

## RESPONSE TO EXTERNAL EXTERNAL EXAMINER'S COMMENTS

Title: DEVELOPMENT OF WATER QUALITY INDEX (WQI) FOR THE JUKSKEI RIVER CATCHMENT, JOHANNESBURG.

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Comment	Page	Response/ Action
	iii	<u>Sentence rephrased</u> <i>The Water Quality Index (WQI) is useful in achieving this through simplifying complex water quality data into a single value that can therefore be classified to indicate the quality of any water resource.</i>
Sentence may be too long	iii	<u>Sentence was broken into two sentences.</u> <i>The current data analysis methods being employed by the City of Johannesburg and associated problems were discussed. The benefits of using the water quality index in analysing the data and producing the simple water quality status report on monthly and quarterly basis to align it with City of Johannesburg reporting periods are also explained</i>
Which economy	1	<u>Rephrased</u> <i>In 1990, it was found that the cost of <b>China's</b> surface water pollution to the national economy was 0.5 percent of the gross national product, which was more than the total 1990 exports of the country (Zhulidov et al., 2001).</i>
Are brackets in the correct position	1	<u>Bracket moved to the correct position</u> <i>Abdel-Dayem (2011) found that the cost of damage to natural resources (<b>ecosystems</b>) from municipal and industrial wastewater in Egypt was about 0.1% of gross domestic product.</i>
Changing?	2	<u>Amended</u> <i>The impacts of climate change are becoming very serious with increasing temperatures and <b>changing</b> rainfall patterns. Surface water resources are affected the most due to combined affect caused by the decreased precipitation and increased potential evaporation as a result of rising air temperature (Altansukh and Davaa, 2011).</i>
Missing comma	2	<i>However, water quality analysis results also need to be meaningful to managers and decision makers in the water sector who want to base their decisions on the state of their local water bodies (Akkoyunlu and Akiner, 2012).</i>
Unclear sentence	3	<u>Rephrased</u> <i>Water quality monitoring and the management of the resultant data require huge budgets to maintain.</i>

Missing commas	3	<u>Commas inserted</u> <i>The data being generated, if not being transformed to useful information about the status of the water quality in the catchment, translate to wastage of limited financial resources.</i>
Missing comma	4	<i>The natural ecosystem must be protected from human activities because it is the source of water (Leendertse et al., 2008).</i>
Insertion "the	4	<i>Biswas and Tortajada (2011) indicated that most of the research conducted to date has focussed on the physical scarcity of water with less emphasis on water pollution issues.</i>
Insertion "the	5	<i>Other researchers have cautioned that the continuous deterioration of water quality will become the driving force behind water scarcity problems in the future especially in developing countries (Biswas and Tortajada, 2011; Jain and Singh, 2010).</i>
Groundwater or Ground water?	6	<u>Amended</u> <i>Anthropogenic activities and natural processes can easily degrade the quality of surface and groundwater resources and impair its usability.</i>
Use of capital P for parameters	9	<u>Amended</u> <i>Prevention of river pollution requires effective monitoring of physico-chemical and microbiological parameters (Kolawole et al., 2011).</i>
Other researchers?	10	<u>Rephrased</u> <i>Dehua et al. (2012) highlighted the need to change to automatic sensors rather than physical collection of water samples for analysis at the laboratory.</i>
Missing "by	12	<u>Inserted</u> <i>According to Khalil et al. (2010) the quality of a water body is described by a combination of a sets of physical, chemical and biological variables that are mutually interrelated.</i>
Sentence a bit incoherent	12	<u>Rephrased</u> <i>In most cases it is difficult to approach and to produce meaningful information from a complex water quality data set (Han et al., 2009).</i>
"that"	12	<u>Deleted</u> <i>Powerful statistical methods can reveal remarkable spatio-temporal patterns in measured water quality data and this may lead to new interpretations regarding the human impact on aquatic environments.</i>
space	13	<i>Wang et al. (2013) employed the Cluster Analysis and Principal Component Analysis/Factor <b>Analysis</b> to evaluate temporal/spatial variations in water quality and identify latent sources of water pollution in the Songhua River Harbin region.</i>
spelling	13	<i>The Principal Component <b>Analysis</b>\Factor Analysis indicated that the parameters responsible for water quality variation in the region were mainly related to organic pollution and nutrients.</i>

Incoherent sentence	13	<i>Cieszynska et al. (2012) used the Cluster Analysis to differentiate watercourses according to water quality.</i>
acronym	13	<i>Cieszynska et al., (2012) found that Cluster Analysis was beneficial as compared to other methods (e.g. principal components analysis) as it accounts for the whole variation in the data and no simplification of the information is necessary.</i>
Clumsy sentence	14	<i>According to Papazova and Simeonova (2013), the Multivariate analysis studies are performed to try to assess the river water quality or to optimize the monitoring procedure.</i>
Is this common knowledge	14	<i>Bouza-Deaño et al., (2008) found that in the cases of data set with a seasonal component or with variables correlated, parametric techniques show false positives in some cases.</i>
Unclear	16	<i>The cooperation in management of the water resources is likely to improve when the public understand the status of water quality around them.</i>
Unclear	16	<i>Salih et al., (2012) observed that it is difficult to determine the water quality from a large number of samples, each containing concentration for many parameters.</i>
"the" missing	17	<i>Until <b>the</b> 1990s, South Africa focused on controlling the natural water system to address the lack of water for agricultural and industrial development.</i>
	18	<i>The NWA adopts the Integrated Water Resources Management (IWRM) principles and as a result makes the distinction between “water quality” and “water resource quality”.</i>
Delet "of"	19	<i>The Jukskei River is fed by a number of streams which drain some highly developed areas and urban centres of COJ such as Sandton, Randburg and Midrand.</i>
Kya sands or Kya Sands?	19	<i>The catchment also boasts a number of industrial areas such as Wynberg, Modderfontein, <b>Kya Sands</b> and Linbro Park. Informal settlements which are having severe impacts on the quality of surface water resources are growing immensely. Some of the major informal settlements within the catchment are located in Diepsloot, Alexandra, Ivory Park, Zandspruit and <b>Kya Sands</b>.</i>
COJ or CoJ?	19	<i>COJ runs a water monitoring network composed of 120 sampling points (Burke and Bokako, 2004).</i>
Sentence structure	19	<i>The rapid industrial development, influx of people from rural areas and proliferation of informal settlements have put a lot of pressure on the need for development of a cost effective, optimal water quality monitoring network.</i>
	20	<i>Location of the sampling stations across COJ Rivers were selected based on accessibility, bridges, existing projects (Alexandra Renewal Project and other projects such as COSMO city), location of waste water treatment works (WWTW).</i>
	20	<i>Samples were also collected by Environmental Health and submitted to Johannesburg Water Cydna laboratory owned by COJ on a monthly basis.</i>
Sentence too long		<i>The collected samples are analysed for conventional parameters including turbidity, total dissolved solids, pH, conductivity, and nutrients (ortho-phosphate, total phosphate, ammonia-nitrogen, nitrate+nitrite- nitrogen,</i>

		<i>total nitrogen) as indicators for chemical water quality, which assess the presence of chemicals and nutrients due to illegal industrial effluent discharges, domestic activities, and chemical impact of sewage pollution. E.coli is being measured to determine the impacts of sewage pollution.</i>
June	20	<u>Replaced June by "dry season"</u>
Use of bullets	20	<u>Removed the bullets and rephrased</u>
Determined	20	<u>Replaced determined by used</u>
Make	21	<u>Corrected make to read makes</u>
identity		<u>Corrected identity go read identities</u>
During winter	25	<u>Deleted during winter</u>
Space on degree celcius	25	<u>Deleted space on 24 degree</u>
higher	25	<u>Replaced by longer</u>
imported	27	<u>deleted</u>
Missing "in"	27	<u>inserted</u>
Space between paragraphs	28	<u>Space created</u>
Population according to regions of Joburg- maps do not contain regions boundaries	28	<u>Information on regional population deleted</u>
"of" misplaced in a sentenced	28	<u>"of" deleted</u>
"of" misplaced in a sentenced	29	<u>"of" deleted</u>
Correct notation for phosphate	29	$PO_4^{3-}$
Missing part of sentence	29	<u>" which are shown in figure 3.1" added to the sentence</u>
Explain meaning of heading on figures 3.2 through to 3.11	30-35	<u>Monitoring points acronyms explained FG1, KLS1, JG1, DWJ44, DWJ14, DWJ06, DWJ04, DWJ03, UJ3 and UJ5)</u>
Figure 3.2, 3.3 labelling incorrect	30	<u>Figure labels amended to reflect FG1 and KLS1 for figures 3.2 and 3.3 respectively</u>
Why use arithmetic method	36	<u>Method is commonly used (Tyagi et al, 2013)</u>
Incorrect formula for Amonia	36	<u>Corrected to read <math>NH_4^+</math></u>

How was the classification range obtained for the selection of water quality parameters of concern and whether the range would change depending on the combination of water quality variables comprising the WQI i.e. Why multiply by 50 on qi formula	37	<u>Paragraph added explaining the fact that according to the classification the water quality is acceptable when the rating is 50 and any score less than that means the water quality is polluted. Multiplying by 100 means that the recommendation is for unacceptable water quality as per classification scheme. Therefore instead of using 100 as suggested in most of the literature (Tyagi et al, 2013, Amad et al., 2010; Mophin-Kania and Murugesan, 2011, Gajendran and Jesumi, 2013) multiplying the equation by 50 means that the recommended water quality class is 50 which is acceptable class</u>
Comparison of various WQI types as well as discussion on their strengths, and weaknesses	37	<u>A new section on WQI types (Section 2.6.4) and discussion on their weaknesses and strengths added</u>
WDCS	37	<u>A new section in discussion (chapter 6) has been introduced discussing the implications of implementation of WDCS and RQOs</u>
Nitrate/Nitrite repeat in the sentence	38	<u>Amended - nitrate/nitrite are closely related to ammonia</u>
Table 4.3 Ammonia (NH4+))	39	<u>One closing bracket removed</u>
Capital for chapter	41	<u>Changed to lower case</u>
Table legend for different colours used missing in WQI table 5.1	43	<u>Legend for WQI colours added in table 5.1 Yellow - tolerable; Red - unacceptable</u>
Table legend for different colours used missing in WQI table 5.2	43	<u>Legend for WQI colours added in table 5.2 Green - acceptable; Yellow - tolerable, Red - unacceptable</u>
Table legend for different colours used missing in WQI table 5.3	49	<u>Legend for WQI colours added in table 5.3 Yellow - tolerable ; Red - unacceptable</u>
Closing bracket missing	50	<u>Closing bracket inserted - (Figure 5.4)</u>

Table legend for different colours used missing in WQI table 5.4	52	<u>Legend for WQI colours added in table 5.4</u> <u>Green - acceptable; Yellow - tolerable; Red - unacceptable</u>
Table legend for different colours used missing in WQI table 5.5	55	<u>Legend for WQI colours added in table 5.5</u> <u>Red - unacceptable; Yellow - tolerable</u>
Table legend for different colours used missing in WQI table 5.6	58	<u>Legend for WQI colours added in table 5.6</u> <u>Red - unacceptable; Yellow - tolerable</u>
Table legend for different colours used missing in WQI table 5.7	61	<u>Legend for WQI colours added in table 5.7</u> <u>Red - unacceptable; Yellow - tolerable</u>
"the" missing in section 5.1.8	62	<u>Inserted</u>
Table legend for different colours used missing in WQI table 5.8	64	<u>Legend for WQI colours added in table 5.8</u> <u>Red - unacceptable</u>
Use of "&"	65	<u>Sentence ammended, &amp; replaced by "and"</u>
Table legend for different colours used missing in WQI table 5.9	65	<u>Legend for WQI colours added in table 5.9</u> <u>Red - unacceptable; Yellow - tolerable</u>
Y axis labelling missing on Figure 5.9	66	<u>WQI labelling added to y axis for figure 5.9</u>
Table legend for different colours used missing in WQI table 5.10	67	<u>Legend for WQI colours added in table 5.9</u> <u>Red - unacceptable; Yellow - tolerable</u>
Y axis labelling missing on Figure 5.10	68	<u>WQI labelling added to y axis for figure 5.10</u>
Y axis labelling missing on Figure 5.11	69	<u>WQI labelling added to y axis for figure 5.11</u>
Table legend for different colours used missing in WQI table 5.11	67	<u>Legend for WQI colours added in table 5.11</u> <u>Red - unacceptable</u>
Table legend for different	70	<u>Legend for WQI colours added in table 5.12</u>

colours used missing in WQI table 5.12		<u>Red - unacceptable; Yellow - tolerable</u>
Y axis labelling missing on Figure 5.12	70	<u>WQI labelling added to y axis for figure 5.12</u>
Table legend for different colours used missing in WQI table 5.13	71	<u>Legend for WQI colours added in table 5.13</u> <u>Red - unacceptable; Yellow - tolerable</u>
Y axis labelling missing on Figure 5.13	71	<u>WQI labelling added to y axis for figure 5.13</u>
Incorrect company name - AEL	73	<u>Corrected - AECl</u>
Missing word "occurring"	73	<u>inserted</u>
Spelling error "niticed"	73	<u>Amended to read noticed</u>
What about the stations that are on the threshold of becoming unacceptable?	76	<u>Although there are those stations already on the threshold of becoming unacceptable, the study focussed on those that are currently on an unacceptable level to elevate matters of concern and exposure of the surrounding communities to waterborne diseases. Decision makers can therefore prioritise these areas for immediate actions necessary to alleviate pollution sources.</u>
Upward trend visible on trend test graphs (figure 5.14, 5.15, and 5.16)	77	<u>Although the visual inspection indicate an increasing trend in all monitoring points within the sub-catchment, it is considered insignificant.</u>
Annotation for trend line on figures 5.14-5.33	77-89	<u>Trend line annotated</u>
Closing bracket missing	78	<u>Inserted</u>
Upward trend visible on trend test graphs (figure 5.17, 5.18, 5.19, 5.20, 5.21, 5.22, 5.23, 5.24 and 5.25)	79	<u>Increasing trend visible on the graphs is considered insignificant.</u>
Upward trend visible on trend test graph figure 5.26 and downward trend on figure 5.27	84	<u>Trends are considered insignificant</u>
Upward trend visible on trend test graph figure 5.28 and downward trend on figures 5.29 and 5.30	85	<u>Trends are considered insignificant</u>

Downward trend visible on trend test graphs (figure 5.31, 5.32, and 5.33)	87	<u>Trends are considered insignificant</u>
"a" misplaced in a sentenced	90	<u>"a" deleted</u>
"an" missing in a sentenced	91	<u>"an" inserted</u>
"a" missing in a sentenced	92	<u>"a" inserted</u>
Chapter 6 - discussions missing other important information on WDCS	90	<u>A new section (6.4) integrating WDCS and its implication to the City of Johannesburg introduced to cover these issues</u>
Chapter 5 - results and interpretation lacking some details	41-89	<u>A new section bringing together the trends analysis results and WQI, it is summarising the results and analysis chapter (5.4). a table summarising the possible drivers for trends identified has also been introduced</u>