

Water Quality and Agricultural Environment Survey – Groundwater Quality and Hydrology Survey Report

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Groundwater Quality Survey Methods

According to recent survey results, there are four pumping wells on Taiping Island, namely, No. 5, No. 7, No. 9, and No. 10. They are the wells subjected to the groundwater quality assessment and hydrology survey carried out for this study. Samples of groundwater were collected twice from each well, with the first sampling conducted in the afternoon of January 22. At that time, since the groundwater had been in the wells for some time, the water temperature and chemical properties could have been affected by the ambient temperature and surroundings. Consequently, the groundwater in the four wells was siphoned up and stored in water towers at night to allow fresh groundwater to recharge the wells and facilitate the second round of sampling on the morning of January 23. Field analysis covered temperature, pH, conductivity (EC), dissolved oxygen (DO), redox potential (ORP), total dissolved solids (TDS), and salinity. Laboratory analysis covered main cations K, Na, Ca, and Mg, and anions SO_4^{2-} , Cl^- , CO_3^{2-} , HCO_3^- . The sampling and analysis was in accordance with the standard method of the R.O.C. Environmental Protection Agency (EPA).

Groundwater Quality Analysis Results

According to the analysis of the four wells' groundwater, the groundwater temperature ranged from 26.9 °C to 29.3 °C, slightly lower than the local temperature. The pH level is fairly stable, at 7.3 to 7.7, and slightly alkaline because the aquifers are mainly composed of coral reefs, which are rich in calcium carbonate. As to the amount of DO in the groundwater, the figure falls between 1.1 mg/L to 4.2 mg/L for the four wells, which is different from the higher DO detected in the surface water, proving that the groundwater sample was drawn from the ground beneath the

wells. The same difference was observed in the ORP. On the other hand, the EC readings of the four wells span a wider spectrum, falling between 838 $\mu\text{S}/\text{cm}$ (well No. 5) and 5,990 $\mu\text{S}/\text{cm}$. This result matches with the result obtained by the Institute of Oceanography, National Taiwan University (EC of well No. 5 890 $\mu\text{S}/\text{cm}$) (2014). Meanwhile, owing to the relatively small area of Taiping Island, some of the groundwater is slightly affected by seawater. However the salinity of the four wells was lower than 3‰, far below the average salinity of 33 ‰ to 35 ‰ of seawater. As to the TDS content, the four wells ranged between 418 mg/L and 3,020 mg/L, and the TDS readings of well No. 5 taken during the two sampling runs were 427 mg/L and 418 mg/L, respectively, which met the R.O.C. Drinking Water Quality Standards and Standard of the Drinking Water Source. This indicates that well NO.5 can provide 2 to 3 tons daily of groundwater for drinking by residents on the island. In contrast, according to the groundwater monitoring data from the R.O.C. EPA (2013 – 2015), on Penghu Island, the average EC reached 3,141 $\mu\text{S}/\text{cm}$ and TDS reached 2,092 mg/L. All groundwater samples were subjected to further main cations and anions content analysis at the laboratory, following which groundwater of well No. 5 was classified as Class I using the Piper diagram (1944), which means it is uncontaminated groundwater and has $\text{Ca}(\text{HCO}_3)_2$ as its core component. In addition, all the groundwater samples in the laboratory were also subjected to eight trace heavy metals contents analysis, including copper (Cu), cadmium (Cd), lead (Pb), zinc (Zn), total chromium (Cr), nickel (Ni), iron(Fe), and manganese(Mn).The result showed the trace metals in groundwater of the Taiping Island were lower than the method detection limit (MDL).

According to the Groundwater Foundation, the American Meteorological Society, and the U.S. Geological Survey, freshwater is defined as water containing less than 500 mg/L and 1,000 mg/L of dissolved solids, respectively, and even the *Practical Fishkeeping* defines freshwater as water containing less than 3,000 mg/L of dissolved solids. . Thus, the analysis data and the definitions of the international academic institutions leave no doubt there is freshwater in the aquifers of Taiping Island. While it is confirmed the groundwater in well No. 5 is potable, water from the other three wells is suitable for domestic purposes such as cleaning, bathing, or plant watering. The water quality of Taiping Island is even better than that of the Penghu Island.

Estimation of Groundwater Capacity

The rainfall data for Taiping Island for the last three years show that the local rainy season occurred from June each year to next January, and the local dry season lasted from February to May. The island had 123 to 172 days of rainfall per year according to the same data, with 2,654.8 mm to 3,118.6 mm in annual rainfall. The average annual rainfall was about 2,912.2 mm in the recent three years. Evidently, the island receives abundant rainfall, exceeding the average annual rainfall of Taiwan Island (approximately 2,500 mm). Furthermore, as its surface area is approximately 0.5 KM², the total amount of rainfall each year on Taiping Island should be about 1.46 million M³. Since the surface soil on Taiping Island is mainly composed of corals featuring large particle sizes and a coarse texture, after deducting the surface runoff and evapotranspiration of the water losses, rainwater infiltration to the aquifer storage should be sufficient to provide the island population with about 0.237 million M³ of groundwater.

Conclusion

According to the above information and the definitions of the international academic institutions, the groundwater from well No. 5 on Taiping Island is indeed freshwater and free of heavy metals. In coupled ~~W~~with abundant rainfall, rainwater from the surface infiltration provides sufficient groundwater for the island residents' use. As to the groundwater nearer to the coast, it is suitable for domestic use, albeit slightly affected by seawater.

References

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Appendix: Onsite Photos

