GRAND PORT. DESIGN GUIDELINES

WATER SUPPLY, FIRE PROTECTION, WASTEWATER, IRRIGATION & STORMWATER

PRINCIPLES FOR WATER MANAGEMENT IN GRAND PORT

Water sources for Grand Port:

Grand Port's potable water was planned to be supplied fully by Grand Bahama Utility Company (GBUC). However, considering the impacts of hurricane Dorian on GBUC's well fields, Grand Port has decided to invest in an on-site Sea Water Reverse Osmosis (SWRO) desalination system sized to be able to supply Grand Port's total demand of potable water. Both the SWRO and the wastewater treatment systems will be the responsibility of Grand Port.

Considering Grand Port's commitment to preserve Grand Bahama's natural resources, a water conservation program will be implemented, which amongst other measures will include the use of alternative sources for certain non-potable uses: rainwater harvesting, the high quality permeate (treated effluent) of the wastewater treatment plant with Membrane Bioreactor Technology (MBR)[1] and groundwater from some wells. This water conservation program will also contribute to important operational costs savings.

Water Management in Grand Port will be based upon assigning to each use the source of water which quality is more appropriate for it, preserving for the highest quality requirements the desalinated water.

Designated water uses for each source:

The designated uses for these water sources are:

1. Desalinated water. Drinking, ice production, hand washing and Recreational Water Facilities.
2. Rainwater harvested from the roofs of the buildings. Toilet flushing. Could be also utilized in certain areas for irrigation.
3. MBR permeate. Irrigation in those areas with less potential of contact with guests and staff.[2]
4. Groundwater. Some wells could be also drilled to supply water for firefighting and irrigation for certain areas.

[1] MBRs wastewater treatment systems have been installed in 3 of GPDDG ports: GTCC, PM and AC.

[2] Although the quality of the MBR permeate is safe for irrigation in all areas, GPDDG has established stricter guidelines avoiding the risk of contact between guests/staff and permeate. This risk could be minimized by using appropriate irrigation technologies.

The distribution system for each type of water shall be color coded to prevent cross contamination. The designer shall submit for approval a coloring code. This code must be available for all commercially manufactured pipe.

Appendix DG-1 shows the drawings of all the utilities described in this section

Storage management

These three different quality water sources should be stored in completely separate tanks/cisterns within the property and should never be blended in the same tank except at the point of use, where potable water may be needed to supplement lesser quality water.

POTABLE WATER SYSTEMS

The following section sets out basic Public Health Guidelines for Grand Port's potable water systems as an important part of Grand Port's water safety plan intended to ensure the safety and acceptability of drinking water in Grand Port. For aspects not included in these guidelines the designer must follow the Florida Building Code or the Bahamas Building Code (the one that is stricter).

Water Supply

Drinking water supplied to Grand Port must be from a potable source that meets World Health Organization standards for potable water and the standards provided in Exhibit 1, whichever are more restrictive standards shall apply.

Potable water treatment

1. Potable water treatment systems should be designed to achieve drinking water quality in compliance with Exhibit 1. The microbiological quality of the treated water entering Grand Port's distribution system, the treated water in Grand Port's distribution system and all water directly intended for drinking in Grand Port, should fully comply with the WHO standards for microbiological quality. These standards require that *E. coli*, must not be detectable in any sample as detailed in the table 1 below:

Table 1. WHO Guideline values for verification of microbial quality[3]

Organisms	Guideline value
All water directly intended for drinking *E. coli* bacteria	Must not be detectable in any 100-ml sample
Treated water entering the distribution system *E. coli* bacteria	Must not be detectable in any 100-ml sample
Treated water in the distribution system *E. coli* bacteria	Must not be detectable in any 100-ml sample

[3] Adapted from Table 7.10 Guideline values for verification of microbiological quality. Guidelines for Drinking-water quality. Fourth edition incorporating the first addendum. WHO, 2017.

2. Potable water treatment systems should be designed specifically according to the characterization of the quality the water source[4]. Those treatment systems should be approved by the Global Port Development and Destination Group. Water sources from different qualities shouldn't be blended in the same tank/cisterns. More specifically, harvested rainwater (even treated) and other potable water sources should never be blended except at the point of use, where potable water may be needed to supplement lesser quality water

3. Potable water must be continuously chlorinated to at least 2.0 mg/L (ppm) free residual chlorine at where it enters the Grand Port site or during production at Grand Port with an automatic chlorination device. The water pH must be adjusted so it does not exceed a level of 7.8 or go below 7.0. Potable water should be brought directly to the central storage tank and provided both pre- and post-storage chemical treatment in this area

4. Provide an analyzer controlled, automatic chlorination system. Install the analyzer probe sample point at least 3 meters (10 feet) downstream of the chlorine injection point and piping must include a static mixer or other approved device to insure proper mixing.

5. Use probes to measure free chlorine levels and link them to the analyzer/controller and chemical dosing pumps.

6. Provide a back-up chlorination pump with an automatic switchover that begins pumping chlorine when the primary (in-use) pump fails or cannot meet the chlorination demand.

7. Provide automatic pH adjustment equipment. Install analyzer, controller, and dosing pumps that are designed to accommodate changes in flow rates.

8. The chemical feed/storage room must include provision for proper ventilation. This may include exhaust hoods above all chemical storage and/or feed equipment. Locating chemical storage in a secure area outside of the chemical feed room is acceptable.

Potable Water Tanks/Cisterns

1**.**The size of the potable water storage tank should provide a minimum of 2 days of potable water storage in addition to the required fire protection storage. Based on 15 gal-pax/day with a max facility capacity of 2 ships x 6000pax+2 ships x 1500crew= ~15000 x15 = 225,000 gpd. So, a storage tank with 450,000 gal. PLUS fire flow, is required. However, if the seawater in the canal is approved as a source for firefighting, the additional storage associated to fire flow could be reduced significantly.

2. The size of the potable water storage tank does not include the volume needed for bunkering at this port. Corporate vessels will require bunkering, but Grand Port will not be responsible for supplying potable water for the ships. This will be a direct agreement between GBUC and the Cruise Lines. Grand

[4] In all GPDDG ports in the Caribbean and Central America potable water is disinfected by a CULLIGAN analysis/dosing/recording system comprised of Shipboard-style equipment. Additional potable water treatment may be required depending on the specific water quality of the source

Port will designate the location of the bunkering potable water supply line in the site plan, but conveyance, storage, treatment etc. will be designed and built by GBUC and located outside the property.

3. The interior surface/coating of all potable water storage tanks must be approved for potable water contact by NSF/ANSI Standard 61. Any proposed coating must be submitted during design for approval. In addition, all items that penetrate the tank (e.g., bolts, pipes, pipe flanges) must be coated or lined with the same product used for the tank's interior.

4. All of the supplier or manufacturer's recommendations for applying, drying, and curing the tank coatings must be followed. In addition, the following records must be held on site for the potable water tank coatings:

- Written documentation of the approval from the certification organization (independent of the coating manufacturer).
- The manufacturer's recommendations for applying, drying, and curing.
- Written documentation that the manufacturer's recommendations have been followed for applying, drying, and curing.

5. Ensure that all suction lines within potable water storage tanks are located at least 150 millimeters (mm) or 6 inches from the tank bottom or sump bottom. Any suction pipe greater than 200 mm (8-inches) in diameter must include anti-vortexing device.

6. Ensure that an access hatch for entry into the tanks is installed and provides a secure waterproof seal to protect the tank from contamination.

7. Do not install any storage tanks or pipes containing non-potable liquids (for example waste or gray water) directly over any potable water tanks.

8. Ideally, potable water tanks should be built underground.

9. Size potable water pumps to meet the Grand Port facilities maximum capacity service demands (TBD). Do not use the potable water pumps for any other purpose. All pumping systems shall incorporate variable speed drives with capabilities for PID loop pressure control. All pump controls should include provisions for remote control from the main control room.

10. Properly size potable water pumps and distribution lines so that pressure is maintained at all times and at levels to properly operate all water outlets and equipment.

11. Clean, disinfect and flush all potable water tanks before being placed in service.

12. All cisterns must be equipped with level transducers that can provide an analog signal to the main control room.

Potable water distribution systems

1. The water distribution system should have a loop-network topology with no dead ends. Five complete loops are envisioned with a recirculation pump in each primary loop. The exact location of these recirculation pumps will be determined when a more detailed site plan is available.

2. Valves allowing periodic disinfection of the entire water distribution system should be installed in several points of the network.

3. Ensure a detailed diagram of potable water distribution system showing all locations and potable water equipment/installations positions is provided.

4. Potable water lines must be laid at least 10 feet (3 meters) horizontally from any sewer. This distance should be measured from edge to edge. Vertical separation from the bottom of the potable water line and top of the sewer should be 12 inches. Any deviation from these guidelines should be reviewed and approved by the Global Port Development and Destination Group on a case-by-case basis.

5. All pressure mains shall be HDPE DR11.

6. All pipes should be cleaned and pressure tested. Once approved, disinfect and flush all parts of the water distribution system before the system is placed in service.

7. Do not use lead, cadmium, or other hazardous materials for pipes, fittings, or solder.

8. Paint or stripe potable water piping and fittings blue only at 5-meter (15-foot) intervals.

9. Locate chlorine analyzer(s) at the location of the recirculation pump(s).

10. Provide a visual alarm in the control room to indicate low or high free chlorine readings at the distant point analyzer.

11. All valves need to be non-metallic. Epoxy coated valves and parts will not be accepted. All ball valves shall be true union for servicing with EPDM elastomers. To the greatest extent, all valves shall be from the same manufacturer. All isolation valves for filling tanks need to include electric actuators with the ability to be controlled from the main control room.

12. Bunkering of potable water for ships could be added to this facility. Provisions need to be included for a separate pipeline to the pier for this purpose only.

Backflow Prevention and Cross Connection Control[5]

1. Use appropriate backflow prevention at all cross connections including any outlets or connections to the potable water system where there is a potential health hazard. This may include non -mechanical protection such as an air gap or a mechanical backflow prevention device. Air gaps should ideally be used where feasible and when water under pressure is not required.

[5] Cross-Connection Control Manual. USEPA. 2003

2. In particular if any of the following items are connected to the potable water system then it must be protected against backflow (back siphonage or backpressure) with either air gaps[6], or mechanical backflow prevention devices:

- Any connections to waste water (sewage or gray water) systems. Note: An air gap only must be used for these connections.
- Pumps that require priming.
- Boiler feed water tanks.
- Decorative water features and fountains.
- Food service equipment such as ice machines, coffee machines, some beverage dispensers, combination ovens and similar equipment.
- Any hose-bib connections, hose lines used for cleaning and kitchen pot wash spray hoses.
- Mechanical ware washing machines.
- Swimming pools and any other recreational water facilities.
- Public toilets, shower heads and water fed urinals.
- Detergent dispensers.
- Any water softener and mineralizer drains.
- Fire systems.
- Any other connection to the potable water system where contamination or backflow can occur.

Water distribution system components

Ideally all the components of the water distribution systems should be non-corrosive and must comply with NSF/ANSI Standard 61: Drinking Water System Components[7]. These components include but are not limited to:

- Protective barrier materials (cements, paints, coatings)
- Joining and sealing materials (gaskets, adhesives, lubricants)
- Mechanical devices (water meters, valves, filters)
- Pipes and related products (pipe, hose, fittings)
- Plumbing devices (faucets, drinking fountains)
- Process media (filter media, ion exchange resins)
- Non-metallic potable water materials

Exceptions must be approved by the Global Port Development and Destination Group.

SWRO DESALINATION SYSTEM

The SWRO desalination plant will be located at the back of the house. Feed water will be supplied by a well located within the property and the concentrate will be disposed by a well that will be sized to accommodate disposal of both concentrate and the effluent from the wastewater treatment plant. The

[6] The air gap must be 2 times the inside pipe diameter or a 25mm (1") minimum distance
[7] http://www.nsf.org/services/by-industry/water-wastewater/municipal-water-treatment/nsf-ansi-standard-61

proposed location of both the feed and the disposal wells will be finally determined based upon the results of the hydrogeological study.

RAINWATER HARVESTING

Sources of water for toilet flushing and other non-potable uses such as irrigation for certain areas: Rainwater supplemented with potable water when required.

Catchment areas considered for these guidelines: The roofs of the buildings only.

Collection, storage, distribution and treatment

1. Rainwater should be stored in independent buried tanks/cisterns completely separate from the potable water tanks/cisterns. Due to Grand Port's significant area and dispersion of facilities and to maximize collection, multiple rainwater tanks/cisterns should be located as close as possible to the associated catchment areas and the facilities using rainwater harvesting: mainly bathrooms. In general, the use for irrigation should not define the location of rainwater tanks/cisterns. It is suggested in general to use the tanks/cisterns designated for toilet flushing for the irrigation of close-by landscape areas using portable submersible pumps and hoses.

2. Equipment to minimize organic matter input into the rainwater tank, such as gutter screens, first flush diverters, pre-filters, downspout filters, pre-tank filters and others should be conveniently installed in the collection system.[8]

3. The rainwater tanks/cisterns should be equipped with a calming inlet and an overflow conveyance siphon. Evaluate the feasibility of using a floating inlet filter[9].

4. Automated potable water make-up water connections (to supplement rainwater when required) will be provided and will always have an air gap.[10] Automated connections need to include the ability to be controlled from the main control room.

5. Pipelines supplying water for toilet flushing should be independent from potable water lines.

6. The rainwater distribution pipework should be separate from potable water piping and not installed above potable water tanks or piping.

7. Paint or stripe rainwater water piping and fittings safety gray only at 5-meter (15-foot) intervals.

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[8] See examples in: http://www.smartwatersolutions.net/RainStore-RWH-Product-Catalog.pdf

[9] Idem

[10] The air gap must be 2 times the inside pipe diameter or a 25mm (1") minimum distance

8. If the pipes conveying rainwater have to be installed in parallel with potable lines, they should be installed in separate trenches.

9. All buildings shall have dual plumbing systems to allow non-potable water use for toilets and localized irrigation systems.

10. The disinfection system (by chlorination) should be designed to guarantee that rainwater is free from E.Coli.

System components for rainwater harvesting

Although system components are not required to comply with NSF/ANSI Standard 61 (Drinking Water System Components), it is recommended to be guided in the selection of the system components by the NSF Rainwater Catchment System Components program[11]

IRRIGATION SYSTEMS

1. Grand Port's irrigation system should be divided in two independent sectors, which should be further defined as the site plan is further developed:

   SECTOR 1. LANDSCAPE AREAS OF MAIN GUESTS ACTIVITIES. Source of water: Rainwater supplemented with groundwater and potable water when required or by potable water or groundwater in zones where rainwater catchment is not feasible and irrigation is required.

   SECTOR 2. LANDSCAPE AREAS SURROUNDING AREAS WITH LESS INTERACTION WITH GUEST ACTIVITIES. (mainly back of the house). Treated wastewater (permeate) from the MBR wastewater treatment system. If supplemental potable water is needed, it should be provided through an air gap connection to the effluent holding tank.

2. Connections between both systems should be avoided and exceptionally approved by the Global Port Development and Destination Group.

3. The landscaping contractor shall be responsible for designing the irrigation piping and pumping systems and coordinating these with the rainwater catchment systems, potable water lines and back of house reuse water lines.

4. Landscaping shall be designed around native species to limit water requirements and issues with salinity.

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[11] This program establishes testing guidelines for products such as roofing materials and coatings to confirm that they do not impart contaminants into the water at levels that exceed U.S. Environmental Protection Agency (EPA) health guidelines. See: http://www.nsf.org/consumer-resources/environment/rainwater-collection ; http://info.nsf.org/Certified/Protocols/Listings.asp?TradeName=&Standard=P151 and https://www.nsf.org/newsroom_pdf/water_rainwater_catchment.pdf

5. Consider maximizing drip irrigation and/or subsurface irrigation systems to avoid spraying surrounding areas with irrigation water and to minimize water consumption. Sprinklers, if required for landscape irrigation should be utilized in the areas with less interaction with guests and staff. Sprinklers must be avoided in pool areas.

6. Paint or stripe treated wastewater permeate water piping and fittings purple only at 5-meter (15-foot) intervals.

WASTEWATER SYSTEMS

The following section sets out basic Design Guidelines for Grand Port's wastewater systems. For aspects not included in these guidelines the designer must follow the Florida Building Code or the Bahamas Building Code (whichever one that is stricter).

Wastewater Collection

Lift Stations:

1. Wastewater collection systems will be designed utilizing grinder pumping systems fitted with duplex pumps and automated level controls.

2. A telemetry system shall be provided that allows remote monitoring and alarming of each station.

3. Pumping stations will be located so as to minimize the potential for stormwater infiltration. The top of tank will be a minimum of 6" above the surrounding grade.

4. Due to the high groundwater table, pumping stations will be designed to assure water tightness and buoyancy calculations shall be based on the 100-year flood elevation.

5. Pumping stations shall be designed using the minimum volume required for pump cycling and gravity inlets to avoid holding sewage any longer than necessary.

6. Gravity collection of waste is preferred where feasible to minimize the number of lift stations required. However, given the high ground water table, deep manholes should be avoided. It is anticipated that small localized grinder stations will be required.

Pipelines:

1. Force mains and gravity collection mains shall be HDPE or Schedule 80 PVC. Ductile iron piping will not be permitted.

2. Paint or stripe wastewater collection piping and fittings brown only at 5-meter (15-foot) intervals.

Grease traps:

1. Grease traps will be provided at every restaurant, no toilets or floor drains shall connect with the grease traps. Only food preparation sinks shall be connected.

2. Kitchen facilities will not have in sink grinders. Food waste will be collected in bins and all restaurants will have a small concrete solid trap. These solid traps should be cleaned simultaneously with the outdoors grease trap.

3. Grease traps should be located just outside the restaurant or kitchen in an easily accessible location out of the way of normal traffic. The trap must not be located in flood prone areas. The grease trap should be located downstream of the solid trap.

4. Even when under-sink grease interceptors are installed near kitchen fixtures, each restaurant must have an outdoor grease trap to prevent fats, oil and grease to enter into the collection system.

5. The selection of under-sink grease interceptors should be carried out by the restaurant lessor once the internal plumbing of the restaurant is designed. This selection must be approved by the Global Port Development and Destination Group.

6. Schier (http://www.schierproducts.com/) provides a wide range of products and clear methodologies for the right selection according to the conditions of each application.

7. Prohibited Discharges into the Grease Traps

    a. Sanitary wastewater (blackwater) shall connect to the drain line downstream of the grease trap.

    b. As stated above, garbage grinders are not permitted.

Wastewater Treatment

1. It is Carnival’s policy to utilize membrane bioreactor (MBR) technology to treat the wastewater generated on site. While the Bahamian standard is less stringent, the treatment requirements set forth by Carnival are intended to exceed the standard set in the United States. These requirements are provided in Table 1.

Table 1. EFFLUENT REQUIREMENTS

	Effluent
Ave. Annual Daily Flow, GPD	**TBD**
cBOD5	<10 mg/L
TSS	<2 mg/L
TKN	<30 mg/L
NH3-N	<2 mg/L
TP	<10 mg/L
FOG	<15 mg/L
Max. Water Temp	30 °C
Min. Water Temp	24 °C
E.Coli	<25 mpn

2. A single wastewater treatment plant will be provided in the back of house area.
3. The wastewater treatment plant will include an equalization tank sized to store the peak day flow, or a minimum 20,000 gallons, whichever is greater.
4. A telemetry system shall be provided that allows remote monitoring and alarming of the wastewater plant
5. A dual sludge dewatering box system, similar to that provided at Amber Cove, will be provided.
6. Access to the wastewater plant must be designed to facilitate truck access to the sludge boxes.
7. Effluent disinfection will include sodium hypochlorite and ultraviolet.
8. Influent fine screen shall be a perforated drum, self-cleaning rotary screen.
9. Per Bahamian requirements, a deep disposal well will be required.
10. The disposal well will be sized and located to accommodate disposal of both effluent and concentrate from the on-site SWRO plant. The proposed location of this well will be finally determined based upon the results of the Hydrogeological study.

Effluent Storage Tanks

1. Effluent storage will be provided to facilitate reuse of effluent for irrigating the back of house areas.
2. Effluent storage will be covered to limit algae growth. Ideally tanks should be built underground.
3. A minimum of 1 day of storage shall be provided.
4. All of the supplier or manufacturer's recommendations for applying, drying, and curing the tank coatings must be followed. In addition, the following records must be held on site for the tank coatings:

    - The manufacturer's recommendations for applying, drying, and curing.
    - Written documentation that the manufacturer's recommendations have been followed for applying, drying, and curing.

5. Ensure that all suction lines within storage tanks are located at least 150 millimeters (mm) or 6 inches from the tank bottom or sump bottom. Any suction pipe greater than 200 mm (8-inches) in diameter must include anti-vortexing device.
6. Ensure that an access hatch for entry into the tanks is installed and provides a secure waterproof seal to protect the tank from contamination.
7. Do not install any storage tanks or pipes containing non-potable liquids (for example waste or gray water) directly over any potable water tanks.
8. Ideally, irrigation water storage tanks should be built underground.
9. Properly size reuse pumps and distribution lines so that pressure is maintained at all times and at levels to properly operate all water outlets and equipment.
10. All cisterns must be equipped with level transducers that can provide an analog signal to the main control room.

FIRE PROTECTION

1. Design builder will be directed to design the fire system to comply with Florida Fire Protection Code (6th edition) and the Bahamian building code, whichever is more restrictive.
2. Design builder shall designate an Engineer of Record for the Fire Protection System who is qualified to design a compliant system.

3. System shall, as a minimum:

    1. Include fire hydrants spaced no further apart than 300 ft. and no further than 300 feet from any structure.
    2. Potable water distribution piping shall be sized to accommodate fire flow. As minimum, a 6” distribution pipe should be provided anywhere where hydrants are placed. The possibility of supplying firefighting with seawater from the canal or with groundwater from certain wells will be considered during the detailed design phase. If approved this latter option will imply a reduction of the pipe diameter in most of the water distribution system.
    3. Building sprinkler systems shall be provided where required by Florida Building Code or Bahamian Building Code.
    4. Fire extinguishers should be installed in all food and beverage areas, shops, office spaces, warehouses and other occupied facilities.
    5. A dedicated, diesel driven fire flow pump shall be provided to supplement distribution pumps to provide the higher flow necessary for fire protection.
    6. The potable water storage tank shall provide dedicated storage for fire flow based on the referenced codes. An initial estimate of 100,000 gallons should be considered based on 2,500 gpm for 40 minutes. If the seawater from the canal and/or groundwater from certain wells are approved as sources for firefighting, this volume could be significantly reduced.

STORMWATER MANAGEMENT

The main goals for stormwater management in Grand Port will be:

- To maximize stormwater recharge to the underlying aquifer in order to mitigate the impacts from the canal on the freshwater lens, which, as concluded from the Hydrogeological study implies a movement of the fresh/saltwater interface area several hundred feet landward. Maximizing stormwater recharge will also mitigate the reduction of natural infiltration associated with paved areas, including the access road. This particular aspect can be illustrated by Puerta Maya Cruise Center, in Cozumel (Mexico) with similar geological characteristics than Grand Bahama, where all the runoff of the paved areas is drained by infiltration wells (Appendices DG-2 and DG-3).
- To prevent runoff to be discharged to the canal in order to preserve its water quality. This goal will be achieved by designing the areas surrounding the canal with an adverse slope, diverting runoff away from the canal.

The use of swales and “ponds” is not desirable as they will become mosquito breeding areas. Swales are acceptable for conveyance of storm water, but it should be conveyed, not held.

Runoff will be calculated using the rational method. As in Grand Bahama there are no reliable rainfall Intensity-Duration-Frequency (IDF) records, South Florida records will be utilized. Th design storm event will be a 5-year storm event, although for certain specific areas requiring higher protection against flooding a 10-year storm event could be considered.

Given the geometry of the site, the following should be considered:

1. For the impervious areas north of the lagoon - the back of house, the parking area, shops, etc. – all of the stormwater should be collected and directed to storm drains (drainage wells) per GBPA Building and Sanitary Codes. The GBPA code stipulates the following:

   "Drainage wells to be constructed using an approved drilling contractor, with adequate measures to retain spill water on site. Well to have a minimum diameter of 9-inches and drilled to a minimum depth of 150 ft and verified by Inspector/Engineer of Building & Development Services of the GBPA prior to installation of well casing.

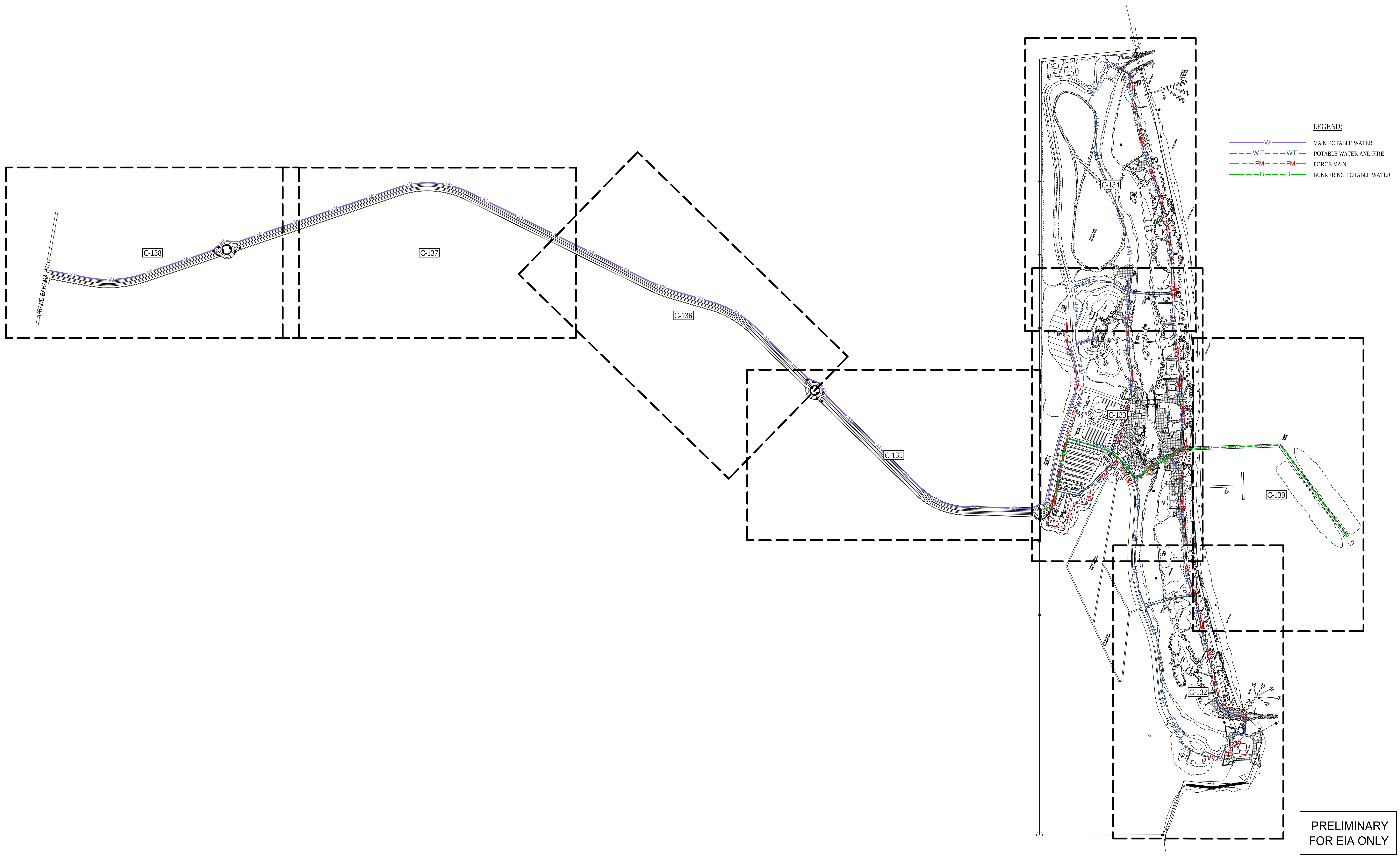
   Casings to be installed and grouted to a minimum depth of 40 ft below the fresh water/ saltwater interface. Building & Development Services of the GBPA to ensure protection of the freshwater table, with an upstand of 6 inches and covered with a mesh basket.
   Catch-pits for the well head to be constructed with concrete of strength 3,000 psi, poured in place, with a minimum dimension of 2-ft width, 3-ft length, 2-ft depth. Frame and covers for catch-pit and wellheads to have a minimum load rating of H-20, and to be of Neenah Foundry, U.S. Foundry or equivalent approved by Building & Development Services of the GBPA."

2. In the portion of the site between the Mini Golf and Beach Volleyball, where there is fairly extensive impervious area:
   a. Grade to storm drainage collection structures and direct flow to drainage wells.
   b. If soils and elevation permit, utilize subsurface drain fields.
3. For the entire site, utilize pervious materials for paths and non-traffic areas wherever feasible.
4. For the roads and paths that are not large impervious areas, use swales to direct excess water away from paths and connect overflow to drainage structures and wells.
5. Drainage will be coordinated with landscape designer to avoid ponding.

Exhibit 1

Water Quality Requirements

Parameter	Potable Water Concentrations
Calcium, mg/l as Ca	<50
Magnesium, mg/l as Mg	<20
Total Hardness, mg/l as $CaCO_3$	80 - 120
Chloride, mg/l as Cl	<150
Total Alkalinity, mg/l as CaCO3	80 - 120
Turbidity, NTU	0 – 2.5
Iron, mg/l as Fe	0.05 – 0.10
Sulfate, mg/l as SO4	<50
Nitrates, mg/l as NO3	<10
Copper, mg/l as Cu	<1.0
Phosphates, mg/l as PO4	<0.10
pH (Field Measurement, pH units)	7.2 – 7.8
Conductivity, µS/cm	<500
Total Dissolved Solids, mg/l as TDS	<250
Sodium, mg/l as Na	<100
Saturation Index, -0.1-+0.5	-0.1 to +0.5
Free Chlorine, mg/l as OCl	2.0
Total THM, ug/l	<50
Hydrogen Sulfide, mg/l as H_2S	<0.01
Color, PCU	<0.1



PRELIMINARY
FOR EIA ONLY

1 OVERALL UTILITY PLAN

0 500 1000 1500

PROJECT NORTH

HASKELL

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-131
AUGUST 30, 2019

LEGEND:

W	MAIN POTABLE WATER
WF	POTABLE WATER AND FIRE
FM	FORCE MAIN
B	BUNKERING POTABLE WATER

NOTES:

1. FIRE AND WATER SERVICES TO EACH BUILDING, CABANA, ETC (AS REQUIRED) WILL BE PROVIDED OFF OF THE LOOPED FIRE AND POTABLE WATER DISTRIBUTION MAIN.

PRELIMINARY FOR EIA ONLY

HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

CARNIVAL

ENVIRONMENTAL IMPACT ASSESSMENT

C-132

AUGUST 30, 2019

PRELIMINARY FOR EIA ONLY

HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-133
AUGUST 30, 2019

PRELIMINARY
FOR EIA ONLY

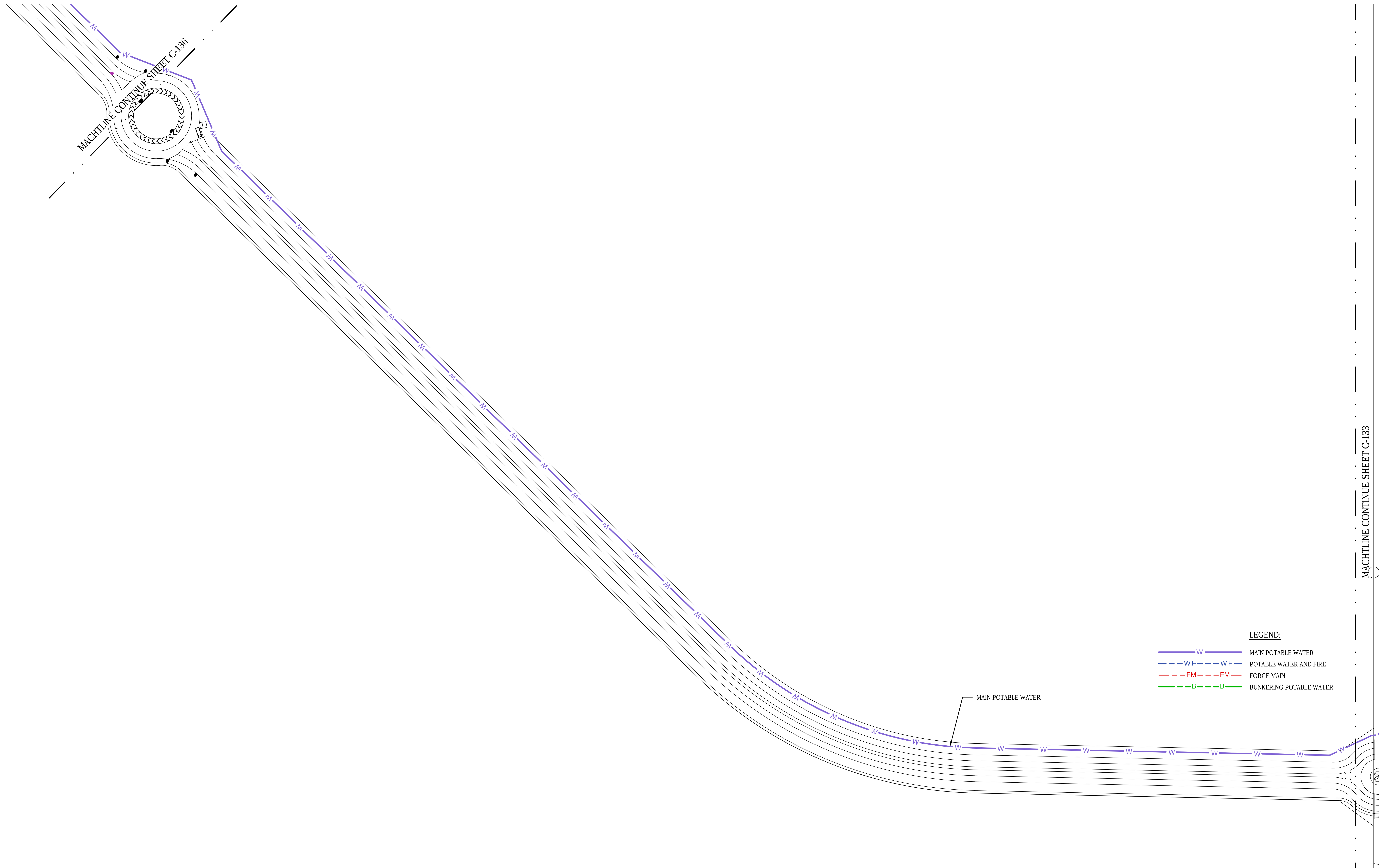
HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT
NORTH

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-134
AUGUST 30, 2019



PRELIMINARY
FOR EIA ONLY

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

HASKELL

CARNIVAL

ENVIRONMENTAL IMPACT ASSESSMENT

C-135

AUGUST 30, 2019

LEGEND:

W	MAIN POTABLE WATER
WF	POTABLE WATER AND FIRE
FM	FORCE MAIN
B	BUNKERING POTABLE WATER

PRELIMINARY
FOR EIA ONLY

HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-136
AUGUST 30, 2019

LEGEND:

W	MAIN POTABLE WATER
WF	POTABLE WATER AND FIRE
FM	FORCE MAIN
B	BUNKERING POTABLE WATER

PRELIMINARY
FOR EIA ONLY

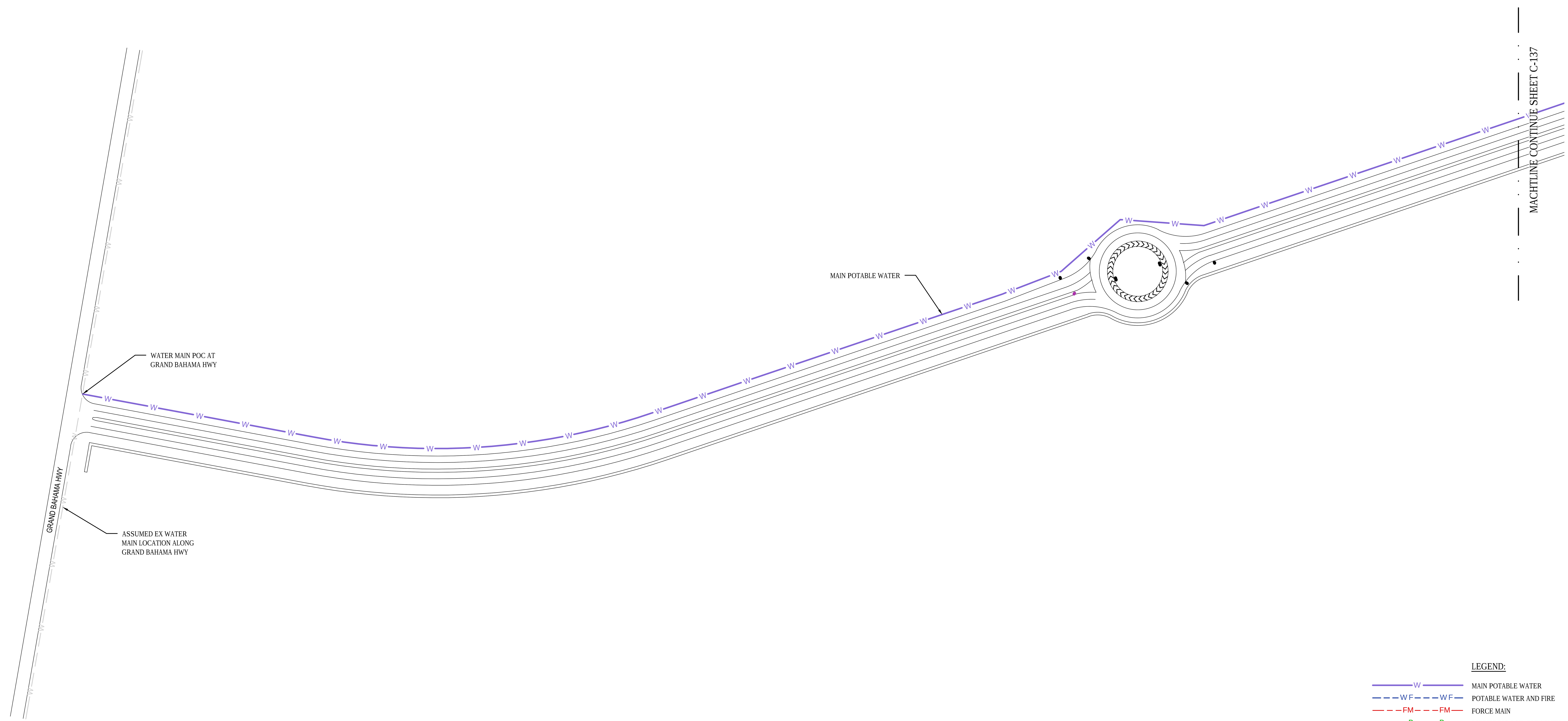
HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-137
AUGUST 30, 2019



PRELIMINARY FOR EIA ONLY

HASKELL

1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-138
AUGUST 30, 2019

PRELIMINARY
FOR EIA ONLY

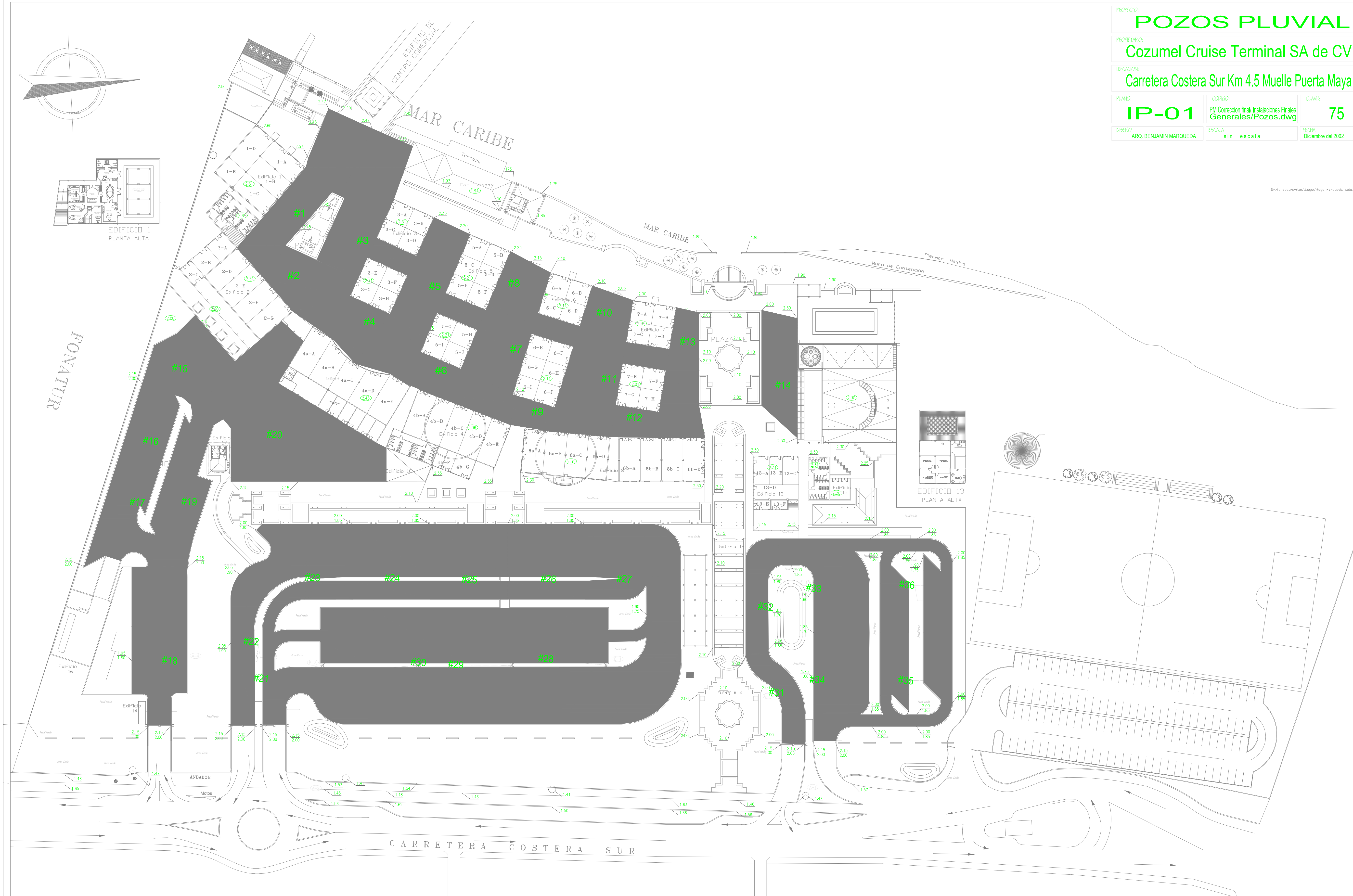
1 UTILITY PLAN

0 100 200 400

PROJECT NORTH

HASKELL

CARNIVAL
ENVIRONMENTAL IMPACT ASSESSMENT
C-139
AUGUST 30, 2019



PROYECTO: **POZOS PLUVIAL**

PROPIETARIO: **Cozumel Cruise Terminal SA de CV**

UBICACION: **Carretera Costera Sur Km 4.5 Muelle Puerta Maya**

PLANO:	CODIGO:	CLAVE:
IP-01	PM Correccion final/ Instalaciones Finales Generales/Pozos.dwg	75
DISEÑO ARQ. BENJAMIN MARQUEDA	ESCALA sin escala	FECHA Diciembre del 2002

D:\Mis documentos\Logos\logo marqueda solo.jpg

Wells	Collection areas (m^2)
#1	774.19
#2	372.52
#3	775.51
#4	334.57
#5	625.56
#6	623.07
#7	485.68
#8	318.71
#9	120.47
#10	364.4
#11	260.6
#12	142.26
#13	516.3
#14	416.01
#15	519.23
#16	415.44
#17	375.65
#18	829.1
#19	565.44
#20	1676.5
#21	977.2
#22	391.65
#23	718.36
#24	589.2
#25	589.2
#26	589.2
#27	786.82
#28	1206.28
#29	1134.42
#30	1132.7
#31	258.2
#32	325.12
#33	609.67
#34	598.59
#35	521.92
#36	527.1
TOTAL	21466.84