment and Planning.

14.1 THE IMPACT OF COAL MINING ON AGRICULTURE

The interaction between future coal mining in the Shire and present extensive agricultural land use is identified on Figure 14.0 and Table 14.0. The following major factors² are considered to be relevant:

- . "direct competition by surface mining for the short term use of areas currently used for agricultural production,
- . short term loss of production from areas of intense agriculture adjacent to surface mines,
- . possible long term degradation of the land and water resources which form the basis of agriculture in the shire (rehabilitation),

1 The Impact of Coal Mining on the Upper Hunter - Hunter Regional Advisory Council 1978. J. Hunt,

2 Ibid

- . competition between agriculture and mining for labour resources,
- . competition between mining and agriculture for water resources,
- . competition between mining and agriculture for rail transport to the port."

Table 14.0: Interaction Between Agriculture and Surface Mining

Area of Mining Tenure	Comment
Muswellbrook	Small surface mine on native pasture.
Bayswater No.2	Surface mine on native pasture.
Liddell	No surface mineable reserves.
Ravensworth No.2 and south	Surface mines on native pasture and adjacent field crop and improved pastures (250 ha.).
A.74 and Theiss Bros. Drayton	Surface mine on native pasture.
E.2/A.129 Carpentaria Exploration	No surface mineable reserves.
A.15 Mt. Arthur North	Surface mineable reserves mainly on native pasture - some improved pasture may be involved (60 ha.).
A.15 Mt. Arthur South	Surface mineable reserves mainly on native pasture - some improved pasture may be involved (100 ha.).
A.86 Mt. Sugarloaf	Small surface mineable reserves on native pasture and beneath field crop area on prime agricultural land, probably not viable.

Source: The Impact of Coal Mining on the Upper Hunter, Table 7, p.50.

The agricultural impacts of the various mines currently subject to Environmental Impact Statements in Muswellbrook Shire are detailed in Appendix 7.

Prime Agricultural Land

Hunt identifies the main areas of prime agricultural land which coincided with prime open cut coal reserves as the area between authorisations A.75 and A.13, east of Jerry's Plains on the Hunter River.

All other areas of surface mineable coal lying beneath alluvial land (which coincides with prime agricultural land) being excluded from mining consideration at this time, as they are subject to a joint interdepartmental committee of inquiry made up of representatives of the N.S.W. Soil Conservation Service, the N.S.W. Department of Mines, the Department of Agriculture and the Water Resources Commission. One of the main questions being examined by the committee is whether it is possible to rehabilitate prime agricultural land to its former status after mining.

At this stage, the Department of Agriculture has expressed its concern that prime agricultural land be safeguarded as a scarce, valuable and versatile agricultural resource. In several areas, prime agricultural land is affected by adjacent surface mining operations - for instance, Wambo and Ravensworth No.2. The Department of Agriculture has indicated that loss of production from small areas of prime agricultural land is not significant in a regional context, as long as the prime resource is preserved for future production when the coal mining is completed.

Major Issues

The important agricultural issues² concerning land use or arising from changes in land use are:

- i) prime agricultural land could be temporarily or permanently lost from agriculture as a result of mining alluvial areas. Preliminary estimates are of the order of 8,000 ha. in the Hunter Region over the next decade;
- ii) the potential for rehabilitation of alluvial land is unknown;

2 Source - Dr. R.G. Woodward - N.S.W. Department of Environment and Planning

- iii) the quantity of water available for irrigation purposes could decline as a result of the high water requirements of coal mining, power generation and industry (a ten-fold increase in the next decade) and disruption of flow of alluvial aquifers as a result of mining;
- iv) the quality of water available for irrigation could decline as a result of the leaching of salts and acids from disturbed mining areas;
- v) the Hunter Region supplies 25% of the state's poultry, 25% of the state's milk, 8% of the state's beef, 60% of the state's wines, part or most of which may be lost as a result of the above impacts;
dramatic overgeneralisation?
- vi) rehabilitation of non-alluvial mined areas is satisfactory but long term stability and farmer acceptability is unknown;
- vii) the availability of labour for agriculture and rural service industries will decline since remuneration is significantly higher in the mining industry;
- viii) there may be increased social disruption to farmers and some farms will have no farming neighbours;
- ix) the services to agriculture may be reduced since mining activity will get priority for services and infrastructure;
- x) however, the market for local agricultural production will increase as a result of the increased population in the area;
- xi) the dust from open cut coal mines may reduce the quality and quantity of agricultural products;
more so than agricultural dust?
- xii) there may be increased pressures for hobby farms and an increase in the number of part-time farms as a result of increased population and better job opportunities;

How so?

leases surely

xiii) the granting of "authorisations" may lead to sterilization of agricultural land even though it may never be mined; and

xiv) the ownership of land after coal mining and rehabilitation needs to be resolved between farmers, coal companies and government.

- general policy? negotiation principles should be outlined to Council.

14.2 RECOMMENDATIONS

1) The viability of intensive agriculture, viticulture and dairying must be strengthened by ensuring that land needed for their activities is not unnecessarily encroached upon and that adequate buffering is provided between noise and dust generating activities and agricultural areas.

2) Any agricultural land (particularly west of the river) affected by mining proposals should be subject to strict management controls to ensure future viability.

3) The proliferation of small acreage farms (hobby farms) must be avoided if it acts to the detriment of viable agricultural holdings.

4) Mining must be prohibited in or under alluvial areas. why?

5) Performance monitoring should be carried out at all times to ensure that mine rehabilitation is successful.

6) Stricter management controls on farming marginal lands or steep sloping land to ~~ensure~~ protect erosion of topsoils and minimize river siltation?!

→ Examination of viability of some rural industries - dairying?

Tourism & Recreation

15

15.0 TOURISM AND RECREATION

Chapters 4 and 5 outlined the various tourist attractions, leisure and recreation facilities existing in the Shire and the towns of Muswellbrook and Denman. Further information can be obtained from the "Hunter Tourism Development Plan, 1980 - Stage One Working Paper 1" and the "Hunter Region Leisure Plan, 1977", both of which are contained within the Supporting Documents to this study.

Leisure and tourism in the Upper Hunter and, in particular, Muswellbrook Shire are important aspects of the area's future growth, particularly because of their potential to broaden the economic base. Although the potential has often been recognised, little has been done in the past to ensure that this resource is carefully planned and managed in line with future needs.

With the anticipated rapid growth in population, an influx of new residents and the establishment of new industries in the Shire, it is clear that the demand for these activities will expand rapidly.

The major effects of this growth can be summarised as follows:

- . Problems will arise in the ability of the existing and established resources to cope with the increase in demand, resulting in the need to reconstruct some facilities and to build new ones, for example:
 - . Additional tourist and business accommodation will be needed, however, the influx of new residents will also create demands for this accommodation.
 - . Roads and access may become inadequate or unsuitable.
 - . Some existing facilities will be too small to remain economic such as community halls, sports clubs etc.
- . Conflicts may result as one land use competes against the next, possibly resulting in the decline of a number of activities, for example:
 - . Dust deposition may affect the productivity and attractiveness of vineyards and farms.

- . Tourist routes may be affected by heavy traffic from coal transport.
- . Land currently used for rural pursuits and therefore giving the Shire its present character will change, possibly resulting in a decrease in the Shire's attractiveness.
- . New industries and activities will create their own facilities and therefore increase the Shire's overall leisure and tourist potential. For example:
 - . Open cut mines as tourist attractions.
 - . Lakes associated with power stations.
 - . Dams associated with mining, for example, new dams required if Authorisation 102 proceeds.

The following future trends have been identified:

- 1) There will be a growth in patronage of the Wollemi National Park. The proposed Manobalai and Goulburn River National Parks can also be expected to be heavily patronised.
- 2) Mines themselves will both directly and indirectly provide tourist, leisure and recreation facilities.
- 3) There will be increased local and tourist traffic along main and local roads. In particular, it is envisaged that a 'scenic drive' tourist route will be created linking the Putty and Broke Roads to the Goulburn River Valley/Gulgong circuit.
- 4) Increasing affluence and greater numbers of people will create demands for improved and, in some cases, additional facilities and activities. It is anticipated, for example, that water sports will grow in popularity.

Local environmental plans for the Shire should therefore address the following issues:

215

- 1) There is a need to separate light traffic associated with commuters and tourism and heavy vehicle movements generated by coal mines and related activities.
- 2) The existing character and essentially rural nature of the Shire should be maintained and, wherever possible, enhanced.
- 3) Major development activities should be utilised as tourist attractions, for example, open cut mine operations and power stations.
- 4) Incompatible land uses should be separated.

Detailed recommendations on the promotion and enhancement of the tourist and leisure industries can be found in the 'Tourist Plan' and 'Leisure Plan' as mentioned above. In addition, the following recommendations are suggested and should be read in conjunction with the aims and strategies put forward in Volume 1.

Recommendations

- 1) Protect agricultural and scenic lands from incompatible development.
- 2) Provide adequate zoned land for a range of recreational activities - adopt an open space strategy and landscape policy.
- 3) Minimise conflicts between adjoining activities.
- 4) Ensure the careful management of areas of land being restored after mining or being held as buffer zones around mining operations.
- 5) Prohibit open cut mining in areas set aside as "scenic protection zones" in a local environmental plan for the Shire.
- 6) Minimise the visual intrusion of any proposed "hobby farm" development.

- 7) Separate light and heavy traffic in order to protect tourists and residents by maintaining the Jerry's Plains, Denman, Sandy Hollow, Muswellbrook Roads for light traffic by physically restricting the entry of large vehicles from these roads into mining areas. In addition, press for the upgrading of the New England Highway to four lane width and the construction of a road and rail bypass to the town of Muswellbrook.
- 8) Encourage heavy vehicle movements along the New England Highway corridor and locate all major power lines, pipelines and conveyors etc. to a low impact corridor south of Muswellbrook town.
- 9) Restrict the development of mining projects which raise noise or dust levels within urban areas above accepted standards or which have significant long term visual impacts.
- 10) Ensure all historic buildings and building groups within the Shire are afforded the maximum protection possible.
- 11) Ensure adequate monitoring and management of land affected by mining.
- 12) Undertake a town improvement scheme aimed at retaining the character and image of the existing towns of Muswellbrook and Denman.

Impacts on Landscape,
Views, Heritage & Wildlife

16

16.0 THE IMPACTS ON LANDSCAPE, VIEWS, HERITAGE AND WILDLIFE

16.1 LANDSCAPE AND VISUAL CONSIDERATIONS

The potential visual impact of mining will result primarily from superimposing an industrial process into a rural landscape. The mining process will introduce elements which contrast strongly in form, colour, texture and scale with the surrounding rural areas. These elements include processing plant and machinery, coal and overburden stockpiles, exposed cut faces and dust.

In order to minimise the potential visual impact of such elements, a basic aim should be to plan the mining process in a manner which will minimise the opportunity for views into it from surrounding areas. For this reason a visual analysis was carried out (see Figure 6.2, Chapter 6.0).

In carrying out the analysis, two basic categories of view have been identified:

- a) from roads adjoining the site
- b) long distance views from the Hunter Valley and Muswellbrook township.

Within both categories, the potential visual impact is directly related to the number of people who will view the mining operations. In the first category a distinction can be drawn between roads in terms of traffic volume.

Major roads carrying large volumes of traffic are areas where visual impact is likely to be greatest. Many smaller roads will be rerouted to allow for mining operations and this gives an opportunity to design the roads and the mine works to minimise unsightly views of mine workings.

In the case of long distance views from areas such as the Hunter Valley and Muswellbrook, screening is often more difficult due to the nature of intermediate landforms. The Hunter Region has been described as a rich and varied rural and natural landscape comprising the broad river valley of the Hunter surrounded by an amphitheatre of mountain ranges of elevations in excess of 1,500 metres and opening onto the low lying coastal lands to the east. The landscape of the Upper Hunter is characterised by the natural environment of

mountains, river valleys and associated floodplains and superimposed urban townscapes of the rural settlements scattered throughout the valley. The prevailing rural image dominating within the Upper Hunter is of a pastoral valley containing small rural settlements and surrounded by natural wooded mountains. An exception to this overview is the range of varied townscapes with their own unique character and rich heritage as previously described in Chapter 6.0.

The rural landscape of the Hunter River Valley constitutes a scenic resource of major regional significance.

An understanding of the physical and visual characteristics of a district is essential if the impact of a proposed development or change in land use is to be adequately assessed. Such an understanding can be greatly assisted by a systematic process of landscape analysis in which the site is divided into a series of individual landscape units, each with a distinctive combination of landform, drainage pattern and location within the landscape elevation. These characteristics generally reflect an underlying consistency in geology which has undergone weathering in relatively stable climatic conditions.

Where the landscape has not been subjected to disturbance by man's activities, a distinctive vegetation association often develops on each landscape unit in response to a uniform set of soil, drainage and micro-climatic conditions.

Due to the high concentration of mining and power operations in the Muswellbrook district and the enormous scale of some of the operations, the impact on the landscape and the scenic quality of the Hunter Valley is likely to be significant.

It is essential that the "visibility" of each mine from major roads be minimized lest the tourist be left with the impression that the whole valley, other than the thin strip of bitumen on which he drives, is being dug up.

Providing that rehabilitation procedures can be successfully implemented as planned, then the final landscape will probably be unrecognisable as modified to the unknowing observer. However, the long duration of many of the operations requires that every effort be made to:

- i) concentrate their activities in areas of low visibility;
- ii) organise mining operations with a view to minimising unsightly aspects, that is, attempt to keep cut faces, spoil dumps etc. out of direct view; *? by moving one or the other*
- ✓ iii) undertake effective contouring and screen planting;
- ✓ iv) create, as soon as possible, a natural looking profile and vegetation to rehabilitation areas.

Fig6.2 Chapter 6 demonstrates these major concerns in the form of a diagram illustrating key view corridors and catchments for the Shire.

16.2 HERITAGE (see description Chapter 6.0)

Heritage aspects can be examined under the following sub-headings:

- Landscape/landform
- Archeology
- Settlement patterns
- Historic buildings and precincts

Landscape

The general landscape of the Hunter Valley is that of a wide alluvial flood plain surrounded by an amphitheatre of mountain ranges in excess of 1,500 metres with scattered urban settlements and villages usually associated with the river. The river flats must be preserved at all costs and this indeed is government policy. The areas most likely to be affected are rolling foothills which have been used for grazing. Significant landscape features should be mapped and preserved (for example, rocky knolls of volcanic origin, major ridgelines etc. - see visual aspects).

Generally, however, there are few landscape features of significance within the Shire (with the exception of the major rivers- Hunter, Goulburn) and the rocky outcrops in the vicinity of Denman and few, if any, lasting impacts are likely on the general landscape providing good management techniques are adhered to.

Archeology

Field investigations in the Mt. Arthur North Environmental Impact Study have revealed a few scattered archeological remnants. Most sites recorded are located along the lower reaches of the tributary streams often below the 150m contour. These have been scattered and mixed by floods, wind and ploughing. Large campsites have been identified on Saddler's and Saltwater Creeks to the south of Mt. Arthur and should be investigated before any operations which may threaten them are contemplated (contact National Parks and Wildlife Service).

At present there are no records of aboriginal art, sacred sites or burial grounds in the area, however, the National Park and Wildlife Service is commencing a survey.

Because of the scattered and generally insignificant nature of archeological sites in the area, it seems unlikely that any significant cumulative impacts will result from mining operations.

Settlement Patterns

The location of historic properties along the Hunter River is living evidence of previous settlement patterns and contributes strongly to the regional character and should be preserved. This means that any action which would threaten not only the homesteads but the pattern of development should be avoided. Elements which combine to establish this pattern include homesteads, home paddock planting, subdivision pattern, fences, setbacks etc.

Historic Buildings/Precincts and Townscapes

1) The Edinglassie Group and its architecture

These buildings, as described in Chapter 6.0, and their siting on the elevated terraces overlooking the rich alluvial Hunter River flats, form quite a coherent and relatively high quality rural grouping. Although they have not all been closely examined, they appear generally to be in good condition. It appears that although they may not individually qualify for classified listing, they should certainly be regarded as an important historic group of buildings typifying the early pattern of rural settlement in the Shire.

In terms of the social heritage of the Region, where continuity of long term human association is considered vital, it should also be noted that a number of the properties have remained in the one family for several generations.

2) Rural River Setting

The eight properties that form an important rural grouping of historic homesteads of fine quality to the south-west of Muswellbrook are Skellatar, Balmoral, Edinglassie, Rouse Lench, Piercefield, Bengalla, Overton and Negoa. The heritage significance of these properties, together with their outbuildings and earlier homesteads (that is, Old Edinglassie) lies in the historical associations of their builders with the early days of the colony, the relatively high quality of their architecture, their inter-relationship as virtual neighbours and their orientation to the Hunter River flats. Several of the buildings can be seen from public roads and from one another across the river and adjacent fields. In terms of their heritage value, these properties cannot be separated from their settings as rural homesteads. It is this rural quality that should be preserved by ensuring that:

- . mining activity is controlled in areas close to these properties;
- . there is an adequate buffer surrounding each property;
- . the property is put to an appropriate ongoing use that relates to its rural setting.

3) Proposed Denman Road Realignment

The proposal to re-route the Denman Road to the north as illustrated in the Mt. Arthur North Environmental Impact Study creates adverse impacts on both Edinglassie and Rouse Lench. Balmoral is not affected by this realignment.

In the case of the latter, the proposed road passes within 100 metres of this historic colonial building. The effect of this would be to seriously impair the broad rural setting enjoyed by this homestead at present. It would be necessary to introduce an intensive landscaped buffer between the new road alignment and the homestead to re-establish an appropriate substitute setting.

Likewise with Edinglassie, the broad expanse of paddocks, with their white painted rail fences extending approximately 400 metres up to the existing Denman Road entrance, creates the manmade rural landscape approach appropriate to the character of this historic sandstone homestead. The re-location of the road 200 metres closer to the homestead will clearly destroy the scale of these wide sweeping paddocks. Other landscaping measures including planting of hedgerows and an approach driveway would be required to re-establish a proper setting for this homestead.

The proposed realignment of Denman Road further down the contour would locate this route on the edge of the floodplain. Here at least there should be good alluvial soils that would allow intensive tree planting to be carried out to re-establish the scenic qualities of this route. The realignment away from the North Mine would increase the visual impact on the rural setting of both Edinglassie and Rouse Lench. Any change in the proposed realignment which removed the road away from these properties would reduce the impact of the road. However, the proposed alignment does reduce the adverse visual impacts of the North Mine when viewed from Denman Road. Views into the mine from the road can be more effectively screened if the road is moved further to the north as proposed.

4) Muswellbrook Town Centre

The town of Muswellbrook contains many fine buildings and streetscapes - see Chapter 6.0. Existing and projected mining activity will undoubtedly put pressure on these areas for redevelopment at some time in the future.

The National Trust's lists relating to Muswellbrook are incomplete and no urban conservation study has been carried out by the Trust or Council. The accompanying photographs of typical main street views show a high collective quality of urban design and historic wallscape coherence.

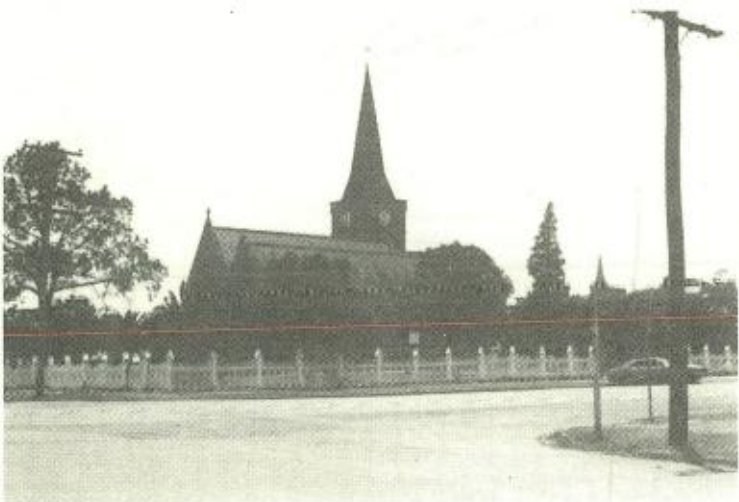
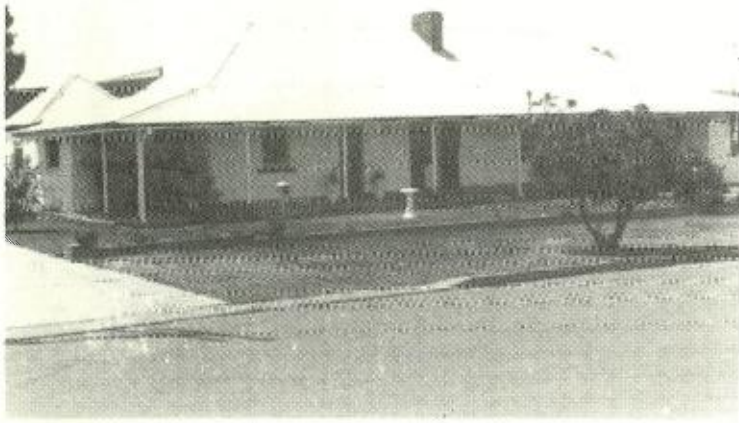
The remaining photographs have been selected from a photographic survey to highlight the interesting topographic form of Muswellbrook, typical streetscape views and a selection of the better quality historic buildings.

It is clear from this preliminary survey that there is a need to prepare a proper urban conservation study of Muswellbrook to identify individual and groups of buildings, spaces and townscape features that will need to be preserved and integrated with the new development.

Such a study would enable Council to enunciate clear planning and design policies with regard to historic parts of the town.

This study could be carried out through Council requesting the National Trust to instruct its Urban Conservation Committee to act or alternatively an approach could be made to the Heritage Branch of the Department of Environment and Planning.

It has been mentioned earlier that the expansion of the town centre is constrained by topography. To ensure that conservation policy would not conflict with development needs, historic buildings have been excluded from calculation of supply of additional floorspace. It has been shown (Chapter 11.0) that there is adequate land available for redevelopment without demolishing any buildings of heritage value.



A selection of photographs illustrating the character of Muswellbrook's older buildings



P.O. Bridge Street, Muswellbrook



Brook Street Intersection



Views from Brook Street



An historic Hotel - Market Street



Recent restoration and recycling of significant buildings in Bridge Street (Campbell's Corner and Loxton House) has shown that high quality space can be provided within such buildings and their rejuvenation makes a substantial impact on the quality of the streetscape and the image of the town.

Initiatives in this area should be actively encouraged by Council policy in order that as the town develops it will have a coherent image, a pleasant appearance and contain a complexity, diversity and richness of built form that is rarely achieved in contemporary commercial development.

It is not suggested that a "museum approach" be taken but rather that buildings of significance be cared for, recycled for new uses and used to define a general context into which new development can be fitted to make a positive contribution to the quality of the town environment.

'Special Precincts', as identified in Chapter 6, should be given particular attention.

Summary

From a preliminary appraisal of the southern sector of Muswellbrook, it is important to preserve and enhance the scenic quality of the south-eastern valley approach into the towns. This can be ensured by devising appropriate controls over the form of mining activity, appropriate landscaping and control of future urban expansion.

The urbanised southern sector of Muswellbrook requires planning and design treatment to ensure that continuing development here results in a proper upgrading of the area. There will obviously be pressure, associated with the mining activity, to change some land uses and this needs to be related to a clear future planning strategy for the town itself.

The Muswellbrook/Denman route along the Hunter River flats is of great visual, tourist and heritage significance. There is a need to develop guidelines for a scenic protection easement - part of a Hunter River environmental corridor incorporating the valley floor, river, floodplain, alluvial flats, historic buildings, prominent landscape features and visually significant valley wall elements.

Most historic buildings relate to the floodplain and/or the urban settlements and villages as a response to the early settlement pattern. Thus the protection of the floodplain (desirable from many other aspects) can substantially contribute to the protection of the settlement pattern and the historic buildings. Within the towns and villages the historic buildings and townscapes may be threatened indirectly by development pressures associated with increased growth.

It is envisaged that once a district heritage survey is complete a range of development controls will be applied within the shire planning scheme to protect and encourage rehabilitation of those properties within the villages and towns.

In order that the homesteads maintain their contribution to the regional character, it is necessary that the farms remain as viable units (although it is likely that such properties would be seen as desirable accommodation by some of the new executive class who will be migrating to the area).

Controls will be necessary also on the Hunter River floodplain to preserve its vital agricultural role as well as that of a major scenic element in the region.

✓ | |||||
Generally, however, it is unlikely that mining operations will have significant direct effects on the heritage aspects of the shire but likely that the indirect effects could be substantial.

Thus thorough heritage studies should be undertaken to record all buildings, townscapes, landscape features, settlement patterns etc. of significance and to recommend means of ensuring their preservation. The various roles of state and local government and private enterprise, including any active involvement of the mining industry, should be thoroughly explored.

16.3 VEGETATION AND WILDLIFE

Vegetation

Although significant areas will be cleared of all vegetation during mine operations, there is no reason why, with careful and considered landscape management practices, the vegetation cannot be restored at least to its present level. The major part of most lease areas is open savannah type woodland and pasture grasses. These can, no doubt, be successfully regenerated. The major impact of vegetation clearing will be on wildlife habitat and thus consideration should be given to preservation of such habitats whenever possible and to the early regeneration of new habitats particularly along watercourses and around dams.

The prime potential impact of such largescale clearing of vegetation will be soil erosion and it is assumed that the conditions of approval for mining operations will ensure that adequate steps are taken to prevent significant erosion and runoff to the Hunter (see Water Quality).

Wildlife

Mining activities and proposals in the area will affect the terrestrial fauna through the direct removal of habitats and environmental modification. The most significant impact will be the removal of vegetation for open cut mining and stockpiling. The vegetation affected will be grassland and open woodland and some small areas of woodland. This will have insignificant impact as there are few native animals existing in the areas to be cleared and/or stripped. The birds and animals inhabiting these areas are common and widely distributed. The larger, more mobile, species will be temporarily driven out and their survival depends on their ability to find suitable alternative unoccupied habitats. Smaller, less mobile, species may perish in the clearing or soil stripping process or soon after in a hostile environment lacking food and shelter.

Generally the mining companies expect reoccupation as rehabilitation is established and as new habitats are created. Recolonisation of the area by any species will only occur if nearby populations remain until the suitable habitats are created. The cumulative effects of Draytons, Mt. Arthur North and South, Black Hill and Bayswater, combined with the urban expansion of Muswellbrook and power station developments, could depopulate a considerable area. Further investigation into this aspect is required and some form of habitat protection may be required and/or some restocking.

It is likely that within each mining lease there will be areas providing above average habitat for wildlife, for example, rocky knolls, densely wooded slopes, water courses etc. It would be desirable if these areas could be conserved wherever possible and mineworks should take such areas into account (for example, Mt. Arthur).

There are few permanent streams within the areas to be mined, however, extreme care must be taken to prevent detrimental impacts to the Hunter River (see Water Quality, Chapter 13). All mines claim that no silt, acidic or toxic wastes or pollutants will be discharged into the Hunter River except under exceptional flood conditions. Careful monitoring by an independent body will be necessary to ensure that all prevention mechanisms outlined in E.I.S.' are effective and strictly adhered to.

16.4 RECOMMENDATIONS

- . Preservation of the visual (scenic) quality of Muswellbrook's picturesque setting so that mining activity does not interfere unduly with the Shire's and town's present rural quality. This could be achieved in part by adopting scenic protection areas in a Local Environmental Plan. See Volume 1 - Scenic Protection Strategies.
- . Establishment of suitable buffers around the key areas to be mined.
- . Identification of key scenic elements of the valley walls (that is, north face of Mount Arthur), significant tree groupings and historic homesteads for priority preservation.
- . Establishment through a management plan of an 'environmental corridor' along the Hunter River (and tributaries) excluding this area from mining or associated activities that could adversely affect this corridor. (See Chapter 11 - Development Opportunities.)
- . Identification of Muswellbrook township's historic building heritage and, where appropriate, their recycling for appropriate uses.
- . Preservation of all its historic homesteads composing the Edinglassie group in the south-west sector of Muswellbrook and push for the realignment of the Muswellbrook-Denman Road so as to not adversely affect these buildings.
- . Plan and manage the orderly extension of Muswellbrook township in accordance with a 'structure plan'. Wherever possible, utilise the mined area adjoining the town (after restoration has taken place) for the purposes of residential areas and/or recreational facilities.
- . Definition of the town road and rail 'gateways' with natural and manmade landscaping, associated with the proposed Muswellbrook buffer zone.

Air Quality

17

17.0 AIR QUALITY

The air quality of the Upper Hunter Valley is affected by a number of activities including discharges of pollutants from Liddell Power Station, coal mining operations, road and rail transport and other activities including fires at burn-off times, sawmills, land ploughing and aerial applications of fertilizers and weedicides.

The major air quality factor of relevance to the Shire is dust, both in terms of its deposition and suspended concentrations. The major factors affecting the levels of dust in any location are the rate of generation, height of generation, average wind speed, percentage of time that winds blow in each direction, size of particles and settling velocities. Other factors influencing dust generation and fall-out rates are terrain, soil type and moisture content.

17.1 DUST DEPOSITION

Dust deposition in areas away from the generating source is dependent on wind speed, particle size and the initial height of the dust plume. As the wind blows the plume away from source, the dust particles will settle out vertically at or near terminal velocities. The carry distance and the wind direction will determine its fallout location¹.

Deposition rates are presently monitored within the Muswellbrook town area by the State Pollution Control Commission (through the Muswellbrook Shire Council), while the Electricity Commission takes measurements at 36 points within a radius of 25 kilometres from Liddell Power Station.

The mean rate of deposition over a two year period (1977 and 1979) for the Muswellbrook urban area was 3.5 gm/m²/month. This figure is much higher than those measured in some other towns in New South Wales in 1978, including Lithgow (1.9 gm/m²/month), Albury (1.8 gm/m²/month) and

1 Sinclair Knight & Partners

Central Sydney ($2.0 \text{ gm/m}^2/\text{month}$). Stockton, in the port of Newcastle, also has a high figure of $3.7 \text{ gm/m}^2/\text{month}$. The reasons for this high figure for Muswellbrook appear to be mainly related to dust generated by the coal mining activity within and to the north-east of the town which is transferred throughout the urban area by vehicles. and captured by the air turbulence characteristics of the Shire. The figures for South Muswellbrook are significantly lower than in the northern parts of the town.

A major source of airborne dust particles is the Liddell Power Station. Figures from the five deposition gauges in its immediate vicinity indicate very high deposition rates (number 1-5 in Appendix 111). However, the power station is not close to major population areas and the prevalent south-easterlies and southerlies are thought to carry little of this dust north-west to Muswellbrook.

The remainder of the Shire has much lower levels of dust deposition. To assess an appropriate background level, median values provide a better indicator of the conditions than mean values, as gauges monitored at monthly intervals do not necessarily reflect average conditions throughout the period as few extreme events raise the mean considerably.

Therefore, background dust deposit values in the Shire, based on gauges away from major dust generating sources, are likely to lie in the range of 0.4 to $0.7 \text{ gm/m}^2/\text{month}$. The figure of $0.7 \text{ gm/m}^2/\text{month}$ has been adopted in the Mt. Arthur North E.I.S. as an appropriate background level.

17.2 SUSPENDED DUST CONCENTRATIONS

As well as fallout of the heavier particles, fine dust particles of varying size will be held in suspension and travel much greater distances before being deposited or dispersed. These dust concentrations act in a similar manner to gases and follow, in part, modified gas laws.

Suspended concentrations around Muswellbrook have never been recorded. While the particulate deposit gauges generate data on average dust fallout over a period of time, they are of little value in assessing instantaneous or short term dust problems.

Activities (for example, mine blasting with unfavourable wind directions, earthmoving operations etc.) are more likely to offend residents in the town than increase in average dust fallout.

17.3 DUST CONTROL MEASURES

Effective dust suppression on transit roads requires deeper study into the dust translation associated with the passage of vehicles over the sealed road surface itself. There should be more attention given to the ability of the sealed surface to absorb and store the transient dust particles. Observations show that the dust deposited on top of current sealed surfaces is readily entrained by the vehicle and transmitted in an agitated air mechanism over a broader area.

It is considered that a sealed surface consisting of coarse metal rolled into a sealed base would moderate this dust translation effect. The large voids in the surface, would be effective capture recesses. They would further ensure that the fine grained eddy mechanisms generated at the surface, due to increase in ^{viscous?} vicious shear forces in the energised air, would help to maintain the dust at the surface and not in the pocket of air carried along behind the vehicle.

Another proposal would be to intersperse 2m "cattle grid" crossings along the transit road to duct away the dust-laden airstream generated under the passing vehicle. This is a recognised conservation practice in some industrial fields (e.g. the Sulphide Corporation-Boolaroo). The degree of the under-vehicle air motion could also be minimised by the fitting of special air deflectors to the lower front of the vehicles themselves.

17.4 OTHER EFFECTS OF DUST

It is a well established fact that the precipitation rate of rain is directly related to the degree of dust in the local atmosphere. It is the minute dust particle which allows the water vapour to coalesce and generate precipitation. The increase in open cut mining in the Upper Hunter Valley would bring beneficial results in the short term to the farmers of the region. Hence the concern of the township for moderation in mining activities could be to the detriment of their near neighbours, the farmers and vintners of the Upper Hunter Valley.

good heavens!

17.5 SUMMARY AND RECOMMENDATIONS

As yet, little research has been carried out into both tolerable dust levels and the characteristics of dust dispersion. Some staff from Newcastle University are working in conjunction with the State Pollution Control Commission on a study of the air quality associated with industrial sites and are also commencing an investigation of the dispersal of dust from coal mines. These studies though are long term projects which plan to monitor dust levels for a period of at least 12 months and preliminary results will not be available for some time.

Sinclair Knight and Partners undertook a comprehensive literature search and held discussions with the SPCC and Sydney University. These revealed that very little research into dust emission has been carried out which is applicable to open cut coal mining. Particularly lacking is field research on the dust generation properties of plant and equipment.

Although further study is necessary to ascertain tolerable dust levels, it is largely a question of the extent that the level of the dust particles in the air can be increased before they either present a health hazard or are unaesthetic to the residents of the Muswellbrook Shire. Although a slight overall rise in dust levels may be quite acceptable to most people, many would react unfavourably to occasional

excessive high dust levels. Therefore, it is necessary to determine both a suitable constant level for dust particles in the air and a suitable level for periodic high emissions.

The major recommendations from this study are:

1. That the Council press for the cleaning up of existing mining operations within and to the north-east of Muswellbrook town in order to minimise dust transference by vehicles.
2. That Council investigate and wherever appropriate initiate programmes of street planting, street watering and road sealing within the town in order to overcome dust problems.
3. The S.P.C.C. and Council, through the environmental Impact Statement process, ensure that all new developments having significant dust generation characteristics be adequately controlled at their source and that effective monitoring procedures be employed.
4. That effective road sealing, dust traps and vehicle design be emphasised and implemented as conditions of consent to new mining projects in the Shire.
5. That proper investigation be held as to acceptable dust levels and adequate monitoring mechanisms.
6. That the impacts in terms of dust, of the proposed Black Hill Mine, be thoroughly investigated in the light of the information contained within this chapter.

Noise & Vibration

18

18.0 NOISE AND VIBRATION IMPACTS

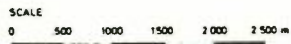
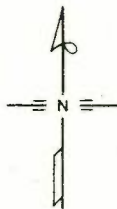
This chapter summarises the second stage of a study carried out by Louis A. Challis and Associates. The first stage involved a survey of existing background noise levels in the township (see Chapter 3). The second stage evaluates the cumulative impact of mine noise and transportation noise on the existing and future residential areas of the town. A set of criteria is presented for acceptable levels of transportation noise, mining noise and blast overpressure and vibration, in residential areas. The noise studies incorporated into recent environmental impact statements for proposed mines in this area have been reviewed with particular emphasis on their likely cumulative impacts.

This chapter also examines various planning options available for optimising land usage and minimising future community noise impact and presents recommendations by which the most advantageous solutions may be achieved.

18.1 DESCRIPTION OF THE AREA

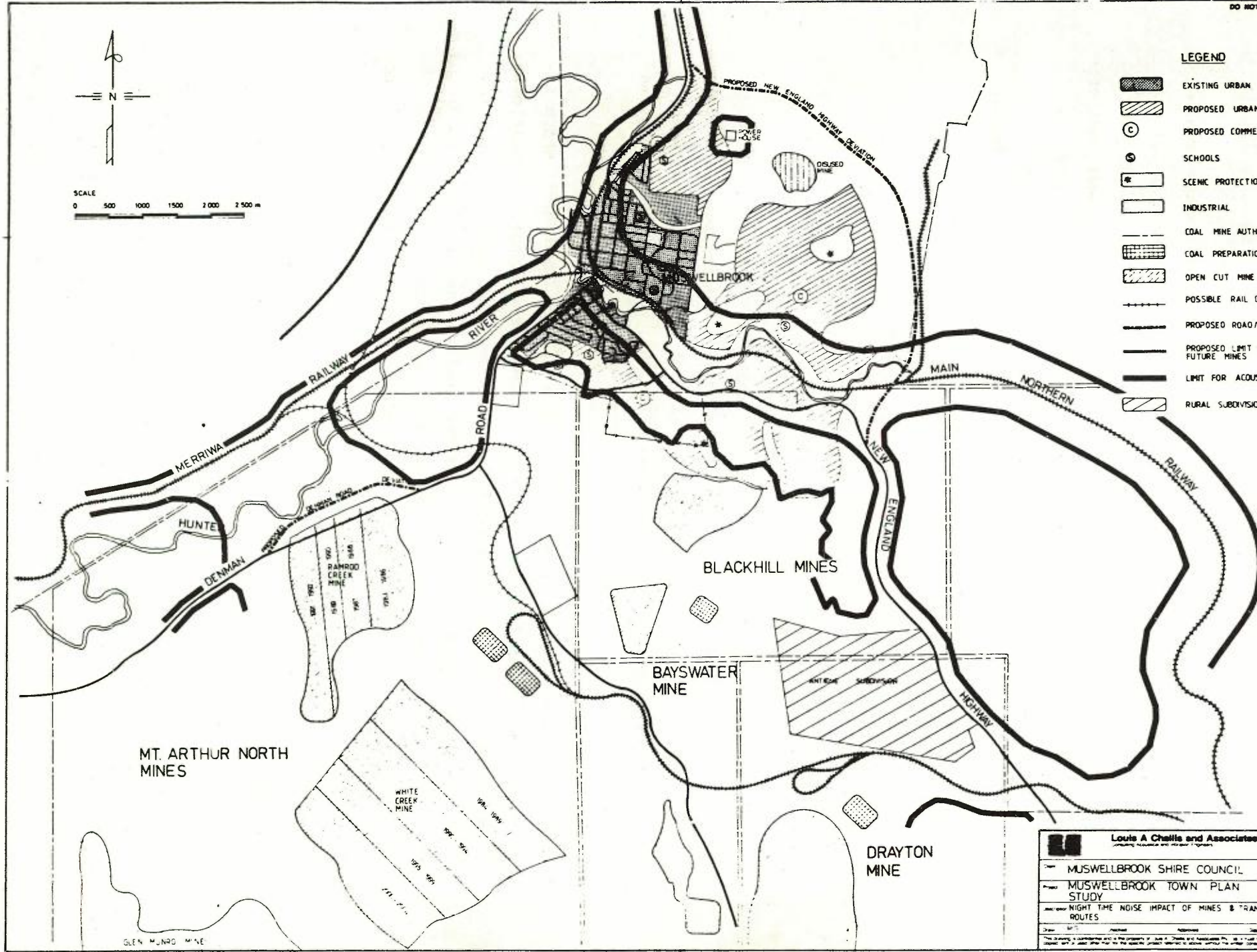
The township of Muswellbrook is located on the Hunter River and the New England Highway and is an important road and rail junction. The Main Northern Rail Line passes through the town which is also the branch point for the Gulgong-Sandy Hollow line which extends to Ulan. Both the railway lines and the roadway pass through the centre of the town and as such currently constitute the most significant noise sources dominating the day-time and night-time background noise levels. (See Chapter 3.)

As discussed earlier in this study, the town of Muswellbrook is almost completely surrounded by coal prospects and Figure 18.0 shows, the coal mine authorisations granted for prospecting are extensive. Of these leases the most important are the proposed Mt. Arthur North Mine, the proposed Theiss Drayton Co-Venture, the existing Bayswater No.2 Mine, the existing Muswellbrook Coal Company No.2 Mine and the proposed Black Hill Mine. Mines currently operating in the area to the north and to the south have not yet significantly modified the acoustical environment of the town. However, as the planned southwards and westwards expansion of the town takes place, in the areas shown on Figure 18.0 the impact of these mines and the proposed mines may become more significant.



LEGEND

- EXISTING URBAN
- PROPOSED URBAN
- PROPOSED COMMERCIAL
- SCHOOLS
- SCENIC PROTECTION ZONES
- INDUSTRIAL
- COAL MINE AUTHORISATION
- COAL PREPARATION AREA
- OPEN CUT MINE
- POSSIBLE RAIL DEVIATION
- PROPOSED ROAD / HIGHWAY DEVIATION
- PROPOSED LIMIT OF POSSIBLE FUTURE MINES
- LIMIT FOR ACOUSTICAL ACCEPTABILITY
- RURAL SUBDIVISION



237

Fig. 18.0

Louis A Challa and Associates Pty Ltd
 CONSULTING ENGINEERS AND ARCHITECTS

MUSWELLBROOK SHIRE COUNCIL
 MUSWELLBROOK TOWN PLAN
 STUDY
 NIGHT-TIME NOISE IMPACT OF MINES & TRANSPORTATION ROUTES

Scale: 1:25,000
 Drawing No: 3793C

GLEN MUNRO MINE

The extent of rail and road traffic currently experienced by the town is relatively modest and is dominated primarily by traffic which is not a direct result of coal mine development. The rail traffic in particular is likely to increase substantially in the future with the development of coal mines to the north of Muswellbrook. Road traffic will increase as the service industries for the local and northern coalfields expand. Future traffic flows are discussed in more detail in Section 18.2 below.

18.2 POSSIBLE CHANGES IN THE ACOUSTICAL ENVIRONMENT

Proposed Mines

(i) Mt. Arthur North Coal Project

This proposal is for the Electricity Commission of New South Wales to establish a mine on the site of Authorisation No.168, located immediately to the south-west of Muswellbrook. The project would consist of three open-cut mines operated over the years 1983-2004, with maximum production by 1989 of 11 million tonnes per annum (mtpa) of raw coal.

The mine nearest to Muswellbrook would be the Ramrod Creek Mine, which is located some 2.5 km from the southernmost limit of residential development, (see Figure 18.0) whilst the other two mines would be located further to the south. Steaming coal would be transported by conveyor to Bayswater and Liddell Power Stations and coking coal would be transported by rail to Newcastle via an extension of the Drayton's rail loop, which is located to the south of the town.

The acoustical impact of this development has been assessed in the "Mt. Arthur North Coal Project, Environmental Impact Statement, Document 5 (Noise Study)". This indicates that the noise impact of the mine would be largely contained within the rural areas in the immediate vicinity of the Ramrod Creek Mine and would not extend to the residential areas of South Muswellbrook.

It appears that under certain operating and meteorological conditions, the impact of this mine may extend over a wider area than is currently indicated in the Noise Study. It is apparent that this mine, in concert with other mines in the area, may result in a degradation of the acoustical environment in the South Muswellbrook growth area below acceptable criteria for residential

development. The assumptions on which the Noise Study for the Ramrod Creek Mine are based, are discussed in Section 18.3 below.

(ii) Drayton Coal Mine

This proposal is for Drayton-Theiss Co. Ltd., to establish a coal mine on the site of Authorisation No.173. The mine would be an open cut operation, located some 4 km to the south-east of Muswellbrook and immediately to the south of the Antienne rural subdivision. Coal would be transported by rail to Newcastle using the rail spurline which would join the Main Northern Line at Liddell.

The acoustical impacts of this mine are assessed in the Environmental Impact Statement for the mine. This indicates that the mine will do little to alter the acoustical environment in the area. However, certain assumptions made in the analysis are incorrect and the impact may extend over a wider area than indicated.

Possible Future Mines

(i) Black Hill Mine

This mine would be located in Authorisation 174 to the south of Muswellbrook and immediately south of an area zoned for residential purposes. It is possible that mining may be carried out approximately 500 metres from the proposed residential subdivision. If mining were to proceed, then it is also probable that it would be carried out in the northern part of the authorisation during the daytime only and that mining operations would not proceed north of the ridge line bounding the southern side of the subdivision.

(ii) Authorisation No.102

It is possible that a coal mining operation and associated liquefaction plant may be established in the area to the west of Muswellbrook. This would extend westwards as far as the line of hills and be limited in the east by the floodplain which lies immediately west of the town (see Figure 18.0).

Rail Traffic

Rail traffic will become the dominant source of noise in the town as coal mining activities increase in the Hunter Valley area. The rail traffic generated by the new mines to the south of the town will be carried by the Drayton rail loop and will not affect the Muswellbrook township.

The rail traffic which will affect the noise environment within Muswellbrook will be the traffic on the Ulan Line and on the Main Northern Line from Werris Creek. These increases will primarily be the result of increased coal transportation, rather than passenger or freight traffic. The coal will be transported in unit trains typically incorporating forty-two CHS waggons with two 80 class diesel locomotives. It is forecast that the numbers of these trains utilising the Main Northern Line will be twenty-four movements per day whilst the number of movements on the Ulan line will be ten per day.

Road Traffic

Traffic on the New England Highway is expected to naturally increase as the commuting and service vehicle numbers increase. The major night-time sources of noise on the Highway (and the Denman Road) are the heavy vehicles and this traffic is also expected to increase as the area develops. (Specific traffic forecasts are not currently available.)

18.3 ACOUSTICAL CRITERIA FOR ACCEPTABLE RESIDENTIAL AMENITY

Basic Acoustical Criteria

Most community noise assessments carried out in Australia over the last ten years have been based on AS1055 the Australian Standard "Code of Practice for Noise Assessment in Residential Areas", whose first drafts were released in 1971 and which was published in 1973 and revised in 1978.

This Standard, whilst covering many aspects of community noise assessment, does not adequately address the critical issues relevant to this study namely the assessment of traffic noise impact and cumulative source impact.

In the past most environmental noise impact assessments have been presented in accordance with this Standard for single developments whose effects may be considered in isolation and whose subsequent impact may also well be evaluated in isolation. In this type of assessment, the predicted future noise levels are compared with the existing noise levels. When multiple developments occur, the phenomenon of "creeping noise" is likely to arise, where each succeeding development results in a slight increase in the "existing" noise levels created by the preceding development.

Thus the multiple coal mine development currently taking place in the Muswellbrook area, together with the rapid increases in transportation noise likely to take place, necessitate a revision of previous practice.

A number of states have recently produced more comprehensive criteria, the most significant being that of the Victorian State Government, under the Environmental Protection Act of 1970 (No.8056). This was gazetted by the Victorian Government on Thursday, 26 March 1981.

All of these criteria relate to the determination of either the A-weighted (L_{10}) mean peak level of the offending noises with suitable corrections for time of day or night, duration of the noise impact and noise character (tonality, impulsiveness, etc.). The Victorian Act and the proposed revised International Standard ISO1996 also propose the use of an equivalent noise level (L_{eq}) to take into account the long term effects of time varying noise.

In this study it is proposed that the criteria contained in Chapter 3 (Figures 3.9 and 3.10- Suggested Criteria for Acceptability) be adopted as the overall planning criteria for the township and the future residential areas. These sets of curves (one for daytime and one for night-time) relate to the statistical characteristics of the noise and allow for higher levels of noises of shorter duration (for example, the passing of vehicles) than for continuous noises such as might emanate from a mine.

These curves are the results of research conducted over the last ten years through a large number of detailed statistical assessments of background noise.

The criteria used fall within the median band of "normally acceptable" daytime or night-time noise. The criteria for the various types of activity have been considered in two categories, as follows:

(i) Mining and Industrial Noise

Since the noise levels from mines and industrial areas are likely to result in a reasonably constant background noise level, punctuated by occasional peaks, the criteria has been specified in terms of elevation of the L_{90} background noise. In order to obviate the creeping noise effect of multiple developments the individual L_{10} level from any mine or industry in isolation should not exceed cumulative L_{90} criteria of 50dB(A) daytime or 40dB(A) night-time.

(ii) Transportation Noise

Traffic noise is a variable noise characterised by high peaks of short duration at close distances and lower level peaks of longer duration at greater distances. The descriptor often used and which we have adopted in this study is the L_{10} (or mean peak) noise level.

This provides a proven objective measure which correlates well with the likely annoyance resulting from increased traffic noise levels.

The recommended criteria are set out as follows:-

Activity	Mean Peak (L_{10}) Intrusive Noise Level-dB(A)	
	Day Time	Night Time
Mining/Industrial (individual)	50	40
Traffic (cumulative)	60	55

Clearly, the critical time for the achievement of residential amenity is night-time, thus emphasis has been placed on the assessment of future night-time noise levels.

18.4 BLAST VIBRATION AND NOISE CRITERIA

There have been many criteria presented for the assessment and adequacy of blast vibration and blast over pressure, the majority of which have been developed by mining organisations, insurance companies and government mining agencies. The reason underlying their research work has, in most cases, been prompted by a concern to develop criteria for their own protection in the face of repeated insurance claims and protracted litigation.

The primary criteria have, in almost all cases, been associated with measurable damage to buildings, with little consideration for physiological disturbance, intrusion or loss of amenity.

In most normal circumstances where such mining activity takes place, the general population is exposed to a maximum of one blast per day and, in the few situations where there are multiple blasts, this is generally as a result of localised demolition work whose period may extend to days or, at most, weeks.

In the case of Muswellbrook with six or more mines likely to be in operation from around 1984 onwards and with two or more pits likely to be operating in a number of these mines, it is clear that the normal criteria of acceptability for one blast per day is no longer relevant. Possibly the most authoritative work on this subject is that presented by the International Standards Organisation in a draft amendment to the ISO Standard 2631 on whole body vibration. This specifically considers blasting and recommends that for residences exposed to three blasts per day, a threshold level of 1.6mm/sec. should apply.

On this basis a criteria of 1.6mm/sec peak particle velocity should be applied for each blast, to control the physiological impact of multiple blast vibration.

To control the effects of blast over pressure the appropriate criteria should not exceed 115dB unweighted, in the frequency range 0.1Hz to 500Hz. This criteria should apply to any residential property not covered by mining covenant. These cumulative criteria for blast vibration and blast over pressure should be applied to any residence which is likely to experience three or more blasts per day.

18.5 MODELLING OF FUTURE ACOUSTICAL ENVIRONMENT

Existing Mines

The acoustical impact of the existing mines is minimal as a result of the distances separating those mines from the main centres of residential activity. What impact is occurring mainly comes as a result of coal truck movements in central Muswellbrook from the Muswellbrook No.2 mine loading bin and in the Antienne subdivision from the Bayswater Mine, carrying coal to the railheads. Whilst this increases general day-time traffic in these areas, there is currently negligible impact at night-time. Because of the much higher noise levels that would be produced by future traffic noise impact (if the transportation routes retain their current positions), and the relatively lower impact from mine noise, our model has ignored the night-time impact of existing mines.

Future Mines

The cumulative acoustical impact of the Mt. Arthur North Coal Project, the Drayton Mine and the Black Hill Coal Mine have been assessed on a night-time basis. The noise contours presented in the respective impact statements for the Mt. Arthur North and Drayton Mines have been used as a basis for our assessment. In the absence of more definite information, indicative noise contours for the Black Hill Mine have been based on a number of assumptions about scale of development.

The $40\text{dB(A)}L_{10}$ noise contour (corresponding to the criteria limit for acceptability at night-time) for the Mt. Arthur North Mine and for the Black Hill Mine have been used, together with the $36\text{dB(A)}L_{\text{eq}}$ contour for the Drayton mine (assuming that this would approximate to the $40\text{dB(A)}L_{10}$ contour). These contours have been reproduced on the same base map (Figure 18.0) and the contours combined.

Transportation Noise

The L_{10} noise levels have been completed for the predicted rail movements, at various distances from the track, over flat ground, assuming two train movements per hour at night on the Main Northern Line and one movement per hour on the Ulan line. The computations are based on detailed movements carried out on coal trains and other classes of trains at various speeds,

lengths and distances from the track. Contours relating to an L_{10} level of 55dB(A) for night-time have been drawn adjacent to each line, to represent the area of land either side of the track which is considered unsuitable for future residential development. These contours have been linked with the 55dB(A) L_{10} contour derived for road traffic on the New England Highway and Denman Road. The road traffic contours have been derived from measurements carried out along these roads and interpolated using the methods recommended in the United Kingdom, Department of Environment (Welsh Office) Document "Calculation of Road Traffic Noise" (1975).

These contours, representing the limits for acoustical acceptability along the major transportation routes, have been linked up with the 40dB(A) L_{10} contours for the future mining developments in the area to provide overall contours showing the limits for acoustical acceptability.

One of the planning options evaluated is the relocation of the Main Northern Line around to the south of Muswellbrook, following the route of the Drayton rail spurline (see Figure 18.1).

A further planning option is the provision of a heavy vehicle bypass to the east and north of the town (see Figure 18.2).

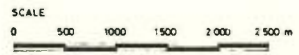
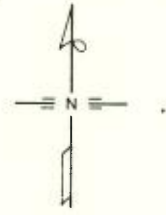
DISCUSSION OF RESULTS AND POSSIBLE PLANNING OPTIONS

General

The data presented by us to indicate the primary results of our analysis and the possible planning options are in the form of detailed plans showing future acoustical impacts in terms of the criteria presented in Section 18.3. By this means a rapid visual assessment is achieved and the broad brush issues presented. The existing situation, as discussed in Chapter 3, is dominated by the traffic on the New England Highway and, to a lesser extent, the Denman Road and the Main Northern Railway Line.

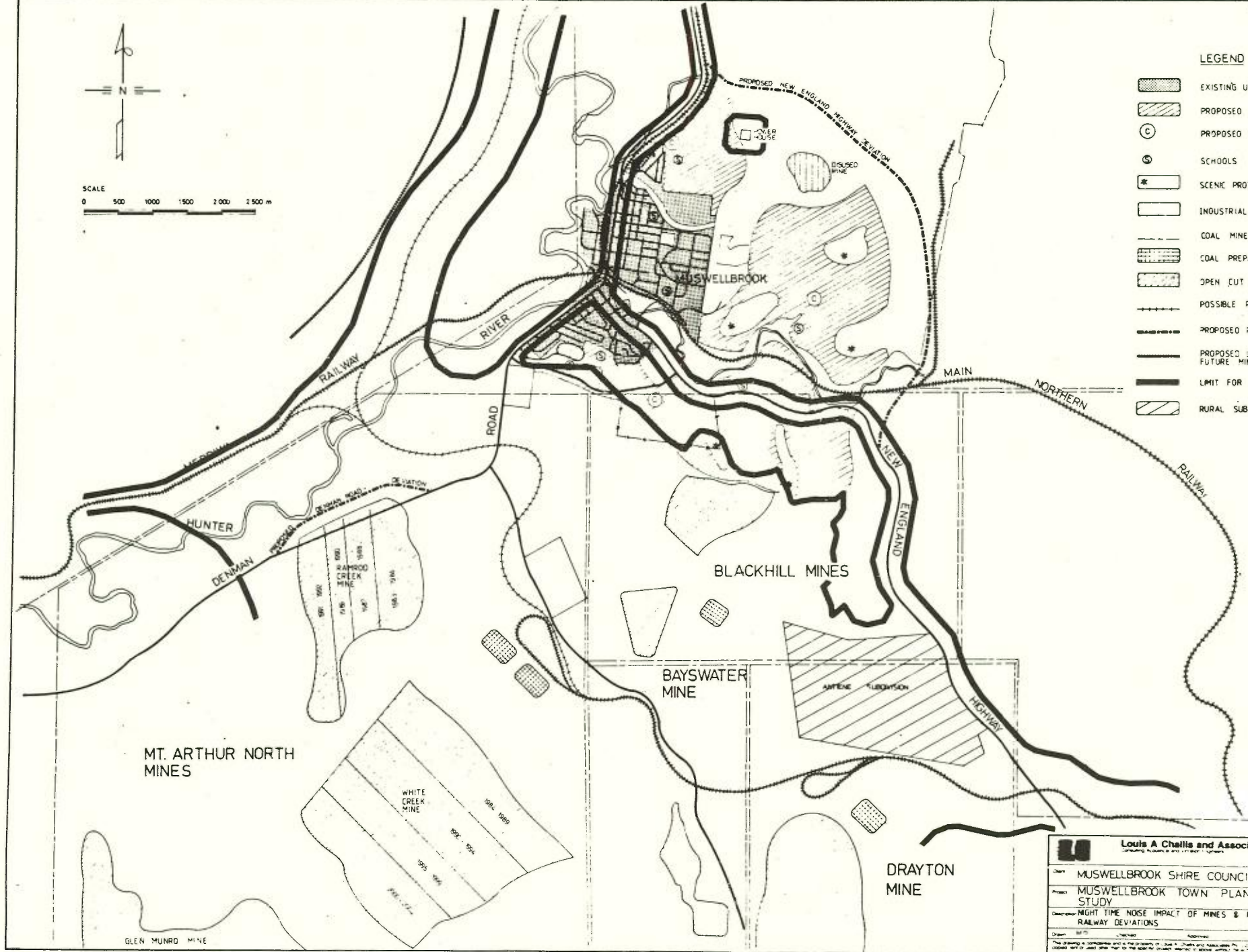
The Future Situation

The results of the growth of vehicular traffic on the New England Highway and on the rail lines passing through the town, as well as the impact of the proposed Drayton Mine and Mt. Arthur North mines, together with the possible Black Hill Mine, are shown on our Figure 18.0. The data used



LEGEND

- EXISTING URBAN
- PROPOSED URBAN
- PROPOSED COMMERCIAL
- SCHOOLS
- SCENIC PROTECTION ZONES
- INDUSTRIAL
- COAL MINE AUTHORISATION
- COAL PREPARATION AREA
- OPEN CUT MINE
- POSSIBLE RAIL DEVIATION
- PROPOSED ROAD/HIGHWAY DEVIATION
- PROPOSED LIMIT OF POSSIBLE FUTURE MINES
- LIMIT FOR ACOUSTICAL ACCEPTABILITY
- RURAL SUBDIVISION



246

Fig. 18.1

Louis A Challis and Associates Pty Ltd
 Chartered Surveyors and Civil Engineers

Client:	MUSWELLBROOK SHIRE COUNCIL	Project No.:	AS 50-04
Project:	MUSWELLBROOK TOWN PLAN STUDY	Drawing No.:	3793C-81-2
Description:	NIGHT TIME NOISE IMPACT OF MINES & PROPOSED RAILWAY DEVIATIONS	Scale:	AS 50-04
Drawn by:	[Signature]	Checked by:	[Signature]
Date:	15/2/81	Approved by:	[Signature]

This drawing is copyright and is the property of Louis A Challis and Associates Pty Ltd. It is not to be reproduced, stored, or used in any way for the purposes of the project without the written consent of the author.

MT. ARTHUR NORTH MINES

WHITE CREEK MINE
 1984 - 1989
 1987 - 1991
 1993 - 1995
 1988 - 1992

RAHROD CREEK MINE
 1981 - 1983
 1984 - 1986
 1987 - 1989
 1990 - 1992

BAYSWATER MINE

BLACKHILL MINES

DRAYTON MINE

GLEN MUNRO MINE

ANTHONY TUBBINSON

ANTHONY TUBBINSON

RAHROD CREEK MINE

HUNTER DENNAN

RAHROD CREEK MINE

ROAD

RAILWAY

RAILWAY

RAILWAY

RAILWAY

RAILWAY

MUSWELLBROOK

POWER HOUSE

DISUSED MINE

PROPOSED NEW ENGLAND HIGHWAY DEVIATION

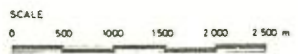
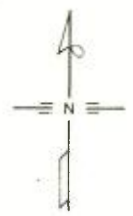
MAIN

NORTHERN

NEW ENGLAND

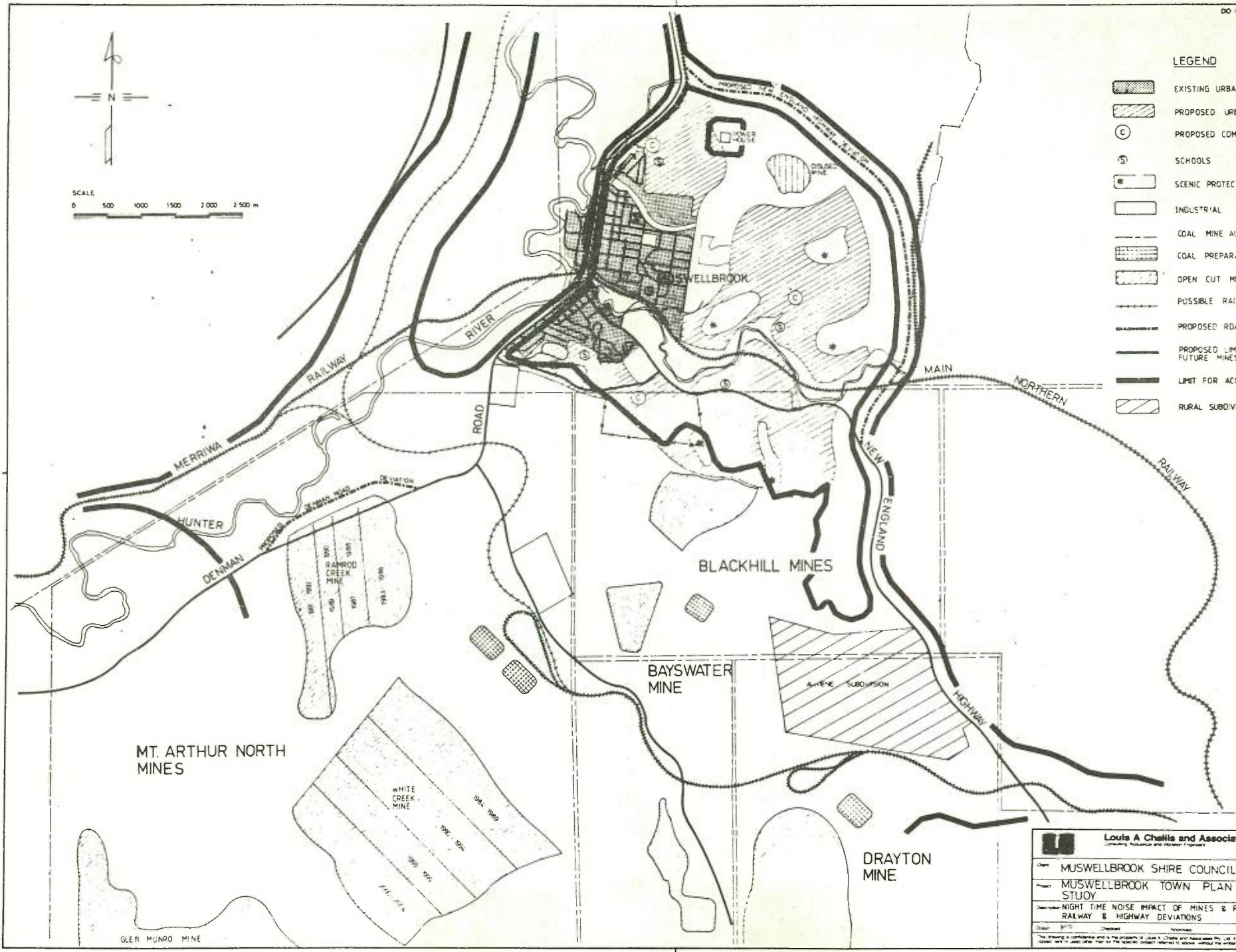
HIGHWAY

RAILWAY



LEGEND

- EXISTING URBAN
- PROPOSED URBAN
- PROPOSED COMMERCIAL
- SCHOOLS
- SCENIC PROTECTION ZONES
- INDUSTRIAL
- COAL MINE AUTHORIZATION
- COAL PREPARATION AREA
- OPEN CUT MINE
- POSSIBLE RAIL DEVIATION
- PROPOSED ROAD/HIGHWAY DEVIATION
- PROPOSED LIMIT OF POSSIBLE FUTURE MINES
- LIMIT FOR ACOUSTICAL ACCEPTABILITY
- RURAL SUBDIVISION



247

Fig. 10.2

Louis A. Chellis and Associates Pty Ltd <small>Consulting, Assessment and Research Engineers</small>		<small>100-102 Clarendon Street Sydney, New South Wales NSW 2000 Australia Telephone: (02) 951 1888</small>	
Client:	MUSWELLBROOK SHIRE COUNCIL	Scale:	AS SHOWN
Project:	MUSWELLBROOK TOWN PLAN STUDY	Date:	
Description:	NIGHT TIME NOISE IMPACT OF MINES & PROPOSED RAILWAY & HIGHWAY DEVIATIONS	Drawing No:	3793C-81
Drawn by:	BT	Checked:	DA
Approved:		Date:	16/11/81

has been derived utilising computer analysis and information contained in the environmental impact statements. The limit lines for acoustical amenity relate to traffic noise levels exceeding 55dB(A) for 10% of the time or individual mine noise levels exceeding 40dB(A) for 10% of the time.

Figure 18.0 shows that the effect of increased traffic flows and, particularly rail traffic through the town, will adversely affect the acoustical amenity of a large portion of the township. Furthermore, considerable areas of possible future residential land on the outskirts of the town will be rendered unsuitable for this purpose as a result of rail and road traffic noise.

The South Muswellbrook residential area must be considered a marginal area for future development as the contour lines pass close to the boundaries of the area. The contour lines in this area are based largely on the Noise Study presented in the Mt. Arthur North Coal Project Environmental Impact Assessment which appears to present an optimistic picture of the mine impact. The operation of this mine, together with the Black Hill Mine, is likely to result in an unacceptable level of night-time acoustical amenity over the southern portion of this area.

Proposed South Muswellbrook Residential Subdivision

A large portion of the area is adequately screened from the proposed Black Hill Mine by the ridge line which marks the proposed limit of mining operations. The creation of an earth mound, particularly near the south-eastern corner of the subdivision, could effectively extend the ridge line in a westerly direction and therefore improve the acoustical amenity of the area if the mine proceeds.

The noise contours in the area of the Antienne subdivision demonstrates that the level of night-time acoustical amenity will be unacceptable over most or all of the area as a result of rail traffic on the Drayton rail loop, operations in the Black Hill area and the noise of traffic on the Highway.

A further mining development may take place to the west of Muswellbrook in Authorisation No.102. The Environmental Impact Assessment for any operations in this area should provide scope for an assessment of the impact of this mine as a component of the cumulative impact of mining

18.6 POSSIBLE MAIN NORTHERN RAILWAY LINE DEVIATION

One option for reducing the impact of the increase of rail traffic through the town is the construction of a railway deviation making use of the proposed rail loading branch lines extending through the Drayton Mine Lease, Bayswater Mine Lease and the Mt. Arthur North Mine Lease. This extension would pass through to the south-west of the town, crossing the Hunter River approximately 3 kilometres from the town and extending to the north on the western side of both the Hunter River and the township of Muswellbrook. This proposal would necessitate two or more high level bridges and up to 15 kilometres of new railway line. The main advantage of this proposal would be a significant diminution in the number of people affected by the noise emission of the coal trains on the Main Northern Line and from Ulan line. A secondary benefit would be the removal of the impact of coal trains in the area of the existing rail siding, whilst the normal passenger services into and out of Muswellbrook could be retained.

A further benefit of this proposal is the possible release of large tracts of railway land and noise-affected land for residential or commercial purposes, whose sale would defray part of the costs of the proposed rail deviation. This could be achieved even if the existing rail line were maintained for normal passenger services.

18.7 POSSIBLE DEVIATION OF THE NEW ENGLAND HIGHWAY

A further improvement in the acoustical amenity of the town could be achieved through the re-routing of the New England Highway to provide a traffic by-pass. This proposal is shown on Figure 18.2 with the main Northern Railway Line being diverted to the west of the town and the New England Highway By-Pass to the east of the town. As this plan shows, the extent of residual acoustical intrusion in the township of Muswellbrook would be dominated by traffic from the Denman Road passing through the town to link up with the proposed deviation of the New England Highway. The cost of this option is capable of being partially offset by the release of land which would otherwise be unsuitable for residential development.

18.8 CONCLUSIONS

The predicted future noise levels in and around Muswellbrook which would result from the growth of mining and transportation activities are presented as noise contours in Figures 18.0 to 18.2. These contours show the limits of acoustical acceptability according to the set of criteria presented in Section 18.3.

The results indicate that the primary impact will come from rail traffic through the town, whilst a secondary impact will be created by the ever increasing traffic on the New England Highway. Such increases in the traffic can be expected to result in an increasing loss of amenity along these routes and the area so affected will expand as time goes by. However, the re-routing of the Main Northern Line and the New England Highway around the town would reduce this impact substantially and free considerable areas of noise-affected land for future residential development.

The environmental impact assessments that have been presented for mining development in the Muswellbrook area have been presented on the basis of each development having its acoustical impact in isolation and the criteria for acceptability being related to "existing" traffic and mining activity.

This approach will inevitably result in "creeping noise" where background noise levels are increased with each succeeding development.

Regrettably, if the Government or other authorities do not take responsibility for the overall acoustical impact of the mining, rail and road traffic noise in the township, it can be argued that this approach is justifiable. Indeed, the survey carried out indicates that the dominant factor controlling existing night-time noise in the town is traffic-related rather than mine-related. (See Chapter 3.) Until this situation changes, it is somewhat difficult to justify more stringent noise criteria for some of the mines, particularly those more distant from the town, whose night-time impact on the town (separate to the nearby farmhouses) is minimal.

However, if the options of re-routing the Main Northern Line and the New England Highway around the town are exercised, then the impact of mining activities on the outer residential areas must be considered.

Thus the criteria presented in Section 18.3 for individual mines/industries, transportation routes and blasting activities are designed to maintain the cumulative impact within the bounds of a "normally acceptable" residential acoustical environment.

18.9 RECOMMENDATIONS

Criteria

(i) Acoustical

It is recommended that the acoustical criteria presented in this chapter (section 18.3) as statistical L_{10} levels for mining/industrial or transportation activities be adopted and applied to all future developments with view to maintaining "normally acceptable" residential acoustical amenity.

(ii) . Blasting

It is recommended that the blast vibration criteria of 1.6mm/sec peak particle velocity (section 18.4) be adopted in residential areas as the limit for any one blast in order to obviate the annoyance from multiple blasts. The blast over pressure wave should be in accordance with existing criteria nominated by the SPCC of 115dB unweighted in the frequency region 0.1Hz to 500Hz.

LAND USAGE

(i) Noise Affected Areas

The noise-affected areas indicated in Figures 18.0 to 18.2 by the noise contour lines should be set aside for uses other than residential.

(ii) Main Northern Railway Line

The option of re-routing the Main Northern Railway Line to the south of Muswellbrook should be carefully considered as a means of minimising the acoustical impact of future traffic on Muswellbrook and as a means of freeing noise-affected land for residential development.

(iii) New England Highway

The option of re-routing the New England Highway to the east of Muswellbrook should be considered as a means of minimising the acoustical impact of future traffic on Muswellbrook and as a means of freeing noise-affected land for residential development.

(iv) Possible Mine - A102

Coal mining and processing operations as may be proposed in the future in Authorisation No.102 be restricted to an area bounded on the east by the ridge of hills as shown on our Figure 18.0.

(v) Possible Black Hill Mine

It is recommended that:

- . the northern limit to mining be the ridge line south of the town;
- . mining activities be carried out as far south as possible at night;
- . the feasibility of creating an earth mound to extend the northern ridge line in a westerly direction be evaluated with a view to providing effective screening over the south-western corner of the South Muswellbrook subdivision.

FUTURE ENVIRONMENTAL IMPACT ASSESSMENTS

(i) Cumulative Effects

The scope of future environmental impact assessments for mines in this area should be extended to include an assessment of the cumulative impact of both the proposed development and the interaction with neighbouring developments. Such an assessment should address the issues of mine noise, transportation noise and blast vibration.

(ii) Acoustical Modelling

Briefs for future noise studies should call for the determination of noise level contours or calculations which are presented in the form of mean peak (L_{10}) noise levels. These should be determined for the initial year of mining operation (except where such an operation would be furthest from the residential areas) and for later years as necessary.

All machines and plant should be treated as operating at their maximum levels, in positions consistent with a "worst-case" analysis. Account should be taken of typical "worst-case" sound propagation conditions, including the effects of prevailing winds and temperature inversions.

BIBLIOGRAPHY

ACOUSTICAL IMPACT ASSESSMENT FOR EXISTING AND PROPOSED RESIDENTIAL
AREAS NEAR PROPOSED BLACK HILL MINE

Louis A. Challis and Associates - April, 1981

ANNUAL RESEARCH REPORT SCONE RESEARCH CENTRE

Soil Conservation Services of N.S.W. - 1979/1980

AN URBAN CASE STUDY PART II: FUNCTION AND ECONOMIC STRUCTURE

Hunter Valley Research Foundation, Monograph No. 31 - Newcastle 1969

ASSESSMENT OF MINING AND TRANSPORTATION IMPACT ON THE FUTURE
DEVELOPMENT OF THE TOWN

Louis A. Challis and Associates - April, 1981

BAYSWATER POWER STATION ENVIRONMENTAL IMPACT STATEMENT

Electricity Commission of N.S.W. - June, 1979

COAL RELATED SETTLEMENT STUDY STAGE 1

N.S.W. Planning & Environment Commission - June, 1980

COMMUNITY FACILITY AND SERVICES DEVELOPMENT PROGRAMME

Jackson Teece Chesterman Willis and Partners Pty. Limited - Jan. 1981

DEVELOPMENT PROJECTS IN NEW SOUTH WALES - AUSTRALIA

Department of Industrial Development and Decentralisation

DRAYTON CO-VENTURE - VOLUME 1 TEXT AND APPENDICES E.I.S.

Dames and Moore - April, 1980

DRAYTON CO-VENTURE - VOLUME 11 SUPPORTING DOCUMENTS E.I.S.

Dames & Moore - April, 1980

ERRARING OPEN CUT COAL PROJECT E.I.S.

The Electricity Commission of N.S.W. - May, 1980

GREATER CESSNOCK STRATEGIC PLAN

Bergsteiner, McInnes & Rigby Pty. Limited - 1976

THE HUNTER REGIONAL LEISURE PLAN

The Hunter Regional Organisation and The Hunter Valley Research
Foundation - 1977

HUNTER REGIONAL PLAN - DISCUSSION PAPER NO. 1 - REVIEW OF MAJOR ISSUES

Hunter Regional Planning Committee - June, 1977

HUNTER REGIONAL PLAN - DISCUSSION PAPER NO. 2 - PRELIMINARY STATEMENTS
OF GOALS AND OBJECTIVES

Hunter Regional Planning Committee - November, 1977

BIBLIOGRAPHY Cont....2

HUNTER REGIONAL PLAN - DISCUSSION PAPER NO. 3 PLANNING PROPOSALS
Hunter Regional Planning Committee - November, 1978

HUNTER REGIONAL PLAN - WORKING PAPER NO. 22 - VISUAL ANALYSIS AND
VISUAL PREFERENCE SURVEY
N.S.W. Planning and Environment Commission

HUNTER REGION POPULATION PROJECTION 1981-2001
Department of Environment and Planning - August, 1980

HUNTER RIVER FLOOD PLAIN MANAGEMENT STUDY
Department of Public Works - September, 1980

HUNTER TOURISM DEVELOPMENT PLAN 1980 - STAGE ONE WORKING PAPER 1

HUNTER VALLEY NO. 1 MINE E.I.S.
James B. Croft and Associates, Newcastle - August, 1979

THE IMPACT OF COAL MINING DEVELOPMENT IN THE UPPER HUNTER ON THE
MUNICIPALITY OF MUSWELLBROOK - 1978
James B. Croft and Associates

IMPLICATIONS OF COAL RELATED GROWTH TO COUNCIL FINANCES
Gutteridge Haskins and Davey Pty. Limited - Jan. 1981

THE IMPACT OF COAL MINING ON THE UPPER HUNTER
Hunter Regional Advisory Council, J. Hunt - 1978

INTRODUCTION TO EXPECTED GROWTH AND AUGMENTATION OF UTILITIES
Gutteridge Haskins and Davey Pty. Limited - December, 1980

LOWER HUNTER SUB-REGION COMMERCIAL CENTRES STUDY
Plant Location International (Australia) Pty. Limited - Sept. 1979

LOWER HUNTER SUB-REGION COMMERCIAL CENTRES STUDY WORKING PAPER
N.S.W. Planning & Environment Commission - April, 1980

MAJOR MANUFACTURING AND MINING INVESTMENT PROJECTS
Department of Industry and Commerce - December, 1980

MT. ARTHUR NORTH COAL PROJECT. ENVIRONMENTAL IMPACT STATEMENT -
HERITAGE SURVEY
Planning Workshop - January, 1981

MT. ARTHUR NORTH COAL PROJECT. WATER MANAGEMENT STUDY
The Electricity Commission of N.S.W. - October, 1980

BIBLIOGRAPHY Cont....3

MUSWELLBROOK HISTORIC BUILDINGS SURVEY
Muswellbrook Historical Society - 1980

MUSWELLBROOK - PREPARING FOR CHANGE - A RECORD OF THE 1980 PUBLIC
DISCUSSION OF MINING AND INDUSTRIAL DEVELOPMENTS IN THE SHIRE OF
MUSWELLBROOK, N.S.W.
Muswellbrook Shire Council - February, 1980

MUSWELLBROOK SHIRE COUNCIL - BUILDING CODE
Muswellbrook Shire Council - 17 September, 1979

MUSWELLBROOK SHIRE COMMUNITY IMPACT STUDY
Gutteridge Haskins and Davey Pty. Limited - 1980

MUSWELLBROOK SHIRE COUNCIL - SUB-DIVISION CODE
Muswellbrook Shire Council

PRELIMINARY PLAN FOR DEVELOPMENT OF WATER RESOURCES IN THE HUNTER
RIVER BASIN
Water Resources Commission - 1979

PROPOSED EXPANSION OF LEMINGTON COLLIERY WARKWORTH E.I.A.
N.S.W. Planning & Environment Commission 80/20 - May, 1980

PROPOSED WARKWORTH MINE E.I.A.
N.S.W. Planning & Environment Commission 80/24 - May, 1980

PROSPECTIVE EXPANSION BLACK COAL INDUSTRY, AUSTRALIA - NEW SOUTH WALES
Joint Coal Board - October, 1980

RAILWAY RELOCATION OPTIONS IN THE VICINITY OF MUSWELLBROOK, N.S.W.
STUDY REPORT
R. Travers Morgan Pty. Limited (Revised) - March, 1981

REFINEMENTS TO PRELIMINARY HUNTER WATER PLAN
Water Resources Commission of New South Wales - 1980

REPORT ON THE HUNTER VALLEY INPUT - OUTPUT STUDY
Unisearch Limited - June, 1980

SANDY HOLLOW - ^{ULAN} URBAN RAILWAY PROPOSAL E.I.S.
Longworth & McKenzie Pty. Limited - April, 1980

SINGLETON AND COAL
A record of the 1979 Public Discussion on the Development of Coal
Mining in the Singleton Shire - November, 1979

SINGLETON PLANNING STUDY - REPORT FOR SINGLETON SHIRE COUNCIL
Bergsteiner McInnes & Rigby Pty. Limited
James B. Croft and Associates - December, 1976

BIBLIOGRAPHY Cont....4

SUBMISSION RE. ERARING OPEN CUT COAL PROJECT E.I.S. - MAY, 1980
Westlakes Residents' Action Group - May, 1980

SUMMARY REPORT TO THE TASK FORCE ON THE LONG TERM STRATEGY FOR THE
EXPORT OF N.S.W. COAL - PRESENT AND POTENTIAL CAPACITIES OF THE COAL-
CARRYING LINES
Public Transport Commission of N.S.W. - February, 1979

SURVEY OF EXISTING BACKGROUND NOISE LEVELS IN THE TOWNSHIP OF MUSWELL-
BROOK, N.S.W.
Louis A. Challis - April, 1981

SYDNEY REGION OPEN SPACE SURVEY
N.S.W. Planning and Environment Commission - 1975

UPPER HUNTER SUB-REGIONAL STUDY - A REPORT TO THE DEPARTMENT OF
ENVIRONMENT AND PLANNING
Gutteridge Haskins and Davey Pty. Limited and
Jackson Teece Chesterman Willis & Partners Pty. Limited
Draft - March, 1981

WATER QUALITY IN THE HUNTER RIVER VALLEY - THE IMPACT OF NATURAL
PROCESSES AND THE LIKELY INFLUENCE OF FUTURE INDUSTRIAL DEVELOPMENT
ON WATER RESOURCES
D.E.J. Garman, G.L. Muir - 1981

STUDY TEAM

Project Director	David Chesterman
Study Co-ordinator	Bruce Goldsmith
Economist	Peter Abelson
Architect/Planner	Peter Annand Michael Bennett
Social Planner	Heather Nesbitt
Planning Assistant	Peter Jensen
Graphics	Elizabeth Fink Naomi Fiegel

