Water Quality at Selected Sites in the Konashen COCA, Southern Guyana

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Chapter 4

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INTRODUCTION

Water is an essential natural resource and its quality and quantity generally guide management plans for its use. Water quality data indicates the existing health of a water body and highlights any current or potential threats to the water body. The data collected from the rapid assessment (RAP) can be used as a baseline for a water quality monitoring program for the 2500 square mile Konashen area, which supports a population of approximately 200 people, and diverse plant and animal life. Water quality is also an appropriate indicator for RAP surveys because it provides information on conditions required for some taxonomic groups studied by other researchers. Water quality plays a major role in human health, and an important aspect of this assessment was to test water quality in areas that the local Wai-Wai community regularly depends on. These include potable water in Masakenari village and water in two main fishing grounds, Wanyakoko and Kanaperu. As owners and managers of the areas, the well-being of the local community is critical to the long-term sustainability of the area. This assessment did not include water resources measurements which are just as important as water quality data for the development of a water management and monitoring program for the area.

STUDY SITES

The five main sites sampled in the Konashen district were Sipu (SR), Acarai (AM), Kamoa (KR), Essequibo (ER), and Masakenari (MA). The complete list of sampling sites is included in Table 4.1 and a few are shown in Figure 4.1.

Sipu: The Sipu site was located on the Sipu River which is a tributary of the Essequibo River. There were no human or industrial sources of pollution evident at this site and dead trees were scattered throughout the river.

Acarai: The Acarai site was located below the Acarai Mountains adjacent to a creek that empties into the Sipu River. This creek was underlain with sand and rock and showed no human or industrial signs of pollution. Oral recollection from the Wai-Wai community signaled the presence of an illegal small-scale gold mining operation in the area around 1990. The two small creeks and a small stagnant pond sampled around the area were well shaded, covered with leaves, and less than a meter deep at the time.

Kamoa: The Kamoa site was located next to the Kamoa River, a tributary of the Essequibo River which was downstream of, and larger than the Sipu River. There were no human or industrial sources of pollution evident at this site and dead trees were scattered throughout the river.

Essequibo: The major river running through the Konashen District is the Essequibo which empties into the Atlantic Ocean. Sampling was conducted between the mouth of the Sipu River and the Kanaperu fishing ground. The village moved from Akuthopono in 2000 following a massive flood.

Table 4.1. Water quality sampling sites.

Site	Elev. (m)	Latitude hddd.ddddd°	Longitude hddd.ddddd°	Description
Sipu River				
GR-SR-01	249.6	01.25.595	- 058.57.044	
GR-SR-02	249.6	01.25.558	- 058.56.958	
GR-SR-03	236.2	01.42.293	- 058.95.154	
GR-SR-04	257.6	01.42.340	- 058.95.202	Black water creek off of Sipu River
GR-SR-05	237.7	01.38.990	- 058.94.486	Black water creek between Acarai and Sipu
GR-SR-06	257.9	01.43.072	- 058.92.941	Intersection of Acarai creek and Sipu River
Acarai Creek				
GR-AM-01	255.4	01.42.180	- 058.95.221	Small creek close to Acarai
GR-AM-02				Creek close to Acarai
GR-AM-03				Acarai creek at bridge between Sipu and Acarai
GR-AM-04	256.6	01.38.989	- 058.94.489	Acarai creek next to camp site
GR-AM-05	279.5	01.38.994	- 058.94.500	Isolated pool next to Acarai creek
Kamoa River				
GR-KR-01	224.6	01.53.179	- 058.82.983	Upstream of Kamoa River site
GR-KR-02	207.3	01.53.189	- 058.82.967	Northern side of the Kamoa River
GR-KR-03				Upstream of Kamoa River site
GR-KR-04				Upstream of Kamoa River site
GR-KR-05				Kamoa River site
GR-KR-06	241.4	01.53.427	- 058.82.692	Creek off of the Kamoa River
GR-KR-07				Creek off of the Kamoa River
GR-KR-08				Creek off of the Kamoa River
GR-KR-09	249	01.53.135	- 058.82.226	
GR-KR-12	235	01.53.193	- 058.81.922	Creek off of the Kamoa River
GR-KR-12b	235	01.53.193	- 058.81.922	Creek off of the Kamoa River
GR-KR-13	227.4	01.52.729	- 058.73.961	
GR-KR-14	226.2	01.52.840	- 058.73.535	Intersection of Essequibo and Kamoa rivers
Essequibo				
GR-ER-01	221.9	01.65.857	- 058.62.648	Akuthopono landing
GR-ER-02				
GR-ER-03	213.4	01.64.913	- 058.62.228	Essequibo River between Masakenari and Akuthopono
GR-ER-04	217.9	01.64.537	- 058.61.705	Essequibo River
GR-ER-05	212.4	01.63.899	- 058.62.064	Essequibo River
GR-ER-06	224.9	01.63.596	- 058.62.860	Essequibo River
GR-ER-07	225.2	01.63.232	- 058.62.268	Essequibo River
GR-ER-08	222.8	01.62.764	- 058.63.016	Essequibo River
GR-ER-09	224.9	01.62.957	- 058.62.429	Western side of the bank
GR-ER-10	221.6	01.62.963	- 058.62.436	Middle of the river
GR-ER-11	237.7	01.62.976	- 058.62.447	Eastern side of the bank

Site	Elev. (m)	Latitude hddd.ddddd°	Longitude hddd.ddddd°	Description
GR-ER-12	212.4	01.64.733	- 058.61.826	Rapids between Masakenari and Akuthopono
GR-ER-13	236.2	01.70.889	- 058.62.016	Kanaperu fishing ground
GR-ER-14	230.1	01.70.889	- 058.62.016	Kanaperu fishing ground
GR-ER-15	228.3	01.68.172	- 058.62.938	Wanyakoko fishing ground, middle of pond
GR-ER-16	232.9	01.68.102	- 058.62.934	Wanyakoko fishing ground, side of pond
GR-ER-17	222.2	01.43.083	- 058.92.948	Intersection of Sipu River and Essequibo River
GR-ER-18	242	01.42.147	- 058.80.210	
GR-ER-19	230.7	01.48.091	- 058.78.892	Upstream of the Kamoa River
Masakenari				
GR-MA-01				Black water creek, upstream of bathing
GR-MA-02				Black water creek, downstream of bathing
GR-MA-03	256	01.62.896	- 058.63.527	Pipe 1
GR-MA-04				Pipe 2, next to school
GR-MA-05				Pipe 3
GR-MA-06				Pipe 4
GR-MA-07	242	01.63.167	- 058.63.471	Village well
GR-MA-08	236.2	01.65.148	- 058.63.627	Palm swamp between Akuthopono and Masakenari

Masakenari: The village has approximately 200 residents and the main supply of potable water comes from a 3.6 m deep well, located at the elevation of 242 m, somewhat below the village which starts at approximately 256 m. Well water is pumped by a solar powered pump to three plastic vats, where they are then piped to four pipes located throughout the village. The well is 1.5 m wide, and made of concrete with a loosely packed clay brick bottom. At the time of this assessment the water level was at 239 m (~ 1 m from the well bottom). The community uses latrines, most of which are located above the well. A creek runs through the community, and is used for bathing and washing. The creek was scattered with dead trees and the only sign of garbage was an empty paint can in the middle of a point approximately 50 m upstream of bathing. Masakenari was approximately 5.8 km upstream of Akuthopono, the site of the old village. In 2000 Akuthopono experienced massive flooding with water levels rising over 9 m from current levels, an estimation based on tree markings made by the Wai-Wai community.

METHODS

A HYDROLAB Quanta multi-sensing system was used to conduct water quality tests in the field (pH, conductivity (mS/cm), turbidity (NTU), and DO (mg/L)). The instrument was calibrated using pH 4 and 7 buffers, 0 and 20 NTU standards, and a 1.412 mS/cm conductivity standard. 100% DO_{sat} was calibrated using MQ water that had been equilibrated with the atmosphere. Measurements were taken as a function of depth (0, 0.8 m and the bottom) at various locations along the center of the Essequibo River, Sipu River, Acarai creek and Komoa River of Guyana. Sampling was also done in creeks and ponds around Sipu, Acarai, Kamoa, Akuthopono and Masakenari. In Masakenari, well water was sampled at the four village pipes and surface water was sampled upstream and downstream of a creek used for domestic purposes.

Water samples were taken from 1 cm below the surface. Alkalinity measurements were made within 24 hours by titrating 40 mls of samples with 0.02 N H_2SO_4 to pH 4.3 and a methyl orange end point. Water samples were also acidified with ultra pure nitric acid to give a 10% acid solution. Some samples were also filtered using a 0.2 µm PES filter (Nalgene) and acidified with nitric acid. All acidified samples were stored for elemental analysis. Samples for mercury analysis were collected from the fishing areas Waynakoko and Kanaperu. This was done in ultra pure HDPE containers that were doubly bagged in plastic zippered storage bags and by two people to reduce sample contamination.

Sediment samples were taken from the banks just below the water surface or in the case of shallow creeks, from the bottom. These were placed in plastic storage bags and stored in a freezer for further analysis. GPS measurements were taken using a Garmin Etrex with a reference point of Prov S Am '56.

Table 4.2. Summary of surface water quality results from large water bodies.

	Essequibo River	Sipu River	Acarai Creek	Kamoa River
pH	5.11 – 6.53	5.49 – 6.24	5.24 – 5.49	5.91 – 6.12
DO (mg/L)	4.26 – 8.25	6.45 – 7.43	7.50 – 8.25	5.88 – 6.91
Turbidity (NTU)	0 – 12.1	5.0 – 19.7	0 – 2.5	23.7 – 43
Alkalinity (mg/L $CaCO_3$)	12.5 – 13.5	10 – 12.5	–	7.5 – 18.75
Conductivity (mS/cm)	< 0.02	< 0.02	< 0.02	< 0.02

Table 4.3. Summary of surface water quality of selected small ponds and creeks.

	Palm Swamp bet Masakenari and Akuthopono (GR-MA-08)	Creek off of Sipu River (GR-SR-04)	Isolated pool adjacent to Acarai Creek (GR-AM-05)	Creek off of Kamoa River (GR-KR-08)
pH	4.81	5.9	4.83	4.89
DO (mg/L)	2.85	4.73	3.19	6.15
Turbidity (NTU)	23.7	19.4	27.1	7.3
Alkalinity (mg/L $CaCO_3$)	–	27.5	–	10
Conductivity (mS/cm)	0.016	0.03	0.012	0.011

Table 4.4. Summary of water quality results from Masakenari drinking water.

	Well (0 m depth)	Well (1 m depth)	Pipe 1	Pipe 2	Pipe 3	Pipe 4
pH	5.27	6.09	6.49	6.42	6.55	6.47
DO (mg/L)	3.22	2.57	5.63	5.06	4.89	5.32
Turbidity (NTU)	8.5	–	0.1	0	1.4	0.5
Conductivity (mS/cm)	0.043	0.043	0.049	0.046	0.055	0.047

RESULTS

The pH of sampled water ranged from 4.74 to 6.24, with the lower pH values obtained in isolated ponds and small creeks, and the higher pH readings seen in the rivers. Alkalinity values ranged from 7.5 to 27.5 mg/L $CaCO_3$. Dissolved oxygen levels ranged from 2.85 to 8.25 mg/L, and were generally lower in isolated ponds and small creeks than in the rivers. Conductivity was below 0.02 mS/cm for most of the waters sampled and was between 0.04 and 0.06 mS/cm in Masakenari village. Table 4.2 summarizes data obtained from the major creek and rivers assessed, and Table 4.3 summarizes data from a subset of the small creeks or isolated pools at various study sites.

Table 4.4 summarizes water quality data obtained in the main drinking water sources for Masakenari village. The pH of the water from the four village pipes was between 6.4 and 6.5, whilst that of 1 m of well water was between 5.3 and 6. Dissolved oxygen levels of the well were below 3.2 mg/L, and at the pipes ranged from 4.9 to 5.6 mg/L. Turbidity of the well and pipe water was below 10 NTU, and conductivity was between 0.04 and 0.06 mS/cm. USEPA/WHO standards for drinking water pH and turbidity are 6.5 – 8.5 and less than 5 NTU, respectively. No standards exist for conductivity, alkalinity or dissolved oxygen.

CONSERVATION RECOMMENDATIONS

Basic water quality data and observations show that the main rivers and creeks of Konashen are free of human or industrial pollution. The pH values of the majority of creeks, rivers and isolated pools are similar to those observed in the Amazon basin, but are lower than the drinking water standards of the WHO or USEPA. Those of the village wells are close to the minimum requirement of 6.5 pH units. Similarly, turbidity levels of some of the rivers were higher than the drinking water standards of 5 NTU. These untreated surface waters are used for drinking and cooking for transient camps. Even though conductivity and hence total dissolved solids concentrations are low, further sample analysis will provide information on the concentration of heavy metals which have extremely low drinking water standards.

The rivers and creeks are used for domestic purposes and only in Masakenari is drinking water obtained from a well. Well water should be monitored on a consistent basis as the well sits downstream of the village garbage holes and latrines, which are unlined. In Akuthopono, water is collected from the river, and garbage is dumped in a hole which was used by the village as a well until the year 2000. This activity could potentially affect the groundwater quality and plans should be made to provide clean drinking water at the site if it is to be developed as an income-generating ecotourism visitor center.

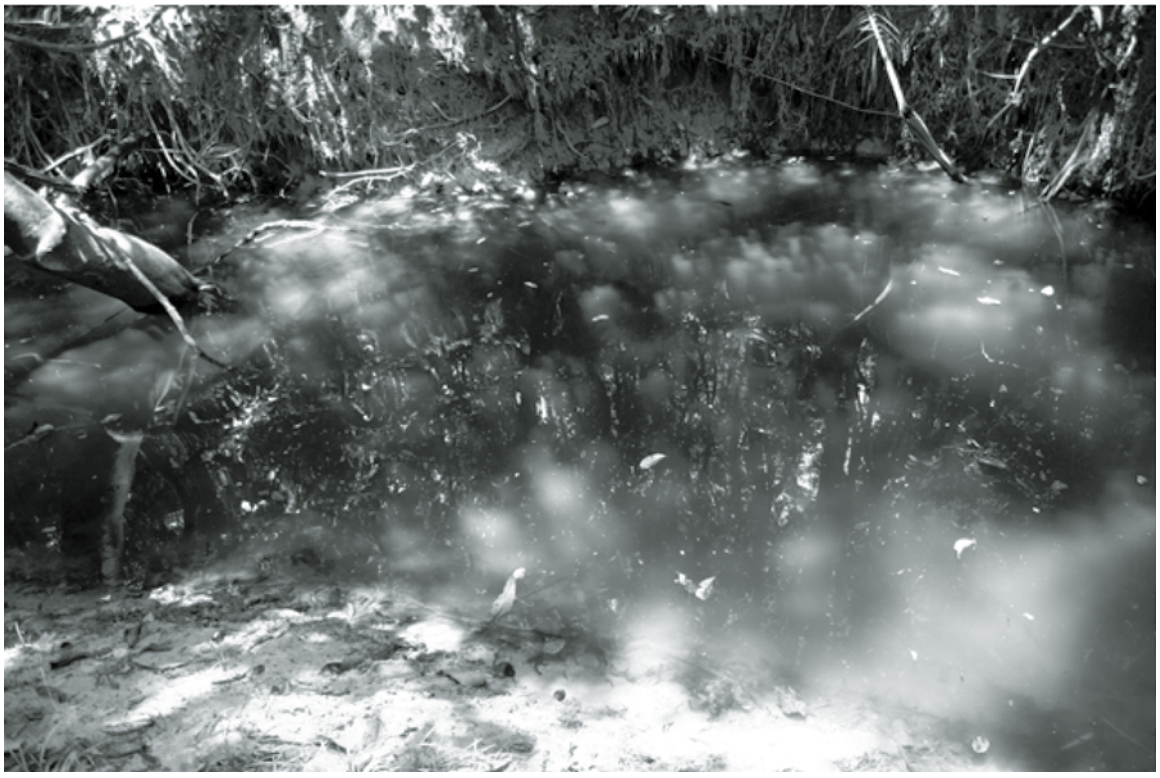
A water quality monitoring program should be established in the area to expand and continue the work begun during this rapid assessment. Such a program should be conducted on a quarterly basis at selected sampling sites along the Essequibo River (e.g. GR-KR-14, GR-ER-17, GR-ER-01, GR-ER-14, GR-ER-15), and in the village (GR-MA-01 – GR-MA-07). This quarterly monitoring should provide two samples each, during the dry and wet seasons.

Water quality monitoring should be extended to include microbial analysis in the more populated area. Sites used to collect aquatic species as well as any new sites identified by the Wai-Wai community should also be monitored for water quality on at least an annual basis.

Plans should be made to quantify the water resources in the area, especially since the area experiences high levels of rainfall and is inundated for large periods of the year. This information will also assist with safer plans for water and sanitation in Masakenari and Akuthopono.

Figure 4.1. Water quality sampling sites in the Konashen COCA

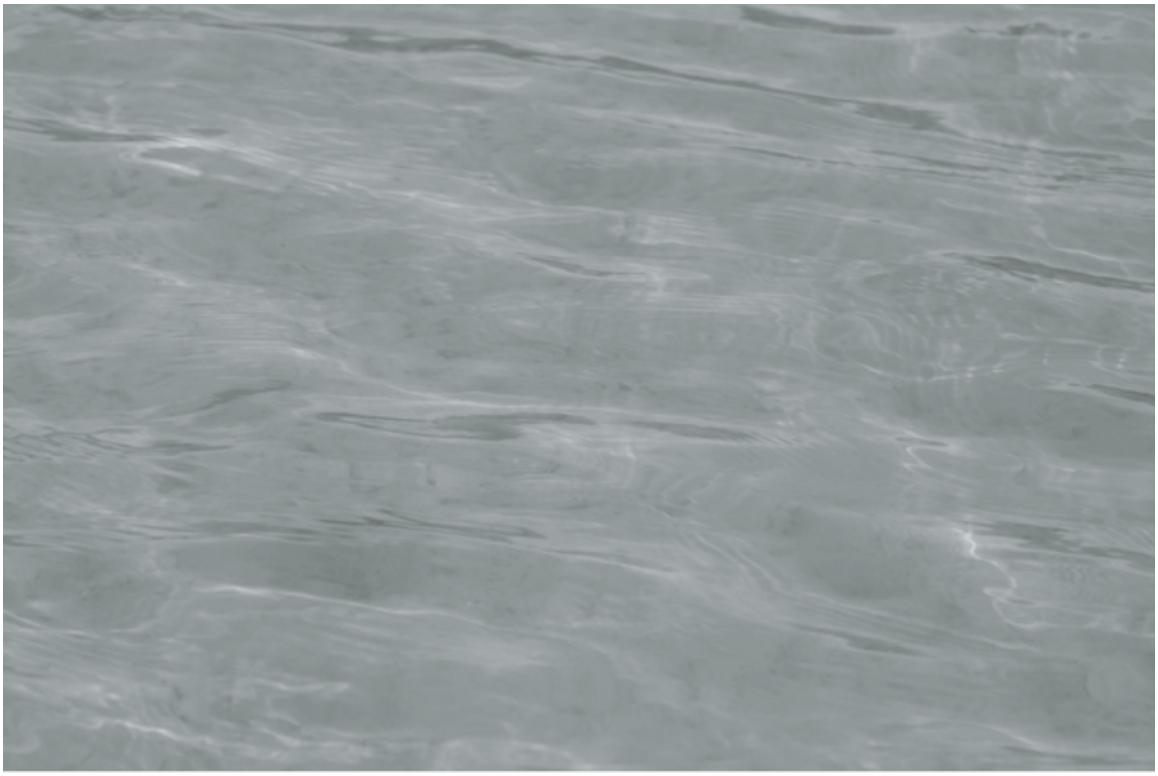
GR-MA-02: Downstream of bathing area at the creek in Masakenari



GR-SR-04: Creek off of the Sipu River

GR-AM-03: Acarai creek

GR-AM-04: Acarai creek



GR-ER-13: Kanaperu fishing ground

GR-ER-01: Akuthopono Landing