User assessment survey of a shallow freshwater lake, Zeekoevlei, Cape Town, with particular emphasis on water quality

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Abstract

The main purpose of the study was to ascertain the extent of use, and use patterns of Zeekoevlei and the users' perception of water quality. In terms of expressed demand, it was established that respondents' recreational activity range was extensive. Respondents participated in active and passive recreation activities: boardsailing (14%), relaxing (24%), braaiing (35%) and picnicking (19%) were the most important activities. The major group of respondents (37%) recorded proximity to home as their principal reason for visiting Zeekoevlei. Less than one half of respondents (45%) classified Zeekoevlei as a clean water vlei. Those who felt the converse to be true objected to the smell (60%), the colour (50%) and the appearance (49%) of the water body. The user population of Zeekoevlei based their assessment of the water quality state of the vlei primarily on olfactory and aesthetic qualities. The perceptions and assessment of users toward water quality in this study are compared to studies conducted at Hartbeespoort Dam and Zandvlei. The majority of respondents recognised that the management and administration of Zeekoevlei is a costly operation and 69% of all respondents expressed a willingness to pay an entry fee should facilities and water quality be improved. This shows some commitment on the part of users towards shouldering the financial costs of improved water quality in Zeekoevlei.

Introduction

With increasing demands being placed upon the limited water resources of South Africa (Department of Water Affairs, 1986; 1991) and upon the financial resources of those organisations funding development and implementation of pollution control technologies (De Wet, 1985; Dutkiewicz, 1985; Huntley, 1987; Department of Water Affairs and Forestry, 1991), it is important that the manifold uses of water bodies are wisely managed.

One important use fulfilled by many of South Africa's water bodies is recreation. Recreational management of lakes and dams requires a knowledge of the users' perceptions and behaviour in response to a variety of water quality conditions.

The purpose of this paper, therefore, is to investigate the perceptions of the public to water quality in a freshwater vlei, Zeekoevlei, in the south-western Cape and to compare these results with other similar studies.

Methods

Study area and sample universe

The area sampled is shown in Fig. 1 and included Zeekoevlei water and its surroundings. The sample unit (users of Zeekoevlei) was defined as those persons who either actively or passively used the vlei for contact and/or non-contact recreation. Users included young and old, men and women. The users of Zeekoevlei constituted an indeterminate universe. Only actual users were interviewed (including local residents) and, hence, no account was taken of potential users.

Since no similar study had been undertaken previously at Zeekoevlei, the survey adopted an exploratory approach. The

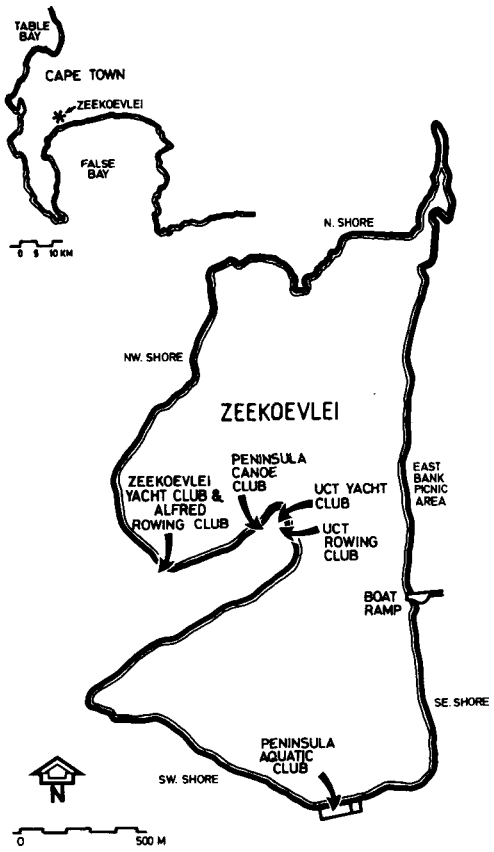

Figure 1
Map of Zeekoevlei showing the user zones surveyed

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TABLE 1
NUMBER OF PEOPLE ENGAGED IN VARIOUS ACTIVITIES AT DIFFERENT ZONES IN ZEEKOEVLEI (zones are shown in Fig. 1)

Zones	Activity																
	Braai	Relax	Picnic	Fish	Boardsail	Ski	Powerboat	Sail	Playground / Ballgames	Walk	Bird watch -ing	Water sport	Canoe	Jog	Row	Misc	Total
1. UCT Yacht and Rowing Club	5	10	3	3	110	10	2	14	1	1	1	7	2	1	5	1	176
2. Zeekoevlei Yacht Club	1	5	3	10	10	-	-	62	3	2	3	4	4	-	6	5	118
3. Peninsula Aquatic Club	13	14	4	4	4	65	16	-	2	2	4	1	-	1	1	1	132
4. Alfred Rowing Club	3	4	1	3	1	-	1	-	-	-	-	1	-	1	3	-	18
5. Peninsula Canoe Club	3	1	-	1	-	9	4	2	1	-	-	-	-	1	-	1	23
6. East Bank Picnic Area	325	232	177	121	22	11	15	15	50	22	15	9	8	10	3	3	1038
7. Boat Ramp	88	83	45	15	84	52	87	41	27	8	8	8	8	5	4	1	564
8. South-East Shore	216	121	121	109	14	9	23	4	21	16	7	6	5	6	2	2	682
9. North-West Shore	8	7	2	19	1	1	1	4	-	4	3	2	1	-	-	1	54
10. South-West Shore	1	2	2	4	-	4	7	-	-	-	-	-	-	1	-	1	22
Other	4	9	3	10	3	1	-	3	3	-	1	-	-	-	-	-	37
TOTAL	667	488	361	299	249	162	156	145	108	55	42	38	28	26	24	16	2864

*Note: Totals sum to more than 1 484 (number of respondents), due to multiple responses; for e.g. a user may visit several zones to partake in various activities.

study is thus a descriptive statement of the users who were interviewed. It is not possible to say anything in a categorical sense about users who were present at the time of the survey, but who were not interviewed. The study can make no generalised inferences about the potential user universe or enter into any statements about statistical probabilities.

As the study was descriptive, every endeavour was made to elicit as many responses as possible. The value of this survey was that it created a data base of the extent of use, and use patterns of the vlei, of user satisfaction with facilities and of their perception of water quality.

Collection of data

The survey was conducted from 1989-12-18 to 1990-01-07 to determine peak usage during the Christmas/New Year holiday period. Highest attendance levels were registered on Christmas and New Year weekends. During these periods approximately 1 000 people per day visited this inland water facility. On an average day, however, only between 100 and 200 people frequented Zeekoevlei.

A team of 11 interviewers was employed to administer a standardised schedule (**Appendix 1**) which contained fixed and open-ended questions. Choice of interview subjects was not predetermined and interviewers were instructed to avoid any specific selection patterns.

Prior to the survey, the questionnaire was pretested on 1989-12-09 and 1989-12-10. On the basis of this pilot study, inconsistencies in the questionnaire were eliminated.

Zeekoevlei was divided into activity zones and field-workers were allocated to specific zones in order to effect maximum coverage of the vlei (Fig. 1).

Computing

Data were analysed utilising the statistical analysis system (SAS), on a Data General MV20000.

Results and discussion

Extent and patterns of usage

The numbers of different users of the delineated zones in Zeekoevlei are shown in Table 1. The most popular areas were the east bank picnic/braai area (43%), the south east shore (28%), the boat ramp (26%) and the UCT Yacht and Rowing Club (10%). The numbers of users at both the Zeekoevlei Yacht Club (6%) and the Peninsula Aquatic Club (6%) were relatively low.

The respondents' range of recreational activities was extensive. Respondents participated in both passive and active recreational activities: braaiing (35%), relaxing in the quiet and peaceful environment (24%), picnicking (19%), fishing (16%) and boardsailing (14%) were the most important activities.

Reasons for visiting Zeekoevlei

Respondents were asked to list their primary reasons for visiting Zeekoevlei in preference to other inland water bodies. A breakdown of their reasons for visiting the resort is shown in Table 2.

Respondents gave a range of reasons, which have been grouped under the following categories: proximity to home, peaceful environment, scenic environment, boardsailing facilities, powerboating, waterskiing, sailing and fishing.

TABLE 2
REASONS FOR VISITING ZEEKOEVLEI (N = 1 484)

Reason	Frequency	% *
Proximity to home	556	37
Peaceful / quiet / relaxing	311	21
Attractive / scenic / shady trees	218	15
Boardsailing	165	11
Facilities: general / playground for children	109	7
Powerboating / waterskiing	102	7
Sailing	99	7
Fishing	77	5

* Note: Percentages sum to more than 100 due to multiple responses.

The major group of respondents (37%) claimed that proximity to home was their principal reason for visiting Zeekoevlei in preference to other inland water resorts; more than two-thirds of respondents (68%) lived within a 10-km radius of Zeekoevlei.

The second most prevalent reason as expressed by 21% of respondents was that Zeekoevlei was a peaceful and quiet place which was ideal for relaxing.

The third major group of Zeekoevlei users (15%) claimed that Zeekoevlei was environmentally superior to the other vleis in the region. Respondents mentioned the attractive surroundings and the pleasant views. It can be inferred from respondents' comments that most people who visited Zeekoevlei exhibited positive traits of responsible behaviour and friendliness. It also became apparent from responses that the area around the vlei provided sufficient space for some degree of privacy.

Water quality

User attitudes toward water quality are summarised in Tables 3 and 4, which show that less than one half of respondents (45%) classified Zeekoevlei as a clean water vlei, whilst 47% felt that the converse was true. Eight percent of respondents either had no opinion or were undecided. The remainder of this section discusses user perception and assessment of water quality, demographic influences, and desired water quality.

Perception of water pollution

Of those who suggested that the vlei was not a clean water vlei, most objected to the smell (60%), the colour (50%) and/or some aspect of appearance (49%) of the water body. More than one quarter of respondents objected to mud (28%) and litter (26%), whilst others objected to weeds/bulrushes (16%), obstacles on the vlei bottom (12%) and the taste of the water (12%). The user population of Zeekoevlei clearly based their assessment of the water quality state of the vlei primarily on olfactory and aesthetic qualities.

This finding also applies to the other three surveys shown in Table 3 where the majority of respondents used the criterion of appearance or visual impact to determine whether or not a water body was polluted. Although most respondents to the Hartbeespoort Dam survey felt that visual appearance of a water body was important, all respondents identified smells or odours as the dominant indicator of polluted water. Odours formed the second most important indicator group in the Zandvlei study.

The differences in response to olfactory qualities between the sample populations probably reflect differences in the flora composition of the three principal water bodies involved in this comparative study. Hartbeespoort Dam and Zeekoevlei are algal-dominated (Jarvis, 1988) whilst Zandvlei is macrophyte-(weed) dominated. Algae cannot easily be removed from water bodies, and as a result, wind-blown algae accumulate and decay along the shoreline, with significant olfactory impact (Kooyoomijian and Clesceri, 1974).

In comparison, macrophytes can be removed by mechanical harvesting (Morant and Grindley, 1982) and therefore have limited olfactory impact. That the Zandvlei responses more closely correspond with the results of the Wisconsin survey is probably a function of the macrophyte-dominance in many Wisconsin lakes (Wetzel, 1975).

Assessment of water pollution

Eighty-nine per cent of respondents made some comment on the vlei and its facilities; of these only 22% of comments were expressed about the state of the vlei. The majority of those comments on water quality (63% of the above) were concerned with litter, weeds and debris. The remainder mentioned other aspects of the water-based amenities. These concerns were further reflected in the improvements requested by respondents and confirm the importance of these factors in determining public usage of Zeekoevlei.

Water quality parameters such as litter, weeds and debris not only influenced the behaviour of persons engaged in contact and/or water-based recreation (such as boardsailors), but also that of persons using the vlei for non-contact, land-based recreation (such as picnickers; Table 4). Together these results suggest that at least part of the value of visiting recreational sites incorporating water bodies lies in the visual amenity provided by the water body itself. It follows, therefore, that water quality degradation is linked to amenity deterioration, at least insofar as the major indicators are concerned. Different user groups, however, had differing water quality concerns at the minor indicator level (Table 4).

In all of the studies reported here, user assessment, like user perception of water pollution is based mainly on visual/olfactory criteria. The difference between studies probably reflects the differing flora compositions of the systems (see previous section on ***Perception of water pollution*** for more detail).

TABLE 3
COMPARISON OF THE RESPONSES OF THE ZEEKOEVLEI USER POPULATION WITH USERS FROM ZANDVLEI (CAPE TOWN CITY COUNCIL, 1987), THE TRANSVAAL (THORNTON, 1987) AND NORTH AMERICA (BARKER, 1971; DAVID, 1971)

Criterion/ Objection	Zeekoevlei %	Zandvlei %	Hartbeespoort %	USA %
Smell	60	9	100	13
Appearance (scum, floating, debris, algae)	49	41	96	51
Silt / mud	28	18	16	31
Litter	26	27	56	25
Weeds / bulrushes	16	48	6	17
Obstacles in water / debris	12	48	52	23
Taste	12	46	1	17
Scientific tests	6	1	29	10
Other	5	46	50	-

Note: Percentages sum to more than 100 due to multiple responses.

TABLE 4
WATER QUALITY ISSUES OF CONCERN TO WATER-BASED (ACTIVE) AND NON-WATER-BASED (PASSIVE) RECREATIONAL USERS OF ZEEKOEVLEI AS IDENTIFIED BY FREQUENCY OF OBJECTION (1 = MOST FREQUENT)

Criterion/Objection	Active users	Passive users
Smell	1 (n=199)	2 (n=72)
Colour	3 (n=136)	1 (n=79)
Appearance	2 (n=155)	3 (n=61)
Muddy bottom	4 (n=84)	4 (n=39)
Litter on embankments	5 (n = 72)	5 (n = 25)

Demographic influences on water quality perceptions (Table 5)

The majority of respondents to this survey were aged between 26 and 55 years (67%). Age did affect perception of water quality, with older (aged over 55 years) respondents more inclined to classify Zeekoevlei as being a clear water body (55% : 45%) than younger (aged under 26 years) respondents (43% : 57%). Age had little effect on the perception of problems in the vlei, with smell, colour and the general appearance being the factors most often cited by respondents of all age groups as being undesirable.

Far fewer females than males were inclined to classify Zeekoevlei as a clean water vlei, in the ratios 35% : 65% and 53% : 48% respectively. Smell and colour were the two indicators of "pollution" that were most often cited by both sexes.

The majority of vlei users were matriculants (education to a secondary level), with a fairly normal distribution of users educated to higher and lower levels. Respondents with a lower level of education were more inclined than higher order groups to classify Zeekoevlei as a clean water body. The following ratios were evident: 51% : 49% (Standard 10/Matric or less); 43% : 57% (University/Technikon) and 37% : 63% (Post-graduate). All groups identified smell, colour and appearance as major determinants of water quality in Zeekoevlei.

Unskilled workers generally viewed the vlei as having better water quality than did professional and skilled workers. All groups identified smell, colour and appearance as the major determinants of "pollution"; however, the importance of these factors varied between occupational groups. Professional and skilled workers placed greater emphasis on the smell of the vlei, whilst unskilled workers placed greater emphasis on appearance. The difference was probably use-related, as professionals tended to engage in more active, water-based activities compared to other occupational groups.

Relatively few respondents were members of any type of organisation. Only 3% of respondents were members of a conservation organisation and 21% were members of recreational organisations (such as yacht, canoe, angling, rowing, powerboating and waterskiing clubs). Four per cent of respondents were members of local home owners' or residents' associations. Boating club association members were dissatisfied with the state of the vlei, with only approximately one-third (35%) rating the vlei as having good water quality.

Similarly, a minority of conservation organisation members also regarded Zeekoevlei as a clean water vlei in the ratio 44% : 56%. Home owners association members and anglers, in contrast, were moderately more satisfied with the state of the vlei, with 52% rating the vlei as having good water quality. In all cases, however, persons maintaining memberships in any of these organisations identified smell, colour and appearance as major factors in determining water quality.

TABLE 5
WATER QUALITY ISSUES OF CONCERN TO ZEEKOEVLEI USERS AS IDENTIFIED BY FREQUENCY OF OBJECTION BY DEMOGRAPHIC FACTOR (1 = MOST FREQUENT)

Factor	Smell	Colour	Appearance	Mud	Litter
Education					
Lower than Matric/Std 10	2	1	2	5	4
Matric/Std 10	1	3	2	4	5
University/technikon	1	2	2	4	5
Post-graduate	1	2	3	4	5
Occupation					
Unskilled	2	1	2	4	4
Skilled	1	3	2	5	4
Professional	1	2	3	4	5
Member					
Conservation	1	1	5	4	3
Yacht	1	3	2	4	5
Canoe	2	1	4	5	3
Local home owners' association	1	2	3	5	4
Angling	3	4	1	5	2
Rowing	1	4	1	3	5
Powerboating	1	3	2	4	5
Waterskiing	1	2	3	4	5
Age					
0 -15 years	1	3	1	5	4
16 - 25 years	1	2	3	4	5
26 - 40 years	1	2	2	4	5
41 - 55 years	1	2	3	4	5
55+ Vears	2	1	3	5	4
Gender					
Male	1	2	2	4	5
Female	1	2	3	5	4

Desired water quality

Respondents to this survey were asked to define, in whatever terms they desired, a clean water vlei. Significantly, only 4% of respondents defined Zeekoevlei as a clean water vlei. Criteria specified by other respondents are given in Table 6.

In keeping with the penchant of the respondents to describe water quality in terms of visually aesthetic qualities, most respondents described a clean water vlei in terms of clear water with no excessive plant growth (in particular, algae). Others in view of the recreational nature of Zeekoevlei, were inclined to describe a clean water vlei in terms of smell and/or hygiene parameters.

Willingness to pay

The amelioration of lake water quality can be a potentially costly process involving the use of specialised equipment and expensive technologies. This fact was recognised by respondents to this survey, 69% of whom expressed a willingness to pay an entry fee, should facilities and water quality be improved. The amounts respondents were prepared to pay for improved facilities and water quality are shown in Table 7.

Approximately two-thirds (66%) of respondents expressed a willingness to contribute 50 cents or more per head per entry for improved facilities/water quality.

Conclusion

This user study shows that environmental concern exists amongst respondents and that less than half of the users considered Zeekoevlei to be a clean vlei. Most users perceived poor water quality in Zeekoevlei to be related to odour, colour and visual appearance. All these factors are caused mainly by periodic dense populations of blue-green algae. Scientists have also identified algal "blooms" to be the main management concern in the vlei (Harding, 1991).

Users recognised that the improvement of lake water quality can be a potentially costly process involving the use of specialised equipment and expensive technologies. A significant majority (69%) of Zeekoevlei users expressed a willingness to pay an entry fee, should facilities and water quality be improved. This willingness to contribute indicated a degree of commitment on the part of the general public toward the maintenance of good

TABLE 6
WATER QUALITY CRITERIA FOR "A CLEAN WATER VLEI" AS DEFINED BY RESPONDENTS TO THIS SURVEY IN TERMS OF FREQUENCY (%) OF OCCURRENCE (N = 1 484)

Characteristic	%*
Clear; non-turbid water	30
No scum or algae	29
No smell	11
Good/safe hygienic quality	
"Living" water	5
No (excess) weeds	5
No debris/obstacles in water	4
No chemical pollution	4
Well flushed	3
No litter on shoreline	2
Sandy bottom	1

* Note: Percentages sum to more than 100 due to multiple responses.

TABLE 7
PROPENSITY TO PAY FOR IMPROVED FACILITIES AND WATER QUALITY AT ZEEKOEVLEI

Amount	Frequency	%
Not prepared to pay	366	25
Undecided	91	7
Less than 50c	51	3
50c to 99c	340	23
Rl to R1-99	359	24
R2 to R4-99	212	14
R5+	65	4
TOTAL	1 484	100

water quality at Zeekoevlei.

User assessments of recreational water bodies are an important component of management, and the views of users from this study have been incorporated in a report that investigates catchment and in-lake options for the management of Zeekoevlei (Harding and Quick, in prep.).

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Appendix 1

Zeekoevlei user satisfaction survey questionnaire

1. (a) What are the main reasons for your visiting Zeekoevlei?

Boardsailing	- 1
Sailing	- 2
Canoeing	- 3
Rowing	- 4
Fishing	- 5
Birdwatching	- 6
Picnicking	- 7
Braaiing	- 8
Walking	- 9
Jogging	- 10
Skiing	- 11
Powerboating	- 12
Others	- 13 Go to l(b)

1. (b) Other - please state reason: .....

2. (a) Why do you visit Zeekoevlei in preference to some other ... inland water resort e.g. Princess Vlei/Zandvlei?

.....

(b) What other inland water resorts do you visit?

.....

3. Do you visit Zeekoevlei on your own? - 1
with your family? - 2
with a group of friends? - 3
with a large organised group? - 4

4. How do you get to Zeekoevlei?

On foot	- 1
Bicycle	- 2
Motorbike	- 3
Car	- 4
Taxi	- 5
Bus	- 6
Train	- 7
Combination of above	- 8 (please specify).....
Other	- 9 (please specify) .....

5. (a) How often do you visit Zeekoevlei?

FREQUENCY	SUMMER (Nov - April)	WINTER (May - Oct)
First time	-1	-1
Once a week	-2	-2
2 or more times/week	-3	-3
Once every 2 weeks	-4	-4
Once a month	-5	-5
Once every 2 to 3 months	-6	-6
Less than every 3 months	-7	-7
Never	-8	-8

(b) What time of day do you normally visit Zeekoevlei?

Early morning	-1
Mid morning	-2
Lunch	-3
Mid afternoon	-4
Late afternoon	-5

6. How many hours do you spend during an average visit to Zeekoevlei?

.....

7. (a) What part(s) of Zeekoevlei do you use? (consult attached map if uncertain of zones)

UCT Yacht and Rowing Club	- 1
Zeekoevlei Yacht Club	- 2
Peninsula Aquatic Club	- 3
Alfred Rowing Club	- 4
Peninsula Canoe Club	- 5
East Bank picnic area	- 6
Boat ramp	- 7
SE shore	- 8
NW shore	- 9 Go to 7b
SW Shore	-10 Go to 7b
Other	-11 Go to 7b

(b) If Other, or N shore please specify and place an X on the map

.....

8. Have you any comments about the facilities listed below? (Circle both Facility Used and Rating)

FACILITY USED RATING

		Poor	Below Average	Average	Good	Excellent	Don't Know
Toilets	-1	-1	-2	-3	-4	-5	-6
Braai places	-2	-1	-2	-3	-4	-5	-6
Lawned area	-3	-1	-2	-3	-4	-5	-6
Playground	-4	-1	-2	-3	-4	-5	-6
Parking	-5	-1	-2	-3	-4	-5	-6
Jetties	-6	-1	-2	-3	-4	-5	-6
Launching area	-7	-1	-2	-3	-4	-5	-6
Bins and litter collection	-8	-1	-2	-3	-4	-5	-6
Security patrols	-9	-1	-2	-3	-4	-5	-6

9. What improvements would you like to see at Zeekoevlei?

.....

10. If you are a resident of the Zeekoevlei area, do you have any specific comments on problems/improvements in your area?

.....

11. (a) Do you consider Zeekoevlei to be a clean water vlei?

YES -1 NO -2 Go to 11(b).

11. (b) If NO what do you object to?

Colour	- 1
Appearance (scum, debris, algae)	- 2
Smell (odour, etc.)	- 3
Taste	- 4
Litter on embankments	- 5
Too shallow	- 6
Weeds (bulrushes)	- 7
Muddy bottom	- 8
Irritation to eyes or skin	- 9
Obstacles in the water	-10
Other (specify)	-11 .....

12. How would you describe a clean water vlei?

.....

13. (a) If better facilities and/or water quality were provided here, would you be prepared to pay an entrance fee (per person) to use them?

YES -1 Go to 13(b)
NO -2 Go to 14

(b) How much would you be prepared to pay?

Less than 50c	-1
50c to 99c	-2
R1,00 to R1,99	-3
R2,00 to R4,99	-4
More than R5,00	-5

14. What suburb/town do you live in?

.....

15. Are you a member of any of the following?

A conservation group	-1
A yacht club	-2
A canoe club	-3
A home owners' association	-4
An angling club	-5
A rowing club	-6
A power boating club	-7
A water skiing club	-8

16. Gender:

Male	-1
Female	-2

17. Your age?

0 to 15	-1
16 to 25	-2
26 to 40	-3
41 to 55	-4
55+ years	-5

18. What is your education level?

Lower than Std 8	-1
Std 8-9	-2
Std 10/Matric	-3
University/Technicon	-4
Post-graduate	-5
Other (specify)	-6 .....

19. Your occupation? .....

20. Are there any additional comments you would like to make?

.....