# SECOND REPORT CONCERNING THE SERVICE, OPERATION AND MAINTENANCE CORRESPONDING TO THE EQUIPMENT ACQUISITION AGREEMENT FOR THE SANITATION OF THE VALSEQUILLO DAM

## GESFAL-030-285/2018 CONTRACT NUMBER: SDRSOT-011/2018

**Managing Director**
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**February 20th, 2018**

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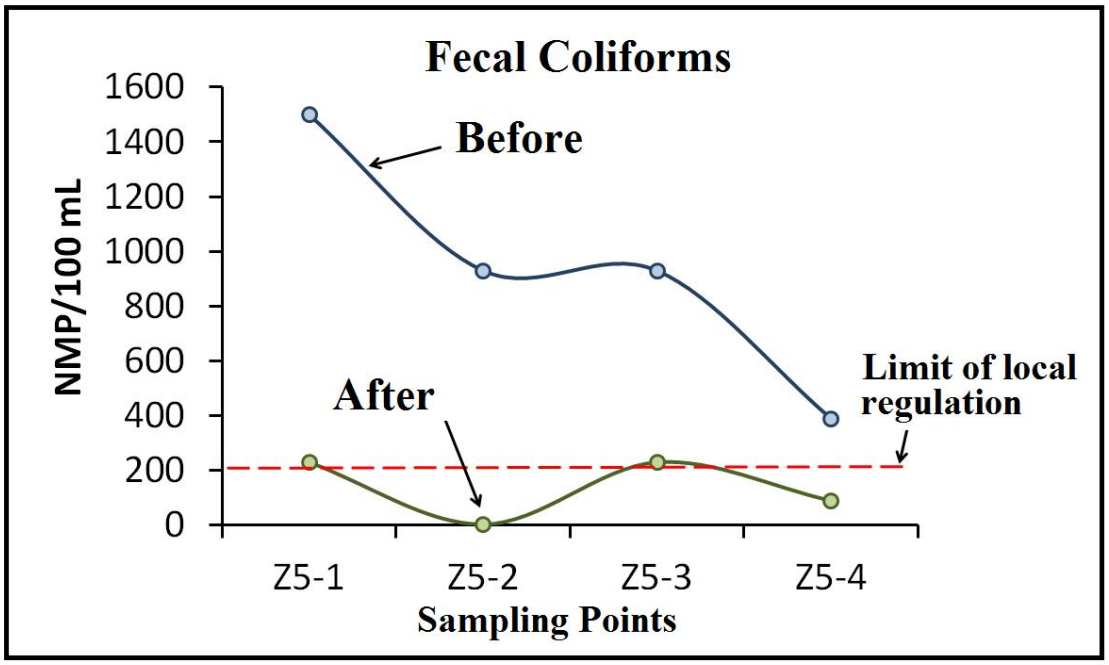
## Graphical Abstract

# Chapter 1 Introduction

This document gives an account of the progress in the implementation of the sanitation program in the Valsequillo dam, in accordance with the provisions in the SDRSOT-011/2018 contract and its related annexes. Likewise, a description is given of the service carried out in terms of the operation of the three Scavenger 2000 units, which are currently working on the sanitation of the Valsequillo dam, Puebla. In terms of water quality, an analysis of the results obtained is also carried out, for which on-site measurements of physical-chemical parameters were carried out, while water samples were taken and sent to certified laboratories for their respective physicochemical and biological analysis.

The results obtained from the certified laboratories showed that the treatment with the Scavenger 2000 lead to a 40% reduction in water color which allows an increase of sunlight penetration in the water column setting the required conditions for a greater development of aquatic fauna. The presence of odors in the dam has disappeared in its entirety, which indicates an increased oxygenation in the Valsequillo dam promoting the growth of aerobic bacteria. Chemical Oxygen Demand (COD) decreased by 68% in a site near the town of San Baltasar Tetela, while in another place the Biochemical Oxygen Demand ($BOD_5$) decreased by 48%. Iron (Fe), Zinc (Zn), Aluminum (Al) and Mn (Mn) decreased in quantity after the treatment. Turbidity is also reducing considerably from 38.2 to 16.1 NTU from the area of the dam called "La Panga" until its curtai.

The treatment proved efficient in the disinfection of Zone 5, obtaining reductions ranging from 75.2% to 99% in 4 sites throughout the work area. Overall, the Classification Declaration of the Atoyac and Xochiac or Hueyapan Rivers and its Tributaries (CDAXRT) is evidently fulfilled; and since the fecal coliforms are the criterion parameter in zone 5 of the Valsequillo dam, it can be asserted that to date the treatment delivered by the Scavenger 2000 units has been successful.

# Chapter 2 (Service description)

## 2.1 Scavenger 2000 Units Operation and daily dose

Since October 15$^{th}$ the SCAVENGER 2000 units have been operated daily for 6 days a week (from Monday to Saturday) applying 250 kilos of oxygen per hour and 60 grams of ozone per hour according to what was established in the agreement. Prior to dosing and in collaboration with the Ministry of Rural Development, Sustainability and Land Management (MRDSL), a plan was defined that included the selection of the sampling sites; which are shown below in figure 1.

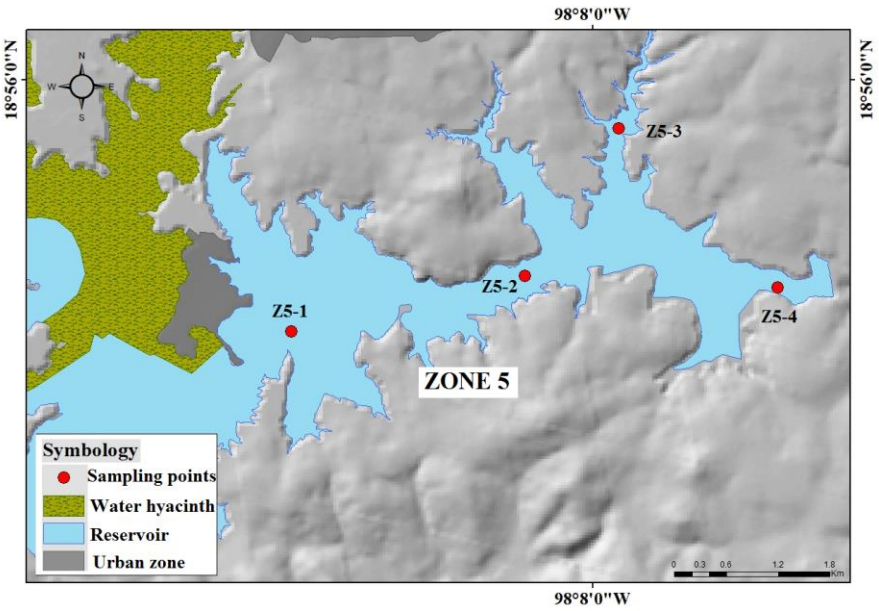



Figure 1. Sampling sites inside sub-zone Z5-F (main water flow)

Likewise, the service provider has segmented zone 5 into 9 sub-zones aiming to guarantee and control the total coverage of the treatment throughout the surface of that particular area, as well as maintaining control of the areas worked on during the period of time in which the service was to last. (Figure 2) This was done based upon the characteristics of the dam in zone 5, such as short hydraulic circuits, main flow, human settlements around the Valsequillo dam, etc. It should be noted that the sub-zone Z5-A is the closest one to a community called San Baltazar Tetela (the panga) while the zone Z5-I is the closest one to the curtain of the dam.

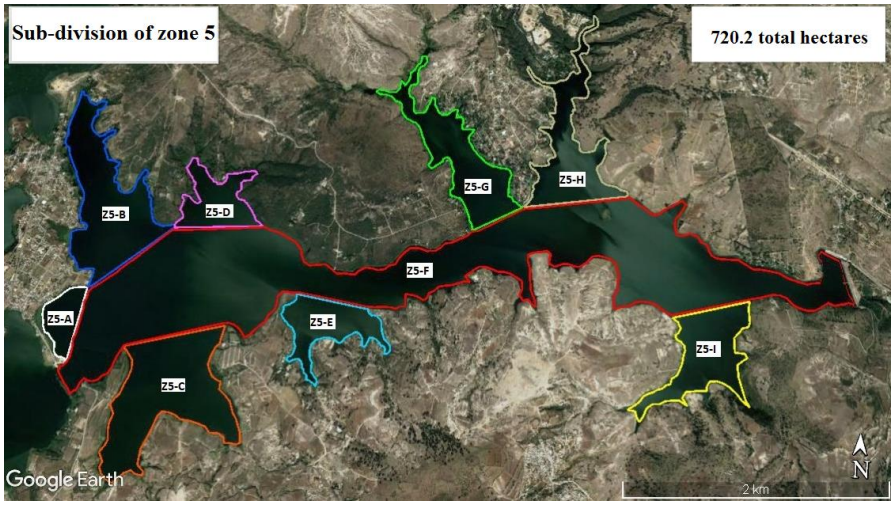



Figure 2. Segmentation of zone 5 of the Valsequillo dam into 9 subzones

As part of the service provided and attempting to know the contours of zone Z5 zone, 90% of the bathymetry of zone Z5 has been built which allows the Scavenger 2000 units to navigate safely around

the area. The bathymetry has prevented possible stranding of the units and has also been useful to find out the different depths that the treatment can reach (Figure 3). It should be noted that this bathymetry will only be useful when the dam is found at its maximum ordinary storage capacity (MOSC). Once the first agricultural cycle of the year has begun; that is, when the floodgates of the dam are opened, the bathymetry must be reconstructed if not adjusted.

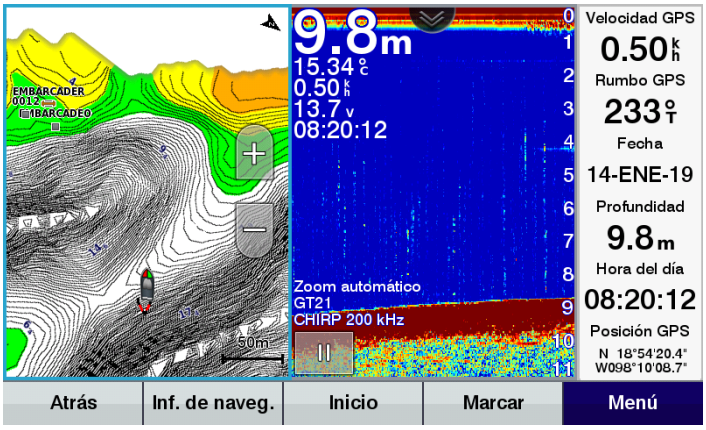



Figure 3. Construction of the bathymetry of zone 5 in the Valsequillo dam

## 2.2 Preventive maintenance

The preventive maintenance of all the systems of the Scavenger 2000 units has been carried out. The following actions are listed below:

- Maintenance service of the Northern Lights, model OM673L3, electric generators; Change of oil and filters.
- Daily cleaning of the marine Strainer filters (main and secondary motor) of the three Scavenger 2000 units
- Cleaning and emptying of the Racor type diesel filters of the three Scavenger 2000 units
- Daily check of the oil and antifreeze levels of the three Scavenger 2000 units.
- Change of oil and filters of both John Deere Model 4045TFM85 engines (main and secondary) of the three units Scavenger 2000

## 2.3 Solution to all flaws

Throughout the operation service of the three units, there have been some flaws inherent to the use of the units. Such flaws and their respective actions are presented in table 1.

Table 1. List of flaws and actions carried out to date to the three Scavenger 2000 units.

| No | Trial 1 | | Trial 2 | | Trial 3 | |
|---|---|---|---|---|---|---|
| | Flaw | Status | Flaw | Status | Flaw | Status |
| 1 | Locked transfer basket | To be fixed | Intermittent rudder sensor | To be fixed | Lights in the machine room do not turn on | Fuses were changed |
| 2 | Slight leakage of | Sealed | Slow transfer | Tuned | Transmission | Replaced |

| | | | | | | |
|---|---|---|---|---|---|---|
| | oil in the transmission | | basket | | drips oil | and fixed |
| 3 | Hydraulic oil filter drip | Fixed | Poor contact air extractor | Fixed | Inverter cube has a loose bolt | Bolt was adjusted |
| 4 | Ballast pump drops the set screws | Set screws were changed | Leakage in secondary motor pump | Corrected | Port solenoid activates both doors | Adjusted |
| 5 | Leakage in secondary motor pump | Getting fixed | Port solenoid activates both doors | Adjusted | Rudder handle has an oil leak | Clamps were tightened |
| 6 | | | Reflectors stopped turning on | Changed | | |
| 7 | | | No-current hydraulic pump | Fused was changed | | |
| 8 | | | Leak found in the cooling system filter | The piece has been requested to the board and is about to be changed | | |

## 2.4 Daily dose

Since October 15th, the first Scavenger 2000 unit has been dosing 250 kilos of oxygen per hour and 60 grams of ozone per hour according to what was established in the agreement (Figure 4).

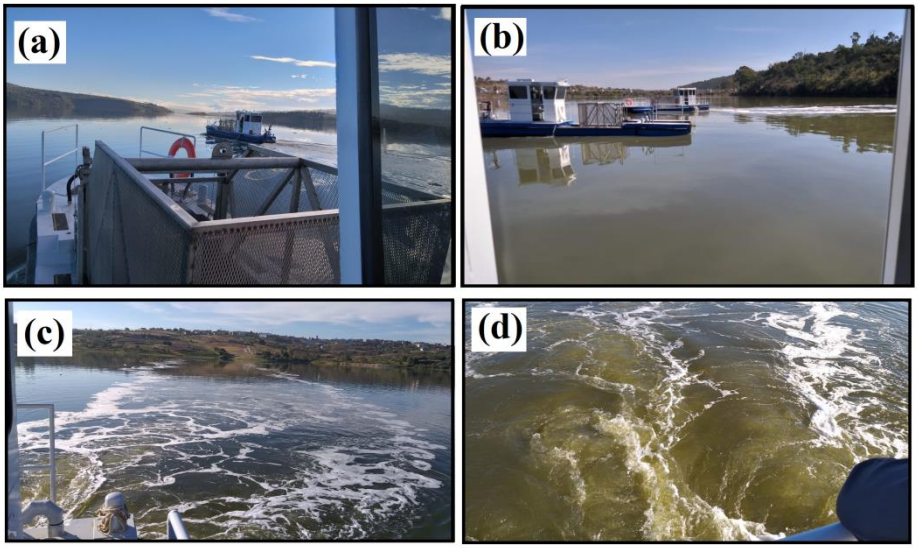



Figure 4. Operation of Scavenger 2000 units. (A) Navigation mode, (b) Treatment mode (c) Treatment trail and (d) Ozone and oxygen microbubbles

As previously stated, the selection of the sampling sites (figure 1) was fixed prior to dosing and in collaboration with the Ministry of Rural Development, Sustainability and Land Management (MRDSL). The relation of the treated sub-zones (from Z5-A to Z5-I) are thoroughly described in the navigation logs (Appendix A).

# Chapter 3 (Water quality measurement)

## 3.1 Methodology

The water quality measurements were carried out in two different ways: (1) On-site measurements and (2) Sampling and determination of different physicochemical and biological parameters in certified laboratories in accordance to the Mexican Accreditation Entity A.C. (MAE)

### 3.1.1 On-site measurements

The on-site measurements were carried out using an S::can spectrometric (Spectrolyser) equipment based on an optical type measurement principle. This equipment has the ability to measure Equivalent Chemical Oxygen Demand (CODeq), Equivalent Biochemical Oxygen Demand Equivalent (BODeq), Total Equivalent Organic Carbon (TOCeq), Color, Nitrates, Turbidity, Dissolved Oxygen (DO), Oxide Potential Reduction (OPR), Potential Hydrogen (pH), Electrical Conductivity, Total Suspended Solids (TSS) and Temperature. The field sensors (Oxi::Lyser, Condu::Lyser, pH::lyser, Redo::Lyser and the Spectrolyser) are all connected to an S::can interface model Con::cube (Figure 5).


Figure 5. Measurement equipment with brand S::can (a) Condu::Lyser, (b) pH::lyser, (c) Redo::Lyser, (d) Oxi::Lyser, (e) Spectrolyser y (f) ) Con::cube.

The equipment was assembled by the supplier in the Scavenger 2000 Puebla 3 unit. To do this, an Open Tank was installed on the bridge in the aft part of the unit. The open tank was fed with water from the dam continually using a submersible pump that was placed at a 2.5 meter depth (Figure 6). The equipment was programmed to measure every 2 or 3 minutes.

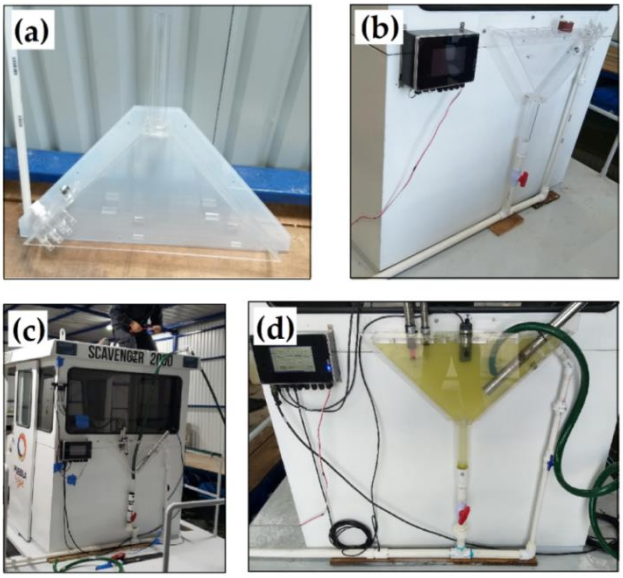



Figure 6. Installation of field equipment in Puebla 3. (a) Open Tank, (b) Assembly of Con:: cube and open tank, (c) Set up of submersible pump and (d) Running equipment

### 3.1.2 Measurement of physicochemical and biological parameters in the laboratory

To determine the quality of the water, sampling was carried out in the sites described in Figure 1. To this end, a certified laboratory with an accredited signatory was hired to take the samples. In site Z5-2 particularly, all the physicochemical and biological parameters stated in the Classification Declaration of the Atoyac and Xochiac or Hueyapan Rivers and its Tributaries (CDAXRT) were measured. Some of the standardized methods used in the measurement of the parameters are described in Table 2.

Table 2. Methods used to measure the physicochemical and biological parameters contained in the CDAXRT

| Parameter | Units | Equipment | Method |
|---|---|---|---|
| Real color (RC) | Pt-Co | Aqua tester, Orbeco/Hellige (Model C611A) | NMX-AA-045-SCFI-2001 |
| Oils and fats | mg/L | Extraction by using hexane as solvent | NMX-AA-005-SCFI-2013 |
| Total phosphorus (TP) | (mg/L) | FA´S OI Analytical - Flow Solution IV | NMX-AA-029-SCFI-2001 |
| Ammoniacal nitrogen($NH_3$-N) | mg/L | FA´S OI Analytical - Flow Solution IV | NMX-AA-026-SCFI-2010 |
| Nitrates ($NO_3^-$) | mg/L | FA´S OI Analytical - Flow | NMX-AA-079-SCFI- |

| | | | |
|---|---|---|---|
| | | Solution IV | 2001 |
| Sulfates ($SO_4^-$) | mg/L | FA´S OI Analytical - Flow Solution IV | US EPA 9036-1986 |
| Clorines ($Cl^-$) | mg/L | FA´S OI Analytical - Flow Solution IV | NMX-AA-073-SCFI-2001 |
| Total cyanide ($CN^-$) | mg/L | FA´S OI Analytical - Flow Solution IV | NMX-AA-058-SCFI-2001 |
| Al, Cr, Cu, Fe, Zn, Mn and Ni | µg / L | ICP-OES CID Thermo Scienctific-6500 | NMX-AA-051-SCFI-2001 |
| Hg | µg / L | Mercury analyzer Hydra IIAA | NMX-AA-051-SCFI-2001 |
| Dimethyl phthalate (DMP), Diethyl phthalate (DEP), Dibutyl phthalate (DBP), Di(2-ethylhexyl) phthalate (DEHP) and Di(n-octil)ftalato (DINP) | µg / L | Gas chromatography (GC / MSD) Agilent technologies 7890B-5977 A MSD | US EPA 8270D 2007 |
| Isophorone (IP) | µg / L | Gas chromatography (GC / MSD) Agilent technologies 7894 B / 5977 A MSD | US EPA 8270D 2007 |
| Total phenols (TPh) | µg / L | FA´S OI Analytical - Flow Solution IV | US EPA 8270D 2007 |

Being a criterion parameter in zone 5, fecal coliforms were measured in 4 different sites, which are referenced in figure 1. Samples were taken and sent to a certified laboratory [Figure 7 (a), (b ), (d) and (e)] and regarding site Z5-2 being an important site (centroid of Zone 5), a certified laboratory with a signatory was hired [Figure 7 (c)].

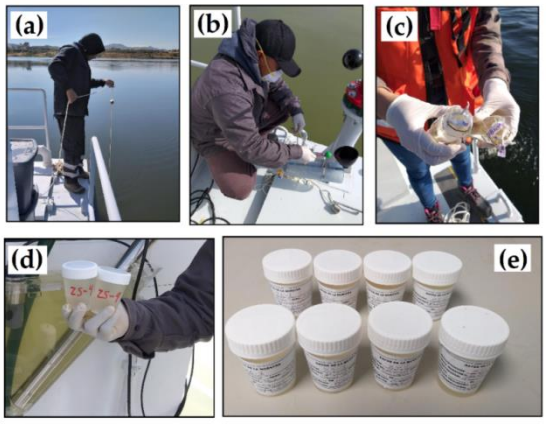



Figure 7. Fecal coliforms sampling at different sites along zone 5 of the Valsequillo dam

### 3.1.3 Statistic Analysis

All data groups were tested to determine homogeneity of variance and normality before statistical processing by employing the Levene and Shapiro-Wilk tests, respectively. In case of acceptance, the differences between the concentration values between one group and another were determined through the one-way analysis of variance (ANOVA). In case of non-acceptance of normality and homogeneity of variance, the Kruskal-Wallis test was performed. To identify the source of significant differences between the groups, Tukey post hoc tests and the Dunn method were performed with a p=0.05 significance level for the parametric and nonparametric data, respectively. Statistical analyzes were performed using Sigma Plot 12.0.

## Chapter 4 (Results)

### 4.1.1 Criterion parameter for zone 5 (Fecal Coliforms)

Fecal coliforms were a criterion parameter in the engineering design for zone 5 of the present project. This is because the ozone treatment carried out by the Scavenger 2000 tends to be more efficient in terms of disinfection when it operates under conditions of low concentrations of organic matter. The results obtained from the certified laboratories showed that the treatment with the Scavenger 2000 unit was efficient in the disinfection of Zone 5, obtaining fecal coliforms reductions of 84.6%, 99%, 75.2% and 76.9% in the sampling sites Z5- 1, Z5-2, Z5-3 and Z5-4, respectively (Table 3).

Table 3. Fecal coliform concentrations before and after the treatment with SCAVENGER 2000 in 4 sampling sites in zone 5 of the Valsequillo dam at a 2.5 meters depth

| Sample site | Fecal coliforms (MPN/100 mL.) | | Removal percentage |
|---|---|---|---|
| | Initial value[^] | Final value | |
| Z5-1 | 1500 | 230[+] | 84.6 % |
| Z5-2 | 930 | 3[*] | 99 % |
| Z5-3 | 930 | 230[+] | 75.2 % |
| Z5-4 | 390 | 90[+] | 76.9 % |

[^]31/October/2019 [+]29/January/2019; [*]15/February/2019

The results obtained comply with what is established by the NOM-001-SEMARNAT-1996 norm in all sampling sites. The same applies for CDAXRT at sites Z5-2 and Z5-4 (see appendix B). Regarding sites Z5-1 and Z5-3, fecal coliform concentration values were obtained very close to the CDAXRT established limits (Figure 8).

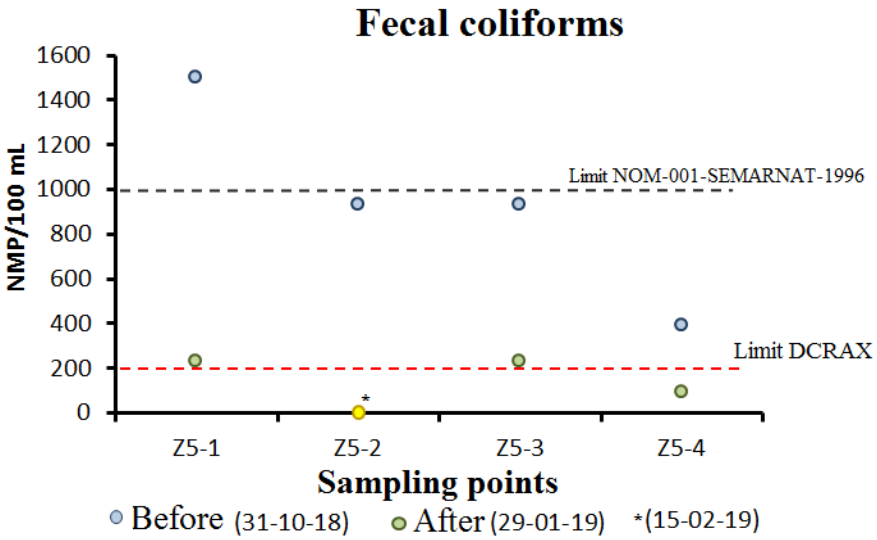



Figure 8. Concentration of fecal coliforms in 4 sampling sites before and after the Scavenger 2000 operation

Such results show that the goal of eliminating the criterion parameter is practically under compliance by what is established in the agreement specified in this document. It is expected that in the next measurements the values that are above 200 MPN / 100 mL will drop.

### 4.1.2 On-site measurements

The results pertaining to the 9 sub-zones (from Z5-A to Z5-I) showed that there is a decreasing trend of essentially all on-site parameters. The pH values range from 6.8 to 7.4 throughout the sampling areas, complying with what is established in the CDAXRT (6.5-8.5). Dissolved Oxygen presented values between 0.33 and 7.7 mg / L, Z5-H being the place where the lowest value was found and Zone Z5-C where the highest value was found followed by zone Z5-I ( near the curtain). The DO is in agreement with the OPR, since the sites where the highest OD values were recorded, positive OPR values were also observed, with zones Z5-C and Z5-I being the highest (Figure 9). The water temperature did not show significant variations (between 17 and 20°C) nor did the conductivity. It should be noted that in the zone Z5-D no conductivity values are reported because the sensor was missing at the time when the measurements were carried out. Notwithstanding the above, the conductivity presents similar values to the 8 remaining work zones with the exception of site Z5-C, where a value of 525 µS / cm is observed (Figure 9).

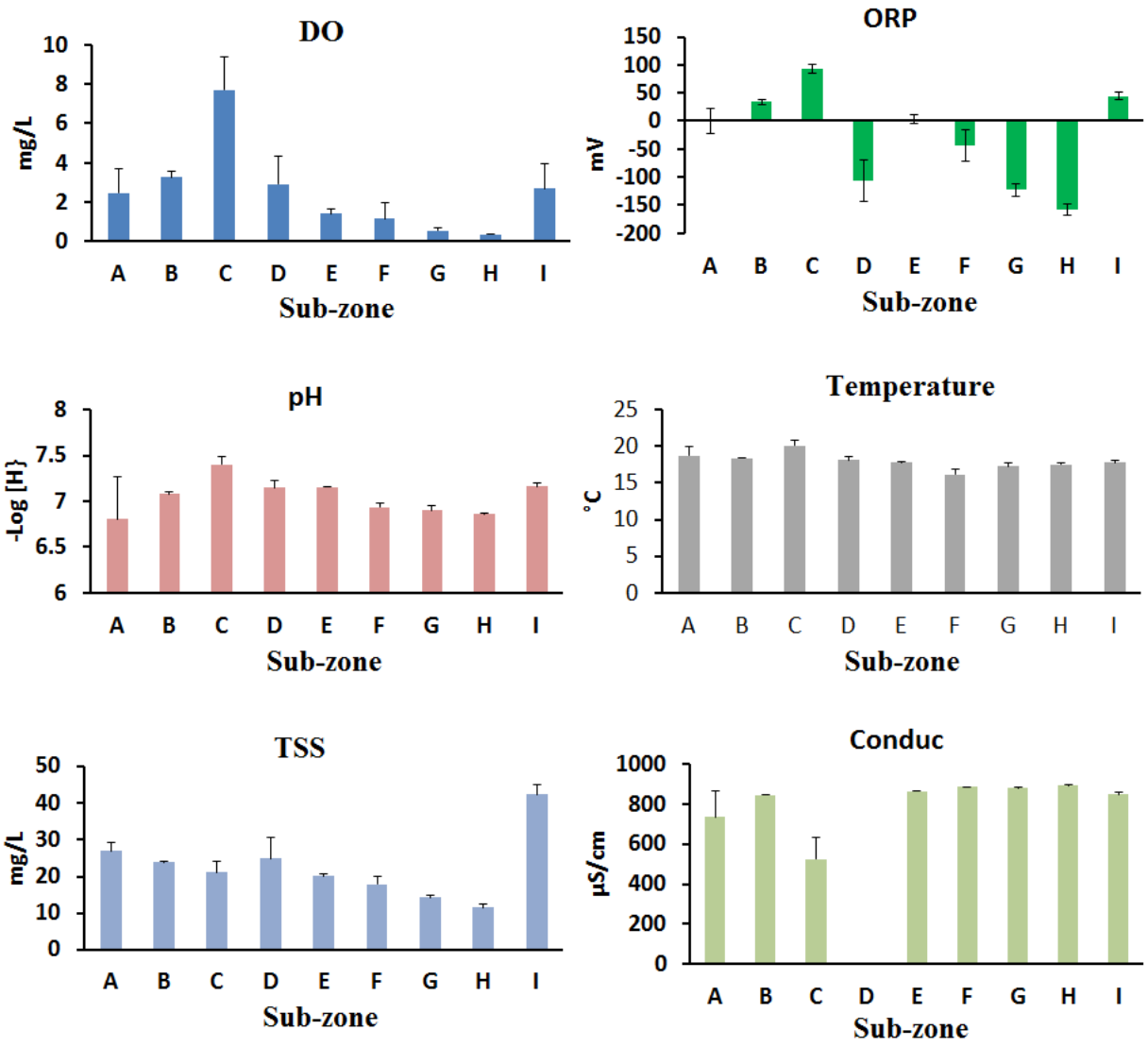



Figure 9. Conventional physical-chemical on-site parameters

The CODeq, BODeq, TOCeq, Color and Turbidity values showed a very similar pattern, that is, a decreasing tendency from zone Z5-A to Z5-H. In all these parameters, however, a sudden increase was observed in the zone Z5-I with a statistically significant difference ($p < 0.05$) between zone Z5-I zone and the rest of the zones (Figure 10).

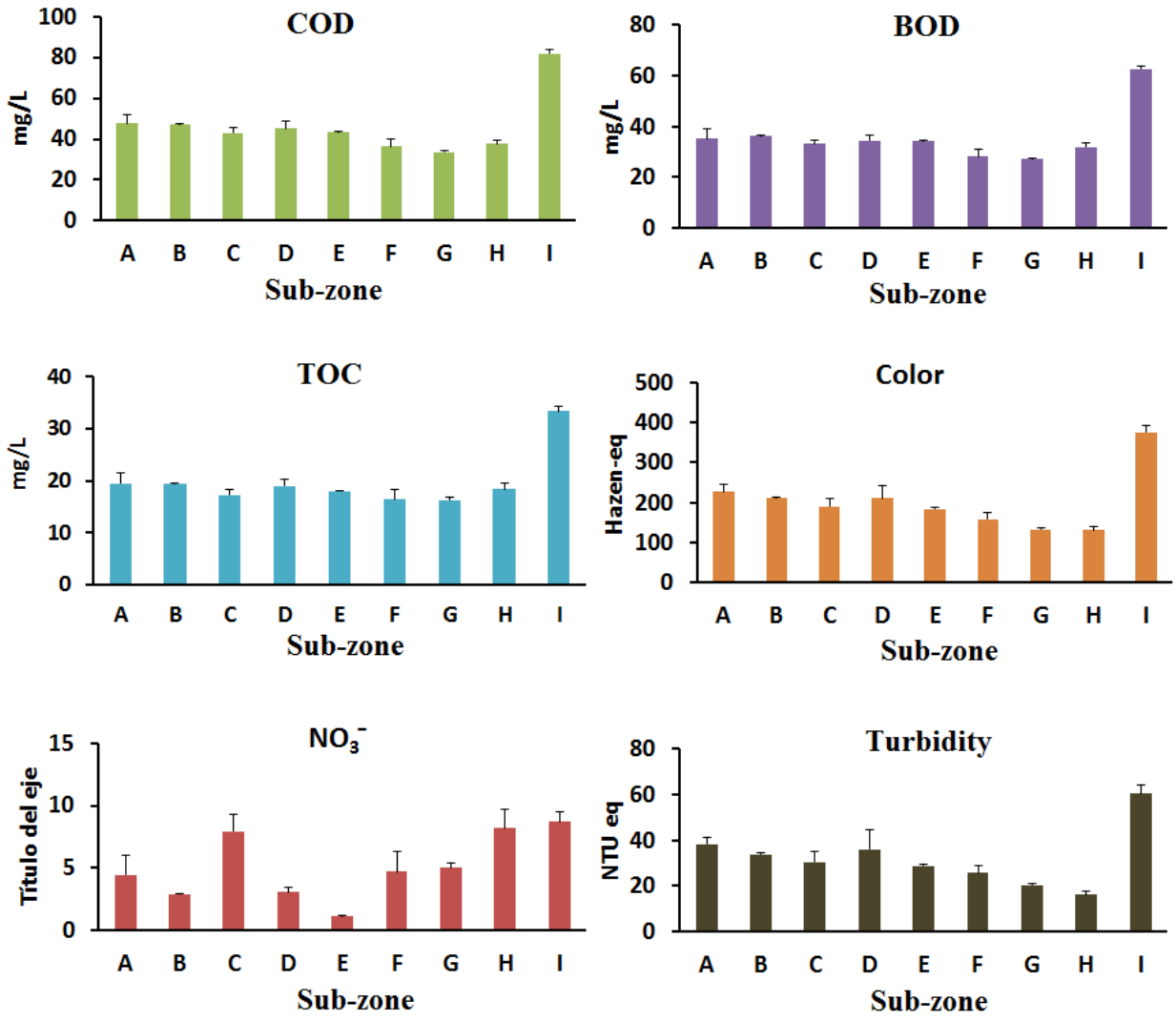



Figure 10. Non-conventional on-site physicochemical parameters

The increase of the CODeq and the BODeq values in zone Z5-I may be associated with the presence of a greater quantity of photosynthetic organisms (mainly algae). This argument gains strength when compared to the increase in the DO in this area, since it is greater than in the rest of the zones (except zone Z5-C). Notwithstanding the foregoing, the injection of ozone by the Scanvenger 2000 proved to be effective in those areas with high levels of organic matter. Such is the case of the sampling site Z5-1 (See figure 1 to identify the site), where a COD concentration of 120 mg/L was recorded before the Scavenger 2000 treatment, hereinafter, the COD decreased to 38 ± 0.8 mg/L at the same site (Table 4).

Table 4. Initial and current concentrations of COD and $DBO_5$

| SAMPLING SITE | COD | | $BOD_5$ | |
|---|---|---|---|---|
| | INITIAL (Laboratory) | CURRENT (Scan) | INITIAL (Laboratory) | CURRENT (Scan) |
| Z5-1 | 120 | 38 ± 0.8 | 5 | 28.12 ± 0.03 |
| Z5-2 | 12 | 36.9 ± 0.8 | 12 | 28.17 ± 0.02 |
| Z5-3 | ND | 37.3 ± 0.9 | 3 | 30.2 ± 0.3 |
| Z5-4 | 13 | 38.4 ± 0.1 | 9 | 30.7 ± 0.1 |

Regarding sites Z5-2, Z5-3 and Z5-4, the COD levels increased with respect to the initial values. One possible explanation is that some recalcitrant compounds are not digested by the potassium permanganate at the time of the COD determination, once the ozone acts, the structure of these compounds changes to a simpler one which can then be digested by the permanganate and therefore gives out a higher signal than the original. Another possibility is that more phytoplankton and/or zooplankton has been produced than the original one, in which case its presence could result in an increase in the measurement of this parameter. In the present work, the concentration of algae and/or chlorophyll that would have allowed to confirm this hypothesis was not measured. On-site observations, however, presented green patches that could indicate the presence of algae and/or cyanobacteria whose coloration was dark green. This phenomenon was observed particularly at the sites closer to the curtain (Z5-H, Z5-I and Z5-4) (Figure 11).

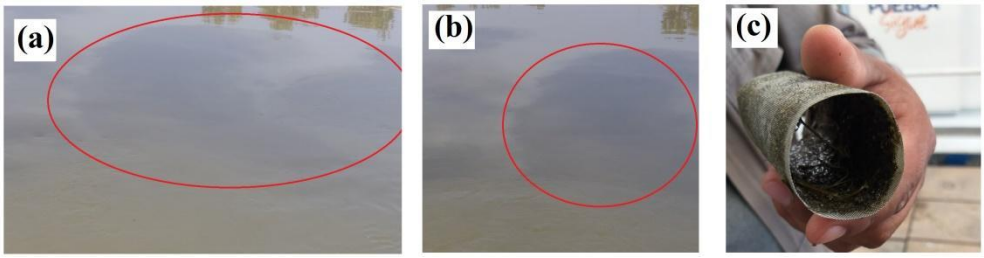



Figure 11. Patches of presumed phytoplankton. (a) Zone Z5-I, (b) Sampling site Z5-4 and (c) Water filter of the hydraulic system of Scavenger 2000 (Puebla 2) during treatment in Zone Z5-I

With respect to the nitrate ion concentration, when statistically comparing the values with the rest of the treated areas, it can be observed that the values in zone Z5-I are greater than in the rest of the zones ($P < 0.05$), which could account for the nitrification process that may be enhanced by the oxygen being injected by the Scavenger 2000 in the Valsequillo dam. This occurs in the 9 sites in which area 5 was segmented in as well as in the 4 sites in which Zone Z5-F was segmented (Figure 12). In both cases an increase of the nitrate ion is observed from the "Panga" to the curtain of the dam.

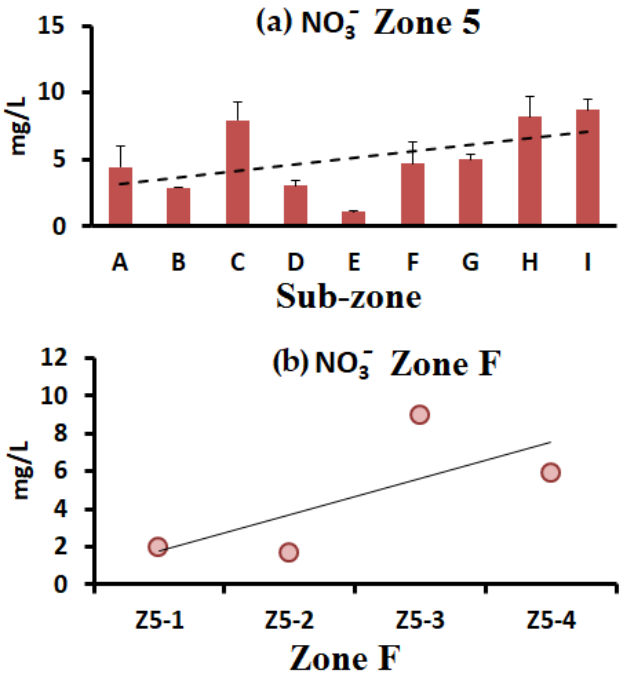



Figure 12. Nitrate ion concentration values (a) sub-zones of zone 5 and (b) sampling sites of sub-zone Z5-F

Likewise, it can be observed that the pH decreases slightly in zone Z5-H with respect to the water flow (from Z5-A to Z5-I) (see figure 9). This could be explained by the fact that during the nitrification process, two hydrogen atoms are produced for each molecule of ammonium present (Equations 1 and 2).

$$NH_4^+ + \frac{1}{2}O_2 \rightarrow NO_2^- + 2H^+ + H_2O \text{.....Equation 1}$$

$$NO_2^- + \frac{1}{2}O_2 \rightarrow NO_3^- \text{.....Equation 2}$$

This process (enhanced by the oxygenation produced by the Scavenger 2000) likewise favors the denitrification process (Equation 3).

$$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2 \text{.....Equation 3}$$

This process is carried out under anoxic and/or facultative conditions. Such conditions are found mainly at the bottom of the water column or in the sediments. Therefore, the surface oxygenation (up to 10 m) carried out by the Scavenger 2000 along with the biological processes that occur at the bottom of the dam, can completely eliminate the nitrogen. This process, however, is slow and will depend to a large extent on the conditions forged by human use (openings of the floodgates) and on the natural conditions of the Valsequillo dam.

The parameters observed in the 9 sub-zones of zone 5 (from Z5-A to Z5-I) have a similar behavior than those observed in the sampling sites within sub-zone Z5-F (Z5-1, Z5-2, Z5-3 and Z5-4). There is a

decrease in the CODeq and a subsequent rise beginning at site Z5-3. The same goes for the BODeq and the equivalent TOC. Color shows a significant decrease from Z% -1 to Z5-4, going from 185 beam units to 145 at the site Z5-3. Turbidity also decreases from 33 to 23 NTUeq from Z5-1 to Z5-4 (Figure 13).

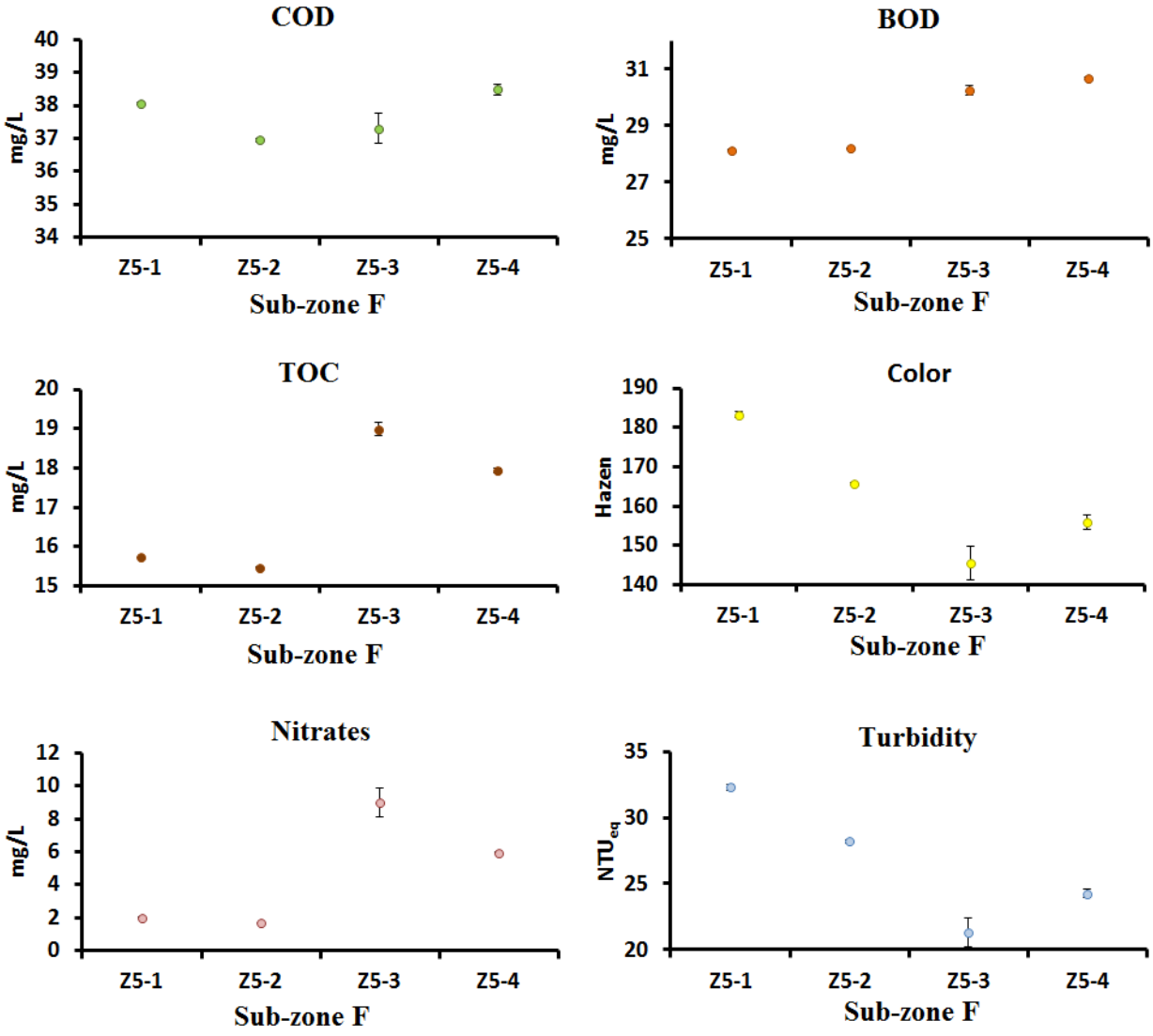



Figure 13. Concentration values of unconventional parameters at the sampling sites along sub-zone Z5-F

The suspended solids' concentration drops around 8 units from Z5-1 to Z5-3. The treatment performed by the Scanver 2000 units has proven to be effective when oxygenating, since the concentration values range from 0.59 ± 0.12 to 1 ± 0.37 from site Z5-1 to Z5-4. (Figure 14). This correlates with the operation strategy of the Scavenger 2000 units, because ever since the beginning of operations, the treatment has been favoured in the area where the main water flow of the dam is found (ZONE Z5-F and Z5-A)) (without neglecting the rest of the areas). This is the reason why it is assumed that the water that flows to the curtain passing through all the areas and intermediate sites tends to have better quality.

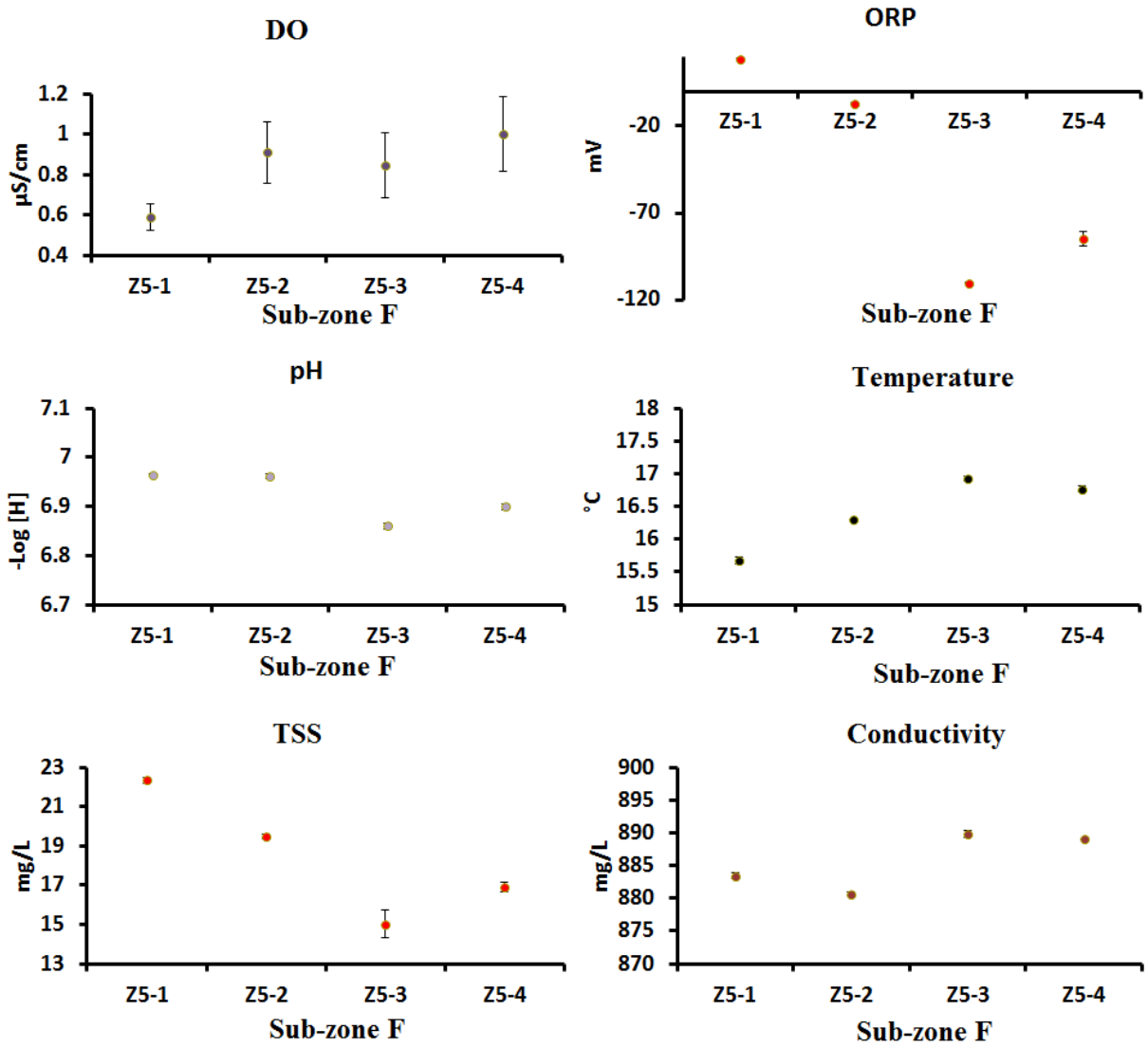



Figure 14. Concentration values of conventional on-site parameters at the sampling sites along sub-zone Z5-F

### 4.1.3 Measurement in certified laboratories

To comply with the established agreement, the supplier has hired certified laboratories to measure all the parameters of the declaration (see Appendix B). For this, a baseline was measured with 4 complete declarations (CDAXRT) in 4 different sampling sites (Z5-1, Z5-2, Z5-3 and Z5-4), which are addressed in the previous report (FIRST REPORT CONCERNING THE SERVICE, OPERATION AND MAINTENANCE CORRESPONDING TO THE EQUIPMENT ACQUISITION AGREEMENT FOR THE SANITATION OF THE VALSEQUILLO DAM). In the present report, the results which correspond to the measured parameters of the CDAXRT are accounted for in the site Z5-2 (see Appendix B), which are compared with the previously measured results (previous to the treatment) with the current ones. Table 5 contains the results of the

parameters contained in the CDAXRT as well as the maximum limits established by the NOM-001-SEMARNAT-1996 norm and by CDAXRT itself. (Table 5).

Table 5. Results corresponding to CDAXRT before and after treatment

| Number | **Parameter (mg/L ó µg/L)** | **MAXIMUM PERMISSIBLE LEVEL** | | **DATE OF SAMPLING ON SITE (Z5-2)** | | **% compliance** | |
|---|---|---|---|---|---|---|---|
| | | **NOM-001-SEMARNAT-1996** | **CDAXRT** | **31-10-18** | **24-01-19** | **NOM-001-SEMARNAT-1996** | **CDAXRT** |
| 1 | As | 0.49 | 0.05 | NA | NA | 100 % | 100 % |
| 2 | Cd | 0.10 | 0.004 | NA | NA | 100 % | 100 % |
| 3 | CN | 3.00 | 0.01 | 0.0011 | 0.0023 | 100 % | 100 % |
| | Cu | 6.00 | 0.05 | NA | 0.001 | 100 % | 100 % |
| 5 | Cr | 1.00 | 0.05 | NA | NA | 100 % | 100 % |
| 6 | Hg | 0.01 | 0.001 | NA | NA | 100 % | 100 % |
| 7 | Ni | 4.00 | 0.6 | NA | NA | 100 % | 100 % |
| 8 | Pb | 10.00 | 0.03 | NA | NA | 100 % | 100 % |
| 9 | Zn | 20.00 | 0.12 | 0.005 | NA | 100 % | 100 % |
| 10 | SST | 125.00 | 56.4 | NA | 11 | 100 % | 100 % |
| 11 | BOD | 150.00 | 20 | 12 | 6.2 | 100 % | 100 % |
| 12 | COD | 320.00 | 40 | 14 | 38 | 100 % | 100 % |
| 14 | SS | 2.00 | <1 | NA | NA | 100 % | 100 % |
| 15 | Fats and Oils | 25.00 | 9.1 | NA | NA | 100 % | 100 % |
| 16 | FC (MPN) | 2000.00 | <200 | 930 | 3 | 100 % | 100 % |
| 19 | Total phosphorus | 30.00 | 0.73 | 2.1 | 2.5 | 100 % | 0 % |
| 20 | TN | 60.00 | 14.5 | 11.97 | 12.34 | 100 % | 100 % |
| 21 | TDS | N/A | 500 | 488 | 549 | - | 0 % |
| 22 | N ($NH_3$) | N/A | 0.66 | 10.52 | 11.6 | - | 0 % |
| 23 | Total phenols | N/A | 0.01 | 0.013 | 0.08 | - | 100 % |
| 24 | Sulfates | N/A | 150 | 61.5 | 61.7 | - | 100 % |
| 26 | Fe | N/A | 0.32 | 0.089 | 0.065 | - | 100 % |
| 27 | Chlorides | N/A | 250 | 64 | 0.023 | - | 100 % |
| 28 | Benzene | N/A | 0.01 | NA | NA | - | 100 % |
| 29 | Toluene | N/A | 0.20 | NA | NA | - | 100 % |
| 30 | Ethylbenzene | N/A | 0.1 | NA | NA | - | 100 % |
| 31 | Vibrio fischeri toxicity (UT) | N/A | <1 | <1 | <1 | - | 100 % |
| | Toxicity daphnia magna(UT) (48H) | N/A | <1 | <1 | <1 | - | 100 % |
| 32 | Sulfides | N/A | 0.002 | NA | NA | - | 100 % |
| 33 | Al | N/A | 0.05 | 0.026 | NA | - | 100 % |
| 34 | Mn | N/A | 0.1 | 0.32 | 0.2761 | - | 100 % |
| 35 | Methyl chloride | N/A | 0.0002 | NA | NA | - | 100 % |
| 36 | Chloroform | N/A | 0.03 | NA | NA | - | 100 % |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 37 | Vinyl chloride | N/A | 0.002 | NA | NA | - | 100 % |
| 38 | 1,2 Dichlorobenzene | N/A | 0.01 | NA | NA | - | 100 % |
| 39 | 1,3 Dichlorobenzene | N/A | 0.01 | NA | NA | - | 100 % |
| 40 | 1,4 Dichlorobenzene | N/A | 0.01 | NA | NA | - | 100 % |
| 41 | 1,2 Dichloroethano | N/A | 0.069 | NA | NA | - | 100 % |
| 42 | Tetrachlorethylene | N/A | 0.05 | NA | NA | - | 100 % |
| 43 | Bis 2 (ethyl hexyl) Phthalate | N/A | 0.003 | NA | NA | - | 100 % |
| 44 | Nitrobenzene | N/A | 0.03 | NA | NA | - | 100 % |
| 45 | Real Color (Pt-Co) | N/A | <15 | 100 | 60 | - | 47 % |
| 46 | MBAS | N/A | 0.10 | 0.21 | 0.72 | - | 0 % |

The cases in which the declaration is not fulfilled are discussed below:

The total phosphorus is a parameter of great importance that plays an essential role in the eutrophication of the Valsequillo dam. Phosphorus is an element that is found in great abundance in detergents. Wastewater from agricultural runoff has gained relevance because they carry fertilizers which contain phosphorus in their currents. The treatment carried out by Scavenger 2000 has two purification routes, the first is through direct oxidation with ozone and/or the hydroxyl radicals produced as by-products (particularly when there is ultraviolet radiation). The second route of purification is through water oxygenation that in turn allows the generation of aerobic microorganisms capable of consuming phosphorus. This effect is expected to be achieved in a greater amount of time than the current value.

Another important factor to consider is the fact that the Water hyacinths present in the Valsequillo dam trap a significant amount of phosphorus brought in by the Atoyac and Alseseca rivers. Notwithstanding the foregoing, phosphorus is also released by this plant its time of death. This phenomenon could be causing a considerable rise in the amount found inside the dam. For all the above it is expected that once you move to the next stage of the service remove the Water hyacinths from the dam), this parameter will begin to decrease.

Regarding the ammoniacal nitrogen, this parameter should continue to be monitored. Nonetheless, it is expected that once a higher level of oxygenation is reached in the dam, the nitrification process (previously discussed) will be enhanced and therefore allow the reduction of this parameter .

In regard to the methylene blue active substances (MBAS), it is a parameter that is related to the surfactants, which are molecules that are formed by a hydrophobic group and a hydrophilic group. These compounds tend to be located between the interfaces amid the aqueous medium and the other phases of the system, such as air, oily liquids and particles. This feature gives it the ability to generate foam, emulsification and/or particle suspension. The treatment with the Scavenger 2000 tends to stir the waters that it treats by oxygenating it and therefore generating turbulence along with foam when

the water has a high content of these substances. It is likely that taking water samples in the area of influence of the treatment will result in higher than expected concentrations due to the physical effect of the agitation, which does not necessarily imply an increase per se of this parameter.

### 4.1.4 Organoleptic properties

The organoleptic properties of water are those properties that are related to the human senses, namely: temperature, taste, smell, color, turbidity, etc. While it is true that such properties are difficult to measure in this type of water; that is, it is not recommended to drink the water from the Valsequillo dam, they can be perceived and in some cases they can be related to the parameters of water quality measured and reported in this document.

The turbidity was not originally measured in the baseline (since it is not contained in the declaration), so the current measurements have no previous reference; a reduction, however, is presumed since a greater sunlight penetration in the water column is observed after treatment with the Scavenger 2000 units (Figure 15). While it is true that the clarity of water varies from day to day (the wind patterns plays an important role), the observed trend is a greater clarification from the beginning of the treatment and to date.

Likewise, a 40% decrease was observed in the color measurements carried out by the certified laboratories,which also explains the greater daylight penetration in the water column (see Table 5, parameter 45).

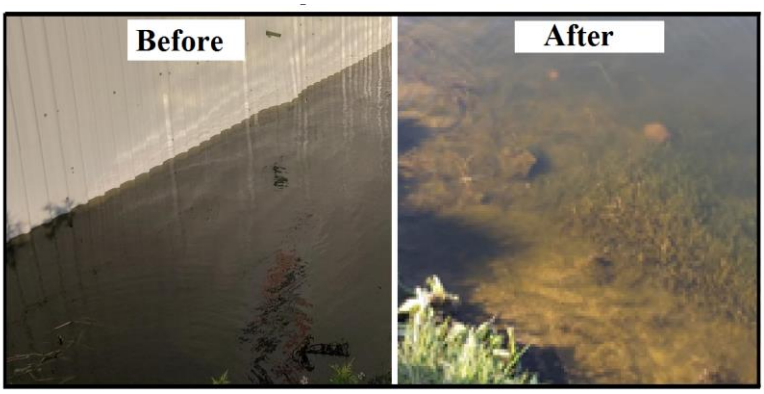



Figure 15. Appearance of water on the shore of the peninsula of San Baltazar Tétela, Valsequillo, Puebla

Another property in which a great improvement has been noticed is precisely the smell. Prior to the Scavenger 2000 units operation, a foul odor was perceived, as described by the signatory sent by the certified laboratory in the baseline sampling dated October 31, 2018 (see Annex 3 of the FIRST REPORT CONCERNING THE SERVICE, OPERATION AND MAINTENANCE CORRESPONDING TO THE EQUIPMENT ACQUISITION AGREEMENT FOR THE SANITATION OF THE VALSEQUILLO DAM). In contrast, as observed on February 15$^{th}$, 2019 by the signatory of the certified laboratory at the time of sampling (See Appendix B of this document), the odor at the Valsequillo dam was absent.

The foregoing relates to the same observations that operators of the Scavenger 2000 units make daily in addition to the identical comments received by the inhabitants of the zones surrounding area 5 of the Valsequillo dam show.

## 4.2 Conclusions

The treatment through the operation of the Scavenger 2000 units (Puebla 1, Puebla 2 and Puebla 3) of the waters of the Valsequillo dam in zone 5, has proven to be effective in reaching the desired levels established by the Classification Declaration of the Atoyac and Xochiac or Hueyapan Rivers and its Tributaries (CDAXRT). The criterion parameter (fecal coliforms) removed of up to 99% (site Z5-2). It is expected that over time, some parameters in which there was no reduction, will result in time reduce. The removal of Water hyacinths will be fundamental not only for the removal of phosphorus but also for other parameters.

In general terms (qualitative and quantitative), the water from the Valsequillo dam has shown an improvement and the operation of the units must be continued in order to continue improving the quality of the water.