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LETABA CATCHMENT RESERVE DETERMINATION STUDY – WETLAND SCOPING REPORT FINAL FEBRUARY 2006

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Letaba Catchment Reserve Determination Wetland Scoping Report i

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EXECUTIVE SUMMARY

Based on the National Land Cover 2000 coverage, as well as the topographic analysis undertaken, there appears to be a fairly high concentration of relatively large wetlands between the Letsitele and Thabina Rivers in the south west of the catchment and in the area east and west of the Groot Letaba River immediately downstream of this. This appears to stretch as far as the Nsami River confluence with the Groot Letaba River. The wetlands extend from the Sour Lowveld Bushveld through a section of Mixed Lowveld Bushveld into the Mopane Bushveld. Most of the identified systems therefore occur along the Drakensberg foothills and valley and the Pieterberg plateau and lowveld hydrogeological regions of the catchment.

Topographically, the systems appear to comprise mostly valley bottom wetlands which are linked to water courses. The quaternary catchments in which these wetlands occur include predominantly B81D and B81 E although there are also some systems in B81C. Besides in this area, no other wetland systems were picked up from the NLC 2000 data source available.

Based on the topographic analysis, it is also likely that wetlands occur in the upper section of the catchment on the plateaus where slopes are gentle and rainfall is higher. In particular, wetlands are expected to occur in sections of quaternary catchments B81A, B82A and B82B. These systems fall within the Drakensberg escarpment hydrogeological region and would be restricted predominantly to isolated systems in the upper reaches of the small tributaries of the main rivers. They are expected to comprise mostly hillslope seepage and narrow channeled valley bottom wetlands. Should these occur, they are likely to contribute to baseflows in the upper sections of the streams. Valley bottom wetlands are also expected along the stream channels in these upper reaches. These are likely to be narrow and across much of the area, impacted by afforestation.

Probably the most culturally and geo-hydrologically interesting systems that occur in the catchment are the two thermal spring systems, one at Eiland (Hans Merensky Nature Reserve) and the other (Soutini-Baleni) close to the banks of the Klein Letaba River in its middle reaches. The latter is particularly culturally significant and is thought to be one of the few remaining undeveloped hot springs in South Africa and is a traditional Tsonga salt manufacturing site. Apart from the thermal springs, almost all the other wetlands identified or expected to occur in the catchment are associated with either the Rooiwater complex, granite intrusions, the Goudplaats gneiss or quaternary deposits.

Springs in the Drakensberg escarpment hydrogeological regions provide baseflow to the rivers yielding typically between 1 and 3 l/sec (Haupt & Sami, 2004). Quaternary catchment B81A, which occurs in the Drakensberg escarpment region and which is expected to support wetlands, generates approximately 39% of the baseflow in the Letaba catchment (Haupt & Sami, 2004).

In the Drakensberg foothills and valley region, the aquifers are of a composite type, and the wetlands are mostly seasonally to temporarily wet and expected to dry up during winter months or drought years. These systems may also contribute to baseflow in the rivers and streams, particularly in quaternary catchment B81D where baseflow contribution is high (approximately 13% of the total Letaba catchment according to Haupt & Sami, 2004). Losses from evapotranspiration in large wetland systems like that along the Thabina River may reduce the baseflow contribution from this quaternary during summer months. These losses may be far less during winter months. Winter baseflow contribution is likely to be key for maintaining the aquatic ecosystems during the dry months.

In the Pietersburg plateau and lowveld hydrogeological region, which covers over 50% of the catchment, groundwater levels are generally below stream level, thereby reducing the opportunity for flow augmentation in the rivers (Haupt & Sami, 2004). The wetlands in this region are therefore mostly temporarily wet and are expected to dry up during winter months or drought years. These systems are likely to be important for flood attenuation where they occur in the valley bottoms since they are large and have the capacity to absorb large volumes of water, have gentle slopes, and are likely to be well vegetated. Being vegetated and given their location in the hot lowveld zone where evaporation far exceeds rainfall, evapotranspiration losses from these systems is expected to be high.

Primary aquifers consisting of saturated alluvium are also present along the major river systems and are composed of unconsolidated clayey silts to course gravel and boulders. These aquifers are recharged during periods of high streamflow and discharge to the river once the stream stage drops. These are considered important aquifers (Haupt & Sami, 2004) especially with regard to their role in maintaining the ecosystems along the rivers. While these aquifers support mainly the river-related ecosystems, they may also serve to support some of the larger riparian wetlands such as those along the Thabina River and those in the Pietersburg plateau and Lowveld region.

The Santini-Baleni thermal spring wetlands which also occur in the Pietersburg plateau and Lowveld hydrogeological region have cultural significance and provide valuable resources to the local communities who utilize them. They also provide biodiversity support and should be protected.

Interpretation of the information currently available for the catchment suggests that the wetlands in the Drakensberg escarpment and Drakensberg foothills and valley regions are likely to have been more impacted upon than those in the other two hydrogeological regions. Afforestation, alien plant invasion and irrigation are likely to be the main impacts in the Drakensberg escarpment and Drakensberg foothills and valley region, while cultivation and overgrazing are likely to be the main impacts in the Pietersburg plateau and Lowveld region.

The high lying springs, perched aquifers and associated wetlands in the Drakensberg escarpment region are expected to be most vulnerable in terms of impacts. These systems are likely to be small, easily drained, have steep slopes, are susceptible to erosion and water quality changes, and are often overlooked in land-use planning. In contrast, the large valley bottom systems in the Pietersburg plateau and Lowveld region are expected to be more robust in terms of absorbing impacts related to water quality changes and flow reduction. Encroachment into these systems is also limited by flooding and the shallow gradients of these systems probably makes them less susceptible to erosion than the systems in the top of the catchment.

Interpretation of the information currently available for determining the EIS suggests that the wetlands in the Drakensberg escarpment region and the thermal springs in the Pietersburg plateau and Lowveld region are likely to have the highest EIS (scoring High and considered to be ecologically important and sensitive and which play a role in moderating the quantity and quality of water of major rivers). The likely occurrence of Red Data listed species, populations of unique species, and sensitivities to water quality changes and changes in the natural hydrological regime would probably be the main attributes that account for this.

Despite the systems in the Drakensberg foothills and valley region also being considered important for moderating the quantity and quality of water in the catchment, they score lower in terms of the EIS evaluation (Moderate – systems considered to be ecologically important and sensitive on a provincial or local scale where the biodiversity is less sensitive to flow related changes and where the system plays less of a role in moderating the quantity and quality of water to major rivers). The lower score was mainly a result of a lack of Red Data listed species and populations of unique species.

A fundamental constraint in this whole scoping exercise is the lack of an inventory of wetlands in the Letaba catchment and in particular in the main quaternaries where wetlands have been identified or are expected to occur (B81A, B81C, B81D, B81E, B82A and B82B). This together with a lack of baseline data on any of the wetlands (besides the thermal springs) in the catchment, makes it very difficult to identify priority wetland sites for undertaking Reserves. Another constraint has to do with the existing inadequacies with respect to the wetland Reserve determination method, particularly the inability of the current method to deal with groundwater-surface water interactions and the role of interflow and perched groundwater in these systems.

Given these constraints, it is recommended that the valley bottom systems in the Pietersburg plateau and Lowveld hydrogeological region are targeted for reserve studies at this stage. In addition, the existing method is more applicable to riparian wetlands than other types such as hillslope seepage systems, thus rendering the valley bottom wetlands in the lower part of the catchment more suitable candidates for reserve determination. From purely a practical point of view, at this stage it is therefore sensible to focus only on the riparian type wetlands along the valley bottoms in quaternary catchment B81E. These are candidate sites for determining an Ecological Reserve following an Intermediate approach.

The Thabina wetland in quaternary B81D is certainly a candidate site for determining an Ecological Reserve following a Comprehensive approach given that it occurs in an area where the aquifer is vulnerable to drought and where impacts on the aquifer are high. However, given the possible groundwater component of this system, this would require further refinement of the existing methods.

The wetlands in quaternary catchment B81A are candidate sites for determining an Ecological Reserve following a rapid approach because of the potential influence of further afforestation, irrigation or other development on both baseflows and the biodiversity services of these systems. This must include developing Resource Quality Objectives (RQO's) for these systems.

As already stressed however, a fundamental gap to taking this forward is the lack of an inventory and baseline data on the wetlands in the Letaba catchment and in particular in the main quaternaries where wetlands have been identified or are expected to occur (B81A, B81C, B81D, B81E, B82A and B82B). It is therefore recommended that an inventory of wetlands is done in these quaternary catchments. This should include verification of the existence of the systems between the Letsitele and Thabina Rivers in the south west of the catchment and in the area east and west of the Groot Letaba River immediately downstream of this. Similarly, the upper catchment (quaternary B81A in particular) should be visited to check whether or not the areas indicated as likely to support wetlands actually have wetlands.

The approach to the inventory of the wetlands should include field verification and sampling, plus a more detailed air photo analysis using stereo pairs and classification and finer resolution mapping in accordance with Kotze *et al*. (2004) and Thompson e*t al.* (2002). Once an inventory is available for these quaternary catchments and once the systems have been classified, the wetlands could be prioritised based on functionality in accordance with Kotze *et al*. (2004) in order to provide a screening of further candidate sites for Reserve Determination. Baseline data should be collected on a stratified sample of the wetlands to inform the prioritization. This type of information is also essential for determining a “reference state” for the various HGM wetland types in these quaternary catchments. Without a basic understanding of these systems, their key drivers, and their dynamics, it will not be possible to define “reference states” or trajectories of change for these systems.

It is also recommended that should an inventory of the wetlands be undertaken, the wetlands be classified according to the method proposed by Kotze, Marneweck, Batchelor, Lindley and Collins (2004). In the longer term it is also recommended that further baseline studies are undertaken on a stratified sample of all the different HGM wetland types in the different hydrogeological regions in the catchment in order to support any Reserve studies that may be required or may be undertaken in the future.

Any advances made with respect to wetland reserves undertaken in the catchment should be used to further develop the current methods. Any new attributes, criteria, models or approaches used should be documented and incorporated as an update of the existing method so that they can be used in future Reserve Determinations. This will allow the methods to develop in parallel with current understanding and science in the short term thereby supporting the incremental development of the methods.

ABBREVIATIONS

D: RDM	Directorate: Resource Directed Measures
DWAF	Department of Water Affairs & Forestry
EC	Ecological Category
EIS	Ecological Importance and Sensitivity
EWR	Ecological Water Requirement
GIS	Geographical Information System
GPS	Geographical Positioning System
HGM	Hydro-geomorphic
NGDB	National Groundwater Database
NLC	National Land Cover
NWA	National Water Act
PES	Present Ecological Status
RDM	Resource Directed Measures
RQO	Resource Quality Objective
TDS	Total Dissolve Solids
ToR	Terms of Reference

GLOSSARY

Agglomorate: A rock composed of sharp fragments set in a fine matrix.
Andesitic: An intermediate igneous rock.
Basalt: A very fine grained igneous rock derived from volcanic upwelling.
Baseflow: the component of river flow as mean annual flow in millimeters
Basic: In larv and rocks, dark, dense material containing 50% or less of silica.
Delineation (of a wetland): to determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators (see definition of a wetland).
Diabase: a dark, grey-green, fine-grained gabbro with a characteristics texture, in which the interstices of tabular plagioclase crystals are filed by augite.
Dolomite: The mineral $CaMg(CO_3)_2$; also the rock that consists mainly of this mineral.
Dyke: a vertical or semi-vertical wall-like igneous intrusion which cuts across the bedding planes of a rock.
Endorheic: closed drainage e.g. a pan.
Feldspar: A white or pink crystalline mineral, largely formed of alumino-silicates of barium, calcium, potassium and sodium. Feldspars are abundant in metamorphic rocks.
Ferricrete: a very hard soil horizon made up of cementation of iron oxides at or near the land surface.
Floodplain: wetland inundated when a river overtops its banks during flood events resulting in the wetland soils being saturated for extended periods of time.
Gabbro: a group of dark-coloured, course-grained basic intrustive igneous rocks composed principally of calcium-rich basic plagioclase and pyroxene. Gabbro is formed through the crystalisation of basaltic magma, usually as large igneous intrusions deep within the earth's crust.
Gneiss: A highly metamorphosed rock of a granular texture and with a banded appearance.
Granite: A course-grained igneous rock that consists largel;y of quartz, alkali feldspar, and plagioclase feldspar.
Groundwater: subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated under pressure equal to or greater than atmospheric.
Hydrology: the study of water, particularly the factors affecting its movement on land.
Karst: A type of topography that is formed over limestone, dolomite or gypsum by dissolution and which is dominated by underground streams, caves and hollows.
Komatiites: An ultramafic volcanic rock with >18% MgO composed of olivine and pyroxene in a glassy groundmass. Characteristic of archaean terrains.
Lithology: the character of a rock; its composition, structure, texture and hardness.
Mafic: Pertaining to or composed predominantly of magnesium rock-forming silicates. In general, synonymous with "dark minerals".
Migmatite: A metamorphic rock injected with igneous material.
Palustrine (wetland): non-tidal wetlands dominated by persistent emergent plants (e.g. reeds) emergent mosses or lichens, or shrubs or trees.
Perched water table: the upper limit of a zone of saturation in soil, separated by a relatively impermeable unsaturated zone from the main body of groundwater.
Periodotite: An ultamafic rock with 40-90% olivine and pyroxene.
Permanently wet soil: soil, which is flooded or waterlogged to the soil surface throughout the year, in most years.
Pluton: A mass of igneous rock which has solidified underground. Plutons vary in size from batholiths, sills and dykes.
Porphytic: A textual term for those igneous rocks in which larger crystals are set in a finer

groundmass.
Quartzite: A rock comprised essentially of quartz.
Rhyolite: The extrusive equivalent of granite with quartz and alkali feldspar in a glassy groundmass.
Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas, which are saturated or flooded for prolonged periods, would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).
Runoff: total water yield from a catchment including surface and subsurface flow.
Schist: A strongly foliated crystalline rock formed by dynamic metamorphism whuich can be readily spilt into thin flakes or slabs due to well-developed parallelism of more than 50% of the minerals present.
Seasonally wet soil: soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season, but is predominantly dry during the dry season.
Sedges: Grass-like plants belonging to the family Cyperaceae sometimes referred to as nutgrasses. Papyrus is a member of this family.
Sill: An intrusion of igneous rock which spreads along bedding planes in a nearly horizontal layer.
Syenite: A group of plutonic igneous rocks consisting principally of alkali feldspar, usually with one or more mafic minerals such as hornblende or biotite.
Tuff: Volcanic sediment.
Ultramafic: A rock comprising >90% ferromagnesian minerals.
Vadose Zone: unsaturated zone – zone of oxidation between the surface and the groundwater interface.
Value (soil colour): the relative lightness or intensity of colour.
Vlei: a colloquial South African term for wetland.
Water regime: when and for how long the soil is flooded or saturated.
Wetland catchment: the area up-slope of the wetland from which water flows into the wetland and including the wetland itself.
Wetland delineation: the determination and marking of the boundary of a wetland on a map.
Wetland: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

1. BRIEF

The brief for the wetland scoping study was as follows:

- To review any existing information that may be of use with respect to identifying the extent of and types of wetlands in the Letaba Catchment;
- Determine the functions and benefits of the wetlands;
- Identify the main constraints with respect to undertaking a wetland Reserve for the catchment;
- To define data needs for the wetland Reserve including:
  - ii) consideration of the possible use of the new National Land Cover dataset (NLC2000) for assisting with identifying possible systems for consideration for Reserve Determinations; and
  - iii) consideration of alternative approaches for assisting with identifying wetlands in the catchment for Reserve Determinations.
- Consider some of the new developments pertaining to our understanding of wetlands that may be relevant to undertaking a wetland Reserve for the catchment; and
- To produce a short report on the findings including recommendations for the way forward with respect to the wetland Reserve;

2. APPROACH

Given the limited time allocated in the budget to this task, this report was only intended to provide a very broad overview of the situation with respect to wetlands in the Letaba River catchment. Apart from a brief site visit to Soutini during IFR site selection in 2003, no other field verification or assessment was possible. Most of the investigation was therefore desktop. In addition to a review of existing information, the first step in the investigation was to try to establish the extent and distribution of wetlands in the catchment.

2.1 AVAILABLE INFORMATION AND SOURCES

Information from the following sources was used to assist with the investigation:

- Mr. Mick Angliss (Limpopo Province Department of Agriculture Land and Environment) provided copies of the field data sheets and other information on the Soutini wetland and general literature on other thermal springs;
- Mr. Piet-Louis Grundling from Working for Wetlands (WfWetlands) was contacted regarding their experience with wetlands in the catchment;
- Dr. Wynand Vlok from the University of the North was contacted regarding his experience with wetlands in the catchment;
- Extracted data from the NLC 2000 dataset for the Letaba River catchment; and
- 1:50 000 topographic sheets of the the catchment.

The information provided by Mr. Mick Angliss was very useful with respect to the location and description of the thermal springs in the catchment. WFWetlands unfortunately had no data on the wetlands of the catchment and their opinion was that very little information is available in this regard.

This investigation therefore represents the first attempt to identify the types and potential location of wetlands in the Letaba catchment. These steps were followed:

- indication of the occurrence of wetlands in the catchment, all areas marked as wetlands on the digital 1:50 000 topographic maps were captured using heads-up digitising in ArcView 3.2.
- all low gradient (gradual slope) areas in the high rainfall areas of the upper catchment where wetlands were most likely to occur and where drainage was indicated as diffuse were identified. These were marked as dots on the 1:50 000 digital coverage.
- all areas identified as potential wetlands on the NLC 2000 dataset extract of the catchment (raw data for the catchment supplied compliments of the CSIR) were captured in ArcView. Together this provided an indication of the potential wetland sites in the catchment. As no field verification was undertaken, the mapping can at best be considered provisional.

2.2 CLASSIFYING THE WETLANDS

Given the course nature of this assessment, the lack of data, and the limitations with respect to ground truthing, it was not considered relevant to undertake a Hydro-geomatic classification of the wetlands at this stage. Instead, those that could be coarsely mapped as complex units were mapped, thus serving simply as an indication of the areas in the catchment where wetlands are likely to occur. In order to get some idea of the likely functionality of the types of wetlands found in the catchment, a generic functional assessment using the scoring system in Wetland-Assess (Kotze, Marneweck, Batchelor, Lindley and Collins, 2004) was undertaken. This was done at a very course-level (per wetland type per Hydrogeological Region in the catchment). This provided some indication of the likely ecosystem services that the various wetland types in the different Hydrogeological Regions are performing.

2.3 CURRENT STATUS OF WETLAND

In order to establish at least a general baseline for the current status of the wetlands, and to get a first level estimate of their relative ecological importance, a generic wetland Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS) analysis was conducted (modified from Department of Water Affairs and Forestry, 1999). While it was not possible to score the different criteria for the PES as there are no field data available for the catchment, due consideration of the criteria was given in making the value judgements about the PES. These criteria considered included those provided in the procedure for determination of Resource Directed Measures for wetland ecosystems (Department of Water Affairs and Forestry, 1999). The assessment was applied generally to the different wetland types in each Hydrogeological Region in the catchment. Land use was used to establish a first level indication of the general PES of the wetlands. Experience gained from work in other catchments was also used in coming up with the PES. An evaluation of the impacts on groundwater in the catchment (Haupt & Sami, 2004) was used to supplement the findings relating to the general impacts on the wetlands. General assumptions based on the biogeographics of the wetlands in the catchment were used to establish a first level indication of the EIS.

2.4 REQUIREMENTS FOR WETLAND RESERVE DETERMINATION IN THE LETABA CATCHMENT

In addition to the above and given the current level of understanding and data currently available, a general comment was also provided relating to determining a Wetland Reserve in the catchment. Gaps were identified with respect to what is still needed to be done before a wetland reserve can be undertaken.

3. FINDINGS

3.1 WETLAND TYPES AND DISTRIBUTION IN THE LETABA RIVER CATCHMENT

Based on the NLC 2000 coverage, as well as the topographic analysis undertaken, there appears to be a fairly high concentration of relatively large wetlands between the Letsitele and Thabina Rivers in the south west of the catchment and in the area east and west of the Groot Letaba River immediately downstream of this (Figures 2 and 3). These appear to stretch as far as the Nsami River confluence with the Groot Letaba River. Wetlands extend form the Sour Lowveld Bushveld through a section of Mixed Lowveld Bushveld into the Mopane Bushveld. Most of the identified systems therefore occur along the Drakensberg foothills and valley and the Pieterberg plateau and lowveld hydrogeological regions of the catchment.

Topographically, the systems appear to comprise mostly valley bottom wetlands which are linked to water courses. These appear to include floodplain sections of the Thabina River in particular. Reference has been made to the occurrence of a Thabina wetland and the 1:50 000 topographic sheets indicate the presence of a large wetland along the middle section of the Thabina River. The quaternary catchments in which these wetlands occur include predominantly B81D and B81 E although there are also some systems in B81C (Figure 3).

Besides this area, no other wetland systems were picked up from the NLC 2000 data source available. Based on the topographic analysis however, it is likely that wetlands occur in the upper section of the catchment on the plateaus where slopes are gentle and rainfall is higher. In particular, wetlands are expected to occur in sections of the North Eastern Montane Grassland in the headwaters of the watercourses where the landscape is gently undulating. Areas where these types of systems are likely to be found are marked as red dots on Figures 2 and 3. This includes quaternary catchments B81A, B82A and B82B.

These systems fall within the Drakensberg escarpment hydrogeological region and would be restricted predominantly to isolated systems in the upper reaches of the small tributaries of the main rivers. They are expected to comprise mostly hillslope seepage and narrow channeled valley bottom wetlands. Should these occur, they are likely to contribute to baseflows in the upper sections of the streams. Groundwater augmentation of baseflow from interflow and possibly even deeper aquifers might be expected. Valley bottom wetlands are also expected along the stream channels in these upper reaches. These are likely to be narrow and across much of the area, impacted by afforestation. Stratified ground truthing in combination with more detailed air photo analysis should be undertaken to establish the extent, types and distribution of these upper catchment systems, particularly the hillslope seepage systems associated with the grassland zone.

Probably the most culturally and geo-hydrologically interesting systems that occur in the catchment are the two thermal spring systems, one at Eiland (Hans Merensky Nature Reserve) and the other (Soutini-Baleni) close to the banks of the Klein Letaba River in its middle reaches (see Figure 2 for the location of the two thermal spring systems). The latter is particularly culturally significant and is thought to be one of the few remaining undeveloped hot springs in South Africa and is a traditional Tsonga salt manufacturing site. The current eye discharge is 3 $lsec^{-1}$ (Kent, 1996 in Angliss, 1998) and the water temperature is $42.8^{0}C$, classifying the spring as “Hot or Hypothermal”.

Many archaeological artifacts, some dating as far back as the stone age, and more recently, early iron age have been found at the site (Angliss, 1988, questionnaire data sheet, South African Natural Heritage Programme). The wetland falls under the authority of Chief N.L. Mahumani.

Views of the Soutini-Baleni wetland

Traditional salt works still take place below the wetland on the banks of the Klein Letaba River

3.2 GEOHYDROLOGY OF THE WETLANDS IN THE CATCHMENT

Apart from the thermal springs, almost all the other wetlands identified or expected to occur in the catchment are associated with either the Rooiwater complex, granite intrusions, the Goudplaats gneiss or quaternary deposits. As already mentioned, the main hydrogeological regions in which the wetlands occur include the Drakensberg excarpment, Drakensberg foothills and valley, and Pietersberg plateau and lowveld regions. The former area has a high rainfall exceeding 1000 mm/annum and the main aquifers are associated with fractured dyke contact zones and lithological contact zones (Department of Water Affairs and Forestry, 1990). Storage in these aquifers is very limited and on the steeper slopes (exceeding 15^0), recharge to these aquifers is rapidly discharged in the form of springs (Haupt & Sami, 2004). These provide baseflow to the rivers that may exceed 200 mm/annum. These springs are likely to be associated with seepage wetlands in the upper catchment, especially where slopes are locally less steep and the springs are more unconfined (groundwater discharge occurs over a front rather than at a point source). Most permanent and semi-permanently wet wetland systems in the catchment will be restricted to this region. Spring yields typically vary between 1 and 3 l/sec (Haupt & Sami, 2004). Quaternary catchment B81A, which occurs in the Drakensberg escarpment region and which is expected to support wetlands, generates approximately 39% of the baseflow in the Letaba catchment (Haupt & Sami, 2004). This quaternary catchment only makes up just over 1% of the entire Letaba catchment, yet contributes approximately 39% of the baseflow.

In the Drakensberg foothills and valley region, rainfall varies between 500-1000 mm/annum and the slopes are generally flat to moderate (less than 15^0). The aquifers are of a composite type, consisting of a fractured zone and overlying weathered zone aquifers (Department of Water Affairs and Forestry, 1990). Deep weathering occurs along the rivers and streams in this region and the dyke contact zones are highly fractured (Haupt & Sami, 2004). Within this region, the granite aquifers are a good groundwater resource (Haupt & Sami, 2004), but are vulnerable to changes in rainfall patterns and impacts in terms of groundwater quality. During times of drought, the aquifers may dry up. The wetlands in this region are therefore mostly seasonally to temporarily wet and are expected to dry up during winter months or drought years. These systems may also contribute to baseflow in the rivers and streams, particularly in quaternary catchment B81D where baseflow contribution is high (approximately 13% of the total Letaba catchment according to the Haupt & Sami report, 2004). This quaternary only makes up just over 3.5% of the Letaba catchment yet contributes approximately 13% of the baseflow. Losses from evapotranspiration in large wetland systems like that along the Thabina River may reduce the baseflow contribution from this quaternary during summer months. These losses may be far less during winter months. Winter baseflow contribution is likely to be key for maintaining the aquatic ecosystems during the dry months.

In the Pietersburg plateau and lowveld hydrogeological region, which covers over 50% of the catchment, rainfall varies from 500-600 mm/annum. Here groundwater levels are generally below stream level, thereby reducing the opportunity for flow augmentation in the rivers (Haupt & Sami, 2004). The wetlands in this region are therefore mostly temporarily wet and are expected to dry up during winter months or drought years. These systems are likely to be important for flood attenuation where they occur in the valley bottoms since they are large and have the capacity to absorb large volumes of water, have gentle slopes, and are likely to be well vegetated. Being vegetated and given their location in the hot lowveld zone where evaporation far exceeds rainfall, evapotranspiration losses from these systems are expected to be high.

Primary aquifers consisting of saturated alluvium are often present along the major river systems and are composed of unconsolidated clayey silts to course gravel and boulders. These aquifers extend along the major rivers and can be up to 500 m wide and 10 m thick (Haupt & Sami, 2004). These aquifers are recharged during periods of high streamflow and discharge to the river once the stream stage drops. These are considered important aquifers (Haupt & Sami, 2004) especially with regard to their role in maintaining the ecosystems along the rivers. While these aquifers support mainly the river-related ecosystems, they may also serve to support some of the larger riparian wetlands such as those along the Thabina River and those in the Pietersburg plateau and Lowveld region.

3.3 LIKELY ECOSYSTEM SERVICES PROVIDED BY THE WETLANDS IN THE DIFFERENT HYDROGEOLOGICAL REGIONS IN THE CATCHMENT

3.3.1 Drakensberg escarpment region

An indication of the likely ecosystem services provided by the valley bottom and hillslope seepage wetlands in the Drakensberg escarpment region is given in Figure 1. Given the discussions above, these wetlands are likely to be very important for streamflow augmentation and because they occur in the north eastern montane grassland vegetation type, they are likely to be important for the maintenance of biodiversity in this region of the catchment.

3.3.2 Drakensberg foothills and valley region

Given the importance of quaternary catchment B81D for baseflow augmentation, and as discussed above, the wetlands in this region are likely to be important for streamflow augmentation during the winter months in particular when evapotranspitration from the systems is lowest. The wetlands are also likely to support local biodiversity enhancement and play a role in flood attenuation. The deep alluvial aquifers along the valley bottom wetlands may result in the prolonged storage of water in this section of the catchment, particularly throughout the drier winter months. An indication of the likely ecosystem services provided by the wetlands in this region is given in Figure 1.

3.3.3 Pietersburg plateau and Lowveld region

Given the large size and location of these systems along the low gradient valley bottoms, these systems are likely to be important for flood attenuation. Since their wetting regime is variable and since they may be dry for extended periods, these systems are expected to have the capacity to absorb large volumes of water following the first summer rains, thereby enhancing flood attenuation in the catchment. The systems are also well vegetated thereby promoting diffuse flow when flooded and encouraging sediment deposition and associated phosphate removal. However, given their location in the hot lowveld zone where evaporation far exceeds rainfall, evapotranspiration losses from these systems is expected to be high. Based on this plus the discussions above, these systems are therefore unlikely to contribute to baseflow augmentation in the catchment. An indication of the likely ecosystem services provided by these systems is given in Figure 1.

The thermal spring wetlands also occur in the Pietersburg plateau and Lowveld hydrogeological region. An indication of the likely ecosystem services provided by these is also given in Figure 1. These wetlands in particular have cultural significance and provide valuable resources to the local communities who utilize them. They also provide biodiversity support.

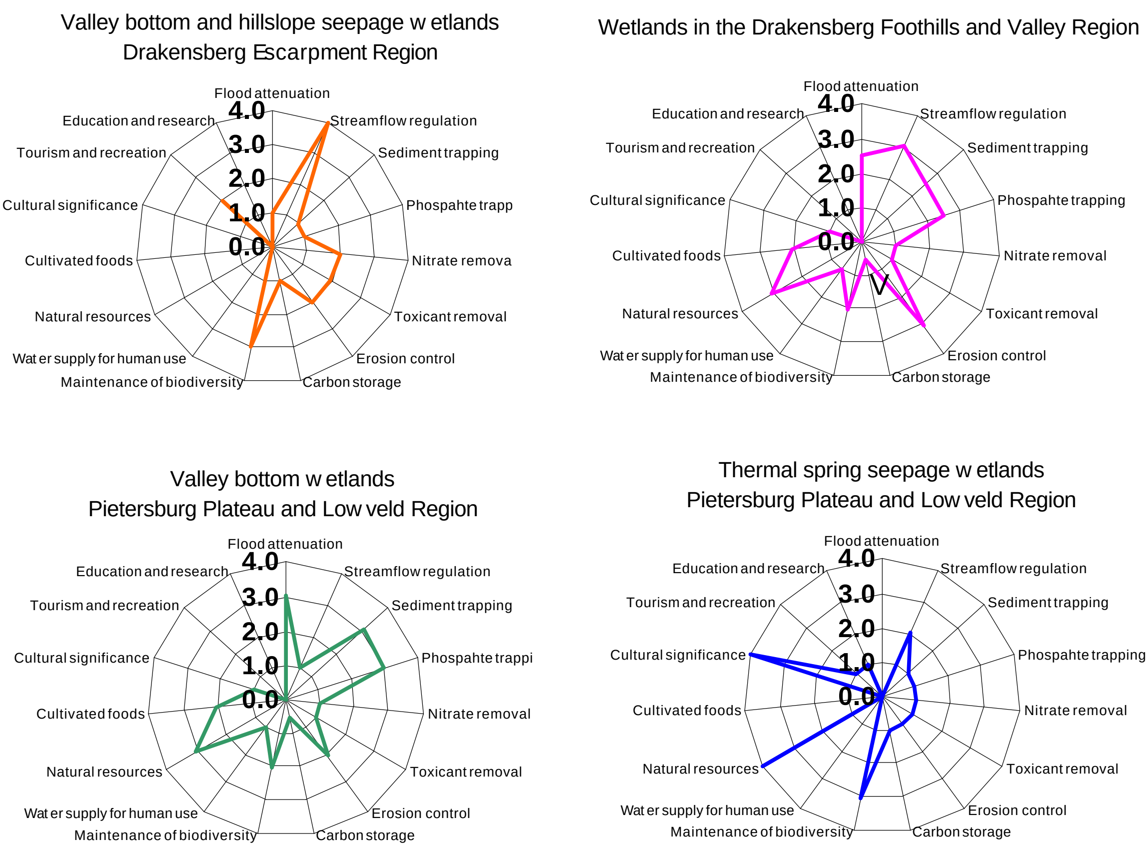

Figure 1: An indication of the likely ecosystem services provided by the different wetland types in the Letaba catchment according to the hydrogeological region in which they occur. The scoring system used is taken from the Wetland Assess level 2 assessment (Kotze, Marneweck, Batchelor, Lindley and Collins, 2004).

3.4 REFERENCE CONDITIONS OF THE WETLANDS

Since baseline data are not available for the wetlands in the catchment, it was not possible to comment on reference conditions for the wetlands. There is thus a need for further work in this regard, particularly with respect to collecting baseline information on representative examples of the various HGM wetland types in the catchment.

3.5 PRESENT ECOLOGICAL STATE AND ECOLOGICAL IMPORTANCE AND SENSITIVITY OF THE WETLANDS

Interpretation of the information currently available for the catchment suggests that the wetlands in the Drakensberg escarpment and Drakensberg foothills and valley regions are likely to have been more impacted upon than those in the other two hydrogeological regions. Afforestation, alien plant invasion and irrigation are likely to be the main impacts in the Drakensberg escarpment and Drakensberg foothills and valley region, while cultivation and overgrazing are likely to be the main impacts in the Pietersburg plateau and Lowveld region. Clearly there are likely to be exceptions to these general assumptions. Some of the thermal springs for example, have been severely modified for recreational purposes.

The high lying springs, perched aquifers and associated wetlands in the Drakensberg escarpment region are however expected to be most vulnerable, particularly considering the impacts related to afforestation and alien plant invasion. These systems are likely to be small, easily drained, have steep slopes, are susceptible to erosion and water quality changes, and are often overlooked in land-use planning. In contrast, the large valley bottom systems in the Pietersburg plateau and Lowveld region are expected to be more robust in terms of absorbing impacts related to water quality changes and flow reduction. Encroachment into these systems is also limited by flooding and the shallow gradients of these systems probably make them less susceptible to erosion than the systems in the top of the catchment. However once erosion is initiated in the larger valley bottom systems in the lower regions, the process may be difficult to counteract given the unconsolidated nature of the sediments making up these systems, and the size of the systems. Clearly further work is required to establish a baseline on the wetlands in the different regions and to determine the PES of some of the systems and to get an idea on the trajectory of change with respect to the wetlands in the different regions.

Interpretation of the information currently available for determining the EIS suggests that the wetlands in the Drakensberg escarpment region and the thermal springs in the Pietersburg plateau and Lowveld region are likely to have the highest EIS. The likely occurrence of Red Data listed species, populations of unique species, and sensitivities to water quality changes and changes in the natural hydrological regime would probably be the main attributes that account for this. A first level and very general relative ecological importance and sensitivity analysis of the wetlands tends to confirm this (Table 1).

Both the systems in the Drakensberg escarpment region and the thermal springs in the Pietersburg plateau and Lowveld region were rated as High (systems considered to be ecologically important and sensitive and which play a role in moderating the quantity and quality of water of major rivers). The latter aspect (moderating the quantity and quality of water of major rivers) only really applies to the wetlands in the escarpment region in this case. Despite the systems in the Drakensberg foothills and valley region also being considered important for moderating the quantity and quality of water in the catchment, they scored lower in terms of the EIS evaluation Moderate – systems considered to be ecologically important and sensitive on a provincial or local scale where the biodiversity is less sensitive to flow related changes and where the system plays less of a role in moderating the quantity and quality of water to major rivers. The lower score was mainly a result of a lack of Red Data listed species and populations of unique species. These systems did however score higher on some attributes such as providing migration, breeding and feeding sites for wetland species (Table 1).

Table 1: First level relative ecological importance and sensitivity results for the wetlands according to hydrogeological region in the Letaba catchment. The criteria and scoring is based on that in the procedure for determination of Resource Directed Measures for wetland ecosystems (Department of Water Affairs and Forestry, 1999).

	HYDROGEOLOGICAL REGIONS			
CRITERIA	**DRAKENSBERG ESCARPMENT**	**DRAKENSBERG FOOTHILLS AND VALLEY**	**PIETERSBURG PLATEAU AND LOWVELD**	
1. Rare and endangered species	3	1	0	1
2. Populations of unique species	2	1	0	3
3. Species / taxon richness	3	3	2	3
4. Diversity of habitat types or features	3	3	3	3
5. Migration/breeding and feeding site for wetland species	2	3	3	2
6. Sensitivity to changes in natural hydrological regime	4	2	2	4
7. Sensitivity to water quality changes	4	1	1	2
8. Flood storage, energy dissipation and particulate/element removal	1	2	2	0
MODIFYING DETERMINANTS				
9. Protected status	0	0	0	0
10. Ecological integrity	2	2	3	4
TOTAL	24	18	16	22
MEDIAN	3	2	2	3
EIS Evaluation	**High**	**Moderate**	**Moderate**	**High**

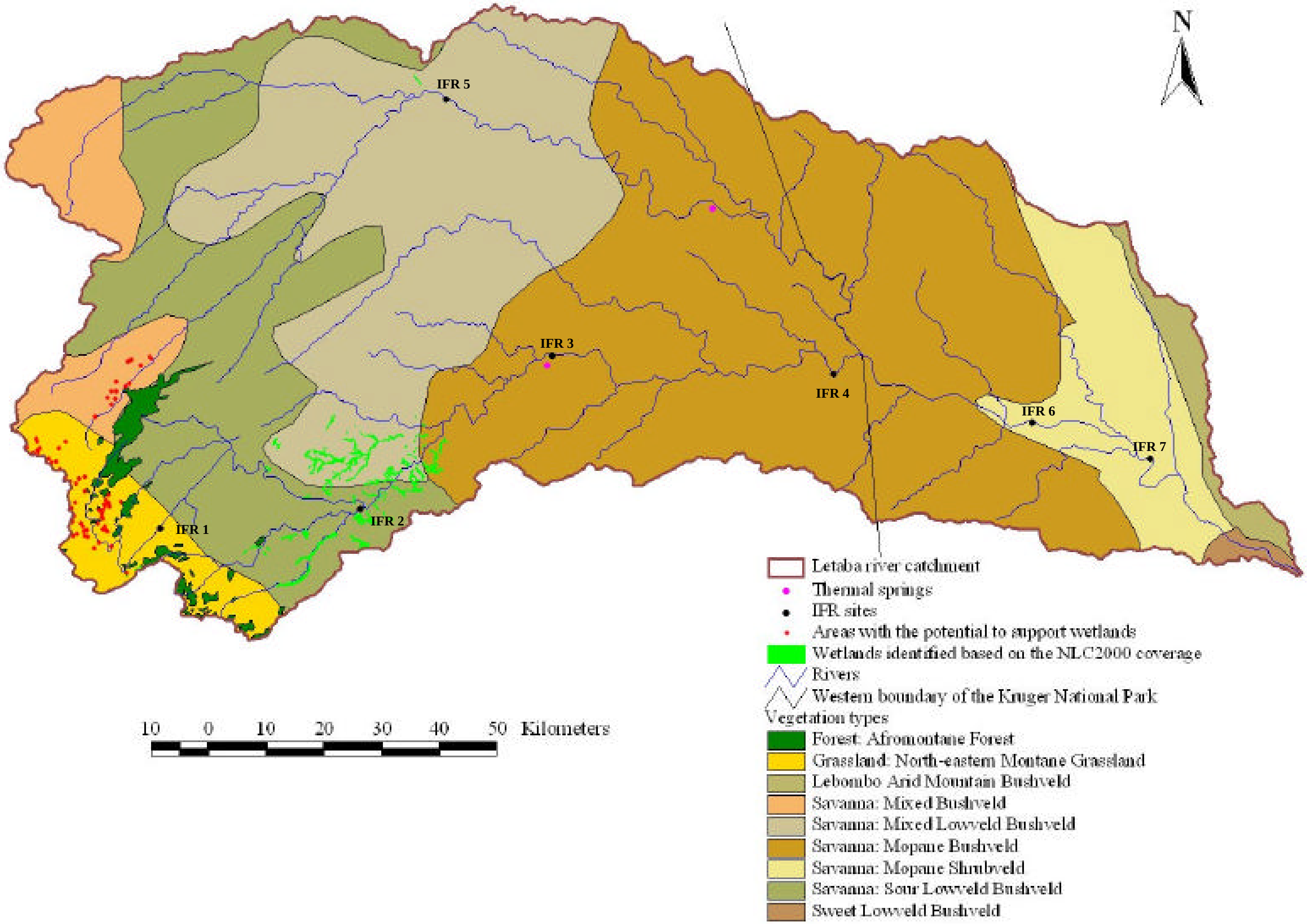

Figure 2: Potential wetland distribution within the Letaba River catchment in relation to vegetation type.

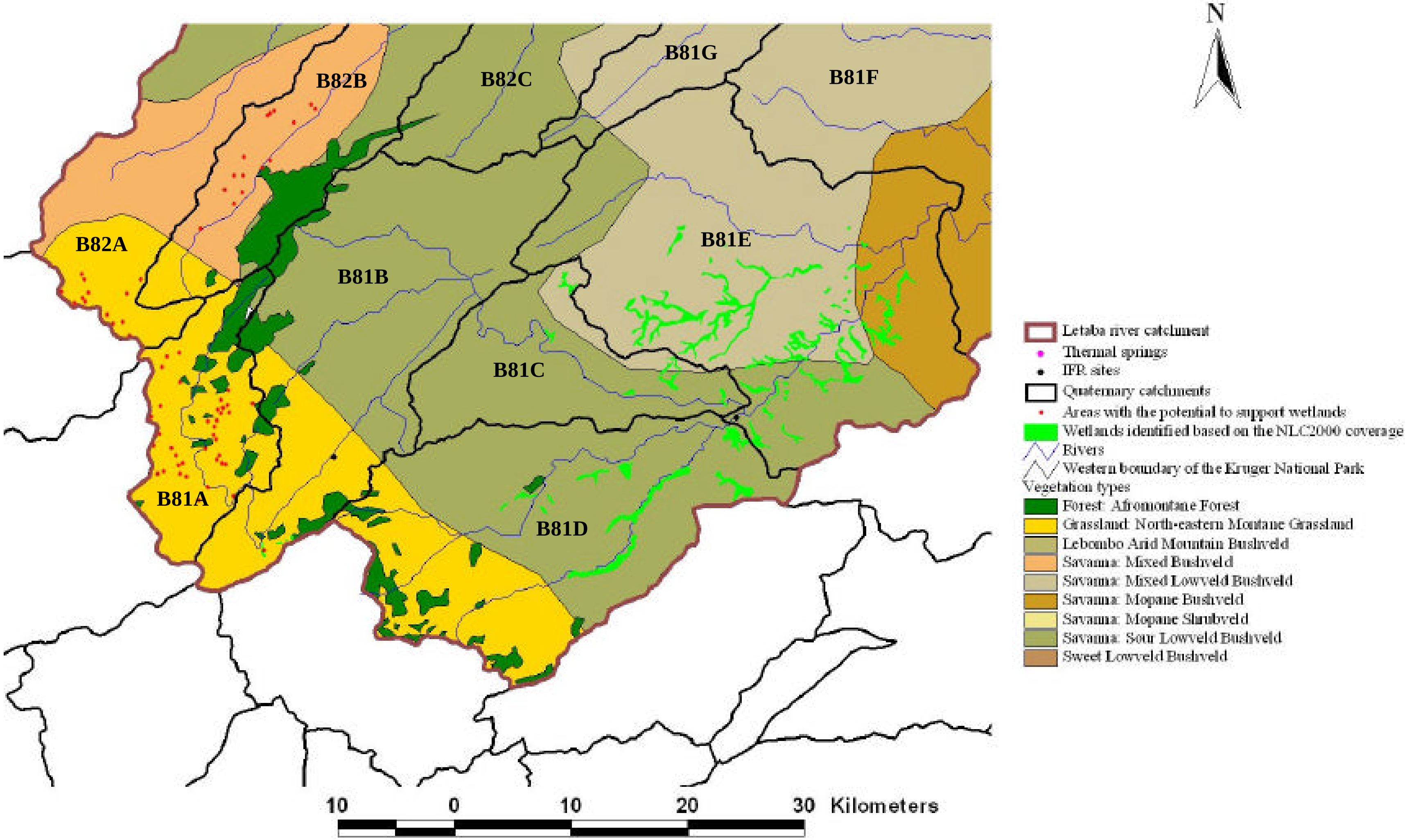

Figure 3: Potential wetland distribution in the upper catchment of the Letaba River in relation to vegetation type and quaternary catchments.

4. RECOMMENDATIONS RELATING TO DETERMINING A WETLAND RESERVE FOR THE CATCHMENT

4.1 MAIN CONSTRAINTS WITH RESPECT TO UNDERTAKING A WETLAND RESERVE IN THE CATCHMENT

A fundamental constraint to undertaking a wetland reserve study is the lack of an inventory of wetlands in the Letaba catchment and in particular in the main quaternaries where wetlands have been identified (or are expected to occur, (B81A, B81C, B81D, B81E, B82A and B82B). This together with a lack of baseline data on any of the wetlands (besides the thermal springs) in the catchment, makes it very difficult to identify priority wetland sites for undertaking Reserves. Another constraint has to do with the existing inadequacies with respect to the wetland Reserve determination method, particularly the inability of the current method to deal with groundwater-surface water interactions and the role of interflow and perched groundwater in these systems.

4.2 CANDIDATE SITES FOR RESERVE DETERMINATION AND LEVEL OF STUDY

Given the existing inadequacies with respect to the wetland Reserve determination method, particularly the inability of the current method to deal with groundwater-surface water interactions and the role of interflow and perched groundwater in these systems, it is recommended that the valley bottom systems in the Pietersburg plateau and Lowveld hydrogeological region are targeted for reserve studies at this stage. In addition, the existing method is more applicable to riparian wetlands than other types such as hillslope seepage systems, thus rendering the valley bottom wetlands in the lower part of the catchment more suitable candidates for reserve determination. From purely a practical point of view, at this stage it is therefore sensible to focus only on the riparian type wetlands along the valley bottoms in quaternary catchment B81E. These are candidate sites for determining an Ecological Reserve following an Intermediate approach.

The Thabina wetland in quaternary B81D is certainly a candidate site for determining an Ecological Reserve following a Comprehensive approach given that it occurs in an area where the aquifer is vulnerable to drought and where impacts on the aquifer are high. However, given the possible groundwater component of this system, this would require further refinement of the existing methods. While the system does not fulfill some of the existing criteria for following a comprehensive approach such as it is not a Ramsar wetland or a wetland with potential Ramsar status, it does not have national or provincial protected status, and it does not support endangered species, it does fulfill others such as it is large and has complicated hydraulics (DWA&F, 1999), and it occurs in an area with considerable pressure on the groundwater aquifer which could cause irreversible damage to the wetland in the long term.

The wetlands in quaternary catchment B81A are candidate sites for determining an Ecological Reserve following a rapid approach because of the influence of afforestation, irrigation or other development on both baseflows and the biodiversity services of these systems. This must include developing Resource Quality Objectives (RQOs) for these systems. However, before this can be done, these systems need to be identified and mapped and so it is recommended that an inventory of wetlands is done in this quaternary catchment and that the wetlands are classified according to the method proposed by Kotze, Marneweck, Batchelor, Lindley and Collins (2004).

4.3 WAY FORWARD

There is very limited information relating to an inventory and baseline data on the wetlands in the Letaba catchment, particularly in the main quaternaries where wetlands have been identified or are expected to occur (B81A, B81C, B81D, B81E, B82A and B82B). It is therefore recommended that an inventory of wetlands is done in these quaternary catchments. This should include verification of the existence of the systems between the Letsitele and Thabina Rivers in the south west of the catchment and in the area east and west of the Groot Letaba River immediately downstream of this. Similarly, the upper catchment (quaternary B81A in particular) should be visited to check whether or not the areas indicated as likely to support wetlands actually have wetlands. Here the intention should not necessarily be to map all the wetlands, but rather to undertake a detailed enough level of assessment to identify the priority wetlands that are part of key wetland complexes in the upper catchment.

The approach to the inventory of the wetlands should include field verification (see Kotze and Marneweck, 1999) and sampling, plus a more detailed air photo analysis using stereo pairs and classification and finer resolution mapping in accordance with Kotze *et al*. (2004) and Thompson e*t al.* (2002). Once an inventory is available for these quaternary catchments and once the systems have been classified, the wetlands could be prioritised based on functionality in accordance with Kotze *et al*. (2004) in order to provide a screening of further candidate sites for Reserve Determination. Baseline data should be collected on a stratified sample of the wetlands to inform the prioritization. This type of information is also essential for determining a "reference state" for the various HGM wetland types in these quaternary catchments. Without a basic understanding of these systems, their key drivers, and their dynamics, it will not be possible to define "reference states" or trajectories of change for these systems.

It is also recommended that should an inventory of the wetlands be undertaken, the wetlands be classified according to the method proposed by Kotze, Marneweck, Batchelor, Lindley and Collins (2004). This Hydro-geomorphic (HGM) based classification for Palustrine wetlands as included in WETLAND ASSESS provides a useful framework for assessing complex wetland systems that may include several types within one wetland complex. Using this method one is able to determine a reference state, PES and EIS for each type within the complex. The classification as defined in WETLAND ASSESS also inherently incorporates the following aspects that are a requirement of establishing a Reference state or condition:

- Geomorphology: Terrain unit, landform, substrate type and sediment dynamics;
- Hydrology: Water source, hydrodynamics and periodicity of wetting; and
- Water chemistry: TDS, nutrients, toxic constituents.

In the longer term it is also recommended that further baseline studies are undertaken on a stratified sample of all the different HGM wetland types in the different hydrogeological regions in the catchment in order to support the any Reserve studies that may be required or may be undertaken in the future. Any advances made with respect to wetland reserves undertaken in the catchment should be used to further develop the current methods. Any new attributes, criteria, models or approaches used should be documented and incorporated as an update of the existing method so that they can be used in future Reserve Determinations. This will allow the methods to develop in parallel with current understanding and science in the short term thereby supporting the incremental development of the methods.

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