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# ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

**Date 31.07.2021**

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PARACEL

**Pulp Mill, River Port, Transmission Line and Electrical Substation in Concepción – Paraguay**

**VOLUME II – Book I - ENVIRONMENTAL DIAGNOSIS OF THE PHYSICAL ENVIRONMENT**

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# 8 DELIMITATION OF AREAS OF INFLUENCE

According to Law 294/93, in its Article 1, *"the Environmental Impact Assessment is mandatory. For legal purposes, Environmental Impact shall be understood as any modification of the environment caused by human works or activities that have, as a positive or negative, direct or indirect consequence, to affect life in general, biodiversity, the quality or a significant amount of natural or environmental resources and their use, welfare, health, personal safety, habits and customs, cultural heritage or legitimate livelihoods"*.

Article 3°, paragraph c, of the mentioned law, "*determines the limits of the geographical area to be affected, with a physical, biological, socioeconomic and cultural description, detailed both quantitatively and qualitatively, of the area of direct influence of the works or activities and an environmental inventory of it, in such a way as to characterize its state prior to the projected transformations, with special attention to the determination of the watersheds.*"

Therefore, the environmental diagnosis was carried out in three areas of influence of the enterprise: Directly Affected Area (DAA), Direct Influence Area (DIA) and Indirect Influence Area (IIA), being, respectively, the areas affected locally, directly and indirectly by the incidence of environmental impacts.

- ✓ DAA: area of installation of the project, including the industrial areas, accesses and support areas (port and transmission line). DAA also includes the 6 accommodation camps.
- ✓ DIA:
  - For the physical and biotic environment, a radius of 5 km is being considered in the surroundings of PARACEL pulp mill and 25 meters range of transmission line. The impacts of port, wood transport and accommodation camps on the Direct Influence Area were also considered, although they are not included in the map. The DIA was determined based on atmospheric dispersion study, water effluent discharge (the distance of effluent is smaller than boundary) and industrial noise impacts (in 5 km the noise emitted by the mill will be practically the same as the environment).
  - For the socioeconomic environment, DIA includes: the district of Concepción, 13 km radius from the mill that contains Belem, Horqueta and Loreto, accommodation camps and transmission line. The impacts of wood transportation on the DIA were considered
- ✓ IIA:
  - For the physical environment, the Hydrographic Units (department), defined according to Resolution n. 376/2012, were considered as the reference base. In this way, the DIA (radius of 5 km from the site - DAA) was overlaid on the limits of the Hydrographic Units. The overlay of this information resulted in the definition of the IIA as the CIH18-Rio Pilcomayo and CIH8-Aquidaban Units. These units cover part of the middle and lower Paraguay sub-basin. It is worth to observe that this sub-basin was not considered in its entirety in the IIA, because relevant users were not found close enough (in terms of water quality impact)

downstream of the point of discharge of the effluents, in the portion covering the sub-basin. Another factor that justifies the definition of this IIA limit refers to the dispersion of the treated effluents in the Paraguay River, which is rapid and occurs very close to the point of release (between 0.37 and 0.42 m), this point being located upstream of the pulp mill water intake.

- For the biotic environment, the Indirect Influence Area considered the ecoregions that the Department of Concepción intercepts and, in part, the Aquidabán and Pilcomayo watersheds, namely Cerrado, Alto Paraná, Chaco Húmedo and Chaco Seco. The organization of information by ecoregions in the available bibliography justified the choice of this criterion.
- For the socio-economic environment, the IIA includes the three northern departments of the country: Concepción, San Pedro and Amambay

The following maps demonstrate the influence areas for physical, biotic and socioeconomic environment.

**Figure 1 – Map of the Areas of Influence for Physical Environment**

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-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

Brazil

Paraguay

Argentina

BELLA VISTA

FILADELFIA

PEDRO J CABALLERO

PUERTO PINASCO

T-412 T-413

T-99 CONCEPCION

T-98

T-97 T-16

TACUATÍ

SAN PEDRO YCUAMANDYYU

VILLA HAYES

ASUNCION AREGUA

CAACUPE

CNEL OVIEDO

PARAGUARI

VILLARRICA

CAAZAPA

SAN JUAN BAUTISTA

PILAR

ENCARNACION

Rio Paraguay

CAMP 7

CAMP 6

CAMP 1

CAMP 11

CAMP 9

CAMP 3

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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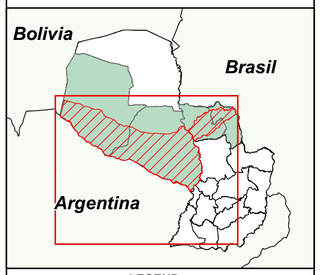
-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

LOCATION MAP




LEGEND

- Structures - Transmission Line
- Accommodations (Camps)
- Capitals
- Transmission Line
- Hydrography
- Main routes
- Secondary routes
- IIA - Indirect Influence Area
- DAA - Directly Affected Area
- DIA - Diet Influence Area
- CIH Rio Pilcomayo and Aquidaban
- Easement Lane
- South America

ESCALA GRAFICA:

0 20 40 80 km

DATUM SIRGAS 2000
PROYECCION: UTM

DATA SOURCE:

- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).

PARACEL PÖYRY

ENVIRONMETAL AND SOCIAL STUDY

CIH8 Aquidaban and CIH18 Rio Pilcomayo

INFLUENCE AREA

| ESCALA: | 1:1.500.000 | FECHA: | 28/05/2021 |
|---|---|---|---|
| PROYECTO N°: | | FOLHA: | FORMATO: |
| RESP. TECNICO: Romualdo Hirata | | FIRMA: | REV. 0 |

**Figure 2 – Map of the Areas of Influence for the Biotic Environment**

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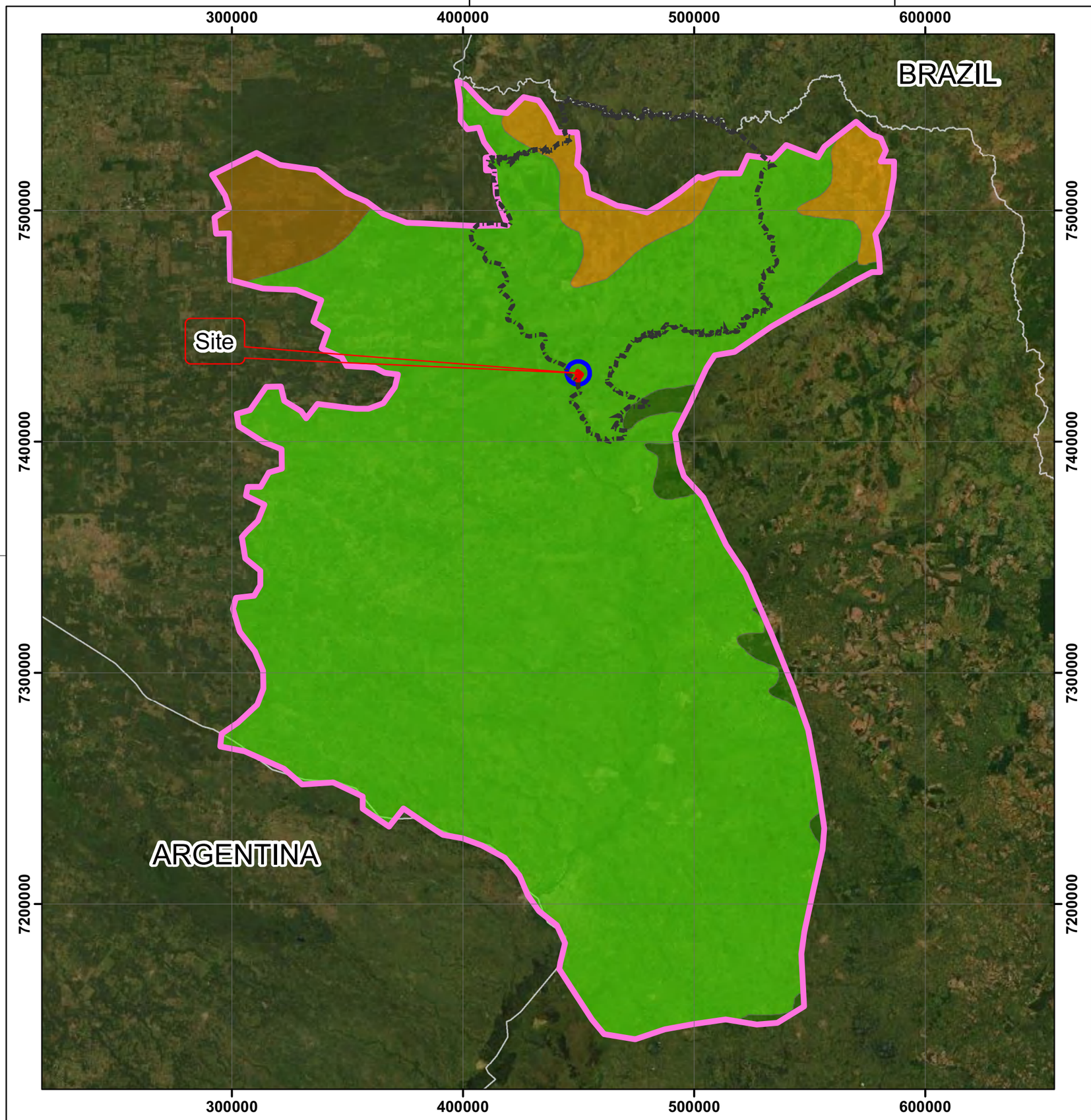


Coordinate System: SIRGAS 2000 - UTM Zone 23S
Projection: UTM - Universal Transverse of Mercator
Datum: SIRGAS 2000

SOURCES:

- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos). Informe Técnico Mapa de cobertura del Paraguay año 2011

## Legend

- Concepcíón Department
- ADA
- DIA
- IIA
- Alto Parana Ecoregion
- Chaco Húmedo Ecoregion
- Chaco Seco Ecoregion
- Cerrado Ecoregion

N

0 25 50 100 150 Kilometers

PARACEL PÖYRY

| | | | |
|---|---|---|---|
| MAP TITLE: BIOTIC ENVIRONMENT | | | |
| PROJECT: PARACEL | | | |
| LICENSING PROCESS: ENVIRONMENT IMPACT STUDY (EIAp-RIMA) | | | |
| LICENSE TYPE: ENVIRONMENT LICENSE | | | |
| LOCALIZATION: CONCEPCIÓN-PY | | CIH: CIH8 Aquidaban and CIH18 Pilcomayo River | |
| SCALE: 1:1.750.000 | DATE: 2020/05/25 | TECHNICAL MANAGER: EDUARDO MARTINS Biologist | CRBio Nº: 26.063/01-D |

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**Figure 3 – Map of the Areas of Influence for the Socioeconomic Environment**

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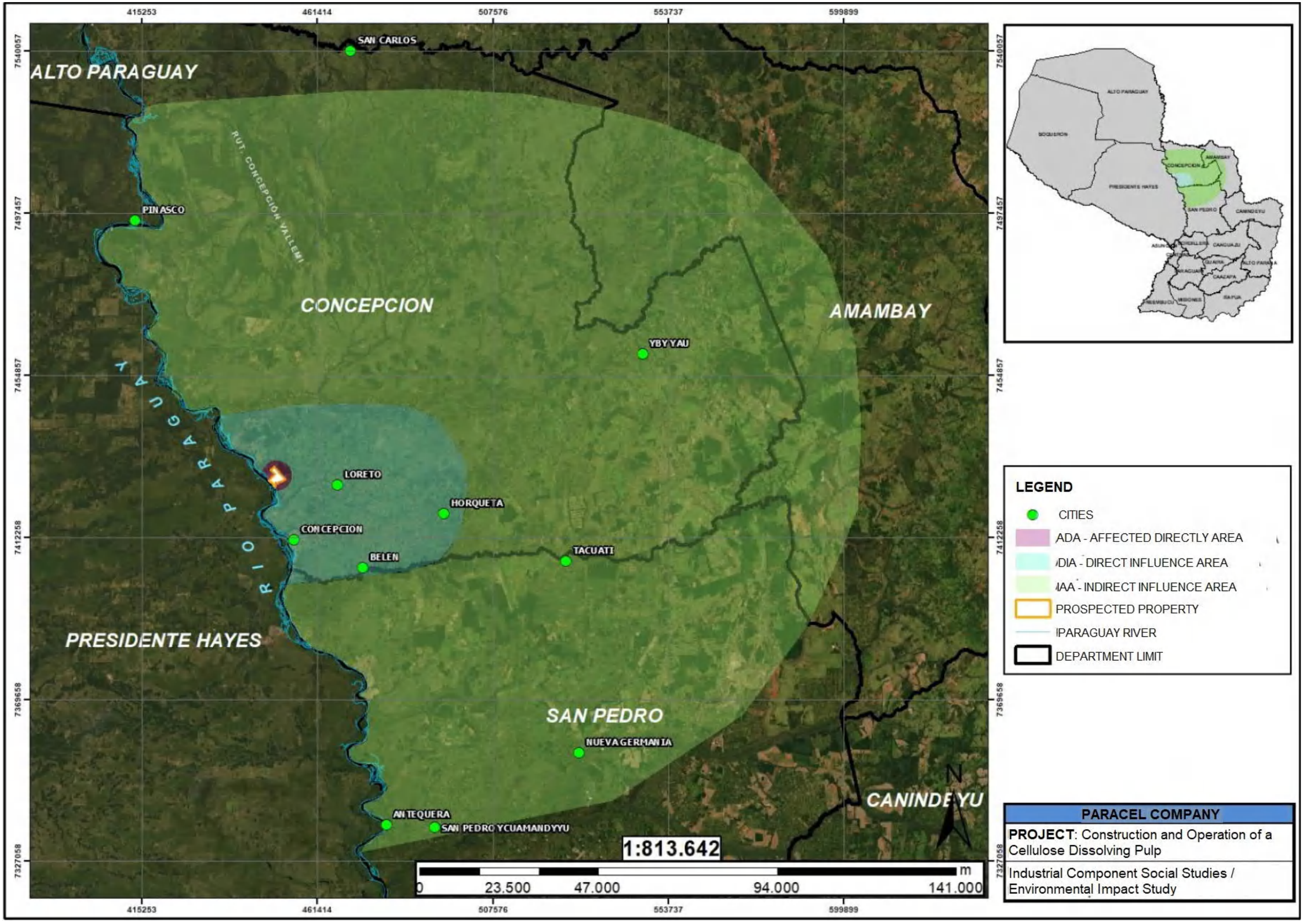


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# 9 ENVIRONMENT DIAGNOSIS

## 9.1 Physical environment

The diagnosis of the physical environment allows us to observe the current states of climate and meteorology, air quality, noise, geology, geomorphology, pedology and hydrology (surface and underground water resources) of the areas of influence and thus obtain an adequate evaluation of the environmental impacts related to the implementation and operation of PARACEL pulp mill.

For the compilation of primary and secondary data, the areas of influence were considered as follows:

- IIA - Aquidabán (12,515 km$^2$) and Pilcomayo River (86,694 km$^2$) Hydrographic Units, according to MADES Resolution n. 376/2012
- DIA - Radius of 5 km around the DAA. This delimitation was due to atmospheric dispersion studies;
- DAA - Includes the internal region owned by PARACEL, where the industrial unit will be properly established, in addition to the water collection pipe and land effluent outlet.

## 9.2 Climate and Meteorology

The climate type in Paraguay is tropical to subtropical, governed by tropical air mass and polar air mass, with hot and rainy summers and low and less rainy winters. The average annual temperature is 23°C and the average annual maximum is 29°C. There is a marked difference between the distribution of rainfall in the two regions into which the country is divided. In the Eastern Region, the average annual temperature ranges from 21°C to 23°C. In the Western Region, the average annual temperature is 24°C. The average recorded rainfall is 1,700 mm in the eastern region and 400 mm in the western region, near the border with Argentina and Bolivia (DGEEC, 2011).

According to Grassi et al. (2005), the Eastern Region, has an undulating and humid feature confined between the Paraguay and Paraná rivers, has a rugged topography with good drainage and a growing rainfall regime to the east and where the climate varies from humid sub-humid to humid, in the same orientation, giving rise to the large subtropical forests of the Atlantic basin.

According to this classification Pasten et al. (2011), the Eastern Region is defined with two types of climates:

- Tropical Shroud/Dry Winter (Aw): covers much of the department of Concepción and a small portion of northwest San Pedro;
- Temperate/No Dry Season/Hot Summer (Cfa) includes the departments of Amambay, Canindeyú, Central, Cordillera, Caaguazú, Alto Paraná, Paraguarí, Guairá, Ñeembucú, Misiones Itapúa and much of San Pedro.

The result of Köppen's climate classification, which can be seen in the Figure below, determined that in Paraguay there are three types of climate: tropical savannah with dry winter (Aw), semi-arid (Steppe) warm during all year (Bsh) and temperate climate, without dry season and hot summer (Cfa), this is the predominant climate in much of Paraguay (Pasten et al. 2011).

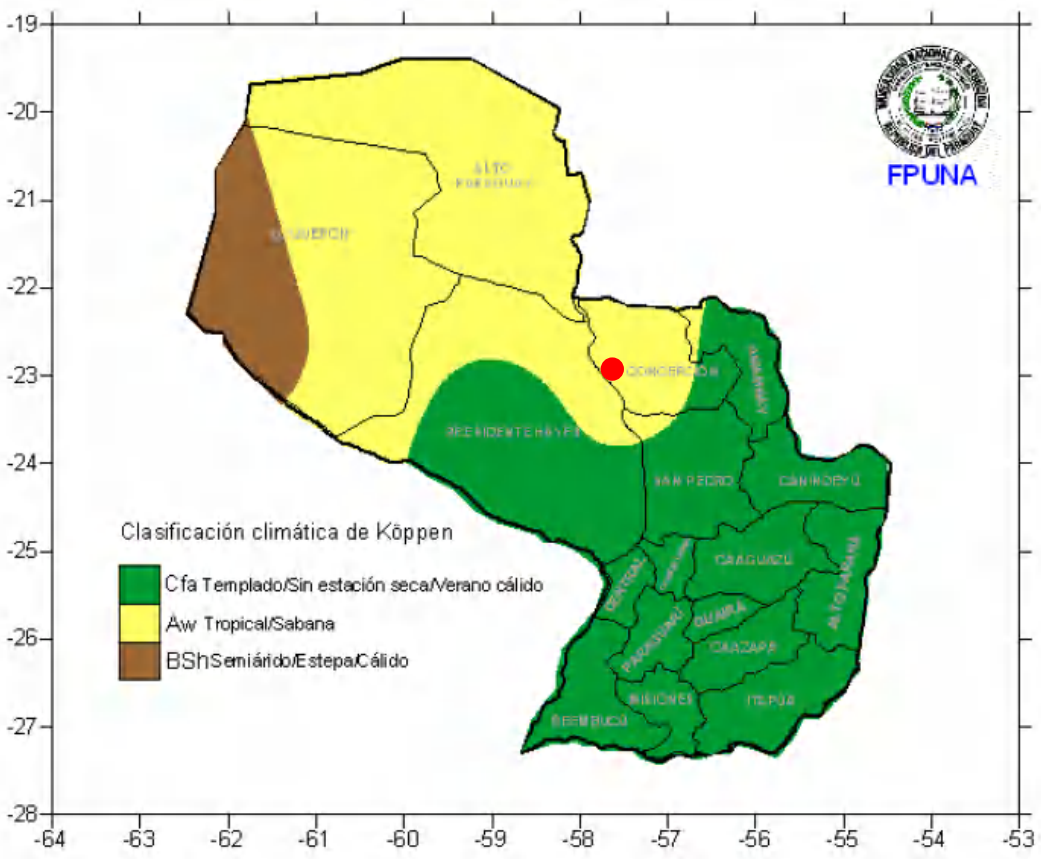



**Figure 4 - Climate Classification of Köppen (1971-2010). Source: Pasten et al. (2011)**

In the Figure below you can see the result of Thornthwaite's climate classification, where it’s possible to observe the 5 different types of climate of Paraguay.

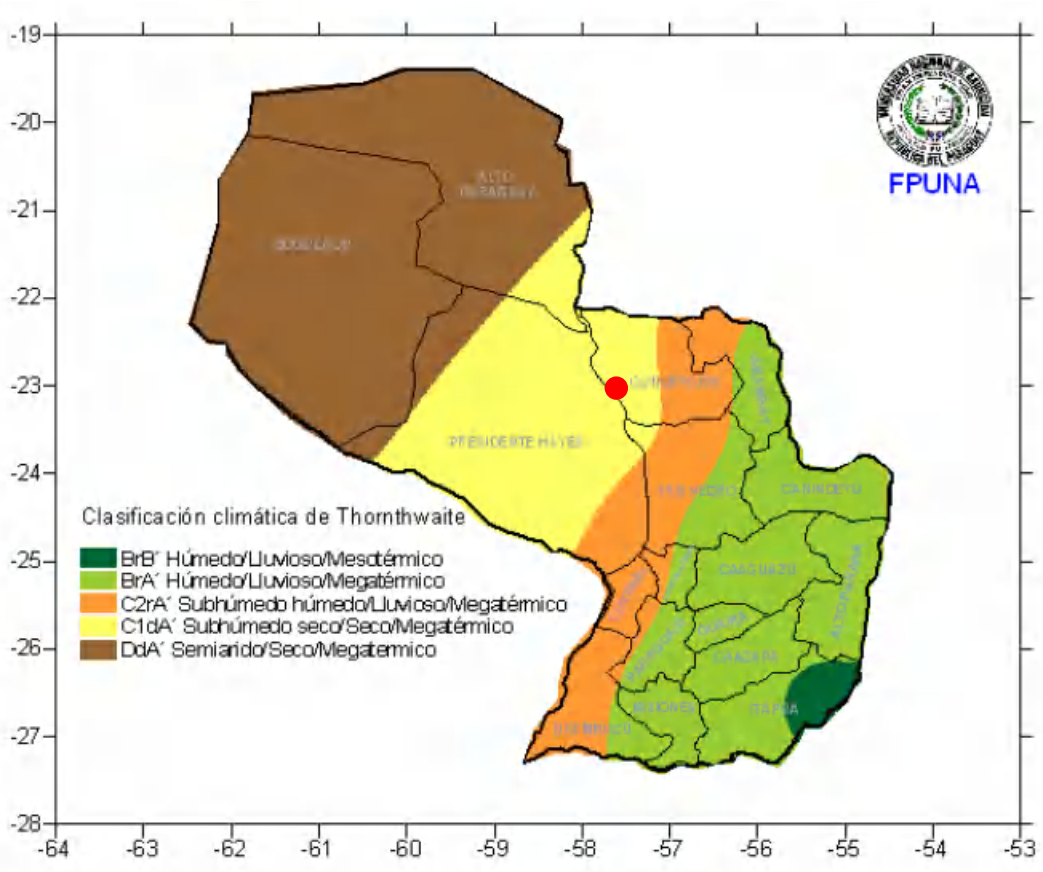



**Figure 5 - Thornthwaite climate classification (1971-2010). Source: Pasten et al. (2011)**

According to Pasten et al. (2011), the Western Region is defined considering four types of climate:

- Dry sub-humid/dry/megathermal (C1dA'): it includes the western part of the department of Concepción and a small portion of the department of San Pedro;
- Humid sub-humid/rainy/megathermal (C2rA'): covers the east of Concepción, a strip of San Pedro, Central department, west of Cordillera and west of Ñeembucú;
- Wet/Rain/Megathermal (BrA'): includes the departments of Canindeyú, Alto Paraná, Guairá, Caazapá, Misiones, east of Amambay, southeast of San Pedro, east of Cordillera, east of Ñeembucú and a large part of Itapúa;
- Wet/Rain/Mesothermal (BrB'): includes only a small part of Itapúa.

### 9.2.1 Metodology

The climatic characterization of the region where the pulp mill is located considered the analysis of the following parameters: temperature, relative humidity, wind direction and speed, precipitation, solar radiation and water balance.

The meteorological and climatic information presented comes from the Climatological and Meteorological Study, carried out by the Company "CATAVENTO AMBIENTALE METEOROLOGIA E MEIO AMBIENTE", the data were obtained by surface meteorological stations approved in the region of the company.

The data used for the study of the region's climate were obtained from the Integrated Surface Database (ISD), which can be consulted on the website of the National Oceanic and Atmospheric Administration (NOAA). Four surface weather stations were chosen for the analysis of climate conditions in the region, which were more representative of the company's area, as shown below.

- Puerto Casado (USAF:860860/ICAO:SGLV), located 116 km of the north of the project, installed in the coordinates 22°16'58.80 "S e 57°55'58.80 "W. The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- Pozo Colorado (USAF: 861280/ICAO: SGPC), located 136 km west of the project, at coordinates 23°30'0.00 "S e 58°46'58.80 "W. The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- San Pedro (USAF: 861850/ICAO: SGSP), 99 km south of the project, located at coordinates 24° 4'1.20 "S e 57° 4'58.80 "W The data series examined is composed of 7 years (from 01/01/2013 to 31/12/2019);
- Teniente Coronel Carmelo Peralta (USAF: 861340/ICAO: SGCO), used as a reference station for the region, about 21 km from the project, located at coordinates 23°26'31.20 "S e 57°25'37.20 "W. The data series examined is composed of 10 years (from 01/01/2010 to 31/12/2019).

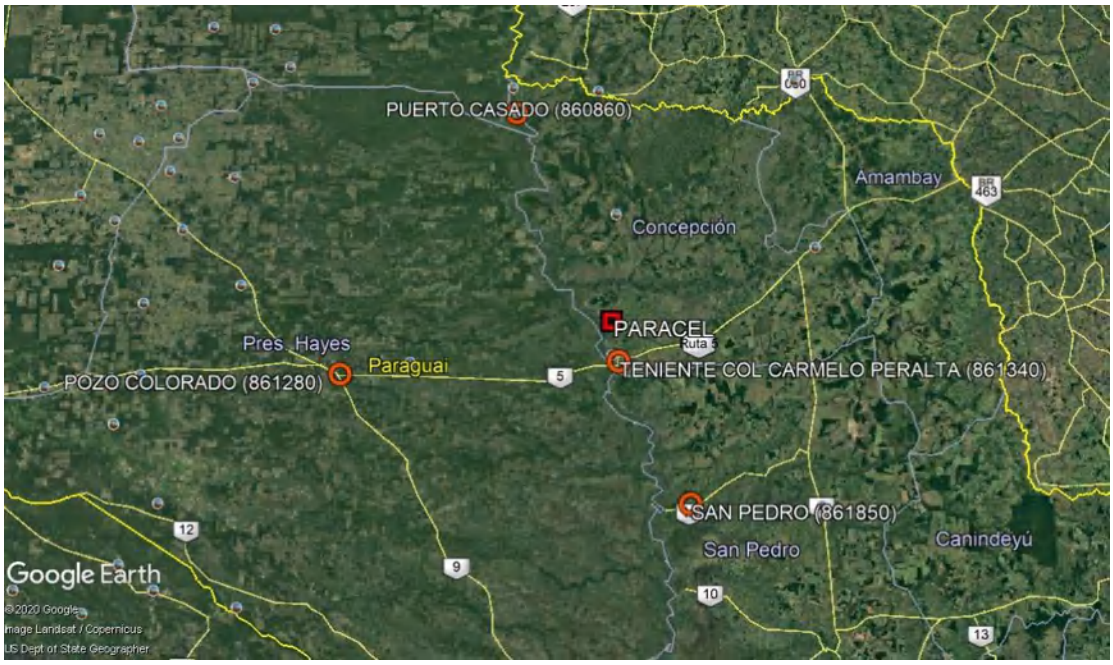



**Figure 6 - Map of the location of the weather stations distant from the project. Source: Google Earth, 2020**

### 9.2.2 Rainfall precipitation

No rainfall data are available in the database used for the study. Therefore, the study of rainfall precipitation was carried out by consulting the bibliography with information from previous studies of the region and the country.

Most of the country's rainfall is convective, produced by isolated storms or lines of instability that are frequent in spring and autumn. The average annual precipitation shows a great spatial variation. The greatest amplitude is towards the south of the country, varying zonally from 400 mm in the northwest of the Chaco to more than 1,800 mm in the Eastern Region.

The Paraná River basin is the wettest, with annual averages above 1800 mm, while the Paraguay River basin receives maximums of 1600 mm in the eastern region. Rainfall also shows great seasonal variability. They are lowest in July and August, and the average of the least rainy month usually does not reach 5% of the annual total. The highest volumes of precipitation occur during the months of October to April and are generally recorded in the form of storms or rainfall, as a result of atmospheric instability caused by strong warming of the lower layers of the atmosphere (Mayeregger and Romero 2017).

The highest precipitation rates in the region of Concepción occur in the summer. The month with the lowest rates is August, with an average of 28mm. In February and November, precipitation reaches its highest levels, between 128 and 152 mm on average. The average annual rainfall is approximately 1,190 mm[1].

[1] Source: https://es.weatherspark.com/

### 9.2.3 Atmospheric pressure

At the Puerto Casado station (860860), located 116 km north of PARACEL pulp mill, the atmospheric pressure varied between 1,001.4 and 1,004.9 hPa, while the average for the period from 2013 to 2019 was 1,002.9 hPa.

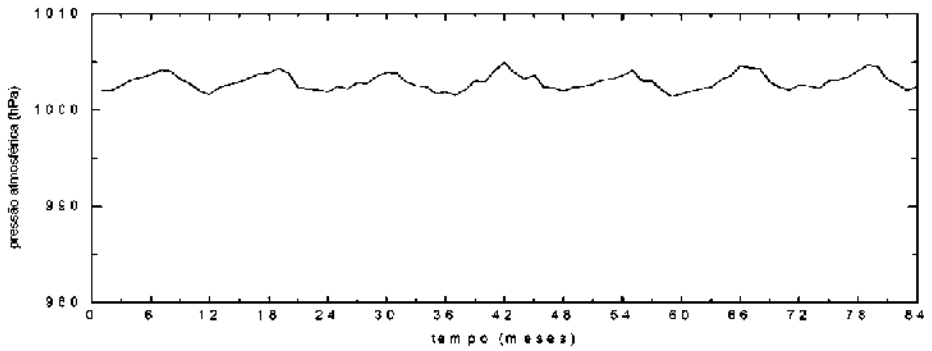



**Figure 7 – Average monthly atmospheric pressure at the Puerto Casado station**

At the Pozo Colorado station (861280), located 136 km west of the project, the atmospheric pressure varied between 999.4 and 1,002.7 hPa, while the average for the period from 2013 to 2019 was 1,000.8 hPa.

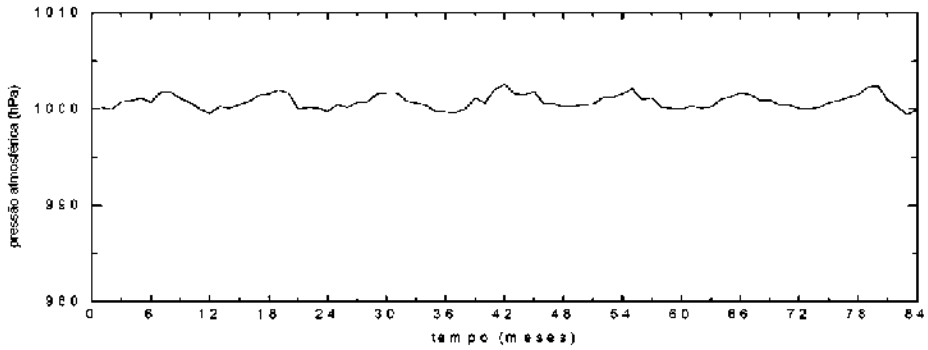



**Figure 8 – Average monthly atmospheric pressure at the Pozo Colorado station**

At the San Pedro station (861850), located 99 km southeast of the project, the atmospheric pressure varied between 1,002.1 and 1,005.5 hPa, while the average for the period from 2013 to 2019 was 1,003.6 hPa.

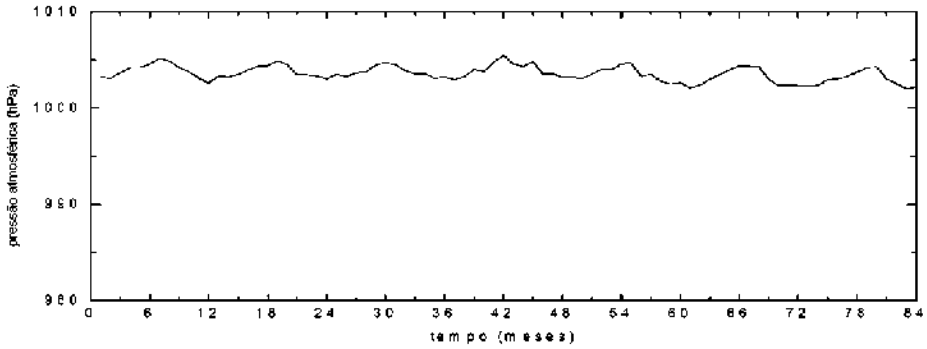



**Figure 9 – Average monthly air pressure at San Pedro station**

At the Lieutenant Colonel Carmelo Peralta station (861340), 21 km from the project, the atmospheric pressure varied between 1,001.5 and 1,007.5 hPa, while the provisional average climate for the period from 2010 to 2019 was 1,003.9 hPa.

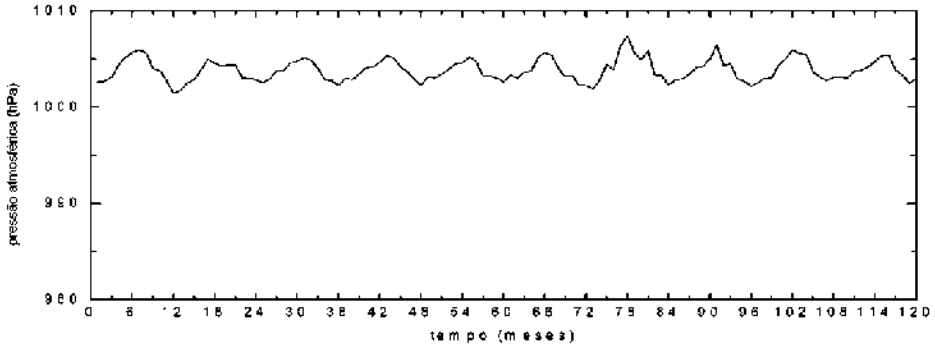



**Figure 10 – Average monthly atmospheric pressure at the Teniente Coronel Carmelo Peralta station**

Although the four weather stations cover a relatively large area and are separated by considerable distances, the atmospheric pressure behavior was similar in all stations and the average for the region was 1,002.8hPa.

### 9.2.4 Air temperature

At the Puerto Casado station, the average monthly temperature varied between 16.9˚C and 31˚C, while the average for the period from 2013 to 2019 was 25.7˚C.

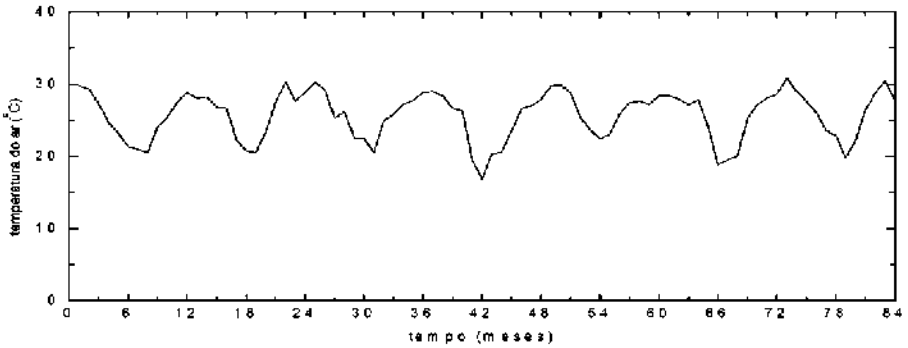



**Figure 11 – Average monthly temperature at Puerto Casado station.**

At Pozo Colorado station, the monthly average temperature varies between 15,5˚C and 31,2˚C, while the average for the period from 2013 to 2019 was 24.7˚C.

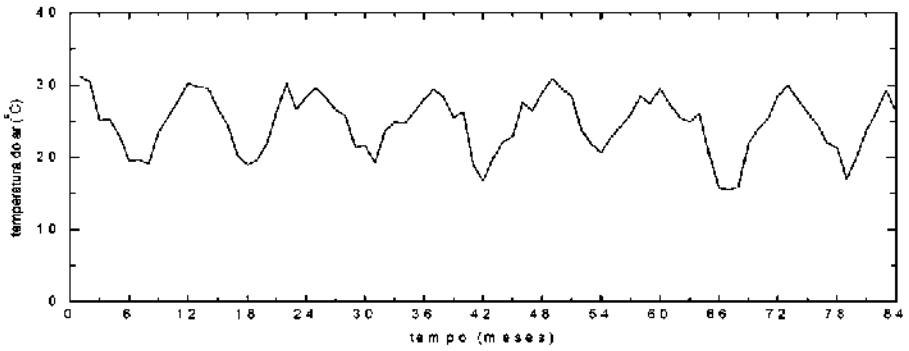



**Figure 12 – Average monthly temperature at Pozo Colorado station**

At the San Pedro station, the average monthly temperature varied between 16.5˚C and 30.5˚C, while the average climate for the period from 2013 to 2019 was 24.1˚C.

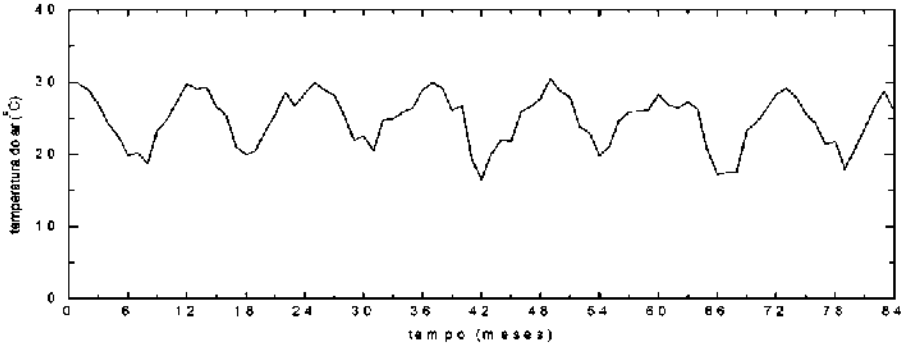



**Figure 13 – Average monthly temperature at San Pedro station**

At Teniente Coronel Carmelo Peralta station, the average monthly temperature varied between 15.5˚C and 29.6˚C, while the provisional average climate for the period from 2010 to 2019 was 24.3˚C.

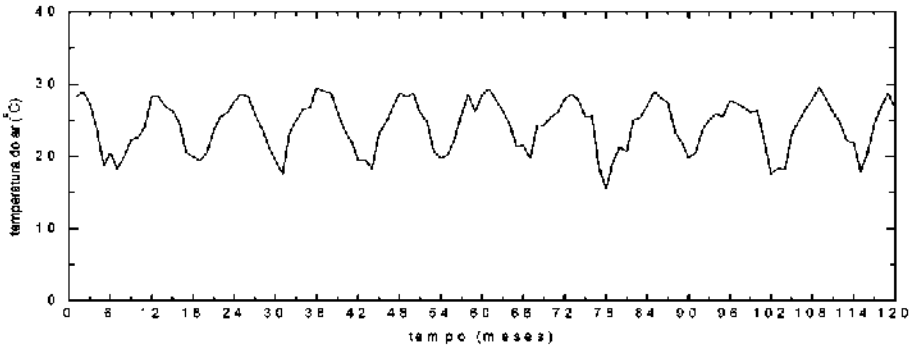



**Figure 14 – Average monthly temperature at station Teniente Coronel Carmelo Peralta**

The air temperature in the region is defined by the effect of continentality and topographic uniformity, presenting a great amplitude. In summer, as it is a tropical region, the maximum temperatures can exceed 30˚C, and in winter frost phenomena can be registered as a consequence of the entry of cold fronts.

The average temperatures are very similar in all the weather stations, from 24.1˚C in the San Pedro station, which is further south, to 25.7˚C in the Puerto Casado station, located further north. In the large region analyzed, the average temperature was 24.7˚C.

### 9.2.5 Relative humidity

At the Puerto Casado station, the monthly relative humidity varied between 46.7% and 79.6%, while the average for the period from 2013 to 2019 was 63%.

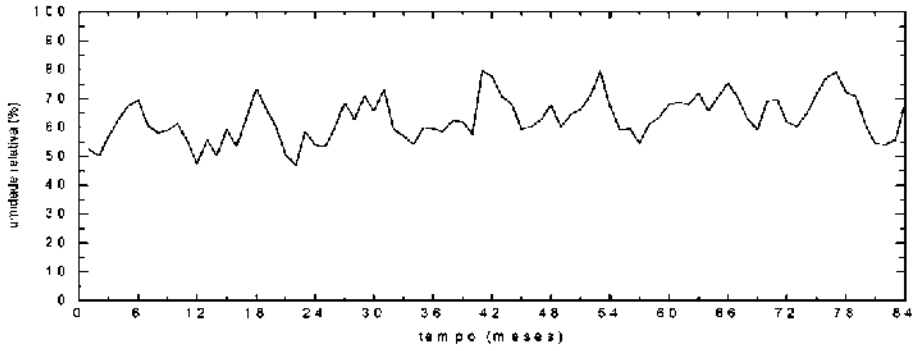



**Figure 15 – Average monthly relative humidity at Puerto Casado station**

At the Pozo Colorado station, the monthly relative humidity varied between 51.7% and 83.6%, while the average for the period from 2013 to 2019 was 70.2%.

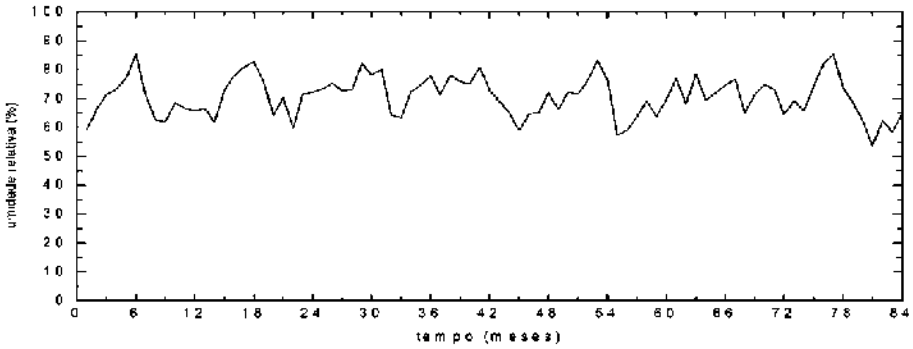



**Figure 16 – Average monthly relative humidity at station Pozo Colorado**

In the San Pedro station, the monthly relative humidity varied between 56.1% and 85.4%, while the average for the period from 2013 to 2019 was 70.5%.

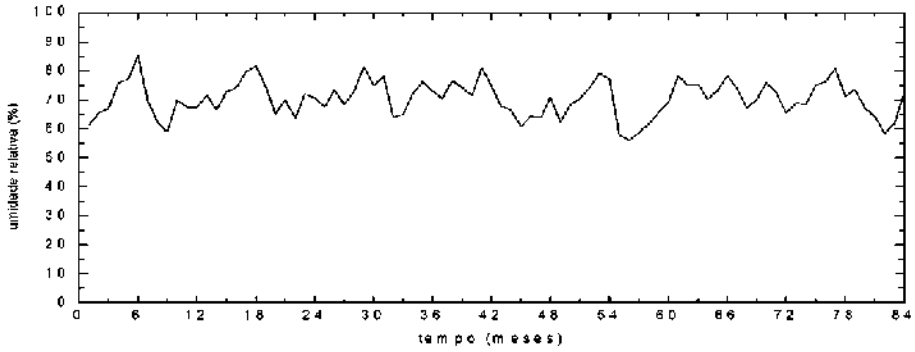



**Figure 17 – Average monthly relative humidity at San Pedro station**

At Teniente Coronel Carmelo Peralta station, the monthly relative humidity varied between 51.4% and 85.5%, while the provisional average for the period from 2010 to 2019 was 70.9%.

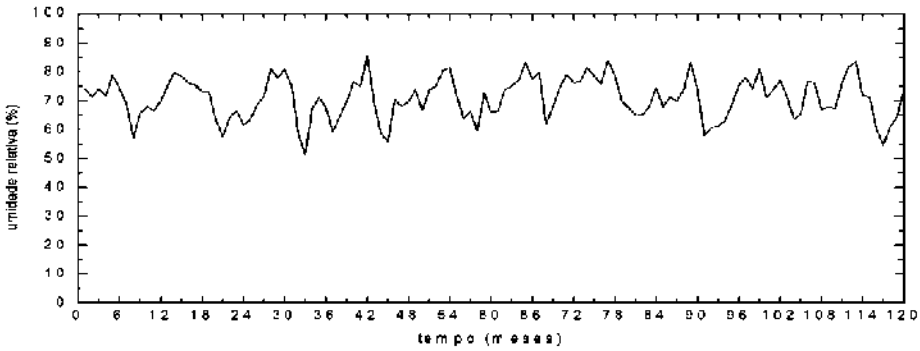



**Figure 18 – Average monthly relative humidity at station Teniente Coronel Carmelo Peralta**

The relative humidity at the Puerto Casado station, to the north of the future PARACEL factory, has an average relative humidity of 63%. The other regions presented values

between 70.2% and 70.9%, the highest value being at the station of Lieutenant Colonel Carmelo Peralta. This difference is due to the variability of rainfall among the regions.

### 9.2.6 Wind

At the Puerto Casado station, the average monthly wind speed varied between 0.76 and 2.49 m/s, while the average for the period from 2013 to 2019 was 1.47 m/s.

The wind rose generated with the data obtained at the Puerto Casado station proves the predominance of south and north winds.

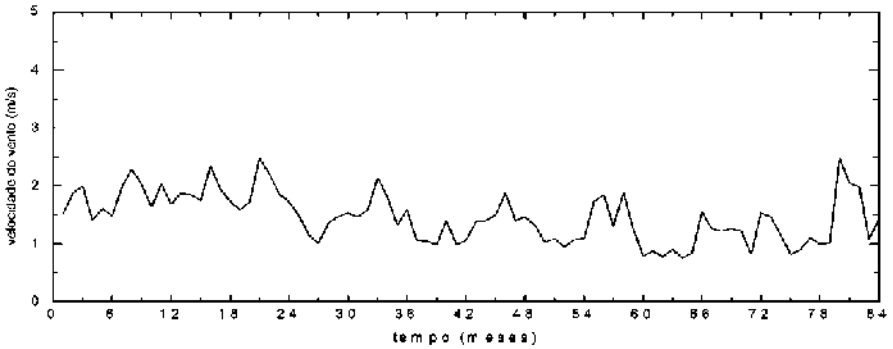



**Figure 19 – Average wind speed at Puerto Casado station**

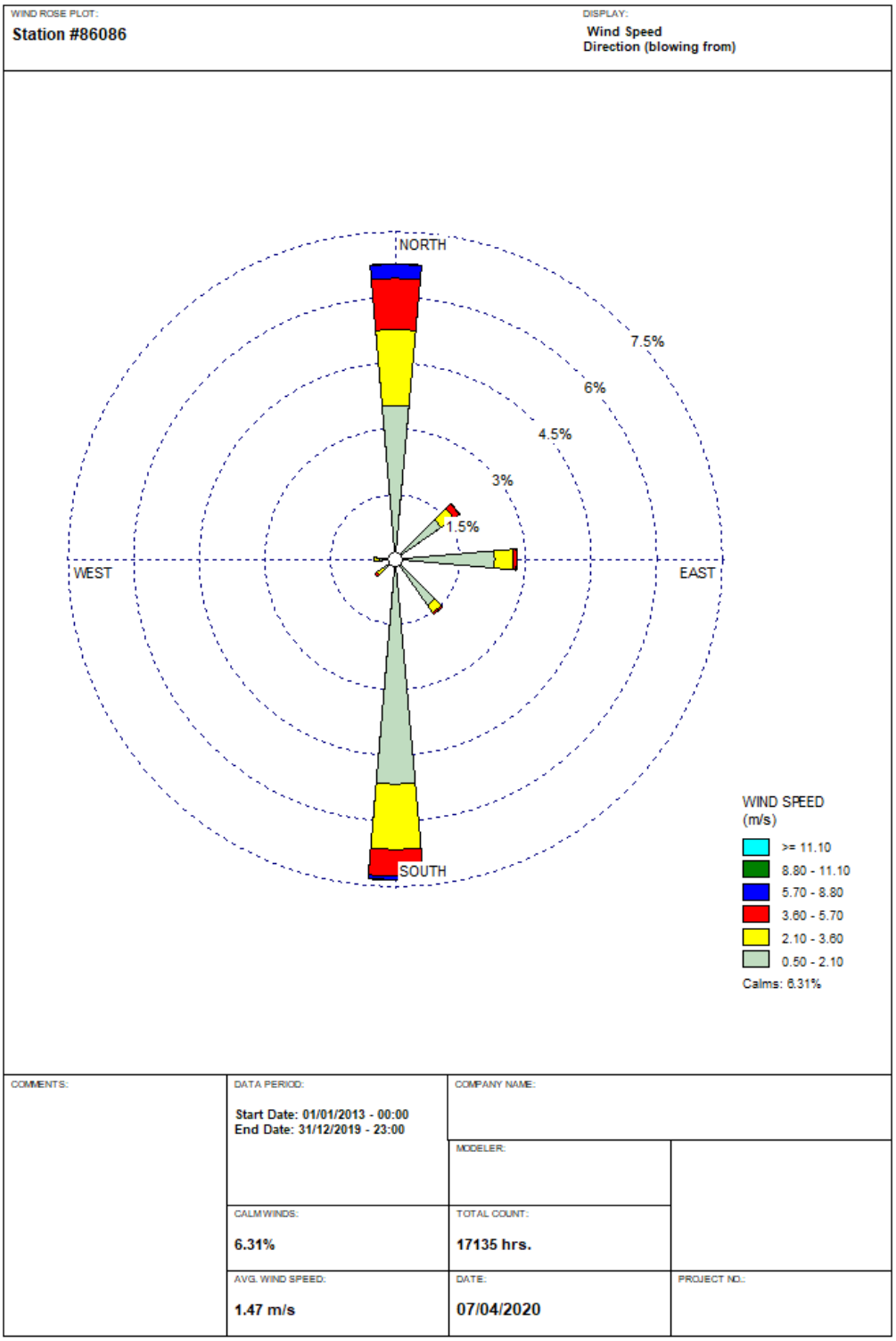



**Figure 20 – Wind rose observed at the station Puerto Casado**

At the Pozo Colorado station, the average monthly wind speed varied between 0.7 and 5.0 m/s, while the average for the period from 2013 to 2019 was 2.5 m/s.

The wind rose generated with the data observed at the Pozo Colorado station proves the predominance of south and north winds, with important components from the northeast and east.

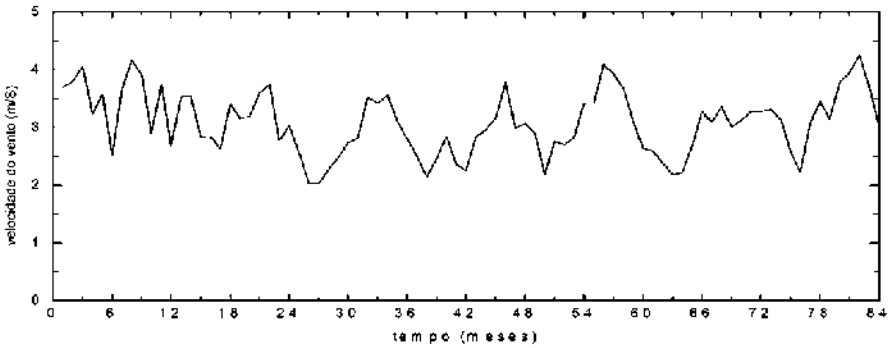



**Figure 21 – Average wind speed at station Pozo Colorado**

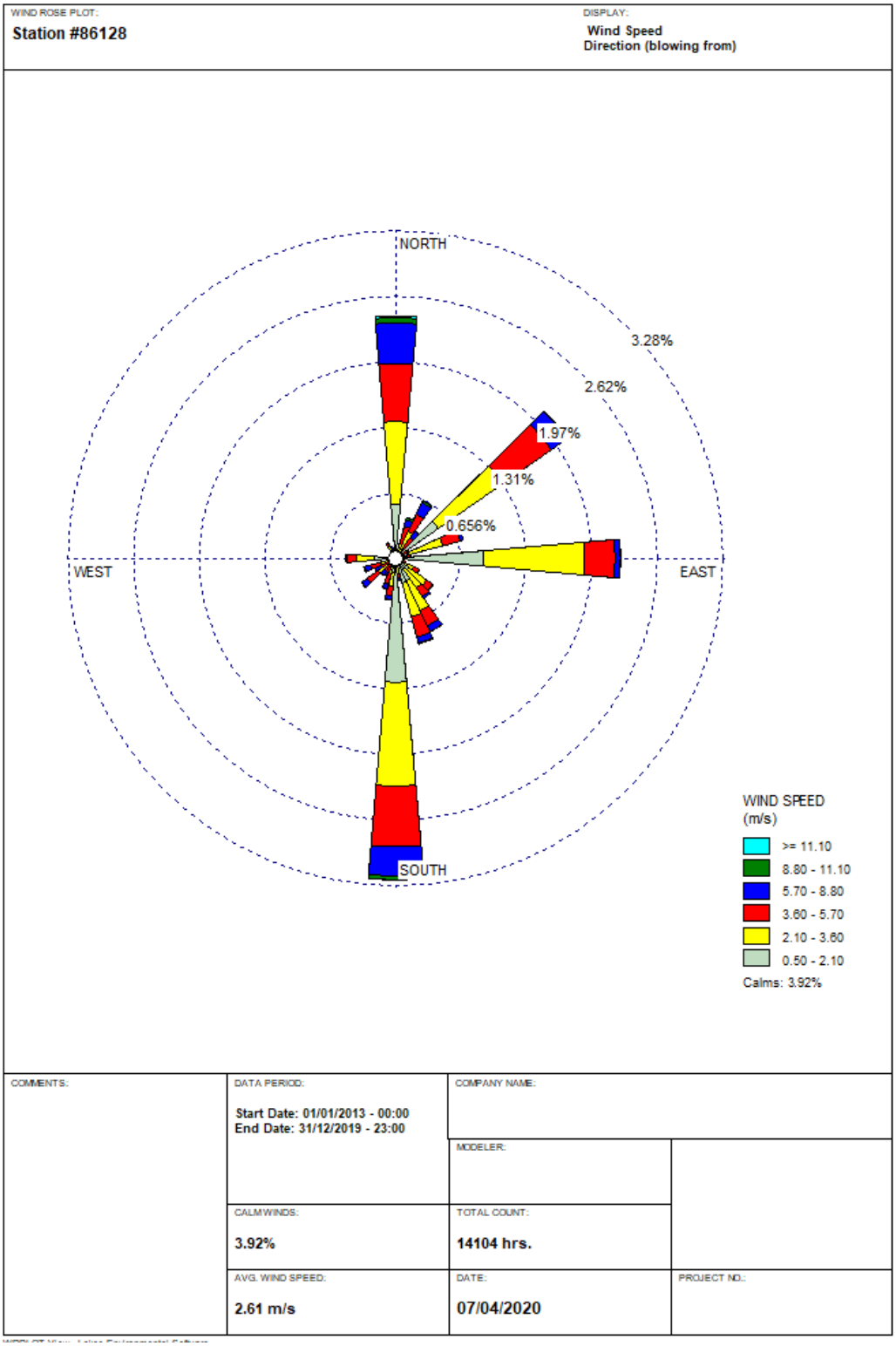



**Figure 22 – Wind rose observed at Pozo Colorado station**

At the San Pedro station, the average monthly wind speed varied between 0.5 and 3.7 m/s, while the average for the period from 2013 to 2019 was 1.9 m/s.

The wind rose generated with the data observed at the San Pedro station proves the predominance of two winds from the south and north, followed by winds from the east.

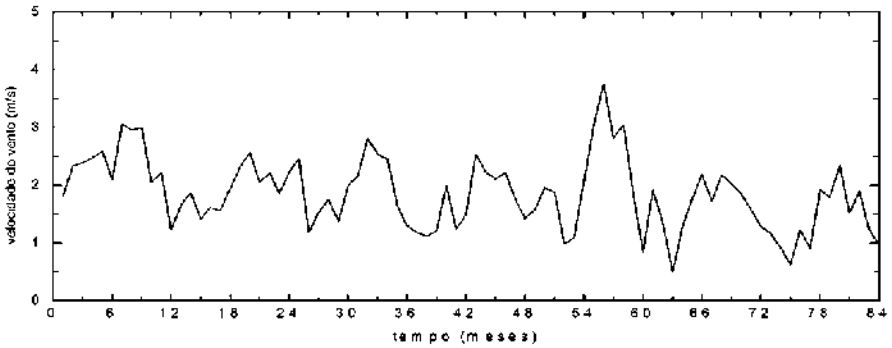



**Figure 23 – Average wind speed at the station San Pedro**

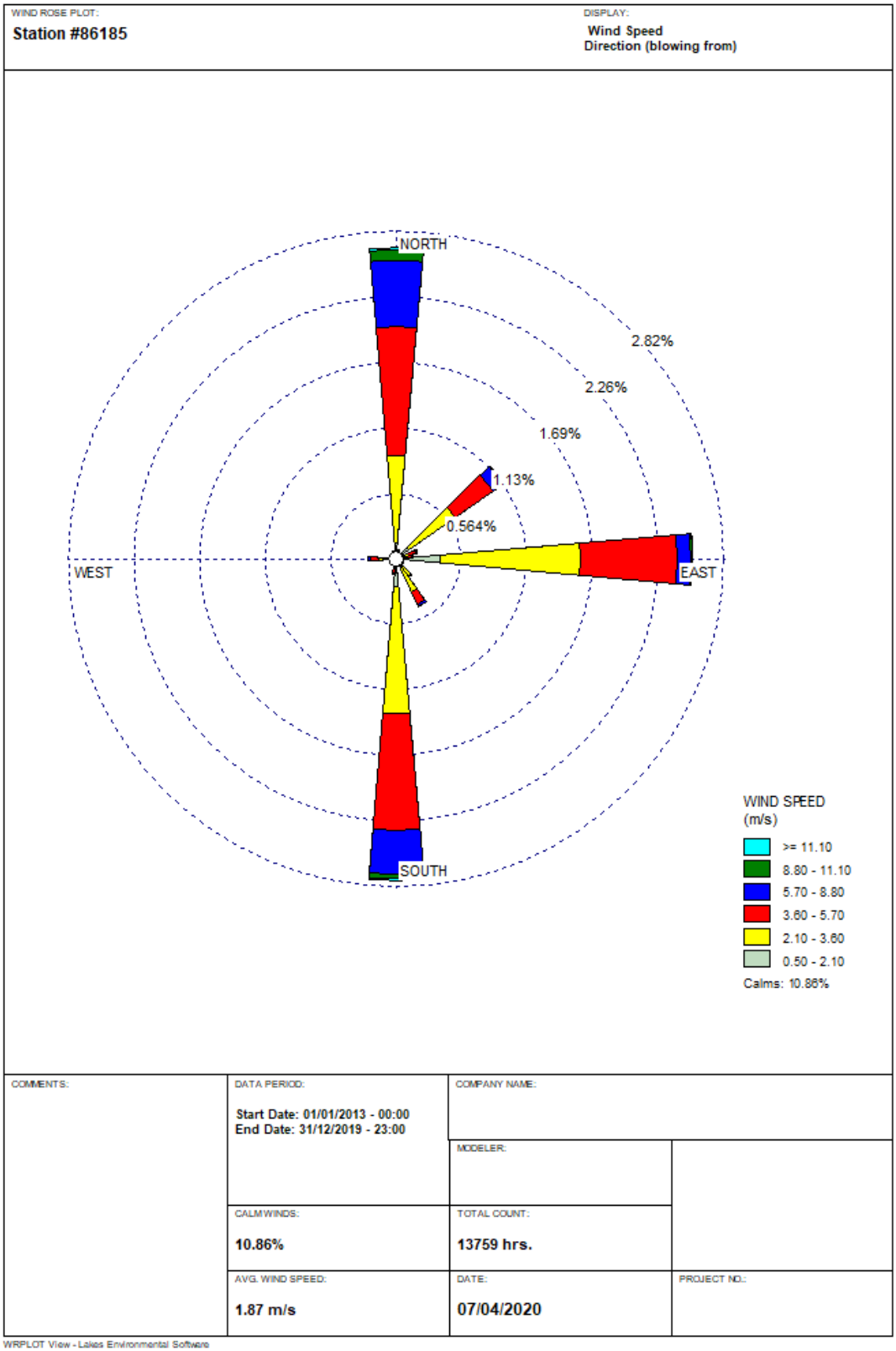



**Figure 24 – Wind rose observed at the station San Pedro**

At the Teniente Coronel Carmelo Peralta station, the average monthly wind speed varied between 1.8 and 4.9 m/s, while the provisional average for the period from 2010 to 2019 was 3.2 m/s.

The wind rose generated with the data observed at the Teniente Coronel Carmelo Peralta station proves the predominance of two winds from the south, followed by northeast and east, and with a less important component from the southeast.

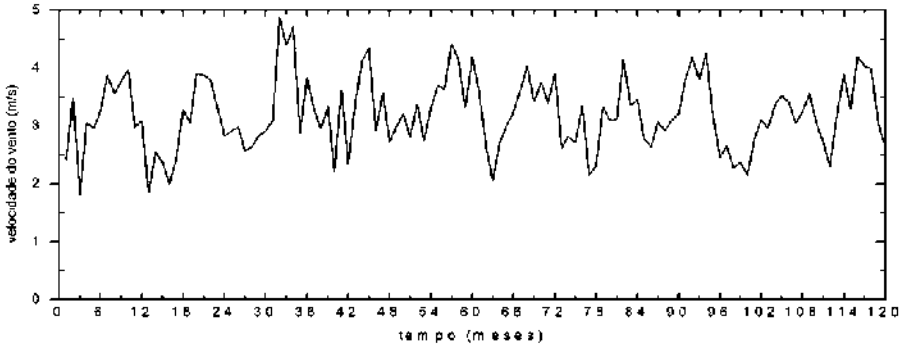



**Figure 25 – Average wind speed at the station Teniente Coronel Carmelo Peralta**

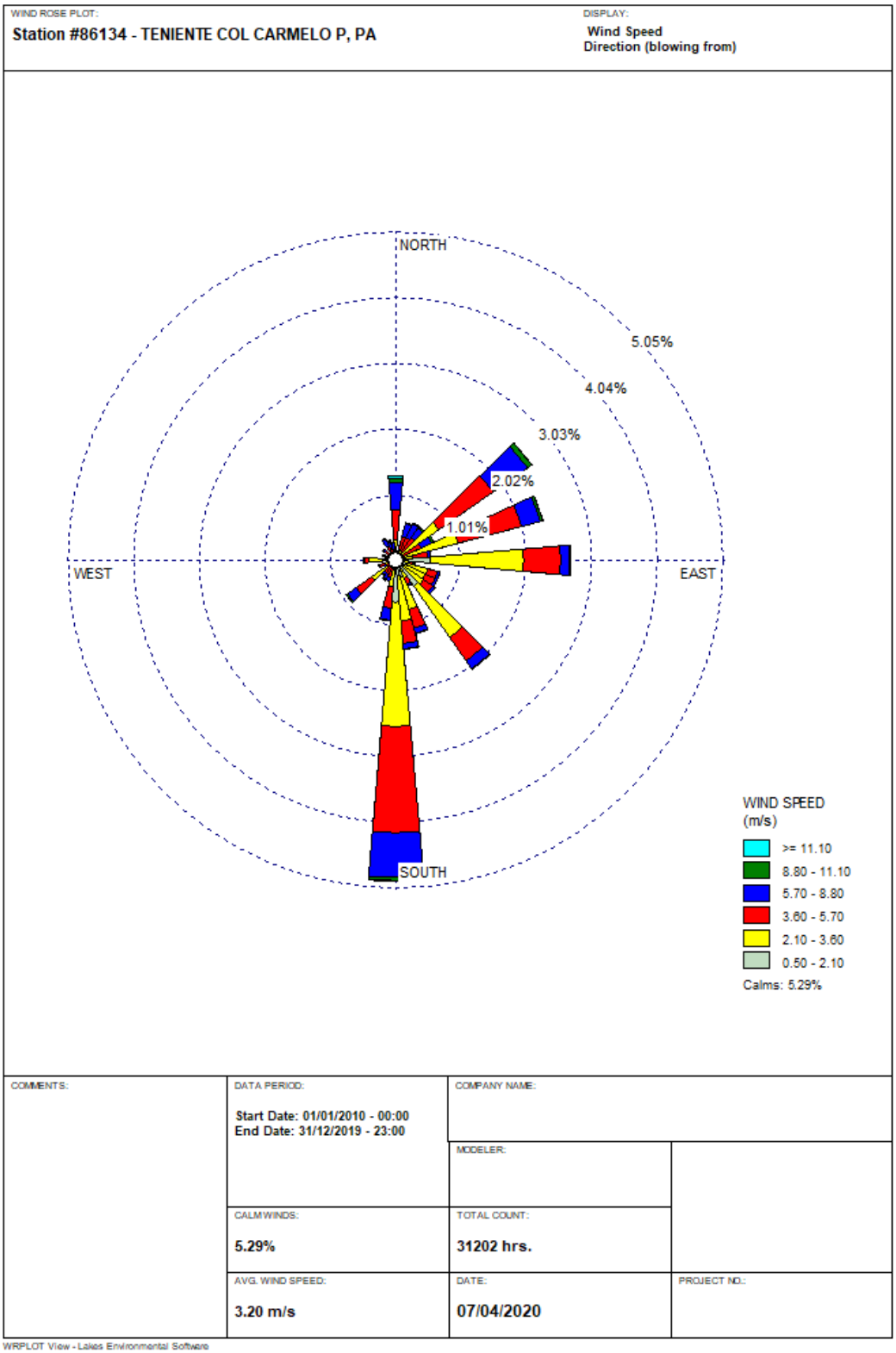



**Figure 26 – Wind rose observed at the station Teniente Coronel Carmelo Peralta**

The wind intensities in all regions are very similar and can be classified as weak winds, between 1.4 and 3.2 m/s. The highest wind speeds were registered at Teniente Coronel Carmelo Peralta station. The predominant wind directions are north and south, followed by northeast and east winds.

## 9.3 Air quality

This item presents the results of the Air Quality Monitoring report of the PARACEL pulp mill in the Municipality of Concepción, Department of Concepción, Paraguay.

The objective of the monitoring is to verify the air quality before the implementation and operation of the pulp mill (background).

The air quality monitoring was carried out through 2 campaigns, the first in the period from September 25 to October 16, 2019, and the second in the period from February 12 to March 4$^{th}$, 2020.

This report was prepared using SEAM Resolution No. 259/2015, which establishes the air quality standard.

The complete report is presented in **ANNEX I** of this document.

#### 9.3.1.1 Collection points

Three different points were defined to evaluate the air quality in the region where the PARACEL factory is installed, which are:

- Point 01 – SENACSA/ Departmental Animal Health Commission

  Address: Calle Gral. Díaz c/ Rufino Spika – Concepción/Paraguay

  Coordinates: UTM 21K 0454572 - 7410810

- Point 02 – Loreto Municipality/ Paraguay

  Address: Av. Eusebio Ayala Y Centro Corá – Loreto/Paraguay

  Coordinates: UTM 21K 0466753 - 7426022

- Point 03 – National Police Station – Comisaría nº18 Col. Roberto L. Petit

  Address: Puesto Policial Nacional – Comisaría nº18 – Col. Roberto L. Petit – Concepción/Paraguay

  Coordinates: UTM 21K 0457325 – 7434506

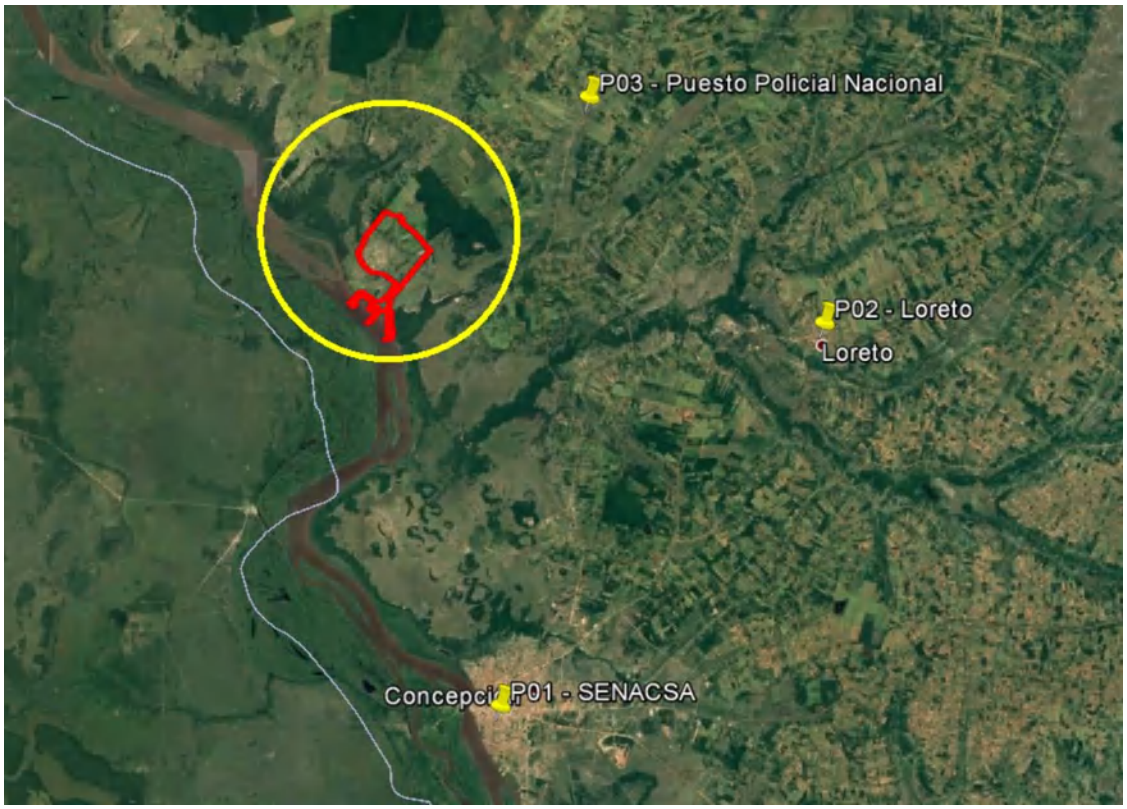



**Figure 27 – Location of campaign monitoring points. Source: Pöyry Tecnologia (2021)**

**Figure 28 – Point P01. Source: Geoavaliar (2020)**

**Figure 29 – Point P02. Source: Geoavaliar (2020)**

**Figure 30 – Point P03. Source: Geoavaliar (2020)**

#### 9.3.1.2 Parameters

To monitor the current air conditions, the parameters were considered: Total Suspended Particles (TSP), Inhalable Particles (IP - $PM_{10}$), Respirable Particles (RP - $PM_{2.5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Total Reduced Sulfur (TRS), Carbon Monoxide (CO), Ozone ($O_3$), Hydrogen Sulfide ($H_2S$) and Volatile Organic Compounds (VOC).

#### 9.3.1.3 Methods

The samples were taken at 3 points, and 7 collections occurred at each of the sampling locations (points), with an approximate duration of 24 hours for the parameters Total Suspended Particles (TSP), Inhalable Particles (IP - $PM_{10}$), Respirable Particles (RP - $PM_{2.5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Ozone ($O_3$), Hydrogen Sulfide ($H_2S$); approximately 1 hour for Total Reduced Sulfur (TRS) and Carbon Monoxide (CO) parameters; 20 minutes for Volatile Organic Compounds (VOC).

The references of the methodologies used are presented below.

- 40 CFR Appendix B to Part 50 - Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method);
- 40 CFR Appendix J to Part 50 - Reference Method for the Determination of Particulate Matter as $PM_{10}$ in the Atmosphere;
- 40 CFR Appendix L to Part 50 - Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere;
- ISO 4220:1983 - Ambient air — Determination of a gaseous acid air pollution index — Titrimetric method with indicator or potentiometric end-point detection;
- US EPA METHOD Nº QN 1277:1977 - Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere/
- EQOA-0206-148 - Environment S.A Model O342M UV Photometric Ozone Analyzer;
- US EPA EMC Conditional Test Method (CTM-030) - Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers;
- US EPA Method 16A - Total Reduced Sulfur – Impinger – Adapted Method for Air Quality Monitoring;
- US EPA Method 11 — Determination Of Hydrogen Sulfide Content Of Fuel Gas Streams In Petroleum Refineries – Adapted Method for Air Quality Monitoring;
- US EPA Method 18 - Volatile Organic Compounds by Gas Chromatography

In order to compare and assess the results registered, the limits stated by SEAM Resolution n. 259/2015 were considered and also the limits of the air quality standards presented by the US EPA - Environmental Protection Agency.

#### 9.3.1.4 Results

The results are presented in the table below.

# Table 1 – Results of first air quality campaign

| Resultados del Análisis<br>Concentración de Setiembre - Octubre/2019 | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Estación de Monitoreo | Colecta | Resultado del Monitoreo | | | | | | | | | | En acuerdo con la Resolución SEAM nº 259 del 3 de júlio de 2015 ( µg/m3 ) | | | | | | | | CETESB | |
| | | PTS (MP) µg/m³ (24 horas) | PI (PM10) µg/m³ (24 horas) | PI (PM2,5) µg/m³ (24 horas) | $SO_2$ µg/m³ (24 horas) | $NO_2$ µg/m³ (1 hora) | VOC µg/m³ (20 minutos) | $O_3$ µg/m³ (8 horas) | CO µg/m³ (8 horas) | TRS µg/m³ (1 hora) | $H_2S$ µg/m³ (24 horas) | PTS | PI (PM10) | PI (PM2,5) | $SO_2$ | $NO_2$ | VOC | $O_3$ | CO | TRS | $H_2S$ |
| Punto 01 - Senacsa/ Comision Departamental de Salud Animal | 1ª | 69,37 | 42,39 | 31,96 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 136,99 | 70,90 | 56,31 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 201,09 | 93,51 | 65,84 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 150,55 | 78,23 | 58,41 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 113,27 | 53,59 | 42,82 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 130,91 | 64,34 | 52,52 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 178,64 | 63,88 | 50,36 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Punto 02 - De Municipalidad de Loreto/ Paraguay | 1ª | 55,11 | 32,91 | 28,36 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 66,04 | 37,92 | 30,49 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 64,06 | 31,36 | 27,99 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 8,36 | 5,40 | 4,72 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | 150 | 30 | 20 | 200 | | 120 | 10 | 6,55 | 6,55 |
| | 5ª | 23,00 | 11,72 | 9,10 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 36,15 | 20,27 | 16,49 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 38,72 | 21,79 | 18,52 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Punto 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit | 1ª | 54,55 | 29,33 | 21,27 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 32,05 | 20,30 | 14,26 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 98,98 | | | | | | | | | | |
| | 3ª | 34,87 | 26,89 | 16,30 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 98,68 | | | | | | | | | | |
| | 4ª | 40,75 | 27,70 | 18,48 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 35,89 | 25,65 | 16,12 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 99,06 | | | | | | | | | | |
| | 6ª | 23,87 | 17,01 | 11,43 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 100,49 | | | | | | | | | | |
| | 7ª | 16,96 | 7,39 | 5,45 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 25,14 | | | | | | | | | | |

# Table 2 – Results of second air quality campaign

**Resultados del Análisis**
**Concentraciones de Febrero-Marzo/2020**

| Estación de Monitoreo | Colecta | Resultado del Monitoreo | | | | | | | | | | En acuerdo con la Resolución SEAM nº 259 del 3 de júlio de 2015 ( µg/m3 ) | | | | | | | | CETESB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PTS (MP) µg/m³ (24 horas) | PI (PM10) µg/m³ (24 horas) | PI (PM2,5) µg/m³ (24 horas) | $SO_2$ µg/m³ (24 horas) | $NO_2$ µg/m³ (1 hora) | VOC µg/m³ (20 minutos) | $O_3$ µg/m³ (8 horas) | CO µg/m³ (8 horas) | TRS µg/m³ (1 hora) | $H_2S$ µg/m³ (24 horas) | PTS | PI (PM10) | PI (PM2,5) | $SO_2$ | $NO_2$ | VOC | $O_3$ | CO | TRS | $H_2S$ |
| Punto 01 - Senacsa/ Comision Departamental de Salud Animal | 1ª | 59,93 | 34,35 | 23,95 | 17,63 | 1,09 | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 64,74 | 32,77 | 25,38 | 19,48 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 53,56 | 34,77 | 21,81 | 16,82 | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 48,89 | 29,94 | 19,18 | 13,28 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 49,91 | 27,52 | 16,79 | 12,46 | N.D. | 0,11 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 70,10 | 36,31 | 23,16 | 14,14 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 56,08 | 30,55 | 17,31 | 11,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Punto 02 - De Municipalidad de Loreto/ Paraguay | 1ª | 42,31 | 25,48 | 19,54 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 70,43 | 38,33 | 29,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 67,22 | 27,47 | 30,34 | N.D. | N.D. | 0,15 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 76,89 | 43,09 | 35,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | 150 | 30 | 20 | 200 | 20 | 120 | 10 | 6,55 | 6,55 |
| | 5ª | 40,11 | 26,30 | 20,66 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 59,36 | 26,96 | 20,74 | N.D. | N.D. | 0,38 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 60,93 | 30,70 | 23,28 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Punto 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit | 1ª | 107,18 | 38,13 | 27,37 | N.D. | N.D. | 0,01 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 83,68 | 29,73 | 20,09 | N.D. | N.D. | 0,21 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 165,03 | 58,49 | 44,16 | N.D. | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 103,01 | 42,58 | 25,62 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 133,13 | 49,92 | 27,51 | N.D. | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 74,95 | 31,48 | 19,22 | N.D. | N.D. | 0,24 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 132,30 | 45,49 | 26,11 | N.D. | N.D. | 0,15 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |

**Nota 1.** Límite establecido por medio de la Resolución SEAM 259/2015
**Nota 2.** No Existe límite en establecido en la Resolución SEAM 259/2015 para Compuestos Orgánicos Volatiles (COV). Asimismo, empleose el límite de exposición fijados por base horaria (TWA) por la "American Conference of Governmental Industrial Hygienists (ACGIH)" para Tolueno, el COV identificado en el análisis.
**Nota 3.** No existe límite para comparación fijados por la Resolución SEAM n 259/2015, para los parámetros TRS e $H_2S$. Asimismo, se empleo el límite de percepción del olor para $H_2S$ presente en la FISPQ del producto.

**PTS - Total Suspended Particles**

Considering Resolution n. 259/2015, there is no limit for Total Suspended Particles (TSP), being therefore in charge of the environmental body the interpretation of the reported results.

**Inhalable Particles (IP - $PM_{10}$)**

Considering the limit established by Resolution n. 259/2015, whose maximum permitted 24-hour concentration of Inhalable Particles ($PM_{10}$) is 150 µg/$m^3$, after comparing the results obtained in the two monitoring campaigns, it was confirmed that in the monitored period all data collections were below the limit established in the regulations.

**Respirable Particles (PR - $PM_{2.5}$)**

Considering the limit established in Resolution n. 259/2015, whose maximum concentration in the 24-hour period of Respirable Particles ($PM_{2.5}$) is 30 µg/$m^3$, after comparing the data obtained in the two monitoring campaigns, it was revealed that all the collections of Point 01, and one collection of Point 02, presented concentrations above the regulations. It is possible that this is material associated with re-suspension of particulate matter from unpaved roads and emissions from vehicles running on diesel fuel. Other data obtained showed concentrations below the limit established by the aforementioned resolution in the monitoring period.

According to GEOAVALIAR, the difference observed in the premises has its origin in circumstances around Point 01, in Concepción, Paraguay. That monitoring point has unpaved public roads and is largely diesel-fueled vehicles. Thus, the phenomenon of re-suspension of particulates and vehicle emissions contribute by the addition in the analyses performed, since Points 02 and 03 are located respectively in a small jurisdiction and rural area and show little or no influence on the events verified.

**$SO_2$ - Sulfur Dioxide**

Considering the limit established by Resolution n. 259/2015, and the maximum permitted 24-hour concentration of Sulfur Dioxide ($SO_2$) of 20 µg/$m^3$, after comparing the results obtained in the two monitoring campaigns, the concentration below the regulatory limit was verified, because it was not detected.

**$NO_2$ - Nitrogen Dioxide**

Considering the limit established by Resolution n. 259/2015, and the maximum permitted 1 (one) hour concentration of Nitrogen Dioxide ($NO_2$) of 200 µg/$m^3$, after comparing the data obtained in the two monitoring campaigns, it was verified that all data collected were presented below the limit, once the parameter was not detected.

**$O_3$ - Tropospheric Ozone**

It is verified that the data obtained in the two monitoring campaigns presented data below the limit established in Resolution n. 259/2015 whose average concentration of 8 (eight) hours is 120 µg/$m^3$.

**CO – Carbon Monoxide**

The results obtained in the two monitoring campaigns were below the limit established by Resolution n. 259/2015, whose 8 (eight) hour average concentration is 10 µg/ $m^3$.

**$H_2S$ - Total Reduced Sulfur and Hydrogen Sulfide**

There is no reference to emission limits for these parameters in the technical literature. Therefore, the control body must establish a comparison between the data obtained and international environmental regulations.

According to Geoavaliar, in Point 03 of the first campaign, possible sources of hydrogen sulfide pollutant emissions through lagoons and water wells containing vegetation in the process of eutrophication and putrefaction were verified in the location near the monitoring equipment and devices. From that consideration it's possible to consider the emission of hydrogen sulfide originated from the Anaerobic Digestion process (process of conversion of organic matter in conditions of absence of oxygen), are employed inorganic electron acceptors such as $NO_3$ (reduction of Nitrate), $SO_4$ (reduction of Sulfate) or methane formation ($CH_4$). Anaerobic digestion can be considered as an ecosystem of different groups of microorganisms that are in interaction to convert complex organic matter into methane, carbon gas, water, hydrogen sulphide and ammonia gas, and other new bacterial cells. It should be noted that the results obtained are expressed in micrograms per cubic meter of air collected, and any source of contribution in the vicinity is capable of significantly altering the results.

In the second campaign, it was observed that the contaminants Hydrogen Sulfide and Total Reduced Sulfur are below the odour perception limit for $H_2S$ by the IFCS (6.55 $\mu g/m^3$).

**VOCs - Volatile Organic Compounds**

The results obtained are significantly below the American Conference of Governmental Industrial Hygienists (ACGIH) average daily value for toluene exposure of 20 ppm. The comparative value was adopted since Resolution n. 259/2015 does not state a standard for that contaminant.

## 9.4 Noise

This item presents the results of the Environmental Noise Monitoring Report for the area surrounding the PARACEL pulp mill in Concepción - Paraguay, and aims to verify the environmental sound pressure level present in the area, prior to the implementation and operation of the plant (background levels).

The research work (in the field) to measure environmental sound pressure levels was carried out by the Pöyry team on October 24$^{th}$ and 25$^{th}$, 2019.

Environmental sound pressure levels were measured at 05 different points in the day and night period, covering 10 measurements. The values obtained were compared with the limits established by the Law for the Prevention of Noise Pollution (Law n. 1,100/97).

The complete report is presented in **ANNEX I** of this document.

### 9.4.1 Relevant Law

Law n. 1,100/1997 aims to prevent noise pollution on public roads, squares, parks, sidewalks, exhibition halls, meeting centers, sports and social clubs and in all public and private activities that produce noise pollution in Paraguay.

Article 9th of the aforementioned law establishes the noise limits, according to the type of environment, as shown in the table below.

**Table 3 – Noise limits established by Law 1100/97 (in decibel "A" dB (A))**

| Environment | Night (20:00 – 07:00) | Day (07:00 – 20:00) | Day (Occasional peak) (07:00 – 12:00 / 14:00 – 19:00) |
|---|---|---|---|
| Residential areas, specific use, public spaces: recreation areas, parks, squares and public roads | 45 | 60 | 80 |
| Hybrid areas, transition areas, city center areas, specific programs, service areas and public buildings | 55 | 70 | 85 |
| Industrial area | 60 | 75 | 90 |

The article 9th states:

- Occasional Peaks: discontinuous noises and sounds that exceed the permitted levels and occasionally occur during the day, with a maximum of twenty peaks per hour. This noise and sound level will only be permitted at the following times: from 7:00 to 12:00 and from 14:00 to 19:00;
- The residential, mixed and industrial areas are those that will be defined in the regulatory plan of each Municipality with their characteristics and established activities.

The noise level guidelines, according to the World Bank Group General EHS Guidelines is shown in the table below.

**Table 4 – Noise limits established by World Bank Group General EHS Guidelines**

| Receptor | Daytime (07:00 – 22:00) | Nighttime (22:00 – 07:00) |
|---|---|---|
| Residential; institutional; educational | 55 | 45 |
| Industrial; commercial | 70 | 70 |

### 9.4.2 Locations of point analysis

To define the measurement points, the area around the PARACEL pulp mill was considered, prior to implementation and operation (background).

A total of 05 (five) different points were defined for the measurement of the sound pressure level in the environment, in the daytime and nighttime periods, totaling 10 measurements, as described in the following table.

**Table 5 – Points of analysis for environmental noise pressure.**

| Point | Place | Coordinates | |
|---|---|---|---|
| | | Latitud | Longitud |
| NO01 | Cerrito | 23°15'4.62"S | 57°29'36.53"O |
| NO02 | Horno Carbón | 23°13'31.85"S | 57°29'33.20"O |
| NO03 | Policía Laguna | 23°12'4.55"S | 57°27'20.60"O |
| NO04 | Pyrendá | 23°14'23.26"S | 57°26'19.28"O |
| NO05 | San Miguel | 23°16'27.03"S | 57°27'25.65"O |

The following figure shows the map with the location of the 05 measurement points, while the other figures show images of each measurement point.

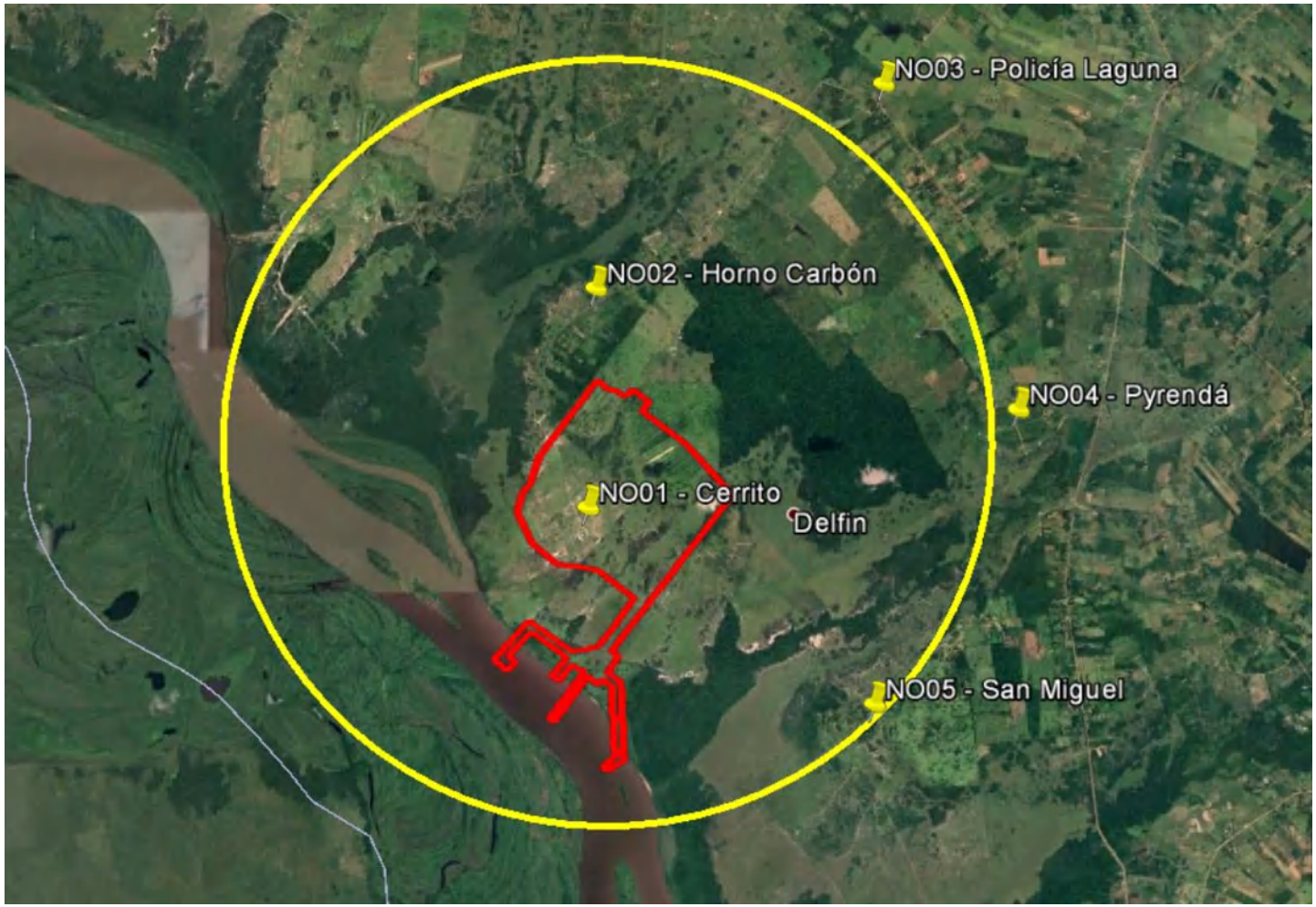



**Figure 31 – Map of the location of the 5 ambient sound pressure level measurement points. Source: altered from Google Earth (2021)**

**Figure 32 – Point NO01 (23°15'4.62"S; 57°29'36.53"O). Source: Pöyry Tecnologia (2019)**

**Figure 33 – Point NO02 (23°13'31.85"S; 57°29'33.20"O). Source: Pöyry Tecnologia (2019)**

**Figure 34 – Point NO03 (23°12'4.55"S; 57°27'20.60"O). Source: Pöyry Tecnologia (2019)**

**Figure 35 – Point NO04 (23°14'23.26"S; 57°26'19.28"O). Source: Pöyry Tecnologia (2019)**

**Figure 36 – Point NO05 (23°16'27.03"S; 57°27'25.65"O). Source: Pöyry Tecnologia (2019)**

### 9.4.3 Methods

The measurement methodology was based on the instructions of NBR 10.151/2019 (from Brazil). The evaluation method consisted in measuring the equivalent sound pressure level (LAeq) in A-weighted decibels, commonly called dB(A), as recommended in chapter 1.3 of NBR 10.151/2019.

The measurements had been performed at points located about 1.2 meters from the ground and at least 2.0 meters from the property boundary and from any other reflective surface, such as walls, barriers, etc.

The time for measuring the ambient sound pressure level was 3 minutes for each point sampled. During the measurements, wind protection from the microphone was used.

The evaluation of the sound pressure was made in the 2 periods recommended by NBR 10.151/2019, that is, day and night periods.

### 9.4.4 Equipment

The characteristics of the sound level meter and acoustic calibrator used in this monitoring are presented below. The certificates are presented in VOLUME IV - Noise Monitoring Report.

**Characteristics of the sound level meter device**

- Model: Decibelimeter DT-8852
- Norm of Reference: IEC 61672-1 Class 2
- Precision: ± 1,4 dB
- Frequency Ray: 31.5 Hz ~ 8 KHz
- Dynamic scale: 50 dB
- Memory data: 32.700 data
- Scale levels:
    - Lo (low): 30 dB ~ 80 dB
    - Med (medium): 50d B ~ 100 dB
    - Hi (high): 80 dB ~ 130 dB
    - Auto: 30 dB ~ 130 dB
- Frequency shift: A/C
- Time shift: “fast” (125 ms) and “slow” (1s)
- Microphone: 1/2 inch with eletrical capacitor
- Resolution: 0,1dB
- Serial number: 150622900
- Calibration certificate n. 3547
- Calibration date: 08/03/2018

**Characteristics of the acustic calibrator**

- Model: Calibrator SC-05
- Norm of Reference: IEC 60942 Class 2
- Noise pressure levels outlet: 94 dB e 114 dB
- Frequency outlet: 1.000 Hz ± 4%
- Precision: ± 0,5 dB
- Serial number: 150621430
- Calibration certificate n. 3885
- Calibration date: 07/03/2018

### 9.4.5 Results and Conslusions

The results of the sound pressure level measurements at the 05 measurement points and the comparison with the limits defined by Law n. 1,100/97 are presented below.

The location of the PARACEL pulp mill has no defined zoning. Therefore, the comparison of the results will be made within the limits of the Mixed Areas and Industrial Areas stated by Law n. 1,100/97; and World Bank Group General EHS Guidelines references.

**Table 6 – Results of environment sound pressure level measurements**

| Point | Distance from the pul mill (km) | Period | Time | Law n. 1,100/97 (legal standards) | | World Bank Group General EHS Guidelines | | Results LAeq (dB(A)) |
|---|---|---|---|---|---|---|---|---|
| | | | | Mixed area | Industrial area | Residential; institutional; educational | Industrial; commercial | |
| NO01 - Cerrito | 0,0 | Day | 12:11 | 70 | 75 | 55 | 70 | 43,1 |
| | | Night | 20:36 | 55 | 60 | 45 | 70 | 35,0 |
| NO02 - Horno Carbón | 1,0 | Day | 10:58 | 70 | 75 | 55 | 70 | 50,7 |
| | | Night | 21:00 | 55 | 60 | 45 | 70 | 38,8 |
| NO03 - Policía Laguna | 4,9 | Day | 10:38 | 70 | 75 | 55 | 70 | 43,1 |
| | | Night | 21:20 | 55 | 60 | 45 | 70 | 50,2 |
| NO04 - Pyrendá | 4,1 | Day | 10:16 | 70 | 75 | 55 | 70 | 34,5 |
| | | Night | 21:48 | 55 | 60 | 45 | 70 | 35,9 |
| NO05 - San Miguel | 3,2 | Day | 09:50 | 70 | 75 | 55 | 70 | 43,5 |
| | | Night | 19:35 | 55 | 60 | 45 | 70 | 46,9 |

The results of the environmental sound pressure level measurement in the area near the PARACEL pulp mill were between 34.5 dB(A) and 50.7 dB(A) during the daytime period; and between 35.0 dB(A) and 50.2 dB(A) during the nighttime period. These results are below the limits of the mixed and industrial areas, defined in Law n. 1,100/97.

The measurement points are located in houses up to 4.9 km away from the site where the PARACEL pulp mill will be located. In this campaign, which was intended to define the background of the area, the highest results, in the day and night periods, originated from the sounds emitted by animals, birds and the movement of people and vehicles.

## 9.5 Geology

From a geological point of view, Paraguay is located on two different formations: the Brazilian shield and the Andean Depression, which largely correspond to the regions already mentioned. The eastern region is more diverse in its origin, with formations originating in the Mesozoic, Paleozoic and even the Agnostozoic, one of the oldest formations, while the whole of the Chaco territory, with few exceptions, corresponds to

Tertiary layers, with relatively recent geological ages between two and 65 million years (DBEnvironnement, 1999).

The following figure presents a synthesis of the geology of Paraguay and the stratigraphic column of the geology of Paraguay. The regional geological characterization and the areas of influence of the PARACEL pulp mill are presented below, with data from the website of the Vice-Ministry of Mines and Energy.

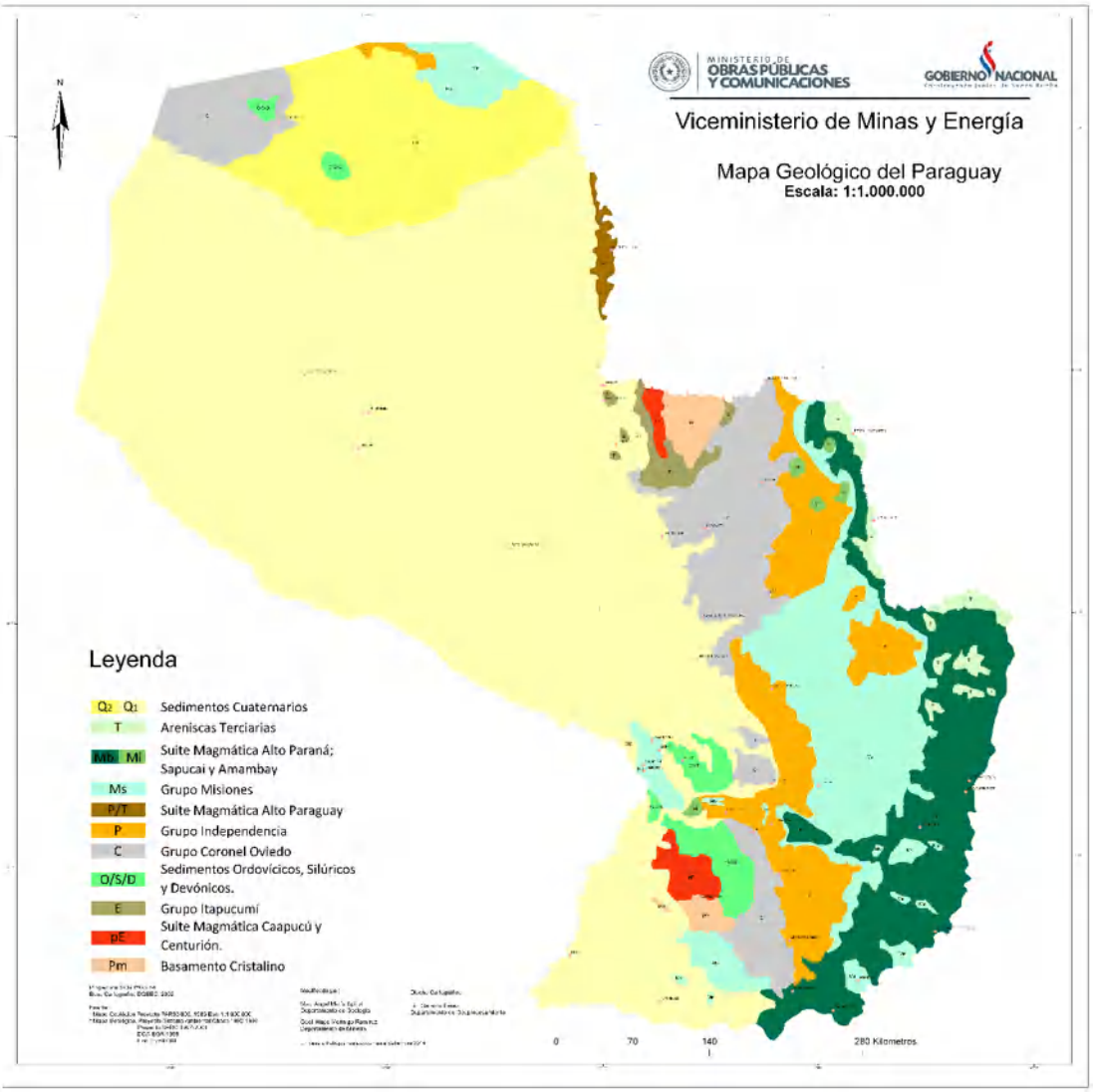



**Figure 37 – Synthesis of the Geology of Paraguay. Source: González, 2000**

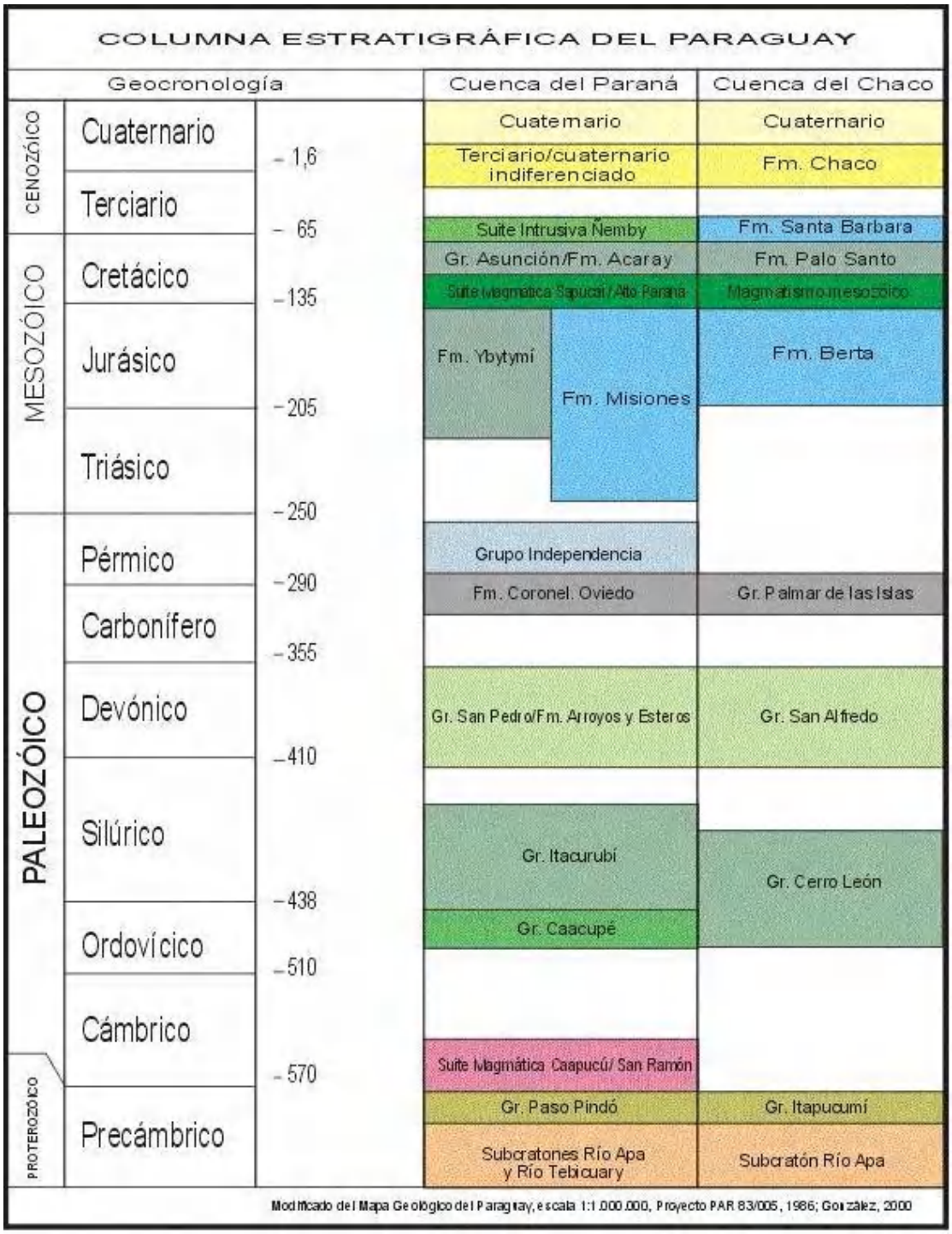



**Figure 38 – Tectonic-Stratigraphic Column of Paraguay. Source: González, 2000**

### 9.5.1 Regional Characterization (IIA)

#### 9.5.1.1 Chratonical Provinces

The Chrathonic Provinces of Paraguay are located mainly in the Eastern Region and occur in two distinct areas. One to the north in the border area with Brazil, called the Province of Rio Apa and the other, the Province of Rio Tebicuary in the Central-South.

Both provinces are formed by chronic blocks that include the oldest units with Paleoproterozoic ages, Meso Proterozoic Folded Belts and Neoproterozoic-Eocambrian platform units.

The Apa River Block is made up of the homonymous complex and is represented mainly by gneiss, mafic and leukocratic, granite-gneiss, metasediments and granitic-pegmatic intrusives of Lower to Middle Proterozoic age and the Centurion Magmatic Suit corresponding to thick granite-type plutonic-volcanic rocks, sometimes porphyritic and acidic to intermediate pyroclastic metavolcanic rocks, of Middle Proterozoic age (K/Ar 1,650 ± 63 Ma).

The Apa River Complex is disproportionately covered by carstic metasedimentites of the San Luis Group, in its western portion, while in the eastern part it is superimposed by carbonate-classic rocks of the Itapucumi Group of Vendian age. Both units, in turn, are intruded by plutonic igneous and intermediate acidic volcanic rocks called San Ramon Magmatic Suites. This last magmatism is considered a non-detectonic event of the Brasiliano Cycle.

The Province of Rio Apa is mainly a producer of limestone, calcite, dolomitic and marble. It also presents anomalies of metallic minerals such as Ag-Pb-Zn and tin; in addition, there are quartz veins, pegmatites carrying large sheets of muscovite and other pegmatites carrying tourmaline and beryl.

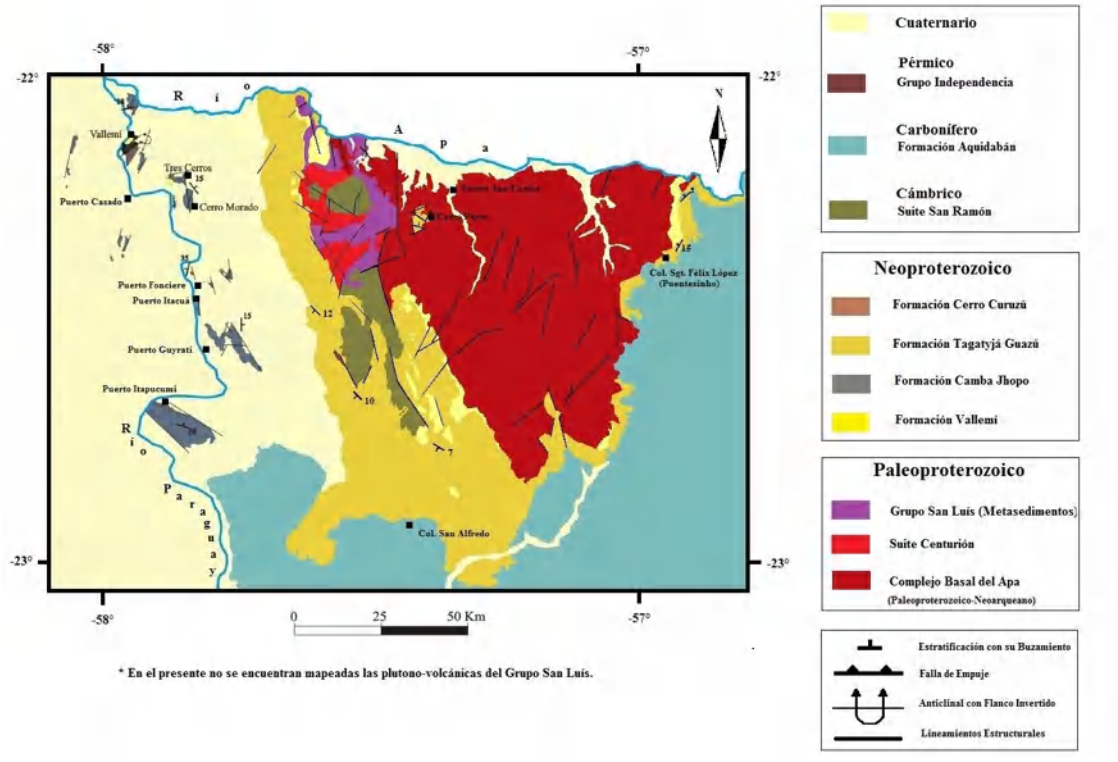



**Figure 39 – Craton of Apa river. Source: website Geología del Paraguay**

The Rio Tebicuary Block located southeast of Asuncion is represented by three lithostratigraphic units: Rio Tebicuary Complex, Paso Pindó Group and the Caapucu Magmatic Suite.

The Tebicuary River Complex includes two units: the Villa Florida Metamorphic Suite and the Centu-Cué Granodiorite. The first one gathers a set of crystalline rocks affected by regional metamorphism of medium to high degree, within the amphibolite and

granulite facies, of Lower Proterozoic age, Transamazonian Cycle (2,000 ± 200 Ma). Lithologically, this unit is constituted by paragneis and orthogneis, associated with quartzite, chalcosilicate, marble, amphibolite and ultrabasic rocks, transformed into talc shale and serpentinite. On the other hand, the second unit is represented by intruded porphyritic acid rock in the gneisses. This last event evidences intense deformations during the synthetodetectonic phase of the Trans-Amazonian Cycle, generating folding, migmatization and fracturing.

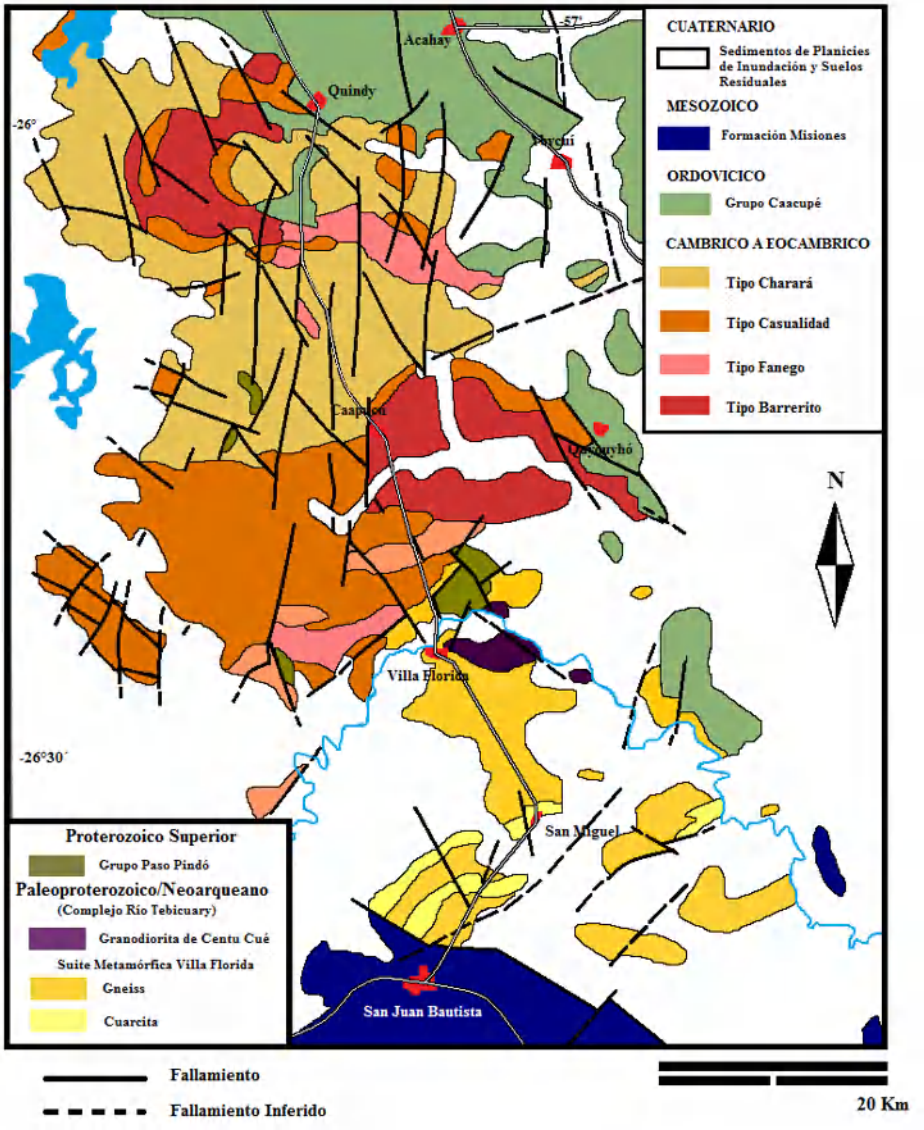



**Figure 40 – Craton of Tebicuary river. Source: website Geología del Paraguay**

The Paso Pindó Group takes a divergent position on the Tebicuary River Complex. This unit, made up of silica sediments and volcanic-clastic sediments, has been affected by a low grade metamorphism (easy from green shales), during the Brasiliano Cycle, in the Upper Proterozoic (± 600Ma).

The Caapucu Magmatic Suite intrudes in the post-tectonic phase of the Brasiliano Cycle to the Tebicuary River Complex and the Paso Pindó Group. This acidic magmatic event is constituted by rocks with several emplacement levels (plutonic, hypoabyssal and

effusive), mainly from coarse to porphyritic granites, granite/rhyolite porphyry and rhyolite, of Rb/Sr 531 ± 5 age (Cubas et al. 1997).

Small isolated occurrences of granitic rocks in the Caapucu Magmatic Suite, occur in the center of the Eastern Region, associated with the structuring of the Asuncion Rift.

With regard to tectonics, the Tebicuary River Block can be divided into two main events: the Trans-Amazonian Cycle (Tebicuary River Complex) and the Brazilian Cycle (Paso Pindó Group and Caapucú Magmatic Suite).

#### 9.5.1.2 Phanerozoic Basin

The Phanerozoic in Paraguay is represented by two large basins: Chaco Basin and Parana Basin. In them, sedimentary sequences of ages: Ordovisic/silurian constitute the deposition base, in the marginal zone of the Paleo-Pacific Plate, before the subduction with the Gondwana continent.

##### 9.5.1.2.1 Paraná Basin

The Paraná River Basin covers a vast area of the South American continent, approximately 1,500,000 $km^2$, occupying parts of southern Brazil, northeastern Argentina, eastern Paraguay and northern Uruguay. With its major axis oriented in the NNE-SSW direction and its structural depocenter located along the Paraná River, with a record of sedimentary and volcanic rocks, whose total thickness exceeds 7,000 meters.

In Eastern Paraguay, six wide-scale sedimentary sequences or super sequences are recognized, separated from each other by regionally discordant surfaces (MILANI, 1997).

The first super sequence of Ordovician/Silurian age is found in discordant contact on the crystalline basement, observed east of Asunción, in the Acahay Valley and bordering the northeast of the Tebicuary River Block. This is a group of sedimentary rocks deposited in a continental environment that is morphologically abrupt, in lateral contact with a transgressive sea, which reaches the maximum flooding in the Lower Silurian. In its coastal environment it deposits conglomerates, interspersed with conglomerate sandstones, which gradually turn into sandstones, forming a group of thick clastic rocks called the Caacupé Group. Concurrently, the sequence continues with clastic rocks of the Itacurubi Group, mainly made up of fine sandstones, shales and claystones, highly fossiliferous, constituting the geochronological supports of the sequence, with the inferior Silurian llandover age.

Devonian-age rocks are arranged in discordance with the previous one, in continental and marine deposits. Rocks of marine origin were not directly observed in the field, being identified only in the Asunción 1 and 2 exploratory wells (PECTEN, 1982), in which about 450 meters of these sediments were described. Those of continental origin rest in erosive discordance on the Silurian fossiliferous units. These have been first identified in wells and called Santa Elena Formation (GONZÁLEZ ET AL., 1994), later geological mapping works defined coarse sandstones as belonging to this unit, calling them Arroyos and Esteros Formation (DIONISI, 1999).

The deposition of the Devonian sequence is interrupted by continental readjustment tectonism (Eoherceric Orogenia). This event is responsible for the restructuring of the basin in the Lower Carboniferous, with sedimentation resuming from the Upper Carboniferous (Stephaniano), as the third Carboniferous/Permian super sequence. It is

environmentally influenced by very varied climatic conditions, beginning under glacial and periglacial dominance, depositing the Aquidaban and Coronel Oviedo formations, as a succession of continental and marine clastic sediments. The Permian deposits, in regional agreement, sediments of continental wind and fluvial, coastal and marine environments, which in a lithologic point of view are characterized by sandstones, siltstones, claystones and limestones, which agglutinate in the Independencia Group.

The continentalization of the Paraná Basin from the Upper Permian, in the Triassic, deposited continental fluvial and eolian sandstones, called Misiones Formation. This group is distributed in a north-south strip, deposited in discordance on carboniferous/Permian rocks.

The Misiones Formation windsand sandstones are characteristically quartz sandstone, homogeneous, with little clayey material as a matrix, little cemented, friable, saccharine and locally silicified. Overlying and interspersed with the aeolian sandstones there are intrusions and extrusions of basaltic rocks of the Upper Parana Magmatic Suite. These are presented as lava spills, sills and dikes in sediments of the pre-existing units, in preferential northwest-southeast directions. Petrographically the basaltic rocks show a subophytic texture, joint crystallization of pyroxene and plagioclase, of age between 127 and 108 million years. The upper divergent contact of the suite is deposited sandstones of the Acaray Formation and/or quaternary sediments.

#### 9.5.1.2.2 Del Chaco Basin

The Chaco Basin is bounded on the west by the Andes Mountains and on the east and northeast by the Brazilian shield; it occupies an area of 246,725 $km^2$, in the Western Region of Paraguay. It is a pericratonic basin, formed by several depocenters or sub-basins separated by structural highs, each one of them with a unique tectonic-sedimentary record. To the NW the Curupayty and Carandayty sub-basins are accommodated, both representing areas with well-developed Paleozoic sequences. On the other hand, Mesozoic-Cenozoic subsidence areas occur mainly in the Pirity and Pilar sub-basins. The tectonic style of the Chaco Basin is characterized by the presence of NW and NE structural guidelines of Brazilian age. Later reactivations of these structures, during the Paleozoic, result in the characterization of four subsidence cycles: Lower Paleozoic, Upper Paleozoic, Upper Mesozoic and Cenozoic. The phases are separated by erosive discordances or absence of sedimentation.

The sedimentary cycle of the Lower Paleozoic is represented by continental and marine clastic deposits of Ordovician, Silurian and Devonian ages. The Ordovician-age sediments (Cerro León Group) are preserved in depth in the Carandayty sub-basin. In contrast, occurrences of sedimentary rocks attributed to the Silurian and Devonian are presented in the northwestern portion, associated with high structures (Cerro León and San Alfredo Range).

The sedimentary cycle of the Upper Paleozoic, carboniferous/permian sequence, constitutes the Group “Palmar de las Islas”, mainly composed of deposits in the Carandayty and Curupayty sub-basins, as well as some outcrops in the northern portion of the Chaco, associated with the Alto de Lagerenza. The Carboniferous age sediments are composed of two units, a lower one or San José Formation, made up of sandstones combined with claystones, sticks and diamictites. The upper unit or Cabrera Formation, starts with local conglomerates and mainly sandstones, with higher levels of clay and oolitic limestone.

The Mesozoic/Cenozoic unit, called the Adria Jara formation, is composed of sandstones with conglomerate levels and claystone, found mainly in the Curupayty sub-basin, in erosive discordance on carboniferous sediments.

On the other hand, the Mesozoic-Cenozoic sediments in the Pirity sub-basin comprise three formations: Berta, Palo Santo and Santa Barbara. The first is made up of sandstones interspersed with claystone, the second is made up of intercalations of conglomerate sandstones, sandstones, claystones, marls and evaporites; finally, the Santa Bárbara Formation consists of sandstones, siltstones, claystones, evaporites and calcareous.

In the Pirity sub-basin there are magmatic rocks of basaltic composition of Lower Cretaceous age (128 ±5 Ma).

During the Lower to Middle Eocene, between 500 and 1,000 meters of continental sediments were deposited in several depots of the Chaco Basin, in marine parts, called Chaco Formation. In general, this formation consists of alternating sandstones, silts and claystones.

The Quaternary period in the Chaco Basin is a continuity of the Chaco Formation sedimentation, with heterogeneous continental deposits.

#### 9.5.1.3 Alkaline Magmatism

The alkaline rocks of Paraguay occur in various parts of Eastern Paraguay distributed in six provinces: Alto Paraguay, Rio Apa, Amambay, Central, Asuncion and Misiones, these rocks are tectonically associated with extensional structures (continental rifts, intersection of structural lines and lines in areas of chronic margins), which affected the western portion of the Parana Basin in the Mesozoic. The alkaline provinces of Paraguay differ from each other in their petrographic, chemical, geochronological and tectonic characteristics.

The petrographic composition of these rocks presents great variation, with greater predominance of alkaline silica rocks, unlike carbonatite rocks which are restricted to only one province (Amambay Province). Chemically, the silicatic lithologies vary from ultrabasic to acidic and in general represent differentiated petrographic terms. As for the Na/K ratio they can be differentiated in sodium alkaline provinces and potassium alkaline provinces.

Evidence from geology and geophysics indicates that the conditions of alkaline rocks in Paraguay are strongly controlled by a distensional tectonics developed during the Mesozoic, related to the fragmentation of the Gondwana and opening of the South Atlantic

In terms of geochronology, these rocks cover a wide age spectrum extending from 255 million years to 39 million years.

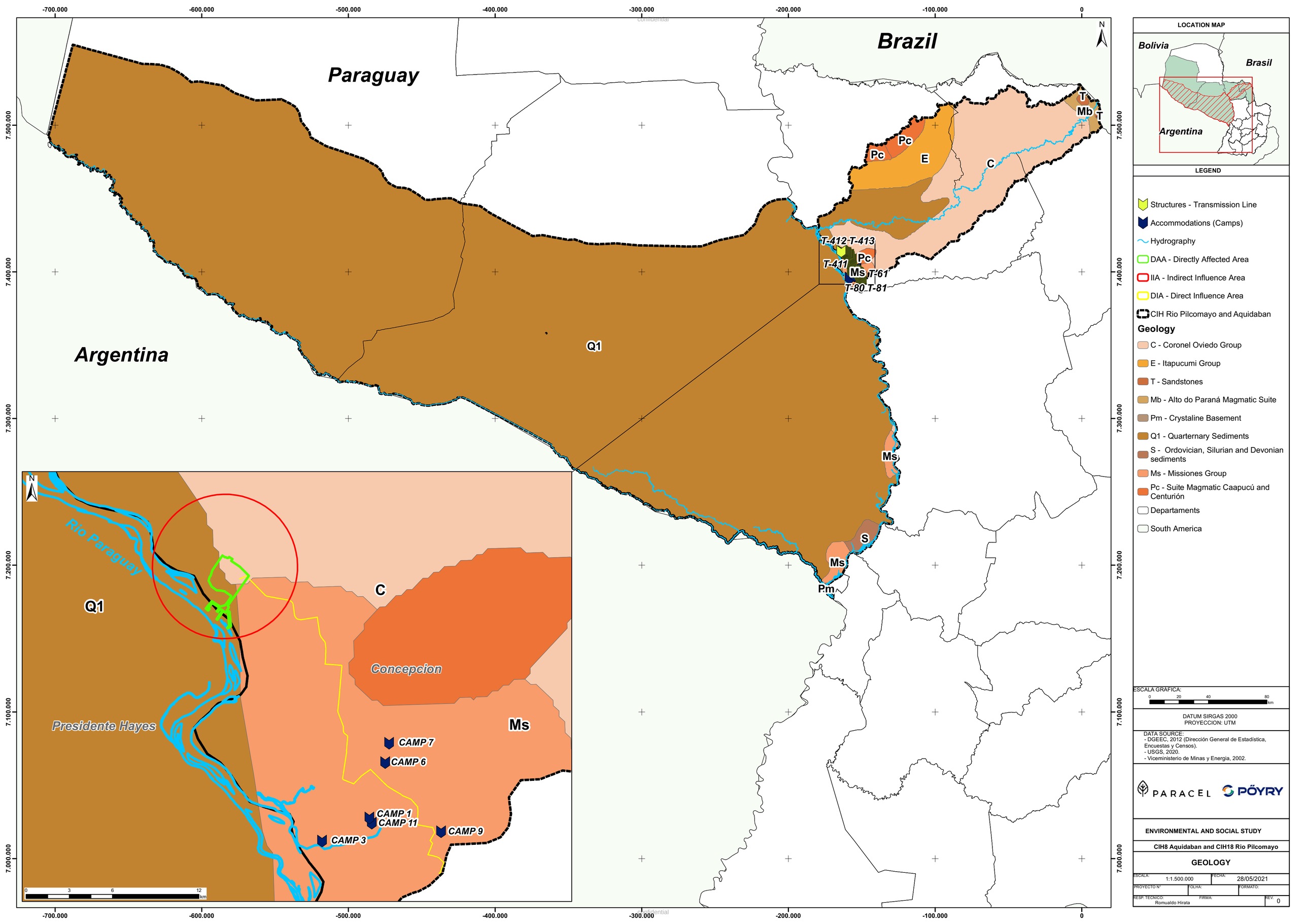
In general, alkaline rocks are associated with Paleozoic-Mesozoic sediments and are covered by recent alluvial deposits.

The mode of occurrence is also quite diversified and varies from province to province. The intrusive forms appear as annular complexes (Alkaline-Carbonate Complex) and stocks. The extrusive forms include lavas, domes and plug and the hypoabyssal forms generally in the form of embankments or swarms of embankments.

### 9.5.2 Local Characterization (DIA)

The PARACEL pulp mill is inserted in 3 different groups, which are C - Coronel Oviedo, Q1 - Quaternary Sediments and Ms - Missions Group, as shown in the map below.

**Figure 41 – Geology map of the influence areas**



Paraguay
Brazil
Argentina
Q1
Pc
E
C
T
Mb
T-412
T-413
T-411
Ms
T-61
T-80
T-81
S
Pm
Rio Paraguay
Presidente Hayes
Concepcion
CAMP 7
CAMP 6
CAMP 1
CAMP 11
CAMP 3
CAMP 9
LOCATION MAP
Bolivia
Brasil
Argentina
LEGEND
Structures - Transmission Line
Accommodations (Camps)
Hydrography
DAA - Directly Affected Area
IIA - Indirect Influence Area
DIA - Direct Influence Area
CIH Rio Pilcomayo and Aquidaban
Geology
C - Coronel Oviedo Group
E - Itapucumi Group
T - Sandstones
Mb - Alto do Paraná Magmatic Suite
Pm - Crystaline Basement
Q1 - Quarternary Sediments
S - Ordovician, Silurian and Devonian sediments
Ms - Missiones Group
Pc - Suite Magmatic Caapucú and Centurión
Departaments
South America
ESCALA GRAFICA:
DATUM SIRGAS 2000
PROYECCION: UTM
DATA SOURCE:
- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).
- USGS, 2020.
- Viceministerio de Minas y Energia, 2002.
PARACEL
PÖYRY
ENVIRONMENTAL AND SOCIAL STUDY
CIH8 Aquidaban and CIH18 Rio Pilcomayo
GEOLOGY
ESCALA: 1:1.500.000
FECHA: 28/05/2021
PROYECTO N°
FOLHA:
FORMATO:
RESP. TECNICO: Romualdo Hirata
FIRMA:
REV. 0

#### 9.5.2.1 C – Coronel Oviedo Group (Independencia Group)

The group is made up of the San Miguel and Tacuary formations, of Permian age, which emerge in Eastern Paraguay in an area of 7,996 km$^2$. The name Independencia Serie was used by Harrington (1980), to designate the sedimentary layers of the upper Permian. In 1956, the same author designated the same unit of the Independencia Formation, (ECKEL, 1959) he again used the denomination Independencia Series in a Gondwana or Santa Catarina system. Putzer (1962) called the Permian age layers the Passa Dois Serie.

In the description of the geology of grid 41, Coronel Oviedo (ANONYMOUS, 1966), the lower and middle Permian-age layers are called the Ybytyruzú Series, divided into the Pañetey and Independencia Formations. Wiens (1982) proposes for the Permian the division into San Miguel, Tacuary, Tapytá and Cabacuá formations. In the preliminary adaptation of the stratigraphic column of Paraguay, for the PAR-83/005 Project, these formations were gathered in the Independencia Group. In this explanatory text the Independencia Group is divided into the San Miguel and Tacuary formations with the elimination of the Tapytá and Cabacuá formations which, in reality, belong to the base of the Triassic/Jurassic age unit.

The group emerges maintaining the direction of the so-called Gondwanic layers, N-S/NNW-SSE, with dipping towards the E, in areas that are frequently faulty. North of the Jejuí/Aguaray Guazú Fault zone, in the Alto Apa, the Group is absent due to erosion in the Lower Triassic. The formations of the group are correlated with the units of the groups Guatá and Passa Dois, in the Paraná Basin, in Brazil.

#### 9.5.2.2 Q1 – Quaternary Sediments - San Antonio formation

The accumulated sediments are grouped here, near the area of the Paraguay River and its tributaries, which are at a lower elevation of 70 meters, in the eastern region of the country. It covers an area of 60,782 km$^2$. It is made up of a light creamy sandstone, of medium to coarse granulation with scattered gravel, interspersed with shales. The sandstones, in contact with these shales, present clay clasts. There are also layers of clayey sandstones up to 1.5 metres thick. The sedimentation environment is essentially water-based (fluvial).

In Candú Creek, on the property of Señor Virgilio Larrea, there are vertebrate fossils that were described by Presser and Crosa (1984). These fossils found in the described place, in the locality of Ytororó, are contained in a sedimentary succession described by the mentioned authors as:

- Blue-green sediments, with good selection, predominance of medium-grained sands, apparently solid, associated with clay sheets;
- Poorly selected sediments with a predominance of medium to thick sand and secondary layers of clay. They present levels with fossils in contact with the previous sequence and;
- Spotted sediments, with good selection, with medium grain sands and subordinate fine sands and clay. Apparently massive.

According to the same authors, the fossils found are typical of a Pleistocene fauna and present three species of Glyptodonts, two of Lestodontes and one of Megatherion associated with other vertebrates not clearly systematized.

The name San Antonio formation is formally proposed for the lithostratigraphic designation of these sediments, based on a proposal by Palmieri and Velazquez (1982). In the valleys of the current drainage network of Eastern Paraguay, from the Apa River in the north to the Paraná River in the south and east, and the Paraguay River in the west, there is an extensive deposition of Holocene age sediments.

#### 9.5.2.3 Ms – Missiones Group

The sediments of the Misiones Fm. have emerged in Eastern Paraguay according to the same structural direction of the previous Gondwanic units. It covers an area of approximately 35,000 $km^2$. The basal contact is by erosion discordance with the Carboniferous and Permian units.

The Misiones Fm. represents the diverse sub-environments of a great climatic desert of increasing aridity, whose existence was prolonged until the basaltic volcanism of the Trapp of the Paraná.

The winds that moved the desert dunes came from the north to the northeast of the source.

The Misiones Fm. is characterized by red sandstones of Mesozoic age, in which ancient units edge with a very subtle erosive disconformity, not recognizable at the surface level.

To the north of the Jejuí/Aguaray Guazú fault, the lower contact is over sediments of the Aquidabán Fm. (Permian-Carboniferous) and to the south of this structural element, with the Permian Tacuary Fm. The roof of the formation, throughout the country, is covered in erosive discordance by the basalts of the Upper Parana formation (Jurassic-Cretaceous).

In the geological map this formation is represented by a discontinuous strip of protrusions where the North (Pedro Juan Caballero), to the South, in the region of San Juan Bautista. It also appears inside the basaltic "plateau", as in the area adjacent to the Paraná River, between Encarnación and Trinidad (Route 6). The formation has two sedimentary layers, one of fluvial origin and the other, predominantly of wind origin. The sedimentary layer in the river environment occupies preferably a basal part of the formation, but it can also be found in the sandy sediments of wind origin. This basal layer (facies) is made up of essentially solid sandstones, locally with crossed stratification, fine to medium grain and interspersed clayey layers. There are also conglomerate levels or breccias with clay clasts, siltstone and shales, with a small lateral continuity of the sandy bodies.

The basal part thus represents a facies of alluvial plains associated with a river environment. This section of the formation was divided by Wiens (1982), into two formations, called Tapyta and Cabacuá, with about 325 meters thick and its definition was made based on in-depth descriptions. In the Paraná Basin, a fluvial depositional phase associated with the base of the Misiones Formation has been known for a long time. Sometimes this basal fluvial phase is separated into a specific formation, as in Brazil, the Pirambóia Formation. At regional level this separation in mapping becomes difficult to demonstrate. Taking into account a good aquifer and the maps distinguishing the two formations, it is concluded to erroneous interpretations. More detailed studies, especially in groundwater prospecting, show that the two units, river and wind, are interdigitated.

The wind part is characterized by a remarkable bi-modality in the granulometric distinction in blades of a few millimeters. They present larger cross stratifications with crossed "sets" starting with grains of 500-700µ and ending with 177-250µ. In the region of Colonia Independencia, in the locality called Salto Boni, you can observe sandstones with bimodal granulation (350-500µ and 500-710µ) with wide sets of crossed stratification, with more than 4 meters long by 1.5 meters high. The sandstone is strongly silicified and has an intrusive saddle at the bottom. The slope of the strata is between 10 and 20° and the face of the escarpment is exposed to about 25 meters in height. Under the intrusive body, the sandstones show sets of crossed strata over 12 meters long and up to 3 meters high.

The Misiones formation is transgressive over all other sedimentary units in the basin, including the Crystalline Basement. This transgressive is due to extensive tectonic movements of a vertical nature, which devastated the basin at the end of the Permian or at the beginning of the Triassic, caused simultaneously by the fragmentation of the Pangaea and the uplift of the Paleozoic Andes (Permo-Triassic). The sedimentary environment, predominant for this formation (wind), is also an important factor in the transgressive character, especially because of the advance of the sand dunes over the paleo-topography.

Locally, it may present conglomerate layers at its base, made up of quartz and quartzite cobbles, as in the vicinity of San Juan Bautista, never exceeding 2 meters (GÓMEZ DUARTE, verbal information).

These layers can also run along the column next to more fluvial facies. The edges commonly show wind work, all of them being quite polished (result of wind erosion).

The Triassic age, proposed for the beginning of the sedimentation of this unit, is based on the contact of this formation with the lower unit, Tacuary Formation, well described in the literature on this matter, in the Paraná Basin. In the E margin of the Basin, the contact zone is characterized by a level of fossil regolith (fossil soil) indicating, in its conformation, an almost gradual passage towards different sedimentation conditions. Towards the interior of the basin, the passage is transitional. On the W margin of the basin, in Eastern Paraguay, the contact between the Tertiary Formations and Misiones can be observed on the Mbocayaty route and Colonia Independencia, 17 km from the first city, on the route and on a lateral road that starts in this place.

At this point, the base of this unit (Misiones formation), presents clayey sandstones with crossed stratification and clasts of shales from the Tacuary Formation, in the "foresets" of the crossed strata. The granulometry of the sandstones that carry the shale clasts is between 250-350 µ and between 500-710 µ for the sandstones with crossed stratifications of greater size. However, the area is very faulted these sandstones with shale clasts of the oldest unit constitute a basal breccia of the Misiones formation, well described in the fossil regolith level of the basin. As in Eastern Paraguay, the Misiones formation is crossed by alkaline intrusions from the Upper Jurassic, a Triassic - Jurassic age is admitted for this formation. In the front of the cliffs covered by the Alto Paraná formation (basalts), as in the Northern (area of Pedro Juan Caballero and Capitán Bado) and Central regions (area of the Cordillera and Ybytyruzú), the erosion that continues in the front of the cliff provides a great amount of sand grains of this formation, which is going to be deposited in the adjacent low area, making that an extensive sandy cover is formed, frequently confused, in mapping works, with the Misiones formation.

### 9.5.3 Geological characterization of DAA

In May 2020, the Paraguayan company GEOSTAN GEO-ENGINEERING carried out 25 surveys in the area of the PARACEL (DAA) pulp mill.

In general, studies at depths of 15 to 20 meters show a constant stratigraphy composed of layers of sand and sandstone in different degrees of alteration.

In the first 4 meters, the profile often presents a layer of silty sands in gray, yellow or brown, with low resistance and SPT (Standard Penetration Test) values between 6 and 11 meters.

In the sequence, new layers of silty clay sand are found, with significantly higher strengths ($16 \leq SPT \leq 72$) or, still, sandstone layers with thicknesses greater than 4 meters interposed to the main layer or continuous up to the drilling limit.

The water level was not reached in 20 of the 25 wells, up to the drilling limit. It should be noted that, in order to obtain more information on the water level, mechanized excavations will be carried out in the project area.

The following figures show the location of the drilling points and also a stratigraphic profile of one of the points (as an example) where it was possible to reach the water level (SM5).

**Figure 42 – Location of drilling points**

## MIXED DRILLING

| PROBE | NORTH COORDINATE | EAST COORDINATE | QUOTA |
|---|---|---|---|
| SM-01 | 7,430,267.0000 | 449,690.0000 | 95.00 |
| SM-02 | 7,429,745.0000 | 449,649.0000 | 86.00 |
| SM-03 | 7,429,695.0000 | 449,944.0000 | 86.00 |
| SM-04 | 7,429,823.0000 | 450,221.0000 | 95.00 |
| SM-05 | 7,429,198.0000 | 450,229.0000 | 82.00 |
| SM-06 | 7,428,926.0000 | 450,651.0000 | 88.00 |
| SM-07 | 7,427,414.0106 | 450,165.4044 | 0.00 |
| SM-08 | 7,427,206.5208 | 448,911.2046 | 0.00 |
| SM-09 | 7,426,678.9950 | 449,566.8453 | 0.00 |
| SM-10 | 7,426,256.7747 | 449,880.3004 | 0.00 |

## PERCUSSION DRILLING

| PROBE | NORTH COORDINATE | EAST COORDINATE |
|---|---|---|
| SB-01 | 7,430,271.4821 | 449,693.6408 |
| SB-02 | 7,429,500.0000 | 450,650.1083 |
| SB-03 | 7,429,699.6898 | 449,946.9646 |
| SB-04 | 7,429,827.8844 | 450,224.5607 |
| SB-05 | 7,428,664.9626 | 450,260.9695 |
| SB-06 | 7,428,930.5798 | 450,654.4998 |
| SB-07 | 7,429,912.6732 | 450,500.0000 |
| SB-08 | 7,428,676.4803 | 450,004.6518 |
| SB-09 | 7,429,028.8564 | 449,534.9940 |
| SB-10 | 7,428,594.1624 | 449,479.0414 |

## SPT DRILLING

| PROBE | NORTH COORDINATE | EAST COORDINATE |
|---|---|---|
| SPT-01 | 7,429,976.5233 | 449,956.0681 |
| SPT-02 | 7,429,914.4936 | 450,035.3369 |
| SPT-03 | 7,429,897.1334 | 449,881.0575 |
| SPT-04 | 7,429,791.2037 | 450,018.3335 |
| SPT-05 | 7,429,726.3521 | 450,279.7255 |
| SPT-06 | 7,429,707.4752 | 450,128.5456 |
| SPT-07 | 7,429,618.7451 | 450,046.0631 |
| SPT-08 | 7,429,638.0471 | 450,234.7088 |
| SPT-09 | 7,429,520.0924 | 450,149.0097 |
| SPT-10 | 7,429,502.3819 | 450,263.8857 |
| SPT-11 | 7,429,617.7804 | 449,882.5707 |
| SPT-12 | 7,429,498.2133 | 450,024.0090 |
| SPT-13 | 7,429,418.2143 | 450,173.2194 |
| SPT-14 | 7,429,828.4763 | 449,667.5170 |
| SPT-15 | 7,429,630.7433 | 449,669.7808 |
| SPT-16 | 7,429,527.3918 | 449,833.2510 |
| SPT-17 | 7,429,443.8227 | 449,850.2326 |
| SPT-18 | 7,429,426.1520 | 449,927.6346 |
| SPT-19 | 7,429,375.5356 | 450,000.9159 |
| SPT-20 | 7,429,966.1148 | 450,500.0000 |
| SPT-21 | 7,430,039.9813 | 449,973.4728 |
| SPT-22 | 7,430,043.0534 | 449,852.1041 |
| SPT-23 | 7,429,843.9923 | 449,944.8036 |
| SPT-24 | 7,429,584.6382 | 450,193.5522 |
| SPT-25 | 7,429,753.8889 | 449,786.8386 |
| SPT-26 | 7,429,552.9091 | 449,946.4558 |
| SPT-27 | 7,428,870.2486 | 450,732.4581 |
| SPT-28 | 7,428,779.6525 | 450,844.3783 |
| SPT-29 (NOTE 8) | 7,428,690.2934 | 450,226.1047 |
| SPT-30 (NOTE 8) | 7,428,679.8600 | 450,000.0000 |
| SPT-31 (NOTE 8) | 7,428,420.9578 | 450,324.6052 |

## WELLS

| PROBE | NORTH COORDINATE | EAST COORDINATE | QUOTE |
|---|---|---|---|
| GW-01 | 7,430,729.0000 | 449,839.0000 | 100.00 |
| GW-02 | 7,430,301.0000 | 450,165.0000 | 91.00 |
| GW-04 | 7,428,109.0000 | 448,716.0000 | 74.00 |

## MECHANIZED DRILLING

| PROBE | NORTH COORDINATE | EAST COORDINATE |
|---|---|---|
| EM-01 | 7,430,271.4821 | 449,693.6408 |
| EM-02 | 7,429,744.1802 | 449,648.9074 |
| EM-03 | 7,429,699.6898 | 449,946.9646 |
| EM-04 | 7,429,827.8844 | 450,224.5607 |
| EM-05 | 7,429,198.3284 | 450,224.2436 |
| EM-06 | 7,428,929.5672 | 450,655.0734 |
| EM-07 | 7,429,966.1148 | 450,500.0000 |

## REVISION TABLE

CODE:
PR -PRELIMINARY
PA -FOR APPROVAL
PI -FOR INFORMATION
PC -FOR QUOTATION
CO -FOR COMMENTS
LE -RELEASED FOR CONSTRUCTION
LD -RELEASE FOR DETAILING
CC -AS BUILT
CA -CANCELED

| REV. | DATE | PROJ. | VERIF. | APPROV. | AUTHOR. | CODE | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0 | 10/06/20 | fvy | leu | itf/brt | rmq | PI | FOR INFORMATION |

## NOTES

1. Dimensions, dimensions and coordinates in meters, except where indicated;
2. Coordinate System WGS84;
3. All services must be performed according to the Official Technical Standards of Paraguay and, failing that, according to ASTM standards.;
4. All the specifications and definitions contained in the document PARACEL N: 109001759-001-1000-F-0701 must be respected;
5. In percussion soundings, the rejection criteria defined in item 7.2, p. 5, of the ASTM D.2113-99 standard. Only after the rejection is reached, the rotary probes should be started;
6. With the 20 samples collected in the auger drilling, the following laboratory tests must be carried out:

- Grading with sedimentation;
- Atterberg limits (LL, LP);
- Grain Density;
- Moisture in situ of sample to be taken to the laboratory in an aluminum capsule;

Normal Proctor (5 points) and CBR (5 points) in laboratory compacted samples;

7. The mechanized excavation must reach a depth of 7.0m or until the water table has been found. All occurrences must be photographed and presented in a technical report. At the end of the day the excavation should be filled with the soil from your own excavation.
8. SPT-29, SPT-30 and SPT-31 polls should be done as first priority.

## LEGEND

SP-01 — PERCURSSION DRILLING - SPT TYPE (REF.: ASTM D.1586-11)

SB-01 — SOUNDING DRILLING - 25cm IN DIAMETER AND 5.0m DEPTH WITH SAMPLE COLLECTION EACH 1.0m DEPTH

SM-01 — MIXED DRILLING - SPT FOLLOWED BY ROTATION (REF.: ASTM D.2113-99)

GW-01 — ENVIRONMENTAL MONITORING WELLS

EM-01 — MECHANIZED DRILLING (SEE NOTE 7))

## PENDENCIES

## CONSULTED DOCUMENTS

| TITLE | NUMBER | REV. |
|---|---|---|
| Monitoring Well Surveys - GEOSTAN | 2615 | |

## REFERENCE DOCUMENTS

| TITLE | NUMBER |
|---|---|
| General Mill Site Layout - Master Plan - General Layout | 109001759-001-1000-M05-0001 |

## DISTRIBUTION

| TO | REVISION 0 | a | b | c | d | e | f |
|---|---|---|---|---|---|---|---|
| PARACEL | E | | | | | | |
| PÖYRY | E | | | | | | |

N: PRINT/PLOT (HARD COPY) E: ELECTRONIC FILE

PÖYRY

PARACEL
PARACEL PROJECT
LOCAL: ZAPATERO CUÉ - MUNICIPALIDAD DE CONCEPCIÓN

RESP./TITLE/CREA NUMBER | CUSTOMER NUMBER | REV.

TITLE

PARACEL PROJECT - BASIC ENGINEERING SERVICES
LOCATION OF DRILLING POINTS
MAP

| SCALE | UNIT | PROJECTION | PÖYRY NUMBER | REV. |
|---|---|---|---|---|
| 1:5000 | m | | 109001759-001-1000-Z03-0005 | 0 |

confidential



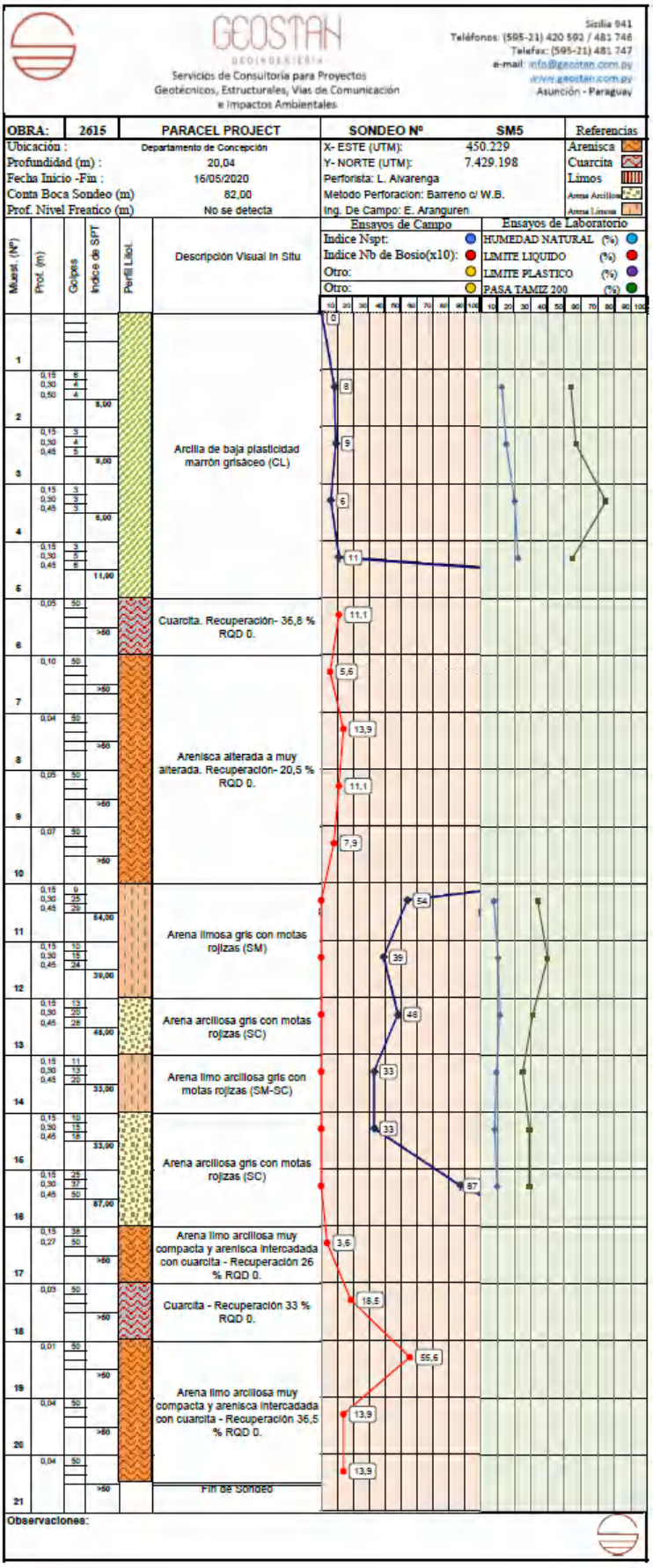



**Figure 43 – Stratigraphic profile of the probe point SM05**

confidential

## 9.6 Geomorphology (Relief and Orography)

The Paraguay River divides the country into two distinct regions: the Gran Chaco or Western Region in the west and the Jungle or Eastern Region in the east, which is considerably mountainous. The Gran Chaco is part - except for the western end - of an alluvial plain that extends from Paraguay to the bordering countries and is covered with grasslands, swamps and bushes. The jungle is formed mainly by the southern portion of the Paraná plateau, at an elevation of 305 to 610 m, which constitutes a basin where numerous tributaries of the Paraguay and Paraná rivers originate; and by the gentle mountain ranges that are part of the Brazilian system that penetrate this area, creating wild valleys.
To the west, the plain drops precipitously into a region of hills covered with fertile pastureland that ends at the Paraguay River. The main mountain system is made up of the Amambay, Mbaracayú and Caaguazú mountain ranges, which have altitudes that rarely exceed 800 meters. Another secondary mountain system, located in the center of the country, is formed by the Cordillera de los Altos, Ybytypanema and the so-called Cordillerita. Among the most outstanding peaks are the Tres Kandú (842 m), Capii (816 m) and Peró (815 m) mountains, all in the department of Guairá. Some authors consider, however, that Paraguayan territory is structured in three regions: the aforementioned Chaco and Selva regions, and the region known as Campo, which extends through the most depressed sector of the Paraguayan valley and the final stretch of the river courses that drain into it, that is, the central and southern area of the country.

The following is a geomorphological characterization of the influence areas of the PARACEL pulp mill.

### 9.6.1 Regional Characterization (IIA)

Most of the Eastern region has a slightly undulating topography, with an elevation that varies between 50 and 750 meters above sea level. Its major orographic systems are the Amambay, Mbaracayú, Ybytyrusú and Caaguazú mountain ranges. The highest point is Cerro Pero (Cerro Tres Kandu), with 842 meters, located in the IV Department of Guairá.
The western region has an average elevation of 130 m above sea level and its maximum height sporadically reaches 300 m and constitutes a flat plain, with a slight slope from the Andean counter-fronts. The slope of this vast plain over 550 kilometers long is only 1%, from its most northern point towards the Paraguay River, containing isolated heights that do not belong to any system, such as Cerro León, Chovoreca and Jara and closer to the Paraguay River the Olimpo, Celina, Confuso, Galván, Siete Cabezas and Desolación.

The following figure shows the topography map of Paraguay, highlighting the points of highest elevation.

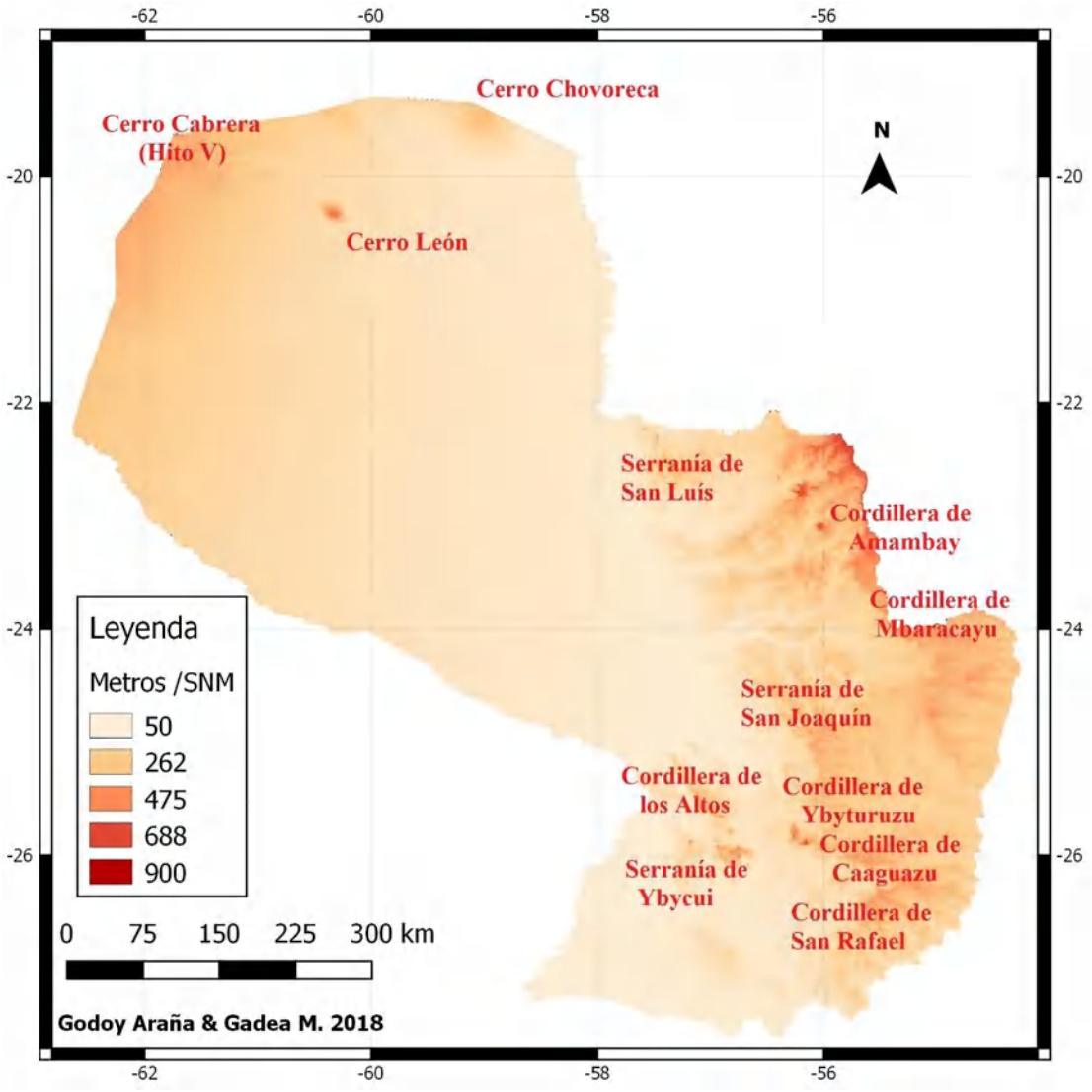



**Figure 44 – Map of Topography and Orography of Paraguay. Source: Godoy Araña & Gadea (2018)**

### 9.6.2 Caracterización Local (DIA y DAA)

The topography of the areas of influence of the PARACEL pulp mill has plateaus and valleys, which are flat to almost flat lands that receive the drainage water from the high places, which are the hills and mountains.

The valley is flanked by higher places and is narrower than it is long, while the plain, also called the "llanura", is a large area both wide and long (flatlands), further away from the high places.

According to the Geology of Paraguay site, in the Department of Concepción, on Route n. 5, on the way to Pedro Juan Caballero, you can see Cerro Memby, which geomorphologically, according to its characteristics, would be assigned the name of Butte (isolated hills with cliffs). It is constituted essentially by red sandstones of the Triassic - Jurassic known as the sandstones of the Misiones Formation. To acquire this form, an intense material removal (erosion) had to have occurred in the course of geological time.

Below is the topography map in relation to the areas of influence of the PARACEL pulp mill (DAA, DIA and IIA). In addition, the most representative points of highest elevation are presented.

Visual impacts

The pulp mill will be located in the municipality of Concepción, about 15 km from the city center. City people may not see the impact on the landscape, however, everyone who lives nearby, or uses the roads and/or waterway near the company may feel the impact on the landscape.

According to the environmental diagnosis, the existing agricultural routes and activities throughout the study area have historically already led to a modification of the landscape, favoring generalist species, rather than those more sensitive to changes in the environment.

The area planned for the implementation of PARACEL's industrial unit is located in a rural area of the cattle activity, however part of the water intake area, effluent emissary and river port are located in areas of natural vegetation.

Obviously, the industrial unit consisting of buildings, towers and chimneys will change the local landscape.

To mitigate the impact on the landscape the project must be implemented to favor the integration of the plant with the environment, such as the implementation of tree curtains and reuse of the soil from earthworks in gardens within the industrial area in accordance with the Landscape Rehabilitation Program besides revegetation of riparian forests.

**Figure 45 – Topography and orography map of the areas of influence**

Confidential

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

Paraguay

Brazil

Argentina

Alto Paraguay

Boqueron

Presidente Hayes

San Pedro

Canindeyu

Cordillera de Amambay

Serranía de San Luís

Concepcion

Amambay

T-412 T-413

T-411 T-98 T-99

T-97

T-96 T-37

Cordillera

Caaguazu

Asuncion

Central

Guaira

Paraguari

Caazapa

Ñeembucu

Misiones

Itapua

Rio Paraguay

CAMP 7

CAMP 6

CAMP 1

CAMP 11

CAMP 9

CAMP 3

0 3 6 12 km

LOCATION MAP

LEGEND

- Structures - Transmission Line
- Accommodations (Camps)
- DAA - Directly Affected Area
- DIA - Direct Influence Area
- IIA - Indirect Influence Area
- Hydrography
- CIH Rio Pilcomayo and Aquidaban
- Geomorphological Unit

**Height (m/SNM)**

- 50
- 270
- 480
- 700
- Departaments
- South America

ESCALA GRAFICA: 0 20 40 80 km

DATUM SIRGAS 2000
PROYECCION: UTM

DATA SOURCE:
- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).
- Geología del Paraguay, 2020. (https://www.geologiadelparaguay.com.py)

PARACEL PÖYRY

**ENVIRONEMTAL AND SOCIAL STUDY**

**CIH8 Aquidaban and CIH18 Rio Pilcomayo**

**GEOMORPHOLOGICAL UNITS**

| ESCALA: | 1:1.500.000 | FECHA: | 28/05/2021 |
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| PROYECTO N° | | FOLHA: | FORMATO: |
| RESP. TECNICO: Romualdo Hirata | | FIRMA: | REV. 0 |

Confidential

## 9.7 Edaphology (Soils)

The soil we see around us has taken a long time, several thousand years, to form and acquire the characteristics and properties it has today. Soil formation depends on several factors. Firstly, any soil has first been a solid rock formed in previous geological eras, and on which numerous decomposition agents have been acting, such as water, gases in the atmosphere, living organisms and their remains. These agents have acted together and continue to do so over the years, breaking up and pulverizing the rocks, releasing chemical elements to form new compounds and providing organic remains (humus). Soil particles such as sand, silt and clay are the remnants of that initial rock. These, with the humus, house the chemical elements essential for the nutrition of all plants and by extension the animals that feed on them, thus contributing to the formation of more complex compounds, initiated by photosynthesis.

As a result of these interactions and taking into account the great diversity of geological materials (rocks and minerals) that exist on the planet, a great diversity of soil types was produced, each with its own characteristics. Paraguay has a great variety of geological materials, which has given rise to a very notable diversity of soils. All these soils have been classified and inventoried considering the two natural regions of the country, the eastern and the western or chaco regions. The soils presented in this chapter group the soils according to the general physiography where they are found and their geological origins.

### 9.7.1 Regional Characterization (IIA)

The two natural regions of the country belong to well-differentiated geological basins: the eastern region is part of the great geological basin of the Paraná, while the western region or “chaco” is located in the most northern portion of another great geological basin, called the “chaco paranaense”. The figure below shows the two geological basins and the location of the country in them.

The geological and geomorphological development of these basins resulted in very varied soil conditions, which, with the climatic gradients of precipitation and temperature, accommodated different ecosystems. Due to its central-southern location in the South American continent and because it is located in two geological basins with very different characteristics, the Paraguayan territory is the meeting place of several ecosystems, such as the Atlantic Forest of the Alto Paraná, the Cerrado, the high forests of the Central Forest, the low fields and wetlands of the Pantanal Chaqueño, those of the banks of the Paraguay River and those of the Ñeembucú, the extensive hydromorphic savannas of the depressed Chaco and the xerophytic forest of the Chaco, among the main ones that are found in the Paraguayan territory.

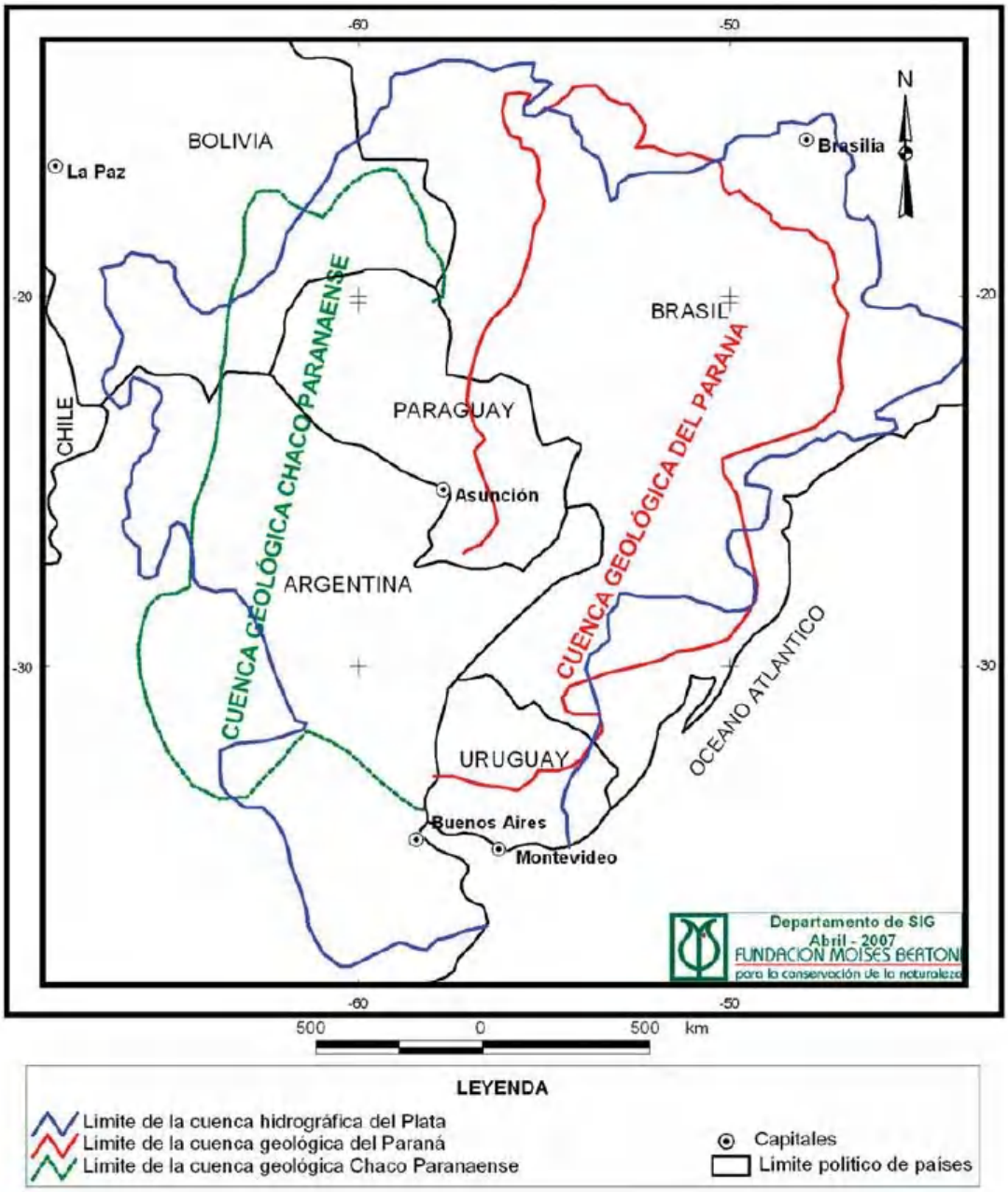



**Figure 46 – Location of Paraguay in geological basins and in the Rio de la Plata river basin. Source: Fundación Moisés Bertoni (2007)**

In the eastern region is the most western edge of the Paraná geological basin. This border follows a flexure line located east of the current course of the Paraguay River. This river can be considered the border between the Paraná geological basin and the Chaco geological basin, although portions of the Chaco slightly penetrate the eastern region and vice versa.

The figure also shows the limits of the Rio de la Plata basin, formed by the Paraná, Paraguay and Uruguay rivers. The geological basin line is different from the river basin line, thus illustrating the difference between geological basin and river basin.

The national territory is almost equally divided between the two geological basins, which explains the division of the country into its two natural regions: eastern and

western. The following description of the soils follows this separation of its natural regions.

#### 9.7.1.1 Eastern Region of Paraguay

According to the Moisés Bertoni Foundation (2007), the map below provides guidance by considering the physiography of the eastern region first and the geological origin of the soils second. The map has been adapted from the "Mapa de Reconocimiento de Suelos de la Región Oriental" (LÓPEZ, O. ET AL, 1995) to the Revised Soil Legend System of the FAO (United Nations Food and Agriculture Organization), of 1990, which is the official classification of the world's soils. The cartographic units of the Geological Map of Paraguay were used as a basis (FÚLFARO, V.J. AND D. ALVARENGA, 1986).

By physiography, it is meant the natural topography of the land, such as mountain range, hills, valleys and plains.

#### 9.7.1.2 Paraguay's Western Region

The physical characteristics of the western region or Paraguayan Chaco are very different from those of the eastern region, to such an extent that in spite of possessing 61% of the country's surface area it is home to only about 2% of the human population and produces 3% of the agricultural crops. It is, however, a large producer of cattle and still maintains continuous masses of xerophytic forest (FUNDACIÓN MOISÉS BERTONI, 2007).

The Paraguayan Chaco is located entirely in the northern part of the great geological basin of the Paraná Chaco. This geological basin has diffuse boundaries, determined by the very nature of a very extensive geographical basin, formed by active geological periods. It is a region that has not been studied with the detail of the eastern region, but certain knowledge has been acquired that allows its characterization. Its general physiography corresponds to a vast plain or prairie, whose general slope goes unnoticed by the human eye, except in certain areas towards the border with Bolivia. The slope of this plain is directed towards the Paraguay River, the common collector of the waters of existing watercourses. Despite its apparent uniformity, it is possible to distinguish several sub-regions (MAP OF CHACO SUB-REGIONS, 1986), with soil characteristics related to their geological past and current physiography.

The figure below is an adaptation of the Soil Map of the Western Region (HOFFMAN, R. ET AL, 1999) and the Geological Map of Paraguay (FÚLFARO, V.J. AND D. ALVARENGA, 1986).

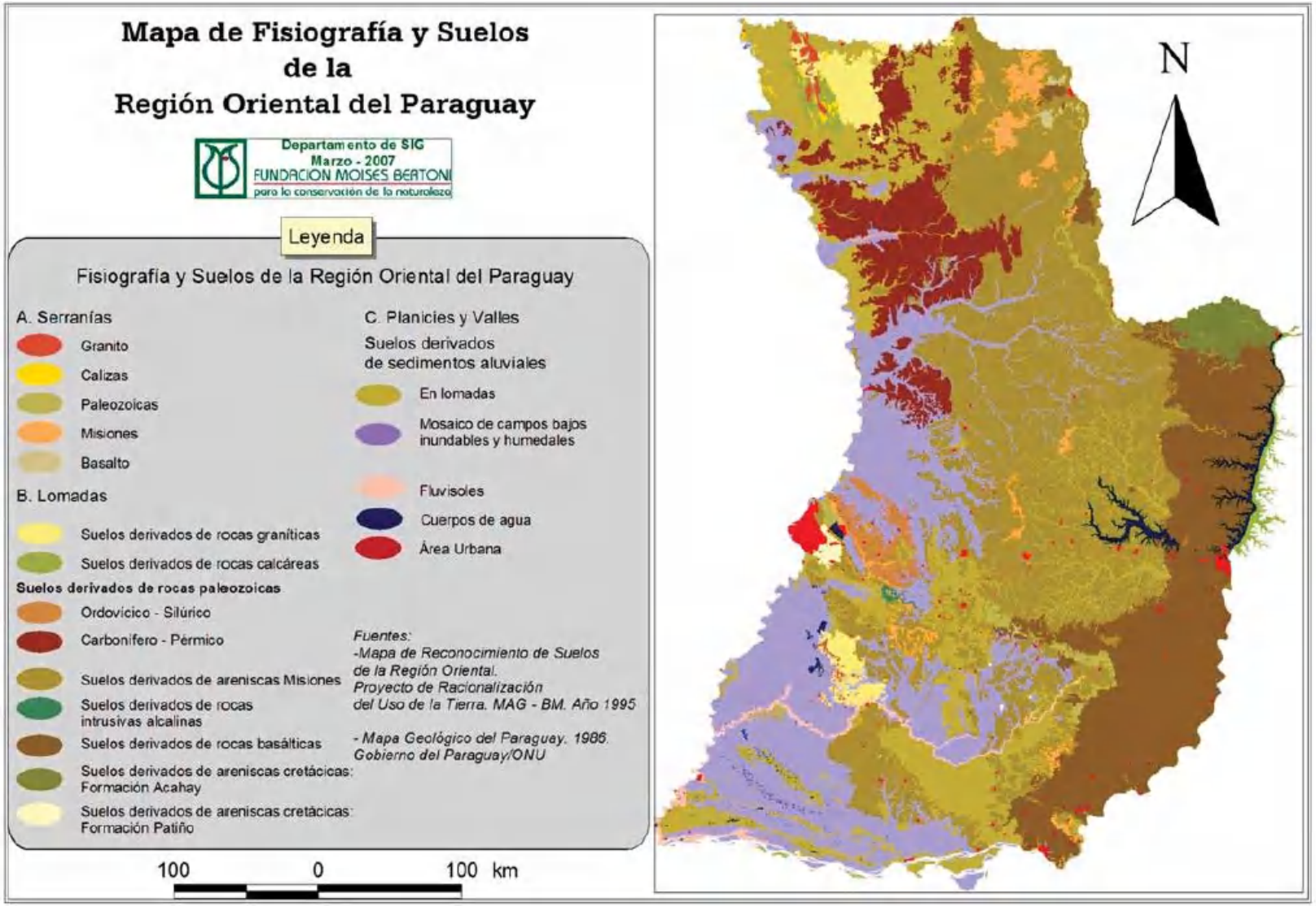



**Figure 47 – Physiography and soil map of the Eastern Region of Paraguay. Source: Fundación Moisés Bertoni (2007)**

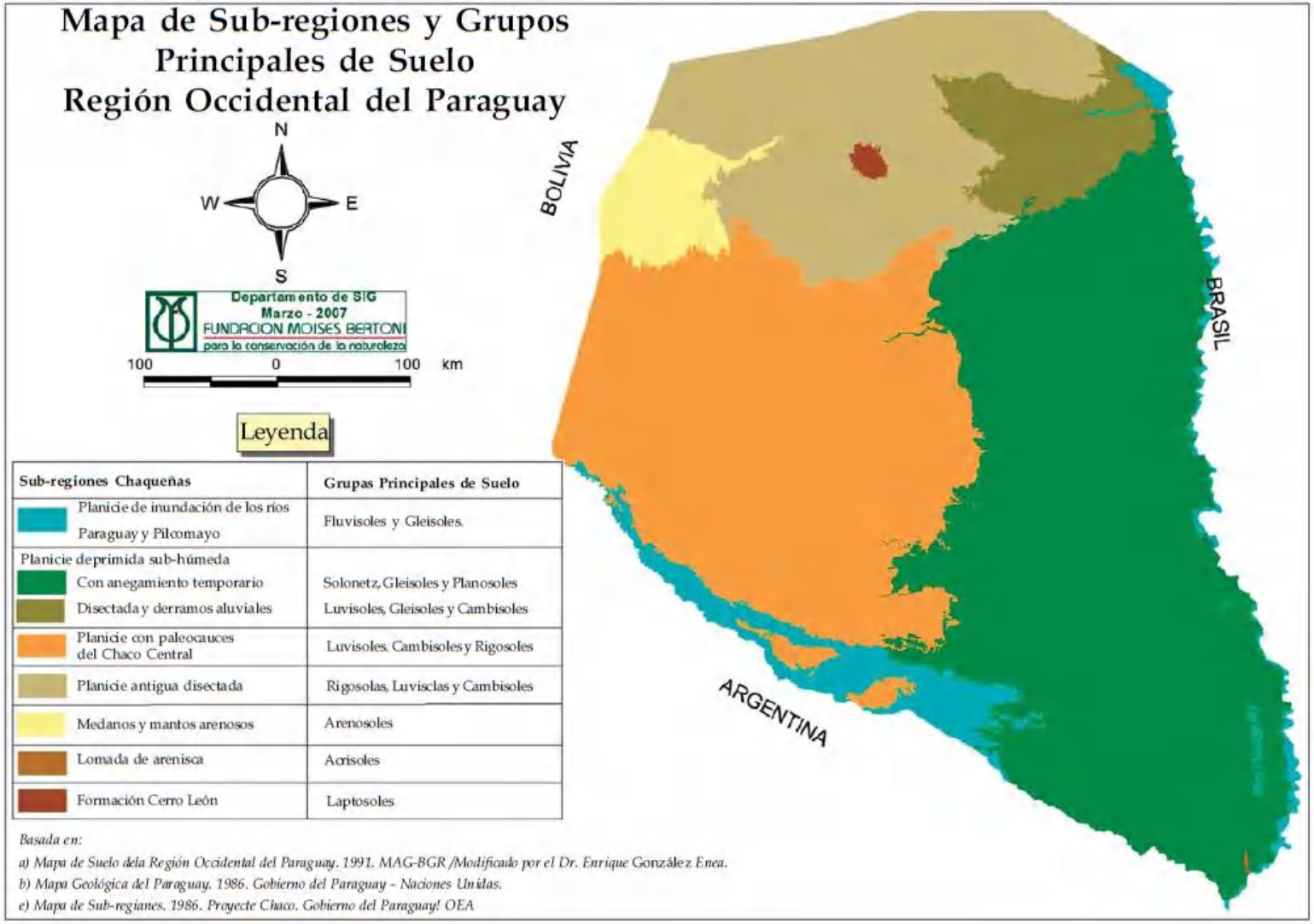



**Figure 48 – Physiography and soil map of the Western Region of Paraguay. Source: Fundación Moisés Bertoni (2007)**

### 9.7.2 Local Characterization (DAA and DIA)

The soils of Paraguay are fertile in the Chaco and of medium fertility in the Eastern region, predominantly Podzolic Soils (Ultisols), Structured Red Soils (Oxisols and Alfisols), Planosols (Alfisols), Quartz Sands and Lithosols (Entisols) and Solonetz (Aridisols).

The aptitude of the soils of the Eastern region is predominantly agricultural, while in the Western region or Chaco it is predominantly pastoral, existing lands of forest aptitude and for environmental conservation in the two regions of the country.

The areas of influence of the PARACEL pulp mill have basically two types of soil: sandy and clay (figure below).

The sandy soils are suitable for forestry. Normally, this type of soil has little capacity to retain water, although it can improve depending on the concentration of organic matter it possesses. Water erosion has devastating effects on sandy soil.

Clay soils are harder and heavier, dark red in color, and when wet they become extremely slippery precisely because of their ability to retain water. Clayey soils are excellent for agricultural production, as they are less prone to erosion. Likewise, loamy soils - a mixture of sand and clay - are also suitable for agriculture. The most outstanding feature of this type of soil is the accumulation of sandy sediments and of white and granular marl. The igneous rocks come from the depths of the earth and have melted to the surface. The sedimentary rocks were formed from clay by pressure from the earth's layers.

Specifically on the riverbanks of the Paraguay in the eastern region and the Pilcomayo in the western region, periodic contributions and depositions of alluvial materials transported by these watercourses are formed, which is reflected in the variety of successive layers of soil that accumulate. The content of organic matter is also very variable from one layer to the next. These soils are not stable for agricultural use, due to the constant danger of flooding, and are covered with grass vegetation and species from humid places. They are used in extensive cattle raising.

**Figure 49 – Soil map of the areas of influence**

confidential

Paraguay

Alto Paraguay

Brasil

Argentina

Boqueron

Concepcion

Amambay

Presidente Hayes

San Pedro

Canindeyu

Cordillera

Caaguazu

Asuncion
Central

Guaira

Paraguari

Caazapa

Ñeembucu

Misiones

Itapua

T-412 T-413
T-411 T-98 T-99
T-97
T-96
T-46

Rio Paraguay

CAMP 7
CAMP 6
CAMP 1
CAMP 11
CAMP 9
CAMP 3

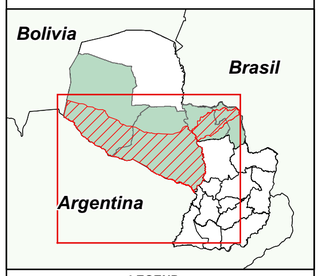
0 3 6 12 km

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

LOCATION MAP




LEGEND

- Structures - Transmission Line
- Accommodations (Camps)
- Hydrography
- DAA - Directly Affected Area
- DIA - Direct Influence Area
- IIA - Indirect Influence Area
- CIH Rio Pilcomayo and Aquidaban

**Soils types**

- Mix of residuals and transported soils silty clay, silty sand
- Fine to meddium sand soils
- Transported floodplain soils, predominantly clayey
- Generally transported wind soils, fine sands
- Departaments
- South America

ESCALA GRAFICA: 0 20 40 80 km

DATUM SIRGAS 2000
PROYECCION: UTM

FUENTE DE DATOS:
- Geología del Paraguay, 2020. (http://www.geologiadelparaguay.com.py)

PARACEL PÖYRY

**ENVIRONMENTAL AND SOCIAL STUDY**

**CIH8 Aquidaban and CIH18 Rio Pilcomayo**

**PEDOLOGY**

| ESCALA: | 1:1.500.000 | FECHA: | 28/05/2021 |
|---|---|---|---|
| PROYECTO N° | | FOLHA: | FORMATO: |
| RESP. TECNICO: Romualdo Hirata | | FIRMA: | REV. 0 |

## 9.8 Speleology

According to Warnes (2002), in the extreme northeast of the Department of Concepción, on the border with the Federative Republic of Brazil, we find the largest karst area in Paraguay, which extends over 1,070 km$^2$ within the department, forming part of the Aquidabán ecoregion.

This area represents the only karstic landscape in Paraguay, with well-defined characteristics typical of this type of geography. It is an extremely rich area of great biological diversity where most of the typical phenomena of this type of terrain are found: caves, caverns, lakes, sinkholes, dolines, and carcavas.

The environmental laws of Paraguay protect the natural resources, thus defending the tourist-scientific heritage. There is Resolution n. 4577/2011 that declares several areas called caverns, located in the zone of Vallemi, Department of Concepción, as a protected wild area under the category of natural monument. The figure below shows the areas defined by Resolution n. 4577/2011, mentioned above.

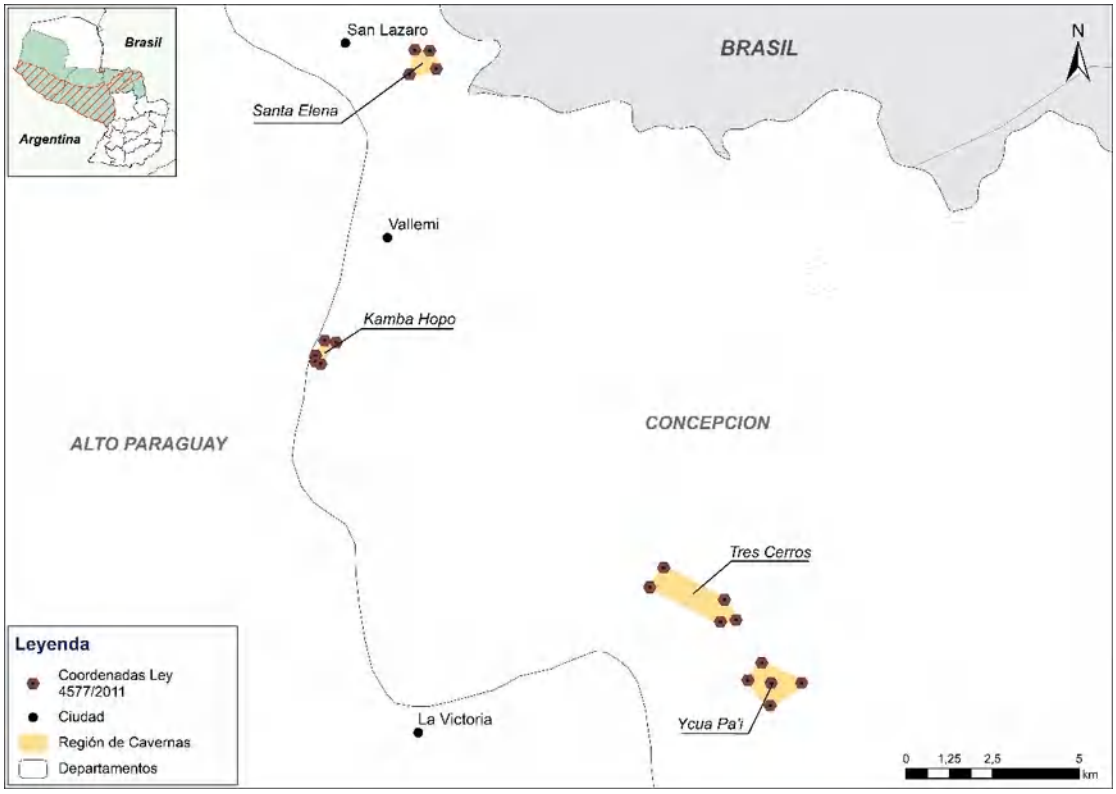



**Figure 50 – Location of the caves according to the Resolution n. 4577/2011**

The location of these caves in relation to the areas of influence of the PARACEL pulp mill is presented below. Therefore, the region of the caves is not included in the areas of influence (DAA, DIA or IIA). It should be noted that the nearest cave (Ycua Pa'i) is 115 km northwest of the area of the future pulp mill.

**Figure 51 – Map of the caves in relation to the areas of influence**

Confidential

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

Brasil

Paraguay

Argentina

Alto Paraguay

Santa Elena

Kamba Hopo

Tres Cerros

Ycua Pa'i

Boqueron

Concepcion

Amambay

T-412 T-413

T-411 T-98 T-99

T-97

T-96 T-46

Presidente Hayes

San Pedro

Canindeyu

Cordillera

Caaguazu

Asunción

Central

Guaira

Paraguari

Caazapa

Ñeembucu

Misiones

Itapua

Concepción

Río Paraguay

CAMP 7

CAMP 6

CAMP 1

CAMP 11

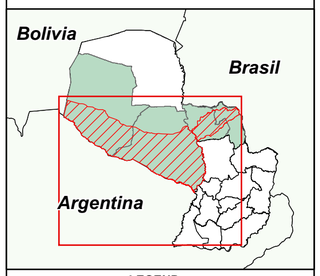
CAMP 9

CAMP 3

Presidente Hayes

0 3 6 12 km

LOCATION MAP




LEGEND

- Structures - Transmission Line
- Accommodations (Camps)
- Caves
- Transmission Line
- Hydrography
- IIA - Indirect Influence Area
- DAA - Directly Affected Area
- DIA - Direct Influence Area
- CIH Rio Pilcomayo and Aquidaban
- Caves Region
- Departaments
- South America

ESCALA GRAFICA:
0 20 40 80 km

DATUM SIRGAS 2000
PROYECCION: UTM

DATA SOURCE:
- Ley Nº 4577, 2011.
- Geología del Paraguay, 2020.
(https://www.geologiadelparaguay.com.py)

PARACEL PÖYRY

ENVIRONMENTAL AND SOCIAL STUDY

CIH8 Aquidaban and CIH18 Rio Pilcomayo

SPELEOLOGY

| ESCALA: | 1:1.500.000 | FECHA: | 28/05/2021 |
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| PROYECTO Nº | | FOLHA: | FORMATO: |
| RESP. TECNICO: Romualdo Hirata | | FIRMA: | REV. 0 |

Confidential

## 9.9 Hydrology (Surface Water Resources)

Paraguayan territory belongs entirely to the great basin of the River Plate, one of the largest rivers in the American hemisphere, as well as in the whole world, due to the extension, the flows it produces, and its natural resources (PMCIC, 2014).

The basin of the Plata is, by its geographical extension and the flow of its rivers, one of the most important in the world. Its importance also lies in the fact that it is a territory shared by five countries (CIC, 2020).

With its 3.1 million square kilometers, the Plata Basin occupies one fifth of South America, including territories of Argentina, Bolivia, Brazil, Paraguay and Uruguay, as seen in the following figure (CIC, 2020).

The waters of two large rivers converge in the Río de la Plata: the Paraná and the Uruguay, both of which, by their turn, collect the flow of other very important rivers, such as the Paraguay, the Bermejo, the Pilcomayo and the Iguazú, among many others (CIC, 2020).

Through its wide estuary in the Atlantic Ocean, the Plata Basin delivers a flow of 25,000 $m^3/s$ to the sea.

**Figure 52 – Basin of the Plata by country. Source: CIC (2020)**

**Water resources management**

Thus, in Paraguay, there is concern about water resources highlighted by the extensive legal framework, among which are SEAM Resolution n. 222/2002 (Standard of Water Quality in the Entire National Territory), SEAM Resolution n. 50/2006 (National Water Resources Management), SEAM Resolution n. 255/2006 (Classification of All Waters of Paraguay in Class 2) and Law n. 3239/2007 (Water Resources of Paraguay).

In accordance with Law n. 3239/2007, the integrated and sustainable management of Paraguay's water resources is governed by the following principles:

a) Water, whether surface or underground, is the public property of the State and its ownership will not be subject to any form of limitation.

b) Access to water for the satisfaction of basic needs is a human right and must be guaranteed by the State, in adequate supply and with appropriate quality

c) Water resources have multiple uses and functions and this characteristic must be adequately addressed, respecting the hydrological cycle and always favoring, in the first place, the use for consumption by the human population.

d) The hydrographic unit is the basic unit for water resources management.

e) Water is a natural good that conditions the survival of all living beings and the ecosystems that shelter them.

f) Water resources are a finite and vulnerable good.

g) Water resources have a social, environmental and economic value.

h) Water resources management should be carried out within the framework of sustainable development, and should be decentralized, participatory and gender-sensitive.

i) The Paraguayan State possesses the non-transferable and non-delegable function of property and guardianship of national water resources.

The management of water resources in Paraguay occurs through the hydrographic units, which are the basic management units, according to Law n. 3239/2007.

In Paraguay, there are 19 Hydrographic Units (Figure above) classified in two regions: the Western Region and the Eastern Region, according to Resolution n. 376/2012.

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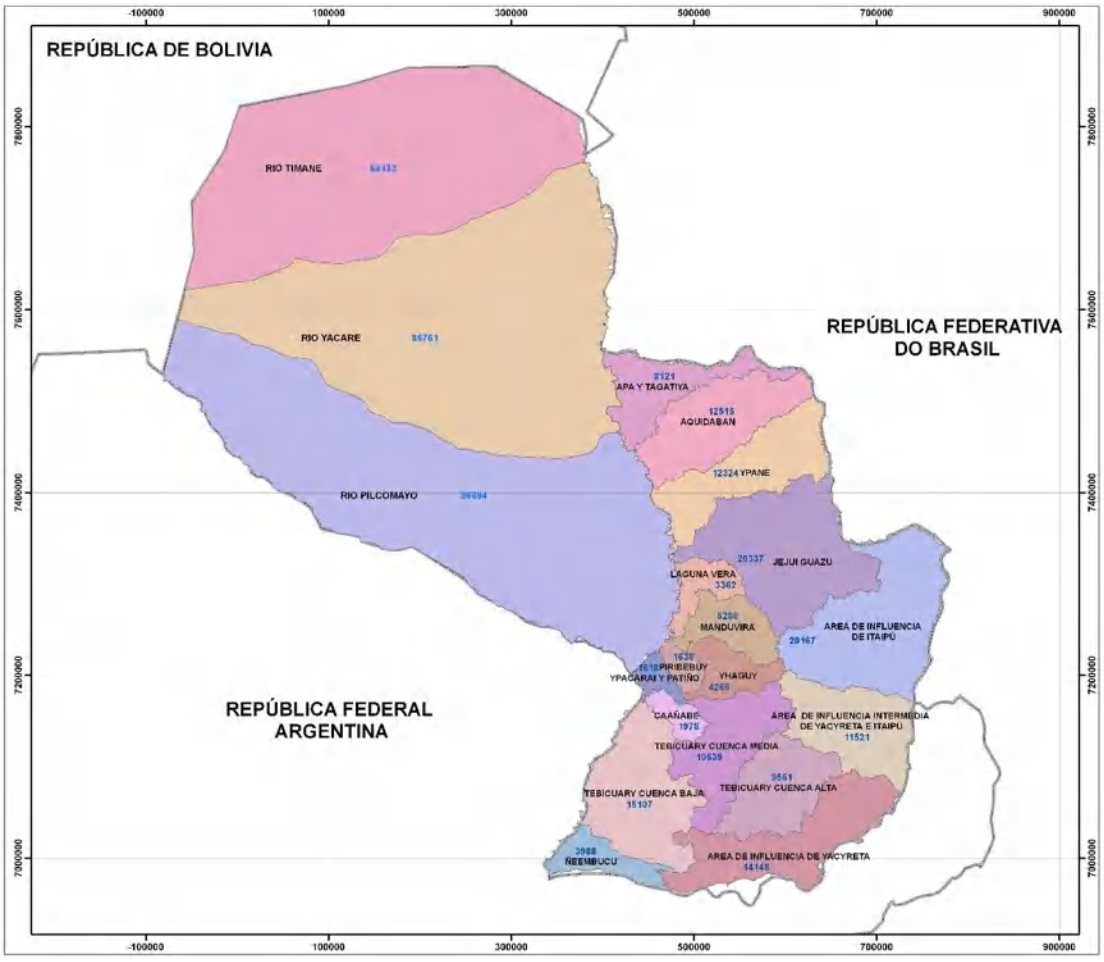



**Figure 53 – Hydrographic Units of Paraguay. Source: MADES (2020)**

The following table presents the characteristics (region, name and area) of the Hydrographic Units of Paraguay.

**Table 7 – Hydrographic Units of Paraguay**

| Region | Name | Area (km²) |
|---|---|---|
| Eastern | Apa and Tagatiya | 8,121 |
| | Aquidabán | 12,515 |
| | Area of Intermediate Influence of Yacyreta and Itaipu | 11,521 |
| | Influence Area of Itaipu | 20,167 |
| | Influence Area of Yacyreta | 14,148 |
| | Caanabe | 1,978 |
| | Jeiui Guazu | 20,337 |
| | Laguna Vera | 3,362 |
| | Oriental Manduvirá | ~ 5,286 |
| | Neembucú | ~ 3,988 |
| | Piribebuy | 1,638 |
| | Tebicuary Cuenca Alta | 9,561 |
| | Tebicuary Cuenca Baja | 15,107 |
| | Tebicuary Cuenca Media | 10,539 |
| | Yhaguy | 4,266 |
| | Ypacaraí and Patinc | 1,618 |
| | Ypané | 12,324 |
| Western | Rio Pilcomayo | 86,694 |
| | Rio Yacaré | 85,761 |
| | Rio Timme | 68,133 |

Source: Resolution SEAM n. 376/2012.

The planned site for the implementation of the PARACEL pulp mill will be in Concepción, near the Paraguay River. For ESIA, the Aquidabán and Pilcomayo River hydrographic units were adopted as an Indirect Influence Area. Thus, these hydrographic units will be addressed in this chapter on water resources.

The following figure shows the location of the future PARACEL pulp mill on the water resources map.

**Figure 54 – Map of water resources.**

confidential

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

Paraguay

Brazil

Alto Paraguay

Boqueron

CIH Aquidaban

Concepcion

Amambay

T-412 T-413

T-411 T-98 T-99

T-97

T-96 T-31

CIH Rio Pilcomayo

Presidente Hayes

Argentina

San Pedro

Canindeyu

Cordillera

Caaguazu

Asuncion

Central

Guaira

Paraguari

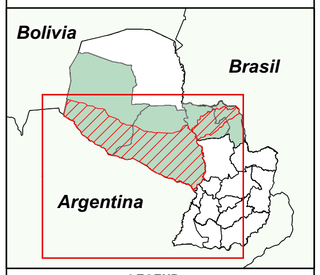
Caazapa

Ñeembucu

Misiones

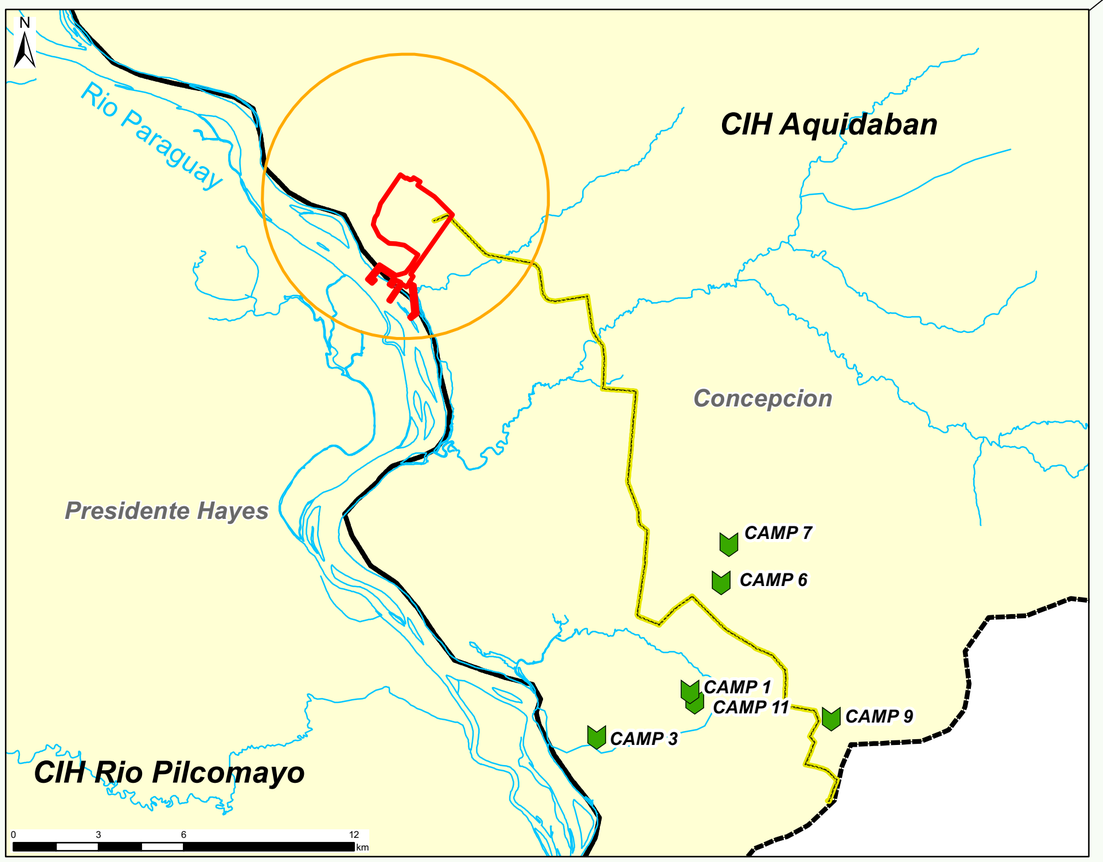
Itapua

## LOCATION MAP




## LEGEND

- Structures - Trsnmission Line
- Accommodations (Camps)
- Hydrography
- DAA - Directly Affected Area
- DIA - Direct Influence Area
- IIA - Indirect Influence Area
- CIH Rio Pilcomayo and Aquidaban
- Departaments
- South America




ESCALA GRAFICA:
0 20 40 80
km

DATUM SIRGAS 2000
PROYECCION: UTM

DATA SOURCE:
- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).

PARACEL PÖYRY

**ENVIRONMENTAL AND SOCIAL STUDY**

**CIH8 Aquidaban and CIH18 Rio Pilcomayo**

**WATER RESOURCES**

| | | | |
|---|---|---|---|
| ESCALA: 1:1.650.000 | | FECHA: 28/05/2021 | |
| PROYECTO N° | FOLHA: | FORMATO: | |
| RESP. TECNICO: Romualdo Hirata | FIRMA: | | REV. 0 |

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### 9.9.1 Regional Characterization (IIA)

#### 9.9.1.1 Aquidabán Hydrographic Basin

The Aquidabán River basin has an area of approximately 1,254,812 ha (SEAM & DIGESA, 2006), within the departments of Amambay and Concepción, and flows into the Paraguay River north of the city of Concepción, as illustrated in the figure below.

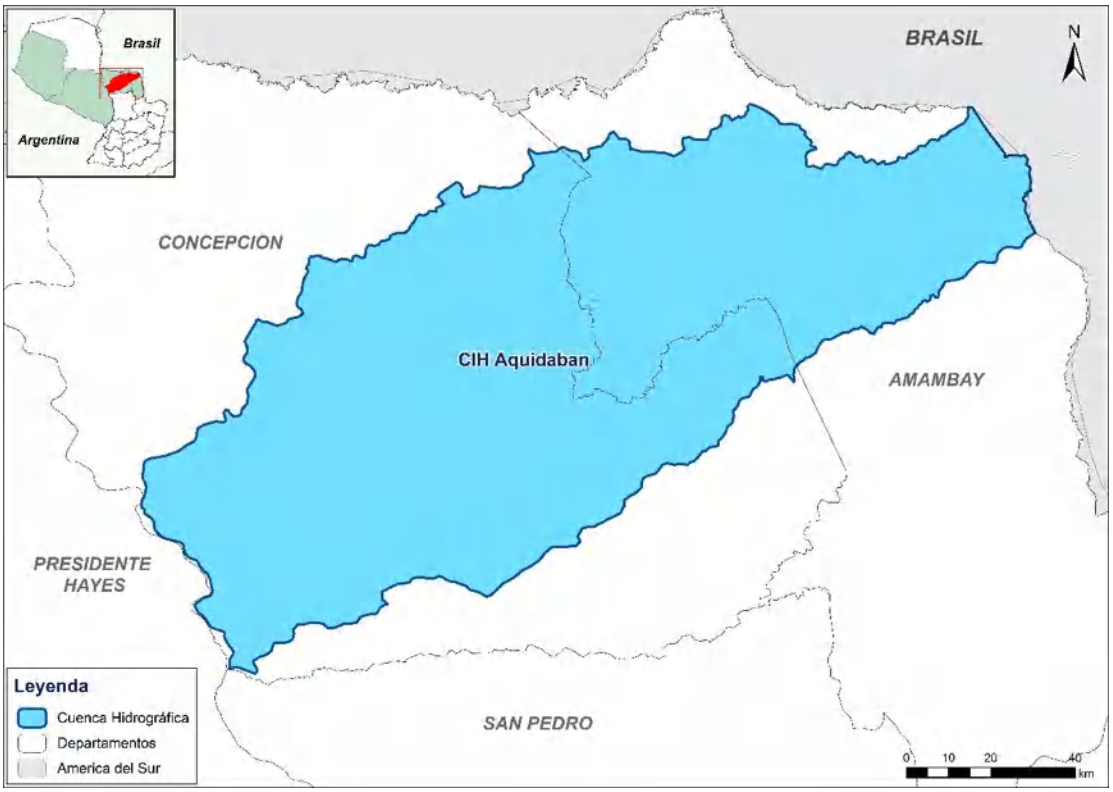


**Figure 55 – Map of the Hydrographic Basin of Aquidabán**

The basin is 59.3% occupied by cattle and 28.6% by forest, which includes approximately 87.9% of the entire basin area. Small rural producers occupy 7.6% of the basin area, mechanized cultivation 2.6%, flooded areas 1.6% and water and city occupy approximately 0.1%, as presented in the following table.

With respect to pollution loads, there are three districts with a total population of 36,150 inhabitants, of which 19% reside in urban areas, which constitutes the potential contributor to sanitation loads. The diffuse load from agricultural areas is 2 to 10 times higher than the sanitary load. With regard to industrial loads, there are no significant sources in this basin (SEAM & DIGESA, 2006).

**Table 8 – Aquidabán River Basin Occupations**

| Mechanized cultivation | Cattle raising | Forest | Water | Small area ranchers | Flood | City | Total |
|---|---|---|---|---|---|---|---|
| 32,408 | 744,261 | 359,133 | 1,810 | 95,613 | 20,042 | 1,810 | 1.254,812 |
| 2.6% | 59.3% | 28.6% | 0.1% | 7.6% | 1.6% | 0.1% | 100.0% |

Source: SEAM & DIGESA (2006).

**Figure 56 – Aquidabán River Basin Occupations**

The Aquidabán River rises in the Amambay mountain range after traveling approximately 250 km through the departments of Amambay and Concepción, in an east-west direction. This river is a tributary of the Paraguay River and its mouth occurs north of the city of Concepción, 35 km from the central region. Its main tributaries are the Trementina and Negla Rivers.

The Aquidabán River as well as all surface water resources in Paraguay are classified as a Class 2 river, according to SEAM Resolution n. 255/2006.

The relevant characteristic of this river's water is the relatively high concentration of total and dissolved solids, depending on the time of collection, and the presence of significant nutrient contents. The cause of the high solids value can be attributed, mainly, to the recurrent diffuse loads of agricultural activities, also carrying nitrogen and phosphorus that are components of chemical fertilizers. The variation in concentration, especially of solids, is closely correlated to the recorded precipitation (SEAM & DIGESA, 2006).

#### 9.9.1.2 Pilcomayo river basin unity

The Pilcomayo river basin, which belongs to the Plata Basin system, with an area of approximately 290,000 km², covers an important natural resource region of Latin America, shared by Argentina, Bolivia and Paraguay, with an estimated population of 1,500,000 inhabitants (CTDCRP, 2020).

The spatial distribution is Upper, Middle and Lower Basin from Northwest to Southeast. Some 44% of the total area of the Basin is in Paraguay, 31% in Bolivia and 25% in Argentina, as illustrated in the following figure (CTDCRP, 2020).

**Figure 57 – Map of Pilcomayo hydrographic basin.**

In the High Basin, the Pilcomayo is a mountain river that when leaving the Andes (or "sub-Andean") in the city of Villa Montes, enters the Chaco plain, in a southeasterly direction, extending about 1,000 km to the Paraguay River (of which 835 km are the border between Argentina and Paraguay). In this section it becomes a river of flat land - "llanura" (CTDCRP, 2020).

The so-called "Lower Pilcomayo", one of the numerous streams that drain the Chaco and flow into the Paraguay River, seems hydrologically disconnected from the upper river. Another of its singularities is that in this flat course (the Chaco of Paraguay and Argentina) the river is lost, that is to say, it does not flow directly into the Paraguay river. This occurs due to sedimentation or siltation (CTDCRP, 2020).

The Pilcomayo River in the plains (llanura) is one of the best examples of river mega-fan, frequent in the eastern slopes of the Andes in South America. It is also the largest of them (>200,000 km$^2$) and the only one in the world that presents the phenomenon of extinction of the riverbed by siltation. It is not simply an endorheic river which disappears at some point, of which there are examples in the world, but where the river disappears there is still a remarkable flow that extends to form wetlands (CTDCRP, 2020).

The Pilcomayo River as well as all surface water resources in Paraguay are classified as a Class 2 river, according to SEAM Resolution n. 255/2006.

The upper basins of the Bermejo and Pilcomayo rivers are responsible for most of the sediment production in the del Plata Basin, the main cause of the need for clarification of water for consumption by the riparian cities. Sediments are deposited in the waterways and cause the progressive advance of the Paraná River Delta over the Plata River. Another determining process in the phenomena of production and transport of sediments is related to anthropic activities of land use (CIC, 2017).

The Pilcomayo River has an average annual flow of 203 $m^3/s$ and an annual contribution of sediments of the same order of magnitude as the Bermejo, but does not have enough energy to transport its solid load to the Paraguay River (CIC, 2017).

The Pilcomayo river basin is particularly critical because of centuries of mining pollution in the upper basin, with the presence of significant environmental liabilities.

#### 9.9.1.3 Wetlands

Still in the context of water resources, wetlands are important ecosystems, protected by the Ramsar Convention, a Convention on Wetlands of International Importance, which is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and sustainable use of wetlands and their resources (WCRP, 2014).The characteristics of the natural resources of the Río de la Plata Basin indicate that the wetlands represent the main ecosystems of the region (WCPIC, 2014).

The La Plata Basin has the largest system of river wetlands on the planet, covering almost 3,500 $km^2$, made up of a corridor of wetlands connected by the axis of the large Paraguay, Paraná and La Plata rivers (CIC, 2017).

Paraguay has large areas of wetlands such as the Paraguayan Pantanal, the Central Chaco Lagoons, the Humid Chaco Lagoons, the Cerrado wetlands, those belonging to Arroyos and Esteros, those of the Atlantic Forest, the Ñeembucú wetland, and the flooded pastures (PMCIC, 2014).

These wetland areas are recognized as highly productive ecosystems and one of the most obvious indicators of their wealth and diversity are the wetland birds; these birds constitute a natural resource of great intrinsic human and ecological value, throughout history they have appeared prominently in human culture, as a source of food or ornamentation as well as in the folkloric sense (PMCIC, 2014).

These ecosystems perform extremely important functions such as: water reserve and purification, flood buffering, carbon sinks, sediment, organic matter and nutrient storage and/or export sites. In addition, they play a critical role in the life cycle of numerous species of fauna and flora and support trophic chains of adjacent ecosystems (WCPI, 2014).

Paraguay currently has 6 Ramsar sites or Wetlands of International Importance covering 785,970 hectares and the designation of Asunción Bay is expected to cover 2,585 hectares (WCPIC, 2014).

In the Indirect Influence Area, in the Pilcomayo River Hydrographic Unit, is the Tifunque Ramsar Site, located 235 km from the pulp mill site. In addition, there is the Estero Milagro Ramsar Site (35 km from the factory), located outside the Indirect Influence Area, as shown on the map below.

**Tifunque Ramsar site**

Created in June 7th, 1995, it is located in the department of Presidente Hayes (24°15'S 059°30'W) and has 280,000 ha (Ramsar, 2020).

An alluvial plain along the Pilcomayo River that is flooded most of the year and is characterized by the presence of patches of forest, extensive lakes and palm tree savannas. The water courses follow the old riverbeds, with gallery forests growing alongside. Another sector is made up of vast dry plains of grasses and bushes. Located in the biogeographical region of tropical deciduous forest, the site, in excellent condition, is a good representative of biodiversity. Located along the migration route, birds are abundant in species and number. Several endangered wildlife species (rhea, caiman, turtle and jaguar) and fish species breed here. The site is important for Potamogeton striatus, a critically endangered plant, and is compatible with a distinct mammal fauna. There are extensive farming, extraction of forest products and poaching. The site shares a border with Argentina (RAMSAR, 2020).

**Figure 58 – Map pointing Ramsar sites in the PARACEL pulp mill area**

confidential

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

N

Paraguay

Brazil

Argentina

Alto Paraguay

Boqueron

Concepcion

Amambay

San Pedro

Canindeyu

Presidente Hayes

Cordillera

Caaguazu

Asuncion

Central

Guaira

Paraguari

Caazapa

Ñeembucu

Misiones

Itapua

CIH Aquidaban

CIH Rio Pilcomayo

Ramsar Estero Milagro

Ramsar Tifunque

T-412 T-413

T-411 T-98 T-99

T-176 T-97

LOCATION MAP

LEGEND

- Structures -Transmission Line
- Accommodations (Camps)
- Site Ramsar Tifunque
- Site Ramsar Estero Milagro
- Hydrography
- DAA - Directly Affected Area
- DIA - Direct Influence Area
- IIA - Indirect Influence Area
- CIH Rio Pilcomayo and Aquidaban
- Departaments
- South America

ESCALA GRAFICA:
0 20 40 80
km

DATUM SIRGAS 2000
PROYECCION: UTM

FUENTE DE DATOS:
- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).

PARACEL PÖYRY

**ENVIRONMENTAL AND SOCIAL STUDY**

**CIH8 Aquidaban and CIH18 Rio Pilcomayo**

**RAMSAR SITES**

| | | | |
|---|---|---|---|
| ESCALA: 1:1.650.000 | | FECHA: 28/05/2021 | |
| PROYECTO N° | FOLHA: | FORMATO: | |
| RESP. TECNICO: Romualdo Hirata | FIRMA: | | REV. 0 |

### 9.9.2 Local Chacarterization (DIA and DAA)

The future PARACEL pulp mill will be located in Concepción, near the Paraguay River, where the treated effluent will be discharged through an emissary system. In addition, the Arroyo Seco river is also within the direct influence area of the ESIA. Thus, for the studies of local water resources, the two rivers were considered.

#### 9.9.2.1 Paraguay river

The water intake and discharge of treated effluents from the PARACEL pulp mill will be carried out over a stretch of approximately 1.0 km (which is part of the DAA and DIA) on the Paraguay River. However, there are no data available for only this 1.0 km stretch of the Paraguay River describing its demand, mining, navigation and demand/availability data. Therefore, the data presented here are related to the Paraguay river as a whole.

Paraguay has a very important and extensive hydrographic network throughout its territory. In fact, the Paraguay river separates and limits two natural regions with very different natural and socioeconomic characteristics (MADES, 2020).

The hydrography of the River Plate Basin is made up of three large water systems: the Paraná, Paraguay and Uruguay, in addition to the River Plate itself, into which some smaller rivers flow. Paraguay is a tributary of the Paraná, while the latter joins with Uruguay to form the Plata river. The drainage areas of each of them form the main sub-basins of the system (CIC, 2020).

The Paraguay River Basin has an area of 1,095,000 km², which covers about 35% of the entire area of the Plata Basin, which is 3,100,000 km², as illustrated in the figure below.

**Figure 59 – The Plata Basin by sub-basin. Source: CIC (2020)**

The Paraná and Paraguay rivers run from north to south and form an axis that divides the Basin into two parts: to the east there is a dense river network with abundant rivers, while to the west the contributions are from flatlands with low flow (CIC, 2020).

One third of the basin of the Paraguay river corresponds to Brazil (370,000 km²), another third to Paraguay (355,000 km²) and the rest is divided between Argentina (165,000 km²) and Bolivia (205,000 km²) as illustrated in the figure below. Almost all of it extends over a vast alluvial plain, with very little slope and extensive flood plains (CIC, 2020).

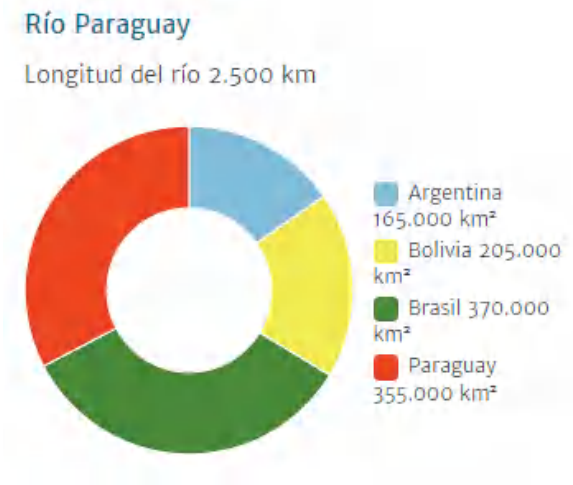


**Figure 60 – Distribution of Paraguay river basin among the countries. Source: CIC (2020)**

The Plata Basin can be subdivided into 7 sub-basins, among which the Upper Paraguay sub-basin and the Middle and Lower Paraguay sub-basin are located in Paraguay (CIC, 2017), as shown in the figure below.

**Figure 61 – Map of Plata sub-basins. Source: CIC (2017)**

According to CIC (2017), the Upper Paraguay Sub-basin (Figure below) includes two large environments, the highlands (so called "Planalto") and the enormous wetland (so called "Pantanal"). The Pantanal formation acts as a large water reservoir at the waters' source for the Plata system that also retains increased amounts of sediment, arising from agriculture in the "Planalto" highlands. Sedimentation is a major threat to the ecosystem because of the wide variety of species that have their natural habitat in this wetland. Maintaining the slow runoff of the Pantanal is key to preventing a greater incidence of flooding downstream of the Paraguay river and in the already affected Paraná river.

**Figure 62 – Map of sub-basin of Alto Paraguay. Source: CIC (2017)**

The Middle and Lower Paraguay Sub-basin (Figure below) is defined from the estuary of the Apa river to the confluence with the Paraná river. It should be noted that the location of the PARACEL pulp mill is in this sub-basin. The Paraguay river, in spite of the contributions it receives in its upper basin, would present a negative water balance in part of this section, if only its right bank tributaries were considered, since its overflows do not return to the main channel, recharging lateral depressions in which water is retained until it evaporates. However, its left bank tributaries - Aquidabán, Jejui, Aguaray and Tebicuary- generate important contributions. Along the main course of Paraguay, the city of Asunción is located in the sub-basin, affected by frequent flooding. This section is an important part of the Paraguay-Paraná Waterway and receives, on its right bank, two tributaries: the lower Pilcomayo and Bermejo rivers.

This sub-basin includes part of the Hydrographic Units CIH18-Rio Pilcomayo and CIH8-Aquidaban, used as the reference unit for defining the IIA for the physical environment. The entire sub-basin was not considered in the IIA because no relevant users were found downstream, sufficiently close (in terms of affecting its quality) to the point of discharge of the effluents. Furthermore, the dispersion of treated effluents in the Paraguay River is very fast and occurs very close to the discharge location (between 0.37 and 0.42 m), and this point is located upstream of the water intake for the pulp mill.

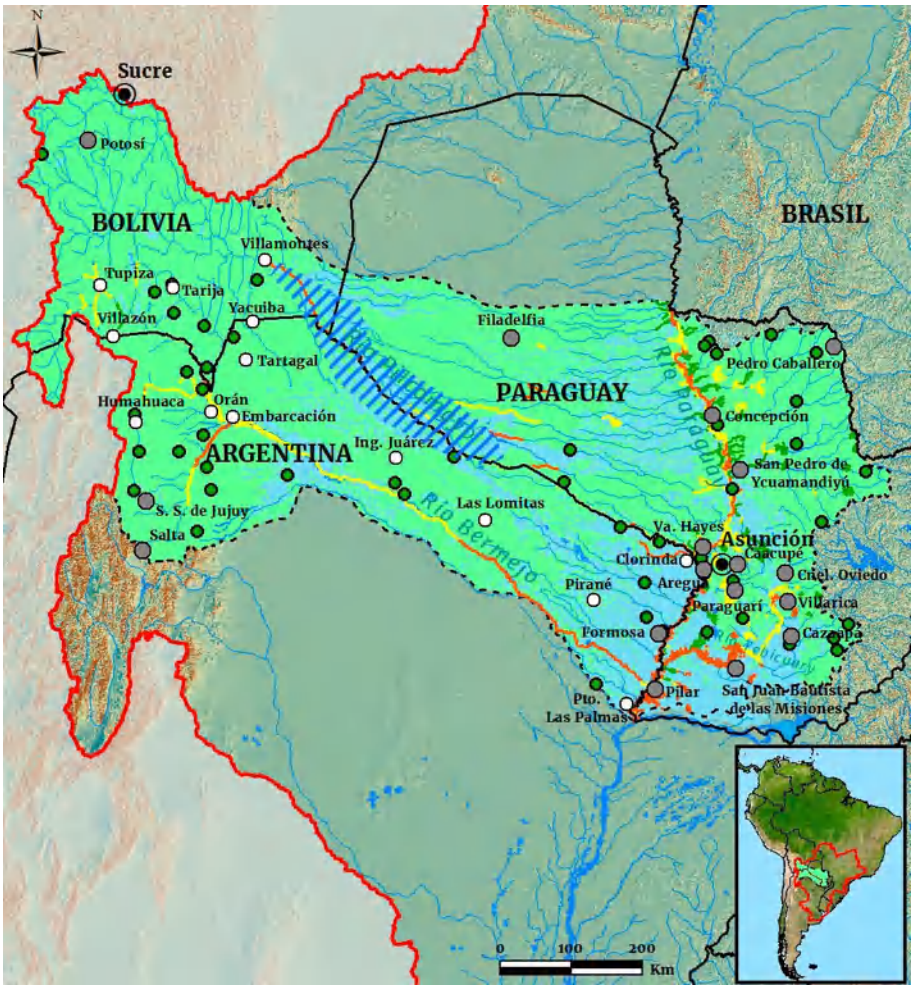


**Figure 63 – Map of sub-basins of Medio and Bajo Paraguay. Source: CIC (2017)**

The Paraguay river rises in the Chapada de Parecís (Brazil) and, after 2,550 km, flows into the Paraná River, at the height of the city of Resistencia (Argentina) (CIC, 2020). The city of Asunción, the capital of Paraguay, is located along the main course of the river (CIC, 2017).

The Paraguay river and all Paraguay's surface water resources are classified as a Class 2 river, according to SEAM Resolution n. 255/2006.

Its left bank tributaries are the Aquidabán, Jejui, Aguaray, and Tebicuary rivers and its right bank tributaries are the Pilcomayo and Bermejo rivers (CIC, 2017).

**Figure 64 – Paraguay river. Source: Pöyry Tecnologia (2019)**

The floodplains on the banks, the enormous volume of solid material carried by the Bermejo river and the backwaters produced by the waters of the Paraná River, which cause irregularities in the river's regime and changes in its year-on-year variation, are its main characteristics (CIC, 2020).

The flood plain of the Paraguay river and its continuation in the Paraná river determine a hydrological continuum of wetlands and a biological corridor that extends from north to south from the great Pantanal in the Upper Paraguay, through the wetlands (CIC, 2017).

A summary of average annual flows (period 1971-2010) of the Paraguay river is presented in the table below.

**Table 9 – Summary of average annual flows of the Paraguay river to its confluence with the Paraná river**

| Points | Simulated flow rate ($m^3/s$) | Observed flow rate ($m^3/s$) | Period |
|---|---|---|---|
| Paraguay river at Puerto Pilcomayo | 3,805 | 3,964 | 1971-2010 |
| Paraguay river in Puerto Bermejo | 5,091 | 4,696 | |
| Paraguay river at Concepción Hydrological Station | - | 2,179 | - |

Source: Adapted from CIC (2017)

## Demand for Water Resources

The main activities related to water use in the basin are consumptive demands (population, livestock, irrigation and industrial), mining, hydroelectricity and navigation.

### Consumption demands

Urban services related to water demand involve drinking water and sanitation services. The demand for drinking water supply -depending on the location of the urban area in question- is met by large rivers such as Paraguay and also by groundwater (CIC, 2017).

With respect to sanitary sewerage, low coverage is a critical problem. Every day, 2.9 million cubic meters of untreated sewage are discharged into the Paraguay river and only 11% of the sewage is treated before reaching the river (ESSAP, 2020).

Land use is changing rapidly, in the Paraguay river system, in Brazilian territory, leading to the opening or extension of the agricultural and livestock frontier, due to the cultivation of soybeans and the exploitation of livestock (CIC, 2017).

Agriculture in Paraguay occupies the eastern region of the country, with a high participation of mechanized activities, due to the predominance of soybean cultivation. Pasture cultivation areas have experienced considerable variation in recent years due to changes in land use (CIC, 2017).

The industrial sector accounts for most of the country's industrial production in the Paraná systems (CIC, 2017).

The values of consumer demand presented in the Paraguayan sub-basin indicate higher consumption in terms of population, livestock and irrigation. The irrigation demand is higher with 552 Hm³/year (37%), followed by livestock with 484 Hm³/year (32%) and population 443 Hm³/year (30%) (CIC, 2015). The consumption by industry is the lowest with 10 Hm³/year (1%), as presented in the table and figure below.

The participation of the Paraguayan sub-basin in the River Plate Basin corresponds to only 4.5%.

**Table 10 – Consumption demand by usage in $Hm^3$/year**

| Population | Cattle raise | Irrigation | Industrial | Others | Total | Percentage of the Plata basin |
|---|---|---|---|---|---|---|
| 443 | 484 | 552 | 10 | - | 1.489 | 4.5% |

Source: Adapted from CIC (2015)

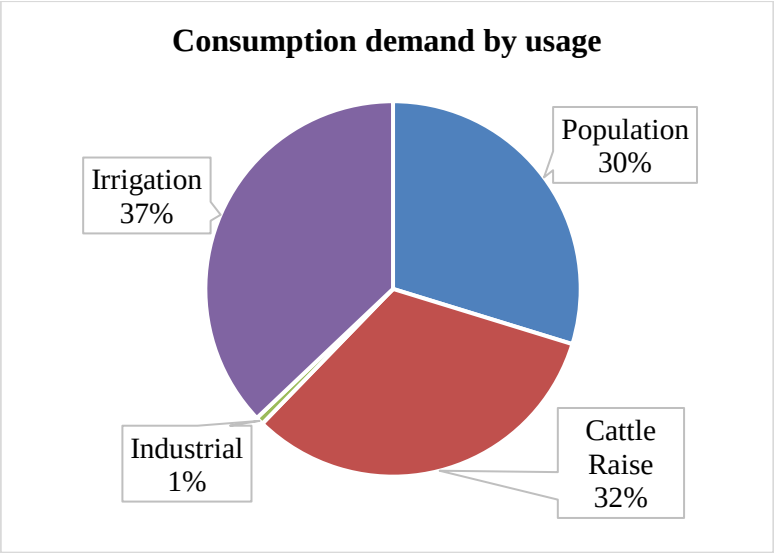


**Figure 65 – Consumption demand by usage. Source: Adapted from CIC (2015)**

### Mining

One of the important environmental aspects of mining is the products used in the activity, which are deposited in the sediments of the rivers in the Basin and generate accumulated effects historically downstream from the production areas (CIC, 2017).

On a larger scale, the pollution generated by mining is mainly observed in the Paraguay River system, particularly in two of the main tributary sub-basins, the Bermejo and the Pilcomayo (CIC, 2017).

### Hydroelectricity

The Plata Basin has a very important hydroelectric generation capacity. Its use means a relevant portion of the energy generation in the countries involved. For Paraguay in particular, it represents the largest percentage of its GDP (CIC, 2017). There are also two hydroelectric plants, Iguazú and Acaray, located entirely in Paraguay. Of course, there is no hydroelectric plant on the Paraguay River in the factory's area of influence.

### Navigation

For Paraguay, the waterways of the Paraguay and Paraná rivers represent a fundamental factor in its foreign trade, given its status as a Mediterranean country, since they have provided access to the sea since colonial times (CIC, 2014).

In the regional context, these routes are now a fundamental pillar of integration of the regions of the Plata Basin, and have become an important means of transporting cargo, due to the advantages of river transport (CIC, 2014).

The Paraguay river, the most important waterway in the country, has the characteristics of a plain river, where, due to the natural process of the river, subject to erosion, transport and sedimentation, morphological changes occur in the bed, which changes the navigation channel during time (CIC, 2014).

The variable levels of the river, subject to the precipitation regime in its basin, determine a hydrological cycle of the Paraguay river that we can classify into Low Waters (November, December, January, February), High Waters (May, June, July, August), and Medium Waters (March, April, September, October) (CIC, 2014).

In periods of low-level water there are usually difficulties in navigation, because the low levels of the river produce the appearance of the critical crossings. It should be noted that the Paraguay river does not have any artificial flow regulation system but due to anomalies its hydrological cycle is sometimes altered (CIC, 2014).

Navigation in the Plata Basin is done in a complex system on the Paraguay river. Based on this, there is a program called waterway Paraguay-Paraná (CIC, 2014).

This waterway is the main route that connects the countries of the La Plata Basin, being an important route because of its capacity to transport large loads (CIC, 2017).

The Paraguay-Paraná Waterway is a regional agreement between Argentina, Bolivia, Brazil, Paraguay and Uruguay to facilitate navigation and foreign and domestic trade. It is made up of the Paraguay, Paraná and Uruguay Rivers. It is one of the longest natural waterways in the world: 3,442 km, and extends from Puerto Cáceres (Brazil) to Nueva Palmira (Uruguay), as illustrated in the figure below. It is one of the most significant transport routes for the integration of Mercosur (MAGYP. 2020).

**Figure 66 – Map with waterways of Plata Basin. Source: CIC (2017)**

## The Availability-Demand Ratio

Water resource uses can lead to conflicts when there is no balance between availability and demand for consumptive uses or when non-consumptive uses alter the conditions of the water system, with its variability in time and space (CCC, 2017).

The following table presents a qualitative evaluation of water uses in the Upper and Lower Paraguay sub-basins. In the Upper Paraguay sub-basin there are problems of navigation, recreation/tourism and aquaculture/fishing, and some problems of irrigation and conflict of uses. In the Lower Paraguay sub-basin there are problems of navigation, and some problems of human supply, irrigation and conflict of uses, Recreation/Tourism, Aquaculture/Fishing and conflict of uses.

**Table 11 – General qualitative evaluation of water usage**

| Water usage | Sub-basin | |
|---|---|---|
| | Upper Paraguay | Lower Paraguay |
| Human supply | There are no dominant problems | There are only a few problems |
| Irrigation | There are only a few problems | There are only a few problems |
| Hydropower | There are no dominant problems | There are no dominant problems |
| Navigation | There are problems | There are problems |
| Recreation/Tourism | There are problems | There are only a few problems |
| Fishing/Water farming | There are problems | There are only a few problems |
| Conflict of Uses | There are only a few problems | There are only a few problems |

Source: Adapted from CIC (2017).

## Quality

Special consideration should be given to mining activity in the upper basin of the Paraguay river in Bolivia and Brazil. There are tin deposits in the form of cassiterite and acid drainage, a consequence of mining activity and its environmental liabilities, which contaminate rivers and groundwater (CIC, 2017).

Downstream, in Paraguay, the greatest loads of pollutants come from agricultural activity (crops and pastures) and, mainly, from discharges of domestic and industrial effluents in areas near large urban centers such as Concepción (CIC, 2017).

For the ESIA, three water quality monitoring campaigns were carried out on the Paraguay River at two points, one upstream and the other downstream from the raw water intake and treated effluent discharge locations of the future pulp mill, respectively.

#### 9.9.2.2 Arroyo Seco

Arroyo Seco is part of the Aquidabán Hydrographic Unit and is a tributary of the Paraguay river. It flows downstream from the water intake point of the PARACEL pulp mill.

Arroyo Seco, as well as all of Paraguay's surface water resources are classified as a Class 2 river, according to SEAM Resolution n. 255/2006.

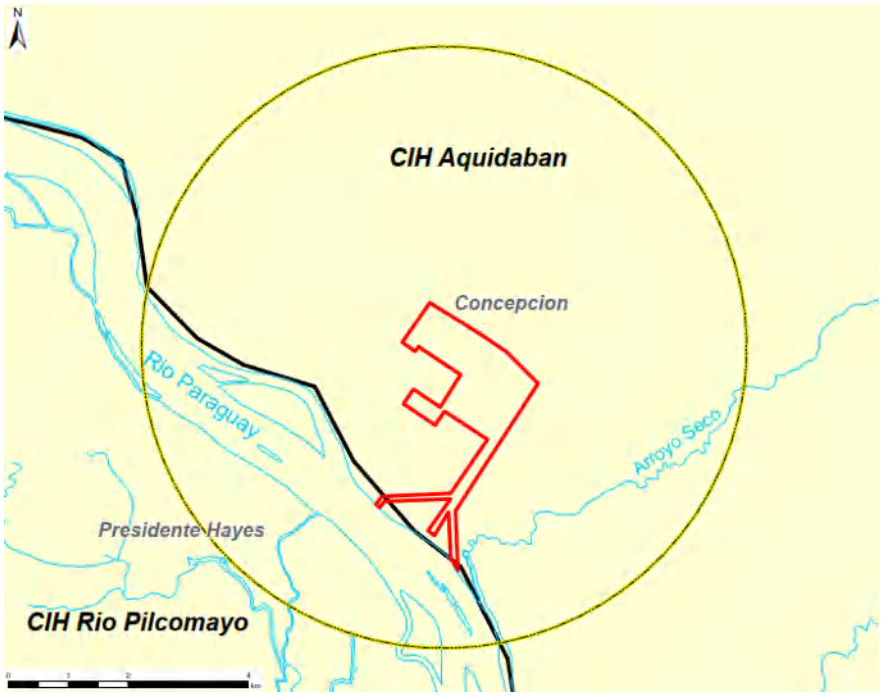


**Figure 67 – Location map of Arroyo de Seco.**

### 9.9.3 Surface water and sediment quality

This item presents the results of the Surface Water and Sediment Quality Monitoring report of the Paraguay River, in the location planned for the collection of raw water and treated effluent disposal from the PARACEL pulp mill.

The purpose of the monitoring is to verify the quality of the water and sediments of the Paraguay River before the implementation and operation of the pulp mill (background).

Surface water and sediment sampling was performed at two (2) points and three (3) campaigns, covering the region's dry and rainy periods. The campaigns were carried out on the following dates:

- 1st Campaign, October 25, 2019, dry season
- 2nd Campaign, December 15, 2019, rainy season;
- 3rd Campaign, February 17, 2020, rainy season.

It is worth mentioning that a total of 6 campaigns have been planned, yet, due to the coronavirus pandemic, it was not possible to execute the collection of water and sediment samples.

This report was prepared using SEAM Resolution n 222/2002, which determines the standard for water quality in the national territory.

The complete report is presented in **ANNEX I** of this document.

#### 9.9.3.1 Monitoring points

The sampling points were established with the objective of knowing the quality of surface water and sediments in the region where the PARACEL pulp mill is located before its operation - that is why it is considered a background for future monitoring studies. The definition of the sampling points was based on the raw water intake and treated liquid effluent discharge points of the future pulp mill, located on the Paraguay River, as shown in the figure below.

**Figure 68 – Location of surface water and sediment sampling points. Source: Pöyry Tecnologia (2021)**

**Table 12 – Coordinates of surface water and sediment sampling points**

| Point | Coordinates |
|---|---|
| FW01 / SE01 | 23°15'16.51"S, 57°31'31.62"O |
| FW02 / SE02 | 23°17'17.54"S, 57°29'32.41"O |

Source: Pöyry Tecnologia (2020)

**Figure 69 – Point FW01 / SE01. Source: Pöyry Tecnologia (2020)**

**Figure 70 – Point FW02 / SE02. Source: Pöyry Tecnologia (2020)**

#### 9.9.3.2 Standards

To monitor current surface water and sediment conditions in the Paraguay river, in the region of intake water and discharge of treated effluents from the pulp mill, the main control parameters for Class 2 rivers of SEAM Resolution n. 222/2002 were considered.

#### 9.9.3.3 Methods

The sampling of surface water and sediments was verified according to the rules and procedures of the Standard Methods for the Examination for Water and Wastewater of the EPA/USA. The type of sampling was simple (exact), i.e., sampling surface water or sediment in sufficient quantity for analysis.

Most of the sampling and analysis of the parameters were executed by INYMA CONSULT Laboratory, with the exception of the analysis of Chlorates, AOX, Paraquat and 2.4D (surface water); Percentage of Solids and 2.4D (sediment) were executed by BIOAGRI AMBIENTAL LTDA. (Mérieux NutriSciences).

The Paraguayan laboratory INYMA CONSULT is in the process of accreditation, currently interrupted due to the COVID-19 pandemic. INYMA's professional solvency is recognized by several government agencies, such as ERSSAN, for drinking water analysis and all analysis protocols were presented at MADES. INYMA is also the reference laboratory for CONALAYPA (National Commission for the Management of Lake Ypacaraí) and is the only one in Paraguay that participates since 2009 in annual evaluations of interlaboratory analysis with the samples provided by INTI (National Institute of Industrial Technology) of Argentina.

Part of the tests conducted by INYMA were referred to laboratories accredited in these determinations. The analysis of some heavy metals was performed by MULTILAB Laboratory and the analysis of pesticides and glyphosates in water and sediments in ANALÍTICA S.A.

The Brazilian laboratory BIOAGRI AMBIENTAL LTDA (Mérieux NutriScience) is accredited for testing and calibration by ISO 17025, with certificate issued by CGCRE (General Coordination of Accreditation of INMETRO - Brazil).

Figures below presents INYMA's certificates of participation in INTI's interlaboratory tests (year 2017) and the accreditation certificate of BIOAGRI AMBIENTAL LTDA. The other certificates can be found in the attached files of VOLUME IV - Analytical Reports (Surface Water and Sediment Monitoring Report).

Instituto Nacional de Tecnología Industrial
INTI
Ministerio de Producción Presidencia de la Nación
INTI Química
INTERLABORATORIOS
INTI SAI

Programa de Ensayos de Aptitud

**"Aguas – Parámetros Básicos"**

*Ensayo Nº 8 – Año 2017 (PRQ-03/2017)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L.***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***dureza, alcalinidad, pH, cloruro, nitrato, sulfato, calcio, potasio, sodio, sólidos totales***
*se extiende el presente certificado que así lo acredita.*

*Lic. Pablo Álvarez* *Lic. Ariel Galli* *Ing. Sofía Frangie*

**Figure 71 – Certificate INYMA Laboratory in attendance to sampling realized by INTI among labs (year 2017)**

Instituto Nacional de Metrologia, Qualidade e Tecnologia – Inmetro
*Coordenação Geral de Acreditação*

*Signatário dos Acordos de Reconhecimento Mútuo da International Laboratory Accreditation Cooperation (ILAC), da Interamerican Accreditation Cooperation (IAAC) e International Accreditation Forum (IAF).*

*Certificado de Acreditação*

Acreditação nº CRL 0677

Acreditação Inicial: 03-02-2014

**Bioagri Ambiental Ltda**
Rua Dr. José Elias, 98 - Alto da Lapa - São Paulo/SP

*A Coordenação Geral de Acreditação do Inmetro (Cgcre) concede acreditação ao Organismo de Avaliação da Conformidade acima identificado, no endereço citado, segundo os requisitos estabelecidos na ABNT NBR ISO/IEC 17025:2017. Esta acreditação constitui a expressão formal do reconhecimento de sua competência para realizar atividades de ensaios, conforme Escopo de Acreditação.*

Assinado de forma digital por ALDONEY FREIRE COSTA:54879590720
Dados: 2019.12.04 07:56:36 -03'00'

*Aldoney Freire Costa*
*Coordenador Geral de Acreditação*

*A situação atual da acreditação e seu escopo devem ser verificados no endereço eletrônico www.inmetro.gov.br/credenciamento/laboratoriosAcreditados.asp*

MOD-CGCRE-024 – Rev. 06 – Apr. MAR/19 – Pg. 01/01

**Figure 72 – Certificate of accreditation of the Bioagri Ambiental Ltda**

For the execution of the analysis, a specific analytical method was used for the parameters evaluated, as presented in the following tables:

**Table 13 – Methods of analysis for surface water**

| Tests | Methods of analysis |
|---|---|
| Total Alkalinity | SM 2320 B |
| Aluminium (Al) | @ICP-MS |
| Total Arsenic (As) | @ICP-MS |
| Barium (Ba) | @ICP-MS |
| Cadmium (Cd) | @ICP-MS |
| Calcium | SM 3500 Ca D. EDTA |
| Lead (Pb) | @ICP-MS |
| Free Cyanide ($CN^-$) | SM 4500-CN. E Colorimetric method |
| Chlorine | SM 4500-Cl Argentometric method |
| Copper (Cu) | @ICP-MS |
| Fecal Coliforms | SM 9222 D. Fecal Coliform Membrane Filter |
| Electrical conductivity at 25°C | SM 2510. Laboratory Method |
| True colour | SM 2120 B. Visual Comparison Method |
| Total chrome (Cr) | SM 3500-Cr. Colorimetric Method |
| Hexavalent chromium ($Cr^{6+}$) | SM 3500-Cr. Colorimetric Method |
| Trivalent Chromium ($Cr^{3+}$) | Calculation |
| Biochemical Oxygen Demand ($BOD_5$) | SM 5210. 5-Day BOD Test |
| Total Hardness ($CaCO_3$) | SM 2340. EDTA Titrimetric Method |
| Tin (Sn) | @ICP-MS |
| Soluble iron ($Fe^{2+}$) (in situ) | SM 3500-Fe D |
| Total Phosphorus (P) | SM 4500-P. Ascorbic Acid Method |
| Glyphosate | @LC-MS/MS |
| Phenol Index ($C_6H_5OH$) | SM 5530. Chloroform Extraction Method |
| Magnesium | SM 3500 Mg E. Calculation |
| Manganese (Mn) | Hach method 8149 |
| Total Mercury (Hg) | @ICP-MS |
| Nickel (Ni) | @ICP-MS |
| Nitrate ($N\text{-}NO_3^-$) | EPA method 352.1 |
| Nitrite ($N\text{-}NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Ammonia Nitrogen ($NH_3$) | SM 4500-$NH_3$. Phenate Method |
| Total Kjeldahl Nitrogen (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method |

| Tests | Methods of analysis |
|---|---|
| Oils and Fats | SM 5520. Partition-Gravimetric Method |
| Dissolved Oxygen | SM 4500-O. Membrane Electrode Method |
| Polychlorinated Biphenyls (PCB's) | @GC-MS |
| Pesticides in water | @SPME-GC-MS |
| pH (on site) | SM 4500-$H^+$. Electrometric Method |
| Potassium | SM 3500-K. Flame Emission Photometric Method |
| Selenium (Se) | @ICP-MS |
| Silica | SM 4500 –Si D |
| Sodium (Na) | SM 3500-Na. Flame Emission Photometric Method |
| Total Dissolved Solids | SM 2540 C. Total Solids Dried at 180ºC |
| Sulphate ($SO_4^{-2}$) | SM 4500 - $SO_4^{-2}$. Turbidimetric Method |
| Turbidity | SM 2130. Nephelometric Method |
| Zinc (Zn) | @ICP-MS |
| Semi-volatile organic compounds SVOC | EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparation: EPA 3510 C:1996, 3535 A:2007 |
| Anions | EPA 300.0: 1993, 300.1: 1999, POP PA 032 - Rev. 13 |
| Paraquat | POP 05.192/05 - LC-MS/MS |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.

**Table 14 – Methods of analysis of sediments**

| Tests | Methods of analysis |
|---|---|
| Aluminium (Al) | SM 3500-Al D |
| Antimony (Sb) | @ICP-MS |
| Total Arsenic (As) | SM 3500-As C. Silver Diethyldithiocarbamate Method |
| Barium (Ba) | @ICP-MS |
| Boron (B) | @ICP-MS |
| Cadmium (Cd) | @ICP-MS |
| Copper (Cu) | ICUMSA |
| Total Chrome (Cr) | SM 3500 - Cr. Colorimetric Method |
| Hexavalent Chromium ($Cr^{6+}$) | SM 3500 - Cr. Colorimetric Method |
| Trivalent Chromium ($Cr^{3+}$) | Cálculo |
| Biochemical Oxygen Demand ($BOD_5$) | SM 5210. 5-Day BOD Test |
| Tin (Sn) | @ICP-MS |
| Total Phosphorus (P) | SM 4500-P. Ascorbic Acid Method |
| Glyphosate | @LC-MS/MS |
| Total Mercury (Hg) | @ICP-MS |
| Nitrate (N-$NO_3^-$) | EPA method 352.1 |
| Nitrite (N-$NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Total Kjeldahl Nitrogen (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method |
| Nickel (Ni) | @ICP-MS |
| Polychlorinated biphenyls (PCBs) | @GC-ECD |
| Chlorinated Pesticides in Sediments | @LC/MS/MS |
| Silver (Ag) | @ICP-MS |
| Lead (Pb) | SM 3500-Pb C. |
| Selenium (Se) | Osburn, R. L., A. D. Shendrikar, and P. W. West, Anal. Chem., 43 (4), 594-597 (1971) |
| Zinc (Zn) | @ICP-MS |
| Percentage of Solids | SMWW, 22ª Edition, 2012 - Method 2540 G |
| Semi-Volatile Organic Compounds (SVOCs) | EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparation: EPA 3550 C:2007 |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.

**Figure 73 – Surface water sampling. Source: Pöyry Tecnologia (2020)**

**Figure 74 – Equipment for sampling surface water at depth. Source: Pöyry Tecnologia (2020)**

**Figure 75 – pH and temperature measurement *in situ*. Source: INYMA (2019)**

**Figure 76 – Dredging for sampling of the sediments. Source: Pöyry Tecnologia (2020)**

#### 9.9.3.4 Results

The following tables present the results of the surface water and sediment analysis for the three campaigns. The results of the surface waters were compared with the standards established for class 2 water bodies by SEAM Resolution n. 222/02. With regard to sediments, it should be noted that there is no legal reference for comparing the results.

#### 9.9.3.4.1 Surface waters

**Table 15 – Results of 1st, 2nd and 3rd campaigns – Surface waters – FW01 (Parameters *in situ*)**

| Parameters *in situ* | Unit | Results | | | Resolution n. 222/02* |
|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | |
| **Depth: 0.5 meters** | | | | | |
| pH | - | 7.66 | 7.16 | 7.15 | 6.0 – 9.0 |
| Temperature | ºC | 26.5 | 31.1 | 32.7 | - |
| Conductivity at 25ºC | µS/cm | 162 | 322 | 3182 | - |
| Dissolved Oxygen | mg/L | 7.06 | 6.60 | 5.80 | ≥ 5 |
| Oxygen Saturation | % | 89 | 81 | 80 | - |
| **Depth: 2.5 meters **** | | | | | |
| pH | - | 7.53 | 7.32 | 7.70 | 6.0 – 9.0 |
| Temperature | ºC | 26.9 | 31.5 | 32.4 | - |
| Conductivity at 25ºC | µS/cm | 141.5 | 313 | 203 | - |
| Dissolved Oxygen | mg/L | 7.29 | 7.20 | 6.00 | ≥ 5 |
| Oxygen Saturation | % | 92 | 91 | 83 | - |
| **Depth: 5.5 meters ***** | | | | | |
| pH | - | 7.60 | 7.12 | 7.15 | 6.0 – 9.0 |
| Temperature | ºC | 27.3 | 30.6 | 32.5 | - |
| Conductivity at 25ºC | µS/cm | 150 | 346 | 183 | - |
| Dissolved Oxygen | mg/L | 7.80 | 7.26 | 6.11 | ≥ 5 |
| Oxygen Saturation | % | 100 | 96 | 85.4 | - |

* Resolution SEAM n. 222/02, article 3rd for surface water Class 2.

** In the 2nd campaign, the Depth was 3.0 meters and in the 1st campaign was 2.5 meters.

*** In the 2nd campaign, the Depth was 6.0 meters and in the 1st campaign was 5.0 metros.

## Table 16 – Results of 1st, 2nd and 3rd Campaigns – Surface waters – FW01

| Parameter | Unit | Results | | | Detection Limits | Limits of Resolution SEAM n. 222/2002 * |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| **Physicochemicals** | | | | | | |
| Oils and Fats | mg/L | ND | ND | ND | 2 | Absent |
| Total Alkalinity ($CaCO_3$) | mg/L | 34.7 | 30.8 | 34.7 | 0.56 | - |
| AOX** | µg/L | 120 | 220 | 110 | 20 | - |
| Free Cyanates ($CN^-$) | mg/L | ND | ND | ND | 0.01 | Max. 0.2 |
| Chlorates** | mg/L | ND | 0.04 | 0.02 | 0.02 | - |
| Chlorides (Cl) | mg/L | 28.5 | 64.8 | 23.6 | 0.25 | Max. 250 |
| Color | uPtCo | 75 | 65 | **82** | < 1 | ≤ 75 |
| Biochemical Oxygen Demand ($BOD_5$) | mg/L | ND | 1.6 | 1.4 | 0.5 | ≤ 5 |
| Total Hardness ($CaCO_3$) | mg/L | 32 | 41 | 36.5 | 0.5 | Max. 300 |
| Total Phosphorus (P) | mg/L | 0.021 | **0.090** | **0.160** | 0.004 | Max. 0.05 |
| Phenol Index (1) | mg/L | ND | ND | ND | 0.024 | Max. 0.5 |
| Fluctuating Materials | mg/L | Absent | Absent | Absent | - | Absent |
| Nitrate ($N\text{-}NO_3^-$) | mg/L | 0.30 | 1.98 | 1.01 | 0.03 | Max. 10 |
| Nitrite ($N\text{-}NO_2^-$) in situ | mg/L | 0.003 | 0.004 | ND | 0.002 | Max. 1.0 |
| Ammonia Nitrogen (N) | mg/L | ND | ND | 0.014 | 0.006 | - |
| Non-ionized ammonia ($NH_3$) (calculation) | mg/L | ND | ND | ND | - | Max. 0.02 |
| Total Kjeldahl Nitrogen (NTK) | mg/L | **0.84** | **1.18** | **1.01** | 0.03 | Max. 0.6 |
| Potassium (K) | mg/L | 2.38 | 3.22 | 2.50 | 0.1 | - |
| Sodium (Na) | mg/L | 18.3 | 44.0 | 21.5 | 0.5 | Max. 200 |
| Total dissolved solids | mg/L | 124 | 220 | 139 | 5 | Max. 500 |
| Sulphate ($SO_4^{-2}$) | mg/L | 3.6 | 12 | 17 | 1 | Max. 250 |
| Turbidity | UNT | 36.98 | 61.43 | 35.8 | 0.02 | ≤ 100 |
| **Bacteriological** | | | | | | |
| Fecal Coliforms | UFC/100ml | < 10 | 11 | < 10 | 10 | ≤ 1000 |
| **Metals** | | | | | | |
| Total Aluminium (Al) | mg/L | **3.55** | **7.00** | **3.00** | 0.05 | Max. 0.2 |
| Arsenic (As) | mg/L | 0.008 | 0.006 | 0.003 | 0.001 | Max. 0.01 |
| Barium (Ba) | mg/L | ND | 0.06 | ND | 0.05 | Max. 2.0 |
| Cadmium (Cd) | mg/L | ND | ND | ND | 0.0005 | Max. 0.001 |
| Copper (Cu) | mg/L | ND | ND | ND | 0.01 | Max. 1.0 |
| Total Chrome (Cr) | mg/L | ND | ND | ND | 0.005 | Max. 0.55 |
| Hexavalent Chromium ($Cr^{6+}$) | mg/L | ND | ND | ND | 0.005 | Max. 0.05 |
| Trivalent Chromium ($Cr^{3+}$) | mg/L | ND | ND | ND | 0.005 | Max. 0.5 |

| Parameter | Unit | Results | | | Detection Limits | Limits of Resolution SEAM n. 222/2002 * |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| Tin (Sn) | mg/L | ND | ND | ND | 0.005 | Max. 2.0 |
| Soluble iron ($Fe^{+2}$) in situ | mg/L | **0.35** | 0.17 | **0.55** | 0.05 | Max. 0.3 |
| Manganese (Mn) | mg/L | 0.08 | 0.08 | ND | 0.025 | Max. 0.1 |
| Total Mercury (Hg) (2) | mg/L | ND | ND | ND | 0.001 | Max. 0.002 |
| Nickel (Ni) | mg/L | 0.006 | 0.003 | 0.005 | 0.001 | Max. 0.025 |
| Lead (Pb) | mg/L | 0.002 | 0.004 | ND | 0.001 | Max. 0.01 |
| Selenium (Se) | mg/L | 0.003 | 0.002 | ND | 0.001 | Max. 0.01 |
| Zinc (Zn) | mg/L | 0.07 | ND | ND | 0.05 | Max. 3.0 |
| **Pesticides** | | | | | | |
| 2.4 D** | µg/L | ND | ND | 0.005 | 0.005 | - |
| Alaclor | mg/L | ND | ND | ND | 0.014 | 0 |
| Anthracine | mg/L | ND | ND | ND | 0.008 | 0.003 |
| Gamma Chlordane | mg/L | ND | ND | ND | 0.012 | 0 |
| 4.4' - DDT | mg/L | ND | ND | ND | 0.007 | 0.002 |
| Endosulfan | mg/L | ND | ND | ND | 0.019 | 0.056 |
| Endrin | mg/L | ND | ND | ND | 0.009 | 0.002 |
| Glyphosate | mg/L | ND | ND | ND | 2.7 | 0.7 |
| Heptachlor | mg/L | ND | ND | ND | 0.005 | 0 |
| Lindane (BHC) | mg/L | ND | ND | ND | 0.002 | 0.0002 |
| Methoxychlorine | mg/L | ND | ND | ND | 0.005 | 0.04 |
| Paraquat** | µg/L | ND | ND | ND | 0.1 | - |
| Polychlorinated Biphenyls (PCB's) (3) | mg/L | ND | ND | ND | 0.2 | 0 |
| Propanil | mg/L | ND | ND | ND | 0.132 | 0.02 |
| Simazine | mg/L | ND | ND | ND | 0.027 | 0.004 |

* Resolution SEAM n. 222/02, article 3 for surface water – class 2.

**Analysis by Bioagri Laboratory.

(1) Maximum rate of Phenols allowed for the discharge of effluents into surface water bodies, article 7 of SEAM Resolution n. 222/02.

(2) Sum of organic and inorganic mercury.

(3) The outsourced laboratory reports the PCB result as less than 0.2 microgram/L, which is the limit of quantification of the method used.

ND: no detectable.

The detection limits of organic compounds are expressed in micrograms per liter (µg/L).

**Table 17 – Results of 1st, 2nd and 3rd Campaigns – Surface Waters – FW02 (Parameters *in situ*)**

| Parameters *in situ* | Unit | Results | | | Limits of Resolution n. 222/02* |
|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | |
| **Depth: 0.5 meters** | | | | | |
| pH | - | 7.56 | 7.11 | 7.12 | 6.0 – 9.0 |
| Temperature | ºC | 26.8 | 30.7 | 32.4 | - |
| Conductivity at 25ºC | µS/cm | 177 | 322 | - | - |
| Dissolved Oxygen | mg/L | 7.11 | 6.37 | 5.93 | ≥ 5 |
| Oxygen Saturation | % | 89.5 | 85 | 82 | - |
| **Depth: 2.5 meters **** | | | | | |
| pH | - | 7.50 | 7.17 | 7.12 | 6.0 – 9.0 |
| Temperature | ºC | 26.8 | 30.7 | 32.6 | - |
| Conductivity at 25ºC | µS/cm | 164 | 318 | 174 | - |
| Dissolved Oxygen | mg/L | 7.70 | 7.18 | 6.05 | ≥ 5 |
| Oxygen Saturation | % | 97.2 | 91 | 82.4 | - |
| **Depth: 5.0 meters ***** | | | | | |
| pH | - | 7.50 | 7.14 | 7.08 | 6.0 – 9.0 |
| Temperature | ºC | 26.7 | 31.0 | 32.8 | - |
| Conductivity at 25ºC | µS/cm | 174 | 319 | 162 | - |
| Dissolved Oxygen | mg/L | 7.80 | 7.14 | 6.20 | ≥ 5 |
| Oxygen Saturation | % | 100 | 91 | 86 | - |

* Resolution SEAM n. 222/02, article 3rd for surface Waters Class 2.

** In the 2nd campaign, the Depth was 2.0 meters and in the 1st campaign was 2.5 meters.

*** In the 2nd campaign, the Depth was 4.0 meters and in the 1st campaign was 5.0 meters.

## Table 18 – Results of 1st, 2nd and 3rd Campaign – Surface Waters – FW02

| Parameters | Unit | Results | | | Detection limits | Limits of Resolution n. 222/02* |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| **Physicochemicals** | | | | | | |
| Oils and Fats | mg/L | ND | ND | ND | 2 | Absent |
| AOX** | µg/L | 100 | 250 | 62 | 20 | - |
| Free Cyanides ($CN^-$) | mg/L | ND | ND | ND | 0.01 | Max. 0.2 |
| Chlorates** | mg/L | ND | 0.04 | ND | 0.02 | - |
| Color | uPtCo | 70 | **80** | 75 | 1 | ≤ 75 |
| Biochemical Oxygen Demand ($BOD_5$) | mg/L | ND | 1.6 | 1.5 | 0.5 | ≤ 5 |
| Total Hardness ($CaCO_3$) | mg/L | 34 | 41 | 35.0 | 0.5 | Max. 300 |
| Total Phosphorus (P) | mg/L | **0.063** | **0.080** | **0.135** | 0.004 | Max. 0.05 |
| Phenol Index (1) | mg/L | ND | ND | ND | 0.024 | Max. 0.5 |
| Fluctuating Materials | mg/L | Absent | Absent | Absent | - | Absent |
| Nitrate ($N\text{-}NO_3^-$) | mg/L | 0.28 | 1.92 | 0.27 | 0.03 | Max. 10 |
| Nitrite ($N\text{-}NO_2^-$) in situ | mg/L | 0.008 | 0.006 | ND | 0.002 | Max. 1.0 |
| Ammonia Nitrogen (N) | mg/L | ND | ND | 0.015 | 0.006 | - |
| Non-ionized ammonia ($NH_3$) (calculation) | mg/L | ND | ND | ND | - | Max. 0.02 |
| Total Kjeldahl Nitrogen (NTK) | mg/L | **1.63** | **1.63** | **1.03** | 0.03 | Max. 0.6 |
| Sodium (Na) | mg/L | 19.7 | 42.6 | 22.0 | 0.5 | Max. 200 |
| Total Dissolved Solids | mg/L | 130 | 213 | 124 | 5 | Max. 500 |
| Sulphate ($SO_4^{-2}$) | mg/L | 4.2 | 12.4 | 13.5 | 1 | Max. 250 |
| Turbidity | UNT | 38.97 | 66.74 | 38.1 | 0.02 | ≤ 100 |
| **Bacteriological** | | | | | | |
| Fecal Coliforms | UFC/100ml | < 10 | 13 | < 10 | 10 | ≤ 1000 |
| **Metals** | | | | | | |
| Aluminum Total (Al) | mg/L | **4.07** | **5.9** | **4.00** | 0.05 | Max. 0.2 |
| Arsenic (As) | mg/L | 0.008 | 0.005 | 0.003 | 0.001 | Max. 0.01 |
| Barium (Ba) | mg/L | ND | 0.06 | ND | 0.05 | Max. 2.0 |
| Cadmium (Cd) | mg/L | ND | ND | ND | 0.0005 | Max. 0.001 |
| Copper (Cu) | mg/L | ND | ND | ND | 0.01 | Max. 1.0 |
| Total Chrome (Cr) | mg/L | ND | ND | ND | 0.005 | Max. 0.55 |
| Hexavalent Chromium ($Cr^{6+}$) | mg/L | ND | ND | ND | 0.005 | Max. 0.05 |
| Trivalent Chromium ($Cr^{3+}$) | mg/L | ND | ND | ND | 0.005 | Max. 0.5 |
| Tin (Sn) | mg/L | ND | ND | ND | 0.005 | Max. 2.0 |
| Soluble iron ($Fe^{+2}$) in situ | mg/L | **0.61** | 0.18 | **0.79** | 0.05 | Max. 0.3 |

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| Parameters | Unit | Results | | | Detection limits | Limits of Resolution n. 222/02* |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| Manganese (Mn) | mg/L | 0.08 | 0.09 | 0.056 | 0.025 | Max. 0.1 |
| Total Mercury (Hg) (2) | mg/L | ND | ND | ND | 0.001 | Max. 0.002 |
| Nickel (Ni) | mg/L | 0.006 | 0.003 | 0.006 | 0.001 | Max. 0.025 |
| Lead (Pb) | mg/L | 0.002 | 0.003 | ND | 0.001 | Max. 0.01 |
| Selenium (Se) | mg/L | 0.003 | 0.002 | ND | 0.001 | Max. 0.01 |
| Zinc (Zn) | mg/L | 0.07 | ND | ND | 0.05 | Max. 3.0 |
| **Pesticides** | | | | | | |
| 2.4 D | µg/L | ND | ND | ND | 0.005 | - |
| Alachlor | mg/L | ND | ND | ND | 0.014 | 0 |
| Atrazine | mg/L | ND | ND | ND | 0.008 | 0.003 |
| Gamma Chlordane | mg/L | ND | ND | ND | 0.012 | 0 |
| 4.4' - DDT | mg/L | ND | ND | ND | 0.007 | 0.002 |
| Endosulfan | mg/L | ND | ND | ND | 0.019 | 0.056 |
| Endrin | mg/L | ND | ND | ND | 0.009 | 0.002 |
| Glyphosate | mg/L | ND | ND | ND | 2.7 | 0.7 |
| Heptachlor | mg/L | ND | ND | ND | 0.005 | 0 |
| Lindane (BHC) | mg/L | ND | ND | ND | 0.002 | 0.0002 |
| Paraquat** | µg/L | ND | ND | ND | 0.1 | - |
| Methoxychlorine | mg/L | ND | ND | ND | 0.005 | 0.04 |
| PCBs (Polychlorinated biphenyls) (3) | mg/L | ND | ND | ND | 0.2 | 0 |
| Propanil | mg/L | ND | ND | ND | 0.132 | 0.02 |
| Simazine | mg/L | ND | ND | ND | 0.027 | 0.004 |

* SEAM Resolution n. 222/02, Article 3 for class 2 surface waters.

**Analysis carried out by the Bioagri laboratory.

(1) Maximum rate of Phenols allowed for the discharge of effluents in surface water bodies, article 7 of SEAM Resolution n. 222/02.

(2) Sum between organic mercury and inorganic mercury.

(3) The outsourced laboratory reports the PCB result as less than 0.2 micrograms/L, which is the limit of quantification of the method used.

ND: not detectable.

Limits of detection of organic compounds are expressed in micrograms per liter (µg/L).

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#### 9.9.3.4.2 Sediments

**Table 19 – Results of 1st, 2nd and 3rd Campaigns – Sediments – SE01**

| Parameter | Unit | Results | | | Detection limit | Legal limits |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| **Physicochemicals** | | | | | | |
| Humidity | % p/p bu | 24.55 | 25.20 | 22.80 | 0.1 | SR |
| Biochemical Oxygen Demand ($BOD_5$) | mg/kg bu | 193 | 121 | 128 | 10 | SR |
| Total Phosphorus (P) | mg/kg bs | 51.3 | 217 | 235 | 12 | SR |
| Nitrate ($NO_3^-$) | mg/kg bs | 42.3 | 17.1 | 58.2 | 3.3 | SR |
| Nitrite ($NO_2^-$) | mg/kg bs | ND | ND | ND | 0.2 | SR |
| Total Kjeldahl Nitrogen (NTK) | mg/kg bs | 467 | 570 | 314 | 80 | SR |
| Percentage of solids** | % p/p | 11.5 | 73.1 | 74.4 | 0.05 | SR |
| **Metals** | | | | | | |
| Aluminium (Al) | %p/p bs | 1.88 | 1.64 | 4.00 | 0.2 | SR |
| Antimony (Sb) | mg/kg bs | ND | ND | ND | 1 | SR |
| Arsenic (As) | mg/kg bs | 2.1 | 1.8 | 1.8 | 1 | SR |
| Barium (Ba) | mg/kg bs | 110 | 72 | 97 | 5 | SR |
| Boron (B) | mg/kg bs | 5 | ND | ND | 5 | SR |
| Cadmium (Cd) | mg/kg bs | ND | ND | ND | 1 | SR |
| Copper (Cu) | mg/kg bs | ND | 4 | ND | 4 | SR |
| Total Chrome (Cr) | mg/kg bs | 21.1 | 14 | 20 | 3 | SR |
| Hexavalent Chromium ($Cr^{6+}$) | mg/kg bs | ND | ND | ND | 3 | SR |
| Trivalent Chromium ($Cr^{3+}$) | mg/kg bs | 21.1 | 14 | 20 | 3 | SR |
| Total Mercury (Hg) | mg/kg bs | ND | ND | ND | 1 | SR |
| Nickel (Ni) | mg/kg bs | 5 | 10 | 10 | 1 | SR |
| Silver (Ag) | mg/kg bs | ND | ND | ND | 1 | SR |
| Lead (Pb) | mg/kg bs | 24 | 2.7 | ND | 2 | SR |
| Selenium (Se) | mg/kg bs | < 4 | 1.8 | 1.9 | 0.8 | SR |
| Zinc (Zn) | mg/kg bs | 24 | 24 | 24 | 4 | SR |
| **Pesticides** | | | | | | |
| 2.4 D** | mg/kg | ND | ND | ND | 0.0035 | SR |
| Alachlor | mg/kg bs | ND | ND | ND | 0.00380 | SR |
| Atrazine | mg/kg bs | ND | ND | ND | 0.00010 | SR |
| Carbofuran | mg/kg bs | ND | ND | ND | 0.00016 | SR |
| Diazinon | mg/kg bs | ND | ND | ND | 0.00014 | SR |
| Glyphosate | mg/kg bs | ND | ND | ND | 0.0027 | SR |

| Parameter | Unit | Results | | | Detection limit | Legal limits |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| PCBs | mg/kg bs | ND | ND | ND | 0.2237 | SR |

bu: sediment drained with humidity from the pores. (wet basis). bs: dry basis (no humidity).

SR: no references.

** Analyses carried out by the laboratory Bioagri.

## Table 20 – Results of 1st, 2nd and 3rd Campaigns – Sediments – SE02

| Parameter | Unit | Results | | | Detection limit | Legal limits |
|---|---|---|---|---|---|---|
| | | 1st | 2nd | 3rd | | |
| **Physicochemicals** | | | | | | |
| Humidity | % p/p bu | 26.43 | 25.35 | 24.15 | 0.1 | SR |
| Biochemical Oxygen Demand ($BOD_5$) | mg/kg bu | 283 | 247 | 102 | 10 | SR |
| Total Phosphorus (P) | mg/kg bs | 104 | 18.1 | 263 | 12 | SR |
| Nitrate ($NO_3^-$) | mg/kg bs | 157 | ND | 52.2 | 3.3 | SR |
| Nitrite ($NO_2^-$) | mg/kg bs | ND | 865 | ND | 0.2 | SR |
| Total Kjeldahl Nitrogen (NTK) | mg/kg bs | 560 | 247 | 271 | 80 | SR |
| Percentage of solids** | % p/p | 70.5 | 47.9 | 74.2 | 0.05 | SR |
| **Metales** | | | | | | |
| Aluminium (Al) | %p/p bs | 2.00 | 1.79 | 2.60 | 0.2 | SR |
| Antimony (Sb) | mg/kg bs | ND | ND | ND | 1 | SR |
| Arsenic (As) | mg/kg bs | 2.6 | 2.2 | 1.0 | 1 | SR |
| Barium (Ba) | mg/kg bs | 57 | 70 | 107 | 5 | SR |
| Boron (B) | mg/kg bs | ND | ND | ND | 5 | SR |
| Cadmium (Cd) | mg/kg bs | ND | ND | ND | 1 | SR |
| Copper (Cu) | mg/kg bs | ND | 6 | ND | 4 | SR |
| Total Chrome (Cr) | mg/kg bs | 19.4 | 13 | 19 | 3 | SR |
| Hexavalent Chromium ($Cr^{6+}$) | mg/kg bs | ND | ND | ND | 3 | SR |
| Trivalent Chromium ($Cr^{3+}$) | mg/kg bs | 19.4 | 13 | 19 | 3 | SR |
| Total Mercury (Hg) | mg/kg bs | ND | ND | ND | 1 | SR |
| Nickel (Ni) | mg/kg bs | ND | 13 | 9 | 1 | SR |
| Silver (Ag) | mg/kg bs | ND | ND | ND | 1 | SR |
| Lead (Pb) | mg/kg bs | 15 | 2.3 | ND | 2 | SR |
| Selenium (Se) | mg/kg bs | 4 | 0.8 | ND | 0.8 | SR |
| Zinc (Zn) | mg/kg bs | 9 | 26 | 20 | 4 | SR |
| **Pesticidas** | | | | | | |
| 2.4 D** | mg/kg | ND | ND | ND | 0.0035 | SR |
| Alachlor | mg/kg bs | ND | ND | ND | 0.00380 | SR |
| Atrazine | mg/kg bs | ND | ND | ND | 0.00010 | SR |
| Carbofuran | mg/kg bs | ND | ND | ND | 0.00016 | SR |
| Diazion | mg/kg bs | ND | ND | ND | 0.00014 | SR |
| Glyphosate | mg/kg bs | ND | ND | ND | 0.0027 | SR |
| PCBs | mg/kg bs | ND | ND | ND | 0.2237 | SR |

bu: sediment drained with humidity from the pores. (wet basis). bs: dry basis (no humidity).

SR: no references.

** Analyses carried out by the laboratory Bioagri.

#### 9.9.3.5 Conclusions

In order to define the quality of the surface waters of the Paraguay River before the implementation and operation of the PARACEL dissolving and bleached pulp mill, to be considered as a background and reference for future monitoring studies, three campaigns were carried out to collect and investigate surface water and sediments at two points during dry and rainy seasons.

The results of the surface waters were compared with the standards established for class 2 water bodies by SEAM Resolution n. 222/2002. With regard to sediments, it should be noted that there is no legal reference for comparing the results.

It should be noted that most of the parameters analyzed presented concentrations below the limits established by SEAM Resolution n. 222/2002. In the following, only the results of the parameters in disagreement with the legislation will be commented.

In point FW01, of the physicochemical parameters, total phosphorus showed a concentration of 0.0160 mg/L in the third campaign and 0.09 mg/L in the second, results above the limit of 0.05 mg/L. In the first campaign, the value obtained was 0.021 mg/L, below the limit allowed by legislation. Total Kjeldahl nitrogen showed a concentration above the value permitted by legislation in all three campaigns (limit of 0.06 mg/L): 1.01 mg/L in the third campaign, 1.18 mg/L in the second and 0.84 mg/L in the first.

Also in the third campaign, the recorded color value was 82 uPtCo, above the established limit (≤ 75 uPtCo). In the first two campaigns, the values obtained did not exceed the limit established in SEAM Resolution n. 222/2002.

With regard to metals, the concentration of aluminum obtained was 3.00 mg/L, the lowest recorded in the three campaigns at that time, but still above the limit of 0.2 mg/L. Soluble iron had the highest concentration of the three campaigns, 0.55 mg/L (limit of 0.3 mg/L). Bacteriological and pesticide parameters did not show values higher than those allowed by SEAM Resolution n. 222/2002 in the three campaigns.

In point FW02, of the physicochemical parameters analyzed, in the first campaign, total phosphorus and total Kjeldahl nitrogen showed values higher than those permitted. Unlike the second campaign, the results of the color parameter were kept within the established limit.

With regard to total phosphorus, a concentration of 0.135 mg/L (limit of 0.05 mg/L) was obtained, the highest value recorded in the three campaigns already carried out. For total Kjeldahl nitrogen a concentration of 1.03 mg/L (limit 0.6 mg/L) was obtained, the lowest value recorded in the three campaigns.

For metals, aluminum had a concentration of 4.00 mg/L (limit of 0.2 mg/L), the lowest value recorded in the three campaigns. Soluble iron had the highest concentration in all three campaigns: 0.79 mg/L, above the limit of 0.3 mg/L. It should be noted that a concentration of 0.61 mg/L (above the limit) was obtained in the first campaign and 0.18 mg/L in the second (below the limit).

Bacteriological and pesticide parameters do not exceed the values allowed by SEAM Resolution n. 222/2002.

As was observed in the 3 campaigns, when comparing the results obtained at Point FW01, located upstream of the effluent discharge points of the future PARACEL pulp mill; and at Point FW02, located downstream of the raw water intake point, it is observed that Point FW02 presents higher concentrations, mainly when the parameters

that exceeded the limits of SEAM Resolution n. 222/2002 are observed. It should be noted that there are no sources of contribution that justify the increase in concentrations between the two points. Therefore, it is believed that this fact may be associated with sampling or discharge matters from Arroyo Seco, which should be better explained in the future through the analysis of the results of subsequent campaigns.

Phosphorus and nitrogen are nutrients naturally derived from the dissolution of compounds present in the soil and the decomposition of organic matter, which can contribute to the results found. As this is a region where agricultural activities take place, nutrient concentrations above the permitted limit may also be associated with the use of fertilizers.

As for the values of aluminum and iron in disagreement with the legislation, these can be related to the substrate layer of the soils of the region and therefore can be considered as natural from the surface waters.

Regarding the color parameter at point FW01, it is believed that such non-conformity is associated with the time of harvesting, the rainy period of the region, because there may be an increase in dissolved and suspended solids, mainly material in organic and inorganic colloidal state, thus corroborating the alteration of this parameter.

It should also be noted that, in the third campaign, carried out in February/2020, the Paraguay River showed a higher concentration of dissolved and suspended substances than in the first and second campaigns, held in October and December/2019, respectively. This is due to the severe drought in October, November and December. The increase in precipitation in the region contributed to the alteration of the concentrations of the parameters analyzed, reducing electrical conductivity and all cations and anions.

### 9.9.4 Water quality provided by ESSAP

To complement the ESIA monitoring campaign, the results of the analysis of raw water from the Paraguay River in the Concepción section, provided by ESSAP (Paraguayan Health Service Company), carried out between 2017 and 2018, will be presented below.

**Table 21 – Water quality results by ESSAP**

| Parameters | Unit | feb/17 | apr/17 | aug/17 | sep/17 | dec/17 | feb/18 | mar/18 | apr/18 | jul/18 | dec/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | - | 7.1 | 7.1 | 6.9 | 7 | 7.3 | 6.7 | 6.8 | 7 | 7 | 6.8 |
| Turbidity | NTU | 99.4 | 21.9 | 16.9 | 15.4 | 20.4 | 21.1 | 8.96 | 5.32 | 13.6 | 24.5 |
| Color | Pt-Co | 250 | 75 | 80 | 50 | 240 | 300 | 100 | 90 | 100 | 120 |
| Total alkalinity | $mgCaCO_3/L$ | 40 | 30 | 30 | 31 | 31 | 34 | 35 | 39 | 30 | 34 |
| Conductivity | µS/cm | 119.6 | 81.4 | 76 | 77.8 | 91 | 94.3 | 100.1 | 147 | 156 | 105 |
| Total dissolved solids | mg/L | 60 | 41 | 38 | 39 | 45 | 47 | 50 | 50 | 73 | 52 |
| Aluminium | mg/L | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 | <0.006 |
| Calcium | mg/L | 9.3 | 8.8 | 8.8 | 7.6 | 8.8 | 13.2 | 9.6 | 10.8 | 8 | 18.6 |
| Magnesium | mg/L | 4 | 1.68 | 1.9 | 2.4 | 2.6 | 3.1 | 2.9 | 2.6 | 1.7 | 2.7 |
| Total hardness | $mgCaCO_3/L$ | 47 | 29 | 30 | 29 | 33 | 46 | 36 | 38 | 27 | 28 |
| Chloride | mg/L | 12.5 | 25 | 2.5 | 3 | 5 | 0.5 | 9.5 | 16.5 | 2 | 5 |
| Sulphate | mg/L | 1 | 0.992 | 0.98 | 1.01 | 1.2 | 4.24 | 1.9 | 0.67 | 9.17 | 18 |
| Silice | mg/L | 18.97 | 16.99 | 18.31 | 19.89 | 20.4 | 23.86 | 22.9 | 36.24 | 16.32 | 17 |
| Ammonia Nitrogen | mg/L | 0.036 | 0.033 | 0.023 | 0.063 | 0.036 | 0.046 | 0.037 | 0.021 | 0.041 | 0.03 |
| Nitrite | mg/L | 0.045 | 0.048 | 0.042 | 0.026 | 0.039 | 0.029 | 0.023 | 0.02 | 0.013 | 0.003 |
| Nitrate | mg/L | <2.00 | <2.00 | <2.00 | <2.00 | 0.833 | 1.342 | 0.97 | 0.105 | 0.62 | 1 |
| Iron | mg/L | 1.98 | 2.26 | 2.19 | 0.504 | 1.92 | 1.307 | 1.47 | 1.38 | 0.02 | 0.107 |

| Parameters | Unit | feb/17 | apr/17 | aug/17 | sep/17 | dec/17 | feb/18 | mar/18 | apr/18 | jul/18 | dec/18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium | mg/L | 11.24 | 6.09 | 2.1 | 5.1 | 5.3 | 4.82 | 4.88 | 4.9 | 4.89 | 4.89 |
| Potassium | mg/L | 0.94 | 1.02 | 1.84 | 1.4 | 1.6 | 1.52 | 1.6 | 1.6 | 1.69 | 1.69 |
| Chrome | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Manganese | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Zinc | mg/L | ND | ND | ND | ND | ND | ND | <0.5 | ND | ND | ND |
| Copper | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| lead | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Cadmium | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Total Mercury | mg/L | ** | ** | ** | ** | ** | ** | ** | ** | ** | ** |
| Arsenic | mg/L | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Synthetic detergents | mg/L | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| Fats and oils and hydrocarbons | mg/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Temperature | ºC | 25 | 26 | 21 | 22 | 25 | 23.2 | 23 | 25 | 19 | 28 |
| Total Coliforms | UFC/100 mL | 3,500 | 3,800 | 1,200 | 2,300 | 1,600 | 3,100 | 1,900 | 2,000 | 3,000 | 2,700 |
| Fecal coliforms | UFC/100 mL | 290 | 220 | 10 | 190 | 150 | 300 | 150 | 180 | 400 | 480 |
| Chemical Oxygen Demand | mg/L | 22 | 20 | 27 | 21 | 19 | 25 | 24 | 20 | 20 | 23 |
| Biochemical Oxygen Demand | mg/L | 1.0 | 0.6 | 1.7 | 1.6 | 1.0 | 2.4 | 2.0 | 1.7 | 2.6 | 1.6 |

## 9.10 Hydrogeology (Groundwater Resources)

Paraguay not only has extensive natural surface water resources, but also a wealth of groundwater. Groundwater is the most important water resource in Paraguay, because of its easy access and availability in terms of quality and quantity (PMCIC, 2014).

Paraguay has great potential in terms of groundwater, which is contained in aquifers that are strategic for the country's socioeconomic development and for the social well-being of its inhabitants (PMCIC, 2014).

Paraguay's main aquifers are located in the subsoil of the country's two regions, the Eastern Region and the Western Region. Some of these aquifers are locally distributed and are restricted to the national territory, as is the case with the following aquifers: Patiño, Caacupé, Arroyos and Esteros, Itacurubí, while others, such as the Guaraní (Misiones aquifer), Yrendá, Independencia, Col. Oviedo, Alto Paraná, Pantanal and Acaray, are shared with neighbouring countries and have been classified as transboundary aquifers (PMCIC, 2014).

The Plata Basin is also rich in groundwater resources. It largely coincides with the Guarani Aquifer System (SAG in Spanish), one of the largest groundwater reservoirs in the world, with an area of 1,190,000 km². To the west of the Basin is the Yrendá-Toba-Tarijeño Aquifer System (SAYTT), which in the majority is located in the semi-arid zone of the Basin, the Gran Chaco American Biome, with an area of 410,000 km² (CIC, 2017).

The following figure shows the map of the transboundary aquifers of the Plata Basin.

**Figure 77 – Map of the transboundary aquifers of the Plata Basin. Source: CIC (2017)**

In the La Plata Basin, the natural development of urban and rural populations, associated with the strong increase in agricultural and industrial activities, has significantly increased the use of water resources, particularly those of underground origin. This growth, as expected, in addition to demographic parameters, is due to the intrinsic characteristics of the aquifers, such as the occurrence of potentially productive units and the quality of the groundwater (CIC, 2017).

In Paraguay, too, groundwater is widely used for human and industrial supply, as for example in the outskirts of its capital, Asunción. In other regions, it is mainly used for livestock and for public supply in dispersed locations (CIC, 2017).

The following figure shows the annual volumes of groundwater exploited in the Basin.

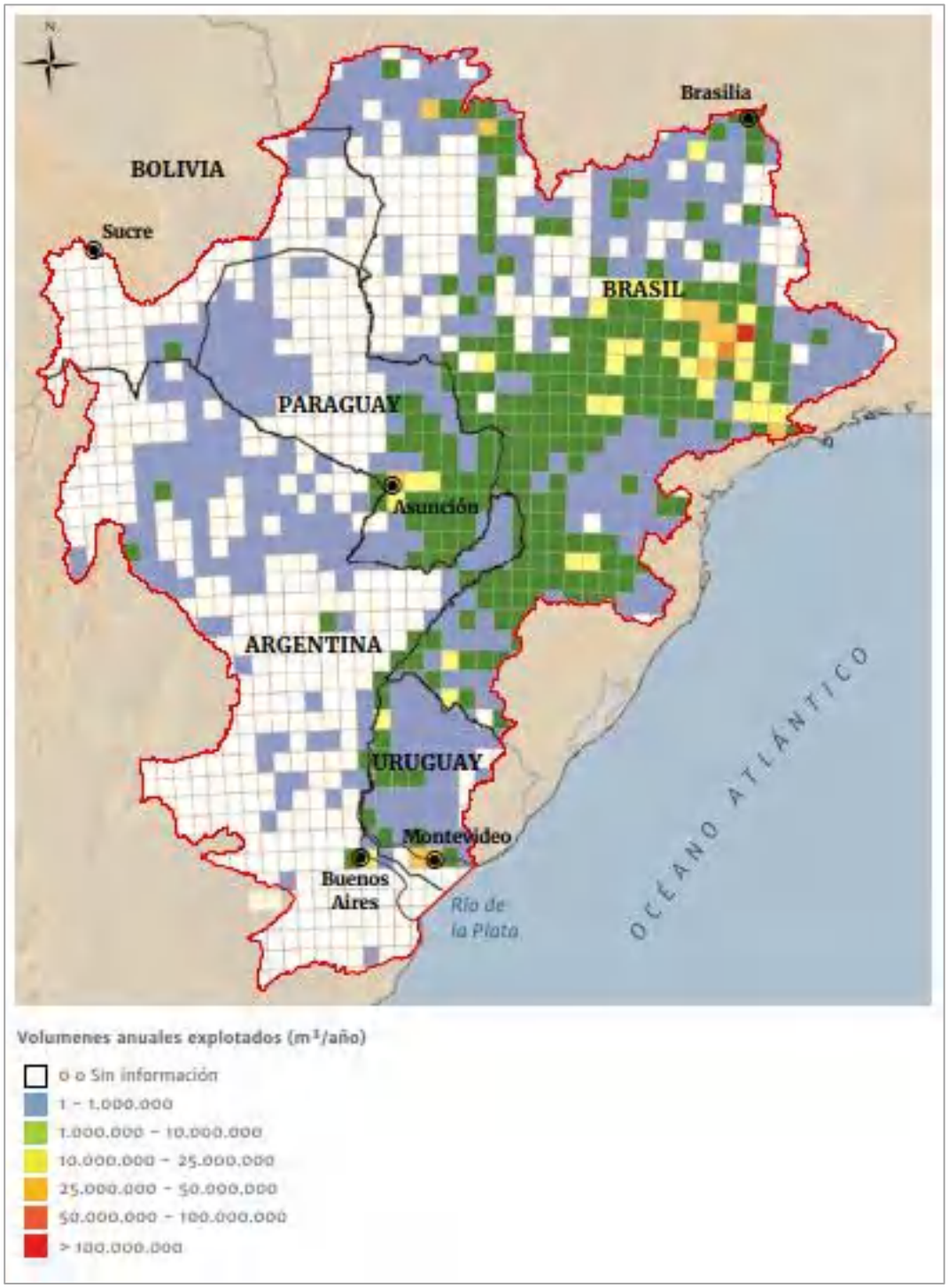



**Figure 78 – Volumes of groundwater exploited annually. Source: CIC (2017)**

The potability of the groundwater in the Basin was analyzed, in terms of salinity, taking into account the values of the electrical conductivities of the samples analyzed, given that they represent an approximation of the total dissolved salt content.

The concentrations of these salts, expressed in µS/cm were arranged in regular intervals distributed throughout the area of the Basin, and present the following results:

- 0 – 100 µS/cm – Registered only in the extreme North and Northeast regions of the Brazilian territory;
- 100 – 500 µS/cm – Widely predominant throughout the Basin, mainly in the Paraná Sub-basin in Brazil, and smaller portions in other countries;
- 500 – 1000 µS/cm – This interval occurs as strips aligned in a north-south direction, separating the Paraná Basin from those located further west in the region, also extending over part of Bolivian territory, the Brazilian Pantanal area and the eastern and western regions of Argentina;
- 1000 – 3000 µS/cm – This concentration interval, which marks the beginning of the occurrence of waters with inadequate quality for human health, is available in the Argentine and Paraguayan Chaco, in addition to the central and southern portion of Argentina;
- 3000 µS/cm – the area of occurrence of this interval of highly saline waters is restricted to a region of the Paraguayan and Argentine Chaco, corresponding to the fraction of the area of occurrence of the SAYTT Aquifer.

The following figure shows the geographical distribution of occurrence of these intervals.

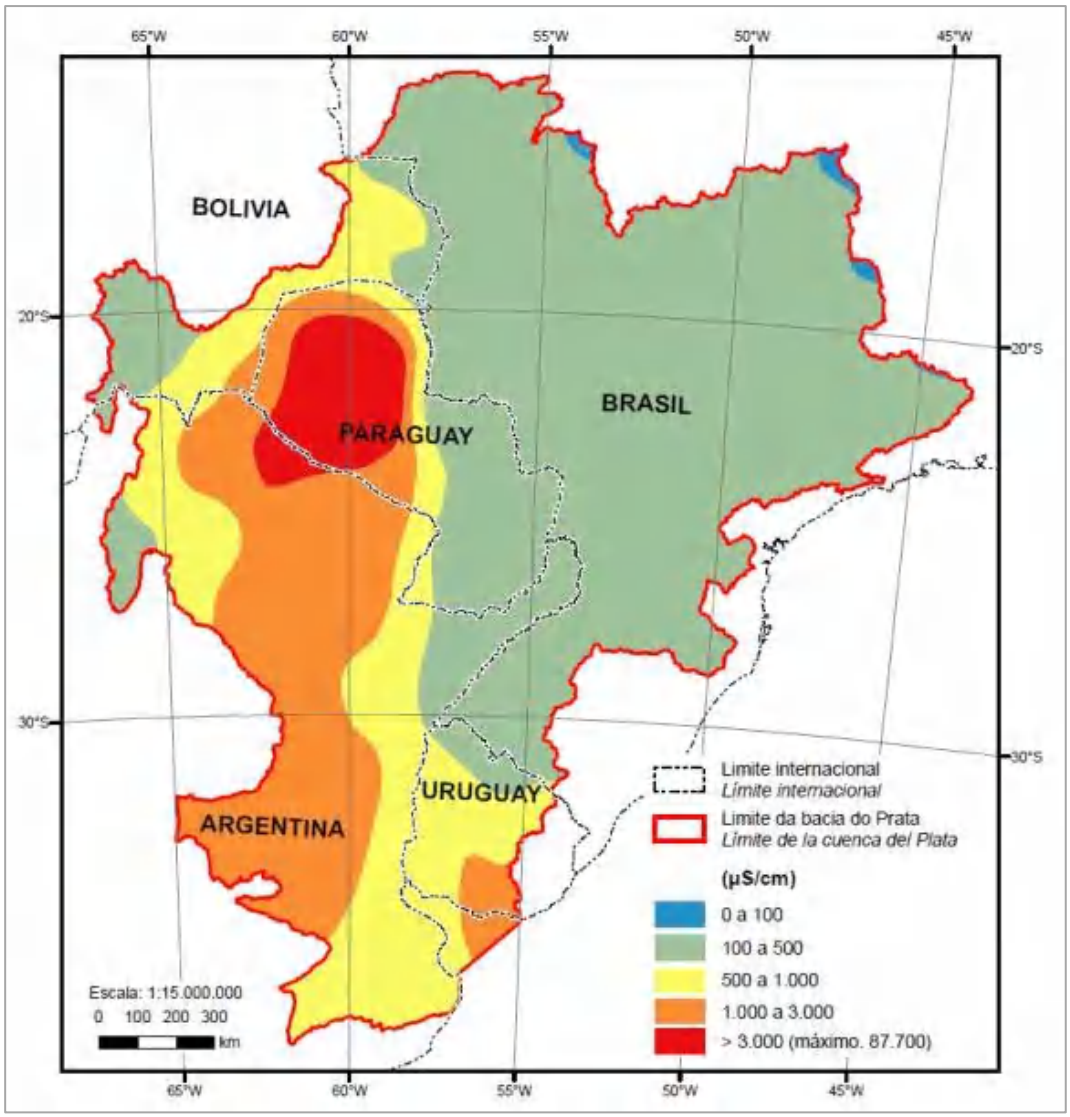



**Figure 79 – Groundwater salinity distribution. Source: Diniz *et al.* (2015)**

The natural vulnerability of groundwater is presented in the figure below. The lower regions or those with more dense drainage, such as the Chaco, Pantanal and the main drainage areas, present high to extreme vulnerabilities. The compartment represented by the Paraná Sedimentary Basin has medium to low vulnerability in relation to the others and high portions such as the Bolivian Andes present Low vulnerability index.

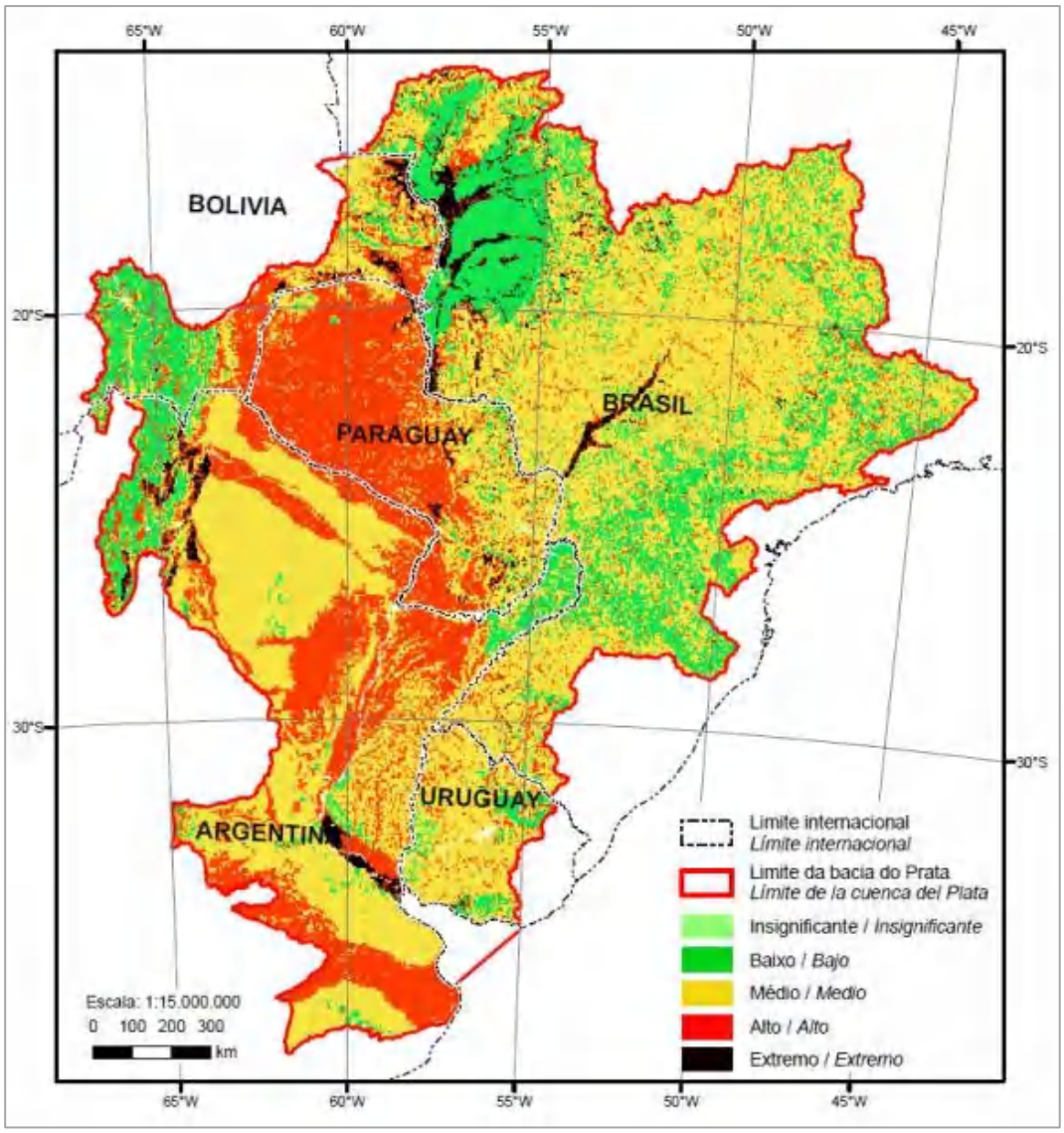



**Figure 80 – Natural vulnerability of the groundwater of the Plata Basin. Source: Diniz *et al.* (2015)**

The planned location for the implementation of the PARACEL pulp mill will be in the city of Concepción, near the Paraguay River. For ESIA, the Aquidabán and Pilcomayo River hydrographic units were adopted as an indirect area of influence. Thus, the aquifers present in these hydrographic units will be addressed in this chapter on groundwater.

The following figure shows the location of the future PARACEL pulp mill on the aquifer systems map.

**Figure 81 – Map of Aquifer Systems**

confidential

-700.000 -600.000 -500.000 -400.000 -300.000 -200.000 -100.000 0

7.600.000 7.500.000 7.400.000 7.300.000 7.200.000 7.100.000 7.000.000

Paraguay

Alto Paraguay

Brazil

Boqueron

Concepcion

Acuífero Guaraní

CIH Aquidaban

Amambay

Acuífero Aquidaban

CIH Rio Pilcomayo

Presidente Hayes

Acuífero SAYTT

Argentina

San Pedro

Canindeyu

Cordillera

Caaguazu

Asuncion

Central

Guaira

Paraguari

Caazapa

Ñeembucu

Misiones

Itapua

Rio Paraguay

Acuífero Aquidaban

CIH Aquidaban

CAMP 7

CAMP 6

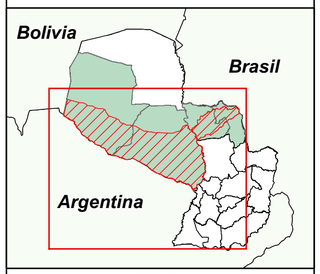
CAMP 1

CAMP 11

CAMP 3

CAMP 9

LOCATION MAP




LEGEND

- Structures - Transmission Line
- Accommodations (Camps)
- Transmission Line
- Hydrography
- IIA - Indirect Influence Area
- DAA - Directly Afected Area
- DIA - Direct Influence Area
- CIH Rio Pilcomayo and Aquidaban

**Region of Aquifers**

- Aquifer Aquidaban
- Aquifer Guaraní
- Aquifer SAYTT
- Departaments
- South America

ESCALA GRAFICA: 0 20 40 80 km

DATUM SIRGAS 2000
PROYECCION: UTM

DATA SOURCE:
- DGEEC, 2012 (Dirección General de Estadística, Encuestas y Censos).
- SEAM, 2015 (Secretaría Del Ambiente)

PARACEL PÖYRY

**ENVIRONMENTAL AND SOCIAL STUDY**

**CIH8 Aquidaban and CIH18 Rio Pilcomayo**

**AQUIFER SYSTEMS**

| | | | |
|---|---|---|---|
| ESCALA: | 1:1.621.853 | FECHA: | 28/05/2021 |
| PROYECTO N° | | FOLHA: | FORMATO: |
| RESP. TECNICO: Romualdo Hirata | | FIRMA: | REV. 0 |

### 9.10.1 Regional Characterization (IIA)

For this study, the main aquifers considered were the Yrendá-Toba-Tarijeño Aquifer System (SAYTT) and the Guaraní Aquifer System (SAG).

#### 9.10.1.1 Aquifer System Yrendá-Toba-Tarijeño - SAYTT

According to CIC (2015), the SAYTT is shared by the three countries of the South American Gran Chaco, which are Argentina, Bolivia and Paraguay. Each of the countries that contain the aquifer has given it a name to identify it within its territory. So we have to: Argentina: Acuífero Toba (T), Bolivia: Acuífero Tarijeño (T) and Paraguay: Acuífero Yrendá (Y).

The SAYTT is an aquifer system of great regional importance due to the existing expectations in a region with water shortage, semi-arid climate and with other aquifers where its supply is brackish or salt water, not suitable for human consumption or agricultural production. Its knowledge and subsequent sustainable management would favor a correct management of the soil, which, undeniably, the services provided by both natural resources are integrated for the development of the region.

The rocks assigned to the Quaternary that appear in the SAYTT region extend over some 521,904 $km^2$, distributed among the following countries in order of surface area: Argentina: 303,220 $km^2$ (58.1%), Paraguay: 196,988 km2 (37.7%) and Bolivia 21,696 km2 (4.2%) (GULISANO 2014).

In Paraguay the Yrendá Aquifer System is located in three departments (Boquerón, Pte. Hayes and Alto Paraguay).

The most important river in the SAYYT, in Paraguay, is the Pilcomayo river, with an area of 272,000 $km^2$ (approx. 8.4% of the Plata basin). It is the natural border between Argentina - Bolivia and Argentina - Paraguay. This river is characterized by its permanent wandering due to the large volume of sediments it carries. This has created through thousands of years a great continental delta, with apex in the triple border and its maximum opening on the Paraguay River from Bahía Negra in Paraguayan territory, to Route 81 in the province of Formosa, which has remained practically as a division of the Pilcomayo and Bermejo basins.

This gigantic alluvial fan could be divided into two types of morphology. To the north in Paraguayan territory, a dense network of deactivated-clogged paleo-catchment areas has been formed, which today constitutes one of the sources of water supply for human consumption. These paleo-channels present a direct recharge of rainwater and since a few decades ago the artificial recharge of this phreatic aquifer, superimposed on the SAY, has been carried out in the area. On the other hand, towards the south there is a series of streams and rivers that constitute the active network of paleo-catchment areas and new channels. All the watercourses finally discharge into the Paraguay River which is the great receiver of all the waters that descend from the Andes. The surface of this great continental paleo-delta is about 200,000 $km^2$, located almost entirely in Paraguayan territory.

According to CIC (2015), in Paraguay, the compilation of data from the Yrendá aquifer (SAY), in Paraguayan territory, presented 382 deep wells in Excel spreadsheets and 227 wells with less than 50 meters deep in SISAG origin sheets. A map of the location of the wells was presented where the quality of the water is defined according to its salinity

(fresh, brackish and salty, as well as dry wells), in addition to a sheet with physical-chemical data of some wells.

Under the denomination of SAY, it is understood that confined and/or semi-confined aquifers extend throughout the Chaco at various levels and at different depths, constituting multi-layer systems, formerly called the Yrendá Aquifer Complex (GODOY, 1990), constituting at the regional level a single hydrogeological system, although differences in detail may occur at the local level, occupied by different groundwater flow systems. South of the 20th parallel, the SAY is below a depth of 50 m to the west, bordering Bolivia, and below 5 - 3 m to the east, in the Humid Chaco, even overcoming the phreatic level near the Paraguay River, causing the flow of the aquifers to be confined to the phreatic level. The piezometric levels range from 25 m to close to rising, in the channels that run in a west-east direction, tributaries of the Paraguay River.

In the area between the Bolivian Sub-Andean and the Parapetí River, the permeability (K) of the deep aquifers varies from 8.6 - 17.3 m/day; the transmissibility (T) from 1,075 - 2,150 $m^2$/day and the storage coefficient (S) from 5.10-4 - 6. 10-6; in the Bolivian-Paraguayan border area permeability varies from 6 to 8 m/day and transmissibility from 400 to 200 $m^2$/day and in the central Paraguayan Chaco permeability varies from 0.3 to 8.0 m/day and transmissibility from 50 to 100 $m^2$/day. The wells that capture these aquifers have specific flows that vary from 2.0 to 3.6 $m^3$/h/m. Their maximum total porosity is 40% and the effective porosity is between 7 and 10%. The actual underground flow rate varies from approximately 20 m/year to 46 m/year. (GODOY V. EUGENIO, 1990).

The large hydraulic load of the confined aquifers indicates that the recharge zone is at a much higher level than the land where the well is located, and as the area is semi-arid with a strong water deficit it is difficult for these aquifers to receive fresh water by direct infiltration of rainfall. As well, the isolated freatic aquifers are insufficient to feed the deep aquifers that contain large volumes of fresh water. It is strong to think that the recharge is produced by infiltration of rainfall and rivers in Bolivian territory, mainly along a strip of thick piedmont sediments about 15 to 20 km wide, which runs parallel to the sub-Andean mountain ranges, as well as by infiltration of the Pilcomayo River during floods through its alluvial fan. (GODOY V. EUGENIO, 1990).

In times of low water, the salinity of the surface courses and wetlands increases, indicating a subterranean source of water. The discharge zone is characterized by the occurrence of brackish to salty wetlands in the direction of underground flow. The formation of evaporative minerals in discharge areas produced by regional flow systems of mineralized (salt) groundwater is a characteristic of the area.

#### 9.10.1.2 Guaraní Aquifer System (Sistema Aquifero Guarani – SAG, in Spanish)

According to CIC (2015), the transboundary Guarani Aquifer System (SAG) has an area of 1,087,879.15 $km^2$, extending over the Chaco - Paranaense sedimentary basin. It is the most important hydro-stratigraphic unit in the southern portion of the South American continent, and is associated with the siliciclastic rocks of the Plata Basin (Brazil and Paraguay), the Chaco - Paranaense Basin (Argentina) and the Northern Basin (Uruguay), which represent an evolutionary history common to the eastern portion of the Bolivian Chaco (FRANCA ET AL, 1995).

The regional climate in its area of occurrence is characterized as humid, with rainfall ranging from 1,200 to 1,500 mm/year.

Its waters are widely used for human and industrial supply and for thermal tourism, due to their thermal properties in the places where the aquifer is confined by the basalts of the Serra Geral formation.

The Guarani Aquifer System is formed by sandstones of the Jurassic period (Brazil), of the Tacuarembó formation (Uruguay), Misiones (Paraguay) and by the fluvio-lake sandstones of the Piramboia/Rosario do Sul formation (Brazil) and Rivera (Uruguay).

Outcrop zones occur in two bands located to the west and east of the zone of occurrence and correspond to approximately 10% of the total area of the aquifer, being confined to 90%.

The average thickness is 250 meters and the flows vary between 60 and 200 $m^3$/h in areas close to the outcropping zones and from 200 to 400 $m_3$/h in the confined areas. Locally it can present much lower values in the outcrop areas.

The waters are calcium and magnesium bicarbonate near the outcropping areas and sodium in the deeper areas. The pH is alkaline and dry residue values vary from 200 to 600 mg/l. The temperature varies from 18 to 63°C, depending on the depths of occurrence of the aquifer.

This aquifer system is of great importance at the regional and transnational level, representing a fundamental resource for socioeconomic development and in the operation and maintenance of associated ecosystems.

### 9.10.2 Local Characterization (DIA and DAA)

According to the hydrogeological map, the areas of direct influence and directly affected by the PARACEL pulp mill are located in the Aquidauana - Aquidaban Aquifer System.

According to PMCIC (2015), the Aquidauana-Aquidaban Transboundary Aquifer System is located in the Paraná River Basin, with an area of approximately 27,000 $km^2$, of which 14,600 $km^2$ are in Brazil and 12,300 $km^2$ in Paraguay extending in a NE-SW direction, being used for human and animal supply both in Brazil and Paraguay.

The aquifer is of the semi-confined type, made up of glassy-marine sediments with intense variations in facies, presenting flows that are also quite dispersed, with average values oscillating between 10-20 $m^3$/h/well.

From the chemical point of view, it also presents waters with quite variable characteristics. Its use in the short term has become essential for human supply and to allow the economic development of the region, with agricultural and livestock characteristics.

### 9.10.3 Groundwater quality

According to GODOY and PAREDES (1995), practically all the potential aquifers in the Eastern region have water suitable for human consumption, irrigation and industry. In the Western region, or Chaco of Paraguay, the chemical quality of the waters of the Yrendá Aquifer System is a limiting factor for domestic, livestock, agricultural and industrial use. The presence in most of the area of water with high salt content is due to

the fact that, among the sediments that fill the basin, there are evaporite salts (mainly gypsum), which, due to their solubility, give rise to brackish or salty water.

As part of this study, groundwater wells located near the PARACEL pulp mill area was tested. Groundwater Quality Monitoring was conducted to verify the quality of the groundwater prior to the implementation and operation of the pulp mill (background).

Groundwater sampling collection was performed at 06 (six) points, covering the region's dry and rainy periods. The figure and table below show the location of the points.

The results of these 6 points are presented in ESIA Plantations report, Volume II, Tomo I.

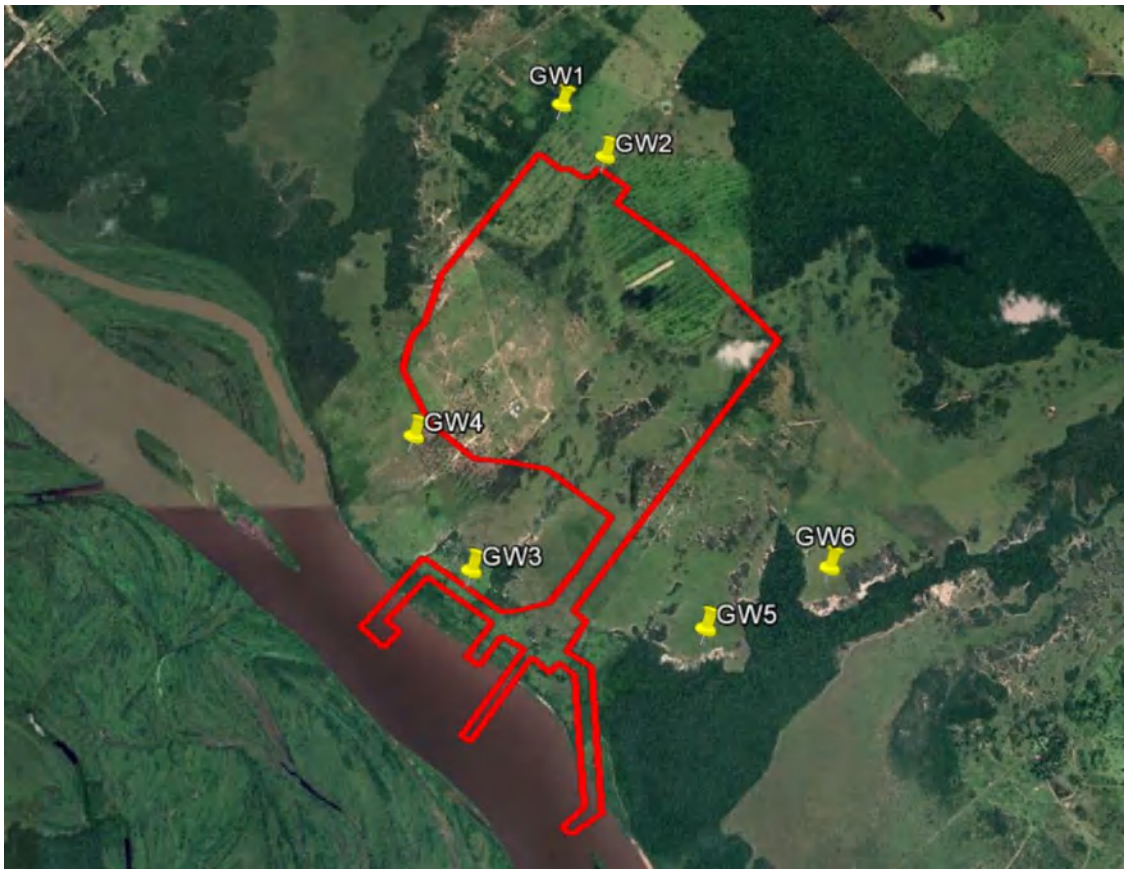



**Figure 82 – Location of monitoring points for groundwater collection campaigns Source: Adapted from Google Earth (2021)**

**Table 22 – Coordinates of groundwater monitoring points**

| Point | Coordinates |
|---|---|
| GW1 | 23°13'54.71"S 57°29'25.08"O |
| GW2 | 23°14'8.63"S 57°29'13.66"O |
| GW3 | 23°15'51.86"S 57°29'50.26"O |
| GW4 | 23°15'19.78"S 57°30'4.88"O |
| GW5 | 23°16'5.34"S 57°28'51.63"O |
| GW6 | 23°15'51.16"S 57°28'19.73"O |

Source: Pöyry Tecnologia (2020)

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# ANNEX I
# ANALYSIS REPORTS

# ANNEX I
# SURFACE WATER CAMPAIGN REPORTS

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# INFORME

# DE

# LABORATORIO

para

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**Atención**:
Ing. Romualdo Hirata
Ing. Cristina Colella
Ing. Celso Tsutsumi

***Tercera campaña de muestreo, 17 de Febrero de 2020.***

***Fecha del informe: 20/03/2020***



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## INFORME DE LABORATORIO - RESULTADOS DE ANALISIS

**SOLICITUD N° 2020/114**

**Solicitud de:** PÖYRY TECNOLOGIA LTDA.
Sr. Ing. Romualdo Hirata; Sra. Ing. Cristina Colella

**Toma de muestra:** Dr. Juan Escribá Ticoulat – Inyma Consult S.R.L.
Ing. Oscar Benítez – Inyma Consult S.R.L.

**Fecha de recepción en laboratorio:** 18/02/2020 **Fecha del Informe:** 20/03/2020

| C.I Nº | Descripción de la muestra | Fecha y hora de toma | Lugar | Coordenadas UTM |
|---|---|---|---|---|
| **3-115** | AS1 – Aguas Arriba | 17/02/20 09:20 | Río Paraguay, zona de Loreto, Concepción, PY | 21 K 446252 mE 7428200 mS |

| *Fecha de análisis* | *Parámetros in situ* | *Unidad* | *Resultados* | *Límite según Resolución 222/02** |
|---|---|---|---|---|
| | **Profundidad: 0,5 metros** | | | |
| 17/02/2020 | pH | - | 7,15 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,7 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | 3182 | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 5,80 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 80 | - |
| | **Profundidad: 2,5 metros** | | | |
| 17/02/2020 | pH | - | 7,70 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,4 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | 203 | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 6,00 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 83 | - |
| | **Profundidad: 5,5 metros** | | | |
| 17/02/2020 | pH | - | 7,15 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,5 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | 183 | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 6,11 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 85,4 | - |

*Resolución nº 222/02 de la SEAM, artículo 3º, para aguas superficiales de clase 2.



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| Fecha de análisis | Parámetros Fisicoquímicos | Unidad | Resultados | Limite de Detección | Límite según Resolución 222/02* |
|---|---|---|---|---|---|
| 24/02/2020 | Aceites y Grasas | mg/L | < 2 | < 2 | Ausentes |
| 24/02/2020 | Cianuro ($CN^-$) libre | mg/L | < 0,01 | < 0,01 | Máx. 0,2 |
| 18/02/2020 | Color | uPtCo | 82 | < 1 | ≤ 75 |
| 18/02/2020 | Demanda Biológica de Oxígeno ($DBO_5$) | mg/L | 1,4 | < 0,5 | ≤ 5 |
| 18/02/2020 | Dureza Total ($CaCO_3$) | mg/L | 36,5 | < 0,5 | Máx. 300 |
| 19/02/2020 | Fósforo Total (P) | mg/L | 0,160 | < 0,004 | Máx. 0,05 |
| 25/02/2020 | Índice de Fenoles[1] | mg/L | < 0,01 | < 0,01 | Máx. 0,5 |
| 17/02/2020 | Materias Flotantes | mg/L | ausentes | - | Ausentes |
| 18/02/2020 | Nitrato ($N\text{-}NO_3^-$) | mg/L | 1,01 | < 0,03 | Máx. 10 |
| 17/02/2020 | Nitrito ($N\text{-}NO_2^-$) *in situ* | mg/L | < 0,002 | < 0,002 | Máx. 1,0 |
| 18/02/2020 | Nitrógeno Amoniacal (N) | mg/L | 0,015 | < 0,006 | - |
| 18/02/2020 | Amonio no ionizado ($NH_3$) (cálculo) | mg/L | < 0,0002 | - | Máx. 0,02 |
| 19/02/2020 | Nitrógeno Total Kjeldahl (NTK) | mg/L | 1,01 | < 0,03 | Máx. 0,6 |
| 20/02/2020 | Sodio (Na) | mg/L | 21,5 | < 0,5 | Máx. 200 |
| 18/02/2020 | Sólidos Disueltos Totales | mg/L | 139 | < 5 | Máx. 500 |
| 20/02/2020 | Sulfato ($SO_4^{-2}$) | mg/L | 17 | < 1 | Máx. 250 |
| 18/02/2020 | Turbiedad | UNT | 35,8 | < 0,02 | ≤ 100 |
| **Fecha de análisis** | **Parámetros Bacteriológicos** | **Unidad** | **Resultados** | **Limite de Detección** | **Límite según Resolución 222/02*** |
| 18/02/2020 | Coliformes Fecales | UFC/100 ml | < 1 | < 1 | ≤ 1000 |
| **Fecha de finalización de análisis** | **Metales** | **Unidad** | **Resultados** | **Limite de Detección** | **Límite según Resolución 222/02*** |
| 13/03/2020 | Aluminio Total (Al) ICP/MS | mg/L | 3,00 | 0,05 | Máx. 0,2 |
| 13/03/2020 | Arsénico (As) ICP/MS | mg/L | 0,003 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Bario (Ba) ICP/MS | mg/L | < 0,05 | < 0,05 | Máx. 2,0 |
| 13/03/2020 | Cadmio (Cd) ICP/MS | mg/L | < 0,0005 | < 0,0005 | Máx. 0,001 |
| 13/03/2020 | Cobre (Cu) ICP/MS | mg/L | < 0,01 | < 0,01 | Máx. 1,0 |
| 20/02/2020 | Cromo Total (Cr) | mg/L | < 0,005 | < 0,005 | Máx. 0,55 |
| 20/02/2020 | Cromo Hexavalente ($Cr^{6+}$) | mg/L | < 0,005 | < 0,005 | Máx. 0,05 |
| 20/02/2020 | Cromo Trivalente ($Cr^{3+}$) | mg/L | < 0,005 | < 0,005 | Máx. 0,5 |
| 13/03/2020 | Estaño (Sn) ICP/MS | mg/L | < 0,005 | < 0,005 | Máx. 2,0 |



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| | | | | | |
|---|---|---|---|---|---|
| 17/02/2020 | Hierro ferroso soluble ($Fe^{+2}$) *in situ* | mg/L | 0,55 | < 0,05 | Máx. 0,3 |
| 19/02/2020 | Manganeso (Mn) | mg/L | < 0,05 | < 0,025 | Máx. 0,1 |
| 13/03/2020 | Mercurio Total (Hg) ICP/MS[2] | mg/L | < 0,001 | < 0,001 | Máx. 0,002 |
| 13/03/2020 | Níquel (Ni) ICP/MS | mg/L | 0,005 | < 0,001 | Máx. 0,025 |
| 13/03/2020 | Plomo (Pb) ICP/MS | mg/L | < 0,001 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Selenio (Se) ICP/MS | mg/L | < 0,001 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Zinc (Zn) ICP/MS | mg/L | < 0,05 | < 0,05 | Máx. 3,0 |
| ***Fecha de finalización de análisis*** | ***Pesticidas*** | ***Unidad*** | ***Resultados*** | ***Limite de Detección (µg/L)*** | ***Límite según Resolución 222/02**** |
| 16/03/2020 | Alacloro | mg/L | ND | 0,014 | cero |
| 16/03/2020 | Atrazina | mg/L | ND | 0,008 | 0,003 |
| 16/03/2020 | Gamma Clordano | mg/L | ND | 0,012 | cero |
| 16/03/2020 | 4,4' - DDT | mg/L | ND | 0,007 | 0,002 |
| 16/03/2020 | Endosulfan | mg/L | ND | 0,019 | 0,056 |
| 16/03/2020 | Endrin | mg/L | ND | 0,009 | 0,002 |
| 16/03/2020 | Glifosato | mg/L | ND | 2,7 | 0,7 |
| 16/03/2020 | Heptacloro | mg/L | ND | 0,005 | cero |
| 16/03/2020 | Lindano (BHC) | mg/L | ND | 0,002 | 0,0002 |
| 16/03/2020 | Metoxicloro | mg/L | ND | 0,005 | 0,04 |
| 16/03/2020 | PCBs (Bifenilos Policlorados)[3] | mg/L | < 0,2 | < 0,2 | cero |
| 16/03/2020 | Propanil | mg/L | ND | 0,132 | 0,02 |
| 16/03/2020 | Simazina | mg/L | ND | 0,027 | 0,004 |

*Resolución nº 222/02 de la SEAM, artículo 3º, para aguas superficiales de clase 2.
[1] Limite de índice de fenoles máximo permitido para vertido de efluentes a cursos de aguas superficiales, artículo 7º de la Res. 222/02 de la SEAM.
[2] Suma entre mercurio orgánico y mercurio inorgánico.
[3] El laboratorio tercerizado reporta el resultado de PCBs como menor que 0,2 microgramos/L, el cual es el límite de cuantificación del método empleado.
**ND:** no detectable.
Límites de detección de los compuestos orgánicos (pesticidas) están expresados en microgramos por litro (µg/L).

**Observación**:
Las unidades de medida para los compuestos orgánicos (pesticidas) según la Resolución 222/02 de la SEAM están expresados en miligramos por litro (mg/L). Sin embargo los resultados de los ensayos y el límite de detección del método analítico están expresados en microgramos por litro (µg/L).
Los resultados de metales realizados por ICP-MS están expresados en mg/L y el laboratorio tercerizado informa el límite de cuantificación de cada ensayo en mg/L y no menciona el límite de detección.

**Carmen Escribá S.**
**Ing. Química**
**Reg. Prof. Nº 359**



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## Métodos empleados para la determinación de los siguientes ensayos

| *Ensayos* | *Métodos* |
|---|---|
| Aceites y Grasas | SM 5520. Partition-Gravimetric Method. |
| Aluminio (Al) | @ICP-MS |
| Arsénico total (As) | @ICP-MS |
| Bario (Ba) | @ICP-MS |
| Cadmio (Cd) | @ICP-MS |
| Cianuro ($CN^-$) libre | SM 4500-CN. E Colorimetric method. |
| Cobre (Cu) | @ICP-MS |
| Coliformes Fecales | SM 9222 D. Fecal Coliform Membrane Filter Procedure. |
| Color verdadero | SM 2120 B. Visual Comparison Method. |
| Conductividad eléctrica a 25 ºC | SM 2510. Laboratory Method. |
| Cromo total (Cr) | SM 3500-Cr. Colorimetric Method. |
| Cromo Hexavalente ($Cr^{6+}$) | SM 3500-Cr. Colorimetric Method. |
| Cromo Trivalente ($Cr^{3+}$) | Cálculo |
| Demanda Biológica de Oxígeno ($DBO_5$) | SM 5210. 5-Day BOD Test. |
| Dureza Total ($CaCO_3$) | SM 2340. EDTA Titrimetric Method. |
| Estaño (Sn) | @ICP-MS |
| Fósforo Total (P) | SM 4500-P. Ascorbic Acid Method. |
| Glifosato | @LC-MS/MS |
| Hierro ferroso soluble ($Fe^{2+}$) *(in situ)* | SM 3500-Fe D. |
| Indice de Fenoles ($C_6H_5OH$) | SM 5530. Chloroform Extraction Method. |
| Manganeso (Mn) | Hach method 8149 |
| Mercurio Total (Hg) | @ICP-MS |
| Nitrato (N-$NO_3^-$) | EPA method 352.1 |
| Nitrito (N-$NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Nitrógeno Amoniacal ($NH_3$) | SM 4500-$NH_3$. Phenate Method. |
| Nitrógeno Total Kjeldahl (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method. |
| Níquel (Ni) | @ICP-MS |
| Oxígeno Disuelto | SM 4500-O. Membrane Electrode Method. |
| PCBs (Bifenilos Poli Clorados) | @GC-MS |
| Pesticidas en agua | @SPME-GC-MS |
| pH *(in situ)* | SM 4500-$H^+$. Electrometric Method. |
| Plomo (Pb) | @ICP-MS |
| Selenio (Se) | @ICP-MS |
| Sodio (Na) | SM 3500-Na. Flame Emission Photometric Method. |
| Sólidos Disueltos Totales | SM 2540 C. Total Solids Dried at 180ºC |
| Sulfato ($SO_4^{-2}$) | SM 4500-$SO_4^{2-}$. Turbidimetric Method |
| Turbiedad | SM 2130. Nephelometric Method. |
| Zinc (Zn) | @ICP-MS |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.
@: Ensayos realizados en otros laboratorios de Paraguay.



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## Tipos de envase y preservación de las muestras

| *Tipo de Análisis* | *Envase* | *Preservante* |
|---|---|---|
| Aceites y Grasas | Botella de Vidrio de 1000 ml | $H_2SO_4$ |
| Nitrogenados, Fosforados y Fenoles | Botella de Plástico de 1000 ml | $H_2SO_4$ |
| Fisicoquímicos | Botella de Plástico de 1000 ml | Sin preservante |
| Cianuro | Botella de Plástico de 100 ml | NaOH |
| Cromo VI | Botella de Plástico de 500 ml | Sulfato de amonio y NaOH |
| Bacteriológicos | Bolsa Estéril de 300 ml | Sin preservante |
| Metales | Botella de Plástico de 1000 ml | $HNO_3$ |
| Pesticidas | Botella de Vidrio de 1000 ml | Sin preservante |
| PCBs | Botella de Vidrio de 1000 ml | Sin preservante |
| Glifosato | Botella de Plástico de 1000 ml | Sin preservante |



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# INFORME

# DE

# LABORATORIO

# (Resultados adicionales)

para

**PÖYRY TECNOLOGIA LTDA.**
*Process Industries Division*
*Av. Alfredo Egídio de Souza Aranha, 100 – Bloco B – 5 andar*
*São Paulo - SP - 04726-170 - Brasil*
*Tel. +55 11 3472 7345*

**Atención**:
Ing. Romualdo Hirata
Ing. Cristina Colella
Ing. Celso Tsutsumi

***Tercera campaña de muestreo, 17 de febrero de 2020.***

***Fecha del informe: 20/03/2020***



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## INFORME DE LABORATORIO - RESULTADOS DE ANALISIS

**SOLICITUD N° 2020/114A**

**Solicitud de:** PÖYRY TECNOLOGIA LTDA.
Sr. Ing. Romualdo Hirata; Sra. Ing. Cristina Colella

**Toma de muestra:** Dr. Juan Escribá Ticoulat – Inyma Consult S.R.L.
Ing. Oscar Benítez – Inyma Consult S.R.L.

**Fecha de recepción**
**En el laboratorio:** 18/02/2020 **Fecha del Informe:** 20/03/2020

| C.I Nº | Descripción de la muestra | Fecha y hora de toma | Lugar | Coordenadas UTM |
|---|---|---|---|---|
| **3-115** | AS1 – Aguas Arriba | 17/02/2020 09:30 | Río Paraguay, zona de Loreto, Concepción, PY | 21 K 446252 mE 7428200 mS |

| ***Fecha de análisis*** | ***Parámetros Fisicoquímicos*** | ***Unidad*** | ***Resultados*** | ***Límite de Detección*** | ***Límite según Resolución 222/02**** |
|---|---|---|---|---|---|
| 18/02/2020 | Alcalinidad Total ($CaCO_3$) | mg/L | 34,7 | 1,12 | - |
| 18/02/2020 | Calcio (Ca) | mg/L | 9,84 | 0,4 | - |
| 18/02/2020 | Cloruro (Cl) | mg/L | 23,6 | 0,5 | Máx. 250 |
| 18/02/2020 | Magnesio (Mg) | mg/L | 2,89 | 0,24 | - |
| 19/02/2020 | Potasio (K) | mg/L | 2,50 | 0,1 | - |
| 19/02/2020 | Sílice ($SiO_2$) | mg/L | 29 | 1 | - |

*Resolución nº 222/02 de la SEAM, artículo 3º, para aguas superficiales de clase 2.

**Carmen Escribá S.**
**Ing. Química**
**Reg. Prof. Nº 359**



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## Métodos empleados para la determinación de los siguientes ensayos

| *Ensayos* | *Métodos* |
|---|---|
| Alcalinidad Total | SM 2320 B |
| Calcio | SM 3500 Ca D. EDTA |
| Cloruro | SM 4500-Cl Argentometric method. |
| Magnesio | SM 3500 Mg E. Cálculo |
| Potasio | SM 3500-K. Flame Emission Photometric Method. |
| Sílice | SM 4500 –Si D. |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.

## Tipos de envase y preservación de las muestras

| *Tipo de Análisis* | *Envase* | *Preservante* |
|---|---|---|
| Fisicoquímicos | Botella de Plástico de 1000 ml | Sin preservante |



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# INFORME

# DE

# LABORATORIO

para

**PÖYRY TECNOLOGIA LTDA.**
*Process Industries Division*
*Av. Alfredo Egídio de Souza Aranha, 100 – Bloco B – 5 andar*
*São Paulo - SP - 04726-170 - Brasil*
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**Atención**:
Ing. Romualdo Hirata
Ing. Cristina Colella
Ing. Celso Tsutsumi

***Tercera campaña de muestreo, 17 de Febrero de 2020.***

***Fecha del informe: 20/03/2020***



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## INFORME DE LABORATORIO - RESULTADOS DE ANALISIS

**SOLICITUD N° 2020/115**

**Solicitud de:** PÖYRY TECNOLOGIA LTDA.
Sr. Ing. Romualdo Hirata; Sra. Ing. Cristina Colella

**Toma de muestra:** Dr. Juan Escribá Ticoulat – Inyma Consult S.R.L.
Ing. Oscar Benítez – Inyma Consult S.R.L.

**Fecha de recepción en laboratorio:** 18/02/2020 **Fecha del Informe:** 20/03/2020

| C.I Nº | Descripción de la muestra | Fecha y hora de toma | Lugar | Coordenadas UTM |
|---|---|---|---|---|
| **3-116** | AS2 – Aguas Abajo | 17/02/20 10:10 | Río Paraguay, zona de Loreto, Concepción, PY | 21 K 449652 mE 7424490 mS |

| *Fecha de análisis* | *Parámetros in situ* | *Unidad* | *Resultados* | *Límite según Resolución 222/02** |
|---|---|---|---|---|
| | **Profundidad: 0,5 metros** | | | |
| 17/02/2020 | pH | - | 7,12 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,4 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 5,93 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 82 | - |
| | **Profundidad: 2,5 metros** | | | |
| 17/02/2020 | pH | - | 7,12 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,6 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | 174 | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 6,05 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 82,4 | - |
| | **Profundidad: 5 metros** | | | |
| 17/02/2020 | pH | - | 7,08 | 6,0 – 9,0 |
| 17/02/2020 | Temperatura | ºC | 32,8 | - |
| 17/02/2020 | Conductividad a 25 ºC | µS/cm | 162 | - |
| 17/02/2020 | Oxigeno Disuelto | mg/L | 6,20 | ≥ 5 |
| 17/02/2020 | Saturación de Oxigeno | % | 86 | - |

*Resolución nº 222/02 de la SEAM, artículo 3º, para aguas superficiales de clase 2.



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| Fecha de análisis | Parámetros Fisicoquímicos | Unidad | Resultados | Limite de Detección | Límite según Resolución 222/02* |
|---|---|---|---|---|---|
| 24/02/2020 | Aceites y Grasas | mg/L | < 2 | < 2 | Ausentes |
| 24/02/2020 | Cianuro ($CN^-$) libre | mg/L | < 0,01 | < 0,01 | Máx. 0,2 |
| 18/02/2020 | Color | uPtCo | 75 | < 1 | ≤ 75 |
| 18/02/2020 | Demanda Biológica de Oxígeno ($DBO_5$) | mg/L | 1,5 | < 0,5 | ≤ 5 |
| 18/02/2020 | Dureza Total ($CaCO_3$) | mg/L | 35,0 | < 0,5 | Máx. 300 |
| 19/02/2020 | Fósforo Total (P) | mg/L | 0,135 | < 0,004 | Máx. 0,05 |
| 25/02/2020 | Índice de Fenoles | mg/L | < 0,01 | < 0,024 | Máx. 0,5[1] |
| 17/02/2020 | Materias Flotantes | mg/L | ausentes | - | Ausentes |
| 18/02/2020 | Nitrato ($N\text{-}NO_3^-$) | mg/L | 0,27 | < 0,03 | Máx. 10 |
| 17/02/2020 | Nitrito ($N\text{-}NO_2^-$) *in situ* | mg/L | < 0,002 | < 0,002 | Máx. 1,0 |
| 18/02/2020 | Nitrógeno Amoniacal (N) | mg/L | 0,015 | < 0,006 | - |
| 18/02/2020 | Amonio no ionizado ($NH_3$) (cálculo) | mg/L | < 0,0002 | - | Máx. 0,02 |
| 19/02/2020 | Nitrógeno Total Kjeldahl (NTK) | mg/L | 1,03 | < 0,03 | Máx. 0,6 |
| 20/02/2020 | Sodio (Na) | mg/L | 22,0 | < 0,5 | Máx. 200 |
| 18/02/2020 | Sólidos Disueltos Totales | mg/L | 124 | < 5 | Máx. 500 |
| 20/02/2020 | Sulfato ($SO_4^{-2}$) | mg/L | 13,5 | < 1 | Máx. 250 |
| 18/02/2020 | Turbiedad | UNT | 38,1 | < 0,02 | ≤ 100 |
| **Fecha de análisis** | **Parámetros Bacteriológicos** | **Unidad** | **Resultados** | **Limite de Detección** | **Límite según Resolución 222/02*** |
| 18/02/2020 | Coliformes Fecales | UFC/100 ml | < 1 | < 1 | ≤ 1000 |
| **Fecha de finalización de análisis** | **Metales** | **Unidad** | **Resultados** | **Limite de Detección** | **Límite según Resolución 222/02*** |
| 13/03/2020 | Aluminio Total (Al) ICP/MS | mg/L | 4,00 | 0,05 | Máx. 0,2 |
| 13/03/2020 | Arsénico (As) ICP/MS | mg/L | 0,003 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Bario (Ba) ICP/MS | mg/L | < 0,05 | < 0,05 | Máx. 2,0 |
| 13/03/2020 | Cadmio (Cd) ICP/MS | mg/L | < 0,0005 | < 0,0005 | Máx. 0,001 |
| 13/03/2020 | Cobre (Cu) ICP/MS | mg/L | < 0,01 | < 0,01 | Máx. 1,0 |
| 20/02/2020 | Cromo Total (Cr) | mg/L | < 0,005 | < 0,005 | Máx. 0,55 |
| 20/02/2020 | Cromo Hexavalente ($Cr^{6+}$) | mg/L | < 0,005 | < 0,005 | Máx. 0,05 |
| 20/02/2020 | Cromo Trivalente ($Cr^{3+}$) | mg/L | < 0,005 | < 0,005 | Máx. 0,5 |
| 13/03/2020 | Estaño (Sn) ICP/MS | mg/L | < 0,005 | < 0,005 | Máx. 2,0 |



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| | | | | | |
|---|---|---|---|---|---|
| 17/02/2020 | Hierro ferroso soluble ($Fe^{+2}$) *in situ* | mg/L | 0,79 | < 0,05 | Máx. 0,3 |
| 19/02/2020 | Manganeso (Mn) | mg/L | 0,056 | < 0,025 | Máx. 0,1 |
| 13/03/2020 | Mercurio Total (Hg) ICP/MS | mg/L | < 0,001 | < 0,001 | Máx. 0,002[2] |
| 13/03/2020 | Níquel (Ni) ICP/MS | mg/L | 0,006 | < 0,001 | Máx. 0,025 |
| 13/03/2020 | Plomo (Pb) ICP/MS | mg/L | < 0,001 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Selenio (Se) ICP/MS | mg/L | < 0,001 | < 0,001 | Máx. 0,01 |
| 13/03/2020 | Zinc (Zn) ICP/MS | mg/L | < 0,05 | < 0,05 | Máx. 3,0 |
| ***Fecha de finalización de análisis*** | ***Pesticidas*** | ***Unidad*** | ***Resultados*** | ***Limite de Detección (µg/L)*** | ***Límite según Resolución 222/02**** |
| 16/03/2020 | Alacloro | mg/L | ND | 0,014 | cero |
| 16/03/2020 | Atrazina | mg/L | ND | 0,008 | 0,003 |
| 16/03/2020 | Gamma Clordano | mg/L | ND | 0,012 | cero |
| 16/03/2020 | 4,4' - DDT | mg/L | ND | 0,007 | 0,002 |
| 16/03/2020 | Endosulfan | mg/L | ND | 0,019 | 0,056 |
| 16/03/2020 | Endrin | mg/L | ND | 0,009 | 0,002 |
| 16/03/2020 | Glifosato | mg/L | ND | 2,7 | 0,7 |
| 16/03/2020 | Heptacloro | mg/L | ND | 0,005 | cero |
| 16/03/2020 | Lindano (BHC) | mg/L | ND | 0,002 | 0,0002 |
| 16/03/2020 | Metoxicloro | mg/L | ND | 0,005 | 0,04 |
| 16/03/2020 | PCBs (Bifenilos Policlorados)[3] | mg/L | < 0,2 | < 0,2 | cero |
| 16/03/2020 | Propanil | mg/L | ND | 0,132 | 0,02 |
| 16/03/2020 | Simazina | mg/L | ND | 0,027 | 0,004 |

*Resolución nº 222/02 de la SEAM, artículo 3º, para aguas superficiales de clase 2.
[1] Limite de índice de fenoles máximo permitido para vertido de efluentes a cursos de aguas superficiales, artículo 7º de la Res. 222/02 de la SEAM.
[2] Suma entre mercurio orgánico y mercurio inorgánico.
[3] El laboratorio tercerizado reporta el resultado de PCBs como menor que 0,2 microgramos/L, el cual es el límite de cuantificación del método empleado.
**ND:** no detectable.
Límites de detección de los compuestos orgánicos están expresados en microgramos por litro (µg/L).

**Observación**:
Las unidades de medida para los compuestos orgánicos (pesticidas) según la Resolución 222/02 de la SEAM están expresados en miligramos por litro (mg/L). Sin embargo los resultados de los ensayos y el límite de detección del método analítico están expresados en microgramos por litro (µg/L).
Los resultados de metales realizados por ICP-MS están expresados en mg/L y el laboratorio tercerizado informa el límite de cuantificación de cada ensayo en mg/L y no menciona el límite de detección.

**Carmen Escribá S.**
**Ing. Química**
**Reg. Prof. Nº 359**



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## Métodos empleados para la determinación de los siguientes ensayos

| *Ensayos* | *Métodos* |
|---|---|
| Aceites y Grasas | SM 5520. Partition-Gravimetric Method. |
| Aluminio (Al) | @ICP-MS |
| Arsénico total (As) | @ICP-MS |
| Bario (Ba) | @ICP-MS |
| Cadmio (Cd) | @ICP-MS |
| Cianuro ($CN^-$) libre | SM 4500-CN. E Colorimetric method. |
| Cobre (Cu) | @ICP-MS |
| Coliformes Fecales | SM 9222 D. Fecal Coliform Membrane Filter Procedure. |
| Color verdadero | SM 2120 B. Visual Comparison Method. |
| Conductividad eléctrica a 25 ºC | SM 2510. Laboratory Method. |
| Cromo total (Cr) | SM 3500-Cr. Colorimetric Method. |
| Cromo Hexavalente ($Cr^{6+}$) | SM 3500-Cr. Colorimetric Method. |
| Cromo Trivalente ($Cr^{3+}$) | Cálculo |
| Demanda Biológica de Oxígeno ($DBO_5$) | SM 5210. 5-Day BOD Test. |
| Dureza Total ($CaCO_3$) | SM 2340. EDTA Titrimetric Method. |
| Estaño (Sn) | @ICP-MS |
| Fósforo Total (P) | SM 4500-P. Ascorbic Acid Method. |
| Glifosato | @LC-MS/MS |
| Hierro ferroso soluble ($Fe^{2+}$) *(in situ)* | SM 3500-Fe D. |
| Indice de Fenoles ($C_6H_5OH$) | SM 5530. Chloroform Extraction Method. |
| Manganeso (Mn) | Hach method 8149 |
| Mercurio Total (Hg) | @ICP-MS |
| Nitrato (N-$NO_3^-$) | EPA method 352.1 |
| Nitrito (N-$NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Nitrógeno Amoniacal ($NH_3$) | SM 4500-$NH_3$. Phenate Method. |
| Nitrógeno Total Kjeldahl (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method. |
| Níquel (Ni) | @ICP-MS |
| Oxígeno Disuelto | SM 4500-O. Membrane Electrode Method. |
| PCBs (Bifenilos Poli Clorados) | @GC-MS |
| Pesticidas en agua | @SPME-GC-MS |
| pH *(in situ)* | SM 4500-$H^+$. Electrometric Method. |
| Plomo (Pb) | @ICP-MS |
| Selenio (Se) | @ICP-MS |
| Sodio (Na) | SM 3500-Na. Flame Emission Photometric Method. |
| Sólidos Disueltos Totales | SM 2540 C. Total Solids Dried at 180ºC |
| Sulfato ($SO_4^{-2}$) | SM 4500-$SO_4^{2-}$. Turbidimetric Method |
| Turbiedad | SM 2130. Nephelometric Method. |
| Zinc (Zn) | @ICP-MS |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.
@: Ensayos realizados en otros laboratorios de Paraguay.



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## Tipos de envase y preservación de las muestras

| *Tipo de Análisis* | *Envase* | *Preservante* |
|---|---|---|
| Aceites y Grasas | Botella de Vidrio de 1000 ml | $H_2SO_4$ |
| Nitrogenados, Fosforados y Fenoles | Botella de Plástico de 1000 ml | $H_2SO_4$ |
| Fisicoquímicos | Botella de Plástico de 1000 ml | Sin preservante |
| Cianuro | Botella de Plástico de 100 ml | NaOH |
| Cromo VI | Botella de Plástico de 500 ml | Sulfato de amonio y NaOH |
| Bacteriológicos | Bolsa Estéril de 300 ml | Sin preservante |
| Metales | Botella de Plástico de 1000 ml | $HNO_3$ |
| Pesticidas | Botella de Vidrio de 1000 ml | Sin preservante |
| PCBs | Botella de Vidrio de 1000 ml | Sin preservante |
| Glifosato | Botella de Plástico de 1000 ml | Sin preservante |



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# INFORME

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# LABORATORIO

para

**PÖYRY TECNOLOGIA LTDA.**
*Process Industries Division*
*Av. Alfredo Egídio de Souza Aranha, 100 – Bloco B – 5 andar*
*São Paulo - SP - 04726-170 - Brasil*
*Tel. +55 11 3472 7345*

**Atención**:
Ing. Romualdo Hirata
Ing. Cristina Colella
Ing. Celso Tsutsumi

***Tercera campaña de muestreo, 17 de Febrero de 2020.***

***Fecha del informe: 20/03/2020***



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## INFORME DE LABORATORIO - RESULTADOS DE ANALISIS

**SOLICITUD N° 2020/116**

**Solicitud de:** PÖYRY TECNOLOGIA LTDA.
Sr. Ing. Romualdo Hirata; Sra. Ing. Cristina Colella

**Toma de muestra:** Dr. Juan Escribá Ticoulat – Inyma Consult S.R.L.
Ing. Oscar Benítez - Inyma Consult S.R.L.

**Fecha de recepción en laboratorio:** 18/02/2020 **Fecha del Informe:** 20/03/2020

| C.I. Nº | Descripción de la muestra | Fecha y hora de toma | Lugar | Coordenadas UTM |
|---|---|---|---|---|
| **7-396** | SED1 – Sedimento superficial del lecho del río Paraguay | 17/02/2020 08:30 | Río Paraguay, zona de Loreto, Concepción, PY | 21 K 445977 mE 7428289 mS |

| *Fecha de análisis* | *Parámetros Fisicoquímicos* | *Unidad* | *Resultados* | *Límite de Detección* | *Límites* |
|---|---|---|---|---|---|
| 18/02/2020 | Humedad | % p/p bh | 22,80 | 0,1 | SR |
| 18/02/2020 | Demanda Biológica de Oxígeno ($DBO_5$) | mg/kg bh | 128 | 10 | SR |
| 19/02/2020 | Fósforo Total (P) | mg/kg bs | 235 | 12 | SR |
| 12/03/2020 | Nitrato ($NO_3^-$) | mg/kg bs | 58,2 | 3,3 | SR |
| 12/03/2020 | Nitrito ($NO_2^-$) | mg/kg bs | < 0,2 | 0,2 | SR |
| 18/02/2020 | Nitrógeno Total Kjeldahl (NTK) | mg/kg bs | 314 | 80 | SR |
| ***Fecha de finalización*** | ***Metales*** | ***Unidad*** | ***Resultados*** | ***Límite de cuantificación*** | ***Límites*** |
| 28/02/2020 | Aluminio (Al) | %p/p bs | 4,00 | 0,2 | SR |
| 13/03/2020 | Antimonio (Sb) ICP/MS | mg/kg bs | < 1 | 1 | SR |
| 21/02/2020 | Arsénico (As) | mg/kg bs | 1,8 | 1 | SR |
| 13/03/2020 | Bario (Ba) ICP/MS | mg/kg bs | 97 | 5 | SR |
| 13/03/2020 | Boro (B) ICP/MS | mg/kg bs | < 5 | 5 | SR |
| 13/03/2020 | Cadmio (Cd) | mg/kg bs | < 1 | 1 | SR |
| 02/03/2020 | Cobre (Cu) | mg/kg bs | < 1,6 | < 1,6 | SR |
| 03/03/2020 | Cromo Hexavalente ($Cr^{6+}$) | mg/kg bs | < 3 | 3 | SR |
| 03/03/2020 | Cromo Total (Cr) | mg/kg bs | 20 | 3 | SR |
| 03/03/2020 | Cromo Trivalente ($Cr^{3+}$) | mg/kg bs | 20 | 3 | SR |
| 13/03/2020 | Mercurio Total (Hg) ICP/MS | mg/kg bs | < 1 | 1 | SR |
| 13/03/2020 | Níquel (Ni) ICP/MS | mg/kg bs | 10 | 1 | SR |
| 13/03/2020 | Plata (Ag) ICP/MS | mg/kg bs | < 1 | 1 | SR |



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Asunción - Paraguay E-mail: labinyma@gmail.com

| | | | | | |
|---|---|---|---|---|---|
| 27/03/2020 | Plomo (Pb) | mg/kg bs | < 2 | 2 | SR |
| 12/03/2020 | Selenio (Se) | mg/kg bs | 1,9 | 0,8 | SR |
| 13/03/2020 | Zinc (Zn) ICP/MS | mg/kg bs | 24 | 4 | SR |
| ***Fecha de finalización*** | ***Pesticidas*** | ***Unidad*** | ***Resultados*** | ***Límite de Detección*** | ***Límites*** |
| 03/03/2020 | Alacloro | mg/kg bs | < 0,00380 | 0,00380 | SR |
| 03/03/2020 | Atrazina | mg/kg bs | < 0,00010 | 0,00010 | SR |
| 03/03/2020 | Carbofuran | mg/kg bs | < 0,00016 | 0,00016 | SR |
| 03/03/2020 | Diazinon | mg/kg bs | < 0,00014 | 0,00014 | SR |
| 03/03/2020 | Glifosato | mg/kg bs | < 0,0027 | 0,0027 | SR |
| 03/03/2020 | PCBs | mg/kg bs | < 0,2237 | 0,2237 | SR |

**Observaciones:**
bh: sedimento escurrido con humedad de poro. (base húmeda)
bs: base seca (sin humedad).
SR: Sin referencias.
% p/p: porcentaje peso sobre peso.

<: este símbolo indica que el resultado obtenido es inferior al valor mencionado.

**Carmen Escribá S.**
**Ing. Química**
**Reg. Prof. Nº 359**



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**Métodos empleados para la determinación de los siguientes ensayos**

| ***Ensayos*** | ***Métodos*** |
|---|---|
| Aluminio (Al) | SM 3500-Al D. |
| Antimonio (Sb) | @ICP-MS |
| Arsénico total (As) | SM 3500-As C. Silver Diethyldithiocarbamate Methodl. |
| Bario (Ba) | @ICP-MS |
| Boro (B) | @ICP-MS |
| Cadmio (Cd) | SM 3500-Cd D. Dithizone method. |
| Cobre (Cu) | ICUMSA GS2/3-29 |
| Cromo total (Cr) | SM 3500-Cr. Colorimetric Method. |
| Cromo Hexavalente ($Cr^{6+}$) | SM 3500-Cr. Colorimetric Method. |
| Cromo Trivalente ($Cr^{3+}$) | Cálculo |
| Demanda Biológica de Oxígeno ($DBO_5$) | SM 5210. 5-Day BOD Test. |
| Estaño (Sn) | @ICP-MS |
| Fósforo Total (P) | SM 4500-P. Ascorbic Acid Method. |
| Humedad | Pérdida por secado a 110ºC. |
| Glifosato | @LC-MS/MS |
| Mercurio Total (Hg) | @ICP-MS |
| Nitrato ($N\text{-}NO_3^-$) | EPA method 352.1 |
| Nitrito ($N\text{-}NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Nitrógeno Total Kjeldahl (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method. |
| Níquel (Ni) | @ICP-MS |
| PCBs (Bifenilos Poli Clorados) | @GC-ECD |
| Pesticidas cloarados en sedimentos | @LC/MS/MS |
| Plata (Ag) | @ICP-MS |
| Plomo (Pb) | SM 3500-Pb D. Dithizone Method |
| Selenio (Se) | Osburn, R. L., A. D. Shendrikar, and P. W. West, *Anal. Chem.*, **43 (4)**, 594-597 (1971) |
| Zinc (Zn) | @ICP-MS |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.
@: Métodos realizados en otros laboratorios.



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## Tipos de envase y preservación de las muestras de sedimentos superficiales

| *Tipo de Análisis* | *Envase* | *Preservante* |
|---|---|---|
| Fisicoquímicos | Bolsa ziplog 1 kg | Sin preservante |
| Metales | Bolsa ziplog 1 kg | Sin preservante |
| Pesticidas y PCBs | Bolsa ziplog 1 kg | Sin preservante |



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# INFORME

# DE

# LABORATORIO

para

**PÖYRY TECNOLOGIA LTDA.**
*Process Industries Division*
*Av. Alfredo Egídio de Souza Aranha, 100 – Bloco B – 5 andar*
*São Paulo - SP - 04726-170 - Brasil*
*Tel. +55 11 3472 7345*

**Atención**:
Ing. Romualdo Hirata
Ing. Cristina Colella
Ing. Celso Tsutsumi

***Tercera campaña de muestreo, 17 de Febrero de 2020.***

***Fecha del informe: 20/03/2020***



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## INFORME DE LABORATORIO - RESULTADOS DE ANALISIS

**SOLICITUD N° 2020/117**

**Solicitud de:** PÖYRY TECNOLOGIA LTDA.
Sr. Ing. Romualdo Hirata; Sra. Ing. Cristina Colella

**Toma de muestra:** Dr. Juan Escribá Ticoulat – Inyma Consult S.R.L.
Ing. Oscar Benítez - Inyma Consult S.R.L.

**Fecha de recepción en laboratorio:** 18/02/2020 **Fecha del Informe:** 20/03/2020

| C.I. Nº | Descripción de la muestra | Fecha y hora de toma | Lugar | Coordenadas UTM |
|---|---|---|---|---|
| **7-397** | SED2 – Sedimento superficial del lecho del río Paraguay | 17/02/2020 10:50 | Río Paraguay, zona de Loreto, Concepción, PY | 21 K 449544 mE 7424634 mS |

| *Fecha de análisis* | *Parámetros Fisicoquímicos* | *Unidad* | *Resultados* | *Límite de Detección* | *Límites* |
|---|---|---|---|---|---|
| 18/02/2020 | Humedad | % p/p bh | 24,15 | 0,1 | SR |
| 18/02/2020 | Demanda Biológica de Oxígeno ($DBO_5$) | mg/kg bh | 102 | 10 | SR |
| 19/02/2020 | Fósforo Total (P) | mg/kg bs | 263 | 12 | SR |
| 12/03/2020 | Nitrato ($NO_3^-$) | mg/kg bs | 52,2 | 3,3 | SR |
| 12/03/2020 | Nitrito ($NO_2^-$) | mg/kg bs | < 0,2 | 0,2 | SR |
| 18/02/2020 | Nitrógeno Total Kjeldahl (NTK) | mg/kg bs | 271 | 80 | SR |
| ***Fecha de finalización*** | ***Metales*** | ***Unidad*** | ***Resultados*** | ***Límite de cuantificación*** | ***Límites*** |
| 28/02/2020 | Aluminio (Al) | %p/p bs | 2,60 | 0,2 | SR |
| 13/03/2020 | Antimonio (Sb) ICP/MS | mg/kg bs | < 1 | 1 | SR |
| 21/02/2020 | Arsénico (As) | mg/kg bs | 1,0 | 1 | SR |
| 13/03/2020 | Bario (Ba) ICP/MS | mg/kg bs | 107 | 5 | SR |
| 13/03/2020 | Boro (B) ICP/MS | mg/kg bs | < 5 | 5 | SR |
| 13/03/2020 | Cadmio (Cd) | mg/kg bs | < 1 | 1 | SR |
| 02/03/2020 | Cobre (Cu) | mg/kg bs | < 1,6 | < 1,6 | SR |
| 03/03/2020 | Cromo Hexavalente ($Cr^{6+}$) | mg/kg bs | < 3 | 3 | SR |
| 03/03/2020 | Cromo Total (Cr) | mg/kg bs | 19 | 3 | SR |
| 03/03/2020 | Cromo Trivalente ($Cr^{3+}$) | mg/kg bs | 19 | 3 | SR |
| 13/03/2020 | Mercurio Total (Hg) ICP/MS | mg/kg bs | < 1 | 1 | SR |
| 13/03/2020 | Níquel (Ni) ICP/MS | mg/kg bs | 9 | 1 | SR |
| 13/03/2020 | Plata (Ag) ICP/MS | mg/kg bs | < 1 | 1 | SR |



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| | | | | | |
|---|---|---|---|---|---|
| 27/03/2020 | Plomo (Pb) | mg/kg bs | < 2 | 2 | SR |
| 12/03/2020 | Selenio (Se) | mg/kg bs | < 0,8 | 0,8 | SR |
| 13/03/2020 | Zinc (Zn) ICP/MS | mg/kg bs | 20 | 4 | SR |
| ***Fecha de finalización*** | ***Pesticidas*** | ***Unidad*** | ***Resultados*** | ***Límite de Detección*** | ***Límites*** |
| 03/03/2020 | Alacloro | mg/kg bs | < 0,00380 | 0,00380 | SR |
| 03/03/2020 | Atrazina | mg/kg bs | < 0,00010 | 0,00010 | SR |
| 03/03/2020 | Carbofuran | mg/kg bs | < 0,00016 | 0,00016 | SR |
| 03/03/2020 | Diazinon | mg/kg bs | < 0,00014 | 0,00014 | SR |
| 03/03/2020 | Glifosato | mg/kg bs | < 0,0027 | 0,0027 | SR |
| 03/03/2020 | PCBs | mg/kg bs | < 0,2237 | 0,2237 | SR |

**Observaciones:**
bh: sedimento escurrido con humedad de poro. (base húmeda)
bs: base seca (sin humedad).
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% p/p: porcentaje peso sobre peso.

<: este símbolo indica que el resultado obtenido es inferior al valor mencionado.

**Carmen Escribá S.**
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| Bario (Ba) | @ICP-MS |
| Boro (B) | @ICP-MS |
| Cadmio (Cd) | SM 3500-Cd D. Dithizone method. |
| Cobre (Cu) | ICUMSA GS2/3-29 |
| Cromo total (Cr) | SM 3500-Cr. Colorimetric Method. |
| Cromo Hexavalente ($Cr^{6+}$) | SM 3500-Cr. Colorimetric Method. |
| Cromo Trivalente ($Cr^{3+}$) | Cálculo |
| Demanda Biológica de Oxígeno ($DBO_5$) | SM 5210. 5-Day BOD Test. |
| Estaño (Sn) | @ICP-MS |
| Fósforo Total (P) | SM 4500-P. Ascorbic Acid Method. |
| Humedad | Pérdida por secado a 110ºC. |
| Glifosato | @LC-MS/MS |
| Mercurio Total (Hg) | @ICP-MS |
| Nitrato ($N\text{-}NO_3^-$) | EPA method 352.1 |
| Nitrito ($N\text{-}NO_2^-$) | SM 4500-$NO_2$. Colorimetric Method |
| Nitrógeno Total Kjeldahl (NTK) | SM 4500-$N_{org}$. Semi-Micro-Kjeldahl Method. |
| Níquel (Ni) | @ICP-MS |
| PCBs (Bifenilos Poli Clorados) | @GC-ECD |
| Pesticidas cloarados en sedimentos | @LC/MS/MS |
| Plata (Ag) | @ICP-MS |
| Plomo (Pb) | SM 3500-Pb D. Dithizone Method. |
| Selenio (Se) | Osburn, R. L., A. D. Shendrikar, and P. W. West, *Anal. Chem.*, **43 (4)**, 594-597 (1971) |
| Zinc (Zn) | @ICP-MS |

SM: Standard Methods for the Examination of water and wastewater. 17th Edition. APHA, AWWA, WPCF. 1989.
@: Métodos realizados en otros laboratorios.



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3 de Mayo 3819 c/ San Jorge Tel. - Fax.: (595) 21 671675
Asunción - Paraguay E-mail: labinyma@gmail.com

## Tipos de envase y preservación de las muestras de sedimentos superficiales

| *Tipo de Análisis* | *Envase* | *Preservante* |
|---|---|---|
| Fisicoquímicos | Bolsa ziplog 1 kg | Sin preservante |
| Metales | Bolsa ziplog 1 kg | Sin preservante |
| Pesticidas y PCBs | Bolsa ziplog 1 kg | Sin preservante |



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# RESUMO DOS RESULTADOS DA AMOSTRA N° 44196/2020-0

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884649 | | |
| ***Identificação do Cliente:*** | Análise de Águas Superficiais - Ponto 1 | | |
| ***Amostra Rotulada como:*** | Água Superficial Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da amostragem:*** | 17/02/2020 10:20:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:11 | ***Data de Elaboração do RRA:*** | 18/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | Unidade | LQ/ Faixa | Resultados analíticos | Data de Ensaio |
|---|---|---|---|---|
| Clorato | mg/L | 0,02 | < 0,02 | 21/02/2020 16:43 |
| AOX | µg/L | 20 | 110 | 11/03/2020 16:32 |
| 2,4-D | µg/L | 0,005 | < 0,005 | 21/02/2020 13:29 |
| Paraquat | µg/L | --- | Resultado em anexo | 26/02/2020 15:25 |

Paraquat (água) - Externo Bioensaios

**Notas**
**"Mérieux NutriSciences" é nome fantasia, a razão social permanece Bioagri Ambiental Ltda.**
**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da amostragem, são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de amostragem de responsabilidade do interessado.

**Dados de Origem**
Resumo dos resultados da amostra n° 44196/2020-0 preparado com os dados dos relatórios de ensaio: 44196/2020-0 - Piracicaba anexados a este documento.
**Declaração de Conformidade**

**Referências Metodológicas e Locais de Execução**
Bioagri Ambiental Ltda.- Matriz: Rua Aljovil Martini, 177/201, Bairro Dois Córregos - Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto.
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3510 C:1996, 3535 A:2007
AOX: EPA 1650-C (Análise subcontrada com Laboratório TestAmerica Savannah - 5102,LaRoche Avenue - Savannah, GA)
Ânions: EPA 300.0: 1993, 300.1: 1999, POP PA 032

Chave de Validação: 857b47cb5e10b20402624d81cf6444b2

*Julia Joly Valverde*
*Controle de Qualidade*
*CRQ 04493051 – 4ª Região*

*Marcos Ceccatto*
*Diretor Técnico*
*CRQ 04364387 – 4ª Região*



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MERIEUX NutriSciences

Ensaios NBR ISO/IEC 17025 CRL 0172

# RELATÓRIO DE ENSAIO N° 44196/2020-0 - Piracicaba

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884649 | | |
| ***Identificação do Cliente:*** | Análise de Águas Superficiais - Ponto 1 | | |
| ***Amostra Rotulada como:*** | Água Superficial Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da amostragem:*** | 17/02/2020 10:20:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:11 | ***Data de Elaboração do RE:*** | 18/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | CAS | Unidade | LQ/ Faixa | Resultados analíticos | Incerteza | Data do Ensaio |
|---|---|---|---|---|---|---|
| Clorato | 14866-68-3 | mg/L | 0,02 | < 0,02 | n.a. | 21/02/2020 16:43 |
| 2,4-D | 94-75-7 | µg/L | 0,005 | < 0,005 | n.a. | 21/02/2020 13:29 |

**Notas**
**"Mérieux NutriSciences" é nome fantasia, a razão social permanece Bioagri Ambiental Ltda.**
**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
n.a. = Não Aplicável.
Incerteza = Incerteza expandida (U), que é baseada na incerteza padrão combinada, com um nível de confiança de 95% (k=2).

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da amostragem, são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de amostragem de responsabilidade do interessado.

**Responsabilidade Técnica**
Os ensaios foram realizados na unidade da Bioagri Ambiental Ltda. - Matriz, situada na Rua Aljovil Martini, 177/201, Bairro Dois Córregos, Cep. 14420-833, Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto, CRQ n° 04364387, 4ª.Região.

**Referências Metodológicas**
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3510 C:1996, 3535 A:2007
Ânions: EPA 300.0: 1993, 300.1: 1999, POP PA 032

Chave de Validação: 857b47cb5e10b20402624d81cf6444b2

*Julia Joly Valverde*
*Controle de Qualidade*
*CRQ 04493051 – 4ª Região*

*Marcos Ceccatto*
*Diretor Técnico*
*CRQ 04364387 – 4ª Região*



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# Laudo Analítico BQ-216627/20

**Cliente:** Bioagri Ambiental Ltda.
**Endereço:** Rua Aujovil Martini, 177 E 201 - 13420-833 - Piracicaba-SP

**Proposta Comercial/Plano de Amostragem:** BOP-20843-19
**Ident. da Amostra:** 8884649-44196/2020 - Água Superficial - Ponto 1
**Local Amostragem:** --
**Tipo Amostra:** Água Superficial
**Amostrado por:** Cliente
**Data da amostragem:** 17/02/2020 10h 20min
**Data de Recebimento:** 28/02/2020 13h 00min
**Data do Laudo:** 12/03/2020

| Parâmetro | Resultado | Unidade | Método | LOQ | LOD | IM | D.Digit. |
|---|---|---|---|---|---|---|---|
| Paraquate | ND | µg/L | POP 05.192/05 - LC-MS/MS | 0,1 | --- | --- | 11/03/2020 |

**Legenda:**

AL: Prejudicado por Acidente Laboratorial
AOAC: Association of Analytical Communities
ASTM: American Society for Testing and Materials
EPA: US-Environmental Protection Agency
IM: Incerteza da medição
LOD: Limite de detecção
LOQ: Limite de quantificação
MAOQ-FURG: Manual de Análises em Oceanografia Química da FURG
MFL: Milhões de Filamentos por Litro
NBR: Norma Brasileira da ABNT
ND: Não detectado
OECD: Organização para Cooperação e Desenvolvimento Econômico
POP: Procedimento Operacional Padrão
SM: Standard Methods da APHA-AWWA-WEF
V.O.: Valores Orientadores
VMP: Valor Máximo Permitido
VR: Valor Recomendado
VRQ: Valor de Referência de Qualidade

**Nota:**
A realização das análises dentro do prazo de validade de cada parâmetro é garantida desde que todo o trâmite analítico (amostragem e análise) tenha sido de responsabilidade da NSF International.Desvios percebidos no ato do recebimento de amostras são informados aos interessados para deliberação a respeito da continuidade do processo analítico.

Liberado eletronicamente por:

Andrea Ferreira Machado
Química
CRQ-05201620-5ª Região


NSF Bioensaios - Prestação de Serviços de Análises e Certificação Ltda. - Rua Palermo, 257 - 94480-775 - Viamão - RS - Brasil
Fone: (55 51) 3493-6888 Fax: (55 51) 3493-6885 / e-mail: nsf-bioensaios@nsf.org
Os resultados referem-se apenas a amostra ensaiada. Este documento só pode ser reproduzido na íntegra e sem alterações.

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# RESUMO DOS RESULTADOS DA AMOSTRA N° 44197/2020-0

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884653 | | |
| ***Identificação do Cliente:*** | Análise de Águas Superficiais - Ponto 2 | | |
| ***Amostra Rotulada como:*** | Água Superficial Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da amostragem:*** | 17/02/2020 11:20:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:12 | ***Data de Elaboração do RRA:*** | 18/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | Unidade | LQ/ Faixa | Resultados analíticos | Data de Ensaio |
|---|---|---|---|---|
| Clorato | mg/L | 0,02 | < 0,02 | 21/02/2020 16:43 |
| AOX | µg/L | 20 | 62 | 10/03/2020 01:50 |
| 2,4-D | µg/L | 0,005 | < 0,005 | 21/02/2020 13:29 |
| Paraquat | µg/L | --- | Resultado em anexo | 26/02/2020 15:25 |

Paraquat (água) - Externo Bioensaios

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**Plano de Amostragem**
Plano de amostragem de responsabilidade do interessado.

**Dados de Origem**
Resumo dos resultados da amostra n° 44197/2020-0 preparado com os dados dos relatórios de ensaio: 44197/2020-0 - Piracicaba anexados a este documento.
**Declaração de Conformidade**

**Referências Metodológicas e Locais de Execução**
Bioagri Ambiental Ltda.- Matriz: Rua Aljovil Martini, 177/201, Bairro Dois Córregos - Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto.
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3510 C:1996, 3535 A:2007
AOX: EPA 1650-C (Análise subcontrada com Laboratório TestAmerica Savannah - 5102,LaRoche Avenue - Savannah, GA)
Ânions: EPA 300.0: 1993, 300.1: 1999, POP PA 032

Chave de Validação: e21fef330c93862769b6065a2e48abc9

*Julia Joly Valverde*
*Controle de Qualidade*
*CRQ 04493051 – 4ª Região*

*Marcos Ceccatto*
*Diretor Técnico*
*CRQ 04364387 – 4ª Região*



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Ensaios NBR ISO/IEC 17025 CRL 0172

# RELATÓRIO DE ENSAIO N° 44197/2020-0 - Piracicaba

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884653 | | |
| ***Identificação do Cliente:*** | Análise de Águas Superficiais - Ponto 2 | | |
| ***Amostra Rotulada como:*** | Água Superficial Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da amostragem:*** | 17/02/2020 11:20:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:12 | ***Data de Elaboração do RE:*** | 18/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | CAS | Unidade | LQ/ Faixa | Resultados analíticos | Incerteza | Data do Ensaio |
|---|---|---|---|---|---|---|
| Clorato | 14866-68-3 | mg/L | 0,02 | < 0,02 | n.a. | 21/02/2020 16:43 |
| 2,4-D | 94-75-7 | µg/L | 0,005 | < 0,005 | n.a. | 21/02/2020 13:29 |

**Notas**
**"Mérieux NutriSciences" é nome fantasia, a razão social permanece Bioagri Ambiental Ltda.**
**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
n.a. = Não Aplicável.
Incerteza = Incerteza expandida (U), que é baseada na incerteza padrão combinada, com um nível de confiança de 95% (k=2).

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da amostragem, são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de amostragem de responsabilidade do interessado.

**Responsabilidade Técnica**
Os ensaios foram realizados na unidade da Bioagri Ambiental Ltda. - Matriz, situada na Rua Aljovil Martini, 177/201, Bairro Dois Córregos, Cep. 14420-833, Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto, CRQ n° 04364387, 4ª.Região.

**Referências Metodológicas**
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3510 C:1996, 3535 A:2007
Ânions: EPA 300.0: 1993, 300.1: 1999, POP PA 032

Chave de Validação: e21fef330c93862769b6065a2e48abc9

*Julia Joly Valverde*
*Controle de Qualidade*
*CRQ 04493051 – 4ª Região*

*Marcos Ceccatto*
*Diretor Técnico*
*CRQ 04364387 – 4ª Região*



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# Laudo Analítico BQ-216628/20

**Cliente:** Bioagri Ambiental Ltda.
**Endereço:** Rua Aujovil Martini, 177 E 201 - 13420-833 - Piracicaba-SP

**Proposta Comercial/Plano de Amostragem:** BOP-20843-19
**Ident. da Amostra:** 8884653-44197/2020 - Água Superficial - Ponto 2
**Local Amostragem:** --
**Tipo Amostra:** Água Superficial
**Amostrado por:** Cliente
**Data da amostragem:** 17/02/2020 11h 20min
**Data de Recebimento:** 28/02/2020 13h 00min
**Data do Laudo:** 12/03/2020

| Parâmetro | Resultado | Unidade | Método | LOQ | LOD | IM | D.Digit. |
|---|---|---|---|---|---|---|---|
| Paraquate | ND | µg/L | POP 05.192/05 - LC-MS/MS | 0,1 | --- | --- | 11/03/2020 |

**Legenda:**

AL: Prejudicado por Acidente Laboratorial
AOAC: Association of Analytical Communities
ASTM: American Society for Testing and Materials
EPA: US-Environmental Protection Agency
IM: Incerteza da medição
LOD: Limite de detecção
LOQ: Limite de quantificação
MAOQ-FURG: Manual de Análises em Oceanografia Química da FURG
MFL: Milhões de Filamentos por Litro
NBR: Norma Brasileira da ABNT
ND: Não detectado
OECD: Organização para Cooperação e Desenvolvimento Econômico
POP: Procedimento Operacional Padrão
SM: Standard Methods da APHA-AWWA-WEF
V.O.: Valores Orientadores
VMP: Valor Máximo Permitido
VR: Valor Recomendado
VRQ: Valor de Referência de Qualidade

**Nota:**
A realização das análises dentro do prazo de validade de cada parâmetro é garantida desde que todo o trâmite analítico (amostragem e análise) tenha sido de responsabilidade da NSF International.Desvios percebidos no ato do recebimento de amostras são informados aos interessados para deliberação a respeito da continuidade do processo analítico.

Liberado eletronicamente por:

Andrea Ferreira Machado
Química
CRQ-05201620-5ª Região


NSF Bioensaios - Prestação de Serviços de Análises e Certificação Ltda. - Rua Palermo, 257 - 94480-775 - Viamão - RS - Brasil
Fone: (55 51) 3493-6888 Fax: (55 51) 3493-6885 / e-mail: nsf-bioensaios@nsf.org
Os resultados referem-se apenas a amostra ensaiada. Este documento só pode ser reproduzido na íntegra e sem alterações.

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# RESUMO DOS RESULTADOS DA AMOSTRA N° 44194/2020-0

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884636 | | |
| ***Identificação do Cliente:*** | Análise de Sedimentos Ponto 01 | | |
| ***Amostra Rotulada como:*** | Sedimento Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da Amostragem :*** | 17/02/2020 10:00:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:10 | ***Data de Elaboração do RRA:*** | 09/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | Unidade | LQ/ Faixa | Resultados analíticos | Data de Ensaio | F1 | F2 |
|---|---|---|---|---|---|---|
| Porcentagem de Sólidos | % p/p | 0,05 | 74,4 | 21/02/2020 14:57 | --- | --- |
| 2,4-D | mg/kg | 0,0033 | < 0,0033 | 21/02/2020 14:58 | --- | --- |

Flag 1 (F1): Análises marcadas com "X" na coluna Flag 1 indicam análise realizada fora do holding time do parâmetro, podendo possuir desvios que podem comprometer os resultados, devendo ser avaliado com estas ressalvas.
Flag 2 (F2): Análises marcadas com "X" na coluna Flag 2 indicam análise realizada com a amostra sendo recebida de forma inapropriada, tanto em conteúdo, frasco ou temperatura, tendo sido autorizada pelo interessado. Desta forma os resultados podem possuir desvios que podem comprometer os resultados, devendo ser avaliados com esta ressalva.

**Notas**
**"Mérieux NutriSciences" é nome fantasia, a razão social permanece Bioagri Ambiental Ltda.**
**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
**Data do Ensaio: Refere-se a data de início do ensaio**

Resultados expressos na base seca (quando aplicável). Porcentagem de Sólidos 105°C e Cinzas 550°C.

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da Amostragem , são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de Amostragem de responsabilidade do interessado.

**Dados de Origem**
Resumo dos resultados da amostra n° 44194/2020-0 preparado com os dados dos relatórios de ensaio: 44194/2020-0 - Piracicaba anexados a este documento.
**Declaração de Conformidade**

**Referências Metodológicas e Locais de Execução**
Bioagri Ambiental Ltda. - Matriz: Rua Aljovil Martini, 177/201, Bairro Dois Córregos - Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto.
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3550 C:2007
Porcentagem de Sólidos e Cinzas: SMWW, 22ª Edição, 2012 - Método 2540 G

Chave de Validação: 7498e7b012937bf5693af64101f7fba8

*Juliana Bombasaro*
*Controle de Qualidade*
*CRQ 04469985 – 4ª Região*

*Marcos Ceccattto*
*Diretor Técnico*
*CRQ 04364387– 4ª Região*



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Ensaios NBR ISO/IEC 17025 CRL 0172

# RELATÓRIO DE ENSAIO N° 44194/2020-0 - Piracicaba

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884636 | | |
| ***Identificação do Cliente:*** | Análise de Sedimentos Ponto 01 | | |
| ***Amostra Rotulada como:*** | Sedimento Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da Amostragem :*** | 17/02/2020 10:00:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:10 | ***Data de Elaboração do RE:*** | 09/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | CAS | Unidade | LQ/ Faixa | Resultados analíticos | Incerteza | Data Início do Ensaio | Corrida | Cód. Método | F1 | F2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Porcentagem de Sólidos | --- | % p/p | 0,05 | 74,4 | 7,4 | 21/02/2020 14:57 | --- | 53 | --- | --- |
| 2,4-D | 94-75-7 | mg/kg | 0,0033 | < 0,0033 | n.a. | 21/02/2020 14:58 | --- | 2608 | --- | --- |

Flag 1 (F1): Análises marcadas com "X" na coluna Flag 1 indicam análise realizada fora do holding time do parâmetro, podendo possuir desvios que podem comprometer os resultados, devendo ser avaliado com estas ressalvas.
Flag 2 (F2): Análises marcadas com "X" na coluna Flag 2 indicam análise realizada com a amostra sendo recebida de forma inapropriada, tanto em conteúdo, frasco ou temperatura, tendo sido autorizada pelo interessado. Desta forma os resultados podem possuir desvios que podem comprometer os resultados, devendo ser avaliados com esta ressalva.

**Notas**
**"Mérieux NutriSciences" é nome fantasia, a razão social permanece Bioagri Ambiental Ltda.**
**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
**Data do Ensaio: Refere-se a data de início do ensaio.**
n.a. = Não Aplicável.
Incerteza = Incerteza expandida (U), que é baseada na incerteza padrão combinada, com um nível de confiança de 95% (k=2).

Resultados expressos na base seca (quando aplicável). Porcentagem de Sólidos 105°C e Cinzas 550°C.

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da Amostragem , são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de Amostragem de responsabilidade do interessado.

**Responsabilidade Técnica**
Os ensaios foram realizados na unidade da Bioagri Ambiental Ltda. - Matriz, situada na Rua Aljovil Martini, 177/201, Bairro Dois Córregos, Cep. 14420-833, Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto, CRQ n° 04364387, 4ª.Região.

**Referências Metodológicas**
2608 SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3550 C:2007
53 Porcentagem de Sólidos e Cinzas: SMWW, 22ª Edição, 2012 - Método 2540 G

Chave de Validação: 7498e7b012937bf5693af64101f7fba8

*Juliana Bombasaro*
*Controle de Qualidade*
*CRQ 04469985 – 4ª Região*

*Marcos Ceccattto*
*Diretor Técnico*
*CRQ 04364387– 4ª Região*



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# RESUMO DOS RESULTADOS DA AMOSTRA N° 44195/2020-0

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884637 | | |
| ***Identificação do Cliente:*** | Análise de Sedimentos - Ponto 2 | | |
| ***Amostra Rotulada como:*** | Sedimento Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da Amostragem :*** | 17/02/2020 11:00:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:11 | ***Data de Elaboração do RRA:*** | 06/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | Unidade | LQ/ Faixa | Resultados analíticos | Data de Ensaio | F1 | F2 |
|---|---|---|---|---|---|---|
| Porcentagem de Sólidos | % p/p | 0,05 | 74,2 | 21/02/2020 14:57 | --- | --- |
| 2,4-D | mg/kg | 0,0034 | < 0,0034 | 21/02/2020 14:58 | --- | --- |

Flag 1 (F1): Análises marcadas com "X" na coluna Flag 1 indicam análise realizada fora do holding time do parâmetro, podendo possuir desvios que podem comprometer os resultados, devendo ser avaliado com estas ressalvas.
Flag 2 (F2): Análises marcadas com "X" na coluna Flag 2 indicam análise realizada com a amostra sendo recebida de forma inapropriada, tanto em conteúdo, frasco ou temperatura, tendo sido autorizada pelo interessado. Desta forma os resultados podem possuir desvios que podem comprometer os resultados, devendo ser avaliados com esta ressalva.

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**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
**Data do Ensaio: Refere-se a data de início do ensaio**

Resultados expressos na base seca (quando aplicável). Porcentagem de Sólidos 105°C e Cinzas 550°C.

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da Amostragem , são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de Amostragem de responsabilidade do interessado.

**Dados de Origem**
Resumo dos resultados da amostra n° 44195/2020-0 preparado com os dados dos relatórios de ensaio: 44195/2020-0 - Piracicaba anexados a este documento.
**Declaração de Conformidade**

**Referências Metodológicas e Locais de Execução**
Bioagri Ambiental Ltda. - Matriz: Rua Aljovil Martini, 177/201, Bairro Dois Córregos - Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto.
SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3550 C:2007
Porcentagem de Sólidos e Cinzas: SMWW, 22ª Edição, 2012 - Método 2540 G

Chave de Validação: ba364e97bd6f71ff548d19da916b5384

Ana Paula Ribeiro
Controle de Qualidade
CRQ 04467817 – 4ª Região

Joseane Maria Bülow
Gerente Técnica
CRQ 09200516 – 9ª Região



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MERIEUX NutriSciences

Ensaios NBR ISO/IEC 17025 CRL 0172

# RELATÓRIO DE ENSAIO N° 44195/2020-0 - Piracicaba

**Processo Comercial N° 15745/2019-7**

| *DADOS REFERENTES AO CLIENTE* | |
|---|---|
| ***Empresa solicitante:*** | Poyry Tecnologia LTDA |
| ***Endereço:*** | Avenida Alfredo Egidio de Souza Aranha, 100 - 3,4,5,6,7 Andares Bloco B - Chacara Santo Antonio - São Paulo - SP - CEP: 04.726-170 |
| ***Nome do Solicitante:*** | Celso Tomio Tsutsumi |

| *DADOS REFERENTES A AMOSTRA* | | | |
|---|---|---|---|
| ***Identificação do item de ensaio:*** | 8884637 | | |
| ***Identificação do Cliente:*** | Análise de Sedimentos - Ponto 2 | | |
| ***Amostra Rotulada como:*** | Sedimento Projeto Paraguai | | |
| ***Coletor:*** | Interessado | | |
| ***Data da Amostragem :*** | 17/02/2020 11:00:00 | | |
| ***Data da entrada no laboratório:*** | 20/02/2020 22:11 | ***Data de Elaboração do RE:*** | 06/03/2020 |

## RESULTADOS PARA A AMOSTRA

| Parâmetros | CAS | Unidade | LQ/ Faixa | Resultados analíticos | Incerteza | Data Início do Ensaio | Corrida | Cód. Método | F1 | F2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Porcentagem de Sólidos | --- | % p/p | 0,05 | 74,2 | 7,4 | 21/02/2020 14:57 | --- | 53 | --- | --- |
| 2,4-D | 94-75-7 | mg/kg | 0,0034 | < 0,0034 | n.a. | 21/02/2020 14:58 | --- | 2608 | --- | --- |

Flag 1 (F1): Análises marcadas com "X" na coluna Flag 1 indicam análise realizada fora do holding time do parâmetro, podendo possuir desvios que podem comprometer os resultados, devendo ser avaliado com estas ressalvas.
Flag 2 (F2): Análises marcadas com "X" na coluna Flag 2 indicam análise realizada com a amostra sendo recebida de forma inapropriada, tanto em conteúdo, frasco ou temperatura, tendo sido autorizada pelo interessado. Desta forma os resultados podem possuir desvios que podem comprometer os resultados, devendo ser avaliados com esta ressalva.

**Notas**
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**Este Relatório de Ensaio só pode ser reproduzido por inteiro e sem nenhuma alteração.**
**LQ / Faixa = Limite de Quantificação ou Faixa de Trabalho, quando aplicável.**
**Data do Ensaio: Refere-se a data de início do ensaio.**
n.a. = Não Aplicável.
Incerteza = Incerteza expandida (U), que é baseada na incerteza padrão combinada, com um nível de confiança de 95% (k=2).

Resultados expressos na base seca (quando aplicável). Porcentagem de Sólidos 105°C e Cinzas 550°C.

Os resultados se aplicam somente a amostra conforme recebida.
Informações relevantes à validade do ensaio, como a data da Amostragem , são de responsabilidade do interessado.
**Plano de Amostragem**
Plano de Amostragem de responsabilidade do interessado.

**Responsabilidade Técnica**
Os ensaios foram realizados na unidade da Bioagri Ambiental Ltda. - Matriz, situada na Rua Aljovil Martini, 177/201, Bairro Dois Córregos, Cep. 14420-833, Piracicaba/SP, registrada no CRQ 4ª Região sob nº 16082-F e responsabilidade técnica do profissional Marcos Donizete Ceccatto, CRQ n° 04364387, 4ª.Região.

**Referências Metodológicas**
2608 SVOC: Determinação: EPA 8270 D:2014, POP PA 076 - Rev. 17 / Preparo: EPA 3550 C:2007
53 Porcentagem de Sólidos e Cinzas: SMWW, 22ª Edição, 2012 - Método 2540 G

Chave de Validação: ba364e97bd6f71ff548d19da916b5384

Ana Paula Ribeiro
Controle de Qualidade
CRQ 04467817 – 4ª Região

Joseane Maria Bülow
Gerente Técnica
CRQ 09200516 – 9ª Região



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# ANNEX II
# CERTIFICATES

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Instituto Nacional de Tecnología Industrial

INTI

INTI Química

INTERLABORATORIOS

INTI SAI

Programa de Ensayos de Aptitud

# "Análisis de elementos traza en solución acuosa 2016"

*Ensayo Nº 08 - Año 2016 (PRQ-02/2016)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L.***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***arsénico, cadmio, cromo y plomo*** *se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ariel Galli

Dra. Laura Hermida

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Instituto Nacional de Tecnología Industrial

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INTERLABORATORIOS

INTI SAI

# Programa de Ensayos de Aptitud

# "Aguas 2012" (PRQ-01/2012)

*Por cuanto el laboratorio* ***Inyma Consult S.R.L. – Aguas y Efluentes***

*ha participado en el ensayo interlaboratorio, reportando datos de medición satisfactorios para los analitos:* ***cloruro, nitrato, sulfato, calcio, cinc, hierro y potasio,***

*se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ana Hernández

Lic. Liliana Valiente

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Instituto Nacional de Tecnología Industrial

INTI

INTI Química

INTERLABORATORIOS

INTI SAI

Programa de Ensayos de Aptitud

# "Aguas 2016"

*Ensayo Nº 12 - Año 2016 (PRQ-01/2016)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L.***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***cloruro, fluoruro,nitrato, sulfato, calcio, magnesio, cinc, hierro y potasio***
*se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ariel Galli

Dra. Laura Hermida

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Instituto Nacional de Tecnología Industrial
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Ministerio de Producción
Presidencia de la Nación

INTI Química
INTERLABORATORIOS

INTI SAI

# Programa de Ensayos de Aptitud

## "*Aguas – Parámetros Básicos*"

*Ensayo Nº 8 – Año 2017 (PRQ-03/2017)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L.***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***dureza, alcalinidad, pH, cloruro, nitrato, sulfato, calcio, potasio, sodio, sólidos totales***
*se extiende el presente certificado que así lo acredita.*

*Lic. Pablo Álvarez*

*Lic. Ariel Galli*

*Ing. Sofía Frangie*

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# "Aguas – Parámetros Básicos"

*Ensayo Nº 6 – Año 2013 (PRQ-03/2013)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L. – Laboratorio de Ensayos de Aguas y Efluentes***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***cloruro, nitrato, sulfato, potasio, sodio, alcalinidad total, dureza total, sólidos totales, pH y conductividad,***

*se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ana Hernández

Lic. Liliana Valiente

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# "Aguas 2014" (PRQ-01/2014)

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L. – Laboratorio de Aguas y Efluentes***

*ha participado en el ensayo interlaboratorio, reportando datos de medición satisfactorios para los analitos:* ***cloruro, fluoruro, nitrato, sulfato, calcio, cinc, hierro, magnesio y potasio,***

*se extiende el presente certificado que así lo acredita.*

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## "Aguas – Parámetros Básicos"

*Ensayo N° 7 – Año 2015 (PRQ-05/2015)*

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L. – Laboratorio de Ensayos de Aguas y Efluentes***

*ha participado en este ensayo de aptitud reportando datos de medición satisfactorios para los parámetros:* ***cloruro, nitrato, sulfato, magnesio, alcalinidad total, dureza total, sólidos totales, pH y conductividad,***

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# *"Análisis de Elementos Traza en Solución Acuosa 2014"*

(PRQ-02/2014)

*Por cuanto el laboratorio* ***INYMA CONSULT S.R.L. – Laboratorio Aguas y Efluentes***

*ha participado en el ensayo interlaboratorio, reportando datos de medición satisfactorios para los analitos:* ***arsénico, cadmio, cromo y plomo,***

*se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ana Hernández

Lic. Liliana Valiente

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**ORGANISMO ACREDITADO POR EL ONA**
**FICHA DE CLIENTE**

| | |
|---|---|
| **NOMBRE** | **ANALITICA S.A** |
| **TIPO DE ORGANISMO** | Laboratorio de Ensayos |
| **DIRECCIÓN** | Pedro Gill Nº 935 casi Ytororo |
| **CIUDAD** | Lambaré |
| **TELEFONO** | 595-021 908-555 |
| **FAX** | 595-021 908-555 |
| **PERSONA DE CONTACTO** | Ing. Sumijiro Takaoka, Director General / Lic. Mercedes Coronel, Responsable del Sistema de Calidad |
| **E-MAIL** | calidad@analitica.com.py |

**ALCANCE DE LA ACREDITACIÓN CONCEDIDA AL LABORATORIO ANALITICA S.A, COMO LABORATORIO DE ENSAYO, DE ACUERDO A LA NORMA NP-ISO/IEC 17025:2006, EQUIVALENTE A LA NORMA ISO/IEC 17025:2005 "REQUISITOS GENERALES PARA LA COMPETENCIA DE LOS LABORATORIOS DE ENSAYO Y CALIBRACION" Y DE LOS REQUISITOS ESTABLECIDOS EN LOS REGLAMENTOS, CRITERIOS Y POLITICAS DEL ONA APLICABLES A LOS LABORATORIOS DE ENSAYOS EN SU VERSION VIGENTE.**

***ALCANCES N°04 y 06 SUSPENDIDOS TEMPORALMENTE A P ETICION DEL CLIENTE.**

| Nº | Ensayos | Sustrato/Matriz | Normas, Procedimientos Internos o especificaciones | Instalaciones | Fecha de Acreditación | Fecha de Vencimiento |
|---|---|---|---|---|---|---|
| 1 | **Determinación de Aflatoxinas en Oleaginosas**<br><br>**Analitos:**<br>Aflatoxinas B1 LQ: 1,00 µg/kg<br>Aflatoxinas B2 LQ: 1,00 µg/kg<br>Aflatoxinas G1 LQ: 1,00 µg/kg | Semillas Oleaginosas | **AN-MA-003 Versión 04**<br>(Extracción columna Inmunoafinidad- Detección Derivatización Post Columna / Fluorescencia) | Permanente | 2017/05/08 | 2020/05/08 |

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| | Aflatoxinas G2 LQ: 1,00 µg/kg | | | | | |
| 2 | **Determinación de Multiresíduos de Pesticidas por GC/MS en Granos de Soja.**<br><br>**Analitos**:<br>Alfa Endosulfan LQ: 0,0301 mg/kg<br>Beta Endosulfan LQ: 0,0312 mg/kg<br>Endosulfan Sulfato LQ: 0,0299 mg/kg<br>Alfa hexaclorociclohexano<br>LQ: 0,0125 mg/kg<br>Gamma hexaclorociclohexano (Lindano)<br>LQ: 0,0102 mg/kg<br>4,4' DDE LQ: 0,0052 mg/kg<br>2,4 DDD LQ: 0,0050 mg/kg<br>4,4 DDD LQ: 0,0010 mg/kg<br>2,4 DDT LQ: 0,0047 mg/kg<br>4,4 DDT LQ: 0,0116 mg/kg<br>Metamidofos LQ: 0,0425 mg/kg<br>Carbaril LQ: 0,0050 mg/kg<br>Pimiricarb LQ: 0,0053 mg/kg<br>Clorpirifos metil LQ: 0,0057 mg/kg<br>Metalaxil LQ: 0,0051 mg/kg<br>Pirimifos Metil LQ: 0,0063 mg/kg<br>Clorpirifos LQ: 0,0056 mg/kg<br>Fipronil LQ: 0,0021 mg/kg<br>Fludioxonil LQ: 0,0050 mg/kg<br>Tebuconazol LQ: 0,0051 mg/kg<br>Bifentrin LQ: 0,0050 mg/kg<br>Lambda Cialotrina LQ: 0,0098 mg/kg<br>Permetrina LQ: 0,0054 mg/kg<br>Cipermetrina LQ: 0,0219 mg/kg | Semillas de Soja | **AN-MA-004 Versión 04**<br>(Extracción sólido /Liquido - Cromatografía Gaseosa/ Espectrofotometría de masas) | Permanente | 2017/05/08 | 2020/05/08 |
| 3 | **Determinación de Multiresíduos de Pesticidas en Agua por SPME-GC/MS.**<br><br>**Analitos:**<br>Alfa Hexaclorociclohexano (Alfa HCH)<br>LQ: 0,010 µg/L<br>Beta Hexaclorociclohexano (Beta HCH) | **Agua**<br>(Agua Potable; Agua subterránea; Agua de lagos; Agua de océanos, costas, estuarios y playas; Agua de ríos y | **AN-MA-006 Versión 04**<br>( Micro Extracción Sólido/Capillar- Liquido- Cromatografía Gaseosa/ Espectrofotometría de masas) | Permanente | 2017/05/08 | 2020/05/08 |

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| | LQ: 0,024 µg/L<br>Gamma Hexaclorociclohexano (Lindano)<br>LQ: 0,011 µg/L<br>Hexaclorobenceno (HCB) LQ: 0,006 µg/L<br>Heptacloro LQ: 0,018 µg/L<br>Heptacloro Epóxido A LQ: 0,035 µg/L<br>Heptacloro Epóxido B LQ: 0,005 µg/L<br>Alfa Clordano LQ: 0,026 µg/L<br>Gamma Clordano LQ: 0,040 µg/L<br>Aldrin LQ: 0,012 µg/L<br>Dieldrin LQ: 0,014 µg/L<br>Endrin LQ: 0,029µg/L<br>4,4 DDT LQ: 0,024 µg/L<br>2,4 DDT LQ: 0,016 µg/L<br>4,4 DDD LQ: 0,006 µg/L<br>2,4 DDD LQ: 0,010 µg/L<br>4,4 DDE LQ: 0,002 µg/L<br>2,4 DDE LQ: 0,002 µg/L<br>Alfa Endosulfan LQ:0,62 µg/L<br>Beta Endosulfan LQ:0,117 µg/L<br>Endosulfan Sulfato LQ:0,046 µg/L<br>Atrazina LQ:0,027 µg/L<br>Simazina LQ:0,090 µg/L<br>Permetrina LQ:0,218 µg/L<br>Cipermetrina LQ:0,466 µg/L<br>Lambda Cialotrina LQ:0,348 µg/L<br>Bifentrin LQ:0,0376 µg/L<br>Clorpirifos LQ:0,018 µg/L<br>Clorpirifos Metil LQ:0,002 µg/L<br>Pirimifos Metil LQ:0,004 µg/L<br>Pirimicarb LQ:0,057 µg/L<br>Carboxin LQ:0,057 µg/L<br>Pentaclorofenol LQ: 4,096 µg/L<br>Propanil LQ: 0,440 µg/L<br>Alacloro LQ: 0,047 µg/L<br>Metolacloro LQ: 0,095 µg/L<br>Metoxicloro LQ: 0,018 µg/L<br>Pesticidas volátiles:<br>1,2 Dicloropropano LQ: 0,243 µg/L<br>1,3 Dicloropropano LQ: 0,489 µg/L | arroyos; Aguas pluviales; Aguas residuales; Agua de cuencas; Agua de humedales) Clasificación según la Agencia de Protección al Medioambiente de Estados Unidos (EPA) | | | | |

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| | 1,3 Dicloropropeno LQ: 0,190 µg/L<br>1,2 Dibromo-3-clorporopano LQ: 0,190 µg/L | | | | | |
| *4 | ***Determinación de Residuos de Zearalenona por HPLC en Soja y Maíz**<br><br>**Analito:**<br>Zearalenona LQ: 30,0 µg/kg | *Soja y Maíz | ***AN-MA-012 Versión 03**<br>(Extracción con columna de inmunoafinidad-Cromatografía Líquida de Alta Eficacia/Detector UV) | Permanente | 2017/05/08 | 2020/05/08 |
| 5 | **Determinación de Multiresíduos de Pesticidas por GC-MS en Semillas Oleaginosas**<br><br>**Analitos:**<br>Etridazole LQ: 0,0150 mg/kg<br>Alfa HCH LQ: 0,0100 mg/kg<br>HCB LQ: 0,0100 mg/kg<br>Beta HCH LQ: 0,0100 mg/kg<br>Gamma HCH LQ: 0,0100 mg/kg<br>Clorotalonil LQ: 0,0050 mg/kg<br>Propanil LQ: 0,0200 mg/kg<br>Heptacloro LQ: 0,0100 mg/kg<br>Aldrin LQ: 0,0200 mg/kg<br>Heptacloro Epoxido B LQ: 0,0100mg/kg<br>Heptocloro Epoxido A LQ: 0,0100 mg/kg<br>2,4 DDE LQ: 0,0100 mg/kg<br>Alfa Endosulfan LQ: 0,0500 mg/kg<br>4,4 DDE LQ: 0,0100 mg/kg<br>Dieldrin LQ: 0,0200 mg/kg<br>2,4 DDD LQ: 0,0100 mg/kg<br>Endrin LQ: 0,0100 mg/kg<br>Beta Endosulfan LQ: 0,1000 mg/kg<br>4,4 DDD LQ: 0,0100 mg/kg<br>2,4 DDT LQ: 0,0100 mg/kg<br>4,4 DDT LQ: 0,0200 mg/kg<br>Endosulfan Sulfato LQ: 0,0500 mg/kg<br>Metoxicloro LQ: 0,0500 mg/kg | Semillas Oleaginosas | **AN-MA-014 Versión 03**<br>(Extracción Solido/Liquido-Cromatografía Gaseosa/ Espectrofotometría de masas) | Permanente | 2017/05/08 | 2020/05/08 |
| *6 | ***Determinación de Residuos de Ditiocarbamatos en Semillas Oleaginosas.** | *Semillas Oleaginosas | ***AN-MA-015 Versión 02**<br>( Extracción Solido/Liquido-Cromatografía Gaseosa/ Espectrofotometría de masas) | Permanente | 2017/05/08 | 2020/05/08 |

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| | **Analitos**:<br>Ditiocarbamatos expresados como Disulfuro de carbono, incluyendo Maneb, Mancozeb, Metiram, Propineb, Tiram y Ziram<br>Ditiocarbamatos - Disulfuro de carbono<br>LQ: 0,0250 mg/kg | | | | | |
| 7 | Determinación de Multiresiduos de Pesticidas por LC-MSMS en semillas oleaginosas y cereales<br><br>**Analitos**<br>(Monceren) Pencycuron LQ = 0,010 00 mg/kg<br>3-Hydroxycarbofuran LQ = 0,010 00 mg/kg<br>Acephate LQ = 0,010 00 mg/kg<br>Acetamiprid LQ = 0,010 00 mg/kg<br>Acibenzolar-S-methyl LQ = 0,010 00 mg/kg<br>Aldicarb LQ = 0,010 00 mg/kg<br>Aldicarb sulfone LQ= 0,01000 mg/kg<br>Aldicarb sulfoxide LQ = 0,010 00 m/kg<br>Ametryn LQ = 0,010 00 mg/kg<br>Aminocarb LQ = 0,010 00 mg/kg<br>Amitraz LQ = 0,010 00 m/kg<br>Azoxystrobin LQ = 0,010 00 mg/kg<br>Benalaxyl LQ = 0,010 00 mg/kg<br>Bendiocarb LQ = 0,010 00 mg/kg<br>Benzoximate LQ = 0,010 00 mg/kg<br>Bifenazate LQ = 0,010 00 mg/kg<br>Bitertanol LQ = 0,010 00 mg/kg<br>Boscalid LQ = 0,010 00 mg/kg<br>Bromucanozole Isomer LQ = 0,010 00 mg/kg<br>Bromucanozole Isomer LQ = 0,010 00 mg/kg<br>Bupirimate LQ = 0,010 00 mg/kg<br>Buprofezin LQ = 0,010 00 mg/kg<br>Butoxycarboxim LQ = 0,010 00 mg/kg<br>Carbaryl LQ = 0,010 00 mg/kg<br>Carbendazim LQ = 0,010 00 mg/kg<br>Carbetamide LQ = 0,010 00 mg/kg<br>Carbofuran LQ = 0,010 00 mg/kg<br>Carboxin LQ = 0,010 00 mg/kg | Semillas Oleaginosas y Cereales | **AN-MA-017 Ver. 05**<br>(Extracción Solido/ Liquido - Cromatografía Líquida de Alta Eficacia/Espectrofotometría de masas en tándem) | Permanente | 2017/05/08 | 2020/05/08 |

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| | Carfentrazone-ethyl LQ = 0,010 00 mg/kg<br>Chlorantraniliprole LQ = 0,010 00 mg/kg<br>Chlorfluazuron LQ = 0,010 00 mg/kg<br>Chlorotoluron LQ = 0,010 00 mg/kg<br>Clethodim Isomer 1 LQ = 0,010 00 mg/kg<br>Clethodim Isomer 2 LQ = 0,010 00 mg/kg<br>Clofentezine LQ = 0,010 00 mg/kg<br>Cloroxuron LQ = 0,010 00 mg/kg<br>Clorpirifos LQ = 0,010 00 mg/kg<br>Cyazofamid LQ = 0,010 00 mg/kg<br>Cycluron LQ = 0,010 00 mg/kg<br>Cymoxanil LQ = 0,010 00 mg/kg<br>Cyproconazole Isomer 1 LQ = 0,010 00 mg/kg<br>Cyproconazole Isomer 2 LQ = 0,010 00 mg/kg<br>Cyprodinil LQ = 0,010 00 mg/kg<br>Cyromazine LQ = 0,010 00 mg/kg<br>Desmedipham LQ = 0,010 00 mg/kg<br>Diazinon LQ = 0,010 00 mg/kg<br>Diclobutrazol LQ = 0,010 00 mg/kg<br>Dicrotophos LQ = 0,010 00 mg/kg<br>Diethofencarb LQ = 0,010 00 mg/kg<br>Difenoconazole Isomer 1<br>LQ = 0,010 00 mg/kg<br>Difenoconazole Isomer 2<br>LQ = 0,01000 mg/kg<br>Diflubenzuron LQ = 0,01000 mg/kg<br>Dimethoate LQ = 0,010 00 mg/kg<br>Dimethomorph Isomer 1 LQ = 0,010 00 mg/kg<br>Dimethomorph Isomer 2 LQ = 0,010 00 mg/kg<br>Dimoxyatrobin LQ = 0,010 00 mg/kg<br>Diniconazole LQ = 0,010 00 mg/kg<br>Dinotefuran LQ = 0,010 00 mg/kg<br>Dioxacarb LQ = 0,010 00 mg/kg<br>Diuron LQ = 0,010 00 mg/kg<br>Emamectin-benzoate b1a LQ = 0,010 00 mg/kg<br>Epoxiconazole LQ = 0,010 00 mg/kg<br>Etaconazole Isomer 1 LQ = 0,010 00 mg/kg<br>Ethiofencarb LQ = 0,010 00 mg/kg | | | | | |

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| | Ethiprole LQ = 0,010 00 mg/kg<br>Ethofumesate LQ = 0,010 00 mg/kg<br>Famoxadone LQ = 0,010 00 mg/kg<br>Fenamidone LQ = 0,010 00 mg/kg<br>Fenarimol LQ = 0,010 00 mg/kg<br>Fenazaquin LQ = 0,010 00 mg/kg<br>Fenbuconazole LQ = 0,010 00 mg/kg<br>Fenhexamid LQ = 0,010 00 mg/kg<br>Fenobucarb LQ = 0,010 00 mg/kg<br>Fenoxycarb LQ = 0,010 00 mg/kg<br>Fenpropimorph LQ = 0,010 00 mg/kg<br>Fenpyroximate LQ = 0,010 00 mg/kg<br>Flonicamid LQ = 0,010 00 mg/kg<br>Flufenacet LQ = 0,010 00 mg/kg<br>Flufenoxuron LQ = 0,010 00 mg/kg<br>Fluometuron LQ = 0,010 00 mg/kg<br>Fluoxastrobin LQ = 0,010 00 mg/kg<br>Fluquinconazole LQ = 0,010 00 mg/kg<br>Flusilazole LQ = 0,010 00 mg/kg<br>Flutolanil LQ = 0,010 00 mg/kg<br>Flutriafol LQ = 0,010 00 mg/kg<br>Forchlorfenuron LQ = 0,010 00 mg/kg<br>Formetanate LQ = 0,010 00 mg/kg<br>Fuberidazole LQ = 0,010 00 mg/kg<br>Furalaxyl LQ = 0,010 00 mg/kg<br>Furathiocarb LQ = 0,010 00 mg/kg<br>Hexaconazole LQ = 0,010 00 mg/kg<br>Hexythiazox LQ = 0,010 00 mg/kg<br>Hydramethylnon LQ = 0,010 00 mg/kg<br>Imazalil LQ = 0,010 00 mg/kg<br>Imidacloprid LQ = 0,010 00 mg/kg<br>Ipconazole Isomer 1 LQ = 0,010 00 mg/kg<br>Ipconazole Isomer 2 LQ = 0,010 00 mg/kg<br>Iprovalicarb Isomer 1 LQ = 0,010 00 mg/kg<br>Iprovalicarb Isomer 2 LQ = 0,010 00 mg/kg<br>Isoprocarb LQ = 0,010 00 mg/kg<br>Isoproturon LQ = 0,010 00 mg/kg<br>Kresoxim-methyl LQ = 0,010 00 mg/kg<br>Linuron LQ = 0,010 00 mg/kg<br>Lufenuron LQ = 0,010 00 mg/kg | | | | | |

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| | Mandipropamid LQ = 0,010 00 mg/kg<br>Mefenacet LQ = 0,010 00 mg/kg<br>Mepanipyrim LQ = 0,010 00 mg/kg<br>Mepromil LQ = 0,010 00 mg/kg<br>Mesotrione LQ = 0,010 00 mg/kg<br>Metaflumizone LQ = 0,010 00 mg/kg<br>Metalaxyl LQ = 0,010 00 mg/kg<br>Metconazole LQ = 0,010 00 mg/kg<br>Methabenzthiazuron LQ = 0,010 00 mg/kg<br>Methamidophos LQ = 0,010 00 mg/kg<br>Methiocarb LQ = 0,01000 mg/kg<br>Methomyl LQ = 0,010 00 mg/kg<br>Methoprotryne LQ = 0,010 00 mg/kg<br>Methoxyfenozide LQ = 0,010 00 mg/kg<br>Metobromuron LQ = 0,010 00 mg/kg<br>Metribuzin LQ = 0,010 00 mg/kg<br>Meviphos Isomer 1 LQ = 0,010 00 mg/kg<br>Meviphos Isomer2 LQ = 0,010 00 mg/kg<br>Mexacarbate LQ = 0,010 00 mg/kg<br>MonocrotophosLQ = 0,010 00 mg/kg<br>Monolinuron LQ = 0,010 00 mg/kg<br>Myclobutanil LQ = 0,010 00 mg/kg<br>Neburon LQ = 0,010 00 mg/kg<br>Nitenpyram LQ = 0,010 00 mg/kg<br>Novaluron LQ = 0,010 00 mg/kg<br>Nuarimol LQ = 0,010 00 mg/kg<br>Omethoate LQ = 0,010 00 mg/kg<br>Oxadixyl LQ = 0,010 00 mg/kg<br>Oxamyl LQ = 0,010 00 mg/kg<br>Paclobutrazol LQ = 0,010 00 mg/kg<br>Penconazole LQ = 0,010 00 mg/kg<br>Phenmedipham LQ = 0,010 00 mg/kg<br>Picoxystrobin LQ = 0,010 00 mg/kg<br>Piperonyl butoxide LQ = 0,010 00 mg/kg<br>Pirimicarb LQ = 0,010 00 mg/kg<br>Prochloraz LQ = 0,010 00 mg/kg<br>Promecarb LQ = 0,010 00 mg/kg<br>Prometon LQ = 0,010 00 mg/kg<br>Prometryne LQ = 0,010 00 mg/kg<br>Propagite LQ = 0,010 00 mg/kg | | | | | |

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| | Propamocarb LQ = 0,010 00 mg/kg<br>Propiconazole Isomer 1 LQ = 0,010 00 mg/kg<br>Propiconazole Isomer 2 LQ = 0,010 00 mg/kg<br>Propuxur LQ = 0,010 00 mg/kg<br>Prothioconazole LQ = 0,010 00 mg/kg<br>Pymetrozine LQ = 0,010 00 mg/kg<br>Pyracarbolid LQ = 0,010 00 mg/kg<br>Pyraclostrobin LQ = 0,010 00 mg/kg<br>Pyridaben LQ = 0,010 00 mg/kg<br>Pyrimethanil LQ = 0,010 00 mg/kg<br>Pyriproxyfen LQ = 0,010 00 mg/kg<br>Quinalophos LQ = 0,010 00 mg/kg<br>Quinixyfen LQ = 0,010 00 mg/kg<br>Rotenone LQ = 0,010 00 mg/kg<br>Secbumeton LQ = 0,010 00 mg/kg<br>Siduron LQ= 0,010 00 mg/kg<br>Simetryn LQ = 0,010 00 mg/kg<br>Spinetoram LQ = 0,010 00 mg/kg<br>Spinosad (Spinosyn A) LQ = 0,010 00 mg/kg<br>Spinosad (Spinosyn D) LQ = 0,010 00 mg/kg<br>Spirodichlofen LQ = 0,010 00 mg/kg<br>Spirotetramat LQ = 0,010 00 mg/kg<br>Spiroxamine Isomer 1 LQ = 0,010 00 mg/kg<br>Spiroxamine Isomer 2 LQ = 0,010 00 mg/kg<br>Tebuconazole LQ = 0,010 00 mg/kg<br>Tebufenpyrad LQ = 0,010 00 mg/kg<br>Tebuthiuron LQ = 0,010 00 mg/kg<br>Teflubenzuron LQ = 0,010 00 mg/kg<br>Temephos LQ = 0,010 00 mg/kg<br>Terbumeton LQ = 0,010 00 mg/kg<br>Terbutryn LQ = 0,010 00 mg/kg<br>Tetraconazole LQ = 0,010 00 mg/kg<br>Thiabendazole LQ = 0,010 00 mg/kg<br>Thiacloprid LQ = 0,010 00 mg/kg<br>Thiametoxam LQ = 0,010 00 mg/kg<br>Thidiazuron LQ = 0,010 00 mg/kg<br>Thiobencarb LQ = 0,010 00 mg/kg<br>Thiofanox LQ = 0,010 00 mg/kg<br>Thiophanate-methyl LQ = 0,010 00 mg/kg<br>Triadimefon LQ = 0,010 00 mg/kg | | | | | |

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|---|---|---|---|---|---|---|
| | Triadimenol LQ = 0,010 00 mg/kg<br>Tricyclazole LQ = 0,010 00 mg/kg<br>Trifloxystrobin LQ = 0,010 00 mg/kg<br>Triflumizole LQ = 0,010 00 mg/kg<br>Triflumuron LQ = 0,010 00 mg/kg<br>Triticonazole LQ = 0,010 00 mg/kg<br>Vamidothion LQ = 0,010 00 mg/kg<br>Zoxamide LQ = 0,010 00 mg/kg<br>Fipronil LQ = 0,010 00 mg/kg<br>Fluazinam LQ = 0,010 00 mg/kg<br>Fludioxonil LQ = 0,010 00 mg/kg | | | | | |
| 8 | **Determinación de Multiresíduos de Pesticidas Polares por LC-MSMS en Semillas Oleaginosas.**<br><br>**Analitos:**<br>2,4 D, 2,4,5 T, Diclorprop, MCPA, MCPB, Mecoprop.<br>2,4 D LQ: 0,0250 mg/kg<br>2,4,5 T LQ: 0,0250 mg/kg<br>Diclorprop LQ: 0,0250 mg/kg<br>MCPA LQ: 0,0250 mg/kg<br>MCPB LQ: 0,0500 mg/kg<br>Mecoprop LQ: 0,0250 mg/kg | Semillas Oleaginosas | **AN-MA-018 Versión 03**<br>(Extracción Solido/Liquido - Cromatografía Líquida de Alta Eficacia/Espectrofotometría de masas en tándem) | Permanente | 2017/05/08 | 2020/05/08 |
| 9 | **Determinación de Residuos de Glifosato en semillas oleaginosas por LC-MS/MS**<br><br>LQ: 0,281 mg/kg | Semillas de Oleaginosas | **AN-MA-022 Ver.:02**<br>(Extracción Solido/Liquido-Cromatografía Líquida de Alta Eficacia/Espectrofotometría de masas en tándem) | Permanente | 2017/05/08 | 2020/05/08 |
| 10 | **Determinación de residuos de Bifenilos Policlorados (PCB) por GC-ECD en aceite de transformador**<br><br>**Analitos**<br>Aroclor 1242 LQ: 0,500 mg/L<br>Aroclor 1248 LQ: 0,500 mg/L<br>Aroclor 1254 LQ: 0,500 mg/L | Aceite de Transformador | **AN-MA-002 Ver.: 01**<br>(Norma de Referencia: ASTM: D 4059-00.2010-Cromatografía Gaseosa/Detector de Captura de Electrones) | Permanente | 2017/05/08 | 2020/05/08 |

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| 11 | **Determinación de residuos de herbicidas de amonio cuaternario por LC/MSMS en semillas oleaginosas y cereales**<br><br>**Analitos**<br>Paraquat LQ: 0,00050 mg/kg<br>Diquat LQ: 0,00050 mg/kg<br>Mepiquat LQ: 0,00050 mg/kg | Semillas Oleaginosas y cereales | **AN-MA-020 Ver.: 04**<br>(Extracción Solido/Liquido - Cromatografía Líquida de Alta Eficacia/Espectrofotometría de masas en tándem) | Permanente | 2017/05/08 | 2020/05/08 |
| Responsable Técnico del Laboratorio: Bioq. Allison Alegre | | | | | | |

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**ORGANISMO ACREDITADO POR EL ONA**
**FICHA DE CLIENTE**

| | |
|---|---|
| **NOMBRE** | **Grupo Multilab S.A.** |
| **TIPO DE ORGANISMO** | Laboratorio de Ensayos |
| **DIRECCIÓN** | Mariscal Estigarribia Nº 1349 e/ Pa'i Perez y Curupayty |
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| **TELEFONO** | 230 560 / 3 |
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| **PERSONA DE CONTACTO** | Dra. Arlene Schuller, Gerente de Calidad |
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**ALCANCE DE LA ACREDITACIÓN CONCEDIDA AL LABORATORIO DEL GRUPO MULTILAB S.A., COMO LABORATORIO DE ENSAYO, DE ACUERDO A LA NORMA NP-ISO/IEC 17025:2018, EQUIVALENTE A LA NORMA ISO/IEC 17025:2017 "REQUISITOS GENERALES PARA LA COMPETENCIA DE LOS LABORATORIOS DE ENSAYO Y CALIBRACION" Y DE LOS REQUISITOS ESTABLECIDOS EN LOS REGLAMENTOS, CRITERIOS Y POLITICAS DEL ONA APLICABLES A LOS LABORATORIOS DE ENSAYOS EN SU VERSION VIGENTE.**

| **Nº** | **DESCRIPCIÓN DE ENSAYO** (especificar Limite de Cuantificación y/o intervalo de trabajo) | **SUSTRATO/MATRIZ** (Material/ Producto) | **COMPONENTE/ PARÁMETRO O CARACTERÍSTICA PROBADA** (Analito) | **NORMAS/ PROCEDIMIENTOS/ ESPECIFICACIONES** (año/edición/revisión/ versión) | **TIPO DE INSTALACIONES EN QUE SE DESARROLLAN LOS ENSAYOS** (permanentes, fuera de sus instalaciones permanentes y en instalaciones temporales o móviles asociadas, o en las instalaciones del cliente) | **Fecha de Acreditación** | **Fecha de Vencimiento** |
|---|---|---|---|---|---|---|---|
| 1 | Determinación de metales pesados (cadmio y plomo) por ICP/MS | Riñón bovino y porcino | - Cadmio*<br>- Plomo*<br><br>*LQ: 250 µg/kg | ECO-PT-024<br>Versión 2<br>(Digestión ácida asistida por microondas en vaso | Permanente | 2020-02-24 | 2023-02-24 |



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| | | | | cerrado y detección por ICP/MS). | | | |
| 2 | Determinación de Cadmio, Mercurio y Plomo por ICP/MS | Pilas primarias, Pilas primarias tipo botón y Baterías | - Cadmio *<br>- Mercurio *<br>- Plomo *<br>*LQ: 0,030 mg/L = 0,001 % (p/p) | ECO-PT-044<br>Versión 5<br>(Digestión ácida y detección por ICP/MS) | Permanente | 2020-02-24 | 2023-02-24 |
| 3 | Determinación de Quinolonas por HPLC/FLD | Músculo bovino y porcino | - Ciprofloxacina*<br>- Norfloxacina *<br>- Enrofloxacina*<br>*LQ: 10 µg/kg | ECO-PT-034<br>Versión 4<br>(Hidrólisis ácida, extracción sólido-líquido, extracción en fase sólida SPE y detección por HPLC/FLD) | Permanente | 2020-02-24 | 2023-02-24 |
| 4 | Determinación de β-Agonistas por LC/MS/MS | Orina bovina | - Salbutamol *<br>- Clembuterol *<br>- Brombuterol *<br>- Mapenterol *<br>- Ractopamina *<br>- Zilpaterol *<br>* LQ:0,0005 mg/kg | ECO-PT-020<br>Versión 3<br>(Hidrólisis ácida, extracción líquido-líquido, extracción en fase sólida SPE y detección por LC/MS/MS) | Permanente | 2020-02-24 | 2023-02-24 |
| 5 | Determinación de Avermectinas por HPLC/FLD | Hígado bovino | - Doramectina<br>(LQ: 50 µg/kg)<br>- Ivermectina<br>(LQ: 50 µg/kg)<br>- Abamectina<br>(LQ: 10 µg/kg) | ECO-PT-040<br>Versión 3<br>(Extracción sólido-líquido, extracción en fase sólida SPE, derivatización y detección por HPLC/FLD) | Permanente | 2020-02-24 | 2023-02-24 |
| 6 | Determinación de | Grasa bovina y | α – HCH (Alfa | ECO-PT-057 | Permanente | 2020-02-24 | 2023-02-24 |



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|---|---|---|---|---|---|---|---|
| | Piretroides y Organoclorados por GC-µECD | porcina | Hexaclorociclohexano)*<br>- β – HCH (Beta Hexaclorociclohexano)*<br>- δ – HCH (Delta Hexaclorociclohexano)*<br>- γ – HCH (Lindano) (Gamma Hexaclorociclohexano)*<br>- Dieldrín*<br>- 4,4´-DDT*<br>- 4,4´-DDE*<br>- Alfa-Endosulfan*<br>- Beta-Endosulfan*<br>- HCB (Hexaclorobenceno)*<br>* LQ: 75 µg/kg<br>- Permetrina<br>LQ: 100 µg/kg<br>- Deltametrina<br>LQ: 25 µg/kg<br>- Cipermetrina<br>LQ: 50 µg/kg<br>- α-Cipermetrina (Alfa-Cipermetrina)<br>LQ: 50 µg/kg | Versión 4<br>(Limpieza con hexano, extracción en fase sólida SPE y detección por GC-µECD). | | | |
| 7 | Determinación de Esteroides por | Orina bovina | - 17β-Trembolona *<br>- 17β-Boldenona * | ECO-PT-052<br>Versión 6 | Permanente | 2020-02-24 | 2023-02-24 |



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| | LC/MS/MS | | - Metiltestosterona *<br><br>* LQ: 0,5 µg/kg | (Hidrólisis enzimática, extracción líquido-líquido y detección por LC/MS/MS) | | | |
| 8 | Determinación de Estilbenos, Zeranol y derivados y Esteroides por GC/MS | Orina bovina | - Dietilestilbestrol (trans-DES) *<br>- Dienestrol *<br>- Hexestrol *<br>- 17β-estradiol *<br>- Zeranol (Alfa Zearalanol) *<br>- Taleranol (Beta Zearalanol) *<br>- Alfa Zearalenol *<br>- Beta Zearalenol *<br>* LQ: 1 µg/kg<br><br>- 17β-19-Nortestosterona<br>LQ: 0,5 µg/kg | ECO-PT-042<br>Versión 5<br>(Hidrólisis enzimática, extracción líquido-líquido, extracción en fase sólida SPE y detección por GC/MS) | Permanente | 2020-02-24 | 2023-02-24 |
| 9 | Determinación de PCB´s por GC/MS | Grasa bovina | - PCB 28 *<br>- PCB 52 *<br>- PCB 101 *<br>- PCB 118 *<br>- PCB 138 *<br>- PCB 153 *<br>- PCB 180 *<br><br>* LQ: 15 µg/kg | ECO-PT-060<br>Versión 3<br>(Limpieza con hexano, extracción con clean up dispersivo y detección por GC-MS) | Permanente | 2020-02-24 | 2023-02-24 |
| 10 | Determinación de β-Agonistas por | Hígado Bovino | - Clembuterol*<br>- Salbutamol* | ECO-PT-059 | Permanente | 2020-02-24 | 2023-02-24 |



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| | LC/MS/MS | | - Brombuterol*<br>- Mapenterol*<br>- Ractopamina*<br>- Zilpaterol*<br><br>*LQ= 0,5 µg/kg | Versión 4<br>Hidrólisis ácida, extracción en fase sólida SPE y detección por LC/MS/MS | | | |
| 11 | Determinación de Aflatoxina M1 por LC/MS/MS | Leche entera bovina<br>Leche cruda bovina<br>Leche materna humana | Aflatoxina M1<br>LQ= 0,010 µg/L | ECO-PT-077<br>Versión 3<br>Extracción en fase sólida SPE y detección por LC/MS/MS | Permanente | 2020-02-24 | 2023-02-24 |
| 12 | Determinación de Coccidiostáticos por LC/MS/MS | Músculo Bovino | - Monensina<br>LQ= 0,5 µg/kg<br>- Salinomicina<br>LQ= 5 µg/kg<br>- Lasalocid<br>LQ= 5 µg/kg | ECO-PT-065<br>Versión 3<br>Extracción con solvente orgánico acidificado, clean up dispersivo y detección por LC/MS/MS | Permanente | 2020-02-24 | 2023-02-24 |
| 13 | Determinación de Tetraciclinas por LC/MS/MS | Músculo Bovino | - Tetraciclina*<br>- Clortetraciclina*<br>- Oxitetraciclina*<br><br>*LQ= 2,5 µg/kg | ECO-PT-070<br>Versión 3<br>Extracción QUECHERS y detección por LC/MS/MS | Permanente | 2020-02-24 | 2023-02-24 |
| 14 | Determinación de gliadina (gluten alergénico) en alimentos por ELISA sándwich R7001 (r-Biopharm) | Alimentos de origen animal y vegetal | LQ: 5 mg/kg de Gluten | ECO-AL-PT-001<br>Versión 3<br>Extracción con cocktail patentado y detección por ELISA | Permanente | 2020-02-24 | 2023-02-24 |



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| 15 | Determinación de gliadina (gluten alergénico) en alimentos por ELISA competitivo R7021(r-Biopharm) | Alimentos altamente hidrolizados y/o altamente fermentados | LQ: 10 mg/kg de Gluten | ECO-AL-PT-003 Versión. 3 Extracción con etanol y detección por ELISA | Permanente | 2020-02-24 | 2023-02-24 |
| 16 | Determinación de Organofosforados por GC/MS | Grasa bovina | - Diazinon (LQ: 200 µg/kg) - Etion (LQ: 500 µg/kg) - Clorpirifos (LQ: 25 µg/kg) - Etil-paration (LQ: 5 µg/kg) - Metil-paration (LQ: 5 µg/kg) - Diclorvos (LQ: 5 µg/kg) | ECO-PT-080 Versión 2 Extracción con solvente orgánico, clean up dispersivo y detección por GC/MS | Permanente | 2020-02-24 | 2023-02-24 |
| 17 | Determinación de Levamisol y/o Benzoimidazoles por LC/MS/MS | Hígado bovino | - Levamisol (LQ: 25 µg/kg) - Mebendazol (LQ: 15 µg/kg) - Albendazol (LQ: 250 µg/kg) - Fenbendazol (LQ: 125 µg/kg) - Oxfendazol (LQ: 125 µg/kg) | ECO-PT-078 Versión 3 Extracción con solvente acidificado, clean up dispersivo y detección por LC/MS/MS | Permanente | 2020-02-24 | 2023-02-24 |
| 18 | Determinación de | | Aroclor 1242* | ASTM D4059-00 | Permanente | 2020-02-24 | 2023-02-24 |



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|---|---|---|---|---|---|---|---|
| | Bifenilos Policlorados (PCB's) en aceite dieléctrico por GC/µECD | Aceite dieléctrico de transformador | Aroclor 1248*<br>Aroclor 1254*<br>Aroclor 1260*<br><br>*LQ: 5 mg/kg | Reaprobado: 2018)<br><br>Procedimiento de Aplicación:<br>ECO-MA-PT-001 Versión 2 | | | |
| Responsable Técnico del Laboratorio EcoNatura: Bioq. Alicia Salgueiro | | | | | | | |

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Instituto Nacional de Tecnología Industrial
INTI

SAI
Servicio Argentino de Interlaboratorios

# ENSAYO DE APTITUD

# "AGUAS 2014"

**PRQ-01/2014**

## INFORME FINAL

Fecha de emisión: diciembre de 2014

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# 1. INTRODUCCIÓN

El objetivo fundamental de este estudio es el de ofrecer a los laboratorios interesados la posibilidad de controlar los resultados de ensayos obtenidos mediante la utilización de métodos analíticos rutinarios y de tener una evidencia objetiva de su desempeño técnico.

Esta actividad permite, si se realiza en forma continua, identificar las posibles causas de error en los métodos y por lo tanto perfeccionar los procedimientos de ensayo a fin de disminuir dichos errores, así como también evaluar los desvíos, desarrollar nuevos métodos y realizar la comparación de los mismos.

Desde el primer ensayo de este tipo llevado a cabo en el año 1994, se ha incrementado el número de parámetros a determinar, el número de participantes y el grado de acuerdo alcanzado.

En el presente ensayo (ronda Nº 11) hay un ingreso de nuevos participantes, les damos la bienvenida y esperamos que nos acompañen en los próximos ejercicios.
Para los laboratorios que han realizado varias rondas de la intercomparación agradecemos que nos ayuden a la continuidad de la actividad.
Para los laboratorios ausentes en esta oportunidad, esperamos que sólo sea un evento transitorio.

La evaluación de los ensayos de aptitud confirma que la participación continua en los mismos trae aparejada una mejora en la calidad de las mediciones.

La organización y evaluación de este estudio fueron realizadas por INTI-Química (Lic. Pablo Álvarez y Lic. Ana Hernández) con el soporte técnico administrativo de INTI-Servicio Argentino de Interlaboratorios y el aporte de conocimientos y experiencias de los profesionales que constituyen el grupo de trabajo del Programa para la Calidad de las Mediciones Químicas y que formaron parte de la organización de los ensayos de aptitud previos.

El INTI preserva la confidencialidad de los participantes mediante la asignación de un código único elegido en forma aleatoria y el cual sólo es conocido por el propio participante y el INTI. El tratamiento de los resultados y el informe de los mismos se realizan utilizando ese mismo código.

El personal de INTI firma un compromiso de confidencialidad.



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# 2. MUESTRAS ENVIADAS

## 2.1 Preparación de las muestras

Se enviaron dos soluciones, una para el análisis de aniones y otra para el análisis de cationes. La solución de aniones contiene los siguientes analitos: cloruro, fluoruro, nitrato y sulfato. La solución de cationes contiene los siguientes analitos: calcio, cinc, hierro, magnesio y potasio.
Las soluciones se prepararon utilizando agua desmineralizada por ósmosis inversa con tratamiento final de pulido, de conductividad 1,2 µS/cm.

La solución de aniones se preparó pesando en balanza analítica cantidades adecuadas de:
Cloruro de potasio p. a. marca Merck, art. 1.04936.1000, lote K34333136 526.
Fluoruro de sodio p. a. marca Carlo Erba, lote 1870
Nitrato de sodio p. a. marca Merck, art. 1.06537.0500, lote A670737 623.
Sulfato de sodio anhidro p. a. marca Merck, art. 1.06649.1000, lote A663249 549.
Se agregó la cantidad de agua necesaria por pesada hasta alcanzar el volumen final de solución.

La solución de cationes se preparó pesando en balanza analítica cantidades adecuadas de:
Carbonato de calcio p. a. marca Anedra, art. 6451, lote 5254.
Cloruro de magnesio hexahidrato p.a. marca Merck, art. 1.05833.0250, lote A451933 632.
Cloruro de potasio p. a. marca Merck, art. 1.04936.1000, lote K34333136 526.
En el caso del hierro y el cinc se tomó, utilizando material volumétrico calibrado, un volumen adecuado de la solución preparada de hierro en ácido nítrico 2 – 5 %, marca Chem Lab – IONEX, art. 01.0901.0500, lote 17.1491611.20, conc. (1000 ± 2) mg/L y de la solución de cinc en ácido nítrico 2 – 5 %, marca Chem Lab - IONEX, art. CL 01.2611.0100 lote 16.0650711.10, conc. (1000 ± 2) mg/L. La alícuota utilizada también fue pesada en balanza analítica.

Se agregó la cantidad de agua necesaria para la dilución final por pesada.
Se acidificó la solución con ácido clorhídrico fumante 37 % marca Merck, art. 1.00317.2500, lote k 32739617 349.

Las muestras enviadas a los participantes se envasaron en frascos de polietileno de 500 $cm^3$ sin uso, lavados convenientemente y mantenidos en agua desmineralizada por una semana.
El fraccionamiento se realizó manualmente en campana de flujo laminar y los envases se enjuagaron con la solución muestra.

Las pesadas se realizaron en INTI-Química. Se determinó la masa por comparación con pesas patrones con trazabilidad a los patrones nacionales.



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### 2.2 Valores Asignados

Solución Aniones

| | |
|---|---|
| Cloruro (mg/l) | 75,02 ± 0,88 |
| Fluoruro (mg/l) | 1,637 ± 0,044 |
| Nitrato (mg/l) | 30,62 ± 0,52 |
| Sulfato (mg/l) | 39,92 ± 0,80 |

Solución Cationes

| | |
|---|---|
| Calcio (mg/l) | 60,0 ± 1,0 |
| Cinc (mg/l) | 0,397 ± 0,010 |
| Hierro (mg/l) | 0,499 ± 0,012 |
| Magnesio (mg/l) | 29,96 ± 0,51 |
| Potasio (mg/l) | 17,96 ± 0,45 |

Los valores asignados fueron establecidos por los laboratorios metrológicos del INTI, cuyas capacidades de medición y calibración (CMC´s) fueron declaradas y aprobadas por el CIPM-MRA en el año 2009 (apéndice C del BIPM, http://kcdb.bipm.org/appendixC/)

La incertidumbre en el valor de cada concentración fue calculada teniendo en cuenta todos los pasos involucrados en la preparación y medición de las soluciones, siguiendo las recomendaciones indicadas en las guías JCGM 100:2008 y EURACHEM/CITAC 2012 (ver Anexo IV).

## 3. RESULTADOS ENVIADOS POR LOS PARTICIPANTES

### 3.1. Métodos de análisis

Las técnicas y los métodos de análisis utilizados fueron elegidos por los participantes y se mencionan a continuación.

3.1.1. Análisis de aniones

3.1.1.1. Determinación de cloruro

1) Argentometría (indicador cromato de potasio). Laboratorios: 1, 2, 4, 5, 6, 7, 9, 10, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 29, 30, 33 y 34.

2) Cromatografía iónica (detector conductimétrico). Laboratorios: 11, 31, 35 y 36.



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3) Titulación potenciométrica. Laboratorios: 08 y 28.

4) Electrodo selectivo (ISE). Laboratorio: 3.

3.1.1.2. Determinación de nitrato

5) Espectrofotometría directa (UV, 220 nm). Laboratorios: 1, 2, 4, 5, 7, 10, 14, 15, 16, 21, 25, 26, 30 y 37.

6) Espectrofotometría (reducción con cadmio). Laboratorios: 6, 8, 13, 22 y 33.

7) Espectrofotometrías (SNEDD, benzoico, brusina, kit comerciales). Laboratorios: 3, 9, 20, 23 y 34.

8) Electrodo selectivo (ISE). Laboratorios: 17 y 29.

9) Cromatografía iónica (detector conductimétrico). Laboratorios: 11, 31, 35 y 36.

3.1.1.3. Determinación de sulfato

10) Turbidimetría. Laboratorios: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29 y 30.

11) Cromatografía iónica (detector conductimétrico). Laboratorios: 11, 31, 35 y 36.

12) Gravimetría. Laboratorios: 18, 33 y 34.

3.1.1.4. Determinación de fluoruro

13) Espectrofotometría (decoloración laca de circonio). Laboratorios: 20, 25 y 30.

14) Electrodo selectivo fluoruro (ISE). Laboratorios: 1, 2, 3, 12, 14, 21, 26, 27, 29 y 34.

15) Cromatografía iónica. Laboratorios: 11, 31, 35 y 36.

16) Espectrofotometría con SPADNS. Laboratorios: 6, 7, 9, 13, 15, 16, 17, 23 y 28.

17) Otras espectrofotometrías. Laboratorio: 8.



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3.1.2. Análisis de cationes

3.1.2.1 Determinación de calcio

18) Volumetría (EDTA). Laboratorios: 1, 2, 4, 5, 6, 7, 9, 10, 13, 16, 17, 18, 19, 20, 21, 23, 25, 26, 27, 29, 30, 33, 34 y 36.

19) Espectrometría de absorción atómica. Laboratorios: 3, 15 y 28.

20) Espectrometría de emisión (ICP - OES). Laboratorio: 31.

21) Cromatografía iónica. Laboratorios: 11 y 35.

22) Espectrometría de emisión (ICP - MS). Laboratorio: 8.

3.1.2.2. Determinación de magnesio

23) Volumetría (EDTA). Laboratorios: 1, 2, 4, 5, 6, 7, 9, 10, 13, 16, 17, 19, 20, 21, 23, 25, 26, 29, 30, 33, 34 y 36.

24) Espectrometría de absorción atómica. Laboratorios: 3, 12, 15 y 28.

25) Cromatografía iónica. Laboratorios: 11 y 35.

26) Espectrometría de emisión (ICP - MS). Laboratorio: 8.

27) Espectrometría de emisión (ICP - OES). Laboratorio: 31.

3.1.2.3. Determinación de potasio

28) Espectrometría de emisión (llama). Laboratorios: 1, 3, 5, 6, 13, 14, 19, 20, 21, 25, 27, 30 y 34.

29) Espectrometría de absorción atómica. Laboratorios: 9, 12, 15, 26 y 28.

30) Espectrometría de emisión (ICP - OES). Laboratorio: 31.

31) Cromatografía iónica. Laboratorios: 11 y 35.

32) Espectrometría de emisión (ICP - MS). Laboratorio: 8.

33) Electrodo selectivo (ISE). Laboratorio: 7 y 17.



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3.1.2.4. Determinación de hierro

34) Espectrofotometría (o-fenantrolina). Laboratorios: 1, 6, 13, 17, 19, 22, 25 y 30.

35) Espectrometría de absorción atómica (llama): Laboratorios: 2, 3, 5, 7, 12, 14, 15, 20, 21, 24, 26, 28, 32, 34 y 35.

36) Espectrometría de emisión (ICP - OES). Laboratorios: 11 y 31.

37) Espectrometría de emisión (ICP - MS). Laboratorio: 8.

38) Otras espectrofotometrías (tioglicolato, tiocianato, kit comerciales). Laboratorios: 9, 10, 23 y 36.

3.1.2.5. Determinación de cinc

39) Espectrometría de absorción atómica (llama). Laboratorios: 3, 5, 7, 9, 12, 14, 15, 20, 21, 22, 24, 26, 28, 30, 32, 34 y 35.

40) Espectrometría de emisión (ICP – OES). Laboratorios: 11 y 31.

41) Espectrofotometría (zincón). Laboratorios: 1, 6, 17, 19 y 25.

42) Espectrometría de emisión (ICP - MS). Laboratorio: 8.

El listado de los métodos no pretende cubrir todos los ensayos informados pero es lo suficientemente detallado para mostrar las capacidades instaladas de los participantes y su grado de equipamiento. También indica los métodos que han mostrado ser eficientes y logrado la preferencia de los analistas.

**3.2 Datos enviados**

Los datos enviados por los participantes pueden verse en las tablas 1 y 2.
El número de cifras significativas y las unidades figuran tal como fueron informadas por los participantes.



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**TABLA 1**
**Datos enviados por los participantes – Aniones**

| Laboratorio N° | Muestra N° | Cloruro (mg/L) | Fluoruro (mg/L) | Nitrato (mg/L) | Sulfato (mg/L) |
|---|---|---|---|---|---|
| 01 | 09 | 71,4 | 1,77 | 29,3 | 39,7 |
| 02 | 12 y 36 | 74 | 1,65 | 30 | 44 |
| 03 | 39 | 75,0 | 1,7 | 29 | 46,3 |
| 04 | 08 | 76,9 | NI | 29,6 | 42,3 |
| 05 | 25 | 76,75 | NI | 28,1 | 43,7 |
| 06 | 33 | 77,7 | 1,6 | 26,8 | 37,2 |
| 07 | 35 | 80,0 | 1,4 | 31,0 | 38,3 |
| 08 | 20 | 79,7 | 1,59 | 26,8 | 40,3 |
| 09 | 17 | 73 | 1,8 | 32 | 40 |
| 10 | 34 | 75 | NI | 30,5 | 37,0 |
| 11 | 30 | 76,3 | 1,68 | 30,7 | 41,4 |
| 12 | 47 | NI | 1,8 | NI | NI |
| 13 | 22 | 76 | 1,5 | 28 | 41 |
| 14 | 21 | 74,4 | 1,68 | 31 | 37 |
| 15 | 28 | 71,8 | 1,39 | 31,75 | 36,3 |
| 16 | 05 | 76,0 | 1,54 | 33,00 | 30,0 |
| 17 | 27 y 49 | 79,97 | 1,34 | 35 | 39,8 |
| 18 | 15 | 78 | NI | NI | 42 |
| 19 | 44 | NI | NI | NI | 37,4 |
| 20 | 14 | 78,3 | 1,77 | NI | 40,5 |
| 21 | 04 | 75 | 1,47 | 29,0 | 43 |
| 22 | 19 | 73 | NI | 22,5 | 42 |
| 23 | 40 | 80 | 1,40 | 32 | 39 |
| 24 | 16 | NI | NI | NI | NI |
| 25 | 06 | 74,1 | 1,59 | 31,0 | 39,8 |
| 26 | 43 | 60,0 | 1,63 | 33,3 | 42,0 |
| 27 | 41 | 79,8 | 1,92 | NI | 44,48 |
| 28 | 10 | 72,6 | 1,63 | NI | 40,3 |
| 29 | 29 | 75,7 | 1,61 | 33,3 | 33,2 |
| 30 | 46 | 71,7 | 1,68 | 29,5 | 43,7 |
| 31 | 42 | 75 | 1,7 | 33 | 40 |
| 32 | 42 | NI | NI | NI | NI |
| 33 | 24 | 80 | NI | 33 | 35 |
| 34 | 26 | 61 | 1,8 | 47,9 | 35 |
| 35 | 03 | 74,65 | 1,63 | 29,30 | 40,05 |
| 36 | 11 | 73,8 | 1,66 | 29,5 | 39,5 |
| 37 | 31 | NI | NI | 30,91 ± 1,10 | NI |

NI: No Informó



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**TABLA 2**
**Datos enviados por los participantes – Cationes**

| Laboratorio N° | Muestra N° | Calcio (mg/L) | Cinc (mg/L) | Hierro (mg/L) | Magnesio mg/L) | Potasio (mg/L) |
|---|---|---|---|---|---|---|
| 01 | 47 | 44,1 | 0,26 | 0,5 | 25,9 | 15,6 |
| 02 | 48 | 60 | NI | 0,54 | 30 | NI |
| 03 | 25 | 65,6 | 0,7 | 0,8 | 29,1 | 20,3 |
| 04 | 38 | 59,3 | NI | NI | 30,1 | NI |
| 05 | 07 | 65,66 | 0,368 | 0,486 | 11,71 | 22,84 |
| 06 | 26 | 50,2 | 0,35 | 0,41 | 36,4 | 16,2 |
| 07 | 49 | 60,1 | 0,32 | 0,53 | 30,3 | 18,0 |
| 08 | 08 | 73,6 | 0,488 | 0,699 | 38,2 | 21,4 |
| 09 | 42 | 60 | 0,42 | 0,53 | 30 | 18 |
| 10 | 24 | 59,7 | NI | 0,57 | 27,6 | NI |
| 11 | 06 | 60,2 | 0,44 | 0,57 | 30,1 | 18,0 |
| 12 | 10 | NI | 0,41 | 0,5 | 29,2 | 17,5 |
| 13 | 35 | 58 | NI | 0,45 | 28 | 16 |
| 14 | 03 | NI | 0,391 | 0,480 | NI | 17,5 |
| 15 | 14 | 51,16 | 4,29 | 0,5 | 29,71 | 13,94 |
| 16 | 04 | 137,0 | NI | NI | 32,8 | NI |
| 17 | 19 | 55 | 0,44 | 0,53 | 38 | 19 |
| 18 | 33 | 62 | NI | NI | NI | NI |
| 19 | 16 | 70,0 | 0,43 | 0,63 | 26,4 | 13,2 |
| 20 | 39 | 61,5 | 0,32 | 0,47 | 32,9 | 20,9 |
| 21 | 27 | 48 | 0,32 | 0,53 | 34 | 16 |
| 22 | 21 | NI | 0,42 | 0,68 | NI | NI |
| 23 | 15 | 58 | NI | 0,53 | 36 | NI |
| 24 | 36 | NI | 0,440 | 0,50 | NI | NI |
| 25 | 30 | 60,9 | 0,37 | 0,52 | 29,2 | 18,4 |
| 26 | 23 | 58,0 | 0,45 | 0,55 | 31,0 | 17,5 |
| 27 | 20 | 63,4 | NI | NI | NI | 11,7 |
| 28 | 43 | 61,4 | 0,44 | 0,53 | 29,6 | 17,4 |
| 29 | 41 | 59,4 | NI | NI | 30,4 | NI |
| 30 | 32 | 57 | 0,40 | 0,59 | 33,7 | NI |
| 31 | 22 | 59 | 0,40 | 0,48 | 30 | 18 |
| 32 | 22 | NI | 0,39 | 0,51 | NI | NI |
| 33 | 34 | 60 | NI | NI | 30 | NI |
| 34 | 37 | 61 | 0,3 | 0,5 | 32 | 15 |
| 35 | 28 | 64,57 | 0,42 | 0,43 | 31,17 | 18,80 |
| 36 | 05 | 59,6 | NI | 0,51 | 31,8 | NI |
| 37 | 18 | NI | NI | NI | NI | NI |

NI: No Informó



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## 4. EVALUACIÓN DEL DESEMPEÑO DE LOS LABORATORIOS

La evaluación del desempeño de los laboratorios participantes se llevó a cabo utilizando como criterio el parámetro *z-score,* a partir del valor asignado (X) y de la desviación estándar para la evaluación de la aptitud ($\tilde{\sigma}$), tal como se muestra en la definición indicada en el Anexo III.

El valor de $\tilde{\sigma}$ utilizada en el cálculo del *z-score*, para cada uno de los analitos, se ha prefijado teniendo presente objetivos de desempeño. Los valores de $\tilde{\sigma}$ para los diferentes analitos se muestran en la tabla siguiente:

| ANIONES | | CATIONES | |
|---|---|---|---|
| **ANALITO** | $\tilde{\sigma}$ | **ANALITO** | $\tilde{\sigma}$ |
| cloruro | 3,5 % | calcio | 5 % |
| fluoruro | 8 % | cinc | 8 % |
| nitrato | 5 % | hierro | 8 % |
| sulfato | 8 % | magnesio | 5 % |
| - | - | potasio | 8 % |

Los valores asignados (X) para cada uno de los analitos son los provistos por los laboratorios metrológicos del INTI.

Los parámetros *z-score*, para cada uno de los analitos, pueden verse en los gráficos 10 a 18 (Anexo I).
Las tablas 3 y 4, con los valores de los *z-score* para los aniones y cationes, pueden verse en el Anexo II.

## 5. TRATAMIENTO ESTADÍSTICO DE LOS RESULTADOS

Para estudiar el comportamiento del conjunto de resultados de la presente ronda interlaboratorios se realizan los cálculos estadísticos.

En la primera etapa de la evaluación se procedió al examen crítico de los datos, descartándose aquellos que resultaban obviamente discordantes.

En la etapa siguiente se procedió al análisis estadístico aplicando los métodos robustos (Algoritmo A) recomendados en la norma ISO/IEC 13528:2005 (ver Anexo IV) para los ensayos de aptitud.

A continuación se presentan los valores promedios robustos (Algoritmo A) y desviación estándar robusta:



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| Analito | Nª total de datos | Valor Asignado (mg/l) | Valor medio robusto (mg/l) | Desviación estándar robusta (mg/l) | Desviación estándar relativa porcentual (%) |
|---|---|---|---|---|---|
| Cloruro | 32 | 75,02 | 75,5 | 3,3 | 4,4 |
| Fluoruro | 27 | 1,637 | 1,63 | 0,15 | 9,2 |
| Nitrato | 29 | 30,62 | 30,45 | 2,3 | 7,6 |
| Sulfato | 33 | 39,92 | 39,9 | 3,3 | 8,3 |
| Calcio | 31 | 60,0 | 60,15 | 3,8 | 6,3 |
| Cinc | 25 | 0,397 | 0,393 | 0,058 | 15 |
| Hierro | 30 | 0,499 | 0,514 | 0,042 | 8,2 |
| Magnesio | 30 | 29,96 | 30,91 | 2,8 | 9,1 |
| Potasio | 23 | 17,96 | 17,70 | 2,3 | 13 |

Para su comparación con los valores obtenidos en las rondas interlaboratorios anteriores, ver la tabla “Datos históricos” en el Anexo II del presente informe.

En las Tablas 5 y 6 (Anexo II) se resumen los valores numéricos correspondientes a las desviaciones de los resultados enviados por cada uno de los participantes con respecto al valor asignado.

## 6. COMPARACIÓN DE LOS RESULTADOS OBTENIDOS SEGÚN EL MÉTODO UTILIZADO

Como surge de la observación del listado detallado de los métodos utilizados por los participantes, resulta que:

- Nitrato, fluoruro, hierro y potasio presentan la mayor diversidad de métodos utilizados para su determinación.
- los métodos turbidimétricos son los más utilizados para determinar sulfato, y este hecho se repite en los interlaboratorios anteriores.
- la complejometría con EDTA es la preferida para la determinación de calcio y magnesio y la absorción atómica es preferida para determinar cationes metálicos.

En el gráfico 19 (Anexo I) se puede observar cómo varían los resultados obtenidos para un mismo analito utilizando distintas técnicas de análisis.
Se representó el valor medio obtenido con los métodos más utilizados para la determinación de fluoruro y su correspondiente desviación estándar, comparándolos con



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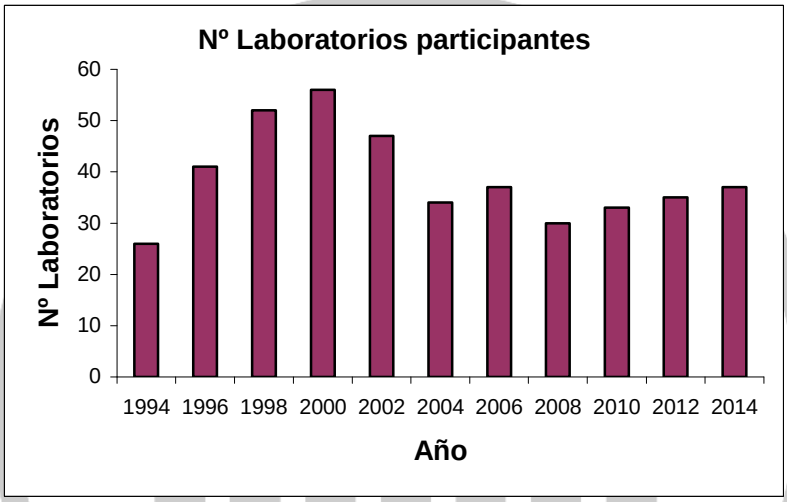
el valor asignado. Se hace notar que en este caso en particular, se promediaron el mismo número de datos, los cuales no fueron considerados inconsistentes.

## 7. COMENTARIOS

El número total de laboratorios participantes en los distintos ensayos interlaboratorio realizados hasta la fecha, se muestran en el siguiente gráfico:




En los últimos ejercicios se puede apreciar una tendencia creciente suave en la cantidad de participantes.

Para el presente interlaboratorio, se observa en la siguiente tabla, para cada analito, el número de resultados satisfactorios, cuestionables y no satisfactorios evaluados mediante el z-score:

| Analito | Satisfactorios | Cuestionables | No satisfactorios |
|---|---|---|---|
| Cloruro | 30 | - | 2 |
| Fluoruro | 25 | 2 | - |
| Nitrato | 24 | 3 | 2 |
| Sulfato | 31 | 1 | 1 |
| Calcio | 24 | 1 | 6 |
| Cinc | 17 | 4 | 4 |
| Hierro | 24 | 2 | 4 |
| Magnesio | 21 | 4 | 5 |
| Potasio | 17 | 3 | 3 |

El número de datos satisfactorios respecto del número de datos recibidos en los distintos interlaboratorios fueron los siguientes (expresados como porcentaje):



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| Año | % datos satisfactorios |
|---|---|
| 1994 | 68 |
| 1996 | 83 |
| 1998 | 81 |
| 2000 | 82 |
| 2002 | 76 |
| 2004 | 82 |
| 2006 | 68 |
| 2008 | 67 |
| 2010 | 69 |
| 2012 | 78 |
| 2014 | 82 |

Estos resultados en conjunto son satisfactorios, los valores medios interlaboratorios (valores robustos) muestran muy buena concordancia con los valores asignados. El porcentaje de datos satisfactorios teniendo en cuenta los ensayos interlaboratorios anteriores ha mejorado significativamente y se ha mantenido el nivel de exigencia en la evaluación del desempeño de los laboratorios, tal como se evidencia en los $\tilde{\sigma}$ utilizados en el cálculo del parámetro Z (valores de excelencia).

Entre los ensayos de aniones, nitrato tiene el menor porcentaje de datos satisfactorios (82,8 %) y dentro de los ensayos de cationes, cinc y magnesio presentan los menores porcentajes de datos satisfactorios (68 % y 70 % respectivamente).

En este ejercicio también se observa que la homogeneidad de la expresión de los resultados informados por los participantes es bastante dispersa (recordar que la guía de la referencia 5 recomienda utilizar a lo sumo dos cifras significativas en la expresión de la incertidumbre).

También hay que insistir en la revisión de los cálculos y supervisión del informe de resultados ya que, por ejemplo, hay datos expresados en otras especies químicas.

A fin de lograr un mecanismo de mejora continua, solicitamos a los laboratorios que nos envíen cualquier sugerencia o comentario que consideren oportuno.

Por otro lado, en caso de tener alguna duda sobre la ejecución de los métodos de ensayo, de las causas de diferencias en los resultados o dudas sobre las evaluaciones individuales, esperamos su consulta.



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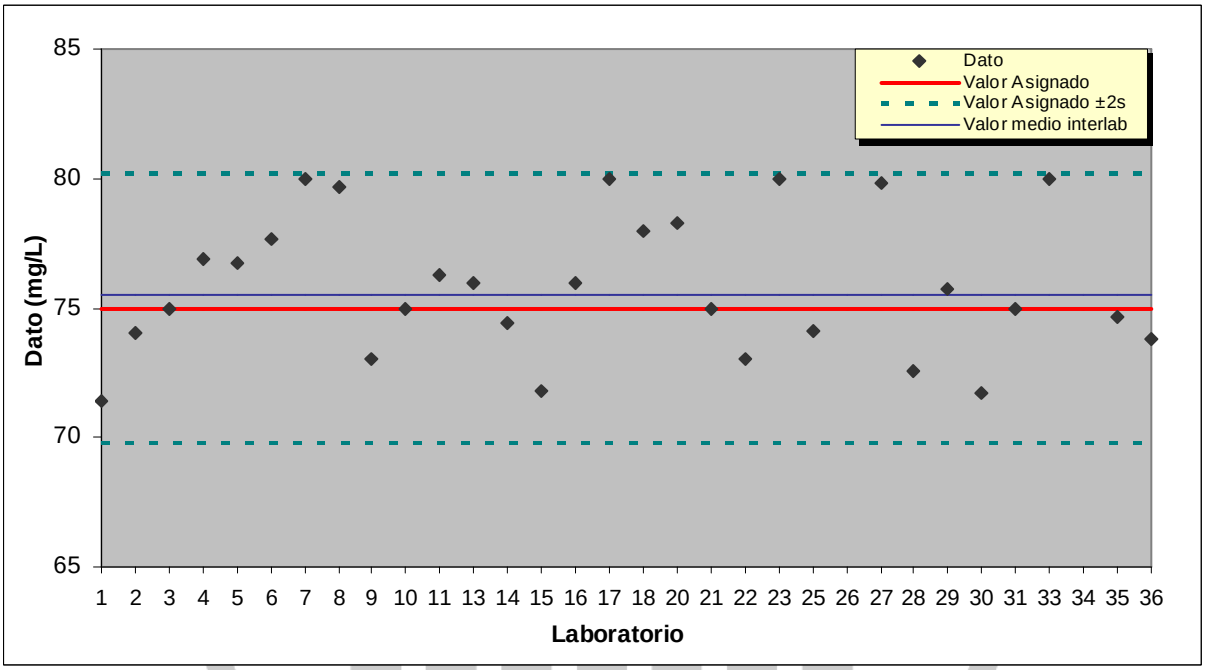
# ANEXO I

## GRÁFICO 1

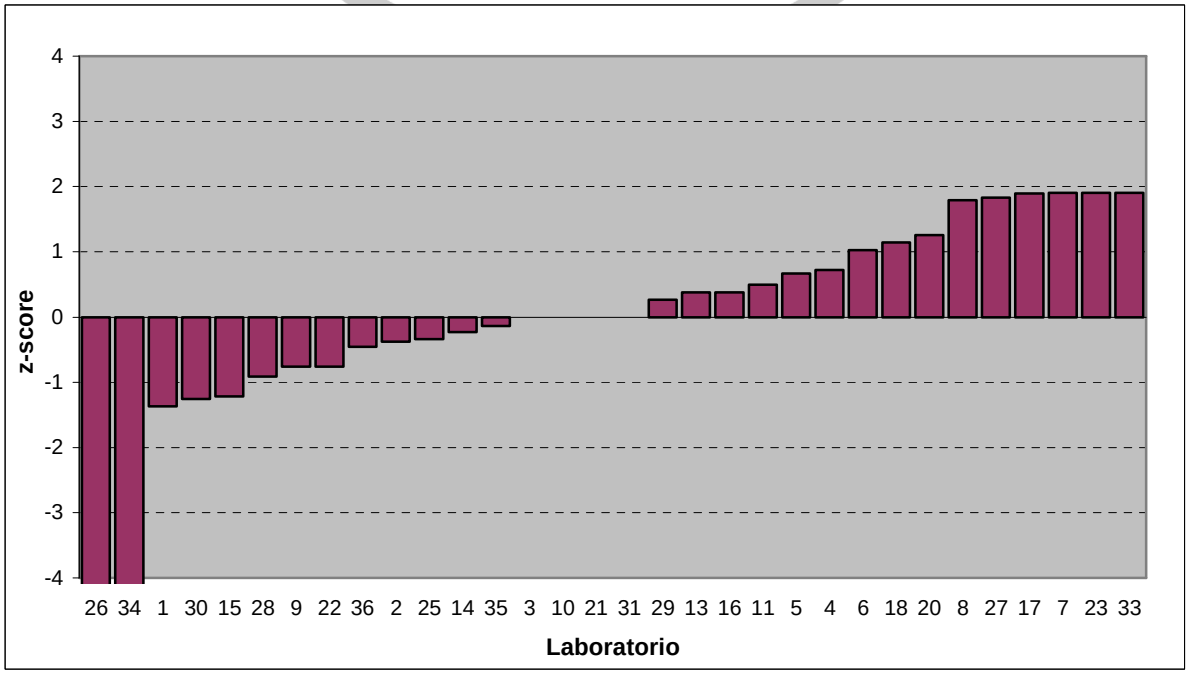
Datos enviados por los participantes – Cloruro




Laboratorios cuyos valores exceden el ámbito del gráfico: 26 y 34

## GRÁFICO 10

Parámetro z – Cloruro




Laboratorios cuyos parámetros z exceden el ámbito del gráfico: 26 y 34



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**GRÁFICO 2**
Datos enviados por los participantes – Fluoruro

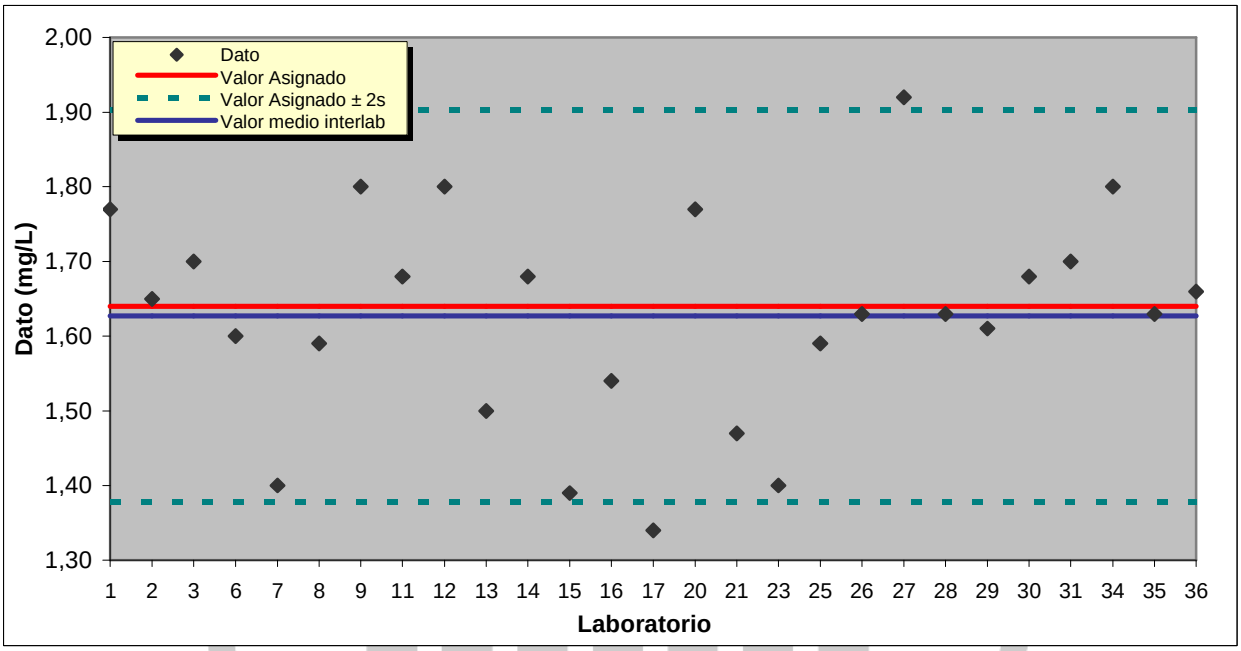


**GRÁFICO 11**
Parámetro z – Fluoruro

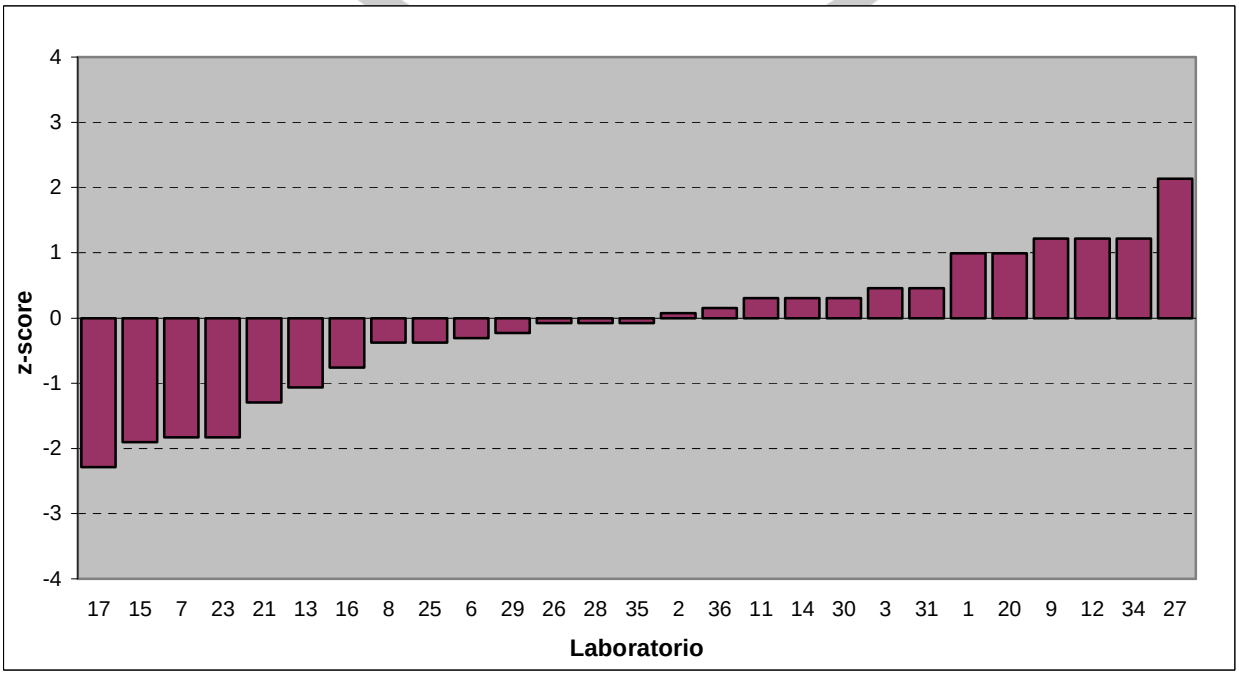




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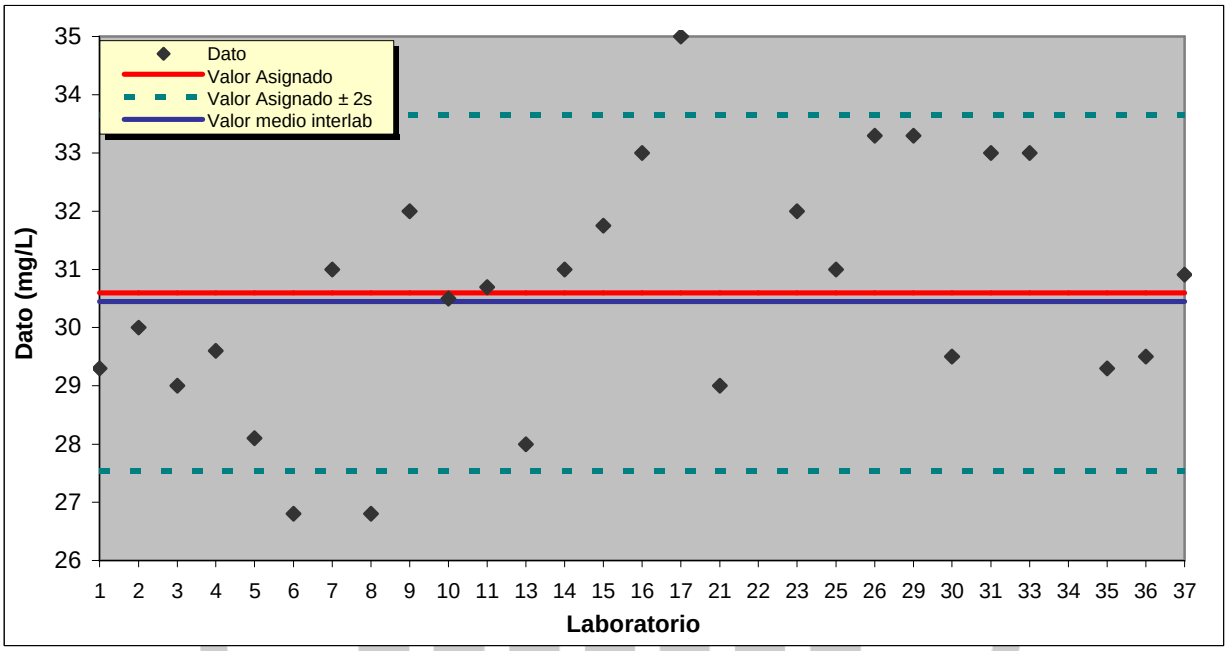
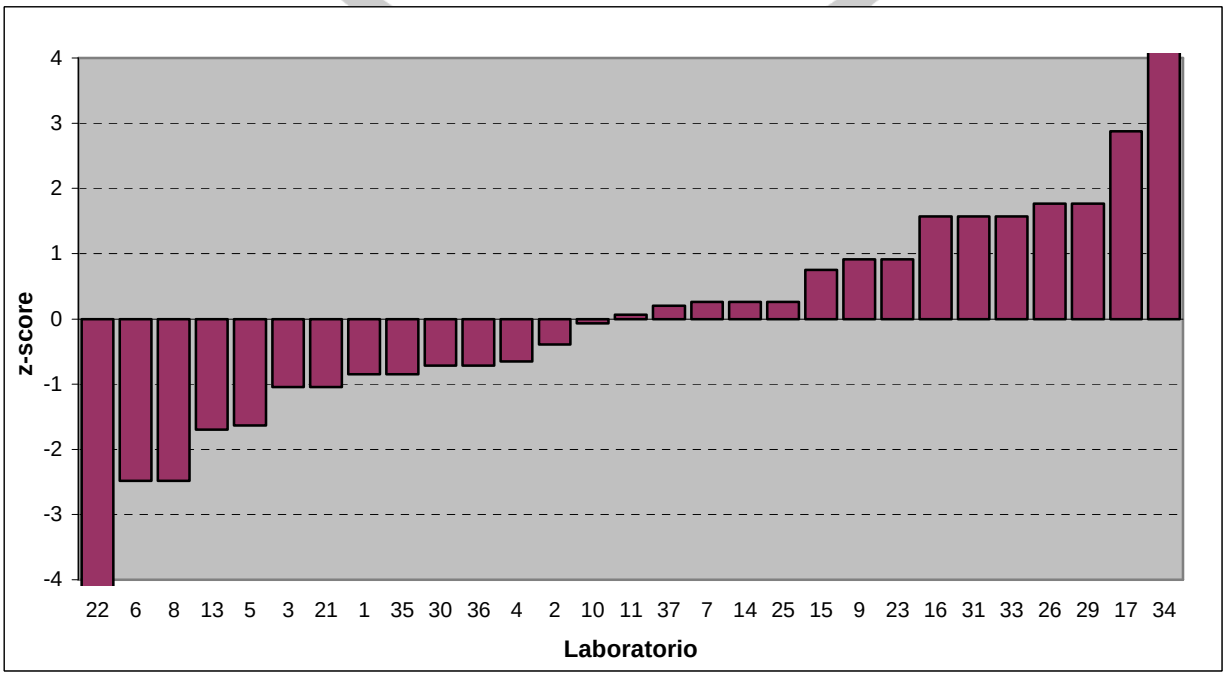
**GRÁFICO 3**
Datos enviados por los participantes – Nitrato




Laboratorios cuyos valores exceden el ámbito del gráfico: 22 y 34

**GRÁFICO 12**
Parámetro z – Nitrato




Laboratorios cuyos parámetros z exceden el ámbito del gráfico: 22 y 34



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**GRÁFICO 4**
Datos enviados por los participantes – Sulfato

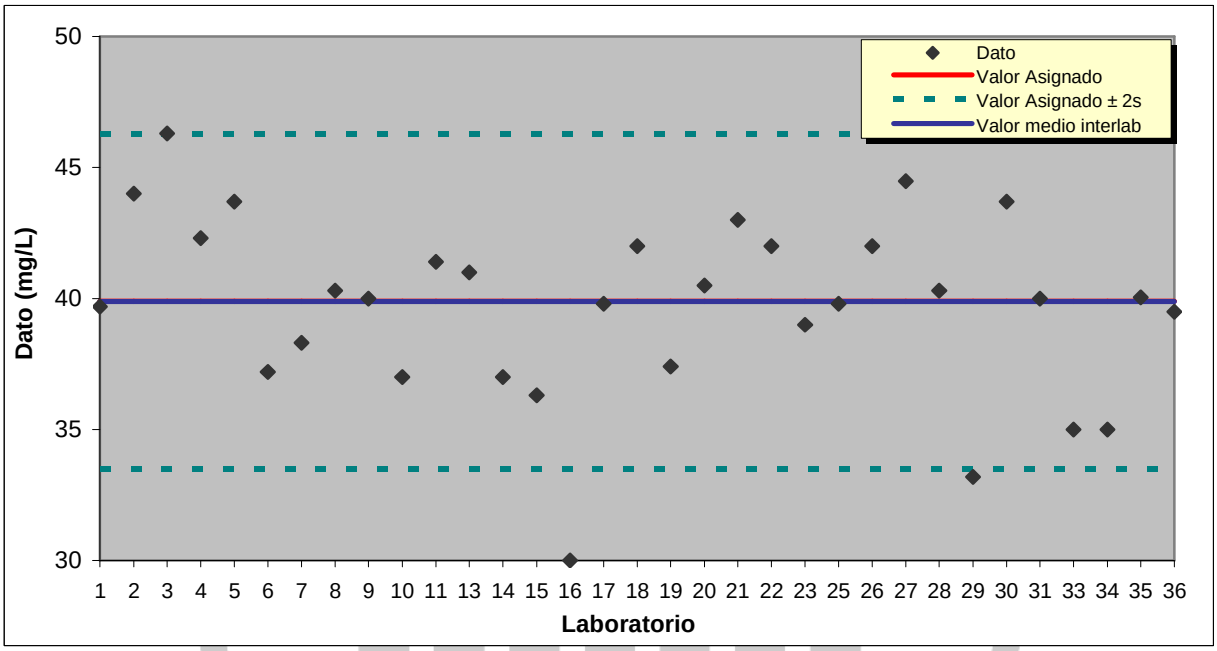


**GRÁFICO 13**
Parámetro z – Sulfato

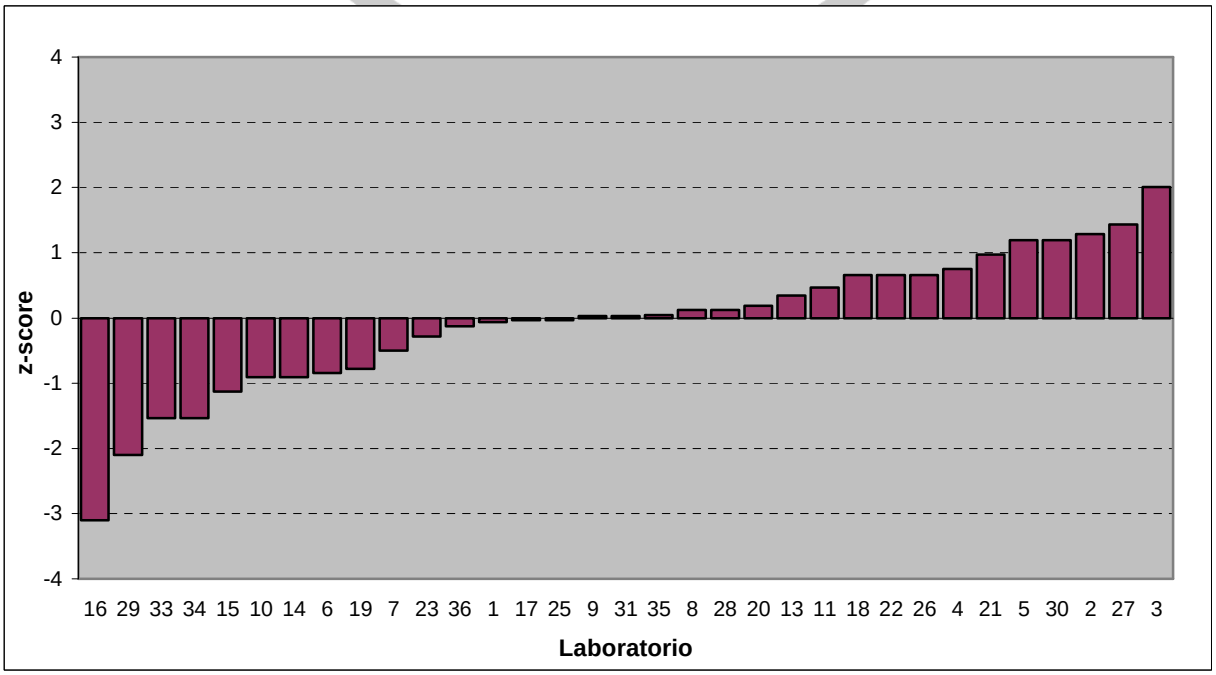




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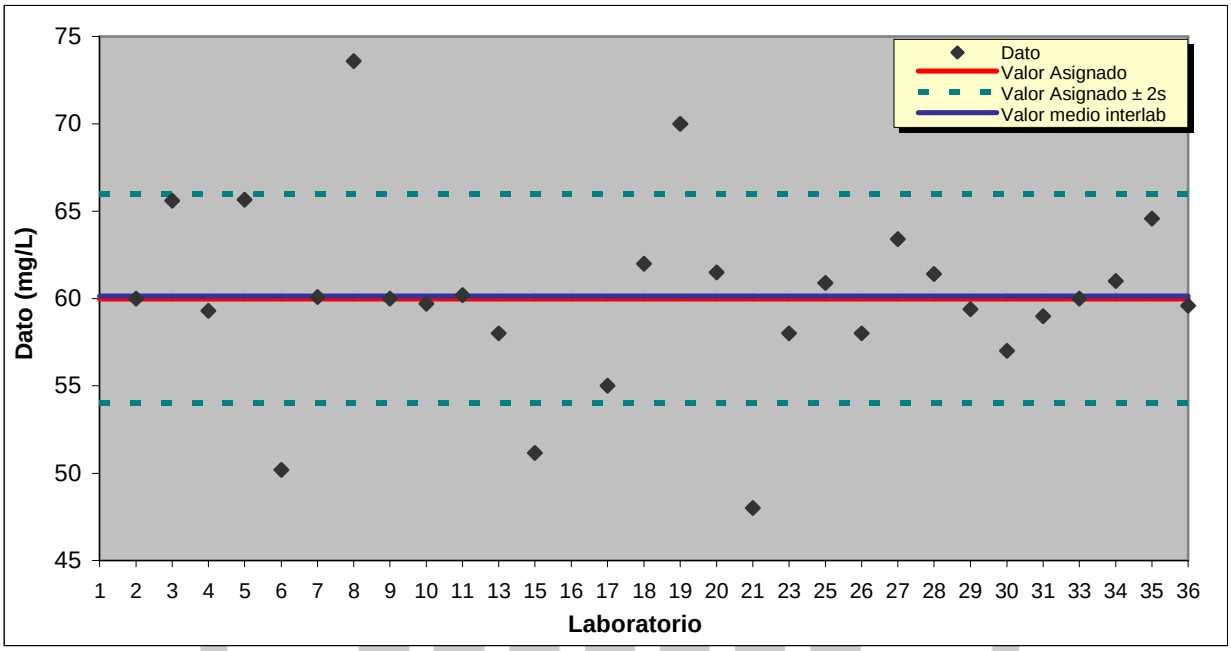
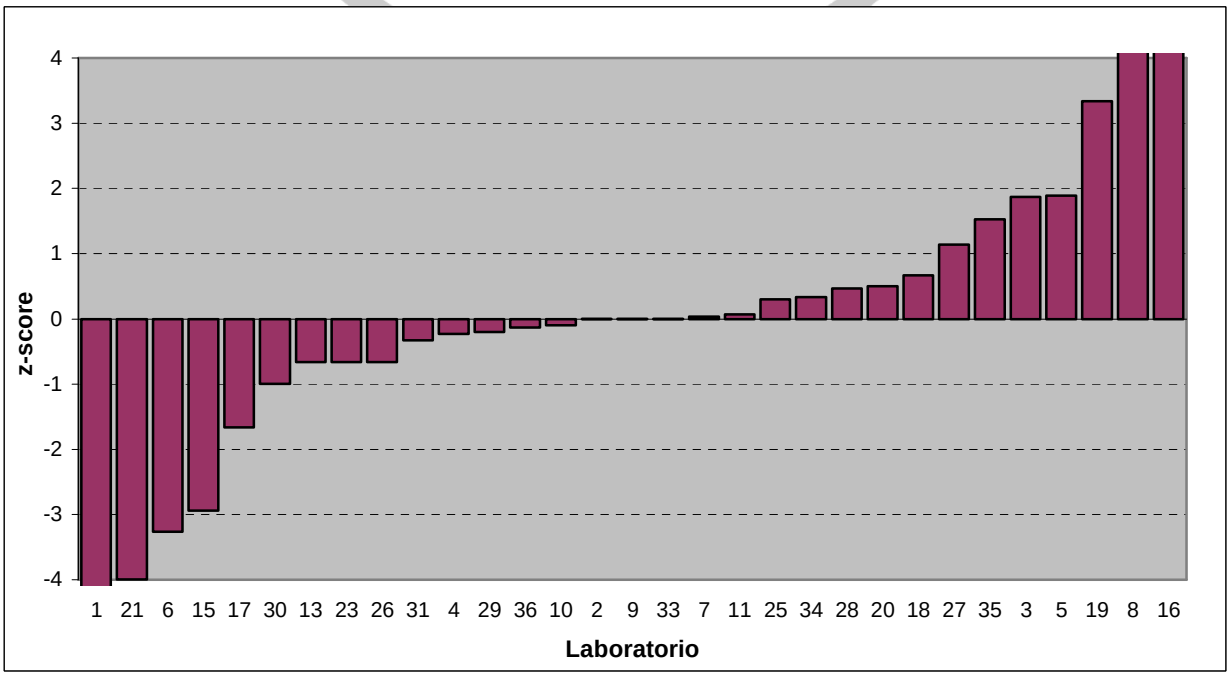
**GRÁFICO 5**
Datos enviados por los participantes –Calcio




Laboratorios cuyos valores exceden el ámbito del gráfico: 1 y 16

**GRÁFICO 14**
Parámetro z – Calcio




Laboratorios cuyos parámetros z exceden el ámbito del gráfico: 1, 8, 16 y 21



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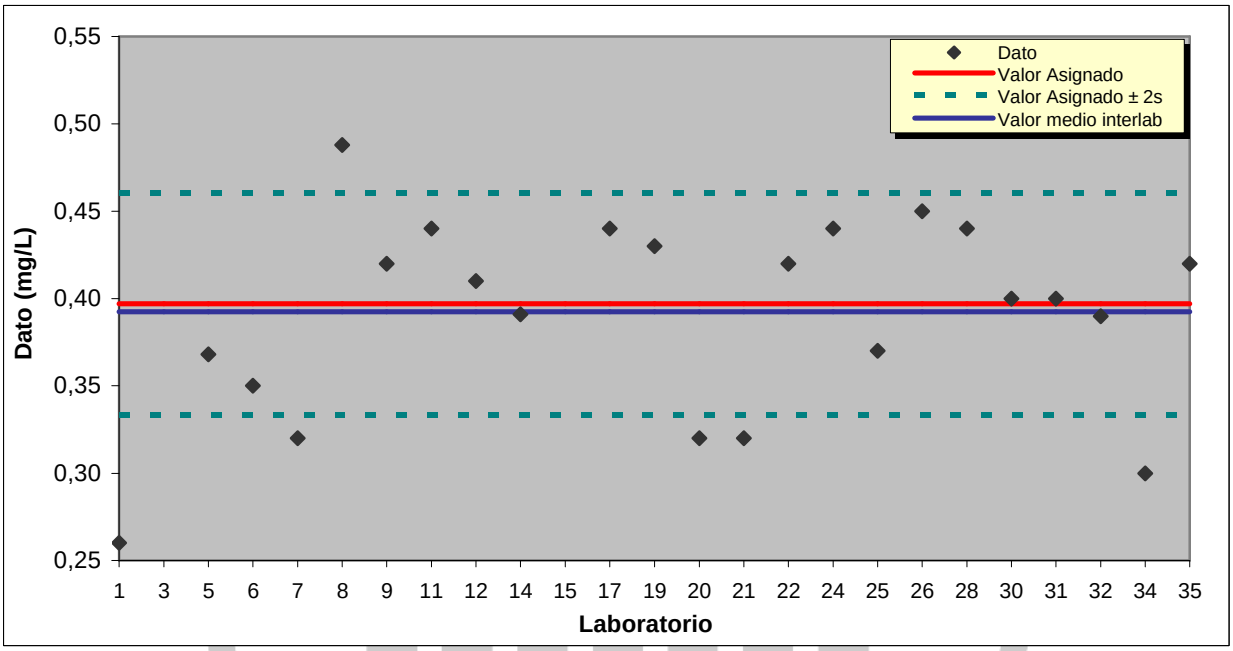
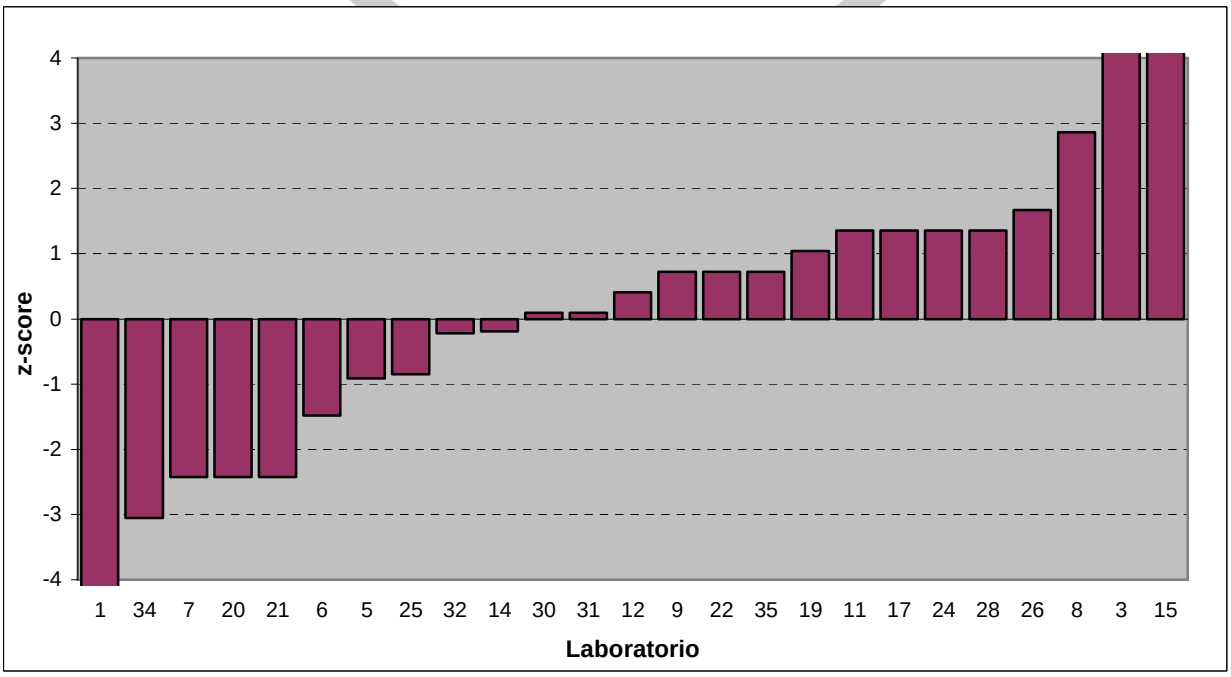
**GRÁFICO 6**
Datos enviados por los participantes – Cinc




Laboratorios cuyos valores exceden el ámbito del gráfico: 3 y 15

**GRÁFICO 15**
Parámetro z – Cinc




Laboratorios cuyos parámetros z exceden el ámbito del gráfico: 1, 3 y 15



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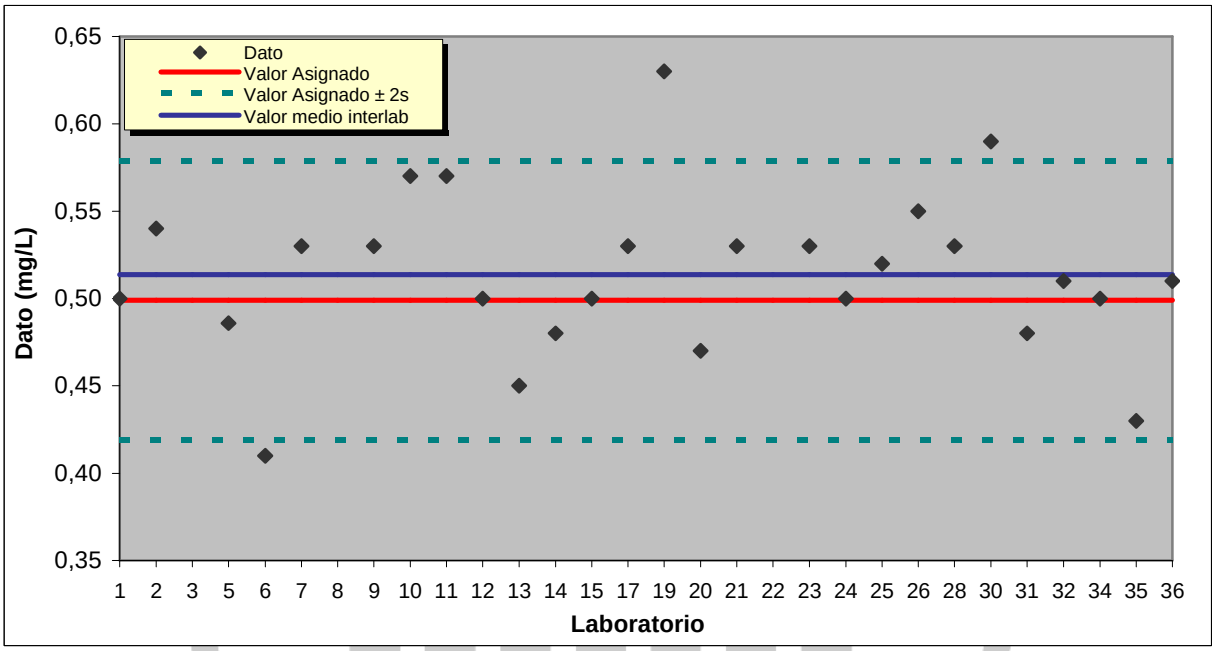
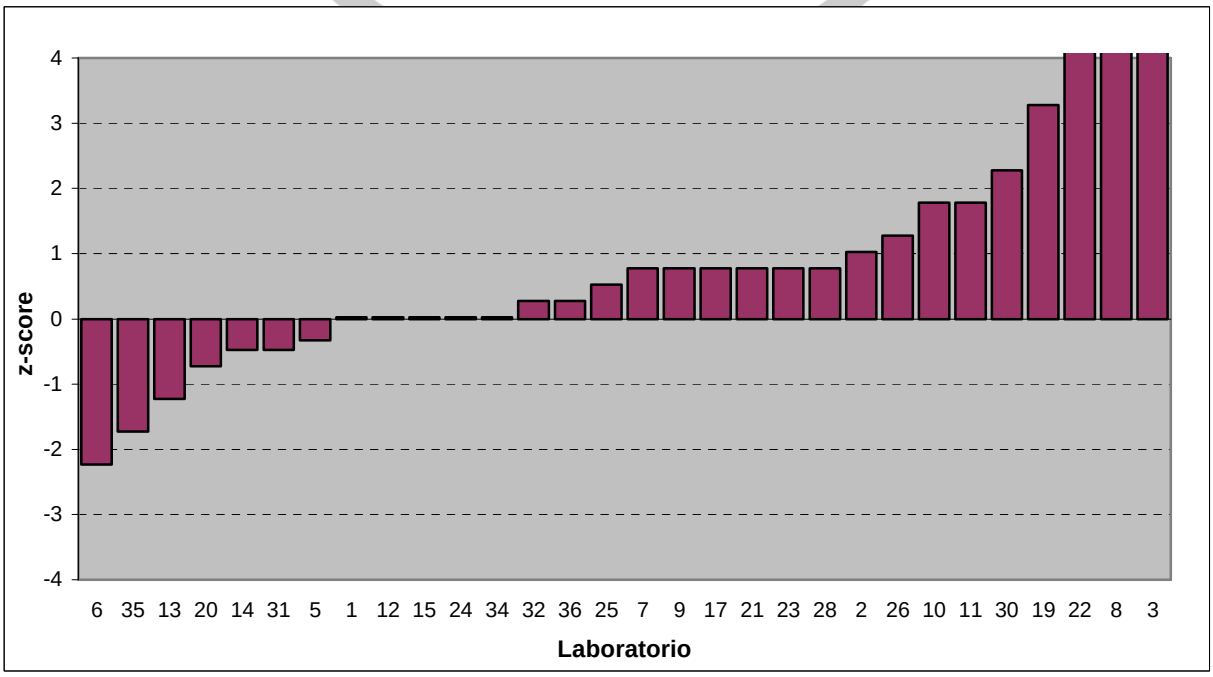
**GRÁFICO 7**
Datos enviados por los participantes – Hierro




Laboratorios cuyos valores exceden el ámbito del gráfico: 3, 8 y 22

**GRÁFICO 16**
Parámetro z – Hierro




Laboratorios cuyos valores exceden el ámbito del gráfico: 3, 8 y 22



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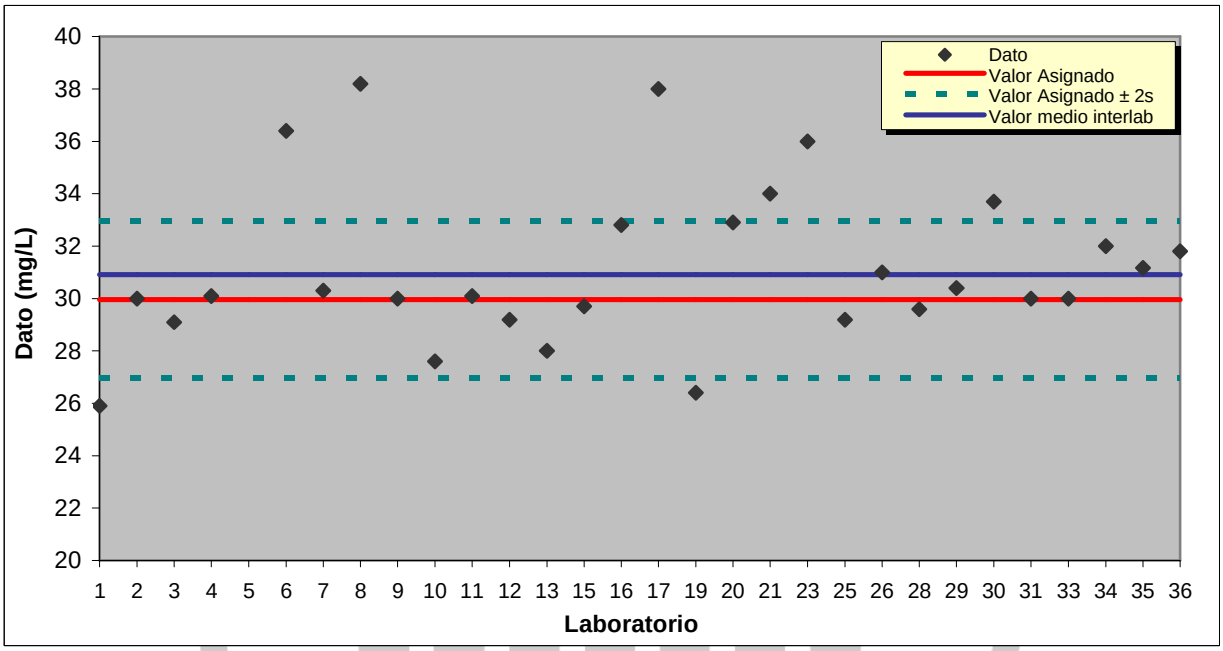
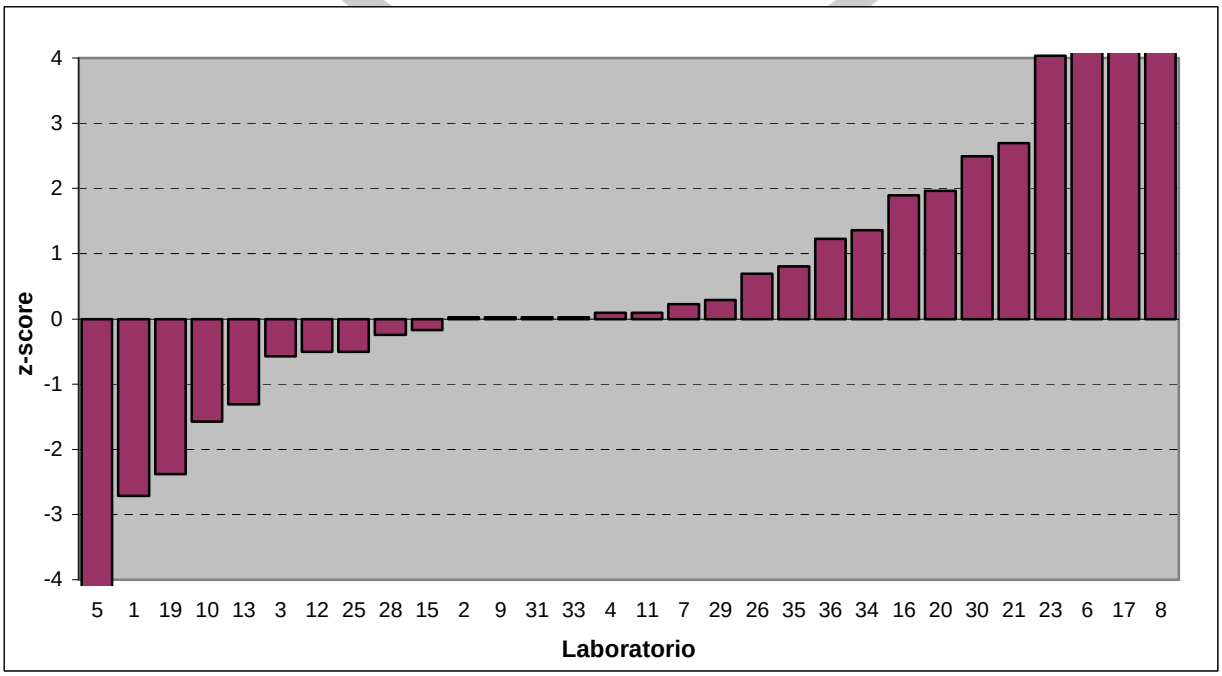
**GRÁFICO 8**
Datos enviados por los participantes – Magnesio




Laboratorio cuyo valor excede el ámbito del gráfico: 5

**GRÁFICO 17**
Parámetro z – Magnesio




Laboratorios cuyos parámetros z exceden el ámbito del gráfico: 5, 6, 8, 17 y 23



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**GRÁFICO 9**
Datos enviados por los participantes – Potasio

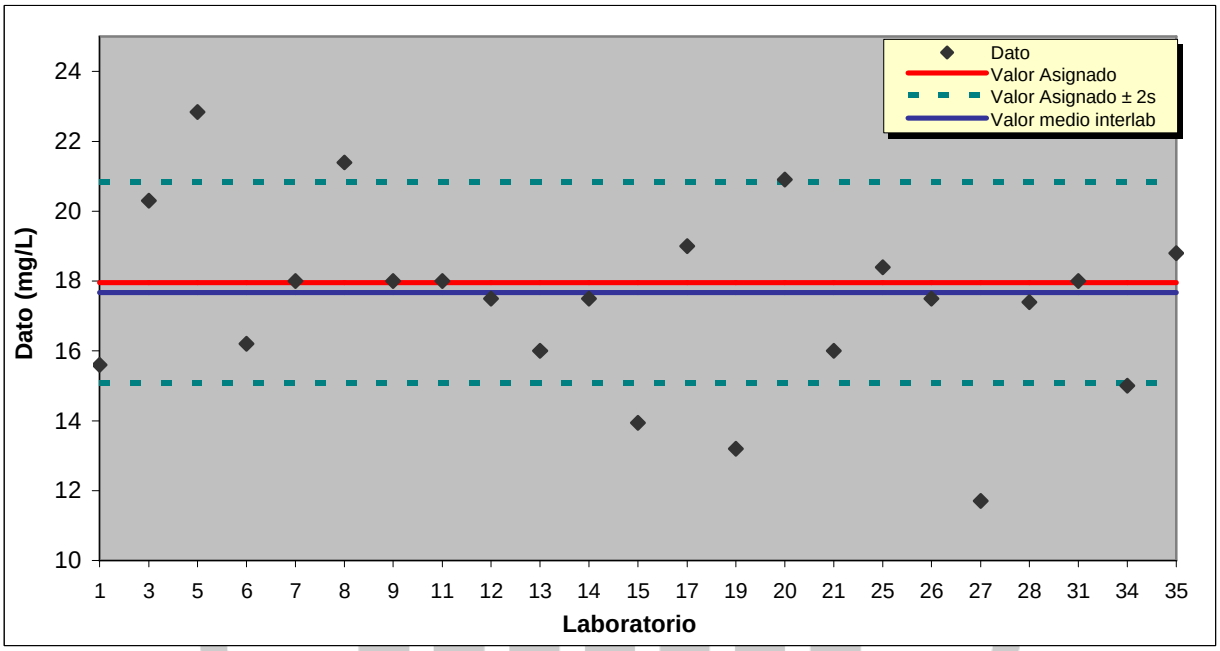


**GRÁFICO 18**
Parámetro z – Potasio

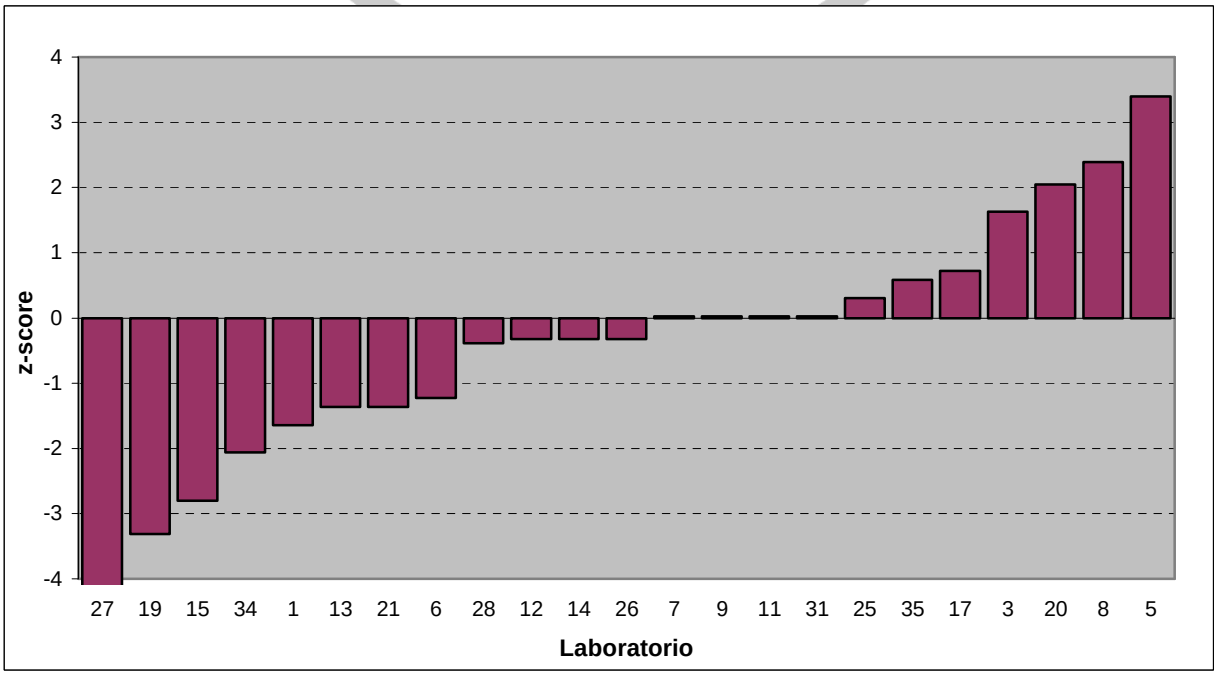




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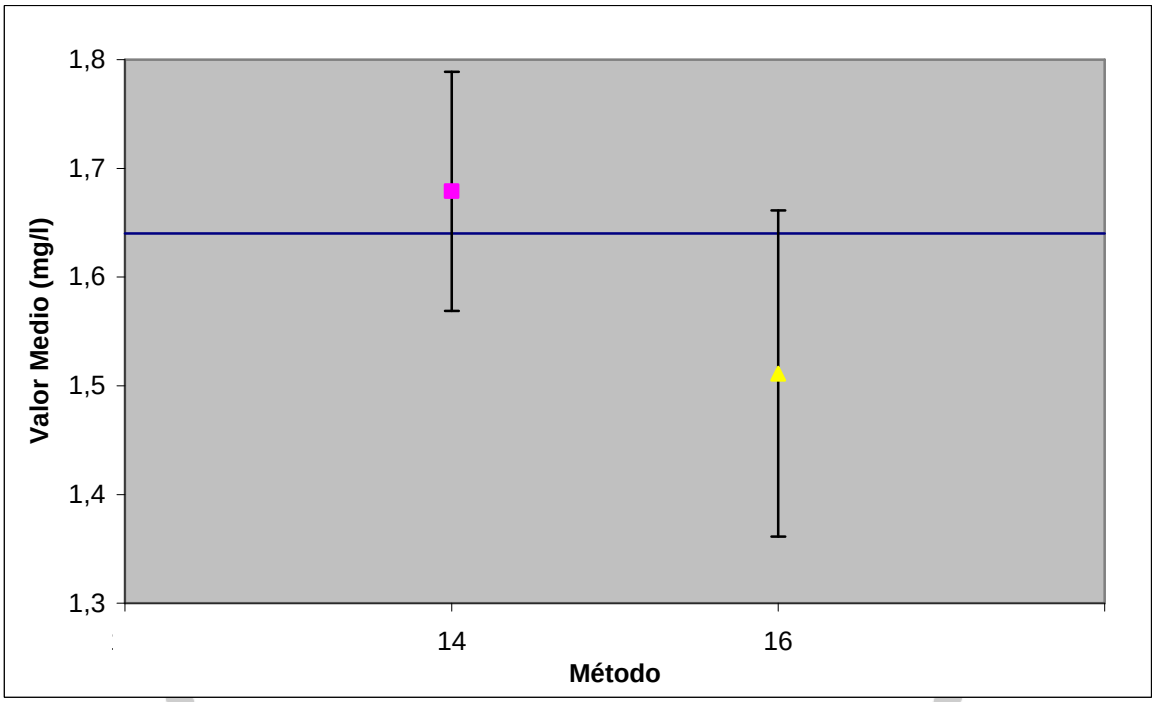
**GRÁFICO Nº 19**
Desviación según método – Fluoruro




14: Electrodo selectivo fluoruro (ISE)
16: Espectrofotometría con SPADNS



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# ANEXO II

## Información Estadística

### 1. Tablas de z-score

**Tabla 3 - Aniones**

| N°Lab. | cloruro | fluoruro | nitrato | sulfato |
|---|---|---|---|---|
| 1 | -1,37 | 0,99 | -0,85 | -0,06 |
| 2 | -0,38 | 0,08 | -0,39 | 1,28 |
| 3 | 0,00 | 0,46 | -1,05 | 2,01 |
| 4 | 0,72 | - | -0,65 | 0,75 |
| 5 | 0,67 | - | -1,63 | 1,19 |
| 6 | 1,03 | -0,30 | -2,48 | -0,85 |
| 7 | 1,90 | -1,83 | 0,26 | -0,50 |
| 8 | 1,79 | -0,38 | -2,48 | 0,13 |
| 9 | -0,76 | 1,22 | 0,92 | 0,03 |
| 10 | 0,00 | - | -0,07 | -0,91 |
| 11 | 0,50 | 0,30 | 0,07 | 0,47 |
| 12 | - | 1,22 | - | - |
| 13 | 0,38 | -1,07 | -1,70 | 0,34 |
| 14 | -0,23 | 0,30 | 0,26 | -0,91 |
| 15 | -1,22 | -1,91 | 0,75 | -1,13 |
| 16 | 0,38 | -0,76 | 1,57 | -3,10 |
| 17 | 1,89 | -2,29 | 2,88 | -0,03 |
| 18 | 1,14 | - | - | 0,66 |
| 19 | - | - | - | -0,78 |
| 20 | 1,26 | 0,99 | - | 0,19 |
| 21 | 0,00 | -1,30 | -1,05 | 0,97 |
| 22 | -0,76 | - | -5,29 | 0,66 |
| 23 | 1,90 | -1,83 | 0,92 | -0,28 |
| 24 | - | - | - | - |
| 25 | -0,34 | -0,38 | 0,26 | -0,03 |
| 26 | -5,71 | -0,08 | 1,76 | 0,66 |
| 27 | 1,83 | 2,13 | - | 1,43 |
| 28 | -0,91 | -0,08 | - | 0,13 |
| 29 | 0,27 | -0,23 | 1,76 | -2,10 |
| 30 | -1,26 | 0,30 | -0,72 | 1,19 |
| 31 | 0,00 | 0,46 | 1,57 | 0,03 |
| 32 | - | - | - | - |
| 33 | 1,90 | - | 1,57 | -1,54 |
| 34 | -5,33 | 1,22 | 11,31 | -1,54 |
| 35 | -0,13 | -0,08 | -0,85 | 0,05 |
| 36 | -0,46 | 0,15 | -0,72 | -0,13 |
| 37 | - | - | 0,20 | - |



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## Tabla 4 - Cationes

| N°Lab. | calcio | cinc | hierro | magnesio | potasio |
|---|---|---|---|---|---|
| 1 | -5,30 | -4,31 | 0,03 | -2,71 | -1,64 |
| 2 | 0,00 | - | 1,03 | 0,03 | - |
| 3 | 1,87 | 9,54 | 7,54 | -0,57 | 1,63 |
| 4 | -0,23 | - | - | 0,09 | - |
| 5 | 1,89 | -0,91 | -0,33 | -12,18 | 3,40 |
| 6 | -3,26 | -1,48 | -2,23 | 4,30 | -1,22 |
| 7 | 0,04 | -2,42 | 0,78 | 0,23 | 0,03 |
| 8 | 4,54 | 2,87 | 5,01 | 5,50 | 2,39 |
| 9 | 0,00 | 0,72 | 0,78 | 0,03 | 0,03 |
| 10 | -0,10 | - | 1,78 | -1,58 | - |
| 11 | 0,07 | 1,35 | 1,78 | 0,09 | 0,03 |
| 12 | - | 0,41 | 0,03 | -0,51 | -0,32 |
| 13 | -0,66 | - | -1,23 | -1,31 | -1,36 |
| 14 | - | -0,19 | -0,48 | - | -0,32 |
| 15 | -2,94 | 122,58 | 0,03 | -0,17 | -2,80 |
| 16 | 25,67 | - | - | 1,90 | - |
| 17 | -1,66 | 1,35 | 0,78 | 5,37 | 0,72 |
| 18 | 0,67 | - | - | - | - |
| 19 | 3,34 | 1,04 | 3,28 | -2,38 | -3,31 |
| 20 | 0,50 | -2,42 | -0,73 | 1,96 | 2,05 |
| 21 | -4,00 | -2,42 | 0,78 | 2,70 | -1,36 |
| 22 | - | 0,72 | 4,53 | - | - |
| 23 | -0,66 | - | 0,78 | 4,03 | - |
| 24 | - | 1,35 | 0,03 | - | - |
| 25 | 0,30 | -0,85 | 0,53 | -0,51 | 0,31 |
| 26 | -0,66 | 1,67 | 1,28 | 0,69 | -0,32 |
| 27 | 1,14 | - | - | - | -4,36 |
| 28 | 0,47 | 1,35 | 0,78 | -0,24 | -0,39 |
| 29 | -0,20 | - | - | 0,29 | - |
| 30 | -1,00 | 0,09 | 2,28 | 2,50 | - |
| 31 | -0,33 | 0,09 | -0,48 | 0,03 | 0,03 |
| 32 | - | -0,22 | 0,28 | - | - |
| 33 | 0,00 | - | - | 0,03 | - |
| 34 | 0,34 | -3,05 | 0,03 | 1,36 | -2,06 |
| 35 | 1,53 | 0,72 | -1,73 | 0,81 | 0,58 |
| 36 | -0,13 | - | 0,28 | 1,23 | - |
| 37 | - | - | - | - | - |



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## 2. Desviación de los resultados respecto del valor asignado

**Tabla 5 - Aniones**

| Lab. Nº | Cloruro | | Fluoruro | | Nitrato | | Sulfato | |
|---|---|---|---|---|---|---|---|---|
| | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío |
| **1** | 71,4 | -4,80 | 1,77 | 7,93 | 29,3 | -4,25 | 39,7 | -0,50 |
| **2** | 74 | -1,33 | 1,65 | 0,61 | 30 | -1,96 | 44 | 10,28 |
| **3** | 75,0 | 0,00 | 1,7 | 3,66 | 29 | -5,23 | 46,3 | 16,04 |
| **4** | 76,9 | 2,53 | - | - | 29,6 | -3,27 | 42,3 | 6,02 |
| **5** | 76,75 | 2,33 | - | - | 28,1 | -8,17 | 43,7 | 9,52 |
| **6** | 77,7 | 3,60 | 1,6 | -2,44 | 26,8 | -12,42 | 37,2 | -6,77 |
| **7** | 80,0 | 6,67 | 1,4 | -14,63 | 31,0 | 1,31 | 38,3 | -4,01 |
| **8** | 79,7 | 6,27 | 1,59 | -3,05 | 26,8 | -12,42 | 40,3 | 1,00 |
| **9** | 73 | -2,67 | 1,8 | 9,76 | 32 | 4,58 | 40 | 0,25 |
| **10** | 75 | 0,00 | - | - | 30,5 | -0,33 | 37,0 | -7,27 |
| **11** | 76,3 | 1,73 | 1,68 | 2,44 | 30,7 | 0,33 | 41,4 | 3,76 |
| **12** | - | - | 1,8 | 9,76 | - | - | - | - |
| **13** | 76 | 1,33 | 1,5 | -8,54 | 28 | -8,50 | 41 | 2,76 |
| **14** | 74,4 | -0,80 | 1,68 | 2,44 | 31 | 1,31 | 37 | -7,27 |
| **15** | 71,8 | -4,27 | 1,39 | -15,24 | 31,75 | 3,76 | 36,3 | -9,02 |
| **16** | 76,0 | 1,33 | 1,54 | -6,10 | 33,00 | 7,84 | 30,0 | -24,81 |
| **17** | 79,97 | 6,63 | 1,34 | -18,29 | 35 | 14,38 | 39,8 | -0,25 |
| **18** | 78 | 4,00 | - | - | - | - | 42 | 5,26 |
| **19** | - | - | - | - | - | - | 37,4 | -6,27 |
| **20** | 78,3 | 4,40 | 1,77 | 7,93 | - | - | 40,5 | 1,50 |



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**Tabla 5 - Aniones (continuación)**

| Lab. Nº | Cloruro | | Fluoruro | | Nitrato | | Sulfato | |
|---|---|---|---|---|---|---|---|---|
| | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío |
| **21** | 75 | 0,00 | 1,47 | -10,37 | 29,0 | -5,23 | 43 | 7,77 |
| **22** | 73 | -2,67 | - | - | 22,5 | -26,47 | 42 | 5,26 |
| **23** | 80 | 6,67 | 1,40 | -14,63 | 32 | 4,58 | 39 | -2,26 |
| **24** | - | - | - | - | - | - | - | - |
| **25** | 74,1 | -1,20 | 1,59 | -3,05 | 31,0 | 1,31 | 39,8 | -0,25 |
| **26** | 60,0 | -20,00 | 1,63 | -0,61 | 33,3 | 8,82 | 42,0 | 5,26 |
| **27** | 79,8 | 6,40 | 1,92 | 17,07 | - | - | 44,48 | 11,48 |
| **28** | 72,6 | -3,20 | 1,63 | -0,61 | - | - | 40,3 | 1,00 |
| **29** | 75,7 | 0,93 | 1,61 | -1,83 | 33,3 | 8,82 | 33,2 | -16,79 |
| **30** | 71,7 | -4,40 | 1,68 | 2,44 | 29,5 | -3,59 | 43,7 | 9,52 |
| **31** | 75 | 0,00 | 1,7 | 3,66 | 33 | 7,84 | 40 | 0,25 |
| **32** | - | - | - | - | - | - | - | - |
| **33** | 80 | 6,67 | - | - | 33 | 7,84 | 35 | -12,28 |
| **34** | 61 | -18,67 | 1,8 | 9,76 | 47,9 | 56,54 | 35 | -12,28 |
| **35** | 74,65 | -0,47 | 1,63 | -0,61 | 29,30 | -4,25 | 40,05 | 0,38 |
| **36** | 73,8 | -1,60 | 1,66 | 1,22 | 29,5 | -3,59 | 39,5 | -1,00 |
| **37** | - | - | - | - | 30,91 | 1,01 | - | - |



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**Tabla 6 - Cationes**

| Lab. Nº | Calcio | | Cinc | | Hierro | | Magnesio | | Potasio | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío |
| **1** | 44,1 | -26,49 | 0,26 | -34,51 | 0,5 | 0,20 | 25,9 | -13,55 | 15,6 | -13,14 |
| **2** | 60 | 0,02 | - | - | 0,54 | 8,22 | 30 | 0,13 | - | - |
| **3** | 65,6 | 9,35 | 0,7 | 76,32 | 0,8 | 60,32 | 29,1 | -2,87 | 20,3 | 13,03 |
| **4** | 59,3 | -1,15 | - | - | - | - | 30,1 | 0,47 | - | - |
| **5** | 65,66 | 9,45 | 0,368 | -7,30 | 0,486 | -2,61 | 11,71 | -60,91 | 22,84 | 27,17 |
| **6** | 50,2 | -16,32 | 0,35 | --11,84 | 0,41 | -17,84 | 36,4 | 21,50 | 16,2 | -9,80 |
| **7** | 60,1 | 0,18 | 0,32 | -19,40 | 0,53 | 6,21 | 30,3 | 1,13 | 18,0 | 0,22 |
| **8** | 73,6 | 22,69 | 0,488 | 22,92 | 0,699 | 40,08 | 38,2 | 27,50 | 21,4 | 19,15 |
| **9** | 60 | 0,02 | 0,42 | 5,79 | 0,53 | 6,21 | 30 | 0,13 | 18 | 0,22 |
| **10** | 59,7 | -0,48 | - | - | 0,57 | 14,23 | 27,6 | -7,88 | - | - |
| **11** | 60,2 | 0,35 | 0,44 | 10,83 | 0,57 | 14,23 | 30,1 | 0,47 | 18,0 | 0,22 |
| **12** | - | - | 0,41 | 3,27 | 0,5 | 0,20 | 29,2 | -2,54 | 17,5 | -2,56 |
| **13** | 58 | -3,32 | - | - | 0,45 | -9,82 | 28 | -6,54 | 16 | -10,91 |
| **14** | - | - | 0,391 | -1,51 | 0,480 | -3,81 | - | - | 17,5 | -2,56 |
| **15** | 51,16 | -14,72 | 4,29 | 980,60 | 0,5 | 0,20 | 29,71 | -0,83 | 13,94 | -22,38 |
| **16** | 137,0 | 128,37 | - | - | - | - | 32,8 | 9,48 | - | - |
| **17** | 55 | -8,32 | 0,44 | 10,83 | 0,53 | 6,21 | 38 | 26,84 | 19 | 5,79 |
| **18** | 62 | 3,35 | - | - | - | - | - | - | - | - |
| **19** | 70,0 | 16,69 | 0,43 | 8,31 | 0,63 | 26,25 | 26,4 | -11,88 | 13,2 | -26,50 |
| **20** | 61,5 | 2,52 | 0,32 | -19,40 | 0,47 | -5,81 | 32,9 | 9,81 | 20,9 | 16,37 |



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**Tabla 6 - Cationes (continuación)**

| Lab. Nº | Calcio | | Cinc | | Hierro | | Magnesio | | Potasio | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío |
| **21** | 48 | -19,99 | 0,32 | -19,40 | 0,53 | 6,21 | 34 | 13,48 | 16 | -10,91 |
| **22** | - | - | 0,42 | 5,79 | 0,68 | 36,27 | - | - | - | - |
| **23** | 58 | -3,32 | - | - | 0,53 | 6,21 | 36 | 20,16 | - | - |
| **24** | - | - | 0,440 | 10,83 | 0,50 | 0,20 | - | - | - | - |
| **25** | 60,9 | 1,52 | 0,37 | -6,80 | 0,52 | 4,21 | 29,2 | -2,54 | 18,4 | 2,45 |
| **26** | 58,0 | -3,32 | 0,45 | 13,35 | 0,55 | 10,22 | 31,0 | 3,47 | 17,5 | -2,56 |
| **27** | 63,4 | 5,68 | - | - | - | - | - | - | 11,7 | -34,86 |
| **28** | 61,4 | 2,35 | 0,44 | 10,83 | 0,53 | 6,21 | 29,6 | -1,20 | 17,4 | -3,12 |
| **29** | 59,4 | -0,98 | - | - | - | - | 30,4 | 1,47 | - | - |
| **30** | 57 | -4,98 | 0,40 | 0,76 | 0,59 | 18,24 | 33,7 | 12,48 | - | - |
| **31** | 59 | -1,65 | 0,40 | 0,76 | 0,48 | -3,81 | 30 | 0,13 | 18 | 0,22 |
| **32** | - | - | 0,39 | -1,76 | 0,51 | 2,20 | - | - | - | - |
| **33** | 60 | 0,02 | - | - | - | - | 30 | 0,13 | - | - |
| **34** | 61 | 1,68 | 0,3 | -24,43 | 0,5 | 0,20 | 32 | 6,81 | 15 | -16,48 |
| **35** | 64,57 | 7,63 | 0,42 | 5,79 | 0,43 | -13,83 | 31,17 | 4,04 | 18,80 | 4,68 |
| **36** | 59,6 | -0,65 | - | - | 0,51 | 2,20 | 31,8 | 6,14 | - | - |
| **37** | - | - | - | - | - | - | - | - | - | - |



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### 3. Datos Históricos

La presente tabla muestra las desviaciones estándar obtenidas, para cada uno de los analitos, en todas las rondas interlaboratorio ejecutadas hasta la fecha.
Se encuentran resaltadas las mejores desviaciones estándar.

| Analitos | Cl | F | $NO_3$ | $SO_4$ | Ca | Zn | Fe | Mg | K |
|---|---|---|---|---|---|---|---|---|---|
| **$S_L$ % Aguas 96** | 4,5 | -- | 7,6 | 11,4 | 7,9 | -- | 24,1 | 9,3 | -- |
| **$S_L$ % Aguas 98** | 3,4 | -- | 8,1 | 15,2 | 3,4 | 18,8 | 13,1 | 4,2 | -- |
| **$S_L$ % Aguas 00** | 6,3 | 15,6 | 8,0 | 6,1 | 5,1 | 21,5 | 9,8 | 5,8 | -- |
| **$S_L$ % Aguas 02** | 5,3 | 10,1 | 6,6 | 11,5 | 8,5 | 10,0 | 11,9 | 7,2 | 8,9 |
| **$S_L$ % Aguas 04** | 6,1 | 5,9 | 8,6 | 9,0 | 4,6 | 21,0 | 6,7 | 3,7 | 11,0 |
| **$S_L$ % Aguas 06** | 3,0 | 8,4 | 8,9 | 8,4 | 10,0 | 8,3 | 9,3 | 13,0 | 12,0 |
| **$S_L$ % Aguas 08** | 5,7 | 11,8 | 3,2 | 11,3 | 6,4 | 5,6 | 12,2 | 7,7 | 5,8 |
| **$S_L$ % Aguas 10** | 5,6 | 12,6 | 5,1 | 9,3 | 6,4 | 10,2 | 9,1 | 10,5 | 8,5 |
| **$S_L$ % Aguas 12** | 4,7 | 6,9 | 3,8 | 11,6 | 3,7 | 7,3 | 7,8 | 7,0 | 7,6 |
| **$S_L$ % Aguas 14** | 4,4 | 9,2 | 7,6 | 8,3 | 6,3 | 15 | 8,2 | 9,1 | 13 |



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# ANEXO III

## Definiciones

### 1. Definiciones generales

**1.1 Resultado de un medición:** es el conjunto de valores de una magnitud atribuidos a un mesurando, acompañados de cualquier otra información relevante disponible.

**1.2 Precisión:** proximidad entre las indicaciones o los valores medidos obtenidos en mediciones repetidas de un mismo objeto, o de objetos similares, bajo condiciones especificadas.

**1.3 Repetibilidad:** precisión de la medición bajo un conjunto de condiciones de repetibilidad: mismo procedimiento de medición, mismo operador, mismo equipamiento, en el mismo sitio y en un período corto de tiempo.

**1.4 Desviación estándar de repetibilidad:** es la desviación estándar de los resultados de una medición obtenida bajo condiciones de repetibilidad.

**1.5 Reproducibilidad:** precisión de la medición bajo un conjunto de condiciones de reproducibilidad: mismo procedimiento de medición, diferentes operadores, diferente equipamiento, en diferentes sitios y en un período largo de tiempo.

**1.6 Desviación estándar de reproducibilidad:** es la desviación estándar de resultados de ensayos obtenidos en condiciones de reproducibilidad.

**1.7 Error sistemático:** es una componente del error total que, en mediciones repetidas, permanece constante o varía de forma predecible.

**1.8 Error aleatorio:** es una componente del error total que, en mediciones repetidas, varía de forma impredecible.

**1.9 Sesgo:** valor estimado de un error sistemático.

**1.10 Incertidumbre:** parámetro no negativo que caracteriza la dispersión de los valores atribuidos a un mesurando, a partir de la información que se utiliza.



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## 2. Definiciones sobre tratamiento de los resultados

**2.1 Valor asignado (X)** = valor atribuido a una propiedad particular de un ítem de un ensayo de aptitud

**2.2 Desviación estándar para la evaluación de la aptitud ($\tilde{\sigma}$)** = medida de la dispersión utilizada en la evaluación de los resultados de un ensayo de aptitud, basada en la información disponible.

**2.3 Parámetro z-score**
El parámetro *z-score* se define de la siguiente manera:

$$z = \frac{x_i - X}{\tilde{\sigma}}$$

donde:

$x_i$ = valor promedio de los resultados de cada laboratorio
X = valor asignado a la muestra
$\tilde{\sigma}$ = desviación estándar para la evaluación de la aptitud

Los criterios para la evaluación son los siguientes:

$|z| \leq 2$ satisfactorio  $2 < |z| < 3$ cuestionable  $|z| \geq 3$ no satisfactorio



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# ANEXO IV

## REFERENCIAS BIBLIOGRÁFICAS

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Instituto Nacional de Tecnología Industrial
INTI

SAI
Servicio Argentino de Interlaboratorios

# ENSAYO DE APTITUD

# "ANÁLISIS DE ELEMENTOS TRAZA EN SOLUCIÓN ACUOSA 2014"

**PRQ-02/2014**

## INFORME FINAL

Fecha de emisión: diciembre de 2014

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# 1. INTRODUCCIÓN

El objetivo fundamental de este estudio es el de ofrecer a los laboratorios interesados la posibilidad de controlar los resultados de ensayos obtenidos mediante la utilización de métodos analíticos rutinarios y de tener una evidencia objetiva de su desempeño técnico.

Esta actividad permite, si se realiza en forma continua, identificar las posibles causas de error en los métodos y por lo tanto perfeccionar los procedimientos de ensayo a fin de disminuir dichos errores, así como también evaluar los desvíos, desarrollar nuevos métodos y realizar la comparación de los mismos.

El programa de ensayos de aptitud en soluciones acuosas, incluye determinaciones de analitos en muy bajas concentraciones a fin de evaluar la medición de parámetros al nivel de trazas.

Este tipo de ensayo representa un desafío para los laboratorios participantes, quienes deben garantizar el buen funcionamiento de sus equipos, el control de las instalaciones y condiciones ambientales del laboratorio y del manejo de las muestras para evitar contaminaciones.
También representa un desafío para los organizadores en lo que concierne a la preparación y estabilidad de las muestras enviadas utilizando una metodología de trabajo que permita obtener una incertidumbre aceptable en el valor asignado a la concentración de las muestras.
Desde el primer ensayo de este tipo llevado a cabo en el año 1998, se han ido efectuando cambios en los procedimientos de preparación de las muestras sintéticas con el fin de evitar las interferencias durante la ejecución de los ensayos de los distintos analitos y al mismo tiempo garantizar la estabilidad de las muestras. También es de interés que las muestras presenten características de riesgos menores para que, siendo menos peligrosas, no tengan inconvenientes de aduanas y puedan participar laboratorios extranjeros.

En el presente ensayo hay ingresos de nuevos participantes; les damos la bienvenida y esperamos que nos acompañen en los próximos ejercicios.
Para los laboratorios que han realizado varias rondas de la intercomparación agradecemos que nos ayuden a la continuidad de la actividad.

La organización y evaluación de este estudio fueron realizadas por INTI-Química (Lic. Pablo Álvarez y Lic. Ana Hernández) con el soporte técnico administrativo de INTI-Servicio Argentino de Interlaboratorios y el aporte de conocimientos y experiencias de los profesionales que constituyen el grupo de trabajo del Programa para la Calidad de las Mediciones Químicas y que organizaron los ensayos interlaboratorios previos.

El INTI preserva la confidencialidad de los participantes mediante la asignación de un código único elegido en forma aleatoria y el cual es solo conocido por el propio participante y el INTI. El tratamiento de los resultados y el informe de los mismos se realizan utilizando ese mismo número.
El personal de INTI firma un compromiso de confidencialidad.



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# 2. MUESTRAS ENVIADAS

## 2.1 Preparación de las muestras

Se envió una solución acuosa para el análisis de elementos traza la cual contiene los siguientes analitos: arsénico, cadmio, cromo, y plomo.
También se envió una solución, preparada especialmente, que contiene mercurio.

Las soluciones se prepararon utilizando agua desmineralizada por ósmosis inversa con tratamiento final de pulido, de conductividad 0,9 µS/cm.

Las soluciones se prepararon tomando (con pipetas calibradas antes del uso) y pesando las alícuotas necesarias de las siguientes soluciones:

- Arsénico: solución estándar de arsénico (Plasma HIQU) IONEX (solución que contiene 1,32 g $As_2O_3$ en ácido nítrico 2 a 5 %), marca CL – Chem Lab art. CL1.0133.0500, lote Nº 17.0060112.10, concentración As: (1000 ± 2) mg/L.
- Cadmio: solución estándar de cadmio (Plasma HIQU) – IONEX (solución preparada de $Cd(NO_3)_2$ en ácido nítrico 0,5 mol/L), marca CL – Chem Lab art. CL 01.0301.0500, lote N° 18.2061801.20 concentración Cd: (1000 ± 2) mg/L.
- Cromo: solución estándar de cromo (Plasma HIQU) – IONEX (solución preparada en ácido nítrico 2 a 5 %) marca CL – Chem Lab art. CL01.0362.0500, lote N° 17.0941109.10, concentración Cr: (1000 ± 2) mg/L.
- Mercurio: solución estándar de mercurio preparada en ácido nítrico 5 % en volumen, marca Inorganic Ventures CGHG1-5, lote F2-HGO2096, concentración Hg: (1002 ± 6) mg/L.
- Plomo: solución estándar de plomo (Plasma HIQU) – IONEX (solución que contiene 1,599 g de nitrato de plomo por litro en ácido nítrico 2 a 5 %) marca Chem Lab Spectro ECON art. N° CL 01.1226.0500, lote N° 17.1611808.40 concentración Pb (II): (1000 ± 2) mg/L.

En la acidificación de las soluciones se usó ácido nítrico 65% marca Suprapur (Merck), art. 1.00441.1000, lote Z 228041-104.
Para la estabilización de la solución que contiene mercurio se utilizó dicromato de potasio.

Los envases de las muestras son frascos de vidrio de 500 $cm^3$ y 250 $cm^3$ sin uso, lavados convenientemente y mantenidos con agua desmineralizada durante 1 semana.
Los frascos se enjuagaron con las soluciones muestras correspondientes y el fraccionamiento se realizó manualmente en campana de flujo laminar.

Las pesadas se realizaron en INTI-Química y se determinó la masa por comparación con pesas patrones con trazabilidad a los patrones nacionales.



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### 2.2 Valores Asignados

| | |
|---|---|
| Arsénico (µg/l) | 44,1 ± 4,4 |
| Cadmio (µg/l) | 34,5 ± 3,4 |
| Cromo (µg/l) | 54,5 ± 5,4 |
| Mercurio (µg/l) | 33,5 ± 5,0 |
| Plomo (µg/l) | 75,3 ± 7,5 |

Los valores asignados fueron establecidos por los laboratorios metrológicos del INTI, cuyas capacidades de medición y calibración (CMC´s) fueron declaradas y aprobadas por el CIPM-MRA en el año 2009 (apéndice C del BIPM, http://kcdb.bipm.org/appendixC/)

La incertidumbre en el valor de cada concentración fue calculada teniendo en cuenta todos los pasos involucrados en la preparación y medición de las soluciones, siguiendo las recomendaciones indicadas en las guías JCGM 100:2008 y EURACHEM/CITAC 2012 (ver Anexo IV).

## 3. RESULTADOS ENVIADOS POR LOS PARTICIPANTES

### 3.1 Métodos de análisis

Las técnicas y los métodos de análisis utilizados fueron elegidos por los participantes y se describen a continuación.

3.1.1 Determinación de Arsénico

1) Absorción atómica (generación de hidruros). Laboratorios: 2, 7, 9, 10, 12, 15 y 18.

2) Absorción atómica (con horno de grafito). Laboratorios: 8, 11, 16 y 20.

3) Espectrofotometría (dietilditiocarbamato de plata). Laboratorios: 3, 14 y 21.

4) Espectrometría de emisión (ICP – OES). Laboratorio: 17.

5) Espectrometría de emisión (ICP – MS). Laboratorios: 1, 5, 6 y 19.



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3.1.2 Determinación de Cadmio

6) Absorción atómica con llama. Laboratorios: 1, 3, 4, 7, 8, 9, 10 y 12.

7) Absorción atómica (con horno de grafito). Laboratorios: 11, 13, 15, 16, 18 y 20.

8) Espectrometría de emisión (ICP - OES). Laboratorio: 17.

9) Espectrometría de emisión – masa (ICP – MS). Laboratorios: 5, 6 y 19.

10) Colorimetría con ditizona. Laboratorio: 14.

3.1.3 Determinación de Cromo

11) Absorción atómica con llama. Laboratorios: 1, 3, 4, 7, 8, 9 y 10.

12) Absorción atómica (con horno de grafito). Laboratorios: 11, 13, 15, 16 y 18.

13) Espectrofotometría (Difenilcarbazida). Laboratorios: 14 y 21.

14) Espectrometría de emisión (ICP-OES). Laboratorio: 17.

15) Espectrometría de emisión – masa (ICP – MS). Laboratorios: 5, 6, y 19.

3.1.4 Determinación de Plomo

16) Absorción atómica con llama. Laboratorios: 1, 3, 4, 7, 9 y 10.

17) Absorción atómica (con horno de grafito). Laboratorios: 8, 11, 13, 15, 16, 18 y 20.

18) Espectrofotometría (Ditizona). Laboratorio: 14.

19) Espectrofotometría de emisión - masa (ICP- MS). Laboratorios: 5, 6 y 19.

20) Espectrometría de emisión (ICP-OES). Laboratorio: 17.

3.1.5 Determinación de Mercurio

21) Absorción atómica (acoplada a generación de vapor frío). Laboratorios: 8,10, 12, 15, 16 y 18.

22) Analizador de mercurio por inyección de flujo. Laboratorios: 6, 7 y 19.

23) Espectrofotometría de emisión - masa (ICP- MS). Laboratorios: 1 y 5.



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### 3.2 Datos enviados

Los datos enviados por los participantes pueden verse en la Tabla 1.
El número de cifras significativas y las unidades figuran tal como fueron informadas por los participantes.

En los gráficos 1 a 9 (ANEXO I) se pueden observar las desviaciones de todos los resultados respecto del valor asignado para cada analito y la desviación estándar (σ) utilizada en el calculo del parámetro z.
Se indica además, en el mismo gráfico, el valor promedio robusto obtenido aplicando el procedimiento estadístico descripto en el punto 5 de este informe.

**TABLA 1**
**Datos enviados por los participantes - Elementos trazas**

| Laboratorio N° | Muestra N° | Arsénico µg/L | Cadmio µg/L | Cromo µg/L | Mercurio µg/L | Plomo µg/L |
|---|---|---|---|---|---|---|
| 01 | 06 | 47,7 | 29 | 170 | ND* | <140 (LQ) |
| 02 | 25 | 39 | NI | NI | NI | NI |
| 03 | 19 | 0,0270 | 32,08 | 38,28 | NI | 56,26 |
| 04 | 21 | NI | 36 | 59 | NI | 73 |
| 05 | 20 y 07’ | 55 | 41,6 | 73 | 31 | 95,2 |
| 06 | 02 y 09’ | 38,1 | 29,9 | 55,0 | 40,1 | 76,8 |
| 07 | 09 y 04' | 43,2 | 31 | 52 | 36 | 76 |
| 08 | 04 y 18' | 49,6 | 32 | 55 | 33,1 | 67,7 |
| 09 | 18 | 49,1 | 29,5 | 33,7 | NI | 75,6 |
| 10 | 31 y 05' | 41,88 | 35,0 | 50,0 | 35,2 | 80,0 |
| 11 | 32 | 48,00 | 37,38 | 47,80 | NI | 75,80 |
| 12 | 14 y 10' | 45 | 43 | NI | 30 | NI |
| 13 | 33 | 46 | 36 | 54 | NI | 73 |
| 14 | 24 | 40,9 | 38,5 | 50,3 | NI | 77,4 |
| 15 | 16 y 11' | 48,4 | 33,6 | 53,8 | 30,0 | 80,1 |
| 16 | 37 y 12' | 50 | 31 | 51 | 41 | 30 |
| 17 | 36 | 46 | 35 | 54 | NI | 74 |
| 18 | 15 y 17' | 44 | 31,6 | 39,2 | 32 | 82,4 |
| 19 | 38 y 02' | 43 | 33 | 54 | 34 | 74 |
| 20 | 11 | 43,4 | 29,2 | NI | NI | 75,3 |
| 21 | 29 y 40 | 41 | NI | 55 | NI | NI |

‘ Botella para la determinación de mercurio
NI: No Informó
ND: No Detectado
* Medido sobre la muestra “Trazas”
LQ: Límite de Cuantificación



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## 4. EVALUACIÓN DEL DESEMPEÑO DE LOS LABORATORIOS

La evaluación del desempeño de los laboratorios participantes se llevó a cabo utilizando como criterio el parámetro *z-score,* a partir del valor asignado (X) y de la desviación estándar para la evaluación de la aptitud ($\tilde{\sigma}$), tal como se muestra en la definición indicada en el Anexo III.

El valor de $\tilde{\sigma}$ utilizada en el cálculo del *z-score*, para cada uno de los analitos, se ha prefijado teniendo presente objetivos de desempeño. Los valores de $\tilde{\sigma}$ para los diferentes analitos se muestran en la tabla siguiente:

| Trazas | |
|---|---|
| **ANALITO** | $\tilde{\sigma}$ |
| Arsénico | 10 % |
| Cadmio | 10 % |
| Cromo | 10 % |
| Mercurio | 15 % |
| Plomo | 10 % |

Los valores asignados (X) para cada uno de los analitos son los provistos por los laboratorios metrológicos del INTI.

Los parámetros *z-score*, para cada uno de los analitos, pueden verse en los gráficos 6 a 10 (Anexo I).
La tabla 3, con los valores de los z-scores para los 5 analitos, puede verse en el Anexo II.

## 5. TRATAMIENTO ESTADÍSTICO DE LOS RESULTADOS

Para estudiar el comportamiento del conjunto de resultados de la presente ronda interlaboratorios se realizan los cálculos estadísticos.

En la primera etapa de la evaluación se procedió al examen crítico de los datos, descartándose aquellos que resultaban obviamente discordantes.

En la etapa siguiente se procedió al análisis estadístico aplicando los métodos robustos (Algoritmo A) recomendados en la norma ISO/IEC 13528:2005 (ver anexo IV) para los ensayos de aptitud.



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A continuación se presentan los valores promedios robustos (Algoritmo A) y desviación estándar robusta:

| Analito | N° total de datos | Valor Asignado (mg/l) | Valor medio robusto (mg/l) | Desviación estándar robusta (mg/l) | Desviación estándar robusta relativa (%) |
|---|---|---|---|---|---|
| Arsénico | 20 | 44,1 | 44,7 | 4,1 | 9,2 |
| Cadmio | 19 | 34,5 | 33,6 | 3,9 | 11,6 |
| Cromo | 18 | 54,5 | 52,6 | 4,6 | 8,7 |
| Mercurio | 10 | 33,5 | 34,2 | 4,4 | 12,9 |
| Plomo | 17 | 75,3 | 75,9 | 3,3 | 4,3 |

Para su comparación con los valores obtenidos en las rondas interlaboratorios anteriores, ver la tabla “Datos históricos” en el Anexo II del presente informe.

En la Tabla 4 (Anexo II) se resumen los valores numéricos correspondientes a las desviaciones de todos los resultados enviados por cada uno de los participantes con respecto al valor asignado.

## 6. COMPARACIÓN DE LOS RESULTADOS OBTENIDOS SEGÚN EL MÉTODO UTILIZADO

En este ejercicio, la metodología utilizada por los participantes fue variada, con una cantidad de 5 metodologías por analito, excepto para el mercurio. Algunos participantes han utilizado metodologías nuevas como el ICP – MS y el ICP – OES, con muy buen desempeño para los participantes que ya tienen experiencia en este tipo de metodologías.
En el gráfico 11 (Anexo I) se puede observar como varían los resultados obtenidos para el analito cadmio utilizando distintos métodos de ensayo. Se representa el valor medio obtenido con los métodos más utilizados y su correspondiente desviación estándar comparándolos con el valor asignado.
No es posible realizar la comparación entre métodos para los otros analitos porque no se alcanza el número mínimo de 5 participantes por método de ensayo.



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## 7. COMENTARIOS

En la tabla siguiente se observan, para cada analito, el número de resultados satisfactorios, cuestionables y no satisfactorios, evaluadas mediante el parámetro z:

| Analito | satisfactorios | cuestionables | no satisfactorios |
|---|---|---|---|
| Arsénico | 18 | 1 | 1 |
| Cadmio | 17 | 2 | - |
| Cromo | 13 | 2 | 3 |
| Mercurio | 10 | - | - |
| Plomo | 14 | 2 | 1 |

El número de datos satisfactorios, datos cuestionables y datos no satisfactorios respecto del número total de datos recibidos es del 85,7 %, 8,3 % y 6,0 % respectivamente.

El desempeño global es muy bueno. Hay una mejora notable comparando los porcentajes para los interlaboratorios llevados a cabo en los años anteriores.

| Interlab. | % satisfactorios | % cuestionables | % no satisfactorios |
|---|---|---|---|
| 2002 | 81 | 7,9 | 11 |
| 2004 | 77 | 15,6 | 7,3 |
| 2006 | 68,5 | 10,5 | 20,9 |
| 2008 | 76,3 | 8,6 | 15,1 |
| 2010 | 81,2 | 3,8 | 15,0 |
| 2012 | 85,4 | 5,8 | 8,7 |

Los informes de resultados durante este ensayo de aptitud se presentaron más homogéneos respecto a las unidades pero las cifras significativas deben ajustarse a los valores de incertidumbre que realmente pueden alcanzarse en los laboratorios de ensayos. Este aspecto es parte de la capacidad técnica del laboratorio y no debe descuidarse porque es evaluado en estos ejercicios de la misma forma que su capacidad de medición.

A fin de lograr un mecanismo de mejora continua, solicitamos a los laboratorios que nos envíen cualquier sugerencia o comentario que consideren oportuno.

Por otro lado, en caso de tener alguna duda sobre la ejecución de los métodos de ensayo, de las causas de diferencias en los resultados o dudas sobre las evaluaciones individuales, esperamos su consulta.



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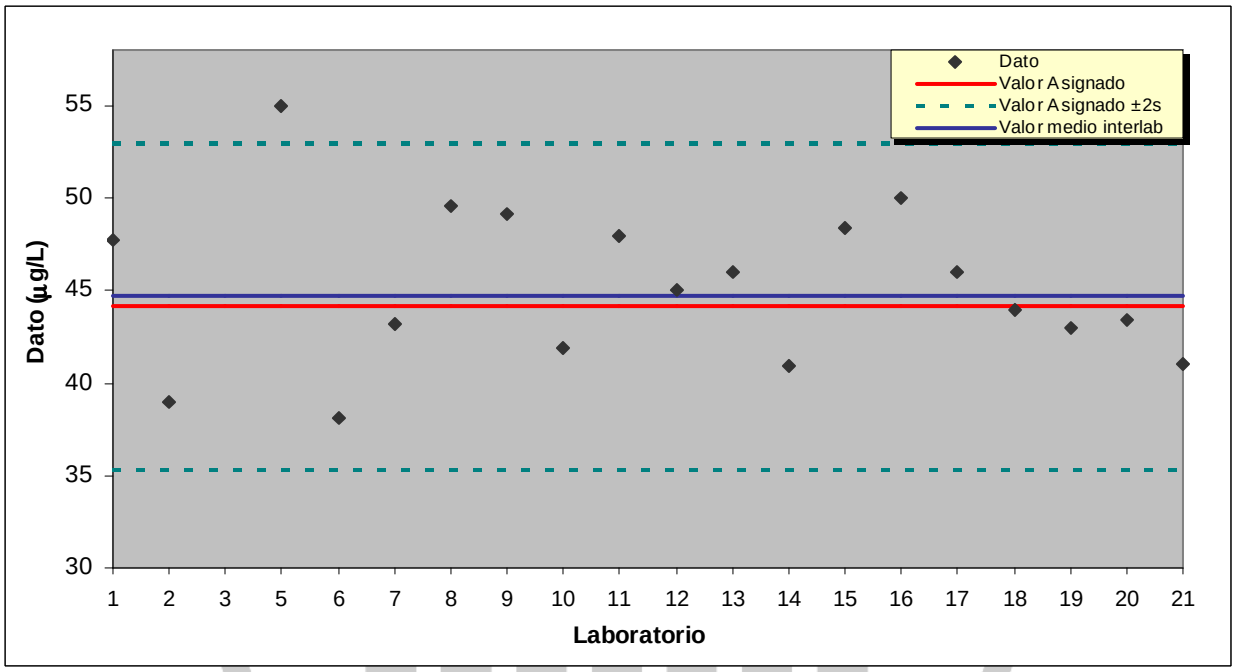
# ANEXO I

## GRÁFICO 1

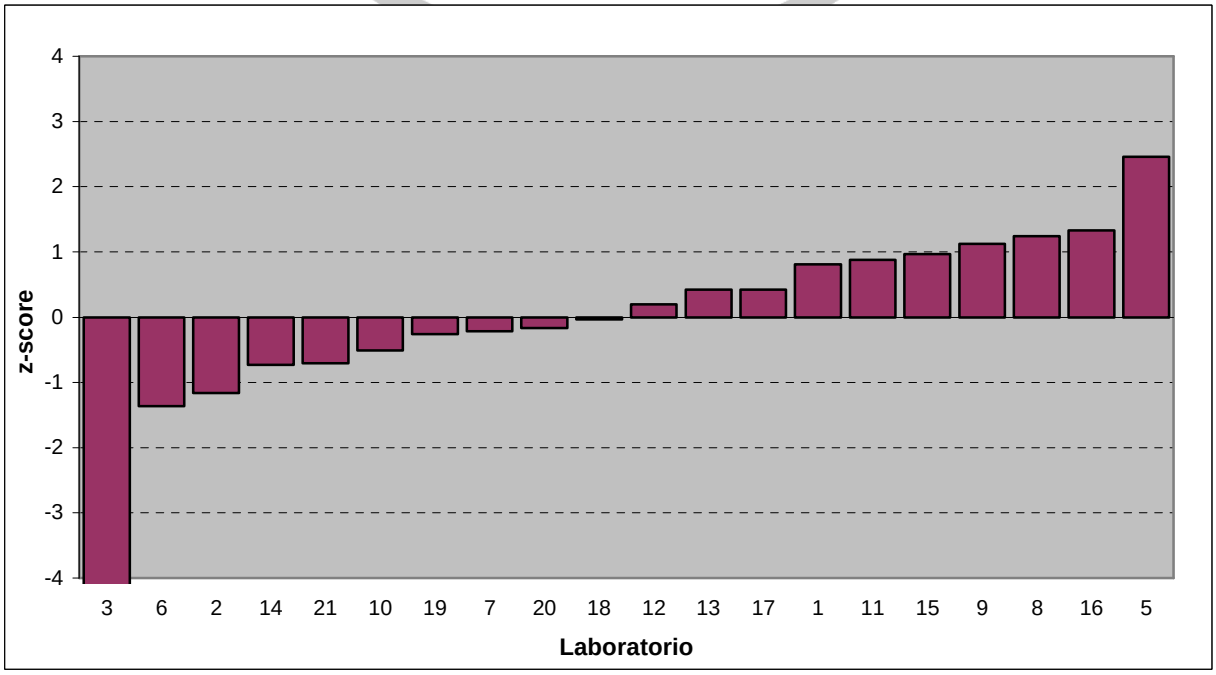
Datos enviados por los participantes – Arsénico




Laboratorio cuyo valor excede el ámbito del gráfico: 3

## GRÁFICO 6

Parámetro z – Arsénico




Laboratorio cuyo parámetro z excede el ámbito del gráfico: 3



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**GRÁFICO 2**
Datos enviados por los participantes – Cadmio

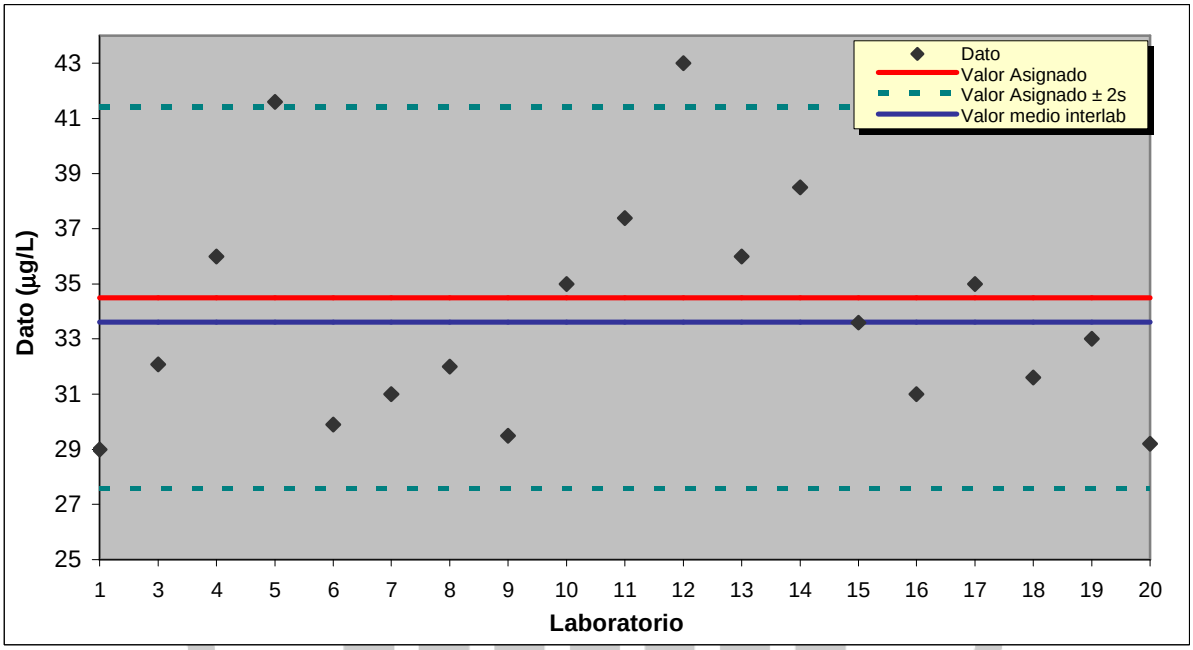


**GRÁFICO 7**
Parámetro z – Cadmio

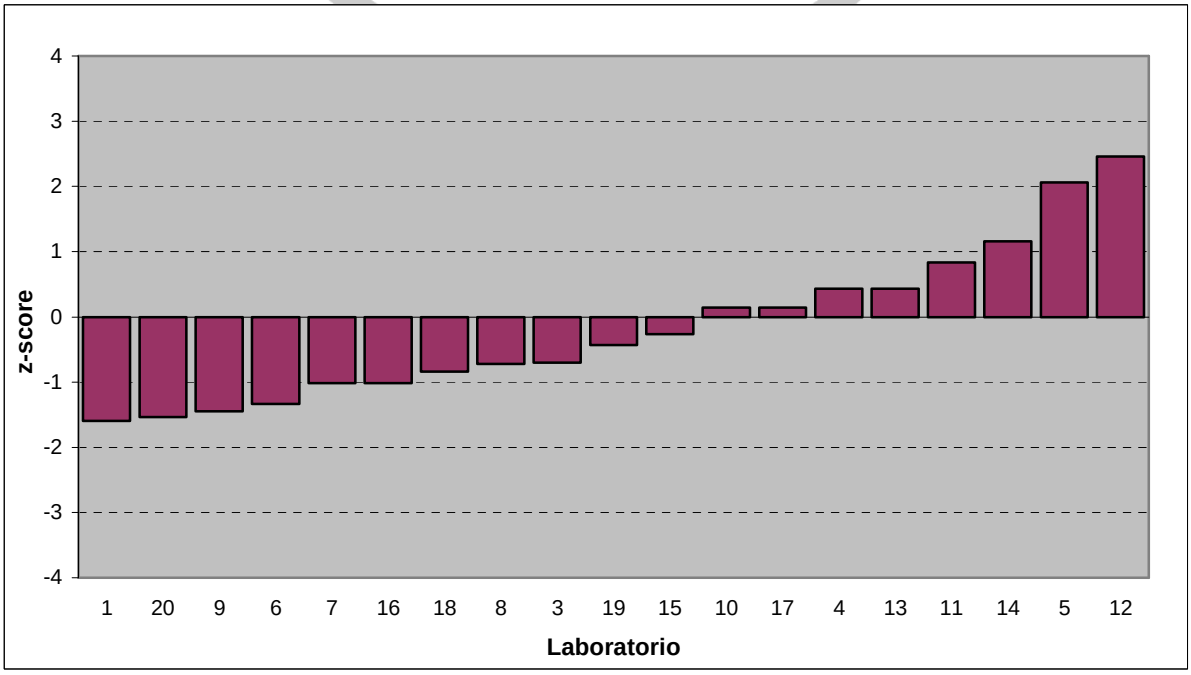




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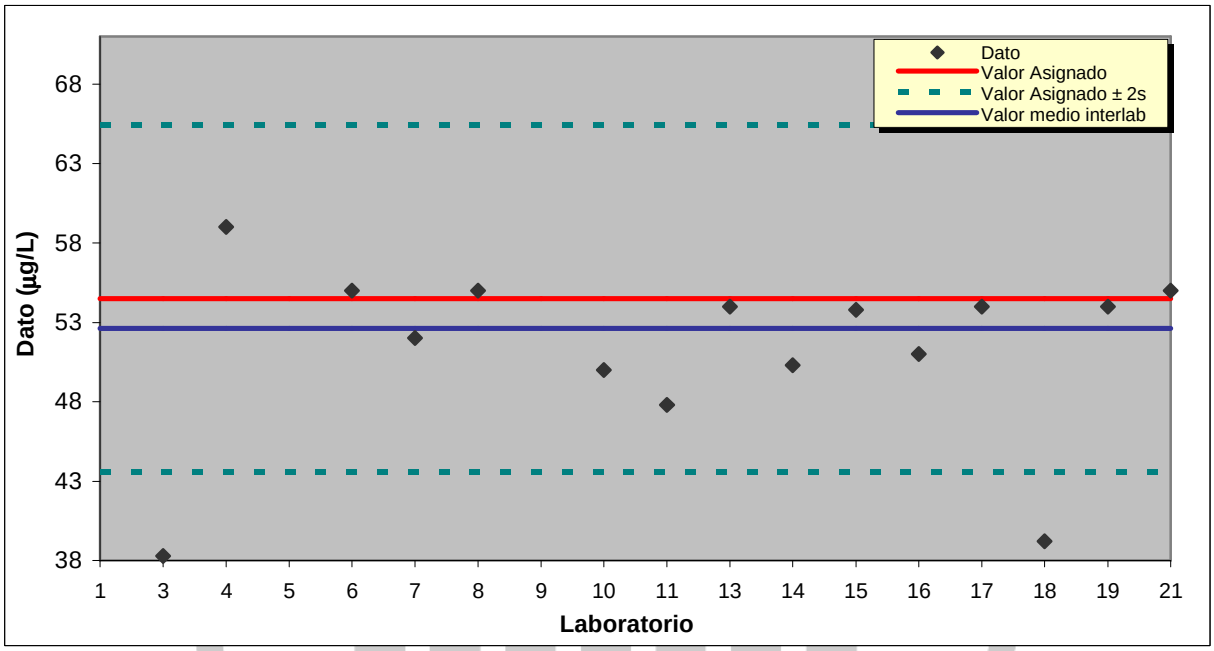
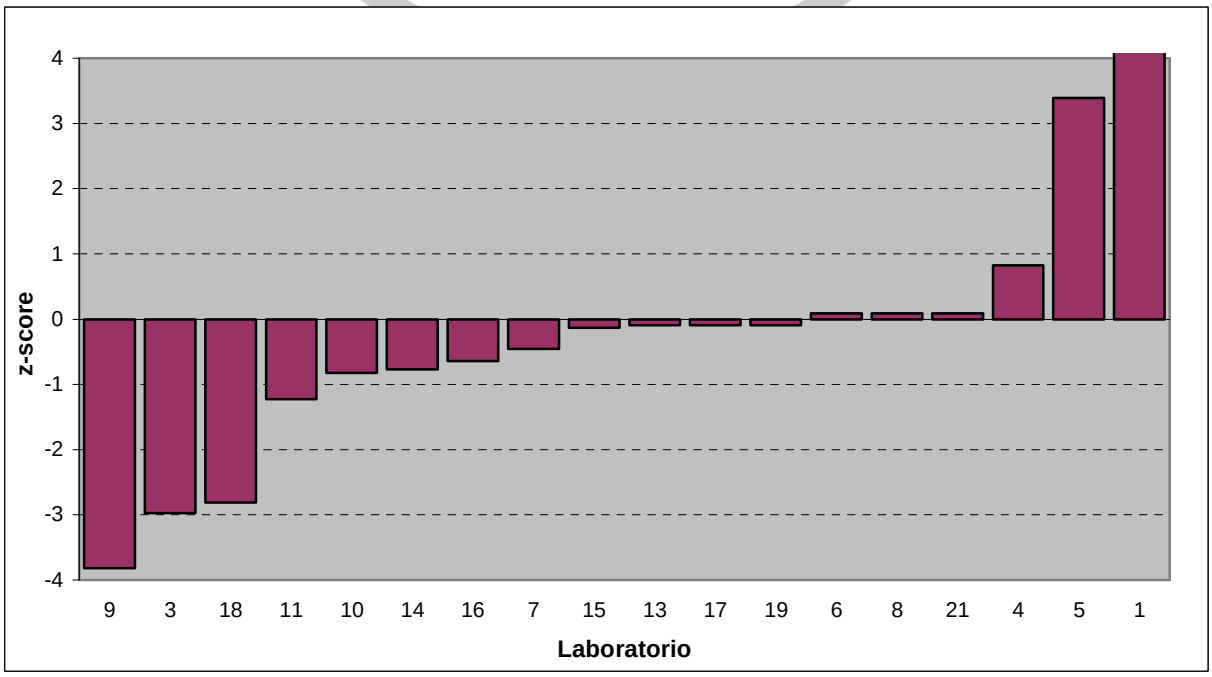
**GRÁFICO 3**
Datos enviados por los participantes – Cromo




Laboratorios cuyos valores exceden el ámbito del gráfico: 1, 5 y 9

**GRÁFICO 8**
Parámetro z – Cromo




Laboratorio cuyo parámetro z excede el ámbito del gráfico: 1



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**GRÁFICO 4**
Datos enviados por los participantes – Mercurio

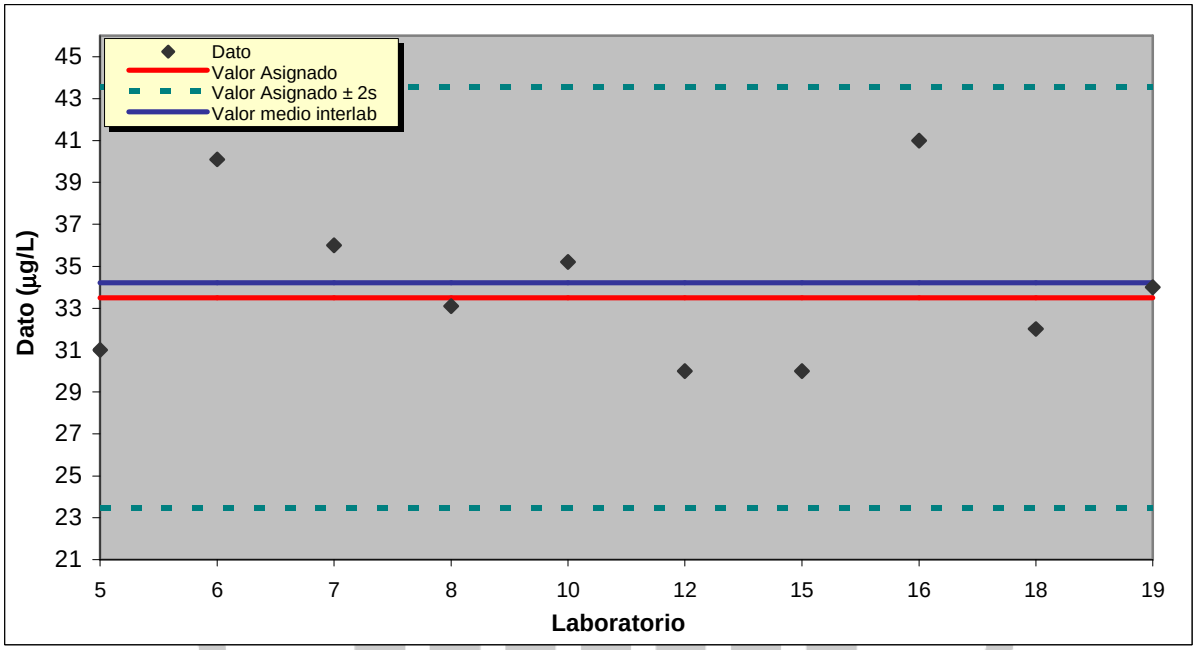


**GRÁFICO 9**
Parámetro z – Mercurio

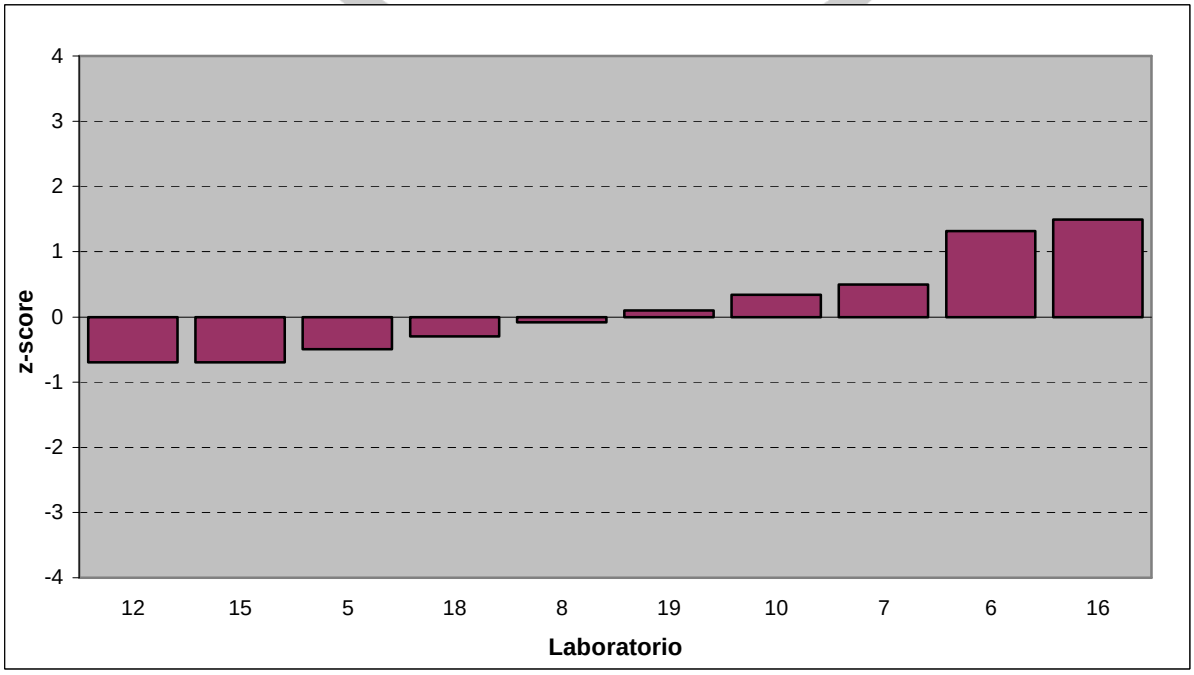




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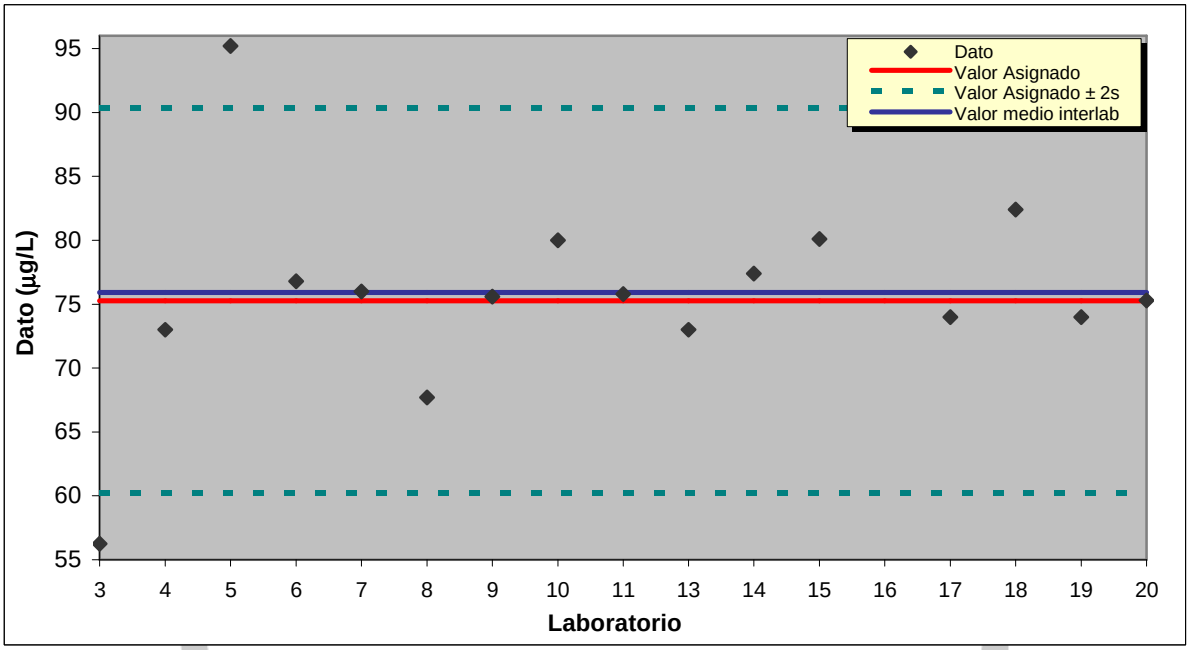
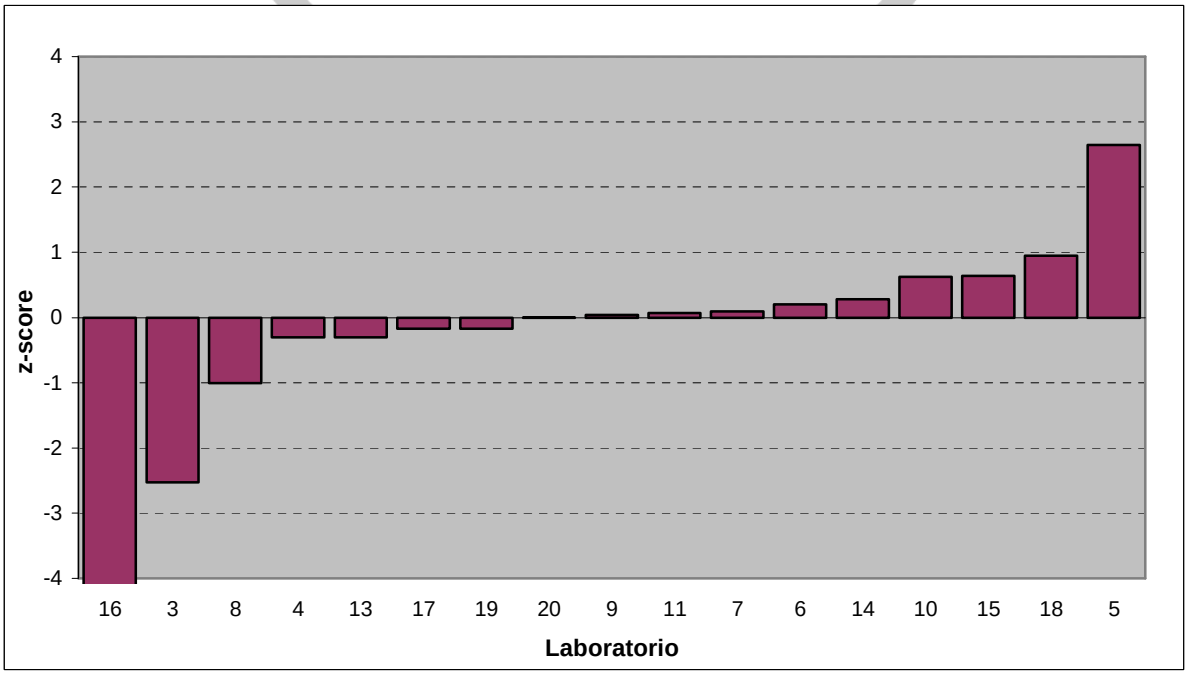
**GRÁFICO 5**
Datos enviados por los participantes – Plomo




Laboratorio cuyo valor excede el ámbito del gráfico: 16

**GRÁFICO 10**
Parámetro z – Plomo




Laboratorio cuyo parámetro z excede el ámbito del gráfico: 16



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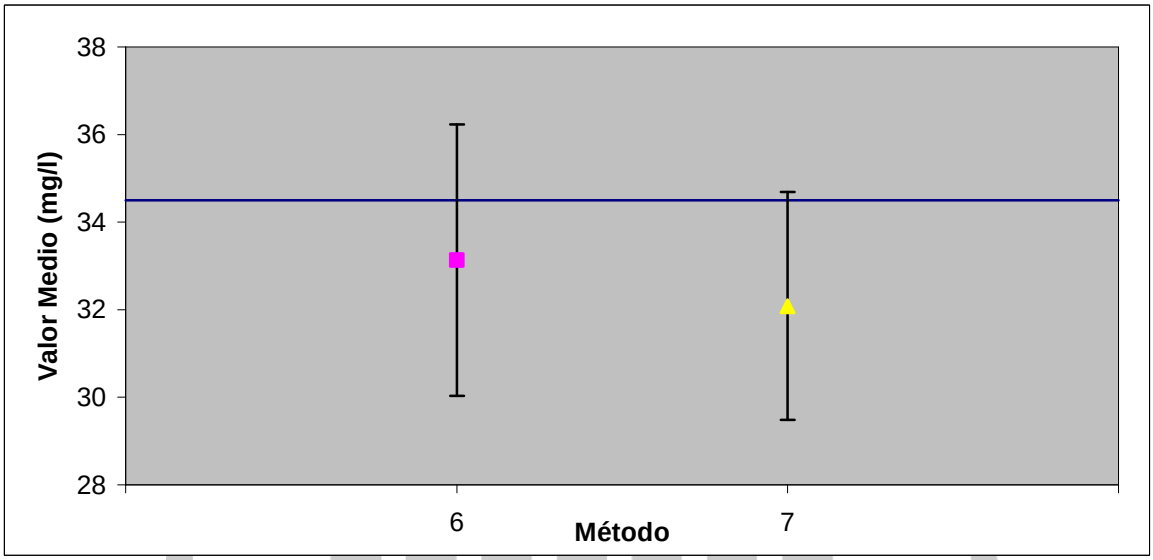
**GRÁFICO Nº 11**
Desviación según método – Cadmio




6: Absorción atómica con llama
7: Absorción atómica con horno de grafito



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# ANEXO II

## Información Estadística

### 1. Tabla de z-score

**Tabla 3**

| N° Lab | arsénico | cadmio | cromo | mercurio | plomo |
|---|---|---|---|---|---|
| 1 | 0,81 | -1,59 | 21,19 | - | - |
| 2 | -1,16 | - | - | - | - |
| 3 | -9,99 | -0,70 | -2,98 | - | -2,53 |
| 4 | - | 0,43 | 0,83 | - | -0,30 |
| 5 | 2,46 | 2,06 | 3,39 | -0,50 | 2,65 |
| 6 | -1,37 | -1,33 | 0,09 | 1,31 | 0,20 |
| 7 | -0,21 | -1,01 | -0,46 | 0,50 | 0,10 |
| 8 | 1,24 | -0,72 | 0,09 | -0,08 | -1,01 |
| 9 | 1,13 | -1,45 | -3,82 | - | 0,04 |
| 10 | -0,51 | 0,14 | -0,83 | 0,34 | 0,63 |
| 11 | 0,88 | 0,83 | -1,23 | - | 0,07 |
| 12 | 0,20 | 2,46 | - | -0,70 | - |
| 13 | 0,42 | 0,43 | -0,09 | - | -0,30 |
| 14 | -0,73 | 1,16 | -0,77 | - | 0,28 |
| 15 | 0,97 | -0,26 | -0,13 | -0,70 | 0,64 |
| 16 | 1,33 | -1,01 | -0,64 | 1,49 | -6,01 |
| 17 | 0,42 | 0,14 | -0,09 | - | -0,17 |
| 18 | -0,03 | -0,84 | -2,81 | -0,30 | 0,95 |
| 19 | -0,26 | -0,43 | -0,09 | 0,10 | -0,17 |
| 20 | -0,17 | -1,54 | - | - | 0,00 |
| 21 | -0,71 | - | 0,09 | - | - |



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## 2. Desviación de los resultados respecto del valor asignado

**Tabla 4**

| Lab. Nº | Arsénico | | Cadmio | | Cromo | | Mercurio | | Plomo | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío | Valor lab. | % desvío |
| **1** | 47,7 | 8,09 | 29 | -15,94 | 170 | 211,93 | - | - | - | - |
| **2** | 39 | -11,62 | - | - | - | - | - | - | - | - |
| **3** | 0,0270 | -99,94 | 32,08 | -7,01 | 38,28 | -29,76 | - | - | 56,26 | -25,27 |
| **4** | - | - | 36 | 4,35 | 59 | 8,26 | - | - | 73 | -3,03 |
| **5** | 55 | 24,63 | 41,6 | 20,58 | 73 | 33,94 | 31 | -7,46 | 95,2 | 26,46 |
| **6** | 38,1 | -13,66 | 29,9 | -13,33 | 55,0 | 0,92 | 40,1 | 19,70 | 76,8 | 2,02 |
| **7** | 43,2 | -2,11 | 31 | -10,14 | 52 | -4,59 | 36 | 7,46 | 76 | 0,96 |
| **8** | 49,6 | 12,40 | 32 | -7,25 | 55 | 0,92 | 33,1 | -1,19 | 67,7 | -10,07 |
| **9** | 49,1 | 11,26 | 29,5 | -14,49 | 33,7 | -38,17 | - | - | 75,6 | 0,43 |
| **10** | 41,88 | -5,10 | 35,0 | 1,45 | 50,0 | -8,26 | 35,2 | 5,07 | 80,0 | 6,27 |
| **11** | 48,00 | 8,77 | 37,38 | 8,35 | 47,80 | -12,29 | - | - | 75,80 | 0,69 |
| **12** | 45 | 1,97 | 43 | 24,64 | - | - | 30 | -10,45 | - | - |
| **13** | 46 | 4,24 | 36 | 4,35 | 54 | -0,92 | - | - | 73 | -3,03 |
| **14** | 40,9 | -7,32 | 38,5 | 11,59 | 50,3 | -7,71 | - | - | 77,4 | 2,82 |
| **15** | 48,4 | 9,68 | 33,6 | -2,61 | 53,8 | -1,28 | 30,0 | -10,45 | 80,1 | 6,40 |
| **16** | 50 | 13,30 | 31 | -10,14 | 51 | -6,42 | 41 | 22,39 | 30 | -60,15 |
| **17** | 46 | 4,24 | 35 | 1,45 | 54 | -0,92 | - | - | 74 | -1,70 |
| **18** | 44 | -0,29 | 31,6 | -8,41 | 39,2 | -28,07 | 32 | -4,48 | 82,4 | 9,46 |
| **19** | 43 | -2,56 | 33 | -4,35 | 54 | -0,92 | 34 | 1,49 | 74 | -1,70 |
| **20** | 43,4 | -1,65 | 29,2 | -15,36 | - | - | - | - | 75,3 | 0,03 |
| **21** | 41 | -7,09 | - | - | 55 | 0,92 | - | - | - | - |



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## 3. Datos Históricos

La presente tabla muestra las desviaciones estándar obtenidas, para cada uno de los analitos, en todas las rondas interlaboratorio ejecutadas hasta la fecha.
Se encuentran resaltadas las mejores desviaciones estándar.

| Desv. est. relativa % | Arsénico | Cadmio | Cromo | Mercurio | Plomo |
|---|---|---|---|---|---|
| $s_L$ Trazas '98 | 16,9 | - | 8,7 | 11,4 | 15 |
| $s_L$ Trazas '00 | 13,1 | 9,1 | 15 | 16,4 | 13,5 |
| $s_L$ Trazas '02 | 11,2 | 10,8 | 11,2 | 14,2 | 11,7 |
| $s_L$ Trazas '04 | 15,5 | 9,1 | 10,8 | 22,2 | 9,3 |
| $s_L$ Trazas '06 | 9,1 | 9.1 | 7,7 | 17,4 | 11,5 |
| $s_L$ Trazas '08 | 11,2 | 11,0 | 14,5 | 16,0 | 11,6 |
| $s_L$ Trazas '10 | 6,2 | 8,8 | 11,5 | 14,2 | 7,3 |
| $s_L$ Trazas '12 | 11,7 | 12,0 | 11,0 | 10,6 | 11,4 |
| $s_L$ Trazas '14 | 9,2 | 11,6 | 8,7 | 12,9 | 4,3 |



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# ANEXO III

## Definiciones

### 1. Definiciones generales

**1.1 Resultado de un medición:** es el conjunto de valores de una magnitud atribuidos a un mesurando, acompañados de cualquier otra información relevante disponible.

**1.2 Precisión:** proximidad entre las indicaciones o los valores medidos obtenidos en mediciones repetidas de un mismo objeto, o de objetos similares, bajo condiciones especificadas.

**1.3 Repetibilidad:** precisión de la medición bajo un conjunto de condiciones de repetibilidad: mismo procedimiento de medición, mismo operador, mismo equipamiento, en el mismo sitio y en un período corto de tiempo.

**1.4 Desviación estándar de repetibilidad:** es la desviación estándar de los resultados de una medición obtenida bajo condiciones de repetibilidad.

**1.5 Reproducibilidad:** precisión de la medición bajo un conjunto de condiciones de reproducibilidad: mismo procedimiento de medición, diferentes operadores, diferente equipamiento, en diferentes sitios y en un período largo de tiempo.

**1.6 Desviación estándar de reproducibilidad:** es la desviación estándar de resultados de ensayos obtenidos en condiciones de reproducibilidad.

**1.7 Error sistemático:** es una componente del error total que, en mediciones repetidas, permanece constante o varía de forma predecible.

**1.8 Error aleatorio:** es una componente del error total que, en mediciones repetidas, varía de forma impredecible.

**1.9 Sesgo:** valor estimado de un error sistemático.

**1.10 Incertidumbre:** parámetro no negativo que caracteriza la dispersión de los valores atribuidos a un mesurando, a partir de la información que se utiliza.



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## 2. Definiciones sobre tratamiento de los resultados

**2.1 Valor asignado (X)** = valor atribuido a una propiedad particular de un ítem de un ensayo de aptitud

**2.2 Desviación estándar para la evaluación de la aptitud ($\tilde{\sigma}$)** = medida de la dispersión utilizada en la evaluación de los resultados de un ensayo de aptitud, basada en la información disponible.

**2.3 Parámetro z-score**
El parámetro *z-score* se define de la siguiente manera:

$$z = \frac{x_i - X}{\tilde{\sigma}}$$

donde:

$x_i$ = valor promedio de los resultados de cada laboratorio
X = valor asignado a la muestra
$\tilde{\sigma}$ = desviación estándar para la evaluación de la aptitud

Los criterios para la evaluación son los siguientes:

$|z| \leq 2$ satisfactorio  $2 < |z| < 3$ cuestionable  $|z| \geq 3$ no satisfactorio



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# ANEXO IV

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# Programa de Ensayos de Aptitud

# "*Análisis de Elementos Traza en Solución Acuosa* 2012"

(PRQ-02/2012)

*Por cuanto el laboratorio* ***Inyma Consult S.R.L. – Aguas y Efluentes***

*ha participado en el ensayo interlaboratorio, reportando datos de medición satisfactorios para los analitos:* ***arsénico, cadmio, cromo y plomo,***

*se extiende el presente certificado que así lo acredita.*

Lic. Pablo Álvarez

Lic. Ana Hernández

Lic. Liliana Valiente

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Instituto Nacional de Metrologia, Qualidade e Tecnologia – Inmetro

***Coordenação Geral de Acreditação***

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# SURFACE AND GROUNDWATER QUALITY MONITORING

TECNOAMBIENTAL
·INGENIERÍA Y CONSULTORÍA·

## 1ST MONITORING CAMPAIGN REPORT

| | |
|---|---|
| CONTRACTING COMPANY: | PARACEL SA. |
| DEPARTMENT: | CONCEPCIÓN AND AMAMBAY |
| DISTRICTS: | CONCEPCIÓN, SGTO. JOSÉ FELIX LÓPEZ, LORETO AND BELLA VIST |
| CONSULTANT: | TECNOAMBIENTAL S.R.L. |
| REPORTED PERIOD: | RAINY SEASON (JANUARY-FEBRUARY) |

## APRIL 2021

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## I. INTRODUCTION

The terms of reference of the water quality monitoring consulting service prepared by PARACEL SA defines this report's guidelines. The firm is in charge of the project "Construction and operation of a plant for the manufacture of BKP cellulose pulp on the Paraguay River", which is developing approximately 15 km north of the city Concepción. This report also responds to the International Finance Corporation (IFC) environmental requirements, the financing entity, that requires a baseline of the environmental conditions before implementing the project to collect useful data to monitor potential changes resulting from the project's implementation.

The purpose of this document is to establish a baseline of the surface and groundwater quality in the project's direct area of influence (DAI) and indirect area of influence (IAI) before the conversions to industrial zone and plantation forestry respectively occur.

The main objectives of the monitoring are the following:

- Obtain quantitative information of the River Paraguay's water quality at 2 points located in DAI of the future Industrial plant, before and after the treated effluent's discharge point from the future factory located 20 km upstream port of the city of Concepción.
- Measure the groundwater level and analyse the groundwater quality of 6 existing monitoring wells in the future BKP cellulose pulp manufacturing plant's DAI.
- Obtain quantitative information of the surface water quality (streams and rivers running through the so-called "Farm Zone" in the Departments of Concepción and Amambay) at 18 monitoring stations.
- Analyse and, where technically feasible, measure the groundwater level of 14 artesian wells distributed in the "Farm Zone" of the Departments of Concepción and Amambay.

The samplings take place in two campaigns covering the dry and rainy seasons. The preliminary results presented in this report belong to the latter.

PARACEL SA selected and provided the monitoring points that correspond to sites of interest where land-use changes will occur in the short term, mainly the transformations of pastures for livestock converted to an industrial zone or forest plantations as the case may be.

A certified laboratory, the Multidisciplinary Centre for Technological Research (CEMIT) of the National University of Asunción (UNA), analysed the samples. CEMIT's calibrated equipment and standardised procedures were used during sampling and transporting samples.

The National Accreditation Body (ONA), dependent on the National Council of Science and Technology (CONACYT), accredited the CEMIT's laboratory.

# II. METHODOLOGY

## 2.1 General information about the study area

This section collects some data mentioned in the environmental impact assessment report of the future industry prepared by the consultancy POYRY in 2020 and aims to establish the hydrological and hydrogeological context in which the monitoring carries out.

The project's location is in the city of Concepción; therefore, the surface and groundwater monitored are part of the Aquidabán River Basin. This basin has an approximate area of 1,254,812 ha and flows into the River Paraguay to the north of Concepción. Its main tributaries are the Trementina and Negla streams, and it is characterised by its relatively high concentration of total and dissolved solids, depending on the time of collection and the presence of significant nutrient contents.

### 2.1.1 Surface water

The future factory's location is in the Middle and Lower Paraguay sub-basin, which is part of the hydrographic units mentioned above.

In the area of direct influence is the River Paraguay, from which raw water is to be collected and which is the main body of surface water to receive the wastewater treated and generated by the project, in a stretch of approximately 1 km, through a submarine wastewater discharge pipe.

Dispersion of treated effluents in the River Paraguay expects to occur very close to the discharge point between 0.37 and 0.42 m upstream of the factory's water intake.

In the AII is the Tinfunqué Ramsar site, which is 235 km from the future factory. Likewise, the Estero Milagro Ramsar site is 35 km away but outside the area of indirect influence.

Hydrographically, the most critical watercourses for the present study are the Trementina stream, Napegue stream, Negla stream, Hermosa stream, Pitanohaga stream, Aquidabán River and Paraguay River.

### 2.1.2. Groundwater

Regarding the hydrogeological characteristics, the factory is in the Aquidauana-Aquidabán Aquifer System.

This system is in the River Paraná basin, covering approximately 27,000 $km^2$, of which 12,300 $km^2$ are in Paraguay and the rest in Brazilian territory. It is used mainly for human and animal supply in both countries.

The aquifer is a semi-confined type, made up of glaciomarine sediments with significant facies variations, and has very dispersed flows rates with average values ranging between 10-20 $m^3$/h/ well.

The water's chemical characteristics are very variable also.

## 2.2 Location and details of monitoring points

There are 40 sampling points selected to monitor water quality in the DAI and IAI, 20 of which are surface watercourses and 20 are groundwater.

As for the political-administrative limits of the study area, 4 points are in the district of Bella Vista in the Department of Amambay and 36 points are distributed in the districts of Concepción, Sgt José Felix López and Loreto in the Department of Concepción.

PARACEL provided the coordinates of the 20 monitoring points for surface waters; 18 points are existing watercourses located in the so-called "Farm Zone" of the project's AII, and 2 points are on the River Paraguay in the DAI of the future industry. The number of sampling points is detailed below, according to the denominations given to the surface waters:

- One point corresponds to the Hermosa stream, a tributary of the Apa River.
- One point corresponds to the Napegue stream, a tributary of the Negla stream.
- One point is on the Negla stream, a tributary of the Aquidabán River.
- Ten points are on the Trementina stream, a tributary of the Aquidabán River.
- One point is on an unnamed stream, a tributary of the Aquidabán River.
- Two points are on the Aquidabán River.
- One point corresponds to the Laguna Penayo stream.
- One point corresponds to the Pitanohaga stream.
- Two points are on the Paraguay River at the DAI of the future's industrial plant.

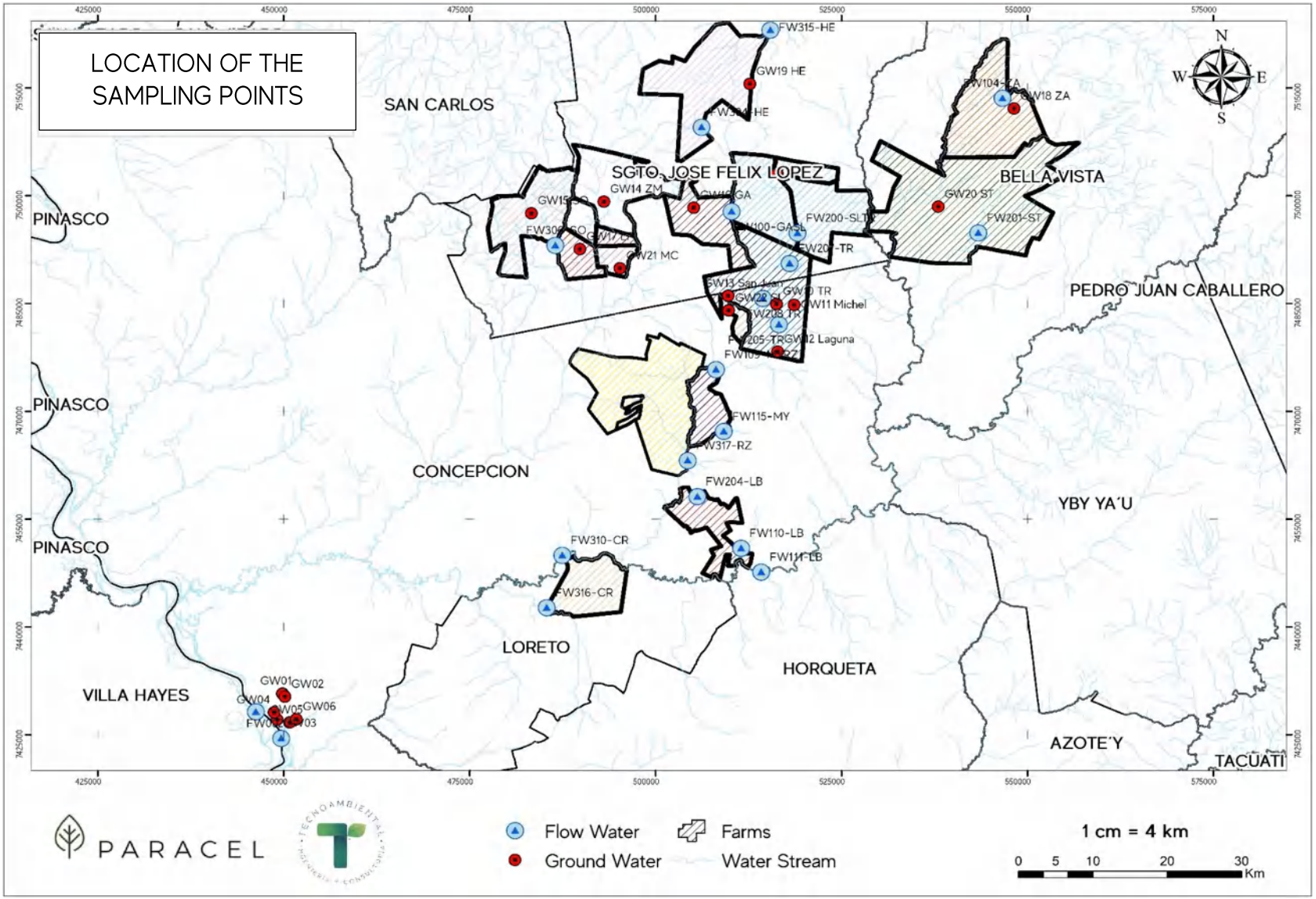
Regarding groundwater monitoring points:

- Fourteen points are deep tubular wells located in the "Farm Zone", these wells are currently in service. Their waters are extracted with submersible pumps and are used to supply drinking water to the area's human populations.
- Six points are located in the future industry's DAI and relate to deep tubular wells built exclusively for groundwater quality monitoring.

In the existing properties in the so-called "Farm Zone", the land use is changing from cattle pasture to *Eucalyptus sp.* plantation while in the DAI from floodplain pasture to an industrial zone.

The 40 monitoring points were selected to verify the existing surface, and groundwater quality in the DAI and the "Farm Zone" (IAI) before land-use conversions occur due to project implementation.

The following map shows the properties' boundaries and the spatial distribution of the monitoring points, classifying between surface water and groundwater points. The hydrography layer of the study area is also displayed.


LOCATION OF THE SAMPLING POINTS
SAN CARLOS
SGTO. JOSE FELIX LOPEZ
BELLA VISTA
PINASCO
PEDRO JUAN CABALLERO
CONCEPCION
YBY YA´U
LORETO
HORQUETA
VILLA HAYES
AZOTE´Y
TACUATI
FW315-HE
GW19 HE
GW18 ZA
GW14 ZM
GW20 ST
FW201-ST
FW200-SLT
GW21 MC
GW11 Michel
GW12 Laguna
FW115-MY
FW317-RZ
FW204-LB
FW110-LB
FW111-LB
FW310-CR
FW316-CR
GW01
GW02
GW04
GW06
N
S
W
E
PARACEL
Flow Water
Ground Water
Farms
Water Stream
1 cm = 4 km
0 5 10 20 30
Km

| TABLE 1. SAMPLING POINTS | | | | | | |
|---|---|---|---|---|---|---|
| | Nº | CODE | UTM COORDINATES | TYPE OF SAMPLE | MONITORED PARAMETERS | LOCATION, DESCRIPTION, OBJECTIVES |
| NEGLA STREAM MICRO-WATERSHED | 1 | FW 104 - ZA | 21K 546639,23 mE 7513553,82 mS | F.W. | Described in Table 2 | Negla stream – Upper part of the micro-watershed – Determine the surface water quality of the Farm "Zapallo". |
| | 2 | G.W. 18-ZA | 21K 548201.00 mE 7512128.00 mS | G.W. | Described in Table 3 | Headquarters of the "Zapallo" farm – Deep tubular well used for water drinking supply - Determine the groundwater quality of Farm "Zapallo". |
| | 3 | F.W. 201-ST | 21K 543911.54 mE 7497910.60 mS | F.W. | Described in Table 2 | Napague stream - Upper middle part of the Negla stream micro-watershed - Determine Farm "Santa Teresa's surface water quality. |
| | 4 | G.W. 20-ST | 21K 537999.00 mE 7498476.00 mS | G.W. | Described in Table 3 | Headquarters of the "Santa Teresa" farm - Deep tubular well used for drinking water supply - Determine the groundwater quality of Farm "Santa Teresa". |
| HERMOSA STREAM MICRO-BASIN | 5 | FW 315-HE | 21K 515424,99 mE 7523026,00 mS | F.W. | Described in Table 2 | "Hermosa" stream - Upper watershed of the "Hermosa" creek micro-watershed - Determine the surface water quality at the outlet of Farm "Hermosa". |
| TREMENTINA. STREAM MICRO-WATERSHED | 6 | GW 19-HE | 21K 512695.00 mE 7515558.00 mS | G.W. | Described in Table 3 | Headquarters of the "Hermosa" farm - Deep tubular well for drinking water supply - Determine the current groundwater quality of Farm "Hermosa". |
| | 7 | FW 304-HE | 21K 506172,99 mE 7509505,00 mS | F.W. | Described in 2 | Trementina stream – Upper watershed of the Trementina stream micro-watershed – Determine surface water quality at the outlet of Farm "Hermosa." |
| | 8 | G.W. 23-SL | 21K 516367.00 mE 7503054.00 mS | G.W. | Described in 3 | Headquarters of the "San Liberato" farm – Deep tubular well for water provision for human consumption – Determine groundwater's current quality in the "San Liberato" farm. |
| | 9 | G.W. 16-GA | 21K 505125.00 m E 7498320.00 m S | G.W. | Described in 3 | Headquarters of the "San Gavilán" farm at 200 metres from *Eucalyptus sp.* plantations – Deep tubular well to provide water for human consumption – Determine the current groundwater quality of the "Gavilán" farm. |
| | 10 | FW 100-GASL | 21K 510205.03 mE 7497780.65 mS | F.W. | Described in 2 | Trementina stream – Middle/upper catchment of the Trementina stream micro-watershed runs through approximately 7 km of *Eucalyptus sp.* plantations – Determine the surface water quality at the plantation's exit. |
| TREMENTINA STREAM MICRO-WATERSHED | 11 | FW 200-SL | 21K 519072.00 mE 7494784.00 mS | F.W. | Described in 2 | Tributary of the Trementina stream at the southeast of the headquarters of the "San Liberato" farm – middle catchment of the Trementina stream – Determine surface water quality at the outlet of Farm "San Liberato". |
| | 12 | F.W. 207-TR | 21K 518004.00 mE 7490567.00 mS | F.W. | Described in 2 | Tributary of the Trementina stream, 5 km at the north of the headquarters of the "Trementina" farm – middle catchment of the Trementina stream – Determine the current surface water quality of the property. |
| | 13 | F.W. 208-TR | 21K 514416.00 mE 7485700.00 mS | F.W. | Described in 2 | Trementina stream, 2 km northwest of the Trementina farm's headquarters – Middle catchment of the Trementina stream – Determine the property's current surface water quality. |
| | 14 | GW 11-MICHEL | 21K | GW | Described in 3 | Deep tubular wells located in new plantations of *Eucalyptus sp* – Middle basin |

| TABLE 1. SAMPLING POINTS | | | | | | |
|---|---|---|---|---|---|---|
| | Nº | CODE | UTM COORDINATES | TYPE OF SAMPLE | MONITORED PARAMETERS | LOCATION, DESCRIPTION, OBJECTIVES |
| | | | 518643.00 mE 7484801.00 mS | | | of the Trementina stream – Well for water for human consumption. |
| | 15 | G.W. 10-TR | 21K 516254.00 mE 7484946.00 mS | G.W. | Described in 3 | Trementina farm headquarters –Middle basin of the Trementina stream, dairy farm and corrals within 200 metres of the All of the well, use for drinking water supply – Determine current groundwater quality. |
| | 16 | G.W. 13-SAN JUAN | 21K 509767.00 mE 7486076.00 mS | G.W. | Described in 3 | "San Juan" farm, the middle basin of the Trementina stream – Well for drinking water supply – Determine the "San Juan" farm's current groundwater quality. |
| | 17 | G.W. 22-SILVA | 21K 509830.00 m E 7484037.00 m S | G.W. | Described in 3 | "Silva" farm, the middle basin of the Trementina stream – Well for drinking water supply – Determine current groundwater quality of the "Silva" farm. |
| | 18 | F.W. 205-TR | 21K 516574.00 mE 7482061.00 mS | F.W. | Described in 2 | Trementina stream, 2.7 km east of the Trementina farm headquarters, middle catchment of the Trementina stream micro-catchment – Determine the property's current surface water quality. |
| | 19 | G.W. 12-Laguna | 21K 516419.00 mE 7478307.00 mS | G.W. | Described in 3 | "Laguna" farm, the middle basin of the Trementina stream micro-basin – Well for drinking water supply and irrigation of seedlings, currently developing a forest nursery and plantation of new crops of *Eucalyptus sp* – Determine the current quality of groundwater in the "Laguna" farm. |
| TREMENTINA STREAM MICRO-WATERSHED | 20 | F.W. 109-MYRZ | 21K 508110.00 mE 7475784.00 mS | F.W. | Described in 2 | Trementina stream, point located between the "Mandyju" and "Rancho Z" property boundaries – middle catchment of the "Trementina" stream micro-watershed – Determine the current surface water quality of the property. |
| | 21 | F.W. 115-MANDYJU | 21K 509155.00 mE 7467194.00 mS | F.W. | Described in 2 | Trementina stream, a point located 11 km southeast of the "Rancho Z" forest plantations – middle catchment of the Trementina stream micro-watershed – Determine Mandyju's ranch current surface water quality. |
| | 22 | F.W. 317-RZ | 21K 503324.00 mE 7459243.00 mS | F.W. | Described in 2 | Trementina stream – lower catchment of the Trementina stream micro-catchment – Determine the current surface water quality at the exit of "Rancho Z". |
| | 23 | F.W. 204-LB | 21K 498840.00 mE 7451514.00 mS | F.W. | Described in 2 | Trementina stream point located 5 km upstream of the outflow point of the Trementina stream to the Aquidabán River – The lower watershed of the "Trementina" stream micro-watershed – Representative point of the quality of water discharging from the Trementina stream into the Aquidabán River. |
| REPRESENTATIVE POINTS OF THE RIVER AQUIDABÁN | 24 | FW 110-LB | 21K 511487.00 mE 7450940.00 mS | F.W. | Described in 2 | Unnamed Stream – Tributary of the Aquidabán River – Determine surface water quality. |
| | 25 | F.W. 111-LB | 21 K 514185.37 mE 7447625.56 mS | F.W. | Described in 2 | Aquidabán River – Lower-middle basin of the Aquidabán River catchment – Determine the current surface water quality. |
| | 26 | F.W. 310-CR | 21 K 487444.00 mE 7449950.00 mS | F.W. | Described in 2 | Aquidabán River – Lower basin of the Aquidabán River catchment – Determine the current Surface water quality in the All of the "Cristo Rey" farm. |

| TABLE 1. SAMPLING POINTS | | | | | | |
|---|---|---|---|---|---|---|
| | Nº | CODE | UTM COORDINATES | TYPE OF SAMPLE | MONITORED PARAMETERS | LOCATION, DESCRIPTION, OBJECTIVES |
| | 27 | F.W. 316-CR | 21K 485341.00 mE 7442662.00 mS | F.W. | Described in 2 | "Laguna Penayo" stream – Lower basin of the Aquidabán River – Determine the "Soledad" farm's surface water quality. |
| PITANOHAGA STREAM MICRO-WATERSHED | 28 | G.W. 14-ZM | 21K 493064.00 mE 7499176.00 mS | G.W. | Described in 3 | Headquarters of the "Zanja Morotĩ" farm - Deep tubular well for drinking water supply – Determine the current groundwater quality of the "Zanja Morotĩ" farm. |
| | 29 | G.W. 15-SO | 21K 483316.00 mE 7497562.00 mS | G.W. | Described in 3 | Headquarters of the "Soledad" farm - Deep tubular well for drinking water supply – Determine the current quality of the groundwater of the "Soledad" farm. |
| MICROCUENCA DEL AO PITANOHAGA | 30 | FW 306 -SO | 21K 486496.00 mE 7493077.00 mS | FW | Described in 2 | Tributary of the Pitanohaga stream– Upper catchment of the Pitanohaga stream micro-watershed – Determine the surface water quality of the Soledad farm. |
| | 31 | G.W. 17-LP | 21K 489833.00 mE 7492572.00 mS | G.W. | Described in 3 | Headquarters of "La Paraguaya" farm - Deep tubular well for water provision for human consumption – Determine the current quality of the farm's groundwater. |
| | 32 | G.W. 21-MC | 21K 495202.00 mE 7489899.00 mS | G.W. | Described in 3 | Headquarters of the "Machuca-cue" farm - Deep tubular well for drinking water supply – Determine the farm's groundwater's current quality. |
| ADA | 33 | GW 01 | 21K 449839.00 mE 7430729.00 mS | GW | Described in 3 | The directly affected area by the future PARACEL industry, currently a floodable grassland area – Deep tubular wells built exclusively for the periodic and systematic monitoring of the groundwater quality of the aquifer, to detect possible chemical alterations of the water as a consequence of the implementation and operation of the industrial plant. |
| | 34 | GW 02 | 21K 450165.00 mE 7430301.00 mS | | | |
| | 35 | GW 03 | 21K 449136.00 mE 7427123.00 mS | | | |
| | 36 | GW 04 | 21K 448716.00 mE 7428109.00 mS | | | |
| | 37 | GW 05 | 21K 450803.00 mE 7426714.00 mS | | | |
| | 38 | GW 06 | 21K 451708.00 mE 7427153.00 mS | | | |
| | 39 | F.W. 01 | 21K 446252.08 mE 7428199.87 mS | F.W. | Described in 4 | Paraguay River – Project's ADA – To monitor a point located 2.5 km upstream before the effluent discharge point. |
| | 40 | F.W. 02 | 21K 449651.97 mE 7424489.86 mS | | | Paraguay River – Project's ADA – To monitor point located 2.5 km downstream of the effluent discharge point. |

### 2.3 Monitored parameters determined by sample type

The table below shows the monitored parameters for each sample or monitoring points according to terms of reference. It was analysed 67 parameters (physicochemical, agrochemical, hydrobiological and bacteriological) for 18 surface water points.

| TABLE 2. MONITORED PARAMETERS FOR SURFACE WATER | |
|---|---|
| IN SITU MONITORING PARAMETERS | |
| 1- Water temperature | 4- Dissolved oxygen |
| 2- Hydrogen potential | 5- Turbidity |
| 3- Electrical conductivity | |

| PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS | | | |
|---|---|---|---|
| **PARAMETERS INCLUDED IN THIS REPORT** | | **PARAMETERS THAT INCLUDES THE FINAL REPORT OF THE FIRST CAMPAIGN** | |
| 6- Suspended sediments | 14- Ammonia | 22- Aluminium | 30- Selenium |
| 7-Total dissolved solids | 15- Nitrites | 23- Cadmium | 31- Zinc |
| 8- Oil and grease | 16- Hardness | 24- Hexavalent chromium | 32- Arsenic |
| 9- COD (oxygen demand chemical) | 17- Sodium | 25- Trivalent chromium | 33- Barium |
| 10- BOD5 (oxygen demand biochemical) | 18- Sulphates | 26- Tin | 34- Total mercury |
| 11- Total phosphorus | 19- Cyanides | 27- Nickel | |
| 12- Total nitrogen | 20- Copper | 28- Manganese | |
| 13- Nitrates | 21- Soluble iron | 29- Lead | |
| **AGROCHEMICALS** | | | |
| 35- Glyphosate | 43- DDE | 51- 2,4-D | 59- Imidacloprid |
| 36- AMPA | 44- DDD | 52- Lambda-cyhalothrin* | 60- Methyl-paraoxon |
| 37- Aldrin | 45- Atrazine | 53- Bifenthrin | 61- Thiamethoxam* |
| 38- Endrin | 46- Simazine | 54- Cypermethrin | 62- Sulfluramide* |
| 39- Dieldrin | 47- Carbaryl | 55- Chlorpyrifos | 63- Fipronil* |
| 40- Lindane | 48- Carbofuran | 56- Dichlorvos | |
| 41- Chlordane | 49- Heptachlor | 57- Methamidophos | |
| 42- DDT | 50- Methomyl | 58- Tebuconazole | |
| *Notes: This document does not report the following parameters: Lambda-cyhalothrin, Thiamethoxam, and Sulfluramide. | | | |
| **HYDROBIOLOGICAL PARAMETERS** | | | |
| 64- Phytoplankton diversity:<br>▪ Genus<br>▪ Species composition<br>▪ Dominance | | 65- Zooplankton diversity:<br>▪ Genus<br>▪ Species composition<br>▪ Dominance | |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| 66- Faecal coliforms | | 67- Total coliforms | |

TABLE 3. PARAMETERS DETERMINED FOR GROUNDWATER

| IN SITU MONITORING PARAMETERS | | |
|---|---|---|
| 1- Water temperature | | 3- Electrical conductivity. |
| 2- Hydrogen potential | | |
| **PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS** | | |
| 4- Total dissolved solids | 10- Bicarbonates | 16- Total phosphorus |
| 5- Organic matter | 11- Carbonates | 17- Total nitrogen |
| 6- Hardness | 12- Sulphates | 18- Sodium |
| 7- Nitrates | 13- Calcium | 19- Potassium |
| 8- Chlorides | 14- Magnesium | 20- Boron |
| 9- Alkalinity | 15- Fluorine | |
| **BACTERIOLOGICAL PARAMETERS** | | |
| 21- Faecal coliforms | 21- Total coliforms | 23- *Escherichia coli* |

Table 3 shows the parameters analysed for groundwater monitoring that are 23 determinations for the twenty samples extracted from the artesian and monitoring wells.

The two sampling points on the Paraguay River are crucial monitoring points for the PARACEL's future industry. According to POYRY's environmental impact assessment report (2020), this river will work as a waterway to transport raw materials, chemical inputs, and products.

The future industry's port will be on the Paraguay River (AII). At the same time, raw water will be extracted from this river for treatment and use in the industrial processes and will also be the receiving body for the treated effluents generated at the paper mill.
Given the particular importance of the points on the River Paraguay, 68 analytical determinations, including a broader range of agrochemicals and halogenated organic compounds (AOX), were carry out in points F.W01 and F.W02. Table 4 shows in detail the parameters determined for these points.

TABLE 4. PARAMETERS DETERMINED FOR THE PARAGUAY RIVER

| IN SITU MONITORING PARAMETERS |
|---|

| | | | |
|---|---|---|---|
| 1- Water temperature | | 4- Dissolved oxygen | |
| 2- Hydrogen potential | | 5- Turbidity | |
| 3- Electrical conductivity | | | |
| **PHYSICO-CHEMICAL ANALYTICAL DETERMINATIONS** | | | |
| **PARAMETERS INCLUDED IN THIS REPORT** | | **PARAMETERS THAT INCLUDES IN THE FINAL REPORT OF THE FIRST CAMPAIGN** | |
| 6- Floating materials | 16- Hardness | 25- Aluminium | 34- Zinc |
| 7- Total dissolved solids | 17- Sodium | 26- Cadmium | 35- Arsenic |
| 8- Oil and grease | 18- Sulphates | 27- Hexavalent chromium | 36- Barium |
| 9- COD (oxygen demand chemical)) | 19- Cyanides | 28- Trivalent chromium | 37- Total mercury |
| 10- BOD5 (oxygen demand biochemical | 20- Copper | 29- Trivalent chromium | |
| 11- Total phosphorus | 21- Soluble iron | 30- Tin | |
| 12- Total nitrogen | 22- Colour | 31- Manganese | |
| 13- Nitrates | 23- Phenols index | 32- Lead | |
| 14- Ammonia | 24-PCBs (Polychlorinated Biphenyls) | 33- Selenium | |
| 15- Nitrites | | | |
| **AGROCHEMICALS** | | | |
| 38- Glyphosate | 46- DDE | 54- 2,4-D | 62- Imidacloprid |
| 39- AMPA | 47- DDD | 55- Lambda-cyhalothrin* | 63- Methyl-paraoxon |
| 40- Aldrin | 48- Atrazine | 56- Bifenthrin | 64- Thiamethoxam* |
| 41- Endrin | 49- Simazine | 57- Cypermethrin | 65- Sulfluramide* |
| 42- Dieldrin | 50- Carbaryl | 58- Chlorpyrifos | 66- Fipronil* |
| 43- Lindane | 51- Carbofuran | 59- Dichlorvos | |
| 44- Chlordane | 52- Heptachlor | 60- Methamidophos | |
| 45- DDT | 53- Methomyl | 61- Tebuconazole | |
| *Notes: This document does not report the following parameters: Lambda-cyhalothrin, Thiamethoxam, and Sulfluramide. | | | |
| **BATERIOLOGICAL PARAMETERS** | | | |
| 67- Faecal coliforms | | 68- Total coliforms | |

## 2.4. Sample collection procedures

### 2.4.1 Surface water (FW.)

In situ measurements were performed (pH, temperature, conductivity and dissolved oxygen) and were collected samples for the rest parameters to be analysed in the laboratory (Tables 1 and 3) by immersing plastic containers to a depth of 30 cm below the surface of the water. For bacteriological sampling, a sterile sampling cup was submerged to a depth of 30 cm, fill it with water and closing it tightly underwater to avoid external contamination.

The cups, duly identified, were placed in coolers with ice to avoid altering the samples' composition before analysis. The surface sampling procedure and the preservation of the samples until they arrived at the laboratory (Table 5), for each point, was based on the Standard Methods 22nd. Ed. For surface water (Tables 6, 7 and 8).

### 2.4.2 Groundwater (GW.)

Groundwater samples were taken to determine physicochemical and bacteriological parameters in the laboratory (Table 2). On the other hand, parameters as pH, temperature and conductivity were measured on-site.

### 2.4.3 Sample containers and preservatives

Table 5 details all the parameters, sample containers, volumes and preservatives applied according to the parameter's analysis method.

| TABLE 5. FLASKS AND PRESERVATIVES PER SAMPLE TYPE | | | | | | |
|---|---|---|---|---|---|---|
| **SAMPLE CONTAINER** | **MATERIAL** | **VOLUME** | **PRESERVATIVE** | **PARAMETERS** | **FW** | **GW** |
| Bacteriology | Plastic | 100 mL | s/p | Total coliforms<br>Faecal coliforms<br>*Escherichia coli* | ✓ | ✓ |
| BOD5 | Plastic | 1L | s/p | COD, BOD5 | ✓ | |
| CF | Plastic | 2L | s/p | Solids, Turbidity, Alkalinity, Nitrite, Nitrate, Colour, Chloride, Magnesium, Calcium, Sulphate | ✓ | ✓ |
| Phenols | Plastic | 1L | $H_2SO_4$ 1+1, up to pH<2 | Phenols, $Cr^{+6}$ | ✓F W PY | |
| Metals | Plastic | 1L | $HNO_3$ 1+1, up to pH<2 | CrT, Hg, Zn, Cd, Pb, Se, Sn, Al, Cu, Mn, Ni | ✓ | ✓ |
| NTK | Plastic | 1L | $H_2SO_4$ 1+1, hasta pH<2 | P.T., NTK, N-$NH_3$ | ✓ | ✓ |
| Iron | Plastic | 250 mL | HCl 1+1, up to pH<2 | Iron, sodium, potassium | ✓ | |
| Sulphides | Plastic | 500 mL | Zn acetate + NaOH up to pH>9 | Sulphur | ✓ | |
| Multi-waste | Amber glass | 1L | s/p | Multi-waste | ✓ | |
| Sulphuramid and lambda-cyhalothrin | Amber glass | 1L | s/p | Sulphuramid and Lambda-cyhalothrin | ✓ | |
| Bifenthrin y Thiamethoxam | Plastic | 1L | s/p | Bifenthrin y Thiamethoxam | ✓ | |
| Glyphosate and AMPA | Plastic | 1L | s/p | Glyphosate and AMPA | ✓ | |
| Fipronil | Amber glass | 1L | s/p | Fipronil | ✓ | |
| PCBs | Amber glass | 1L | s/p | PCBs | ✓ FW PY | |
| FITO | Plastic | 250 mL | Lugol | Phytoplankton | ✓* | |
| ZOO | Plastic | 100 L | Formaldehyde 10% | Zooplankton | ✓* | |

Sample collection and preservation conditions. Ref.: s/p (Without preservative), BOD5 (Biochemical Oxygen Demand); COD (Chemical Oxygen Demand); FQ (Some Physicochemical parameters); NTK (Total Nitrogen Kjeldahl); CrT (Total Chromium) and AMPA (α-Amino-3-hydroxy-5-methyl-4-isoxazole propionic acid), FITO (Phytoplankton) y ZOO (Zooplankton).

### 2.5 Applied analytical methods

The tables below detail the analytical methods applied for the determination of each parameter.

| TABLE 6. METHODS FOR HYDROBIOLOGICAL-BACTERIOLOGICAL PARAMETERS | | | |
|---|---|---|---|
| **HYDROBIOLOGICAL** | | | |
| **PARAMETERS** | **METHODS** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2** |
| Phytoplankton | Phytoplankton counting techniques - SM 10200 F | <100 Cells | No limits |

| | | | |
|---|---|---|---|
| Zooplankton | Zooplankton counting techniques – SM 10200 G | Not applicable | No limits |
| **MICROBIOLOGICAL PARAMETERS - GROUNDWATER** | | | |
| **PARAMETERS** | **METHODS** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER NP REGULATION 2400180** |
| Total coliforms | Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C | >23 NMP/100mL | <1,1 NMP/100mL |
| Faecal coliforms | Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C | >23 NMP/100mL | <1,1 NMP/100mL |
| *E. coli* | Escherichia coli SM 9260 F | Presence/100mL | Absence/100mL |
| **MICROBIOLOGICAL PARAMETERS – SURFACE WATER** | | | |
| **PARAMETERS** | **METHODS** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2** |
| Faecal coliforms | Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C | >160.000 NMP/100mL | ≤ 1.000 NMP/100mL |
| Total coliforms | Standard fermentation technique for Total coliforms SM 9221 B Bacterial density estimation SM 9221 C | >160.000 NMP/100mL | Not applicable |

| TABLE 7. METHODS APPLIED TO PHYSICO-CHEMICAL PARAMETERS | | | | |
|---|---|---|---|---|
| **PARAMETERS** | **METHODS** | **MONITORING EQUIPMENT** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2** |
| Water temperature | Laboratory and field methods SM-2550 B | Conductimeter/Oximeter/pHmeter WTW MULTI 350 | Not applicable | No limits |
| Dissolved oxygen | Membrane electrode method SM-4500-O G | Conductimeter/Oximeter/pHmeter WTW MULTI 350 | 0,10 mg O2/L | No less than 5 $mg.L^{-1}$ |
| pH | Electrometric method SM-4500 - $H^+$ | Conductimeter/Oximeter/pHmeter WTW MULTI 350 | 0 a 14 | 6 a 9 |
| Conductivity | Laboratory method SM-2510 -B | Conductimeter/Oximeter/pHmeter WTW MULTI 350 | 0 a 199,9 mS/cm | No limits |
| Alkalinity | Titration method SM-2320 B | Current calibrated glass material | 1,0 $mg.L^{-1}$ | No limits |
| Turbidity | Nephelometric method SM-2130 B | THERMO ORION AQ 4500 Turbidimeter | 0,10 NTU | 100 NTU |
| Floating materials | Visual | Not applicable | Not applicable | Visually absent |
| Oil and grease | Method SM 5520-B | QUIMIS 01317M-53 stove and rotary evaporator EYELA SB1000 | 0,020 $mg.L^{-1}$ | Visually absent |
| Total phosphorus | Ascorbic acid method SM-4500-P E | Schimadzu - UV Spectrophotometer 1700 | 0,025 mg $PO4^{-3}.L^{-1}$ | 0,05 $mg.L^{-1}$ |
| NTK | Macro-Kjeldahl SM-4500-N B; phenate method SM-4500 F | Gerhardt Turbosog/ Schimadzu Digester - UV Spectrophotometer 1700 | 0,025 mg $N.L^{-1}$ | 0,6 $mg.L^{-1}$ |
| Nitrate nitrogen | AOAC Official Method 973.50 Brucine Colorimetric Method | Schimadzu - UV Spectrophotometer 1700 | 0,10 mg $N(NO3^-).L^{-1}$ | 10 $mg.L^{-1}$ |
| Nitrite nitrogen | Colorimetric method SM-4500 ($NO2^-$) B | Schimadzu - UV Spectrophotometer 1700 | 0,0025 mg $N\text{-}NO2^-.L^{-1}$ | 1,0 $mg.L^{-1}$ |
| Ammonia nitrogen | Phenol salt method SM-4500 (NH3) F | Schimadzu - UV Spectrophotometer 1700 | 0,015 mg $N\text{-}NH3.L^{-1}$ | 0,02 $mg.L^{-1}$ |
| BOD5 | 5-day BOD test - SM-5210 B | WTW OXI 3310 Oximeter | 0,10 mg $O2.L^{-1}$ | 5 $mg.L^{-1}$ |
| COD | Closed reflux, colorimetric method - SM-5220 D | Schimadzu - UV Spectrophotometer 1700 | 5,0 $mgO2.L^{-1}$ | SLE |
| Dissolved solids totals | Gravimetric method SM-2540 C | Sartorius Analytical Balance / Stove QUIMIS 0317M-S3 | 2,0 $mg.L^{-1}$ | 500 $mg.L^{-1}$ |
| Colour | Visual comparison method SM-2120 B | Schimadzu - UV Spectrophotometer 1700 | 5 mg $Pt.L^{-1}$ | 75 $mgPt.L^{-1}$ |
| Trivalent chromium | Calculation method (Total chromium – Hexavalent chromium) | Not applicable | 0,05 $mg.L^{-1}$ | 0,5 $mg.L^{-1}$ |
| Hexavalent chromium | Colorimetric method (SM-3500-Cr B) | Schimadzu - UV Spectrophotometer 1700 | 0,05 $mg.L^{-1}$ | 0,05 $mg.L^{-1}$ |
| Copper | AAS-Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 0,05 $mg.L^{-1}$ | 1,0 $mg.L^{-1}$ |
| Arsenic | Colorimetric method (SM-3500-As B) | Schimadzu - UV Spectrophotometer 1700 | <0,01 $mg.L^{-1}$ | 0,01 $mg.L^{-1}$ |
| Boron | Colorimetric method (SM-4500-B C) | Schimadzu - UV Spectrophotometer 1700 | 1,0 $mg.L^{-1}$ | No limits |
| Manganese | AAS- Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113) | AA-7000 Shimadzu | 0,05 $mg.L^{-1}$ | 0,1 $mg.L^{-1}$ |
| Nickel | AAS- Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113) | AA-7000 Shimadzu | 0,010 $mg.L^{-1}$ | 0,025 $mg.L^{-1}$ |
| Zinc | AAS- Air-Acetylene Flame (SM-3111-B) | AA-7000 Shimadzu | 0,05 $mg.L^{-1}$ | 3,0 $mg.L^{-1}$ |
| Cadmium | AAS-GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 0,0008 $mg.L^{-1}$ | 0,001 $mg.L^{-1}$ |
| Lead | AAS-GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 0,002 $mg.L^{-1}$ | 0,01 $mg.L^{-1}$ |
| Selenium | AAS-GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 0,005 $mg.L^{-1}$ | 0,01 $mg.L^{-1}$ |
| Tin | AAS-GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 1,0 $mg.L^{-1}$ | 2,0 $mg.L^{-1}$ |
| Aluminium | AAS-GFA (SM-3113) | AA-7000 Shimadzu / GFA -7000 | 0,10 $mg.L^{-1}$ | 0,2 $mg.L^{-1}$ |

| TABLE 7. METHODS APPLIED TO PHYSICO-CHEMICAL PARAMETERS | | | | |
|---|---|---|---|---|
| **PARAMETERS** | **METHODS** | **MONITORING EQUIPMENT** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER SEAM REGULATION 222/02 CLASS 2** |
| Fluorine | Method SM 4500 F C Ion-selective electrode | Multiparameter with selective fluoride electrode OAKTON | 0,05 $mg.L^{-1}$ | No limits |
| Phenols | Direct photometric method SM-5530 D | Schimadzu - UV Multiparameter with selective fluoride electrode OAKTON 1700 | 0,04 $mg.L^{-1}$ | No limits |
| Total hardness | EDTA titrimetric method - SM-2340 C | Current calibrated glass material | 1,0 $mg.L^{-1}$ | 300 $mgCa.L^{-1}$ |
| Chlorides | Argentometric SM-4500 -$Cl^-$ B | Current calibrated glass material | 0,5 mg $Cl^-.L^{-1}$ | No limits |
| Magnesium | Calculation method SM-3500 B | Not applicable | 0,2 mg $Mg.L^{-1}$ | No limits |
| Calcium | EDTA titrimetric method SM-3500 B | Current calibrated glass material | 0,4 $mg.L^{-1}$ | No limits |
| Potassium | AAS-Flame nitrous oxide-acetylene (SM-3111-D)/GFA (SM- 3113) | AA-7000 Shimadzu | 0,25 $mg.L^{-1}$ | No limits |
| Sodium | AAS-Air-acetylene flame (SM-3111-B) | AA-7000 Shimadzu | 0,25 $mg.L^{-1}$ | 200 $mg.L^{-1}$ |
| Soluble iron | Phenanthroline method SM-3500-Fe B | Schimadzu - UV Spectrophotometer 1700 | 0,05 mg $Fe.L^{-1}$ | No limits |
| Sulphates | Turbidimetric method SM-4500 - $SO4^{-2}$ E | THERMO ORION AQ 4500 Turbidimeter | 1,0 mg $SO4^{-2}.L^{-1}$ | 250 $mg.L^{-1}$ |
| Cyanides | SM 4500-CN E – Standard method – Standard methods used to analyse drinking and wastewater, 17th Edition (APHA-AWWA-WPCF). | Thermo Scientific Evolution 60S UV-Visible Spectrophotometer | 0,02 mg. $L^{-1}$ | 0,07 mg. $L^{-1}$ |
| PCB | Determination of PCBs residues in an aqueous matrix by GC-ECD *Gas Chromatography - Electron Capture Detector* | Gas Chromatography | 0,2237 mg. $L^{-1}$ | 0 (zero) |
| Total mercury | Method ICP/MES *"Inductively Coupled Plasma Mass Spectrometry"* | Spectrophotometer. | 0,05 mg. L-1 | No limits |
| Barium | Method icp/mes *"inductively coupled plasma mass spectrometry"* | Spectrophotometer. | <0,001 mg. L-1 | 2 mg. $L^-$ |

| TABLE 8. APPLIED METHODS FOR THE DETERMINATION OF AGROCHEMICALS | | | |
|---|---|---|---|
| **AGROCHEMICALS** | | | |
| **PARAMETERS** | **METHODS** | **LIMITS OF QUANTIFICATION IN WATER** | **PERMISSIBLE LIMITS AS PER REGULATION 222/02 SEAM CLASS 2** |
| OC- Aldrin | Extraction US-EPA 8081B and 3510 with modifications. Quantification by EPA 608.1 with modifications - GC-MS/MS | <1,00 | No limits |
| OC-Endrin | | <1,25 | 2 |
| OC-Dieldrin | | <1,50 | No limits |
| 2,4-D | | <2,50 | 30 |
| Atrazine | | <2,00 | 3 |
| Carbaryl | | <3,50 | No limits |
| Carbofuran | | <3,00 | 40 |
| Cypermethrin | | <1,20 | No limits |
| Chlordane | | <0,9 | 0 |
| Chlorpyrifos | | <5,00 | No limits |
| DDD | | <2,00 | No limits |
| DDE | Extraction US-EPA 8081B and 3510 with modifications. Quantifications by EPA 608.1 with modifications - GC-MS/MS | <2,00 | No limits |
| DDT | | <2,00 | 2 |
| Dichlorvos | | <10,0 | 10 |
| Heptachlor | | <1,50 | 0 |
| Imidacloprid | | <5,00 | No limits |
| Lindane | | <0,200 | 0,2 |
| Methamidophos | | <25,0 | No limits |
| Methylparaoxon | | <25,0 | No limits |
| Methomyl | | <25,0 | No limits |
| Simazine | | <2,50 | 4 |
| Tebuconazole | | <2,00 | No limits |
| Sulfluramid | * | | No limits |
| Lambdacyalothrin | * | | No limits |
| Lambdacyalothrin | * | | No limits |
| Thiamethoxam | * | | No limits |
| Glyphosate/AMPA in water | Extraction: In-house method (According to Amarante, J. et al; 2002) Quantification by HPLC/FLD | 0,3 µg/L | 0,7 |
| Fipronil | Method: LC-MS/MS *Liquid Chromatography Mass Spectrometry* | 0,0100 mg. $L^{-1}$ | |

***Notes:** Due to the pandemic, the suppliers of the reagents and laboratory chemicals necessary to determine Sulfluramid, Lambdacyalothrin, Lambdacyalothrin and Thiamethoxam, have not yet been delivered causing delays in the determination of these agrochemicals (Appendix E. Supplier's note).

## 2.6 Data quality control

As established in the National Water Quality Standard (Regulation SEAM No. 222/02 – Art. 13), the sampling techniques and respective analysis were carried out according to the internationally recognised methodology: The Standard Methods – To examine water and wastewater – APHA – AWWA – WPCF. Tables 6, 7 and 8 show the methods and equipment used for each parameter's analytical determination.

A team of technicians from the CEMIT's laboratory and TECNOAMBIENTAL performed the field sampling. The samples were taken according to the methodology previously described, ensuring the correct application of procedures, flasks, preservatives and cold chain maintenance from the sampling site to the laboratories.

Using a "field blank" eliminates the possibility that the flasks are a source of contamination. Field blanks are containers filled with deionised water free of the analyte in question and are preserved and analysed in the same wat as any other sample for the same determination.

If the analytical determinations made on the field blanks show results close to zero (0), the flasks did not contaminate during the trip, and the samples are representative of the points analysed.

The CEMIT Water Quality Laboratory, which belongs to the National University of Asunción (UNA), has been accredited since 2015 by the Paraguay National Accreditation Body (ONA). The professional responsible for the processing and analysis of the results is the chemist Claudia Ávalos de Enciso.

Other laboratories also accredited by the ONA analysed the following parameters; Total mercury, Barium, Cyanides, Fipronil and PCBs.

ANALITICA SA tested Total mercury and Barium. This laboratory is also accredited by the ONA, according to Standard NP-ISO/EIC 17025:2018.

The Water Quality Laboratory of the Faculty of Exact and Natural Sciences of the National University of Asunción (FACEN-UNA) analysed Cyanides.

Eco Natura laboratory, which is part of the MULTI LAB group, analysed FIpronil and PCBs. This institute is accredited according to NO-ISO/EIC 17025:2018 by the ONA.

**2.7 Data interpretation models**

The steps followed for the presentation and interpretation of the results of the analytical determinations are the following:

- Processing the results and comparing with the limits established in Regulation SEAM No. 222/02 "By which the water quality standard is established in the national territory" for Class 2, a category in which all surface waters are classified.
- The series of determinations at the different sampling points are shown on graphs and descriptive statistics for each parameter. The sampling point's parameters that are out of range are reported.
- For each point, the percentage of parameters that complies and does not comply with Regulation SEAM No. 222/02 was determined.

## III. RESULTS

### 3.1 General performance of surface water's parameters

Table 9 shows a summary of the results obtained for each parameter analysed in surface water; it also highlights the points that present some deviation and the percentage of monitoring points that complies with Regulation SEAM No. 222/02 "Establishing the water quality standard in the national territory" and those beyond the permissible limits.

TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS

| Nº | PARAMETER | AVERAGE | MONITORING POINTS WITH DEVIATIONS | COMPLY WITH THE LIMITS | | BEYOND THE LIMITS | |
|---|---|---|---|---|---|---|---|
| | | | | Nº | % | Nº | % |
| 1 | Temperature | 24,5 ºc | No limits | | | | |
| 2 | pH | 6,87 | FW317-RZ, FW 11-LB | 18 | 90% | 2 | 10% |
| 3 | Electrical conductivity | 130,50 µS/.cm | No limits | | | | |
| 4 | Dissolved oxygen | 5,7 mg O2/L | FW 207-TR, FW 208-TR, FW 115-MY, FW 110-LB FW 109-MYRZ | 15 | 75% | 5 | 25% |
| 5 | Turbidity | 140,154 NTU | FW 200-SLTR, FW 205-TR FW 111-LB, FW 310-CR | 16 | 80% | 4 | 20% |
| 6 | Floating materials | 51,36 | No limits | | | | |
| 7 | Total dissolved solids (TDS) | 161,7 | All the points complies with the limits | 20 | 100% | 0 | 0% |
| 8 | Oil and grease | 8,78 mg/L | No limits | | | | |
| 9 | COD | 78,2 mg $O_2$/L | No limits | | | | |
| 10 | BOD5 | 3,15 mg $O_2$/L | FW 205-TR, FW 310-TR, FW 316-CR | 16 | | 3 | |
| 11 | Total phosphorus | 0,07 mg/L | FW 315-HE, FW 304-HE, FW 207-TR, FW205-TR, FW 109-MYRZ, FW 115-MY FW 110-LB, FW 111-LB FW310-CR, FW01 | 9 | 45% | 11 | 55% |
| 12 | Total nitrogen | 0,77 mg/L | FW 315-HE, FW 208-TR FW 316-CR | 16 | 80% | 4 | 20% |
| 13 | Nitrates | 2,7 mg/L | All the points complies with the limits | 20 | 100% | 0 | 0% |
| 14 | Ammonia | 0,12 mg/L | All the points exceeds the maximum limits | 0 | 0% | 20 | 100% |
| 15 | Nitrites | 0,12 mg/L | All the points complies with the limits | 20 | 100% | 0 | 0% |
| 16 | Hardness | 30,70 mg CaCO3/L | All the points complies with the limits | 20 | 100% | 0 | 0% |
| 17 | Sulphates | >2 mg/L | All the points complies with the limits | 20 | 100% | 0 | 0% |
| 18 | Sodium | 7,42 mg/L | All the points are under the limits of quantification in water; therefore complies with the limits | 20 | 100% | 0 | 0% |
| 19 | Aluminium | -- | All the points are under the limits of quantification (LOQ=0,1) | 20 | 100% | 0 | 0 |
| 20 | Cadmium | --- | All the points are under the limits of quantification (LOQ=0,0008) | 20 | 100% | 0 | 0 |
| 21 | Hexavalent chromium | -- | All the points are under the limits of quantification (LOQ=0,0500) | 20 | 100% | 0 | 0% |
| 22 | Trivalent chromium | -- | All the points are under the limits of quantification (LOQ=0,0500) | 20 | 100% | 0 | 0% |
| 23 | Copper | -- | All the points are under the limits of quantification | 20 | 100% | 0 | 0% |
| 24 | Tin | | All the points are under the limits of quantification (LOQ=1) | 20 | 100% | 0 | 0 |

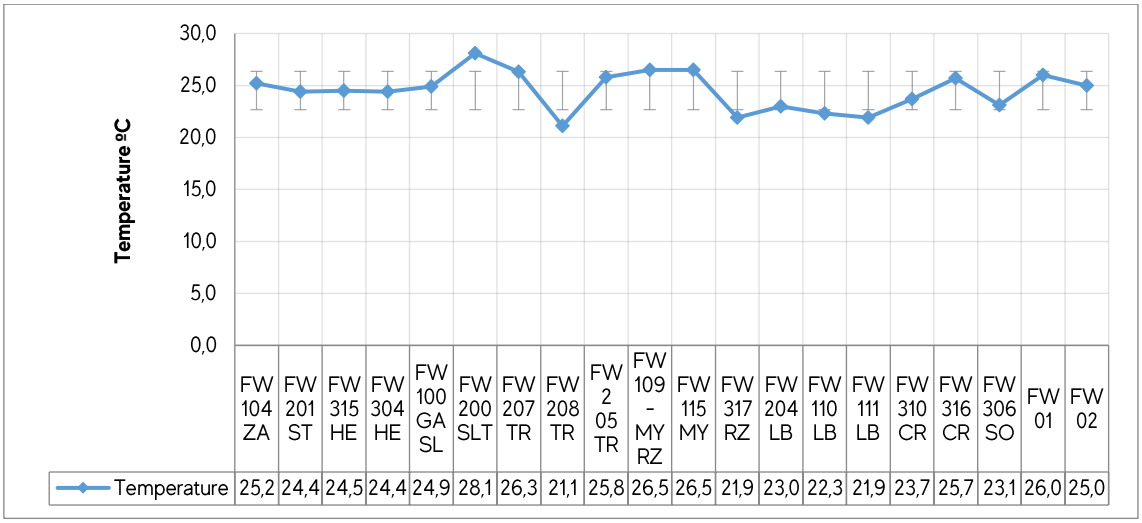
| TABLE 9. SUMMARY OF SURFACE WATER QUALITY ANALYSIS | | | | | | | |
|---|---|---|---|---|---|---|---|
| Nº | PARAMETER | AVERAGE | MONITORING POINTS WITH DEVIATIONS | COMPLY WITH THE LIMITS | | BEYOND THE LIMITS | |
| | | | | Nº | % | Nº | % |
| 25 | Nickel | 0,098 mg/L | 18 points under the limits of quantification and only 2 determinations beyond the limits | 18 | 90% | 2 | 10% |
| 26 | Manganese | 0,207 mg/L | FW315-HE, FW205-TR FW110-LB, FW111-LB FW310-CR, FW01, FW02 | 13 | 65% | 7 | 35% |
| 27 | Lead | 0,0118 mg/L | FW317-RZ, FW316-CR FW306-SO | 17 | 85% | 3 | 15% |
| 28 | Selenium | -- | All the points are under the limits of quantification (LOQ=1) | 20 | 100% | 0 | 0 |
| 29 | Zinc | 0,14 mg/L | - | 20 | 100% | 0 | 0% |
| 30 | Arsenic | -- | - | 20 | 100% | 0 | 0% |
| 31 | Soluble iron | 1,3 mg/L | All the surface water sampling points exceeds the maximum limits | 0 | 0% | 20 | 100% |
| 32 | Total mercury | -- | All the points are under the limits of quantification (LOQ=0,001) | 20 | 100% | 0 | 0% |
| 33 | Barium | 0,139 mg/L | All the points are under the limits of quantification | 20 | 100% | 0 | 0% |
| 34 | Cyanides | >0,02 mg/L | All the points complies with the limits and are under the limits of quantification | 20 | 100% | 0 | 0% |
| 35 | Faecal coliforms | 3677,4 NMP/100 mL | All points are beyond the limits except FW 316-CR, FW01 and FW02. | 4 | 20% | 16 | 80% |
| 36 | Total coliforms | 9129,6 NMP/100 mL | FW104-ZA, FW315-HE, FW304-HE, FW200-SLTRE, FW207-TR, FW208-TR, FW205-TR, FW109-MYRZ, FW115-MY, FW317-RZ, FW204-LB, FW110-LB, FW310-CR | 6 | 30% | 14 | 70% |

### 3.2 Analysis and interpretation of results

The next graphs show each parameter's behaviour determined at the 19 monitoring points, contrasting them with limits established by Regulation SEAM No. 222/02, according to the objectives.

Details per sampling point are in Appendix C.

### 3.2.1 Water temperature

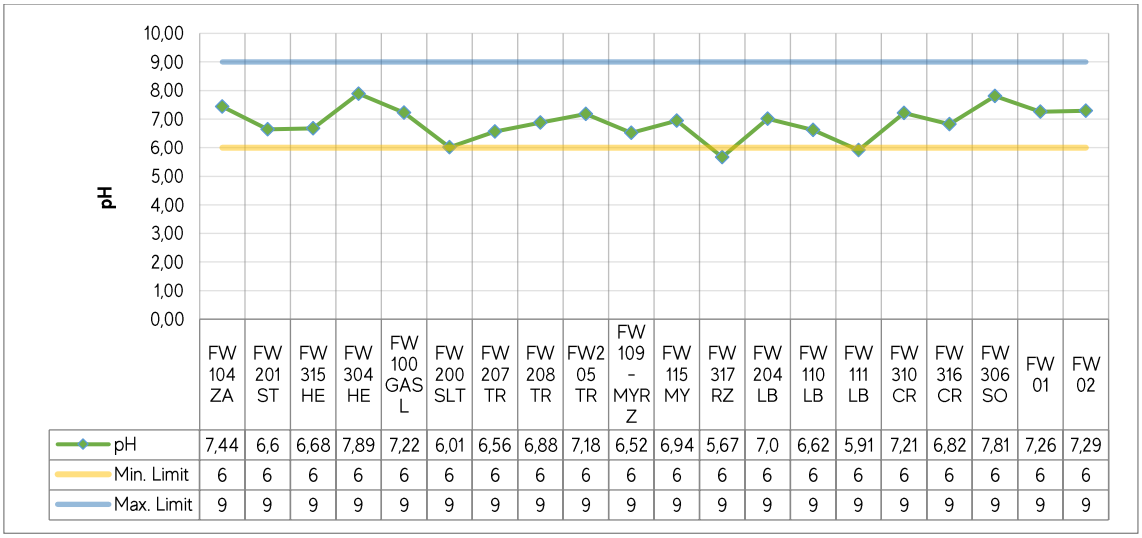



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature | 25,2 | 24,4 | 24,5 | 24,4 | 24,9 | 28,1 | 26,3 | 21,1 | 25,8 | 26,5 | 26,5 | 21,9 | 23,0 | 22,3 | 21,9 | 23,7 | 25,7 | 23,1 | 26,0 | 25,0 |

Figure 1. Comparative analysis of water temperature at monitoring points

SEAM Regulation No. 222/02 does not establish limit values for the temperature of Class water 2; only for effluents discharge to water bodies, whose limit value is 40 ºC. The average water temperature recorded in the first campaign was 24.5 ºC. The maximum value was measure at the point FW200-SLTR (28.1 ºC) and the minimum at FW208-TR (21.1 ºC).

### 3.2.2 Hydrogen potential (pH)



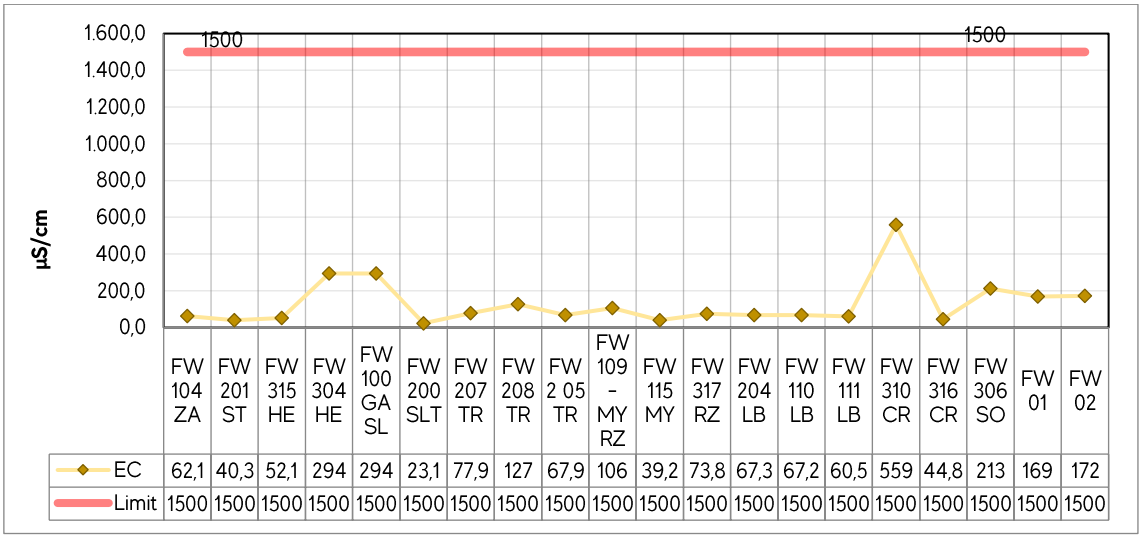

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GAS L | FW 200 SLT | FW 207 TR | FW 208 TR | FW2 05 TR | FW 109 - MYR Z | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 7,44 | 6,6 | 6,68 | 7,89 | 7,22 | 6,01 | 6,56 | 6,88 | 7,18 | 6,52 | 6,94 | 5,67 | 7,0 | 6,62 | 5,91 | 7,21 | 6,82 | 7,81 | 7,26 | 7,29 |
| Min. Limit | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Max. Limit | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

Figure 2. Comparative analysis of pH values at different monitoring points

The SEAM Regulation No. 222/02 establishes a minimum and maximum limit of 6 and 9. Figure 2 shows that none point exceeds the upper limit; as for the lowest, points FW317-RZ and FW111-LB show slightly acid pH values.

The 90% of the points comply with Regulation 222/02. The average pH magnitude in the first campaign is 6.8 which is very close to the ideal value of 7.

### 3.2.3 Electrical conductivity



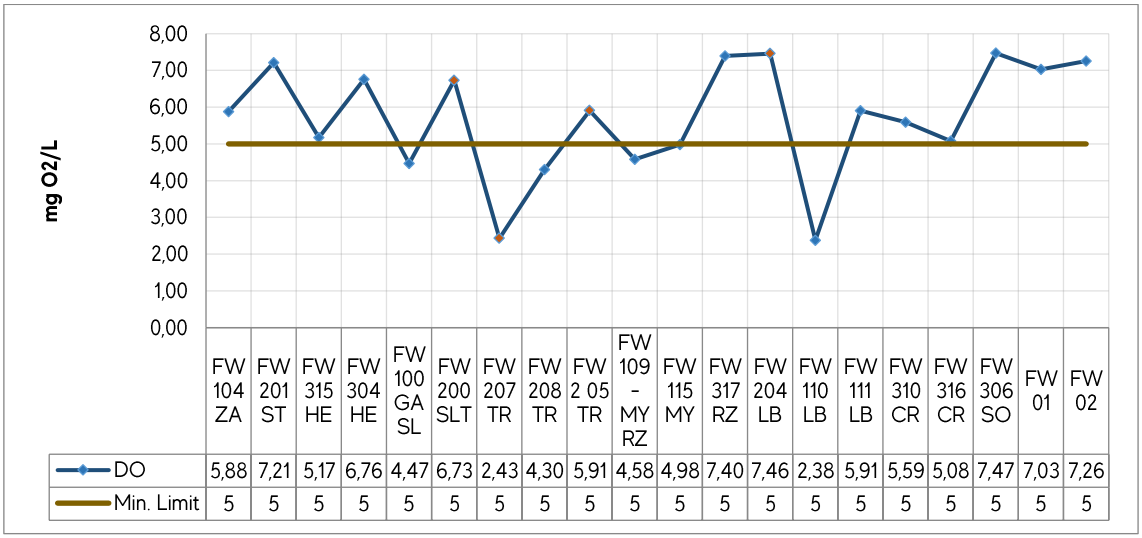

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EC | 62,1 | 40,3 | 52,1 | 294 | 294 | 23,1 | 77,9 | 127 | 67,9 | 106 | 39,2 | 73,8 | 67,3 | 67,2 | 60,5 | 559 | 44,8 | 213 | 169 | 172 |
| Limit | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |

Figure 3. Comparative analysis of electrical conductivity values at different monitoring points

Regulation 222/02 does not set any limit for the electrical conductivity parameter for Class 2 water. The limit of 1500 µS/cm established in the regulation NP 24 001 80 "General requirements for drinking water" is taken as a reference. None determination carried out exceeds the mentioned number.

The average value of the parameter evaluated in the first campaign was 130,5 µS/cm. The point FW316-CR has the maximum value which is at the "Laguna Penayo" stream.

### 3.2.4 Dissolved oxygen



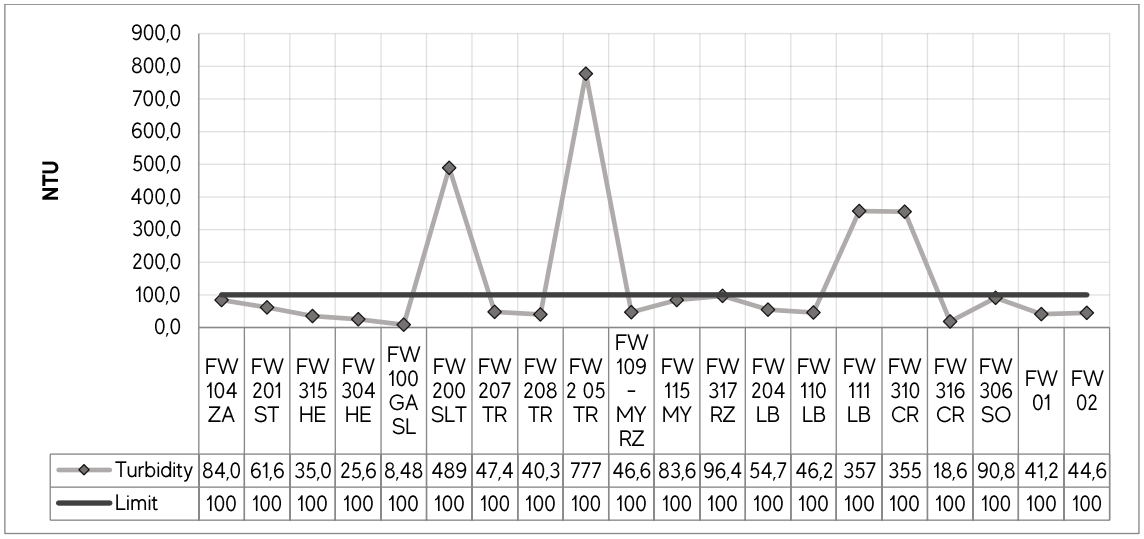

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DO | 5,88 | 7,21 | 5,17 | 6,76 | 4,47 | 6,73 | 2,43 | 4,30 | 5,91 | 4,58 | 4,98 | 7,40 | 7,46 | 2,38 | 5,91 | 5,59 | 5,08 | 7,47 | 7,03 | 7,26 |
| Min. Limit | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

Figure 4. Comparative analysis of dissolved oxygen at different monitoring points

According to Regulation 222/02, dissolved oxygen of waters classify as Class 2 should not be less than five (5 mg $O_2$/l). At points FW207-TR, FW208-TR, FW115-MY, FW110-LB and FW109-MYRZ, the value is lower.

The 74% of the 19 points comply with the regulation. The average DO in the first campaign is 5.8 mg $O_2$/l.

### 3.2.5 Turbidity



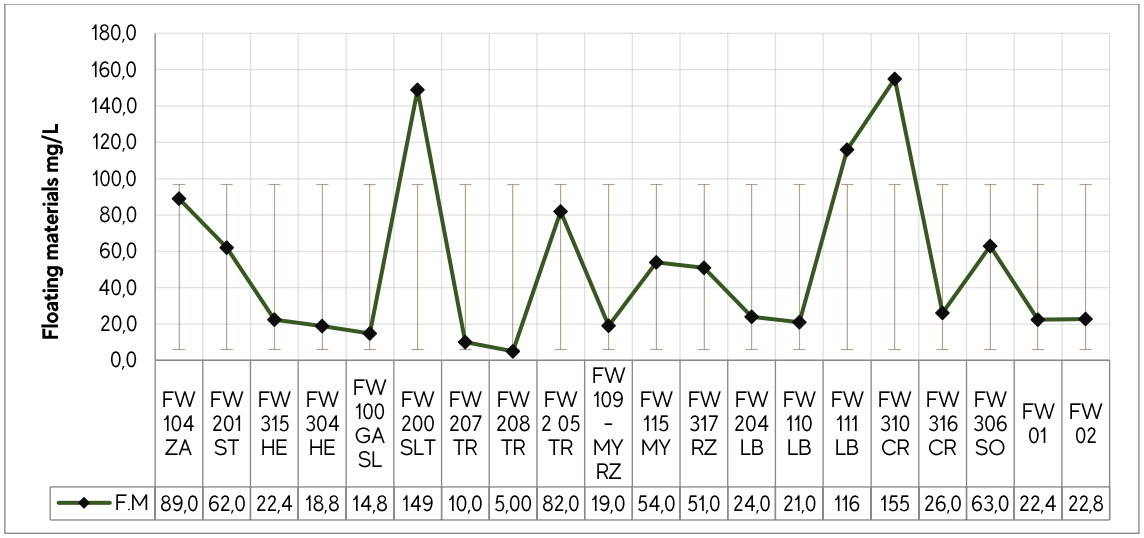

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turbidity | 84,0 | 61,6 | 35,0 | 25,6 | 8,48 | 489 | 47,4 | 40,3 | 777 | 46,6 | 83,6 | 96,4 | 54,7 | 46,2 | 357 | 355 | 18,6 | 90,8 | 41,2 | 44,6 |
| Limit | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Figure 5. Comparative analysis of turbidity at different monitoring points

The maximum value established in Regulation 222/02 for Class 2 watercourse's NTU is 100. The results of the points FW200-SLTR, FW205-TR, FW111-LB and FW316-CR exceed the permissible limit.

The presence of chlorophyll and sediments may influence high turbidity values; the average value measured for this parameter in the first campaign is 140,154 NTU.

### 3.2.6 Floating materials



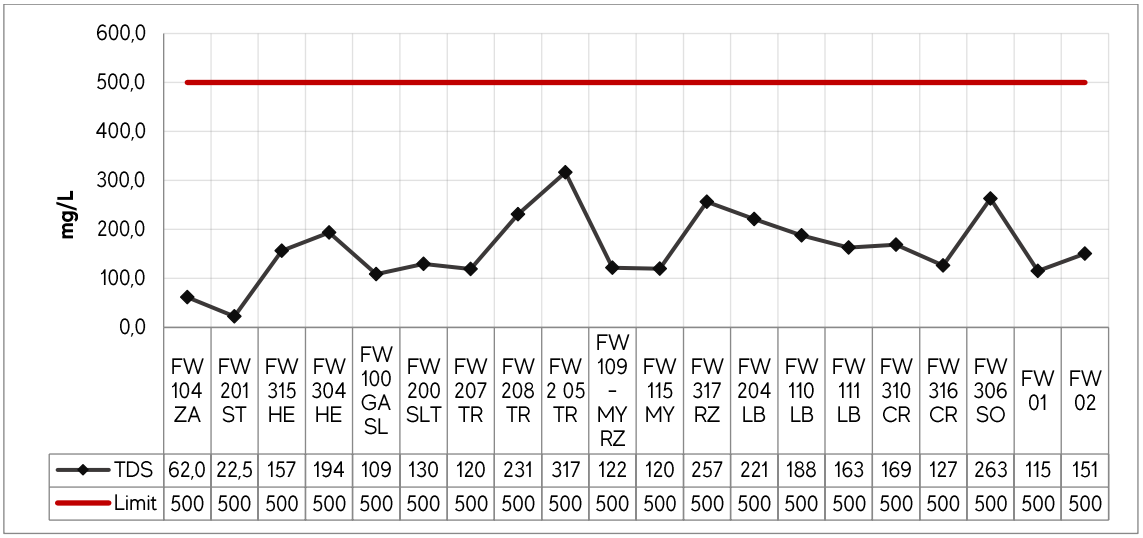

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F.M | 89,0 | 62,0 | 22,4 | 18,8 | 14,8 | 149 | 10,0 | 5,00 | 82,0 | 19,0 | 54,0 | 51,0 | 24,0 | 21,0 | 116 | 155 | 26,0 | 63,0 | 22,4 | 22,8 |

Figure 6. Comparative analysis of the presence of floating materials at different monitoring points

The national Regulation 222/02 does not set limits for this parameter but indicates that it should be virtually absent.

According to the results, the parameter's average is 51,36 mg/l. The points FW200 SL-TR, FW111-LB and FW310-CR show values higher than the mean's standard deviation even without established limits. The presence of floating material may be influence by the principal livestock activity in the area.

### 3.2.7 Total dissolved solids

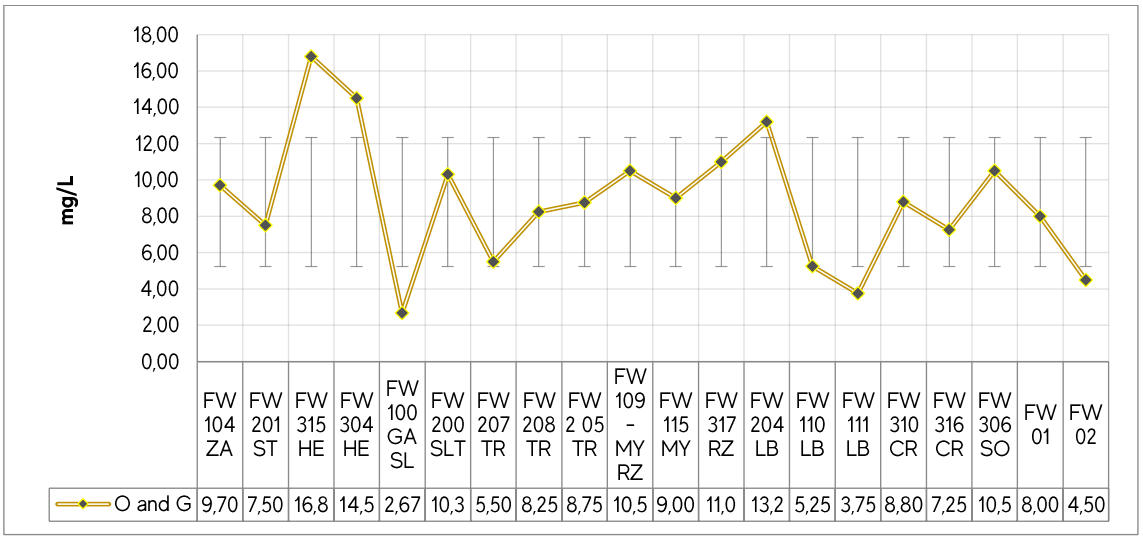



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TDS | 62,0 | 22,5 | 157 | 194 | 109 | 130 | 120 | 231 | 317 | 122 | 120 | 257 | 221 | 188 | 163 | 169 | 127 | 263 | 115 | 151 |
| Limit | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |

Figure 7. Comparative analysis of total dissolved solids (TDS) at different monitoring points

The permissible limit established in the national regulation is 500 mg/l which none monitoring point exceeded in this campaign. The average TDS value is 161,7 mg/l.

### 3.2.8 Oil and grease



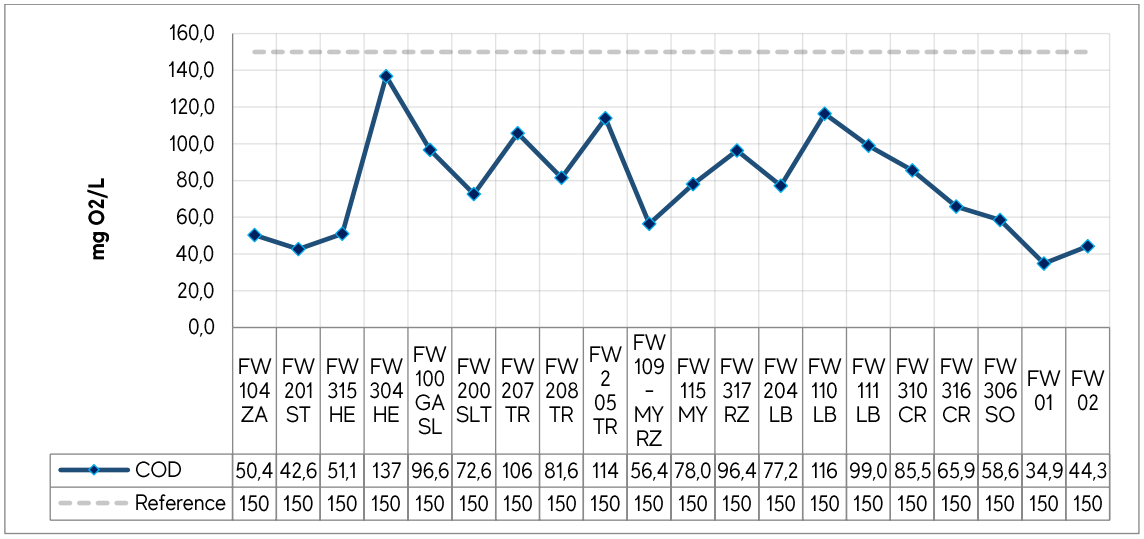

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O and G | 9,70 | 7,50 | 16,8 | 14,5 | 2,67 | 10,3 | 5,50 | 8,25 | 8,75 | 10,5 | 9,00 | 11,0 | 13,2 | 5,25 | 3,75 | 8,80 | 7,25 | 10,5 | 8,00 | 4,50 |

Figure 8. Comparative analysis of oil and grease at different monitoring points

For waters Class 2, the national regulation does not establish a limit; it only indicates that it must be virtually absent. For effluent discharges to water bodies, the maximum limits are 20 mg/l for mineral oils and grease and 50 mg/l for animal or vegetable oils and grease.

The average parameter in the first campaign is 8,7 mg/l. The value indicated in FW315-HE is the maximum value measured with 16.8 mg/l. This point's location is close to the departmental route D001 which can be related the higher value.

### 3.2.9 Chemical oxygen demand

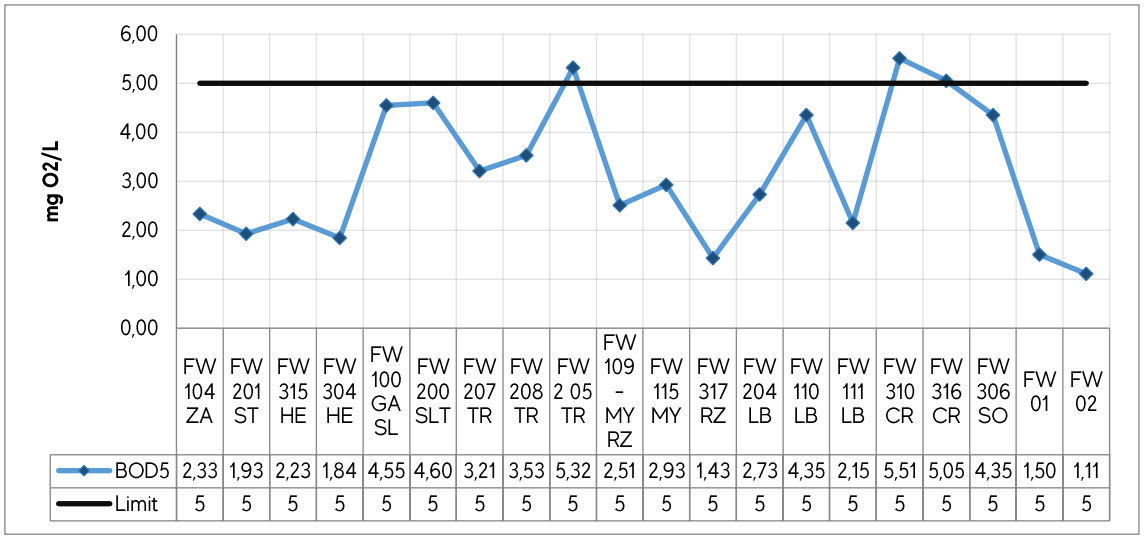



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 – MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COD | 50,4 | 42,6 | 51,1 | 137 | 96,6 | 72,6 | 106 | 81,6 | 114 | 56,4 | 78,0 | 96,4 | 77,2 | 116 | 99,0 | 85,5 | 65,9 | 58,6 | 34,9 | 44,3 |
| Reference | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 |

Figure 9. Comparative analysis of COD at different monitoring points

Regulation 222/02 does not establish a permissible limit for water classified as Class 2. It is only defined in Art. 7 a maximum value of 150 mg $O_2$/l for effluents discharge in water bodies. The average COD measured is equivalent to 78,19 mg $O_2$/l.

### 3.2.10 Biological oxygen demand

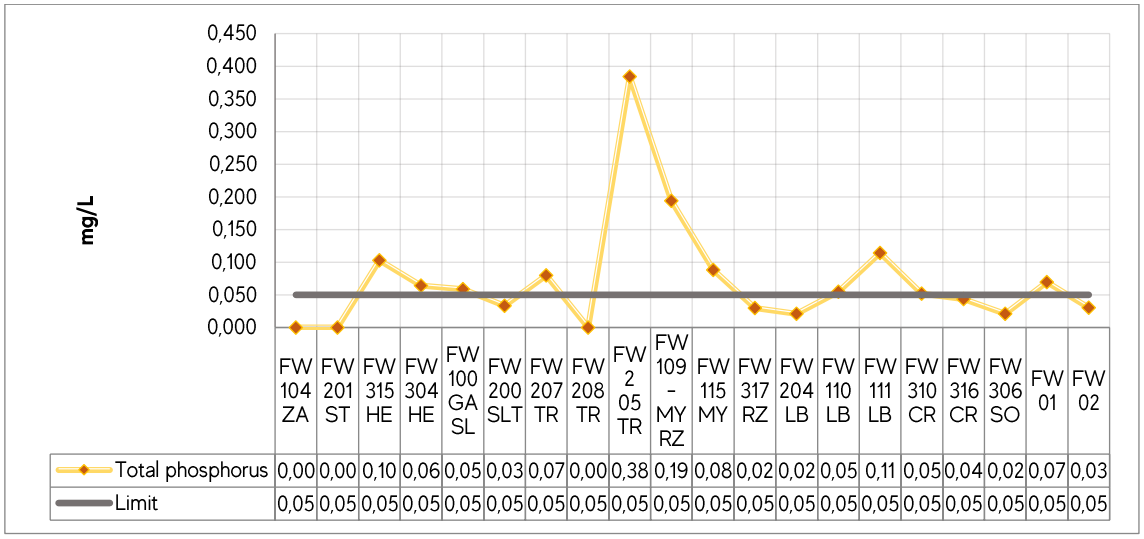



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 – MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BOD5 | 2,33 | 1,93 | 2,23 | 1,84 | 4,55 | 4,60 | 3,21 | 3,53 | 5,32 | 2,51 | 2,93 | 1,43 | 2,73 | 4,35 | 2,15 | 5,51 | 5,05 | 4,35 | 1,50 | 1,11 |
| Limit | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

Figure 10. Comparative analysis of BOD5 at different monitoring points

Regulation 222/02 sets a maximum of 5 mg $O_2$/l for the BOD5 parameter. A percentage of 84 of the monitored points comply with the limits, and the 3 points that slightly exceed it are FW205-TR, FW310-CR and FW316-CR. The BOD5 average in the first campaign is 3,158 mg $O_2$/l.

### 3.2.11 Total phosphorus




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total phosphorus | 0,00 | 0,00 | 0,10 | 0,06 | 0,05 | 0,03 | 0,07 | 0,00 | 0,38 | 0,19 | 0,08 | 0,02 | 0,02 | 0,05 | 0,11 | 0,05 | 0,04 | 0,02 | 0,07 | 0,03 |
| Limit | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |

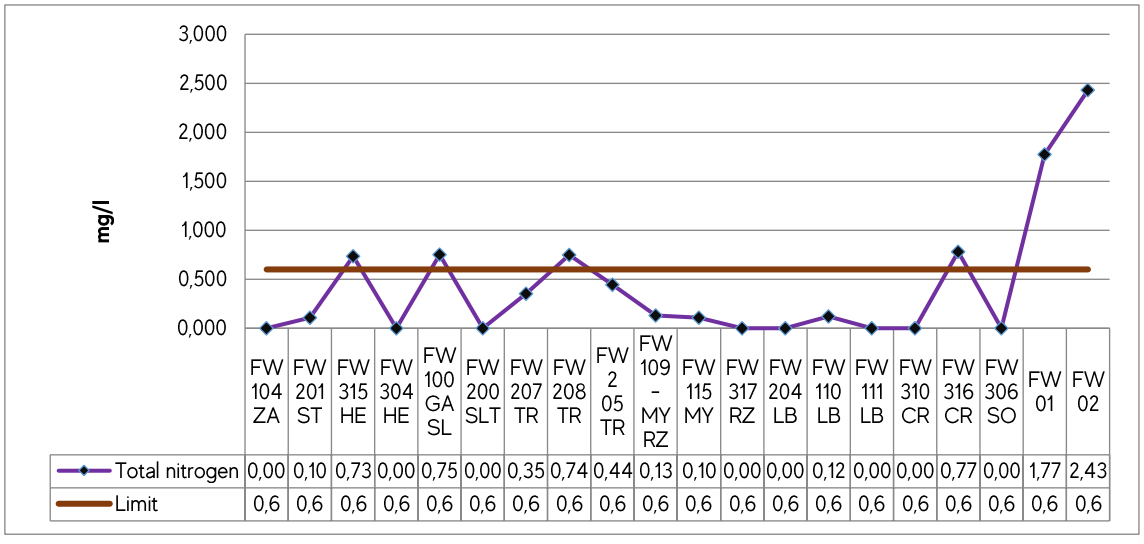
Figure 11. Comparative analysis of total phosphorus at different monitoring points

The presence of phosphorus in water is usually related to the use of organic or synthetic fertilisers. When excesses in the application of fertilisers or agrochemicals happen, it is usual that a fraction that the vegetation doesn't absorb infiltrates into the soil, reaching groundwater and surface water.

The legislation of reference establishes the presence of phosphorus in water to a maximum of 0.05 mg/L.

As shown in figure 11, this parameter's levels exceeded the limit at points FW 315-HE, FW 304-HE, FW 207-TR, FW 205-TR, FW 109-MYRZ, FW 115-MY, FW 110-LB, FW11-LB, FW 310-CR and FW01.

### 3.2.12 Total nitrogen



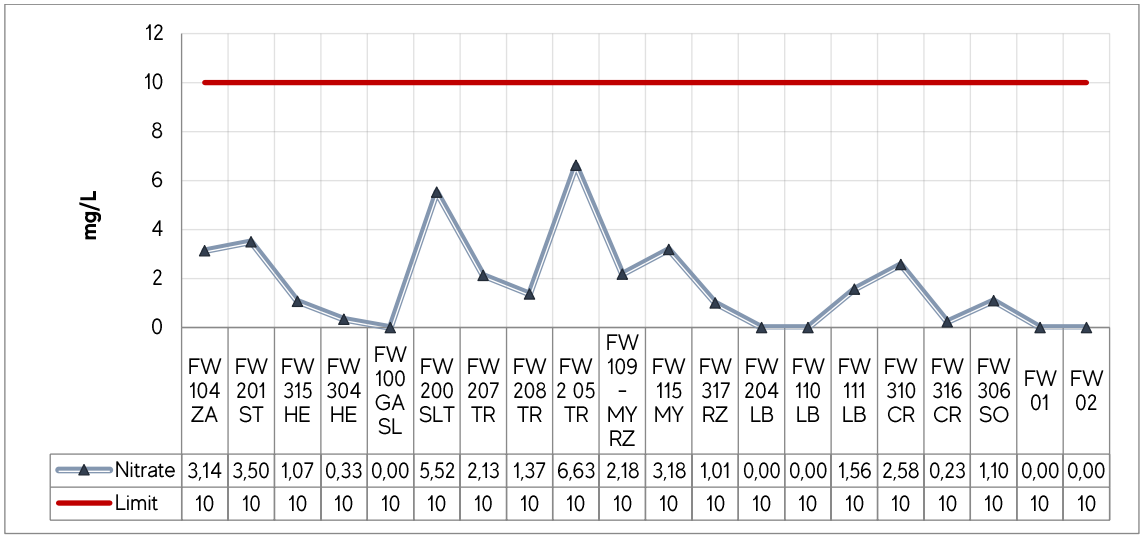

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total nitrogen | 0,00 | 0,10 | 0,73 | 0,00 | 0,75 | 0,00 | 0,35 | 0,74 | 0,44 | 0,13 | 0,10 | 0,00 | 0,00 | 0,12 | 0,00 | 0,00 | 0,77 | 0,00 | 1,77 | 2,43 |
| Limit | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 |

Figure 12. Comparative analysis of total nitrogen at different monitoring points

The limit set by the national water standard for total nitrogen is 0.6 mg/l; the points exceeding the maximum are FW 315-HE, FW 100-GASL, FW 208-TR and FW 316-CR.

The median for this parameter is 0.7 mg/L. A percentage of 70% of the monitoring points shows values under the range.

### 3.2.13 Nitrate



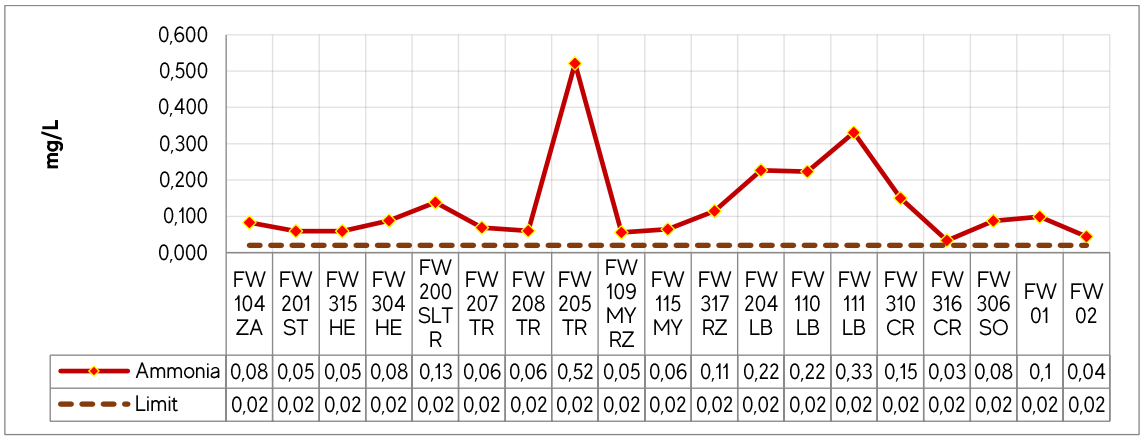

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate | 3,14 | 3,50 | 1,07 | 0,33 | 0,00 | 5,52 | 2,13 | 1,37 | 6,63 | 2,18 | 3,18 | 1,01 | 0,00 | 0,00 | 1,56 | 2,58 | 0,23 | 1,10 | 0,00 | 0,00 |
| Limit | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Figure 13. Comparative analysis of nitrate levels at different monitoring points

The legislation established a maximum of 10 mg/l for nitrates. None of the points exceeds this value except for point FW205-TR that reaches the maximum result with 6.63 mg/l.

The nitrate's results average is 2.7 mg/l, far below the limit.

### 3.2.14 Ammonia



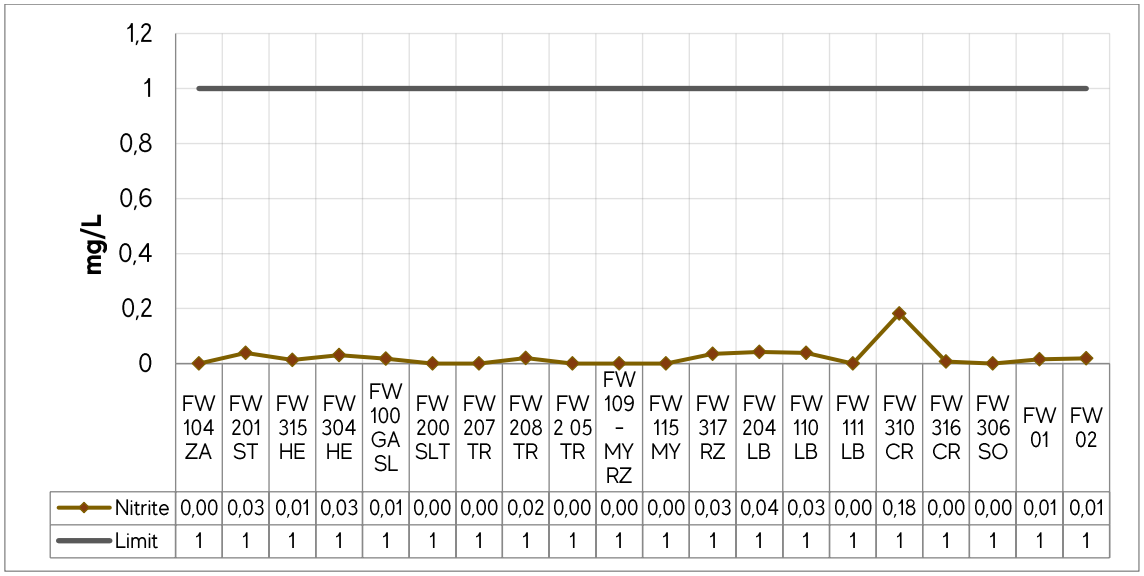

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ammonia | 0,08 | 0,05 | 0,05 | 0,08 | 0,13 | 0,06 | 0,06 | 0,52 | 0,05 | 0,06 | 0,11 | 0,22 | 0,22 | 0,33 | 0,15 | 0,03 | 0,08 | 0,1 | 0,04 |
| Limit | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |

Figure 14. Comparative analysis of ammonia levels at monitoring points

The ammonia levels exceed at all the points with an average value of 0.12 mg/l, which is five times higher than the maximum reference value.

In water bodies that don't receive industrial effluents and are in agro livestock's areas, the primary source of ammonia comes from the degradation of organic matter, specifically the decomposition of faecal matter which can explain the values obtained.

### 3.2.15 Nitrite

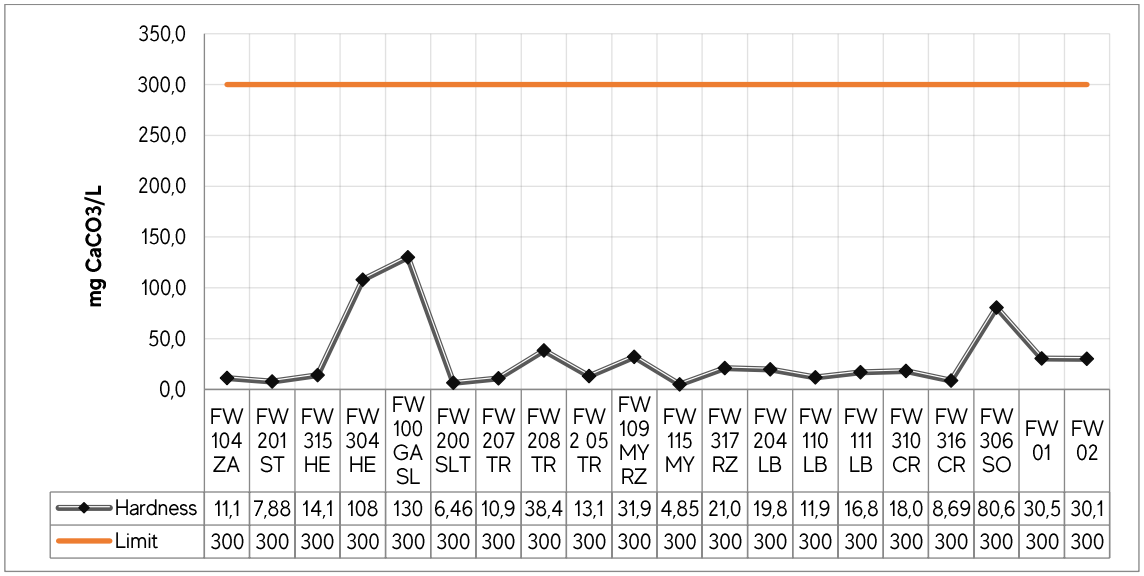



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrite | 0,00 | 0,03 | 0,01 | 0,03 | 0,01 | 0,00 | 0,00 | 0,02 | 0,00 | 0,00 | 0,00 | 0,03 | 0,04 | 0,03 | 0,00 | 0,18 | 0,00 | 0,00 | 0,01 | 0,01 |
| Limit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 15. Comparative analysis of nitrite levels at monitoring points

For nitrate levels, the maximum established by Regulation 222/02 is 1 mg/l. All monitored points comply with the permissible limit with an average result of 0.024 mg/l.

### 3.2.16 Hardness

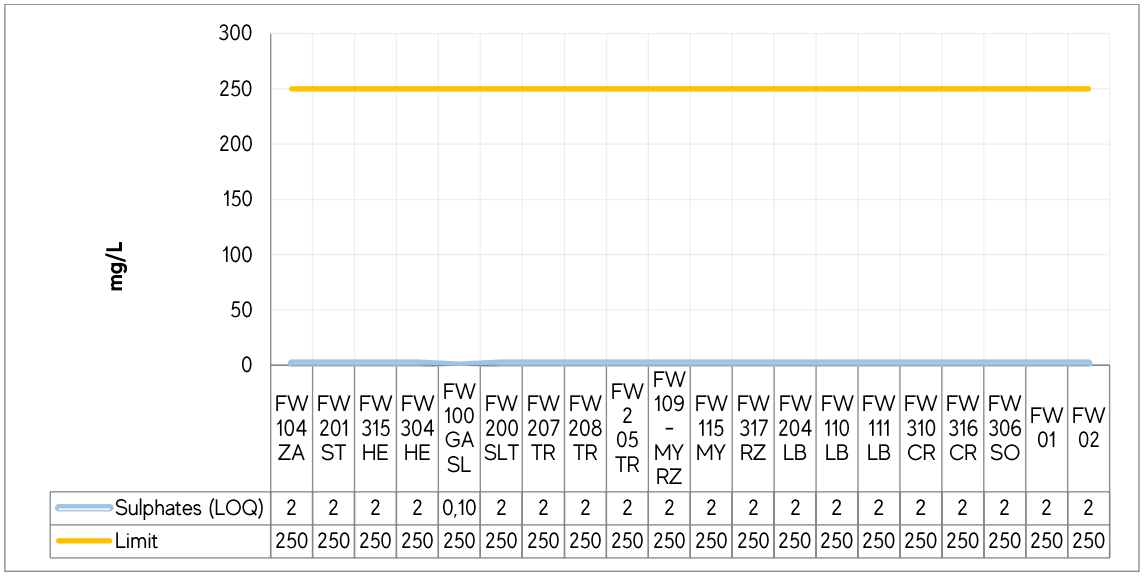



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hardness | 11,1 | 7,88 | 14,1 | 108 | 130 | 6,46 | 10,9 | 38,4 | 13,1 | 31,9 | 4,85 | 21,0 | 19,8 | 11,9 | 16,8 | 18,0 | 8,69 | 80,6 | 30,5 | 30,1 |
| Limit | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

Figure 16. Comparative analysis of hardness levels at monitoring points

Hardness is a water quality parameter mainly influence by the geological formations of the hydrological area in which a given watercourse is located. Regulation 222/02 stipulates a maximum level of 300 mg/l for this parameter; none result yielded a value higher than limits. The average result in the first campaign is 30.7 mg $CaCO_3$/l.

### 3.2.17 Sulphates

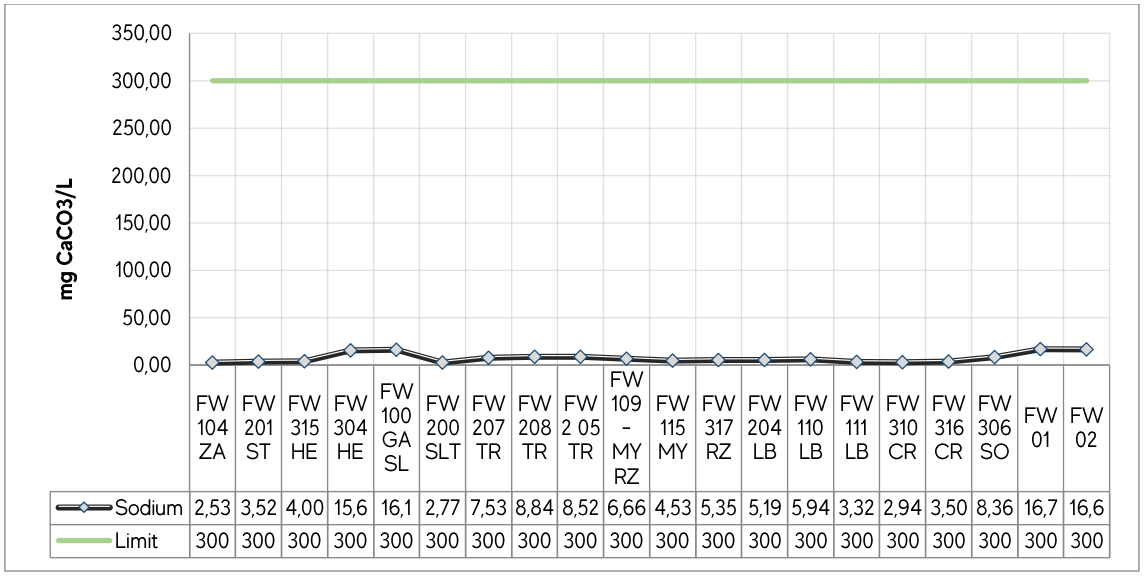



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulphates (LOQ) | 2 | 2 | 2 | 2 | 0,10 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Limit | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |

Figure 17. Comparative analysis of sulphates levels at monitoring points

All the 19 samples were below the detection limit of the turbidimetric method SM-4500, equal to 2 mg/l. Figure 17 shows a flat line with no points exceeding the permissible limit defined in Regulation 222/02, up to 250 mg/l.

### 3.2.18 Sodium

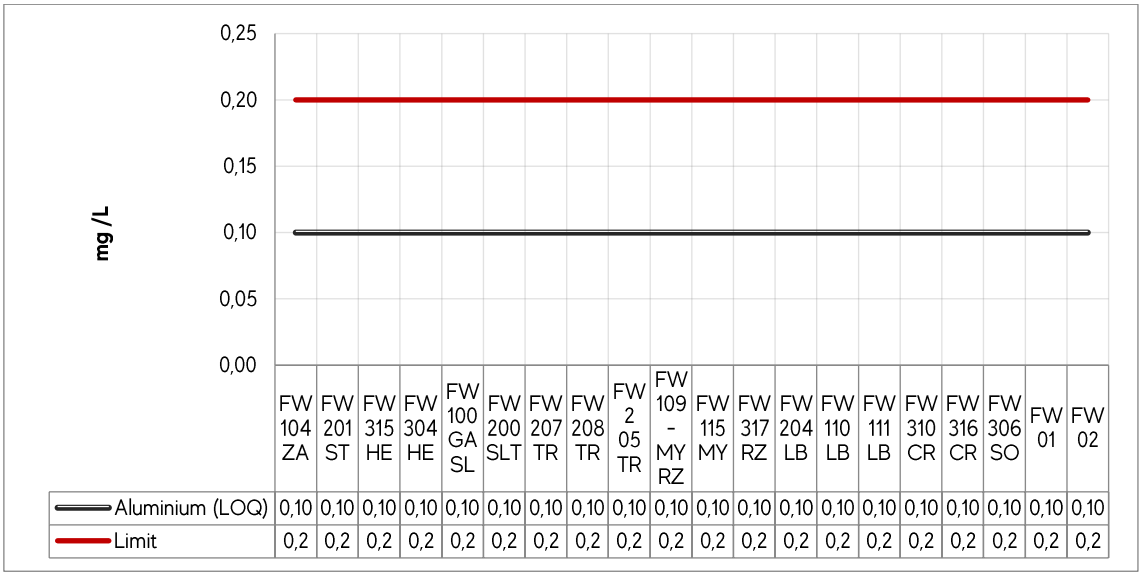



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium | 2,53 | 3,52 | 4,00 | 15,6 | 16,1 | 2,77 | 7,53 | 8,84 | 8,52 | 6,66 | 4,53 | 5,35 | 5,19 | 5,94 | 3,32 | 2,94 | 3,50 | 8,36 | 16,7 | 16,6 |
| Limit | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

Figure 18. Comparative analysis of sodium levels at monitoring points

The highest values of sodium are measured at FW 304-HE ("Hermosa" stream), FW 100-GASL ("Trementina stream") and at the points of the Paraguay River (FW01 and FW02). Even the points with the highest concentrations are less than the limit established by Regulation 222/02.

### 3.2.19 Aluminium



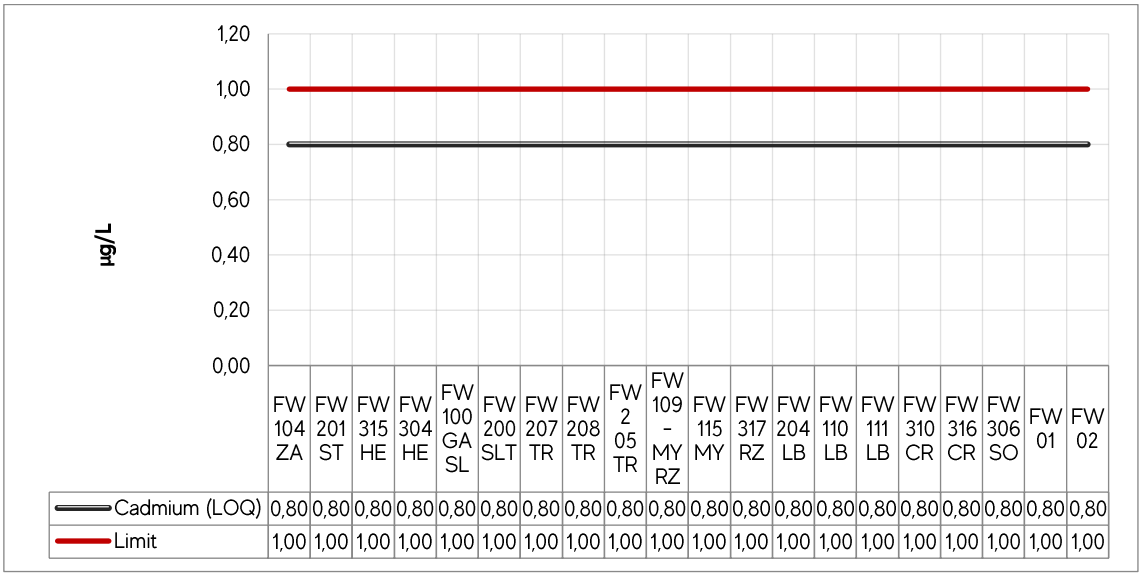

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminium (LOQ) | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 | 0,10 |
| Limit | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |

Figure 19. Comparative analysis of aluminium levels at monitoring points

Aluminium levels was measured with AAS-GFA method (SM-3113). The limit of quantification (LOQ) of this method is 0.2 mg/l. According to Regulation 222/02 the permissible limits of aluminium in surface water is 0.1 mg/l.

Figure 19 shows that at all monitoring points the aluminium levels are below the LOQ. In conclusion, all the points comply with the water standard limits for this parameter.

### 3.2.20 Cadmium



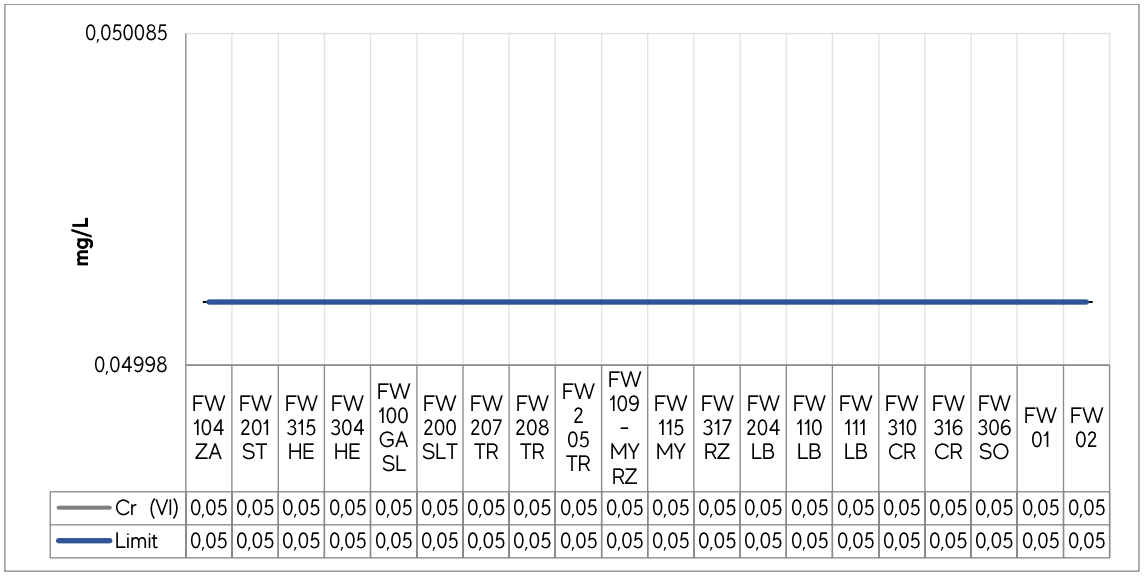

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cadmium (LOQ) | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 |
| Limit | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |

Figure 20. Comparative analysis of cadmium levels at monitoring points

Cadmium levels was measured with AAS-GFA method (SM-3113). The limit of quantification (LOQ) of this method is 0.8 µg/ for cadmium. According to Regulation 222/02 the permissible limits of aluminium in surface water is 1 µg/L

All monitoring points have levels of aluminium below the LOQ. In conclusion, all the points comply with the water standard limits for this parameter.

### 3.2.21 Hexavalent chromium



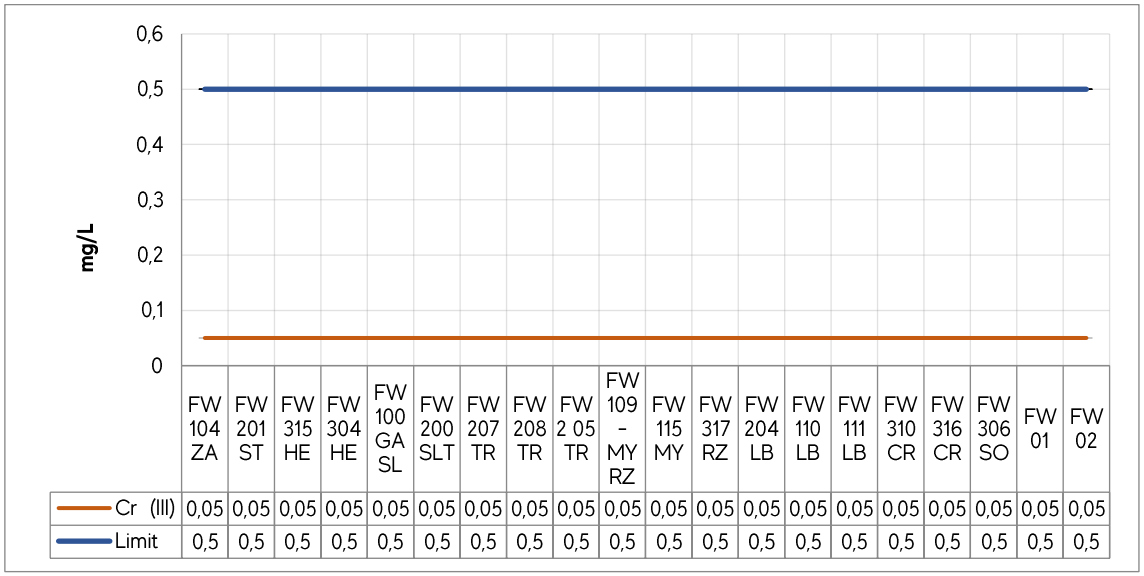

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cr (VI) | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |
| Limit | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |

Figure 21. Comparative analysis of hexavalent chromium levels at monitoring points

The colorimetric method (SM-3500-Cr B) was used to determine the levels of this parameter. The limit of quantification (LOQ) in aqueous matrix is 0.05 mg/l. The hexavalent chromium at all sampling points was below the LOQ.

Under those circumstances, all the points are in accordance with the water standard limits for this parameter.

### 3.2.22 Trivalent chromium



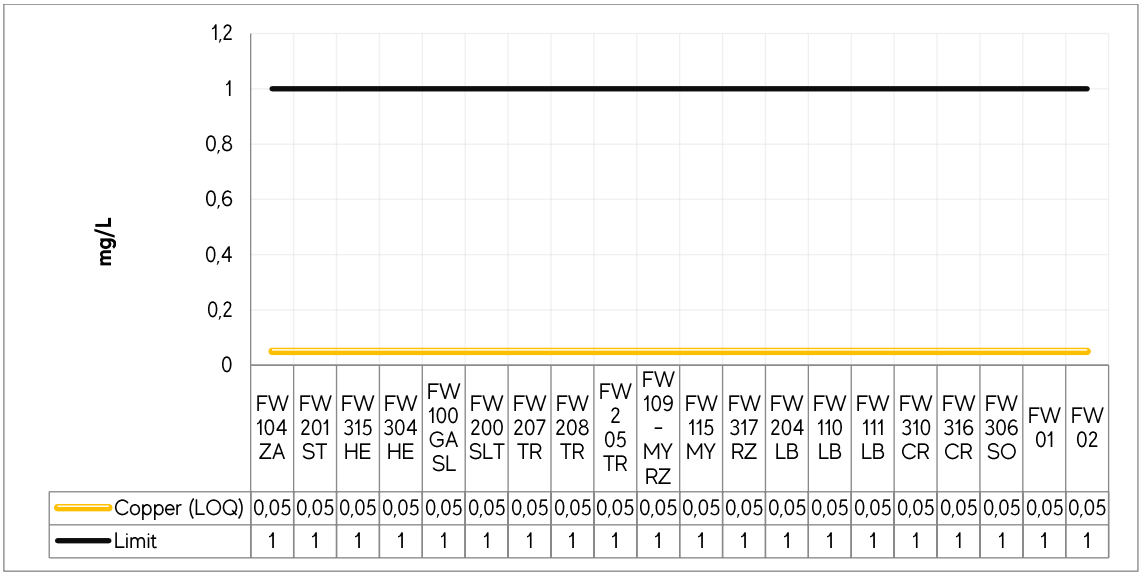

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cr (III) | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |
| Limit | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 | 0,5 |

Figure 22. Comparative analysis of trivalent chromium levels at monitoring points

For this determination, the calculation method (Total Chromium - Hexavalent Chromium) was used. The limit of quantification (LOQ) is 0.05 mg/l. The flat line on the graph shows that the 20 points analysed are below the LOQ.

It is important to note that the maximum permissible value according to the national water standard is 10 times higher than the limit of quantification.

### 3.2.23 Copper



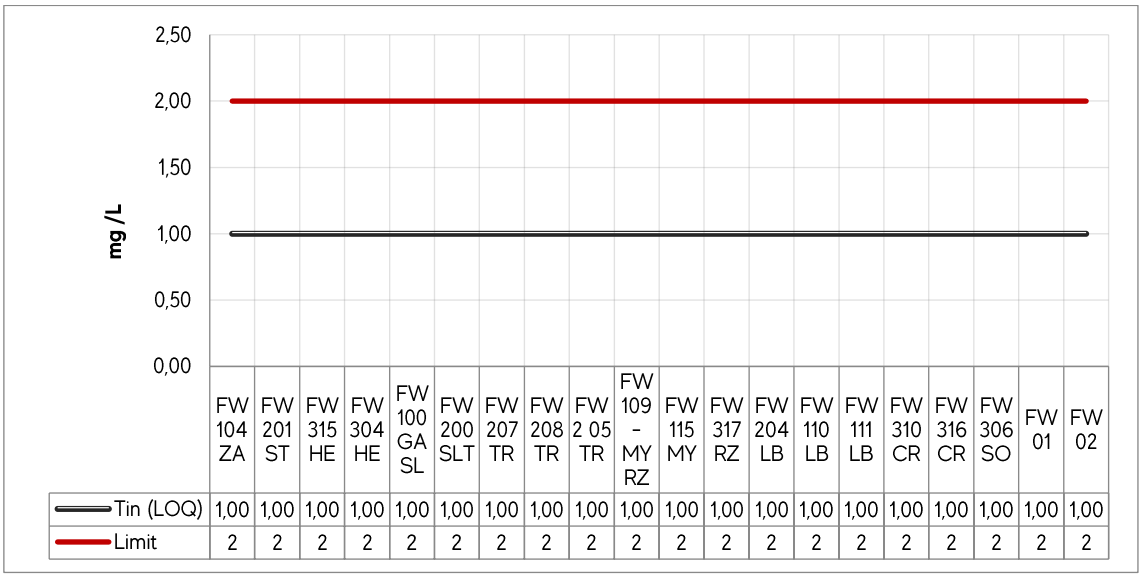

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Copper (LOQ) | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |
| Limit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 23. Comparative analysis of copper levels at monitoring points

The copper determinations method is AAS-Air-Acetylene Flame (SM-3111-B)/GFA (SM-3113), which has a sensitivity or limit of quantification in the water of 0.05 mg/l. For this parameter, there are no detectable and quantifiable copper concentrations in any of the 20 samples.

The fact that all samples were below the detection limit explains the flat line in figure 23; 100% of the monitored points are within the range for this parameter.

### 3.2.24 Tin

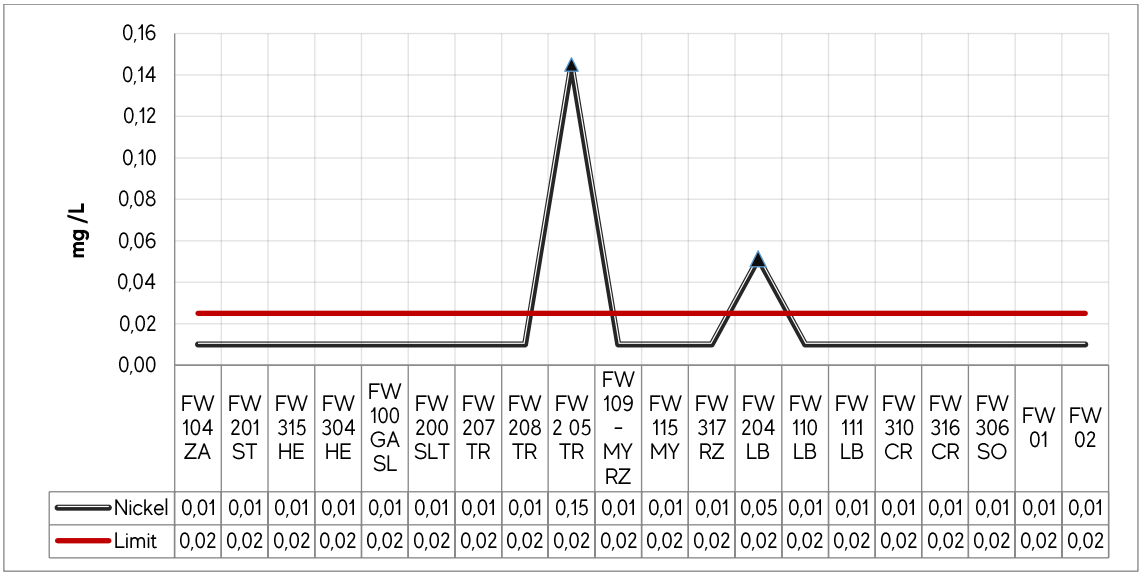



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tin (LOQ) | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 | 1,00 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 24. Comparative analysis of tin levels at monitoring points

At all points the concentrations of tin were below the limit of quantification. Since the LOQ (1 mg/l) is lower than the maximum allowed by the water standard regulation (2 mg/l), it is deducted that all the monitoring points comply with the regulation's limits.

### 3.2.25 Nickel

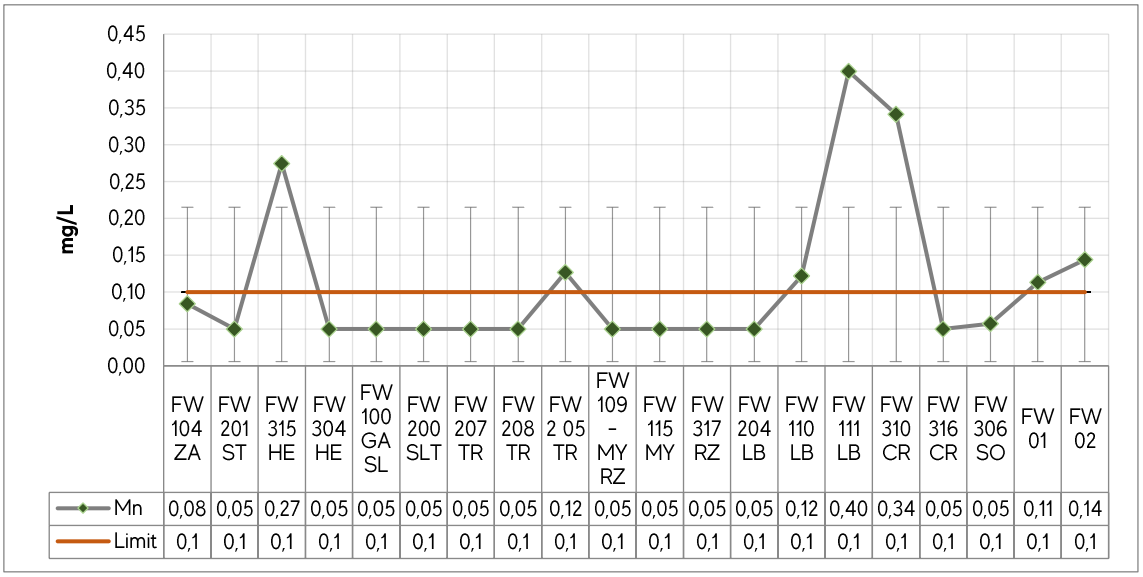



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nickel | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,15 | 0,01 | 0,01 | 0,01 | 0,05 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 |
| Limit | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |

Figure 25. Comparative analysis of nickel levels at monitoring points

The results of nickel at 18 monitoring points are below the limit of quantification (LOQ= 0.01 mg/L). However, in FW 208-TR and FW 204-LB the values are higher than the limit established by the water standard regulation, which is 0.025 mg/L.

### 3.2.26 Manganese

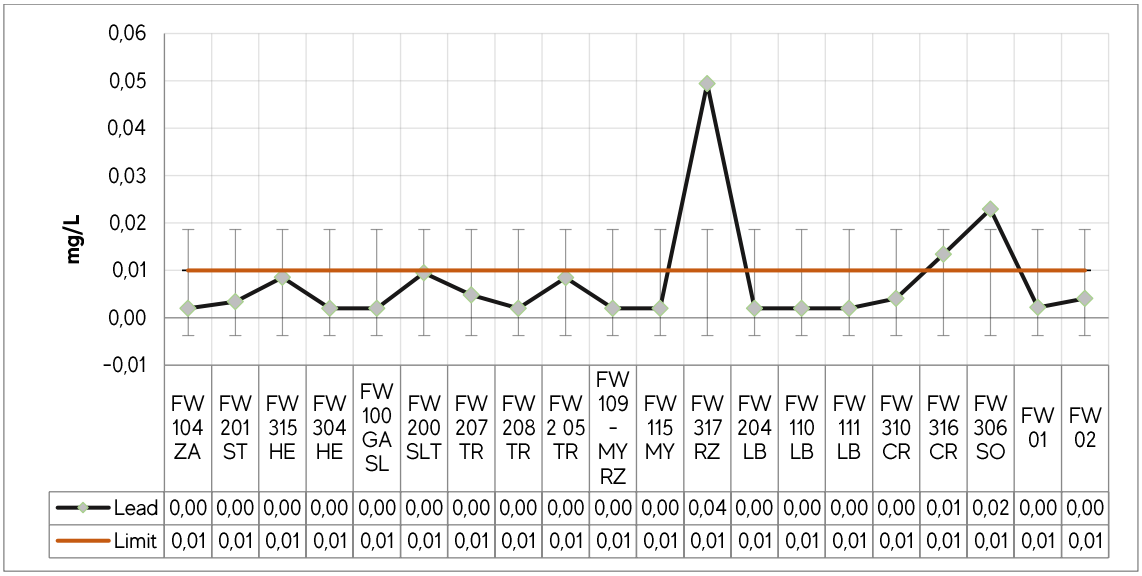



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mn | 0,08 | 0,05 | 0,27 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,12 | 0,05 | 0,05 | 0,05 | 0,05 | 0,12 | 0,40 | 0,34 | 0,05 | 0,05 | 0,11 | 0,14 |
| Limit | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 |

Figure 26. Comparative analysis of manganese levels at monitoring points

The graph shows that points FW 315-HE, FW 205-TR, FW 110 LB, FW 111 LB, FW 310 CR and the two points on the Paraguay River (FW 01 and FW 02) have higher values than the maximum established for waters classify as Class II by the Regulation. The maximum permissible value for this element is 0.1 mg/L and the limit of quantification (LOQ) of the method used to measure is 0.05 mg/L.

### 3.2.27 Lead

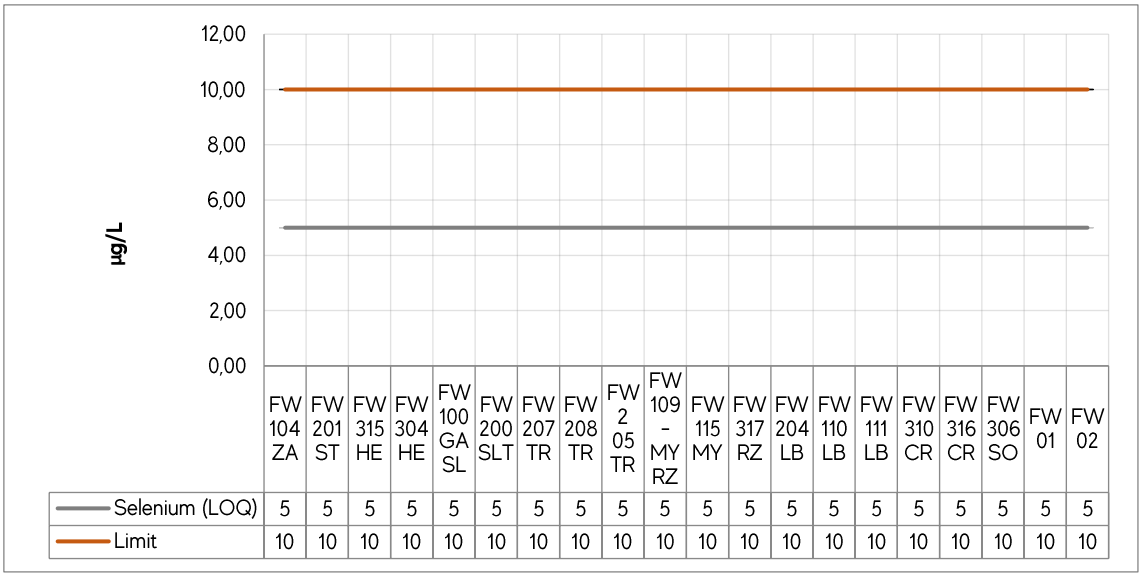



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lead | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,04 | 0,00 | 0,00 | 0,00 | 0,00 | 0,01 | 0,02 | 0,00 | 0,00 |
| Limit | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 |

Figure 27. Comparative analysis of lead levels at monitoring points

The method used to determine lead levels is AAS-GFA (SM-3113). The limit of quantification (LOQ) is 0.002 mg/l. The figure 27 reveals that in 9 points the levels were below the LOQ but in 3 points with quantifiable values, the values exceed the water standard limits (0.01 mg/L).

### 3.2.28 Selenium




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Selenium (LOQ) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Limit | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Figure 28. Comparative analysis of selenium levels at monitoring points

At all sampling points selenium concentrations were below the limit of quantification (LOQ= 5 µg/L). According to Regulation 222/02 the maximum permissible level is 10 µg/L. Therefore, it can be deduced that all points are in accordance with the reference legislation.

### 3.2.29 Zinc

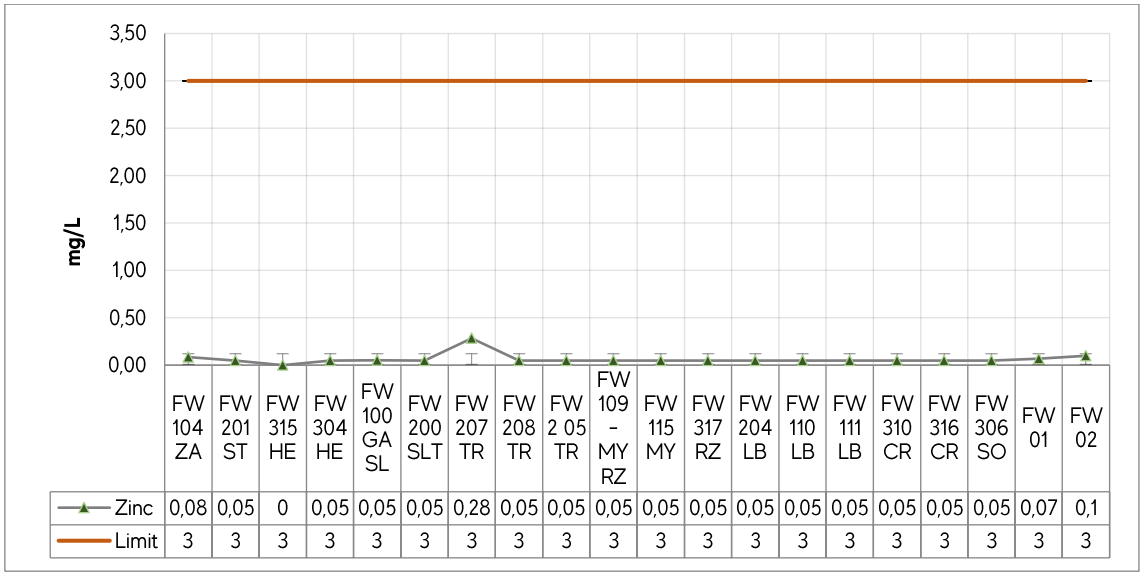



Figure 29. Comparative analysis of zinc levels at monitoring points

Zinc concentrations are below the maximum limit established in the water regulation at all points. Even in 75% of the sampled points the zinc levels were under the limit of quantification (LOQ=0.05).

### 3.2.30 Arsenic

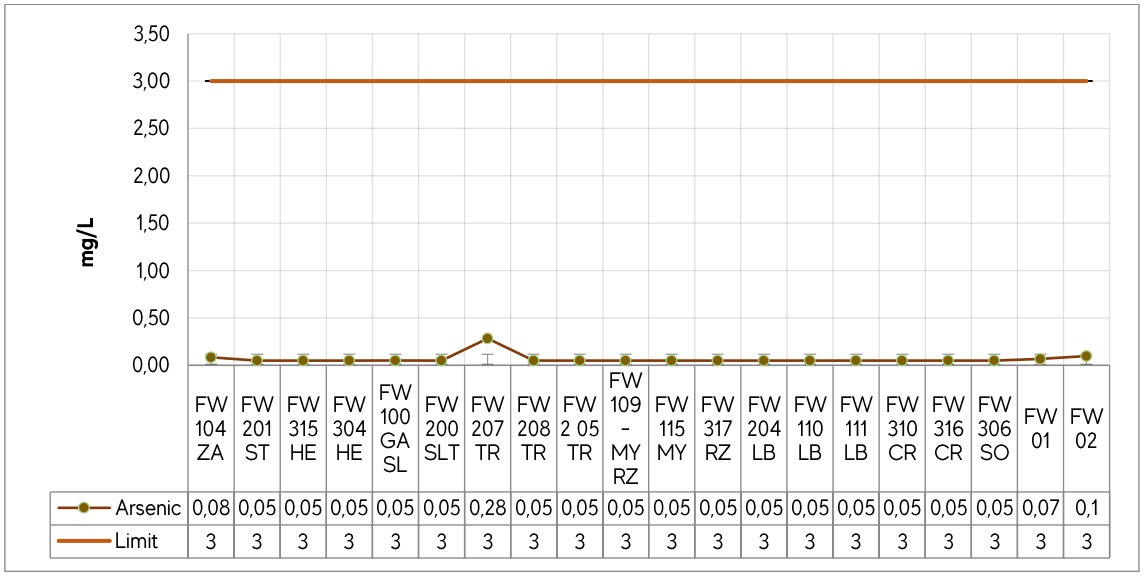
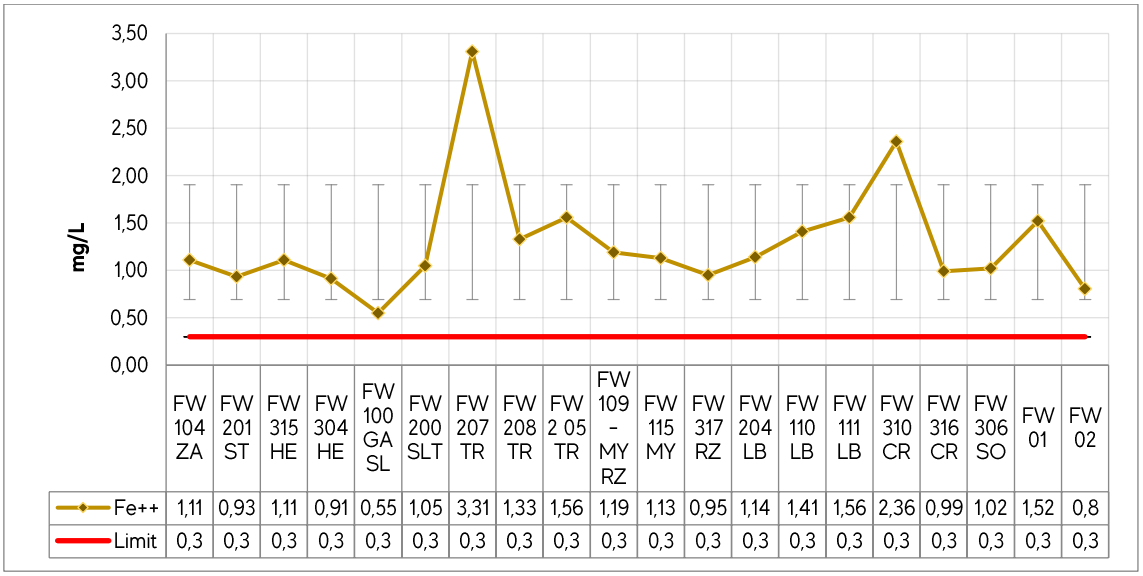



Figure 30. Comparative analysis of zinc levels at monitoring points

As figure 30 illustrates, the arsenic concentrations in all the points are below the maximum defined by the national regulation. In 85% of them, the values are not detectable by the method used to measure; which is LOQ=0.05.

### 3.2.31 Soluble iron



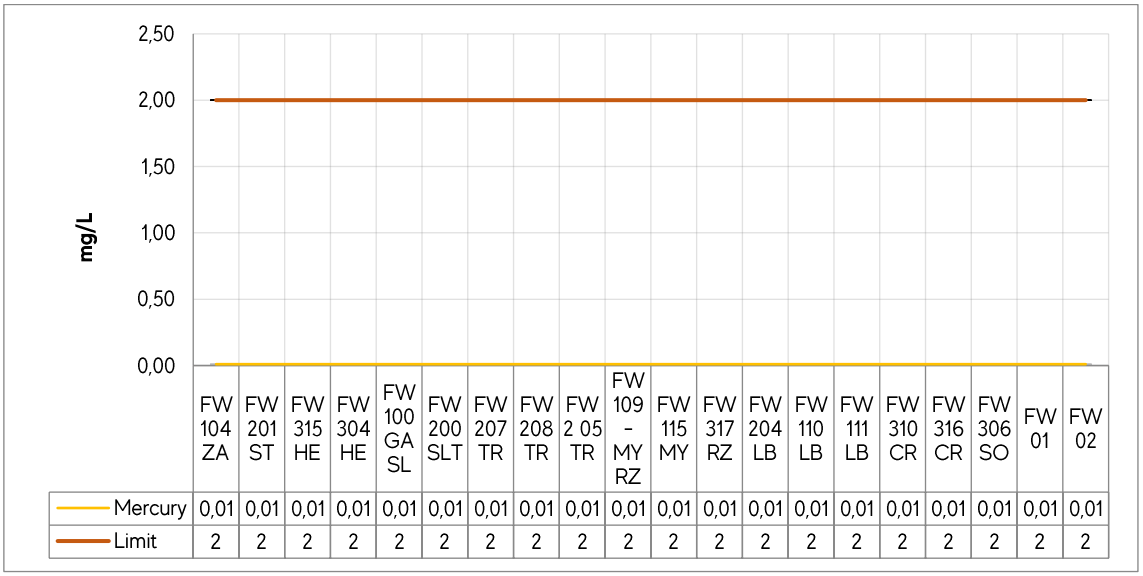

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fe++ | 1,11 | 0,93 | 1,11 | 0,91 | 0,55 | 1,05 | 3,31 | 1,33 | 1,56 | 1,19 | 1,13 | 0,95 | 1,14 | 1,41 | 1,56 | 2,36 | 0,99 | 1,02 | 1,52 | 0,8 |
| Limit | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 | 0,3 |

Figure 31. Comparative analysis of soluble iron levels at monitoring points

The geological formations of a river basin determine the presence of iron in the water. Regulation 222/02 determines a maximum level of 0.3 mg/l for this element.

In the first monitoring campaign, all 20 points reach levels higher than the maximum permissible for waters classify as Class 2 according to the regulation. The average value is up to 1.3 mg/l which is four times higher than the limit.

### 3.2.32 Total mercury

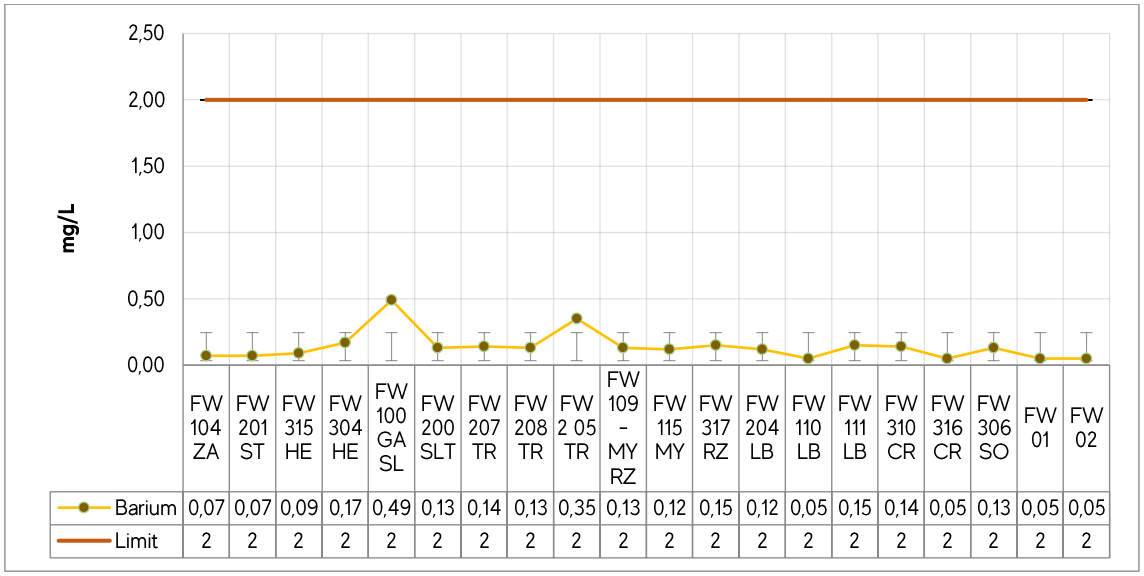



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mercury | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 32. Comparative analysis of total mercury levels at monitoring points

Levels of mercury were not detected at any of the 20 points. The national water regulation establishes a limit of 2 mg/l for this parameter. Regarding to the limit of quantification for the method used to analyse the samples is 0.01 mg/l.

### 3.2.33 Barium

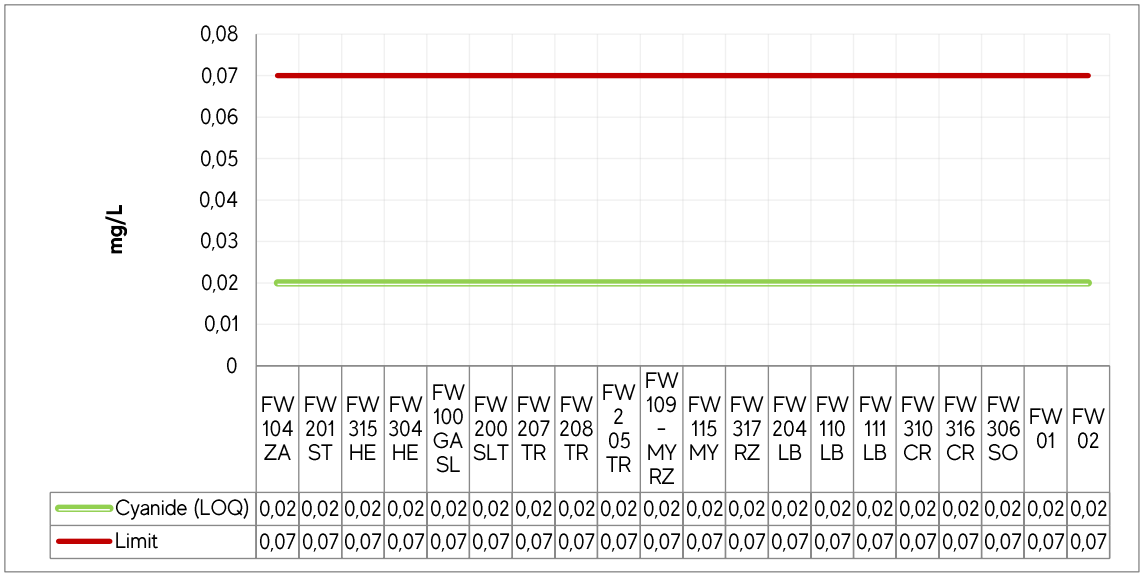



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Barium | 0,07 | 0,07 | 0,09 | 0,17 | 0,49 | 0,13 | 0,14 | 0,13 | 0,35 | 0,13 | 0,12 | 0,15 | 0,12 | 0,05 | 0,15 | 0,14 | 0,05 | 0,13 | 0,05 | 0,05 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 33. Comparative analysis of barium levels at monitoring points

All the values measured are within the permissible limit established by the Regulation 222/02. The highest value recorded belongs to the point FW 100 GASL and it is approximately 4 times lower than the maximum defined by the mentioned legislation.

### 3.2.34 Cyanide




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT | FW 207 TR | FW 208 TR | FW 2 05 TR | FW 109 - MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cyanide (LOQ) | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 |
| Limit | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 | 0,07 |

Figure 34. Comparative analysis of cyanides levels at monitoring points

The SM 4500 CN E method used for cyanides determinations has a limit of quantification (LOQ) equal to 0.02 mg/l, which was not detected in all the sampling points. The regulation establishes a limit 3.5 times higher than LOQ; therefore, it is inferred that the 20 samples comply with the reference regulation.

### 3.2.35 Glyphosate

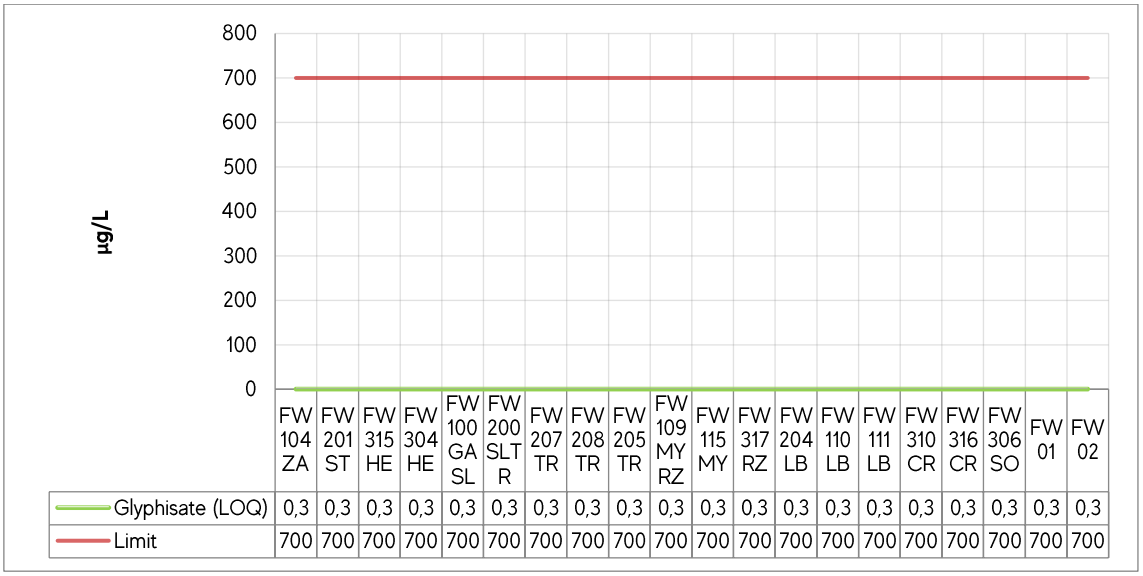



Figure 35. Comparative analysis of glyphosate levels at monitoring points

Glyphosate is a systemic herbicide ($C_3H_8NO_6P$) marketed under the name Round-up, widely used in agricultural and forestry activities.

The water regulation establishes a limit up to 700 µg/l for this substance. The limit of quantification in aqueous matrix is 0.3 µg/l which is not detected in any of the surface water sampling points.

### 3.2.36 AMPA

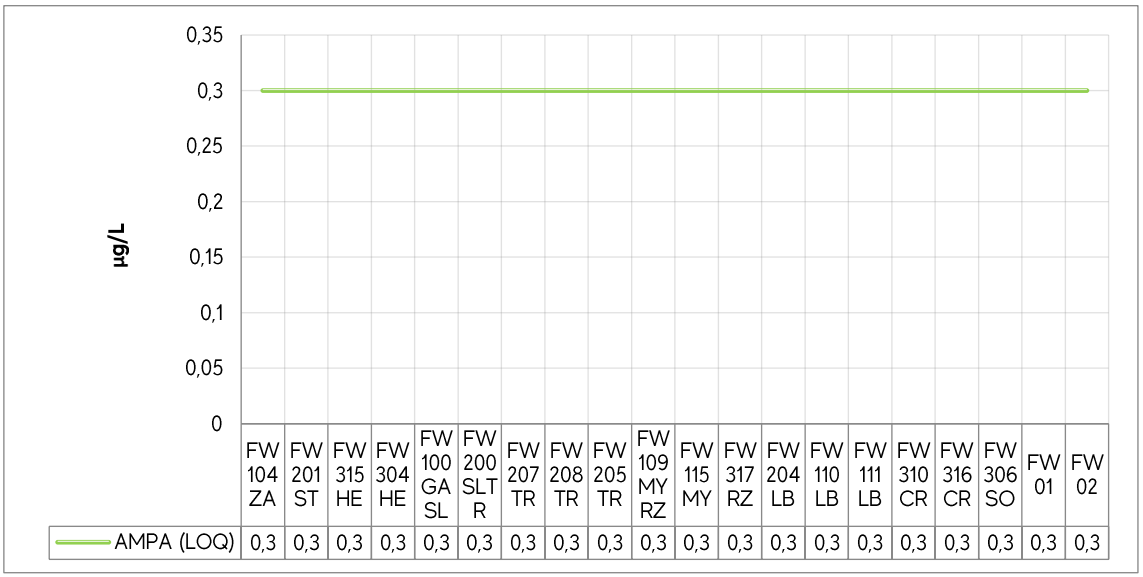


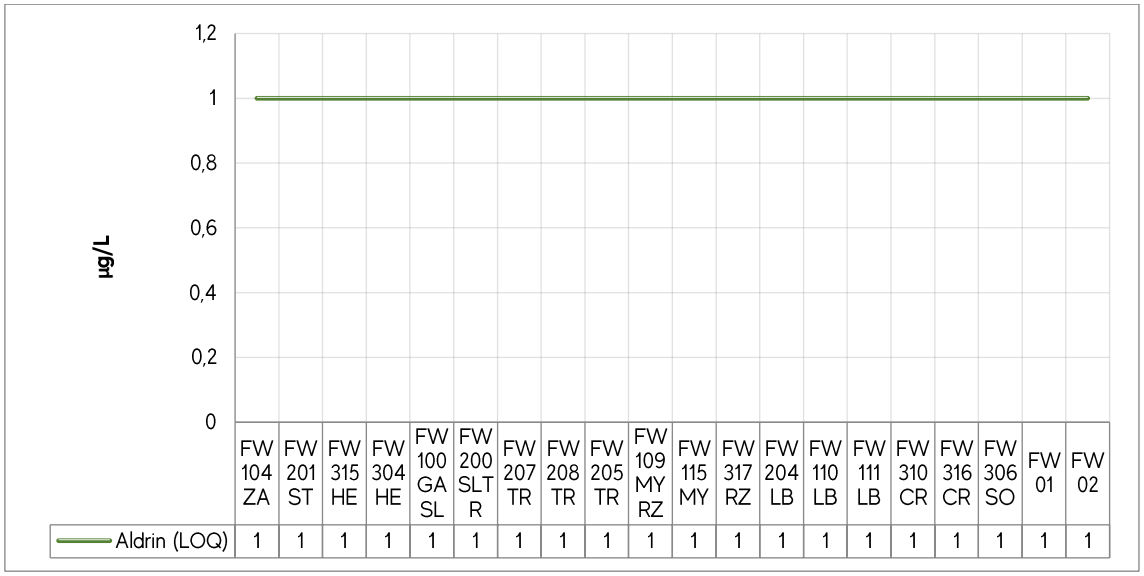

Figure 36. Comparative analysis of AMPA levels at monitoring points

The main metabolite of glyphosate is AMPA (amino-methyl phosphoric acid), which, due to its high solubility, can contaminate surface water.

The national water regulation does not establish limits for this substance.

The limit of quantification of the method used to determine this parameter is 0.3 µg/l. In any of the sampling points were detected levels of AMPA during the first campaign.

### 3.2.37 Aldrin

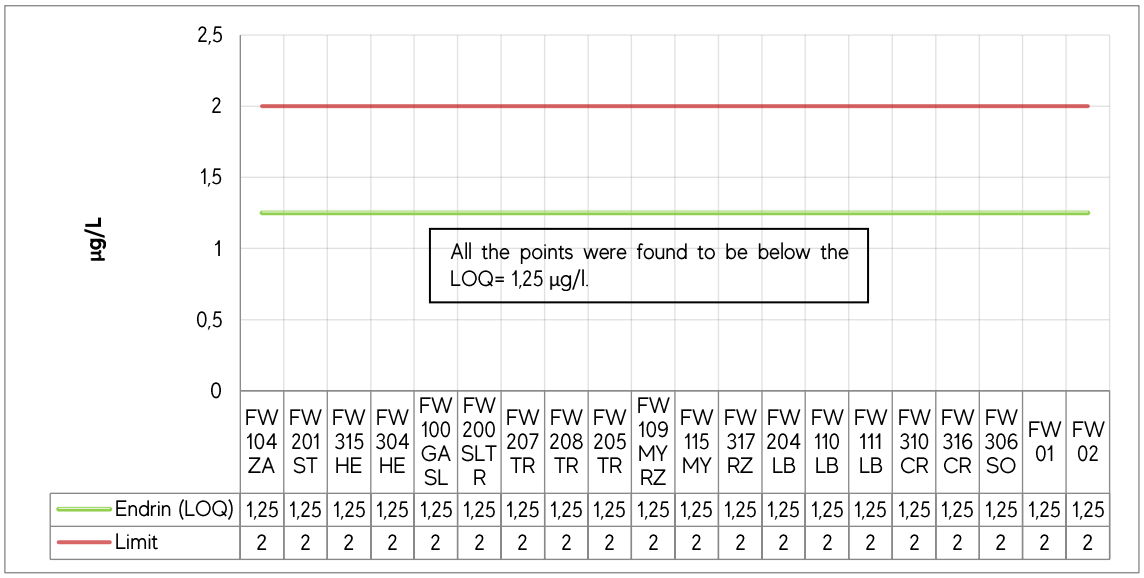



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aldrin (LOQ) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Figure 37. Comparative analysis of Aldrin levels at monitoring points

Aldrin is a non-systemic insecticide which has no maximum limit established by the national water regulation. At none of the samples were was detected levels of this substance. The limit of quantification of the method used to measure this parameter is 1 µg/L.

### 3.2.38 Endrin



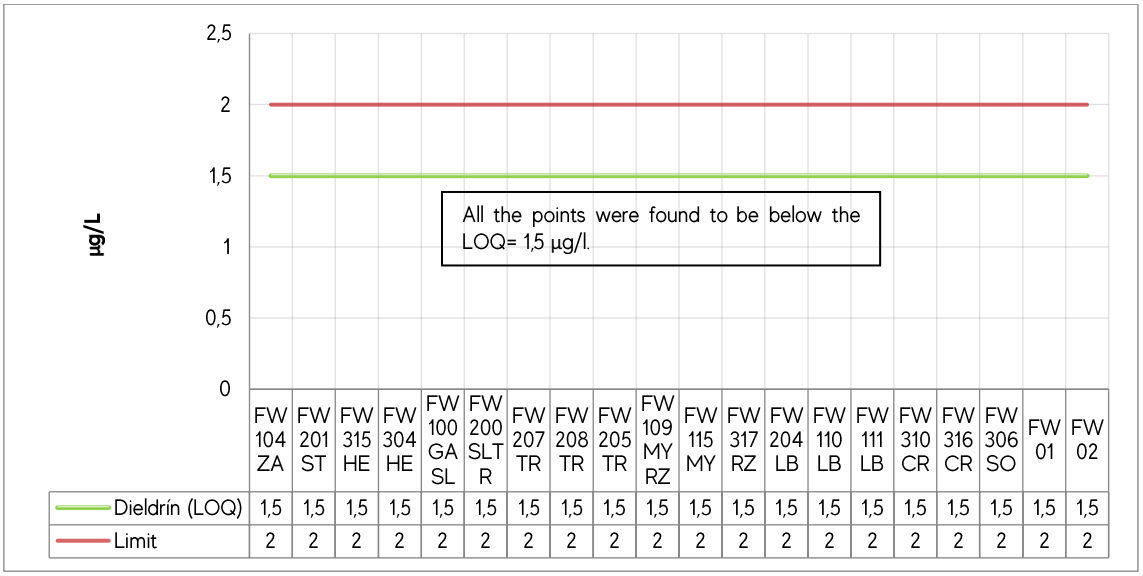

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Endrin (LOQ) | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 | 1,25 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 38. Comparative analysis of Endrin levels at monitoring points

Endrin ($C_{12}H_8Cl_6O$) is an insecticide and rodenticide. Regulation 222/02 establishes a maximum admissible value for waters Class II up to 2 µg/L. The limit of quantification of the method used to measure this parameter is 1.25 µg/L.

There were not detected levels of Endrin in the samples analysed.

### 3.2.39 Dieldrin



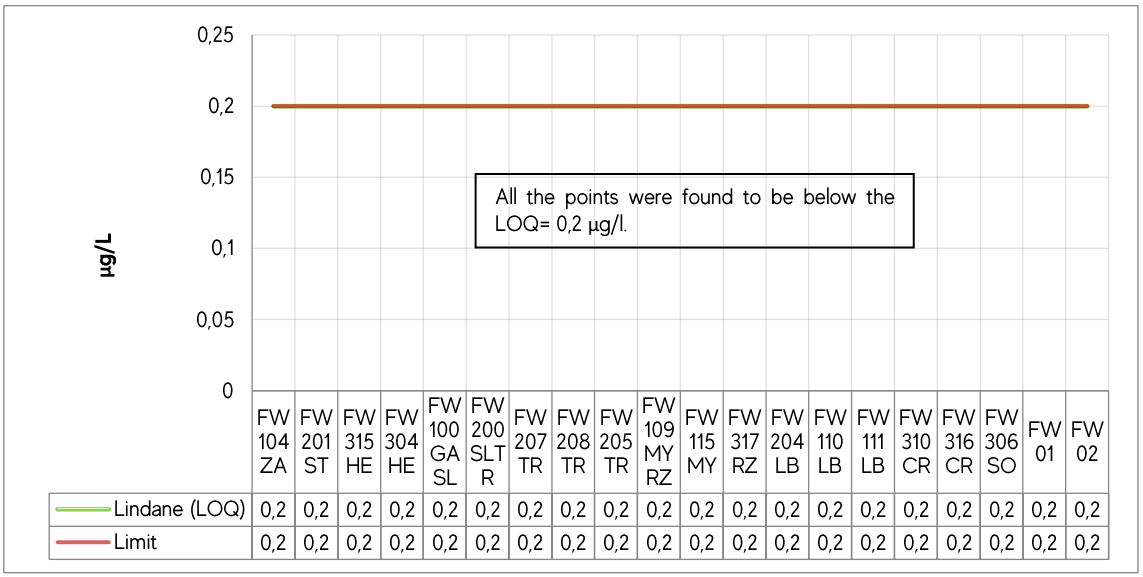

| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dieldrín (LOQ) | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 | 1,5 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 39. Comparative analysis of Dieldrin levels at monitoring points

Dieldrin (C12H8Cl6O) is an insecticide. The national water regulation sets a maximum limit for this substance of 2 µg/l.

The method's limit of quantification is 1.5 µg/L. It was not detected this agrochemical at any of the sampling points.

### 3.2.40 Lindane

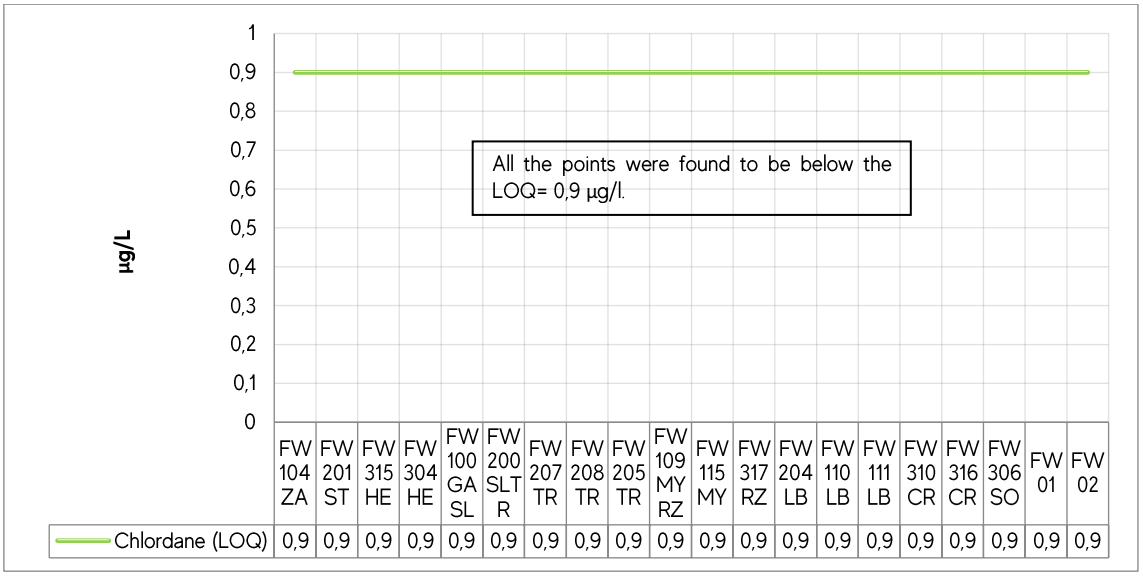



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lindane (LOQ) | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |
| Limit | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |

Figure 40. Comparative analysis of Lindane levels at monitoring points

Lindane (C6H6CL6) is an insecticide distributed under the trade name Gamexane. Both the permissible limit established by the water regulation and method's LOQ sets a value of 0.2 µg/l. Lindane was not detected at the sampling points.

### 3.2.41 Chlordane

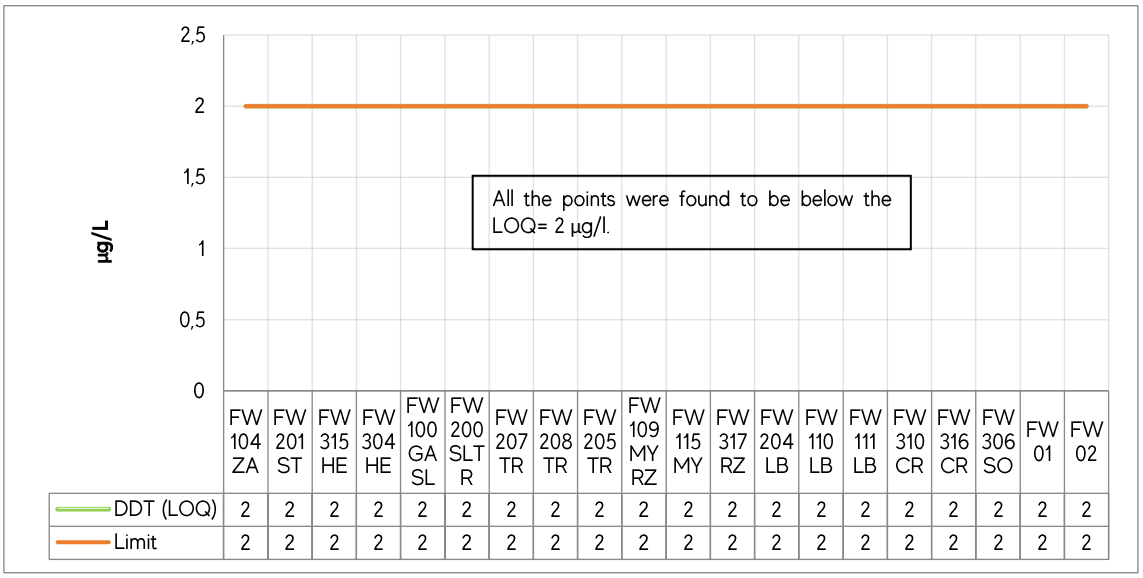



| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chlordane (LOQ) | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 | 0,9 |

Figure 41. Comparative analysis of chlordane levels at monitoring points

Chlordane ($C_{10}H_6Cl_8$) is an insecticide with no limit established in the national water regulation. The limit of quantification of this parameter is 0.9 µg/L. At all sampling points, chlordane levels was below the LOQ.

### 3.2.42 DDT




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DDT (LOQ) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Limit | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Figure 42. Comparative analysis of DDT levels at monitoring points

DDT ($C_{14}H_9Cl_{5)}$ is an insecticide. According to the national water regulation, the maximum permissible concentration in Class II surface water is 2 µg/L.

The limit of quantification of this parameter is 2 µg/L. DDT levels were below LOQ at all the 20 monitoring points.

### 3.2.43 DDE

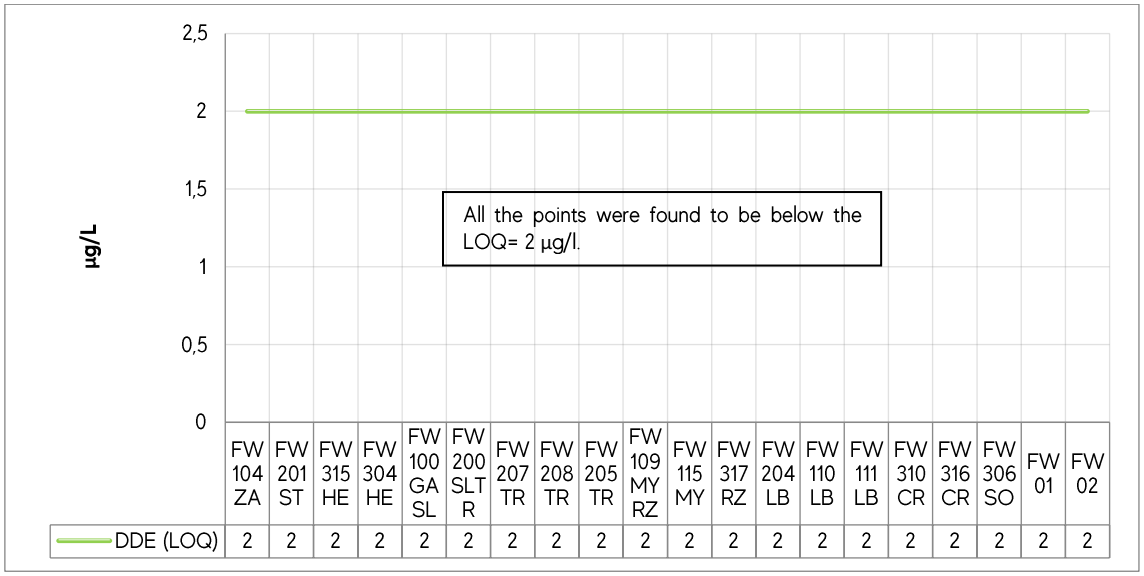



Figure 43. Comparative analysis of DDE levels at monitoring points

Likewise, other pesticides, no evidence of DDE was found in surface water. In all cases the DDE concentrations were below the method's limit of quantification which is LOQ= 2 µg/l.

The national water regulation does not establish maximum limits for this substance.

### 3.2.44 DDD

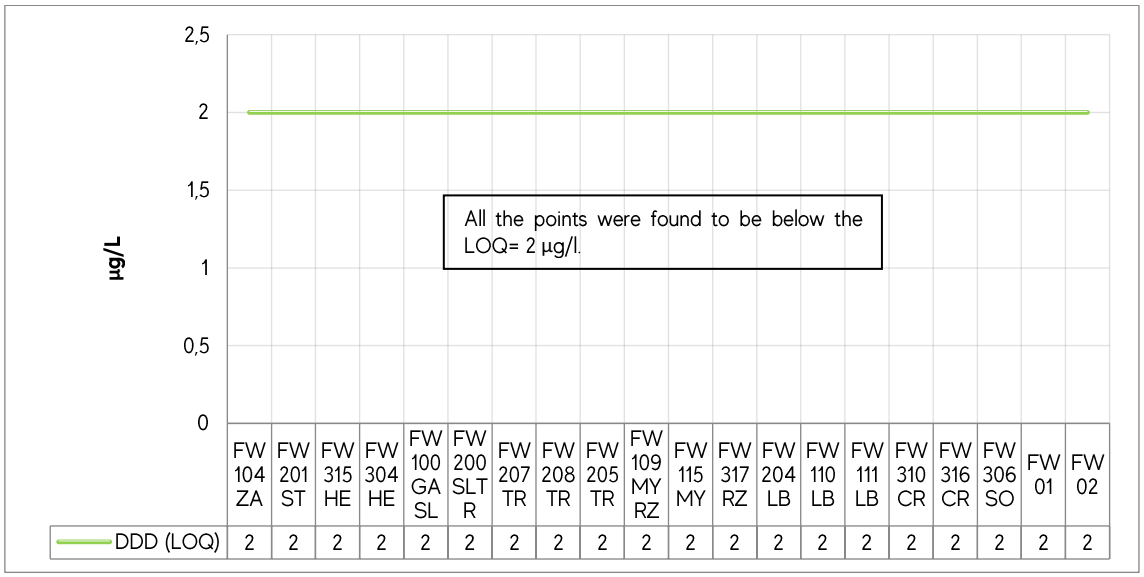



Figure 44. Comparative analysis of DDD levels at monitoring points

DDD is a metabolite resulting from the degradation of the insecticide DDT. The national water regulation does not establish a maximum limit for this parameter.

There is no evidence of DDD in the samples analysed during the first campaign. The method's limit of quantification is 2 µg/ which is not exceeded at any sampling point.

### 3.2.45 Atrazine

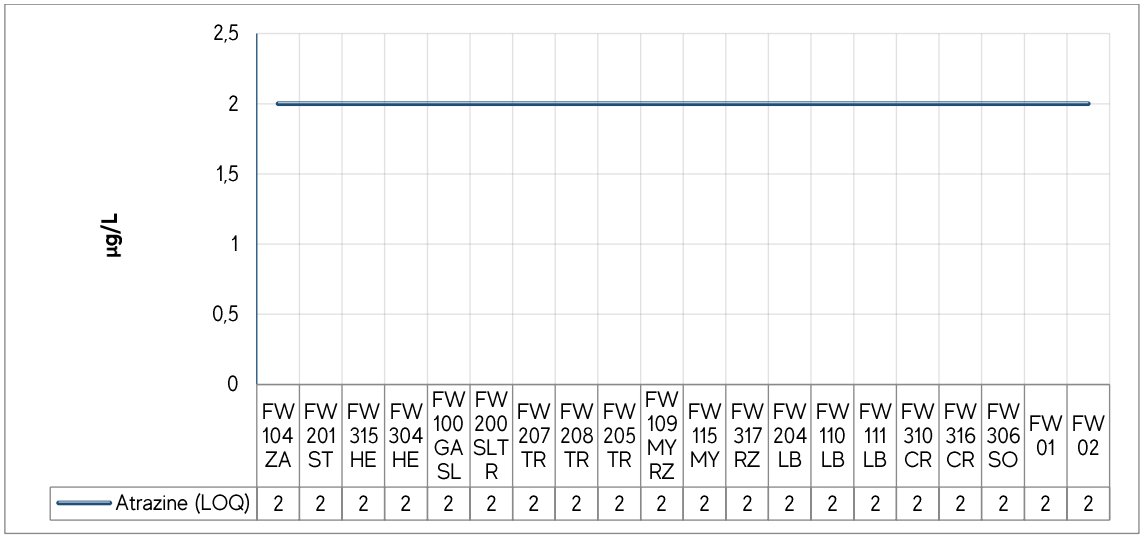



Figure 45. Comparative analysis of atrazine levels at monitoring points

Atrazine ($C_8H_{14}ClN_5$) is an herbicide distributed under the trade names Atramyl or Atraplex. The water standard regulation does not establish limits for this substance.

During the first monitoring campaign, there was no evidence of atrazine in surface waters. The limit of quantification is LOQ= 2 µg/L. None of the 20 samples exceeded this value.

### 3.2.47 Simazine

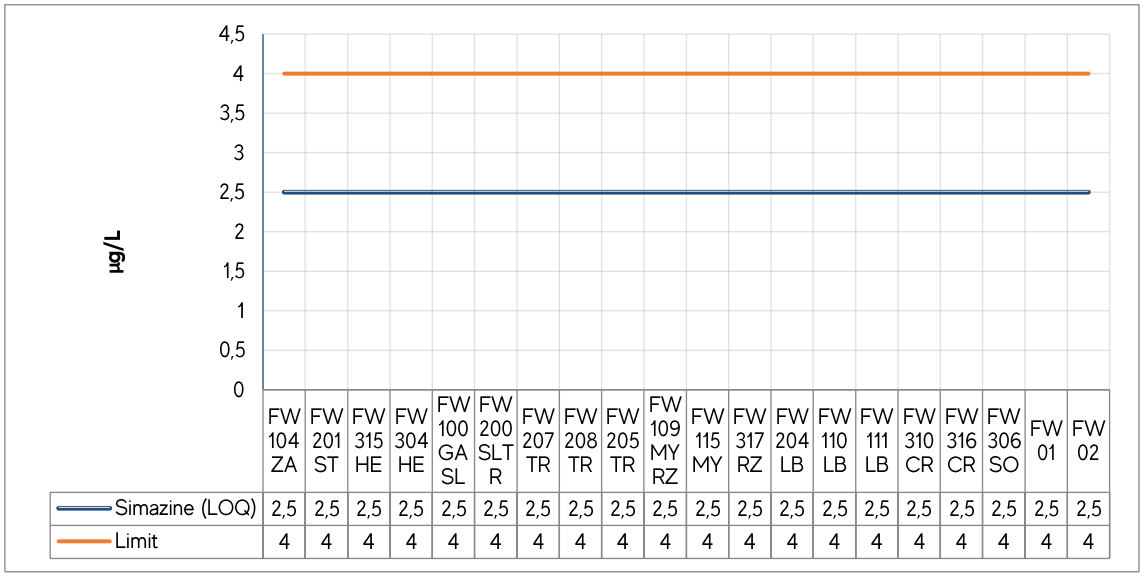



Figure 46. Comparative analysis of simazine levels at monitoring points

Simazine ($C_7H_{12}ClN_5$) is an herbicide distributed under the trade name SIMAPLEX. Regulation 222/02 establishes a maximum of 4 µg/l for this substance.

The analytical method used has a limit of quantification equal to 2.5 µg/l which none of the samples reached. All the monitoring points comply with the established limits.

### 3.2.48 Carbaryl

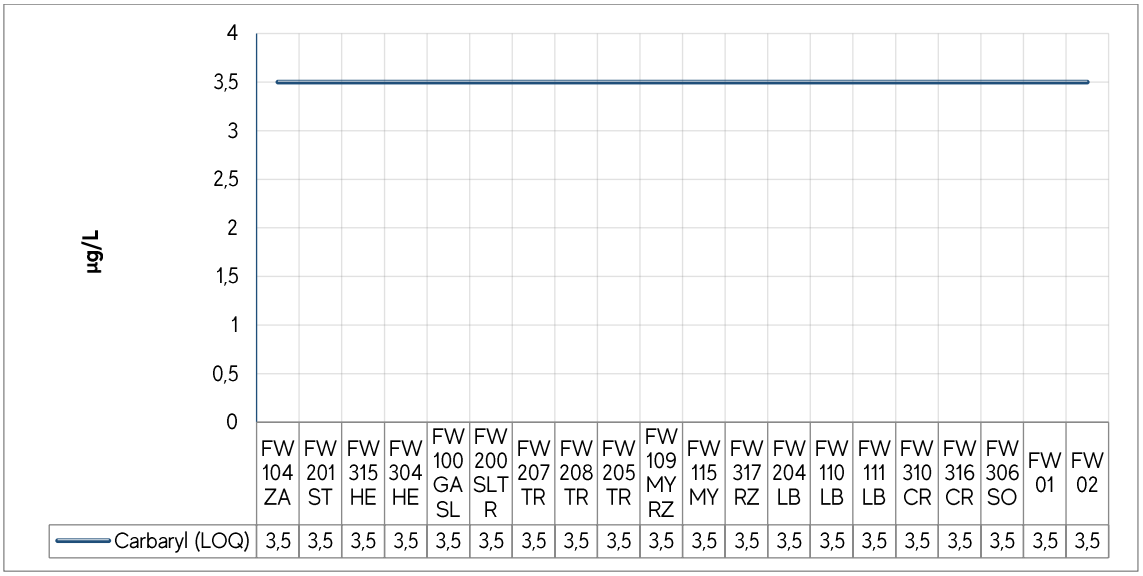



Figure 47. Comparative analysis of Carbaryl levels at monitoring points

Carbaryl ($C_{12}H_{11}NO_2$) is an insecticide used to control insects and ectoparasites. It is distributed under the trade names HORTEVI and CARBARYL.

The analytical method used has a limit of quantification equal to 3.5 µg/L. It was not detected quantifiable levels at any of the points.

### 3.2.49 Heptachlor

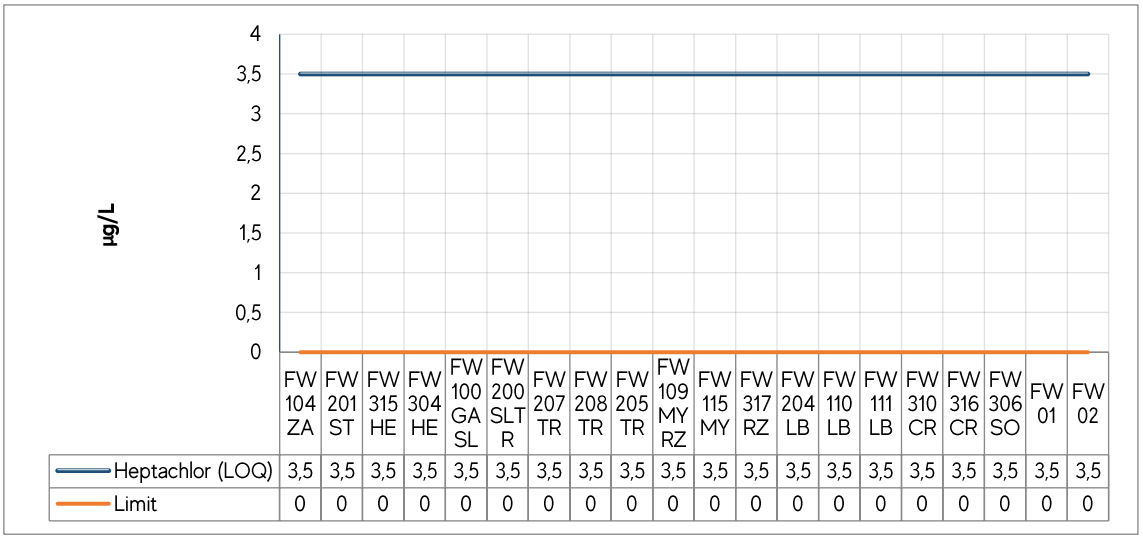



Figure 48. Comparative analysis of heptachlor levels at monitoring points

Heptachlor ($C_{10}H_5Cl_7$) is an insecticide used to control ants and termites. The national water regulation establishes that the concentration of this substance in the aqueous matrix must be 0 µg/L (zero).

The limit of quantification is higher than the maximum permissible by the water regulation (LOQ = 3.5 µg / L), which is why none of the points are within the limits but it is not detected quantifiable values of Heptachlor.

### 3.2.50 Methomyl

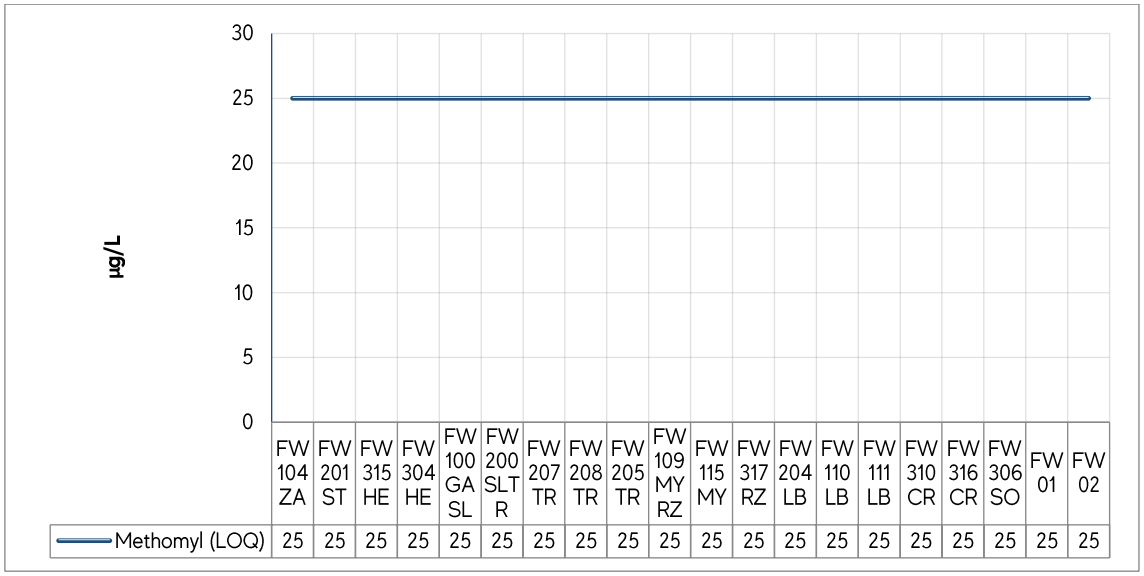



Figure 49. Comparative analysis of Methomyl levels at monitoring points

Methomyl ($C_5H_{10}N_2O_2S$) is an insecticide marketed under the name Lannate®BR. The national water regulation does not establish limits for this pesticide.

The limit of quantification is 25 µg/L and none of the samples exceeded this value.

### 3.2.51 2,4 D

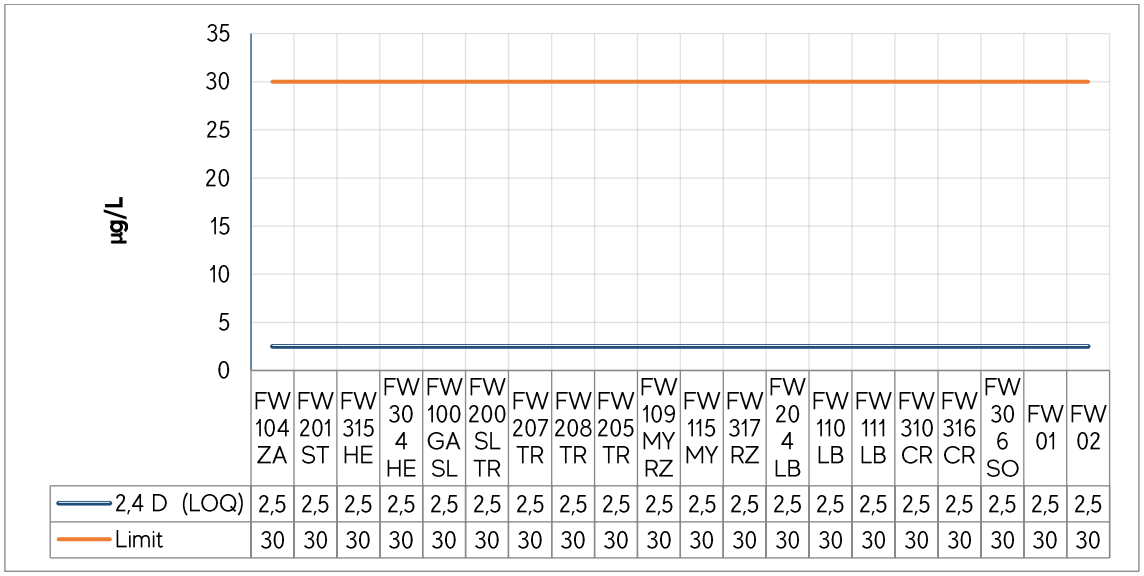



Figure 50. Comparative analysis of 2,4 D levels at monitoring points

2,4 D ($C_8H_6Cl_2O_3$) is an herbicide distributed under the trade names DMA® 6 and Cleanspray (among others). According to Regulation 222/02, the concentration of this herbicide in surface water must not exceed 30 µg/L.

The analytical method used has a limit of quantification of 2.5 µg/L None of the samples exceeds this threshold; therefore, all samples are within the limit established by the water regulation.

### 3.2.52 Cypermethrin

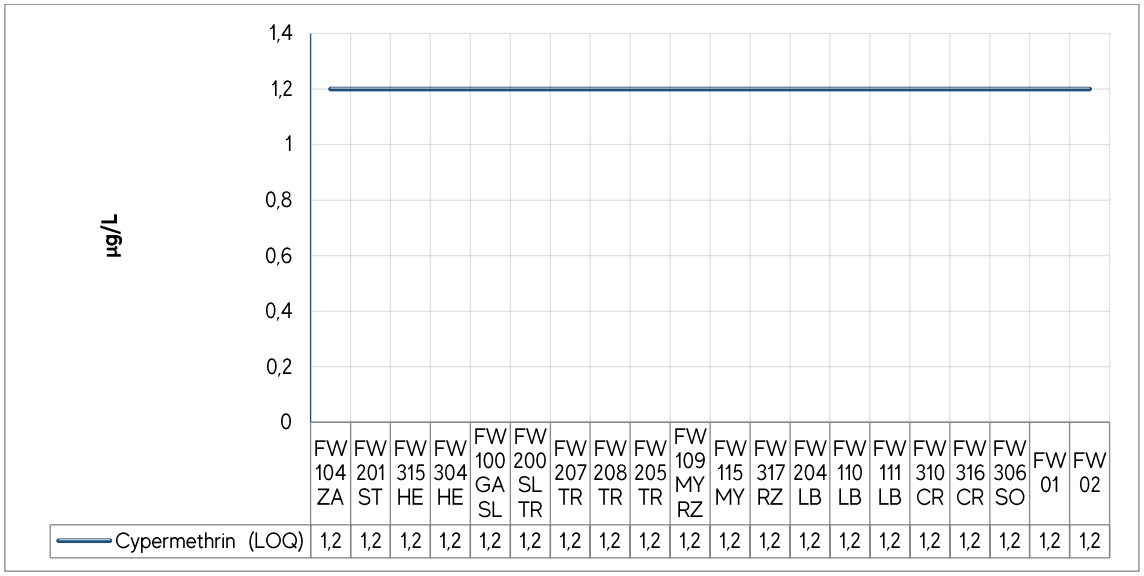



Figure 51. Comparative analysis of Cypermethrin levels at monitoring points

Cypermethrin ($C_{22}H_{19}Cl_2NO_3$) is an insecticide and acaricide distributed in the market under the trade names Trine-aktra and SUPERMYL among others. The water regulation does not establish limits for this pesticide.

As for the analytical results obtained, no quantifiable levels of Cypermethrin were detected in any sample. The limit of quantification is 1.2 µg/L.

### 3.2.53 Chlorpyrifos

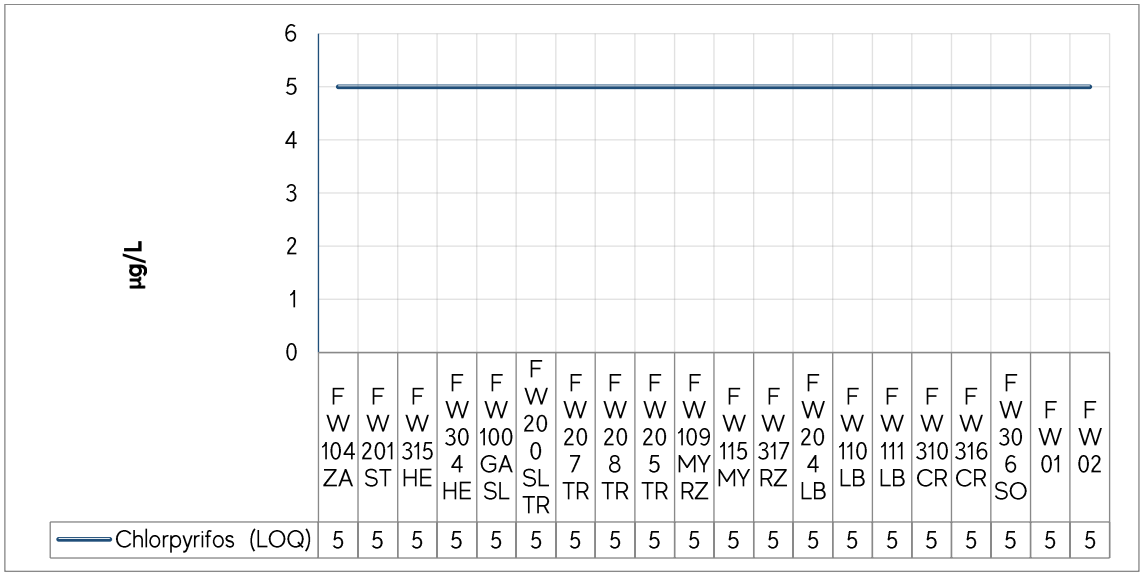



Figure 52. Comparative analysis of Chlorpyrifos levels at monitoring points

Chlorpyrifos ($C_9H_{11}Cl_3NO_3PS$) is an insecticide commonly called CLORFOS and BRONCO®. The national water regulation does not establish a limit for this pesticide.

In none of the samples taken during the first campaign are quantifiable levels of Chlorpyrifos. The limit of quantification of the method used to analyse is 5 µg/L.

### 3.2.54 Dichlorvos

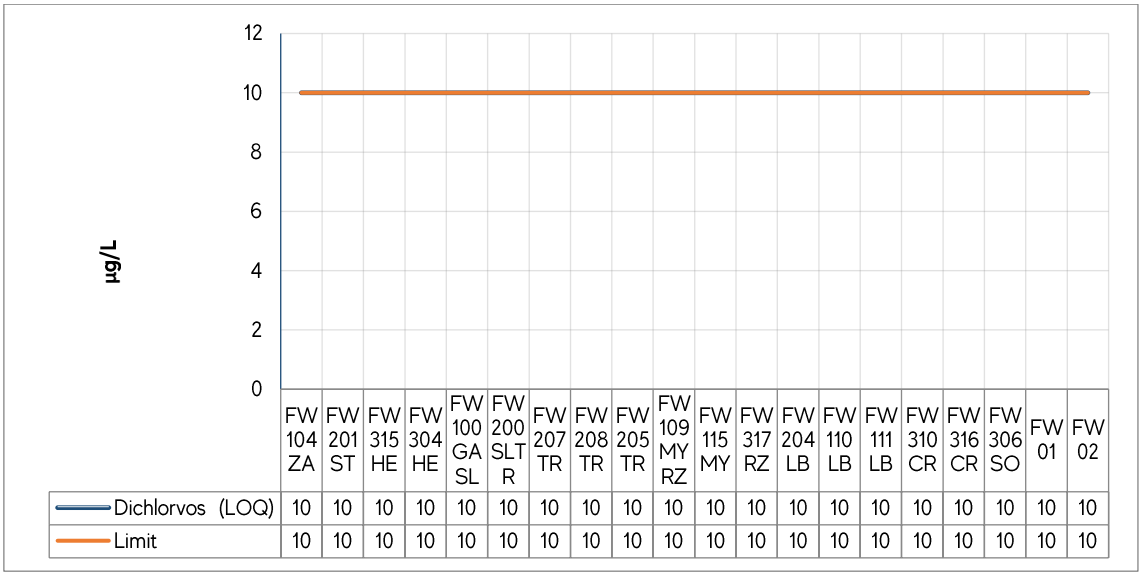



Figure 53. Comparative analysis of Dichlorvos levels at monitoring points

Dichlorvos ($C_4H_7Cl_2O_4P$) is an insecticide and arachnicide trade under commercial names such as Diclovan. According to the national surface water regulation, the maximum concentration allowed for this pesticide is 10 µg/L.

The limit of quantification of the method used to analyse the samples is 10 µg/L (equal to the maximum permissible). No quantifiable levels of Dichlorvos are detected in any sample.

### 3.2.55 Methamidophos

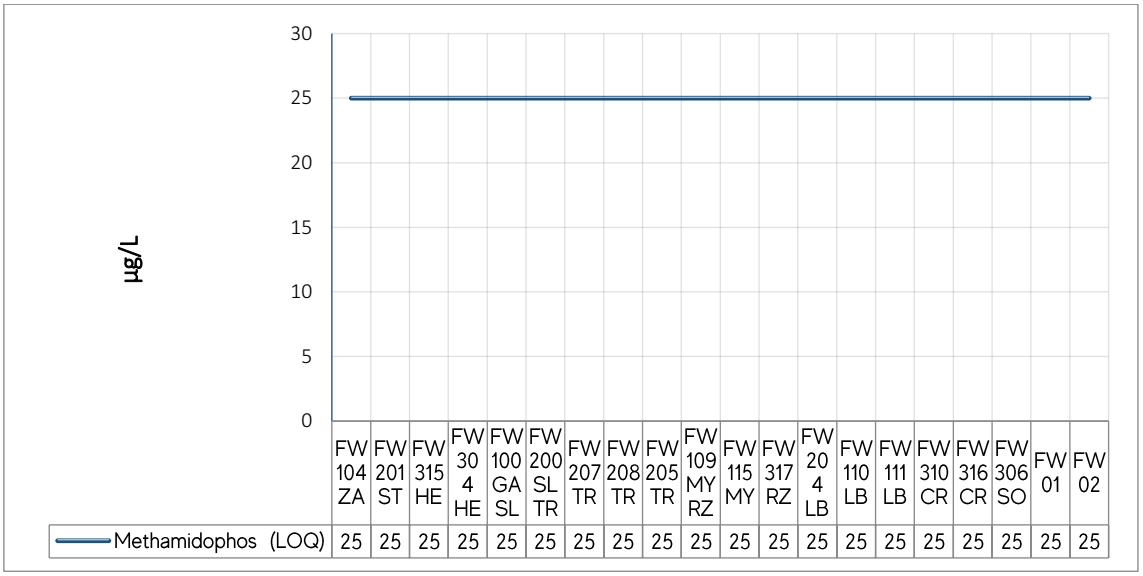



Figure 54. Comparative analysis of Methamidophos levels at monitoring points

Methamidophos ($C_2H_8NO_2PS$) is an insecticide and acaricide. This pesticide does not have limits established in the national water regulation.

The method's limit of quantification is 25 µg/L and none of the samples exceeds this value.

### 3.2.56 Tebuconazole

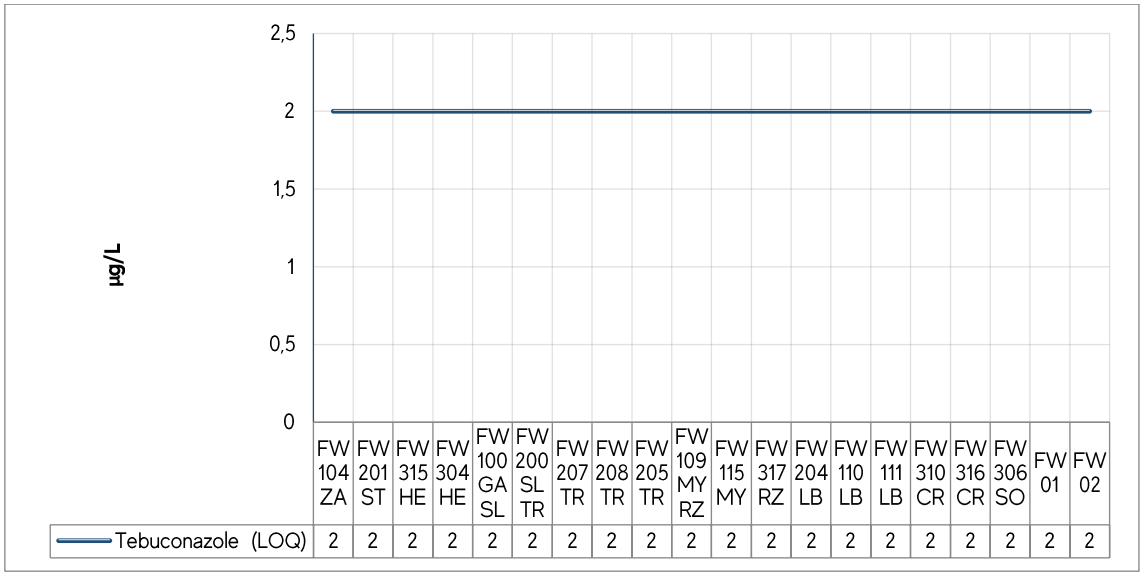



Figure 55. Comparative analysis of Tebuconazole levels at monitoring points

Tebuconazole ($C_{16}H_{22}ClN_3O$) is a fungicide trade under the name Folitra Max among others. It is use mainly in the prevention and eradication of fungi that attack horticultural crops. The water standard regulation does not establish a limit for this parameter.

As for the results, there is no evidence of Tebuconazole in surface waters of the area of study. The limit of quantification is 2 µg/L which no sample exceeds.

### 3.2.57 Imidacloprid

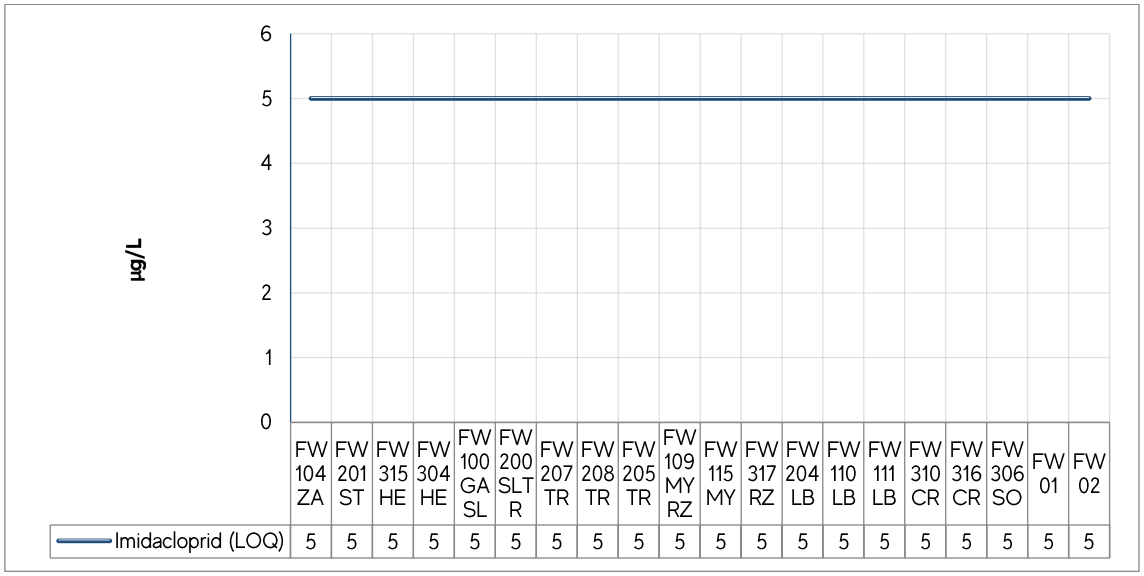



Figure 56. Comparative analysis of Imidacloprid levels at monitoring points

Imidacloprid ($C_9H_{10}ClN_5O_2$) is a systemic insecticide used to control insects, aphids and thrips in various crops. Its commercial name is Dagger or Hephaestus among others.

This pesticide is not detected in any of the points. The limit of quantification is 5 µg/L, and the national regulation does not establish a maximum permissible level for this parameter.

### 3.2.58 Methyl paraoxon

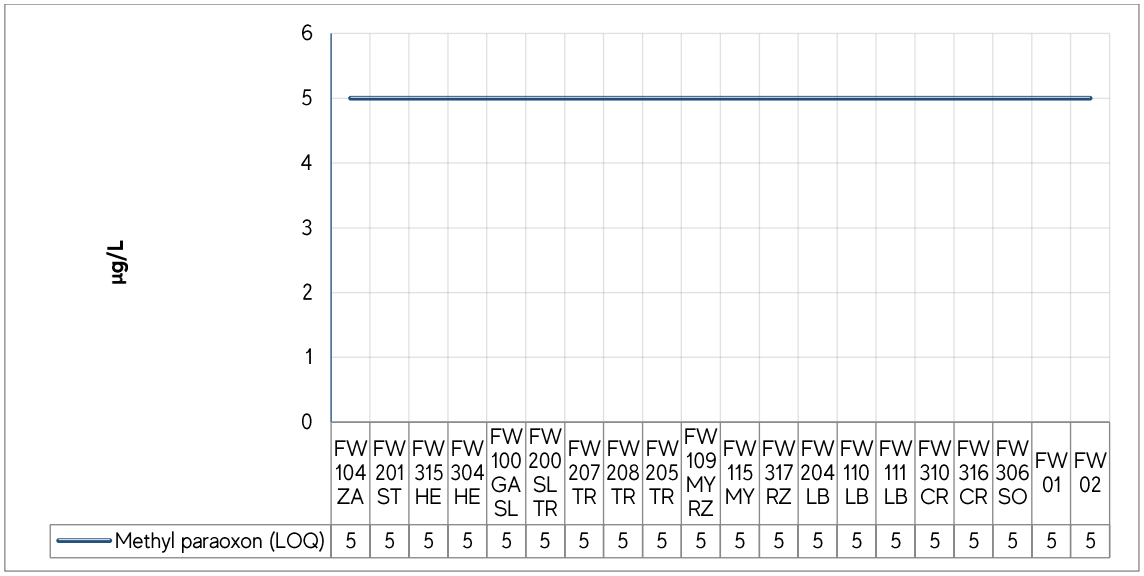



Figure 57. Comparative analysis of methyl paraoxon levels at monitoring points

Methyl Paraoxon ($C_8H_{10}NO_6P$) is a non-systemic and broad-spectrum insecticide. The national water regulation does not establish limits for this pesticide.

No quantifiable levels of this substance is found in any sample. The limit of quantification of the method used is 5 µg/L.

### 3.2.58 Fipronil

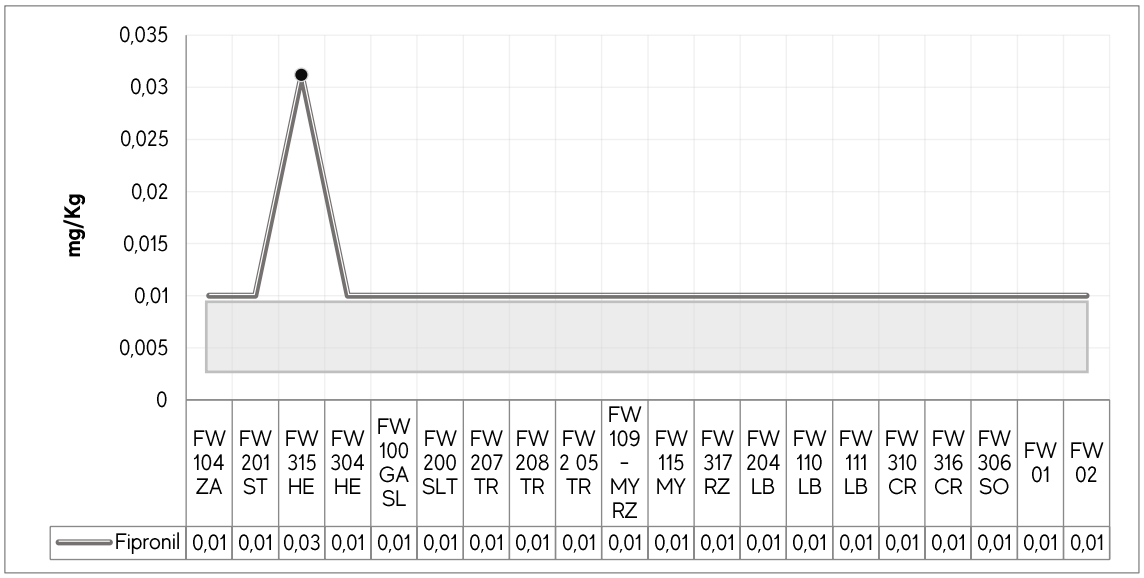
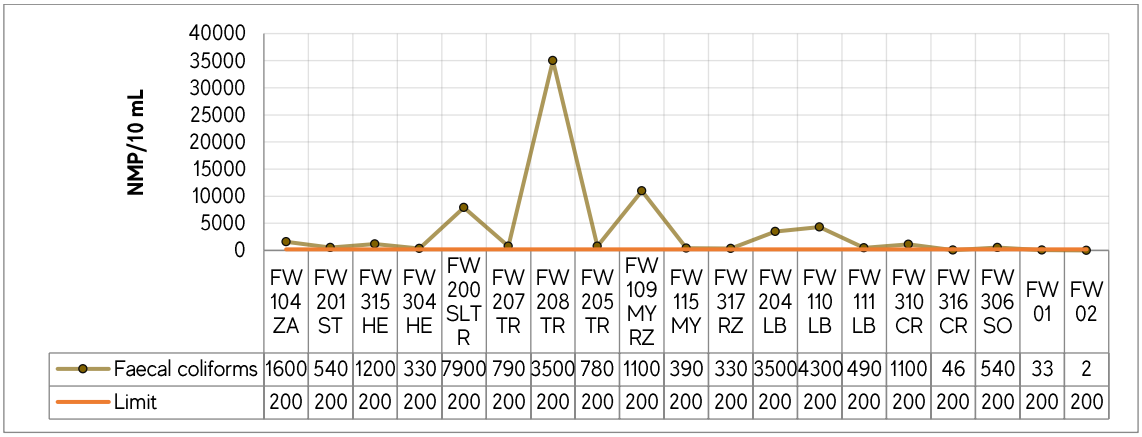



Figure 58. Comparative analysis of Fipronil levels at monitoring points

Regulation 222/02 does not establish a limit for Fipronil concentrations in surface water. The method used to determine Fipronil has a limit of quantification (LOQ) up to 0.01 mg/kg that is not detected in any sample points but FW 315-HE with 0.03113 mg/kg.

### 3.2.59 Faecal coliforms




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Faecal coliforms | 1600 | 540 | 1200 | 330 | 7900 | 790 | 3500 | 780 | 1100 | 390 | 330 | 3500 | 4300 | 490 | 1100 | 46 | 540 | 33 | 2 |
| Limit | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |

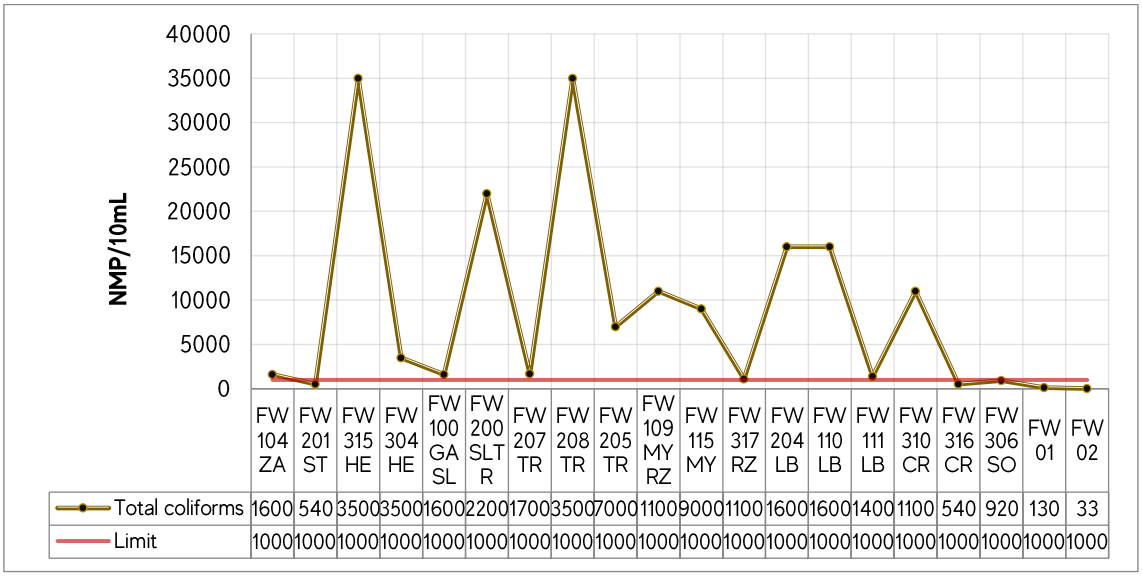
Figure 59. Comparative analysis of faecal coliforms levels at monitoring points

According to the water regulation, in those classify as Class 2, the presence of faecal coliforms must be less than 200 NMP/100ml.

All samples values are beyond the established limits except from the Paraguay River monitoring points (FW01 and FW02) and FW316-CR ("Laguna Penayo" stream).

A percentage of 84% of the samples have values above the maximum permissible. The average for this parameter is 3677 NMP/100ml.

### 3.2.60 Total coliforms




| | FW 104 ZA | FW 201 ST | FW 315 HE | FW 304 HE | FW 100 GA SL | FW 200 SLT R | FW 207 TR | FW 208 TR | FW 205 TR | FW 109 MY RZ | FW 115 MY | FW 317 RZ | FW 204 LB | FW 110 LB | FW 111 LB | FW 310 CR | FW 316 CR | FW 306 SO | FW 01 | FW 02 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total coliforms | 1600 | 540 | 3500 | 3500 | 1600 | 2200 | 1700 | 3500 | 7000 | 1100 | 9000 | 1100 | 1600 | 1600 | 1400 | 1100 | 540 | 920 | 130 | 33 |
| Limit | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |

Figure 60. Comparative analysis of total coliforms levels at monitoring points

According to the water regulation, the permissible limit for this parameter is 1000 NMP/ml. Figure 60 shows that only 5 points are under this value while 75% of the points exceeds.

### 3.2.61 Colour

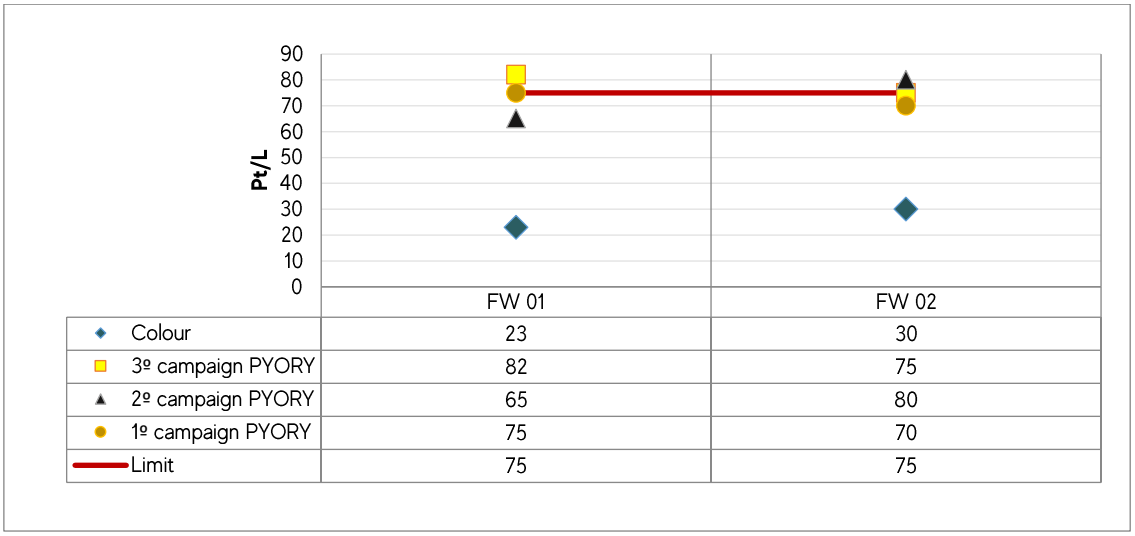



Figure 61. Comparative analysis of colour at two points of the Paraguay River and three previous monitoring campaigns

Comparing to the values obtained in previous campaigns performed by POYRY (2020) for the project's environmental impact assessment, in the current campaign, the colour is within the range recommended by Regulation 222/02; in comparison with the background results that were close to or exceeded the limit of 75Pt/l.

The colour variations depend on the flow and sediment dragging variations, which relates to climate's conditions. In this case, the values are representative of the rainy season.

### 3.2.62 Phenols index

TABLE 10. COMPARATIVE ANALYSIS OF PHENOLS INDEX AT DIFFERENT SAMPLING POINTS

| | PHENOLS INDEX (mg/L) | |
|---|---|---|
| | **FW01** | **FW02** |
| Current campaign | <0,0005 ND | <0,0005 ND |
| 3° Campaign PYORY | <0,024 ND | <0,024 ND |
| 2° Campaign PYORY | <0,024 ND | <0,024 ND |
| 1° Campaign PYORY | <0,024 ND | <0,024 ND |

In all campaigns, phenol at both points is below the limit of quantification (LOQ) therefore not detected. It is essential to mention that the current method is more sensitive than the ones used by POYRY.

The maximum value established by the national water regulation is 0.05 mg/L. None of the 2 points nor the 4 monitoring campaigns exceeds this limit.

### 3.2.63 PCBs

TABLE 11. COMPARATIVE ANALYSIS OF PCBs INDEX AT DIFFERENT SAMPLING POINTS

| | PCB (µg/L /L) | |
|---|---|---|
| | **FW01** | **FW02** |
| Current campaign | <10 µg/L ND | <10µg/L ND |
| 3° Campaign PYORY | <0,2 µg/L ND | <0,2 µg/L ND |
| 2° Campaign PYORY | <0,2 µg/LND | <0,2 µg/L ND |
| 1° Campaign PYORY | <0,2 µg/L ND | <0,2 µg/L ND |

The method used during the first, second and third campaigns is more sensitive than the current one. Nevertheless, in all campaigns, PCB levels is below the limit of quantification (LOQ) and so, not detected.

According to Regulation 222/02, the presence of PCBs in waters classified as Class 2 should be zero.

### 3.3 General performance of groundwater parameters

Table 12 summarises the results obtained for each parameter analysed in groundwater; it also highlights the points that are beyond the established limits and the percentage of monitoring points that comply with regulations.

Regulation 222/02 "Establishing the water quality standard in the national territory" and NP 2400180 established the limits of the analysed parameters and were used to compare the results.

| Nº | PARAMETER | AVERAGE | WITHIN THE LIMITS | | BEYOND THE LIMITS | |
|---|---|---|---|---|---|---|
| | | | Nº | % | Nº | % |
| 1 | Temperature | 23,58 ºC | | | | |
| 2 | pH | 6,72 | 15 | 79% | **4** | **21%** |
| 3 | Electrical conductivity | 640,1 µS/.cm | 17 | 89% | **2** | **11%** |
| 4 | Dissolved solids | 422,31 mg/L | 16 | 84% | **3** | **16%** |
| 5 | Organic matter | 1,7 mg $O_2$/L | | | | |
| 6 | Hardness | 100.5 mg $CaCO_3$/L | 14 | 73% | **5** | **27%** |
| 7 | Total phosphorus | 0,908 mg/L | 4 | 21% | **15** | **79%** |
| 8 | Total nitrogen | 1,335 mg/L | 16 | 84% | **3** | **26%** |
| 9 | Nitrates | 37,2 mg/L | 15 | 79% | **4** | **21%** |
| 10 | Chlorides | 60,82 mg/L | 17 | 89% | **2** | **11%** |
| 11 | Alkalinity | 109.12 mg $CaCO_3$/L | 16 | 84% | **3** | **16%** |
| 12 | Bicarbonates | 53,17 mg $CaCO_3$/L | | | | |
| 13 | Carbonates | 0 mg $CaCO_3$/L | | | | |
| 14 | Sulphates | 44,53 mg/L | 18 | 94% | **1** | **6%** |
| 15 | Sodium | 67,9 mg/L | 17 | 89% | **2** | **11%** |
| 16 | Potassium | 3,66 mg/L | 18 | 94% | **1** | **6%** |
| 17 | Calcium | 26,3 mg/L | 18 | 94% | **1** | **6%** |
| 18 | Magnesium | 10,1 mg/L | 18 | 94% | **1** | **6%** |
| 19 | Fluorine | 0,52 mg/L | | | | |
| 20 | Boron | 1,84 mg/L | 19 | 100% | **0** | **0%** |
| 21 | Faecal coliforms | 15,9 NMP/100mL | 1 | 7% | **13** | **93%** |
| 22 | Total coliforms | >21 NMP/10mL | 2 | 10% | **17** | **90%** |
| 23 | *E Coli* | | 14 | 73% | **5** | **27%** |

### 3.4 Comparative analysis of the groundwater's parameters

The following graphs provide each parameter's results determined in the 19 wells sampled on the first monitoring campaign.

### 3.4.1 Temperature

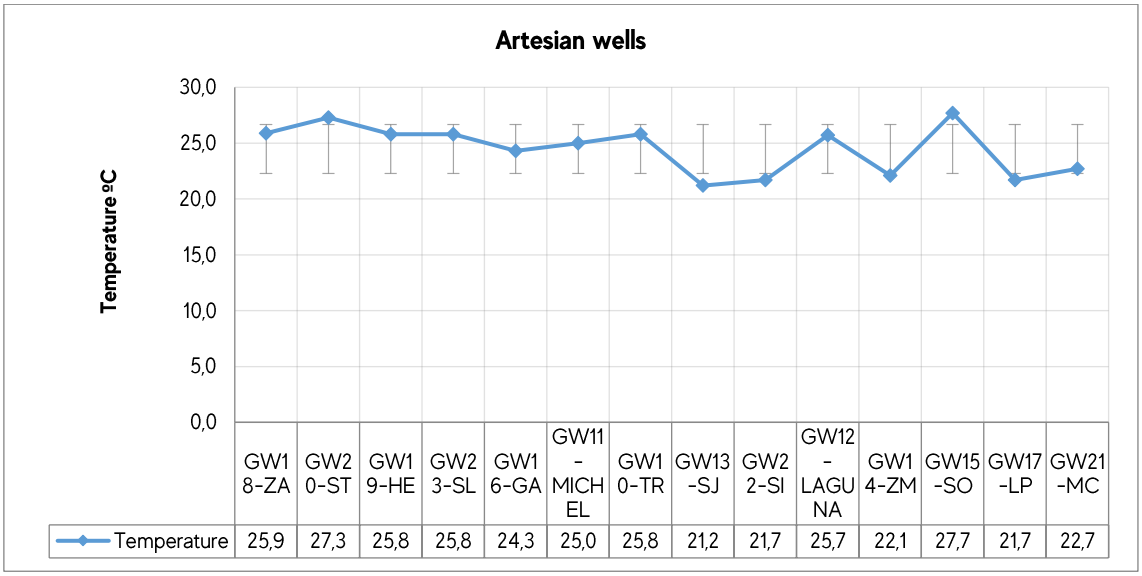



Figure 62. Comparative analysis of temperature measured in artesian wells at the forest plantation area

The artesian wells that provide drinking water to the local population of the "Farm zone" are the monitored points in which the average temperature is 24.5 ºC. The regulations do not establish a limit to analyse this parameter.

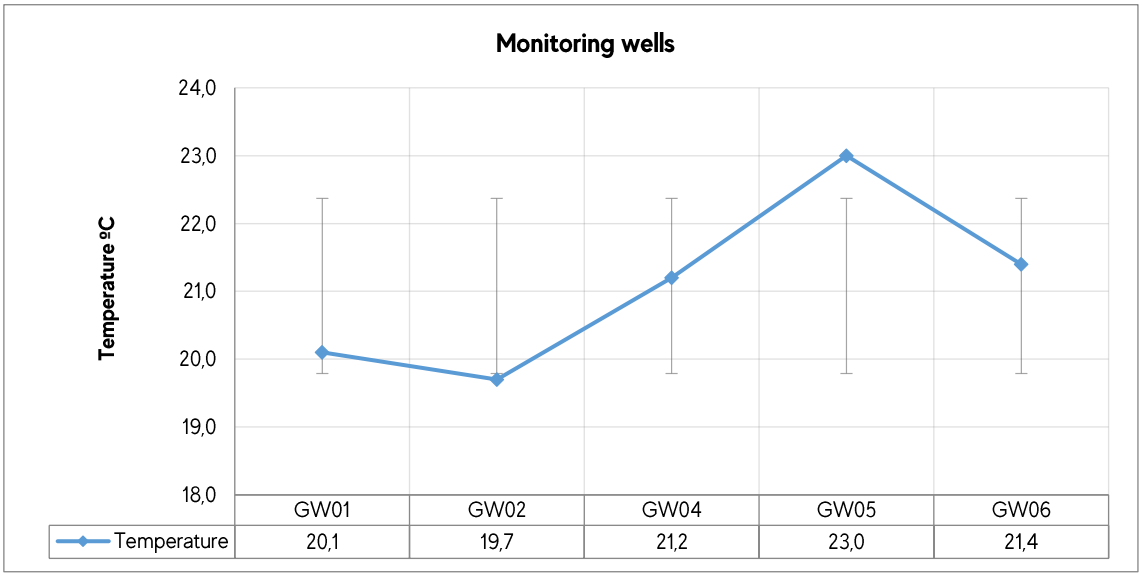
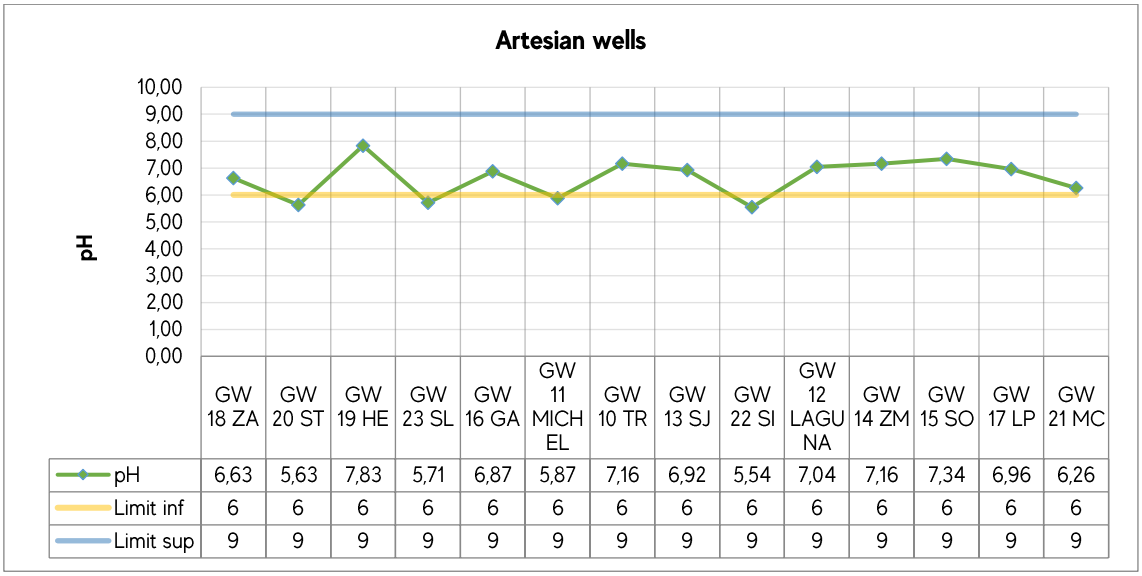



Figure 63. Comparative analysis of temperature measured in monitoring wells at the DAI

The average temperature of the water extracted from the monitoring wells located in the AID of the future industrial plant is 21.08 ºC.

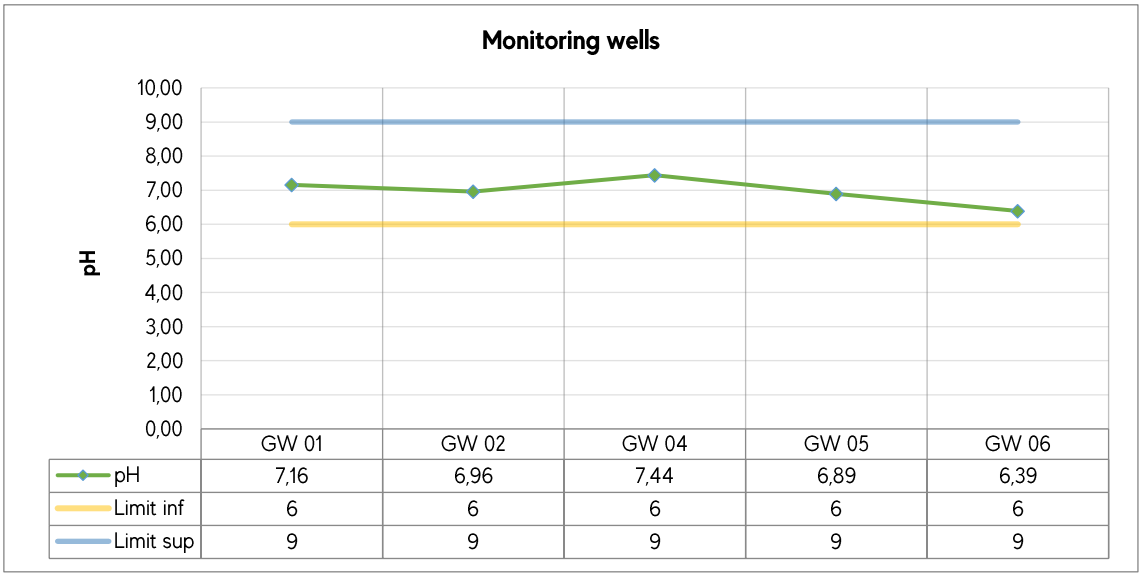
### 3.4.2 Hydrogen potential




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 6,63 | 5,63 | 7,83 | 5,71 | 6,87 | 5,87 | 7,16 | 6,92 | 5,54 | 7,04 | 7,16 | 7,34 | 6,96 | 6,26 |
| Limit inf | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Limit sup | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |

Figure 64. Comparative analysis of pH measured in artesian wells at the forest plantation area

The pH parameter was measured in situ. Regulation 222/02 establishes a limit of range between 6 and 9. Figure 64 shows that none of the points exceeds the upper limit; as for the lower limit, GW20-ST, GW23-SL, GW11-MICHEL and GW22-SILVA show slightly acid pH values.

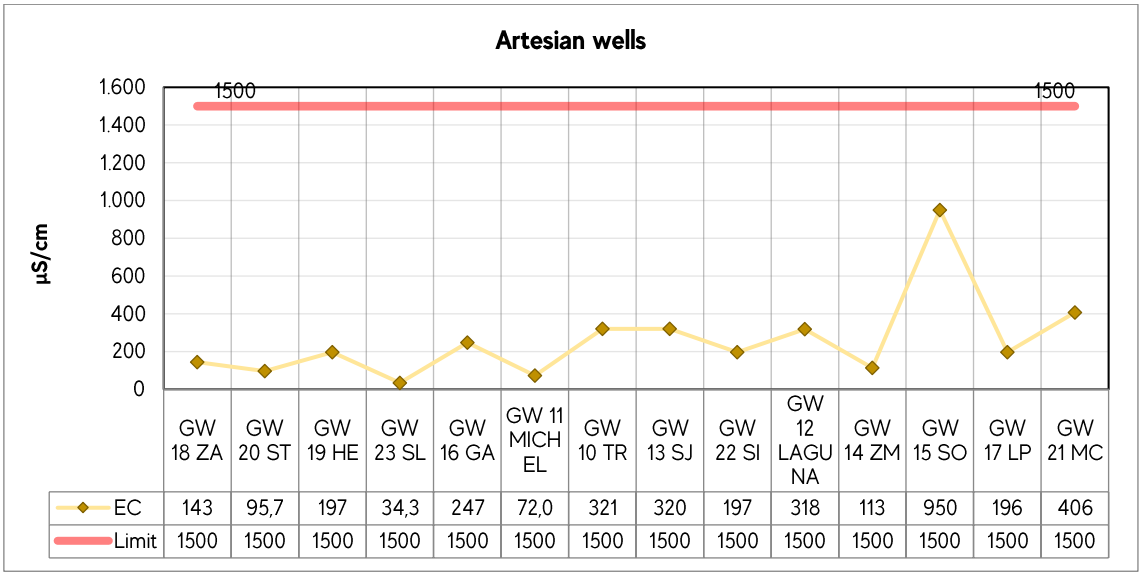



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| pH | 7,16 | 6,96 | 7,44 | 6,89 | 6,39 |
| Limit inf | 6 | 6 | 6 | 6 | 6 |
| Limit sup | 9 | 9 | 9 | 9 | 9 |

Figure 65. Comparative analysis of pH measured in monitoring wells at the DAI

In the DAI's monitoring wells, all pH values are within the range established in the water regulation.

### 3.4.3 Electrical conductivity

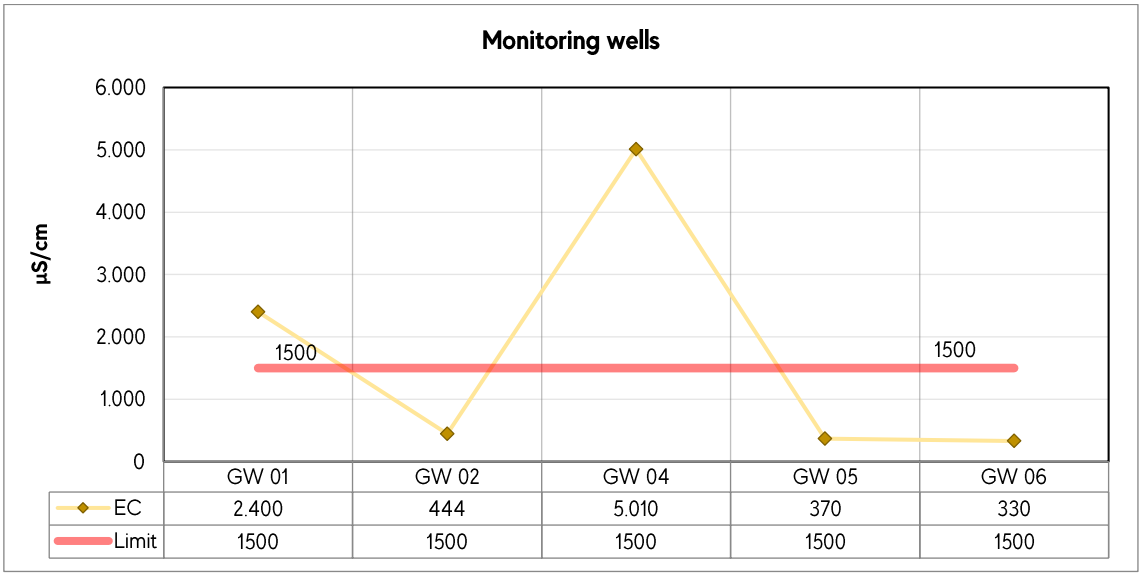



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICH EL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGU NA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EC | 143 | 95,7 | 197 | 34,3 | 247 | 72,0 | 321 | 320 | 197 | 318 | 113 | 950 | 196 | 406 |
| Limit | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 | 1500 |

Figure 66. Comparative analysis of EC measured in artesian wells at the forest plantation area

For Class 2 water, Regulation 222/02 does not set any limit for the electrical conductivity. The limit of 1500 µS/.cm established in NP 2400180 "General Requirements for drinking water" is taken as a reference. None determination carried out exceeds the limit mentioned.

The average value is 257.8 µS/cm for the forestry area. The maximum value measured belongs to GW15-SW which represents to the farm "Soledad".

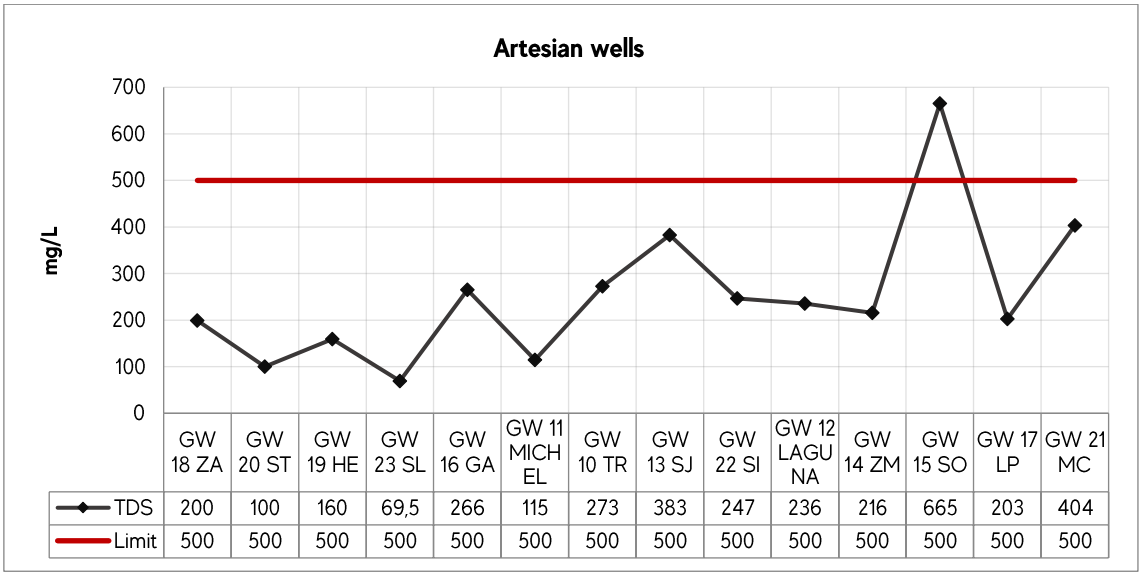



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| EC | 2.400 | 444 | 5.010 | 370 | 330 |
| Limit | 1500 | 1500 | 1500 | 1500 | 1500 |

Figure 67. Comparative analysis of EC measured in monitoring wells at the DAI

Compared to the forest plantation zone, higher electrical conductivity values are recorded in the DAI zone. The average EC value from the monitoring wells is 1710 µS/cm and the points GW01 and GW04 exceed the maximum values.

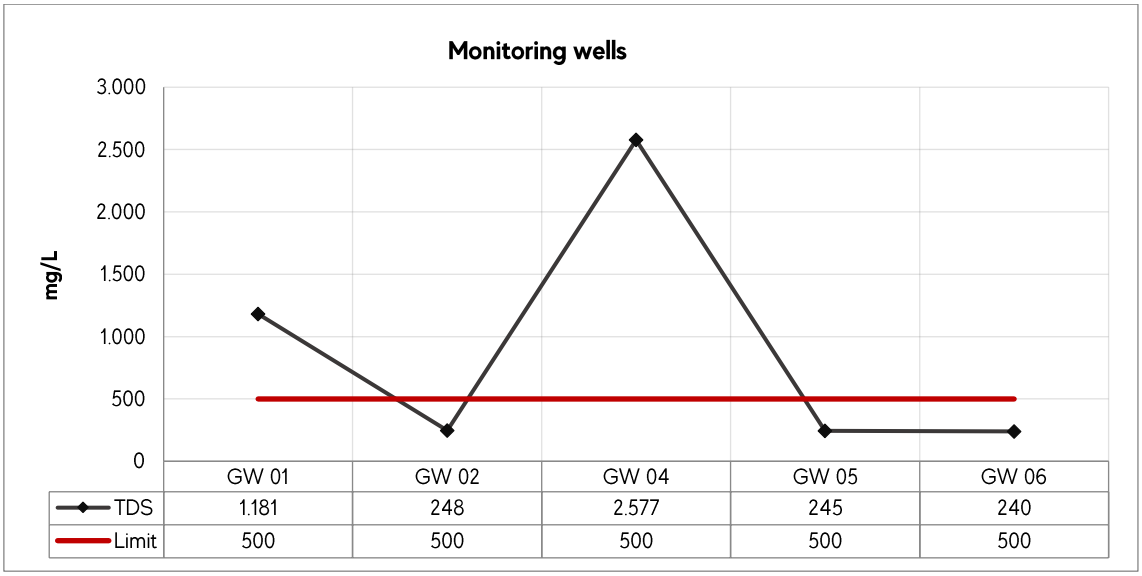
### 3.4.4 Total dissolved solids (TDS)




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICH EL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGU NA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TDS | 200 | 100 | 160 | 69,5 | 266 | 115 | 273 | 383 | 247 | 236 | 216 | 665 | 203 | 404 |
| Limit | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |

Figure 68. Comparative analysis of TDS measured in artesian wells at the forest plantation area

The national water regulation establishes a limit of 500 mg/l for this parameter. In the first monitoring campaign, the average TDS value is 252.4 mg/l where only GW 15-SW exceeds the limit.

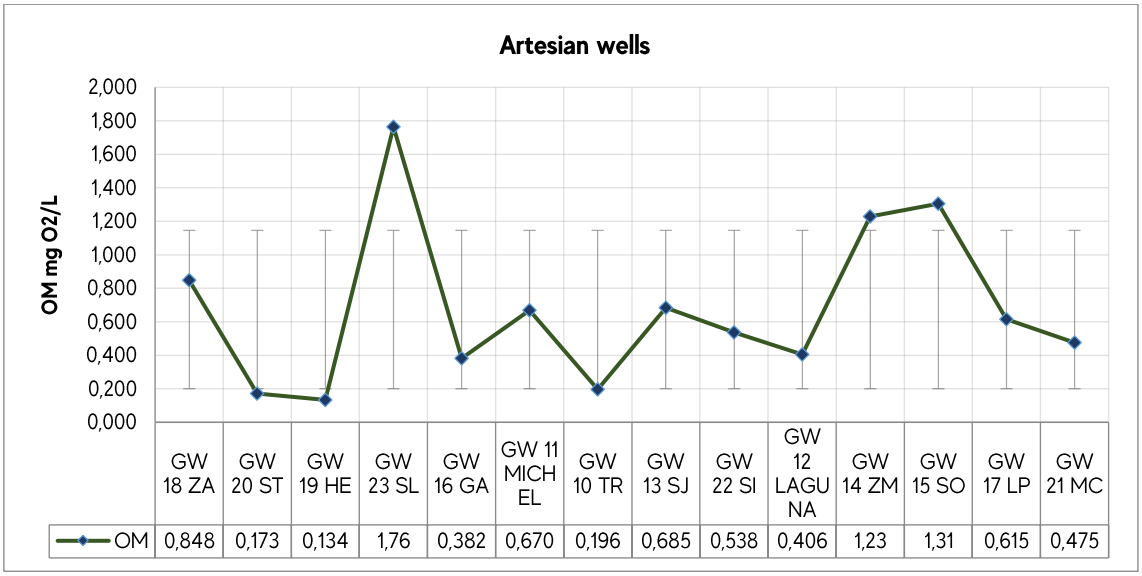



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| TDS | 1.181 | 248 | 2.577 | 245 | 240 |
| Limit | 500 | 500 | 500 | 500 | 500 |

Figure 69. Comparative analysis of TDS measured in monitoring wells at the DAI

The average TDS value is 898.2 mg/l in the DAI zone, which is considerably higher compared to the TDS in the forest plantation area.

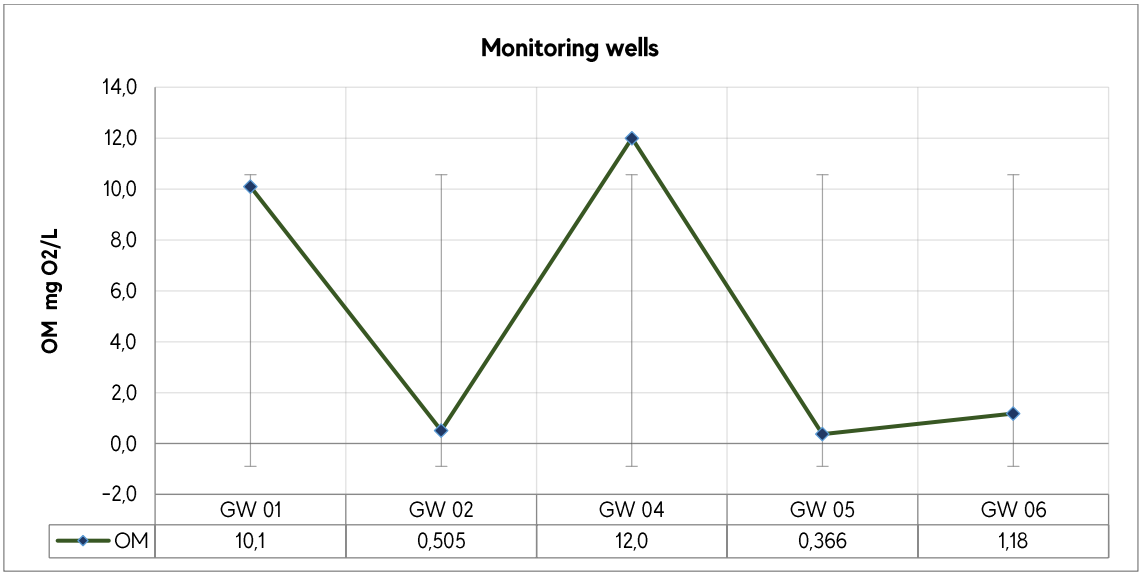
### 3.4.5 Organic matter




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OM | 0,848 | 0,173 | 0,134 | 1,76 | 0,382 | 0,670 | 0,196 | 0,685 | 0,538 | 0,406 | 1,23 | 1,31 | 0,615 | 0,475 |

Figure 70. Comparative analysis of OM measured in artesian wells at the forest plantation area

Regulation 222/02 does not determine a maximum concentration for organic matter. The average result is 0.7 mg $O_2$/l. But, GW23-SL, GW14-ZM and GW15-SO shows values above the standard deviation.

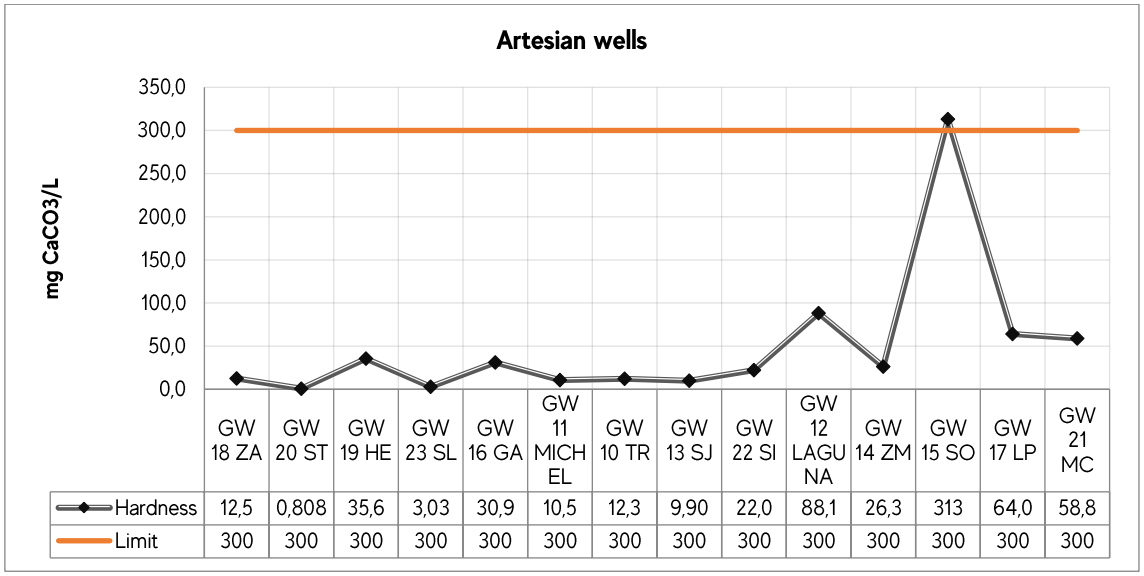



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| OM | 10,1 | 0,505 | 12,0 | 0,366 | 1,18 |

Figure 71. Comparative analysis of OM measured in monitoring wells at the DAI

The average value of OM at the DAI area is 4.8 mg O2/l, which is significantly higher than the average obtained in the forest plantation zone.

### 3.4.6 Hardness

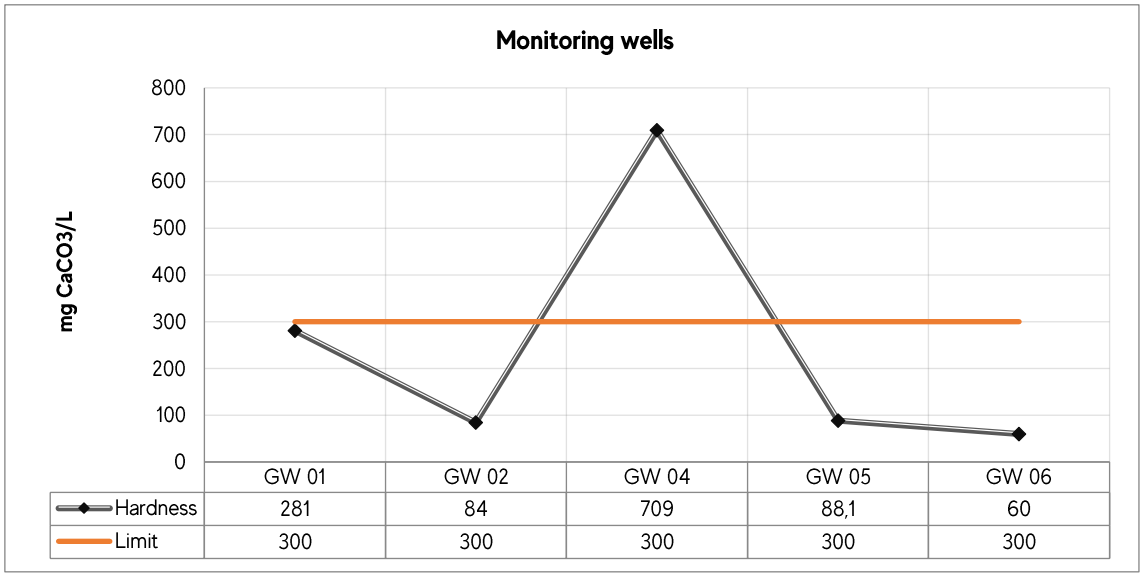



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hardness | 12,5 | 0,808 | 35,6 | 3,03 | 30,9 | 10,5 | 12,3 | 9,90 | 22,0 | 88,1 | 26,3 | 313 | 64,0 | 58,8 |
| Limit | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

Figure 72. Comparative analysis of hardness levels measured in artesian wells at the forest plantation area

Hardness is a water quality parameter influenced by the hydrological area's geological formations in which a well is located. Regulation 222/02 stipulates a maximum of 300 mg/l for this parameter.

The average hardness value in this first campaign is 49.1 mg $CaCO_3$/l. In the forest plantation area, only GW15-SO has a higher result than the permissible limit.

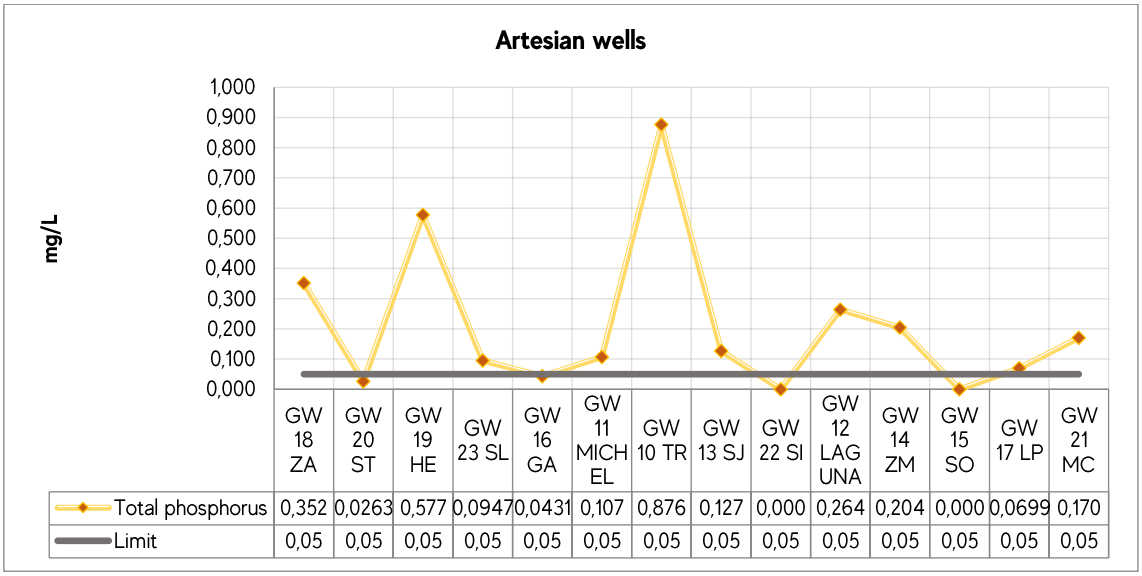



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Hardness | 281 | 84 | 709 | 88,1 | 60 |
| Limit | 300 | 300 | 300 | 300 | 300 |

Figure 73. Comparative analysis of hardness levels measured in monitoring wells at the DAI

In the DAI zone, the average hardness value is 244.46 mg CaCO3/l. Only the value measured at the monitoring well GW04 is above the limit.

### 3.4.7 Total phosphorus

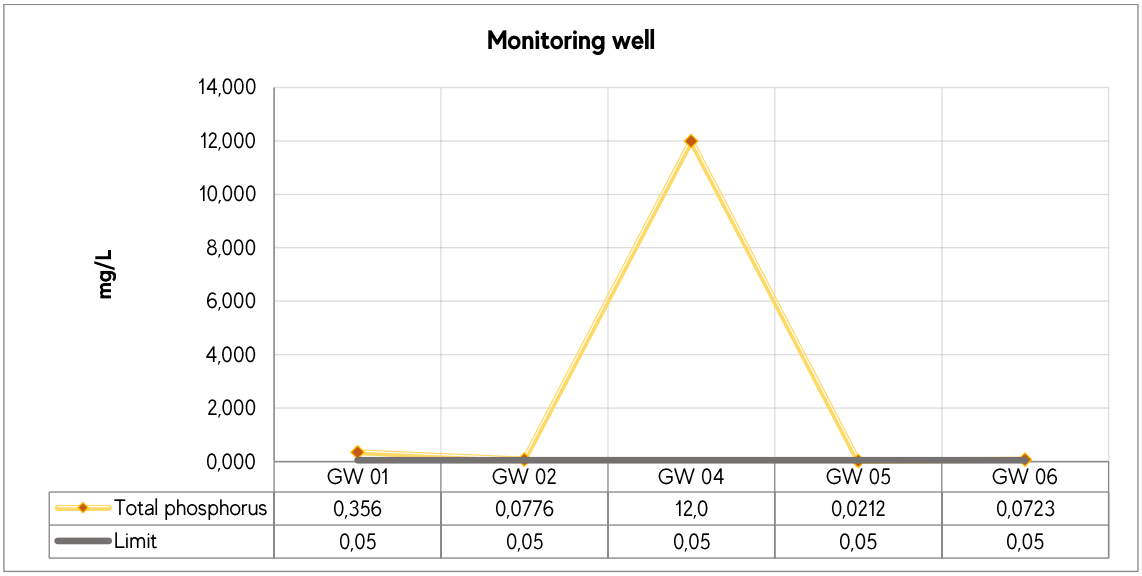



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total phosphorus | 0,352 | 0,0263 | 0,577 | 0,0947 | 0,0431 | 0,107 | 0,876 | 0,127 | 0,000 | 0,264 | 0,204 | 0,000 | 0,0699 | 0,170 |
| Limit | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |

Figure 74. Comparative analysis of total phosphorus levels measured in artesian wells at the forest plantation area

Over-fertilisation causes that a fraction of phosphorus not assimilated by the vegetation to infiltrate into the soils and reach groundwater or surface water, which can explain the high phosphorus concentrations.

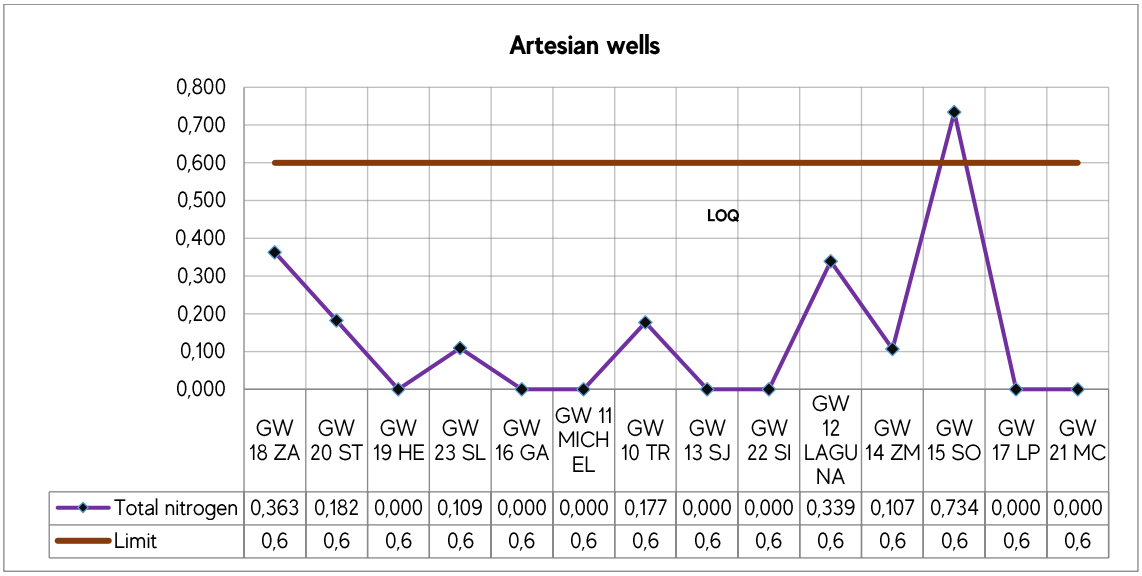
Figure 74 shows that only 4 wells of the forestry area comply with the regulation's established limit. In the remaining 10 wells, the limits exceed up to 17 times the maximum recommended by the national water regulation (0.05 mg/L).




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Total phosphorus | 0,356 | 0,0776 | 12,0 | 0,0212 | 0,0723 |
| Limit | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |

Figure 75. Comparative analysis of total phosphorus levels measured in monitoring wells at the DAI

### 3.4.8 Total nitrogen

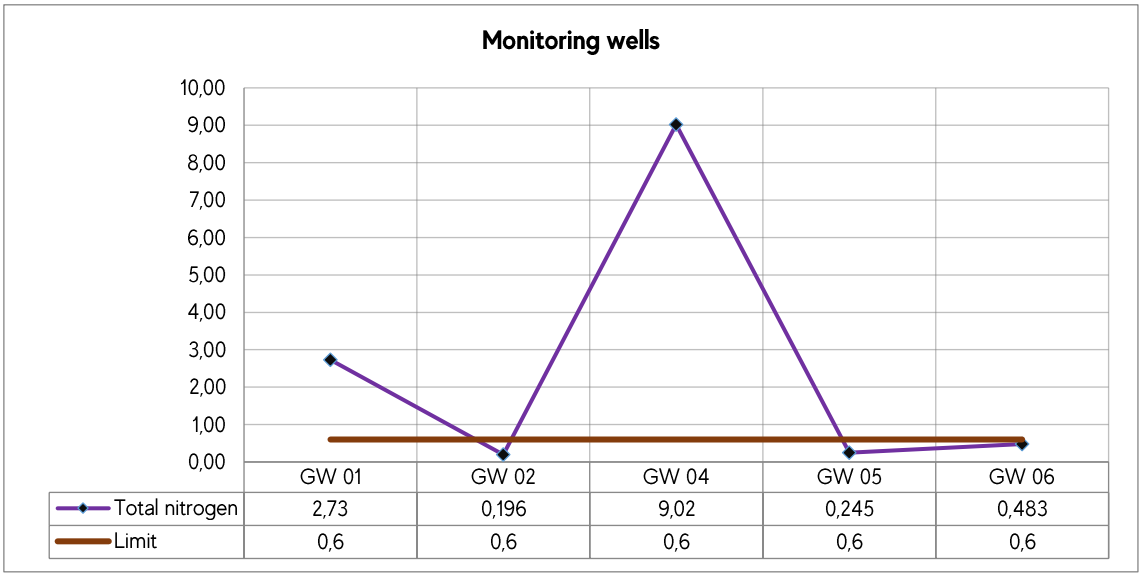



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total nitrogen | 0,363 | 0,182 | 0,000 | 0,109 | 0,000 | 0,000 | 0,177 | 0,000 | 0,000 | 0,339 | 0,107 | 0,734 | 0,000 | 0,000 |
| Limit | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 |

Figure 76. Comparative analysis of total nitrogen levels measured in artesian wells at the forest plantation area

Figure 76 shows that the limit of quantification (LOQ) for total nitrogen equals 1 mg/l. At points, GW 19-HE, GW 16-GA, GW 11-MICHEL, GW 13-SAN JUAN, GW 22-SILVA, GW 14-ZM, GW 17-LP and GW 21-MC, the concentrations of total nitrogen are lower than the LOQ.

GW 15-SO is the only point that exceeds LOQ with a value of 0.734 mg/l.

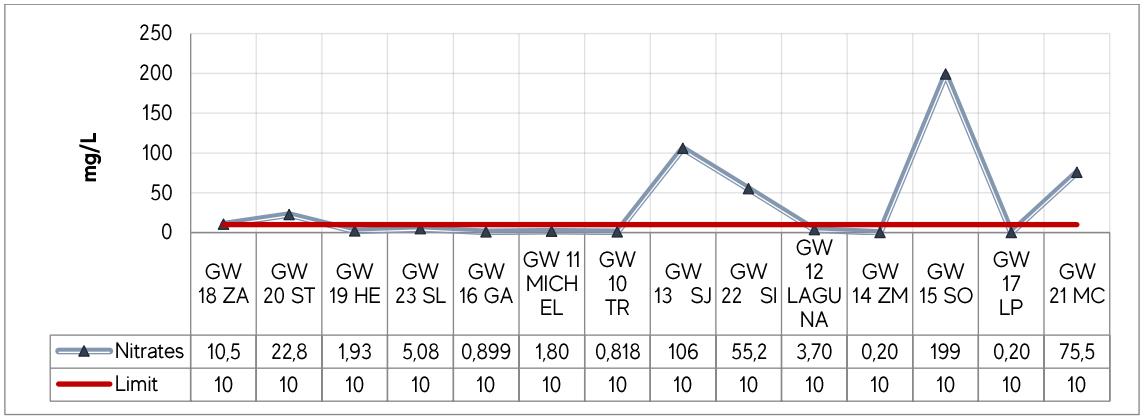



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Total nitrogen | 2,73 | 0,196 | 9,02 | 0,245 | 0,483 |
| Limit | 0,6 | 0,6 | 0,6 | 0,6 | 0,6 |

Figure 77. Comparative analysis of total nitrogen levels measured in monitoring wells at the DAI

GW01 and are the two monitoring wells in the DAI with values above the limit. The average value of nitrogen in groundwater future industrial plant zone is 2.5 mg/L.

### 3.4.9 Nitrates

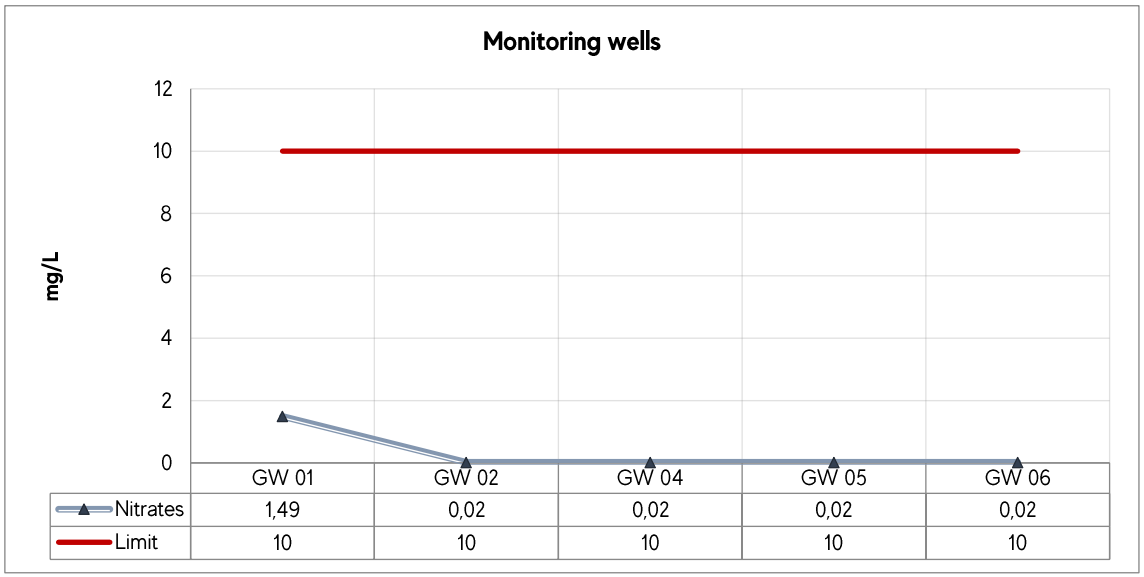



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICH EL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGU NA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrates | 10,5 | 22,8 | 1,93 | 5,08 | 0,899 | 1,80 | 0,818 | 106 | 55,2 | 3,70 | 0,20 | 199 | 0,20 | 75,5 |
| Limit | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |

Figure 78. Comparative analysis of nitrate levels measured in artesian wells at the forest plantation area

For nitrates, the maximum level established by the legislation is 10 mg/l. GW 18-ZA. GW 20-ST, GW-13 San Juan, GW 22-Silva, GW 15-SO and GW 21- MC exceed the maximum limit.

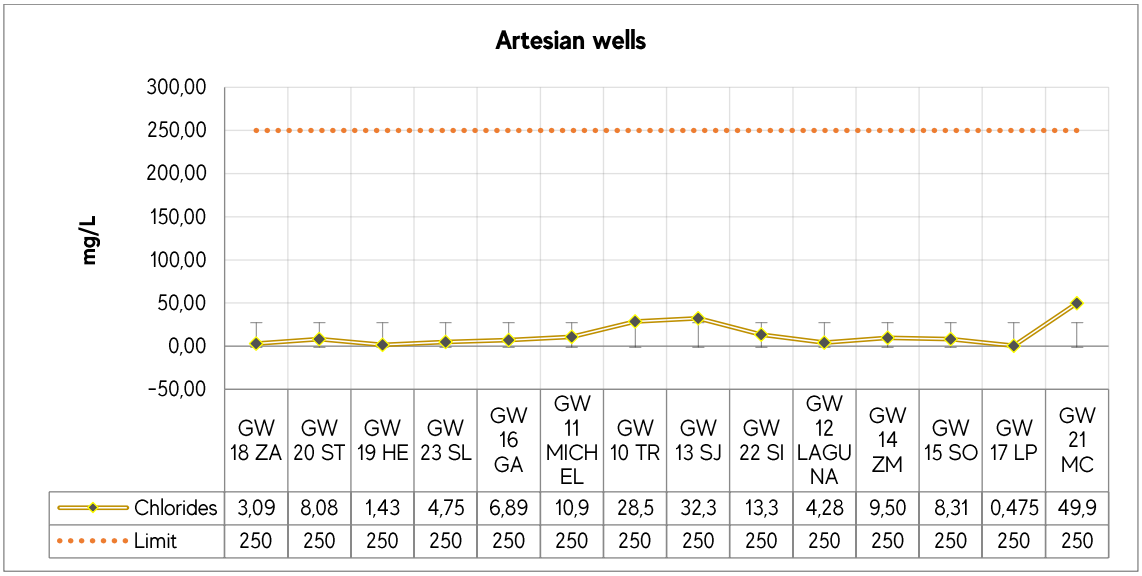
Statistically, 79% of wells are within the range while 21% are beyond the limits. The average value of nitrates is 37.2 mg/l.




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Nitrates | 1,49 | 0,02 | 0,02 | 0,02 | 0,02 |
| Limit | 10 | 10 | 10 | 10 | 10 |

Figure 79. Comparative analysis of nitrate levels measured in monitoring wells at the DAI

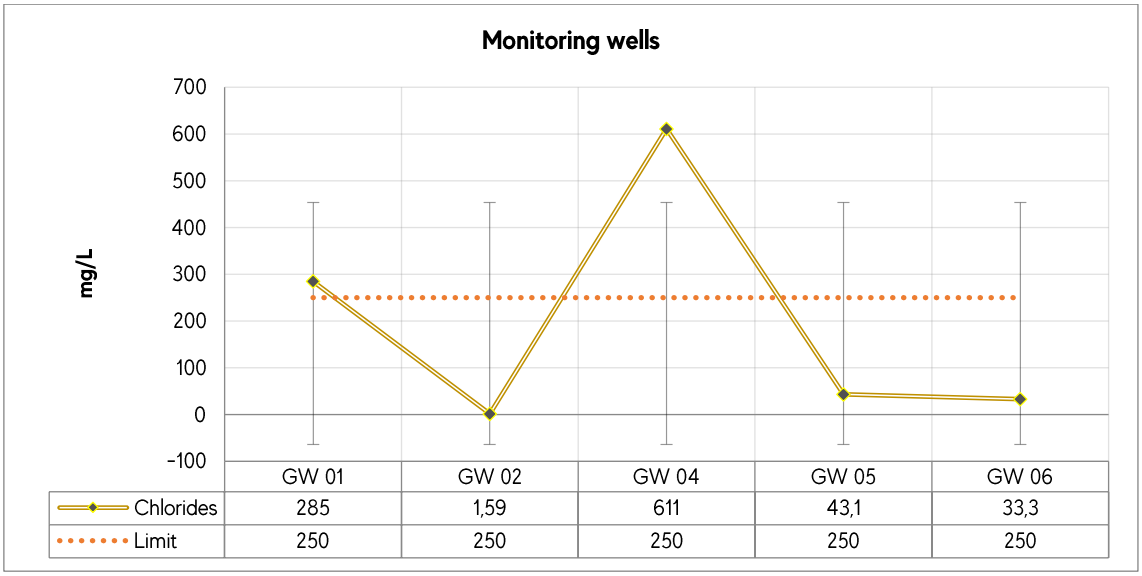
### 3.4.8 Chlorides




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chlorides | 3,09 | 8,08 | 1,43 | 4,75 | 6,89 | 10,9 | 28,5 | 32,3 | 13,3 | 4,28 | 9,50 | 8,31 | 0,475 | 49,9 |
| Limit | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |

Figure 80. Comparative analysis of chloride levels measured in artesian wells at the forest plantation area

According to Law 1614/2000, Chloride's permissible limit is 250 mg/l. None well exceeds this maximum limit. The average chloride value is 12.9 mg/l.

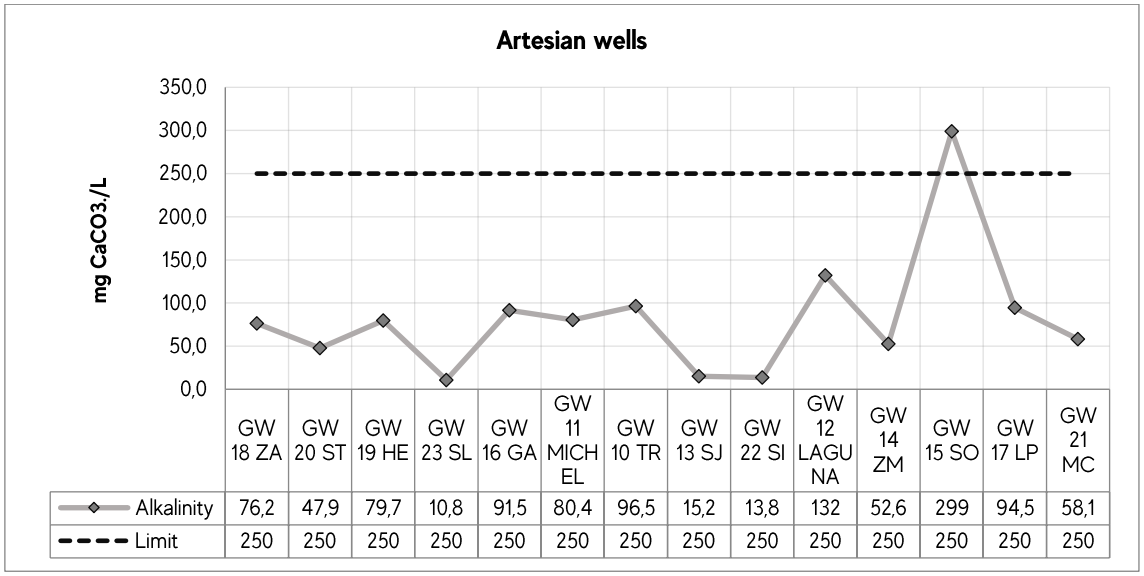



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Chlorides | 285 | 1,59 | 611 | 43,1 | 33,3 |
| Limit | 250 | 250 | 250 | 250 | 250 |

Figure 81. Comparative analysis of chloride levels measured in monitoring wells at the DAI

In the DAI, the monitoring wells GW01 and GW04 show values above the established limit. The average result of the parameter is 194.7 mg/l.

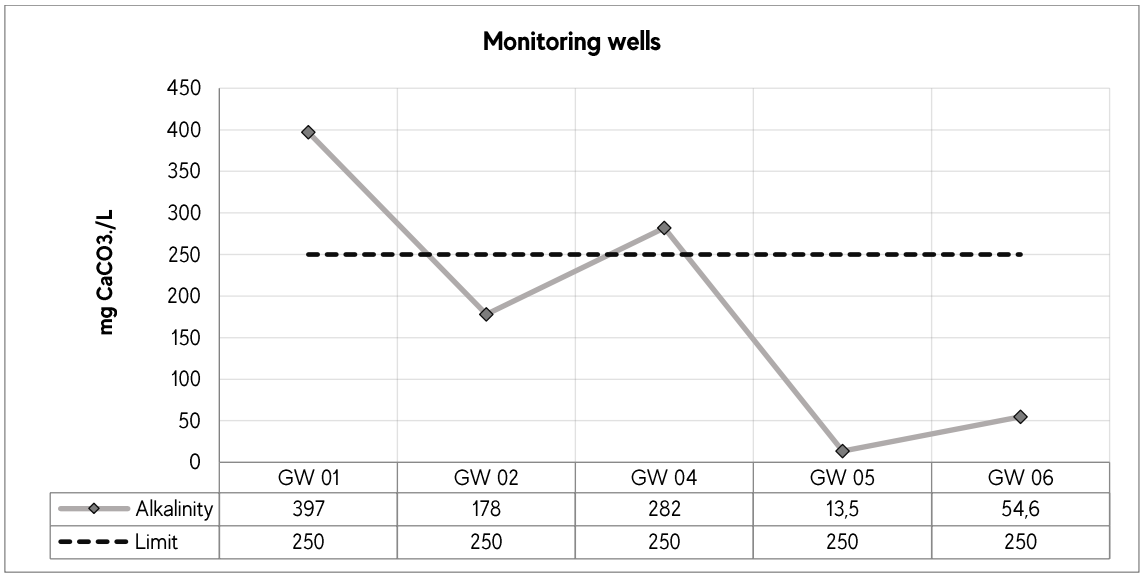
### 3.4.9 Alkalinity




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alkalinity | 76,2 | 47,9 | 79,7 | 10,8 | 91,5 | 80,4 | 96,5 | 15,2 | 13,8 | 132 | 52,6 | 299 | 94,5 | 58,1 |
| Limit | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |

Figure 82. Comparative analysis of alkalinity levels measured in artesian wells at the forest plantation area

The Law 1614/2000 establishes a maximum value of 250 mg $CaCO_3$/l. Figure 82 shows that only well GW15-SO exceeds the limit. The average alkalinity concentration is 82 mg $CaCO_3$/l.




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Alkalinity | 397 | 178 | 282 | 13,5 | 54,6 |
| Limit | 250 | 250 | 250 | 250 | 250 |

Figure 83. Comparative analysis of alkalinity levels measured in monitoring wells at the DAI

In the DAI, monitoring wells GW01 and GW04 have concentrations above the limit. The average is 185.02 mg CaCo3/l.

### 3.4.10 Bicarbonates

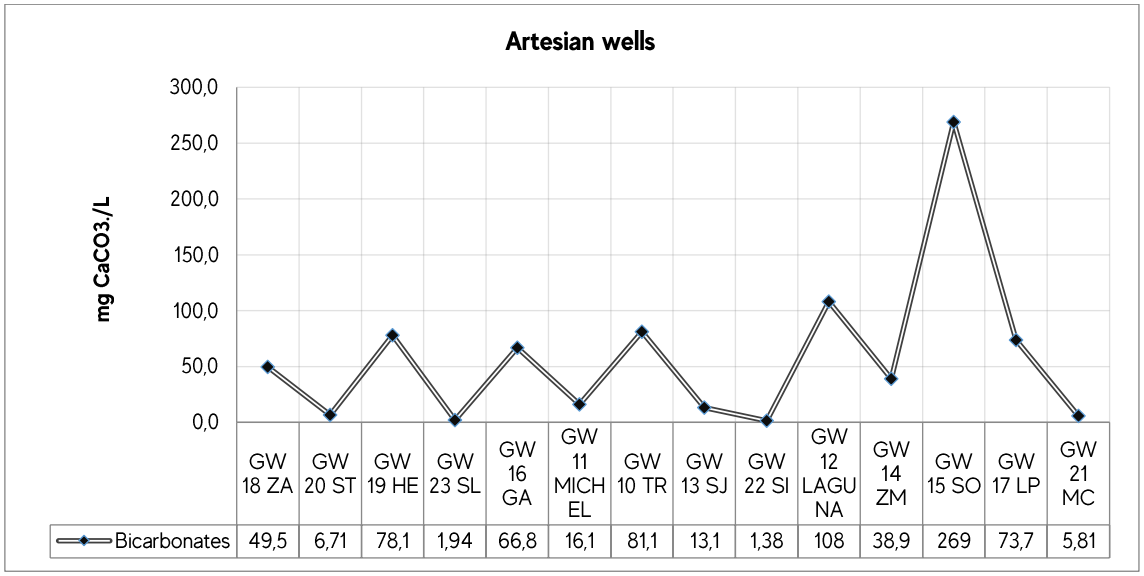



Figure 84. Comparative analysis of bicarbonate levels measured in artesian wells at the forest plantation area

Bicarbonate is a water quality parameter with no set limit. The types of minerals in the geological formation where the wells are, influence the concentrations of this parameter. The average value of bicarbonates is 57.9 mg CaCO3/l.

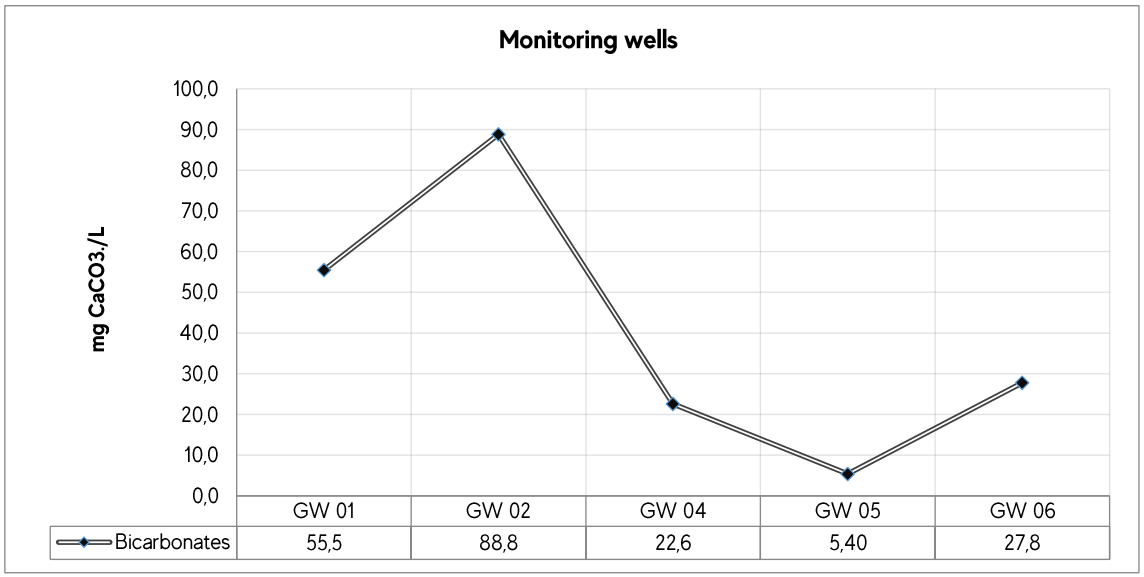



Figure 85. Comparative analysis of bicarbonate levels measured in monitoring wells at the DAI

In the DAI zone, the average bicarbonate concentration is 40.02 mg CaCo3/l.

### 3.4.11 Carbonates

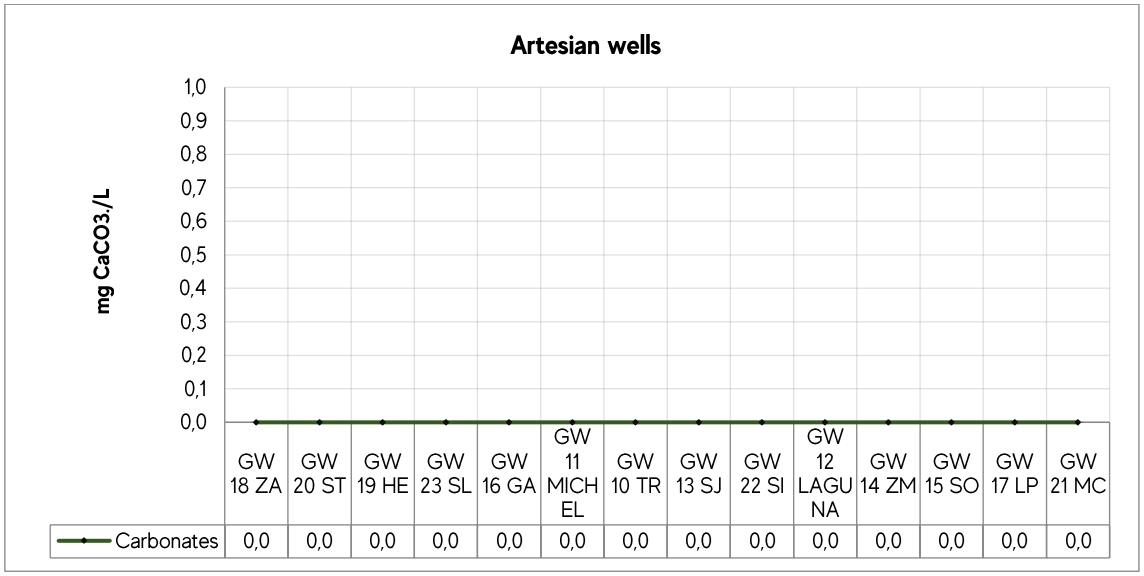



Figure 86. Comparative analysis of carbonate levels measured in artesian wells at the forest plantation area

Carbonate is a water quality parameter with no set limit. According to the laboratory results, there is no presence of this parameter in any sample.

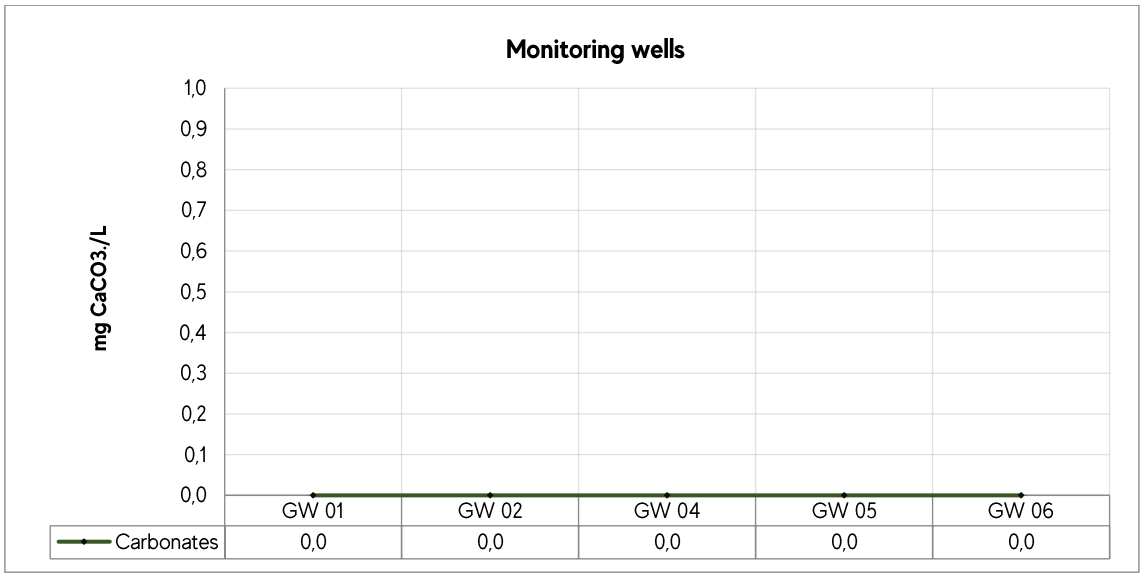
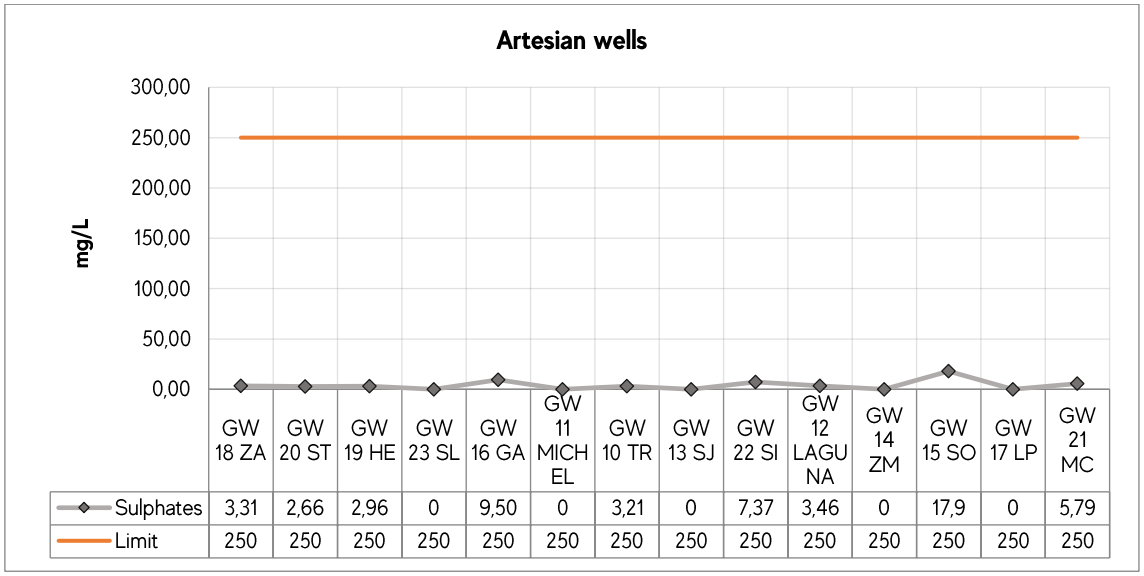



Figure 87. Comparative analysis of carbonate levels measured in monitoring wells at the DAI

As the artesian well's results, the monitoring well's values in the DAI are equal to zero.

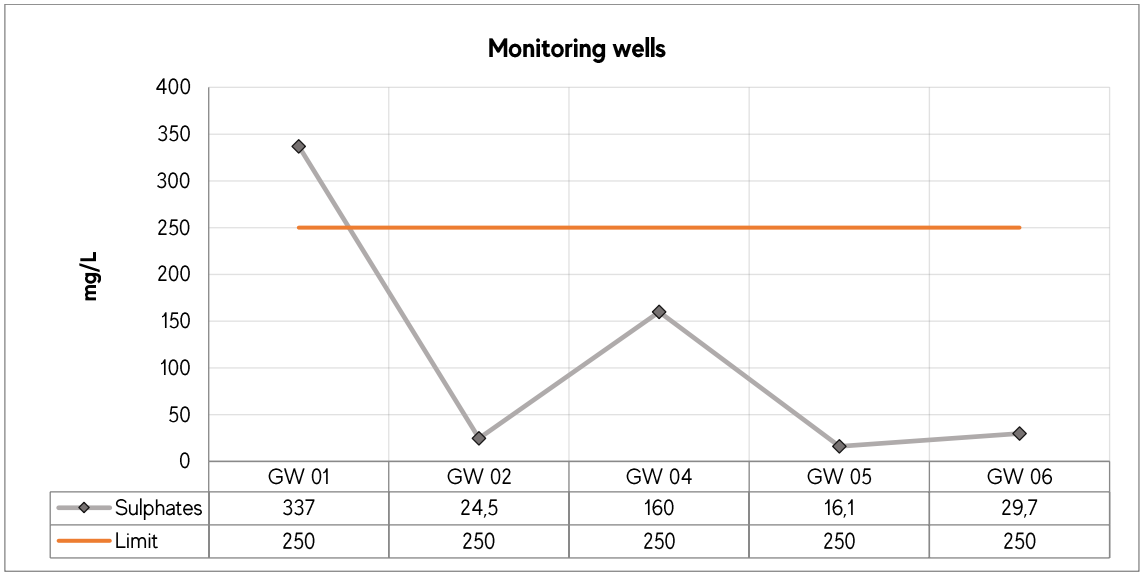
### 3.4.12 Sulphates




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sulphates | 3,31 | 2,66 | 2,96 | 0 | 9,50 | 0 | 3,21 | 0 | 7,37 | 3,46 | 0 | 17,9 | 0 | 5,79 |
| Limit | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |

Figure 88. Comparative analysis of sulphate levels measured in artesian wells at the forest plantation area

In contrast to surface water, all the artesian well's monitored points show sulphate concentrations. Regulation 222/02 defines a maximum of 250 mg/l for this parameter, and the highest determination is 17.9 mg/l at point GW18-SO. All the samples are within the range, and the average sulphate value is 4 mg/l.

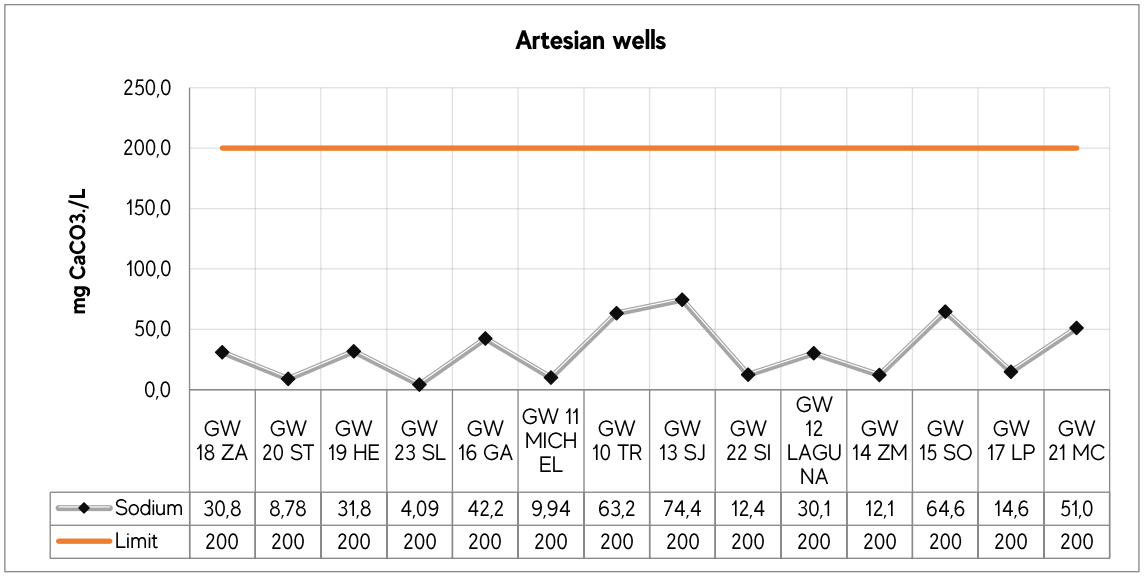



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Sulphates | 337 | 24,5 | 160 | 16,1 | 29,7 |
| Limit | 250 | 250 | 250 | 250 | 250 |

Figure 89. Comparative analysis of sulphate levels measured in monitoring wells at the DAI

In the DAI zone, the only well that exceeds the limit is GW01 with 337 mg/L. The average value of sulphates is 113.46 mg/L.

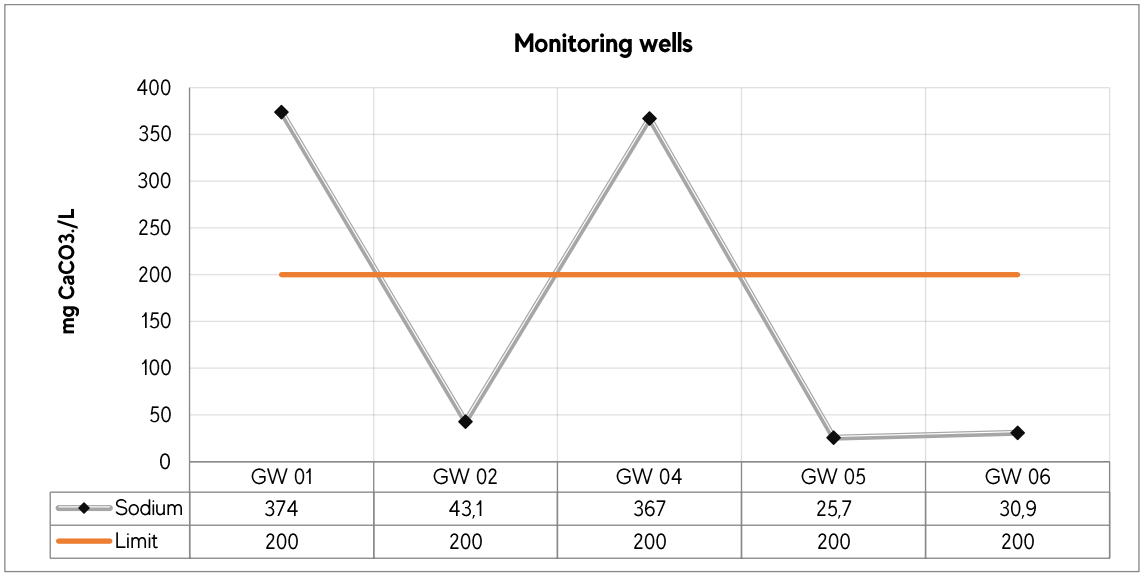
### 3.4.13 Sodium




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sodium | 30,8 | 8,78 | 31,8 | 4,09 | 42,2 | 9,94 | 63,2 | 74,4 | 12,4 | 30,1 | 12,1 | 64,6 | 14,6 | 51,0 |
| Limit | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |

Figure 90. Comparative analysis of sodium levels measured in artesian wells at the forest plantation area

In all the sampled wells, the sodium concentrations are lower than the maximum levels established in Regulation 222/02. Statistically, the average sodium concentration in groundwater is 32.14 mg/L.

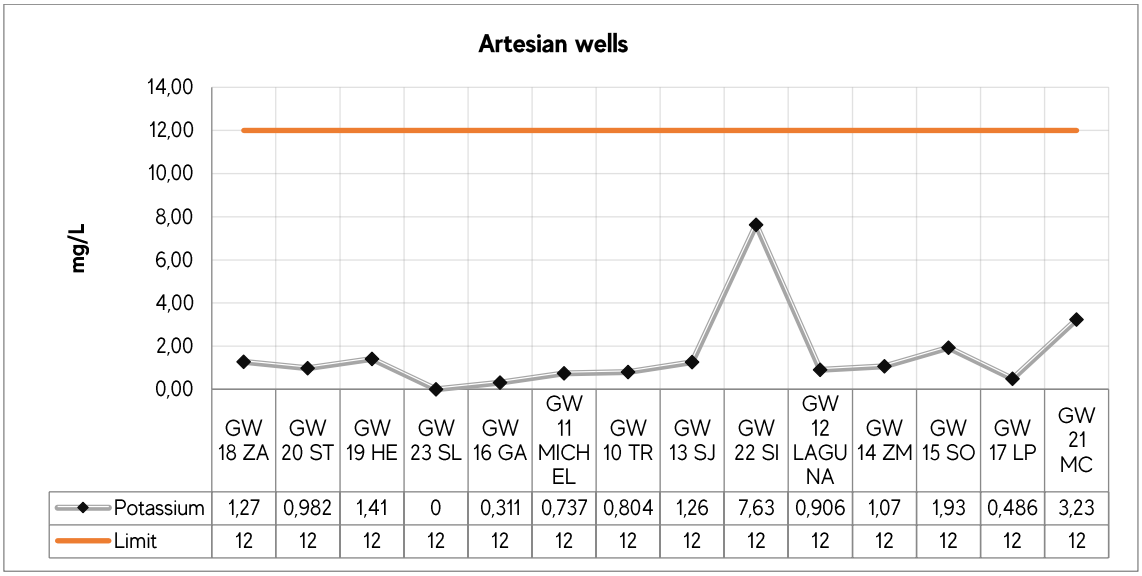



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Sodium | 374 | 43,1 | 367 | 25,7 | 30,9 |
| Limit | 200 | 200 | 200 | 200 | 200 |

Figure 91. Comparative analysis of sodium levels measured in monitoring wells at the DAI

In the DAI zone the average sodium concentration is 168.14 mg/l. Only wells GW01 and GW04 have values above the limit.

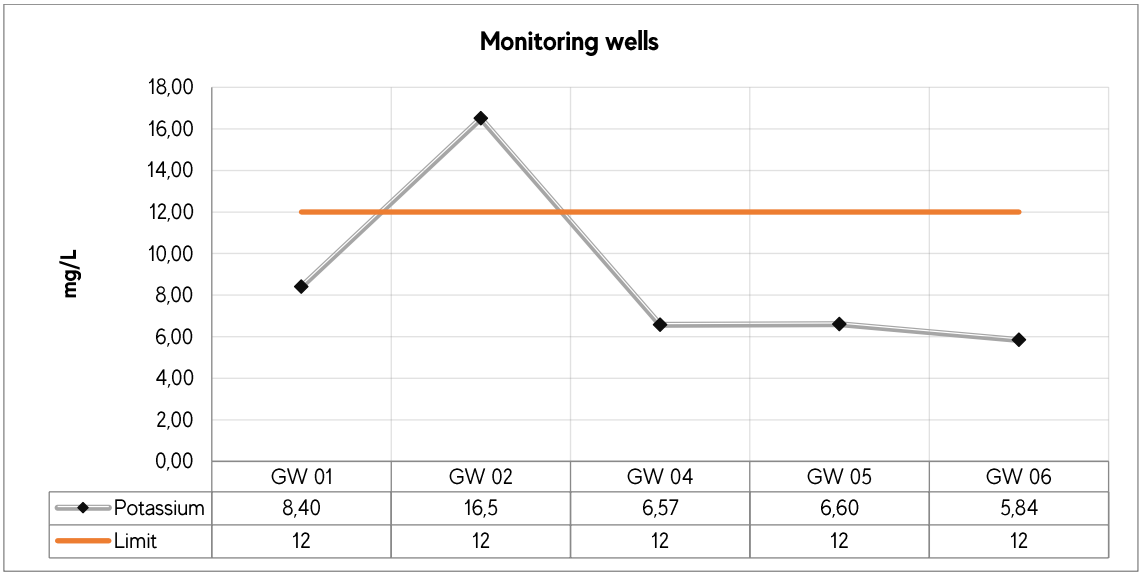
### 3.4.13 Potassium




| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Potassium | 1,27 | 0,982 | 1,41 | 0 | 0,311 | 0,737 | 0,804 | 1,26 | 7,63 | 0,906 | 1,07 | 1,93 | 0,486 | 3,23 |
| Limit | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |

Figure 92. Comparative analysis of potassium levels measured in artesian wells at the forest plantation area

The recommended sodium limits, in Law 1614/2000, is less than 12 mg/L. All the artesian well's results are within this range.




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Potassium | 8,40 | 16,5 | 6,57 | 6,60 | 5,84 |
| Limit | 12 | 12 | 12 | 12 | 12 |

Figure 93. Comparative analysis of potassium levels measured in monitoring wells at the DAI

In the DAI zone, monitoring well GW02 exceeds the value established in the reference regulation, the average potassium concentration in groundwater at the future industrial plant zone is 8.7 mg/l.

### 3.4.14 Calcium

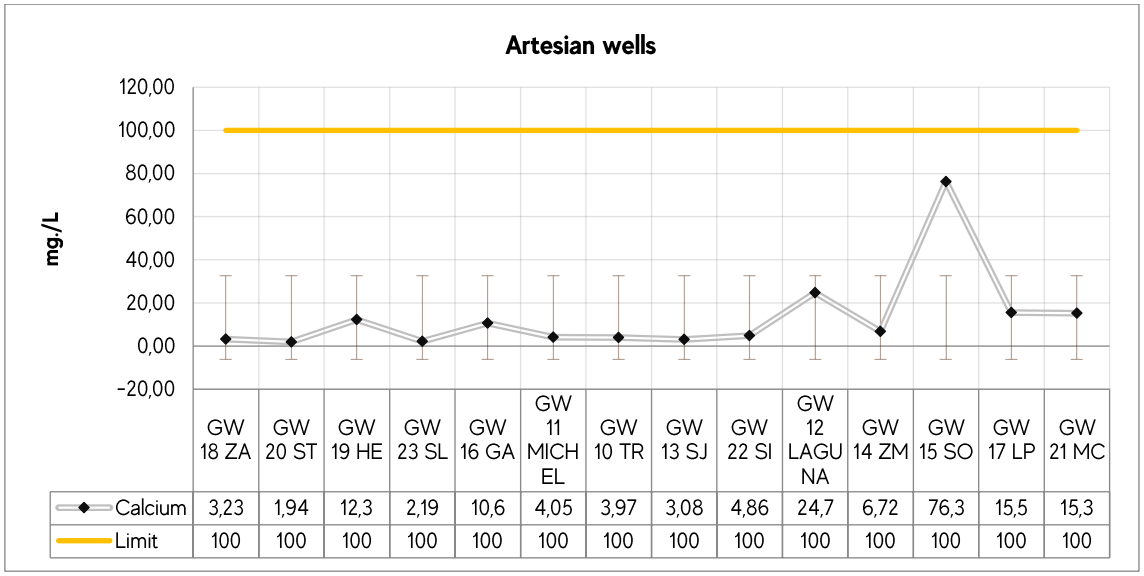



Figure 94. Comparative analysis of calcium levels measured in artesian wells at the forest plantation area

Regulation 222/02 does not establish a maximum value for this parameter; therefore, the limit value considered is 100 mg/l which is set by Law 1614/2000. Figure 94 shows that none points exceed this value. The average result is 13,19 mg/l.

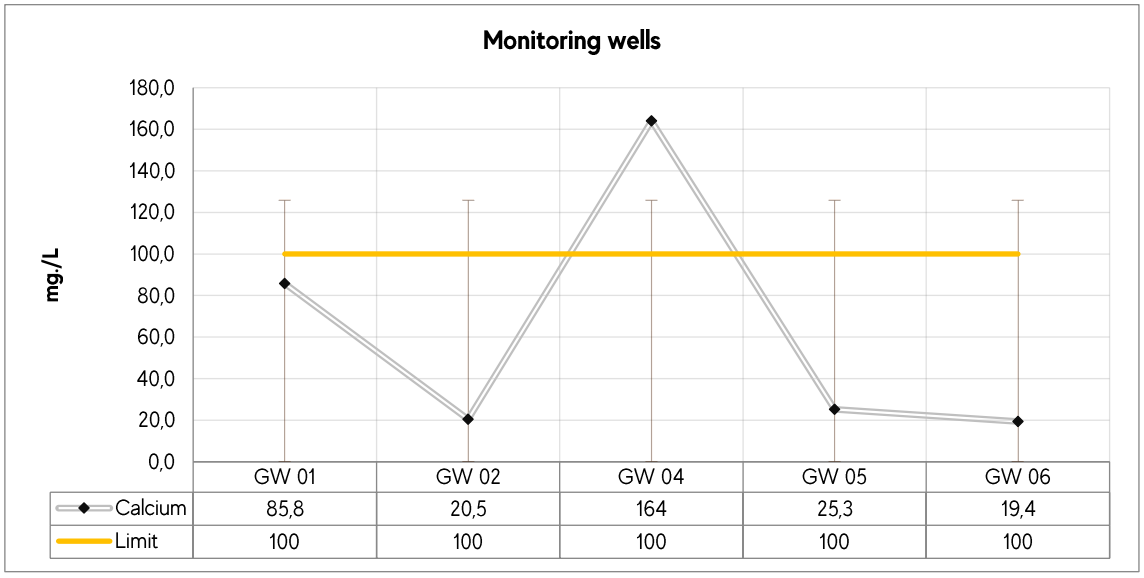
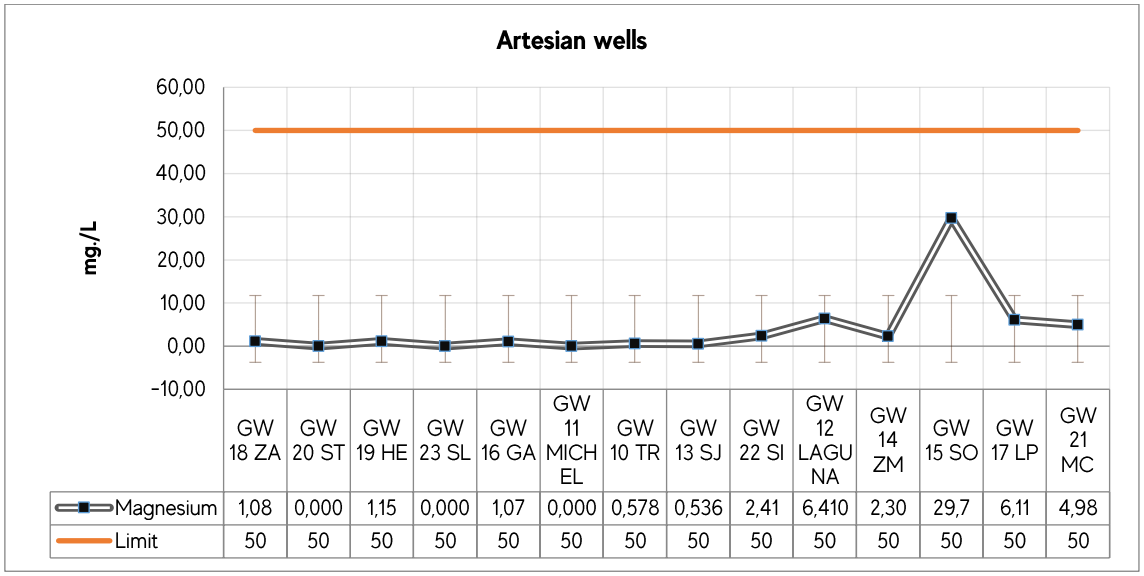



Figure 95. Comparative analysis of calcium levels measured in monitoring wells at the DAI

Figure 95 illustrates that the highest concentrations are recorded in the DAI monitoring wells. GW04 is the only point that exceeds the established limit. The average calcium value in this area is 63 mg/l.

### 3.4.14 Magnesium

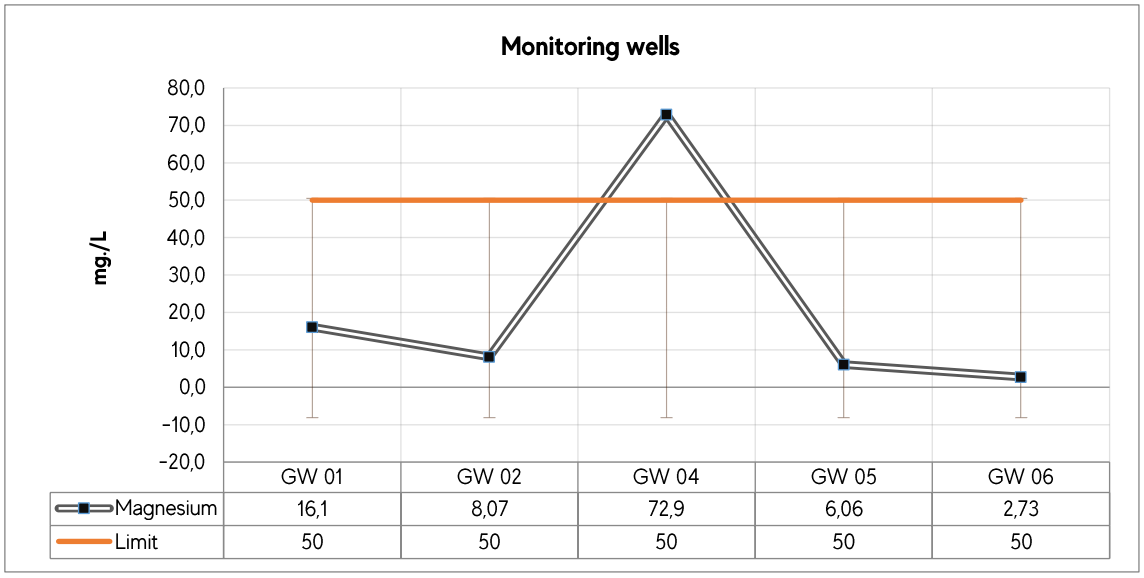



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Magnesium | 1,08 | 0,000 | 1,15 | 0,000 | 1,07 | 0,000 | 0,578 | 0,536 | 2,41 | 6,410 | 2,30 | 29,7 | 6,11 | 4,98 |
| Limit | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |

Figure 96. Comparative analysis of magnesium levels measured in artesian wells at the forest plantation area

The water standard for the national territory does not establish a maximum level for this parameter; thus, Law 1614/2000 is used as a reference and it establishes 50 mg/l for magnesium level.

None point exceeds the reference value in the forest plantation area. The average magnesium value at all points is 5.1 mg/l.




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Magnesium | 16,1 | 8,07 | 72,9 | 6,06 | 2,73 |
| Limit | 50 | 50 | 50 | 50 | 50 |

Figure 97. Comparative analysis of magnesium levels measured in monitoring wells at the DAI

In the DAI zone, point GW04 exceeds the limit value established by Law 1614/2000. The average magnesium value in this zone is 21.17 mg/l.

### 3.4.15 Fluoride

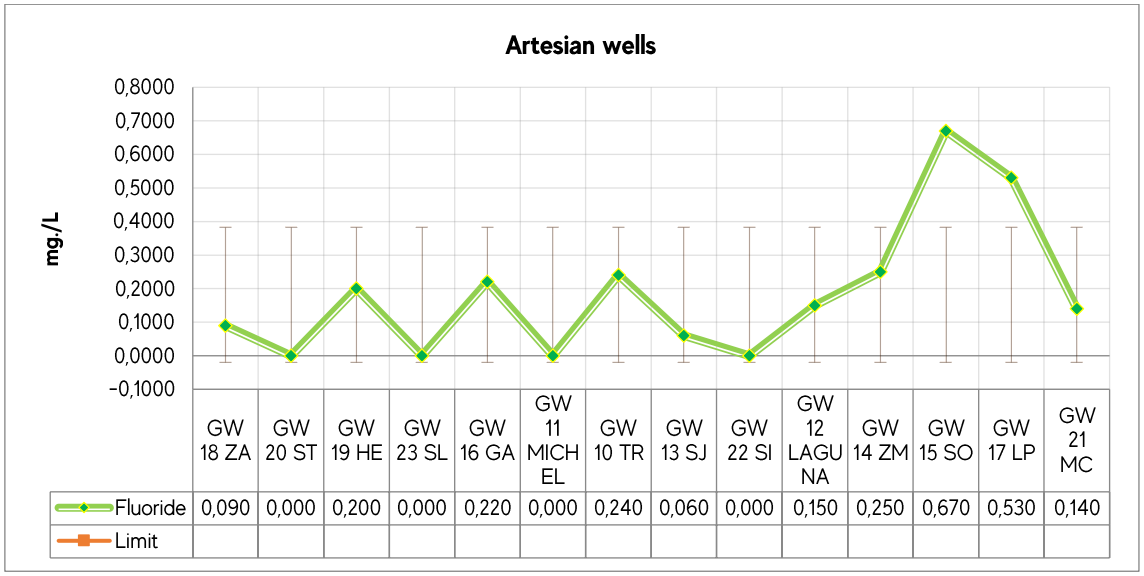



Figure 98. Comparative analysis of fluoride levels measured in artesian wells at the forest plantation area

Fluoride is a parameter with no established limits by the legislation.

The average fluoride value, in the forest plantation area, is 0.2 mg/l.

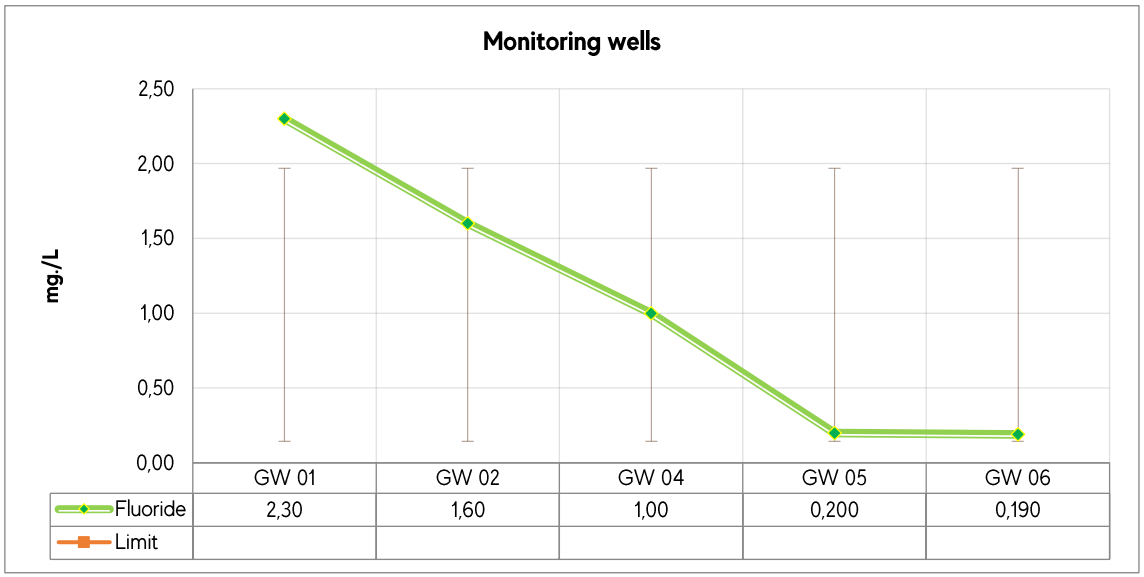
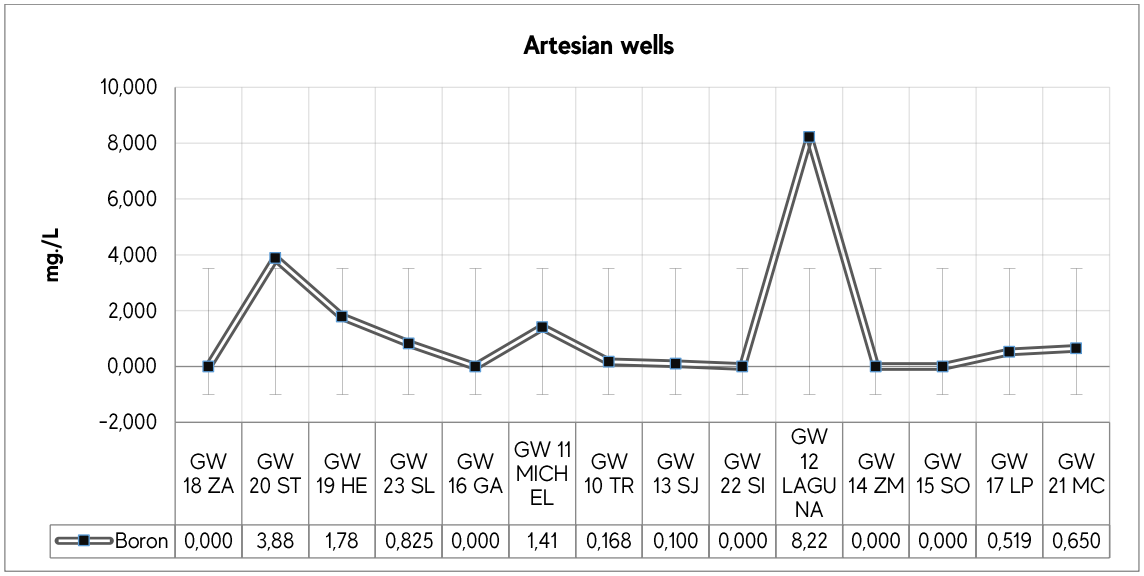



Figure 99. Comparative analysis of fluoride levels measured in monitoring wells at the DAI

In the DAI zone, fluoride has an average concentration of 1.05 mg/l. The highest determination recorded is in well GW01.

### 3.4.16 Boron

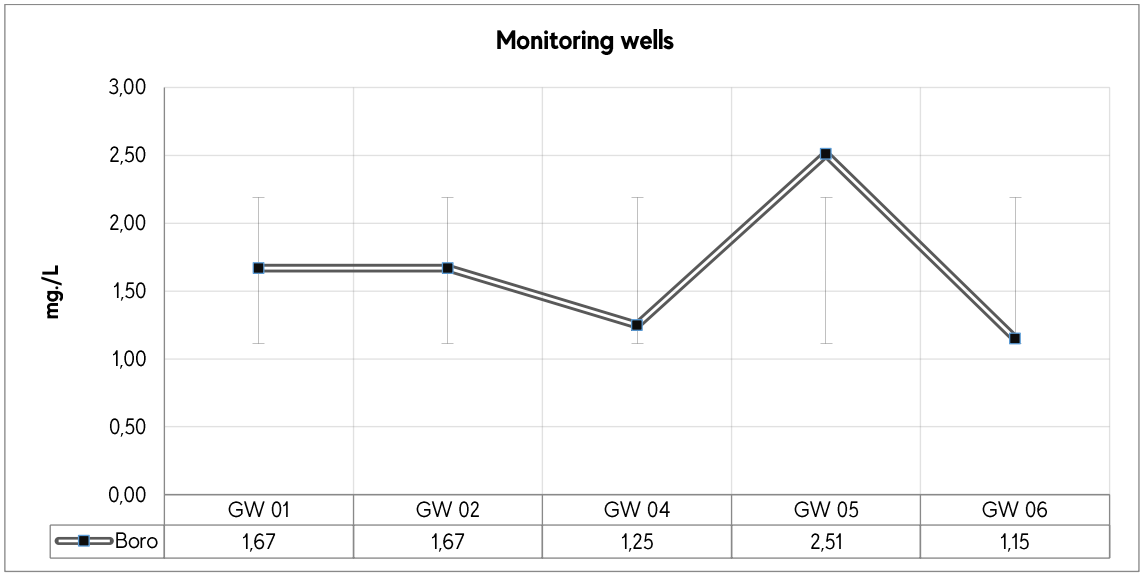



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICHEL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGUNA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boron | 0,000 | 3,88 | 1,78 | 0,825 | 0,000 | 1,41 | 0,168 | 0,100 | 0,000 | 8,22 | 0,000 | 0,000 | 0,519 | 0,650 |

Figure 100. Comparative analysis of boron levels measured in artesian wells at the forest plantation area

In GW 18-ZA, GW 16-GA, GW 13-SJ, GW 22-SI, GW 14-ZM and GW 15-SO, the concentrations of boron are not detectable considering the analytical method's limit of quantification in the water which is 1 mg/L.

The highest result is in well GW 12-LAGUNA; however, this parameter does not have established limits. Statistically, the average boron value is 2 mg/l.

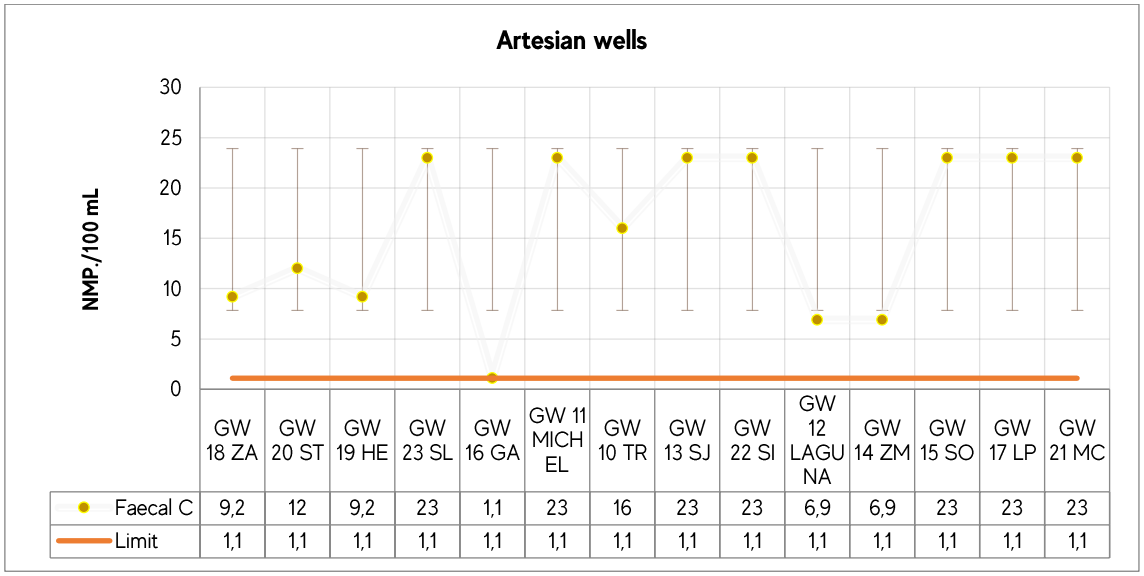



| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Boro | 1,67 | 1,67 | 1,25 | 2,51 | 1,15 |

Figure 101. Comparative analysis of boron levels measured in monitoring wells at the DAI

In the DAI zone, Boron values obtained from the samples of the monitoring wells has an average value of 1.65 mg/L.

### 3.4.17 Faecal coliforms

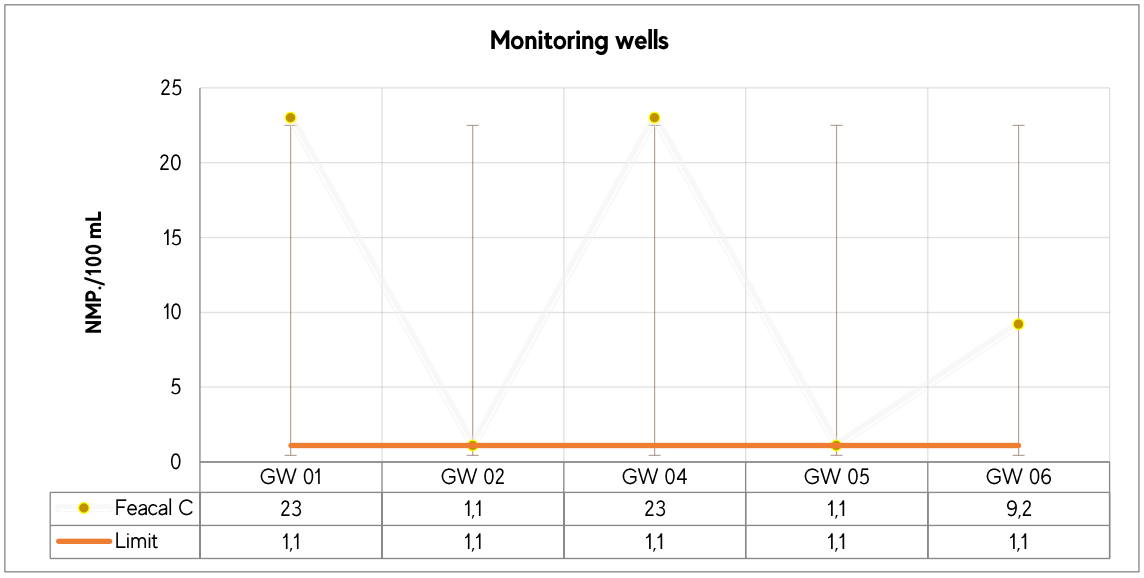



| | GW 18 ZA | GW 20 ST | GW 19 HE | GW 23 SL | GW 16 GA | GW 11 MICH EL | GW 10 TR | GW 13 SJ | GW 22 SI | GW 12 LAGU NA | GW 14 ZM | GW 15 SO | GW 17 LP | GW 21 MC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Faecal C | 9,2 | 12 | 9,2 | 23 | 1,1 | 23 | 16 | 23 | 23 | 6,9 | 6,9 | 23 | 23 | 23 |
| Limit | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 |

Figure 102. Comparative analysis of faecal coliforms levels measured in artesian wells at the forest plantation area

Since the water of the artesian wells are for human consumption, the results are compared to the maximum limits set in NP 2400180 norm for faecal coliform.

All the wells located at the forest plantation area have concentrations above the established limit in this campaign. Only GW16-GA does not exceed the maximum value of 1.1 NMP/100ml.




| | GW 01 | GW 02 | GW 04 | GW 05 | GW 06 |
|---|---|---|---|---|---|
| Feacal C | 23 | 1,1 | 23 | 1,1 | 9,2 |
| Limit | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 |

Figure 103. Comparative analysis of faecal coliforms levels measured in monitoring wells at the DAI

In the DAI zone, 3 of the monitoring wells, except GW02 and GW05, have faecal coliform concentrations above the limits.

### 3.4.17 Total coliforms

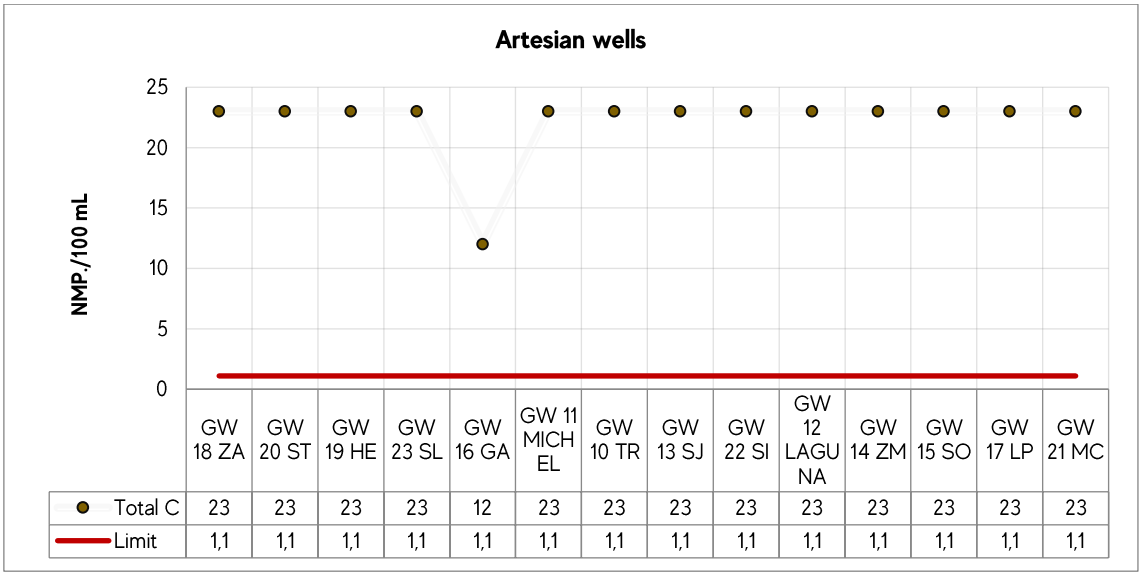



Figure 104. Comparative analysis of total coliforms levels measured in artesian wells at the forest plantation area

Total coliforms values of artesian wells are compared with the limits set by NP 2400180 which establishes a maximum of 1.1 NMP/100ml in water used for human consumption. All the wells art the forest plantation zone exceeds this limit.

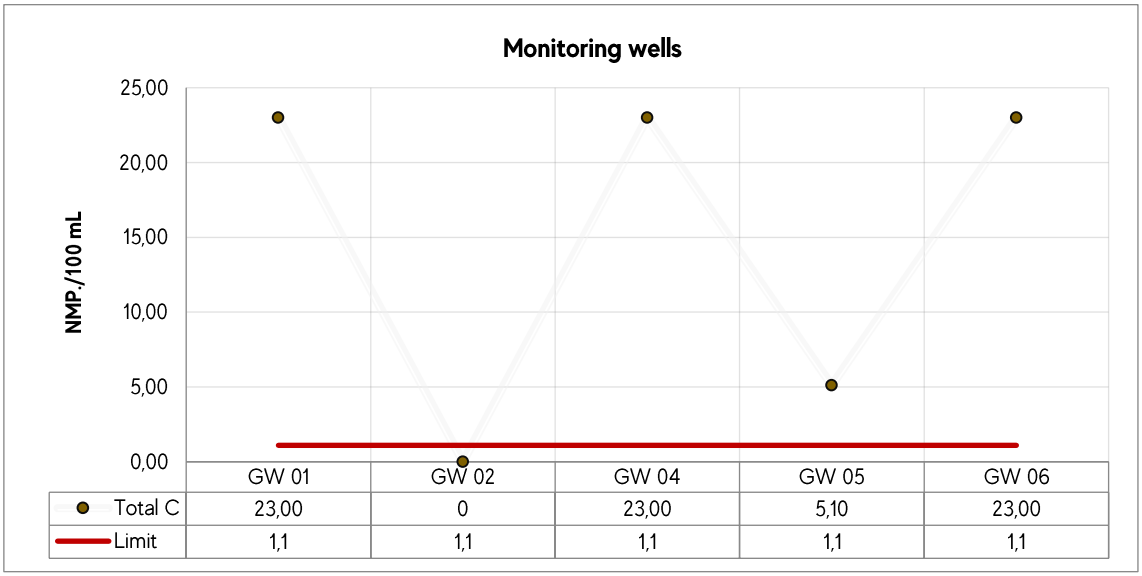



Figure 105. Comparative analysis of total coliforms levels measured in monitoring wells at the DAI

In the DAI zone, all monitoring wells except for GW02 shows concentrations of total coliforms above the established limit.

### 3.4.18 Escherichia coli

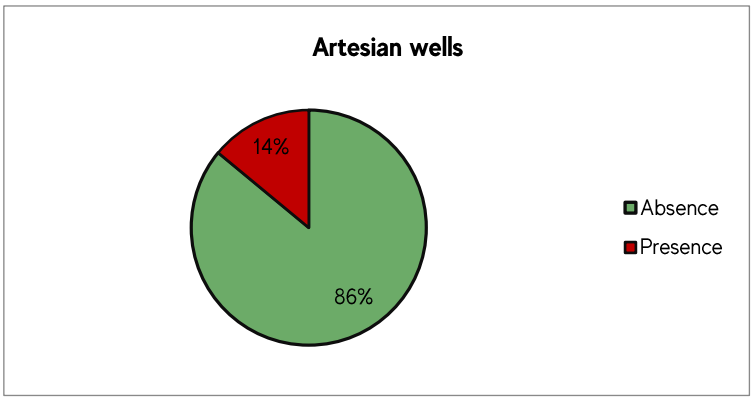



Figure 106. Presence-absence test of *E. coli* in artesian wells at the forest plantation area

According to NP 2400180, *Escherichia coli* bacteria must be absent from water for human consumption. In GW22-SILVA Y GW 23-SL it is found the presence of this bacteria.

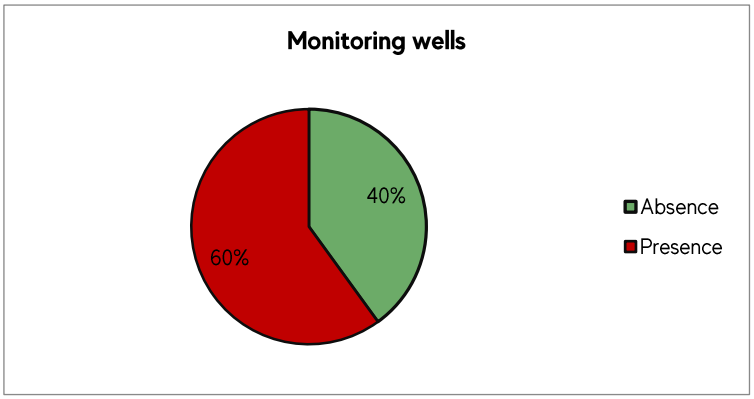



Figure 107. Presence-absence test of *E. coli* in monitoring wells at the DAI

*Escherichia coli* is found in the following DAI monitoring wells: GW01, GW04, and GW05.

## IV. CONCLUSION

This report presents the direct area of influence and indirect area of influence's results of the first water monitoring campaign. According to the consultancy terms, it should be two campaigns to monitor groundwater and surface water quality, one in the rainy season and other in the dry season; the present report corresponds to the first one.

PARACEL provided the coordinates of 40 monitoring points, 20 for surface water and 20 for groundwater. Of the total number, 39 were sampled and analysed and only one monitoring well in the DAI was not sampled since it was not found water (Appendix D. Evidence).

In terms of the parameters defined, a 100% of the parameters for groundwater are reported in this document, as well as 63 of 67 of the parameters established for surface water. Sulfluramide, Bifenthrin, Thiamethoxam y Lambdacyalothrin are the 4 parameters that are not included since these determinations depend on reagents and chemical substances that were not possible to acquire until now due to pandemic (Appendix E. Suppliers note).

According to the terms of reference, Glyphosate, Sulfluramide, Lambdacyhalothrin, Bifenthrin, Thiamethoxam, Carbofuran, Lindane and Fipronil are the parameters to report for the 18 surface water points. However, 22 agrochemicals are included in addition (Table 4).

Laboratories certified by the ONA (National Accreditation Body) are the responsible of the results obtained by analytical determinations. The analysis and evaluation of the results are contrast with the following normative:

- Regulation SEAM Nº 222/02 "BY WHICH THE WATER QUALITY PADRON OF THE NATIONAL TERRITORY IS ESTABLISHED".
- Law 1614/200 - GENERAL LAW ON THE REGULATORY AND TARIFFING FRAMEWORK FOR THE DRINKING WATER AND SANITARY SEWERAGE SERVICE - ANNEX I.
- NP 24 001 80. DRINKING WATER: GENERAL REQUIREMENTS

Regarding the surface water results, the main findings are:

- Of the 63 parameters analysed (physicochemical, agrochemical and bacteriological), 44 have limits established in the regulations while 19 do not.
- Of the 44 parameters with defined limits, 31 (75%) do not show any deviation compared to the regulation's limits and 13 parameters (25%) show values above the maximum allowed in at least one monitoring point.
- During the first monitoring campaign no traces of agrochemicals were found in surface waters. Still, there are pendant determinations as Sulfluramide, Bifenthrin, Thiamethoxam and Lambdacyhalothrin and the only exception is Fipronil at point FW 315-HE.
- The physicochemical parameters that do not have any deviation are (20): floating materials, total dissolved solids (TDS), oils and fats, nitrates, nitrites, hardness, sulphate, sodium, aluminium, cadmium, trivalent chromium, hexavalent chromium, copper, tin, selenium, zinc, arsenic, mercury, barium, cyanide.
- The physicochemical parameters with deviations are (9): pH, Dissolved Oxygen, Turbidity, BOD5, Total Phosphorus, Total Nitrogen, Nickel, Manganese and Lead.

In the case of groundwater, specifically at forest plantation area, the main findings are:

- The 14 artesian wells located in the forest plantation area provides water for human consumption.
- Of the 23 physicochemical and bacteriological parameters evaluated, 18 have limits established in the current regulations, and 5 do not have defined limits.
- Of the 18 parameters with defined limits, 11 (61%) do not show any deviation regarding current regulations and 7 (39%) show values above the maximum permitted in at least one monitoring point.

- The 11 parameters that do not show any deviation in the 14 wells evaluated are electrical conductivity, total dissolved solids, hardness, total nitrogen, chlorides, sulphates, sodium, potassium, calcium, magnesium, fluoride and E coli.
- The parameters deviated from the established limits are pH, total phosphorus, nitrates, alkalinity, faecal coliforms and total coliforms.
- The parameters that most frequently show deviations in the 14 sampled wells are nitrates (42%), total phosphorus (71%), faecal coliforms (92%) and total coliforms (100%).

As for the monitoring wells placed at DAI zone of the future industry, the groundwater main findings are:

- A total of 5 monitoring wells located in the AID were analysed. Unlike the wells in the forest plantation area, these well's purposes are exclusively for monitoring groundwater quality.
- One of the monitoring wells did not have water.
- The parameters results were significantly higher in comparison with the values obtained in the forest plantation zone.

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# APPENDIX A:
# SURFACE WATER
# LABORATORY RESULTS

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**A.1 Analytical determinations of point FW104-ZA**

| TABLE 1. PARAMETERS MEASURED ON THE SITE – FW104-ZA | | | |
|---|---|---|---|
| **FW 104-ZA** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time: | 18:30 | Air temperature: | 28,5 ºC |
| Atmospheric conditions: | Cloudy skies, drizzle | Relative humidity: | 60% |
| UTM coordinates: | 21K 546639,23 mE; 7513553,82 mS | Elevation: | 190 m |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation2 22/02** | **Alternative reference standards *** |
| 1 | Water temperature | Tº | ºC | 25,2 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,44 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 62,1 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,88 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 84,0 | 100 NTU | |

| TABLE 2. PHYSICOCHEMICAL PARAMETERS – FW 104-ZA | | | | | | |
|---|---|---|---|---|---|---|
| **FW 104-ZA** | | | | | | |
| **PHYSICOCHEMICAL PARAMETER** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 6 | Floating materials | | | **89,0** | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 62,0 | 500 | |
| 8 | Oil and grease | | mg/L | **9,70** | Visually absent | |
| 9 | Chemical oxygen demand | COD | mg $O_2$/L | 50,4 | No limits | [1] <150 |
| 10 | Biological oxygen demand | BOD5 | mg $O_2$/L | 2,33 | 5 | |
| 11 | Total phosphorus | P | mg/L | <0,0200 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 3,14 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | **0,083** | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,0025 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 11,1 | 300 | |
| 17 | Sodium | Na | mg/L | 2,53 | 200 | |
| 18 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 19 | Cyanides | | mg/L | <0,02 LOQ | 0,2 | |
| 20 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 21 | Soluble iron | $Fe^{++}$ | mg/L | **1,110** | 0,3 | |
| 22 | Aluminium | Al | mg/L | <0,100 | 0,2 | |
| 23 | Cadmium | Cd | µg/L | <0,000800 | 0,001 | |
| 24 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 25 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 26 | Tin | Sn | mg/L | <1,00 | 2 | |
| 27 | Nickel | Ni | mg/L | 0,0839 | 0,025 | |
| 28 | Manganese | Mn | mg/L | 0,0839 | 0,1 | |
| 29 | Lead | Pb | mg/L | 0,00200 | 0,01 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Selenium | Se | mg/L | 0,00500 | 0,01 | |
| 31 | Zinc | Zn | mg/L | 0,0851 | 3 | |
| 32 | Arsenic | As | mg/L | 0,0143 | 0,5 | |
| 33 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 34 | Barium | Ba | mg/L | 0,07 | 2 | |

TABLE 1. TABLE 3. AGROCHEMICAL IN SURFACE WATER – FW 104-ZA

**FW 104-ZA**

**AGROCHEMICAL**

| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Regulation 222/02** | **Alternative reference standards** * |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atrazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacyalothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLEE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |
| | | | | | | | |

| TABLE 4. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW104-ZA | | | | |
|---|---|---|---|---|
| **FW 104 – ZA – HYDROBIOLOGICAL PARAMETERS** | | | | |
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(805)** | | | **Cylindrospermum sp.** | 805 |
| | | | | |
| Presence of organic material | + | | TOTAL CELLS/mL | 805 |
| Presence of sediment | +++ | | Abundant/dominant organism | Cylindrospermum sp. 100% |
| Presence of bacteria | +++ | | Range of risk | Null |
| Presence of fungal hyphae | X | | | |
| **CODES** | | | | |
| **+**(less than half of the field) | **++** (half of the field) | | **+++** (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº 65) ZOOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| Absence of zooplankton. | | | | |
| Plant remains | No | | TOTAL CELLS /mL | Not applicable |
| Colour | Yellowish | | Abundant/dominant organism | Not applicable |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Total coliforms | NMP/100mL | 1600 | 1000 NMP/100mL |
| 67 | Faecal coliforms | NMP/100mL | 1600 | 200 NMP/100mL |

**A2 Analytical determinations of point FW 201-ST**

| TABLE 5. PARAMETERS MEASURED ON THE SITE – FW 201-ST | | | |
|---|---|---|---|
| **FW 201-ST** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:50 | Air temperature | 26 ºC |
| Atmospheric conditions | Cloudy sky, drizzle | Relative humidity | 58% |
| UTM coordinates | 21K 543911.54 m E 7497910.60 m S | Elevation | 179 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | Tº | ºC | 24,4 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,6 | 6 – 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 40,3 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,21 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | NTU | 61,6 | 100 NTU | |

| TABLE 6. PHYSICOCHEMICAL PARAMETERS - FW201-ST | | | | | | |
|---|---|---|---|---|---|---|
| **FW 201-ST** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 6 | Floating materials | | | 62,0 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 22,5 | 500 | |
| 8 | Oil and grease | | mg/L | 7,50 | Visually absent | |
| 9 | Chemical oxygen demand | COD | mg $O_2$/L | 42,6 | No limits | [1] <150 |
| 10 | Biological oxygen demand | BOD5 | mg $O_2$/L | 1,93 | 5 | |
| 11 | Total phosphorus | P | mg/L | <0,0200 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,108 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 3,5 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0594 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0388 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 7,88 | 300 | |
| 17 | Sodium | Na | mg/L | 2,53 | 200 | |
| 18 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 19 | Cyanides | | mg/L | <0,02 LOQ | 0,2 | |
| 20 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 21 | Soluble iron | $Fe^{++}$ | mg/L | 0,935 | 0,3 | |
| 22 | Aluminium | Al | mg/L | <0,100 | 0,2 | |
| 23 | Cadmium | Cd | µg/L | <0,000800 | 0,001 | |
| 24 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 25 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 26 | Tin | Sn | mg/L | <1,00 | 2 | |
| 27 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 28 | Manganese | Mn | mg/L | <0,01 | 0,1 | |
| 29 | Lead | Pb | mg/L | 0,00337 | 0,01 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 31 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 32 | Arsenic | As | mg/L | 0,0132 | 0,5 | |
| 33 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 34 | Barium | Ba | mg/L | 0,07 | 2 | |

TABLE 7. AGROCHEMICALS IN SURFACE WATER – FW201-ST

**FW 201-ST**

**AGROCHEMICAL**

| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Regulation 222/02** | **Alternative reference standards** * |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atrazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacyalothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLEE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

TABLE 8. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW201-ST

| FW 201-ST – HYDROBIOLOGICAL PARAMETERS | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C H L O R O P H Y T A (69) | | *Ankistrodesmus sp.* | 69 |
| B A C I L L A R I O P H Y T A (46) | | *Pennate diatoms* | 46 |
| E U G L E N O Z O A (184) | | *Euglena sp.* | 184 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **299** |
| Presence of sediment | +++ | Abundant/dominant organism: | *Euglena sp.* 61,5% |
| Presence of bacteria | +++ | Range of risk: | Null |
| Spicules | X | | |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (se observa en forma esporádica) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº 65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | Not applicable |
| Colour | Yellowish | Abundant/dominant organism | Not applicable |

| BACTERIOLOGICAL PARAMETERS | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 540 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 540 | 1000 NMP/100mL |

**A3 Analytical determinations of point FW 315-HE**

| TABLE 9. PARAMETERS MEASURED ON THE SITE – FW315-HE | | | |
|---|---|---|---|
| **FW 315-HE** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 10:30 | Air temperature | 25 ºC |
| Atmospheric conditions | Cloudy, rainy all-day | Relative humidity | 78% |
| UTM coordinates | 21K 515424,99mE; 7523026,00 mS | Elevation | 184 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | Tº | ºC | 24,5 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,68 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 52,1 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,17 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | NTU | 35,0 | 100 NTU | |

| TABLE 10. PHYSICOCHEMICAL PARAMETERS - FW 315-HE | | | | | | |
|---|---|---|---|---|---|---|
| **FW 315-HE** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 6 | Floating materials | | | 22,4 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 157 | 500 | |
| 8 | Oil and grease | | mg/L | 16,8 | Visually absent | |
| 9 | Chemical oxygen demand | COD | mg $O_2$/L | 51,1 | No limits | [1] <150 |
| 10 | Biological oxygen demand | BOD5 | mg $O_2$/L | 2,23 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,103 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,734 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 1,07 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0587 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0136 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 14,1 | 300 | |
| 17 | Sodium | Na | mg/L | 4 | 200 | |
| 18 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 19 | Cyanides | | mg/L | <0,02 | 0,2 | |
| 20 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 21 | Soluble iron | $Fe^{++}$ | mg/L | 1,11 | 0,3 | |
| 22 | Aluminium | Al | mg/L | <0,1 | 0,2 | |
| 23 | Cadmium | Cd | µg/L | <0,0080 | 0,001 | |
| 24 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 25 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 26 | Tin | Sn | mg/L | <1,0 | 2 | |
| 27 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 28 | Manganese | Mn | mg/L | 0,274 | 0,1 | |
| 29 | Lead | Pb | mg/L | 0,0085 | 0,01 | |
| 30 | Selenium | Se | mg/L | <0,005 | 0,01 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 32 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 33 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 34 | Barium | Ba | mg/L | 0,09 | 2 | |

| TABLE 11. AGROCHEMICALS IN SURFACE WATER – FW315-HE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 315-HE** | | | | | | | |
| **AGROCHEMICAL** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atrazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacyalothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLEE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | 0,03 | No limits | |

| TABLE 12. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW 315-HE | | | | |
|---|---|---|---|---|
| **FW 315-HE – HYDROBIOLOGICAL PARAMETERS** | | | | |
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| CYANOBACTERIA **(395)** | | | *Pseudanabaena sp.1* | 135 |
| | | | *Pseudanabaena sp.2* | 180 |
| | | | *Pseudanabaena sp.3* | 80 |
| BACILLARIOPHYTA **(20)** | | | *Pennate diatoms* | 20 |
| EUGLENOZOA **(10)** | | | *Euglena sp.* | |
| | | | | |
| Presence of organic material | | + | TOTAL CELLS /mL | **425** |
| Presence of sediment | | +++ | Abundant/dominant organism | Pseudanabaena sp.2 38,9% |
| Mushroom spores | | x | Range of risk | Null |
| **CODES** | | | | |
| **+**(less than half of the field) | | **++** (half of the field) | **+++** (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº 65) ZOOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value (Org/m³)** |
| COPEPODS | | | *Harpacticoida sp* | 20 |
| | | | | |
| Plant remains | | | TOTAL CELLS /mL | 20 |
| Colour | | | Abundant/dominant organism | *Harpacticoida sp 100%* |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 1200 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 35000 | 1000 NMP/100mL |

**A4 Analytical determinations of point FW304-HE**

| TABLE 13. PARAMETERS MEASURED ON THE SITE – FW 304-HE. | | | |
|---|---|---|---|
| **FW 304-HE** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 11:30 | Aire temperature | 24 ºC |
| Atmospheric conditions | Cloudy skies, light rain | Relative humidity | 76% |
| UTM coordinates | 21K 506172,99 mE; 7509505,00 mS | Elevation | 180 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | Tº | ºC | 24,4 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,89 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 294 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 6,76 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 25,6 | 100 NTU | |

| TABLE 14. PHYSICOCHEMICAL PARAMETERS – FW304-HE | | | | | | |
|---|---|---|---|---|---|---|
| **FW 304-HE** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 6 | Floating materials | | | 18,8 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 194 | 500 | |
| 8 | Oil and grease | | mg/L | 14,5 | Visually absent | |
| 9 | Chemical oxygen demand | COD | mg $O_2$/L | 137 | No limits | [1] <150 |
| 10 | Biological oxygen demand | BOD5 | mg $O_2$/L | 1,84 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0639 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 0,338 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0880 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0306 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 108 | 300 | |
| 17 | Sodium | Na | mg/L | 15,6 | 200 | |
| 18 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 19 | Cyanides | | mg/L | <0,02 | 0,2 | |
| 20 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 21 | Soluble iron | $Fe^{++}$ | mg/L | 0,913 | 0,3 | |
| 22 | Aluminium | Al | mg/L | <0,01 | 0,2 | |
| 23 | Cadmium | Cd | µg/L | <0,008 | 0,001 | |
| 24 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 25 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 26 | Tin | Sn | mg/L | <1 | 2 | |
| 27 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 28 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |
| 29 | Lead | Pb | mg/L | <0,002 | 0,01 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 31 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 32 | Arsenic | As | mg/L | 0,0616 | 0,5 | |
| 33 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 34 | Barium | Ba | mg/L | 0,17 | 2 | |

| TABLE 15. AGROCHEMICALS IN SURFACE WATER - FW 304-HE | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 304-HE** | | | | | | | |
| **AGROCHEMICAL** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atrazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacyalothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLEE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 16. HYDROBIOLOGICAL AND BACTERIOLOGICAL PARAMETERS – FW304-HE | | | | |
|---|---|---|---|---|
| **FW 304-HE – HYDROBIOLOGICAL PARAMETERS** | | | | |
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(120)** | | | *Phormidium sp.* | 120 |
| B A C I L L A R I O P H Y T A **(15)** | | | *Gomphonema sp.* | 15 |
| E U G L E N O Z O A **(25)** | | | *Euglena sp.* | 25 |
| | | | | |
| Presence of organic material | + | | TOTAL CELLS /mL | **160** |
| Presence of sediment | + | | Abundant/dominant organism | *Phormidium sp.* 75,0% |
| | | | Range of risk | Null |
| **CODES** | | | | |
| +(less than half of the field) | ++ (half of the field) | | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | | Alert I – between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº 65) ZOOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| Absence of zooplankton. | | | | |
| Plant remains | No | | TOTAL CELLS /mL | |
| Colour | Yellowish | | Abundant/dominant organism | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 330 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 3500 | 1000 NMP/100mL |

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### A.5 Analytical determinations of point FW 100-GASL

| TABLE 2. PARAMETERS MEASURED ON THE SITE – FW 100-GASL | | | |
|---|---|---|---|
| **FW 100-GASL** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | | Air temperature | |
| Atmospheric conditions | | Relative humidity | |
| UTM coordinates | | Elevation | |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 24,9 | NO LIMITS | |
| 2 | Hydrogen potential | pH | --- | 7,22 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 294 | NO LIMITS | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | **4,47** | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 8,48 | 100 NTU | |

| TABLE 3. PHYSICOCHEMICAL PARAMETERS - FW 100-GASL | | | | | | |
|---|---|---|---|---|---|---|
| **FW 100-GASL** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 14,8 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 109 | 500 | |
| 8 | Oil and grease | | mg/L | 2,67 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 96,6 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 4,55 | 5 | |
| 11 | Total phosphorus | P | mg/L | **0,0586** | 0,05 | |
| 12 | Total nitrogen | N | mg/L | **0,750** | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | **0,0457** | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0179 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 130 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | 0,102 | 250 | |
| 18 | Sodium | Na | mg/L | 16,1 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | 0,0518 | 3 | |
| 30 | Arsenic | As | mg/L | 0,913 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | **0,550** | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,49 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 4. AGROCHEMICALS IN SURFACE WATER – FW 100-GASL | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICAL** | | | | | | | |
| **GROUP AOX** | **Nº** | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLEE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O | µg/L | <0,01 | No limits | |

| TABLE 5. - HYDROBIOLOGICAL PARAMETERS - FW 100-GASL | | | | |
|---|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Presence of organic material | | | TOTAL CELLS /mL | |
| Presence of sediment | | | Abundant/dominant organism | |
| | | | Range of risk | Null |
| **CODES** | | | | |
| +(less than half of the field) | ++ (half of the field) | | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | | |
| **Type** | | | **Species** | **Measured value** |
| Absence of zooplankton | | | | |
| Plant remains | | | TOTAL CELLS /mL | |
| Colour | | | Abundant/dominant organism | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 140 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 1600 | 1000 NMP/100mL |

### A.6 Analytical determinations of point FW 200-SLTR

| TABLE 6. PARAMETERS MEASURED ON THE SITE – FW 200-SLTR | | | |
|---|---|---|---|
| **FW 200-SLTR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 14:30 | Air temperature | 28 ºC |
| Atmospheric conditions | Cloudy, light rain | Relative humidity | 83% |
| UTM coordinates | 21K 519072.00 m E; 7494784.00 m S | Elevation | 173 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 28,1 | NO LIMITS | |
| 2 | Hydrogen potential | pH | --- | 6,01 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 23,1 | NO LIMITS | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 6,73 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 489 | 100 NTU | |

| TABLE 7. PHYSICOCHEMICAL PARAMETERS - FW 200-SLTR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 200-SLTR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 149 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 130 | 500 | |
| 8 | Oil and grease | | mg/L | 10,3 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 72,6 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 4,60 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0334 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 5,52 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,138 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 6,46 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 2,77 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 7. PHYSICOCHEMICAL PARAMETERS - FW 200-SLTR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 200-SLTR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,00947 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0536 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,05 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,13 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 8. AGROCHEMICALS IN SURFACE WATER – FW 200-SLTR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards.*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 8. AGROCHEMICALS IN SURFACE WATER – FW 200-SLTR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 9. HYDROBIOLOGICAL PARAMETERS - FW 200-SLTR | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(276)** | | *Pseudanabaena sp.* | 276 |
| B A C I L L A R I O P H Y T A **(92)** | | Diatomeas pennadas | 92 |
| E U G L E N O Z O A **(25)** | | *Euglena sp.* | 25 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **393** |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.* 70,2% |
| | | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a |
| Colour | Yellowish | Abundant/dominant organism | n/a |

| **BACTERIOLOGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 7900 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 22000 | 1000 NMP/100mL |

### A.7 Analytical determinations of point FW 207-TR

| TABLE 10. DATOS Y PARAMETERS TOMADOS EN CAMPO FW 207-TR. | | | |
|---|---|---|---|
| **FW 207-TR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 15:10 | Air temperature | 28 ºC |
| Atmospheric conditions | Cloudy, rainy | Relative humidity | 76% |
| UTM coordinates | 21K 518004.00 m E; 7490567.00 m S | Elevation | 161 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 26,3 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,56 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 77,9 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | **2,43** | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 47,4 | 100 NTU | |

| TABLE 11. PHYSICOCHEMICAL PARAMETERS - FW 207-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 207-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 10,0 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 120 | 500 | |
| 8 | Oil and grease | | mg/L | 5,50 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 106 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 3,21 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0796 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,352 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 2,13 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0687 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 10,9 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 7,53 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 11. PHYSICOCHEMICAL PARAMETERS - FW 207-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 207-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0048 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | 0,284 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0190 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 3,31 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,14 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 12. AGROCHEMICALS IN SURFACE WATER – FW 207-TR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 207 - TR** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3P S | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 12. AGROCHEMICALS IN SURFACE WATER – FW 207-TR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 207 - TR** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 13. HYDROBIOLOGICAL PARAMETERS - FW 207-TR | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(1150)** | | *Pseudanabaena sp.* | 1150 |
| C H L O R O P H Y T A **(322)** | | *Chlorococcales coccoides* | 322 |
| B A C I L L A R I O P H Y T A **(161)** | | *Diatomeas pennadas* | 161 |
| C R Y P T O P H Y T A **(23)** | | *Cryptomonadales sp* | 23 |
| E U G L E N O Z O A **(184)** | | *Phacus sp.* | 115 |
| | | *Trachelomonas sp.* | 69 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **1840** |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.* 62,5% |
| | | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a |
| Colour | Yellowish | Abundant/dominant organism | n/a |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 790 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 1700 | 1000 NMP/100mL |

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## A.8 Analytical determinations of point FW 208-TR

| TABLE 14. PARAMETERS MEASURED ON THE SITE - FW 208-TR | | | |
|---|---|---|---|
| **FW 208-TR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 7:00 | Air temperature | 26 ºC |
| Atmospheric conditions | Sunny with some clouds | Relative humidity | 60% |
| UTM coordinates | 21K 514416.00 m E; 7485700.00 m S | Elevation | 140 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 21,1 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,88 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 127 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | **4,30** | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 40,3 | 100 NTU | |

| TABLE 15. PHYSICOCHEMICAL PARAMETERS - FW 208-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 208-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 5,00 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 231 | 500 | |
| 8 | Oil and grease | | mg/L | 8,25 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 81,6 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 3,53 | 5 | |
| 11 | Total phosphorus | P | mg/L | <0,0200 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,748 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 1,37 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0603 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0203 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 38,4 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 8,84 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |

| TABLE 15. PHYSICOCHEMICAL PARAMETERS - FW 208-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 208-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0359 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,33 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,13 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 16. AGROCHEMICALS IN SURFACE WATER – FW 208 TR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 208 TR** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| AOX GROUP | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limites** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

TABLE 17. HYDROBIOLOGICAL PARAMETERS - FW 208-TR

| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
|---|---|---|---|
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(135)** | | *Pseudanabaena sp.* | 135 |
| C H L O R O P H Y T A **(50)** | | *Monoraphidium sp.* | 50 |
| B A C I L L A R I O P H Y T A **(10)** | | *Diatomeas pennadas* | 10 |
| C R Y P T O P H Y T A **(5)** | | *Cryptomonadales sp* | 5 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **200** |
| Presence of sediment | +++ | Abundant/dominant organism | Pseudanabaena sp. 67,5% |
| | | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |

| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
|---|---|---|---|
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | |
| Colour | Yellowish | Abundant/dominant organism | |

| **BACTERIOLÓGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | **35000** | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | **35000** | 1000 NMP/100mL |

## A.9 Analytical determination of point FW205-TR

| TABLE 18. PARAMETERS MEASURED ON THE SITE - FW 205-TR. | | | |
|---|---|---|---|
| **FW 205-TR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 15:50 | Air temperature | 26 ºC |
| Atmospheric conditions | Cloudy, rainy | Relative humidity | 80% |
| UTM coordinates | 21K 516574.00 m E; 7482061.00 m S | Elevation | 151 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 25,8 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,18 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 67,9 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,91 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 77,7 | 100 NTU | |

| TABLE 19. PHYSICOCHEMICAL PARAMETERS - FW 205-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 205-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 82,0 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 317 | 500 | |
| 8 | Oil and grease | | mg/L | 8,75 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 114 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 5,32 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,384 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,443 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 6,63 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,521 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 13,1 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 8,52 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | 0,145 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,127 | 0,1 | |

| TABLE 19. PHYSICOCHEMICAL PARAMETERS - FW 205-TR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 205-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0085 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0360 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,56 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,35 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 20. AGROCHEMICALS IN SURFACE WATER – FW 205-TR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 205-TR** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 20. AGROCHEMICALS IN SURFACE WATER – FW 205-TR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 205-TR** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 21. HYDROBIOLOGICAL PARAMETERS - FW 205 TR | | | |
|---|---|---|---|
| **FW 205-TR – HYDROBIOLOGICAL PARAMETERS** | | | |
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| B A C I L L A R I O P H Y T A **(146)** | | *Navicula sp.* | **146** |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **146** |
| Presence of sediment | +++ | Abundant/dominant organism | *Navicula sp.* 100% |
| Insect remains | X | Range of risk | Null |
| **CODES** | | | |
| **+**(less than half of the field) | **++** (half of the field) | **+++** (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| ROTÍFERA **(20)** | | *Bdelloidea* | 20 |
| Plant remains | No | TOTAL CELLS /mL | **20** |
| Colour | Yellowish | Abundant/dominant organism | *Bdelloidea* 100% |

| **BACTERIOLOGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 780 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 7000 | 1000 NMP/100mL |

## A.10 Analytical determinations of point FW 109-MYRZ

| TABLE 22. PARAMETERS MEASURED ON THE SITE - FW 109-MYRZ | | | |
|---|---|---|---|
| **FW 109-MYRZ** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 17:45 | Air temperature | 28ºC |
| Atmospheric conditions | Cloduy | Relative humidity | 68% |
| UTM coordinates | 21K 508110.00 m E; 7475784.00 m S | Elevation | 130 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 26,5 | NO LIMITS | |
| 2 | Hydrogen potential | pH | --- | 6,52 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 106 | NO LIMITS | [2]<1250 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | **4,58** | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 46,6 | 100 NTU | |

| TABLE 23. PHYSICOCHEMICAL PARAMETERS - FW 109-MYRZ | | | | | | |
|---|---|---|---|---|---|---|
| **FW 109-MYRZ** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 19,0 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 122 | 500 | |
| 8 | Oil and grease | | mg/L | 10,5 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 56,4 | NO LIMITS | [1]<150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 2,51 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,194 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,132 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 2,18 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0554 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,0025 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 31,9 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 6,66 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 23. PHYSICOCHEMICAL PARAMETERS - FW 109-MYRZ | | | | | | |
|---|---|---|---|---|---|---|
| **FW 109-MYRZ** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,19 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,13 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 24. AGROCHEMICALS IN SURFACE WATER – FW 109-MYRZ | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 109-MYRZ** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3P S | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 24. AGROCHEMICALS IN SURFACE WATER – FW 109-MYRZ | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 109-MYRZ** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 25. HYDROBIOLOGICAL PARAMETERS - FW 109-MYRZ | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(322)** | | *Pseudanabaena sp.* | 322 |
| C H L O R O P H Y T A **(138)** | | *Monoraphidium sp.* | 138 |
| B A C I L L A R I O P H Y T A **(184)** | | *Diatomeas pennadas* | **184** |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **644** |
| Presence of sediment | + | Abundant/dominant organism | *Pseudanabaena sp.* 50,0% |
| Presence of bacterias | +++ | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |
| **BACTERIOLÓGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Feacal coliforms | NMP/100mL | 11000 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 11000 | 1000 NMP/100mL |

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### A.11 Analytical determinations of point FW 115-MY

| TABLE 26. PARAMETERS MEASURED ON THE SITE - FW 115-MY | | | |
|---|---|---|---|
| **FW 115-MY** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 18:40 | Air temperature | 28,6 ºC |
| Atmospheric conditions | Cloudy | Relative humidity | 70% |
| UTM coordinates | 21K 509155.00 m E; 7467194.00 m S | Eelevation | 138 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 26,5 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,94 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 39,2 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | **4,98** | >5 mg $O_2$/L | |
| 5 | Turbidity | | m | 83,6 | 100 NTU | |

| TABLE 27. PHYSICOCHEMICAL PARAMETERS - FW 115-MY | | | | | | |
|---|---|---|---|---|---|---|
| **FW 115-MY** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 6 | Floating materials | | | 54,0 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 120 | 500 | |
| 8 | Oil and grease | | mg/L | 9,00 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 78,0 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 2,93 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0882 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,106 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 3,18 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,065 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 4,85 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 4,53 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,13 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,12 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

TABLE 28. AGROCHEMICALS IN SURFACE WATER – FW 115-MY

**FW 115-MY**

**AGROCHEMICALS**

| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
|---|---|---|---|---|---|---|---|
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | No limits | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 29. HIDROBIOLÓGICAL PARAMETERS - FW 115-MY | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C H L O R O P H Y T A **(92)** | | *Monoraphidium sp.* | 92 |
| B A C I L L A R I O P H Y T A (69) | | *Diatomeas pennadas* | 69 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **161** |
| Presence of sediment | +++ | Abundant/dominant organism | *Monoraphidium sp.* 57,1% |
| Insect remain | X | Range of risk | |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |

| **BACTERIOLÓGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit de Medida** | **Determinación** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 390 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 9000 | 1000 NMP/100mL |

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## A.12 Analytical determinations of point FW 317-RZ

| TABLE 30. PARAMETERS MEASURED ON THE SITE - FW 317-RZ | | | |
|---|---|---|---|
| **FW 317-RZ** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 8:20 | Air temperature | 25,6 ºC |
| Atmospheric conditions | Partly cloudy | Relative humidity | 65% |
| UTM coordinates | 21K 503324.00 m E; 7459243.00 m S | Elevation | 116 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | $T_{agua}$ | ºC | 21,9 | No limits | |
| 2 | Hydrogen potential | pH | --- | 5,67 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 73,8 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,40 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 96,4 | 100 NTU | |

| TABLE 31. PHYSICOCHEMICAL PARAMETERS - FW 317-RZ | | | | | | |
|---|---|---|---|---|---|---|
| **FW 317-RZ** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 51,0 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 257 | 500 | |
| 8 | Oil and grease | | mg/L | 11,0 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 96,4 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 1,43 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0299 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 1,01 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,115 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0351 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 21,0 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 5,35 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 31. PHYSICOCHEMICAL PARAMETERS - FW 317-RZ | | | | | | |
|---|---|---|---|---|---|---|
| **FW 317-RZ** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0494 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0132 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 0,951 | 0,3 | |
| 32 | Mercurio | Hg | mg/L | 0,001 | 2 | |
| 33 | Mercury | Ba | mg/L | 0,15 | 2 | |
| 34 | Barium | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 32. AGROCHEMICALS IN SURFACE WATER – FW 317-RZ | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O | µg/L | <0,01 | No limits | |

| TABLE 33. HIDROBIOLÓGICAL PARAMETERS - FW 317-RZ | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(192)** | | *Pseudanabaena sp.* | 192 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **192** |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.* 100% |
| | | Rango de riesgo | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |
| **BACTERIOLÓGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | **330** | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | **1100** | 1000 NMP/100mL |

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### A.13 Analytical determinations of point FW 204-LB

| TABLE 34. PARAMETERS MEASURED ON THE SITE - FW 204-LB | | | |
|---|---|---|---|
| **FW 204-LB** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 9:30 | Air temperature | 28 ºC |
| Atmospheric conditions | Parcialmente nublado | Relative humidity | 68% |
| UTM coordinates | 21 K 498840.00 m E; 7451514.00 m S | Elevation | 104 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 23,0 | NO LIMITS | |
| 2 | Hydrogen potential | pH | --- | 7,0 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 67,3 | NO LIMITS | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,46 | >5 mg $O_2$/L | |
| 5 | Turbidity | | m | 54,7 | 100 NTU | |

| TABLE 35. PARAMETERS PHYSICOCHEMICAL FW 204-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 204-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 24,0 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 221 | 500 | |
| 8 | Oil and grease | | mg/L | 13,2 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 77,2 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 2,73 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0211 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,226 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0420 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 19,8 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 5,19 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | 0,0513 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 35. PARAMETERS PHYSICOCHEMICAL FW 204-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 204-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0772 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,14 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,12 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 36. AGROCHEMICALS IN SURFACE WATER – FW 204-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 204-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | No limits | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 36. AGROCHEMICALS IN SURFACE WATER – FW 204-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 204-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 37. HIDROBIOLÓGICAL PARAMETERS - FW 204-LB | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| B A C I L L A R I O P H Y T A **(391)** | | *Diatomeas pennadas* | 115 |
| | | *Gomphonema sp.* | 92 |
| | | *Navicula sp.* | 184 |
| E U G L E N O Z O A **(46)** | | *Euglena sp.* | |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **437** |
| Presence of sediment | +++ | Abundant/dominant organism | *Navicula sp. 42,1%* |
| Presence of bacteria | +++ | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | **3500** | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | **16000** | 1000 NMP/100mL |

## A.14 Analytical determinations of point FW 110-LB

| TABLE 38. PARAMETERS MEASURED ON THE SITE - FW 110-LB | | | |
|---|---|---|---|
| **FW 110-LB** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 6:50 | Air temperature | 23,6 ºC |
| Atmospheric conditions | Partly cloudy | Relative humidity | 58% |
| UTM coordinates | 21K 511487.00 m E; 7450940.00 m S | Elevation | 122 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 22,3 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,62 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 67,2 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 2,38 | >5 mg $O_2$/L | |
| 5 | Turbidity | | m | 46,2 | 100 NTU | |

| TABLE 39. PHYSICOCHEMICAL PARAMETERS - FW 110-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 110-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 21,0 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 188 | 500 | |
| 8 | Oil and grease | | mg/L | 5,25 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 116 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 4,35 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0548 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,121 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,224 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0394 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 11,9 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 5,94 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,122 | 0,1 | |

| TABLE 39. PHYSICOCHEMICAL PARAMETERS - FW 110-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 110-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | | 0,01 | |
| 28 | Selenium | Se | mg/L | | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,41 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,05 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 40. AGROCHEMICALS IN SURFACE WATER – FW 110-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 110-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 40. AGROCHEMICALS IN SURFACE WATER – FW 110-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 110-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O | µg/L | <0,01 | No limits | |

| TABLE 41. HIDROBIOLÓGICAL PARAMETERS - FW 110-LB | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| CYANOBACTERIA **(315)** | | *Pseudanabaena sp.1* | 65 |
| | | *Pseudanabaena sp.2* | 250 |
| BACILLARIOPHYTA **(15)** | | *Diatomeas pennadas* | 15 |
| CRYPTOPHYTA **(15)** | | *Cryptomonadales sp* | 15 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | 350 |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.2* 71,4% |
| Protists | X | Range of risk | Null. |
| Rizhopods | X | | |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | **4300** | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | **160000** | 1000 NMP/100mL |

### A.15 Analytical determinations of point FW 111-LB

| TABLE 42. PARAMETERS MEASURED ON THE SITE - FW 111-LB | | | |
|---|---|---|---|
| **FW 111-LB** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 6:00 | Air temperature | |
| Atmospheric conditions | Cloudy | Relative humidity | |
| UTM coordinates | 21 K 514185.37 m E; 7447625.56 m S | Elevation | 121 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 21,9 | No limits | |
| 2 | Hydrogen potential | pH | --- | 5,91 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 60,5 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,91 | >5 mg $O_2$/L | |
| 5 | Turbidity | | m | 35,7 | 100 NTU | |

| TABLE 43. PHYSICOCHEMICAL PARAMETERS - FW 111-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 111-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 116 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 163 | 500 | |
| 8 | Oil and grease | | mg/L | 3,75 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 99,0 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 2,15 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,114 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 1,56 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,331 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 16,8 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 3,32 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,400 | 0,1 | |

| TABLE 43. PHYSICOCHEMICAL PARAMETERS - FW 111-LB | | | | | | |
|---|---|---|---|---|---|---|
| **FW 111-LB** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | <0,002 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,56 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,15 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 44. AGROCHEMICALS IN SURFACE WATER – FW 111-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 111-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | No limits | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 44. AGROCHEMICALS IN SURFACE WATER – FW 111-LB | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 111-LB** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 45. HIDROBIOLÓGICAL PARAMETERS - FW 111-LB | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| B A C I L L A R I O P H Y T A (207) | | *Diatomeas pennadas* | 207 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **207** |
| Presence of sediment | +++ | Abundant/dominant organism | *Diatomeas pennadas* 100% |
| | | Rango de riesgo | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | N/a. |
| Colour | Yellowish | Abundant/dominant organism | N/a. |

| **BACTERIOLÓGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 490 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 1400 | 1000 NMP/100mL |

### A.16 Analytical determinations of point FW 310-CR

| TABLE 46. PARAMETERS MEASURED ON THE SITE - FW 310-CR | | | |
|---|---|---|---|
| **FW 310-CR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 18:20 | Air temperature | |
| Atmospheric conditions | Cloudy | Relative humidity | |
| UTM coordinates | 21 K 487444.00 m E; 7449950.00 m S | Elevation | 110 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | $T_{agua}$ | ºC | 23,7 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,21 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 559 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,59 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 355 | 100 NTU | |

| TABLE 47. PHYSICOCHEMICAL PARAMETERS FW 310-CR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 310-CR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 155 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 169 | 500 | |
| 8 | Oil and grease | | mg/L | 8,80 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 85,5 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 5,51 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0518 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 2,58 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,150 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,182 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 18,0 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 2,94 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,0 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,01 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,341 | 0,1 | |

| TABLE 47. PHYSICOCHEMICAL PARAMETERS FW 310-CR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 310-CR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,00407 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 2,36 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,14 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 48. AGROCHEMICALS IN SURFACE WATER – FW 310-CR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3P S | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 49. HYDROBIOLOGICAL PARAMETERS - FW 310-CR | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| B A C I L L A R I O P H Y T A **(184)** | | *Synedra sp.* | 184 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | **184** |
| Presence of sediment | +++ | Abundant/dominant organism | *Synedra sp.* 100% |
| | | Range of risk | Null |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |

| **BACTERIOLÓGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 11000 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 11000 | 1000 NMP/100mL |

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## A.17 Analytical determinations of point FW 316-CR

| TABLE 50. PARAMETERS MEASURED ON THE SITE - FW 316-CR | | | |
|---|---|---|---|
| **FW 316-CR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 18:50 | Air temperature | |
| Atmospheric conditions | Rainy | Relative humidity | |
| UTM coordinates | 21K 485341.00 m E; 7442662.00 m S | Topographical elevation | 110 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 25,7 | No limits | |
| 2 | Hydrogen potential | pH | --- | 6,82 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 44,8 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 5,08 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 18,6 | 100 NTU | |

| TABLE 51. PHYSICOCHEMICAL PARAMETERS - FW 316-CR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 316-CR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 26,0 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 127 | 500 | |
| 8 | Oil and grease | | mg/L | 7,25 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 65,9 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 5,05 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0435 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 0,779 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 0,231 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0331 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,00778 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 8,69 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 3,50 | 200 | |
| 19 | Aluminum | Al | mg/L | <01,00 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | <0,0500 | 0,1 | |

| TABLE 51. PHYSICOCHEMICAL PARAMETERS - FW 316-CR | | | | | | |
|---|---|---|---|---|---|---|
| **FW 316-CR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0134 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 0,991 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,05 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 52. AGROCHEMICALS IN SURFACE WATER – FW 316-CR | | | | | | | |
|---|---|---|---|---|---|---|---|
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 53. HIDROBIOLÓGICAL PARAMETERS - FW 316-CR | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A **(50)** | | *Pseudanabaena sp.* | 50 |
| C H L O R O P H Y T A **(35)** | | *Monoraphidium sp.* | 35 |
| B A C I L L A R I O P H Y T A **(10)** | | *Diatomeas pennadas* | 10 |
| C R Y P T O P H Y T A **(20)** | | *Cryptomonadales* | 20 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | 115 |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.* 43,5% |
| Presence of nematodes | X | Range of risk | Null. |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | n/a. |
| Colour | Yellowish | Abundant/dominant organism | n/a. |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 46 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 540 | 1000 NMP/100mL |

## A.18 Analytical determinations of point FW 306-SO

| TABLE 54. PARAMETERS MEASURED ON THE SITE FW 306-SO | | | |
|---|---|---|---|
| **FW 306-SO** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 14:30 | Air temperature | |
| Atmospheric conditions | Cloudy | Relative humidity | |
| UTM coordinates | 21K 486496.00 m E, 7493077.00 m S | Elevation | 176 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards *** |
| 1 | Water temperature | $T_{agua}$ | ºC | 23,1 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,81 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 213 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,47 | > 5 mg $O_2$/L | |
| 5 | Turbidity | | m | 90,8 | 100 NTU | |

| TABLE 55. PHYSICOCHEMICAL PARAMETERS - FW 306-SO | | | | | | |
|---|---|---|---|---|---|---|
| **FW 306-SO** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 63,0 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 263 | 500 | |
| 8 | Oil and grease | | mg/L | 10,5 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 58,6 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 4,35 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0208 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | 1,10 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0872 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | <0,00250 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 80,6 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 8,36 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,0571 | 0,1 | |

| TABLE 55. PHYSICOCHEMICAL PARAMETERS - FW 306-SO | | | | | | |
|---|---|---|---|---|---|---|
| **FW 306-SO** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0229 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | <0,0500 | 3 | |
| 30 | Arsenic | As | mg/L | 0,0539 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,02 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,13 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |

| TABLE 56. AGROCHEMICALS IN SURFACE WATER – FW 306-SO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 306-SO** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 35 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 36 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 37 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 38 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 39 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 40 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 41 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 42 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 43 | DDE | -- | µg/L | <2,00 | No limits | |
| | 44 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 45 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 46 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 47 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 48 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 49 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 50 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 51 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 52 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 53 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 54 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 55 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 56 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 57 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 58 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 59 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 60 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 61 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |

| TABLE 56. AGROCHEMICALS IN SURFACE WATER – FW 306-SO | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 306-SO** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| FLUORATED | 62 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 63 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

| TABLE 57. HIDROBIOLÓGICAL PARAMETERS - FW 306-SO | | | |
|---|---|---|---|
| **(Nº 64) PHYTOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| C Y A N O B A C T E R I A (345) | | *Pseudanabaena sp.* | 345 |
| C H L O R O P H Y T A (184) | | *Monoraphidium sp.* | 184 |
| B A C I L L A R I O P H Y T A (230) | | *Diatomeas pennadas* | 230 |
| | | | |
| Presence of organic material | + | TOTAL CELLS /mL | 759 |
| Presence of sediment | +++ | Abundant/dominant organism | *Pseudanabaena sp.* 45,5% |
| Fungal spores | X | Range of risk | Null. |
| **CODES** | | | |
| +(less than half of the field) | ++ (half of the field) | +++ (whole field) | **X** (sporadically observed) |
| Risk level (UNESCO) | Null until 10.000 Cel/mL | Alert I - between 10.000 to 20.000 Cel/mL | Alert II More than 20.000 Cel/mL |
| **(Nº65) ZOOPLANKTON DIVERSITY** | | | |
| **Type** | | **Species** | **Measured value** |
| Absence of zooplankton. | | | |
| Plant remains | No | TOTAL CELLS /mL | N/a. |
| Colour | Yellowish | Abundant/dominant organism | N/a. |
| **BACTERIOLOGICAL PARAMETERS** | | | |
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 66 | Faecal coliforms | NMP/100mL | 540 | 200 NMP/100mL |
| 67 | Total coliforms | NMP/100mL | 920 | 1000 NMP/100mL |

## A.19 Analytical determinations of point FW 01

| TABLE 58. PARAMETERS MEASURED ON THE SITE FW 01 | | | |
|---|---|---|---|
| **FW 01 - PY** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 10:20 | Air temperature | |
| Atmospheric conditions | Soleado | Relative humidity | |
| UTM coordinates | 21K 446252.08 m E 7428199.87 m S | Elevation | 85 |

**IN SITU MEASUREMENTS**

| Nº | Parameter | Symbol | Unit | Measured value | Limites | |
|---|---|---|---|---|---|---|
| | | | | | Regulation 222/02 | Alternative reference standards* |
| 1 | Water temperature | $T_{agua}$ | ºC | 26,0 | No limits | |
| 2 | Hydrogen potential | pH | --- | 7,26 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 169 | No limits | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,03 | >5 mg $O_2$/L | |
| 5 | Turbidity | | m | 41,2 | 100 NTU | |

| TABLE 59. PHYSICOCHEMICAL PARAMETERS FW 01 | | | | | | |
|---|---|---|---|---|---|---|
| **FW 01 - PY** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 22,4 | Visually absent | |
| 7 | Total dissolved solids | TDS | mg/L | 115 | 500 | |
| 8 | Oil and grease | | mg/L | 8,00 | Visually absent | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 34,9 | No limits | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 1,50 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0694 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 1,77 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | <0,100 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0989 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0153 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 30,5 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 16,7 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,113 | 0,1 | |

| TABLE 59. PHYSICOCHEMICAL PARAMETERS FW 01 | | | | | | |
|---|---|---|---|---|---|---|
| **FW 01 - PY** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,00219 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | 0,0694 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 1,52 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,05 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |
| **ADDITIONAL PARAMETERS DETERMINED IN PARAGUAY RIVER** | | | | | | |
| 35 | Colour | | Pt/L | 23 | 75 | |
| 36 | Phenols index | | mg/L | <0,00500 | 0,5 | |
| 37 | PCBs | | mg/L | Not detected. | 0 | |

| **BACTERIOLOGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 38 | Faecal coliforms | NMP/100mL | 33 | 200 NMP/100mL |
| 39 | Total coliforms | NMP/100mL | 130 | 1000 NMP/100mL |

| TABLE 60. AGROCHEMICALS IN SURFACE WATER – FW PY 01 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW PY 01** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 40 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 41 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 42 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 43 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 44 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 45 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 46 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 47 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 48 | DDE | -- | µg/L | <2,00 | No limits | |
| | 49 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 50 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 51 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 52 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 53 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 54 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 55 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 56 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 57 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |
| | 58 | Bifenthrin | C23H22 | µg/L | -- | No limits | |

| TABLE 60. AGROCHEMICALS IN SURFACE WATER – FW PY 01 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW PY 01** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | № | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| | | | ClF3NO2 | | | | |
| | 59 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 60 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 61 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 62 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 63 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 64 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 65 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 66 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 67 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 68 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

## A.20 Analytical determinations of point FW 02

| TABLE 61. PARAMETERS MEASURED ON THE SITE - FW02 | | | |
|---|---|---|---|
| **FW 02 - PY** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 9:30 | Air temperature | |
| Atmospheric conditions | Sunny | Relative humidity | |
| UTM coordinates | 21K 449651.97 m E 7424489.86 m S | Elevation | 81 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limites** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 1 | Water temperature | $T_{agua}$ | ºC | 25,0 | NO LIMITS | |
| 2 | Hydrogen potential | pH | --- | 7,29 | 6 - 9 | |
| 3 | Electrical conductivity | σ | µS/cm | 172 | NO LIMITS | [2] <1500 |
| 4 | Dissolved oxygen | DO | mg $O_2$/L | 7,26 | > 5mg $O_2$/L | |
| 5 | Turbidity | | m | 44,6 | 100 NTU | |

.

| TABLE 62. PHYSICOCHEMICAL PARAMETERS - FW 02 | | | | | | |
|---|---|---|---|---|---|---|
| **FW 02 - PY** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| 6 | Floating materials | | | 22,8 | Visually absent.. | |
| 7 | Total dissolved solids | TDS | mg/L | 151 | 500 | |
| 8 | Oil and grease | | mg/L | 4,50 | Visually absent. | |
| 9 | Chemical oxygen demand | DQO | mg $O_2$/L | 44,3 | NO LIMITS | [1] <150 |
| 10 | Biological oxygen demand | $DBO_5$ | mg $O_2$/L | 1,11 | 5 | |
| 11 | Total phosphorus | P | mg/L | 0,0305 | 0,05 | |
| 12 | Total nitrogen | N | mg/L | 2,43 | 0,6 | |
| 13 | Nitrates | $NO_{3-}$ | mg/L | <0,100 | 10 | |
| 14 | Ammonia | $NH_3$ | mg/L | 0,0441 | 0,02 | |
| 15 | Nitrites | $NO_{2-}$ | mg/L | 0,0186 | 1 | |
| 16 | Hardness | | mg $CaCO_3$/L | 30,1 | 300 | |
| 17 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 18 | Sodium | Na | mg/L | 16,6 | 200 | |
| 19 | Aluminum | Al | mg/L | <0,01 | 0,2 | |
| 20 | Cadmium | Cd | mg/L | <0,0008 | 2 | |
| 21 | Hexavalent chromium | Cr (VI) | mg/L | <0,0500 | 0,05 | |
| 22 | Trivalent chromium | Cr (III) | mg/L | <0,0500 | 0,5 | |
| 23 | Copper | Cu | mg/L | <0,0500 | 1 | |
| 24 | Tin | Sn | mg/L | <1,00 | 2 | |
| 25 | Nickel | Ni | mg/L | <0,001 | 0,025 | |
| 26 | Manganese | Mn | mg/L | 0,144 | 0,1 | |

| TABLE 62. PHYSICOCHEMICAL PARAMETERS - FW 02 | | | | | | |
|---|---|---|---|---|---|---|
| **FW 02 - PY** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured** | **Limits** | |
| 27 | Lead | Pb | mg/L | 0,0041 | 0,01 | |
| 28 | Selenium | Se | mg/L | <0,005 | 0,01 | |
| 29 | Zinc | Zn | mg/L | 0,0983 | 3 | |
| 30 | Arsenic | As | mg/L | <0,0100 | 0,5 | |
| 31 | Soluble iron | $Fe^{++}$ | mg/L | 0,804 | 0,3 | |
| 32 | Mercury | Hg | mg/L | 0,001 | 2 | |
| 33 | Barium | Ba | mg/L | 0,05 | 2 | |
| 34 | Cyanides | $CN^-$ | mg/L | <0,02 | 0,07 | |
| **ADDITIONAL PARAMETERS DETERMINED IN PARAGUAY RIVER** | | | | | | |
| 35 | Colour | -- | Pt/L | 30,0 | 75 | |
| 36 | Phenols index | -- | mg/L | <0,00500 | 0,5 | |
| 37 | PCBs | -- | mg/L | Not detected. | 0 | |

| **BACTERIOLOGICAL PARAMETERS** | | | | |
|---|---|---|---|---|
| **Nº** | **Parameters** | **Unit** | **Measured value** | **Regulation 222/02** |
| 38 | Faecal coliforms | NMP/100mL | 2 | 200 NMP/100mL |
| 39 | Total coliforms | NMP/100mL | 33 | 1000 NMP/100mL |

| TABLE 63. AGROCHEMICALS IN SURFACE WATER – FW 02 - PY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 02 - PY** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | Nº | **Parameter** | **Chemical formula** | **Unit** | **Measured value** | **Limits** | |
| | | | | | | **Regulation 222/02** | **Alternative reference standards*** |
| PHOSPHOGLYCINE | 40 | Glyphosate | C3H8NO6P | µg/L | <0,300 | 0,7 | |
| | 41 | AMPA | CH6NO3P | µg/L | <0,300 | No limits | |
| CHLORDANE | 42 | Aldrin | C12H8Cl6 | µg/L | <1,00 | No limits | |
| | 43 | Endrin | C12H8Cl6O | µg/L | <1,25 | 2 | |
| | 44 | Dieldrin | C12H8Cl6O | µg/L | <1,50 | No limits | |
| | 45 | Lindane | C6H6Cl6 | µg/L | <0,2 | 0,2 | |
| | 46 | Chlordane | C10H6Cl8 | µg/L | <0,90 | No limits | |
| | 47 | DDT | C10H6Cl8 | µg/L | <2,00 | 2 | |
| | 48 | DDE | -- | µg/L | <2,00 | No limits | |
| | 49 | DDD | -- | µg/L | <2,00 | No limits | |
| TRIAZINE | 50 | Atriazine | C8H14ClN5 | µg/L | <2,00 | 3 | |
| | 51 | Simazine | C7H12ClN5 | µg/L | <2,50 | 4 | |
| CARBAMATE | 52 | Carbaryl | C12H11NO2 | µg/L | <3,50 | No limits | |
| | 53 | Carbofuran | C12H15NO3 | µg/L | <3,00 | 4 | |
| | 54 | Heptachlor | C10H5Cl7 | µg/L | <1,50 | 0 | |
| | 55 | Methomyl | C5H10N2O2S | µg/L | <25,0 | No limits | |
| ALKYLCHLORO-PHENOXY | 56 | 2,4 D | C8H6Cl2O3 | µg/L | <2,50 | 30 | |
| PYRETHROIDS | 57 | Lambdacialothrin | $C_{23}H_{19}ClF_3NO_3$ | µg/L | -- | No limits | |

| TABLE 63. AGROCHEMICALS IN SURFACE WATER – FW 02 - PY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **FW 02 - PY** | | | | | | | |
| **AGROCHEMICALS** | | | | | | | |
| GROUP AOX | № | **Parameter** | **Chemical** | **Unit** | **Measured** | **Limits** | |
| | 58 | Bifenthrin | C23H22 ClF3NO2 | µg/L | -- | No limits | |
| | 59 | Cypermethrin | C22H19Cl2NO3 | µg/L | <1,20 | No limits | |
| | 60 | Chlorpyrifos | C9H11Cl3NO3PS | µg/L | <5,00 | No limits | |
| | 61 | Dichlorvos | C4H7Cl2O4P | µg/L | <10,0 | 10 | |
| | 62 | Methamidophos | C2H8NO2PS | µg/L | <25,0 | No limits | |
| TRIAZOLE | 63 | Tebuconazole | C16H22ClN3O | µg/L | <2,00 | 1 | |
| NEONICOTINOID | 64 | Imidacloprid | C9H10ClN5O2 | µg/L | <5,00 | No limits | |
| | 65 | Methylparaoxon | C8H10NO6P | µg/L | <25,0 | No limits | |
| | 66 | Thiamethoxam | C10H6F17NO2S | µg/L | -- | No limits | |
| FLUORATED | 67 | Sulfluramide | C10H6F17NO2S | µg/L | -- | No limits | |
| PHENYLPYRAZOLES | 68 | Fipronil | C12H4Cl2F6N4O. | µg/L | <0,01 | No limits | |

*Alternative reference standards refers to other national water quality standards, such as Law 1614/200 and NP 24001/80, as well as IFC EHS Guidelines.

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# APPENDIX B
# GROUNDWATER LABORATORY RESULTS

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**B1. Analytical determinations of the sampling point GW 18-ZA**

| TABLE 1. PARAMETERS MEASURED ON THE SITE - GW 18-ZA | | | |
|---|---|---|---|
| **GW 18-ZA** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 15:10 | Air temperature | 25,9 ºC |
| Atmospheric conditions | Cloudy, drizzle | Relative humidity | 80% |
| UTM coordinates | 21K 548201.00 m E; 7512128.00 m S | Elevation | 211 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENT** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,9 | No limits | |
| 2 | Hydrogen potential | pH | | 6,63 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 143 | - | 1250 |

| TABLE 2. PHYSICOCHEMICAL PARAMETERS - GW 18-ZA | | | | | | |
|---|---|---|---|---|---|---|
| **GW 18-ZA** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 200 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,848 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 12,5 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,352 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,363 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 10,5 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 3,09 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 76,2 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 49,5 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 3,31 | 250 | |
| 15 | Sodium | Na | mg/L | 30,8 | 200 | |
| 16 | Potasium | K | mg/L | 1,27 | - | 12 |
| 17 | Calcium | Ca | mg/L | 3,23 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 1,08 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,09 | - | 1,5 |
| 20 | Boron | B | mg/L | <0,100 | No limits | |

| TABLE 3. BACTERIOLOGICAL PARAMETERS | | | | |
|---|---|---|---|---|
| **GW 18-ZA** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | 16 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B2. Analytical determinations of sampling point GW20-ST**

| TABLE 4. PARAMETERS MEASURED ON THE SITE - GW 20-ST | | | |
|---|---|---|---|
| **GW 20-ST** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:00 | Air temperature | 28,5 ºC |
| Atmospheric conditions | Nublado | Relative humidity | 60% |
| UTM coordinates | 21K 537999.00 m E; 7498476.00 m S | Elevation | 186 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 27,3 | No limits | |
| 2 | Hydrogen potential | pH | -- | 5,63 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 95,7 | - | 1250 |

| TABLE 5. PHYSICOCHEMICAL PARAMETERS - GW 20-ST | | | | | | |
|---|---|---|---|---|---|---|
| **GW 20-ST** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 100 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,173 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 0,808 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0263 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,182 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 22,8 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 8,08 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 47,9 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 6,71 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 2,66 | 250 | |
| 15 | Sodium | Na | mg/L | 8,78 | 200 | |
| 16 | Potasium | K | mg/L | 0,982 | - | 12 |
| 17 | Calcium | Ca | mg/L | 1,94 | - | 100 |
| 18 | Magnesium | Mg | mg/L | <0,243 | - | 50 |
| 19 | Fluorine | F | mg/L | <0,05 | - | 1,5 |
| 20 | Boron | B | mg/L | 3,88 | No limits | |

| TABLE 6. BACTERIOLOGICAL PARAMETERS - GW 20-S | | | | |
|---|---|---|---|---|
| **GW 20-ST** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | 12 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B3. Analytical determinations of sampling point GW 19-HE**

| TABLE 7. PARAMETERS MEASURED ON THE SITE - GW 19-HE | | | |
|---|---|---|---|
| **GW 19-HE** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 12:20 | Air temperature | 28 ºC |
| Atmospheric conditions | Cloudy, drizzle | Relative humidity | 76% |
| UTM coordinates | 21K 512695.00 m E; 7515558.00 m S | Elevation | 230 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,8 | No limits | |
| 2 | Hydrogen potential | pH | | 7,83 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 197 | - | 1250 |

| TABLE 8. PHYSICOCHEMICAL PARAMETERS - GW 19-HE | | | | | | |
|---|---|---|---|---|---|---|
| **GW 19-HE** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 160 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,134 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 35,6 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,577 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_3$- | mg/L | 1,93 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 1,43 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$./L | 79,7 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$./L | 78,1 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$./L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 2,96 | 250 | |
| 15 | Sodium | Na | mg/L | 31,8 | 200 | |
| 16 | Potasium | K | mg/L | 1,41 | - | 12 |
| 17 | Calcium | Ca | mg/L | 12,3 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 1,15 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,20 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,78 | No limits | |

| TABLE 9. BACTERIOLOGICAL PARAMETERS - GW 19-HE | | | | |
|---|---|---|---|---|
| **BACTERIOLOGICAL PARAMETERS - GW 19-HE** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 2 | Faecal coliforms | NMP/100mL | 9,2 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B4. Analytical determinations of sampling point GW 23-SL**

| TABLE 10. PARAMETERS MEASURED ON THE SITE - GW 23-S | | | |
|---|---|---|---|
| **GW 23-SL** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:00 | Air temperature | 28 ºC |
| Atmospheric conditions | Cloudy | Relative humidity | 76% |
| UTM coordinates | 21K 516367.00 m E; 7503054.00 m S | Elevation | 205 |
| Water level | 19 | Water table | 186 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,8 | No limits | |
| 2 | Hydrogen potential | pH | | 5,71 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 34,3 | - | 1250 |

| TABLE 11. PHYSICOCHEMICAL PARAMETERS - GW 23-SL | | | | | | |
|---|---|---|---|---|---|---|
| **GW 23-SL** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 69,5 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 1,76 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 3,03 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0947 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,109 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 5,08 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 4,75 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$./L | 10,8 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$./L | 1,94 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$./L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 15 | Sodium | Na | mg/L | 4,09 | 200 | |
| 16 | Potasium | K | mg/L | <0,250 | - | 12 |
| 17 | Calcium | Ca | mg/L | 2,19 | - | 100 |
| 18 | Magnesium | Mg | mg/L | <0,243 | - | 50 |
| 19 | Fluorine | F | mg/L | <0,05 | - | 1,5 |
| 20 | Boron | B | mg/L | 0,825 | NO LIMITS | |

| TABLE 12. BACTERIOLOGICAL PARAMETERS - GW 23-SL | | | | |
|---|---|---|---|---|
| **GW 23-SL** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | 23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B5. Analytical determinations for sampling point GW 16-GA**

| TABLE 13. PARAMETERS MEASURED ON THE SITE - GW 16-GA | | | |
|---|---|---|---|
| **GW 16-GA** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:00 | Air temperature | 29,6ºC |
| Atmospheric conditions | Sunny | Relative humidity | 65% |
| UTM coordinates | 21K 505125.00 m E; 7498320.00 m S | Elevation | 219 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 24,3 | No limits | |
| 2 | Hydrogen potential | pH | | 6,87 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 247 | - | 1250 |

| TABLE 14. PHYSICOCHEMICAL PARAMETERS - GW 16-GA | | | | | | |
|---|---|---|---|---|---|---|
| **GW 16-GA** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 266 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,382 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 30,9 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0431 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 0,899 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 6,89 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 91,5 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 66,8 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 9,50 | 250 | |
| 15 | Sodium | Na | mg/L | 42,2 | 200 | |
| 16 | Potasium | K | mg/L | 0,311 | - | 12 |
| 17 | Calcium | Ca | mg/L | 10,6 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 1,07 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,22 | - | 1,5 |
| 20 | Boron | B | mg/L | <0,100 | No limits | |

| TABLE 15. BACTERIOLOGICAL PARAMETERS - GW 16-GA | | | | |
|---|---|---|---|---|
| **GW 16-GA** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | <1,1 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | 12 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B6. Analytical determinations for sampling point GW 11-MICHEL**

| TABLE 16. PHYSICOCHEMICAL PARAMETERS - GW 11-MICHEL | | | |
|---|---|---|---|
| **GW 11-MICHEL** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 06:50 | Air temperature | 24,5 ºC |
| Atmospheric conditions | Cloudy, drizzle | Relative humidity | 82% |
| UTM coordinates | 21K 518643.00 m E; 7484801.00 m S | Elevation | 182 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,0 | No limits | |
| 2 | Hydrogen potential | pH | | 5,87 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 72,0 | - | 1250 |

| TABLE 17. PHYSICOCHEMICAL PARAMETERS - GW 11-MICHEL | | | | | | |
|---|---|---|---|---|---|---|
| **GW 11-MICHEL** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 115 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,670 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 10,5 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,107 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 1,80 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 10,9 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 80,4 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 16,1 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 15 | Sodium | Na | mg/L | 9,94 | 200 | |
| 16 | Potasium | K | mg/L | 0,737 | - | 12 |
| 17 | Calcium | Ca | mg/L | 4,05 | - | 100 |
| 18 | Magnesium | Mg | mg/L | <0,243 | - | 50 |
| 19 | Fluorine | F | mg/L | <0,05 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,41 | No limits | |

| TABLE 18. BACTERIOLOGICAL PARAMETERS - GW11-MICHEL | | | | |
|---|---|---|---|---|
| **GW 11-MICHEL** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

## B7. Analytical determinations for sampling point GW 10-TR

| TABLE 19. PARAMETERS MEASURED ON THE SITE - GW 10-TR | | | |
|---|---|---|---|
| **GW 10-TR** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 7:20 | Air temperature | 25 ºC |
| Atmospheric conditions | Cloudy | Relative humidity | 81% |
| UTM coordinates | 21K 516254.00 m E 7484946.00 m S | Elevation | 157 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,8 | No limits | |
| 2 | Hydrogen potential | pH | | 7,16 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 321 | - | 1500 |

| TABLE 20. PHYSICOCHEMICAL PARAMETERS - GW 10-TR | | | | | | |
|---|---|---|---|---|---|---|
| **GW 10-TR** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 273 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,196 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 12,3 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,876 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,177 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 0,818 | 1 | |
| 10 | Chlorides | Cl- | mg/L | 28,50 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 96,5 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 81,1 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 3,21 | 250 | |
| 15 | Sodium | Na | mg/L | 63,2 | 200 | |
| 16 | Potasium | K | mg/L | 0,804 | - | 12 |
| 17 | Calcium | Ca | mg/L | 3,97 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 0,578 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,24 | - | 1,5 |
| 20 | Boron | B | mg/L | 0,168 | No limits | |

| TABLE 21. BACTERIOLOGICAL PARAMETERS - GW 10-TR | | | | |
|---|---|---|---|---|
| **GW 10-TR** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 22 | Faecal coliforms | NMP/100mL | 10 | 1,1 NMP/100mL |
| 23 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 24 | E. coli | NMP/100mL | Absent | Absent |

**B8. Analytical determinations for sampling point GW 13-San Juan**

| TABLE 22. PARAMETERS MEASURED ON THE SITE - GW 13-SAN JUAN | | | |
|---|---|---|---|
| **GW 13-San Juan** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 8:20 | Air temperature | 26,5 ºC |
| Atmospheric conditions | Sunny, disperse clouds | Relative humidity | 80% |
| UTM coordinates | 21K 509767.00 m E; 7486076.00 m S | Elevation | 184 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 21,2 | No limits | |
| 2 | Hydrogen potential | pH | | 6,92 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 320 | - | 1250 |

| TABLE 23. PHYSICOCHEMICAL PARAMETERS - GW 13-SAN JUAN | | | | | | |
|---|---|---|---|---|---|---|
| **GW 13-San Juan** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 383 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,685 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 9,90 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,127 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 106 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 32,3 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 15,2 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 13,1 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 15 | Sodium | Na | mg/L | 74,4 | 200 | |
| 16 | Potasium | K | mg/L | 1,26 | - | 12 |
| 17 | Calcium | Ca | mg/L | 3,08 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 0,536 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,06 | - | 1,5 |
| 20 | Boron | B | mg/L | 0,100 | No limits | |

| TABLE 24.BACTERIOLOGICAL PARAMETERS - GW 13-SAN JUAN | | | | |
|---|---|---|---|---|
| **GW 13-San Juan** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 22 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 24 | E. coli | NMP/100mL | Absent | Absent |

**B9. Analytical determinations for sampling point GW 22-Silva**

| TABLE 25. PARAMETERS MEASURED ON THE SITE – GW22-SILVA | | | |
|---|---|---|---|
| **GW 22-Silva** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 8:50 | Air temperature | 27 °C |
| Atmospheric conditions | Sunny, disperse clouds | Relative humidity | 80% |
| UTM coordinates | 21K 509830.00 m E; 7484037.00 m S | Elevation | 179 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 21,7 | No limits | |
| 2 | Hydrogen potential | pH | | 5,54 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 197 | - | 1250 |

| TABLE 26. PHYSICOCHEMICAL PARAMETERS - GW 22-SILVA | | | | | | |
|---|---|---|---|---|---|---|
| **GW 22-Silva** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 247 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,538 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 22,0 | 300 | |
| 7 | Total phosphorus | P | mg/L | <0,0200 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 55,2 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 13,3 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 13,8 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 1,38 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 7,37 | 250 | |
| 15 | Sodium | Na | mg/L | 12,4 | 200 | |
| 16 | Potasium | K | mg/L | 7,63 | - | 12 |
| 17 | Calcium | Ca | mg/L | 4,86 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 2,41 | - | 50 |
| 19 | Fluorine | F | mg/L | <0,05 | - | 1,5 |
| 20 | Boron | B | mg/L | <0,100 | No limits | |

| TABLE 27. BACTERIOLOGICAL PARAMETERS - GW 22-SILVA | | | | |
|---|---|---|---|---|
| **GW 22-Silva** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | 23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B10. Analytical determinations for sampling point GW 12- Laguna**

| TABLE 28. PARAMETERS MEASURED ON THE SITE - GW 12-LAGUNA | | | |
|---|---|---|---|
| **GW 12- Laguna** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 16:30 | Air temperature | 28,6 ºC |
| Atmospheric conditions | Cloudy | Relative humidity | 79% |
| UTM coordinates | 21K 516419.00 m E; 7478307.00 m S | Elevation | 154 |
| Water level | 12,3 | Water table | 183,3 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 25,7 | No limits | |
| 2 | Hydrogen potential | pH | | 7,04 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 318 | - | 1250 |

| TABLE 29. PHYSICOCHEMICAL PARAMETERS - GW 12-LAGUNA | | | | | | |
|---|---|---|---|---|---|---|
| **GW 12- Laguna** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 236 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,406 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 88,1 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,264 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,339 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 3,70 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 4,28 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 132 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 108 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 3,46 | 250 | |
| 15 | Sodium | Na | mg/L | 30,1 | 200 | |
| 16 | Potasium | K | mg/L | 0,906 | - | 12 |
| 17 | Calcium | Ca | mg/L | 24,7 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 6,410 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,15 | - | 1,5 |
| 20 | Boron | B | mg/L | 8,22 | No limits | |

| TABLE 30. BACTERIOLOGICAL PARAMETERS - GW 12-LAGUNA | | | | |
|---|---|---|---|---|
| **GW 12- Laguna** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | 6,9 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Ausente | Ausencia |

**B11. Analytical determinations for sampling point GW 14-ZM**

| TABLE 31. PARAMETERS MEASURED ON THE SITE - GW 14-ZM | | | |
|---|---|---|---|
| **GW 14-ZM** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:40 | Air temperature | 29,5 º C |
| Atmospheric conditions | Cloudy, drizzle | Relative humidity | 79% |
| UTM coordinates | 21K 493064.00 m E; 7499176.00 m S | Elevation | 212 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 22,1 | No limits | |
| 2 | Hydrogen potential | pH | | 7,16 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 113 | - | 1250 |

| TABLE 32. PARÁMETROS FISICOQUÍMICOS GW 14-ZM | | | | | | |
|---|---|---|---|---|---|---|
| **GW 14-ZM** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 216 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 1,23 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 26,3 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,204 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,107 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 9,50 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 52,6 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 38,9 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 15 | Sodium | Na | mg/L | 12,1 | 200 | |
| 16 | Potasium | K | mg/L | 1,07 | - | 12 |
| 17 | Calcium | Ca | mg/L | 6,72 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 2,30 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,25 | - | 1,5 |
| 20 | Boron | B | mg/L | <0,100 | No limits | |

| TABLE 33. BACTERIOLOGICAL PARAMETERS - GW 14-ZM | | | | |
|---|---|---|---|---|
| **GW 14-ZM** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 22 | Faecal coliforms | NMP/100mL | 6,9 | 1,1 NMP/100mL |
| 23 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 24 | E. coli | NMP/100mL | Absent | Absent |

**B12. Analytical determinations for sampling point GW 15-SO**

| TABLE 34. PARAMETERS MEASURED ON THE SITE - GW 15-SO | | | |
|---|---|---|---|
| **GW 15-SO** | | | |
| **DATOS DEL PUNTO DE MUESTREO** | | | |
| Sampling time | 12:10 | Air temperature | 24,8 ºC |
| Atmospheric conditions | Cloudy, rainy | Relative humidity | 60% |
| UTM coordinates | 21K 483316.00 m E, 7497562.00 m S | Elevation | 290 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 27,7 | No limits | |
| 2 | Hydrogen potential | pH | | 7,34 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 950 | - | 1250 |

| TABLE 35. PHYSICOCHEMICAL PARAMETERS - GW 15-SO | | | | | | |
|---|---|---|---|---|---|---|
| **GW 15-SO** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 665 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 1,31 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 313 | 300 | |
| 7 | Total phosphorus | P | mg/L | <0,0200 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,734 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 199 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 8,31 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 299 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 269 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 17,9 | 250 | |
| 15 | Sodium | Na | mg/L | 64,6 | 200 | |
| 16 | Potasium | K | mg/L | 1,93 | - | 12 |
| 17 | Calcium | Ca | mg/L | 76,3 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 29,7 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,67 | - | 1,5 |
| 20 | Boron | B | mg/L | <0,100 | No limits | |

| TABLE 36. BACTERIOLOGICAL PARAMETERS - GW 15-SO | | | | |
|---|---|---|---|---|
| **GW 15-SO** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 22 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 24 | E. coli | NMP/100mL | Absent | Absent |

**B13. Analytical determinations for sampling point GW 17-LP**

| TABLE 37. PARAMETERS MEASURED ON THE SITE - GW 17-LP | | | |
|---|---|---|---|
| **GW 17-LP** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 14: 50 | Air temperature | 26,8 ºC |
| Atmospheric conditions | Sunny, disperse clouds | Relative humidity | 60% |
| UTM coordinates | 21K 489833.00 m E, 7492572.00 m S | Elevation | 215 |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | Tº | ºC | 21,7 | No limits | |
| 2 | Hydrogen potential | pH | | 6,96 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 196 | - | 1250 |

| TABLE 38. PHYSICOCHEMICAL PARAMETERS - GW 17-LP | | | | | | |
|---|---|---|---|---|---|---|
| **GW 17-LP** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 203 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,615 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 64,0 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0699 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 0,475 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 94,5 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 73,7 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | <2,00 | 250 | |
| 15 | Sodium | Na | mg/L | 14,6 | 200 | |
| 16 | Potasium | K | mg/L | 0,486 | - | 12 |
| 17 | Calcium | Ca | mg/L | 15,5 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 6,11 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,53 | - | 1,5 |
| 20 | Boron | B | mg/L | 0,519 | No limits | |

| TABLE 39. BACTERIOLOGICAL PARAMETERS - GW 17-LP | | | | |
|---|---|---|---|---|
| **GW 17-LP** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B14. Analytical determinations for sampling point GW 21-MC**

| TABLE 40. PARAMETERS MEASURED ON THE SITE - GW 21-MC | | | |
|---|---|---|---|
| **GW 21-MC** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 15:30 | Air temperature | 26,5 ºC |
| Atmospheric conditions | Cloudy | Relative humidity | 63% |
| UTM coordinates | 21K 495202.00 m E; 7489899.00 m S | Elevation | 177 |
| Water level | 10,70 | Water table | 166,3 |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 22,7 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 6,26 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 406 | - | 1250 |

| TABLE 41. PHYSICOCHEMICAL PARAMETERS - GW 21-MC | | | | | | |
|---|---|---|---|---|---|---|
| **GW 21-MC** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 404 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,475 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 58,8 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,170 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | <0,100 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 75,5 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 49,9 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 58,1 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 5,81 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 5,79 | 250 | |
| 15 | Sodium | Na | mg/L | 51,0 | 200 | |
| 16 | Potasium | K | mg/L | 3,23 | - | 12 |
| 17 | Calcium | Ca | mg/L | 15,3 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 4,98 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,14 | - | 1,5 |
| 20 | Boron | B | mg/L | 0,650 | No limits | |

| TABLE 42. BACTERIOLOGICAL PARAMETERS - GW 21-MC | | | | |
|---|---|---|---|---|
| **GW 21-MC** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B15. Analytical determinations for sampling point GW 01**

| TABLE 43. PARAMETERS MEASURED ON THE SITE - GW 01 | | | |
|---|---|---|---|
| **GW 01** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 11:40 | Air temperature | 29,7 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 64% |
| UTM coordinates | 21K 449839.00 m E 7430729.00 m S | Elevation | 123 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 20,1 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 7,16 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 2.400 | - | 1250 |

| TABLE 44. PHYSICOCHEMICAL PARAMETERS - GW 01 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 01** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 1.181 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 10,1 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 281 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,356 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 2,73 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | 1,49 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 285 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 397 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 55,5 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 337 | 250 | |
| 15 | Sodium | Na | mg/L | 374 | 200 | |
| 16 | Potasium | K | mg/L | 8,40 | - | 12 |
| 17 | Calcium | Ca | mg/L | 85,8 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 16,1 | - | 50 |
| 19 | Fluorine | F | mg/L | 2,30 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,67 | No limits | |

| TABLE 45. BACTERIOLOGICAL PARAMETERS - GW 01 | | | | |
|---|---|---|---|---|
| **GW 01** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | >23 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Present | Absent |

**B16. Analytical determinations for sampling point GW 02**

| TABLE 46. PARAMETERS MEASURED ON THE SITE - GW 02 | | | |
|---|---|---|---|
| **GW 02** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 9:40 | Air temperature | 28,5 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 65% |
| UTM coordinates | 21k 450165.00 m E 7430301.00 m S | Elevation | 116 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 19,7 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 6,96 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 444 | - | 1250 |

| TABLE 47. PHYSICOCHEMICAL PARAMETERS - GW 02 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 02** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 248 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,505 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 84 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0776 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,196 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 1,59 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 178 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 88,8 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 24,5 | 250 | |
| 15 | Sodium | Na | mg/L | 43,1 | 200 | |
| 16 | Potasium | K | mg/L | 16,5 | - | 12 |
| 17 | Calcium | Ca | mg/L | 20,5 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 8,07 | - | 50 |
| 19 | Fluorine | F | mg/L | 1,60 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,67 | No limits | |

| TABLE 48. BACTERIOLOGICAL PARAMETERS - GW 02 | | | | |
|---|---|---|---|---|
| **GW 02** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | <1,1 | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | <1,1 | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

**B17. Analytical determinations for sampling point GW 03 (NO WATER)**

| TABLE 49. PARAMETERS MEASURED ON THE SITE - GW 03 | | | |
|---|---|---|---|
| **GW 03** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 13:30 | Air temperature | 30,4 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 67% |
| UTM coordinates | 21 k 449680.00 m E<br>7426904.00 m S | Elevation | 83 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | - | NO LIMITS | |
| 2 | Hydrogen potential | pH | | - | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | - | - | 1250 |

| TABLE 50. PHYSICOCHEMICAL PARAMETERS - GW 03 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 03** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | - | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | - | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | - | 300 | |
| 7 | Total phosphorus | P | mg/L | - | 0,05 | |
| 8 | Total nitrogen | N | mg/L | - | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | - | 10 | |
| 10 | Chlorides | Cl- | mg/L | - | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | - | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | - | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | - | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | - | 250 | |
| 15 | Sodium | Na | mg/L | - | 200 | |
| 16 | Potasium | K | mg/L | - | - | 12 |
| 17 | Calcium | Ca | mg/L | - | - | 100 |
| 18 | Magnesium | Mg | mg/L | - | - | 50 |
| 19 | Fluorine | F | mg/L | - | - | 1,5 |
| 20 | Boron | B | mg/L | - | No limits | |

| TABLE 51. BACTERIOLOGICAL PARAMETERS - GW 03 | | | | |
|---|---|---|---|---|
| **GW 03** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | - | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | - | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | - | Absent |

**B18. Analytical determinations for sampling point GW 04**

| TABLE 52. PARAMETERS MEASURED ON THE SITE - GW 04 | | | |
|---|---|---|---|
| **GW 04** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 10:00 | Air temperature | 29.7 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 58 % |
| UTM coordinates | 21k 449136.00 m E 7427123.00 m S | Elevation | 94 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 21,2 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 7,44 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 5.010 | - | 1250 |

| TABLE 53. PHYSICOCHEMICAL PARAMETERS - GW 04 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 04** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | **2.577** | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 12,0 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | **709** | 300 | |
| 7 | Total phosphorus | P | mg/L | 12,0 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 9,02 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | **611** | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$./L | **282** | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$./L | 22,6 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$./L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 160 | 250 | |
| 15 | Sodium | Na | mg/L | **367** | 200 | |
| 16 | Potasium | K | mg/L | 6,57 | - | 12 |
| 17 | Calcium | Ca | mg/L | **164** | - | 100 |
| 18 | Magnesium | Mg | mg/L | **72,9** | - | 50 |
| 19 | Fluorine | F | mg/L | 1,00 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,25 | No limits | |

| TABLE 54. BACTERIOLOGICAL PARAMETERS - GW 04 | | | | |
|---|---|---|---|---|
| **GW 04** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | **>23** | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | **>23** | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Present | Absent |

## B19. Analytical determinations for sampling point GW 05

| TABLE 55. PARAMETERS MEASURED ON THE SITE - GW 05 | | | |
|---|---|---|---|
| **GW 05** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 14:50 | Air temperature | 31,2 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 52 % |
| UTM coordinates | 21K 450803.00 m E 7426714.00 m S | Elevation | 91 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 23,0 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 6,89 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 370 | - | 1250 |

| TABLE 56. PHYSICOCHEMICAL PARAMETERS - GW 05 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 05** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 245 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 0,366 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 88,1 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0212 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,245 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 43,1 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$./L | 13,5 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$./L | 5,40 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$./L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 16,1 | 250 | |
| 15 | Sodium | Na | mg/L | 25,7 | 200 | |
| 16 | Potasium | K | mg/L | 6,60 | - | 12 |
| 17 | Calcium | Ca | mg/L | 25,3 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 6,06 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,200 | - | 1,5 |
| 20 | Boron | B | mg/L | 2,51 | No limits | |

| TABLE 57. BACTERIOLOGICAL PARAMETERS - GW 05 | | | | |
|---|---|---|---|---|
| **GW 05** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | **5,1** | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | **1,1** | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Present | Absent |

## B20. Analytical determinations for sampling point GW 06

| TABLE 58. PARAMETERS MEASURED ON THE SITE - GW 06 | | | |
|---|---|---|---|
| **GW 06** | | | |
| **SAMPLING POINT DATA** | | | |
| Sampling time | 16:00 | Air temperature | 30,08 ºC |
| Atmospheric conditions | Sunny | Relative humidity | 57 % |
| UTM coordinates | 21k 451708.00 m E<br>7427153.00 m S | Elevation | 90 m |
| Water level | No data | Water table | No data |

| **IN SITU MEASUREMENTS** | | | | | | |
|---|---|---|---|---|---|---|
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 1 | Water temperature | $T_{agua}$ | ºC | 21,4 | NO LIMITS | |
| 2 | Hydrogen potential | pH | | 6,39 | 6-9 | |
| 3 | Electrical conductivity | σ | µS/cm | 330 | - | 1250 |

| TABLE 59. PHYSICOCHEMICAL PARAMETERS - GW 06 | | | | | | |
|---|---|---|---|---|---|---|
| **GW 06** | | | | | | |
| **PHYSICOCHEMICAL PARAMETERS** | | | | | | |
| **Nº** | **Parameter** | **Symbol** | **Unit** | **Measured value** | **Limits** | |
| | | | | | **Regulation 222/02** | **Annexe I Law 1614/2000.** |
| 4 | Total dissolved solids | TDS | mg/L | 240 | 500 | |
| 5 | Organic matter | OM | mg $O_2$/L | 1,18 | No limits | |
| 6 | Hardness | --- | mg $CaCO_3$/L | 60 | 300 | |
| 7 | Total phosphorus | P | mg/L | 0,0723 | 0,05 | |
| 8 | Total nitrogen | N | mg/L | 0,483 | 0,6 | |
| 9 | Nitrates | $NO_{3-}$ | mg/L | <0,0200 | 10 | |
| 10 | Chlorides | Cl- | mg/L | 33,3 | - | 250 |
| 11 | Alkalinity | --- | mg $CaCO_3$/L | 54,6 | - | 250 |
| 12 | Bicarbonates | --- | mg $CaCO_3$/L | 27,8 | No limits | |
| 13 | Carbonates | | mg $CaCO_3$/L | 0,00 | No limits | |
| 14 | Sulphates | $SO_4^{2-}$ | mg/L | 29,7 | 250 | |
| 15 | Sodium | Na | mg/L | 30,9 | 200 | |
| 16 | Potasium | K | mg/L | 5,84 | - | 12 |
| 17 | Calcium | Ca | mg/L | 19,4 | - | 100 |
| 18 | Magnesium | Mg | mg/L | 2,73 | - | 50 |
| 19 | Fluorine | F | mg/L | 0,190 | - | 1,5 |
| 20 | Boron | B | mg/L | 1,15 | No limits | |

| TABLE 60. BACTERIOLOGICAL PARAMETERS - GW 06 | | | | |
|---|---|---|---|---|
| **GW 06** | | | | |
| **BACTERIOLOGICAL PARAMETERS** | | | | |
| **Nº** | **Parameter** | **Unit** | **Measured value** | **Regulation NP 2400180 limits** |
| 21 | Faecal coliforms | NMP/100mL | **>23** | 1,1 NMP/100mL |
| 22 | Total coliforms | NMP/100mL | **9,2** | 1,1 NMP/100mL |
| 23 | E. coli | NMP/100mL | Absent | Absent |

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# APPENDIX C:
# ANALYSIS OF THE RESULTS PER POINT

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### C1 FW104-ZA - NEGLA STREAM – UPPER PART OF THE MICRO-WATERSHED

| TABLE 1. OUT-OF-RANGE PARAMETERS – FW104-ZA | | | | |
|---|---|---|---|---|
| **COD: FW 104-ZA** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 40 | **4** |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Ammonia | 0,083 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,110 mg/L | | 0,3 mg/L | |
| Total coliforms | 16000 NMP/100mL | | 1000 NMP/100mL | |
| Faecal coliforms | 16000 NMP/100mL | | 200 NMP/100mL | |

### C2 GW18-ZA – HEADQUARTERS OF "ZAPALLLO" FARM – DEEP TUBULAR WELL USED FOR WATER DRINKING SUPPLY

| TABLE 2. OUT-OF-RANGE PARAMETERS – GW18-ZA | | | | |
|---|---|---|---|---|
| **COD: GW 18-ZA** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | **4** |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,352 mg/L | | 0,05 | |
| Nitrates | 10,5 mg/L | | 10 | |
| Faecal coliforms | 16 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

### C3 FW201-ST – NAPAGUE STREAM – UPPER MIDDLE PART OF THE NEGLA STREAM MICRO-WATERSHED

| TABLE 3. OUT-OF-RANGE PARAMETERS – FW201-ST | | | | |
|---|---|---|---|---|
| **COD: FW 201-ST** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 41 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Ammonia | 0,0594 mg/L | | 0,02 mg/L | |
| Soluble iron | 0,935 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 540 NMP/100mL | | 200 NMP/100mL | |

### C4 GW 20-ST - HEADQUARTERS OF THE "SANTA TERESA" FARM - DEEP TUBULAR WELL USED FOR DRINKING WATER SUPPLY

| TABLE 4. OUT-OF-RANGE PARAMETERS – GW20-ST | | | | |
|---|---|---|---|---|
| **COD: GW 20-ST** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |

| OUT-OF-RANGE PARAMETER | LABORATORY RESULTS | REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS |
|---|---|---|
| pH | 5,63 | 6-9 |
| Nitrates | 22,8 mg/L | 10 mg/L |
| Faecal coliforms | 12 NMP/100mL | 1,1 NMP/100mL |
| Total coliforms | >23 NMP/100mL | 1,1 NMP/100mL |

**C5 FW 315-HE - "HERMOSA" STREAM - UPPER WATERSHED OF THE "HERMOSA" CREEK MICRO-WATERSHED**

| TABLE 5. OUT-OF-RANGE PARAMETERS – FW315-HE | | | | |
|---|---|---|---|---|
| **COD: FW 315-HE** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 37 | 7 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Total phosphorus | 0,103 mg/L | | 0,05 mg/L | |
| Total nitrogen | 0,734 mg/L | | 0,6 mg/L | |
| Ammonia | 0,0587 mg/L | | 0,02 mg/L | |
| Manganese | 0,274 mg/L | | 0,1 mg/L | |
| Soluble iron | 1,11 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 1200 | | 200 NMP/100mL | |
| Total coliforms | 35000 | | 1000 NMP/100mL | |

**C6 GW 19-HE – HEADQUARTERS OF THE "HERMOSA" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY**

| TABLE 6. OUT-OF-RANGE PARAMETERS – GW19-HE | | | | |
|---|---|---|---|---|
| **COD: GW 19-HE** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 15 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,577 mg/L | | 0,05 mg/L | |
| Faecal coliforms | 9,2 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C7 GW 304-HE - TREMENTINA STREAM – UPPER WATERSHED OF THE TREMENTINA STREAM MICRO-WATERSHED**

| TABLE 7. OUT-OF-RANGE PARAMETERS – GW304-HE | | | | |
|---|---|---|---|---|
| **COD: FW 304-HE** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | **5** |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Total phosphorus | 0,0639 mg/L | | 0,05 mg/L | |
| Ammonia | 0,0880 mg/L | | 0,02 mg/L | |
| Soluble iron | 0,913 mg/L | | 0,3 mg/L | |

| | | |
|---|---|---|
| Faecal coliforms | 330 NMP/100mL | 200 NMP/100mL |
| Total coliforms | 3500 NMP/100mL | 1000 NMP/100mL |

**C8 GW 23-SL - HEADQUARTERS OF THE "SAN LIBERATO" FARM – DEEP TUBULAR WELL FOR WATER PROVISION FOR HUMAN CONSUMPTION**

| TABLE 8. OUT-OF-RANGE PARAMETERS – GW23-SL | | | | |
|---|---|---|---|---|
| **COD: GW 23-SL** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| pH | 5,71 | | 6-9 | |
| Total phosphorus | 0,0947 mg/L | | 0,05 mg/L | |
| Faecal coliforms | 23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C9 GW 16-GA - HEADQUARTERS OF THE "SAN GAVILÁN" FARM AT 200 METRES FROM *EUCALYPTUS SP.* PLANTATIONS – DEEP TUBULAR WELL TO PROVIDE WATER FOR HUMAN CONSUMPTION**

| TABLE 9. OUT-OF-RANGE PARAMETERS – GW16-GA | | | | |
|---|---|---|---|---|
| **COD: GW 16-GA** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 17 | 1 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total coliforms | 12 NMP/100mL | | 1,1 NMP/100mL | |

**C10 FW 100-GASL - TREMENTINA STREAM – MIDDLE/UPPER CATCHMENT OF THE TREMENTINA STREAM MICRO-WATERSHED RUNS THROUGH APPROXIMATELY 7 KM OF *EUCALYPTUS SP.* PLANTATIONS**

| TABLE 10. OUT-OF-RANGE PARAMETERS FW 100-GASL | | | | |
|---|---|---|---|---|
| **COD: FW 100-GASL** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 38 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02** | |
| Dissolved oxygen | 4,47 mg/L | | >5 mg/L | |
| Total phosphorus | 0,0586mg/L | | 0,05 mg/L | |
| Total Nitrogen | 0,750 mg/L | | 0,6 mg/L | |
| Ammonia | 0,0457 mg/L | | 0,02 mg/L | |
| Soluble Iron | 0,550 mg/L | | 0,3 mg/L | |

**C11 FW 200-SL - TRIBUTARY OF THE TREMENTINA STREAM AT THE SOUTHEAST OF THE HEADQUARTERS OF THE "SAN LIBERATO" FARM – MIDDLE CATCHMENT OF THE TREMENTINA STREAM**

| TABLE 11. OUT-OF-RANGE PARAMETERS – FW200-SL | | | | |
|---|---|---|---|---|
| **COD: FW 200-SL** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Turbidity | 489 NTU | | 100NTU | |
| Ammonia | 0,138 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,05 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 7900 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 22000 NMP/100mL | | 1000 NMP/100mL | |

**C12 FW 207-TR - TRIBUTARY OF THE TREMENTINA STREAM, 5 KM AT THE NORTH OF THE HEADQUARTERS OF THE "TREMENTINA" FARM – MIDDLE CATCHMENT OF THE TREMENTINA STREAM**

| TABLE 12. OUT-OF-RANGE PARAMETERS – FW207-TR | | | | |
|---|---|---|---|---|
| **COD: FW 207-TR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 38 | 6 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Dissolved oxygen | 2,43 mg $O_2$/L | | > 5 mg $O_2$/L | |
| Total phosphorus | 0,0796 mg/L | | 0,05 mg/L | |
| Ammonia | 0,0687 mg/L | | 0,02 mg/L | |
| Soluble iron | 3,31 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 790 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 1700 NMP/100mL | | 1000 NMP/100mL | |

**C13 FW 208-TR - TREMENTINA STREAM, 2 KM NORTHWEST OF THE TREMENTINA FARM'S HEADQUARTERS – MIDDLE CATCHMENT OF THE TREMENTINA STREAM**

| TABLE 13. OUT-OF-RANGE PARAMETERS – FW208-TR | | | | |
|---|---|---|---|---|
| **COD: FW 208-TR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 38 | 6 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Dissolved oxygen | 4,30 mg $O_2$/L | | > 5 mg $O_2$/L | |
| Total nitrogen | 0,748 mg/L | | 0,6 mg/L | |
| Amoniaco | 0,0603 mg/L | | 0,02 mg/L | |
| Ammonia | 1,33 mg/L | | 0,3 mg/L | |
| Soluble iron | 35000 NMP/100mL | | 200 NMP/100mL | |
| Faecal coliforms | 35000 NMP/100mL | | 1000 NMP/100mL | |

**C14 GW 11-MICHEL - DEEP TUBULAR WELLS LOCATED IN NEW PLANTATIONS OF *EUCALYPTUS SP* – MIDDLE BASIN OF THE TREMENTINA STREAM**

| TABLE 14. OUT-OF-RANGE PARAMETERS – GW11-MICHEL | | | | |
|---|---|---|---|---|
| **COD: GW 11-MICHEL** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| pH | 5,87 | | 6-9 | |
| Total phosphorus | 0,107 mg/L | | 0,05 mg/L | |
| Faecal coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C15 GW 10-TR - TREMENTINA FARM HEADQUARTERS –MIDDLE BASIN OF THE TREMENTINA STREAM, DAIRY FARM AND CORRALS WITHIN 200 METRES OF THE AII OF THE WELL, USE FOR DRINKING WATER SUPPLY**

| TABLE 15. OUT-OF-RANGE PARAMETERS – GW10-TR | | | | |
|---|---|---|---|---|
| **COD: GW 10-TR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 15 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,876 mg/L | | 0,05 | |
| Faecal coliforms | 10 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C16 GW 13-SAN JUAN - "SAN JUAN" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM – WELL FOR DRINKING WATER SUPPLY**

| TABLE 16. OUT-OF-RANGE PARAMETERS – GW13-SAN JUAN | | | | |
|---|---|---|---|---|
| **COD: GW 13-SAN JUAN** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 26 | 6 | 16 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 LIMITS** | |
| Total phosphorus | 0,127 mg/L | | 0,05 mg/L | |
| Nitrates | 106 mg/L | | 10 mg/L | |
| Faecal coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C17 GW 22-SILVA - "SILVA" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM - WELL FOR DRINKING WATER SUPPLY**

| TABLE 17. OUT-OF-RANGE PARAMETERS – GW22-SILVA | | | | |
|---|---|---|---|---|
| **COD: GW 22-SILVA** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| pH | 5,54 | | 6-9 | |
| Nitrates | 55,2 mg/L | | 10 mg/L | |
| Faecal coliforms | 23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C18 FW 205-TR - TREMENTINA STREAM, 2.7 KM EAST OF THE TREMENTINA FARM HEADQUARTERS, MIDDLE CATCHMENT OF THE TREMENTINA STREAM MICRO-CATCHMENT**

| TABLE 18. OUT-OF-RANGE PARAMETERS – FW205-TR | | | | |
|---|---|---|---|---|
| **COD: FW 205-TR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 36 | 8 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| BOD5 | 5,32 mg $O_2$/L | | 5 mg $O_2$/L | |
| Total phosphorus | 0,384 mg/L | | 0,05 mg/L | |
| Ammonia | 0,521 mg/L | | 0,02 mg/L | |
| Manganese | 0,127 mg/L | | 0,1 mg/L | |
| Soluble iron | 1,56 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 780 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 7000 NMP/100mL | | 1000 NMP/100mL | |
| Nickel | 0,145 mg/L | | 0,025 mg/L | |

**C19 GW 12-LAGUNA - "LAGUNA" FARM, THE MIDDLE BASIN OF THE TREMENTINA STREAM MICRO-BASIN - WELL FOR DRINKING WATER SUPPLY AND IRRIGATION OF SEEDLINGS, CURRENTLY DEVELOPING A FOREST NURSERY AND PLANTATION OF NEW CROPS OF *EUCALYPTUS SP***

| TABLE 19. OUT-OF-RANGE PARAMETERS – GW12-LAGUNA | | | | |
|---|---|---|---|---|
| **COD: GW 12-LAGUNA** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 15 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,264 mg/L | | 0,05 mg/L | |
| Faecal coliforms | 6,9 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C20 FW 109-MYRZ – TREMENTINA STREAM, POINT LOCATED BETWEEN THE "MANDYJU" AND "RANCHO Z" PROPERTY BOUNDARIES – MIDDLE CATCHMENT OF THE "TREMENTINA" STREAM MICRO-WATERSHED**

| TABLE 20. OUT-OF-RANGE PARAMETERS – FW109-MYRZ | | | | |
|---|---|---|---|---|
| **COD: FW 109-MYRZ** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 38 | 6 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Dissolved oxygen | 4,58 mg $O_2$/L | | > 5 mg $O_2$/L | |
| Total phosphorus | 0,194 mg/L | | 0,05 mg/L | |
| Ammonia | 0,055 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,19 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 11000 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 11000 NMP/100mL | | 1000 NMP/100mL | |

**C21 FW 115-MANDYJU – TREMENTINA STREAM, A POINT LOCATED 11 KM SOUTHEAST OF THE "RANCHO Z" FOREST PLANTATIONS – MIDDLE CATCHMENT OF THE TREMENTINA STREAM MICRO-WATERSHED**

| TABLE 21. OUT-OF-RANGE PARAMETERS – FW115-MANDYJU | | | | |
|---|---|---|---|---|
| **COD: FW 115- MANDYJU** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 38 | 6 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Dissolved oxygen | 4,98 mg $O_2$/L | | >5 mg $O_2$/L | |
| Total phosphorus | 0,0882 mg/L | | 0,05 mg/L | |
| Ammonia | 0,065 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,13 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 390 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 9000 NMP/100mL | | 1000 NMP/100mL | |

**C22 FW 317-RZ – TREMENTINA STREAM – LOWER CATCHMENT OF THE TREMENTINA STREAM MICRO-CATCHMENT**

| TABLE 22. OUT-OF-RANGE PARAMETERS – FW317-RZ | | | | |
|---|---|---|---|---|
| **COD: FW 317-RZ** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Ammonia | 0,115 mg/L | | 0,02 mg/L | |
| Soluble iron | 0,951 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 330 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 1100 NMP/100mL | | 1000 NMP/100mL | |
| Lead | 0,0494 mg/L | | 0,01 mg/L | |

### C23 FW 204-LB - TREMENTINA STREAM POINT LOCATED 5 KM UPSTREAM OF THE OUTFLOW POINT OF THE TREMENTINA STREAM TO THE AQUIDABÁN RIVER – THE LOWER WATERSHED OF THE "TREMENTINA" STREAM MICRO-WATERSHED

| TABLE 23. OUT-OF-RANGE PARAMETERS – FW204-LB | | | | |
|---|---|---|---|---|
| **COD: FW 204-LB** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Ammonia | 0,226 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,14 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 3500 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 16000 NMP/100mL | | 1000 NMP/100mL | |
| Nickel | 0,0513 mg/L | | 0,025 mg/L | |

### C24 FW 110-LB - UNNAMED STREAM – TRIBUTARY OF THE AQUIDABÁN RIVER

| TABLE 24. OUT-OF-RANGE PARAMETERS – FW110-LB | | | | |
|---|---|---|---|---|
| **COD: FW 110-LB** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 37 | 7 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Dissolved oxygen | 2,38 mg $O_2$/L | | >5 mg $O_2$/L | |
| Total phosphorus | 0,0548 mg/L | | 0,05 mg/L | |
| Manganese | 0,122 mg/L | | 0,1 mg/L | |
| Ammonia | 0,224 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,41 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 4300 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 160000 NMP/100mL | | 1000 NMP/100mL | |

### C25 FW 111-LB - AQUIDABÁN RIVER – LOWER-MIDDLE BASIN OF THE AQUIDABÁN RIVER CATCHMENT

| TABLE 25. OUT-OF-RANGE PARAMETERS – FW111-LB | | | | |
|---|---|---|---|---|
| **COD: FW 111-LB** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 37 | 7 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| pH | 5,91 | | 6 - 9 | |
| Total phosphorus | 0,114 mg/L | | 0,05 mg/L | |
| Ammonia | 0,331 mg/L | | 0,02 mg/L | |
| Manganese | 0,4 mg/L | | 0,1 mg/L | |
| Soluble iron | 1,56 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 490 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 1400 NMP/100mL | | 1000 NMP/100mL | |

### C26 FW 310-CR - AQUIDABÁN RIVER – LOWER BASIN OF THE AQUIDABÁN RIVER CATCHMENT

| TABLE 26. OUT-OF-RANGE PARAMETERS – FW310-CR | | | | |
|---|---|---|---|---|
| **COD: FW 310-CR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 36 | 8 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Turbidity | 355 NTU | | 100 NTU | |
| BOD5 | 5,51 mg $O_2$/L | | 5 mg $O_2$/L | |
| Total phosphorus | 0,0518 mg/L | | 0,05 mg/L | |
| Ammonia | 0,150 mg/L | | 0,02 mg/L | |
| Manganese | 0,341 mg/L | | 0,1 mg/L | |
| Soluble iron | 2,36 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 11000 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 11000 NMP/100mL | | 1000 NMP/100mL | |

### C27 FW 316-CR - "LAGUNA PENAYO" STREAM – LOWER BASIN OF THE AQUIDABÁN RIVER

| TABLE 27. OUT-OF-RANGE PARAMETERS – FW316-CR | | | | |
|---|---|---|---|---|
| **COD: FW 316-CR** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| BOD5 | 5,05 mg $O_2$/L | | 5 mg $O_2$/L | |
| Total nitrogen | 0,779 mg/L | | 0,6 mg/L | |
| Ammonia | 0,0331 mg/L | | 0,02 mg/L | |
| Soluble iron | 0,991 mg/L | | 0,3 mg/L | |
| Lead | 0,0134 mg/L | | 0,01 mg/L | |

### C28 GW 14-ZM - HEADQUARTERS OF THE "ZANJA MOROTÏ" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY

| TABLE 28. OUT-OF-RANGE PARAMETERS – GW14-ZM | | | | |
|---|---|---|---|---|
| **COD: GW 14-ZM** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 15 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,204 mg/L | | 0,05 mg/L | |
| Faecal coliforms | 6,9 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C29 GW 15-SO - HEADQUARTERS OF THE "SOLEDAD" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY**

| TABLE 29. OUT-OF-RANGE PARAMETERS – GW15-SO | | | | |
|---|---|---|---|---|
| **COD: GW 15-SO** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 11 | 7 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total dissolved solids | 665 mg/L | | 500 mg/L | |
| Hardness | 313 mg $CaCO_3$/L | | 300 mg $CaCO_3$/L | |
| Total nitrogen | 0,734 mg/L | | 0,6 mg/L | |
| Nitrates | 199 mg/L | | 10 mg/L | |
| Alkalinity | 299 mg $CaCO_3$./L | | 250 mg $CaCO_3$./L | |
| Faecal coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C30 FW 306-SO - TRIBUTARY OF THE PITANOHAGA STREAM- UPPER CATCHMENT OF THE PITANOHAGA STREAM MICRO-WATERSHED**

| TABLE 30. OUT-OF-RANGE PARAMETERS – FW306-SO | | | | |
|---|---|---|---|---|
| **COD: FW 306-SO** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 63 | 19 | 39 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Amoniaco | 0,0872 mg/L | | 0,02 mg/L | |
| Soluble iron | 1,02 mg/L | | 0,3 mg/L | |
| Faecal coliforms | 540 NMP/100mL | | 200 NMP/100mL | |
| Total coliforms | 920 NMP/100mL | | 1000 NMP/100mL | |
| Lead | 0,0229 mg/L | | 0,01 mg/L | |

**C31 GW 17-LP - HEADQUARTERS OF "LA PARAGUAYA" FARM – DEEP TUBULAR WELL FOR WATER PROVISION FOR HUMAN CONSUMPTION**

| TABLE 31. OUT-OF-RANGE PARAMETERS – GW17-LP | | | | |
|---|---|---|---|---|
| **COD: GW 17-LP** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 15 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,0699 mg/L | | 0,05 mg/L | |
| Faecal coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C32 GW 21-MC - HEADQUARTERS OF THE "MACHUCA-CUE" FARM - DEEP TUBULAR WELL FOR DRINKING WATER SUPPLY**

| TABLE 32. OUT-OF-RANGE PARAMETERS – GW21-MC | | | | |
|---|---|---|---|---|
| **COD: GW 21-MC** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 LAW 1614/2000 AND NP 24 001 80 LIMITS** | |
| Total phosphorus | 0,170 mg/L | | 0,05 mg/L | |
| Nitrates | 75,5 mg/L | | 10 mg/L | |
| Faecal coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

**C.33 FW01 PARAGUAY RIVER – PROJECT'S ADA – POINT LOCATED 2.5 KM UPSTREAM BEFORE THE EFFLUENT DISCHARGE POINT.**

| TABLE 33. OUT-OF-RANGE PARAMETERS FW 01 – PARAGUAY RIVER | | | | |
|---|---|---|---|---|
| **COD: FW 01** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 64 | 15 | 44 | 5 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Total phosphorus | 0,0694 mg/L | | 0,05 mg/L | |
| Ammonia | 0,0989 mg/L | | 0,02 mg/L | |
| Nitrites | 0,01533 mg/L | | 1 mg/L | |
| Manganese | 0,113 mg/L | | 0,1 mg/L | |
| Soluble Iron | 1,52 mg/L | | 0,3 mg/L | |

C.34 **FW02 PARAGUAY RIVER – PROJECT'S ADA –POINT LOCATED 2.5 KM DOWNSTREAM OF THE EFFLUENT DISCHARGE POINT**.

| TABLA 34. OUT-OF-RANGE PARAMETERS FW 02 | | | | |
|---|---|---|---|---|
| **COD: FW 02** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 64 | 15 | 46 | 3 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **REGULATION SEAM 222/02 PERMISSIBLE LIMITS** | |
| Ammonia | 0,0441 mg/L | | 0,02 | |
| Manganese | 0,144 mg/L | | 0,1 mg/L | |
| Soluble iron | 0,804 mg/L | | 0,3 mg/L | |

**C.35 MONITORING WELL GW01 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT**

| TABLA 35. OUT-OF-RANGE PARAMETERS GW 01 | |
|---|---|
| **COD:** | PARAMETERS |

| GW 01 | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
|---|---|---|---|---|
| | 23 | 5 | 5 | 13 |

| OUT-OF-RANGE PARAMETER | LABORATORY RESULTS | REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80 PERMISSIBLE LIMITS |
|---|---|---|
| Electric conductivity | 2400 | 1250 |
| Total dissolved solids | 1.181 | 500 |
| Hardness | 281 | 300 |
| Total phosphorus | 0,356 | 0,05 |
| Total nitrogen | 2,73 | 0,6 |
| Chlorides | 285 | 250 |
| Alkalinity | 397 | 250 |
| Sulfates | 337 | 250 |
| Sodium | 374 | 200 |
| Fluorine | 2,30 | 1,5 |
| E Coli | Presence | Absent |
| Fecal coliforms | >23 NMP/100mL | 1,1 NMP/100mL |
| Total coliforms | >23 NMP/100mL | 1,1 NMP/100mL |

## C.36 MONITORING WELL GW02 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

| TABLA 36. OUT-OF-RANGE PARAMETERS GW 02 | | | | |
|---|---|---|---|---|
| COD: GW 02 | PARAMETROS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |

| OUT-OF-RANGE PARAMETER | LABORATORY RESULTS | REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80 PERMISSIBLE LIMITS |
|---|---|---|
| Hardness | 84 | 300 |
| Total phosphorus | 0,0776 | 0,05 |
| Potassium | 16,5 | 12 |
| Fluorine | 1,60 | 1,5 |

## C.37 MONITORING WELL GW04 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

| TABLA 37. OUT-OF-RANGE PARAMETERS GW 04 | | | | |
|---|---|---|---|---|
| COD: GW 04 | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 23 | 5 | 5 | 13 |

| OUT-OF-RANGE PARAMETER | LABORATORY RESULTS | LÍMITS: REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80 |
|---|---|---|
| Electric Conductivity | 5.010 | 1250 |
| TDS | 2.577 | 500 |
| Hardness | 709 | 300 |
| Total phosphorus | 12 | 0,05 |
| Total nitrogen | 9,02 | 0,6 |
| Chlorides | 611 | 250 |
| Alkalinity | 282 | 250 |
| Sodium | 367 | 200 |
| Calcium | 164 | 100 |

| | | |
|---|---|---|
| Magnesium | 72,9 | 50 |
| E Coli | Presence | Absent |
| Fecal coliforms | >23 NMP/100mL | 1,1 NMP/100mL |
| Total coliforms | >23 NMP/100mL | 1,1 NMP/100mL |

### C.38 MONITORING WELL GW05 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

| TABLA 38. OUT-OF-RANGE PARAMETERS GW 05 | | | | |
|---|---|---|---|---|
| **COD: GW 05** | PARAMETERS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **LÍMITS REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80** | |
| Hardness | 88,1 | | 300 | |
| E Coli | Presence | | Absent | |
| Fecal coliforms | 1,1 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | 5,1 NMP/100mL | | 1,1 NMP/100mL | |

### C.39 MONITORING WELL GW06 LOCATED IN THE ADA OF THE INDUSTRIAL PLANT

| TABLA 39. OUT-OF-RANGE PARAMETERS GW 06 | | | | |
|---|---|---|---|---|
| **COD: GW 06** | PARAMETROS | | | |
| | PARAMETER QUANTITY | NO LIMITS | COMPLY WITH THE LIMITS. | BEYOND THE LIMITS |
| | 23 | 5 | 14 | 4 |
| **OUT-OF-RANGE PARAMETER** | **LABORATORY RESULTS** | | **LÍMITS: REGULATION SEAM 222/02 LAW 1614/2000 y NP 24 001 80** | |
| Total phosphorus | 60 mg/L | | 0,05 mg/L | |
| Total nitrogen | 0,073 mg/L | | 0,6 mg/L | |
| Fecal coliforms | 9,2 NMP/100mL | | 1,1 NMP/100mL | |
| Total coliforms | >23 NMP/100mL | | 1,1 NMP/100mL | |

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# APPENDIX D.
# PHOTOGRAPHY GALLERY OF THE FIRST MONITORING CAMPAIGN

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| FW 104 - ZA | |
|---|---|
| | |

| GW 18-ZA | |
|---|---|
| | |

| FW 201-ST | |
|---|---|
| | |

| GW 20-ST | |
|---|---|
| | |

FW 315-HE

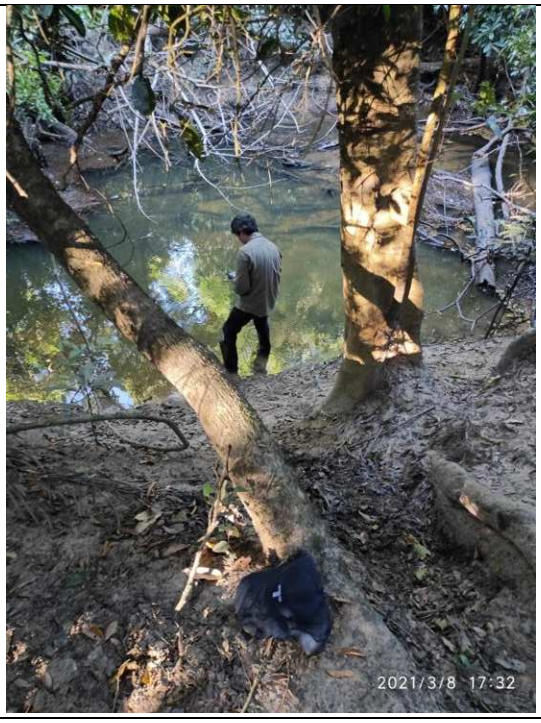
GW 19-HE

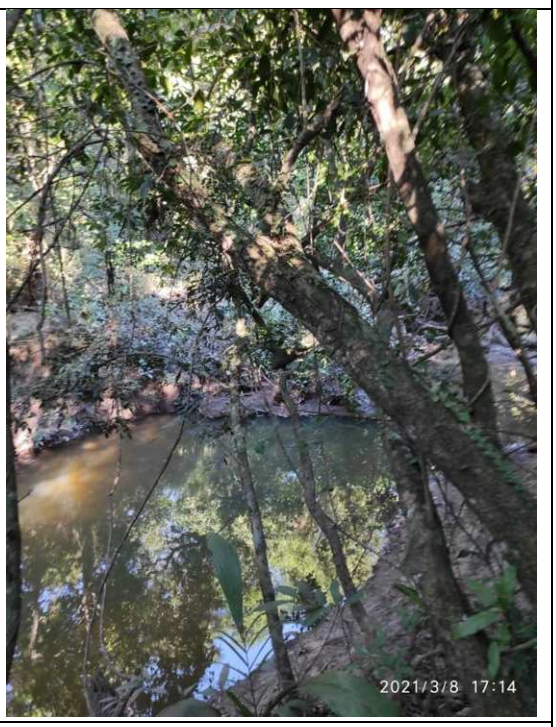
FW 304-HE

GW 23-SL

GW 16-GA

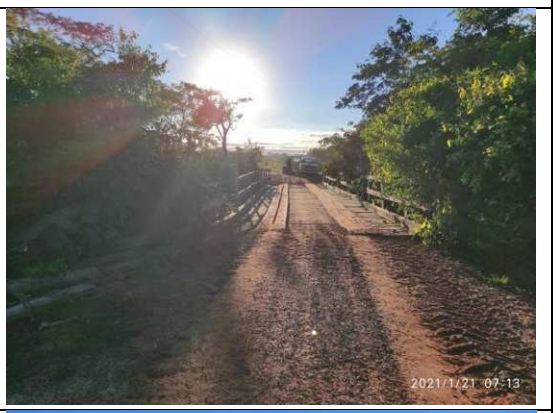
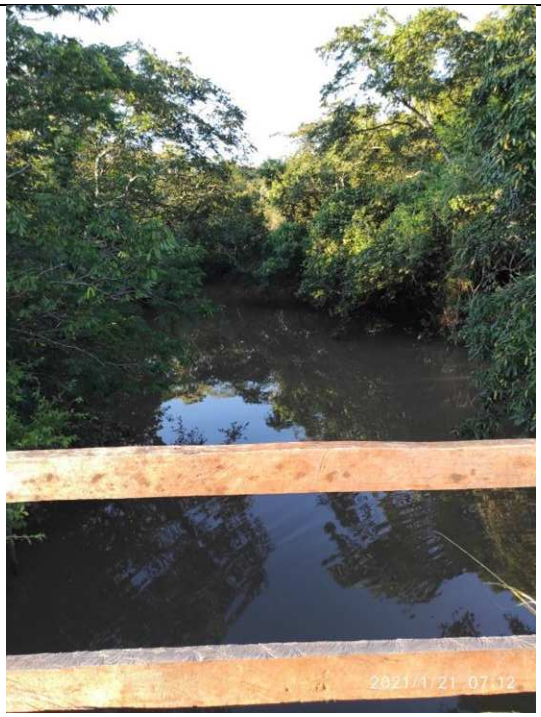
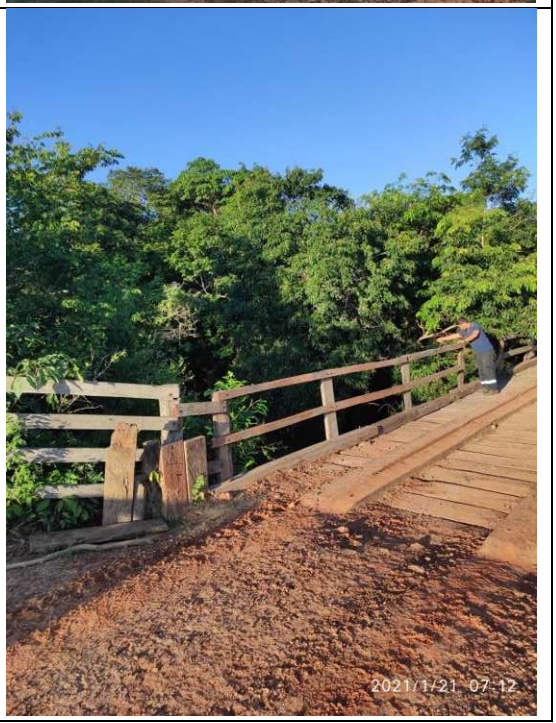
FW 100-GASL




FW 200-SL

| FW 207-TR | |
|---|---|
| | |

| FW 208-TR | |
|---|---|
| |  |
|  |  |

| GW 11-MICHEL | |
|---|---|
| | |

| GW 10-TR | |
|---|---|
| | |

| GW 13-SAN JUAN | |
|---|---|
| | |

| FW 205-TR | |
|---|---|
| | |

| GW 12- Laguna | |
|---|---|
| | |

| FW 109-MYRZ | |
|---|---|
| | |

| FW 115-MANDYJU | |
|---|---|
| | |

| FW 317-RZ | |
|---|---|
| | |

FW 204-LB

FW 110-LB

FW 111-LB

FW 310-CR

| FW 316-CR | |
|---|---|
| | |

| GW 14-ZM | |
|---|---|
| | |

| GW 15-SO | |
|---|---|
| | |

| FW 306 -SO | |
|---|---|
| | |

GW 17-LP

GW 21-MC

FW 01

FW 02

GW 01

GW 02

GW 03

GW 04

GW 05

GW 06

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# APPENDIX E.
# SUPPLIERS NOTE

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San Lorenzo, 20 de Abril de 2021

Dr. Gilberto Antonio Benitez
CEMIT.-
Presente.-

En relación los productos que fueron cotizados de la cartera **SIGMA ALDRICH** y que aún siguen pendientes de entrega, informamos que el motivo de la demora obedece a la crisis sanitaria actual, ya que los vuelos están supeditados a vuelos cargueros no comerciales (como es habitual), por lo que las fechas de embarque dependen exclusivamente de las informaciones que recibimos desde origen USA.

A la fecha seguimos aguardando confirmación de vuelo que estimamos sería dentro de este mes, de igual manera estamos duplicando esfuerzos para que estos tiempos logísticos demoren lo menos posible y podamos cumplir con sus necesidades.

De nuestra mayor consideración.-

B.C. Rossana Vallejos.
Productos Químicos y Reactivos
Vicente Scavone & Cía. S.A.E

**TRANSLATION**

Note: texts between parenthesis and with different fonts are our comments and they describe certain particularities of the document, such as logos, and others.

(*There is a Logo:* **LASCA laboratory**)

San Lorenzo, 20th April, 2021

Dr. Gilberto Antonio López
CEMIT
Present:

Regarding to the products from SIGMA ALDRICH that are still pending delivery, we inform you that the reason for the delay is due to the current health crisis, since the flights depends on non-commercial cargo flights (as usual), so the shipment dates rest exclusively on the information we receive from the USA.

We are still awaiting confirmation of the flight, which we estimate will be within this month. We are also doubling our efforts so that these logistical issues can be solve as soon as possible so we can meet your needs.

Kind regards,

B.C. Rossana Vallejos
Reagents and chemical products
Vicente Scavone & Cía. S.A.E

# ANNEX II
# AIR QUALITY MONITORING REPORT

# MONITORING REPORT OF AIR QUALITY

**Monitored organization:**

# POYRY TECNOLOGIA LTDA (Paracel Project)

**Monitored Places:**

**(Campaign executed between September 25 to October 16, 2019)**

**POINT 01 - SENACSA / Departmental Commission on Animal Health**

**POINT 02 - Municipality of Loreto / Paraguay**

**POINT 03 - National Police Post - Police Station No. 18 Col. Roberto L. Petit**

NOVEMBER – 19


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**1.0 – SERVICE OBJECIVE**

**2.0 – GENERAL DATA**

2.1 – CONTRACTING COMPANY
2.2 – CONTRACTING COMPANY
2.3 – RESPONSIBILITIES

2.3.1 – SUPERVISION
2.3.2 – COLLECTION TEAM
2.3.3 – PREPARATION AND APPROVAL OF THE REPORT
2.3.4 – TECHNICAL RESPONSIBLE

2.4 – MONITORING POINTS

**3.0 – MATERIALS AND EVALUATION METHODS**

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3.2 – METHODOLOGY

**4.0 – SAMPLING AND PRODUCTION CONDITIONS**

4.1 – CONSIDERATIONS

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5.1 – TABLE OF RESULTS OF PARTICLES IN THE ATMOSPHERE
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**6.0 – ÍNDICE DE CALIDAD DEL AIRE**

**7.0 – DECLARATION OF CONFORMITY**

**8.0 – ANNEXES**

FIELD DATA
ANALYTICAL AWARD
SATELLITE IMAGE AND IDENTIFICATION OF THE MONITORING POINT
CALIBRATION AND TECHNICAL CONTROL


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# 1.0 – SERVICE OBJECTIVE

Determine the concentrations of Total Suspended Particles (PTS), Inhalable Particles (PI - $PM_{10}$), Breathable Particles (PR - $PM_{2,5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Total Sulfur Content (TRS), Carbon Monoxide (CO), Ozone ($O_3$), Hydrogen Sulfide ($H_2S$) and Volatile Organic Compounds (VOC) in 3 (three) points, during the period between September 25 and October 16, 2019, in the Cities of Concepción and Loreto, located in Paraguay, in accordance with the request for GEOAVALIAR Service 259-19.

# 2.0 – GENERAL DATA

## 2.1 – CONTRACTING COMPANY:

Bussiness Identity: PÖYRY TECNOLOGIA LTDA
Address: Av. Alfredo Egídio de Souza Aranha, Bloco B 5º andar
CEP: 04.726-170 – São Paulo/ SP.

## 2.2 – CONTRACTOR COMPANY:

Business Identity: GEOAVALIAR ANÁLISES E CONSULTORIAS AMBIENTAIS LTDA
Tax ID (CNPJ): 06.965.622/0001-30
IBAMA CTF: 593129
Address: Rua Anjo da Guarda, nº.: 708 – Bairro Fonte Grande
CEP 32013.460 - Contagem/MG

## 2.3 - RESPONSABILITIES:

### 2.3.1 – SUPERVISION (CONCEPCIÓN AND LORETO PROJECT - PARAGUAY)

**Cyro Croce Launy**
Sustainability Manager of the company Paracel

### 2.3.2 – COLLECTION TEAM (GEOAVALIAR):

**Edvandro Maurício da Silva**
Production Engineer / Esp. in Labor Segment Engineering
**Filipe de Almeida Mendonça**
Technician in Labor Safety

### 2.3.3 – PREPARATION AND APPROVAL OF THE REPORT (GEOAVALIAR):

**Kamila Lopes Morais**
Technician in Industrial Chemistry

**Gustavo de Castro Salles**
Chemical Engineer

### 2.3.4 – TECHNICAL RESPONSIBLE (GEOAVALIAR):

**Leonardo de Salles**
Soil and Environment Specialist Geographer


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## 2.4 – MONITORING POINTS:

The monitored points for the installation of the sampling equipment were defined by the Contracting Company in accordance with the following:

- Item 01 - SENACSA / Departmental Commission on Animal Health

Address: Calle Gral. Díaz c/ Rufino Spika - Concepción / Paraguay
Coordinates: UTM 21K 0454572 - 7410810

- Item 02 - Municipality of Loreto / Paraguay

Address: Av. Eusebio Ayala Y Centro Corá - Loreto / Paraguay
Coordinates: UTM 21K 0466753 - 7426022

- Point 03 - Puesto National Police - Comisaríto No.18 Col. Roberto L. Petit

Address: Puesto National Police - Comisaríto nº18 - Col. Roberto L. Petit - Concepcion / Paraguay
Coordinates: UTM 21K 0457325 - 7434506

Figure: Geoavaliar - Point 01

Figure: Geoavaliar - Point 02

Figure: Geoavaliar - Point 03


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# 3.0 - MATERIALS AND EVALUATION METHODS

## 3.1 - MATERIALS (Instruments used in samplings):

- CALIBRATOR FLAKE

N. of the measuring cup ..... ..... GEO CPV-0266
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA
Date of calibration..... ..... 05/30/2019

- HI-VOL PTS MEASUREMENT EQUIPMENT (LARGE VOLUME SAMPLERS)

Team N. ..... ..... ... GEO-HIVOL n. 005
Calibration date ..... ..... . 12/02 , 19/02 and 26/02 / 2019
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA

- HI-VOLS MEASURING EQUIPMENT (LARGE VOLUME SAMPLERS WITH INERTIAL PARTICLE SEPARATOR)

Team N. ..... ..... .. ..... GEO-PM10 n. 01
Calibration date ..... ..... ..... . .. 02/12, 02/19 and 02/26/2019
Maker ..... ..... . INDIAN ENERGY E COM. LTDA

Team N. ..... ..... ..... GEO-PM2.5 n.02
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA
Calibration date ..... ..... ..... . 02/12, 02/19 and 02/26/2019

- TRI-GAS INSTRUMENT ( SMALL VOLUME SAMPLER FOR GASES)

Team N. ..... ..... ..... ... ..... GEO-WHEAT 02
Maker ..... ..... . .... ENERGÉTICA IND. E COM. LTDA

- HYPOTHERMAL NEEDLES

NEEDLE 2,0 L / min (SO2 pigtail ). ..... ..... OC-152
NEEDLE 0.2 L / min (NO2 Pigtail) ..... ..... OC -266
NEEDLE 0.2 L / min (H2S Pigtail) ..... ..... OC-268
NEEDLE 0.7 L / min (pigtail CO and O3 ) ..... ..... OC- 155
Manufacturer ..... .... ..... ENERGÉTICA IND. E COM. LTDA
Calibration Date (SO2, NO2, H2 S, O2 , CO ) ..... .... ..... 02/12, 02/19 and 02/26/2019

Volumetric burette 500 mL ..... ..... BO-500 -ML
Certificate number ..... ..... BO-500-ML17 / 08/16
Volumetric burette 150 mL ..... ..... BO-150 -ML
Certificate number ..... ..... BO-150-ML17 / 08/16
Calibration date ..... ..... ..... 08/17/16

- VOST DRY GASOMETER (COLLECTION of Reduced Total Sulfur and Volatile Organic Compounds, TRS and VOC in English)

Equipment n. ..... ..... ..... CCOV-001
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA.
Certificate number ..... ..... ..... 166A18


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### 3.2 – METHODS

**40 CFR Appendix B to Part 50** - Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

**40 CFR Appendix J to Part 50** - Reference Method for the Determination of Particulate Matter as $PM_{10}$ in the Atmosphere

**40 CFR Appendix L to Part 50** - Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere

**ISO 4220:1983** - Ambient air — Determination of a gaseous acid air pollution index — Titrimetric method with indicator or potentiometric end-point detection

**US EPA METHOD Nº QN 1277:1977 -** Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere

**EQOA-0206-148 -** Environnement S.A Model O342M UV Photometric Ozone Analyzer

**US EPA EMC Conditional Test Method (CTM-030)** - Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers
**US EPA Method 16A** - Total Reduced Sulfur – Impinger – Adapted Method for Monitoring Air Quality

**US EPA Method 11** — Determination Of Hydrogen Sulfide Content Of Fuel Gas Streams In Petroleum Refineries – Adapted Method for Monitoring Air Quality

**US EPA Method 18** - Volatile Organic Compounds by Gas Chromatography

In order to compare and study the results, the limits described in SEAM Resolution n. 259 of 7/3/2015 and the limits of air quality standards presented by the US EPA - Environmental Protection Agency were adopted.

For the determination of the local atmospheric pressure, a portable barometer, owned by **GEOAVALIAR Análise e Consultorias Ambientais Ltda**.

## 4.0 - CONDITIONS OF SAMPLING AND PRODUCTION

### 4.1 - CONSIDERATIONS

The evaluations meet the requirements of the sampling procedures / standards accepted by all environmental control agencies in the country.

Sampling was carried out in 03 (three) points, consisting of 07 (seven) collections per point, lasting approximately 24 (twenty four) hours for the Total Suspended Particles (PTS), Inhalable Particles (PI - $PM_{10}$) parameters), Breathable Particles ($PM_{2.5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Ozone ($O_3$), Sulphidic Gas ($H_2S$); approximately 1 (one) hour for the Reduced Total Sulfur (TRS) and Carbon Monoxide (CO) parameters, and 20 (twenty) minutes for the Volatile Organic Compounds (VOC)

The results presented are the responsibility of **GEOAVALIAR Análise e Consultorias Ambientais Ltda**, which are limited only to the conditions presented on the dates of the evaluations.


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# 5.0 – RESULTS

## 5.1 – TABLE OF RESULTS OF PARTICLES IN THE ATMOSPHERE

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-HI-VOL 002 | Calibration Date | 2019-09-25 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-09-25 | 2019-09-26 | 10:05 | 10:05 | | X | | X | | | 20,5 | 1,6369 | 1440 | 2119,81 | 147,05 | **69,37** |
| 2ª | 2019-09-26 | 2019-09-27 | 10:23 | 10:23 | X | | | X | | | 25,5 | 1,5634 | 1440 | 1997,53 | 273,65 | **136,99** |
| 3ª | 2019-09-27 | 2019-09-28 | 10:44 | 10:44 | X | | | X | | | 28,0 | 1,4516 | 1440 | 1835,47 | 369,10 | **201,09** |
| 4ª | 2019-09-28 | 2019-09-29 | 11:07 | 11:07 | X | | | X | | | 30,5 | 1,5202 | 1440 | 1917,97 | 288,75 | **150,55** |
| 5ª | 2019-09-29 | 2019-09-30 | 11:26 | 11:26 | X | | | X | | | 35,5 | 1,4968 | 1440 | 1868,97 | 211,70 | **113,27** |
| 6ª | 2019-09-30 | 2019-10-01 | 11:42 | 11:42 | X | | | X | | | 35,5 | 1,5584 | 1440 | 1952,48 | 255,60 | **130,91** |
| 7ª | 2019-10-01 | 2019-10-02 | 12:00 | 12:00 | X | | | X | | | 33,5 | 1,5228 | 1440 | 1912,20 | 341,60 | **178,64** |

**Note: The duration of each collection was 24 hours.**

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-PM-10 01 | Calibration Date | 2019-09-25 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-09-25 | 2019-09-26 | 10:05 | 10:05 | | X | | X | | | 20,5 | 1,1059 | 1440 | 1592,54 | 67,50 | **42,39** |
| 2ª | 2019-09-26 | 2019-09-27 | 10:23 | 10:23 | X | | | X | | | 25,5 | 1,1136 | 1440 | 1603,62 | 113,70 | **70,90** |
| 3ª | 2019-09-27 | 2019-09-28 | 10:44 | 10:44 | X | | | X | | | 28,0 | 1,1195 | 1440 | 1612,12 | 150,75 | **93,51** |
| 4ª | 2019-09-28 | 2019-09-29 | 11:07 | 11:07 | X | | | X | | | 30,5 | 1,1229 | 1440 | 1617,02 | 126,50 | **78,23** |
| 5ª | 2019-09-29 | 2019-09-30 | 11:26 | 11:26 | X | | | X | | | 35,5 | 1,1325 | 1440 | 1630,84 | 87,40 | **53,59** |
| 6ª | 2019-09-30 | 2019-10-01 | 11:42 | 11:42 | X | | | X | | | 35,5 | 1,1316 | 1440 | 1629,56 | 104,85 | **64,34** |
| 7ª | 2019-10-01 | 2019-10-02 | 12:00 | 12:00 | X | | | X | | | 33,5 | 1,1300 | 1440 | 1627,21 | 103,95 | **63,88** |

**Note: The duration of each collection was 24 hours.**

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-PM-2,5 01 | Calibration Date | 2019-09-25 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-09-25 | 2019-09-26 | 10:05 | 10:05 | | X | | X | | | 20,5 | 1,1017 | 1440 | 1586,38 | 50,70 | **31,96** |
| 2ª | 2019-09-26 | 2019-09-27 | 10:23 | 10:23 | X | | | X | | | 25,5 | 1,1111 | 1440 | 1599,95 | 90,10 | **56,31** |
| 3ª | 2019-09-27 | 2019-09-28 | 10:44 | 10:44 | X | | | X | | | 28,0 | 1,1164 | 1440 | 1607,60 | 105,85 | **65,84** |
| 4ª | 2019-09-28 | 2019-09-29 | 11:07 | 11:07 | X | | | X | | | 30,5 | 1,1206 | 1440 | 1613,59 | 94,25 | **58,41** |
| 5ª | 2019-09-29 | 2019-09-30 | 11:26 | 11:26 | X | | | X | | | 35,5 | 1,1288 | 1440 | 1625,53 | 69,60 | **42,82** |
| 6ª | 2019-09-30 | 2019-10-01 | 11:42 | 11:42 | X | | | X | | | 35,5 | 1,1293 | 1440 | 1626,19 | 85,40 | **52,52** |
| 7ª | 2019-10-01 | 2019-10-02 | 12:00 | 12:00 | X | | | X | | | 33,5 | 1,1252 | 1440 | 1620,36 | 81,60 | **50,36** |

**Note: The duration of each collection was 24 hours.**


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| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-HI-VOL 002 | Calibration Date | 2019-10-02 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-10-02 | 2019-10-03 | 15:26 | 15:26 | | X | | X | | | 26,5 | 1,4833 | 1440 | 2135,89 | 117,70 | **55,11** |
| 2ª | 2019-10-03 | 2019-10-04 | 15:43 | 15:43 | | X | | X | | | 27,5 | 1,3082 | 1440 | 1883,84 | 124,40 | **66,04** |
| 3ª | 2019-10-04 | 2019-10-05 | 15:59 | 15:59 | X | | | X | | | 27,5 | 1,3437 | 1440 | 1934,91 | 123,95 | **64,06** |
| 4ª | 2019-10-05 | 2019-10-06 | 16:17 | 15:37 | | | X | X | | | 18,5 | 1,3836 | 1400 | 1937,61 | 16,20 | **8,36** |
| 5ª | 2019-10-06 | 2019-10-07 | 15:56 | 15:16 | | | X | X | | | 20,0 | 1,3071 | 1400 | 1830,52 | 42,10 | **23,00** |
| 6ª | 2019-10-07 | 2019-10-08 | 15:35 | 14:55 | | X | | X | | | 22,0 | 1,3966 | 1400 | 1955,76 | 70,70 | **36,15** |
| 7ª | 2019-10-08 | 2019-10-09 | 15:14 | 14:34 | X | | | X | | | 26,0 | 1,3805 | 1400 | 1933,19 | 74,85 | **38,72** |

**Note: The duration of each collection was 24 hours.**

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-PM-10 01 | Calibration Date | 2019-10-02 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-10-02 | 2019-10-03 | 15:26 | 15:26 | | X | | X | | | 26,5 | 1,1205 | 1440 | 1613,59 | 53,10 | **32,91** |
| 2ª | 2019-10-03 | 2019-10-04 | 15:43 | 15:43 | | X | | X | | | 27,5 | 1,1217 | 1440 | 1615,18 | 61,25 | **37,92** |
| 3ª | 2019-10-04 | 2019-10-05 | 15:59 | 15:59 | X | | | X | | | 27,5 | 1,1226 | 1440 | 1616,58 | 50,70 | **31,36** |
| 4ª | 2019-10-05 | 2019-10-06 | 16:17 | 15:37 | | | X | X | | | 18,5 | 1,1047 | 1400 | 1547,01 | 8,35 | **5,40** |
| 5ª | 2019-10-06 | 2019-10-07 | 15:56 | 15:16 | | | X | X | | | 20,0 | 1,1088 | 1400 | 1552,70 | 18,20 | **11,72** |
| 6ª | 2019-10-07 | 2019-10-08 | 15:35 | 14:55 | | X | | X | | | 22,0 | 1,1131 | 1400 | 1558,80 | 31,60 | **20,27** |
| 7ª | 2019-10-08 | 2019-10-09 | 15:14 | 14:34 | X | | | X | | | 26,0 | 1,1192 | 1400 | 1567,39 | 34,15 | **21,79** |

**Note: The duration of each collection was 24 hours.**

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-PM-2,5 01 | Calibration Date | 02/10/19 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1ª | 2019-10-02 | 2019-10-03 | 15:26 | 15:26 | | X | | X | | | 26,5 | 1,1190 | 1440 | 1611,33 | 45,70 | **28,36** |
| 2ª | 2019-10-03 | 2019-10-04 | 15:43 | 15:43 | | X | | X | | | 27,5 | 1,1205 | 1440 | 1613,55 | 49,20 | **30,49** |
| 3ª | 2019-10-04 | 2019-10-05 | 15:59 | 15:59 | X | | | X | | | 27,5 | 1,1201 | 1440 | 1612,99 | 45,15 | **27,99** |
| 4ª | 2019-10-05 | 2019-10-06 | 16:17 | 15:37 | | | X | X | | | 18,5 | 1,1042 | 1400 | 1546,38 | 7,30 | **4,72** |
| 5ª | 2019-10-06 | 2019-10-07 | 15:56 | 15:16 | | | X | X | | | 20,0 | 1,1061 | 1400 | 1548,93 | 14,10 | **9,10** |
| 6ª | 2019-10-07 | 2019-10-08 | 15:35 | 14:55 | | X | | X | | | 22,0 | 1,1105 | 1400 | 1555,15 | 25,65 | **16,49** |
| 7ª | 2019-10-08 | 2019-10-09 | 15:14 | 14:34 | X | | | X | | | 26,0 | 1,1183 | 1400 | 1566,08 | 29,00 | **18,52** |

**Note: The duration of each collection was 24 hours.**


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| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-HI-VOL 002 | Calibration Date | 09/10/19 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| 1ª | 2019-10-09 | 2019-10-10 | 18:09 | 17:29 | X | | | X | | | 30,5 | 1,5780 | 1400 | 2209,86 | 120,55 | **54,55** |
| 2ª | 2019-10-10 | 2019-10-11 | 17:46 | 17:06 | X | | | X | | | 31,0 | 1,5506 | 1400 | 2171,52 | 69,60 | **32,05** |
| 3ª | 2019-10-11 | 2019-10-12 | 17:23 | 16:43 | X | | | | X | | 33,0 | 1,6445 | 1400 | 2302,92 | 80,30 | **34,87** |
| 4ª | 2019-10-12 | 2019-10-13 | 17:01 | 16:21 | X | | | | X | | 32,0 | 1,6340 | 1400 | 2288,28 | 93,25 | **40,75** |
| 5ª | 2019-10-13 | 2019-10-14 | 16:37 | 15:57 | X | | | X | | | 30,5 | 1,6831 | 1400 | 2356,99 | 84,60 | **35,89** |
| 6ª | 2019-10-14 | 2019-10-15 | 16:14 | 15:34 | | X | | X | | | 55,0 | 1,5423 | 1400 | 2159,89 | 51,55 | **23,87** |
| 7ª | 2019-10-15 | 2019-10-16 | 15:52 | 15:12 | | | X | X | | | 21,5 | 1,5451 | 1400 | 2163,77 | 36,70 | **16,96** |

**Note: The duration of each collection was 24 hours.**

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-PM-10 01 | Calibration Date | 09/10/19 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| 1ª | 2019-10-09 | 2019-10-10 | 18:09 | 17:29 | X | | | X | | | 30,5 | 1,1274 | 1400 | 1578,84 | 46,30 | **29,33** |
| 2ª | 2019-10-10 | 2019-10-11 | 17:46 | 17:06 | X | | | X | | | 31,0 | 1,1291 | 1400 | 1581,20 | 32,10 | **20,30** |
| 3ª | 2019-10-11 | 2019-10-12 | 17:23 | 16:43 | X | | | | X | | 33,0 | 1,1313 | 1400 | 1584,30 | 42,60 | **26,89** |
| 4ª | 2019-10-12 | 2019-10-13 | 17:01 | 16:21 | X | | | | X | | 32,0 | 1,1304 | 1400 | 1583,00 | 43,85 | **27,70** |
| 5ª | 2019-10-13 | 2019-10-14 | 16:37 | 15:57 | X | | | X | | | 30,5 | 1,1273 | 1400 | 1578,68 | 40,50 | **25,65** |
| 6ª | 2019-10-14 | 2019-10-15 | 16:14 | 15:34 | | X | | X | | | 55,0 | 1,1732 | 1400 | 1642,94 | 27,95 | **17,01** |
| 7ª | 2019-10-15 | 2019-10-16 | 15:52 | 15:12 | | | X | X | | | 21,5 | 1,1159 | 1400 | 1562,67 | 11,55 | **7,39** |

**Note: The duration of each collection was 24 hours.**

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-PM-2,5 01 | Calibration Date | 09/10/19 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| 1ª | 2019-10-09 | 2019-10-10 | 18:09 | 17:29 | X | | | X | | | 30,5 | 1,1297 | 1400 | 1581,97 | 33,65 | **21,27** |
| 2ª | 2019-10-10 | 2019-10-11 | 17:46 | 17:06 | X | | | X | | | 31,0 | 1,1314 | 1400 | 1584,39 | 22,60 | **14,26** |
| 3ª | 2019-10-11 | 2019-10-12 | 17:23 | 16:43 | X | | | | X | | 33,0 | 1,1345 | 1400 | 1588,76 | 25,90 | **16,30** |
| 4ª | 2019-10-12 | 2019-10-13 | 17:01 | 16:21 | X | | | | X | | 32,0 | 1,1323 | 1400 | 1585,71 | 29,30 | **18,48** |
| 5ª | 2019-10-13 | 2019-10-14 | 16:37 | 15:57 | X | | | X | | | 30,5 | 1,1298 | 1400 | 1582,18 | 25,50 | **16,12** |
| 6ª | 2019-10-14 | 2019-10-15 | 16:14 | 15:34 | | X | | X | | | 55,0 | 1,1749 | 1400 | 1645,39 | 18,80 | **11,43** |
| 7ª | 2019-10-15 | 2019-10-16 | 15:52 | 15:12 | | | X | X | | | 21,5 | 1,1131 | 1400 | 1558,72 | 8,50 | **5,45** |

**Note: The duration of each collection was 24 hours.**


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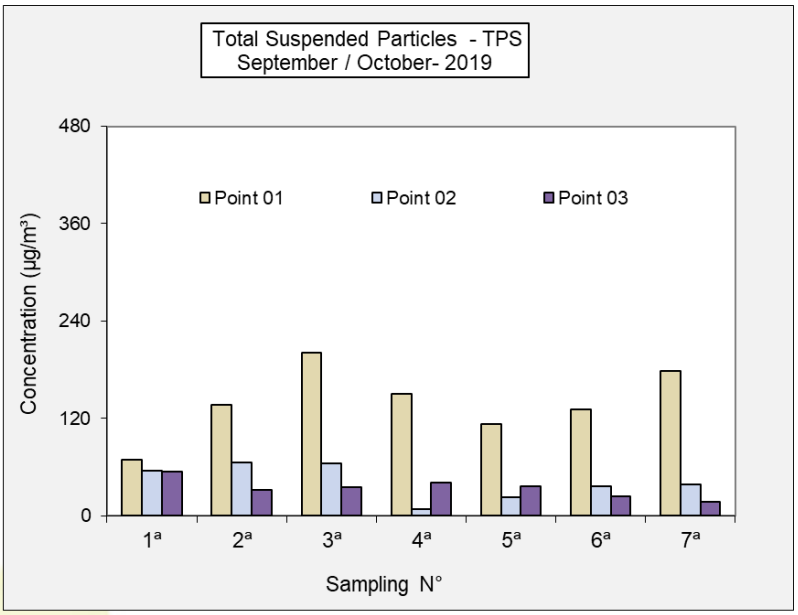
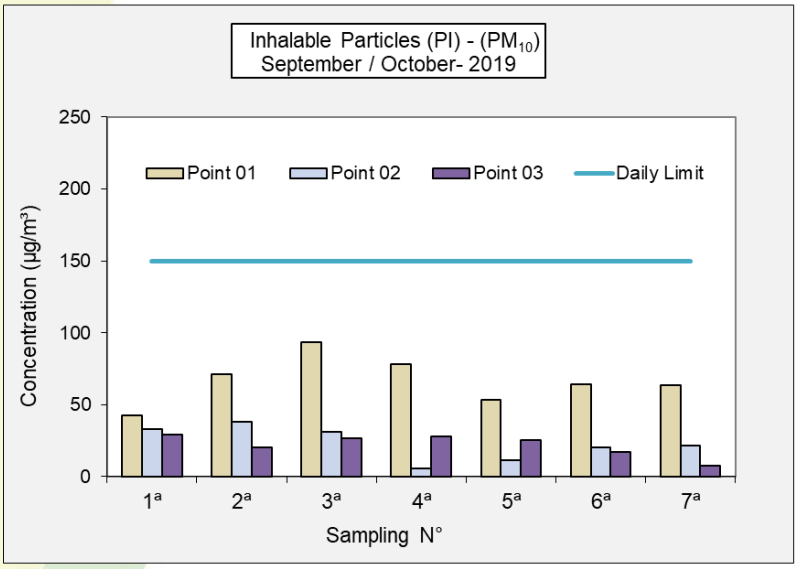
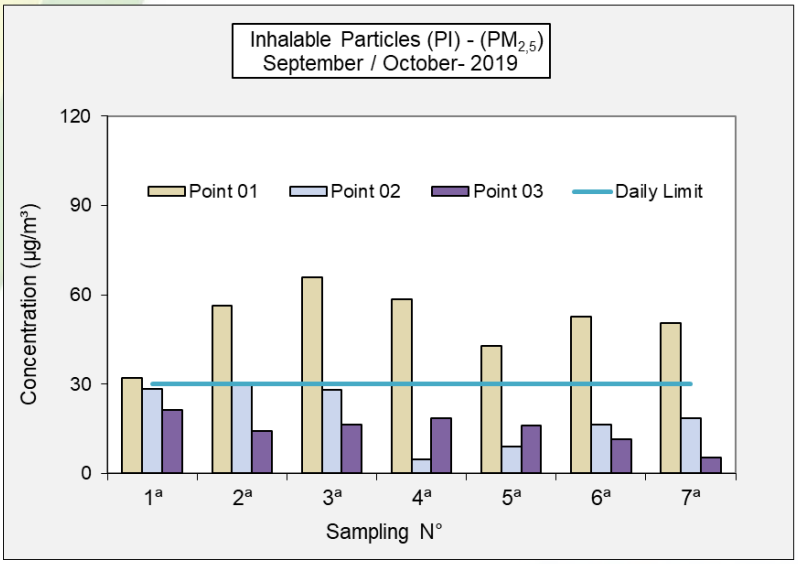
### 5.1.1 – GRAPHICS





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## 5.2 – TABLE OF RESULTS OF GASES IN THE ATMOSPHERE

| AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | | | |
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (ºC) | Concentration (mg / m³) | | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2019-09-25 | 2019-09-26 | 10:05 to 10:05 | 14:29 to 15:29 | 13:20 as 13:20 | 11:30 to 11:50 | | X | | X | | | 293,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-09-26 | 2019-09-27 | 10:22 to 10:22 | 10:44 to 11:44 | 09:31 to 9:31 | 09:05 to 09:25 | X | | | X | | | 298,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-09-27 | 2019-09-28 | 10:44 to 10:44 | 11:11 to 12:11 | 10:50 to a 10:50 | 09:11 to 09:31 | X | | | X | | | 301,0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-09-28 | 2019-09-29 | 11:07 to 11:07 | 10:47 to 11:47 | 08:57 to 08:57 | 10:09 to 10:29 | X | | | X | | | 303,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-09-29 | 2019-09-30 | 11:26 to 11:26 | 10:45 to 11:45 | 08:55 to 08:55 | 10:06 to 10:26 | X | | | X | | | 308,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-09-30 | 2019-10-01 | 11:42 to 11:42 | 10:18 to 11:18 | 08:33 to 08:33 | 09:44 to 10:04 | X | | | X | | | 308,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-01 | 2019-10-02 | 12:00 to 12:00 | 10:14 to 11:14 | 08:30:00 to 08:30 | 09:41 to 10:01 | X | | | X | | | 306,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |

| AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | | | |
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (ºC) | Concentration (mg / m³) | | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2019-10-02 | 2019-10-03 | 15:27 to 15:27 | 15:29 to 16:29 | 14:01 to 15:01 | 15:04 to 15:24 | | X | | X | | | 299,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-03 | 2019-10-04 | 15:43 to 15:43 | 14:41 to 15:41 | 13:04 to 14:04 | 14:09 to 14:29 | | X | | X | | | 300,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-04 | 2019-10-05 | 16:00 to 16:00 | 14:51 to 15:51 | 12:55 to 13:55 | 14:05 to 14:25 | X | | | X | | | 300,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-05 | 2019-10-06 | 16:17 to 16:17 | 14:26 to 15:26 | 12:37 to 13:37 | 13:51 to 14:11 | | | X | X | | | 291,5 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-06 | 2019-10-07 | 15:56 to 15:56 | 14:16 to 15:16 | 13:12 to 14:12 | 12:41 to 13:01 | | | X | X | | | 293,0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-07 | 2019-10-08 | 15:35 to 15:35 | 14:02 to 15:02 | 12:22 to 13:22 | 13:30 to 13:50 | | X | | X | | | 295,0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |
| | 2019-10-08 | 2019-10-09 | 15:14 to 15:24 | 14:15 to 15:15 | 12:45 to 13:45 | 13:51 to 14:11 | X | | | X | | | 299,0 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. |


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| AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | |
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (°C) | Concentration (mg / m³) | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| **Point 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit** | 2019-10-09 | 2019-10-10 | 18:09 ás 18:09 | 15:58 to 16:58 | 17:51 ás 17:51 | 18:54 to 19:14 | X | | | X | | | 303,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-10 | 2019-10-11 | 17:45 ás 17:45 | 14:50 to 15:50 | 14:30 ás 14:30 | 15:33 to 15:53 | X | | | X | | | 304,0 | **N.D.** | **N.D.** | **98,98** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-11 | 2019-10-12 | 17:23 ás 17:23 | 14:25 to 15:25 | 15:56 ás 15:56 | 17:01 to 17:21 | X | | | | X | | 306,0 | **N.D.** | **N.D.** | **98,68** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-12 | 2019-10-13 | 17:01 ás 17:01 | 14:06 to 15:06 | 15:31 ás 15:31 | 16:38 to 16:58 | X | | | | X | | 305,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-13 | 2019-10-14 | 16:37 ás 16:37 | 13:56 to 14:56 | 15:10 ás 15:10 | 16:15 to 16:35 | X | | | X | | | 303,5 | **N.D.** | **N.D.** | **99,06** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-14 | 2019-10-15 | 16:14 ás 16:14 | 13:25 to 14:25 | 15:04 ás 15:04 | 16:09 to 16:29 | | X | | X | | | 295,0 | **N.D.** | **N.D.** | **100,49** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2019-10-15 | 2019-10-16 | 15:52 ás 15:52 | 13:05 to 14:05 | 14:43 ás 14:42 | 15:46 to 16:06 | | | X | X | | | 294,5 | **N.D.** | **N.D.** | **25,14** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |


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# 6.0 - AIR QUALITY INDEX

## 6.1 – AIR QUALITY INDEX IN ACCORDANCE WITH US EPA:

Considering the past practices and currently developed by the EPA - "Environmental Protection Agency" (United States of North America), it was published through the PSI - Pollutant Standard Index, the Air Quality Index, which presents values obtained by a linear algebraic operation. This algebraic function verified the concentration ratio of gaseous pollutants in dimensionless number (IQA). The following table shows the rating of the values:

| AIR QUALITY INDEX - AQI | | | |
|---|---|---|---|
| PTS ($\mu g/m^3$) | IQA | AIR QUALITY | REFERENCE COLOR |
| 0 - 80 | 0 -50 | GOOD | |
| 81 - 240 | 51 -100 | MODERATE | |
| 241 - 375 | 101 - 199 | UNHEALTHY | |
| 376 - 625 | 200 - 299 | BAD | |
| 626 - 875 | 300 - 399 | VERY BAD | |
| 2100 | 400 | CRITICAL | |

In the late 1990s, the EPA did not announce a calculation procedure for the Total Suspended Particles (PTS) standard, and also revised calculation procedures for PM10 and PM2.5, according to the following table:

| AIR QUALITY INDEX - AQI | | | | |
|---|---|---|---|---|
| PM10 ($\mu g/m^3$) | PM2,5 ($\mu g/m^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
| 0 - 54 | 0 - 15 | 0 - 50 | GOOD | |
| 55 - 154 | 16 - 35 | 51 - 100 | MODERATE | |
| 155 - 254 | 36 - 65 | 101 - 150 | UNHEATHY (1) | |
| 255 - 354 | 66 - 150 | 151 - 200 | UNHEATHY | |
| 355 - 424 | 151 - 250 | 201 - 300 | VERY UNHEATHY | |
| 425 - 504 | 251 - 350 | 301 - 400 | HAZARDOUS | |
| 505 - 604 | 351 - 500 | 401 - 500 | | |

**Nota: (1)** - Unhealthy for sensitive groups


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**Ponto 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL**

**PTS - PARTÍCULAS TOTAIS EM SUSPENSÃO**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 25/09/19 | 69,37 | 43 | GOOD | |
| 26/09/19 | 136,99 | 68 | MODERATE | |
| 27/09/19 | 201,09 | 88 | MODERATE | |
| 28/09/19 | 150,55 | 72 | MODERATE | |
| 29/09/19 | 113,27 | 61 | MODERATE | |
| 30/09/19 | 130,91 | 66 | MODERATE | |
| 01/10/19 | 178,64 | 81 | MODERATE | |
| **Média geométrica** | **133,66** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{10}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 25/09/19 | 42,39 | 39 | GOOD | |
| 26/09/19 | 70,90 | 59 | MODERATE | |
| 27/09/19 | 93,51 | 70 | MODERATE | |
| 28/09/19 | 78,23 | 62 | MODERATE | |
| 29/09/19 | 53,59 | 50 | GOOD | |
| 30/09/19 | 64,34 | 56 | MODERATE | |
| 01/10/19 | 63,88 | 55 | MODERATE | |
| **Média aritmética** | **66,69** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{2,5}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 25/09/19 | 31,96 | 92 | MODERATE | |
| 26/09/19 | 56,31 | 135 | UNHEALTHY (1) | |
| 27/09/19 | 65,84 | 151 | UNHEALTHY | |
| 28/09/19 | 58,41 | 139 | UNHEALTHY (1) | |
| 29/09/19 | 42,82 | 113 | UNHEALTHY (1) | |
| 30/09/19 | 52,52 | 129 | UNHEALTHY (1) | |
| 01/10/19 | 50,36 | 125 | UNHEALTHY (1) | |
| **Média aritmética** | **51,17** | | | |


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**Ponto 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY**

**PTS - PARTÍCULAS TOTAIS EM SUSPENSÃO**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 02/10/19 | 54,16 | 34 | GOOD | |
| 03/10/19 | 66,04 | 41 | GOOD | |
| 04/10/19 | 64,06 | 40 | GOOD | |
| 05/10/19 | 8,36 | 05 | GOOD | |
| 06/10/19 | 23,00 | 14 | GOOD | |
| 07/10/19 | 36,15 | 23 | GOOD | |
| 08/10/19 | 38,72 | 24 | GOOD | |
| **Média geométrica** | **34,79** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{10}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 02/10/19 | 32,91 | 30 | GOOD | |
| 03/10/19 | 37,92 | 35 | GOOD | |
| 04/10/19 | 31,36 | 29 | GOOD | |
| 05/10/19 | 5,40 | 05 | GOOD | |
| 06/10/19 | 11,72 | 11 | GOOD | |
| 07/10/19 | 20,27 | 19 | GOOD | |
| 08/10/19 | 21,79 | 20 | GOOD | |
| **Média aritmética** | **23,05** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{2,5}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 02/10/19 | 28,36 | 83 | MODERATE | |
| 03/10/19 | 30,49 | 88 | MODERATE | |
| 04/10/19 | 27,99 | 82 | MODERATE | |
| 05/10/19 | 4,72 | 04 | GOOD | |
| 06/10/19 | 9,10 | 08 | GOOD | |
| 07/10/19 | 16,49 | 52 | MODERATE | |
| 08/10/19 | 18,52 | 57 | MODERATE | |
| **Média aritmética** | **19,38** | | | |


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**Ponto 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT**

**PTS - PARTÍCULAS TOTAIS EM SUSPENSÃO**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 09/10/19 | 54,55 | 34 | GOOD | |
| 10/10/19 | 32,05 | 20 | GOOD | |
| 11/10/19 | 34,87 | 22 | GOOD | |
| 12/10/19 | 40,75 | 25 | GOOD | |
| 13/10/19 | 35,89 | 22 | GOOD | |
| 14/10/19 | 23,87 | 15 | GOOD | |
| 15/10/19 | 16,96 | 11 | GOOD | |
| **Média geométrica** | **32,23** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{10}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 09/10/19 | 29,33 | 27 | GOOD | |
| 10/10/19 | 20,30 | 19 | GOOD | |
| 11/10/19 | 26,89 | 25 | GOOD | |
| 12/10/19 | 27,70 | 26 | GOOD | |
| 13/10/19 | 25,65 | 24 | GOOD | |
| 14/10/19 | 17,01 | 16 | GOOD | |
| 15/10/19 | 7,39 | 07 | GOOD | |
| **Média aritmética** | **22,04** | | | |

**PI - PARTÍCULAS INALÁVEIS ($PM_{2,5}$)**

| DATA | CONCENTRAÇÃO ($\mu g/m^3$) | IQA | QUALIDADE DO AR | COR DE REFERÊNCIA |
|---|---|---|---|---|
| 09/10/19 | 21,27 | 65 | MODERATE | |
| 10/10/19 | 14,26 | 13 | GOOD | |
| 11/10/19 | 16,30 | 52 | MODERATE | |
| 12/10/19 | 18,48 | 57 | MODERATE | |
| 13/10/19 | 16,12 | 51 | MODERATE | |
| 14/10/19 | 11,43 | 11 | GOOD | |
| 15/10/19 | 5,45 | 05 | GOOD | |
| **Média geométrica** | **13,73** | | | |


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# 7.0 – DECLARATION OF CONFORMITY

Measurement results are presented in the following table.

**Analytical Results**
**September-October / 2019 concentrations**

| Monitoring Stations | Sampling | Monitoring Results | | | | | | | | | | According to Resolution SEAM nº 259 fron 3 rd july 2015 ( µg/m3 ) | | | | | | | | CETESB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PTS (MP) µg/m³ (24 hours) | PI (PM 10) µg/m³ (24 hours) | PI (PM 2,5) µg/m³ (24 hours) | $SO_2$ µg/m³ (24 hours) | $NO_2$ µg/m³ (1 hour) | VOC µg/m³ (20 minutes) | $O_3$ µg/m³ (8 hours) | CO µg/m³ (8 hours) | TRS µg/m³ (1 hour) | $H_2S$ µg/m³ (24 hours) | PTS | PI (PM10) | PI (PM2,5) | $SO_2$ | $NO_2$ | VOC | $O_3$ | CO | TRS | $H_2S$ |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 1ª | 69,37 | 42,39 | 31,96 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 136,99 | 70,90 | 56,31 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 201,09 | 93,51 | 65,84 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 150,55 | 78,23 | 58,41 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 113,27 | 53,59 | 42,82 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 130,91 | 64,34 | 52,52 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 178,64 | 63,88 | 50,36 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 1ª | 55,11 | 32,91 | 28,36 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 66,04 | 37,92 | 30,49 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 3ª | 64,06 | 31,36 | 27,99 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 4ª | 8,36 | 5,40 | 4,72 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | 150 | 30 | 20 | 200 | | 120 | 10 | 6,55 | 6,55 |
| | 5ª | 23,00 | 11,72 | 9,10 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 6ª | 36,15 | 20,27 | 16,49 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 7ª | 38,72 | 21,79 | 18,52 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Point 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit | 1ª | 54,55 | 29,33 | 21,27 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2ª | 32,05 | 20,30 | 14,26 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 98,98 | | | | | | | | | | |
| | 3ª | 34,87 | 26,89 | 16,30 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 98,68 | | | | | | | | | | |
| | 4ª | 40,75 | 27,70 | 18,48 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 5ª | 35,89 | 25,65 | 16,12 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 99,06 | | | | | | | | | | |
| | 6ª | 23,87 | 17,01 | 11,43 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 100,49 | | | | | | | | | | |
| | 7ª | 16,96 | 7,39 | 5,45 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | 25,14 | | | | | | | | | | |

**PTS - Total Particles in Suspension**

Considering Resolution n. 259 of the SEAM of July 3, 2015, there is no limit for Total Particles in Suspension (PTS), therefore, the interpretation of the reported results is in charge of the environmental body.

**Inhalable Particles (PI - $PM_{10}$)**

Considering the limit established by Resolution n. 259 of the SEAM of July 3, 2015, whose maximum 24-hour concentration of Inhalable Particles ($PM_{10}$) is 150 µg / $m^3$, after comparing the results obtained, it was confirmed that in the monitored period all data collections were showed below the limit established in the regulations.

**Breathable Particles (PR - $PM_{2,5}$)**

Considering the limit established in SEAM Resolution No. 259 of July 3, 2015, whose maximum concentration in the 24-hour period of Breathable Particles ($PM_{2.5}$) is 30 µg / $m^3$, after comparing the data obtained, it was revealed that all the collections from Point 01 – SENACSA / Departmental Commission on Animal Health, and one collection from Point 02 - Loreto Municipality, presented concentration above the regulations. It is possible that it is material associated with resuspension of particulate originating from unpaved roads and emission of vehicles moved with diesel fuel. Other data obtained showed concentration below the limit established by said resolution in the monitoring period.

The company GEOAVALIAR, through its experts responsible for the monitoring carried out, understands that the difference observed in the premises (Monitoring Points) originates from circumstances around Point 01 (SENACSA / Departmental Commission on Animal Health), in Concepción, Paraguay. That monitoring point has unpaved public roads and are largely diesel-fueled vehicles. Thus, the phenomenon of particulate resuspension and vehicle emissions contribute by the addition in the analyzes carried out, since points 02 and 03 are located respectively in a small jurisdiction and rural area and show little or no influence on the phenomena. verified.

**$SO_2$ - Sulfur Dioxide**

Considering the limit established by Resolution n. 259 of the SEAM of July 3, 2015, and the maximum allowed 24-hour concentration of Sulfur Dioxide ($SO_2$) of 20 µg / $^{m3}$, after comparing the results obtained, the concentration was verified below the regulatory limit, because it was not detected .

**$NO_2$ - Nitrogen Dioxide**

Considering the limit established by Resolution n. 259 of the SEAM of July 3, 2015, and the maximum concentration of 1 (one) hour of Nitrogen Dioxide ($NO_2$) of 200 µg / m3, after comparing the obtained data, it was verified that all collected data were presented under of the limit, once the parameter was not detected.

**$O_3$ - Tropospheric Ozone**

It is verified that the data obtained in the 21 samplings presented data below the limit established in Resolution n. 259 of the SEAM of July 3, 2015 whose average concentration of 8 (eight) hours is 120 µg / $m^3$.

**CO - Carbon monoxide**

The results obtained in the 21 samplings were below the limit established by Resolution n. 259 of the SEAM of July 3, 2015, whose average concentration of 8 (eight) hours is 10 µg / $m^3$.


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**$H_2S$ - Total Reduced Sulfur and Hydrogen Sulfide**

In the technical literature there is no reference to emission limits for these parameters. Therefore, the control body must establish a comparison between the data obtained and international environmental regulations.

Similarly, Geoavaliar company through its experts and technicians responsible for monitoring, at Point 03 - Colonia Roberto L. Petit (in Concepción, PY), with the help of satellite images available on Google Earth and local evaluation, it was verified possible emission sources of the pollutant hydrogen sulfide through lagoons and water wells containing vegetation in the eutrophication and putrefaction process in a town close to the monitoring equipment and devices. From this consideration we managed to attribute the emission of hydrogen sulfide originated from the Anaerobic Digestion process (process of conversion of organic matter in conditions of oxygen absence), accepting inorganic electrons such as $NO_3$ (reduction of Nitrate), $SO_4$ ( Sulfate reduction) or methane formation ($CH_4$). Anaerobic digestion can be considered as an ecosystem of diverse groups of microorganisms that are in interaction for the conversion of complex organic matter into methane, carbon dioxide, water, hydrogen sulfide gas and ammonia, and other new bacterial cells. It is highlighted that the results obtained are expressed in micrograms per cubic meter of the collected air, and any source of contribution in the vicinity is capable of significantly altering the results.

Contagem, Jan. 13, 2019.

**Leonardo de Salles**
CREA MG - 093653D
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# 8.0 – ANNEXES

**- FIELD DATA -**

**- ANALYTICAL AWARD -**

**- SATELLITE IMAGE AND IDENTIFICATION OF THE MONITORING POINT -**

**- CALIBRATION AND TECHNICAL CONTROL**


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| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | set/19 | $a_2$ = | 1,1293 | $b_2$= | 0,2628 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** Sampler N° GEO-HI-VOL 002

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2019-09-25 | 10282,85 | 10306,85 | 1440,0 | 147,05 | 3,68 | 1,64 | 1,47 | 2357,16 | 2119,81 |
| 2 | 2019-09-26 | 10306,87 | 10330,87 | 1440,0 | 273,65 | 3,38 | 1,56 | 1,39 | 2251,31 | 1997,53 |
| 3 | 2019-09-27 | 10330,88 | 10354,88 | 1440,0 | 369,10 | 2,95 | 1,45 | 1,27 | 2090,27 | 1835,47 |
| 4 | 2019-09-28 | 10354,88 | 10378,88 | 1440,0 | 288,75 | 3,21 | 1,52 | 1,33 | 2189,06 | 1917,97 |
| 5 | 2019-09-29 | 10378,88 | 10402,88 | 1440,0 | 211,70 | 3,12 | 1,50 | 1,30 | 2155,38 | 1868,97 |
| 6 | 2019-09-30 | 10402,88 | 10426,88 | 1440,0 | 255,60 | 3,36 | 1,56 | 1,36 | 2244,08 | 1952,48 |
| 7 | 2019-10-01 | 10426,88 | 10450,88 | 1440,0 | 341,60 | 3,22 | 1,52 | 1,33 | 2192,77 | 1912,20 |

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | set/19 | $a_2$ = | 5,5854 | $b_2$= | 0,6059 |
|---|---|---|---|---|---|---|---|

**PM10 SAMPLING CALCULATIONS** Sampler N° GEO-PM-10 01

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2019-09-25 | 5502,11 | 5526,11 | 1440,0 | 67,50 | 34,2 | 34,8 | 1,1059 | 1592,54 |
| 2 | 2019-09-26 | 5526,12 | 5550,12 | 1440,0 | 113,70 | 34,8 | 35,3 | 1,1136 | 1603,62 |
| 3 | 2019-09-27 | 5550,13 | 5574,13 | 1440,0 | 150,75 | 34,3 | 35,0 | 1,1195 | 1612,12 |
| 4 | 2019-09-28 | 5574,14 | 5598,14 | 1440,0 | 126,50 | 34,6 | 35,4 | 1,1229 | 1617,02 |
| 5 | 2019-09-29 | 5598,15 | 5622,15 | 1440,0 | 87,40 | 34,4 | 35,4 | 1,1325 | 1630,84 |
| 6 | 2019-09-30 | 5622,15 | 5646,15 | 1440,0 | 104,85 | 34,7 | 35,7 | 1,1316 | 1629,56 |
| 7 | 2019-10-01 | 5646,16 | 5670,16 | 1440,0 | 103,95 | 34,1 | 35,0 | 1,1300 | 1627,21 |

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | set/19 | $a_2$ = | 7,9302 | $b_2$= | 0,4489 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** Sampler N° GEO-PM-2,5 01

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2019-09-25 | 10281,04 | 10305,04 | 1440,0 | 50,70 | 42,2 | 42,5 | 1,1017 | 1586,38 |
| 2 | 2019-09-26 | 10305,04 | 10329,04 | 1440,0 | 90,10 | 42,1 | 42,5 | 1,1111 | 1599,95 |
| 3 | 2019-09-27 | 10329,06 | 10353,06 | 1440,0 | 105,85 | 41,8 | 42,2 | 1,1164 | 1607,60 |
| 4 | 2019-09-28 | 10353,07 | 10377,07 | 1440,0 | 94,25 | 42,0 | 42,3 | 1,1206 | 1613,59 |
| 5 | 2019-09-29 | 10377,07 | 10401,07 | 1440,0 | 69,60 | 42,4 | 42,8 | 1,1288 | 1625,53 |
| 6 | 2019-09-30 | 10401,07 | 10425,07 | 1440,0 | 85,40 | 42,2 | 42,6 | 1,1293 | 1626,19 |
| 7 | 2019-10-01 | 10425,08 | 10449,08 | 1440,0 | 81,60 | 42,4 | 42,8 | 1,1252 | 1620,36 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 10:05 | 10:05 | | X | | X | | | 754,30 | 20,50 | 293,65 |
| 10:23 | 10:23 | X | | | X | | | 754,10 | 25,50 | 298,65 |
| 10:44 | 10:44 | X | | | X | | | 754,40 | 28,00 | 301,15 |
| 11:07 | 11:07 | X | | | X | | | 753,20 | 30,50 | 303,65 |
| 11:26 | 11:26 | X | | | X | | | 753,80 | 35,50 | 308,65 |
| 11:42 | 11:42 | X | | | X | | | 754,00 | 35,50 | 308,65 |
| 12:00 | 12:00 | X | | | X | | | 754,40 | 33,50 | 306,65 |


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| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | out/19 | $a_2$ = | 1,1156 | $b_2$= | 0,2657 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** **Sampler N°** **GEO-HI-VOL 002**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2019-10-02 | 10451,25 | 10475,25 | 1440,0 | 117,70 | 3,85 | 1,70 | 1,48 | 2443,75 | 2135,89 |
| 2 | 2019-10-03 | 10475,26 | 10499,26 | 1440,0 | 124,40 | 3,10 | 1,51 | 1,31 | 2173,09 | 1883,84 |
| 3 | 2019-10-04 | 10499,26 | 10523,26 | 1440,0 | 123,95 | 3,25 | 1,55 | 1,34 | 2229,85 | 1934,91 |
| 4 | 2019-10-05 | 10523,26 | 10546,60 | 1400,4 | 16,20 | 3,31 | 1,56 | 1,38 | 2190,22 | 1937,61 |
| 5 | 2019-10-06 | 10546,60 | 10569,94 | 1400,4 | 42,10 | 3,01 | 1,48 | 1,31 | 2079,50 | 1830,52 |
| 6 | 2019-10-07 | 10569,94 | 10593,28 | 1400,4 | 70,70 | 3,40 | 1,59 | 1,40 | 2222,36 | 1955,76 |
| 7 | 2019-10-08 | 10593,28 | 10616,62 | 1400,4 | 74,85 | 3,32 | 1,57 | 1,38 | 2193,81 | 1933,19 |

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | out/19 | $a_2$ = | 5,0167 | $b_2$= | 0,6393 |
|---|---|---|---|---|---|---|---|

**PM10 SAMPLING CALCULATIONS** **Sampler N°** **GEO-PM-10 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2019-10-02 | 5670,44 | 5694,44 | 1440,0 | 53,10 | 36,2 | 36,7 | 1,1205 | 1613,59 |
| 2 | 2019-10-03 | 5694,45 | 5718,45 | 1440,0 | 61,25 | 36,5 | 37,2 | 1,1217 | 1615,18 |
| 3 | 2019-10-04 | 5718,46 | 5742,46 | 1440,0 | 50,70 | 36,3 | 36,7 | 1,1226 | 1616,58 |
| 4 | 2019-10-05 | 5742,46 | 5765,8 | 1400,4 | 8,35 | 36,7 | 37,0 | 1,1047 | 1547,01 |
| 5 | 2019-10-06 | 5765,80 | 5789,14 | 1400,4 | 18,20 | 36,4 | 36,8 | 1,1088 | 1552,70 |
| 6 | 2019-10-07 | 5789,14 | 5812,48 | 1400,4 | 31,60 | 36,1 | 36,6 | 1,1131 | 1558,80 |
| 7 | 2019-10-08 | 5812,48 | 5835,82 | 1400,4 | 34,15 | 36,5 | 37,0 | 1,1192 | 1567,39 |

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | out/19 | $a_2$ = | 7,6780 | $b_2$= | 0,4621 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** **Sampler N°** **GEO-PM-2,5 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2019-10-02 | 10449,39 | 10473,39 | 1440,0 | 45,70 | 42,0 | 42,3 | 1,1190 | 1611,33 |
| 2 | 2019-10-03 | 10473,39 | 10497,39 | 1440,0 | 49,20 | 42,3 | 42,7 | 1,1205 | 1613,55 |
| 3 | 2019-10-04 | 10497,39 | 10521,39 | 1440,0 | 45,15 | 42,5 | 42,7 | 1,1201 | 1612,99 |
| 4 | 2019-10-05 | 10521,39 | 10544,73 | 1400,4 | 7,30 | 42,1 | 42,3 | 1,1042 | 1546,38 |
| 5 | 2019-10-06 | 10544,73 | 10568,07 | 1400,4 | 14,10 | 42,7 | 42,9 | 1,1061 | 1548,93 |
| 6 | 2019-10-07 | 10568,07 | 10591,41 | 1400,4 | 25,65 | 42,3 | 42,5 | 1,1105 | 1555,15 |
| 7 | 2019-10-08 | 10591,41 | 10614,75 | 1400,4 | 29,00 | 42,1 | 42,4 | 1,1183 | 1566,08 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 15:26 | 15:26 | | X | | X | | | 745,40 | 26,50 | 299,65 |
| 15:43 | 15:43 | | X | | X | | | 749,00 | 27,50 | 300,65 |
| 15:59 | 15:59 | X | | | X | | | 747,70 | 27,50 | 300,65 |
| 16:17 | 15:37 | | | X | X | | | 748,70 | 18,50 | 291,65 |
| 15:56 | 15:16 | | | X | X | | | 751,10 | 20,00 | 293,15 |
| 15:35 | 14:55 | | X | | X | | | 749,50 | 22,00 | 295,15 |
| 15:14 | 14:34 | X | | | X | | | 749,30 | 26,00 | 299,15 |


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| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | out/19 | $a_2$ = | 1,0805 | $b_2$= | 0,3228 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** — Sampler N° GEO-HI-VOL 002

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2019-10-09 | 10616,91 | 10640,25 | 1400,4 | 120,55 | 3,23 | 1,58 | 1,33 | 2209,86 | 1867,51 |
| 2 | 2019-10-10 | 10640,26 | 10663,60 | 1400,4 | 69,60 | 3,13 | 1,55 | 1,31 | 2171,52 | 1830,66 |
| 3 | 2019-10-11 | 10663,61 | 10686,95 | 1400,4 | 80,30 | 3,48 | 1,64 | 1,39 | 2302,92 | 1941,05 |
| 4 | 2019-10-12 | 10686,95 | 10710,29 | 1400,4 | 93,25 | 3,44 | 1,63 | 1,38 | 2288,28 | 1932,27 |
| 5 | 2019-10-13 | 10710,29 | 10733,63 | 1400,4 | 84,60 | 3,63 | 1,68 | 1,43 | 2356,99 | 1998,28 |
| 6 | 2019-10-14 | 10733,63 | 10756,97 | 1400,4 | 51,55 | 3,10 | 1,54 | 1,24 | 2159,89 | 1740,60 |
| 7 | 2019-10-15 | 10756,97 | 10780,31 | 1400,4 | 36,70 | 3,11 | 1,55 | 1,33 | 2163,77 | 1857,84 |

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | out/19 | $a_2$ = | 4,9592 | $b_2$= | 0,6417 |
|---|---|---|---|---|---|---|---|

**PM10 SAMPLING CALCULATIONS** — Sampler N° GEO-PM-10 01

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2019-10-09 | 5836,13 | 5859,47 | 1400,4 | 46,30 | 36,6 | 37,1 | 1,1274 | 1578,84 |
| 2 | 2019-10-10 | 5859,47 | 5882,81 | 1400,4 | 32,10 | 36,4 | 36,8 | 1,1291 | 1581,20 |
| 3 | 2019-10-11 | 5882,83 | 5906,17 | 1400,4 | 42,60 | 36,8 | 37,3 | 1,1313 | 1584,30 |
| 4 | 2019-10-12 | 5906,18 | 5929,52 | 1400,4 | 43,85 | 36,5 | 37,1 | 1,1304 | 1583,00 |
| 5 | 2019-10-13 | 5929,53 | 5952,87 | 1400,4 | 40,50 | 36,6 | 37,1 | 1,1273 | 1578,68 |
| 6 | 2019-10-14 | 5952,87 | 5976,21 | 1400,4 | 27,95 | 36,3 | 36,7 | 1,1732 | 1642,94 |
| 7 | 2019-10-15 | 5976,21 | 5999,55 | 1400,4 | 11,55 | 36,4 | 36,8 | 1,1159 | 1562,67 |

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | out/19 | $a_2$ = | 6,7468 | $b_2$= | 0,5215 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** — Sampler N° GEO-PM-2,5 01

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2019-10-09 | 10615,08 | 10638,42 | 1400,4 | 33,65 | 41,8 | 42,1 | 1,1297 | 1581,97 |
| 2 | 2019-10-10 | 10638,43 | 10661,77 | 1400,4 | 22,60 | 41,5 | 41,7 | 1,1314 | 1584,39 |
| 3 | 2019-10-11 | 10661,77 | 10685,11 | 1400,4 | 25,90 | 41,7 | 42,0 | 1,1345 | 1588,76 |
| 4 | 2019-10-12 | 10685,12 | 10708,46 | 1400,4 | 29,30 | 41,8 | 42,2 | 1,1323 | 1585,71 |
| 5 | 2019-10-13 | 10708,47 | 10731,81 | 1400,4 | 25,50 | 41,7 | 42,0 | 1,1298 | 1582,18 |
| 6 | 2019-10-14 | 10731,81 | 10755,15 | 1400,4 | 18,80 | 41,6 | 41,8 | 1,1749 | 1645,39 |
| 7 | 2019-10-15 | 10755,15 | 10778,49 | 1400,4 | 8,50 | 41,7 | 41,9 | 1,1131 | 1558,72 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 18:09 | 17:29 | X | | | X | | | 750,10 | 30,50 | 303,65 |
| 17:46 | 17:06 | X | | | X | | | 749,50 | 31,00 | 304,15 |
| 17:23 | 16:43 | X | | | | X | | 749,80 | 33,00 | 306,15 |
| 17:01 | 16:21 | X | | | | X | | 750,20 | 32,00 | 305,15 |
| 16:37 | 15:57 | X | | | X | | | 749,40 | 30,50 | 303,65 |
| 16:14 | 15:34 | | X | | X | | | 749,70 | 55,00 | 328,15 |
| 15:52 | 15:12 | | | X | X | | | 749,30 | 21,50 | 294,65 |

**Note:** Data on ambient temperature and barometric pressure for those extracted from the DMH site - Directorate of Meteorology and Hydrology.


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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1959 | 760 | 298,15 |
| $SO_2$ | 2,1290 | 760 | 298,15 |
| $H_2S$ | 0,1412 | 760 | 298,15 |
| $O_3$ | 0,1854 | 760 | 298,15 |
| CO | 0,0525 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 1 | 2019-09-25 | 2019-09-26 | 7345,40 | 7321,40 | 1440 | 705,682 | 701,880 | 745 | 294 | 282,615 | 3071,404 | 203,702 | 267,467 |
| | 2 | 2019-09-26 | 2019-09-27 | 7369,41 | 7345,41 | 1440 | 709,481 | 705,683 | 749 | 299 | 284,327 | 3090,002 | 204,936 | 269,087 |
| | 3 | 2019-09-27 | 2019-09-28 | 7393,41 | 7369,41 | 1440 | 713,272 | 709,481 | 748 | 301 | 285,763 | 3105,611 | 205,971 | 270,446 |
| | 4 | 2019-09-28 | 2019-09-29 | 7417,41 | 7393,41 | 1440 | 717,061 | 713,272 | 749 | 304 | 286,755 | 3116,398 | 206,686 | 271,386 |
| | 5 | 2019-09-29 | 2019-09-30 | 7441,41 | 7417,41 | 1440 | 720,846 | 717,061 | 751 | 309 | 288,646 | 3136,940 | 208,049 | 273,175 |
| | 6 | 2019-09-30 | 2019-10-01 | 7465,41 | 7441,41 | 1440 | 724,634 | 720,846 | 750 | 309 | 288,954 | 3140,287 | 208,271 | 273,466 |
| | 7 | 2019-10-01 | 2019-10-02 | 7489,41 | 7465,41 | 1440 | 728,420 | 724,634 | 749 | 307 | 288,054 | 3130,509 | 207,622 | 272,615 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Date | | | Time | | | Air Volume (Standard L) | Environmental Conditions | | Corrected Air Volume ($m^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Trigas: 24 hours) | | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) | | CO (Bomba BDXII; Tedlar Bag: 1 hora) | **CO** | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| | Start | End | | Start | End | | | | | | | | | |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2019-09-25 | 2019-09-26 | 2019-09-25 | 10:05 | 10:05 | 14:29 to 15:29 | 3,156 | 745,4 | 293,5 | **0,232** | **3,071** | **0,204** | **0,267** | **0,003** |
| | 2019-09-26 | 2019-09-27 | 2019-09-26 | 10:22 | 10:22 | 10:44 to 11:44 | 3,175 | 749,0 | 298,5 | **0,233** | **3,090** | **0,205** | **0,269** | **0,003** |
| | 2019-09-27 | 2019-09-28 | 2019-09-27 | 10:44 | 10:44 | 11:11 to 12:11 | 3,191 | 747,7 | 301,0 | **0,234** | **3,106** | **0,206** | **0,270** | **0,003** |
| | 2019-09-28 | 2019-09-29 | 2019-09-28 | 11:07 | 11:07 | 10:47 to 11:47 | 3,202 | 748,7 | 303,5 | **0,235** | **3,116** | **0,207** | **0,271** | **0,003** |
| | 2019-09-29 | 2019-09-30 | 2019-09-29 | 11:26 | 11:26 | 10:45 to 11:45 | 3,223 | 751,1 | 308,5 | **0,237** | **3,137** | **0,208** | **0,273** | **0,003** |
| | 2019-09-30 | 2019-10-01 | 2019-09-30 | 11:42 | 11:42 | 10:18 to 11:18 | 3,227 | 749,5 | 308,5 | **0,237** | **3,140** | **0,208** | **0,273** | **0,003** |
| | 2019-10-01 | 2019-10-02 | 2019-10-01 | 12:00 | 12:00 | 10:14 to 11:14 | 3,217 | 749,3 | 306,5 | **0,236** | **3,131** | **0,208** | **0,273** | **0,003** |

| Point | Sampling | Results Laboratory tests | | | | | Blank | | | | Concentration ($\mu g/m^3$) | | | | ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Results Laboratory tests | | | | | | | | | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide"N $O_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| | | $S0_2$ (µg/ 100mL) | $N0_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $S0_2$ (µg/ 100mL) | $N0_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | | | | | |
| 1 | 1 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | <27 | <0,01 | <0,05 | <0,80 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 3 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 4 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 6 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 7 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

| Calibration Data | | "Standard" environmental conditions | |
|---|---|---|---|
| Collected Gas | Critical Orifice Vazão | | |
| TRS | 0,9898 | 760 | 298,15 |
| VOC | 0,9898 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | TRS | VOC |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2019-09-25 | 2019-09-26 | 13:20 | 14:20 | 11:30 to 11:50 | 0,06 | 0,02 | 745,4 | 298,0 | **0,058** | **0,019** |
| | 2019-09-26 | 2019-09-27 | 9:31 | 10:31 | 09:05 to 09:25 | 0,06 | 0,02 | 749,0 | 305,0 | **0,057** | **0,019** |
| | 2019-09-27 | 2019-09-28 | 10:05 | 11:05 | 09:11 to 09:31 | 0,06 | 0,02 | 747,7 | 301,0 | **0,058** | **0,019** |
| | 2019-09-28 | 2019-09-29 | 8:57 | 9:57 | 10:09 to 10:29 | 0,60 | 0,02 | 748,7 | 300,0 | **0,581** | **0,019** |
| | 2019-09-29 | 2019-09-30 | 8:55 | 9:57 | 10:06 to 10:26 | 0,06 | 0,02 | 751,1 | 304,0 | **0,058** | **0,019** |
| | 2019-09-30 | 2019-10-01 | 8:33 | 9:33 | 09:44 to 10:04 | 0,06 | 0,02 | 749,5 | 301,0 | **0,058** | **0,019** |
| | 2019-10-01 | 2019-10-02 | 8:30 | 9:30 | 09:41 to 10:01 | 0,06 | 0,02 | 749,3 | 302,0 | **0,058** | **0,019** |

| Point | Sampling | Results Laboratory tests | | | Blank | | Concentration (µg/m3) Reduced Sulfur Content TRS | Concentration (µg/m3) Volatile Organic Compounds VOC |
|---|---|---|---|---|---|---|---|---|
| | | Results Laboratory tests | | | | | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | | |
| 1 | 1 | < 27 | tcap 19/0908 | < 3,0 | < 27 | < 3,0 | **N.D.** | **N.D.** |
| | 2 | < 27 | tacp 19/1226 | < 3,0 | | | **N.D.** | **N.D.** |
| | 3 | < 27 | tcap 19/1229 | < 3,0 | | | **N.D.** | **N.D.** |
| | 4 | < 27 | tcap 19/1227 | < 3,0 | | | **N.D.** | **N.D.** |
| | 5 | < 27 | tcap 19/1228 | < 3,0 | | | **N.D.** | **N.D.** |
| | 6 | < 27 | tcap 19/1230 | < 3,0 | | | **N.D.** | **N.D.** |
| | 7 | < 27 | tcap 19/1231 | < 3,0 | | | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method


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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1959 | 760 | 298,15 |
| $SO_2$ | 2,1236 | 760 | 298,15 |
| $H_2S$ | 0,1411 | 760 | 298,15 |
| $O_3$ | 0,1852 | 760 | 298,15 |
| CO | 0,0527 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 1 | 2019-10-02 | 2019-10-03 | 7513,76 | 7489,76 | 1440 | 732,295 | 728,490 | 745 | 300 | 285,489 | 3094,770 | 205,628 | 269,896 |
| | 2 | 2019-10-03 | 2019-10-04 | 7537,77 | 7513,77 | 1440 | 736,100 | 732,295 | 749 | 301 | 285,278 | 3092,473 | 205,476 | 269,696 |
| | 3 | 2019-10-04 | 2019-10-05 | 7561,77 | 7537,77 | 1440 | 739,901 | 736,100 | 748 | 301 | 285,525 | 3095,160 | 205,654 | 269,930 |
| | 4 | 2019-10-05 | 2019-10-06 | 7585,11 | 7561,77 | 1400 | 743,579 | 739,901 | 749 | 292 | 273,301 | 2962,645 | 196,849 | 258,373 |
| | 5 | 2019-10-06 | 2019-10-07 | 7608,45 | 7585,11 | 1400 | 747,259 | 743,579 | 751 | 293 | 273,565 | 2965,508 | 197,040 | 258,623 |
| | 6 | 2019-10-07 | 2019-10-08 | 7631,79 | 7608,45 | 1400 | 750,936 | 747,259 | 750 | 295 | 274,790 | 2978,787 | 197,922 | 259,781 |
| | 7 | 2019-10-08 | 2019-10-09 | 7655,13 | 7631,79 | 1400 | 754,615 | 750,936 | 749 | 299 | 276,684 | 2999,314 | 199,286 | 261,571 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | **Date** | | | **Time** | | | **Air Volume (Standard L)** | **Environmental Conditions** | | **Corrected Air Volume ($m^3$)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Trigas: 24 hours) Start | End | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) Start | End | CO (Bomba BDXII; Tedlar Bag: 1 hora) | **CO** | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2019-10-02 | 2019-10-03 | 2019-10-02 | 15:27 | 15:27 | 15:29 to 16:29 | 3,200 | 745,4 | 299,5 | **0,234** | **3,095** | **0,206** | **0,270** | **0,003** |
| | 2019-10-03 | 2019-10-04 | 2019-10-03 | 15:43 | 15:43 | 14:41 to 15:41 | 3,198 | 749,0 | 300,5 | **0,234** | **3,092** | **0,205** | **0,270** | **0,003** |
| | 2019-10-04 | 2019-10-05 | 2019-10-04 | 16:00 | 16:00 | 14:51 to 15:51 | 3,200 | 747,7 | 300,5 | **0,234** | **3,095** | **0,206** | **0,270** | **0,003** |
| | 2019-10-05 | 2019-10-06 | 2019-10-05 | 16:17 | 16:17 | 14:26 to 15:26 | 3,150 | 748,7 | 291,5 | **0,224** | **2,963** | **0,197** | **0,258** | **0,003** |
| | 2019-10-06 | 2019-10-07 | 2019-10-06 | 15:56 | 15:56 | 14:16 to 15:16 | 3,153 | 751,1 | 293,0 | **0,224** | **2,966** | **0,197** | **0,259** | **0,003** |
| | 2019-10-07 | 2019-10-08 | 2019-10-07 | 15:35 | 15:35 | 14:02 to 15:02 | 3,167 | 749,5 | 295,0 | **0,225** | **2,979** | **0,198** | **0,260** | **0,003** |
| | 2019-10-08 | 2019-10-09 | 2019-10-08 | 15:14 | 15:14 | 14:15 to 15:15 | 3,189 | 749,3 | 299,0 | **0,227** | **2,999** | **0,199** | **0,262** | **0,003** |

| Point | Sampling | Results Laboratory tests | | | | | Blank | | | | **Concentration ($\mu g/m^3$)** | | | | **ppm** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Results Laboratory tests | | | | | | | | | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide "$NO_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| | | $S0_2$ (µg/100mL) | $N0_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $S0_2$ (µg/100mL) | $N0_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | | | | | |
| 2 | 1 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 3 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 4 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | < 27 | <0,01 | <0,05 | <0,80 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 6 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 7 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

**Note:**

**01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão | "Standard" environmental conditions | |
|---|---|---|---|
| TRS | 0,9898 | 760 | 298,15 |
| VOC | 0,9898 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | TRS | VOC |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2019-10-02 | 2019-10-03 | 14:01 | 15:01 | 15:04 to 15:24 | 0,06 | 0,02 | 745,4 | 306,0 | **0,057** | **0,019** |
| | 2019-10-03 | 2019-10-04 | 13:04 | 14:04 | 14:09 to 14:29 | 0,06 | 0,02 | 749,0 | 297,0 | **0,059** | **0,020** |
| | 2019-10-04 | 2019-10-05 | 12:55 | 13:55 | 14:05 to 14:25 | 0,06 | 0,02 | 747,7 | 301,0 | **0,058** | **0,019** |
| | 2019-10-05 | 2019-10-06 | 12:37 | 13:37 | 13:51 to 14:11 | 0,60 | 0,02 | 748,7 | 295,0 | **0,591** | **0,020** |
| | 2019-10-06 | 2019-10-07 | 13:12 | 14:12 | 12:41 to 13:01 | 0,06 | 0,02 | 751,1 | 292,0 | **0,060** | **0,020** |
| | 2019-10-07 | 2019-10-08 | 12:22 | 13:22 | 13:30 to 13:50 | 0,06 | 0,02 | 749,5 | 298,0 | **0,059** | **0,020** |
| | 2019-10-08 | 2019-10-09 | 12:45 | 13:45 | 13:51 to 14:11 | 0,06 | 0,02 | 749,3 | 300,0 | **0,058** | **0,019** |

| Point | Results Laboratory tests | | | | | Concentration (µg/m3) | |
|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | Blank | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | **Reduced Sulfur Content TRS** / **Volatile Organic Compounds VOC** |
| 2 | 1 | < 27 | tcap 19/1232 | < 3,0 | < 27 | < 3,0 | **N.D.** / **N.D.** |
| | 2 | < 27 | tacp 19/1233 | < 3,0 | | | **N.D.** / **N.D.** |
| | 3 | < 27 | tcap 19/1235 | < 3,0 | | | **N.D.** / **N.D.** |
| | 4 | < 27 | tcap 19/1234 | < 3,0 | | | **N.D.** / **N.D.** |
| | 5 | < 27 | tcap 19/1225 | < 3,0 | | | **N.D.** / **N.D.** |
| | 6 | < 27 | tcap 19/1223 | < 3,0 | | | **N.D.** / **N.D.** |
| | 7 | < 27 | tcap 19/1222 | < 3,0 | | | **N.D.** / **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method


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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1957 | 760 | 298,15 |
| $SO_2$ | 2,1165 | 760 | 298,15 |
| $H_2S$ | 0,1419 | 760 | 298,15 |
| $O_3$ | 0,1851 | 760 | 298,15 |
| CO | 0,0532 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit | 1 | 2019-10-09 | 2019-10-10 | 7678,84 | 7655,50 | 1400 | 758,345 | 754,667 | 750 | 304 | 278,325 | 3010,090 | 201,810 | 263,250 |
| | 2 | 2019-10-10 | 2019-10-11 | 7702,18 | 7678,84 | 1400 | 762,018 | 758,345 | 750 | 304 | 278,666 | 3013,774 | 202,057 | 263,572 |
| | 3 | 2019-10-11 | 2019-10-12 | 7725,52 | 7702,18 | 1400 | 765,693 | 762,018 | 750 | 306 | 279,525 | 3023,067 | 202,680 | 264,384 |
| | 4 | 2019-10-12 | 2019-10-13 | 7748,86 | 7725,52 | 1400 | 769,369 | 765,693 | 750 | 305 | 278,993 | 3017,318 | 202,295 | 263,882 |
| | 5 | 2019-10-13 | 2019-10-14 | 7772,20 | 7748,86 | 1400 | 773,047 | 769,369 | 749 | 304 | 278,455 | 3011,496 | 201,905 | 263,372 |
| | 6 | 2019-10-14 | 2019-10-15 | 7795,55 | 7772,21 | 1400 | 776,723 | 773,047 | 750 | 295 | 274,473 | 2968,431 | 199,017 | 259,606 |
| | 7 | 2019-10-15 | 2019-10-16 | 7818,89 | 7795,55 | 1400 | 780,398 | 776,723 | 749 | 295 | 274,313 | 2966,706 | 198,902 | 259,455 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | **Date** | | | **Time** | | | **Air Volume (Standard L)** | **Environmental Conditions** | | **Corrected Air Volume ($m^3$)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Trigas: 24 hours) | | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) | | CO (Bomba BDXII; Tedlar Bag: 1 hora) | **CO** | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| | Start | End | | Start | End | | | | | | | | | |
| Point 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit | 2019-10-09 | 2019-10-10 | 2019-10-09 | 18:09 | 18:09 | 15:58 to 16:58 | 3,242 | 750,1 | 303,5 | **0,228** | **3,010** | **0,202** | **0,263** | **0,003** |
| | 2019-10-10 | 2019-10-11 | 2019-10-10 | 17:45 | 17:45 | 14:50 to 15:50 | 3,246 | 749,5 | 304,0 | **0,229** | **3,014** | **0,202** | **0,264** | **0,003** |
| | 2019-10-11 | 2019-10-12 | 2019-10-11 | 17:23 | 17:23 | 14:25 to 15:25 | 3,256 | 749,8 | 306,0 | **0,229** | **3,023** | **0,203** | **0,264** | **0,003** |
| | 2019-10-12 | 2019-10-13 | 2019-10-12 | 17:01 | 17:01 | 14:06 to 15:06 | 3,249 | 750,2 | 305,0 | **0,229** | **3,017** | **0,202** | **0,264** | **0,003** |
| | 2019-10-13 | 2019-10-14 | 2019-10-13 | 16:37 | 16:37 | 13:56 to 14:56 | 3,243 | 749,4 | 303,5 | **0,228** | **3,011** | **0,202** | **0,263** | **0,003** |
| | 2019-10-14 | 2019-10-15 | 2019-10-14 | 16:14 | 16:14 | 13:25 to 14:25 | 3,197 | 749,7 | 295,0 | **0,225** | **2,968** | **0,199** | **0,260** | **0,003** |
| | 2019-10-15 | 2019-10-16 | 2019-10-15 | 15:52 | 15:52 | 13:05 to 14:05 | 3,195 | 749,3 | 294,5 | **0,225** | **2,967** | **0,199** | **0,259** | **0,003** |

| Point | Sampling | Results Laboratory tests | | | | | | | | | Concentration ($\mu g/m^3$) | | | | ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Results Laboratory tests | | | | | Blank | | | | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide "$NO_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| | | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | | | | | |
| 3 | 1 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | < 27 | <0,01 | <0,05 | <0,80 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | < 27 | <0,01 | 0,400 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **99,0** | **N.D.** | **N.D.** |
| | 3 | < 27 | <0,01 | 0,400 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **98,7** | **N.D.** | **N.D.** |
| | 4 | < 27 | <0,01 | <0,05 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | < 27 | <0,01 | 0,400 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **99,1** | **N.D.** | **N.D.** |
| | 6 | < 27 | <0,01 | 0,400 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **100,5** | **N.D.** | **N.D.** |
| | 7 | < 27 | <0,01 | 0,100 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **25,1** | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão | "Standard" environmental conditions | |
|---|---|---|---|
| TRS | 0,9898 | 760 | 298,15 |
| VOC | 0,9898 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | TRS | VOC |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 03 - Posto Policial Nacional - Comsaria nº18 Col. Roberto L. Petit | 2019-10-09 | 2019-10-10 | 17:51 | 18:51 | 18:54 to 19:14 | 0,06 | 0,02 | 745,4 | 302,0 | **0,057** | **0,019** |
| | 2019-10-10 | 2019-10-11 | 14:30 | 15:30 | 15:33 to 15:53 | 0,06 | 0,02 | 749,0 | 305,0 | **0,057** | **0,019** |
| | 2019-10-11 | 2019-10-12 | 15:56 | 16:56 | 17:01 to 17:21 | 0,06 | 0,02 | 747,7 | 304,0 | **0,057** | **0,019** |
| | 2019-10-12 | 2019-10-13 | 15:31 | 16:31 | 16:38 to 16:58 | 0,60 | 0,02 | 748,7 | 311,0 | **0,561** | **0,019** |
| | 2019-10-13 | 2019-10-14 | 15:10 | 16:10 | 16:15 to 16:35 | 0,06 | 0,02 | 751,1 | 310,0 | **0,056** | **0,019** |
| | 2019-10-14 | 2019-10-15 | 15:04 | 16:04 | 16:09 to 16:29 | 0,06 | 0,02 | 749,5 | 307,0 | **0,057** | **0,019** |
| | 2019-10-15 | 2019-10-16 | 14:43 | 15:43 | 15:46 to 16:06 | 0,06 | 0,02 | 749,3 | 296,0 | **0,059** | **0,020** |

| Point | Results Laboratory tests | | | | | Concentration (µg/m3) | |
|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | Blank | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | **Reduced Sulfur Content TRS** / **Volatile Organic Compounds VOC** |
| 3 | 1 | < 27 | tcap 19/1220 | < 3,0 | < 27 | < 3,0 | **N.D.** / **N.D.** |
| | 2 | < 27 | tacp 19/1224 | < 3,0 | | | **N.D.** / **N.D.** |
| | 3 | < 27 | tcap 19/1219 | < 3,0 | | | **N.D.** / **N.D.** |
| | 4 | < 27 | tcap 19/1221 | < 3,0 | | | **N.D.** / **N.D.** |
| | 5 | < 27 | tcap 19/1217 | < 3,0 | | | **N.D.** / **N.D.** |
| | 6 | < 27 | tcap 19/1216 | < 3,0 | | | **N.D.** / **N.D.** |
| | 7 | < 27 | tcap 19/1218 | < 3,0 | | | **N.D.** / **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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GEOAVALIAR
Análises e Consultorias Ambientais Ltda

# MONITORING REPORT OF AIR QUALITY

**Monitored organization:**

# POYRY TECNOLOGIA LTDA (Paracel Project)

**Monitored Places:**

**(Campaign executed between September 25 to October 16, 2019)**

**POINT 01 - SENACSA / Departmental Commission on Animal Health**

**POINT 02 - Municipality of Loreto / Paraguay**

**POINT 03 - National Police Post - Police Station N. 18 Col. Roberto L. Petit**

APRIL – 20


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**5.0 – RESULTS**

5.1 – TABLE OF RESULTS OF PARTICLES IN THE ATMOSPHERE
5.1.1. – DIAGRAMS / GRAPHICS

5.2 – TABLE OF RESULTS OF GASES IN THE ATMOSPHERE

**6.0 – ÍNDICE DE CALIDAD DEL AIRE**

**7.0 – DECLARATION OF CONFORMITY**

**8.0 – ANNEXES**

FIELD DATA
ANALYTICAL AWARD
SATELLITE IMAGE AND IDENTIFICATION OF THE MONITORING POINT
CALIBRATION AND TECHNICAL CONTROL


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# 1.0 – SERVICE OBJECTIVE

Determine the concentrations of Total Suspended Particles (PTS), Inhalable Particles (PI - $PM_{10}$), Breathable Particles (PR - $PM_{2,5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Total Sulfur Content (TRS), Carbon Monoxide (CO), Ozone ($O_3$), Hydrogen Sulfide ($H_2S$) and Volatile Organic Compounds (VOC) in 3 (three) points, during the period between February 12 and March 4, 2020, in the Cities of Concepción and Loreto, located in Paraguay, in accordance with the request for GEOAVALIAR Service 042-20.

# 2.0 – GENERAL DATA

## 2.1 – CONTRACTING COMPANY:

Bussiness Identity: PÖYRY TECNOLOGIA LTDA
Address: Av. Alfredo Egídio de Souza Aranha, Bloco B 5º andar
CEP: 04.726-170 – São Paulo/ SP.

## 2.2 – CONTRACTOR COMPANY:

Business Identity: GEOAVALIAR ANÁLISES E CONSULTORIAS AMBIENTAIS LTDA
Tax ID (CNPJ): 06.965.622/0001-30
IBAMA CTF: 593129
Address: Rua Anjo da Guarda, nº.: 708 – Bairro Fonte Grande
CEP 32013.460 - Contagem/MG

## 2.3 - RESPONSABILITIES:

### 2.3.1 – SUPERVISION (CONCEPCIÓN AND LORETO PROJECT - PARAGUAY)

**Cyro Croce Launy**
Sustainability Manager of the company Paracel

### 2.3.2 – COLLECTION TEAM (GEOAVALIAR):

**Edvandro Maurício da Silva**
Production Engineer / Esp. in Labor Segment Engineering
**Filipe de Almeida Mendonça**
Technician in Labor Safety

### 2.3.3 – PREPARATION AND APPROVAL OF THE REPORT (GEOAVALIAR):

**Kamila Lopes Morais**
Technician in Industrial Chemistry

**Gustavo de Castro Salles**
Chemical Engineer

### 2.3.4 – TECHNICAL RESPONSIBLE (GEOAVALIAR):

**Leonardo de Salles**
Soil and Environment Specialist Geographer


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## 2.4 – LOCALES DE MONITOREO:

The monitored points for the installation of the sampling equipment were defined by the Contracting Company in accordance with the following:

- Item 01 - SENACSA / Departmental Commission on Animal Health

Address: Calle Gral. Díaz c/ Rufino Spika - Concepción / Paraguay
Coordinates: UTM 21K 0454572 - 7410810

- Item 02 - Municipality of Loreto / Paraguay

Address: Av. Eusebio Ayala Y Centro Corá - Loreto / Paraguay
Coordinates: UTM 21K 0466753 - 7426022

- Point 03 – National Policial Officer – Police Station n.18 Col. Roberto L. Petit

Address: Police Station n.18 - Col. Roberto L. Petit - Concepcion / Paraguay
Coordinates: UTM 21K 0457325 - 7434506

Figure: Geoavaliar - Point 01

Figure: Geoavaliar - Point 02

Figure: Geoavaliar - Point 03


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# 3.0 - MATERIALS AND EVALUATION METHODS

## 3.1 - MATERIALS (Instruments used in samplings):

- CALIBRATOR FLAKE

N. of the measuring cup ..... ..... GEO CPV-0266
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA
Date of calibration..... ..... 05/30/2019

- HI-VOL PTS MEASUREMENT EQUIPMENT (LARGE VOLUME SAMPLERS)

Team N. ..... ..... ... GEO-HIVOL n. 005
Calibration date ..... ..... . 12/02 , 19/02 and 26/02 / 2019
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA

- HI-VOLS MEASURING EQUIPMENT (LARGE VOLUME SAMPLERS WITH INERTIAL PARTICLE SEPARATOR)

Team N. ..... ..... .. ..... GEO-PM10 n. 01
Calibration date ..... ..... ..... . .. 02/12, 02/19 and 02/26/2019
Maker ..... ..... . INDIAN ENERGY E COM. LTDA

Team N. ..... ..... ..... GEO-PM2.5 n.02
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA
Calibration date ..... ..... ..... . 02/12, 02/19 and 02/26/2019

- TRI-GAS INSTRUMENT ( SMALL VOLUME SAMPLER FOR GASES)

Team N. ..... ..... ..... ... ..... GEO-WHEAT 02
Maker ..... ..... . .... ENERGÉTICA IND. E COM. LTDA

- HYPOTHERMAL NEEDLES

NEEDLE 2,0 L / min (SO2 pigtail ). ..... ..... OC-152
NEEDLE 0.2 L / min (NO2 Pigtail) ..... ..... OC -266
NEEDLE 0.2 L / min (H2S Pigtail) ..... ..... OC-268
NEEDLE 0.7 L / min (pigtail CO and O3 ) ..... ..... OC- 155
Manufacturer ..... .... ..... ENERGÉTICA IND. E COM. LTDA
Calibration Date (SO2, NO2, H2S, O2, CO ) ..... .... ..... 02/12, 02/19 and 02/26/2019

Volumetric burette 500 mL ..... ..... BO-500 -ML
Certificate number ..... ..... BO-500-ML17 / 08/16
Volumetric burette 150 mL ..... ..... BO-150 -ML
Certificate number ..... ..... BO-150-ML17 / 08/16
Calibration date ..... ..... ..... 08/17/16

- VOST DRY GASOMETER (COLLECTION of Reduced Total Sulfur and Volatile Organic Compounds, TRS and VOC in English)

Equipment n. ..... ..... ..... CCOV-001
Maker ..... ..... ENERGÉTICA IND. E COM. LTDA.
Certificate number ..... ..... ..... 166A18


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### 3.2 – METHODS

**40 CFR Appendix B to Part 50** - Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

**40 CFR Appendix J to Part 50** - Reference Method for the Determination of Particulate Matter as $PM_{10}$ in the Atmosphere

**40 CFR Appendix L to Part 50** - Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere

**ISO 4220:1983** - Ambient air — Determination of a gaseous acid air pollution index — Titrimetric method with indicator or potentiometric end-point detection

**US EPA METHOD Nº QN 1277:1977 -** Sodium Arsenite Method for the Determination of Nitrogen Dioxide in the Atmosphere

**EQOA-0206-148 -** Environnement S.A Model O342M UV Photometric Ozone Analyzer

**US EPA EMC Conditional Test Method (CTM-030)** - Determination of Nitrogen Oxides, Carbon Monoxide, and Oxygen Emissions from Natural Gas-Fired Engines, Boilers and Process Heaters Using Portable Analyzers
**US EPA Method 16A** - Total Reduced Sulfur – Impinger – Adapted Method for Monitoring Air Quality

**US EPA Method 11** — Determination Of Hydrogen Sulfide Content Of Fuel Gas Streams In Petroleum Refineries – Adapted Method for Monitoring Air Quality

**US EPA Method 18** - Volatile Organic Compounds by Gas Chromatography

In order to compare and study the results, the limits described in SEAM Resolution n. 259 of 7/3/2015 and the limits of air quality standards presented by the US EPA - Environmental Protection Agency were adopted.

For the determination of the local atmospheric pressure, a portable barometer, owned by **GEOAVALIAR Análise e Consultorias Ambientais Ltda**.


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# 4.0 - CONDITIONS OF SAMPLING AND PRODUCTION

## 4.1 - CONSIDERATIONS

The evaluations meet the requirements of the sampling procedures / standards accepted by all environmental control agencies in the country.

Sampling was carried out in 03 (three) points, consisting of 07 (seven) collections per point, lasting approximately 24 (twenty four) hours for the Total Suspended Particles (PTS), Inhalable Particles (PI - $PM_{10}$) parameters), Breathable Particles ($PM_{2.5}$), Nitrogen Dioxide ($NO_2$), Sulfur Dioxide ($SO_2$), Ozone ($O_3$), Sulphidic Gas ($H_2S$); approximately 1 (one) hour for the Reduced Total Sulfur (TRS) and Carbon Monoxide (CO) parameters, and 20 (twenty) minutes for the Volatile Organic Compounds (VOC)

The results presented are the responsibility of **GEOAVALIAR Análise e Consultorias Ambientais Ltda**, which are limited only to the conditions presented on the dates of the evaluations.


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# 5.0 – RESULTS

## 5.1 – TABLE OF RESULTS OF PARTICLES IN THE ATMOSPHERE


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| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-HI-VOL 005 | Calibration Date | 2020-02-12 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-12 | 2020-02-13 | 13:35 | 13:35 | X | | | X | | | 31,0 | 1,3267 | 1390 | 2136,50 | 128,05 | **59,93** |
| 2 | 2020-02-13 | 2020-02-14 | 13:04 | 13:04 | X | | | X | | | 31,5 | 1,1977 | 1390 | 1945,47 | 125,95 | **64,74** |
| 3 | 2020-02-14 | 2020-02-15 | 12:30 | 12:30 | X | | | X | | | 32,0 | 1,2723 | 1390 | 2053,78 | 110,00 | **53,56** |
| 4 | 2020-02-15 | 2020-02-16 | 12:02 | 12:02 | X | | | X | | | 32,5 | 1,2889 | 1390 | 2077,17 | 101,55 | **48,89** |
| 5 | 2020-02-16 | 2020-02-17 | 11:30 | 11:30 | X | | | X | | | 32,5 | 1,2017 | 1366 | 1915,27 | 95,60 | **49,91** |
| 6 | 2020-02-17 | 2020-02-18 | 10:58 | 10:58 | X | | | X | | | 33,5 | 1,3124 | 1390 | 2108,43 | 147,80 | **70,10** |
| 7 | 2020-02-18 | 2020-02-19 | 10:25 | 10:25 | X | | | X | | | 34,5 | 1,3070 | 1390 | 2098,63 | 117,70 | **56,08** |

**Note: The duration of each collection was 24 hours.**

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-PM-10 01 | Calibration Date | 2020-02-12 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-12 | 2020-02-13 | 13:35 | 13:35 | X | | | X | | | 31,0 | 1,0973 | 1390 | 1525,51 | 52,40 | **34,35** |
| 2 | 2020-02-13 | 2020-02-14 | 13:04 | 13:04 | X | | | X | | | 31,5 | 1,0989 | 1388 | 1525,75 | 50,00 | **32,77** |
| 3 | 2020-02-14 | 2020-02-15 | 12:30 | 12:30 | X | | | X | | | 32,0 | 1,0984 | 1390 | 1526,96 | 53,10 | **34,77** |
| 4 | 2020-02-15 | 2020-02-16 | 12:02 | 12:02 | X | | | X | | | 32,5 | 1,1003 | 1390 | 1529,69 | 45,80 | **29,94** |
| 5 | 2020-02-16 | 2020-02-17 | 11:30 | 11:30 | X | | | X | | | 32,5 | 1,1005 | 1390 | 1529,86 | 42,10 | **27,52** |
| 6 | 2020-02-17 | 2020-02-18 | 10:58 | 10:58 | X | | | X | | | 33,5 | 1,1015 | 1390 | 1531,30 | 55,60 | **36,31** |
| 7 | 2020-02-18 | 2020-02-19 | 10:25 | 10:25 | X | | | X | | | 34,5 | 1,1041 | 1390 | 1534,95 | 46,90 | **30,55** |

**Note: The duration of each collection was 24 hours.**

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Sampler n.: | GEO-PM-2,5 02 | Calibration Date | 2020-02-12 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-12 | 2020-02-13 | 13:35 | 13:35 | X | | | X | | | 31,0 | 1,1323 | 1390 | 1574,12 | 37,70 | **23,95** |
| 2 | 2020-02-13 | 2020-02-14 | 13:04 | 13:04 | X | | | X | | | 31,5 | 1,1339 | 1390 | 1576,32 | 40,00 | **25,38** |
| 3 | 2020-02-14 | 2020-02-15 | 12:30 | 12:30 | X | | | X | | | 32,0 | 1,1343 | 1390 | 1576,92 | 34,40 | **21,81** |
| 4 | 2020-02-15 | 2020-02-16 | 12:02 | 12:02 | X | | | X | | | 32,5 | 1,1345 | 1390 | 1577,22 | 30,25 | **19,18** |
| 5 | 2020-02-16 | 2020-02-17 | 11:30 | 11:30 | X | | | X | | | 32,5 | 1,1352 | 1390 | 1578,12 | 26,50 | **16,79** |
| 6 | 2020-02-17 | 2020-02-18 | 10:58 | 10:58 | X | | | X | | | 33,5 | 1,1367 | 1390 | 1580,26 | 36,60 | **23,16** |
| 7 | 2020-02-18 | 2020-02-19 | 10:25 | 10:25 | X | | | X | | | 34,5 | 1,1386 | 1390 | 1582,94 | 27,40 | **17,31** |

**Note: The duration of each collection was 24 hours.**


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| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-HI-VOL 005 | Sampler n.: | 2020-02-26 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling N° | DATE | | TIME (h) | | Clear Sky | Cloudy | Rainy | WIND | | | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| | Start | End | Stard | End | | | | Light | Medium | High | | | | | | |
| 1 | 2020-02-26 | 2020-02-27 | 13:35 | 13:35 | X | | | | X | | 26,0 | 1,5419 | 1390 | 2143,56 | 90,70 | **42,31** |
| 2 | 2020-02-27 | 2020-02-28 | 13:03 | 13:03 | X | | | X | | | 25,5 | 1,4242 | 1390 | 1979,91 | 139,45 | **70,43** |
| 3 | 2020-02-28 | 2020-02-29 | 12:35 | 12:35 | X | | | X | | | 27,5 | 1,4795 | 1390 | 2056,76 | 138,25 | **67,22** |
| 4 | 2020-02-29 | 2020-03-01 | 12:03 | 12:03 | X | | | X | | | 29,0 | 1,4220 | 1390 | 1976,91 | 152,00 | **76,89** |
| 5 | 2020-03-01 | 2020-03-02 | 11:33 | 11:33 | X | | | X | | | 29,0 | 1,4465 | 1390 | 2010,86 | 80,65 | **40,11** |
| 6 | 2020-03-02 | 2020-03-03 | 11:01 | 11:01 | X | | | X | | | 27,5 | 1,5238 | 1390 | 2118,42 | 125,75 | **59,36** |
| 7 | 2020-03-03 | 2020-03-04 | 10:30 | 10:30 | X | | | | X | | 28,5 | 1,5431 | 1390 | 2145,15 | 130,70 | **60,93** |

**Note: The duration of each collection was 24 hours.**

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-PM-10 01 | Fecha de Calibraciór | 2020-02-26 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling N° | DATE | | TIME (h) | | Clear Sky | Cloudy | Rainy | WIND | | | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| | Start | End | Stard | End | | | | Light | Medium | High | | | | | | |
| 1 | 2020-02-26 | 2020-02-27 | 13:35 | 13:35 | X | | | | X | | 26,0 | 1,0939 | 1390 | 1520,74 | 38,75 | **25,48** |
| 2 | 2020-02-27 | 2020-02-28 | 13:03 | 13:03 | X | | | X | | | 25,5 | 1,0923 | 1390 | 1518,50 | 58,20 | **38,33** |
| 3 | 2020-02-28 | 2020-02-29 | 12:35 | 12:35 | X | | | X | | | 27,5 | 1,0970 | 1390 | 1525,10 | 41,90 | **27,47** |
| 4 | 2020-02-29 | 2020-03-01 | 12:03 | 12:03 | X | | | X | | | 29,0 | 1,1001 | 1390 | 1529,32 | 65,90 | **43,09** |
| 5 | 2020-03-01 | 2020-03-02 | 11:33 | 11:33 | X | | | X | | | 29,0 | 1,0994 | 1390 | 1528,34 | 40,20 | **26,30** |
| 6 | 2020-03-02 | 2020-03-03 | 11:01 | 11:01 | X | | | X | | | 27,5 | 1,0967 | 1390 | 1524,57 | 41,10 | **26,96** |
| 7 | 2020-03-03 | 2020-03-04 | 10:30 | 10:30 | X | | | | X | | 28,5 | 1,0989 | 1390 | 1527,73 | 46,90 | **30,70** |

**Note: The duration of each collection was 24 hours.**

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Sampler n.: | GEO-PM-2,5 02 | Calibration Date | 2020-02-26 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling N° | DATE | | TIME (h) | | Clear Sky | Cloudy | Rainy | WIND | | | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration ($\mu g/m^3$) |
| | Start | End | Stard | End | | | | Light | Medium | High | | | | | | |
| 1 | 2020-02-26 | 2020-02-27 | 13:35 | 13:35 | X | | | | X | | 26,0 | 1,1082 | 1390 | 1540,59 | 30,10 | **19,54** |
| 2 | 2020-02-27 | 2020-02-28 | 13:03 | 13:03 | X | | | X | | | 25,5 | 1,1076 | 1390 | 1539,84 | 46,10 | **29,94** |
| 3 | 2020-02-28 | 2020-02-29 | 12:35 | 12:35 | X | | | X | | | 27,5 | 1,1106 | 1390 | 1543,96 | 46,85 | **30,34** |
| 4 | 2020-02-29 | 2020-03-01 | 12:03 | 12:03 | X | | | X | | | 29,0 | 1,1137 | 1390 | 1548,32 | 55,65 | **35,94** |
| 5 | 2020-03-01 | 2020-03-02 | 11:33 | 11:33 | X | | | X | | | 29,0 | 1,1140 | 1390 | 1548,67 | 32,00 | **20,66** |
| 6 | 2020-03-02 | 2020-03-03 | 11:01 | 11:01 | X | | | X | | | 27,5 | 1,1114 | 1390 | 1545,03 | 32,05 | **20,74** |
| 7 | 2020-03-03 | 2020-03-04 | 10:30 | 10:30 | X | | | | X | | 28,5 | 1,1125 | 1390 | 1546,60 | 36,00 | **23,28** |

**Note: The duration of each collection was 24 hours.**


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| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-HI-VOL 005 | Calibration Date | 2020-02-19 |
|---|---|---|---|---|---|

**Total Suspended Particles (PTS)**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-19 | 2020-02-20 | 13:26 | 13:26 | | X | | X | | | 33,0 | 1,2118 | 1390 | 1684,59 | 180,55 | **107,18** |
| 2 | 2020-02-20 | 2020-02-21 | 12:54 | 12:54 | | X | | X | | | 30,0 | 1,2534 | 1390 | 1742,42 | 145,80 | **83,68** |
| 3 | 2020-02-21 | 2020-02-22 | 12:26 | 12:26 | X | | | | X | | 28,0 | 1,2252 | 1390 | 1703,31 | 281,10 | **165,03** |
| 4 | 2020-02-22 | 2020-02-23 | 11:55 | 11:55 | X | | | | X | | 24,5 | 1,2252 | 1390 | 1703,31 | 175,45 | **103,01** |
| 5 | 2020-02-23 | 2020-02-24 | 11:22 | 11:22 | X | | | X | | | 28,5 | 1,2101 | 1390 | 1682,24 | 223,95 | **133,13** |
| 6 | 2020-02-24 | 2020-02-25 | 10:52 | 10:52 | | X | | X | | | 28,5 | 1,1546 | 1390 | 1605,08 | 120,30 | **74,95** |
| 7 | 2020-02-25 | 2020-02-26 | 10:23 | 10:23 | | X | | X | | | 29,5 | 1,2168 | 1390 | 1691,64 | 223,80 | **132,30** |

**Note: The duration of each collection was 24 hours.**

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-PM-10 01 | Calibration Date | 2020-02-19 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - PM10**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-19 | 2020-02-20 | 13:26 | 13:26 | | X | | X | | | 33,0 | 1,1073 | 1390 | 1539,38 | 58,70 | **38,13** |
| 2 | 2020-02-20 | 2020-02-21 | 12:54 | 12:54 | | X | | X | | | 30,0 | 1,1020 | 1390 | 1531,94 | 45,55 | **29,73** |
| 3 | 2020-02-21 | 2020-02-22 | 12:26 | 12:26 | X | | | | X | | 28,0 | 1,0982 | 1390 | 1526,73 | 89,30 | **58,49** |
| 4 | 2020-02-22 | 2020-02-23 | 11:55 | 11:55 | X | | | | X | | 24,5 | 1,0913 | 1390 | 1517,10 | 64,60 | **42,58** |
| 5 | 2020-02-23 | 2020-02-24 | 11:22 | 11:22 | X | | | X | | | 28,5 | 1,0994 | 1390 | 1528,44 | 76,30 | **49,92** |
| 6 | 2020-02-24 | 2020-02-25 | 10:52 | 10:52 | | X | | X | | | 28,5 | 1,0978 | 1390 | 1526,16 | 48,05 | **31,48** |
| 7 | 2020-02-25 | 2020-02-26 | 10:23 | 10:23 | | X | | X | | | 29,5 | 1,1028 | 1390 | 1533,14 | 69,75 | **45,49** |

**Note: The duration of each collection was 24 hours.**

| Point: | 03 - POSTO POLICIAL NACIONAL - COMISÁRIA Nº 18 COL. ROBERTO L. PETIT | Sampler n.: | GEO-PM-2,5 01 | Calibration Date | 2020-02-19 |
|---|---|---|---|---|---|

**Inhalable Particles (PI) - $PM_{2,5}$**

| SAMPLING DATA | | | | | WEATHER DATA / WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DATE | | TIME (h) | | | | | WIND | | | | | | | | |
| Sampling N° | Start | End | Stard | End | Clear Sky | Cloudy | Rainy | Light | Medium | High | Air Temperature (°C) | Average Flow ($m^3$/min) | Sampling Time (min) | Volume of Air Sampled ($m^3$) | Collected Massa (mg) | Concentration (µg/$m^3$) |
| 1 | 2020-02-19 | 2020-02-20 | 13:26 | 13:26 | | X | | X | | | 33,0 | 1,1273 | 1390 | 1567,24 | 42,90 | **27,37** |
| 2 | 2020-02-20 | 2020-02-21 | 12:54 | 12:54 | | X | | X | | | 30,0 | 1,1223 | 1390 | 1560,25 | 31,35 | **20,09** |
| 3 | 2020-02-21 | 2020-02-22 | 12:26 | 12:26 | X | | | | X | | 28,0 | 1,1190 | 1390 | 1555,62 | 68,70 | **44,16** |
| 4 | 2020-02-22 | 2020-02-23 | 11:55 | 11:55 | X | | | | X | | 24,5 | 1,1119 | 1390 | 1545,76 | 39,60 | **25,62** |
| 5 | 2020-02-23 | 2020-02-24 | 11:22 | 11:22 | X | | | X | | | 28,5 | 1,1191 | 1390 | 1555,79 | 42,80 | **27,51** |
| 6 | 2020-02-24 | 2020-02-25 | 10:52 | 10:52 | | X | | X | | | 28,5 | 1,1189 | 1390 | 1555,54 | 29,90 | **19,22** |
| 7 | 2020-02-25 | 2020-02-26 | 10:23 | 10:23 | | X | | X | | | 29,5 | 1,1213 | 1390 | 1558,86 | 40,70 | **26,11** |

**Note: The duration of each collection was 24 hours.**


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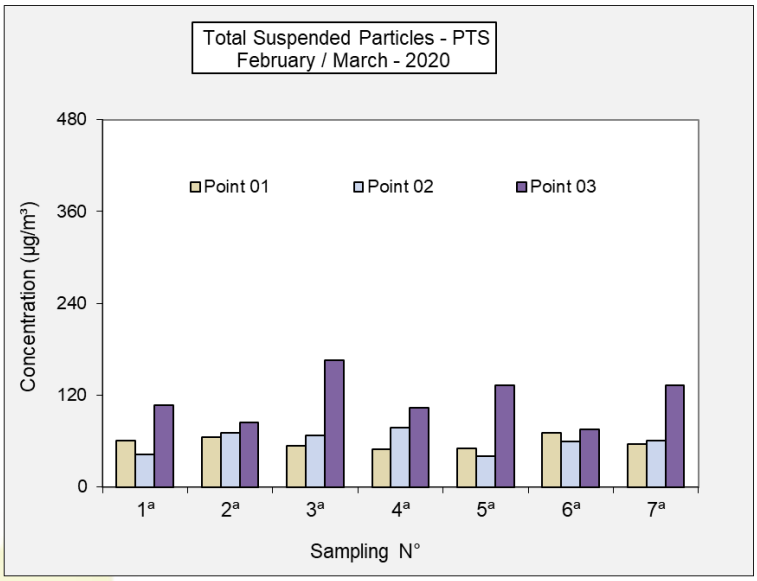
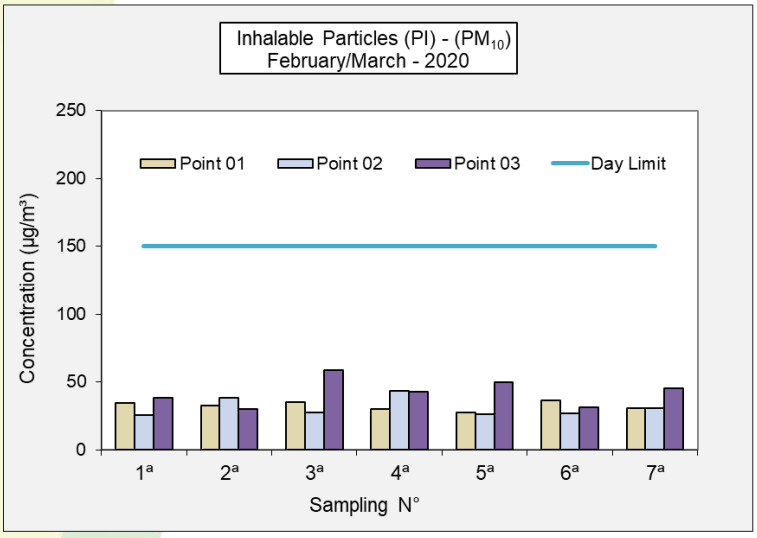
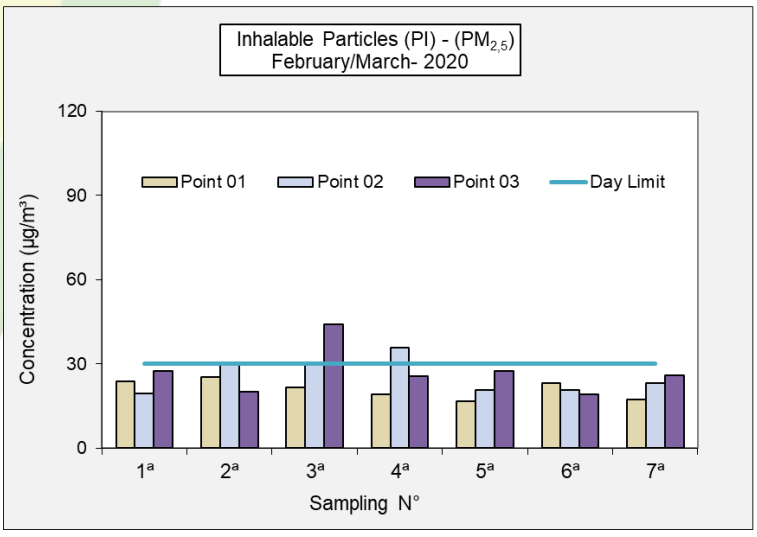
### 5.1.1 – GRAPHICS





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## 5.2 – TABLE OF RESULTS OF GASES IN THE ATMOSPHERE

| AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | | | |
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (ºC) | Concentration (mg / m³) | | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| Punto 01 - Senacsa/ Comision Departamental de Salud Animal | 2020-02-12 | 2020-02-13 | 10:05 to 10:05 | 13:40 to 14:40 | 13:20 to 13:20 | 14:11 to 14:31 | X | | | X | | | 304,0 | **17,63** | **1,09** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-13 | 2020-02-14 | 10:22 to 10:22 | 13:05 to 14:05 | 09:31 to 9:31 | 14:50 to 15:10 | X | | | X | | | 304,5 | **19,48** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-14 | 2020-02-15 | 10:44 to 10:44 | 12:45 to 13:45 | 10:50 to a 10:50 | 11:50 to 12:10 | X | | | X | | | 305,0 | **16,82** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **178,33** |
| | 2020-02-15 | 2020-02-16 | 11:07 to 11:07 | 12:10 to 13:10 | 08:57 to 08:57 | 09:30 to 09:50 | X | | | X | | | 305,5 | **13,28** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-16 | 2020-02-17 | 11:26 to 11:26 | 11:45 to 12:45 | 08:55 to 08:55 | 09:48 to 10:08 | X | | | X | | | 305,5 | **12,46** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **110,28** |
| | 2020-02-17 | 2020-02-18 | 11:42 to 11:42 | 11:05 to 12:05 | 08:33 to 08:33 | 09:30 to 09:50 | X | | | X | | | 306,5 | **14,14** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-18 | 2020-02-19 | 12:00 to 12:00 | 10:45 to 11:45 | 08:30:00 to 08:30 | 10:00 to 10:20 | X | | | X | | | 307,5 | **11,94** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

| AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | | | |
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (ºC) | Concentration (mg / m³) | | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| Punto 02 - De Municipalidad de Loreto/ Paraguay | 2020-02-26 | 2020-02-27 | 15:27 to 15:27 | 13:40 to 14:40 | 14:01 to 15:01 | 16:47 to 17:07 | X | | | | X | | 299,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-27 | 2020-02-28 | 15:43 to 15:43 | 13:10 to 14:10 | 13:04 to 14:04 | 10:20 to 10:40 | X | | | X | | | 298,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-28 | 2020-02-29 | 16:00 to 16:00 | 13:40 to 14:40 | 12:55 to 13:55 | 10:41 to 11:01 | X | | | X | | | 300,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **154,29** |
| | 2020-02-29 | 2020-03-01 | 16:17 to 16:17 | 12:15 to 13:15 | 12:37 to 13:37 | 10:18 to 10:38 | X | | | X | | | 302,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-03-01 | 2020-03-02 | 15:56 to 15:56 | 11:40 to 14:40 | 13:12 to 14:12 | 10:40 to 11:00 | X | | | X | | | 302,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-03-02 | 2020-03-03 | 15:35 to 15:35 | 11:10 to 12:10 | 12:22 to 13:22 | 10:16 to 10:36 | X | | | X | | | 300,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **380,74** |
| | 2020-03-03 | 2020-03-04 | 15:14 to 15:24 | 10:40 to 11:40 | 12:45 to 13:45 | 10:01 to 10:21 | X | | | | X | | 301,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |


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**AIR QUALITY MONITORING - GASES IN THE ATMOSPHERE**

| SAMPLING DATA | | | | | | | WEATHER CONDITIONS | | | | | | | SAMPLING RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| POINT | DATE | | TIME (h) | | | | Sky | | | Wind | | | Air Temperature (ºC) | Concentration (mg / m³) | | | | | | |
| | Start | End | $SO_2$, $NO_2$, $H_2S$ e $O_3$ | CO | TRS | VOC | Clear | Cloudy | Rainy | Weak | Medium | Strong | | $SO_2$ (24 hours) | $NO_2$ (24 hours) | $H_2S$ (24 hours) | $O_3$ (24 hours) | CO (1 hour) | TRS (1 hour) | VOC (20 minutes) |
| **Punto 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit** | 2020-02-19 | 2020-02-20 | 18:09 to 18:09 | 13:30 to 14:30 | 17:51 to 17:51 | 16:33 to 16:53 | | X | | X | | | 303,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **10,45** |
| | 2020-02-20 | 2020-02-21 | 17:45 to 17:45 | 13:00 to 14:00 | 14:30 to 14:30 | 11:58 to 12:18 | | X | | X | | | 304,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **214,73** |
| | 2020-02-21 | 2020-02-22 | 17:23 to 17:23 | 12:30 to 13:30 | 15:56 to 15:56 | 10:19 to 10:39 | X | | | | X | | 306,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **179,17** |
| | 2020-02-22 | 2020-02-23 | 17:01 to 17:01 | 12:00 to 13:00 | 15:31 to 15:31 | 10:05 to 10:25 | X | | | | X | | 305,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2020-02-23 | 2020-02-24 | 16:37 to 16:37 | 11:30 to 12:30 | 15:10 to 15:10 | 10:17 to 10:37 | X | | | X | | | 303,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **243,78** |
| | 2020-02-24 | 2020-02-25 | 16:14 to 16:14 | 11:00 to 12:00 | 15:04 to 15:04 | 10:15 to 10:35 | | X | | X | | | 295,0 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **243,78** |
| | 2020-02-25 | 2020-02-26 | 15:52 to 15:52 | 10:30 to 11:30 | 14:43 to 14:42 | 10:04 to 10:24 | | X | | X | | | 294,5 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **147,07** |

**Note:**

**01)** The meteorological data were extracted from the website DMH - Meteorology and Hydrology Directorate.

**02)** N.D - Not detected by the analysis method.

**03)** The carbon monoxide tests were performed by an on-line gas analyzer TESTO (1 hour of collection in Tedlar Bags).

**04)** The Nitrogen Dioxide and Hydrogen Sulfide tests were performed by the external provider, Quimbiol Serviços Ambientais.

**05)** Ozone tests were performed by the external provider, VANADIUM Laboratório de Análisis Química.

**06) L.D.** - Limite de Detecção do método: **SO2** - 27 µg/100mL; **NO2** - 0,01 mg/L; H2S - 0,05 mg; **O3** - 0,80 µg; **CO** - 3,3 ppm; **TR**S - 27 µg/100mL; VOC - 3,0 µg


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# 6.0 - AIR QUALITY INDEX

## 6.1 – AIR QUALITY INDEX IN ACCORDANCE WITH US EPA:

Considering the past practices and currently developed by the EPA - "Environmental Protection Agency" (United States of North America), it was published through the PSI - Pollutant Standard Index, the Air Quality Index, which presents values obtained by a linear algebraic operation. This algebraic function verified the concentration ratio of gaseous pollutants in dimensionless number (IQA). The following table shows the rating of the values:

| AIR QUALITY INDEX - AQI | | | |
|---|---|---|---|
| PTS ($\mu g/m^3$) | IQA | AIR QUALITY | REFERENCE COLOR |
| 0 - 80 | 0 -50 | GOOD | |
| 81 - 240 | 51 -100 | MODERATE | |
| 241 - 375 | 101 - 199 | UNHEALTHY | |
| 376 - 625 | 200 - 299 | BAD | |
| 626 - 875 | 300 - 399 | VERY BAD | |
| 2100 | 400 | CRITICAL | |

In the late 1990s, the EPA did not announce a calculation procedure for the Total Suspended Particles (PTS) standard, and also revised calculation procedures for PM10 and PM2.5, according to the following table:

| AIR QUALITY INDEX - AQI | | | | |
|---|---|---|---|---|
| PM10 ($\mu g/m^3$) | PM2,5 ($\mu g/m^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
| 0 - 54 | 0 - 15 | 0 - 50 | GOOD | |
| 55 - 154 | 16 - 35 | 51 - 100 | MODERATE | |
| 155 - 254 | 36 - 65 | 101 - 150 | UNHEATHY (1) | |
| 255 - 354 | 66 - 150 | 151 - 200 | UNHEATHY | |
| 355 - 424 | 151 - 250 | 201 - 300 | VERY UNHEATHY | |
| 425 - 504 | 251 - 350 | 301 - 400 | HAZARDOUS | |
| 505 - 604 | 351 - 500 | 401 - 500 | | |

**Nota: (1)** - Unhealthy for sensitive groups


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**Point 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL**

**Total Suspended Particles (PTS)**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-12 | 59,93 | 37 | GOOD | |
| 2020-02-13 | 64,74 | 40 | GOOD | |
| 2020-02-14 | 53,56 | 33 | GOOD | |
| 2020-02-15 | 48,89 | 31 | GOOD | |
| 2020-02-16 | 49,91 | 31 | GOOD | |
| 2020-02-17 | 70,10 | 44 | GOOD | |
| 2020-02-18 | 56,08 | 35 | GOOD | |
| **Geometric Average** | **57,16** | | | |

**Inhalable Particles (PI) - PM10**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-12 | 34,35 | 32 | GOOD | |
| 2020-02-13 | 32,77 | 30 | GOOD | |
| 2020-02-14 | 34,77 | 32 | GOOD | |
| 2020-02-15 | 29,94 | 28 | GOOD | |
| 2020-02-16 | 27,52 | 25 | GOOD | |
| 2020-02-17 | 36,31 | 34 | GOOD | |
| 2020-02-18 | 30,55 | 28 | GOOD | |
| **Geometric Average** | **32,32** | | | |

**Inhalable Particles (PI) - PM2,5**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-12 | 23,95 | 72 | MODERATE | |
| 2020-02-13 | 25,38 | 75 | MODERATE | |
| 2020-02-14 | 21,81 | 66 | MODERATE | |
| 2020-02-15 | 19,18 | 59 | MODERATE | |
| 2020-02-16 | 16,79 | 53 | MODERATE | |
| 2020-02-17 | 23,16 | 69 | MODERATE | |
| 2020-02-18 | 17,31 | 54 | MODERATE | |
| **Arithmetic average** | **21,08** | | | |


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**Point 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY**

**Total Suspended Particles (PTS)**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-26 | 42,31 | 26 | GOOD | |
| 2020-02-27 | 70,43 | 44 | GOOD | |
| 2020-02-28 | 67,22 | 42 | GOOD | |
| 2020-02-29 | 76,89 | 48 | GOOD | |
| 2020-03-01 | 40,11 | 25 | GOOD | |
| 2020-03-02 | 59,36 | 37 | GOOD | |
| 2020-03-03 | 60,93 | 38 | GOOD | |
| **Geometric Average** | **58,10** | | | |

**Inhalable Particles (PI) - PM10**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-26 | 25,48 | 24 | GOOD | |
| 2020-02-27 | 38,33 | 35 | GOOD | |
| 2020-02-28 | 27,47 | 25 | GOOD | |
| 2020-02-29 | 43,09 | 40 | GOOD | |
| 2020-03-01 | 26,30 | 24 | GOOD | |
| 2020-03-02 | 26,96 | 25 | GOOD | |
| 2020-03-03 | 30,70 | 28 | GOOD | |
| **Arithmetic average** | **31,19** | | | |

**Inhalable Particles (PI) - PM2,5**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-26 | 19,54 | 60 | MODERATE | |
| 2020-02-27 | 29,94 | 87 | MODERATE | |
| 2020-02-28 | 30,34 | 88 | MODERATE | |
| 2020-02-29 | 35,94 | 101 | UNHEALTHY (1) | |
| 2020-03-01 | 20,66 | 63 | MODERATE | |
| 2020-03-02 | 20,74 | 63 | MODERATE | |
| 2020-03-03 | 23,28 | 70 | MODERATE | |
| **Arithmetic average** | **25,78** | | | |


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**Point 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT**

**Total Suspended Particles (PTS)**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-19 | 107,18 | 59 | MODERATE | |
| 2020-02-20 | 83,68 | 52 | MODERATE | |
| 2020-02-21 | 165,03 | 77 | MODERATE | |
| 2020-02-22 | 103,01 | 58 | MODERATE | |
| 2020-02-23 | 133,13 | 67 | MODERATE | |
| 2020-02-24 | 74,95 | 47 | GOOD | |
| 2020-02-25 | 132,30 | 67 | MODERATE | |
| **Geometric Average** | **110,51** | | | |

**Inhalable Particles (PI) - PM10**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-19 | 38,13 | 35 | GOOD | |
| 2020-02-20 | 29,73 | 28 | GOOD | |
| 2020-02-21 | 58,49 | 53 | MODERATE | |
| 2020-02-22 | 42,58 | 39 | GOOD | |
| 2020-02-23 | 49,92 | 46 | GOOD | |
| 2020-02-24 | 31,48 | 29 | GOOD | |
| 2020-02-25 | 45,49 | 42 | GOOD | |
| **Arithmetic average** | **42,26** | | | |

**Inhalable Particles (PI) - PM2,5**

| DATE | CONCENTRATIONS (µg/m$^3$) | AQI | AIR QUALITY | REFERENCE COLOR |
|---|---|---|---|---|
| 2020-02-19 | 27,37 | 80 | MODERATE | |
| 2020-02-20 | 20,09 | 62 | MODERATE | |
| 2020-02-21 | 44,16 | 115 | UNHEALTHY (1) | |
| 2020-02-22 | 25,62 | 76 | MODERATE | |
| 2020-02-23 | 27,51 | 81 | MODERATE | |
| 2020-02-24 | 19,22 | 59 | MODERATE | |
| 2020-02-25 | 26,11 | 77 | MODERATE | |
| **Arithmetic average** | **26,25** | | | |


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# 7.0 – DECLARATION OF CONFORMITY

Measurement results are presented in the following table.

**Analytical Results**
**February-March/2020 concentrations**

| Monitoring Stations | Sampling | Monitoring Results | | | | | | | | | | According to Resolution SEAM nº 259 fron 3 rd july 2015 ( µg/m3 ) | | | | | | | | CETESB | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PTS (MP) µg/m³ (24 hours) | PI (PM 10) µg/m³ (24 hours) | PI (PM 2,5) µg/m³ (24 hours) | $SO_2$ µg/m³ (24 hours) | $NO_2$ µg/m³ (1 hour) | VOC µg/m³ (20 minutes) | $O_3$ µg/m³ (8 hours) | CO µg/m³ (8 hours) | TRS µg/m³ (1 hour) | $H_2S$ µg/m³ (24 hours) | PTS | PI (PM10) | PI (PM2,5) | $SO_2$ | $NO_2$ | VOC | $O_3$ | CO | TRS | $H_2S$ |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2020-02-12 | 59,93 | 34,35 | 23,95 | 17,63 | 1,09 | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-13 | 64,74 | 32,77 | 25,38 | 19,48 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-14 | 53,56 | 34,77 | 21,81 | 16,82 | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-15 | 48,89 | 29,94 | 19,18 | 13,28 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-16 | 49,91 | 27,52 | 16,79 | 12,46 | N.D. | 0,11 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-17 | 70,10 | 36,31 | 23,16 | 14,14 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-18 | 56,08 | 30,55 | 17,31 | 11,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2020-02-12 | 42,31 | 25,48 | 19,54 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-13 | 70,43 | 38,33 | 29,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-14 | 67,22 | 27,47 | 30,34 | N.D. | N.D. | 0,15 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-15 | 76,89 | 43,09 | 35,94 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | 150 | 30 | 20 | 200 | 20 | 120 | 10 | 6,55 | 6,55 |
| | 2020-02-16 | 40,11 | 26,30 | 20,66 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-17 | 59,36 | 26,96 | 20,74 | N.D. | N.D. | 0,38 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-18 | 60,93 | 30,70 | 23,28 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| Point 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit | 2020-02-12 | 107,18 | 38,13 | 27,37 | N.D. | N.D. | 0,01 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-13 | 83,68 | 29,73 | 20,09 | N.D. | N.D. | 0,21 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-14 | 165,03 | 58,49 | 44,16 | N.D. | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-15 | 103,01 | 42,58 | 25,62 | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-16 | 133,13 | 49,92 | 27,51 | N.D. | N.D. | 0,18 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-17 | 74,95 | 31,48 | 19,22 | N.D. | N.D. | 0,24 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |
| | 2020-02-18 | 132,30 | 45,49 | 26,11 | N.D. | N.D. | 0,15 | N.D. | N.D. | N.D. | N.D. | | | | | | | | | | |

**Note 1. Limit established by SEAM Resolution 259/2015**
**Note 2. There is no limit established in SEAM Resolution 259/2015 for Volatile Organic Compounds (VOCs). Also, use the exposure limit set by hourly basis (TWA) by the "American Conference of Governmental Industrial Hygienists (ACGIH)" for Toluene, the VOC identified in the analysis.**
**Note 3. There is no limit for comparison set by SEAM Resolution n 259/2015, for the TRS and H2S parameters. Likewise, the limit of perception of the odor for H2S present in the FISPQ of the product was used.**

**PTS - Total Particles in Suspension**

Considering Resolution n. 259 of the SEAM of July 3, 2015, there is no limit for Total Particles in Suspension (PTS); consequently, the interpretation of the reported results is left to the environmental body.

**Inhalable Particles (PI - $MP^{10}$)**

Considering the limit established by Resolution n. 259 of the SEAM of July 3, 2015, whose maximum 24-hour concentration of Inhalable Particles ($MP_{10}$) is 150 µg / $m^3$, after comparing the results obtained, it was confirmed that in the monitored period all data collections were showed below the limit established in the regulations.

**Breathable Particles (PR - $MP_{2,5}$)**

Considering the limit established in SEAM Resolution No. 259 of July 3, 2015, whose maximum concentration in the 24-hour period of Breathable Particles (MP2.5) is 30 µg / $m^3$, after comparing the data obtained, it was revealed that all the collections from Point 01 –SENACSA / Departmental Commission on Animal Health, and one collection from Point 02 - Loreto Municipality, presented concentration above the regulations. It is possible that it is material associated with resuspension of particulate originating from unpaved roads and emission of vehicles moved with diesel fuel. Other data obtained showed concentrations below the limit established by said resolution in the monitoring period.

The company GEOAVALIAR, through its experts responsible for the monitoring carried out, understands that the results in disagreement with the legislation are due to independent factors that directly affected the analysis. Since they do not represent a pattern, they occurred on sporadic days and represent violation only for the finest level of Particulates (PI $PM_{2.5}$) - a pollutant that has an aerodynamic profile and uses long distances.

**$SO_2$ - Sulfur Dioxide**

Considering the limit established by SEAM Resolution No. 259 of July 3, 2015, and the maximum allowed 24-hour concentration of Sulfur Dioxide ($SO_2$) of 20 µg / $m^3$, after comparing the results obtained, it was verified that in the monitored period all collections are below the legal limit, except Point 01 - SENACSA / Departmental Commission on Animal Health in which the inhalable particulate was detected.

Likewise, Geoavaliar, through its technicians responsible for monitoring, believes that the data obtained is related to the emissions from equipment that uses diesel (with sulfur), and also the meteorological conditions will favor the permanence of the pollutant in the atmosphere.

**NO2 - Nitrogen Dioxide**

Considering the limit established by Resolution n. 259 of the SEAM of July 3, 2015, and the maximum concentration of 1 (one) hour of Nitrogen Dioxide ($NO_2$) of 200 µg / $m^3$, after comparing the obtained data, it was verified that the collected data were presented below the limit.

**O3 - Ozone**

It is verified that the data obtained in the 21 samplings, presented data below the limit established in Resolution n. 259 of the SEAM of July 3, 2015 whose average concentration of 8 (eight) hours is 120 µg / $m^3$.


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**CO - Carbon monoxide**

The results obtained in the 21 samplings were below the limit established by Resolution n. 259 of MADES from July 3, 2015, whose average concentration of 8 (eight) hours is 10 µg / $m^3$.

**$H_2S$ - Total Reduced Sulfur and Hydrogen Sulfide**

Among the results of the 21 collections at the monitoring points, it was observed that the contaminants Hydrogen Sulfide and Total Reduced Sulfur are below the limit of perception of odor by the FISPQ of $H_2S$ (6.55 µg / $m^3$).

**VOC - Volatile Organic Compounds**

It is verified that the results obtained in the 21 samplings are presented significantly below that established by the American Conference of Governmental Industrial Hygienists (ACGIH) for a daily average value for exposure to Toluene which is 20 ppm. The comparative value was adopted once Resolution n. 259/2015 does not establish a standard for that pollutant.

Contagem, Apr. 14, 2019.

**Leonardo de Salles**
CREA MG - 093653D
**GEOAVALIAR Análises e Consultorias Ambientais Ltda**

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# 8.0 – ANNEXES

**- FIELD DATA -**

**- ANALYTICAL AWARD -**

**- SATELLITE IMAGE AND IDENTIFICATION OF THE MONITORING POINT -**

**- CALIBRATION AND TECHNICAL CONTROL**



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| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | Feb-20 | $a_2$ = | 1,4556 | $b_2$= | -0,4596 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** — **Sampler N°** **GEO-HI-VOL 005**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2020-02-12 | 5838,70 | 5861,87 | 1390,2 | 128,05 | 3,27 | 1,33 | 1,54 | 1844,45 | 2136,50 |
| 2 | 2020-02-13 | 5861,88 | 5885,05 | 1390,2 | 125,95 | 2,58 | 1,20 | 1,40 | 1665,11 | 1945,47 |
| 3 | 2020-02-14 | 5885,06 | 5908,23 | 1390,2 | 110,00 | 2,97 | 1,27 | 1,48 | 1768,71 | 2053,78 |
| 4 | 2020-02-15 | 5908,23 | 5931,40 | 1390,2 | 101,55 | 3,06 | 1,29 | 1,49 | 1791,77 | 2077,17 |
| 5 | 2020-02-16 | 5931,80 | 5954,57 | 1366,2 | 95,60 | 2,60 | 1,20 | 1,40 | 1641,74 | 1915,27 |
| 6 | 2020-02-17 | 5954,58 | 5977,75 | 1390,2 | 147,80 | 3,19 | 1,31 | 1,52 | 1824,56 | 2108,43 |
| 7 | 2020-02-18 | 5977,75 | 6000,92 | 1390,2 | 117,70 | 3,16 | 1,31 | 1,51 | 1817,04 | 2098,63 |

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | Feb-20 | $a_2$ = | 6,0295 | $b_2$= | 0,5773 |
|---|---|---|---|---|---|---|---|

**PM10 SAMPLING CALCULATIONS** — **Sampler N°** **GEO-PM-10 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2020-02-12 | 4501,76 | 4524,93 | 1390,2 | 52,40 | 43,7 | 44,6 | 1,0973 | 1525,51 |
| 2 | 2020-02-13 | 4524,94 | 4548,08 | 1388,4 | 50,00 | 43,5 | 44,3 | 1,0989 | 1525,75 |
| 3 | 2020-02-14 | 4548,08 | 4571,25 | 1390,2 | 53,10 | 43,9 | 44,9 | 1,0984 | 1526,96 |
| 4 | 2020-02-15 | 4571,26 | 4594,43 | 1390,2 | 45,80 | 43,5 | 44,6 | 1,1003 | 1529,69 |
| 5 | 2020-02-16 | 4594,43 | 4617,6 | 1390,2 | 42,10 | 43,5 | 44,5 | 1,1005 | 1529,86 |
| 6 | 2020-02-17 | 4617,61 | 4640,78 | 1390,2 | 55,60 | 43,7 | 44,8 | 1,1015 | 1531,30 |
| 7 | 2020-02-18 | 4640,78 | 4663,95 | 1390,2 | 46,90 | 43,5 | 44,5 | 1,1041 | 1534,95 |

| Point: | 01 - SENACSA/ COMISION DEPARTAMENTAL DE SALUD ANIMAL | Calibration | Feb-20 | $a_2$ = | 9,0284 | $b_2$= | 0,3709 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** — **Sampler N°** **GEO-PM-2,5 02**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" | COLLECTED |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | $m^3$/min | VOLUME |
| 1 | 2020-02-12 | 25,55 | 48,72 | 1390,2 | 37,70 | 43,5 | 44,0 | 1,1323 | 1574,12 |
| 2 | 2020-02-13 | 48,72 | 71,89 | 1390,2 | 40,00 | 43,1 | 43,7 | 1,1339 | 1576,32 |
| 3 | 2020-02-14 | 71,90 | 95,07 | 1390,2 | 34,40 | 43,3 | 44,0 | 1,1343 | 1576,92 |
| 4 | 2020-02-15 | 95,07 | 118,24 | 1390,2 | 30,25 | 43,7 | 44,4 | 1,1345 | 1577,22 |
| 5 | 2020-02-16 | 118,25 | 141,42 | 1390,2 | 26,50 | 43,3 | 44,1 | 1,1352 | 1578,12 |
| 6 | 2020-02-17 | 141,43 | 164,6 | 1390,2 | 36,60 | 43,5 | 44,2 | 1,1367 | 1580,26 |
| 7 | 18/02/20 | 164,60 | 187,77 | 1390,2 | 27,40 | 43,5 | 44,2 | 1,1386 | 1582,94 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 13:35 | 13:35 | X | | | X | | | 749,40 | 31,00 | 304,15 |
| 13:04 | 13:04 | X | | | X | | | 749,30 | 31,50 | 304,65 |
| 12:30 | 12:30 | X | | | X | | | 749,10 | 32,00 | 305,15 |
| 12:02 | 12:02 | X | | | X | | | 749,50 | 32,50 | 305,65 |
| 11:30 | 11:30 | X | | | X | | | 749,40 | 32,50 | 305,65 |
| 10:58 | 10:58 | X | | | X | | | 749,10 | 33,50 | 306,65 |
| 10:25 | 10:25 | X | | | X | | | 749,80 | 34,50 | 307,65 |


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| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | Feb-20 | $a_2$ = | 1,2382 | $b_2$= | -0,1554 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** — **Sampler N° GEO-HI-VOL 005**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2020-02-26 | 6163,81 | 6186,98 | 1390,2 | 90,70 | 3,26 | 1,49 | 1,54 | 2074,95 | 2143,56 |
| 2 | 2020-02-27 | 6186,99 | 6210,16 | 1390,2 | 139,45 | 2,66 | 1,36 | 1,42 | 1883,89 | 1979,91 |
| 3 | 2020-02-28 | 6210,16 | 6233,33 | 1390,2 | 138,25 | 2,95 | 1,42 | 1,48 | 1978,54 | 2056,76 |
| 4 | 2020-02-29 | 6233,33 | 6256,50 | 1390,2 | 152,00 | 2,68 | 1,36 | 1,42 | 1890,57 | 1976,91 |
| 5 | 2020-03-01 | 6256,50 | 6279,67 | 1390,2 | 80,65 | 2,80 | 1,39 | 1,45 | 1930,17 | 2010,86 |
| 6 | 2020-03-02 | 6279,67 | 6302,84 | 1390,2 | 125,75 | 3,18 | 1,47 | 1,52 | 2050,50 | 2118,42 |
| 7 | 2020-03-03 | 6302,84 | 6326,01 | 1390,2 | 130,70 | 3,18 | 1,47 | 1,54 | 2050,50 | 2145,15 |

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | Feb-20 | $a_2$ = | 5,0313 | $b_2$= | 0,6379 |
|---|---|---|---|---|---|---|---|

**PM10 SAMPLING CALCULATIONS** — **Sampler N° GEO-PM-10 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2020-02-26 | 4827,07 | 4850,24 | 1390,2 | 38,75 | 44,1 | 44,9 | 1,0939 | 1520,74 |
| 2 | 2020-02-27 | 4850,25 | 4873,42 | 1390,2 | 58,20 | 44,2 | 45,2 | 1,0923 | 1518,50 |
| 3 | 2020-02-28 | 4873,42 | 4896,59 | 1390,2 | 41,90 | 43,9 | 44,9 | 1,0970 | 1525,10 |
| 4 | 2020-02-29 | 4896,59 | 4919,76 | 1390,2 | 65,90 | 43,9 | 44,7 | 1,1001 | 1529,32 |
| 5 | 2020-03-01 | 4919,76 | 4942,93 | 1390,2 | 40,20 | 44,0 | 45,0 | 1,0994 | 1528,34 |
| 6 | 2020-03-02 | 4942,93 | 4966,1 | 1390,2 | 41,10 | 44,1 | 44,9 | 1,0967 | 1524,57 |
| 7 | 2020-03-03 | 4966,10 | 4989,27 | 1390,2 | 46,90 | 43,9 | 44,8 | 1,0989 | 1527,73 |

| Point: | 02 - DE MUNICIPALIDAD DE LORETO/ PARAGUAY | Calibration | Feb-20 | $a_2$ = | 6,4131 | $b_2$= | 0,5460 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** — **Sampler N° GEO-PM-2,5 02**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2020-02-26 | 350,79 | 373,96 | 1390,2 | 30,10 | 43,5 | 43,9 | 1,1082 | 1540,59 |
| 2 | 2020-02-27 | 373,96 | 397,13 | 1390,2 | 46,10 | 43,3 | 43,8 | 1,1076 | 1539,84 |
| 3 | 2020-02-28 | 397,13 | 420,3 | 1390,2 | 46,85 | 43,5 | 44,2 | 1,1106 | 1543,96 |
| 4 | 2020-02-29 | 420,30 | 443,47 | 1390,2 | 55,65 | 43,5 | 43,9 | 1,1137 | 1548,32 |
| 5 | 2020-03-01 | 443,47 | 466,64 | 1390,2 | 32,00 | 43,4 | 43,8 | 1,1140 | 1548,67 |
| 6 | 2020-03-02 | 466,64 | 489,81 | 1390,2 | 32,05 | 43,3 | 43,8 | 1,1114 | 1545,03 |
| 7 | 2020-03-03 | 489,81 | 512,98 | 1390,2 | 36,00 | 43,5 | 44,1 | 1,1125 | 1546,60 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 13:35 | 13:35 | X | | | | X | | 745,50 | 26,00 | 299,15 |
| 13:03 | 13:03 | X | | | X | | | 745,40 | 25,50 | 298,65 |
| 12:35 | 12:35 | X | | | X | | | 745,80 | 27,50 | 300,65 |
| 12:03 | 12:03 | X | | | X | | | 745,60 | 29,00 | 302,15 |
| 11:33 | 11:33 | X | | | X | | | 745,50 | 29,00 | 302,15 |
| 11:01 | 11:01 | X | | | X | | | 745,60 | 27,50 | 300,65 |
| 10:30 | 10:30 | X | | | | X | | 745,30 | 28,50 | 301,65 |


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| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | Feb-20 | $a_2$ = | 1,5615 | $b_2$= | -0,4003 |
|---|---|---|---|---|---|---|---|

**PTS SAMPLING CALCULATIONS** **Sampler N°** **GEO-HI-VOL 005**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | PEN DEFLECTION | Flow Rate (m3/min) Barometric pressure and room temperature | | COLLECTED VOLUME Barometric pressure and room temperature | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | (CHART) | Seasonal | Average | Seasonal | Average |
| 1 | 2020-02-19 | 6001,20 | 6024,37 | 1390,2 | 180,55 | 3,18 | 1,21 | 1,51 | 1684,59 | 2103,16 |
| 2 | 2020-02-20 | 6024,38 | 6047,55 | 1390,2 | 145,80 | 3,43 | 1,25 | 1,56 | 1742,42 | 2175,40 |
| 3 | 2020-02-21 | 6047,55 | 6070,72 | 1390,2 | 281,10 | 3,26 | 1,23 | 1,54 | 1703,31 | 2137,78 |
| 4 | 2020-02-22 | 6070,73 | 6093,90 | 1390,2 | 175,45 | 3,26 | 1,23 | 1,54 | 1703,31 | 2147,62 |
| 5 | 2020-02-23 | 6093,91 | 6117,08 | 1390,2 | 223,95 | 3,17 | 1,21 | 1,52 | 1682,24 | 2112,66 |
| 6 | 2020-02-24 | 6117,09 | 6140,26 | 1390,2 | 120,30 | 2,85 | 1,15 | 1,46 | 1605,08 | 2026,25 |
| 7 | 2020-02-25 | 6140,26 | 6163,43 | 1390,2 | 223,80 | 3,21 | 1,22 | 1,53 | 1691,64 | 2120,51 |

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | Feb-20 | $a_2$ = | 5,6009 | $b_2$= | 0,6012 |
|---|---|---|---|---|---|---|---|

**CÁLCULOS DE MOSTREO DE PM $_{10}$** **N° muestra:** **GEO-PM-10 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2020-02-19 | 4664,37 | 4687,54 | 1390,2 | 58,70 | 43,9 | 44,7 | 1,1073 | 1539,38 |
| 2 | 2020-02-20 | 4687,54 | 4710,71 | 1390,2 | 45,55 | 43,8 | 44,7 | 1,1020 | 1531,94 |
| 3 | 2020-02-21 | 4710,72 | 4733,89 | 1390,2 | 89,30 | 43,9 | 44,7 | 1,0982 | 1526,73 |
| 4 | 2020-02-22 | 4733,90 | 4757,07 | 1390,2 | 64,60 | 44,0 | 44,9 | 1,0913 | 1517,10 |
| 5 | 2020-02-23 | 4757,08 | 4780,25 | 1390,2 | 76,30 | 43,8 | 44,6 | 1,0994 | 1528,44 |
| 6 | 2020-02-24 | 4780,25 | 4803,42 | 1390,2 | 48,05 | 44,7 | 44,7 | 1,0978 | 1526,16 |
| 7 | 2020-02-25 | 4803,42 | 4826,59 | 1390,2 | 69,75 | 43,9 | 44,8 | 1,1028 | 1533,14 |

| Point: | 03 - POSTO POLICIAL NACIONAL - COMSARIA Nº 18 COL. ROBERTO L. PETIT | Calibration | Feb-20 | $a_2$ = | 7,6261 | $b_2$= | 0,4653 |
|---|---|---|---|---|---|---|---|

**PM2.5 SAMPLING CALCULATIONS** **Sampler N°** **GEO-PM-2,5 01**

| Sampling | Date | HOURMETER | | TIME | COLLECTED MASS (mg) | FILTER PRESSURE (cmH2O) | | Flow Rate "Qr" $m^3$/min | COLLECTED VOLUME |
|---|---|---|---|---|---|---|---|---|---|
| | | START | END | | | START | END | | |
| 1 | 2020-02-19 | 188,16 | 211,33 | 1390,2 | 42,90 | 43,7 | 44,2 | 1,1273 | 1567,24 |
| 2 | 2020-02-20 | 211,34 | 234,51 | 1390,2 | 31,35 | 43,5 | 43,9 | 1,1223 | 1560,25 |
| 3 | 2020-02-21 | 234,52 | 257,69 | 1390,2 | 68,70 | 43,3 | 43,8 | 1,1190 | 1555,62 |
| 4 | 2020-02-22 | 257,69 | 280,86 | 1390,2 | 39,60 | 43,5 | 44,1 | 1,1119 | 1545,76 |
| 5 | 2020-02-23 | 280,87 | 304,04 | 1390,2 | 42,80 | 43,7 | 44,1 | 1,1191 | 1555,79 |
| 6 | 2020-02-24 | 304,04 | 327,21 | 1390,2 | 29,90 | 43,7 | 44,3 | 1,1189 | 1555,54 |
| 7 | 2020-02-25 | 327,21 | 350,38 | 1390,2 | 40,70 | 43,5 | 44,0 | 1,1213 | 1558,86 |

**WEATHER DATA / WEATHER CONDITIONS**

| Hour | | Clear Sky | Cloudy | Rainy | Wind Conditions | | | Atm. pressure (mmHg) | Temp. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start | End | | | | Light | Medium | High | | ºC | K |
| 13:26 | 13:26 | | X | | X | | | 745,50 | 33,00 | 306,15 |
| 12:54 | 12:54 | | X | | X | | | 745,10 | 30,00 | 303,15 |
| 12:26 | 12:26 | X | | | | X | | 745,40 | 28,00 | 301,15 |
| 11:55 | 11:55 | X | | | | X | | 745,30 | 24,50 | 297,65 |
| 11:22 | 11:22 | X | | | X | | | 745,30 | 28,50 | 301,65 |
| 10:52 | 10:52 | | X | | X | | | 745,60 | 28,50 | 301,65 |
| 10:23 | 10:23 | | X | | X | | | 745,40 | 29,50 | 302,65 |

**Note:** The ambient temperature and barometric pressure data were collected from the DMH - Directorate of Meteorology and Hydrology website.


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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1973 | 760 | 298,15 |
| $SO_2$ | 1,8975 | 760 | 298,15 |
| $H_2S$ | 0,1820 | 760 | 298,15 |
| $O_3$ | 0,1860 | 760 | 298,15 |
| CO | 0,0525 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 1 | 2020-02-12 | 2020-02-13 | 1947,52 | 1924,35 | 1390 | 92,995 | 89,572 | 749 | 304 | 278,916 | 2682,430 | 257,287 | 262,942 |
| | 2 | 2020-02-13 | 2020-02-14 | 1970,69 | 1947,52 | 1390 | 96,416 | 92,995 | 749 | 305 | 279,164 | 2684,814 | 257,516 | 263,175 |
| | 3 | 2020-02-14 | 2020-02-15 | 1993,86 | 1970,69 | 1390 | 99,838 | 96,416 | 749 | 305 | 279,430 | 2687,376 | 257,762 | 263,427 |
| | 4 | 2020-02-15 | 2020-02-16 | 2017,03 | 1993,86 | 1390 | 103,259 | 99,838 | 750 | 306 | 279,585 | 2688,860 | 257,904 | 263,572 |
| | 5 | 2020-02-16 | 2020-02-17 | 2040,20 | 2017,03 | 1390 | 106,682 | 103,259 | 749 | 306 | 279,603 | 2689,040 | 257,921 | 263,590 |
| | 6 | 2020-02-17 | 2020-02-18 | 2063,37 | 2040,20 | 1390 | 110,101 | 106,682 | 749 | 307 | 280,117 | 2693,976 | 258,395 | 264,074 |
| | 7 | 2020-02-18 | 2020-02-19 | 2086,54 | 2063,37 | 1390 | 113,522 | 113,522 | 750 | 308 | 280,442 | 2697,108 | 258,695 | 264,381 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | **Date** | | | **Time** | | | **Air Volume (Standard L)** | **Environmental Conditions** | | **Corrected Air Volume ($m^3$)** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Trigas: 24 hours) | | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) | | CO (Bomba BDXII; Tedlar Bag: 1 hora) | | | | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| | Start | End | | Start | End | | **CO** | $P_2$ (mmHg) | $T_2$ (K) | | | | | |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2020-02-12 | 2020-02-13 | 2020-02-12 | 13:35 | 13:35 | 13:40 to 14:40 | 3,203 | 749,4 | 304,0 | **0,229** | **2,682** | **0,257** | **0,263** | **0,003** |
| | 2020-02-13 | 2020-02-14 | 2020-02-13 | 13:04 | 13:04 | 13:05 to 14:05 | 3,206 | 749,3 | 304,5 | **0,229** | **2,685** | **0,258** | **0,263** | **0,003** |
| | 2020-02-14 | 2020-02-15 | 2020-02-14 | 12:30 | 12:30 | 12:45 to 13:45 | 3,209 | 749,1 | 305,0 | **0,229** | **2,687** | **0,258** | **0,263** | **0,003** |
| | 2020-02-15 | 2020-02-16 | 2020-02-15 | 12:02 | 12:02 | 12:10 to 13:10 | 3,211 | 749,5 | 305,5 | **0,229** | **2,689** | **0,258** | **0,264** | **0,003** |
| | 2020-02-16 | 2020-02-17 | 2020-02-16 | 11:30 | 11:30 | 11:45 to 12:45 | 3,211 | 749,4 | 305,5 | **0,229** | **2,689** | **0,258** | **0,264** | **0,003** |
| | 2020-02-17 | 2020-02-18 | 2020-02-17 | 10:58 | 10:58 | 11:05 to 12:05 | 3,217 | 749,1 | 306,5 | **0,230** | **2,694** | **0,258** | **0,264** | **0,003** |
| | 2020-02-18 | 2020-02-19 | 2020-02-18 | 10:25 | 10:25 | 10:45 to 11:45 | 3,221 | 749,8 | 307,5 | **0,230** | **2,697** | **0,259** | **0,264** | **0,003** |

| Point | Results Laboratory tests | | | | | | | | | | **Concentration (µg/$m^3$)** | | | | **ppm** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | | | Blank | | | | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide"$NO_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| | | $S0_2$ (µg/100mL) | $N0_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $S0_2$ (µg/100mL) | $N0_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | | | | | |
| 1 | 1 | 47,3 | 0,12 | <0,002 | <0,80 | < 3,3 | <27 | <0,01 | <0,05 | <0,80 | **17,6** | **1,09** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | 52,3 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **19,5** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 3 | 45,2 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **16,8** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 4 | 35,7 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **13,3** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | 33,5 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **12,5** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 6 | 38,1 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **14,1** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 7 | 32,2 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **11,9** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão | "Standard" environmental conditions | |
|---|---|---|---|
| TRS | 0,9899 | 760 | 298,15 |
| COV | 0,9899 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | **TRS** | **VOC** |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 01 - Senacsa/ Comision Departamental de Salud Animal | 2020-02-12 | 2020-02-12 | 13:00 | 14:00 | 14:11 to 14:31 | 0,06 | 0,02 | 749,4 | 304,0 | **0,057** | **0,019** |
| | 2020-02-13 | 2020-02-13 | 13:27 | 14:27 | 14:50 to 15:10 | 0,06 | 0,02 | 749,3 | 304,5 | **0,057** | **0,019** |
| | 2020-02-14 | 2020-02-14 | 10:42 | 11:42 | 11:50 to 12:10 | 0,06 | 0,02 | 749,1 | 305,0 | **0,057** | **0,019** |
| | 2020-02-15 | 2020-02-15 | 8:21 | 9:21 | 09:30 to 09:50 | 0,60 | 0,02 | 749,5 | 305,5 | **0,571** | **0,019** |
| | 2020-02-16 | 2020-02-16 | 8:44 | 9:44 | 09:48 to 10:08 | 0,06 | 0,02 | 749,4 | 305,5 | **0,057** | **0,019** |
| | 2020-02-17 | 2020-02-17 | 8:24 | 9:24 | 09:30 to 09:50 | 0,06 | 0,02 | 749,1 | 306,5 | **0,057** | **0,019** |
| | 2020-02-18 | 2020-02-18 | 8:51 | 9:51 | 10:00 to 10:20 | 0,06 | 0,02 | 749,8 | 307,5 | **0,057** | **0,019** |

| Point | Results Laboratory tests | | | | | | Concentration (µg/m3) | |
|---|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | Blank | | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | **Reduced Sulfur Content TRS** | **Volatile Organic Compounds VOC** |
| 1 | 1 | < 27 | tcap 19/1617 | 24,8 | < 27 | 28,0 | **N.D.** | **N.D.** |
| | 2 | < 27 | tacp 20/0002 | 23,3 | | | **N.D.** | **N.D.** |
| | 3 | < 27 | tcap 20/0005 | 31,4 | | | **N.D.** | **178,3** |
| | 4 | < 27 | tcap 19/1653 | 14,3 | | | **N.D.** | **N.D.** |
| | 5 | < 27 | tacp 20/0007 | 30,1 | | | **N.D.** | **110,3** |
| | 6 | < 27 | tcap 19/1654 | 11,0 | | | **N.D.** | **N.D.** |
| | 7 | < 27 | tcap 20/0001 | 20,6 | | | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1973 | 760 | 298,15 |
| $SO_2$ | 1,9013 | 760 | 298,15 |
| $H_2S$ | 0,1822 | 760 | 298,15 |
| $O_3$ | 0,1862 | 760 | 298,15 |
| CO | 0,0526 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 1 | 2020-02-26 | 2020-02-27 | 2272,75 | 2249,58 | 1390 | 200,121 | 196,702 | 746 | 299 | 277,336 | 2672,570 | 256,110 | 261,733 |
| | 2 | 2020-02-27 | 2020-02-28 | 2295,92 | 2272,75 | 1390 | 203,539 | 200,121 | 745 | 299 | 277,122 | 2670,514 | 255,913 | 261,531 |
| | 3 | 2020-02-28 | 2020-02-29 | 2319,09 | 2295,92 | 1390 | 206,955 | 203,539 | 746 | 301 | 277,974 | 2678,726 | 256,700 | 262,336 |
| | 4 | 2020-02-29 | 2020-03-01 | 2342,26 | 2319,09 | 1390 | 210,372 | 206,955 | 746 | 302 | 278,705 | 2685,764 | 257,375 | 263,025 |
| | 5 | 2020-03-01 | 2020-03-02 | 2365,43 | 2342,26 | 1390 | 213,788 | 210,372 | 746 | 302 | 278,723 | 2685,944 | 257,392 | 263,043 |
| | 6 | 2020-03-02 | 2020-03-03 | 2388,60 | 2365,43 | 1390 | 217,205 | 213,788 | 746 | 301 | 278,030 | 2679,265 | 256,752 | 262,388 |
| | 7 | 2020-03-03 | 2020-03-04 | 2411,77 | 2388,60 | 1390 | 220,621 | 217,205 | 745 | 302 | 278,530 | 2684,080 | 257,213 | 262,860 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Date | | | Time | | | Air Volume (Standard L) | Environmental Conditions | | Corrected Air Volume ($m^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Trigas: 24 hours) | | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) | | CO (Bomba BDXII; Tedlar Bag: 1 hora) | **CO** | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| | Start | End | | Start | End | | | | | | | | | |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2020-02-26 | 2020-02-27 | 2020-02-26 | 13:35 | 13:35 | 13:40 to 14:40 | 3,191 | 745,5 | 299,0 | **0,227** | **2,673** | **0,256** | **0,262** | **0,003** |
| | 2020-02-27 | 2020-02-28 | 2020-02-27 | 13:03 | 13:03 | 13:10 to 14:10 | 3,189 | 745,4 | 298,5 | **0,227** | **2,671** | **0,256** | **0,262** | **0,003** |
| | 2020-02-28 | 2020-02-29 | 2020-02-28 | 12:35 | 12:35 | 13:40 to 14:40 | 3,198 | 745,8 | 300,5 | **0,228** | **2,679** | **0,257** | **0,262** | **0,003** |
| | 2020-02-29 | 2020-03-01 | 2020-02-29 | 12:03 | 12:03 | 12:15 to 13:15 | 3,207 | 745,6 | 302,0 | **0,229** | **2,686** | **0,257** | **0,263** | **0,003** |
| | 2020-03-01 | 2020-03-02 | 2020-03-01 | 11:33 | 11:33 | 11:40 to 14:40 | 3,207 | 745,5 | 302,0 | **0,229** | **2,686** | **0,257** | **0,263** | **0,003** |
| | 2020-03-02 | 2020-03-03 | 2020-03-02 | 11:01 | 11:01 | 11:10 to 12:10 | 3,199 | 745,5 | 300,5 | **0,228** | **2,679** | **0,257** | **0,262** | **0,003** |
| | 2020-03-03 | 2020-03-04 | 2020-03-03 | 10:30 | 10:30 | 10:40 to 11:40 | 3,205 | 745,3 | 301,5 | **0,228** | **2,684** | **0,257** | **0,263** | **0,003** |

| Point | Sampling | Results Laboratory tests | | | | | Blank | | | | Concentration (µg/$m^3$) | | | | ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Results Laboratory tests | | | | | | | | | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide "$NO_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| | | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | | | | | |
| 2 | 1 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | < 27 | <0,01 | <0,05 | <0,80 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 3 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 4 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 6 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 7 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão | "Standard" environmental conditions | |
|---|---|---|---|
| TRS | 0,9990 | 760 | 298,15 |
| VOC | 0,9990 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | **TRS** | **VOC** |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 02 - De Municipalidad de Loreto/ Paraguay | 2020-02-26 | 2020-02-26 | 14:31 | 15:31 | 16:47 to 17:07 | 0,06 | 0,02 | 745,5 | 299,0 | **0,059** | **0,020** |
| | 2020-02-27 | 2020-02-27 | 9:09 | 10:09 | 10:20 to 10:40 | 0,06 | 0,02 | 745,4 | 298,5 | **0,059** | **0,020** |
| | 2020-02-28 | 2020-02-28 | 9:32 | 10:32 | 10:41 to 11:01 | 0,06 | 0,02 | 745,8 | 300,5 | **0,058** | **0,019** |
| | 2020-02-29 | 2020-02-29 | 9:10 | 10:10 | 10:18 to 10:38 | 0,60 | 0,02 | 745,6 | 302,0 | **0,580** | **0,019** |
| | 2020-03-01 | 2020-03-01 | 9:28 | 10:28 | 10:40 to 11:00 | 0,06 | 0,02 | 745,5 | 302,0 | **0,058** | **0,019** |
| | 2020-03-02 | 2020-03-02 | 9:05 | 10:05 | 10:16 to 10:36 | 0,06 | 0,02 | 745,5 | 300,5 | **0,058** | **0,019** |
| | 2020-03-03 | 2020-03-03 | 8:50 | 9:50 | 10:01 to 10:21 | 0,06 | 0,02 | 745,3 | 301,5 | **0,058** | **0,019** |

| Point | Results Laboratory tests | | | | Blank | | Concentration (µg/m3) | Concentration (µg/m3) |
|---|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | | | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | **Reduced Sulfur Content TRS** | **Volatile Organic Compounds VOC** |
| 2 | 1 | < 27 | tcap 19/1676 | 23,7 | < 27 | 28,0 | **N.D.** | **N.D.** |
| | 2 | < 27 | tacp 19/1677 | 25,0 | | | **N.D.** | **N.D.** |
| | 3 | < 27 | tcap 19/1684 | 31 | | | **N.D.** | **154,3** |
| | 4 | < 27 | tcap 19/1679 | 27,7 | | | **N.D.** | **N.D.** |
| | 5 | < 27 | tcap 19/1682 | 22,3 | | | **N.D.** | **N.D.** |
| | 6 | < 27 | tcap 19/1680 | 35,4 | | | **N.D.** | **380,7** |
| | 7 | < 27 | tcap 19/1683 | 27,9 | | | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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Análises e Consultorias Ambientais Ltda

***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão (Qoc ) "L/min" | "Standard" environmental conditions | |
|---|---|---|---|
| $NO_2$ | 0,1973 | 760 | 298,15 |
| $SO_2$ | 1,8916 | 760 | 298,15 |
| $H_2S$ | 0,1820 | 760 | 298,15 |
| $O_3$ | 0,1860 | 760 | 298,15 |
| CO | 0,0525 | 760 | 298,15 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Sampling | Date | | Hourmeter | | Collection Time | Meter Volume $m^3$ | | Environmental Conditions | | Air Volume (Standard L) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Start | End | Start | End | | Start | End | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** |
| Point 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit | 1 | 2020-02-19 | 2020-02-20 | 2110,05 | 2086,88 | 1390 | 173,449 | 170,033 | 746 | 304 | 279,415 | 2678,869 | 257,747 | 263,412 |
| | 2 | 2020-02-20 | 2020-02-21 | 2133,22 | 2110,05 | 1390 | 176,867 | 173,449 | 745 | 304 | 279,720 | 2681,794 | 258,028 | 263,699 |
| | 3 | 2020-02-21 | 2020-02-22 | 2156,39 | 2133,22 | 1390 | 180,284 | 176,867 | 745 | 306 | 280,582 | 2690,060 | 258,824 | 264,512 |
| | 4 | 2020-02-22 | 2020-02-23 | 2179,56 | 2156,39 | 1390 | 183,699 | 180,284 | 745 | 305 | 280,142 | 2685,841 | 258,418 | 264,097 |
| | 5 | 2020-02-23 | 2020-02-24 | 2202,73 | 2179,53 | 1392 | 187,116 | 183,699 | 745 | 304 | 279,814 | 2682,698 | 258,115 | 263,788 |
| | 6 | 2020-02-24 | 2020-02-25 | 2225,90 | 2202,73 | 1390 | 190,531 | 187,116 | 746 | 295 | 275,456 | 2640,913 | 254,095 | 259,680 |
| | 7 | 2020-02-25 | 2020-02-26 | 2249,07 | 2225,90 | 1390 | 193,950 | 190,531 | 745 | 295 | 275,259 | 2639,028 | 253,914 | 259,494 |

**SO2, NO2, H2S, O3 and CO Collected Data**

| Point | Date | | | Time | | | Air Volume (Standard L) | Environmental Conditions | | Corrected Air Volume ($m^3$) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Trigas: 24 hours) | | CO (BDXII pump; Tedlar Bag: 1 hour) | $SO_2$, $NO_2$, $H_2S$ and $O_3$ (Lightning: 24 hourss) | | CO (Bomba BDXII; Tedlar Bag: 1 hora) | **CO** | $P_2$ (mmHg) | $T_2$ (K) | **$NO_2$** | **$SO_2$** | **$H_2S$** | **$O_3$** | **CO** |
| | Start | End | | Start | End | | | | | | | | | |
| Point 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit | 2020-02-19 | 2020-02-20 | 2020-02-19 | 13:26 | 13:26 | 13:30 to 14:30 | 3,209 | 745,5 | 303,5 | **0,229** | **2,679** | **0,258** | **0,263** | **0,003** |
| | 2020-02-20 | 2020-02-21 | 2020-02-20 | 12:54 | 12:54 | 13:00 to 14:00 | 3,212 | 745,1 | 304,0 | **0,229** | **2,682** | **0,258** | **0,264** | **0,003** |
| | 2020-02-21 | 2020-02-22 | 2020-02-21 | 12:26 | 12:26 | 12:30 to 13:30 | 3,222 | 745,4 | 306,0 | **0,230** | **2,690** | **0,259** | **0,265** | **0,003** |
| | 2020-02-22 | 2020-02-23 | 2020-02-22 | 11:55 | 11:55 | 12:00 to 13:00 | 3,217 | 745,3 | 305,0 | **0,230** | **2,686** | **0,258** | **0,264** | **0,003** |
| | 2020-02-23 | 2020-02-24 | 2020-02-23 | 11:22 | 11:22 | 11:30 to 12:30 | 3,209 | 745,3 | 303,5 | **0,229** | **2,683** | **0,258** | **0,264** | **0,003** |
| | 2020-02-24 | 2020-02-25 | 2020-02-24 | 10:52 | 10:52 | 11:00 to 12:00 | 3,163 | 745,6 | 295,0 | **0,226** | **2,641** | **0,254** | **0,260** | **0,003** |
| | 2020-02-25 | 2020-02-26 | 2020-02-25 | 10:23 | 10:23 | 10:30 to 11:30 | 3,161 | 745,4 | 294,5 | **0,226** | **2,639** | **0,254** | **0,259** | **0,003** |

| Point | Sampling | Results Laboratory tests | | | | | Blank | | | | Concentration (µg/$m^3$) | | | | ppm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg/L) | $O_3$ (µg) | CO (ppm) | $SO_2$ (µg/100mL) | $NO_2$ (mg/L) | $H_2S$ (mg) | $O_3$ (µg) | **Sulfur Dioxide "$SO_2$"** | **Nitrogen Dioxide "$NO_2$"** | **Sulphidic Acid ($H_2S$)** | **Ozone "$O_3$"** | **Carbon monoxide "CO" (1 hour)** |
| 3 | 1 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | < 27 | <0,01 | <0,05 | <0,80 | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 2 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 3 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 4 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 5 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 6 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |
| | 7 | < 27 | <0,01 | <0,002 | <0,80 | < 3,3 | | | | | **N.D.** | **N.D.** | **N.D.** | **N.D.** | **N.D.** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)

**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.

**03)** P - Atmospheric pressure T - Room temperature

$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time

**04)** L.Q. - Limit of Quantification of the method



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***Sampling Data***

Calibration Data

| Collected Gas | Critical Orifice Vazão | "Standard" environmental conditions | |
|---|---|---|---|
| TRS | 0,9934 | 760 | 298,15 |
| VOC | 0,9934 | 760 | 298,15 |

**TRS and VOC Collected Data**

| Point | Date | | Time | | | Air Volume ($m^3$ Standard) | Air Volume ($m^3$ Standard) | Environmental Conditions | | Corrected Air Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TRS (Trigas: 24 hours) | | TRS (BDXII pump; Tedlar Bag: 60 minutes) | | VOC (BBDXII pump; Tedlar Bag: 20 minutes) | | | | | **TRS** | **VOC** |
| | Start | End | Start | End | | TRS | VOC | $P_2$ (mmHg) | $T_2$ (K) | | |
| Point 03 - Estación de Policía Nacional - Comisária nº18 Col. Roberto L. Petit | 2020-02-19 | 2020-02-19 | 14:20 | 15:20 | 16:33 to 16:53 | 0,06 | 0,02 | 745,5 | 303,5 | **0,057** | **0,019** |
| | 2020-02-20 | 2020-02-20 | 10:44 | 11:44 | 11:58 to 12:18 | 0,06 | 0,02 | 745,1 | 304,0 | **0,057** | **0,019** |
| | 2020-02-21 | 2020-02-21 | 9:12 | 10:12 | 10:19 to 10:39 | 0,06 | 0,02 | 745,4 | 306,0 | **0,057** | **0,019** |
| | 2020-02-22 | 2020-02-22 | 8:55 | 9:55 | 10:05 to 10:25 | 0,60 | 0,02 | 745,3 | 305,0 | **0,571** | **0,019** |
| | 2020-02-23 | 2020-02-23 | 9:11 | 10:11 | 10:17 to 10:37 | 0,06 | 0,02 | 745,3 | 303,5 | **0,057** | **0,019** |
| | 2020-02-24 | 2020-02-24 | 9:04 | 10:04 | 10:15 to 10:35 | 0,06 | 0,02 | 745,6 | 295,0 | **0,059** | **0,020** |
| | 2020-02-25 | 2020-02-25 | 8:53 | 9:53 | 10:04 to 10:24 | 0,06 | 0,02 | 745,4 | 294,5 | **0,059** | **0,020** |

| Point | Results Laboratory tests | | | | Blank | | Concentration (µg/m3) | (µg/m3) |
|---|---|---|---|---|---|---|---|---|
| | Sampling | Results Laboratory tests | | | | | | |
| | | TRS (µg/ 100mL) | Ampoule identification VOC | VOC (µg) | TRS (µg/ 100mL) | VOC (µg) | **Reduced Sulfur Content TRS** | **Volatile Organic Compounds VOC** |
| 3 | 1 | < 27 | tcap 19/1616 | 28,2 | < 27 | 28,0 | **N.D.** | **10,5** |
| | 2 | < 27 | tacp 20/0003 | 32,1 | | | **N.D.** | **214,7** |
| | 3 | < 27 | tcap 20/0008 | 31,4 | | | **N.D.** | **179,2** |
| | 4 | < 27 | tcap 20/0004 | 26,2 | | | **N.D.** | **N.D.** |
| | 5 | < 27 | tcap 19/1675 | 31,5 | | | **N.D.** | **183,0** |
| | 6 | < 27 | tcap 19/1678 | 32,8 | | | **N.D.** | **243,8** |
| | 7 | < 27 | tcap 19/1681 | 30,9 | | | **N.D.** | **147,1** |

**Note:** **01)** N.D. - Not Detected (value below the quantification limit of the analysis method)
**02)** The data of room temperature and barometric pressure were extracted from the website DMH - Meteorology and Hydrology Directorate.
**03)** P - Atmospheric pressure T - Room temperature
$V_{ar}$ = air volume sample, $m^3$ $t_a$ - sampled time
**04)** L.Q. - Limit of Quantification of the method


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# ANNEX III
# NOISE MONITORING REPORT

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**Date 05.08.2020**

**Reference N° 1090001759-003-0000-M-1501**



# ENVIRONMENTAL IMPACT STUDY & REPORT (EIAp/RIMA)

PARACEL

**PARACEL**
**Pulp Mill and Port in Concepción - Paraguay**

**VOLUME IV – ANALYSIS REPORTSp**

**Annex III - Noise Monitoring Report**

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4 RELEVANT LAW
5 MATERIALS AND METHODS
6 RESULTS AND CONCLUSIONS
7 TECHNICAL TEAM
8 REFERENCES

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I Calibration Certificates
II LAeq Calculation Memory

Distribution

| | |
|---|---|
| PARACEL | E |
| PÖYRY | - |

**TECHNICAL MANAGER:** **ROMUALDO HIRATA**
**CREA 0600332092**

| Orig. | 05/08/20 – emf | 05/08/20 – bvv | 05/08/20 – hfw | 05/08/20 – hfw | For information |
|---|---|---|---|---|---|
| Ver. | Date/Author | Date/Verified | Date/Aproved | Date/Authorized | Observation |
| | | | | | |
| | | | | | |

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# 1 INTRODUCTION

This document consists of the Environmental Noise Monitoring Report for the area surrounding the PARACEL pulp mill in Concepción - Paraguay, and is intended to verify the level of environmental sound pressure present in the area, prior to the implementation and operation of the plant (background levels).

The research work (in the field) to measure the ambient sound pressure levels was carried out by the Pöyry Tecnología team on October 24 and 25, 2019.

The ambient sound pressure levels were measured at 05 different points in the day and night periods, totaling 10 measurements. The values obtained were compared with the limits established by the Paraguayan Law on the Prevention of Sound Pollution (Law 1,100 / 97).

# 2 REFERENCE DOCUMENTS

The corresponding documents were used in the preparation of this study or contain instructions and procedures applicable to it.

- Law N. 1,100/97 (Paraguay) - On the Prevention of Noise Pollution, aimed at preventing noise pollution on public roads, squares, parks, sidewalks, exhibition halls, meeting centers, sports and social clubs and in all public and private activities that produce noise pollution;
- Standard NBR 10,151 / 2019 (Brazil) - Evaluation of noise in inhabited areas, seeking the comfort of the community - Procedure.

# 3 DEFINITIONS

The corresponding definitions were used in the preparation of the document.

- Sound pressure level: the difference between the total pressure at the passage of the sound wave (P) and the normal or reference atmospheric pressure (Po). Since the audible sounds reach a range of 106 Pa, a logarithmic scale, the decibel system, is used to measure the sound pressure level;
- Equivalent sound pressure level (LAeq), in weighted decibels “A” [dB (A)]: level obtained from the root mean square value of sound pressure (A-weighted) for the entire measurement range;
- Ambient noise level (LA): the weighted equivalent sound pressure level “A” at the place and time considered in the absence of the noise generated by the sound source in question;
- Decibelmeter or sound level meter: Decibel meter (sound level); sound pressure level measurement device.

# 4 RELEVANT LAW

Law n. 1,100/1997 aims to prevent noise pollution on public roads, squares, parks, sidewalks, exhibition halls, meeting centers, sports and social clubs and in all public and private activities that produce noise pollution in Paraguay.

Article 9th of the aforementioned law establishes the noise limits, according to the type of environment, as shown in the table below.

**Table 1 – Noise limits established by Law 1100/97 (in decibel "A" dB (A))**

| Environment | Night (20:00 – 07:00) | Day (07:00 – 20:00) | Day (Occasional peak) (07:00 – 12:00 / 14:00 – 19:00) |
|---|---|---|---|
| Residential areas, specific use, public spaces: recreation areas, parks, squares and public roads | 45 | 60 | 80 |
| Hybrid areas, transition areas, city center areas, specific programs, service areas and public buildings | 55 | 70 | 85 |
| Industrial area | 60 | 75 | 90 |

The article 9th states:

- Occasional Peaks: discontinuous noises and sounds that exceed the permitted levels and occasionally occur during the day, with a maximum of twenty peaks per hour. This noise and sound level will only be permitted at the following times: from 7:00 to 12:00 and from 14:00 to 19:00;
- The residential, mixed and industrial areas are those that will be defined in the regulatory plan of each Municipality with their characteristics and established activities

# 5 MATERIALS AND METHODS

## 5.1 Locations of point analysis

To define the measurement points, the area around the PARACEL pulp mill was considered, prior to implementation and operation (background).

A total of 05 (five) different points were defined for the measurement of the sound pressure level in the environment, in the daytime and nighttime periods, totaling 10 measurements, as described in the following table.

**Table 2 – Points of analysis for environmental noise pressure.**

| Point | Place | Coordinates | |
|---|---|---|---|
| | | Latitud | Longitud |
| NO01 | Cerrito | 23°15'4.62"S | 57°29'36.53"O |
| NO02 | Horno Carbón | 23°13'31.85"S | 57°29'33.20"O |
| NO03 | Policía Laguna | 23°12'4.55"S | 57°27'20.60"O |
| NO04 | Pyrendá | 23°14'23.26"S | 57°26'19.28"O |
| NO05 | San Miguel | 23°16'27.03"S | 57°27'25.65"O |

The following figure shows the map with the location of the 05 measurement points, while the other figures show images of each measurement point.

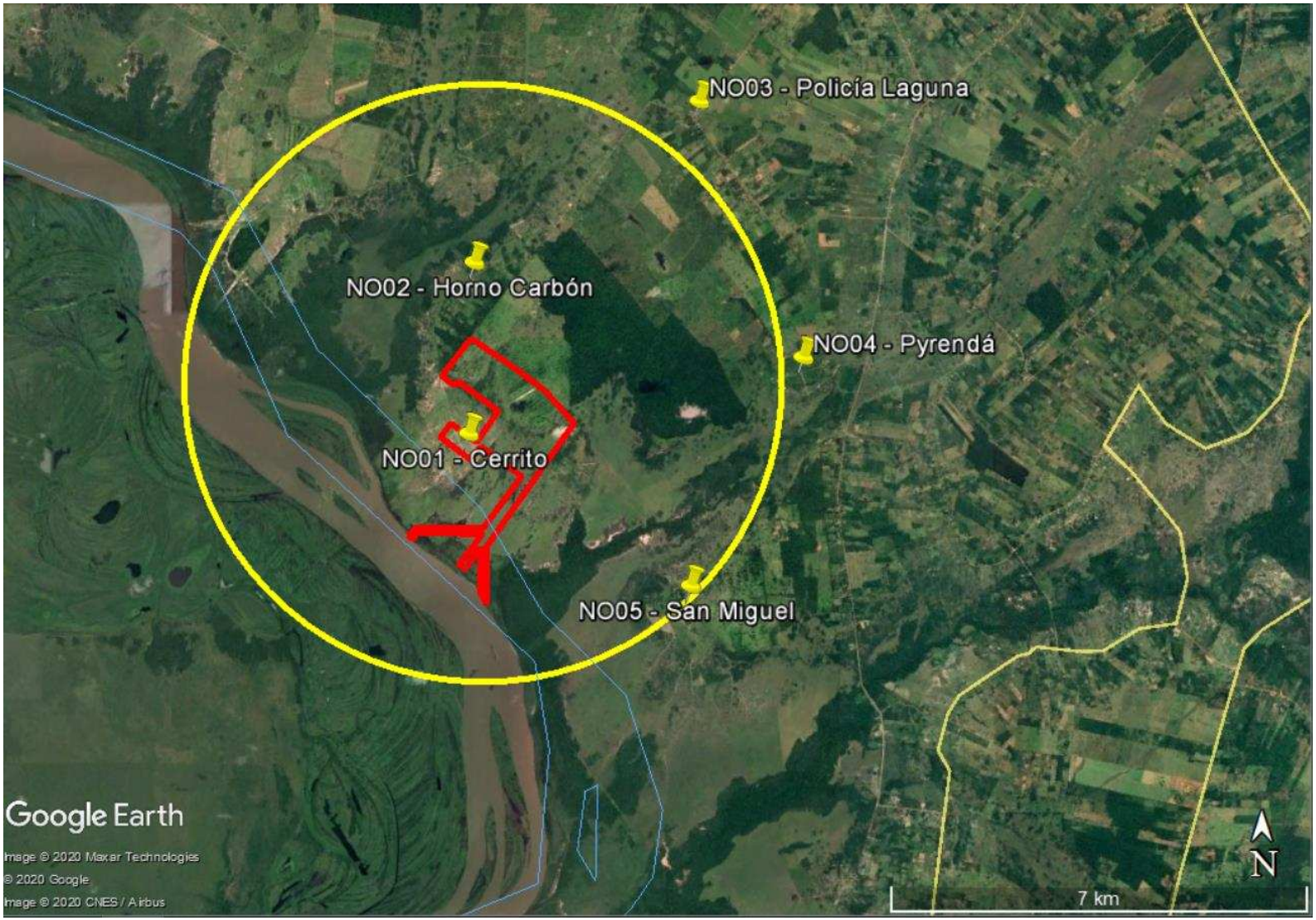


**Figure 1 – Map of the location of the 5 ambient sound pressure level measurement points. Source: altered from Google Earth (2020)**

**Figure 2 – Point NO01 (23°15'4.62"S; 57°29'36.53"O). Source: Pöyry Tecnologia (2019)**

**Figure 3 – Point NO02 (23°13'31.85"S; 57°29'33.20"O). Source: Pöyry Tecnologia (2019)**

**Figure 4 – Point NO03 (23°12'4.55"S; 57°27'20.60"O). Source: Pöyry Tecnologia (2019)**

**Figure 5 – Point NO04 (23°14'23.26"S; 57°26'19.28"O). Source: Pöyry Tecnologia (2019)**

**Figure 6 – Point NO05 (23°16'27.03"S; 57°27'25.65"O). Source: Pöyry Tecnologia (2019)**

## 5.2 Methods

The measurement methodology was based on the instructions of NBR 10.151/2019 (from Brazil). The evaluation method consisted in measuring the equivalent sound pressure level (LAeq) in A-weighted decibels, commonly called dB(A), as recommended in chapter 1.3 of NBR 10.151/2019.

The measurements had been performed at points located about 1.2 meters from the ground and at least 2.0 meters from the property boundary and from any other reflective surface, such as walls, barriers, etc.

The time for measuring the ambient sound pressure level was 3 minutes for each point sampled. During the measurements, wind protection from the microphone was used.

The evaluation of the sound pressure was made in the 2 periods recommended by NBR 10.151/2019, that is, day and night periods.

## 5.3 Equipment

The characteristics of the sound level meter and acoustic calibrator used in this monitoring are presented below. The certificates are presented in **ANNEX I**.

**Characteristics of the sound level meter device**

- Model: Decibelimeter DT-8852
- Norm of Reference: IEC 61672-1 Class 2
- Precision: ± 1,4 dB
- Frequency Ray: 31.5 Hz ~ 8 KHz
- Dynamic scale: 50 dB
- Memory data: 32.700 data
- Scale levels:
    - Lo (low): 30 dB ~ 80 dB
    - Med (medium): 50d B ~ 100 dB
    - Hi (high): 80 dB ~ 130 dB
    - Auto: 30 dB ~ 130 dB
- Frequency shift: A/C
- Time shift: “fast” (125 ms) and “slow” (1s)
- Microphone: 1/2 inch with eletrical capacitor
- Resolution: 0,1dB
- Serial number: 150622900
- Calibration certificate n. 3547
- Calibration date: 08/03/2018

**Characteristics of the acustic calibrator**

- Model: Calibrator SC-05
- Norm of Reference: IEC 60942 Class 2
- Noise pressure levels outlet: 94 dB e 114 dB
- Frequency outlet: 1.000 Hz ± 4%
- Precision: ± 0,5 dB
- Serial number: 150621430
- Calibration certificate n. 3885
- Calibration date: 07/03/2018

# 6 RESULTS AND CONCLUSIONS

The results of the sound pressure level measurements at the 05 measurement points and the comparison with the limits defined by Law n. 1,100/97 are presented below.

The location of the PARACEL pulp mill has no defined zoning. Therefore, the comparison of the results will be made within the limits of the Mixed Areas and Industrial Areas stated by Law n. 1,100/97.

**Table 3 – Results of environment sound pressure level measurements**

| Point | Distance from the pul mill (km) | Period | Time | Law n. 1,100/97 (legal standards) | | Results LAeq (dB(A)) |
|---|---|---|---|---|---|---|
| | | | | Mixed area | Industrial area | |
| NO01 - Cerrito | 0,0 | Day | 12:11 | 70 | 75 | NO01 - Cerrito |
| | | Night | 20:36 | 55 | 60 | 35,0 |
| NO02 - Horno Carbón | 1,0 | Day | 10:58 | 70 | 75 | NO02 - Horno Carbón |
| | | Night | 21:00 | 55 | 60 | 38,8 |
| NO03 - Policía Laguna | 4,9 | Day | 10:38 | 70 | 75 | NO03 - Policía Laguna |
| | | Night | 21:20 | 55 | 60 | 50,2 |
| NO04 - Pyrendá | 4,1 | Day | 10:16 | 70 | 75 | NO04 - Pyrendá |
| | | Night | 21:48 | 55 | 60 | 35,9 |
| NO05 - San Miguel | 3,2 | Day | 09:50 | 70 | 75 | NO05 - San Miguel |
| | | Night | 19:35 | 55 | 60 | 46,9 |

The results of the environmental sound pressure level measurement in the area near the PARACEL pulp mill were between 34.5 dB(A) and 50.7 dB(A) during the daytime period; and between 35.0 dB(A) and 50.2 dB(A) during the nighttime period. These results are below the limits of the mixed and industrial areas, defined in Law n. 1,100/97.

The measurement points are located in houses up to 4.9 km away from the site where the PARACEL pulp mill will be located. In this campaign, which was intended to define the background of the area, the highest results, in the day and night periods, originated from the sounds emitted by animals, birds and the movement of people and vehicles.

## 7 TECHNICAL TEAM

The technical team responsible for preparing this report is as follows:

- Chemical Engineer Celso Tomio Tsutsumi
  CREA 5060443241/D SP / IBAMA 1590847

- Geologist Domingos Fernandes Pimenta Neto
  CREA 210875647-7 / IBAMA 4116583

## 8 REFERENCES

ABNT. Norma NBR 10.151/2019, que dispone la evaluación del nivel de ruido en zonas y áreas con habitación, con objetivo de confort de la comunidad – procedimiento.

PARAGUAY. Ley n.º 1.100/1997. Ley de Prevención de la Contaminación Sonora.

# ANNEX I
# CALIBRATION CERTIFICATES

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Segurança e Precisão ao seu alcance

# Certificado de calibração

**Nº 5758**

**Cliente:** POYRY TECNOLOGIA LTDA
**Endereço:** Avenida Alfredo Egídio de Souza Aranha, 100 **Bairro** CHACARA SANTO ANTONIO
**Cidade:** São Paulo **Estado** SP **CEP** 04726-170
**Equipamento calibrado** MEDIDOR DE NIVEL SONORO **Modelo** DT-8852
**Marca** ENEQUIPA **Nº de Serie** 150622900
**Ordem de Serviço Nº** 6348 **Data da Calibração** 05/03/2020

## CONDIÇÕES AMBIENTAIS

Temperatura 23 ± 3 °C Umidade Relativa 45 a 65 % U.R.

## PROCEDIMENTO DE CALIBRAÇÃO

Procedimento operacional de calibração PE-001 revisão 01, emitido em 11/12/2017 – A calibração foi realizada através do processo de comparação com um padrão rastreado a um laboratório acreditado pela CGCRE/INMETRO.

## PADRÃO UTILIZADO

015 – CALIBRADOR ACUSTICO CAL-BK mod7 – Certificado de calibração nº CBR1800321 – RBC (CAL 0305) – Validade Maio/2020
014 – MEDIDOR DE NIVEL SONORO DEC-INST mod5 – Certificado de calibração nº 49.438 – RBC (CAL 0256) – Validade Junho/2020

## RESULTADOS OBTIDOS

| Tempo de resposta | Escala (dB) | Valor indicado no Instrumento calibrado (dB) | Valor indicado no instrumento em teste (dB) | Erro (dB) | Incerteza (± dB) | k |
|---|---|---|---|---|---|---|
| SLOW A | 50 - 100 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| SLOW A | 80 - 130 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| SLOW A | 30 - 130 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| SLOW A | 80 - 130 | 114 | 113,9 | 0,1 | 0,3 | 2,00 |
| SLOW A | 30 - 130 | 114 | 114,0 | 0,0 | 0,3 | 2,00 |
| FAST A | 50 - 100 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| FAST A | 80 - 130 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| FAST A | 30 - 130 | 94 | 93,9 | 0,1 | 0,3 | 2,00 |
| FAST A | 80 - 130 | 114 | 113,9 | 0,1 | 0,3 | 2,00 |
| FAST A | 30 - 130 | 114 | 114,0 | 0,0 | 0,3 | 2,00 |

| | Fast A 50 - 100 | Fast A 80 - 130 |
|---|---|---|
| Valor anterior | 94,4 | 94,4 |
| Valor após ajuste | 93,9 | 93,9 |

## NOTAS

A incerteza expandida relatada é baseada em uma incerteza padronizada combinada e multiplicada pelo fator de abrangencia padronizado k=2,0 para uma probabilidade de abrangência de 95%.

Os resultados acima referem-se exclusivamente ao equipamento calibrado e as condições supra mencionadas. Este certificado somente pode ser reproduzido na sua forma e conteudo integrais e sem alterações. Não pode ser utilizado para fins promocionais

Executante Vittor Onishi
*Este certificado foi assinado eletronicamente*



confidential

confidential

Segurança e Precisão ao seu alcance

# Certificado de calibração

Nº **5756**



**Cliente:** POYRY TECNOLOGIA LTDA
**Endereço:** Avenida Alfredo Egídio de Souza Aranha, 100 **Bairro** CHACARA SANTO ANTONIO
**Cidade:** São Paulo **Estado** SP **CEP** 04726-170
**Equipamento calibrado** CALIBRADOR PARA MEDIDOR DE NIVEL SONORO **Modelo** SC-05
**Marca** ENEQUIPA **Nº de Serie** 150621430
**Ordem de Serviço Nº** 6349 **Data de Calibração** 05/03/2020

## CONDIÇÕES AMBIENTAIS

Temperatura 23 ± 3 °C Umidade Relativa 45 a 65 % U.R.

## PROCEDIMENTO DE CALIBRAÇÃO

Procedimento operacional de calibração PE-002 revisão 00, emitido em 01/07/2013 – A calibração foi realizada através do processo de comparação com um padrão rastreado a um laboratório acreditado pela CGCRE/INMETRO.

## PADRÃO UTILIZADO

015 – CALIBRADOR ACUSTICO CAL-BK mod7 – Certificado de calibração nº CBR1800321 – RBC (CAL 0305) – Validade Maio/2020

014 – MEDIDOR DE NIVEL SONORO DEC-INST mod5 – Certificado de calibração nº 49.438 – RBC (CAL 0256) – Validade Junho/2020

## RESULTADOS OBTIDOS

| Valor indicado no Instrumento calibrado (dB) | Valor indicado no instrumento em teste (dB) | Erro (dB) | Incerteza (± dB) | k |
|---|---|---|---|---|
| 94 | 94 | 0,0 | 0,3 | 2,00 |
| 114 | 114 | 0,0 | 0,3 | 2,00 |

| Ajuste | | |
|---|---|---|
| Valor anterior | 94,2 | 114,2 |
| Valor após ajuste | 94,0 | 114,0 |

## NOTAS

A incerteza expandida relatada é baseada em uma incerteza padronizada combinada e multiplicada pelo fator de abrangencia padronizado k=2,0 para uma probabilidade de abrangência de 95%.

Os resultados acima referem-se exclusivamente ao equipamento calibrado e as condições supra mencionadas. Este certificado somente pode ser reproduzido na sua forma e conteudo integrais e sem alterações. Não pode ser utilizado para fins promocionais

Data da emissão do certificado 05/03/20

Executado por: Vittor Yudi de Siqueira Onishi
Este certificado foi assinado eletronicamente

Enequipa Equipamentos de Proteção LTDA - Mogi das Cruzes - SP - www.enequipa.com.br
**Fone: 11 4739-3884 | whatsapp 11 97792.2105 | email: vendas@enequipa.com.br**

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# ANNEX II

# $LA_{EQ}$ CALCULATION MEMORY

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| 1 | 48,6 | 45,7 | 44,6 | 36,3 | 51,1 | 46,6 | 45,2 | 50,1 | 45,7 | 49,4 |
| 2 | 43,4 | 42,5 | 42,9 | 36,0 | 54,2 | 41,7 | 42,1 | 50,1 | 42,2 | 44,2 |
| 3 | 41,3 | 40,2 | 45,2 | 36,4 | 45,5 | 39,7 | 42,6 | 50,6 | 39,9 | 52,5 |
| 4 | 40,4 | 58,7 | 42,5 | 37,0 | 42,1 | 38,3 | 42,0 | 47,9 | 39,2 | 46,2 |
| 5 | 39,9 | 62,8 | 40,7 | 36,6 | 40,2 | 36,9 | 41,3 | 48,3 | 38,0 | 45,2 |
| 6 | 40,1 | 52,7 | 42,9 | 35,7 | 38,5 | 36,0 | 41,5 | 49,7 | 37,3 | 53,8 |
| 7 | 47,8 | 45,4 | 41,6 | 35,0 | 37,8 | 35,4 | 41,7 | 51,3 | 37,0 | 49,7 |
| 8 | 45,2 | 42,1 | 40,9 | 34,5 | 37,3 | 34,9 | 41,9 | 50,5 | 36,4 | 49,1 |
| 9 | 42,4 | 41,0 | 39,8 | 34,1 | 36,6 | 34,9 | 41,7 | 50,4 | 36,0 | 51,5 |
| 10 | 41,5 | 40,3 | 39,3 | 33,8 | 35,9 | 34,6 | 41,2 | 49,5 | 35,8 | 52,3 |
| 11 | 40,8 | 39,4 | 38,4 | 33,5 | 35,7 | 35,1 | 39,8 | 49,9 | 35,7 | 52,0 |
| 12 | 40,5 | 39,0 | 38,0 | 33,5 | 36,7 | 35,0 | 39,1 | 49,9 | 36,2 | 51,5 |
| 13 | 40,2 | 49,5 | 37,9 | 33,4 | 36,0 | 34,6 | 38,4 | 50,9 | 36,2 | 51,1 |
| 14 | 39,9 | 45,3 | 37,4 | 33,3 | 36,0 | 34,4 | 38,6 | 49,5 | 36,0 | 53,7 |
| 15 | 39,6 | 43,1 | 37,6 | 33,3 | 37,0 | 34,3 | 39,0 | 50,6 | 36,5 | 50,4 |
| 16 | 39,2 | 43,4 | 38,2 | 33,3 | 36,4 | 34,2 | 38,7 | 50,6 | 36,6 | 53,4 |
| 17 | 39,0 | 42,3 | 38,1 | 33,3 | 38,7 | 34,1 | 38,5 | 51,0 | 36,3 | 48,9 |
| 18 | 39,0 | 40,8 | 38,2 | 33,4 | 54,2 | 34,3 | 38,7 | 49,2 | 35,8 | 52,6 |
| 19 | 39,4 | 39,9 | 39,8 | 33,3 | 48,7 | 34,1 | 38,6 | 50,4 | 35,7 | 52,8 |
| 20 | 40,4 | 39,3 | 40,0 | 33,5 | 43,0 | 34,1 | 38,8 | 48,2 | 36,7 | 46,4 |
| 21 | 40,7 | 40,5 | 40,1 | 35,7 | 40,2 | 34,1 | 39,0 | 45,9 | 36,0 | 43,4 |
| 22 | 40,0 | 41,1 | 39,3 | 35,1 | 38,5 | 34,1 | 39,2 | 47,3 | 35,5 | 42,3 |
| 23 | 42,8 | 53,8 | 40,1 | 34,4 | 37,7 | 34,1 | 38,9 | 47,8 | 35,4 | 51,0 |
| 24 | 53,4 | 55,0 | 40,4 | 34,0 | 38,5 | 34,1 | 38,6 | 49,1 | 35,3 | 46,0 |
| 25 | 45,9 | 60,6 | 39,7 | 33,7 | 38,3 | 34,1 | 38,6 | 50,3 | 35,3 | 43,1 |
| 26 | 42,3 | 63,0 | 42,7 | 33,6 | 37,1 | 34,2 | 38,5 | 49,5 | 35,2 | 42,3 |
| 27 | 40,7 | 63,6 | 41,3 | 34,0 | 42,2 | 34,0 | 38,5 | 50,3 | 35,6 | 56,9 |
| 28 | 40,7 | 58,7 | 39,4 | 33,8 | 48,2 | 34,0 | 38,5 | 50,3 | 35,3 | 47,8 |
| 29 | 39,8 | 54,3 | 41,2 | 33,8 | 46,7 | 33,9 | 38,0 | 49,9 | 35,2 | 45,6 |
| 30 | 39,0 | 52,7 | 43,6 | 33,7 | 55,6 | 33,8 | 38,2 | 50,9 | 35,2 | 45,3 |
| 31 | 38,0 | 48,5 | 40,8 | 33,8 | 51,4 | 33,7 | 38,0 | 52,0 | 34,9 | 44,9 |
| 32 | 37,2 | 47,5 | 39,4 | 33,5 | 47,4 | 33,7 | 38,3 | 49,9 | 34,8 | 43,4 |

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| 33 | 36,8 | 45,4 | 40,1 | 33,4 | 45,1 | 33,9 | 37,7 | 51,1 | 34,9 | 42,7 |
| 34 | 36,3 | 47,0 | 45,4 | 33,2 | 44,2 | 34,1 | 37,6 | 49,7 | 34,7 | 42,5 |
| 35 | 37,4 | 44,7 | 44,5 | 33,4 | 43,5 | 34,0 | 37,4 | 50,5 | 34,9 | 41,9 |
| 36 | 40,1 | 45,9 | 44,5 | 33,3 | 41,9 | 34,0 | 38,2 | 49,7 | 34,7 | 41,4 |
| 37 | 40,1 | 44,8 | 45,7 | 33,5 | 40,7 | 34,1 | 39,3 | 49,9 | 34,6 | 41,5 |
| 38 | 39,6 | 42,7 | 44,4 | 33,3 | 40,3 | 34,0 | 38,6 | 50,6 | 34,9 | 41,3 |
| 39 | 38,0 | 41,3 | 43,5 | 33,3 | 39,4 | 34,1 | 38,2 | 50,5 | 41,8 | 41,2 |
| 40 | 60,0 | 40,7 | 42,9 | 33,3 | 38,3 | 34,1 | 38,4 | 49,0 | 39,2 | 41,2 |
| 41 | 52,6 | 39,3 | 40,1 | 33,3 | 37,0 | 34,1 | 38,1 | 48,1 | 37,6 | 41,3 |
| 42 | 44,4 | 38,8 | 38,1 | 33,2 | 36,8 | 34,1 | 38,1 | 47,9 | 36,7 | 41,3 |
| 43 | 40,8 | 37,1 | 36,8 | 33,2 | 36,0 | 33,9 | 38,0 | 47,8 | 35,9 | 41,4 |
| 44 | 38,8 | 35,8 | 42,5 | 33,5 | 35,7 | 34,0 | 38,1 | 49,8 | 35,8 | 46,5 |
| 45 | 37,8 | 35,4 | 48,4 | 33,4 | 35,5 | 33,9 | 38,8 | 51,3 | 35,5 | 44,2 |
| 46 | 37,0 | 35,6 | 48,4 | 33,4 | 36,8 | 34,1 | 38,5 | 49,8 | 35,3 | 43,7 |
| 47 | 36,6 | 53,6 | 46,4 | 33,2 | 36,0 | 34,2 | 37,8 | 50,3 | 35,1 | 43,5 |
| 48 | 36,8 | 58,1 | 45,2 | 33,2 | 35,6 | 34,0 | 37,3 | 50,3 | 34,9 | 43,7 |
| 49 | 36,1 | 55,1 | 43,4 | 33,1 | 35,4 | 34,1 | 37,1 | 49,9 | 34,9 | 44,0 |
| 50 | 35,9 | 46,8 | 41,5 | 33,3 | 35,8 | 33,9 | 37,1 | 49,3 | 35,3 | 43,9 |
| 51 | 35,8 | 49,9 | 39,5 | 33,1 | 35,6 | 33,8 | 37,5 | 50,2 | 35,1 | 43,1 |
| 52 | 36,1 | 47,5 | 38,7 | 33,2 | 35,4 | 33,8 | 37,4 | 50,7 | 35,0 | 42,7 |
| 53 | 36,0 | 43,3 | 42,7 | 33,2 | 37,8 | 33,7 | 37,2 | 50,3 | 34,9 | 42,3 |
| 54 | 36,1 | 40,0 | 41,3 | 33,5 | 38,5 | 33,7 | 37,3 | 49,3 | 35,0 | 42,1 |
| 55 | 36,9 | 39,0 | 39,4 | 34,3 | 37,4 | 33,7 | 37,4 | 48,5 | 34,9 | 41,7 |
| 56 | 36,7 | 37,4 | 38,1 | 35,6 | 37,1 | 33,6 | 37,4 | 47,6 | 34,9 | 41,3 |
| 57 | 36,9 | 36,8 | 38,2 | 36,1 | 36,1 | 33,6 | 37,4 | 47,4 | 34,9 | 41,6 |
| 58 | 37,6 | 44,1 | 37,8 | 35,5 | 36,1 | 33,5 | 37,9 | 49,7 | 34,7 | 41,3 |
| 59 | 37,1 | 41,7 | 37,9 | 34,8 | 36,9 | 33,5 | 37,9 | 49,1 | 34,6 | 41,1 |
| 60 | 36,9 | 39,5 | 38,7 | 34,3 | 37,8 | 33,6 | 38,2 | 49,3 | 34,6 | 41,3 |
| 61 | 36,4 | 37,9 | 38,6 | 34,3 | 38,6 | 33,6 | 37,8 | 51,3 | 34,6 | 41,3 |
| 62 | 36,0 | 37,0 | 39,0 | 35,1 | 38,2 | 33,6 | 39,7 | 50,9 | 34,7 | 46,9 |
| 63 | 36,0 | 39,8 | 39,7 | 34,5 | 37,7 | 33,7 | 39,0 | 48,9 | 34,9 | 43,6 |

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| 64 | 36,0 | 37,9 | 40,2 | 34,0 | 36,6 | 33,8 | 38,1 | 49,9 | 34,9 | 42,2 |
| 65 | 36,0 | 36,9 | 39,9 | 33,6 | 36,2 | 33,7 | 37,8 | 50,3 | 35,0 | 46,0 |
| 66 | 36,1 | 35,8 | 40,0 | 33,4 | 35,7 | 33,7 | 38,0 | 49,1 | 35,0 | 43,3 |
| 67 | 37,2 | 35,2 | 39,7 | 33,1 | 35,4 | 33,7 | 37,4 | 47,5 | 34,9 | 42,1 |
| 68 | 37,8 | 39,1 | 39,6 | 33,5 | 35,1 | 33,7 | 37,4 | 48,1 | 35,1 | 41,5 |
| 69 | 38,0 | 60,8 | 38,2 | 36,9 | 35,2 | 33,7 | 37,7 | 47,2 | 35,2 | 42,1 |
| 70 | 37,6 | 59,3 | 37,3 | 36,2 | 37,4 | 33,8 | 37,6 | 47,4 | 35,1 | 42,8 |
| 71 | 37,3 | 47,4 | 42,7 | 35,3 | 36,9 | 33,9 | 37,4 | 49,6 | 34,9 | 44,3 |
| 72 | 37,3 | 42,3 | 42,5 | 34,8 | 37,4 | 33,8 | 37,4 | 49,5 | 34,8 | 44,6 |
| 73 | 37,4 | 39,9 | 42,2 | 34,3 | 37,4 | 33,9 | 37,2 | 48,0 | 34,7 | 44,3 |
| 74 | 39,1 | 37,9 | 40,1 | 33,9 | 40,5 | 33,7 | 37,4 | 47,5 | 34,7 | 44,6 |
| 75 | 38,5 | 36,3 | 39,0 | 33,6 | 40,7 | 33,9 | 39,0 | 48,7 | 34,5 | 44,6 |
| 76 | 41,9 | 35,4 | 38,3 | 33,6 | 40,9 | 33,9 | 38,7 | 48,7 | 34,6 | 48,0 |
| 77 | 39,7 | 34,7 | 37,8 | 33,5 | 39,9 | 33,9 | 38,0 | 49,5 | 34,5 | 45,5 |
| 78 | 38,2 | 34,2 | 37,8 | 33,3 | 38,9 | 33,8 | 37,7 | 50,3 | 34,6 | 44,8 |
| 79 | 37,3 | 34,7 | 37,4 | 33,3 | 37,9 | 33,7 | 37,4 | 50,5 | 34,6 | 44,6 |
| 80 | 36,5 | 34,8 | 37,3 | 33,2 | 37,2 | 33,6 | 38,0 | 49,7 | 34,5 | 45,0 |
| 81 | 36,2 | 34,7 | 38,1 | 33,1 | 37,4 | 33,8 | 38,0 | 51,0 | 34,4 | 44,4 |
| 82 | 36,0 | 34,8 | 41,7 | 33,0 | 37,0 | 33,9 | 37,7 | 51,1 | 34,3 | 44,4 |
| 83 | 36,0 | 54,7 | 45,0 | 32,9 | 36,6 | 33,8 | 37,4 | 50,1 | 34,4 | 44,8 |
| 84 | 35,7 | 58,8 | 48,7 | 33,2 | 35,8 | 33,9 | 37,3 | 50,1 | 34,5 | 44,8 |
| 85 | 36,0 | 49,6 | 48,3 | 33,0 | 35,6 | 33,9 | 37,8 | 51,3 | 34,4 | 45,6 |
| 86 | 35,8 | 43,4 | 44,2 | 33,2 | 35,2 | 33,8 | 38,4 | 50,1 | 34,5 | 47,9 |
| 87 | 36,0 | 40,5 | 41,5 | 33,2 | 34,9 | 33,8 | 39,1 | 50,7 | 34,5 | 60,7 |
| 88 | 36,5 | 40,5 | 40,8 | 33,1 | 34,7 | 33,9 | 39,3 | 50,2 | 34,5 | 56,2 |
| 89 | 36,3 | 46,0 | 39,4 | 33,2 | 34,6 | 33,9 | 38,2 | 51,8 | 34,5 | 55,0 |
| 90 | 36,0 | 49,0 | 38,9 | 33,0 | 34,6 | 34,0 | 39,2 | 51,2 | 34,5 | 57,0 |
| 91 | 35,7 | 46,4 | 38,6 | 33,5 | 34,4 | 33,9 | 38,9 | 50,3 | 34,5 | 53,2 |
| 92 | 35,7 | 45,6 | 37,9 | 33,8 | 34,3 | 33,8 | 38,0 | 49,5 | 34,3 | 45,8 |
| 93 | 35,8 | 44,1 | 37,0 | 35,4 | 35,0 | 34,0 | 37,6 | 49,9 | 35,5 | 44,1 |
| 94 | 36,2 | 45,8 | 41,4 | 35,1 | 34,9 | 34,2 | 37,4 | 49,3 | 35,1 | 42,6 |

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| 95 | 36,7 | 44,6 | 40,5 | 34,4 | 36,9 | 34,3 | 37,4 | 50,5 | 34,9 | 41,9 |
| 96 | 36,3 | 44,5 | 40,8 | 34,0 | 39,2 | 34,1 | 37,3 | 53,0 | 35,0 | 41,9 |
| 97 | 36,2 | 46,2 | 39,3 | 33,7 | 38,0 | 34,1 | 37,1 | 53,0 | 35,2 | 42,2 |
| 98 | 36,0 | 44,1 | 38,2 | 33,6 | 37,0 | 34,1 | 37,6 | 53,0 | 34,9 | 42,4 |
| 99 | 35,8 | 44,6 | 37,9 | 33,6 | 36,1 | 34,1 | 37,4 | 52,6 | 34,8 | 42,4 |
| 100 | 36,1 | 46,4 | 42,5 | 33,5 | 35,6 | 33,9 | 37,0 | 52,1 | 34,7 | 43,1 |
| 101 | 36,1 | 44,3 | 43,9 | 33,3 | 35,1 | 33,9 | 36,9 | 52,2 | 35,0 | 45,0 |
| 102 | 36,2 | 44,6 | 42,7 | 33,3 | 35,3 | 33,9 | 37,4 | 53,2 | 35,3 | 45,4 |
| 103 | 36,3 | 44,4 | 41,0 | 33,2 | 35,0 | 33,9 | 38,0 | 52,3 | 35,3 | 46,2 |
| 104 | 39,2 | 42,5 | 40,1 | 33,1 | 34,8 | 34,0 | 37,7 | 52,3 | 35,0 | 46,5 |
| 105 | 45,3 | 41,1 | 41,2 | 33,1 | 34,6 | 34,3 | 37,7 | 52,1 | 35,0 | 47,8 |
| 106 | 41,3 | 41,3 | 44,0 | 33,0 | 34,6 | 34,2 | 37,9 | 51,9 | 35,0 | 59,3 |
| 107 | 39,4 | 39,1 | 40,5 | 32,9 | 34,5 | 34,2 | 38,0 | 51,3 | 35,0 | 56,2 |
| 108 | 39,6 | 40,0 | 39,0 | 33,1 | 34,4 | 34,2 | 38,3 | 51,0 | 34,8 | 56,8 |
| 109 | 40,8 | 41,3 | 38,4 | 33,0 | 34,4 | 34,0 | 38,0 | 51,5 | 34,7 | 56,0 |
| 110 | 39,9 | 44,4 | 38,2 | 32,9 | 34,5 | 34,1 | 38,2 | 51,8 | 34,8 | 47,8 |
| 111 | 39,2 | 43,3 | 42,1 | 32,8 | 34,6 | 34,1 | 38,6 | 53,4 | 34,8 | 43,9 |
| 112 | 38,1 | 44,4 | 42,0 | 32,9 | 34,4 | 34,0 | 38,8 | 54,2 | 34,8 | 42,4 |
| 113 | 37,4 | 44,7 | 40,5 | 32,9 | 34,5 | 34,1 | 38,9 | 54,2 | 34,8 | 41,6 |
| 114 | 37,7 | 44,1 | 39,6 | 32,8 | 35,0 | 34,1 | 38,4 | 53,2 | 34,9 | 41,3 |
| 115 | 37,3 | 42,9 | 38,5 | 32,7 | 34,9 | 34,2 | 37,7 | 53,6 | 34,7 | 41,1 |
| 116 | 38,0 | 39,9 | 39,0 | 32,7 | 40,5 | 34,3 | 37,8 | 53,9 | 34,6 | 41,1 |
| 117 | 37,7 | 48,0 | 44,0 | 32,9 | 50,1 | 34,3 | 37,6 | 54,0 | 34,5 | 41,1 |
| 118 | 37,4 | 47,6 | 43,4 | 32,9 | 50,2 | 34,3 | 37,4 | 53,8 | 34,6 | 43,0 |
| 119 | 37,0 | 42,8 | 41,0 | 32,9 | 48,4 | 34,2 | 37,4 | 53,4 | 34,7 | 43,6 |
| 120 | 36,8 | 40,3 | 39,5 | 32,8 | 47,4 | 34,3 | 45,7 | 54,3 | 34,7 | 45,6 |
| 121 | 36,3 | 43,3 | 37,8 | 32,7 | 47,8 | 34,3 | 42,1 | 52,8 | 34,6 | 46,8 |
| 122 | 36,4 | 41,1 | 43,1 | 32,7 | 47,9 | 34,2 | 40,0 | 52,1 | 34,6 | 47,4 |
| 123 | 36,5 | 43,7 | 44,6 | 32,9 | 48,7 | 34,2 | 39,0 | 52,6 | 34,7 | 46,7 |
| 124 | 36,4 | 43,3 | 41,1 | 33,4 | 52,0 | 34,3 | 38,3 | 50,6 | 34,9 | 46,2 |
| 125 | 36,2 | 40,8 | 39,4 | 33,2 | 49,9 | 34,2 | 37,9 | 49,9 | 34,7 | 44,8 |

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| **126** | 36,3 | 42,9 | 39,0 | 33,0 | 45,0 | 34,2 | 37,7 | 49,8 | 35,2 | 43,7 |
| **127** | 36,4 | 42,3 | 45,1 | 32,9 | 48,5 | 34,3 | 37,8 | 49,9 | 35,0 | 42,9 |
| **128** | 36,4 | 41,9 | 44,3 | 32,9 | 44,1 | 34,3 | 37,8 | 50,3 | 35,0 | 41,9 |
| **129** | 36,6 | 39,9 | 41,7 | 32,8 | 41,1 | 34,3 | 37,6 | 50,6 | 34,8 | 41,3 |
| **130** | 36,5 | 38,8 | 39,2 | 32,7 | 39,9 | 34,1 | 37,3 | 49,3 | 34,5 | 41,0 |
| **131** | 37,0 | 43,0 | 38,0 | 32,9 | 40,4 | 34,3 | 37,1 | 50,3 | 34,4 | 40,7 |
| **132** | 36,8 | 44,0 | 41,2 | 32,7 | 40,4 | 34,2 | 37,7 | 50,4 | 34,5 | 42,1 |
| **133** | 36,7 | 40,5 | 46,1 | 32,7 | 39,3 | 34,1 | 37,4 | 49,5 | 34,4 | 41,5 |
| **134** | 36,6 | 41,1 | 46,5 | 32,6 | 39,0 | 34,1 | 37,4 | 50,9 | 34,4 | 41,1 |
| **135** | 36,3 | 48,1 | 42,1 | 32,5 | 38,2 | 34,2 | 37,2 | 49,7 | 34,4 | 41,5 |
| **136** | 36,2 | 45,8 | 40,3 | 32,6 | 37,0 | 34,2 | 37,7 | 50,6 | 34,5 | 41,8 |
| **137** | 36,7 | 41,5 | 41,2 | 32,7 | 36,3 | 34,3 | 38,1 | 49,9 | 34,6 | 43,2 |
| **138** | 36,2 | 43,3 | 42,5 | 33,0 | 35,8 | 34,2 | 38,3 | 49,1 | 35,0 | 42,9 |
| **139** | 35,8 | 40,7 | 46,0 | 32,9 | 35,6 | 34,2 | 38,9 | 50,7 | 35,4 | 41,6 |
| **140** | 36,3 | 38,7 | 43,7 | 32,9 | 35,7 | 34,1 | 39,3 | 50,8 | 35,1 | 41,5 |
| **141** | 36,8 | 39,6 | 41,3 | 32,9 | 35,8 | 34,1 | 39,7 | 48,5 | 35,2 | 40,9 |
| **142** | 36,5 | 41,3 | 39,2 | 33,0 | 35,8 | 34,3 | 40,2 | 50,1 | 34,9 | 40,8 |
| **143** | 37,0 | 44,3 | 38,2 | 33,0 | 36,3 | 34,2 | 40,9 | 49,1 | 34,7 | 41,1 |
| **144** | 37,0 | 41,3 | 44,0 | 33,0 | 38,7 | 34,1 | 40,9 | 48,0 | 34,8 | 41,0 |
| **154** | 36,6 | 42,6 | 45,6 | 33,1 | 39,4 | 34,2 | 40,4 | 49,5 | 34,7 | 40,8 |
| **146** | 36,8 | 48,7 | 43,7 | 33,2 | 38,1 | 34,1 | 39,7 | 48,6 | 34,6 | 40,8 |
| **147** | 36,5 | 43,9 | 40,6 | 33,1 | 37,1 | 34,1 | 38,4 | 48,5 | 34,7 | 40,9 |
| **148** | 36,1 | 40,8 | 39,3 | 33,1 | 36,4 | 34,3 | 37,8 | 48,5 | 34,6 | 40,9 |
| **149** | 35,8 | 43,2 | 39,9 | 33,0 | 36,5 | 34,3 | 37,2 | 49,5 | 34,4 | 40,8 |
| **150** | 35,7 | 55,2 | 44,1 | 33,0 | 36,4 | 34,2 | 36,8 | 49,7 | 34,5 | 40,9 |
| **151** | 35,7 | 53,0 | 43,6 | 32,9 | 36,1 | 34,0 | 36,6 | 49,6 | 34,4 | 42,1 |
| **152** | 36,8 | 51,3 | 43,7 | 33,5 | 36,6 | 33,9 | 36,8 | 50,9 | 35,3 | 43,2 |
| **153** | 36,6 | 51,3 | 43,6 | 33,7 | 37,0 | 34,1 | 36,8 | 52,6 | 35,1 | 44,0 |
| **154** | 36,7 | 49,7 | 40,4 | 33,8 | 37,0 | 34,0 | 36,6 | 51,4 | 34,9 | 43,7 |
| **155** | 38,4 | 46,7 | 39,0 | 33,7 | 36,5 | 34,0 | 37,6 | 52,6 | 34,8 | 43,3 |
| **156** | 37,4 | 43,5 | 40,1 | 33,7 | 36,0 | 33,9 | 37,5 | 51,5 | 34,7 | 42,9 |

| Measurements | Measurements of Ambient Sound Pressure Levels | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Day Period | | | | | Night Period | | | | |
| | NO01 | NO02 | NO03 | NO04 | NO05 | NO01 | NO02 | NO03 | NO04 | NO05 |
| **157** | 36,8 | 40,5 | 40,3 | 33,5 | 35,7 | 33,9 | 37,1 | 51,5 | 34,7 | 42,3 |
| **158** | 37,0 | 38,8 | 38,6 | 33,3 | 35,6 | 34,2 | 37,3 | 51,0 | 34,7 | 42,1 |
| **159** | 37,1 | 42,7 | 40,5 | 33,3 | 35,8 | 34,1 | 37,0 | 50,2 | 34,7 | 41,7 |
| **160** | 37,7 | 43,1 | 41,2 | 33,7 | 35,8 | 34,0 | 36,9 | 52,2 | 34,7 | 41,5 |
| **161** | 37,0 | 42,1 | 40,9 | 34,2 | 35,7 | 33,8 | 37,0 | 51,7 | 34,7 | 41,6 |
| **162** | 37,1 | 40,2 | 39,8 | 34,5 | 36,1 | 33,8 | 37,1 | 50,2 | 34,7 | 41,8 |
| **163** | 38,1 | 39,3 | 41,1 | 34,6 | 38,4 | 33,7 | 37,4 | 50,5 | 34,6 | 41,7 |
| **164** | 40,0 | 37,9 | 39,0 | 34,9 | 37,4 | 33,8 | 38,0 | 49,9 | 34,4 | 41,4 |
| **165** | 41,3 | 37,4 | 38,2 | 35,4 | 36,6 | 33,8 | 37,6 | 50,5 | 34,3 | 41,4 |
| **166** | 39,8 | 37,8 | 39,1 | 42,3 | 36,5 | 33,7 | 37,6 | 50,4 | 34,3 | 41,8 |
| **167** | 39,2 | 36,7 | 39,1 | 42,1 | 36,6 | 33,9 | 37,8 | 50,7 | 34,3 | 41,7 |
| **168** | 38,3 | 38,7 | 38,9 | 39,6 | 36,6 | 34,1 | 37,8 | 48,7 | 34,3 | 41,8 |
| **169** | 37,7 | 37,8 | 44,4 | 37,8 | 37,4 | 34,4 | 39,0 | 50,3 | 34,3 | 42,4 |
| **170** | 37,9 | 37,8 | 51,0 | 36,6 | 38,9 | 34,4 | 38,7 | 50,4 | 34,3 | 42,1 |
| **171** | 38,4 | 37,0 | 51,4 | 35,6 | 37,9 | 34,3 | 38,6 | 51,1 | 34,5 | 41,9 |
| **172** | 41,3 | 36,6 | 53,0 | 34,7 | 37,2 | 34,3 | 38,7 | 50,1 | 34,4 | 41,7 |
| **173** | 39,6 | 38,4 | 49,4 | 34,1 | 36,6 | 34,6 | 38,8 | 50,3 | 34,4 | 41,7 |
| **174** | 39,1 | 37,7 | 46,5 | 35,2 | 36,4 | 34,5 | 39,0 | 51,0 | 34,3 | 41,8 |
| **175** | 41,4 | 37,4 | 42,1 | 35,1 | 36,1 | 34,4 | 39,2 | 50,7 | 34,3 | 42,7 |
| **176** | 39,3 | 37,8 | 40,6 | 35,0 | 36,2 | 34,3 | 39,3 | 50,7 | 34,3 | 47,2 |
| **177** | 41,3 | 37,0 | 39,0 | 34,8 | 35,9 | 34,4 | 38,8 | 51,5 | 34,2 | 50,3 |
| **178** | 42,7 | 37,7 | 38,4 | 34,8 | 35,8 | 34,9 | 38,2 | 51,5 | 34,3 | 47,7 |
| **179** | 41,7 | 37,1 | 37,9 | 35,1 | 36,0 | 34,6 | 38,4 | 50,9 | 34,5 | 47,3 |
| **180** | 40,5 | 36,6 | 37,4 | 35,7 | 36,6 | 34,9 | 38,7 | 51,1 | 34,7 | 57,6 |
| **LAeq** | **43,1** | **50,7** | **43,1** | **34,5** | **43,5** | **35,0** | **38,8** | **50,2** | **35,9** | **46,9** |