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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page1 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES

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| B | 16/10/2015 | DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES | July Bibiana Salazar, Luisa Fernanda Alzate, Diana Gúzman | Sebastian Piedrahita | María Andrea Patiño |
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| REVIEW | DATE | DESCRIPTION | MADE BY | REVIEWED BY | APPROVED BY |

Review A: Issued for Customer Comments

Revision B: Issued for Client Approval

Revision 0: Approved for Basic Engineering

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page2 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

TABLE OF CONTENTS

| | | Page. |
|-------|--|--------------------------------------|
| 7 | DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES..... | ¡Error! Marcador no definido. |
| 7.1 | Superficial water..... | ¡Error! Marcador no definido. |
| 7.1.1 | Superficial water flow required | ¡Error! Marcador no definido. |
| 7.1.2 | Source identification and location of the capture site | ¡Error! Marcador no definido. |
| 7.1.3 | Infrastructure design and capture, derivation, conduction and distribution system..... | ¡Error! Marcador no definido. |
| 7.1.4 | Average monthly flow of the León River | ¡Error! Marcador no definido. |
| 7.2 | Underground water..... | ¡Error! Marcador no definido. |
| 7.3 | Spillway | ¡Error! Marcador no definido. |
| 7.3.1 | Spillway flow..... | ¡Error! Marcador no definido. |
| 7.3.2 | Receiving source identification..... | ¡Error! Marcador no definido. |
| 7.3.3 | Domestic wastewater | ¡Error! Marcador no definido. |
| 7.4 | Riverbeds occupations | ¡Error! Marcador no definido. |
| 7.5 | Forestry exploitation | ¡Error! Marcador no definido. |
| 7.5.1 | Structural analysis for the project´s direct impact area | ¡Error! Marcador no definido. |
| 7.5.2 | Ecological indices..... | ¡Error! Marcador no definido. |
| 7.5.3 | Volume to take advantage of..... | ¡Error! Marcador no definido. |
| 7.5.4 | Handling of logging products..... | ¡Error! Marcador no definido. |

| | | |
|---|--|---|
|  | <p align="center">MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p align="center">ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p align="center">Page3 of 86</p> |
| | <p align="center">GAT-391-15-CA-AM-PIO-01</p> | <p>Review: B</p> |

- 7.5.5 Species in category of threatened, closed season and / or endemism **¡Error! Marcador no definido.**
- 7.6 Atmospheric emissions **¡Error! Marcador no definido.**
- 7.6.1 Emission sources without project **¡Error! Marcador no definido.**
- 7.6.2 Construction phase of the project..... **¡Error! Marcador no definido.**
- 7.6.3 Operation phase **¡Error! Marcador no definido.**
- 7.6.4 Estimation of emission factors of the possible emissions of particulate material for handling solid bulk cargoes **¡Error! Marcador no definido.**
- 7.6.5 Emission control systems and measures to prevent the emission of particulate material into the atmosphere **¡Error! Marcador no definido.**
- 7.6.6 Treatment and final disposal of the material collected by the control teams **¡Error! Marcador no definido.**
- 7.6.7 Air quality in the area of interest **¡Error! Marcador no definido.**
- 7.7 Construction materials..... **¡Error! Marcador no definido.**
- 7.7.1 Acquisition of material in existing sources **¡Error! Marcador no definido.**

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page4 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

LIST OF FIGURES

| | Page. |
|--|-------|
| Figure No. 7.1 Location of the capture and discharge point in the León River | 16 |
| Figure No. 7.2 Location of infrastructure for potable water in onshore facilities | 18 |
| Figure No. 7.3 Scheme of the Lateral Intake to design | 20 |
| Figure No. 7.4 Average monthly flows of the León River at the Barranquillita and Villarteaga stations | 33 |
| Figure No. 7.5 Average monthly flow of the León River at the Barranquillita station (statistics 1989-1993) | 33 |
| Figure No. 7.6 Location of infrastructure for wastewater in onshore facilities | 36 |
| Figure No. 7.7 Behavior of domestic wastewater networks projected on land, with green arrows for the flow direction | 38 |
| Figure No. 7.8 Location of infrastructure for use and residual water in the dock | 39 |
| Figure No. 7.9 Location of infrastructure for oleaginous liquid waste | 40 |
| Figure No. 7.10 Project's area of direct impact where the logging will be carried out | 42 |
| Figure No. 7.11 Flora sampling points in the project's area of influence | 47 |
| Figure No. 7.12 Relative abundance of the most representative families in the study area | 50 |
| Figure No. 7.13 Absolute and cumulative diameter distribution for trees in the area directly affected by the project | 52 |
| Figure No. 7.14 Stratification trends for the cup dispersion diagram within the project's area of direct impact | 53 |

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page5 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Figure No. 7.15. Location of storage, load and unload areas of solid bulk64

Figure No. 7.16. Location of the area that requires a permit of atmospheric emissions66

Figure No. 7.17. Silos and Grain storage warehouses- Pto Antioquia.71

Figure No. 7.18. Specialized vehicles for bulk transport, high speed unloading hopper and coupled tandem..... **¡Error! Marcador no definido.**

Figure No. 7.19. Lading type unloading system.....75

Figure No. 7.20 Dust collectors78

Figure No. 7.21 Electrostatic Precipitators79

Figure No. 7.22 Communication channels between material sources and project86

LIST OF TABLES

| | Page. |
|---|-------|
| Table No. 7.1 Flow authorized by Resolution No. 0032 of 2012..... | 11 |
| Table No. 7.2 Flow requested in the current License Modification | 12 |
| Table No. 7.3 Estimated volume of water consumption in the construction phase | 13 |
| Table No. 7.4 Volume of water for humidification | 14 |
| Table No. 7.5 Coordinates of the location of the superficial water collection granted by Resolution No. 0032 of 2012 | 15 |
| Table No. 7.6 Location coordinates of the superficial water collection requested in the current Environmental License Modification and change of coordinates for the operation..... | 16 |

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page6 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

| | |
|--|----|
| Table No. 7.7 Identification of the infrastructure of Figure No. 7.2 | 18 |
| Table No. 7.8 Pre-dimensioning of the adduction..... | 24 |
| Table No. 7.9 Predimensioning the sand trap | 24 |
| Table No. 7.10 Predimensioning the pumping..... | 25 |
| Table No. 7.11 Minimum pre-dimensioning of the storage tank for drinking water treatment..... | 27 |
| Table No. 7.12 Predimensioning the water storage tank..... | 27 |
| Table No. 7.13 Predimensioning for hydropneumatic system | 28 |
| Table No. 7.14 Input data of the pumping system towards the Dock | 29 |
| Table No. 7.15 Checking the suction pipe of the pumping system towards the Dock | 29 |
| Table No. 7.16 Checking the pumping system´s piping system towards the dock | 30 |
| Table No. 7.17 Fluvial system of the Gulf of Urabá: flow and area of the river basin | 31 |
| Table No. 7.18 Location Coordinates of the spillway area granted by Resolution No. 0032 of 2012 | 34 |
| Table No. 7.19 Adjustment of the location coordinates of the requested spillway area in the current Environmental License Modification | 35 |
| Table No. 7.20 Identification of the location points of the infrastructure for residual water of Figure No. 7.6..... | 36 |
| Table No. 7.21 Identification of the location points of the infrastructure for wastewater of Figure No. 7.8..... | 39 |
| Table No. 7.22 Forest exploitation areas..... | 41 |

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 7 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Table No. 7.23 Commercial volume of wood that will be exploited in each of the land coverages by the project’s developed activity45

Table No. 7.24 Affected area and number of trees exploited by type of coverage within the project’s area of direct impact46

Table No. 7.25 Floristic composition in the project’s area of influence.....48

Table No. 7.26 Frequency distribution for the normal diameter variable, for trees in the area directly affected by the project.....51

Table No. 7.27 Distribution of the number of species and their abundances (Number of trees) in each stratum (Sociological position), for the trees inventoried in the project’s area of direct impact53

Table No. 7.28 Wealth and Diversity indices for the project’s area of influence....56

Table No. 7.29 Volume of wood to be exploited within the project’s area of direct impact57

Table No. 7.30 Location coordinates of the atmospheric emission permit65

Table No. 7.31. Cargo projection in the short and medium term.68

Table No. 7.32. Bulk silos storage capacity.....69

Table No. 7.33. Bulk loading operation.....73

Table No. 7.34 Emission factors established by the US EPA for grain management, without emission control (category E: poor).....76

Table No. 7.35 Potential emission of particulate material, without the implementation of control systems77

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page8 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

LIST OF PHOTOGRAPHS

| | Page |
|--|------|
| Photograph No. 7.1 Overview of the project's area of influence | 43 |
| Photograph No. 7.2. Area 7693 - Carepa (Antioquia) ¡Error! Marcador no definido. | |
| Photograph No. 7.3. Area 7697 - Turbo (Antioquia) ¡Error! Marcador no definido. | |

LIST OF EQUATIONS

| | Page |
|---|------|
| Equation No. 7.1 Kirshmmmer equation..... | 19 |
| Equation No. 7.2 Equation of losses | 20 |
| Equation No. 7.3 Villemonte's Equation | 21 |
| Equation No. 7.4 Francis equation | 21 |
| Equation No. 7.5 Engels equation | 22 |
| Equation No. 7.6 Submerged hole equation for design flow..... | 23 |
| Equation No. 7.7 Check of suction pipe's equation..... | 29 |
| Equation No. 7.8 Equation for check of discharge pipe..... | 30 |

LIST OF ANNEXES

- Annex 7.1 National Single Format - FUN
- Annex 7.2 Savings and efficient use of water program

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page9 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

Annex 7.3 Rational Use Energy Program

Annex 7.4 Hydrosanitary designs

Annex 7.5 Forest exploitation

Annex 7.6 Sources of existing material

MAP LIST

| Code | Description |
|---------------------------|---|
| MOD_LA_PTO_ANT_56_Demanda | Demand, use and exploitation of natural resources |
| MOD_LA_PTO_ANT_01_LG | General location of the project |

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page10 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

7 DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES

This chapter presents the renewable natural resources that will be used, exploited or affected during the construction and operation phases of the solid bulk cargoes port terminal in the municipality of Turbo, which obtained an Environmental License through Resolution No. 0032 of 2012¹, which will be modified by a multipurpose port terminal called "Puerto Bahía Colombia de Urabá" (see Chapter 3 Description of the Project, of the current environmental impact study).

The modification of the Environmental License object of application, already has the permits of concession of waters and dumping for the operative stage, and forest exploitation for the execution of the project, which were granted by Resolution No. 0032 of 2012 for the project² "*Construction and Operation of a Port Terminal of Solid Bulk Cargoes of Big Draft in Bahía Colombia*", however, in the present modification it is required to request the use of the same flow granted in the operative stage, for the construction stage of the project.

Likewise, it is required to correct the coordinates of the location of the concession points and spillways, due to an error in the origin of the project's coordinates.

In terms of forest exploitation, an increase in the volume to be used is required, in the areas where the works contemplated in the modification of the environmental license will be executed and, additionally, it is required to process a permit of atmospheric emissions during the operation of the port terminal for the management of solid bulk cargoes, during the activities of loading and unloading in the onshore terminal and maritime quay.

On the map MOD_LA_PTO_ANT_56_Demanda, the location of the sites for the exploitation of natural resources is presented and in Annex 7.1 FUN, the completed forms of the water concession permit, dumping permit with minor modifications, permit for forest exploitation and permit of atmospheric emissions is presented as well.

¹ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). By means of which an environmental license is granted. Bogotá, D.C. 135 p..

² Ibid.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page11 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Additionally, Annex 7.2 presents the saving and efficient use of water program for the requested concessions and in Annex 7.3, the rational use of energy program.

7.1 Superficial waters

Because the district of Nueva Colonia does not have a good aqueduct to meet the project's needs, the terminal will require capturing superficial water from the León River during the construction phase for industrial use and in the operation phase for domestic and industrial use.

The conceptual engineering for the capture, transportation, distribution, treatment and adequate disposal of water resources was prepared by PIO SAS³, which served as the main source of information for the numerals 7.1 and 7.3 of this chapter regarding superficial waters and spillways respectively.

7.1.1 Required superficial water flow

According to the Environmental License granted by Resolution No. 0032 of 2012⁴, a grant of superficial water for industrial and domestic use of the León River was granted to the Puerto Bahía Colombia SA Port Society, for a maximum flow rate of 1.5 L / s, 24 hours a day, 7 days a week, for a total volume of 907.2 m³ / week.

The flow authorized in the aforementioned resolution was distributed as indicated below in Table No. 7.1:

Table No. 7.1 Flow authorized by Resolution No. 0032 of 2012⁵

| Capture source | Project phase | Type of Use | Flow Awarded L / s |
|----------------|---------------|--|--------------------|
| Río León | Operation | Domestic (personal hygiene, cleaning of cafeteria's elements and utensils and in the terminal's toilets) | 0,5 |
| | | Industrial (Use against fire) | 0,2 |
| | | Industrial (Cleaning of facilities and minor uses) | 0,8 |

³ PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia. Santiago de Cali, 2015.

⁴ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.

⁵Ibid.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page12 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Source: Resolution No 0032 of 2012⁶

In accordance with the above, in Resolution No. 0032 of 2012⁷, this concession was authorized for the operation phase of the project, however, in the present study for the Modification of Environmental License of the project, it is requested that the same maximum flow of 1.5 L / s is included in the construction phase, for industrial use, taking into account that the necessary measures will be taken to avoid generating additional impacts to those identified in the current Environmental License.

It is worth mentioning that during the construction of the project, the water for human consumption will be supplied with water bottles, water tankers or drinking water service companies, provided they are duly authorized and have the water concession duly granted for the provision of the service.

The flow requested in this project's Modification of Environmental License, will be distributed for industrial use in the production of concrete and environmental management (humidifying of accesses and intervention areas) in the construction phase, as presented in Table No. 7.2.

Table No. 7.2 Flow requested in the current Modification of the current Environmental License.

| Capture source | Project phase | Type of Use | Flow Awarded L / s |
|----------------|---------------|--|--------------------|
| Río León | Construction | Industrial (Concrete plant for the production of simple and reinforced concrete) | 1,37 |
| | | Industrial (Humidification of the access road from the Nueva Colonia district - Puerto Antioquia site and property area) | 0,13 |

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

- Required volume for the production of simple and reinforced concrete

According to recognized authors^{8 9 10} and experience in the field, it is possible to estimate that the volume of water per square meter built on site consumed, is in the

⁶Ibid.

⁷ Ibid.

⁸ FILHO, E. C., Da SILVA, S. R., BRITO, I. G. G. Water Consumption in Construction Site From Metropolitan Region of Recife: Encontro Latinoamericano de Edificações e comunidades sustentáveis, 2013

⁹ GALVÍN, R.M. *Physicochemistry and microbiology of aquatic media. Treatment and quality control of water*. Díaz de Santos, 2003.

¹⁰ PESARRELLO, R. G. *Estudo exploratório quanto ao consumo de água na produção de obras de edifícios: avaliação e fatores influenciadores*: Escola Politécnica da Universidade de São Paulo., 2008

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page13 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

range of 0.2 to 0.25 m³ / m² of work, and the water consumption in the preparation and adaptation of simple and reinforced concrete, is approximately of 200 L / m³ of concrete.

Taking these data into account, the volume of water consumption was estimated for the execution of the work as detailed in Table No. 7.3. To estimate the volume required for concrete fabrication, the following considerations, for concrete slabs, were considered:

- a) CBR of subgrade design = 10%
- b) Concrete Strength f'c = 245 kg / cm² with a breaking module of 4 MPa
- c) Slab thickness of 30 cm with 20 kg / m³ of steel fiber and 600gr / m³ of polypropylene fiber.
- d) Truck for design: 30 t

Table No. 7.3 Estimated volume of water consumption in construction phase

| Projected area (m ²) | Water consumption (m ³) | Total estimated volume of water (m ³) |
|--|--|---|
| 350.080 | 0,2 | 70016 |
| Projected volume of concrete (m ³) | Water consumption (m ³) | Total estimated volume of water (m ³) |
| 123.018 | 0,2 | 24.604 |
| | Total water volume estimated for construction phase (m³) | 94.620 |

Source: PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia., 2015.

According to what is presented in Table No. 7.2, a total flow for the construction stage of 1.5 L / s is requested in the current Environmental License Modification, which is equal to the flow approved by the Environmental License in the Resolution No. 0032 of 2012¹¹ for the operation phase.

¹¹ Ibid.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page14 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

In order to supply the estimated water demand for the construction phase, it is necessary to initially build a storage tank of 300 m³, with its respective pumping system in the projected capture.

Due to the above, with a flow rate of 1.5 L / s, it is possible to capture 129.6 m³ of water in one day for its use in the construction process, related to the production activities of simple and reinforced concrete and humidification of the areas of intervention.

- Volume required for humidification

According to the characteristics of the access road and the project intervention areas in the onshore terminal, a flow of 0.13 L / s was considered for the humidification activity during the construction of the project (see Table No. 7.2).

The estimated frequency of humidification will be two (2) times a day, which will be carried out by means of a 3000-gallon tank car with a speed of 10 km / h, for a performance of 16 km.

This frequency can be modified, because the weather conditions in the area, there is high rainfall, so it will be possible to adjust the frequency ensuring the prevention of dust and particulate material generated by different construction and transit activities of the vehicles associated with the project, such as trucks, heavy machinery and light vehicles (see Table No. 7.4).

Table No. 7.4 Volume of water for humidification

| Description | Units | Values |
|------------------------------------|-----------|----------|
| Tank car capacity | Gallons | 3000 |
| Tank car speed | km/h | 10 |
| Tank truck nozzle flow | L/s | 0,2 |
| Number of nozzles | Unit | 10 |
| Total flow nozzles | L/s | 2 |
| Tank car emptying time | Hours | 1,6 |
| Tank car Performance | km | 16 |
| Tank car filling | Times/day | 1 |
| Volume needed | Liters | 11356,24 |
| Concession flow | L/s | 0,13 |
| Tank car filling time (45 minutes) | s | 2700 |

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page15 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| Description | Units | Values |
|---------------------------|-------|--------|
| Flow required for filling | L/s | 4,21 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.1.2 Source Identification and location of the capture site

Currently, the project has a water concession granted through Resolution No. 0032 of 2012¹², whose capture was located in the coordinates presented in Table No. 7.5.

Table No. 7.5 Location coordinates of the superficial water capture granted by Resolution No. 0032 of 2012

| Description | Name of the source | Flat Coordinates, Magna Sirgas Origin Bogotá | | Geographical coordinates | |
|---------------------------|--------------------|--|------------|--------------------------|--------------|
| | | North | East | Latitude | Longitude |
| superficial water capture | Río León | 1.368.584,06 | 706.355,75 | 7°55' 14,34 | 76°44' 22,81 |

Source: Resolution 032 of 2012¹³

Due to the more detailed designs of the project, for the current Modification of Environmental License, it is requested to modify the location of the capture point in relation to the one previously granted in Resolution No. 0032 of 2012¹⁴ for the operation stage, due to an error in the origin of the coordinates since this point was located in the middle channel of the Leon River and not on its shore.

The change of location coordinates of the water concession is requested, considering it as a minor change, because it continues to be located in the León River approximately 124 m from the originally granted location and does not generate different impacts to the ones identified in the Environmental Impact Study, nor are nearby communities affected, since the use of the León River as a source of supply to populations downstream of the capture was not identified.

The request for the relocation of the coordinates of the capture for the construction and operation stage will be made on the León River downstream of the confluence of this with the Nueva Colonia canal, as presented in Table No. 7.6 and Figure No. 7.1.

¹² Ibid.

¹³ Ibid.

¹⁴ Ibid.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 16 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

According to the identification of the IDEAM, the subzone of the León River corresponds to the identification 1201. The property through which the concession is accessed is located in the Nueva Colonia Village, municipality of Turbo.

Table No. 7.6 Location coordinates of the superficial water capture requested in the current Environmental License Modification and change of coordinates for the operation

| Description | Name of the source | Flat Coordinates, Magna Sirgas Origin Bogotá | |
|---------------------------|--------------------|--|------------|
| | | North | East |
| superficial water capture | León River | 1.368.707,6 | 706.348,01 |

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

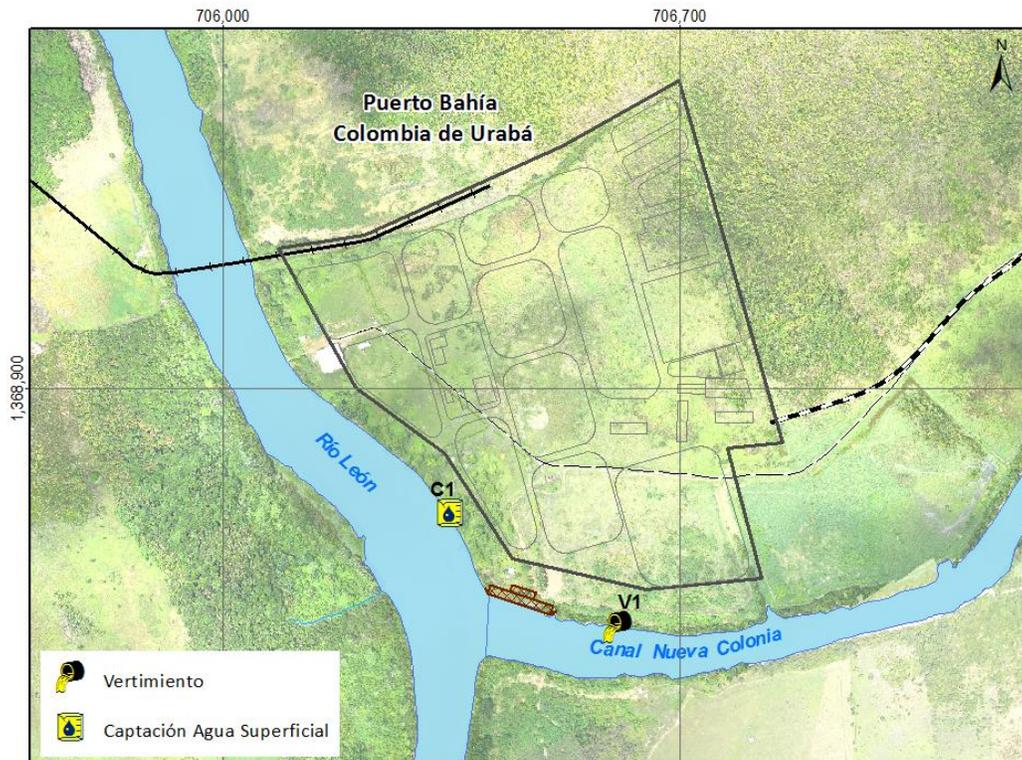


Figure No. 7.1 Location of the capture and spillway point in the León River

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page17 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

7.1.3 Design of infrastructure and capture, derivation, conduction and distribution system

For the onshore installations, a lateral type collection structure is projected, due to the fluvial conditions of the León River. The point of capture located in the flat coordinates (Magna Sirgas, origin Bogotá) presented in Table No. 7.6, detailed as point 1 within Figure No. 7.2, is used.

This point also incorporates a desanding unit and a pumping unit, which allows to raise the raw water to its treatment in the Projected Drinking Water Treatment Plant, which will henceforth be called PTAP.

From this capture, the pipe adduction leads to a compact Potable Water Treatment Plant (PTAP), illustrated as point 2 of the potable water infrastructure in Figure No. 7.2.

The PTAP, in addition to executing the conventional processes of sedimentation, coagulation, filtration and disinfection, must have a flow rate to treat 1.30 L / s of water, which is the daily maximum plus 4% of the average daily flow.

A 300m³ water storage tank is projected, which will supply the fluctuating demands of potable water in the port facilities, represented in point 3 (see Figure No. 7.2), which will also work as a reserve for the needs of the system against fire.

The adequacy of a raw water pumping station is necessary, due to the topographic conditions and architectural layout, just after a sand trap.

The networks and hydraulic points, the connections and other hydraulic elements of the aqueduct network, coded with blue color (see Figure No. 7.2), must be designed and constructed under the RAS norms and others that correspond. It must have pneumatic pressure equipment that allows to provide the entire network of aqueduct with the necessary pressure within the normal operating ranges, at all points of the network.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page18 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

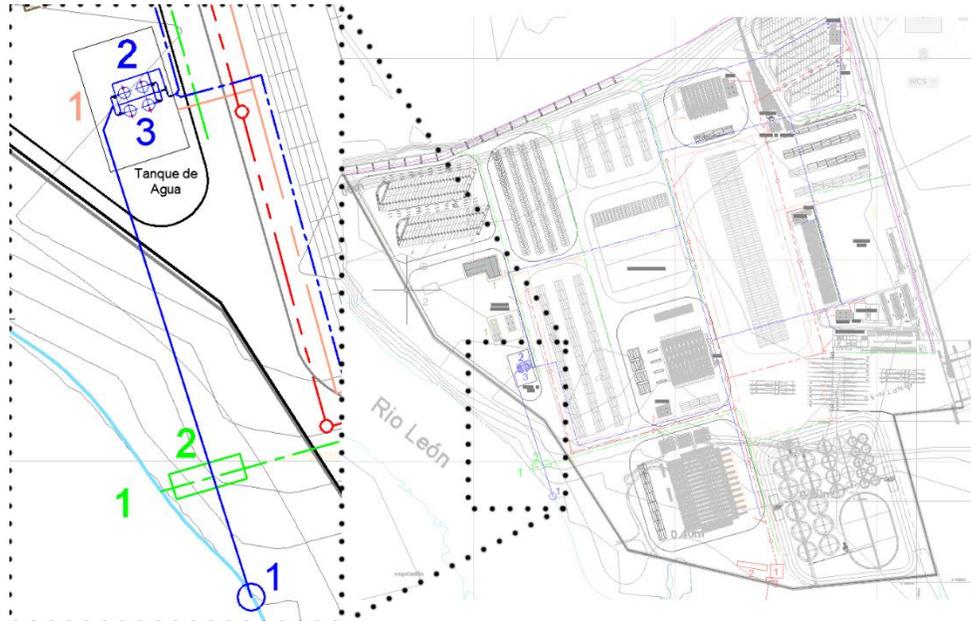


Figure No. 7.2 Location of infrastructure for potable water in onshore facilities
Fuente: PIO S.A.S, 2015.¹⁵

Table No. 7.7 Identification of the infrastructure of Figure No. 7.2

| Identification, ID in blue | Infrastructure |
|----------------------------|--------------------------------|
| 1 | Intake |
| 2 | PTAP, above the projected Tank |
| 3 | Projected tank |

Source: PIO S.A.S, 2015¹⁶.

It should be mentioned that the definitive designs of the potable water treatment plant will be delivered to the competent environmental authority 90 days before the start of the construction phase of the project.

¹⁵ PIO S.A.S. Conceptual Engineering Report: Integrated management of water resources in Puerto Antioquia. Santiago from cali, 2015.

¹⁶ Ibid.

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page19 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

- Capture of continental superficial waters

A pre-dimensioning of the capture structure is presented, detailed in the following items. A lateral type intake is established on the previously defined point and an approximate scheme is illustrated in Figure No. 7. 3..

- Grid design

Losses in the grid

To determine the losses in the grid the Kirshmmmer equation is used, see Equation No. 7.1:

$$h = B \left(\frac{W}{b} \right)^{4/3} hv * \sin \theta$$

Equation No. 7.1 Kirshmmmer Equation
Source: Information of PIO S.A.S, 2015

Where:

h: Loss of Load (m)

B: Form factor (B = 1.79 for circular bars, B = 2.42 for rectangular bars)

W: thickness of the bar (m)

b: minimum space between bars (m)

v: approach speed (m/s)

hv: speed loading (m)

e: angle of the bar with the horizontal

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page20 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

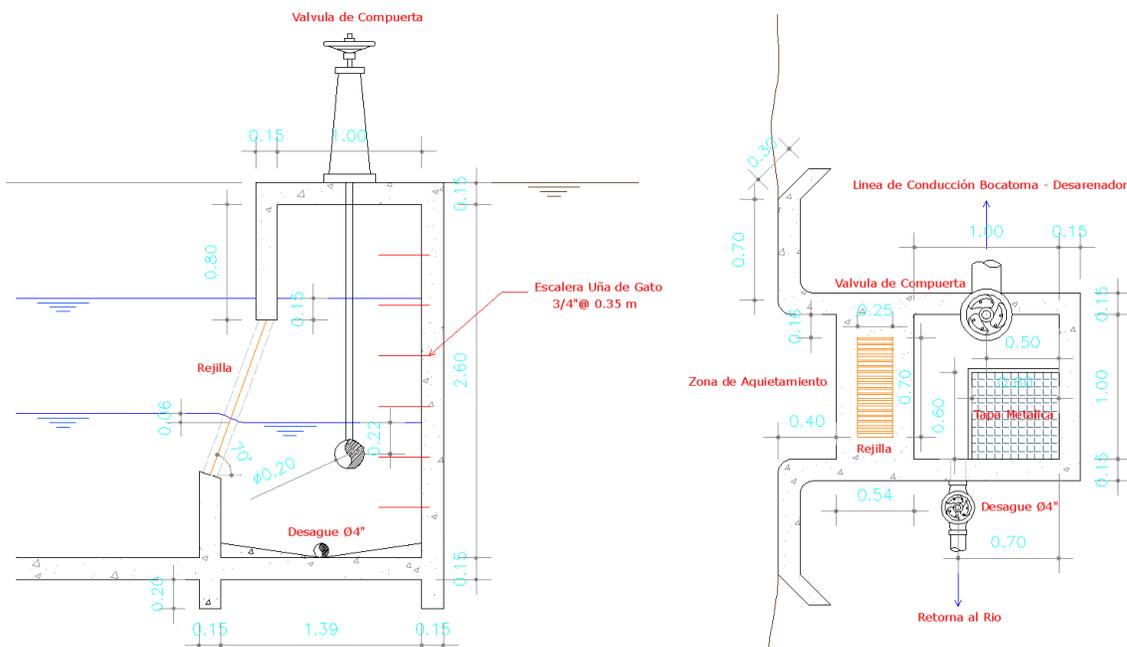


Figure No. 7.3 Scheme of the Lateral Intake to design
Source: PIO S.A.S, 2015

In this design, the bars are circular, with a thickness of ½ inch and a separation of 1 inch, in order to avoid the entry of sticks and coarse solids of more than 1 inch; and an angle of inclination of 70 ° with respect to the horizontal to facilitate the maintenance. Assuming an approach speed of 0.6 m / s, the losses in the grid are equivalent to, see Equation No. 7.2.

$$h = 1,79 \left(\frac{0,0127}{0,0254} \right)^{4/3} 0,01836 * \sin 70 = 0,0123 \text{ m}$$

Equation No. 7.2 Equation of losses
Source: Information of PIO S.A.S, 2015

The minimum losses in the grid should be 0.06 m, due to the accumulation and dragging of floating and suspended material; in this case, the losses calculated with the Kirshmmer equation are less than the minimum, so for the design 6 cm will be used as the losses in the grid.

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page21 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

Flow in the Free spillway

Assuming a load of $H = 0.20$ m above the spillway, the water level is inside the derivation chamber and its respective height:

Water Level within the Derivation Chamber

$$H - 0,06\text{m} = 0,20 - 0,06 = 0,14 \text{ m}$$

Since the water level inside the derivation chamber indicates that the spillway is submerged, the flow rate that can be captured in this condition should be calculated by applying the Villemonte equation, see Equation No. 7.3:

$$Q_1 = Q / (1 - S^n)^{0.385}$$

$$S = (H - \text{pérdidas}) / H$$

Equation No. 7.3 Villemonte equation
Source: Information of PIO S.A.S, 2015

Where:

Q: Flow rate that we need to capture (Design flow $Q = 3 * QMD = 0.00475 \text{ m}^3 / \text{s}$)

Q_1 : Flow rate captured if the spillway was free (not submerged) (m^3 / s)

S: Submergence

n: exponent of the formula as a free spillway ($n = 1,5$)

H: load on the spillway (m)

Using the equations, the collected flow is determined as if the spillway was free:

$$S = (0,20 - 0,06) / 0,20 = 0,70$$

$$Q_1 = Q / (1 - S^{1,5})^{0,385} = 0,006662 \text{ m}^3 / \text{s}$$

Total Length of the Grid

The length of the grid is determined by the Francis equation for free spillway, see Equation No. 7.4:

$$Q = 1,84 * L_e * H^{3/2}$$

Equation No. 7.4 Francis equation

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page22 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Source: Information of PIO S.A.S, 2015

Where:

Q: captured flow if the spillway was free (m³/s)

H: load (H = 0,20)

Le: equivalent length (m)

Using Equation 19 and clearing the equivalent length, is found:

$$Le = \frac{Q}{1,84H^2} = \frac{0,008599 \text{ m}^3/\text{s}}{1,84 * 0,2^{3/2}} = 0,0404 \text{ m}$$

The number of spaces and the number of rods is determined by the following equations, as presented below:

$$N^{\circ} \text{ of spaces} = Le / \text{rods diameter} = 0,0404 / 0,0127\text{m} = 3 \text{ spaces}$$

$$N^{\circ} \text{ of rods} = N^{\circ} \text{ spaces} - 1 = 3 - 1 = 2 \text{ rods}$$

Finally, the total length of the grid is found

$$\text{Total Length} = (N^{\circ} \text{ spaces} * \text{distance between rods}) + (N^{\circ} \text{ rods} * \text{rod diameter})$$

Ec. 22

$$= (3 \text{ spaces} * 0,0254\text{m}) + (2 \text{ rods} * 0,0127\text{m}) = 0,10875 \text{ m}$$

In order to verify the total length of the grid, the Engels equation for lateral spillway is used, see Equation No. 7.5.

$$Q = 1,86 * Le^{0,9} * H^{1,6}$$

Equation No. 7.5 Engels equation

Source: Information of PIO S.A.S, 2015

Where:

Q: captured flow (m³/s)

Le: Effective length (m)

H: load on the crest (m)

Clearing Le you get:

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page23 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

$$Le = [Q/1,86H^{1,6}]^{1/0,9} = [0,008599\text{m}^3/1,86(0,20)^{1,6}]^{1/0,9} = 0,03349 \text{ m}$$

Comparing the values of Le obtained by the Francis (0.00404m) and Engels equation (0.003349 m) it is observed that they do not vary significantly, in such a way that the grid will have a total length of 0.10875 m.

- Derivation chamber design

In order that the person in charge of the maintenance of the structure can enter and maneuver comfortably, dimensions of 1.0 m wide and 1.0 m long are recommended in the upper base. To facilitate the entry, it must also be provided with a 0.6 m x 0.6 m stainless steel metal gate and inch cat's claw ladders, spaced 0.35 m apart.

For the outlet of the water to the intake-desander conduction, a pipe is designed that works as a submerged orifice, whose design flow would correspond to twice the maximum daily flow.

$$Q_{\text{design}} = 2 * Q_{\text{MD}} = 0,003 \text{ m}^3/\text{s} = 3,16 \text{ L/s}$$

Using the submerged orifice equation for the design flow, a 2-inch diameter pipe and a contraction coefficient of 0.61, see Equation No. 7.6.

$$Q = Cd \cdot A \cdot \sqrt{2g \cdot H}$$

Equation No. 7.6 Submerged orifice equation for design flow

Source: Information of PIO S.A.S, 2015

Where:

- Q: design flow (m³/s)
- Cd: contraction coefficient
- A: pipe area (m²)
- H: Pipeline depth (m)

By clearing the depth at which the pipeline should be located, you get:

$$H = \left(\frac{0,003 \text{ m}^3/\text{s}}{0,61 \cdot \left(\frac{\pi \cdot 0,00202 \text{ m}^2}{4} \right)} \right)^2 \cdot \frac{1}{2 \cdot (9,81 \text{ m}/\text{s}^2)} = 0,334 \text{ m}$$

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page24 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

- Adduction

For the design of the adduction, the QMH (1,457 L / s) is taken as the design base flow. It is considered that the desander to be projected is 2 meters away from the intake.

Table 7-8 shows the pre-dimensioning of the adduction.

Table No. 7.8 Pre-dimensioning of the adduction

| Component | Estimated value | Unit |
|---|-----------------|-------------------|
| Slope between intake and sand trap | 1,5 | % |
| Distance | 2 | m |
| Value of "n" for PVC pipe | 0,010 | - |
| Required diameter for Adduction | 2,32=3 | Inch |
| Full pipe flow | 0,004 | m ³ /s |
| Full flow speed | 0,874 | m/s |
| Design Flow / Full Flow | 0,898 | - |
| Vreal relationship | 0,476 | m ³ /s |
| Yreal relationship | 0,019 | m/s |
| Energy check at the desander's point of arrival | 0,036 | m |
| The maximum excess flow expected on arrival at the sand trap is | 1,980 | L/s |

Source: PIO S.A.S, 2015

- Sand trap

A desanding structure is projected to remove the sediments or sands of a certain size that the Leon River capture allows to pass and that could hinder the proper functioning of the projected treatment processes, drastically reducing their efficiency or the same obstruction of the conduction pipelines.

This structure is calculated with the flow rate required for purification plus the projected flow for the fire system and what is determined as flow for other operations, ie, (1,457 L / s). Table No. 7.9 details the predimensioning of the desander.

Table No. 7.9 Predimensioning of the desander

| Component | Estimated value | Unit |
|---------------------------------|-----------------|------------|
| Particle removal | 0,005 | Cm |
| Removal percentage | 80 | % |
| Temperature | 28 | C |
| Kinematic viscosity | 0,00839 | -- |
| Hazen number for% removal of 80 | 4 | Theta/time |

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page25 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| Component | Estimated value | Unit |
|----------------------------------|-----------------|-------------------------------------|
| Density of the estimated sand | 2,65 | g/cm ³ |
| Useful depth | 1,20 | m |
| Maximum sludge depth | 0,20 | m |
| Free edge settler | 0,30 | m |
| Sedimentation Speed (Vs) | 0,268 | cm/s |
| Sedimentation time (ts) | 448 | s |
| Hydraulic Retention Period (Tr) | 0,50 | h |
| Tank volume (Vt) | 3,60 | m ³ |
| Surface area (As) | 3,00 | m ² |
| Tank Dimensions, Length | 1,00 | m |
| Tank dimensions, Width | 3,00 | m |
| Tank´s Surface Hydraulic Load(q) | 57,88 | m ³ /m ² .day |
| Theoretical speed (Vo) | 0,000670 | cm/s |
| Diameter of particles removed | 0,001 | cm |
| Horizontal Speed (Vh) | 0,206 | cm/s |
| Drag Speed (Varr) | 9,29 | cm/s |

Source: PIO S.A.S.

- Pumping

A pumping structure is projected to transport the raw decanted water to the storage tank for the potable Water Treatment Plant.

It is justified to carry out the treatment of potable water to later dispose a part in the fire system, because the storage of untreated water and with color, odor and microbiological properties of a water decanted from this surface source can affect the properties of the fire protection system.

Although there is no clear regulation regarding the required quality of the water to be used in said system, there is an international regulation that exhorts to pre-treat this water to prevent transmission of *legionella*.¹⁷.

Table No. 7.10 details the pre-dimensioning of the pumping. It is necessary to indicate that two emergency pumps with the same characteristics must be available.

Table No. 7.10 Predimensioning of pumping

¹⁷ MARÍN, Rafael. Physicochemistry and microbiology of aquatic media. Water quality treatment and control. Díaz de Santos Colombia, Madrid 2003.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page26 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| Component | Estimated value | Unit | |
|----------------------------------|-----------------|------------------------|----------------|
| Suction Diameter | | | |
| Flow | 0.001457 | m ³ /s | |
| Pumping flow rate | 0.000911 | m ³ /s | |
| Partition of the pumps | 100% | Each one | |
| Flow per pump | 0.000911 | m ³ /s | |
| Design speed | 1 | m/s | |
| Pipe diameter | 1,34 | inches | |
| Commercial diameter | 2 | inches | |
| Speed check | 0,46 | m/s | |
| Impulsion Diameter | | | |
| Flow | 0,001457 | m³/s | |
| Pumping hours | 24 | horas | |
| Pumping flow rate | 0,000911 | m ³ /s | |
| Partition of the pumps | 100% | Each one | |
| Flow per pump | 0,001255 | m ³ /s | |
| K factor for pumping 24 h | 0,90 | - | |
| Economic diameter | 1,07 | inches | |
| Commercial diameter | 2 | inches | |
| Speed check | 0,46 | m/s | |
| Data for the system curve | | | |
| Suction | | | |
| Pipe length | 1 | m | |
| ΣK (Accessories) | 1,9 | - | |
| accessories | Quantity | K | K Total |
| Foot valve | 1 | 1,75 | 1,75 |
| Eccentric reduction | 1 | 0,15 | 0,15 |
| Impulsion | | | |
| Pipe length | 2 | m | |
| ΣK (Accessories) | 37,75 | - | |
| accessories | Quantity | K | K Total |
| 90 ° long elbow | 19 | 0,75 | 14,25 |
| Measurer | 1 | 1 | 1 |
| Meter accessories | - | - | 22,5 |
| Pumping flow | 0,000910625 | m ³ /s | |
| Losses in Pumping | 0.339 | m | |
| Pumping height | 5.899 | m | |
| Pumping Static height of | 5.5 | m | |

Source: PIO S.A.S, 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page27 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

- Storage

A storage tank is pre-dimensioned according to the criteria expressed by RAS 2000¹⁸ in its titles B.8.4.2 and B.9.4.4, detailed in Table No. 7.11.

Table No. 7.11 Minimum pre-dimensioning of the storage tank for potable water treatment

| Component | Estimated value | Unit |
|-------------------|-----------------|----------------|
| Considerable flow | 1,647 | L/s |
| Volume | 52,07 | m ³ |
| Height | 2,20 | m |
| Superficial area | 23,67 | m ² |
| Length, Width | 4,90 | m |
| Free edge | 0,30 | m |
| Walls Height | 2,50 | m |

Source: PIO S.A.S., 2015

The storage tank dimensioned for the fire-fighting system, must have a minimum volume of 85200 L, so adding the volume of 52.07 m³ and 85.2 m³, 137.27 m³ are obtained, in order to supply all the projected demand and with a safety factor for the washing of containers, with the criterion of the use of 3 pressure washers for the washing of 200 containers a day, spending an average of 7.5 L / min, for 5 minutes of washing; it is necessary to adjust the storage tank dimensioning as expressed in Table No. 7.12.

Under these conditions a water storage tank of 300 m³ is obtained.

Table No. 7.12 Predimensioning the water storage tank

| Component | Estimated value | Unit |
|---|-----------------|----------------|
| Volume for use as potable Water | 52,07 | m ³ |
| Volume for fire system use | 85,2 | m ³ |
| Estimated volume for washing operations | 7,5 | m ³ |
| Total estimated volumes | 144,77 | m ³ |
| Security factor (2) | 289,54 | m ³ |
| Total net volume for constructive ease | 300 | m ³ |

Source: PIO S.A.S.

¹⁸ TECHNICAL REGULATION OF THE DRINKING WATER AND BASIC SANITATION SECTOR - RAS 2000. Título B. Sistemas de Acueucto. Bogotá D.C., 2000. 206 p.

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page28 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

- Hydro pneumatic system

The necessary pressure of the hydro pneumatic system is pre-dimensioned to provide drinking water for the onshore installations. A pipe diameter for potable water pipeline of 4 inches is estimated, and a piezo metric level required for the system of minimum 27.1 m.c.a, with a planned pipe length of 2,456 m, as detailed in Table No. 7.13

Table No. 7.13 Predimensioning for hydro pneumatic system

| Numero de grifos acumulado | Factor de simultaneidad de grifos uso residencial | CAUDAL | | DIAMETRO TUBERIA | | VEL. | PERDIDAS | ACCESORIOS | | | | Long. Tuberia | Perdida t. Recto | Perdida total | COTA PIEZOMETRICA |
|----------------------------|---|--------|----------|------------------|------|-------------|---|-------------|------|-----------------|--------------------------|---------------|------------------|---------------|-----------------------------|
| | | MAXIMO | PROBABLE | NOM | REAL | V = Q/ A | UNITARIAS | TIPO | NUM. | Valor K parcial | Perdida accesorios | Lh + Lv | J x L | ht + hm | COTA PIEZOMETRICA REQUERIDA |
| 100 | 0,10 | 3,27 | 4 | 0,1016 | 0,40 | 0,001705756 | J (m/m) = (Q/(0,2785CD ² 2,83)) ^{1/5,4} | DESCRIPCION | N | Tablas | (K x V ² /2g) | m | mca | mca | mca |
| | | | | | | | | CODO 90 | 22 | 0,9 | 0,17 | 2705 | 4,61 | 4,78 | 27,1 |

Source: PIO S.A.S.

- Dock's Water supply

A system is projected for the supply that consists of 4 water exits in the dock, with its hydro pneumatic equipment that allows the arrival of drinking water from the onshore facilities; It will be composed of:

- Splice with 100 mm PVC pipe to 3 "impulsion pipe.
- 100 mm expansion isolation valve.
- Distribution network composed of 100 mm PVC pipes. With flanged joints according to the norm. These pipes will be hung on the underside of the slab of the dock, with a transport capacity of approximately 8 L / s and a maximum load loss of 10.00 m.c.a.
- Four (4) 65 mm underground water outlets, protected by a cast iron box and attached to the side of the dock slab.
- It also establishes the installation of a potable water tank of 15 m³ for an estimated consumption of 80 people and its provision through the network described.
- Pumping water to the dock for industrial use*
- A pumping system is projected that allows water to be transported from the projected storage to the dock area.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page29 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

h) The suction of the pumping system will be carried out by means of an elastomeric hose that, together with the assembly in HD (ductile iron) of the pumping, will develop a total length of 4.7m in Ø4 "at the exit of the storage. The impulsion will be made in Ø90mm Polyethylene pipe (4100m), carbon steel in Ø3 "(28.8m) for the pumping assembly obtaining a total length of approximately 4133.5m, until reaching the dock area. A pumping flow rate of 4 L / s is estimated

i) e presents the pre-dimensioning of the pumping below.

- Checks

Input data, Table No. 7.14 details the input data of the pumping system.

Table No. 7.14 Input data of the pumping system towards the Dock

| Data | Value and Unity |
|---|-----------------------|
| * Flow to be pumped; QMD = | 4.00 L/s |
| * Daily pumping time; t = | 12.0 hours |
| * Average water temperature; T ⁰ = | 26 °C |
| * Acceleration of gravity; g = | 9.81 m/s ² |

Source: PIO S.A.S., 2015.

Equation No. 7.7 presents the check of the suction pipe according to the following equations, see Table No. 7.15:

$$Q_s = [Q_b / N_b]; Q_s = [A_s \times V_s]; A_s = [(p \times \emptyset_s^2) / 4]$$

Equation No. 7.7 Check of suction pipe equation

Source: Information of PIO S.A.S, 2015

Table No. 7.15 Check of the suction pipe of the pumping system towards the Dock

| Data | Value | Unit | Comment |
|--|-------|---|--|
| * Pumps in operation; Nb = | 1 | | |
| * Pumping check flow rate; Qb = | 8.00 | L/s | |
| * Diameter of the suction pipe; Øs = | 4.00 | Inches | Corresponds to the diameter of a pipeline in HD |
| * Area of the suction pipe; As = | 0.008 | m ² | |
| * Speed in the suction pipe; Vs = | 0.99 | m/s | Complies with Literal B.8.5.6.1 of the RAS / 2,000 |
| * Max. Speed. recommended by the RAS / 2,000 | 1.30 | m / s (Value obtained from Table B.8.2, of the RAS / 2,000) | |
| * Minimum recommended speed = | 0.45 | m / s (Value suggested in reference 1) | |

Source: PIO S.A.S., 2015

The projected suction pipe will be 4 inches, through which will pass 8 L / s, which generates a speed of 0.99 m / s.

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CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page30 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Equation No. 7.8 presents the impulse pipe check according to the following equations:

$$Q_s = [Q_b / N_b]; Q_s = [A_s \times V_s]; A_s = [(p \times \varnothing_s^2) / 4]; R = [\varnothing_s / \varnothing_i] > 1$$

Equation No. 7.8 Check of impulse pipe equation
Source: Information of PIO S.A.S, 2015

Table No. 7.16 Check of the piping of the pumping system towards the dock.

| Data | Value | Unit | Comments |
|--|-------|----------------|---|
| * Flow to boost; $Q_i =$ | 8.00 | L/s | |
| * Diameter of the impulse pipe; $\varnothing_i =$ | 3.12 | inches | Corresponds to the diameter of a PE pipe (internal 79.2mm) |
| * Area of the suction pipe; $A_s =$ | 0.005 | m ² | |
| * Speed in the impulse pipe; $V_i =$ | 1.62 | m/s | Complies with Literal B.8.5.6.2 of the RAS / 2,000, $1 > V_i > 3m / s$ |
| * Verif. of the relationship between \varnothing_i and \varnothing_s ; $R =$ | 1.28 | | Complies with Literal B.8.5.6.3 del RAS/2.000, $\varnothing_s > \varnothing_i$ |
| * Pumping check flow rate; $Q_b =$ | 8.00 | L/s | |
| * Diameter of the impulse pipe; $\varnothing_s =$ | 3.00 | | inches in Elastomeric |
| * Impulse pipe area; $A_s =$ | 0.005 | m ² | |
| * Speed in the impulse pipe; $V_s =$ | 1.75 | m/s | |
| * Verif. of the relationship between \varnothing_i and \varnothing_s ; $R =$ | 1.33 | | Complies with Literal B.8.5.6.3 of RAS / 2,000, $\varnothing_s > \varnothing_i$ |
| * Flow rate of pumping check; $Q_b =$ | 8.00 | L/s | |
| * Diameter of the impulse pipe; $\varnothing_s =$ | 3.00 | | inches in Carbon Steel, HD |
| * Impulse pipe area; $A_s =$ | 0.005 | m ² | |
| * Impulse pipe Speed; $V_s =$ | 1.75 | m/s | |
| * Verif. of the relationship between \varnothing_i and \varnothing_s ; $R =$ | 1.33 | | Complies with Literal B.8.5.6.3 of RAS / 2,000, $\varnothing_s > \varnothing_i$ |

Source: PIO S.A.S., 2015

Total dynamic height, NPSHd and Power

A total dynamic height of 165.25m is established, Net head of positive suction available; NSPHd of 7.80m, and a required power of 40 HP motor.

The technical support of the designs is presented in Annex 7.4 Hydrosanitary Designs.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page31 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

7.1.4 Average monthly flow of the León River

According to the SENER study¹⁹, the Atrato River is the main tributary of the Urabá Gulf basin, located on the western margin of the Gulf, has a length of 670 km and a drainage basin of approximately 35,700 km². The annual average flow that the Atrato pours into the gulf is approximately 4,500 m³ / s, as shown in Table No. 7.17.

The second river in importance for its flow and navigability is the León River, followed by the Suriquí, and, with less flow, the Turbo, the Cayman, the Bobal, Necoclí, Guadalito and Currulao.

During the less rainy period, the rivers reduce their flow and do not drain easily, due to the presence of berms, and some even find their mouths obstructed, which makes their contribution become null.

Table No. 7.17 Fluvial system of the Gulf of Urabá: flow and area of the river basin

| River | Average flow rate (m ³ / s) | Area of the basin (km ²) |
|--------------|--|--------------------------------------|
| Atrato | 4.750,00 | 35.700 |
| León | 40,00 | 2.250 |
| Suriquí | 20,00 | 71 |
| Turbo | 5,50 | 95 |
| Caimán Viejo | 4,00 | 97 |
| Caimán Nuevo | 3,70 | 85 |
| Bobal | 3,50 | 59 |
| Necoclí | 3,50 | 0 |
| Guadalito | 2,30 | 0 |
| Currulao | 2,10 | 0 |

Source: SENER. Feasibility study of the development of the port system in Urabá. 2007.

The climate determines the volume of precipitations that receive the basins of the rivers that end at the Gulf of Urabá, what influences directly in the flow of the same ones and in the contribution of the terrigenous material that decant in the Gulf of Urabá and in Bahía Colombia.

The León River has a basin of approximately 2,250 km² and runs from its source, in the south-western foothills of the Abibe mountain range, north of the municipality of Mutatá, to its mouth at 83 km in Bahía Colombia, receiving the contributions of the

¹⁹ SENER. Estudio de viabilidad del desarrollo del sistema portuario en Urabá. 2007.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page32 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Carepa , Apartadó, Chigorodó, Zungo, Vijagual and Grande rivers, being characterized almost all these affluents for presenting a very similar altitudinal segmentation, manifesting in their headwaters as mountain currents with torrential regimes and potential instability of their canyons, until crossing terraced areas and hills, developing narrow alluvial valleys in the piedmont of the mountains, until reaching the alluvial plain of León, where they blur in many arms, forming a very complex network²⁰.

Its main channel appears as an arch that curves on the alluvial plane where it is blurred in networks of very complex channels, propitious for hydrophilic formations that run largely through the Turbo territory on the floodplain units and coastal marine complex.²¹.

The distribution of flows of the Leon River with its tributaries is bimodal, registering during the rainiest months of September and October, episodes of overflow with average flow values of more than 100 m³ / s, which exceeds by several days the capacity of the cross sections that, in the alluvial section of the Barranquillita station, is between 180 and 200 m³ / s.

During the less rainy period corresponding to the months of January to March, the flows are lower than 30 m³ / s with a monthly minimum in March of 16 m³ / s (see Figure No. 7.4)²².

The yields during the first months of the year are of the order of 20 l / s / km², compared to values higher than 120 l / s / km² in the wettest period, due to the fact that during this last period a hydrological continuity is established in the wetlands systems of Bajo Atrato and León, thus increasing surface runoff in the basin²³.

The annual average flow in the Villarteaga River (upper part of the León River) is 18 m³ / s, while in Barranquillita it is 70.8 m³ / s, which implies an average water yield for the basin that varies from 135 to 93 l / s / km², values that are considered high (see Figure No. 7.4 and Figure No. 7.5)²⁴.

²⁰ COLOMBIA. MUNICIPALITY OF TURBO. Land Management Plan: physical-environmental diagnosis. Turbo, 2000. Book 1. Part 1. Page 31.

²¹ *Ibid.* Book 1, Comp. 2 (Biotic). Page 21.

²² *Ibid.*

²³ *Ibid.*

²⁴ *Ibid.*

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page33 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

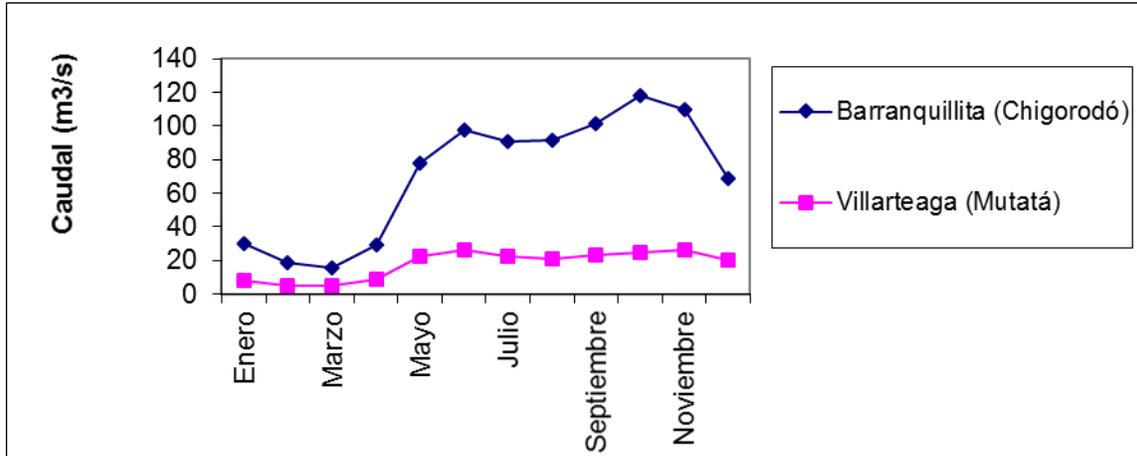


Figure No. 7.4 Average monthly flows of the León River at the Barranquillita and Villarteaga stations
Source: POT Turbo, 2000²⁵.

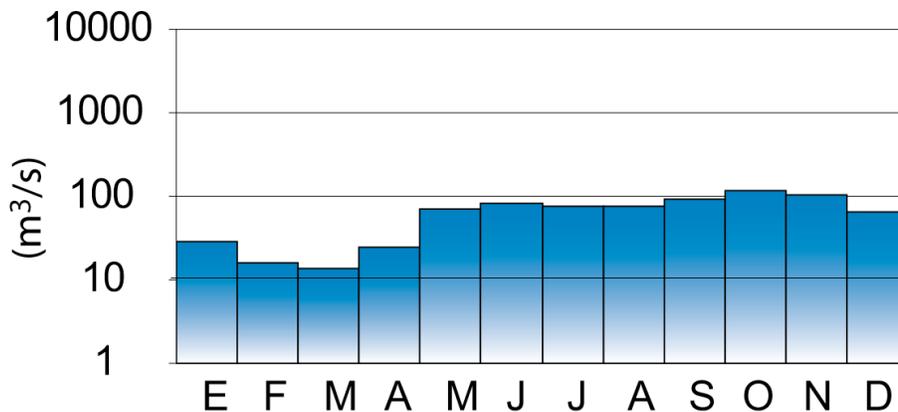


Figure No. 7.5 Average monthly flow of the León River at the Barranquillita station (statistics 1989-1993)
Source: Atlas of the Gulf of Urabá ²⁶

²⁵ COLOMBIA. MUNICIPALITY OF TURBO. Territorial Planning Plan, 2000. Op Cit.

²⁶ INSTITUTE OF MARINE AND COASTAL INVESTIGATIONS JOSÉ BENITO DE ANDREÍS (INVEMAR) and GOVERNMENT OF ANTIOQUIA. Atlas of the Gulf of Urabá: a look at the Caribbean of Antioquia and Chocó. Series of special publications No. 12. Santa Marta: 2007. 180 pages. ISBN 978-958-98104-3-9.

| | | | |
|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page34 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

7.2 Underground waters

For the construction of the port project of Bahía Colombia de Urabá, the use of groundwater is not required, since the area where the project is located, presents a sufficient water supply, therefore the demand for water will be requested from a surface source.

7.3 Spillways

7.3.1 Spillway flow

Currently the project has authorized a spillway flow of 3 L / s over the Nueva Colonia canal, which was granted through Resolution No. 0032 of 2012²⁷ for domestic wastewater and water from washing facilities, which they will pour into the canal after being treated in the wastewater treatment plant – PTAR.

7.3.2 Identification of the receiving source

The spillway authorized by means of Resolution No. 0032 of 2012²⁸, for wastewater, will have as a source the Nueva Colonia canal, before the confluence with the León River; the location is presented in Table No. 7.18.

Table No. 7.18 Coordinates of location of the spillway granted by Resolution No. 0032 of 2012

| Description | Name of the source | Gauss - Kruger flat coordinates | |
|-----------------------|---------------------|---------------------------------|------------|
| | | North | East |
| Dumping of wastewater | Nueva Colonia Canal | 1.368.469,05 | 706.833,96 |

Source: Resolution No. 0032 of 2012²⁹

In the current Modification of the Environmental License, the relocation of the aforementioned waste is requested, which will be located in the flat coordinates

²⁷ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.

²⁸ Ibid.

²⁹ Ibid. .

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|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page35 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

(Magna Sirgas, origin Bogotá) presented in Table No. 7.19, within the site where the project's onshore construction is planned.

This location point is requested as a minor change in relation to that granted by Resolution No. 0032 of 2012, which is located approximately 238 meters from the granted, without this causing additional impacts and / or affecting neighboring communities. See Figure No. 7.1.

The adjustment in the coordinate is mainly due to an error in the origin of the coordinates initially granted, as well as the location of this pouring point in the middle of the channel, which will be actually made on the right margin of the same.

Table No. 7.19 Adjustment of the location coordinates of the spillway requested in the current Modification of Environmental License

| Description | Name of the source | Flat coordinates Magna Sirgas Origin Bogotá | |
|-----------------------|---------------------|---|------------|
| | | North | East |
| Dumping of wastewater | Nueva Colonia Canal | 1.368.533,07 | 706.604,83 |

Source: Aqua & Terra Consultores Asociados., S.A.S, 2015

7.3.3 Domestic wastewater

- Onshore facilities

A sewage network is projected, coded in Figure No. 7.6 with red color, which must be connected by link-ups to the buildings that generate wastewater thanks to its processes, such as sanitary points, washing, cleaning and basic sanitation.

For this reason, the sewage network for wastewater was not projected towards facilities such as storage compartments, as detailed in Figure No. 7.6.

The proposed location of the sewerage chambers in this conceptual engineering phase may be subject to minor modifications due to the lengths of the established networks.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page36 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |



Figure No. 7.6 Location of infrastructure for wastewater in onshore facilities

Source: PIO S.A.S.

Table No. 7.20 Identification of the location points of the infrastructure for wastewater of Figure No. 7.6

| Identification, ID in red | Infrastructure |
|---------------------------|--------------------|
| 1 | PTAR |
| 2 | Drying Beds |
| 3 | Effluent pumping |
| 4 | Effluent discharge |

Source: PIO S.A.S.

The sewage network must be exclusively for liquid waste of domestic origin.

A Wastewater Treatment Plant (WWTP) is projected, coded with the number 1 in red color in Figure No. 7.6, with a capacity to treat 2.56 L / s,

It is important that a grease trap be implemented to prevent the soaps of some maintenance washings for the operations of the port system, affect the other units of biological treatment, a treatment of primary level (sedimentation or physical) and secondary (aeration) to achieve the established goals of effluent quality.

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|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page37 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

It is necessary to have drying beds, coded with number 2, red color, in Figure No. 7.6, in order to properly dispose the waste generated by the treatment processes of the PTAR. It is worth mentioning that the final designs of the wastewater treatment plant will be submitted to the competent authority 90 days before the start of the construction phase of the port project.

Likewise, due to the flood protection required for the onshore Terminal in the area located on the margin of the Canal, it is necessary to design a pumping station for the effluent of the PTAR, coded with the number 3 in red color in Figure No. 7.6, so that said flow reaches the discharge head coded with number 4, and thus be able to perform the respective dumping at the authorized coordinates.

Figure 7.7 shows the behavior of the domestic wastewater networks projected on land, with green arrows for the flow direction to the PTAR.

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|  | <p align="center">MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO</p> |  aqua & terra |
| | <p align="center">ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | Page38 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

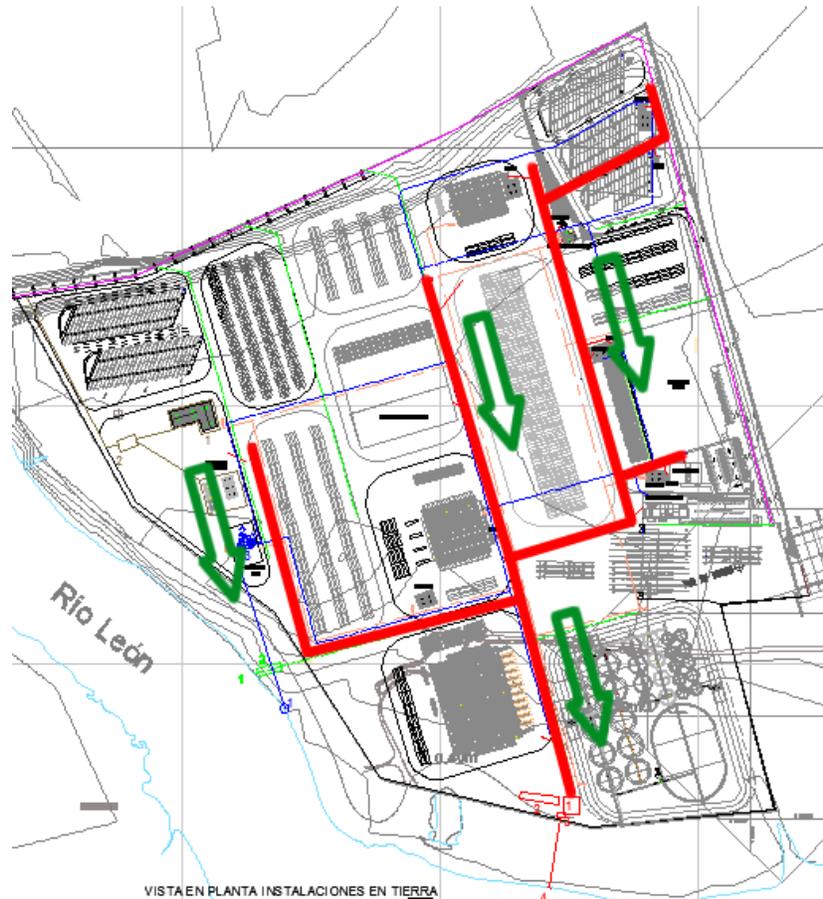


Figure No. 7.7 Behavior of domestic wastewater networks projected on land, with green arrows for the direction of flow

Source: PIO S.A.S., 2015

- Dock

It is planned to have sanitary batteries for basic sanitation needs at the dock. Said units will be mobile containers as sanitary rooms that operate independently of service networks, that is, said domestic wastewater will be stored in the portable sanitary units and a third party service will be responsible for carrying out the maintenance corresponding to their sanitation, removing the excreta in them confined.

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page39 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

This volume of wastewater is not considered for transport or treatment in the projected PTAR. This infrastructure is coded with the number 5 in red color in the following figure.

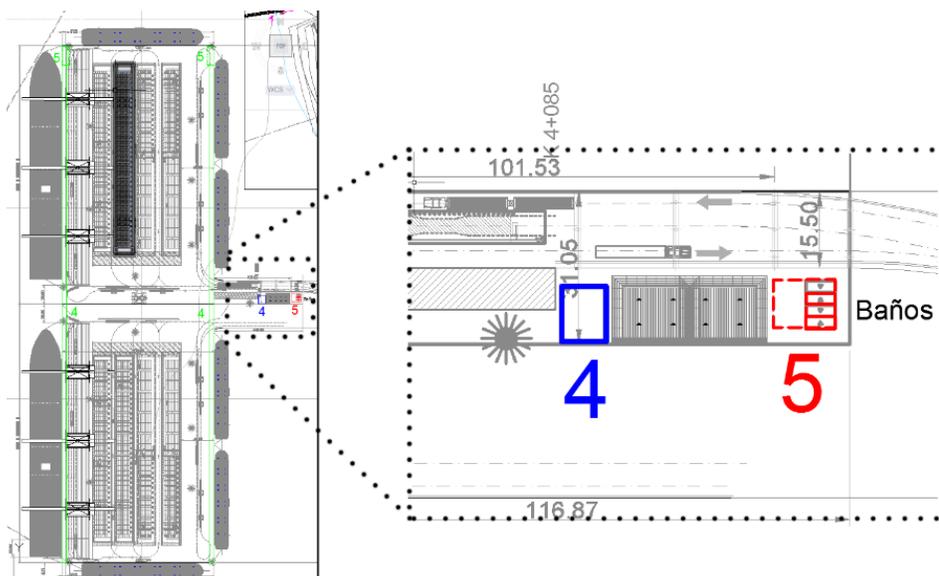


Figure No. 7.8 Location of infrastructure for use and residual water in the dock
Source: PIO S.A.S., 2015

Table No. 7.21 Identification of the location points of the infrastructure for wastewater of Figure No. 7.8

| Identification, ID in red color - waste water, blue color - drinking water | Infrastructure |
|--|--|
| 4 | Potable water storage tank |
| 5 | Container in metallic structure with enclosure of panels for sanitary uses |

Source: PIO S.A.S., 2015

For waste originating from oils (oleaginous) and other waste, a perimeter grid is projected for the projected building of a mechanical workshop, coded with the number 1 in brown color as shown in Figure No. 7.9, to ensure that oil residues be captured by it and avoid mixing with generated runoff.

This network of oily water surrounds the facilities where this feature is projected, such as the maintenance workshops.

The implementation of a Skimmer and / or Hydrocyclone is projected, with the purpose of executing an effective separation of grease and oils from the liquid waste,

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|  | <p align="center">MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p align="center">ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p align="center">Page40 of 86</p> |
| | <p align="center">GAT-391-15-CA-AM-PIO-01</p> | <p>Review: B</p> |

codified in Figure No. 7.9 with the number 2 in brown color, in order to transport said effluent to a storage tank, which allows its extraction by a third party certified in the treatment of this type of waste, thus avoiding dumping to the ground or into bodies of water.

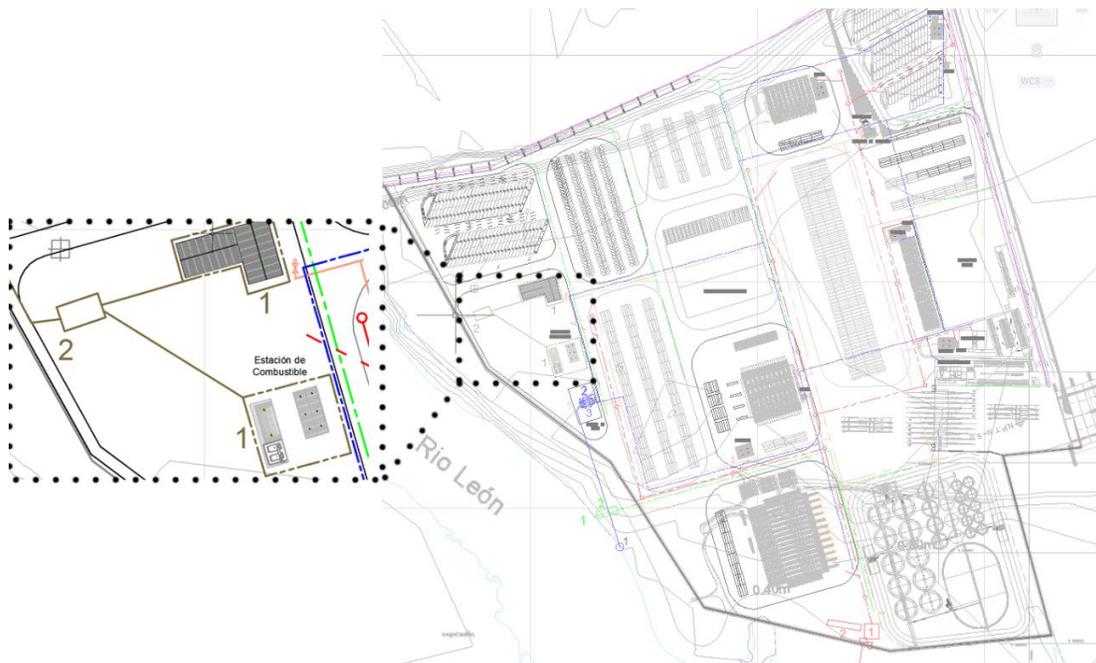


Figure No. 7.9 Location of infrastructure for oleaginous liquid waste

Source: PIO S.A.S.

7.4 Occupations of riverbeds

No permit is required for riverbed occupation for the current Environmental License Modification of the project, since the works contemplated for the operation and construction of the same, such as the suspension bridge that crosses the León River for the support of the viaduct or the jetty (fluvial dock) in the onshore terminal located at the north end of the right margin of the Nueva Colonia Canal, were already

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page41 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

authorized by Resolution No. 0032 of 2012³⁰; On the other hand, said works were designed so that during its construction and operation, interventions are not carried out in the León River's riverbed.

7.5 Forest exploitation

The construction of the necessary works for the development of the Puerto Bahía Colombia Project of Urabá, requires the forest exploitation of the arboreal individuals located in the area of direct affectation of the project; which is formed by a corridor of 2474.7 m long and 60 m wide, for an area of 148,484 m² that runs from the district of Nueva Colonia, to the site where the port's onshore terminal will be built.

The property (350,079 m²) plus the withdrawal strip of the León rivers and the Nueva Colonia canal (63,358.58 m²) have an area of 413,437.68 m²; and a strip of 437.6 m long and 20 m wide (9,832.7 m²), which is within the Protective Forest Reserve of the León and Suriquí River wetlands declared by agreement No 100-02-02-01-0010-2011 by CORPOURABÁ³¹ and which comprises the mangrove vegetation of this area, as shown in Table No. 7.22 and Figure No. 7.10.

This last strip was taken from the Protective Forest Reserve through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ³², with the purpose of constructing the viaduct that will lead from the onshore terminal to the dock.

Table No. 7.22 Forest exploitation areas

| Area to be used | Ecosystem | Name | Volume of wood (m ³) | Area (m ²) | Area (ha) |
|-----------------|--|------------------------|----------------------------------|------------------------|-----------|
| Continental | Wet tropical Zonobioma of the Magdalena-Caribe | Property | 391.53 | 413437.68 | 41,34 |
| Continental | Wet tropical Zonobioma of the Magdalena-Caribe | Terrestrial vegetation | 378.97 | 148484.77 | 14,85 |

³⁰ COLOMBIA. AUTO, RIDAD NACIONAL DE LICENCIAS AMBIENTALES - ANLA. Resolution 0032 (January 25, 2012). Op Cit.

³¹ CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0010-2011 (June 16, 2011). By means of which the category of protected area of the Protective Forest Reserve of the Wetlands is certified between the rivers León and Suriquí in the municipality of Turbo, created in the agreement of the directive council No 100-02-02-01-011-2009 with the category of protected area Regional Natural Park (Decree 2372 of 2010). Apartadó, 7 p.

³² CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the León and Suriquí rivers is partially and temporarily subtracted and a season is partially lifted. Apartadó, 6 p.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page42 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

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|-----------------------------------|---------------------|---|-------|-----------|-------|
| Coastal | Caribbean Halobioma | Mangrove vegetation within the Forest Reserve of the León and Suriquí river wetlands | 36.46 | 5384.42 | 0,54 |
| Coastal | Caribbean Halobioma | Secondary vegetation within the Forest Reserve of the León and Suriquí river wetlands | 18.14 | 4448,32 | 0,44 |
| Total area of forest exploitation | | | | 571755,18 | 57,17 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

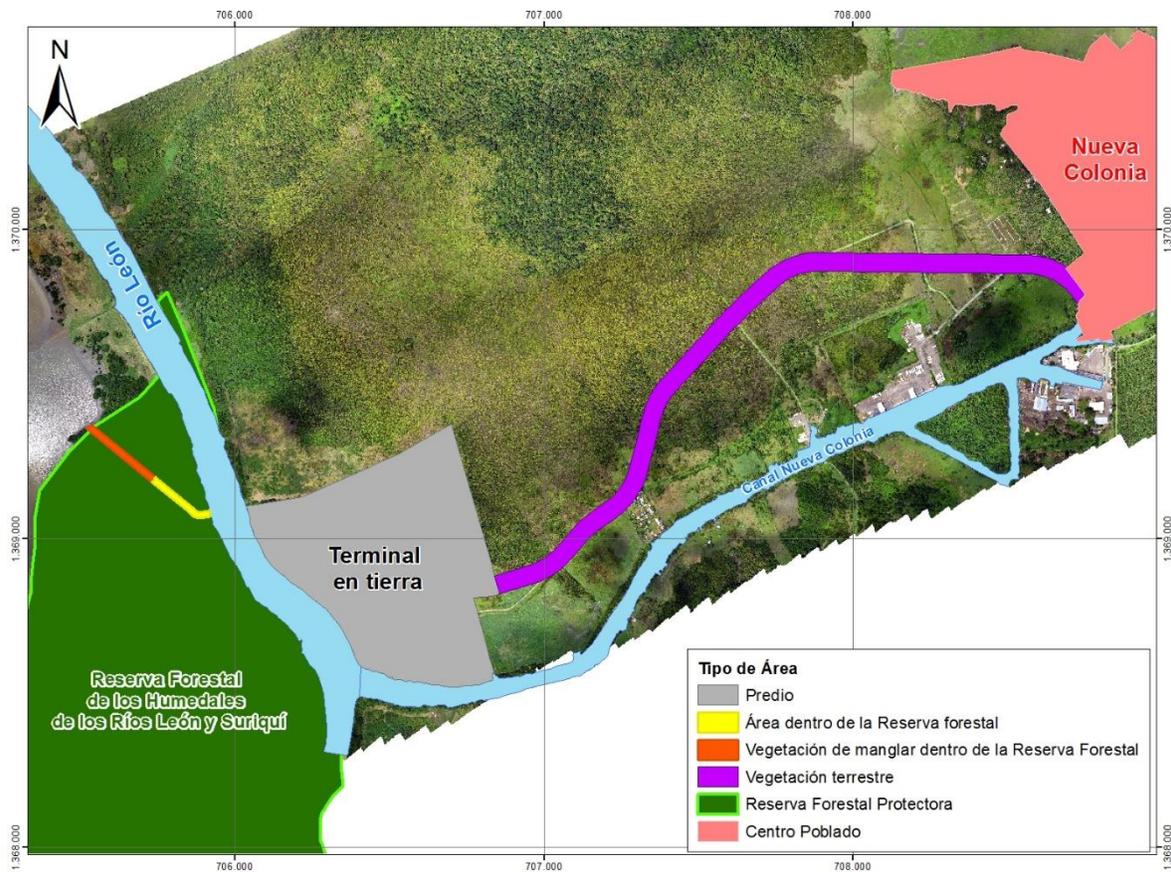


Figure No. 7.10 Area of direct impact of the project where the forest exploitation will be made

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page43 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

7.5.1 Structural analysis for the project's area of direct impact

The floristic characterization of the species identified in the field within the project's intervention area was carried out (Photograph No. 7.1), where the spatial distribution of the species was determined, allowing to know the degree to which they are grouped or dispersed and the amount of existing individuals per unit of land cover interpreted for the project's area of influence, scale 1: 10,000 (Annex 7.5 Forest inventory at 100%).



Photograph No. 7.1 Overview of the project's area of influence

Source: Taken by Puerto Bahía Colombia de Urabá S.A, 2009

The volume under which forest exploitation was estimated for the construction of Puerto Bahía Colombia in Urabá was made taking into account the entire area of influence of the project; however, considering that the land where the land terminal will be built borders the riverbank of the León River and the artificial canal of Nueva

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page44 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Colonia, a retirement area defined by Decree 1076 of 2015³³ must be respected, which corresponds to a strip of 30 meters, conserving the riparian forest of this area. However, the only area that will be intervened and that has been included in the forest habitat, is the one associated to the fluvial pier, which will be located on the right margin of the north end of the artificial canal of Nueva Colonia, this was approved in resolution number 0032 of 2012³⁴, by which the environmental license of the Project was obtained.

Within the areas to be used is a strip of 437.6 m long and 20 m wide (9,832.7 m²), composed of dense high floodplain mangrove cover and high secondary vegetation of the mangrove, which are within the Protective Forest Reserve of the León and Suriquí river wetlands declared by means of the agreement No 100-02-02-01-0010-2011 by CORPOURABÁ³⁵, this strip was subtracted through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ³⁶. The forest species that characterize these mangrove coverings are *Avicennia germinans* (Black mangrove), *Rhizophora mangle* (Red mangrove) and *Laguncularia racemosa* (White mangrove); these species are protected by a closure resolution number 076395 B of August 4, 1995 issued by CORPOURABÁ³⁷ and which was lifted by means of agreement No 100-02-02-01-0004-2011 by CORPOURABÁ³⁸.

Table No. 7.23 shows the commercial volume of wood to be harvested for each type of coverage, during each activity to be carried out in the construction and operation of the project. There it is observed that the coverage with the highest volume of wood

³³ COLOMBIA. MINISTERIO DE AMBIENTE Y DESARROLLO SOSTENIBLE. Decree 1076 (May 26, 2015). By means of which the single regulatory decree of the environmental sector and sustainable development is issued. Bogotá D.C.: El Ministerio, 2015. 654 p.

³⁴ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES - ANLA. Resolution 0032 (January 25, 2012). By means of which an environmental license is granted. Bogotá D.C. : 135 p.

³⁵ CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No. 100-02-02-01-0010-2011., Op cit. 7 p.

³⁶ CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p.

³⁷ COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B (August 4, 2014). By means of which the amounts of the rates for the use of public and private forests are fixed. Section, 2014. 5 p.

³⁸ CORPORATION FOR THE SUSTAINABLE DEVELOPMENT OF URABÁ - CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the rivers León and Suriquí is partially and temporarily subtracted and closure is partially lifted. Apartadó, 6 p.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page45 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

to be extracted, is the gallery and / or riparian forest with 301.86 m³, because this coverage is within the premises where the onshore terminal will be built.

Table No. 7.23 Commercial volume of wood that will be exploited in each of the land coverages by activity developed in the project

| COVERAGE | Symbol | ACTIVITIES | | | Total Commercial volume (m ³) |
|--|--------|---|--|--|---|
| | | Viaduct and Dock | Onshore terminal | Via | |
| | | Transport, manufacture and driving of the piles | Dismantling, cleaning, stripping and filling of the land | Dismantling, cleaning, stripping of the land | |
| Discontinuous urban fabric | 112 | | | 7,83 | 7,83 |
| Banana and plantain | 2213 | | | 6,3 | 6,3 |
| Clean pastures | 231 | 0,77 | 92,17 | 75,82 | 168,76 |
| Woodland pastures | 232 | | | 21,2 | 21,2 |
| Dense high mangrove | 311122 | 31,47 | | | 31,47 |
| Palmares | 311123 | | 1,86 | 45,67 | 47,53 |
| Gallery and / or riparian forest | 314 | 26,3 | 275,56 | | 301,86 |
| Broadleaf planting | 3152 | | | 2,01 | 2,01 |
| Dense flooded herbage- not wooded | 321121 | | 12,21 | 227,23 | 239,44 |
| Arracachal | 321123 | | 0,18 | | 0,18 |
| High secondary vegetation | 3231 | 4,99 | | | 4,99 |
| Total Commercial volume (m³) | | | | | 831,57 |

Source Aqua & Terra Consultores Asociados S.A.S., 2015

Table No. 7.24 shows the number of trees that were found by type of coverage within the project's area of direct impact. There it is observed that the coverage with the greatest number of individuals corresponds to the gallery and / or riparian forest, where the most abundant species are sweet Pithecellobium (Chiminango) with 210 individuals and Apuleia leiocarpa (Combita) with 43 individuals, followed by coverage of clean pastures, where 287 trees were identified, being the species

| | | | | | | | |
|---|--|--|--|--|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO | | | | |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | | | | | Page46 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | | | | | Review: | B |

sweet *Pithecellobium* (Chiminango) with 135 individuals and *Apuleia leiocarpa* (Combita) with 29 individuals, the most abundant species in this coverage.

Table No. 7.24 Affected area and number of trees exploited by type of coverage within the area of direct impact of the project

| Land coverages | | | | | | | Area (m ²) | No of trees |
|--------------------------------|---|------------------------------------|---------------------------|-------------------------|------------------------------------|------------|------------------------|-------------|
| Corine Land Cover Methodology | | | | | | | | |
| Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Symbol | | |
| Artificialized Territories | Urbanized areas | Discontinuous urban fabric | | | | 112 | 5.281,6 | 31 |
| Agricultural Territories | Permanent crops | Herbaceous permanent crops | Banana and plantain | | | 2213 | 2.778,9 | 16 |
| | | Pastures | Clean Pastures | | | 231 | 374.753,7 | 287 |
| | Woodland pastures | | | | 232 | 5.319,0 | 24 | |
| Forests and Semi natural Areas | Forests | Dense forest | High dense forest | Dense high flood forest | Dense high mangrove | 311122 | 1819,1157 | 167 |
| | | | | | Palmares | 311123 | 7.583,0 | 19 |
| | | Gallery and / or riparian forest | | | | 314 | 56.778,4 | 365 |
| | | Forest plantation | Broadleaf planting | | | 3152 | 212,3 | 3 |
| | Areas with herbaceous and / or shrubby vegetation | Pastures | Dense grassland | Dense flooded pastures | Dense flooded herbage - not wooded | 321121 | 108.020,9 | 209 |
| | | | | | | Arracachal | 321123 | 5.710,7 |
| | | Secondary or transition vegetation | High secondary vegetation | | | 3231 | 3.497,6 | 32 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Figure No. 7.11 shows the flora sampling points map by type of coverage within the project's area of direct impact.

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|  | <p align="center">MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p align="center">ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 47 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review: B</p> |

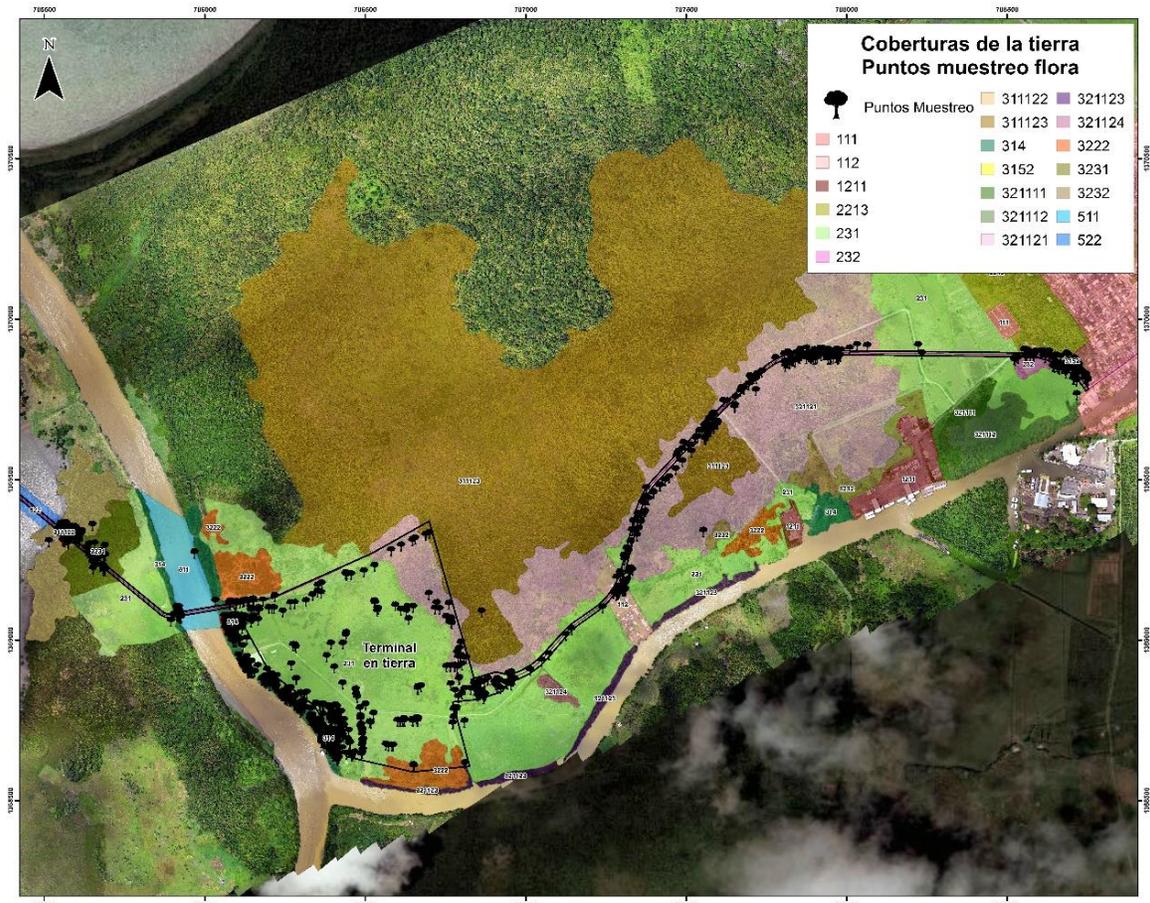


Figure No. 7.11 Flora sampling points in the project's area of influence
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The registered floristic wealth for the area of direct affection of the project is of 12 orders, 23 families, 38 species in 1154 individuals; of the total families one (6%) belongs to the monocotyledonous class and 25 families (94%) to the Magnoliopsid class.

Table No. 7.25 shows the floristic composition within the project's area of influence.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page48 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Table No. 7.25 Floristic composition in the project's area of influence

| Division | Class | Order | Family | Species | Common name |
|-----------------|-------------------|-------------------------------|---------------|------------------------------|----------------------------|
| Angiospermae | Monocotyledonous | Arecales | Arecaceae | <i>Elaeis Oleifera</i> | Coroza |
| | | | | <i>Raphia taedigera</i> | Pangana |
| | | | | <i>Cocos nucifera</i> | Coconut palm |
| Magnoliophyte | Magnoliopsida | Sapindales | Anacardiaceae | <i>Anacardium excelsum</i> | Caracoli |
| | | | | <i>Spondias purpurea</i> | Plum |
| | | | | <i>Spondias mombin</i> | Hobo |
| | | | | <i>Mangifera indica</i> | Mango |
| | | | Sapindaceae | <i>Melicocca bijuga</i> | Mamoncillo |
| | | | Rutaceae | <i>Citrus sp</i> | Orange tree |
| | | | Lamiales | Avicenniaceae | <i>Avicennia germinans</i> |
| | | Lamiaceae | | <i>Gmelina arborea</i> | Melina |
| | | | | <i>Tectona grandis</i> | Teak |
| | | Bignoniaceae | | <i>Tabebuia rosea</i> | Oak |
| | | | | <i>Crescentia Cujete L</i> | Totumillo |
| | | Malvales | Bombacaceae | <i>Ceiba pentandra</i> | Green Bonga |
| | | | | <i>Bombacopsis quinata</i> | Ceiba Tolua |
| | | | | <i>Pachira aquatica</i> | Salt shaker |
| | | | Malvaceae | <i>Ochroma pyramidale</i> | Balso |
| | | | | <i>Sterculia apetala</i> | Camajon |
| | | | | <i>Guazuma ulmifolia</i> | Guacimo |
| | | Rosales | Cecropiaceae | <i>Cecropia telenitida</i> | Yarumo |
| | | | Moraceae | <i>Ficus sp</i> | Lechudo |
| | | | | <i>Ficus glabrata</i> | Higueron |
| | | Myrtales | Combretaceae | <i>Laguncularia racemosa</i> | White mangrove |
| | | | | <i>Terminalia Catappa L</i> | Almond |
| | | | Myrtaceae | <i>Psidium guajava</i> | Guava |
| Melastomataceae | <i>Miconia sp</i> | | Niguito | | |
| Fabales | Fabaceae | <i>Brownea ariza</i> | Ariza | | |
| | | <i>Erythrina indica picta</i> | Sing rooster | | |

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page49 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| Division | Class | Order | Family | Species | Common name |
|----------|-------|---------------|-----------------|-----------------------------|--------------|
| | | | | <i>Pithecellobium dulce</i> | Chiminango |
| | | | | <i>Apuleia leiocarpa</i> | Combita |
| | | | Caesalpiniaceae | <i>Prioria copaifera</i> | Cativo |
| | | | Mimosaceae | <i>Inga codonantha</i> | Guamo |
| | | Laurales | Lauraceae | <i>Beilschmiedi sp</i> | Laurel |
| | | Rhizophorales | Rhizophoraceae | <i>Rhizophora mangle</i> | Red mangrove |
| | | Gentianales | Rubiaceae | <i>Genipa americana</i> | Majagua |
| | | Magnoliales | Annonaceae | <i>Annona muricata</i> | Soursop |
| | | Malpighiales | Dichapetalaceae | <i>Tapura colombiana</i> | Nasedero |

Fuente: Aqua & Terra Consultores Asociados S.A.S., 2015

The most representative families within the project's area of direct involvement are the Fabaceae, Arecaceae, Bombacaceae, Rhizophoraceae, Moraceae, Bignoniaceae, Cecropiaceae and Mimosaceae, as can be seen in:

Figure No. 7.12. The rest of the families have an abundance lower than 2%.

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|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page50 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

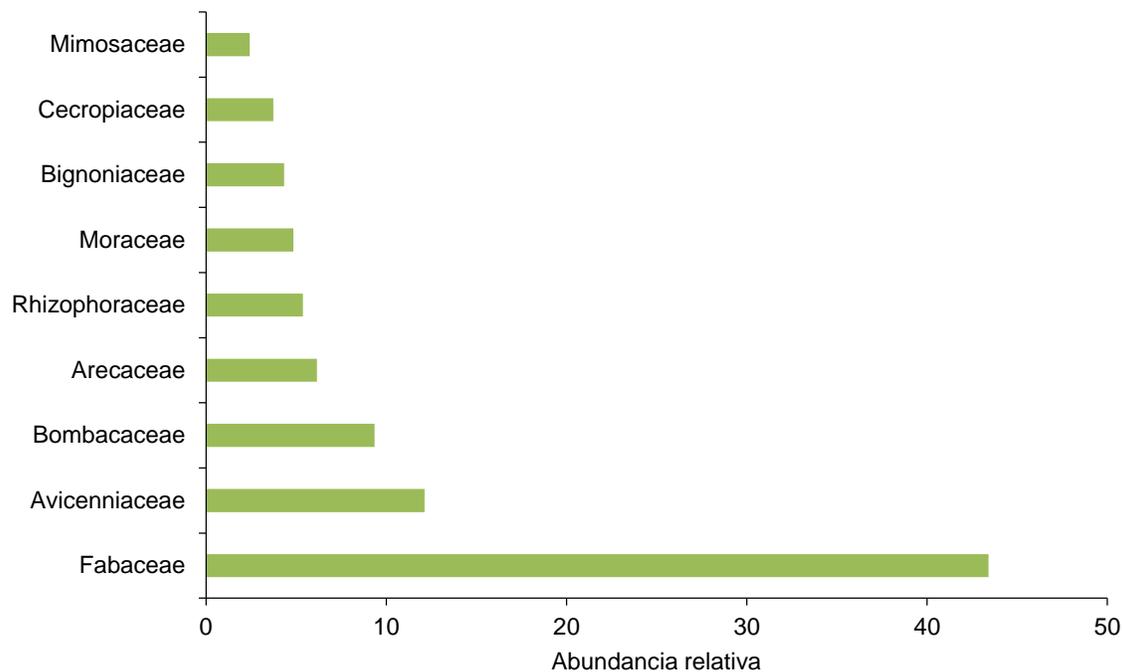


Figure No. 7.12 Relative abundance of the most representative families in the study area
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Next, the structural analysis of the vegetation by unit of coverage present in the area of direct impact of the project is carried out.

- Distribution by diametric and altimetric classes of the different species found

The total structure is the extension of tree species. In tropical forests this phenomenon is reflected in the distribution of individuals by diametric classes. The distribution of the diametric classes for most of the species in tropical forests is that of 'J inverted', that is, the number of trees decreases as the DBH increases (Diameter at Breast Height)³⁹.

³⁹ MELO CRUZ, O. A. Y R. VARGAS RIOS. Ecological and silvicultural assesment of forest ecosystems. University of Tolima, CRQ, Corpocaldas and Cortolima, Ibaguè. 2002. 207 p.
ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT
CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page51 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Table No. 7.26 shows the frequency distribution for the normal diameter variable, which has a decreasing trend, in which approximately the number of individuals of the next class has half of the individuals of the current class

Table No. 7.26 Frequency distribution for the normal diameter variable, for trees in the area directly affected by the project

| Diametric class | class interval | Class mark | Frequency | |
|-----------------|----------------|------------|-----------|-------------|
| | | | Absolute | Accumulated |
| 1 | 9 - 19 cm | 14 | 606 | 606 |
| 2 | 19,1 - 29 cm | 24 | 317 | 923 |
| 3 | 29,1 - 39 cm | 34 | 106 | 1029 |
| 4 | 39,1 - 49 cm | 44 | 60 | 1089 |
| 5 | 49,1 - 59 cm | 54 | 18 | 1107 |
| 6 | 59,1 - 69 cm | 64 | 38 | 1145 |
| 7 | 69,1 - 79 cm | 74 | 4 | 1149 |
| 8 | 79,1 - 89 cm | 84 | 1 | 1150 |
| 9 | 89,1 - 99 cm | 94 | 1 | 1151 |
| 10 | 99,1 - 109 cm | 104 | 2 | 1153 |
| 11 | 109,1 - 120 cm | 114 | 1 | 1154 |
| Total | 1154 | | | |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Figure No. 7.13 shows the diameter distribution tendency, for the trees that are within the project's area of direct impact.

The inverted L or J shape of the histogram is observed, which characterizes forest ecosystems that are heterogeneous or have a tendency to heterogeneity⁴⁰; This is due to the fact that the project's area of direct impact crosses different forest coverings which are characterized by having a floristic composition that identifies each area, such as mangroves, gallery forest and arboreal vegetation associated with floodplains.

⁴⁰ Ibid.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page52 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

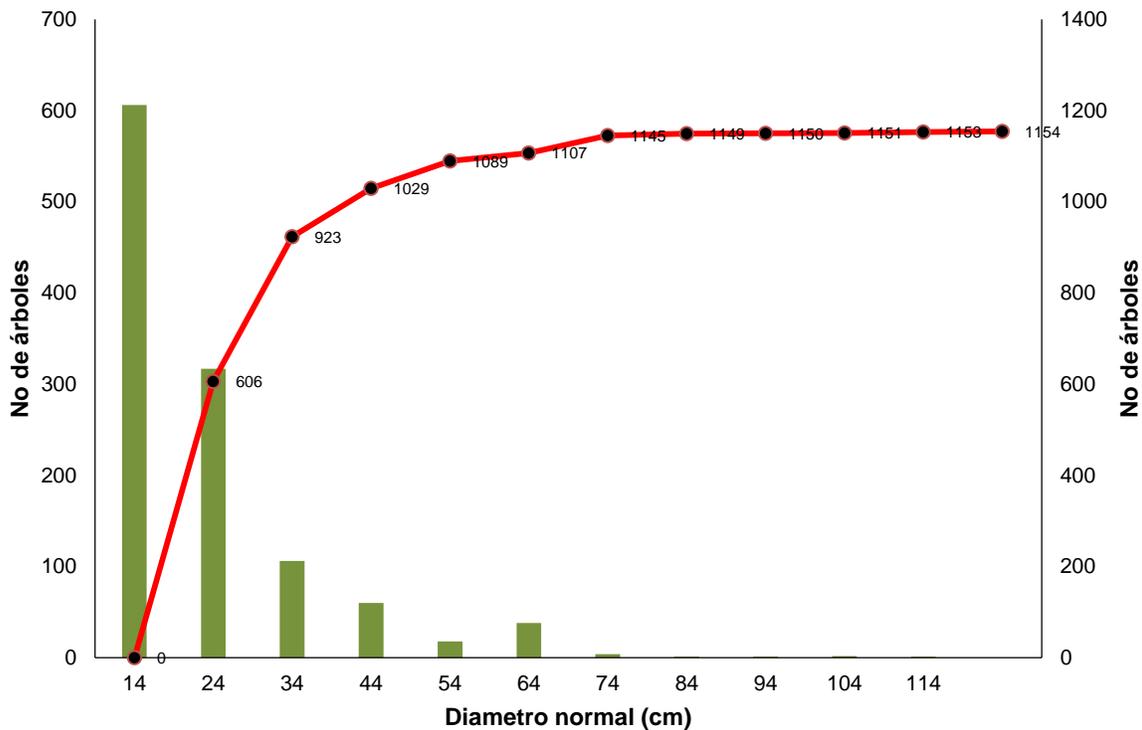


Figure No. 7.13 Diameter distribution in absolute and accumulated form, for trees in the area directly affected by the project
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The distribution of all the individuals reported in the project's area of direct by diameter classes, have greater representation in the following classes: class 1 (Normal diameters between 9 cm to 19 cm) with a total of 606 (52.5%) individuals belonging to 34 species and 22 families; followed by class 2 (Normal diameters between 19.1 cm and 29 cm) with 317 (27.5%) individuals belonging to 27 species and 19 families; class 3 (Normal diameters between 29.1 cm to 39 cm) with 106 (9.2%) individuals of 16 species and 11 families and class 4 (Normal diameters between 39.1 cm to 49 cm) with 60 (5, 2%) individuals of 14 species and 11 families. The other 7 remaining classes represent 6% of the total inventory, corresponding to 65 individuals of 21 species and 8 families.

- Stratification of the forest profile

Figure No. 7.14 shows the tree dispersion diagram for the arboreal individuals identified within the project's area of direct impact, where the stratifications trend can

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page53 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

be evidenced from well-defined conglomerates of points. The number of strata in the forest is equivalent to the number of conglomerates.

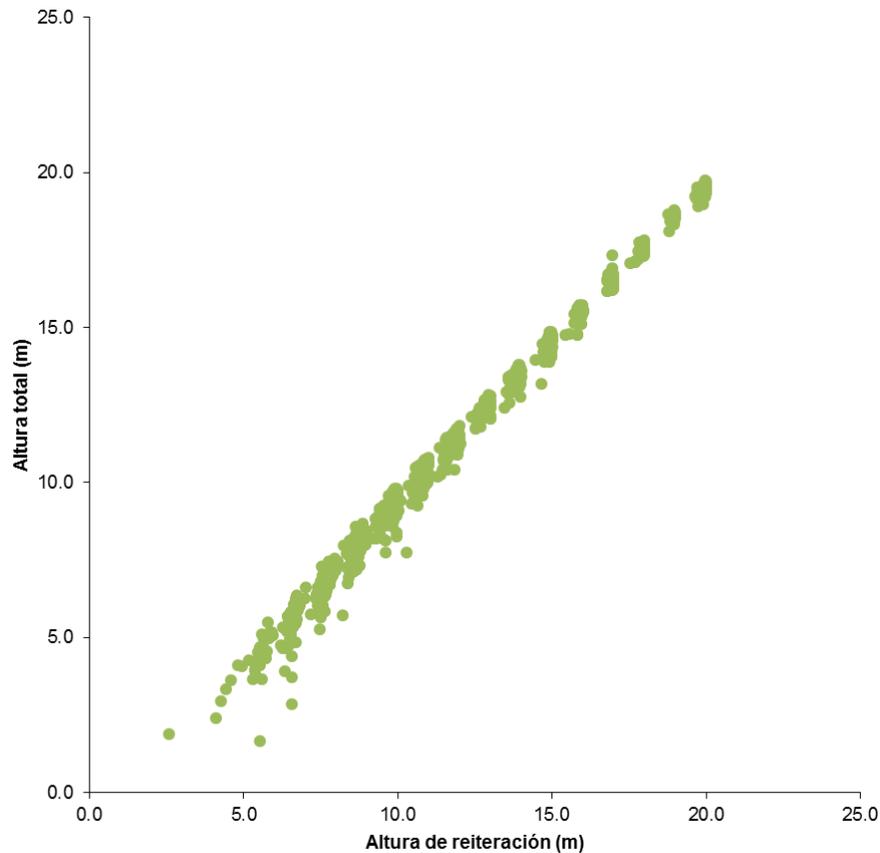


Figure No. 7.14 Stratification trends for the cup dispersion diagram within the project's area of direct impact
Source: Aqua & Terra Consultores Asociados S.A.S., 2015

Table No. 7.27 shows the sociological position for each species identified within the project's area of direct impact. There is observed the grouping of these species by forest stratum, from their respective intervals of total height.

Table No. 7.27 Distribution of the number of species and their abundances (Number of trees) in each stratum (Sociological position), for the trees inventoried in the project's area of direct impact

| Stratum | Interval | No of trees | No of species | Species |
|-----------|-------------|-------------|---------------|----------------------------|
| Stratum I | 1,5 m - 5 m | 44 | 9 | <i>Apuleia leiocarpa</i> |
| | | | | <i>Avicennia germinans</i> |

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page54 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

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|-----------------------------|--------------|-----|----|-------------------------------|
| | | | | <i>Ceiba pentandra</i> |
| | | | | <i>Ficus sp</i> |
| | | | | <i>Laguncularia racemosa</i> |
| | | | | <i>Pachira aquatica</i> |
| | | | | <i>Pithecellobium dulce</i> |
| | | | | <i>Rhizophora mangle</i> |
| | | | | <i>Spondias mombin</i> |
| Stratum II | 5,1 m - 10 m | 464 | 33 | <i>Anacardium excelsum</i> |
| | | | | <i>Annona muricata</i> |
| | | | | <i>Apuleia leiocarpa</i> |
| | | | | <i>Avicennia germinans</i> |
| | | | | <i>Beilschmiedi sp</i> |
| | | | | <i>Bombacopsis quinata</i> |
| | | | | <i>Brownea ariza</i> |
| | | | | <i>Cecropia telenitida</i> |
| | | | | <i>Ceiba pentandra</i> |
| | | | | <i>Citrus sp</i> |
| | | | | <i>Cocos nucifera</i> |
| | | | | <i>Crescentia Cujete L.</i> |
| | | | | <i>Elaeis Oleifera</i> |
| | | | | <i>Erythrina indica picta</i> |
| | | | | <i>Euterpe oleracea</i> |
| | | | | <i>Ficus glabrata</i> |
| | | | | <i>Ficus sp</i> |
| | | | | <i>Genipa americana</i> |
| | | | | <i>Gmelina arborea</i> |
| | | | | <i>Guazuma ulmifolia</i> |
| <i>Inga codonantha</i> | | | | |
| <i>Mangifera indica</i> | | | | |
| <i>Melicocca bijuga</i> | | | | |
| <i>Miconia sp</i> | | | | |
| <i>Pachira aquatica</i> | | | | |
| <i>Pithecellobium dulce</i> | | | | |
| <i>Prioria copaifera</i> | | | | |
| <i>Psidium guajava</i> | | | | |

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page55 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| | | | | |
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| | | | | <i>Rhizophora mangle</i> <i>Tabebuia rosea</i> <i>Tapura colombiana</i> <i>Tectona grandis</i> <i>Terminalia Catappa L</i> |
| Stratum III | 10,1 m - 15 m | 433 | 28 | <i>Apuleia leiocarpa</i> <i>Avicennia germinans</i> <i>Bombacopsis quinata</i> <i>Cecropia telenitida</i> <i>Ceiba pentandra</i> <i>Cocos nucifera</i> <i>Erythrina indica picta</i> <i>Euterpe oleracea</i> <i>Ficus glabrata</i> <i>Ficus sp</i> <i>Genipa americana</i> <i>Gmelina arborea</i> <i>Inga codonantha</i> <i>Mangifera indica</i> <i>Miconia sp</i> <i>Ochroma pyramidale</i> <i>Pachira aquatica</i> <i>Pithecellobium dulce</i> <i>Prioria copaifera</i> <i>Psidium guajava</i> <i>Rhizophora mangle</i> <i>Spondias mombin</i> <i>Spondias purpurea</i> <i>Sterculia apetala</i> <i>Tabebuia rosea</i> <i>Tapura colombiana</i> <i>Tectona grandis</i> <i>Terminalia Catappa L</i> |
| Stratum IV | 15,1 m - 20 m | 213 | 17 | <i>Apuleia leiocarpa</i> <i>Bombacopsis quinata</i> |

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page56 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| | | | | |
|--|--|--|--------------|-------------------------------|
| | | | | <i>Cecropia telenitida</i> |
| | | | | <i>Ceiba pentandra</i> |
| | | | | <i>Erythrina indica picta</i> |
| | | | | <i>Euterpe oleracea</i> |
| | | | | <i>Ficus glabrata</i> |
| | | | | <i>Ficus sp</i> |
| | | | | <i>Guazuma ulmifolia</i> |
| | | | | <i>Inga codonantha</i> |
| | | | | <i>Miconia sp</i> |
| | | | | <i>Ochroma pyramidale</i> |
| | | | | <i>Pachira aquatica</i> |
| | | | | <i>Pithecellobium dulce</i> |
| | | | | <i>Rhizophora mangle</i> |
| | | | | <i>Spondias mombin</i> |
| | | | | <i>Tabebuia rosea</i> |
| | | | Total | |
| | | | | 1154 |
| | | | | 87 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

7.5.2 Ecological indices

Diversity is composed of two elements, variety or wealth and relative abundance of species. Its expression is achieved by recording the number of species, describing relative abundance or by using a measure that combines the two components.

Table No. 7.28 shows the values for the indices of species wealth and diversity found in the project's area of direct impact.

Table No. 7.28 Wealth and Diversity indices for the project's area of influence

| SPECIES DIVERSITY MEASURES | | |
|----------------------------|---------------|-------|
| | | Index |
| Wealth | Margalef | 5,24 |
| | Menhinick | 1,11 |
| Diversity | Shannon | 2,55 |
| | Simpson | 0,86 |
| | Berger-Parker | 0,31 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page57 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

The Margalef index corresponds to 5.24; the Menhinick index corresponds to 1.11, indicating that there is a high species wealth for the entire study area.

For diversity measures, the Shannon index is 2.55, reciprocal of Simpson ($1 / D = 0.86$) and reciprocal of Berger-parker ($1 / d = 0.31$). These results, in general terms, characterize a moderately diverse biotic community, with a tendency towards heterogeneity, typical of the tropical humid forest (bh-T).

7.5.3 Volume to take advantage of

The individuals that require a permit to carry out forest harvesting are presented in Table No. 7.29, which shows the total volume per species (Annex 7.5 Forest harvesting), including the closed species and / or to some degree of threat (numeral 7.5.5 of this chapter), and that through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ⁴¹ the closure was lifted.

Table No. 7.29 Volume of wood to be harvested within the project's area of direct impact.

| Family | Species | Common name | Commercial volume (m ³) |
|----------------|------------------------------|--------------|-------------------------------------|
| Arecaceae | <i>Elaeis Oleifera</i> | Coroza | 11,25 |
| | <i>Raphia taedigera</i> | Pangana | 189,93 |
| | <i>Cocos nucifera</i> | Coconut palm | 5,12 |
| Anacardiaceae | <i>Anacardium excelsum</i> | Caracoli | 3,02 |
| | <i>Spondias purpurea</i> | Plum | 0,48 |
| | <i>Spondias mombin</i> | Hobo | 1,65 |
| | <i>Mangifera indica</i> | Mango | 3,28 |
| Annonaceae | <i>Annona muricata</i> | Soursop | 0,26 |
| Avicenniaceae | <i>Avicennia germinans</i> * | Smoke mangle | 21,66 |
| Bignoniaceae | <i>Tabebuia rosea</i> | Oak | 15,08 |
| | <i>Crescentia Cujete L</i> | Totumillo | 0,69 |
| Bombacaceae | <i>Ceiba pentandra</i> | Green Bonga | 33,55 |
| | <i>Bombacopsis quinata</i> | Ceiba Tolua | 10,04 |
| | <i>Pachira aquatica</i> | Salt shaker | 26,53 |
| Caesalpinaceae | <i>Prioria copaifera</i> * | Cativo | 6,87 |
| Cecropiaceae | <i>Cecropia telenitida</i> | Yarumo | 9,01 |

⁴¹ CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011 (March 17, 2011). By means of which an area of the Protective Forest Reserve of the wetlands between the León and Suriquí rivers is partially and temporarily subtracted and a closure is partially lifted. Apartadó, 6 p.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page58 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

| | | | |
|----------------------|-------------------------------|----------------|---------------|
| Combretaceae | <i>Terminalia Catappa L</i> | Almond | 3,12 |
| | <i>Laguncularia racemosa*</i> | White mangrove | 0,06 |
| Dichapetalaceae | <i>Tapura colombiana</i> | Nacedero | 1,43 |
| Fabaceae | <i>Brownea ariza</i> | Ariza | 0,17 |
| | <i>Erythrina indica picta</i> | Sing rooster | 12,49 |
| | <i>Pithecellobium dulce</i> | Chiminango | 258,14 |
| | <i>Apuleia leiocarpa</i> | Combita | 106,32 |
| Lamiaceas | <i>Gmelina arborea</i> | Melina | 10,5 |
| | <i>Tectona grandis</i> | Teak | 3,5 |
| Lauraceae | <i>Beilschmiedi sp</i> | Laurel | 4,9 |
| Malvaceae | <i>Ochroma pyramidale</i> | Balso | 36,78 |
| | <i>Sterculia apetala</i> | Camagón | 0,2 |
| Melastomataceae | <i>Miconia sp</i> | Niguito | 1,74 |
| Mimosaceae | <i>Inga codonantha</i> | Guamo | 9,07 |
| Moraceae | <i>Ficus glabrata</i> | Higuerón | 13,47 |
| | <i>Ficus sp</i> | Lechudo | 13,49 |
| Myrtaceae | <i>Psidium guajava</i> | Guava | 0,8 |
| Rhizophoraceae | <i>Rhizophora mangle*</i> | Red mangrove | 15,18 |
| Rubiaceae | <i>Genipa americana</i> | Majagua | 0,44 |
| Rutaceae | <i>Citrus sp</i> | Orange tree | 0,18 |
| Sapindaceae | <i>Melicocca bijuga</i> | Mamoncillo | 0,44 |
| Sterculiaceae | <i>Guazuma ulmifolia</i> | Guácimo | 0,73 |
| Overall total | | | 831,57 |

* Species in closed season⁴² and to which the closure was carried out ⁴³

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

The commercial volume of wood for the entire project's area of direct impact is 831.57 m³, which is divided into two areas requested for forest exploitation:

⁴² COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B., Op cit. 5 p.

⁴³ CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ – CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page59 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

- The first one belongs to the humid tropical zonobioma of the Magdalena-Caribe, with a volume of harvested wood of 794.58 m³ in 59.40 hectares, corresponding to an estimate of 13.37 m³ / ha.

- The second belongs to the halobioma of the Caribbean, formed by the species *Avicennia germinans*, *Laguncularia racemosa* and *Rhizophora mangle*, with a volume of wood to be harvested of 36.99 m³ in 1.59 hectares, corresponding to an estimate of 23.26 m³ / ha.

7.5.4 Handling of logging products

The harvested wood will be used in the area, according to the forest uses reported by the community, among which stand out, stakes for fences, domestic constructions, firewood, coal, rods, among others.

In the same way, it will be used in the realization of some of the project's activities, such as forms, signaling enclosure, among other uses.

7.5.5 Species in threatened, closed season and / or endemism category

According to Resolution No. 0192 of 2014 "Threatened species is understood to be one that has been declared as such by international treaties or agreements approved and ratified by Colombia or declared in a threat category by the Ministry of Environment, housing and territorial development"⁴⁴.

After reviewing the CITES⁴⁵ database, the IUCN⁴⁶ red list, the red books of the Alexander von Humboldt Institute⁴⁷ for Biological Resources Research, identifies that for the forest inventory carried out in the study area, the *Prioria copaifera* species (Cativo) was categorized as EN Hazard (EN), due to the fact that two thirds of the

⁴⁴ COLOMBIA. MINISTERIO DE AMBIENTE, VIVIENDA Y DESARROLLO TERRITORIAL. Resolution 0192 (February 22, 2014). By which declared wild species that are threatened in the national territory and other determinations are made. Bogotá: The Ministry, 2014. 2p.

⁴⁵ CITES. [online] <<http://www.cites.org/eng/resources/species.htm>> [Retrieved on August 28, 2015]

⁴⁶ RED LIST Guiding Conservation for 50 years. [online] <<http://www.iucnredlist.org/search/search-basic>> [Retrieved on August 26, 2015]

⁴⁷ ALEXANDER VON HUMBOLDT INSTITUTE FOR BIOLOGICAL RESOURCES RESEARCH – HUMBOLT. [online] <<http://www.humboldt.org.co/humboldt/mostrarpagina.php?codpage=300001102>> [Retrieved on August 13, 2015]

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|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page60 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

natural population have disappeared, as a result of intense logging, according to the red book of Colombian plants⁴⁸. Likewise, two levels of vulnerable (VU) and endangered (EN) threats are identified, in accordance with Resolution 0192 of 2014, for the Colombian *Tapura* (*Nasedero*) (VU) and *Prioria copaifera* (*Cativo*) species (EN).

Closed season Resolution number 076395 B of August 4, 1995⁴⁹ was also found in the database of CORPOURABÁ for the species *Prioria copaifera* (*Cativo*), *Avicennia germinans* (Black mangrove), *Rhizophora mangle* (Red mangrove) and *Laguncularia racemosa* (White Mangrove), which were found in the forest inventory carried out in the area of direct affectation, but that through the agreement No 100-02-02-01-0004-2011 by CORPOURABÁ was lifted⁵⁰.

In turn, the Panganales are identified as endemic vegetation of the area, these are found covering the basin of the Atrato River and part of the Litoral Caribbean, where almost pure formations of the species *Raphia taedigera* (*Pangana*), locally called "Panganales", are located. They are also found in the low areas of the main rivers, in the areas periodically flooded by freshwater or freshwater and saltwater mix, and in the areas that were exploited for timber extraction⁵¹.

It is also important to note that the species that comprise the mangrove are important for the stability and fixation of the soil, as well as for the incursion of other species and for the flow of energy and nutrients⁵².

⁴⁸ CÁRDENAS, Dairon & SALINAS, Nelson. Red book of plants of Colombia. Volume 4. Threatened timber species: First part. Red books series of threatened species of Colombia. Amazon Scientific Research Institute SINCHI - Ministerio de Ambiente, Vivienda y Desarrollo Territorial. 2007. 232 p. ISBN: 978-958-8317-19-9

⁴⁹ COLOMBIA. CORPORACIÓN PARA EL DESARROLLO SOSTENIBLE DEL URABÁ - CORPOURABA. Resolution 076395B (August 4, 2014). By means of which the amounts of the rates for the utilization of the public and private forests are fixed. Apartado, 2014. 5p.

⁵⁰ C CORPORATION FOR THE SUSTAINABLE DEVELOPMENT OF URABÁ - CORPOURABA. Agreement No 100-02-02-01-0004-2011., Op cit. 6 p

⁵¹ NATURAL NATIONAL PARKS. Nature and Science of Los Katíos Natural National Park. [online] <https://www.parquesnacionales.gov.co/PNN/portel/libreria/php/decide.php.patron=01.014003> [Retrieved on October 15, 2015]

⁵² OIMT. OIMT Work Plan on Mangroves. 2002 – 2006.

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|---|--|---|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page61 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

7.6 Atmospheric emissions

7.6.1 Emission sources without project

The project's study area presents little industrial intervention, since it is an area with vocation of export-type plantain and banana crops, where land, fluvial and maritime traffic flows are related, for transportation to the boats in Bahía Colombia.

The industries, that are located in the project's area of influence, are located in the district of Nueva Colonia (Uniban and Banacol), which have a pier, storage area and offices.

It is there where the aforementioned crops are harvested, to proceed with the transfer by means of the banana convoys to the anchorage area, where the export ships are located.

- Fixed Sources

The presence of emissions of gases and particulate material by fixed sources in the project's study area, Nueva Colonia district and project land, located within the jurisdiction of the municipality of Turbo, was not evident.

- Mobile sources

Due to the presence of the banana companies in the district of Nueva Colonia and the transit of the same population to the district, the circulation of light vehicles such as automobiles and motorcycles, buses and heavy goods vehicles was evidenced. For the fluvial and marine transport boats, tugboats and ships are presented (Of the current study of environmental impact, see Chapter 5 Characterization of the area of influence, number 5.3 Socioeconomic environment).

According to the Transit Study of Puerto Antioquia 2015⁵³, the traffic flow between the section of the path of the Rio Grande district and the Nueva Colonia district, presented a total of 1912 vehicles / day, transiting through this section, of which 268

53 PIO SAS & GRUPO VIAL. Basic and detailed engineering, procurement and supply of materials, construction, assembly and commissioning of the works required for phase 1 of the Puerto Antioquia Port Terminal located at the mouth of the León River, in the Gulf of Urabá - Transit Study, Department of Antioquia. Cali, 2015. 203 p
ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT
CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page62 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

are vehicles light and 1644 correspond to heavy vehicles (buses and trucks); this is equivalent to 86% of heavy vehicles and 14% of light vehicles.

Additionally, for the dredging of the León River and the Nueva Colonia Canal, a dredge is constantly presented for the maintenance of the channel, in order to guarantee its navigability and for the artisanal fishing activity, the fishermen transit through boats is presented as well.

- Area Sources

The presence of gas emissions and particulate material in a source area within the project's study area was not evident, as is the district of Nueva Colonia and the area of the property where the port project is located, both are located in the jurisdiction of the municipality of Turbo of the department of Antioquia.

7.6.2 Project's construction phase

In accordance with the stipulations of the applicable regulatory framework for industries that require permits for atmospheric emissions according to Resolution 909 of 2008⁵⁴, Decree 948 of 1995⁵⁵ and Resolution 619 of 1997⁵⁶, the Project does not require applying for a permit for atmospheric emissions in the Construction phase of the Port Terminal.

The activities to be carried out during the construction of the project do not require such permit, since no areas of exploitation of material are requested, nor material crushing plants will be installed, since it is considered that the contractor for the execution of the works, performs the purchase of material with external companies, which must comply with environmental legal regulations and have a valid mining title.

54 COLOMBIA. MINISTERIO DE AMBIENTE, VIVIENDA Y DESARROLLO TERRITORIAL Resolution 909 (June, 5, 2008). By which the regulations and standards of admissible emission of contamination to the atmosphere by fixed sources are established and dispositions are made. Bogotá D.C., 2008

55 COLOMBIA. PRESIDENTE DE LA REPUBLICA. Decree 948 (June 5, 1995). By which are regulated, partially Law 23 of 1973, articles 33, 73, 74, 75 and 75 of Decree-Law 2811 of 1974; articles 41, 42, 43, 44, 45, 48 and 49 of Law 9 of 1979; and Law 99 of 1993, in relation to the prevention and control of atmospheric pollution and the protection of air quality. Bogotá D.C., 1995

56 COLOMBIA. MINISTERIO DEL MEDIO AMBIENTE. Resolution 619 (July 7, 1997). By which the factors are partially established from which permission of atmospheric emission for fixed sources is required. Bogotá D.C., 1997

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|  <p>PUERTO BAHÍA COLOMBIA DE URABÁ S.A. TERMINAL PORTUARIA DE TURBO (2012)</p> | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page63 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review: B</p> |

7.6.3 Operation phase

In accordance with the considerations made by the National Authority of Environmental Licenses - ANLA in Resolution No. 0032 of 2012⁵⁷, in the seventh Article, fourth paragraph () "No permit of atmospheric emissions is granted for the operation stage to the Sociedad Puerto Bahía de Colombia Urabá SA. The company will not be able to start operations without having the permit of atmospheric emissions for the handling and management of solid bulk cargoes".

Therefore, in the present modification for the operation phase of the port terminal the Permission of Atmospheric Emissions is requested, for the activities storage, loading, unloading and transport of the solid bulk cargoes, in accordance with the stipulated in the Article 73 of the Decree 948 of 1995⁵⁸, which establishes in section e) that the activity "Storage, transport, loading and unloading operations in ports susceptible to generating emissions to the air", requires such permit.

It is worth mentioning that the transfer between the ship's side and the onshore facilities will be carried out with specialized vehicles to transport solid bulk cargoes (see Chapter 3 Project description of the current environmental impact study). Likewise, specialized onshore facilities will have the technology to avoid air pollution with particles, since they will also be made up of a battery of silos and specialized warehouses interconnected by systems of conveyor belts that will have delivery systems for vehicle loads, avoiding contamination by dust, particulate material, gases and volatile substances.

The details are presented in Chapter 3 "Description of the project of the current study for the Modification of Environmental License".

- Location of facilities

The storage, loading and unloading of solid bulk area will be built in the onshore terminal, to the south-east of the project site, as shown in Figure No. 7.15.

In the marine dock the loading and unloading of the solid bulk from the ships will be carried out. The unloading configuration of the ships with solid bulk in the 1B, 2B and

⁵⁷ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit.

⁵⁸ COLOMBIA. REPUBLIC PRESIDENT. Decree 948 (June 5, 1995). Op Cit.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page64 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

1D docks, will be made with the ship's own cranes and each service will have a clam (spoon) and a hopper.

In the MOD_LA_PTO_ANT_01_LG map the general location of the project is presented and in Chapter 3 "Description of the project", the infrastructure of the same is detailed.

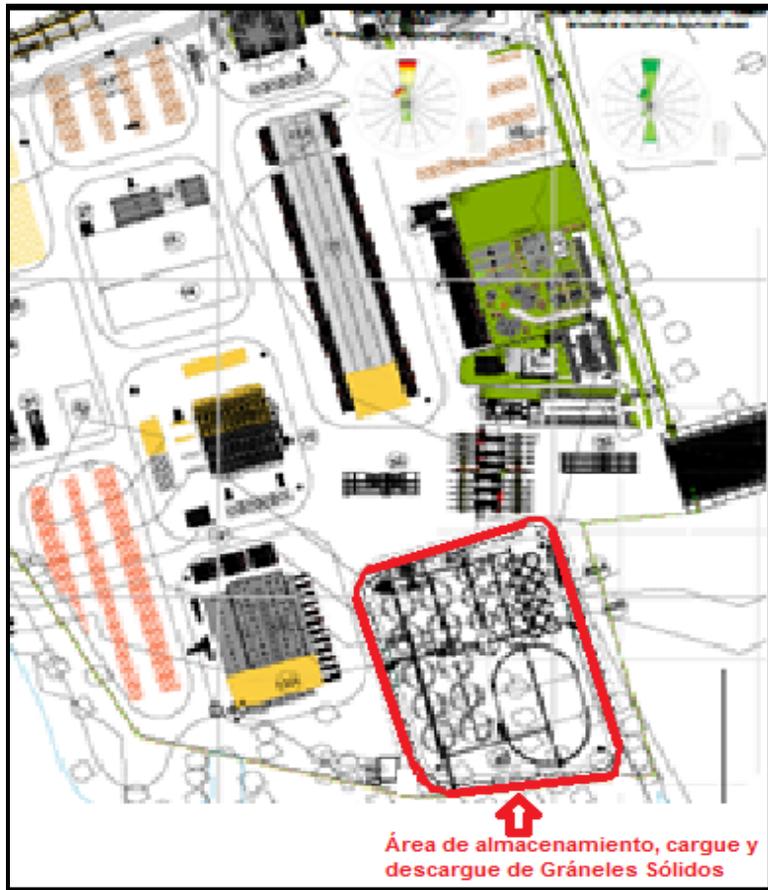


Figure No. 7.15. Location of storage, load and unload areas of solid bulk
Source: PIO S.A.S., 2015

Table No. 7.30 shows the location coordinates of the areas that require a permit for atmospheric emissions and are presented graphically in Figure No. 7.16.

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page65 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

Table No. 7.30 Location coordinates of the atmospheric emission permit

| ZONE | VERTEX | FLAT COORDINATES MAGNA SIRGAS Origin BOGOTÁ | |
|---------------------------------------|--------|--|--------------|
| | | EAST | NORTH |
| Solid bulk cargoes - onshore terminal | 1 | 706.752,49 | 1.368.817,64 |
| | 2 | 706.812,29 | 1.368.610,37 |
| | 3 | 706.645,07 | 1.368.591,57 |
| | 4 | 706.592,95 | 1.368.771,64 |
| Dock 1B - Solid bulk | 5 | 702.875,89 | 1.371.214,46 |
| | 6 | 702.875,89 | 1.370.908,23 |
| | 7 | 702.805,89 | 1.370.908,23 |
| | 8 | 702.805,89 | 1.371.214,46 |
| Dock 2B - Solid bulk | 9 | 702.875,89 | 1.370.874,46 |
| | 10 | 702.875,89 | 1.370.574,93 |
| | 11 | 702.805,89 | 1.370.574,93 |
| | 12 | 702.805,89 | 1.370.874,46 |
| Dock 1D - Solid bulk | 13 | 702.845,89 | 1.371.244,46 |
| | 14 | 702.845,89 | 1.371.194,46 |
| | 15 | 702.645,89 | 1.371.194,46 |
| | 16 | 702.645,89 | 1.371.244,46 |

Source: Aqua & Terra Consultores Asociados S.A.S., 2015

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page66 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: B |

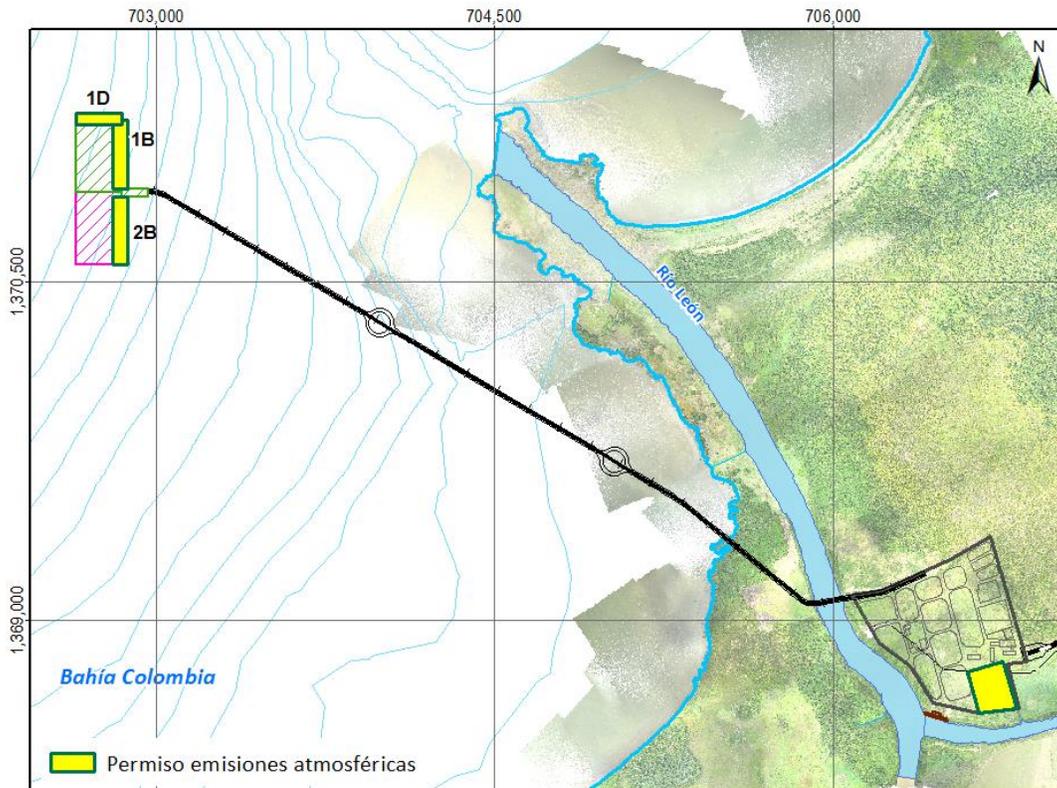


Figure No. 7.16. Location of the area that requires a permit of atmospheric emissions
Source: Aqua & Terra Consultores Asociados S.A.S., 2015 with information of PIO S.A.S., 2015

- Load projection

The project in Puerto Antioquia consists of a multipurpose port for cargo handling, export / import of containers, solid bulks and liquids, as well as an export / import terminal for vehicles.

The main design features of the multipurpose port are based on the projection of cargo from the commercial services of the port and therefore the vessel or design vessel. The projected short and long-term loads (2018 and 2030 respectively), according to the load analysis of CK Americas (2010), are listed in Table No. 7.31.

From the above, it is highlighted that the loads susceptible to the generation of atmospheric emissions of particulate material, are the loose loads and the bulk

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE PROJECT OF CONSTRUCTION AND OPERATION OF A PORT TERMINAL OF SOLID BULK IN THE MUNICIPALITY OF TURBO |  | |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page67 of 86 | |
| | GAT-391-15-CA-AM-PIO-01 | Review: | B |

cargo, for which it was estimated that in 2018 there would be a cargo projection of 400,000 t for loose cargo and 1,000,000 tons of bulk cargo; the other projections are presented in Table No. 7.31.

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|  | MODIFICACIÓN DE LICENCIA AMBIENTAL PARA EL PROYECTO DE CONSTRUCCIÓN Y OPERACIÓN DE UN TERMINAL PORTUARIA DE GRÁNELES SÓLIDOS EN EL MUNICIPIO DE TURBO |  |
| | ZONIFICACIÓN AMBIENTAL, DEMANDA, USO, APROVECHAMIENTO Y/O AFECTACION DE RECURSOS NATURALES, EVALUACIÓN AMBIENTAL, ZONIFICACIÓN DE MANEJO AMBIENTAL, EVALUACIÓN ECONÓMICA AMBIENTAL | Page 68 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review:: |

Table No. 7.31. Load Projection in the short and medium term.

| CARGA MOVILIZADA | 2,018 | 2,019 | 2,020 | 2,021 | 2,022 | 2,023 | 2,024 | 2,025 | 2,026 | 2,027 | 2,028 | 2,029 | 2,030 |
|-------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| TON Movilizada tipo de carga | | | | | | | | | | | | | |
| Contenedores 40 Ft. Llenos Refrig. | 825,000 | 1,650,000 | 1,707,000 | 1,765,973 | 1,826,986 | 1,890,111 | 1,950,356 | 2,003,802 | 2,003,802 | 2,003,802 | 2,003,802 | 2,003,802 | 2,003,802 |
| Contenedores Secos Llenos | 633,540 | 1,267,081 | 1,355,776 | 1,450,681 | 1,523,215 | 1,599,376 | 1,679,344 | 1,729,725 | 1,729,725 | 1,729,725 | 1,729,725 | 1,729,725 | 1,729,725 |
| Vehiculos Movilizados | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 | 36,000 |
| Carga Suelta (TON) | 400,000 | 800,000 | 1,000,000 | 1,015,000 | 1,030,225 | 1,045,678 | 1,061,364 | 1,077,284 | 1,093,443 | 1,109,845 | 1,126,493 | 1,143,390 | 1,160,541 |
| Carga Granel (TON) | 1,000,000 | 1,500,000 | 1,522,500 | 1,545,338 | 1,568,518 | 1,592,045 | 1,615,926 | 1,640,165 | 1,664,767 | 1,689,739 | 1,715,085 | 1,740,811 | 1,766,923 |
| Total TON | 2,894,540 | 5,253,081 | 5,621,276 | 5,812,991 | 5,984,943 | 6,163,210 | 6,342,990 | 6,486,975 | 6,527,737 | 6,569,110 | 6,611,104 | 6,653,728 | 6,696,991 |
| Movilización Carga (TEUs) | | | | | | | | | | | | | |
| TEUs Vacios Refrigerados | 67,500 | 135,000 | 139,800 | 144,770 | 149,917 | 155,246 | 161,270 | 166,615 | 166,615 | 166,615 | 166,615 | 166,615 | 166,615 |
| TEUs Llenos Refrigerados | 82,500 | 165,000 | 170,700 | 176,597 | 182,699 | 189,011 | 195,036 | 200,380 | 200,380 | 200,380 | 200,380 | 200,380 | 200,380 |
| <i>Refrigerados Banana Expo</i> | <i>75,000</i> | <i>150,000</i> | <i>155,250</i> | <i>160,684</i> | <i>166,308</i> | <i>172,128</i> | <i>178,153</i> | <i>183,498</i> | <i>183,498</i> | <i>183,498</i> | <i>183,498</i> | <i>183,498</i> | <i>183,498</i> |
| <i>Refrigerados Otros Impo</i> | <i>7,500</i> | <i>15,000</i> | <i>15,450</i> | <i>15,914</i> | <i>16,391</i> | <i>16,883</i> |
| TEUs Secos Vacios | 10,000 | 20,000 | 21,400 | 22,898 | 24,043 | 25,245 | 26,507 | 27,303 | 27,303 | 27,303 | 27,303 | 27,303 | 27,303 |
| TEUs Secos Llenos | 60,000 | 120,000 | 128,400 | 137,388 | 144,257 | 151,470 | 159,044 | 163,815 | 163,815 | 163,815 | 163,815 | 163,815 | 163,815 |
| Total TEUs | 220,000 | 440,000 | 460,300 | 481,654 | 500,916 | 520,972 | 541,857 | 558,113 | 558,113 | 558,113 | 558,113 | 558,113 | 558,113 |

Source: PRC Análisis

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 69 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

- Bulk silos

For storage of solid bulk there will be a vertical silos battery configuration area. On average it is estimated to receive 30,000 t / boat, with an average of 28 boats per year, that is, 2 boats per month.

Next in Table No. 7.32 and Table No. 7.34, the storage capacity and its respective phases are presented:

Table No. 7.32. Bulk storage silos capacity

| CAPACITY TO STORE GRAINS AND CAKES PUERTO ANTIOQUIA August-29/2014 | | | |
|--|-----------------|-----------------|-----------------|
| GRAIN WAREHOUSE | PHASE-1 | PHASE -2 | PHASE -3 |
| Capacity in flat silos Ø75 ' | 5500 | 5500 | |
| Number of silos Ø75 ' | 8 | 4 | |
| Capacity in flat silos Ø42 ' | 1400 | 1400 | |
| Number of silos Ø42 ' | 8 | 2 | |
| Temporary storage | | | 25500 |
| TOTAL CORN STORE TONS (750 kg / m³) AT EACH PHASE | 55200 | 24800 | 25500 |
| CAKES WAREHOUSE | PHASE -1 | PHASE -2 | PHASE -3 |
| Capacity in flat silos Ø54 ' | 2540 | | |
| Number of silos Ø54 ' | 4 | | |
| Capacity in flat silos Ø48 ' | 1990 | 1990 | |
| Number of silos Ø48 ' | 2 | 2 | |
| Capacity in conical silos Ø36 ' | 1000 | 1000 | |
| Quantity of conical silos Ø36 | 4 | 6 | |
| Tilt-up type cellar, for cakes or fertilizers, of 26.60 m. width x 51.40 m. of Length. between centers | | | 8150 |
| Quantity of warehouses | | | 1 |
| TOTAL TONS OF STORAGE OF CAKES IN EVERY PHASE (600 kg / m³) | 18.140 | 9.980 | 8.150 |

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 70 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

| CAPACITY TO STORE GRAINS AND CAKES PUERTO ANTIOQUIA August-29/2014 | | | |
|---|----------------|-----------------|-----------------|
| GRAIN WAREHOUSE | PHASE-1 | PHASE -2 | PHASE -3 |
| TOTAL ACCUMULATED AT THE END OF EACH PHASE | 18.450 | 28.430 | 36.580 |

Source: Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia, Turbo, Uraba. Ediagro, September 2014.

The total capacity in the first storage phase will be 73,650 t, that is, it has the capacity to store two (2) 30,000 t vessels.

In addition, it provides 24% for more storage. Likewise, the second phase covers the demand established by a ship. And finally, for future phases, it is expected to unload a ship in the shortest time possible by storing it in the receipt hopper that will have the capacity of 25,500 t.

The main loads of solid bulk cargoes are:

- Feed for animals: 615,000 tons / year
- Wheat: 100,000 tons / year
- Corn: 45,000 tons / year
- Fertilizers: 31,000 tons / year

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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  aqua & terra |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

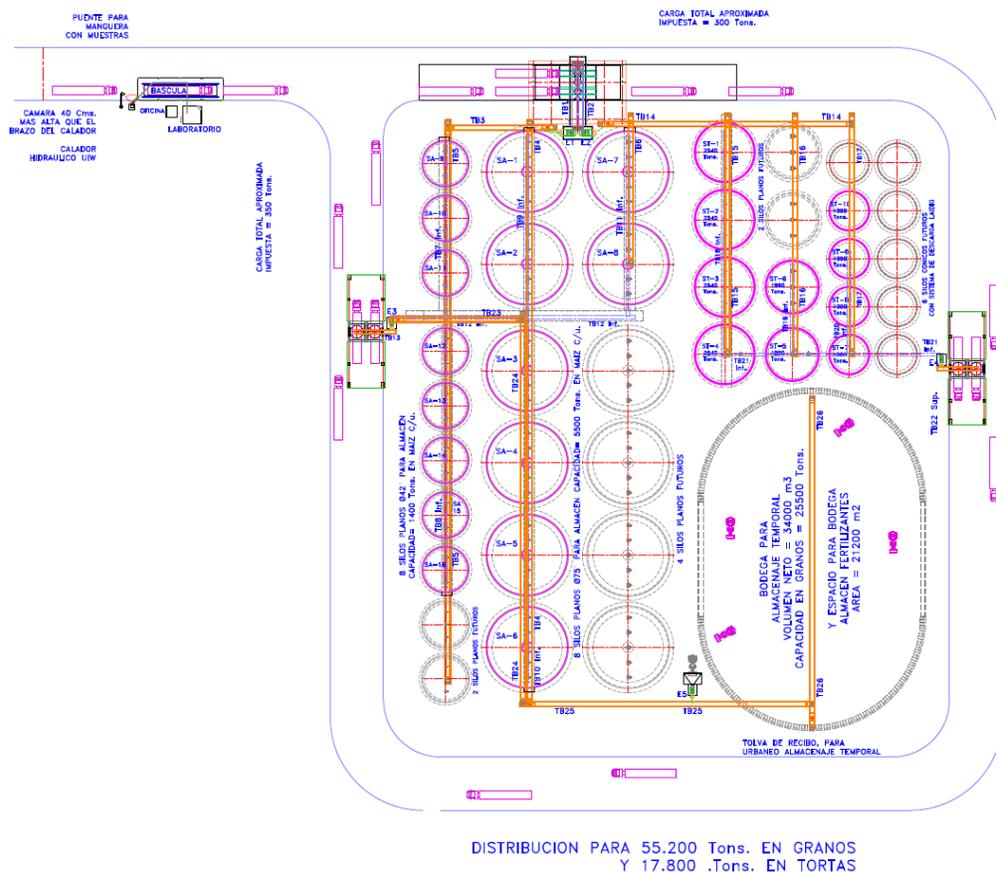


Figure No. 7.17. Silos and storage warehouses of grains Pto Antioquia. Source: EDIAGRO, 2014

- Bulks operation

Solid Bulk Cargoes Ship

The unloading configuration of ships with solid bulk cargoes in docks 1B, 2B and 1D, will be made with the ship's own cranes and will be worked, on average, with three (3) cranes of the ship (3 services).

Each service will have a clam (spoon) with a gross capacity of approximately 25 t and a hopper with a capacity of approximately 20 t. The merchandise will be

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|  | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 72 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

delivered to the importers at the side of the ship, while the storage will be made in the onshore terminal.

The main types of solid bulk cargoes that will be operated are animal feed products, corn, wheat and fertilizers.

To unload solid bulk cargoes, it is also planned to have a mobile crane super post panamax, which will be equipped with a clam (spoon) and a double hopper to load two (2) vehicles simultaneously.

Once the specialized bulk onshore facilities are built, the merchandise will be delivered to the side of the ship and in the bulk onshore facilities, the transfer between the ship's side and the ground facilities will be carried out with specialized vehicles to transport solid bulk cargoes (see Figure No. 7.18).

Specialized onshore facilities will have the technology to avoid air pollution with particles, in addition they will be made up of a battery of silos and specialized warehouses interconnected by systems of conveyor belts, which will have loads delivery systems for vehicles.



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|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 73 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |



Figure No. 7.18. Specialized vehicles for bulk transport, high speed unloading hopper and coupled tandem.

Source: Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia, EDIAGRO, 09/2014.

The daily unloading cycle is presented in the following Table No. 7.33.

Table No. 7.33. Grain loading operation.

| VEHICLES NEEDED | | | |
|---|-------|---------------------------------|-------|
| Maximum download rate sought | 8.000 | tons per day | |
| Direct Load | 30% | 2.400 | t day |
| Load to silos | 70% | 5.600 | t day |
| Nominal capacity transport equipment | 750 | tons per hour, ideal conditions | |
| Real average capacity | 500 | Tons per hour | |
| Hours of work in real conditions | 16 | | |
| Capacity "trailers and trucks" | 30 | tons | |
| Mobile hoppers capacity | 40 | tons | |
| Spoon capacity | 12 | tons | |
| Spoons Average cycle | 2,9 | Minutes | |
| Spoons Tons per hour, average | 248,3 | | |
| Loading time of mobile hopper with spoons | 9,7 | Minutes | |
| Truck filling time from mobile hopper | 6 | Minutes | |

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|  <p>PUERTO BAHÍA COLOMBIA DE URABÁ S.A. TERMINAL PORTUARIO DE GRANALBA (URABÁ)</p> | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  <p>aqua & terra</p> |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 74 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

| VEHICLES NEEDED | | |
|--|-----|-----------------------------------|
| Platform dock to hopper receipt distance | 5 | km |
| Average truck speed | 20 | km/hour |
| Round trip time | 15 | minutes |
| Truck weighing time on the two scales | 10 | minutes |
| Unloading time of each truck in hopper receipt | 5 | minutes |
| Loading silos speed, tons per hour | 360 | for each hopper |
| Alignment time under mobile hopper | 2 | minutes |
| Hopper truck delivery time | 2 | minutes |
| Full cycle time trailer-truck | 40 | minutes |
| Capacity to transport each trailer-truck | 45 | tons per hour |
| Total trucks per hour | 17 | To transport the nominal capacity |
| Trailers quantity needed to load silos | 12 | |
| Trucks quantity load directly | 5 | |

Source: EDIAGRO, 2014.⁵⁹

Finally, for the unloading of cakes (feeding of materials), it has been planned for a Laiding type unloading system for storage silos in concrete or conical bottom steel, with approximately 8 m diameter and 1,100 m³ capacity.

This system allows the loading and unloading of silos under a closed system of emissions, either with access design of load truck to the silo or by automated control of closed transport.

⁵⁹ EDIAGRO. Study of markets for the unloading of solid bulk cargoes in Puerto Antioquia. 2014

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 75 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |



Figure No. 7.18. Laiding type unloading system.
Source: EDIAGRO, 2014.⁶⁰

7.6.4 Estimation of emission factors of the possible emissions of particulate material by handling solid bulk cargoes

In accordance with what was presented in the Environmental Impact Study⁶¹ with which the environmental license was obtained through Resolution No. 0032 of 2012⁶², the emission factors estimated by the US EPA for grain elevators and their processing systems⁶³ were reviewed. Finding an assessment of the possible atmospheric emissions of total particulate material, PM₁₀ and PM_{2.5}, without any environmental control, although the US EPA classifies these emission factors in the "poor" category, which corresponds to tests carried out in a number of facilities that

⁶⁰ Ibid.

⁶¹ PUERTO BAHÍA COLOMBIA DE URABA S.A. y ARAÚJO IBARRA & ASOCIADOS S.A. Environmental impact study for the construction and operation of a port terminal of solid bulk. Turbo. 2010. 428 p.

⁶² COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution 0032 (January 25, 2012). Op Cit

⁶³ UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US EPA). Compilation of air pollutant emission factors. Volume I: stationary point and area source. Chapter 9: Food and agricultural industry – 9.9: Grain processing – 9.9.1: Grain elevators & processes. [online]. AP42. 5a Edición. US EPA, 2003 <<http://www.epa.gov/ttn/chieff/ap42/ch09/index.html>> [Retrieved on February 10, 2010].

ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT

CHAPTER 7 DEMAND__NATURAL_RESOURCES [Medellin], 2015

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|---|---|---|
|  <p>PUERTO BAHÍA COLOMBIA DE URABÁ S.A. TERMINAL PORTUARIO DE BARRANCO NEGRO</p> | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  <p>aqua & terra</p> |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 76 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

can be reasonable, but with the suspicion that the sample is not representative of the sector, which can show much variability⁶⁴.

For the project, the generation of possible emissions with the emission factors was calculated, without the implementation of control systems, as presented in Table No. 7.34:

Table No. 7.34 Emission factors established by the US EPA for grain management, without emission control (category E: poor)

| Operation | TSP | PM ₁₀ | PM _{2,5} |
|--|------------|------------------|-------------------|
| Receipt of grains by ships with port unloader (marine leg) | 0,150 lb/t | 0,038 lb/t | 0,0050 lb/t |
| Grain handling (as unloaders and conveyor belts) | 0,061 lb/t | 0,034 lb/t | 0,0058 lb/t |
| Storage (venting) | 0,025 lb/t | 0,063 lb/t | 0,0011 lb/t |
| Unloading in trucks | 0,086 lb/t | 0,029 lb/t | 0,0049 lb/t |
| ALL OF THE ABOVE | 0,322 lb/t | 0,164 lb/t | 0,0168 lb/t |

Source: US EPA. Grain elevators & processes, 2003⁶⁵.

According to the project's license granted by Resolution No. 0032 of 2012⁶⁶, it was intended to handle a total of 2.2 million tons at the Terminal and 347 days of availability of the facilities, thus envisaging a potential emission of particulate material, which it was calculated with the aforementioned emission factors, with a total of emissions as shown in Table No. 7.35.

For the current Modification of Environmental License, according to the projection of general and loose cargo for the year 2018, it is estimated a total of 400,000 tons of loose cargo and 1,000,000 tons of bulk cargo and for the maximum of the projection the year 2030, a loose load of 1,160,541 tons and bulk cargo 1,766,923 tons for a total of 2,927,464 tons was estimated.

In Table No. 7.35 it can be seen that the particulate material emission concentration (TSP, PM₁₀ and PM_{2.5}) decreased according to the estimate for the load granted

⁶⁴ ESTADOS UNIDOS. UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US EPA). Compilation of air pollutant emission factors. Volume I: stationary point and area source. Introduction to AP 42, Volume I, Fifth Edition [online]. AP42. 5th edition. US EPA, 1995. <<http://www.epa.gov/ttn/chief/ap42/c00s00.pdf>> [Quoted on February 10, 2010].

⁶⁵ US EPA. Grain elevators & processes, 2003. Op Cit

⁶⁶ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution No. 0032 (January 25, 2012). Op Cit.

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|  <p>PUERTO BAHÍA COLOMBIA DE URABÁ S.A. TERMINAL PORTUARIO DE BARRIO LIBRE</p> | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  <p>aqua & terra</p> |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 77 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

for the project through the aforementioned resolution, comparing it with the total of the loading projection of the year 2018.

Therefore, variations in air quality are not very representative for the loads requested in the current license modification.

Table No. 7.35 Potential emission of particulate material, without the implementation of control systems

| Total Load | TSP g / s emission | PM10 g / s Emission | Emission PM2.5 g / s |
|--|--------------------|---------------------|----------------------|
| 2.200.000 t Load Granted in Resolution No. 0032 of 2012 | 10.7 | 5.5 | 0.6 |
| 1.400.000 t. Loose Load and Bulk requested. Year 2018 projection | 6.8 | 3.5 | 0.4 |
| 2.927.464 t. Loose Load and Bulk requested. Year 2030 projection | 14.3 | 7.3 | 0.7 |

Source: Araujo & Barra, 2009 modified by Aqua & Terra Consultores Asociados S.A.S., 2015

The US EPA has not established emission factors with control systems.

7.6.5 Emission control systems and measures to prevent the emission of particulate material into the atmosphere

To reduce or avoid atmospheric emissions such as particulate material and dust in the storage silos loading processes, hose filters and vents will be installed as dust extractors, in order to prevent the formation of an explosive atmosphere in the silos and in the confined conveyor belt system, which is the biggest risk of handling dry cargoes.

The operation of the cranes to be used in the unloading will be completely covered and will be equipped with vacuum suction systems, supported by a pneumatic system associated to them.

It is worth mentioning that the solid bulk storage will be carried out in a closed system, which will have a vertical silos battery configuration area, in order to avoid the generation of particulate material emissions to the environment.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 78 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

Below are some filters that may be used by the project, which are used as control techniques for particles emitted by a pollutant source ⁶⁷.

Hose collectors

Hose collectors provide a complete line of solutions to handle, from annoying fine particles, to extremely heavy loads of these.

A variety of materials have been developed for the filter hose, so that the collectors are suitable for almost any fine particle collection application, including wet, chemical and high temperature applications⁶⁸ (see Figure No. 7.20).

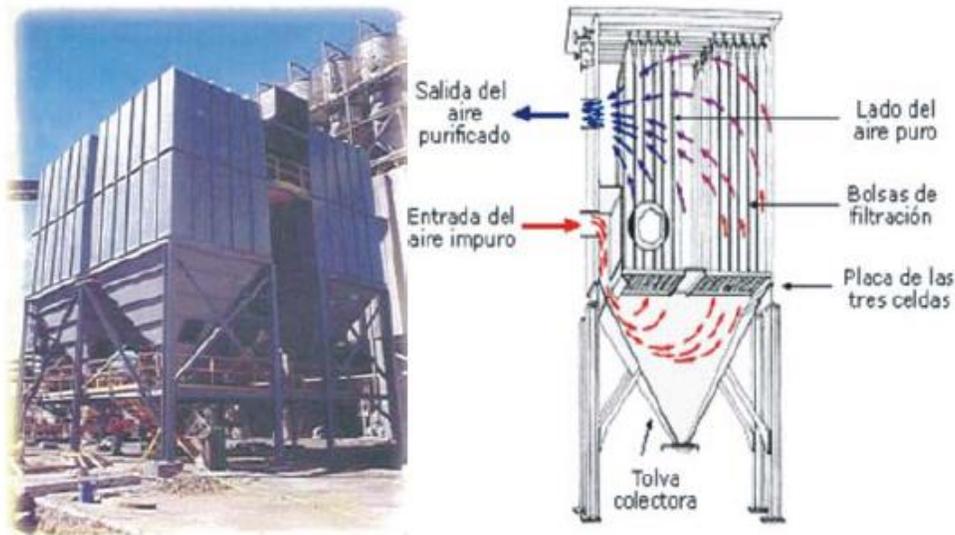


Figure No. 7.19 Hose collectors
Source: Directorate of Sustainable Sector Development, et al., 2004⁶⁹

Electrostatic Precipitators

⁶⁷ DIRECTORATE OF SUSTAINABLE SECTORIAL DEVELOPMENT; MINISTRY OF ENVIRONMENT, HOUSING AND TERRITORIAL DEVELOPMENT, MINISTRY OF TRANSPORTATION. Port Terminal Environmental Guide. Bogotá D.C., 2004. 441 p. ISBN:958973-93-3-4

⁶⁸ Ibid.

⁶⁹ Ibid.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 79 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

Electrostatic precipitators (PES) capture the solid particles in a gas flow by means of electricity. The PES charges the particles with electricity, attracting them to metal plates with opposite charges located in the precipitator. The particles are removed from the plates by "dry blows" and collected in a hopper located in the lower part of the unit⁷⁰ (see Figure No. 7.21).

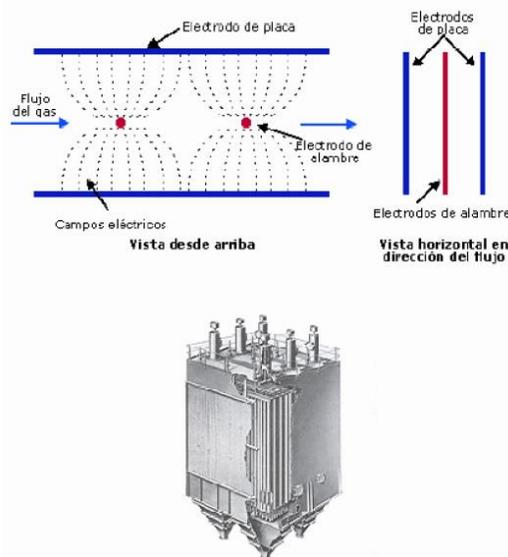


Figure No. 7.20 Electrostatic Precipitators
Source: Directorate of Sustainable Sector Development, et al., 2004⁷¹

Recognizing the possible impact dimensioned, it is planned to implement the following measures to prevent the emission of particulate material into the atmosphere:

- The cranes used for the unloading will be completely covered and will be equipped with vacuum suction systems, supported by a pneumatic system associated to them.

⁷⁰ Ibid

⁷¹ Ibid.

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|  | <p align="center">MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p align="center">ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p align="center">Page 80 of 86</p> |
| | <p align="center">GAT-391-15-CA-AM-PIO-01</p> | <p>Review: <input type="checkbox"/></p> |

- The conveyor belt will be continuously confined with a cover. For the number of fines (high to medium) susceptible to be generated, it is worth implementing closures for the belt in all transfers of the conveyor belt and obviously integrated hose filters as a single piece, for the control of particulate material.
- The conveyor belts to the silos and to the truck loading station will also be completely covered.
- The bucket elevators will be completely covered.
- The silos of the grains will be equipped with aeration, cooling, sweeping, brushing and vacuum systems, which must be provided when necessary. They will also be equipped with an inert gas system inside, in order to avoid the auto ignition of the grains and necessarily the increase of humidity inside the same.
- The transfer will be made between the side of the ship, which will arrive at dock 1B, 2B and 1D and the onshore facilities with specialized vehicles to transport solid bulk cargoes.
- The objects and products that are inside the port facilities must be maintained in perfect conditions of cleanliness and logical order, to prevent the introduction of pests.

In Resolution 909 of 2008 of the Ministry of Environment, Housing and Territorial Development, it is established in Art. 6, for "*any plant or facility in which the grain is unloaded, processed, cleaned, dried, stored or loaded*" of the milling industry, as well as for "*loading or unloading stations of trucks, barges and ships, railway wagons, grain dryers and grain handling operations ...*" of the same industry, the obligation to monitor its emissions of particulate material, complying with the permissible limit of 150 mg / m³ for flows ≤ 0.5 kg / h and 50 mg / m³ otherwise > 0.5, at 25 ° C and 101.325 kPa (limits established for new installations).

Due to the above, a monitoring program for particulate material emissions will be implemented, as presented in the corresponding sheet of the Project Monitoring and Monitoring Plan, in Chapter 11 Plans and Programs, of this environmental impact study.

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 81 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

7.6.6 *Treatment and final disposal of the material collected by the control equipment*

The solid waste generated by the control equipment during the operation of the solid bulk cargoes, such as particulate materials and dust, periodically, must be removed from the filters, as well as other waste resulting from the operation, in addition to the change of decks in poor condition.

The waste generated and coming from organic materials, according to the type of cargo that will be handled in the port, were classified as ordinary waste, which will be temporarily stored in the onshore terminal, where they must be covered and closed for later delivery to an external environmental manager, who must have a valid environmental license to manage and dispose of said waste.

7.6.7 *Air quality in the area of interest*

The compilation of the air quality information recorded in the Environmental Impact Study⁷² was carried out with which the Environmental License for the project was obtained, through Resolution No. 0032 of 2012⁷³ and presented in Chapter 5 in the Characterization of the area of influence, of the current environmental impact study.

It is worth mentioning that air quality monitoring was not carried out, since the conditions of the intervention area did not vary according to the characteristics of the study area.

Comparing the monitoring carried out in 2009 for the activities of the port, with the atmospheric conditions and the generation sources in the 2015 designs, there are no significant variations in terms of infrastructure, industries, vehicular flow and other emission sources that may cause variations in pollution to the environment; therefore, it was considered that it was not representative to perform additional air quality monitoring for the modification of environmental license.

⁷² PUERTO BAHÍA COLOMBIA DE URABA S.A. & ARAÚJO IBARRA & ASOCIADOS S.A., 2010. Op Cit.

⁷³ COLOMBIA. AUTORIDAD NACIONAL DE LICENCIAS AMBIENTALES – ANLA. Resolution No. 0032 (January 25, 2012) Op Cit.

| | | |
|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 82 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

The company Air Clean Systems S.A. (ACS SA) was in charge of carrying out air quality monitoring in the period between September 24 and October 4, 2009 (10 continuous days), in 3 stations of the Project site⁷⁴, whose methodology and results are presented in Chapters 2 in Generality and Chapter 5 in Characterization of the area of influence of the present environmental study.

The main conclusions indicated low levels of suspended particles (TSP and PM10), as well as very low levels of SO₂ and NO₂ (more than 75% of the values below the level of analytical detection) and low levels of CO, although indicators of anthropic activities in the sector.

7.7 Construction materials

7.7.1 Acquisition of material in existing sources

For the construction of the infrastructure associated with the project, the acquisition of materials from existing sources close to the project is planned.

The sands and gravels will be acquired from the Diseños, Agregados y Construcciones de Urabá S.A.S. (D.A. & C. DE URABA S.A.S.) quarry, located on Calle 80, km 1.5 Via Piedras Blancas-Carepa (Antioquia), which meets the legal and environmental requirements for the exploitation of the required materials.

Below is the detailed information of the mining areas concessioned to the aforementioned quarry:

- Mining title and Environmental License of the D.A. & C. DE URABA S.A.S quarry

⁷⁴ AIR CLEAN SYSTEMS S.A. (ACS). Air quality evaluation report for Puerto Bahía Colombia de Urabá S.A. ACS ICA 126. October 2009.

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|---|---|---|
|  | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 83 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

- National Mining Registry HJBL-07 of December 29, 2009, through which the mining title No. 7693 of December 09, 2008 is registered, under which it is authorized in an extension of 1,410.94 hectares, located in the Municipality of Carepa (Antioquia), the technical exploration and economic exploitation of trawls and other concessions. Below are some photographs of the area (see Photo No. 7.2)



Photograph No. 7.2. Area 7693 - Carepa (Antioquia)

Source: D.A & C DE URABA S.A.S (2015)

The contract was initially signed by OLGA LUCIA MARTINEZ RESTREPO, who ceded all the mining rights, in 2009, to Mrs. LUISA FERNANDA ZAPATA RUIZ, legal representative of D.A. & C. DE URABA S.A.S. This assignment was authorized by the mining title director of the Ministry of Mines of the department of Antioquia, through Resolution 3985 of February 03, 2010. In said act it is clarified

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 84 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

that at all times, the new owner will comply with the provisions of the Environmental License granted by Resolution 200-03-20-02-0787-2012, issued by CORPOURABÁ and modified in 2013 by Resolution 200-03-20-01-0146-2013 of the same entity (see Annex 7.6. existing material sources).

- The National Mining Registry HHVN-02 of December 18, 2007, corresponds to the mining title No. 7697 of November 13, 2007, granted by the Government of Antioquia, in 2007, to Mrs. OLGA LUCÍA MARTINEZ RESTREPO, under the which is granted the use of 1,324,600 hectares, in the Municipality of Turbo (Antioquia), for the technical exploration and economic exploitation of a natural sand and gravel mine. Below are some photographs of the area (see Photo No. 7.3).



Photograph No. 7.3. Area 7697 - Turbo (Antioquia)

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|---|--|---|
|  | MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO |  |
| | ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT | Page 85 of 86 |
| | GAT-391-15-CA-AM-PIO-01 | Review: |

Source: D.A & C DE URABA S.A.S (2015)

Likewise, the title was assigned to Mrs. LUISA FERNANDA ZAPATA RUIZ, legal representative of D.A. & C. DE URABA S.A.S., in 2010. This assignment was authorized by the mining title director of the Ministry of Mines of the Department of Antioquia, through Resolution 3983 of February 03, 2010 (see Annex 7.6 Sources of existing material)

- Relation of types of material required in the work

It is estimated that the total volume of concrete used for the works will be 123,018 m³, for which 90,665 m³ of sand and 90,665 m³ of gravel are required, considering a 10% excess material as a factor of safety against possible losses during handling.

- Availability of the materials required in the material sources

The D.A. & C. DE URABA S.A.S quarry is a producer of sand for concrete, sand for glue, sand for plaster, stones for gabion, gravel, grit, pedraplen, raw material, and different granulometries crushed. For which they have a mining title on two areas.

In the first: Mining Title No. 7693, used for the extraction of trawl materials, the proved reserves are of eighteen million cubic meters (18,000,000 m³). In the second area: Mining Title No. 7697, used for the extraction of natural sands and gravel, there are four million cubic meters (4,000,000 m³). (See Annex 7.6.) Sources of existing material)

- Location and access route between the project and the material source

Finally, Figure No. 7.22 shows the communication routes for the transportation of the material between the quarry and the construction site of the "Puerto Antioquia" Port Terminal in the municipality of Turbo, in the district of Nueva Colonia.

| | | |
|---|---|---|
|  | <p>MODIFICATION OF ENVIRONMENTAL LICENSE FOR THE CONSTRUCTION AND OPERATION PROJECT OF A PORT TERMINAL OF SOLID BULK CARGOES IN THE MUNICIPALITY OF TURBO</p> |  |
| | <p>ENVIRONMENTAL ZONING, DEMAND, USE, EXPLOITATION AND / OR AFFECTATION OF NATURAL RESOURCES, ENVIRONMENTAL ASSESSMENT, ENVIRONMENTAL MANAGEMENT ZONING, ECONOMIC ENVIRONMENTAL ASSESSMENT</p> | <p>Page 86 of 86</p> |
| | <p>GAT-391-15-CA-AM-PIO-01</p> | <p>Review:</p> |

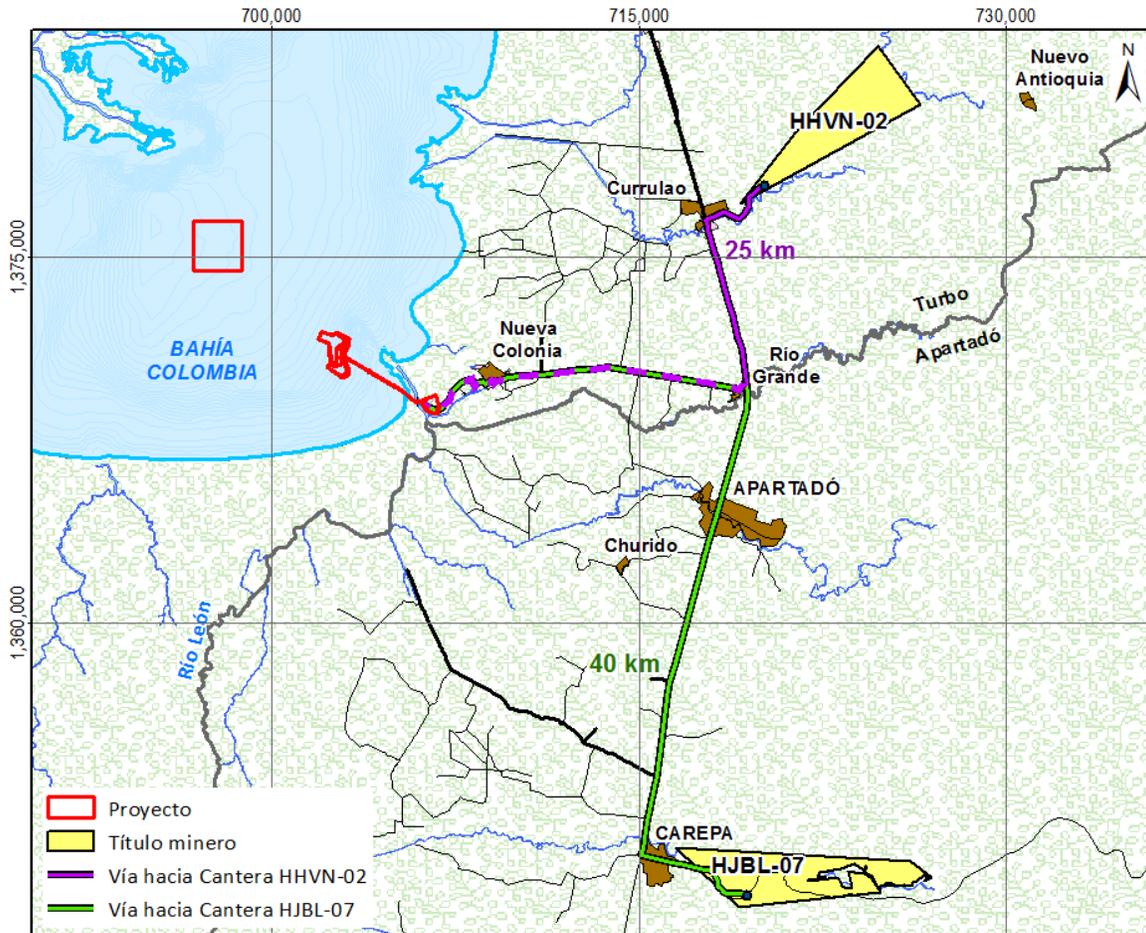


Figure No. 7.21 Communication routes between sources of material and project
Source: Aqua & Terra Consultores Asociados S.A.S., 2015