CHAPTER 5. MPUMALANGA RIVERS: ECOLOGICAL REFERENCE CONDITIONS FOR RIVERINE MACROINVERTEBRATES

Summary

This chapter presents the ecological reference conditions for riverine macroinvertebrates for each of the five identified Reference Groups or Sub-groups in Mpumalanga. A key has been developed for assigning a monitoring site to a Reference Group or Sub-group for river in Mpumalanga. Information detailed for each Reference Group or Sub-group includes details of the environmental characteristics of the Reference Group or Sub-group, expected SASS Scores (including median values and Observed/Expected ratios for single-season and combined-season assessments), a list of expected SASS taxa, and a table for interpreting single-biotope assessments. A banding system for interpreting SASS data and hence biological condition is provided. This chapter is aimed at biomonitoring practitioners actively monitoring rivers in Mpumalanga.

5.1 INTRODUCTION

The results of this study indicate the complexity involved in establishing benchmarks or reference conditions for riverine macroinvertebrates. Through the course of the project it has become eminently clear that to tackle this task without adopting some form of predictive modelling system will severely limit the potential of reference conditions as an interpretative tool within the RHP. The development of predictive modelling systems, however, is extremely time consuming and costly, and requires the co-operation of all organisations involved in biomonitoring. The United Kingdom have been developing their RIVPACS system since the 1970's and numerous researchers from various backgrounds, including freshwater biology, statistics and mathematics., have been involved in the programme. Similarly, Australia, in their development of AusRivAS, which was initiated in 1994, have enlisted the assistance of all groups involved in biomonitoring. In both countries, one organisation has been responsible for most research, development and testing of the respective systems, namely the Institute of Freshwater Ecology in the United Kingdom and the Co-operative Research Centre for Freshwater Ecology in Australia.

It is clear, therefore, that to implement such as system in South Africa is a long-term objective. Biomonitoring is in its infancy in South Africa, with the national implementation design phase having commenced in 1997. With respect to ecological reference conditions for riverine macroinvertebrates, we are in the extremely fortunate position of having the experience of the above mentioned international institutes to draw on. It would be short sighted not to ensure that South Africa's RHP will enable the future development of systems similar to those of RIVPACS and AusRivAS. By securing the adoption of a standardised, national biomonitoring protocol for use in the RHP by all biomonitoring practitioners, we are guaranteeing the future advancement of the RHP with respect to reference conditions and their use in the interpretation of biomonitoring data. The additional investment in terms of time during the first few years of the RHP will result in a return of worthwhile proportions.

On the understanding that the development of predictive models for use in the generation of Ecological Quality Indices (EQIs) based on the ratios of Observed to Expected scores, is beyond the scope of the current project, an interim method for deriving ecological reference conditions for riverine macroinvertebrates has been devised, together with preliminary guidelines for data interpretation. This chapter draws together the analyses of the preceding chapters and provides ecological reference conditions for riverine macroinvertebrates for selected river types in Mpumalanga. For each identified river type, the following are given:

- details of environmental characteristics
- expected SASS Scores (including median values and Observed/Expected ratios for single-season and combined-season assessments)
- a list of expected SASS taxa, and
- a table for interpreting single-biotope assessments.

5.2 REFERENCE GROUPS, ENVIRONMENTAL VARIABLES, BIOLOGICAL BANDING AND CONSIDERATIONS FOR DATA INTERPRETATION

5.2.1 Homogeneous regions and identified river types

Using the spatial framework (see Figure1.1) which divided rivers into homogeneous regions in a hierarchical manner, such that ecoregions represent Level 1, sub-regions Level 2 and river types Level 3, together with multivariate analysis of riverine macroinvertebrate fauna (Figures 4.5 and 4.6), three main Reference Groups have been identified in Mpumalanga (see map - Figure 2.2). These broadly adhere to ecoregions with "river type" factors dividing two of the Reference Groups into two sub-groups each. The following Reference Groups and sub-groups have been identified:

- Reference Group 1: Central Highlands: Mountain Stream and Foothill-cobble Bed sub-regions.
- Reference Group 2: Great Escarpment Mountains: Mountain Stream, Foothill-cobble Bed and Rejuvenated Cascade sub-regions.
- Sub-group 2a: Lowveld: Foothill-cobble Bed and Rejuvenated Cascade sub-regions, with > 60% boulder/cobble substratum type.
- Reference Group 3: Lowveld: Foothill-gravel Bed sub-region.
- Sub-group 3a: Lowveld: mixture of sub-regions including Foothill-cobble Bed, Foothill-gravel Bed and Rejuvenated Cascade sub-regions, with > 60% bedrock substratum type.

Of these, sub-groups 2a and 3a are represented by relatively few sites. Additional sites which fall within these sub-groups need to be assessed so that the sub-groups may be verified and either absorbed into Reference Groups 2 and 3 respectively, or form their own Reference Group.

The following key has been devised to assist biomonitoring practitioners in assigning a monitoring or test site to the appropriate river type in Mpumalanga. Five river types are represented, two of which have been termed sub-groups since they still need to be validated. It is likely that there are additional river types in

Mpumalanga, and which do not "fit" into any identified river type. On the basis of invertebrate communities, a few sites were classified outside of their expected river type and the key provided below would therefore not be suitable for such sites. This key represents a first attempt at typing Mpumalanga rivers. Again, adopting a predictive modelling system in the future will enable Reference Groups to be "typed" with additional Groups identified as different sites are assessed. The assigning of a monitoring site to a Reference Group is automated and based on the probability of the monitoring site belonging to each of the identified Reference Groups. In some cases a monitoring site will not be assigned to any of the Reference Groups, in which case it is returned as "outside the scope of the model" and serves as an indication that the monitoring site may represent a new Reference Group. These types are indicated in the key as "River type not yet described".

5.2.1.1 A key for assigning a monitoring site to a Reference Group for rivers in Mpumalanga

1. Site is in the Central Highlands or Great Escarpment Mountains ecoregions 2
- Site is in the Lowveld ecoregion 5

2. Site is in the Central Highlands ecoregion 3
- Site is in the Great Escarpment Mountains ecoregions 4

3. Site is in the Mountain Stream or Foothill-cobble Bed sub-region and is dominated by cobble/pebble substratum type (60%) ..... **Reference Group 1**
- Site is in a different sub-region ..... River type not yet described

4. Site is in the Mountain Stream, Foothill-cobble Bed or Rejuvenated Cascade sub-region, and is dominated by boulder/cobble/pebble substratum type (80%) ..... **Reference Group 2**
- Site is in a different sub-region ..... River type not yet described

5. Site is in the Mountain Stream sub-region and is dominated by boulder/cobble/pebble substratum types (80%) ..... **Reference Group 2**
- Site is in a different sub-region 6

6. Site has > 60% boulder/cobble substratum type 7
- Site has > 60% bedrock substratum type ..... **Sub-group 3a**

7. Site is in the Foothill-cobble Bed or Rejuvenated Cascade sub-regions ..... **Sub-group 2a**
- Site is in the Foothill-gravel Bed sub-region ..... **Reference Group 3**

Once a site has been allocated to a Reference Group or sub-group, the site characteristics in terms of environmental variables, in particular the substratum composition and dominance, need to be checked.

5.2.2 Characterisation of Reference Groups in terms of environmental variables

An attempt has been made to broadly characterise each Reference Group or sub-group in terms of environmental variables. Median values, 25th and 75th percentiles have been tabulated for each appropriate variable. These ranges should not be considered absolute but should rather serve as a guideline for assigning a monitoring or test site to a Reference Group or sub-group, or deriving expected or reference conditions for environmental variables, in particular water chemistry variables. The environmental characteristics of each Reference Group or sub-group are provided for each Reference Group or sub-group section (see section 5.3).

5.2.3 A biological banding system

Management action depends on the knowledge that a certain impact causes an aquatic community or ecosystem to respond in some way that is outside the natural range of variation (Roux *et al.* 1999) and the ultimate objective of any biomonitoring programme is to facilitate the detection of impairment at a site as reflected by one or more components of the biota. Reference conditions facilitate this by defining what is expected at a site and provide a means of comparing observed conditions with expected conditions. As noted in the previous chapter, this is a complex task and one which requires careful consideration of factors which may potentially affect data interpretation. Any reference condition is also likely to be a dynamic one, changing as our ecological understanding of the system grows (Meyer 1997).

To simplify data interpretation and to aid management decisions, "biological banding" systems are often used with different bands representing different biological conditions. In both RIVPACS and AusRivAS, the ratio of the Observed/Expected (O/E) Taxa and O/E ASPT or O/E SIGNAL (similar to ASPT) are derived, each band representing a different level of biological condition (Furse 2000, Simpson & Norris 2000). A banding system modified from these systems has been adopted for reporting the biological condition of Mpumalanga rivers (Table 5.1), although the method whereby O/E ratios are derived is different. Whereas O/E ratios in RIVPACS and AusRivAS are generated in a modelling system, in this study is O/E are based on median values for SASS4 Score, number of taxa and ASPT per Reference Group. Median rather than mean values were chosen because not all the data are normally distributed.

The banding system was developed by examining the variation in SASS Scores at reference sites relative to the median score for the Reference Group or sub-group to which the reference site belonged. The O/E ratios were calculated using data from the final 57 reference sites. "O" is the observed SASS4 Score, number of taxa or ASPT at a reference site and "E" is the median SASS4 Score, number of taxa or ASPT value of the Reference Group or sub-group within which the reference site falls. In this way the range of O/E ratios could be calculated, together with percentiles. Initially O/E ratios were calculated using combined-biotope, multiple-season SASS Scores. These were then "corrected for season" by examining the O/E ratios for each season (combined-biotopes), as calculated from the seasonal median values for each Reference Group or sub-group (see section 5.2.4). Ratios have certain advantages over absolute values in that they are dependent on the expected (E) score. In this way it is possible to derive expected scores for multiple-seasons in addition to expected scores for each season. Assessments conducted in a single season may therefore also be evaluated

by calculating O/E ratios with the appropriate median value. Details of the division of O/E ratios into bands for facilitating the interpretation of data from monitoring sites, are given in Table 5.1.

Table 5.1 Division of O/E SASS4 Scores, O/E taxa and O/E ASPT, into five bands for reporting the biological condition of Mpumalanga rivers (Modified from the RIVPACS and AusRivAS banding system, Furse 2000, Simpson & Norris 2000). Actual O/E values are given in the sections for each Reference Group or sub-group.

Band	Description	O/E SASS4 Score, O/E Taxa, O/E ASPT
X	**Richer than reference**: O/E greater than 90th percentile of reference sites	More taxa found than expected. SASS4 Score and ASPT greater than expected. Potential biodiversity "hot spot".
A	**Reference:** O/E within range of central 85% of reference sites (i.e. 5th to 90th percentiles)	SASS4 Score, number of taxa and ASPT within range of 85% of reference sites.
B	**Below reference:** O/E below 5th percentile of reference sites. Band width equal to median minus the 5th percentile.	Fewer taxa than expected. SASS4 Score and ASPT lower than expected. Potential impairment of water quality and/or habitat with loss of pollution-sensitive taxa.
C	**Well below reference:** O/E below Band B, Same width as Band B.	Many fewer taxa than expected. SASS4 Score and ASPT much lower than expected. Substantial impairment of water quality and/or habitat. Major loss of pollution-sensitive taxa.
D	**Impoverished:** O/E below Band C to zero.	Few of the expected taxa remain. Severe impairment. Remaining taxa hardy and pollution-tolerant.

Using the key (section 5.2.1) and the biological banding system, the following steps would be taken when assessing a monitoring or test site:

1. *Site allocation:* Following the site allocation key the monitoring site is allocated to a Reference Group or sub-group.
2. *Observed (O) value*: The SASS4 Score, number of taxa and ASPT for the site is calculated if assessed in a single season, or the median SASS4 Score, number of taxa and ASPT for the site is calculated if assessed in multiple (three) seasons.
3. *O/E ratio:* The Observed (O) values are compared with the appropriate Expected (E) values, per season or as medians, and the ratio of O/E calculated.
4. *Biological band:* Bands are derived for each indice using the appropriate Reference Group biological banding table, depending on the Reference Group with which the monitoring site is most similar. If

band allocation differs among indices, the lowest band should be used as the biological condition of the site.

5. *Biotope considerations*: If all three biotope-groups were not assessed, then the biotope-correction tables need to be examined. This is discussed further in sections 5.2.5 and 5.3.1.4. Always attempt to sample at least the SIC/SOOC or AQV/MV biotope-groups, since the GSM biotope-group is generally lacking in taxa and data interpretation based on this biotope-group alone is likely to be problematic.

It should be noted that the O/E ratios and ranges within each of the banding systems are first attempts. It is only through the use and testing of the banding systems that problems will be highlighted and the system improved. Preliminary testing has been undertaken using SASS data for 70 sites, ranging in degree of impact from "Reference" to "Impoverished". Of these 70 sites, 60% were allocated to the same band in terms of O/E SASS4 Score, O/E Taxa and O/E ASPT. When O/E ratios were in Band A, agreement was greatest, but problems arose when O/E SASS4 Score and O/E Taxa were in Bands C or D. In such instances, O/E ASPT was often assigned to Band A. This is most likely because O/E ASPT is actually a ratio based on two average values, i.e. SASS4 Score divided by the number of taxa. Until this can be tested more thoroughly, it is suggested that in such cases the lowest of the bands is used as the overall biological band for the site.

5.2.4 Seasonal considerations

Whilst the SASS4 Score and number of taxa calculated for each season were significantly different amongst seasons, there were minimal differences in the relative percentage contribution of taxa within each season to overall SASS Scores at a site (see Section 4.4.4.3). ASPT did not differ significantly between seasons and most taxa were recorded with relatively similar frequency across all seasons. On this basis, seasonal SASS data has been used to correct the O/E ratios derived from the combined-biotope, multiple-season data such that reference sites sampled in a single season will be comparable to those sampled over three seasons. Note, median values are also given for each season separately so that monitoring undertaken in a single season may be compared with the reference condition in the same season.

Seasonal correction method: Median values were calculated for each season for each Reference Group or sub-group. Using SASS Scores from each reference site (O) and median scores (E), the O/E ratios were calculated for each reference site. 90^{th} and 5^{th} percentiles were calculated and the number of reference sites which fell below the 5^{th} percentile (i.e. below reference, Table 5.1) noted. The range of O/E ratios per season were compared with the multiple-season ranges. Final ranges are based on both multiple- and separate-season ranges.

5.2.5 Biotope considerations

Biotope availability clearly affects SASS4 Scores, number of taxa, and to a lesser extent ASPT. It is important therefore to take the number of biotope-groups sampled into account when comparing SASS

data from a monitoring site with the appropriate Reference condition. To briefly reiterate on biotope availability and its consideration in data interpretation:

- Certain taxa were exclusively or more commonly present in one or two biotope-groups, whilst others were regularly recorded in all three.
- Taxa present in the SIC/SOOC biotope-group contributed the most to overall SASS Scores at a site, followed by the AQV/MV biotope-group. Variation in ASPT between biotope-groups was lower than either SASS4 Score or number of taxa, indicting the importance of using this metric in interpretation of SASS data.
- The SIC/SOOC biotope-group had significantly higher median and mean values for SASS4 Score, number of taxa and ASPT than either the AQV/MV or GSM biotope-group.
- Sampling a single biotope-group resulted in the capturing of a mean number of taxa of between 13.7 and 15.9. Sampling a second biotope-group added a mean number of between 6.1 and 8.5 taxa, and a third biotope-group added a mean number of approximately 1.5 taxa.

Ideally, when assessing a monitoring site, all three biotope-groups should be sampled and comparisons made between the expected scores within each biotope-group and the site in its entirety. However, in practise it is not uncommon for at least one biotope-group to be absent. The variability in SASS4 Scores and number of taxa recorded in a particular biotope-group amongst both reference sites and seasons within a Reference or sub-group, is relatively high. This suggests that it is not merely the presence of a biotope-group that is important, but the quality of the biotope with respect to habitation by riverine macroinvertebrates. Of the three biotope-groups, sampling the SIC/SOOC biotope-group only often returns a high proportion of the SASS4 Score, number taxa and ASPT, most probably because many of the sensitive, and hence high-scoring taxa that occur in this biotope-group. SASS Scores generated in the SIC/SOOC biotope are often therefore comparable to SASS Scores for the site.

It has been difficult to develop a general rule for taking biotope availability into account and it has not been factored into the biological banding system. Of the three indices, ASPT is the most reliable one to use for interpreting data collected at sites which have different biotopes available. With respect to reference conditions, a set of tables (Tables 5.5, 5.9, 5.13, 5.17 and 5.21) has been developed for assisting with data interpretation when not all three biotope-groups have been sampled. The method used is similar to that for seasons (section 5.2.4), but with median values and O/E ratios calculated for each biotope-group within each season within each Reference or sub-group. Expected median values are given for SASS4 Score, number of taxa and ASPT for each biotope-group. O/E bands have been calculated for O/E ASPT for each biotope-group for each Reference or sub-group. The level of confidence in the band widths, i.e. ranges of bands B and C, is very low. The method proposed requires extensive testing and alternative methods will need to be explored if this method proves to be unsuccessful.

5.3 ECOLOGICAL REFERENCE CONDITIONS FOR RIVERINE MACROINVERTEBRATES FOR PARTICULAR RIVER TYPES IN MPUMALANGA

The following sections provide details on the environmental characteristics, expected SASS Scores, expected taxa and biotope considerations for each Reference Group and sub-group.

5.3.1 Reference Group 1: Central Highlands: Mountain Stream and Foothill-cobble Bed sub-regions

Sites in this Reference Group generally fall within the Central Highlands ecoregion and are either in the Mountain Stream or Foothill-cobble Bed sub-regions.

5.3.1.1 Characterisation of Reference Group 1 in terms of environmental variables

- Channel pattern: single thread channel of low or high sinuosity, and low or moderate lateral mobility.
- Altitude: above 600 m.
- Distance from source: always < 100 km and generally < 50 km.
- Stream order: variable, but dominated by 1st, 2nd and 3rd order.
- Stream width: always < 20 m, and generally < 10 m.
- Shallow-water habitat: median (25th and 75th percentile) depth of 0.19 m (0.15 and 0.21 m), mostly cobble riffle, some bedrock rapid.
- Deep-water habitat: median depth of 0.39 m (0.35 and 0.56 m).
- Substratum: occasionally bedrock present (< 5%), but mostly dominated by cobble/pebble (60%) with boulder (15%) and gravel/sand/mud (20%).
- Biotopes: generally have all three biotope-groups present, with SIC/SOOC the most common (75%), then GSM (15%) and AQV/MV (10%).
- Water chemistry: median, 25th and 75th percentile values are tabulated below (Table 5.2). Water chemistry values are based on spot measurements taken per sampling occasion. When a reference site is situated near a DWAF gauging station, more solid water chemistry ranges could be derived.

Table 5.2 Median, (Q25) and 75th (Q75) percentile values for selected water chemistry variables in Reference Group 1 (n = 33).

Variable	Unit	Median	Q25	Q75
pH		8.03	7.93	8.1
Temperature	^{o}C	14.1	13	15.8
Conductivity	mS m^{-1}	13.5	9.8	18.2
Total Dissolved Solids	mg l^{-1}	105	76	128
Turbidity	NTU	1	1	1
Dissolved Oxygen	mg l^{-1}	9.39	7.97	9.39
Alkalinity	as meq l^{-1} CaCO3	1.267	0.893	1.453
Total Phosphorus	mg P l^{-1}	0.017	0.015	0.029
Soluble Reactive Phosphorus	mg P l^{-1}	0.013	0.011	0.014
Kjeldahl Nitrogen	mg N l^{-1}	0.157	0.137	0.243
Nitrite+Nitrate	mg N l^{-1}	0.063	0.04	0.127
Ammonium	mg N l^{-1}	0.04	0.04	0.04
Silica	mg l^{-1}	8.7	6.9	10.2

5.3.1.2 Composite SASS Scores

Expected median values and O/E ratios in each band have been calculated for Reference Group 1 (Table 5.3) based on multiple-season, combined-biotope sampling. The O/E ratios have been corrected for seasonal variation and expected median values are also given for each of three seasons, namely autumn, winter and spring. Observed (O) data from a monitoring site may be compared with the appropriate expected median value (E), i.e. autumn if the monitoring site was assessed in autumn, or multiple-season if the monitoring site was assessed during three seasons and data have been combined, etc. This may be done for each of the three SASS values, namely SASS4 Score, number of taxa and ASPT. The calculated ratios are then compared to the O/E ratios given and the monitoring site is allocated to a band from which an indication of the biological condition is attained (see Table 5.1).

Table 5.3 Reference Group 1: Band ranges (see Table 5.1) for O/E SASS4 Scores, O/E taxa and O/E ASPT. Expected median values for calculating O/E ratios are given for multiple-season, autumn, winter and spring for each indice.

Expected median values for calculating O/E	SASS4 Score	Number of Taxa	ASPT
Autumn	137	22	6.62
Winter	144	25	6.30
Spring	173	29	6.33
Band	**O/E SASS4 Score**	**O/E Taxa**	**O/E ASPT**
X	> 1.3	> 1.1	> 1.1
A	> 0.8-1.3	> 0.7-1.1	> 0.9-1.1
B	> 0.6-0.8	> 0.4-0.7	> 0.7-0.9
C	> 0.4-0.6	< 0.4	> 0.6-0.7
D	< 0.4		< 0.6

5.3.1.3 Expected SASS taxa

Expected taxa were identified by examining the frequency of occurrence of each SASS taxon amongst sites within the particular Reference or sub-group, and compared to the taxa identified in the SIMPER analysis which ranks taxa on the basis of their contribution to the similarity of sites within a Reference or sub-group. The resultant "Expected Taxa" are those present at > 75% of the sites within a Reference or sub-group, and which contributed to the similarity of sites within a Reference or sub-group. Expected taxa for Reference Group 1 are presented in Table 5.4. Taxa which were more common in a particular biotope-group or season are indicated in the table. This does not imply that they are absent from other biotope-groups, and serves as a guide for taking account of the absence of one or more biotope-groups.

Table 5.4 Expected SASS taxa (present at > 75% of sites within the Reference Group) for Reference Group 1, indicating taxa more commonly recorded in a particular biotope-group (S = SIC/SOOC; V = AQV/MV and G = GSM) or season (W = winter and S = spring).

Order	Taxon	%	Biotope	Season
Ephemeroptera	Baetidae (3 types)	91		
	Caenidae	91		
	Heptageniidae	91	S	
	Leptophlebiidae	100	S	
	Tricorythidae	100	S	
Coleoptera	Elmidae/Dryopidae	91	S	
	Psephenidae	82	S	
Trichoptera	Hydropsychidae (2 types)	100	S	
Diptera	Ceratopogonidae	82	G	
	Chironomidae	100		
	Simuliidae	100	S+V	
	Tabanidae	91	S	
	Tipulidae	91	S	
Hemiptera	Corixidae	100		
	Veliidae	91	V	
Odonata	Aeshnidae	82	S	
	Coenagrionidae	91	V	
	Gomphidae	100	G	
Annelida	Oligochaeta	82	S+G	
	Hydrachnellae	91	S	S
Crustacea	Brachyura (Crabs)	100	S	
Platyhelminthes	Planariidae	100	S	
Mollusca	Planorbidae	82	V	S
	Sphaeriidae	91	G	S

Note: when predictive modelling is used, expected taxa are predicted on the basis of the probability of a monitoring or test site belonging to a Reference Group multiplied by the probability of a particular taxon occurring in the Reference Group. It is not possible to derive such expected taxa probabilities without using predictive modelling and an alternative method has been adopted in this study.

5.3.1.4 Biotope considerations

Expected median values for each biotope-group in each season, together with biological band ranges for O/E ASPT are given in Table 5.5. O/E ratios for SASS4 Score and number of taxa were highly variable and have been excluded from Table 5.5 until verification and testing may be undertaken. Interpretation based on the O/E ASPT should enable the influence of biotope availability to be taken into account when a site is monitored. If a single biotope-group was sampled at a monitoring site, the SASS4 Score, number of taxa and ASPT values (O) may be compared with the expected median value (E) for the same biotope-group. The ratio of O/E may be calculated using the ASPT value and the monitoring site may be assigned to a band from which an indication of the biological condition is attained (see Table 5.1).

Table 5.5 Reference Group 1: Expected median values for calculating O/E ratios for each season and biotope-group combination. Band ranges (excluding Band X) for O/E ASPT are given for each biotope-group.

Biotope-group	Season	Expected median values for calculating O/E		
		SASS4 Score	Number of Taxa	ASPT
SIC/SOOC	Autumn	79	12	6.58
SIC/SOOC	Winter	109	16	7.15
SIC/SOOC	Spring	122	18	6.83
AQV/MV	Autumn	69	11	6.06
AQV/MV	Winter	55	10	5.53
AQV/MV	Spring	86	14	6.06
GSM	Autumn	36	7	4.67
GSM	Winter	49	9	5.73
GSM	Spring	53	10	5.42
Band		**O/E ASPT-SIC/SOOC**	**O/E ASPT-AQV/MV**	**O/E ASPT-GSM**
A		≥ 0.9	≥ 0.7	≥ 0.7
B		> 0.7-0.9	> 0.4-0.7	> 0.5-0.7
C		> 0.6-0.7	≤ 0.4	> 0.2-0.5
D		≤ 0.6		≤ 0.2