

Marine Waste Water Survey Bonaire 2021



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Bonaire Boating Company NV
Gerard J A van Erp, marine surveyor

Monique van de Water, WWF-The Netherlands, project lead

Jack Crielaard, consultant, expert water technology

Albert Pieterella, WEB

Wijnand de Wolf, policy advisor STINAPA

Meike Breedveld, policy advisor OLB

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Introduction

Yearly more yachts are visiting the Bonaire National Marine Park and the number of local yachts (private & commercial) is still growing.

During hurricane season (Jun 1st till December 1st) Bonaire is a safe and affordable destination outside the hurricane belt. Most visiting yachts stay on a STINAPA-mooring or in Harbour Village Marina for 6 months many with their crew/owners aboard. Owners are not allowed to leave their boat unattended on a mooring.

Outside hurricane season cruising yachts are visiting Bonaire for shorter periods to enjoy what Bonaire has to offer. Yachting is becoming more important and contributes to the Island economy and tourism diversity.

Despite the growing yachting business, Bonaire has no facility to pump out and to process sewage and grey waste water produced by yachts. Yacht owners discharge their sewage and grey water while on a mooring in the Bonaire Marine Park. Few yachts sail out every week to discharge while sailing in the bay. Yachts docked in the marinas are supposed to use the marina sanitary facilities.

Studies in the Caribbean Sea have shown that discharging waste water enables the spread of diseases in corals and ultimately destroying them. Discharging sewage is also a direct risk and danger for public health.

To reach the best available solutions to come to zero overboard discharge of untreated waste water in the Bonaire Marine Park WNF- The Netherlands, STINAPA, WEB & OLB have initiated this Marine Waste Water Survey 2021.

Methods

During the period from March 29 till May 6 67 yachts (visitors & local) have been surveyed concerning the waste water they discharge. The variety of surveyed yachts is representative for the yachting community (10-18 meter).

Goal of this survey is to learn more about:

- The waste water holding tanks (sewage & grey water) yachts are equipped with.
- Quality & quantity of waste water discharged by yachts.
- Do yacht owners/captains have any preference whether to use shore (marina) pump out facility or a mobile service ?
- The use of cleaning and care products aboard
- The collected information is essential in the next steps towards creating a situation with zero waste water disposal.

All data are collected in an Excel sheet for internal use *.

*Note: For privacy reasons the names of the surveyed yachts will be not published.

[Questionary form, attached as appendix 1](#)

Sources of waste water, Quantity and Quality

- Sewage, also called black water, is the waste water from a toilet. Sewage contains bacteria, pathogens, nutrients and residue of drugs & medication.
- Grey water is the water discharging from a sink and shower. Grey water contains non-biodegradable material from cleaning and care products.



swimming lessons



WEB laboratory



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Sources of waste water:

1. **STINAPA moorings for visiting yachts 48:** High occupancy rate of over 80% on a yearly base*. With 24/7 crew on board these yachts are producing and discharging a vast volume of sewage and grey waste water on a daily base.
2. **STINAPA private moorings, 51:** and mainly in use by (open) boats less than 30 ft. Only a few yachts over 40 ft, no 24/7 crew aboard. Discharge unknown.
3. **Club Nautico 12 slips:** Several day charter vessels and 3 yachts occupied 24/7
4. **Harbour Village Marina, 80 slips:** High occupancy during hurricane season (June 1st -Dec 1st). Discharge in the marina is not allowed. Yacht owners/crew are supposed to use the marina showers and toilets. A few yachts discharge their sewage while sailing out.
5. **Plaza Marina 30 slips* for yachts over 30 feet:** full booked all year long with local privately owned and charter yachts. 2 yachts 24/7 crew aboard, owners/crew are using the hotel sanitary facilities.
6. **Commercial yachts (day charter):** these yachts (about 10) are filling up their holding tank (if present) during each charter. All discharge their waste water at sea.

*Plaza marina is planning to extend the marina with 68 slips in 2022

Currently Bonaire can accommodate 180 yachts over 30 ft.

After expansion of Plaza marina Bonaire can accommodate 248 yachts over 30 ft.

Quantity of sewage

The survey shows that 54 of all surveyed yachts (67) have one or more sewage holding tanks and deck fittings to pump out.

Remarkable: From all participating yachts only 13 out of 67 (Only 20 %...) have ever used a pump out facility before (Europe, Turkey, USA).

Most owners have no precise information available about the capacity of their holding tanks and the volume of sewage and grey water they produce on a daily base.

95% of all yachts discharge their sewage directly (day & night) or at night after keeping sewage in their holding tank.

5% sail out to discharge sewage out at sea.

93% use salt water to flush these toilets.

During the survey only one was yacht equipped with a marine dry composting toilet. This type of toilet doesn't produce any black waste water.

For the STINAPA moorings and Club Nautico (51 yachts) the minimum volume of highly concentrated* sewage discharged is 595.680 liter per year (595.7 m3). Based on 80% occupancy.

*Note: Marine toilets use 50% less water to flush.

For calculation see appendix 2

It is possible to calculate the volume of sewage discharged by the yachts on STINAPA moorings and docked at Club Nautico.

The volume of sewage produced by yachts in Harbour Village Marina and Plaza Marina is not known because the frequency of owners are aboard and whether they are using marina sanitary facilities or not is unknown. With more yachts docked at Harbour Village Marina and Plaza Marina during hurricane season a marine waste water survey during hurricane season is recommended.

When shore or mobile pump out facilities comes available more yacht owners in the marinas will prefer to use their on board sanitary. It's not known how many yachts are going to use the pump out facility. During the survey there were only a few visiting docked in Harbour Village Marina. A brief survey when the marina is full booked will give the answer.

Quantity grey water

The survey shows that only 13 out of 64 yachts (20%) of all yachts are equipped with a grey water holding tank. 5 out of these 13 can't take enough volume to store the volume of one day. Only 8 yachts (12.5%) are equipped with a grey water tank and with a deck fitting to pump out.

This means that grey water generally can't be kept aboard and collected for processing.

To calculate the quantity of grey water is not possible.

The survey included the question of how much fresh water each yacht is using per day. The reason was to estimate the volume of grey water produced aboard.

17 out of 64 yacht owners couldn't answer this question.

Yachts without a desalination device (watermaker) aboard were able to give more accurate answers. They have to fill up their water tanks by sailing into the marina or to transport jerrycans aboard with their dinghy.

The answers given by yachts with a desalination device (watermaker) aboard are not always consistent. (Considered: investment in a desalination device (watermaker), costs of maintenance, tank capacity and usage per day).

Note: Yachts without a watermaker are using daily salt water for household use. We have to consider this as grey water.

Quality of black & grey water

Black water: 93% of all yachts flush their toilets with salt water. With an estimate of up to 1200 m3 of black water to be collected per year this might have consequences for the biological filter system of Bonaire's water treatment plant.

During the survey samples from black water holding tanks have been collected and analyzed by WEB. The composition of the waste water from yachts does not differ much from domestic waste water.

Critical factors are conductivity and the chloride concentration. Analyses of the samples showed a conductivity and a chloride concentration up to 70 times the norm.

Table with analyses.

Date sample taken			Date sample taken											
Analyses		22-apr-21	22-apr-21	Analyses		12-May-21	2-May-21							
COD	mgO2/l	2360	3140	COD	mgO2/l									
N-Total	mgN/l	374	481	N-Total	mgN/l									
NH4	mgN/l	328	412	NH4	mgN/l									
NO3	mgN/l	4.37	6.53	NO3	mgN/l									
NO2	mgN/l	14.3	24.1	NO2	mgN/l									
P-Total	MgP/l	23.1	28.1	P-Total	MgP/l									
Chloride	Mg/l	19500	18200	Chloride	Mg/l	16800	14700	16900	15800	16700	14900	18100	16100	
Geleidba	ms/cm	54.37 mS/cm	52.11 mS/cm	Geleidba	ms/cm	51.62 mS	49.54 mS	44.53 mS	55.01 mS	50.60 mS	46.44 mS	52.69 mS	50.64 mS	
pH	-	8.24 / 22.0	7.41 / 21.9	pH	-	7.45	7.40	6.26	8.13	7.55	7.49	7.46	7.7	

Grey water: Part of the survey was to get a better view concerning the use of cleaning and care products to give researchers a better view on the quality of grey water.

Almost all yachts are using household cleaning and care products. When asked most yacht owners express that they prefer to use biodegradable products, but these products are hard to find or too expensive. Only a few yachts are using biodegradable products.

According the survey the use of bleach and aggressive cleaning products as bilge cleaners is almost zero. 18 yachts (27%) have a washing machine installed.

Collecting waste water

To collect sewage from yachts there are 3 options:

- **Pump out facilities installed in the marinas.**
 - Advantage: It's the cheapest solution for all parties and a relative affordable investment of about \$ 12,000.00 (Excl WEB Connection) for the marina.
 - Disadvantage: Yachts have to leave their mooring or marina slip. With 2 pump out facilities (in each marine one) a facility must be able to handle at least 20 yachts (visitors and local) a day. With limited space in the marinas, it is impossible to give pump out service to all yachts. 7 days a week services will be necessary.
 - Only 5 yachts preferred marina services
- **Mobile pump out service by boat:**
 - Advantage: Yachts can stay where they are moored/docked, pump out service can take place even when the owner/captain is not on board.
 - Disadvantage: It's an expensive solution:
 - A 25-30 ft boat must be purchased and equipped.
 - Costs of fuel, maintenance and write off.
 - For 7 day services 2 full time employees will be in charge
 - Advantages: The mobile service can be combined with other services like:
 - Delivery of fresh water*
 - Pick up of separated garbage**
 - Sale of biodegradable cleaning and care products***.
 - 7 days a week service
 - 26 yachts preferred mobile services
- **Combined services:**
 - 21 yachts didn't prefer marina either mobile pump out services.

*All visiting yachts on the moorings without a watermaker prefer to have fresh water delivered.
**Almost all visiting yachts expressed that garbage is a real problem. There are on shore only 2 small containers to leave garbage. There is no possibility to dispose separate garbage.
***Over 80% of all owners/captains are willing to buy biodegradable cleaning and care products when available at reasonable prices.

Collecting grey water:

Only 12.5% of all yachts are equipped with a grey water tank and deck fitting. This makes it impossible to collect grey water on a large scale.

Pre-treatment and destination

The basic question for the treatment of waste water from yachts is: How can this type of waste water be treated, without negative effects on the functioning of the Waste Water Treatment Plant (WWTP) or the quality of the effluent? To answer this question WEB requested RHDHV to give advice about the amount of dilution and the effects on the WWTP and effluent. The conclusions in short are: Conductivity will not be the problem. However, the Chloride concentration will reach the maximum norm for effluent which has consequences for delivering the effluent for reuse and for the management of disturbances and deviations of chloride concentrations. Without additional measurements or treatment, it will not be safe to treat the water in the WWTP.

This brings us back to the basic question how to treat this salty waste water. The coming months the project team will work on possible directions for solving this puzzle in cooperation with stakeholders.

Investment needs and financing

Sewage

The survey shows that 54 yachts have a sewage holding tank, however... 16 of them, also some newer built yachts, have not enough capacity to hold sewage for more than 2 days.

13 yachts, mainly older yachts, have no sewage holding tank at all.

1 yacht is equipped with a marine composting toilet and doesn't need to have a holding tank.

To reach the level of zero discharge of sewage 43% of all yacht owners must invest to have at least enough capacity to hold sewage for 2 days or more. For most yachts this means an investment between \$ 800 to \$ 1.200,00 in flexible/polypropylene tanks, hoses and deck fittings.

Additional measures for (pre-)treatment.

It is not possible to budget the costs of additional measures at the moment. Further research is needed to find possible solutions directions. However, we expect these costs to be in the same range as the former mentioned costs.

Conclusion

- 20% of all yachts have no black water tank at all
- 23% do not have enough capacity to hold sewage for more than 2 days.

- 57% of all yachts surveyed meet the standard to hold sewage for over 2 days.
- Day charter yachts must be able to pump out after each trip or operation day.

Other options for yacht owners

- To install a Marine Sanitation Device (MSD) USCG class II. This is a minimum investment of \$6,000.00. A yacht with a USCG approved MSD installed will not discharge sewage, according USA standard. European standard can be reached to install an extra filter.
- Note: MSD is not a holding tank but a 24/7 water treatment system.
- For smaller vessels without space for a holding tank the installation of a marine composting can will be a very suitable solution.

See appendix 3

Grey water:

For grey water the situation is more complex.

Only 13 yachts (20%) are equipped with a grey water holding tank, only 8 yachts (12.5%) have enough capacity and deck fitting to hold grey water 2 or more days.

Even the newer and bigger catamarans and mono hulls have limited grey water capacity because yacht designers do not consider grey water as a real environmental problem.

Many countries, included the Netherlands and the USA, have no grey water rules and regulations.

Conclusion: Only 12.5% of all yachts are able to hold grey water for 2 days or more.

Note: All calculations are based with 2 persons aboard 24/7.

Short- and long-term financing / investments

Shore/Marina pump out.

The investment to connect a pump out facility to the island waste water treatment plant will be calculated by WEB. Each connection must be able to take and transport a minimum of 5 m3 waste water (sewage & grey water) per day. Based on 1200 m3 sewage per year and an unknown volume of grey water in the future.

A shore/marina pump out facility will cost about \$12,000.00*, per unit, excluding installation.

Yearly maintenance is about \$ 800.00 and a write off in 10 years.

In most countries a marina pump out facility is a standard and required by permits and laws.

Mobile pump out:

Short term

A (pontoon) vessel with 2 on deck containers to collect sewage and garbage will take an investment between \$ 20K - \$30K. To find and convert an existing vessel will take 2-3 months.

Yearly operational costs to be calculated based on approximately 70 hours of labour per week. (2 full time employees, 35 hours per week to provide 7-day services in high season.)

Long term

To build or convert a durable vessel that will meet the following specifications:

- Hull made of circular material, no fiberglass. Aluminum is a good option.
- Max length 8.5 Meter

- Electric propulsion (48-volt system), batteries (Lithium Carbon) and solar panels
- Storage sewage/grey water: 2-3 m³ (to be calculated)
- Storage fresh water: 2-3 m³ (to be calculated)
- Deck space to collect separated trash (glass, plastic, paper, aluminum and organic garbage)
- The sale of biodegradable cleaning and care products
- Investment approximate \$ 110K - \$ 130K

Another long-term investment: On shore showers, toilets and washing machines for visiting yachts using a mooring. This facility can be financed to raise the mooring fee per night.

Mobile waste water services combined with additional services as delivery of fresh water, collecting trash and the sale of biodegradable products & fresh groceries, this business model can be sourced out.

Financing:

The STINAPA moorings count 80% occupancy on a yearly base.

Many other yachts docked in marinas and the charter fleet will use this mobile services also.

By collecting sewage and providing additional services an environmental problem can be converted into a business model. Fees for these services are to be calculated.

Harbour Village Marina has already expressed to invest in a pump out facility.

With a short-term investment/financing (step 1) of \$20K - \$ 30K to convert a pontoon boat into a service vessel and one pump out facility at Harbour Village Marina. The discharge of sewage in the Bonaire Marina Park can be stopped within a short time.

Shore and mobile pump out facilities and startup operations can be (partly) financed by the EU (UNEP). To apply for a grant a project/business plan must be made up and the project must meet all requirements. See appendix 4 for more information.

There are many other ways to finance this project as a business model by a bank loan, private investors or even a crowdfunding.

Sourcing out: With a solid and long-term contract entrepreneurs will be interested to invest and to take care of all services and to create additional businesses.

Recommendations & concluding advice

Recommendations:

Regarding the current situation, a yearly discharge of at least 595,000 liter of sewage directly in Bonaire Marine Park, expansion of the number of moorings for visiting yachts is not recommended. As long as there are no pump out facilities available consider:

- The survey shows that only a few yachts sail out to discharge their sewage. Encourage all yachts to do so as long as Bonaire has no pump out facility available.
- Start a campaign (flyers & online) to motivate all yachts not to discharge while on a mooring.
- To reduce the number of moorings, special the moorings in shallow waters, and create more deeper water moorings.

Which yachts can use the moorings when pump out facilities are available ?

- In order to be eligible for a mooring a yacht must have a sewage holding tank and enough holding tank capacity for at least 48 hours. Yachts that doesn't meet this standard must dock in one of the marinas and use shore sanitary facilities.
- Now moorings are rented out on a "first come, first serve base", a reservation system is highly recommended. Upon reservation yacht owners must give details about their on-board waste water situation.
- The use of STINAPA moorings is now limited up to 60 ft length. Create moorings for larger (60-80 ft) yachts. Many yachts over 60 ft have up to date waste water systems aboard like larger holding tanks (sewage and grey water) and Marine Sanitation devices (MSD). Of course, these yachts should pay a higher mooring fee.
- Include the fee for pumping out sewage and collecting garbage (7 days a week service ?), in the mooring fee.

Information and introduction:

- Start an online information campaign when the new rules and regulations will become effective.
- Promote the use of biodegradable cleaning and care products.
- Upon arrival hand over our rules and regulations and a welcome package with biodegradable samples as well.
-

Legislation and enforcement:

- Marinas must be obligated to install and maintain a pump out facility. Accessible for yachts and a mobile pump out vessel, a 7-day service a week.
- To be discussed. Once shore and/or mobile pump out are operational violation fines/consequences must be clear.

Follow up collecting data:

- Continue collecting information about all visiting yachts, using moorings and marinas, regarding the waste water situation aboard as a follow up of this survey.
- To collect samples to count coli bacteria and other waste water indicators at the mooring field, Harbour Village Marina & Plaza Marina during the day and night. Most yachts discharge late evening and during the night. Once the discharge of black water has stopped the results can be measured and compared with samples from the past.
- A brief follow up survey to give answer on the question how many yachts in the marinas will use their on board sanitary when pump out facilities comes available ? At this moment we do not know how much sewage these yachts will produce on a yearly base

Concluding advice:

Bonaire is in urgent need of a pump out facility to stop the discharge of highly concentrated and harmful sewage. To stop the discharge of sewage within a short time and to provide extra services for visiting yachts can be reached in 3 steps:

Step 1

- Installing a pump out facility at Harbour Village as soon as possible. (before Jan 1st 2022) Included a pre-treatment or buffer tank (there are unused tanks present) if necessary.
- Modify a (pontoon) vessel (max 30 ft) to collect sewage and separated garbage on the moorings and Club Nautico.

- According the survey calculations yachts with less than 20 liters holding tank capacity per person per day can't hold their sewage for 48 hours.
- Now moorings are rented out on a "first come first serve" base. A reservation system must be in place at the time collection of sewage and garbage starts.
- Include a fee per day for:
 - Collecting sewage and garbage (to be calculated)
 - To cover the extra costs of administration (to be calculated)
 - WEB expenses
- Consider to source out the services of mobile sewage pump out and garbage collection.

Step 2

A second pump out facility at Plaza Marina upon expanding the marina.

To build a durable and sustainable vessel that will meet the following specifications:

- Hull made of circular material, no fiberglass. Aluminum is a good option.
- Max length 8.5 Meter
- Electric propulsion (48-volt system), batteries (Led Carbon) and solar panels
- Storage black/grey water: 2-3 m3 (to be calculated)
- Storage fresh water: 2-3 m3 (to be calculated)
- Deck space to collect separated trash (glass, plastic, paper, aluminum and organic garbage)
- The sale of biodegradable cleaning and care products
- Investment \$ 110K – 130K, partly financed with a UNEP grant.
- Goal: to convert a serious environmental problem into a business model.

Step 3

An on-shore service unit containing toilets, showers and washing machines will contribute to reduce the volume of discharged grey water. Many yacht owners will appreciate these facilities.

Investment not known yet. Financing with a UNEP grant and a daily fee per mooring per day.

It's not an option to collect grey water. Only 12.5% of all yachts are equipped with a grey water holding tank and deck fitting.

According the survey most yacht owners expressed that they feel shame to pump out their sewage into a marina park. They are willing to pay for pump out and additional services like collecting separated garbage. Most yacht owners expressed to use biodegradable cleaning and care product when available at fair prices. To promote and sell (locally produced) biodegradable cleaning & care products is a first step to reduce damage to Bonaire's coral reefs caused by grey water.

Appendix 1 Legislative consequences and preconditions

ISLAND RESOLUTION MARINE PARK BONAIRE

This Island Resolution contains general measures of AUGUST 25, 2010 nr.2 implementing Articles 4, 8, 9, 10, 11, 16, and 17 of the Island Ordinance Nature Management Bonaire (A.B. 2008 nr. 23) and revokes the Island Resolutions containing general measures of June 28, 1991, nr. 8 (A.B. 1991 nr. 10), of December 13, 1991, nr. 1 (A.B. 1991 nr. 21), of December 22, 1993 nr.1 (A.B. 1993 nr 18), of March 20, 1996, nr. 9 (A.B. 1996 nr. 3), of August 18, 1999 nr. 5 (A.B. 1999 nr 11), of August 18, 1999 nr. 6 (A.B. 1999 nr. 12), of September 5, 2003 (A.B. 2003 nr. 10), of January 27, 2005, nr. 3 (A.B. 2005 nr. 2), of December 21, 2007 (A.B. 2007 nr. 17) and of June 25, 2010 nr.16 (A.B. 2010 nr.9) (Island Resolution Marine Park Bonaire).

Article 4 *It is forbidden, without a permit from the Executive Council, to directly or indirectly dump, leak or discharge waste or biological and chemical agents which are harmful to the environment or which can alter the physiological composition of the water, into the waters of the Bonaire Island Territory.*

According to the law vessels are not allowed to discharge waste water of any kind. Despite the law in place Bonaire has no pump out facilities. Moorings for visiting yachts are offered without law enforcement.

How do other countries deal with marine waste water?

Turkey has the strictest laws regarding waste water discharge, the Blue Card System: On anchor or in the marina: The owner/captain has to fill in a form about the number of people aboard and the capacity of the sewage & grey water holding tanks. With this information the system calculates how often yachts have to use the pump out facility and a deposit must be made. In case of a "no show" a fine will be deducted from the deposit on the Blue Card. By repeat violation the yacht owner/captain will be brought to court and the yacht can be confiscated.

Please note: Most marinas in Turkey offer on shore and mobile pump out services, combined with garbage service and delivery of fresh water & groceries.

USA: Toilet's outlets must be closed or sealed also when a sewage tank is present.

Federal law states that if you have a holding tank with a "Y" valve allowing direct overboard discharge of untreated waste, it must be secured in the closed position while operating in all inland and coastal waters. Using a non-releasable wire tie, padlock, or removing the valve handle is considered adequate securing of the device Discharge untreated sewage 3 miles out. No rules & regulations regarding grey water. Most shore and mobile pump out facilities are financed with grants from the Clean Vessel Act Grant program (CVA)

For more details and rules & regulations in other countries see appendix 5

Appendix 2 Epilogue and sources consulted

First of all we would like to thank all yacht owners who were willing to participate in this survey to collect all data and holding tank samples.

Far most yacht owners feel shame that they have to discharge their sewage in a marine park and they are willing to pay for proper solutions regarding collecting sewage and garbage.

By joining forces and knowledge of WWF-The Netherlands, STINAPA, WEB & OLB we are able to make a step forward to stop the discharge of highly concentrated and harmful sewage in the Bonaire Marine Park.

Sources consulted:

- Sewage pollution: mitigation is key for coral reef stewardship, New York Academy of Science, <https://nyaspubs.onlinelibrary.wiley.com/share/CXNTRDSTA5EBIJVY9C3?target=10.1111/nyas.12785>
- A Guidebook for Marina Owners and Operators for the Installation and Operation of Sewage Pump out Stations. WWW.fishandboat.com

Marine waste water survey 2021

Date & time		Date of arrival	Date of departure	Total days
Name and home port		Brand	Type & year	
Material	GRP Aluminum Steel Wood Other	Length Beam Draft	Persons aboard	Crew change on Bonaire
Water tank	Aluminum Stainless steel GRP / prop		Volume liters or gallons	Usage per day
Holding tank Grey water	Aluminum Stainless steel GRP /prop		Volume liters or gallons	How often disposed
Holding tank Black water	Aluminum Stainless steel GRP/prop		Volume liters or gallons	How often disposed
Fuel tank	Aluminum Stainless steel GRP prop		Volume liters or gallons	
Watermaker	Brand		Capacity	
Toilets E M	Salt water flush Fresh water flush		Direct Black water tank	Deck pump out

Chemicals aboard	Washing machine	Dish wash liquid (Photo's)	Chloride (Photo's)	Bilge cleaner (Photo's)	Soap/shampoo (Photo's)	Misc. (Photo's)
Solar power aboard		YES / NO				Remarks:
Wind generator		YES / NO				
Permission to take samples		YES / NO				
Mobile pump out		YES / NO				
Shore pump out		YES / NO				
Dispose of organic material		YES / NO				
Used pump out before		YES / NO				
Place:						

Appendix 2 Calculations

How to calculate the volume of sewage per year?

According to information provided by WEB and consulting 2 manufacturers of pump out facilities, the average flush of a toilet is 4X per 24 hours per person.

Manual marine toilets are using 3-4 liter per flush and electric toilets 4-6 liter per flush (include the fluid and solid waste). Exception: Vacuum toilets use only 1-1.5-liter fresh water per flush, these toilets are not very common.

Calculation volume of highly concentrated sewage produced by yachts using a visitor mooring or docked at Club Nautico:

- 48 moorings and 3 slips at Club Nautico
- 80% occupancy per year
- Average 2 crew aboard
- Average flush per person per 24 hours: 4X*
- Average use per flush 5 liter*

Total minimum highly concentrated sewage discharged per year: 595.680 liter (595.7 m3) for 48 moorings and 3 slips.

*Confirmed by consulting of 2 manufacturers of pump out units.

2021: Bonaire can accommodate a maximum of 180 yachts over 30 ft long.

2022: After expansion of Plaza Marina a maximum of 248 yachts.

Appendix 3 Marine Sanitation Device, classes

MSD Types			
Type I	Flow-through treatment devices that commonly use maceration and disinfection for the treatment of sewage	May be installed only on vessels less than or equal to 65 feet in length	<p>Must produce an effluent with:</p> <ul style="list-style-type: none"> • No visible floating solids • A fecal coliform bacterial count not greater than 1000 per 100 milliliters
Type II	Flow-through treatment devices that may employ biological treatment and disinfection (some Type II MSDs may use maceration and disinfection)	May be installed on vessels of any length	<p>Must produce an effluent with:</p> <ul style="list-style-type: none"> • A fecal coliform bacterial count not greater than 200 per 100 milliliters • No more than 150 milligrams of total suspended solids per liter
Type III	Typically a holding tank where sewage is stored until it can be discharged shore-side or at sea (beyond three miles from shore)	May be installed on vessels of any length	<p>No performance standard; must "be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage." 33 CFR 159.53(c) (PDF)(2 pp, 163 K).</p>

Appendix 4 EU (UNEP) grants

www.unep.org

Press release:

Brussels/Panamá, 29 March 2021 — The European Commission’s Directorate-General for International Partnerships and the UN Environment Program (UNEP) today announced common priorities for environmental cooperation in Latin America and the Caribbean (LAC) for the next five years, aimed at tackling the triple planetary crises of climate change, biodiversity loss, and pollution in the context of the region’s COVID-19 pandemic recovery.

As an ecological hotspot, the LAC region is home to almost half of the world’s biodiversity – including [60 percent of global terrestrial life](#) – and is a champion in [protected marine and terrestrial areas](#): 24 percent of its land is protected, and 23 percent of its marine areas under national jurisdiction. This natural capital is key to build forward better.

“Latin America and the Caribbean constitutes a geopolitical priority for moving forward the environmental global agenda and the European Union’s Green Deal and for maximizing the opportunity of a green recovery,” said Marjeta Jager, Deputy Director General of International Partnerships at the European Commission.

The European Union will support initiatives in the region around three major areas: biodiversity, climate change, and pollution, waste management and circular economy. These priorities were set out as part of an upgraded global [cooperation framework](#) between the European Commission and UNEP, announced in February 2021.

“At the recent regional forum of Ministers of Environment for Latin America and the Caribbean region, we heard resounding commitment to building back better from the COVID-19 pandemic. The European Union and UNEP have a proud history of collaboration in the region, and we look forward to deepening our joint engagement in support of a just and sustainable recovery from the terrible global pandemic,” said UNEP Deputy Executive Director Joyce Msuya.

Appendix 5 Foreign rules & regulations

Netherlands

The Netherlands has introduced regulations on the discharge of black water. From January 2009 it is prohibited to discharge black water (toilet waste) from all pleasure boats on all inland waterways, lakes, the Wadden sea, and territorial waters. Pleasure boats can be installed with holding tanks, dry or chemical toilets or boaters could choose simply not to use their toilets and to use on shore facilities. The Netherlands has no restrictions regarding the discharge of grey water.

France

French law requires that as of 1 January 2008 new vessels, whether French or foreign flagged, are fitted with a treatment system or a holding tank for black water if they wish to have access to French maritime or river ports, moorings, and anchorages.

Users of older vessels which are not equipped with treatment systems or holding tanks for black water are, like all other pleasure yacht users, required to comply with the rules which prohibit discharge in ports and designated anchoring spots. They must, therefore, use shore toilets.

How these rules are to be applied or enforced is not very clear, but it is anticipated that guidelines or a further law defining the extent and manner of application and any sanctions will be issued in the future.

In principle, it is forbidden to flush toilets into canals and rivers, but as pump out facilities is few and far between until now, discreet overboard discharging has been tolerated, this may of course change.

Denmark

Boats built before 1 January 1980 do not have to have a holding tank and can discharge sewage when 2 nautical miles from the shore.

Boats built before 1 January 2000 but after 1 January 1980 which are either less than 10.5m LOA or have a maximum beam of less than 2.8m, do not have to have a holding tank and can discharge sewage when 2 nautical miles from the shore.

Boats outside of the above exemptions, including all boats built after 1 January 2000, must have a holding tank that can be emptied through a deck fitting.

Finland

The discharge of untreated sewage is prohibited at a distance of less than 12 nautical miles from the nearest land, i.e. within their territorial waters.

Germany

Boats under the German flag or that of another HELCOM signatory nation which was built after January 1st, 2003, with a toilet on board, must have a toilet holding system if they have a length of more than 11'50 meters and a width of more than 3.80 meters. If they fall below either this length or this width, they do not have to have a tank. The rules on discharging apply to all pleasure boats that are fitted with a holding tank.

Sweden

From 1 April 2015 all pleasure boats, including foreign-flagged boats, are prohibited from discharging sewage into the lakes, internal waters and territorial waters (12 nautical miles) of Sweden. Recreational craft listed for preservation is not subject to the ban.

Pleasure boats can fit a holding tank, stop using the toilet and go ashore, or use a portable toilet, earth closet, incineration toilet or similar. It is not prohibited for a pleasure boat to have a directly discharging toilet as long as nothing is being discharged. If a boat does not have a toilet, sewage should not be

discharged into the water but dealt with on land. Anyone caught not complying with the ban may face an on-the-spot fine.

Marinas are responsible for ensuring that there are adequate facilities for boat owners to dispose of this waste on land.

The Mediterranean

Spain

Spain has also introduced holding tank requirements, which together with their pollution legislation essentially mean that vessels cannot discharge untreated sewage within Spanish territorial waters (12 nautical miles). The Spanish legislation is ORDEN FOM/1144/2003, 28 April, which for anyone who speaks Spanish can be found at www.fomento.es

Greece

In Greece, the regulations relating to discharges and pollution make a holding tank a practical necessity. Caution should also be exerted with grey water in Greece.

Turkey

Discharge of any kind may be considered illegal. A black water tank has therefore been a practical necessity in Turkey for many years. **New rules have been coming into force in some areas of Turkey (such as the Mugla District) over the last few years which require vessels to carry a Blue Card.** If the rules are enforced to the full all black and grey water will need to be collected and pumped out ashore; the Blue Card will be used to monitor the amount of wastewater deposited ashore to ensure holding tanks are pumped out rather than emptied into the sea.

USA

Section 312 of the Clean Water Act requires the use of operable, U.S. Coast Guard-certified marine sanitation devices (MSDs) onboard vessels that are equipped with installed toilets and operating on U.S. navigable waters.

Untreated sewage discharges are prohibited within three miles from shore.

In order to discharge within three miles, sewage must be treated using a U.S. Coast Guard-approved Type I or Type II MSD. Alternatively, sewage may be stored onboard in a holding tank (Type III MSD). For recreational vessels, there are currently no federal rules in place regulating grey water.

For all vessels, when grey water and sewage are mixed, the resulting discharge must meet sewage effluent requirements.

Federal law also states that if you have a holding tank with a "Y" valve allowing direct overboard discharge of untreated waste, it must be secured in the closed position while operating in all inland and coastal waters. Using a non-releasable wire tie, padlock, or removing the valve handle is considered adequate securing of the device.

The discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land.

Appendix 6 Data overview

Data overview

Surveyed yachts	67: 19 catamarans, 42 mono hulls, 1 trimaran, 5 motor yachts
Location	Moorings: 43, Club Nautico: 5, HVM: 4, Plaza 13, Private: 2
Grey water holding tank	Yes: 13 No: 54
Sewage holding tank	Yes: 54 No: 13
Sewage tank capacity	16: < 100 liter, 21: 101-200 liter, 30: 201> liter
Flush salt or fresh water	Salt: 57, Fresh 5, Both 2, N/A 4
Discharge black water	Direct overboard: 30, Holding tank: 28, Both: 4, N/A: 5
Deck fitting sewage	Yes: 50, No 11, N/A 6
Pump out experience	Yes: 18, No 41, N/A 8
Solar energy	Yes: 55, No 12
Wind energy	Yes: 19, no: 48
Generator	Yes: 32, No 35
Watermaker	Yes: 37, No 30
Washing machine	Yes: 18, No: 49