City of Hollywood
Public Utilities
Vincent Morello, Director
2600 Hollywood Boulevard, Hollywood, FL 33020

[RF ENVIRONMENTAL SERVICES, INC.] RESPONSE DOCUMENT REPORT

IFB No. IFB-211-24-JJ

Replacement of Nanofiltration Process Pressure Vessels and Membrane Elements

RESPONSE DEADLINE: July 11, 2024 at 3:00 pm

Report Generated: Thursday, July 11, 2024

RF Environmental Services, Inc. Response

CONTACT INFORMATION

Company:
RF Environmental Services, Inc.

Email:
thad@rfeswater.com

Contact:
Thaddeus Buckley

Address:
4840 NE 11th Ave
Oakland Park, FL 33334

Phone:
(954) 605-6711

Website:
rfeswater.com

Submission Date:
Jul 11, 2024 2:46 PM

ADDENDA CONFIRMATION

Addendum #1
Confirmed Jul 11, 2024 2:29 PM by Thaddeus Buckley

Addendum #2
Confirmed Jul 11, 2024 2:29 PM by Thaddeus Buckley

QUESTIONNAIRE

1. VENDOR REFERENCE FORM*

Please download the below documents, complete, and upload.

- Vendor_Reference_Form.pdf

Vendor_Ref_Form_-_Frank.pdf
Vendor_Ref_Form_-_jeff.pdf
Vendor_Ref_Form_-_Oscar.pdf

2. HOLD HARMLESS AND INDEMNITY CLAUSE*

I, an authorized representative, the contractor, shall indemnify, defend and hold harmless the City of Hollywood, its elected and appointed officials, employees and agents for any and all suits, actions, legal or administrative proceedings, claims, damage, liabilities, interest, attorney' s fees, costs of any kind whether arising prior to the start of activities or following the completion or acceptance and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part by reason of any act, error or omission, fault or negligence whether active or passive by the contractor, or anyone acting under its direction, control, or on its behalf in connection with or incident to its performance of the contract.

Confirmed

3. NON-COLLUSION STATEMENT*

I , being first duly sworn, depose that:

A. He/she is an authorized representative of the Company, the Proposer that has submitted the attached Proposal.

B. He/she has been fully informed regarding the preparation and contents of the attached Proposal and of all pertinent circumstances regarding such Proposal;

C. Such Proposal is genuine and is not a collusion or sham Proposal;

D. Neither the said Proposer nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Proposer, firm or person to submit a collusive or sham Proposal in connection with the contractor for which the attached Proposal has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Proposer, firm or person to fix the price or prices, profit or cost element of the Proposal price or the Proposal price of any other Proposer, or to secure an advantage against the City of Hollywood or any person interested in the proposed Contract; and

E. The price or prices quoted in the attached Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Proposer or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Confirmed

4. CERTIFICATIONS REGARDING DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS*

The applicant certifies that it and its principals:

A. Are not presently debarred, suspended, proposed for debarment, declared ineligible, sentenced to a denial of Federal benefits by a State or Federal court, or voluntarily excluded from covered transactions by any Federal department or agency;

B. Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction, violation of Federal or State antitrust statutes or

commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

C. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (b) of this certification; and

D. Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default.

Confirmed

5. DRUG-FREE WORKPLACE PROGRAM*

A. IDENTICAL TIE PROPOSALS - Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie proposals will be followed if none of the tied vendors have a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
4. In the statement specified in subsection (1), notify the employee that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer

of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.

5. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program (if such is available in the employee's community) by, any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of these requirements.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

Confirmed

6. SOLICITATION, GIVING, AND ACCEPTANCE OF GIFTS POLICY *

Florida Statute 112.313 prohibits the solicitation or acceptance of Gifts. "No Public officer, employee of an agency, local government attorney, or candidate for nomination or election shall solicit or accept anything of value to the recipient, including a gift, loan, reward, promise of future employment, favor, or service, based upon any understanding that the vote, official action, or judgment of the public officer, employee, local government attorney, or candidate would be influenced thereby." The term "public officer" includes "any person elected or appointed to hold office in any agency, including any person serving on an advisory body."

The City of Hollywood/Hollywood CRA policy prohibits all public officers, elected or appointed, all employees, and their families from accepting any gifts of any value, either directly or indirectly, from any contractor, vendor, consultant, or business with whom the City/CRA does business.

The State of Florida definition of "gifts" includes the following:

- Real property or its use,
- Tangible or intangible personal property, or its use,
- A preferential rate or terms on a debt, loan, goods, or services,
- Forgiveness of indebtedness,
- Transportation, lodging, or parking,
- Food or beverage,

- Membership dues,
- Entrance fees, admission fees, or tickets to events, performances, or facilities,
- Plants, flowers or floral arrangements
- Services provided by persons pursuant to a professional license or certificate.
- Other personal services for which a fee is normally charged by the person providing the services.
- Any other similar service or thing having an attributable value not already provided for in this section.

Any contractor, vendor, consultant, or business found to have given a gift to a public officer or employee, or his/her family, will be subject to dismissal or revocation of contract.

As the person authorized to sign the statement, I certify that this firm will comply fully with this policy.

Confirmed

7. Certificate of Insurance*

See requirements in the #SPECIAL TERM AND CONDITIONS section.

COI_-City_of_Hollywood.pdf

8. PROOF OF SUNBIZ REGISTRATION*

Enter company FEIN to be verified in Sunbiz

81-1455710
Click to Verify *Value will be copied to clipboard*

9. ACKNOWLEDGMENT AND SIGNATURE PAGE

IF CORPORATION - DATE INCORPORATED/ORGANIZED:*
01/27/2016

STATE INCORPORATED/ORGANIZED:*
FL

REMITTANCE ADDRESS*

4840 NE 11th Ave

Oakland Park, FL 33334

BIDDER/PROPOSER'S AUTHORIZED REPRESENTATIVE'S TYPED FULL NAME*
Thaddeus Buckley

IT IS HEREBY CERTIFIED AND AFFIRMED THAT THE BIDDER/PROPOSER CERTIFIES ACCEPTANCE OF THE TERMS, CONDITIONS, SPECIFICATIONS, ATTACHMENTS AND ANY ADDENDA. THE BIDDER/PROPOSER SHALL ACCEPT ANY AWARDS MADE AS A RESULT OF THIS SOLICITATION. BIDDER/PROPOSER FURTHER AGREES THAT PRICES QUOTED WILL REMAIN FIXED FOR THE PERIOD OF TIME STATED IN THE SOLICITATION.*
Confirmed

THE EXECUTION OF THIS FORM CONSTITUTES THE UNEQUIVOCAL OFFER OF BIDDER/PROPOSER TO BE BOUND BY THE TERMS OF ITS PROPOSAL. FAILURE TO SIGN THIS SOLICITATION WHERE INDICATED BY AN AUTHORIZED REPRESENTATIVE SHALL RENDER THE BID/PROPOSAL NON-RESPONSIVE. THE CITY MAY, HOWEVER, IN ITS SOLE DISCRETION, ACCEPT ANY BID/PROPOSAL THAT INCLUDES AN EXECUTED DOCUMENT WHICH UNEQUIVOCALLY BINDS THE BIDDER/PROPOSER TO THE TERMS OF ITS OFFER.*
Confirmed

BID FORM*
Please download the below documents, complete, and upload.

- Bid_Form_MASTER.docx

Bid_Form.pdf
Whole_Bid_Packet.pdf

10. SWORN STATEMENT PURSUANT TO SECTION 287.133 (3) (a) FLORIDA STATUTES ON PUBLIC ENTITY CRIMES

THIS FORM STATEMENT IS SUBMITTED TO THE CITY OF HOLLYWOOD BY:*
(Print individual's name and title) (Print name of entity submitting sworn statement)

THaddeus Buckley

SWORN STATEMENT CONTINUATION:*
Enter business address:

4840 NE 11th Ave Oakland Park FL 33334

SWORN STATEMENT CONTINUATION:*
Enter Federal Employer Identification Number (FEIN) is:

If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement.

81-1455710

SWORN STATEMENT CONTINUATION:*
I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in an federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

YES

SWORN STATEMENT CONTINUATION:*
I understand that "Affiliate," as defined in paragraph 287.133(1)(a), Florida Statutes, means:

1. A predecessor or successor of a person convicted of a public entity crime, or
2. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

Confirmed

SWORN STATEMENT CONTINUATION:*
I understand that "person," as defined in Paragraph 287.133(1)(e), Florida Statues, means any natural person or any entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts let by a public entity, or which otherwise transacts or applies to transact business with a public entity.

The term "person" includes those officers, executives, partners, shareholders, employees, members, and agents who are active in management of an entity

Confirmed

SWORN STATEMENT CONTINUATION:*
Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies.)

Division of Administrative Hearings, determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (attach a copy of the Final Order).

Neither the entity submitting sworn statement, nor any of its officers, director, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

SWORN STATEMENT CONFIRMATION*
I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER

FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC

ENTITY ONLY AND THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR

YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THAT

PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD

AMOUNT PROVIDED IN SECTION 287.017 FLORIDA STATUTES FOR A CATEGORY TWO OF

ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

Confirmed

PRICE TABLES

Line Item	Description	Quantity	Unit of Measure	Unit Cost	Total
1	Furnish replacement membrane pressure vessels, including all associated accessories, connections, and adapters necessary for installation on the existing NF units.	378	EA.	$1,800.00	$680,400.00
2	Furnish replacement membrane elements, including all associated accessories, connections, and adapters necessary for installation in the new pressure vessels, including 21 spare elements.	2,583	EA.	$530.00	$1,368,990.00
3	Complete installation, start-up, and testing of replacement pressure vessels and membrane elements in each NF unit.	7	EA.	$203,000.00	$1,421,000.00
4	Provide all other CONTRACTOR and MEM services not included in other bid items.	1	L.S	$238,600.00	$238,600.00
5	Contingency	1	Allowance	$250,000.00	$250,000.00
6	Indemnification	1	L.S.	$10.00	$10.00
7	Mobilization	1	L.S.	$120,000.00	$120,000.00
8	Demobilization	1	L.S.	$10,000.00	$10,000.00
9	Testing/Permitting	1	Allowance	$50,000.00	$50,000.00
TOTAL					**$4,139,000.00**

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: Thaddeus Buckley (as PM for P&K)

Organization/Firm Name providing reference: McCafferty Brinson
Organization/Firm Contact Name: Frank Brinson **Title:** Vice President
Email: fbrinson@mccaffertybrinson.com **Phone:** 954-802-3058
Name of Referenced Project: Glades Road WTP 40 mgd- Membrane **Contract No:**
Date Services were provided: **Project Amount:** $49,200,000
Referenced Vendor's role in Project: ☒ **Prime Vendor** (Project manager for previous General contractor employer) ☐ **Subcontractor/ Subconsultant**
Would you use the Vendor again? ☒ **Yes** ☐ **No.** Please specify in additional comments

Description of services provided by Vendor (provide additional sheet if necessary): Project manager for construction of a 40 million gallon per day (mgd) capacity nanofiltration plant.

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):
This reference is for the personal experience of Thad Buckley, while an employee of the Poole & Kent Company. Thad served as project manager for construction of a very large, complex project involving the integration of a 40 mgd NF plant to an existing lime softening plant. Thad did an excellent job from beginning to end, and the Owner and Engineer were very satisfied with the completed project.

******THIS SECTION FOR CITY USE ONLY******

Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

Frank A. Brinson

Digitally signed by Frank A. Brinson, P.E.
Date: 2024.07.10 15:59:20 -04'00'

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: Thaddeus Buckley (as PM for P&K)

Organization/Firm Name providing reference: City of Hollywood
Organization/Firm Contact Name: Feng (Jeff) Jiang **Title:** Assistant Dir.
Email: FJiang@hollywoodfl.org **Phone:** 954-921-3930
Name of Referenced Project: Hollywood WTP Membrane Replacement **Contract No:**
Date Services were provided: **Project Amount:** $1,752,000
Referenced Vendor's role in Project: ☐ Prime Vendor ☐ Subcontractor/ Subconsultant
Would you use the Vendor again? ☐ Yes ☐ No. Please specify in additional comments

Description of services provided by Vendor (provide additional sheet if necessary):

Please rate your experience with the Vendor	Need Improvement	Satisfactory	Excellent	Not Applicable
Vendor's Quality of Service				
a. Responsive	☐	☐	☑	☐
b. Accuracy	☐	☐	☑	☐
c. Deliverables	☐	☐	☑	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☑	☐
b. Professionalism	☐	☐	☑	☐
c. Staff turnover	☐	☐	☑	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☑	☐
b. Deliverables	☐	☐	☑	☐

Additional Comments (provide additional sheet if necessary):
City is awarding RF Environmental Services "WTP Reclaim Transfer Pumps Replacement" project.

****THIS SECTION FOR CITY USE ONLY****						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: RF Environmental Services, Inc

Organization/Firm Name providing reference: Broward County
Organization/Firm Contact Name: Oscar Asgar **Title:** Construction Project Mgr.
Email: oasgar@broward.org **Phone:** 954-831-0983
Name of Referenced Project: Broward County WTP 1A & 2A Treatment Unit Rehab **Contract No:**
Date Services were provided: 5/20/2023 **Project Amount:** $4,932,211
Referenced Vendor's role in Project: ☐ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**
Would you use the Vendor again? ☐ **Yes** ☐ **No.** **Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
Replacement of Chemical storage Tanks, installation of new Lime Slaker Systems, demolition and replacement of 30" DI treatment unit influent pipings, treatment unit launder replacement and other miscellanea plant processes.

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☐	☒
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):
Contractor provides excellent workmanship

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☒	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**	Oscar Asgar Oscar Asgar Digitally signed by Oscar Asgar Date: 2024.07.08 11:41:09 -04'00'			**Title:**	Construction Project Manager
	Department:	WWS/ WWOD			**Date:**	7/08/2024

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 07/09/2024

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER		CONTACT NAME:	Kemi Foster-Sterling	
Brown & Brown Insurance Services, Inc.		PHONE (A/C, No, Ext):	(954) 776-2222	FAX (A/C, No): (954) 776-4446
1201 W Cypress Creek Rd		E-MAIL ADDRESS:	Kemi.Foster-Sterling@bbrown.com	
Suite 130		INSURER(S) AFFORDING COVERAGE		NAIC #
Fort Lauderdale	FL 33309	INSURER A :	FCCI Insurance Company	10178
INSURED		INSURER B :	Westchester Surplus Lines Insurance Company	10172
RF Environmental Services Inc, DBA: Milan Construction & Real Estate		INSURER C :		
4840 NE 11th Avenue		INSURER D :		
		INSURER E :		
Oakland Park	FL 33334	INSURER F :		

COVERAGES **CERTIFICATE NUMBER:** 2022-25 COI **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	[X] COMMERCIAL GENERAL LIABILITY [ ] CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PRO-JECT [X] LOC [ ] OTHER:	Y		GL10009354700	06/27/2024	02/27/2025	EACH OCCURRENCE	$ 1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 100,000
							MED EXP (Any one person)	$ 5,000
							PERSONAL & ADV INJURY	$ 1,000,000
							GENERAL AGGREGATE	$ 2,000,000
							PRODUCTS - COMP/OP AGG	$ 2,000,000
								$
A	AUTOMOBILE LIABILITY [X] ANY AUTO [ ] OWNED AUTOS ONLY [ ] SCHEDULED AUTOS [ ] HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY			CA10009354800	06/27/2024	06/27/2025	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
							UM CSL	$ 300,000
A	[X] UMBRELLA LIAB [X] OCCUR [ ] EXCESS LIAB [ ] CLAIMS-MADE [ ] DED [X] RETENTION $ 10,000			UMB10009355100	06/27/2024	06/27/2025	EACH OCCURRENCE	$ 3,000,000
							AGGREGATE	$ 3,000,000
								$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		WC010007021904	06/27/2024	06/27/2025	[X] PER STATUTE [ ] OTH-ER	
							E.L. EACH ACCIDENT	$ 1,000,000
							E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
B	Pollution Liability			G70971070003	10/24/2022	06/27/2025	Each Pollution	$2,000,000
							Aggregate	$2,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

City of Hollywood is an additional insured with respect to General Liability if required by written contract.

CERTIFICATE HOLDER

City of Hollywood
2600 Hollywood Blvd
Hollywood FL 33022

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

6. PRICING (BID FORM)

The City is seeking bids/proposals from qualified vendors for the items listed below in accordance with the terms, conditions, and specifications contained in this solicitation.

Estimated quantities listed are for information and tabulation purposes only. No warranty or guarantee of quantities needed is given or implied. It is understood that the Contractor will furnish the City's needs as they arise.

Line Item	Description	Quantity	Unit of Measure	Unit Cost	Total
1	Furnish replacement membrane pressure vessels, including all associated accessories, connections, and adapters necessary for installation on the existing NF units.	378	EA.	1,800	680,400
2	Furnish replacement membrane elements, including all associated accessories, connections, and adapters necessary for installation in the new pressure vessels, including 21 spare elements.	2,583	EA.	530	1,368,990
3	Complete installation, start-up, and testing of replacement pressure vessels and membrane elements in each NF unit.	7	EA.	203,000	1,421,000
4	Provide all other CONTRACTOR and MEM services not included in other bid items.	1	L.S	238,600	238,600
5	Contingency	1	Allowance	$250,000.00	250,000
6	Indemnification	1	L.S.	$10.00	10 –
7	Mobilization	1	L.S.	120,000	120,000
8	Demobilization	1	L.S.	10,000	19000
9	Testing/Permitting	1	Allowance	$50,000.00	50,000
TOTAL					$ 4,139,000

FORM 1

SUBMITTAL CHECKLIST FORM

The items below are required components of your solicitation response in order for your bid/proposal/submittal to be consider responsive and responsible. Please complete and submit this submittal checklist form as the cover page of your submittal with all of the items below in the order listed.

Please indicated Yes or No in the "Submitted (Yes/No)" column below to indicated which required components were provided with your submittal.

Submitted (Yes/No)	Required Bid Components
YES	This Submittal Checklist Form completed and included as the cover page of your submittal.
YES	A Table of Contents that clearly identifies each section and page number of your submittal.
YES	Information and/or documentation that addresses and/or meets the requirements outlined in Section III – Scope of Work/Services, including any procedural or technical enhancements/innovations which do not materially deviate from the objectives or required content of the Scope of Work/Services.
YES	Forms (Completed) Form 1 Submittal Checklist Form* Form 2 Acknowledgement and Signature Page Form 3 Bid Form* Form 4 Vendor Reference Form* Form 5 Hold Harmless and Indemnity Clause Form 6 Non-Collusion Affidavit Form 7 Sworn Statement…Public Entity Crimes Form 8 Certifications Regarding Debarment… Form 9 Drug-Free Workplace Program Form 10 Solicitation, Giving, and Acceptance… Form 11 W-9 (Request for Taxpayer Identification) Form 12 Trench Safety Form Form 13 Bid Guaranty Form Form 14 List of Subcontractors
YES	Certificate(s) of insurance that meet the requirements of Section 2.17
YES	Proof of State of Florida Sunbiz Registration

This checklist is only a guide, please read the entire solicitation to ensure that your submission includes all required information and documentation.

RF Environmental Services, Inc.
4840 NE 11th Ave
Oakland Park, FL 33334
(954) 605-6711

Table of Contents

FORM 2

ACKNOWLEDGMENT AND SIGNATURE PAGE

This form must be completed and submitted by the date and the time of bid opening.

Legal Company Name (include d/b/a if applicable): RF Environmental Services, Inc.

If Corporation - Date Incorporated/Organized: 01/28/16 Federal Tax Identification Number: 81-1455710

State Incorporated/Organized: FL

Company Operating Address: 4840 NE 11 Ave

City: Fort Lauderdale State: FL Zip Code: 33314

Remittance Address (if different from ordering address):

City: _____ State: _____ Zip Code: _____

Company Contact Person: Thaddeus Buckley Email Address: Thad@rfeswater.com

Phone Number (include area code): 954-605-6711 Fax Number (include area code): _____

Company's Internet Web Address: WWW.RFESwater.com

IT IS HEREBY CERTIFIED AND AFFIRMED THAT THE BIDDER/PROPOSER CERTIFIES ACCEPTANCE OF THE TERMS, CONDITIONS, SPECIFICATIONS, ATTACHMENTS AND ANY ADDENDA. THE BIDDER/PROPOSER SHALL ACCEPT ANY AWARDS MADE AS A RESULT OF THIS SOLICITATION. BIDDER/PROPOSER FURTHER AGREES THAT PRICES QUOTED WILL REMAIN FIXED FOR THE PERIOD OF TIME STATED IN THE SOLICITATION.

Bidder/Proposer's Authorized Representative's Signature: _____ Date: 7/11/24

Type or Print Name: Thaddeus Buckley

THE EXECUTION OF THIS FORM CONSTITUTES THE UNEQUIVOCAL OFFER OF BIDDER/PROPOSER TO BE BOUND BY THE TERMS OF ITS PROPOSAL. FAILURE TO SIGN THIS SOLICITATION WHERE INDICATED BY AN AUTHORIZED REPRESENTATIVE SHALL RENDER THE BID/PROPOSAL NON-RESPONSIVE. THE CITY MAY, HOWEVER, IN ITS SOLE DISCRETION, ACCEPT ANY BID/PROPOSAL THAT INCLUDES AN EXECUTED DOCUMENT WHICH UNEQUIVOCALLY BINDS THE BIDDER/PROPOSER TO THE TERMS OF ITSOFFER.

6. PRICING (BID FORM)

The City is seeking bids/proposals from qualified vendors for the items listed below in accordance with the terms, conditions, and specifications contained in this solicitation.

Estimated quantities listed are for information and tabulation purposes only. No warranty or guarantee of quantities needed is given or implied. It is understood that the Contractor will furnish the City's needs as they arise.

Line Item	Description	Quantity	Unit of Measure	Unit Cost	Total
1	Furnish replacement membrane pressure vessels, including all associated accessories, connections, and adapters necessary for installation on the existing NF units.	378	EA.	1,800	680,400
2	Furnish replacement membrane elements, including all associated accessories, connections, and adapters necessary for installation in the new pressure vessels, including 21 spare elements.	2,583	EA.	530	1,368,990
3	Complete installation, start-up, and testing of replacement pressure vessels and membrane elements in each NF unit.	7	EA.	203,000	1,421,000
4	Provide all other CONTRACTOR and MEM services not included in other bid items.	1	L.S	238,600	238,600
5	Contingency	1	Allowance	$250,000.00	250,000
6	Indemnification	1	L.S.	$10.00	10 –
7	Mobilization	1	L.S.	120,000	120,000
8	Demobilization	1	L.S.	10,000	19000
9	Testing/Permitting	1	Allowance	$50,000.00	50,000
TOTAL					$ 4,139,000

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: RF Environmental Services, Inc

Organization/Firm Name providing reference: Broward County
Organization/Firm Contact Name: Oscar Asgar **Title:** Construction Project Mgr.
Email: oasgar@broward.org **Phone:** 954-831-0983
Name of Referenced Project: Broward County WTP 1A & 2A Treatment Unit Rehab **Contract No:**
Date Services were provided: 5/20/2023 **Project Amount:** $4,932,211
Referenced Vendor's role in Project: ☐ **Prime Vendor** ☐ **Subcontractor/ Subconsultant**
Would you use the Vendor again? ☐ **Yes** ☐ **No.** **Please specify in additional comments**

Description of services provided by Vendor (provide additional sheet if necessary):
Replacement of Chemical storage Tanks, installation of new Lime Slaker Systems, demolition and replacement of 30" DI treatment unit influent pipings, treatment unit launder replacement and other miscellanea plant processes.

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☐	☒
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):
Contractor provides excellent workmanship

******THIS SECTION FOR CITY USE ONLY******						
Verified via:	**Email:**	☒	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**	Oscar Asgar			**Title:**	Construction Project Manager
	Department:	WWS/ WWOD			**Date:**	7/08/2024

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: Thaddeus Buckley (as PM for P&K)

Organization/Firm Name providing reference: City of Hollywood
Organization/Firm Contact Name: Feng (Jeff) Jiang **Title:** Assistant Dir.
Email: FJiang@hollywoodfl.org **Phone:** 954-921-3930
Name of Referenced Project: Hollywood WTP Membrane Replacement **Contract No:**
Date Services were provided: **Project Amount:** $1,752,000
Referenced Vendor's role in Project: ☐ Prime Vendor ☐ Subcontractor/ Subconsultant
Would you use the Vendor again? ☐ Yes ☐ No. Please specify in additional comments

Description of services provided by Vendor (provide additional sheet if necessary):

Please rate your experience with the Vendor	Need Improvement	Satisfactory	Excellent	Not Applicable
Vendor's Quality of Service				
a. Responsive	☐	☐	☑	☐
b. Accuracy	☐	☐	☑	☐
c. Deliverables	☐	☐	☑	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☑	☐
b. Professionalism	☐	☐	☑	☐
c. Staff turnover	☐	☐	☑	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☑	☐
b. Deliverables	☐	☐	☑	☐

Additional Comments (provide additional sheet if necessary):
City is awarding RF Environmental Services "WTP Reclaim Transfer Pumps Replacement" project.

****THIS SECTION FOR CITY USE ONLY****						
Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

FORM 4
VENDOR REFERENCE FORM

City of Hollywood Solicitation #: IFB-211-24-JJ
Reference for: Thaddeus Buckley (as PM for P&K)

Organization/Firm Name providing reference: McCafferty Brinson
Organization/Firm Contact Name: Frank Brinson **Title:** Vice President
Email: fbrinson@mccaffertybrinson.com **Phone:** 954-802-3058
Name of Referenced Project: Glades Road WTP 40 mgd- Membrane **Contract No:**
Date Services were provided: **Project Amount:** $49,200,000
Referenced Vendor's role in Project: ☒ **Prime Vendor** (Project manager for previous General contractor employer) ☐ **Subcontractor/ Subconsultant**
Would you use the Vendor again? ☒ **Yes** ☐ **No.** Please specify in additional comments

Description of services provided by Vendor (provide additional sheet if necessary): Project manager for construction of a 40 million gallon per day (mgd) capacity nanofiltration plant.

Please rate your experience with the Vendor	**Need Improvement**	**Satisfactory**	**Excellent**	**Not Applicable**
Vendor's Quality of Service				
a. Responsive	☐	☐	☒	☐
b. Accuracy	☐	☐	☒	☐
c. Deliverables	☐	☐	☒	☐
Vendor's Organization:				
a. Staff expertise	☐	☐	☒	☐
b. Professionalism	☐	☐	☒	☐
c. Staff turnover	☐	☐	☒	☐
Timeliness/Cost Control of:				
a. Project	☐	☐	☒	☐
b. Deliverables	☐	☐	☒	☐

Additional Comments (provide additional sheet if necessary):
This reference is for the personal experience of Thad Buckley, while an employee of the Poole & Kent Company. Thad served as project manager for construction of a very large, complex project involving the integration of a 40 mgd NF plant to an existing lime softening plant. Thad did an excellent job from beginning to end, and the Owner and Engineer were very satisfied with the completed project.

******THIS SECTION FOR CITY USE ONLY******

Verified via:	**Email:**	☐	**Verbal:**	☐	**Mail:**	☐
Verified by:	**Name:**				**Title:**	
	Department:				**Date:**	

FORM 5

HOLD HARMLESS AND INDEMNITY CLAUSE

RF Environmental Services, Inc.,

(Company Name and Authorized Signature, Print Name)

the contractor, shall indemnify, defend and hold harmless the City of Hollywood, its elected and appointed officials, employees and agents for any and all suits, actions, legal or administrative proceedings, claims, damage, liabilities, interest, attorney's fees, costs of any kind whether arising prior to the start of activities or following the completion or acceptance and in any manner directly or indirectly caused, occasioned or contributed to in whole or in part by reason of any act, error or omission, fault or negligence whether active or passive by the contractor, or anyone acting under its direction, control, or on its behalf in connection with or incident to its performance of the contract.

Signature

Thaddeus Buckley

Printed Name

RF Environmental Services

Name of Company

President

Title

FORM 6

NON-COLLUSION AFFIDAVIT

STATE OF: Florida

COUNTY OF: Broward, being first duly sworn, deposes and says that:

(1) He/she is President of RF Environmental Services the Proposer that has submitted the attached Proposal.

(2) He/she has been fully informed regarding the preparation and contents of the attached Proposal and of all pertinent circumstances regarding such Proposal;

(3) Such Proposal is genuine and is not a collusion or sham Proposal;

(4) Neither the said Proposer nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Proposer, firm or person to submit a collusive or sham Proposal in connection with the contractor for which the attached Proposal has been submitted or to refrain from bidding in connection with such contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Proposer, firm or person to fix the price or prices, profit or cost element of the Proposal price or the Proposal price of any other Proposer, or to secure an advantage against the City of Hollywood or any person interested in the proposed Contract; and

(5) The price or prices quoted in the attached Proposal are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Proposer or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Signature

Thaddeus Buckley

Printed Name

RF Environmental Services, Inc

Name of Company

President

Title

FORM 7

SWORN STATEMENT PURSUANT TO SECTION 287.133 (3) (a) FLORIDA STATUTES ON PUBLIC ENTITY CRIMES

THIS FORM MUST BE SIGNED AND SWORN TO IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICIAL AUTHORIZED TO ADMINISTER OATHS

1. This form statement is submitted to the City of Hollywood by Thaddeus Buckley - President for RF Environmental Services, Inc (Print individual's name and title) (Print name of entity submitting sworn statement) whose business address is 4840 NE 11 Ave, Fort Lauderdale, FL 33334 and if applicable its Federal Employer Identification Number (FEIN) is 81-1455710. If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement.

2. I understand that "public entity crime," as defined in paragraph 287.133(1)(g), Florida Statues, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or with the United States, including, but not limited to, any bid, proposal, reply, or contract for goods or services, any lease for real property, or any contract for the construction or repair of a public building or public work, involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misinterpretation.

3. I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication of guilt, in an federal or state trial court of record relating to charges brought by indictment or information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

4. I understand that "Affiliate," as defined in paragraph 287.133(1)(a), Florida Statutes, means:

    1. A predecessor or successor of a person convicted of a public entity crime, or
    2. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting a controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

5. I understand that "person," as defined in Paragraph 287.133(1)(e), Florida Statues, means any natural person or any entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.

6. Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies.)

✓ Neither the entity submitting sworn statement, nor any of its officers, director, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, nor any affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime subsequent to July 1, 1989.

_____ The entity submitting this sworn statement, or one or more of its officers, directors, executives, partners, shareholders, employees, members, or agents who are active in the management of the entity, or an affiliate of the entity has been charged with and convicted of a public entity crime, but the Final Order entered by the Hearing Officer in a subsequent proceeding before a Hearing Officer of the State of the State of Florida,

Division of Administrative Hearings, determined that it was not in the public interest to place the entity submitting this sworn statement on the convicted vendor list. (attach a copy of the Final Order).

I UNDERSTAND THAT THE SUBMISSION OF THIS FORM TO THE CONTRACTING OFFICER FOR THE PUBLIC ENTITY IDENTIFIED IN PARAGRAPH 1 (ONE) ABOVE IS FOR THAT PUBLIC ENTITY ONLY AND THAT THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND THAT I AM REQUIRED TO INFORM THAT PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.017 FLORIDA STATUTES FOR A CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

_____
(Signature)

Sworn to and subscribed before me this 11th day of July, 2024.

Personally known _____

Or produced identification ✓ Notary Public-State of FLORIDA

Drivers License
(Type of identification)

my commission expires 10.03.26

_____
(Printed, typed or stamped commissioned name of notary public)

ARIANA LISSETTE AVILES
Notary Public - State of Florida
Commission # HH 318713
My Comm. Expires Oct 3, 2026
Bonded through National Notary Assn.

FORM 8

CERTIFICATIONS REGARDING DEBARMENT, SUSPENSION AND OTHER RESPONSIBILITY MATTERS

The applicant certifies that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, sentenced to a denial of Federal benefits by a State or Federal court, or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not within a three-year period preceding this application been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction, violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (b) of this certification; and

(d) Have not within a three-year period preceding this application had one or more public transactions (Federal, State, or local) terminated for cause or default.

Applicant Name and Address:

RF Environmental Services, Inc

4840 NE 11 Ave

Fort Lauderdale, FL 33334

Application Number and/or Project Name:

Hollywood Replacement Nanofiltration Pressure Vessels & Membrane

Applicant IRS/Vendor Number: 81-1455710

Signature

Thaddeus Buckley

Printed Name

RF Environmental Services

Name of Company

President

Title

FORM 9

DRUG-FREE WORKPLACE PROGRAM

IDENTICAL TIE PROPOSALS - Preference shall be given to businesses with drug-free workplace programs. Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie proposals will be followed if none of the tied vendors have a drug-free workplace program. In order to have a drug-free workplace program, a business shall:

1. Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
3. Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
4. In the statement specified in subsection (1), notify the employee that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
5. Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program (if such is available in the employee's community) by, any employee who is so convicted.
6. Make a good faith effort to continue to maintain a drug-free workplace through implementation of these requirements.

As the person authorized to sign the statement, I certify that this firm complies fully with the above requirements.

Signature

Thaddeus Buckley

Printed Name

RF Environmental Services

Name of Company

President

Title

FORM 10

SOLICITATION, GIVING, AND ACCEPTANCE OF GIFTS POLICY

Florida Statute 112.313 prohibits the solicitation or acceptance of Gifts. "No Public officer, employee of an agency, local government attorney, or candidate for nomination or election shall solicit or accept anything of value to the recipient, including a gift, loan, reward, promise of future employment, favor, or service, based upon any understanding that the vote, official action, or judgment of the public officer, employee, local government attorney, or candidate would be influenced thereby." The term "public officer" includes "any person elected or appointed to hold office in any agency, including any person serving on an advisory body."

The City of Hollywood/Hollywood CRA policy prohibits all public officers, elected or appointed, all employees, and their families from accepting any gifts of any value, either directly or indirectly, from any contractor, vendor, consultant, or business with whom the City/CRA does business.

The State of Florida definition of "gifts" includes the following:

Real property or its use,
Tangible or intangible personal property, or its use,
A preferential rate or terms on a debt, loan, goods, or services,
Forgiveness of indebtedness,
Transportation, lodging, or parking,
Food or beverage,
Membership dues,
Entrance fees, admission fees, or tickets to events, performances, or facilities,
Plants, flowers or floral arrangements
Services provided by persons pursuant to a professional license or certificate.
Other personal services for which a fee is normally charged by the person providing the services.
Any other similar service or thing having an attributable value not already provided for in this section.

Any contractor, vendor, consultant, or business found to have given a gift to a public officer or employee, or his/her family, will be subject to dismissal or revocation of contract.

As the person authorized to sign the statement, I certify that this firm will comply fully with this policy.

Signature

Thaddeus Buckley
Printed Name

RF Environmental Services
Name of Company

President
Title

Form **W-9**
(Rev. October 2018)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

▶ Go to *www.irs.gov/FormW9* for instructions and the latest information.

Give Form to the requester. Do not send to the IRS.

Print or type. See Specific Instructions on page 3.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.
RF Environmental Services, Inc.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification of the person whose name is entered on line 1. Check only one of the following seven boxes.

☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☑ S Corporation ☐ Partnership ☐ Trust/estate

☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=Partnership) ▶ _____

Note: Check the appropriate box in the line above for the tax classification of the single-member owner. Do not check LLC if the LLC is classified as a single-member LLC that is disregarded from the owner unless the owner of the LLC is another LLC that is not disregarded from the owner for U.S. federal tax purposes. Otherwise, a single-member LLC that is disregarded from the owner should check the appropriate box for the tax classification of its owner.

☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):

Exempt payee code (if any) _____

Exemption from FATCA reporting code (if any) _____

(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.) See instructions.
4840 NE 11th Ave

Requester's name and address (optional)

6 City, state, and ZIP code
Oakland Park, FL 33334

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the instructions for Part I, later. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN*, later.

Note: If the account is in more than one name, see the instructions for line 1. Also see *What Name and Number To Give the Requester* for guidelines on whose number to enter.

Social security number
[ ][ ][ ] - [ ][ ] - [ ][ ][ ][ ]

or

Employer identification number
8 1 - 1 4 5 5 7 1 0

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions for Part II, later.

Sign Here Signature of U.S. person ▶ [signature] Date ▶ 1/2/24

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. For the latest information about developments related to Form W-9 and its instructions, such as legislation enacted after they were published, go to *www.irs.gov/FormW9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following.

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See What is backup withholding, *later.*

FORM 12

TRENCH SAFETY

This form must be completed and signed by the Respondent.

Failure to complete this form may result in the solicitation being declared non-responsive.

Respondent acknowledges that the Florida Trench Safety Act, Section 553.60 et. seq., which became effective October 1, 1990, shall be in effect during the period of construction of the project. The respondent by signing and submitting the solicitation is, in writing, assuring that it will perform any trench excavation in accordance with applicable trench safety standards. The respondent further identifies the following separate item of cost of compliance with the applicable trench safety standards as well as the method of compliance:

Method of Compliance

Cost

Total $ $100.00

Respondent acknowledges that this cost is included in the applicable items of their submittal and in the Grand Total Solicitation Price. Failure to complete the above will result in the solicitation being declared non- responsive.

The Respondent is, and the Owner and Engineer are not, responsible to review or assess Respondent's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act." Respondent is, and the owner and Engineer are not, responsible to determine if any safety related standards apply to the project, including but not limited to, the "Trench Safety Act."

Witness Signature

Ariana Avilés
Witness Printed Name

2049 Johnson St Hollywood FL 33020
Witness Address

7/11/24
Date

Contractor's Signature

Thaddeus Buckley
Printed Name

President
Title

7/11/24
Date

- END OF SECTION -

Form 13

Bid Guaranty Form

(Construction)

STATE OF FLORIDA

KNOW ALL MEN BY THESE PRESENTS:
That we RF Environmental Services, Inc., as Principal, and Atlantic Specialty Insurance Company, as Surety, are held and firmly bound unto the City of Hollywood in the sum of Four Million One Hundred Thirty Nine Thousand Dollars ($ 4,139,000.00) of the United States, amounting to 5% of the total SOLICITATION Price, for the payment of said sum, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal has submitted the accompanying SOLICITATION, dated July 11th 2024 for

SOLICITATION- IFB-211-24-JJ
Replacement of Nanofiltration Process Pressure Vessels and Membrane Elements

NOW, THEREFORE, if the principal shall not withdraw said SOLICITATION within 90 days after date of the same and shall within ten days after the prescribed forms are presented to him for signature, enter into a written contract with the CITY, in accordance with the SOLICITATION as accepted, and give bond with good and sufficient surety or sureties, and provide the necessary Insurance Certificates as may be required for the faithful performance and proper fulfillment of such Contract, then this obligation shall be null and void.

In the event of the withdrawal of said SOLICITATION within the specified period, or the failure to enter into such contract and give such bond and insurance within the specified time, the principal and the surety shall pay to the City of Hollywood the difference between the amount specified in said SOLICITATION and such larger amount for which the City of Hollywood may in good faith contract with another party to perform the work and/or supply the materials covered by said SOLICITATION.

IN WITNESS WHEREOF, the above bound parties have executed this statement under their several seals this 11th day of July, 2024, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

WHEN THE PRINCIPAL IS AN INDIVIDUAL:

Signed, sealed and delivered in the presence of:

Witness

Address

Signature of Individual

Printed Name of Individual

Witness

Address

WHEN THE PRINCIPAL IS A CORPORATION:

Attest:

Secretary

RF Environmental Services, Inc.
Name of Corporation

4840 NE 11th Avenue
Business Address

Fort Lauderdale, FL 33334

By:
(Affix Corporate Seal)

Thaddeus Buckley
Printed Name

President
Official Title

CERTIFICATE AS TO CORPORATE PRINCIPAL

I, Katherine Buckley, certify that I am the secretary of the Corporation named as Principal in the attached bond; that Thaddeus Buckley who signed the said bond on behalf of the Principal, was then President of said Corporation; that I know his signature, and his signature thereto is genuine and that said bond was duly signed, sealed and attested for and on behalf of said Corporation by authority of its governing body.

(SEAL)
Secretary

Approved SOLICITATION Bond

TO BE EXECUTED BY CORPORATE SURETY:

Attest:

Witness, Jorge L. Bracamonte

Atlantic Specialty Insurance Company
Corporate Surety
605 Highway 169 North, Suite 800
Business Address
Plymouth, MN 55441

BY: _____
(Affix Corporate Seal)
Jessie Sloan, Attorney-In-Fact &
Florida Licensed Resident Agent
Attorney-in-Fact

JCA Surety Group, LLC.
Name of Local Agency
123 Zelma Street, Suite A Orlando, FL 32803
Business Address

Inquiries: (321) 800-6594

STATE OF FLORIDA

Before me, a Notary Public, duly commissioned, qualified and acting, personally appeared, Jessie Sloan to me well known, who being by me first duly sworn upon oath says that he is the attorney-in-fact for the Atlantic Specialty Insurance Company !!!!! that the has been authorized by Atlantic Specialty Insurance Company to execute the forgoing bond on behalf of the CONTRACTOR named therein in favor of the City of Hollywood, Florida. Subscribed and sworn to before me this 11th day of July, 2024

Karen Alvarenga
Notary Public, State of Florida

My Commission Expires: 08/22/2027

- END OF SECTION-

Notary Public State of Florida
Karen Cristine Soares Alvarenga
My Commission HH 436384
Expires 8/22/2027

JCA

THEY BUILD IT, WE BOND IT

July 9, 2024

RF Environmental Services, Inc.
4840 NE 11th Avenue
Fort Lauderdale, FL 33334

Project: IFB-211-24-JJ - Replacement of Nanofiltration Process Pressure Vessels and Membrane Elements

Dear Thad,

The bid bond for the above referenced job has language on the bid bond form that implies you need to write out the percentage of your bid amount in dollar value on the bond form. Please let us know if you have any questions.

Thank you,

Jessie Sloan
Contract Surety Account Manager
Inquiries: (321) 800-6594

Power of Attorney

KNOW ALL MEN BY THESE PRESENTS, that ATLANTIC SPECIALTY INSURANCE COMPANY, a New York corporation with its principal office in Plymouth, Minnesota, does hereby constitute and appoint: **Jorge L. Bracamonte, Jessie Sloan, Karla Tomaszewski**, each individually if there be more than one named, its true and lawful Attorney-in-Fact, to make, execute, seal and deliver, for and on its behalf as surety, any and all bonds, recognizances, contracts of indemnity, and all other writings obligatory in the nature thereof; provided that no bond or undertaking executed under this authority shall exceed in amount the sum of: **unlimited** and the execution of such bonds, recognizances, contracts of indemnity, and all other writings obligatory in the nature thereof in pursuance of these presents, shall be as binding upon said Company as if they had been fully signed by an authorized officer of the Company and sealed with the Company seal. This Power of Attorney is made and executed by authority of the following resolutions adopted by the Board of Directors of ATLANTIC SPECIALTY INSURANCE COMPANY on the twenty-fifth day of September, 2012:

Resolved: That the President, any Senior Vice President or Vice-President (each an "Authorized Officer") may execute for and in behalf of the Company any and all bonds, recognizances, contracts of indemnity, and all other writings obligatory in the nature thereof, and affix the seal of the Company thereto; and that the Authorized Officer may appoint and authorize an Attorney-in-Fact to execute on behalf of the Company any and all such instruments and to affix the Company seal thereto; and that the Authorized Officer may at any time remove any such Attorney-in-Fact and revoke all power and authority given to any such Attorney-in-Fact.

Resolved: That the Attorney-in-Fact may be given full power and authority to execute for and in the name and on behalf of the Company any and all bonds, recognizances, contracts of indemnity, and all other writings obligatory in the nature thereof, and any such instrument executed by any such Attorney-in-Fact shall be as binding upon the Company as if signed and sealed by an Authorized Officer and, further, the Attorney-in-Fact is hereby authorized to verify any affidavit required to be attached to bonds, recognizances, contracts of indemnity, and all other writings obligatory in the nature thereof.

This power of attorney is signed and sealed by facsimile under the authority of the following Resolution adopted by the Board of Directors of ATLANTIC SPECIALTY INSURANCE COMPANY on the twenty-fifth day of September, 2012:

Resolved: That the signature of an Authorized Officer, the signature of the Secretary or the Assistant Secretary, and the Company seal may be affixed by facsimile to any power of attorney or to any certificate relating thereto appointing an Attorney-in-Fact for purposes only of executing and sealing any bond, undertaking, recognizance or other written obligation in the nature thereof, and any such signature and seal where so used, being hereby adopted by the Company as the original signature of such officer and the original seal of the Company, to be valid and binding upon the Company with the same force and effect as though manually affixed.

IN WITNESS WHEREOF, ATLANTIC SPECIALTY INSURANCE COMPANY has caused these presents to be signed by an Authorized Officer and the seal of the Company to be affixed this twenty-seventh day of April, 2020.

ATLANTIC SPECIALTY INSURANCE COMPANY CORPORATE SEAL 1986 NEW YORK

By _____
Paul J. Brehm, Senior Vice President

STATE OF MINNESOTA
HENNEPIN COUNTY

On this twenty-seventh day of April, 2020, before me personally came Paul J. Brehm, Senior Vice President of ATLANTIC SPECIALTY INSURANCE COMPANY, to me personally known to be the individual and officer described in and who executed the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, that he is the said officer of the Company aforesaid, and that the seal affixed to the preceding instrument is the seal of said Company and that the said seal and the signature as such officer was duly affixed and subscribed to the said instrument by the authority and at the direction of the Company.

ALISON DWAN NASH-TROUT
NOTARY PUBLIC - MINNESOTA
My Commission Expires
January 31, 2025

_____
Notary Public

I, the undersigned, Secretary of ATLANTIC SPECIALTY INSURANCE COMPANY, a New York Corporation, do hereby certify that the foregoing power of attorney is in full force and has not been revoked, and the resolutions set forth above are now in force.

Signed and sealed. Dated 11th day of July, 2024.

ATLANTIC SPECIALTY INSURANCE COMPANY CORPORATE SEAL 1986 NEW YORK

This Power of Attorney expires
January 31, 2025

_____
Kara Barrow, Secretary

Please direct bond verifications to surety@intactinsurance.com

Form 14

LIST OF SUBCONTRACTORS

The Respondent shall list below the name and address of each Subcontractor who will perform work under this Contract, and shall also list the portion of the work which will be done by such Subcontractor. After the opening of Submittals, changes or substitutions will be allowed with written approval of the City of Hollywood. Subcontractors must be properly licensed.

	Work to be Performed	**Subcontractor's Name / Address**
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

NOTE: Attach additional sheets if required.

- END OF SECTION -

FORM 15

INFORMATION REQUIRED FROM BIDDERS

GENERAL INFORMATION

The Bidder shall furnish the following information. Failure to comply with this requirement may cause its rejection. Additional sheets shall be attached as required.

1. Contractor's Name/Address: RF Environmental Services, inc
4840 NE 11 Ave, Fort. Lauderdale, FL 33334
Thaddeus Buckley

2. Contractor's Telephone Number: 954-605-6711
and e-mail address: AAviles98@yahoo.com

3. Contractor's License (attach copy): PLEASE SEE ATTACHED
Primary Classification: _____
Broward County License Number (attach copy): _____

4. Number of years as a Contractor in construction work of the type involved in this Contract: 8 years RF Environmental Services, inc
28 years Thaddeus Buckley

5. List the names and titles of all officers of Contractor's firm:
Thaddeus Buckley - President
Katherine Buckley - Secretary + Treasurer.

6. Name of person who inspected site or proposed work for your firm:
Name: Kameron Young
Date of Inspection: June 18th, 2024

7. What is the last project of this nature you have completed?
SEE ATTACHED

8. Have you ever failed to complete work awarded to you; if so, where and why?

N/A

9. Name three individuals or corporations for which you have performed work and to which you refer:

Broward County: Oscar Asgar.
McCafferty Brinson: Frank Brinsah
Hazen + Sawyer: George Wrves

10. List the following information concerning all contracts on hand as of the date of submission of this proposal (in case of co-venture, list the information for all coventures).

Name of Project	City	Total Contract Value	Contracted Date of Completion	% Completion to Date
SEE ATTACHED				

(Continue list on inset sheet, if necessary)

11. What equipment do you own that is available for the work?

-Diesel Generator • Concrete saw • Concrete chain saw
• 30 gal. Air Compressor • Fork lift • Plate Compactor
• welding machine • Pressure washer • Percision Laser
• Pump • Table saw • 30 gal horizon Air comp • Industrial welder

12. What equipment will you purchase for the proposed work?

N/A

13. List at least three similar projects completed within the last five (5) years by the bidder and project manager. For the purpose of this requirement, "similar" projects shall be considered to include municipal drinking water, reverse

osmosis (RO) and/or NF membrane systems with a permeate capacity of 2.0 mgd or greater that have been commissioned within the past five (5) years and are currently in successful service. Also, list at least one RO or NF membrane system project that is fully installed within the past ten (10) years having an aggregate permeate production capacity of 5.0 mgd which is currently in successful service. Include Owner, project value, completion date, reference contact information, and brief project description. The determination of whether a project is sufficiently similar shall be at the sole discretion of the City.

Please see attached: Highlighted Jobs:
- Plantation East WTP Chemical Storage
- Hialeah WTP Lime Slaker Replacement + Chem Bldg Rehab
- Broward County WTP 1A + 2A Treatment Unit Rehab

(Add sheets as requested.)

14. Name the Project Manager proposed for this project. Attach a copy of the project manager's resume.

Thaddeus Buckley - resume attached

NOTE: If requested by CITY, the Bidder shall furnish a notarized financial statement, references and other information, sufficiently comprehensive to permit an appraisal of its current financial condition.

++ END OF SECTION

FORM 16

PROPOSAL

TO THE MAYOR AND COMMISSIONERS
CITY OF HOLLYWOOD, FLORIDA

SUBMITTED 7/11/24

Dear Mayor and Commissioners:

The undersigned, as BIDDER, hereby declares that the only person or persons interested in the Proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this Proposal or in the Contract to be entered into; that this Proposal is made without connection with any other person, company or parties making a Bid or Proposal; and that it is in all respects fair and in good faith without collusion or fraud.

The BIDDER further declares that he has examined the site of the Work and informed himself fully in regard to all conditions pertaining to the place where the Work is to be done; that he has examined the Drawings and Specifications for the Work and contractual documents relative thereto, including the Notice to Bidders, Instructions to Bidders, Proposal Bid Form, Form of Bid Bond, Form of Contract and Form of Performance Bond, General, Supplementary and Technical Specifications, Addenda, Drawings, and Local Preference Program, Exhibit A, and has read all of the Provisions furnished prior to the opening of bids; and that he has satisfied himself relative to the work to be performed.

The undersigned BIDDER has not divulged to, discussed or compared his bid with other bidders and has not colluded with any other BIDDER of parties to this bid whatever.

If this Proposal is accepted, the undersigned BIDDER proposes and agrees to enter into and execute the Contract with the City of Hollywood, Florida, in the form of Contract specified; of which this Proposal, Instructions to Bidders, General Specifications, Supplementary Conditions and Drawings shall be made a part for the performance of Work described therein; to furnish the necessary bond equal to one hundred (100) percent of the total Contract base bid, the said bond being in the form of a Cash Bond or Surety Bond prepared on the applicable approved bond form furnished by the CITY; to furnish all necessary materials, equipment, machinery, tools, apparatus, transportation, supervision, labor and all means necessary to construct and complete the work specified in the Proposal and Contract and called for in the Drawings and in the manner specified; to commence Work on the effective date established in the "Notice to Proceed" from the ENGINEER; and to substantially complete all Contract Work within 30 days with final completion within 45 days, and stated in the "Notice to Proceed" or pay liquidated damages for each calendar day in excess thereof, or such actual and consequential damages as may result therefrom, and to abide by the Local Preference Ordinance, Exhibit A.

The BIDDER acknowledges receipt of the following addenda:

No. 1 Dated June 12, 2024
No. 2 Dated July 3, 2024
No. _____ Dated _____

And the undersigned agrees that in case of failure on his part to execute the said Contract and the Bond within ten (10) days after being presented with the prescribed Contract forms, the check or Bid Bond accompanying his bid, and the money payable thereon, shall be paid into the funds of the City of Hollywood, Florida, otherwise, the check or Bid Bond accompanying this Proposal shall be returned to the undersigned.

Attached hereto is a certified check on the

_____ Bank of _____

or approved Bid Bond for the sum of

4,139,000 ⁰⁰ _____ Dollars ($) according to the conditions under the Instructions to Bidders and provisions therein.

NOTE: If a Bidder is a corporation, the legal name of the corporation shall be set forth below, together with signature(s) of the officer or officers authorized to sign Contracts on behalf of the corporation and corporate seal; if Bidder is a partnership, the true name of the firm shall be set forth below with the signature(s) of the partner or partners authorized to sign Contracts in behalf of the partnership; and if the Bidder is an individual, his signature shall be placed below; if a partnership, the names of the general partners.

WHEN THE BIDDER IS AN INDIVIDUAL:

_____
(Signature of Individual)

_____
(Printed Name of Individual)

_____
(Address)

****

WHEN THE BIDDER IS A SOLE PROPRIETORSHIP OR OPERATES UNDER A TRADE NAME:

_____
(Name of Firm)

_____
(Address)

_____(SEAL)
(Signature of Individual)

****

WHEN THE BIDDER IS A PARTNERSHIP:

_____
(Name of Firm) A Partnership

_____
(Address)

By: _____
(SEAL)
(Partner)

Name and Address of all Partners:

_____

_____

****

WHEN THE BIDDER IS A JOINT VENTURE:

_____
(Correct Name of Corporation)

By: _____ (SEAL)
(Address)

_____
(Official Title)

As Joint Venture
(Corporate Seal)

Organized under the laws of the State of _____, and authorized by the law to make this bid and perform all Work and furnish materials and equipment required under the Contract Documents.

****

WHEN THE BIDDER IS A CORPORATION:

RF Environmental Services, Inc
(Correct Name of Corporation)

By: _____
(SEAL)

Thaddeus Buckley - President

(Official Title)

4840 NE 11 Ave, Fort Lauderdale FL 33334
(Address of Corporation)

Organized under the laws of the State of Florida, and authorized by the law to make this bid and perform all Work and furnish materials and equipment required under the Contract Documents.

CERTIFIED COPY OF RESOLUTION OF
BOARD OF DIRECTORS

RF Environmental Services, Inc
(Name of Corporation)

RESOLVED that Thaddeus Buckley
(Person Authorized to Sign)

President - RF Environmental Services
(Title) (Name of Corporation)

be authorized to sign and submit the Bid or Proposal of this corporation for the following project:

Membrane Softening Plant Membrane Replacement at the Water Treatment Plant
Project Number: 23-4260
Bid No. IFB-211-24-JJ

The foregoing is a true and correct copy of the Resolution adopted by

RF Environmental Services at a meeting of its Board of
(Name of Corporation)

Directors held on the 11th day of July, 2024.

By: Thaddeus Buckley

Title: President

(SEAL)

The above Resolution MUST BE COMPLETED if the Bidder is a Corporation.

- END OF SECTION -

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 07/09/2024

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER		CONTACT NAME:	Kemi Foster-Sterling	
Brown & Brown Insurance Services, Inc.		PHONE (A/C, No, Ext):	(954) 776-2222	FAX (A/C, No): (954) 776-4446
1201 W Cypress Creek Rd		E-MAIL ADDRESS:	Kemi.Foster-Sterling@bbrown.com	
Suite 130		INSURER(S) AFFORDING COVERAGE		NAIC #
Fort Lauderdale	FL 33309	INSURER A :	FCCI Insurance Company	10178
INSURED		INSURER B :	Westchester Surplus Lines Insurance Company	10172
RF Environmental Services Inc, DBA: Milan Construction & Real Estate		INSURER C :		
4840 NE 11th Avenue		INSURER D :		
		INSURER E :		
Oakland Park	FL 33334	INSURER F :		

COVERAGES **CERTIFICATE NUMBER:** 2022-25 COI **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	[X] COMMERCIAL GENERAL LIABILITY [ ] CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PRO-JECT [X] LOC [ ] OTHER:	Y		GL10009354700	06/27/2024	02/27/2025	EACH OCCURRENCE	$ 1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 100,000
							MED EXP (Any one person)	$ 5,000
							PERSONAL & ADV INJURY	$ 1,000,000
							GENERAL AGGREGATE	$ 2,000,000
							PRODUCTS - COMP/OP AGG	$ 2,000,000
								$
A	AUTOMOBILE LIABILITY [X] ANY AUTO [ ] OWNED AUTOS ONLY [ ] SCHEDULED AUTOS [ ] HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY			CA10009354800	06/27/2024	06/27/2025	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
							UM CSL	$ 300,000
A	[X] UMBRELLA LIAB [X] OCCUR [ ] EXCESS LIAB [ ] CLAIMS-MADE [ ] DED [X] RETENTION $ 10,000			UMB10009355100	06/27/2024	06/27/2025	EACH OCCURRENCE	$ 3,000,000
							AGGREGATE	$ 3,000,000
								$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		WC010007021904	06/27/2024	06/27/2025	[X] PER STATUTE [ ] OTH-ER	
							E.L. EACH ACCIDENT	$ 1,000,000
							E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
B	Pollution Liability			G70971070003	10/24/2022	06/27/2025	Each Pollution	$2,000,000
							Aggregate	$2,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

City of Hollywood is an additional insured with respect to General Liability if required by written contract.

CERTIFICATE HOLDER

City of Hollywood
2600 Hollywood Blvd
Hollywood FL 33022

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

State of Florida
Department of State

I certify from the records of this office that RF ENVIRONMENTAL SERVICES, INC. is a corporation organized under the laws of the State of Florida, filed on January 28, 2016, effective January 27, 2016.

The document number of this corporation is P16000009528.

I further certify that said corporation has paid all fees due this office through December 31, 2024, that its most recent annual report/uniform business report was filed on February 14, 2024, and that its status is active.

I further certify that said corporation has not filed Articles of Dissolution.

Given under my hand and the Great Seal of the State of Florida at Tallahassee, the Capital, this the Fourteenth day of February, 2024

Secretary of State

Tracking Number: 5698487124CC

To authenticate this certificate,visit the following site,enter this number, and then follow the instructions displayed.

https://services.sunbiz.org/Filings/CertificateOfStatus/CertificateAuthentication

Membrane WTP's are Highlighted

PERSONAL STATEMENT

"As a result of my tenure working for municipalities in the Tri-County area , I have developed long-standing relationships with many of the County's and City's construction and engineering staff. I understand and can exceed their expectations for project delivery."

OFFICE LOCATION

Miami & Fort Lauderdale, FL

EDUCATION

BS, Mechanical Engineering, National University of Florida, 1996

LICENSES/ REGISTRATIONS

Certified General Contractor – FL, #CGC1518671

Certified Mechanical Contractor – FL, #CMC1250334

Certified Plumbing Contractor – FL, #CFC1429319

Certified Pollutant Storage Contractor – FL, #PCC 1256939

MEMBERSHIPS/ AFFILIATIONS

Designated DBIA Professional

Construction Association of South Florida

Association of General Contractors of America

Thad Buckley, President

Mr. Buckley has more than 20+ years of construction and engineering experience including work on water and wastewater treatment facilities, commercial and industrial HVAC and plumbing projects, and heavy duty industrial mechanical installations. In January 2016 Mr. Buckley founded RF Environmental Services, Inc. (RFES). Mr. Buckley has been responsible for the procurement and execution of water and wastewater treatment projects utilizing the Hard-Bid, CMAR and Design-Build delivery methods. By utilizing his knowledge and expertise in business and project development, estimating, design, start-up, testing and commissioning, and overall quality control for designing, estimating, construction, Mr. Buckley has procured and completed some of the most complex projects in the state. Mr. Buckley has had complete project responsibility for some of the most involved and technically challenging projects throughout Florida, from the largest membrane softening water treatment plant in the United States at 40-mgd to the installation of over 15,000 feet of 20"/24" steel pipe in the tarmac at Miami International Airport. Mr. Buckley has also served as the project executive for multiple, large scale, projects throughout the Tri-County area.

Previous Relevant Work Experience

MWH Constructors, Inc., Florida Regional Manager (2012-2016)

While with MWH Constructors, Inc., Mr. Buckley helped establish the Company's "Hard-Bid" and "Self-Perform" capabilities. With MWHC's main office located in Broomfield, CO, it was Mr. Buckley's responsibility to establishing their Florida based estimating, project management, field staff and "self-perform" teams. These initial efforts culminated in the Award and Substantial Completion of the MWHC's first "Hard-Bid - at Risk" construction project in the Company's history. Mr. Buckley also acted as the Company's general construction, mechanical and plumbing qualifier for the work in Florida.

Poole and Kent, Inc., Vice President (1996-2012)

Mr. Buckley started his professional construction career after graduation from the University of Florida with Poole and Kent as an assistant project manager working at Miami-Dade County's Central District Waste Water Treatment Plant. Having worked there for 16 years Mr. Buckley performed every job required at Poole and Kent from clerk to chief project estimator, and from superintendent to project executive. During this time at Poole and Kent Mr. Buckley gained valuable experience in both general construction and mechanical cost estimating; and the detailed bidding requirements specific to the municipal water & wastewater treatment sector, including insurance and indemnification requirements and standards, bond requirements and construction risk allocation, and scheduling.

Relevant Project Experience

RFES Project Manager, North Regional WWTP Reclaimed Water Plant Expansion, Broward County, Broward, FL

Mr. Buckley led this effort as project manager. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $10.6M project includes the furnish and installation of two (2) 2,500kw Gen-Sets, Sixty-Four (64) Dyna-Sand reuse filters, Two (2) Auto-

Backwash Strainers, Five (5) FRP Tanks, and Twelve (12) Re-Use and Filter Pumps.

RFES Project Manager, WTP Improvements, City of Pembroke Pines, Pembroke Pines, FL

Mr. Buckley led this effort as a project manager, he produced initial and final cost estimates and managed the proposal, design, purchasing and coordination of all major design, process equipment and subcontractor packages. Was directly responsible for assembling the design and construction teams on this project. After completing the design phase, he turned over day-to-day operations of the construction activities to the on-site project management team. This $2.9M project entailed installation of new air scour system on (16) Greenleaf Filter Cell including new blower and air distribution header throughout the water treatment plant.

RFES Project Manager, WTP Lime Feed System Refurbishment, SCC Valve Insertion and Mag-Flow Meter Insertion, City of Pembroke Pines, Pembroke Pines, FL

This $3.1 million project entails the refurbishment of lime systems No. 1 and 2. Mr. Buckley produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. The contract includes the installation of two new slakers, including new lime slurry feed tanks, new slurry feed pumps. Replacement of the lime slurry pumps at Silo No. 3, provide rehabilitation to Silos No. 1 and No. 2. Excavate, cut and install (3) new isolation valves.

RFES Project Manager, WTP 1A and 2A Treatment Unit Rehabilitations, Broward County, Broward, FL

Mr. Buckley led this effort as a project manager, he produced initial and final cost estimates and managed the proposal, design, purchasing and coordination of all major design, process equipment and subcontractor packages. Was directly responsible for assembling the design and construction teams on this project. After completing the design phase, he turned over day-to-day operations of the construction activities to the on-site project management team. This $1.8M project entailed the rehabilitation of existing Lime Treatment Unit #2 at WTP 2A and Lime Treatment Unit #1 at WTP 2A, including 36” Pipe repair.

RFES Project Manager, Sodium Hypochlorite and CO2 Injection System, City of Pembroke Pines, Pembroke Pines, FL

This $2 million project entails the installation of a Sodium Hypochlorite and Carbon Dioxide Injection System. Mr. Buckley produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. The contract included the replacement of components of (2) sodium hypochlorite injection triplex skids, replacement of sodium hypochlorite transfer pump including all electrical cables and piping.

Project Executive (PK), South District WWTP Cogeneration Facility Improvements, Miami-Dade Water & Sewer Department, Miami, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of project managers and engineers during the RFQ, RFP, Design & Construction phases of the project. He produced initial and final cost estimates and managed the proposal, design, purchasing and coordination of all major design, process equipment and subcontractor packages. This included design service agreements in the amount of $2M, cogeneration system equipment package worth $4M and a $3.5M electrical system subcontract agreement.

Project Executive, Belle Glade Wastewater Treatment Plant Improvements, Glades Utility Authority, Belle Glade, FL

Mr. Buckley led this effort in a Principal-in-Charge and Lead Estimator capacity by managing the team of project managers, field staff and estimators. He produced initial and final cost estimates and managed purchasing and

coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $1.6M project includes the installation of bar screen covers, oxidation ditch splash guards, sodium hypochlorite feed system and piping, automatic slide gate and fencing; the modifications of the headworks piping, deep injection well effluent piping, weir; and purchase of outdoor refrigerated samples, WAS pumps, and sludge pumps.

Project Executive, South District WWTP Cogeneration Facility Improvements, Miami-Dade Water & Sewer Department, Miami, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of project managers and engineers during the RFQ, RFP, Design & Construction phases of the project. He produced initial and final cost estimates and managed the proposal, design, purchasing and coordination of all major design, process equipment and subcontractor packages. This included design service agreements in the amount of $2M, cogeneration system equipment package worth $4M and a $3.5M electrical system subcontract agreement. He was also directly responsible for assembling the design and construction teams on this project. After completing the design phase, he turned over day-to-day operations of the construction activities to the on-site project management team. This $20M project entailed the upgrade to the existing Cogeneration System at the South District WWTP including design, permitting, supply, fabrication/installation of (5) new cogeneration units and associated 5kV electrical systems, as well as combustion gas pre-treatment systems, exhaust and engine cooling water heat recovery systems for the digested sludge treatment process and the combustion air cooling through the use of an absorption chiller and hot oil recirculation.

Project Executive, South District WWTP HLD Upgrade to 285-mgd Filter System, Miami-Dade Water & Sewer Department, Miami, FL

Mr. Buckley, as part of the executive bid team on this project, performed the pre-bid estimating for all the wastewater treatment plant process equipment on this project. Then after contract award, acting as a project executive purchased, coordinated and scheduled the delivery all major process equipment for this project, including: (16) 200 hp Backwash Pumps, (7) 500 hp blowers, (12) mixers, switchgear, transformers, MCCs, (161) 24-inch motor operated control valves, (35) flow meters, (43) level transmitters, and multiple local control panels, and the process instrumentation package. These responsibilities included negotiating subcontract and purchase order terms and conditions with both contractor selected and Owner “sole-source” vendors and subcontractors, assuring that Miami-Dade County contract requirements were including in all subcontractor and vendor agreements. This $135M project, part of the $628M high-level disinfection project currently underway at the South District WWTP, entailed the construction of one of the largest deep bed sand filter systems in the US.

Project Executive, South District WWTP Fat, Oil & Grease Septage Facility, Miami-Dade Water & Sewer Department, Miami, FL

Mr. Buckley, as part of the executive bid team on this project, performed the pre-bid estimating for all of the wastewater treatment plant process equipment on this project. After contract award, he acted in a project executive role and purchased, coordinated, and scheduled for delivery all major process equipment for this project, including: grit pumps, overflow & flushing water pumps, slide, weir & sluice gates, submersible pumps, grit classifiers, mechanical bar screens, odor control systems, chemical systems, motor operated control valves, flow meters, level transmitters, local control panels, and the process instrumentation package.

Project Executive, Belle Glade Wastewater Treatment Plant Improvements, Glades Utility Authority, Belle Glade, FL

Mr. Buckley led this effort in a Principal-in-Charge and Lead Estimator capacity by managing the team of project managers, field staff and estimators. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all

phases of construction. This $1.6M project includes the installation of bar screen covers, oxidation ditch splash guards, sodium hypochlorite feed system and piping, automatic slide gate and fencing; the modifications of the headworks piping, deep injection well effluent piping, weir; and purchase of outdoor refrigerated samples, WAS pumps, and sludge pumps.

Project Executive, Hollywood Water Treatment Plant Electrical Power Generator System Expansion, Hollywood, Florida

This $1.7 million project entails the construction of expansion of the generator system at the existing water treatment plant. Mr. Buckley produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. The contract includes the installation of a new 1500 kW, 13.2 kV diesel engine generator set in the existing Generator Building, modifications to the existing switchgear, low voltage MCC, and generator control system; the installation of new component panels for the existing generator section and a new door/panel for the master control section; modifications to existing SCADA systems; installation of a new fuel supply system, new engine cooling system and insulated piping; and removal of modified bitumen roofing and replacing with a new EPDM membrane roofing system.

Project Executive, Hollywood Water Treatment Plant Membrane Replacement, Hollywood, Florida

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing the team of project managers and field staff. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $1.7M project entails the removal and replacement of the nano-filtration membrane elements in the seven existing membrane softening trains at the existing water treatment plant.

Project Executive, Wastewater Repump Stations A, B & E Rehabilitation, City of Fort Lauderdale, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of four project managers and field staff which were charged with completion of all of the City of Fort Lauderdale work being completed concurrently at the time. In this role Mr. Buckley was a key factor in keeping all these projects on schedule and under budget by mitigating subcontractor and vendor claims and changes orders to the fullest extent possible. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $11.7M project entailed the rehabilitation of three re-pump stations for the City of Fort Lauderdale. All electrical and mechanical equipment was replaced and upgraded including generators. All wastewater ductile iron pipelines associated with each respective pump station were replaced as well. A bypass system was installed to help manage the system flow at each pump station. Each station required a system shutdown to install the ductile iron pipe required during the allotted time frame. Major equipment for this project included: four 450 hp horizontal non-clog pumps, one 2,000 kw diesel-electric generator, one 900 kw diesel-electric generator, one 8,000 gallon above-ground fuel storage tank, four 250 horizontal non-clog pumps, three 60 hp horizontal non-clog pumps, four 160 V VFDs, and seven 480 V VFDs.

Project Executive, G.T. Lohmeyer WWTP Pumping System Improvements, City of Fort Lauderdale, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of four project managers and field staff which were charged with completion of all of the City of Fort Lauderdale work being completed concurrently at the time. In this role Mr. Buckley was a key factor in keeping all these projects on schedule and under budget by mitigating subcontractor and vendor claims and change orders to the fullest extent possible. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $12.5M project entailed the following: replacement and upgrade of all field instrumentation, the replacement of the 750 kva generator with a new 1,200 kva generator and motor control center, and upgrade the fuel storage tank to current Building Code standards. At Pump Station No. 1, P&K replaced three 10-inch sewage pumps with three 10-inch horizontal sewage pumps. At Pump Station No. 2, P&K replaced three sewage pumps with three 8” vertical pumps. At Pump Station No. 3, P&K replaced all three 6-inch sewage pumps with three 6-inch vertical pumps. At the dewatering building, P&K replaced all eight sludge pumps with new 6-inch sludge pumps. At the Effluent Pump Station, P&K replaced all three non-potable water pumps.

Project Executive, Waste Management CNG Fueling Facility, Waste Management, Pompano Beach, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing the team of project managers, estimators and field staff. He produced initial and final cost estimates, negotiating the contract with the prime contractor who was working for Waste Management. During construction he managed purchasing, coordination of all major equipment and subcontractor packages and performed general project oversight through all phases of construction. This $1.7M design-build project included the installation of a new water main under the existing truck parking area. Additionally, the project requires the installation of a new compressed natural gas system including equipment, piping, and remote fueling stations for mechanical, electrical and civil systems.

Project Executive, Peele-Dixie Membrane Plant, City of Fort Lauderdale, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of four project managers which were charged with completion of all of the City of Fort Lauderdale work being completed concurrently at the time. In this role Mr. Buckley was a key factor in keeping all these projects on schedule and under budget by mitigating subcontractor and vendor claims and changes orders to the fullest extent possible. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. This $27.3M project entailed the construction of the 12-mgd membrane softening water treatment facility at the existing plant which was built in 1926. In addition to the membrane facility, the project involved building generator and chemical buildings and installed four membrane process skid units each with 77 pressure vessels. The major components of the work included the installation of one 300 hp variable speed membrane feed pump, four raw water cartridge filters, a new high service pump station with five 250 hp vertical turbine high service pumps, three 60 hp transfer pumps, a new chemical tank farm, a metering pump building, and two 1750 kva emergency diesel generators.

Project Executive, Southern Regional WWTP Oxygen System Upgrade, City of Hollywood, FL

Mr. Buckley led this effort in a Principal-in-Charge capacity by managing a team of project managers and engineers during the RFQ, RFP, Design & Construction phases of the project. He produced initial and final cost estimates and managed purchasing and coordination of all major equipment and subcontractor packages; and performed general project oversight through all phases of construction. Mr. Buckley also played a key role in keeping all the projects on schedule and under budget by mitigating subcontractor and vendor claims and changes orders to the fullest extent possible. This $10M design-build project rehabilitated the existing 64 TPD oxygen generation system for the City of Hollywood. The scope of the project included the preliminary and final design, permitting, and construction of the following project components: replacements of the dual 1,250 hp air compressors with three 900 hp units; rehabilitation of two existing LOX storage tanks and piping; rehabilitation of existing cryogenic oxygen generation system; installation of three new ambient air vaporizers, new instrument air compressor, and new instrument air piping; replacement of various piping systems with carbon steel, PVC, 316 stainless steel, and monel stainless steel, and miscellaneous site work. This project required meticulous up-front planning and scheduling, as well as extremely close coordination with the plant operating staff as the SRWWTP is an operating facility.

Project Manager, Fiveash Water Treatment Plant Upgrades – Phase 1, Ft. Lauderdale, FL.

This $12.5 million project upgraded the entire water treatment plant's instrumentation and control system from the existing pneumatic control system to the state-of-the-art PLC and fiber optic control system. This required the replacement of more than 250 automatic control valves and the associated piping throughout the water treatment plant, including (11) on each of the (22) existing gravity filters. The project also involved replacing the main plant's core control system, installing four new lime slakers with new controls and instrumentation, two 200 HP high service pumps, new polymer distribution system with four new polymer feed pumps, a new lime sludge thickening tank with three submersible pumps, a new aqueous ammonia storage tank and pump building with two 10,000 gallon steel storage tanks and four metering pumps, and miscellaneous valves and control upgrades throughout the plant.

Project Manager, Fiveash Water Treatment Plant Filter Rehabilitation, Ft. Lauderdale, FL.

This $2.4 million project entailed the rehabilitation of six of the existing (22) filters at the Fiveash Water Treatment Plant under the WaterWorks 2011 program. During the completion of the contract work, the City of Fort Lauderdale increased our scope of work from six to ten filters. Each of the ten filter rehabilitations included removal of the existing filter internals, including the underdrain system, media and surface wash piping. The inside concrete surfaces of all rehabilitated filters

were refinished and prepared for the new underdrain and media installation. A new 316 stainless steel surface wash system was installed in each filter, and each pair of rehabilitated filters was tested, disinfected, and placed back into operational service within six weeks of being taken out of service.

Project Manager, Glades Road WTP 40-mgd Membrane Softening Process Addition, Boca Raton, FL.

This $49.6 million project included the construction of a 40-mgd Membrane Softening Water Treatment Facility which included the installation of degasifiers, odor control system, and three 1.5 mW generators. To this date this facility remains one of the largest nano-filtration water treatment facilities in the world, having (12) membrane process skid units each with 96 pressure vessels and one 200 HP variable speed membrane feed pump. Also included under the scope of construction for this project was (4) raw water pressure filters rated for a total flow of 47-mgd, a new raw water booster pump station with (6) 250 HP constant speed pumps, a new high service pump station with (2) new dual drive high service pumps rated at 700 HP and 1200 HP, (3) new 100 HP vertical turbine transfer pumps, a new chemical tank farm and metering pump building, a new generator and switchgear building.

Project Manager, G.T. Lohmeyer WWTP Effluent Pump Station, Ft. Lauderdale, FL.

This $6.2 million project required the replacement of five deep well injection pumps. This project was particularly challenging as there was no effective way to isolate the wastewater treatment plant from the effluent pump station, as such all work during scheduled shut-downs had to be closely coordinated at night during low-flow conditions and could not exceed (4) hours. Construction consisted of the following elements: installation of two 1,250 HP – 15,200 GPM and three 1,750 HP – 22,800 GPM, 4,160 volt electric non-clog centrifugal pumps a new effluent pump control system, including new PLC's; wet well level controls, MMI systems and software, and a state-of-the-art pump monitoring system, measuring four temperatures and four vibration readings on each pump and motor. The project involved constructing a new electrical service distribution system for the new pumps, including a FPL vault, VFD control room, and all required HVAC systems

Project Manager, Glades Road Sodium Hypochlorite Generation System, Boca Raton, FL.

This $4 million project included the following: demolition of the existing chlorine gas storage, handling and feed systems; rehabilitation of the existing chlorine storage area and chlorinator room; modifications to receive the new on-site generation and feed equipment; two 70-ton salt/brine tanks each equipped with a salt truck off-loading station and brine make-up water softener system; three 1,500 pound per day (ppd) electrolytic on-site sodium hypochlorite generation units; five 18,500 gallon sodium hypochlorite solution storage tanks; and six hypochlorite metering pumps (each equipped with variable frequency drives); and all associated sitework, yard piping, electrical, instrumentation, and controls improvements.

Additional Project Manager Experience:

Glades Road Wastewater Treatment Plant Sludge System Improvements, Boca Raton, Florida, 2003

Springtree Water Treatment Plant, Sunrise, Florida, 1998

9th Street Pump Station Improvements, Miami, Florida, 1998

Central District WWTP Oxygenation Generation, Miami, Florida, 1996

Central District WWTP Odor Control Facility No. 5, Miami, Florida, 1996

Bal Harbour Pumping Station, Miami, Florida, 1997

Alexander Orr WTP Softening Modifications, Miami, Florida, 1997

World Ford, Hollywood, Florida, 1999

Broward County Libraries Energy Conservation and Ice Storage Facility, Broward County, Florida, 1999

Miami International Airport Concourse "E" Satellite Extension Tunnel and Utility Corridor, Miami, Florida, 1999

Miami International Airport Concourse "J", Miami, Florida, 2000

Miami International Airport South Terminal Expansion, Miami, Florida, 2000

Douglas Lenz

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Membrane WTP's are Highlighted

Project Management / Supervision

Planning, Coordination, Material procurement, Time management, OSHA and EM 385 (US Army Corps of Engineers) Compliance, Manpower loading and Forecast scheduling from Mobilization to Milestones into Substantial & Final Completion. Excellent ability to decipher contracts, drawings with specifications, submittals, shop drawings and surveys. Maintaining As-Built drawings. Dedicated to delivering quality finished product within budget. Experienced in the Procurement and Compliance of building and dewatering permits. Scheduling of Inspections by appropriate Municipalities and Engineer representatives.

Work History

Harry Pepper & Associates Project (General) Superintendent	2011 – 2012
Poole & Kent Company of Florida Project Superintendent	1997 – 2011
Tripp & Associates Project Superintendent	1995 – 1997
Widell & Associates, Inc. Project Superintendent	1987 – 1995
Tripp & Associates Project Superintendent	1984 – 1987
Widell & Associates, Inc. Project Superintendent	1978 – 1984
Grumman Eco-Systems Millwright	1976 – 1978

Experience

Survey

Jobsite Layout and Elevations with Digital Theodolite Transits (Total Stations) and Leica GPS-900 System from Bench Marks / Monuments

Pipe Laying / Pipe Fitting / Plumbing

Ductile Iron (ACIPCO)	Fastite, Flex ring, M.J., Flanged, VIC–Grooved, Field-Flex, Lok-Ring
Steel & Stainless Steel	Threaded, VIC-Grooved, Welded, Flanged
Cast Iron	Hub and No Hub couplings
Copper	Solder Joints (water, air and refrigeration)
Brass	Threaded and Welded
PVC and CPVC	Threaded, Glue, VIC-Groove, Welded
HDPE	VIC-Groove, Flanged, Fusion
R.C.P.	Assembly with testable joints underwater (Price Bros / Hanson)
Concrete	Drainage structures and conduit
Corrugated Metal	Steel and Aluminum
Fiberglass	Ductwork

Concrete

Forming	Using panels with taper-ties and snap-ties (Symons) (Patent) (Economy) plywood Keyways and bulkheads with PVC or Steel waterstop
Placement	Using truck-mounted booms, Hydraulic trailer pumps – crane / bucket
Finishing	Screeds, Laser leveling, vibration, power trowelling machine, hand float, trowel, edging, N.S. grouting of equipment bases, point & patch, sponge rubbing
Cutting	Blade and diamond chain saw and cord drilling, demolition, hydraulic and pneumatic hammers
Reinforcement	Bending, Placement

Carpentry

Rough	Forming for concrete with plywood/lumber. Wood & steel framing for houses, garages, barns. Setting and alignment of roof trusses (wood & steel). Hang and finish drywall. Wood fencing.
Finish	Hanging of doors, frames and hardware (wood, steel & fiberglass). Installation of cabinets, counters and vanities. Wood paneling and trim.

Equipment Operation **CDL Class "A" Safe Driver Florida License**

Crane	Boom trucks, carry deck, hydro (all terrain & truck/carrier), friction (track) using drag, clam and concrete buckets. Sheet piling diesel hammer, vibratory sheet pile driver/extractor, hydraulic auger for cast in place piling.
Excavators	Track-hoe (full size and mini), rubber tire combination, dozer, wheel loader, grader, skid-steer loader with hoe, breaker and broom attachments), tractor with box blade.
Compaction	Jumping Jack rammer, reversible plate, single drum (ride on) vibratory
Forklift	Warehouse lift truck, straight mast rough terrain, shooting boom rough terrain

Welding AC/DC, MIG/TIG/Stick

Cutting Carbon Arc, Plasma, Oxygen and Acetylene

Installation, Leveling and Alignment of:

- R.O. and De-saltation Membranes
- Generators, Silencers, Fuel systems
- Pumps, Motors, Piping
- Gantry systems
- Air compressor systems
- Vacuum pump systems
- Chlorination and chemical feed systems
- Turbine generator
- Barscreens (Parkson)
- Primary & Secondary Clarifiers
- Lime Slakers
- Sodium Hypochlorite Generator
- Pressure sand filter (Roberts)
- Odor control and degasifiers
- Fire sprinkler systems
- Irrigation systems

Experience developed from:

- Construction of WTP and WWTP
- Pumping Stations and Pipe Laying
- Sheet Piling Cofferdams w/tremie seals
- Wellpoint Dewatering Systems
- Open pumping with under-drain systems
- A/C and Refrigeration Equipment
- Commercial Buildings (single and multi-story)
- Shopping Centers and Convenience Stores
- Above ground fuel storage systems
- Service Stations and Fuel Islands
- Steel Buildings and their foundations
- Concrete steel and fiberglass tanks
- Truck Weighing Stations
- Custom multi-million dollar homes

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Job details, history and contacts for the various jobs and projects that I have worked on over my career.

Harry Pepper & Associates **Project / Job Details:**	**2011 – 2012** **Project Value**
Picayune Strand Restoration & Faka/Union Pump Station Collier County, Naples, FL USACE Jacksonville District — HPA Sr. Project Manager SFWMD — Allen Bales (321) 543-7438 Bales@cfl.rr.com	**$79M**
Poole & Kent Company of Florida *(Member of Safety Committee for OSHA Compliance)* **Wastewater/Water Treatment Plants** **Project / Job Details:**	**1997 - 2011** **Project Value**
SDWWTP (Black Point) Chlorine Contact Tanks 5–9, Miami, FL Hazen & Sawyer — Metro Dade Utilities Jose Orlando (305) 393-1711 — Brian Held - Field Inspector (305) 903-6478	**$18M**
SDWWTP (Black Point) Septage Receiving & Solids Process Bldg., Miami, FL Metro Dade Utilities Alex Chong - Field Inspector (305) 710-4853	**$16M**
SRWWTP Oxygen System Upgrade, Hollywood, FL Camp, Dresser, McGee — Air Products Frank Brenson (954) 802-3058 — Sara Hammon	**$10M**
Peele Dixie WTP Membrane and Ground Storage Facility, Ft. Lauderdale, FL Hazen & Sawyer — Rick Johnson - Chief Operator W.D. Brown - Field Inspector — (954) 828-7865 Worked under Thad Buckley	**$26M**
Wastewater Re-pump Stations A, B & E Rehabilitation, Ft. Lauderdale, FL CH2MHill — Camp, Dresser McGee — Chief of Operations Larry Bower – PMT — Jeff Manning — Steve Roberts (954) 520-1713 — (954) 448-3807 — (954) 828-7854	**$17M**
G.T. Lohmeyer WWTP Pumping System Improvements, Ft. Lauderdale, FL CH2MHill — Camp, Dresser McGee — Chief Operator Larry Bower – PMT — Jeff Manning — Steve Curmode (954) 520-1713 — (954) 448-3807 — (954) 523-1002	**$8.5M**
Fiveash Water Treatment Plant Upgrades – Phase 1, Ft. Lauderdale, FL CH2MHill — Hazen & Sawyer — Chief Operator Larry Bower –PMT — George Brown — Rick Johnson (954) 520-1713 — (954) 987-0066 — (954) 828-7865	**$16.5M**
Glades Road WTP Membrane Softening Process Addition – Boca Raton, FL ***"World's Largest Membrane Softening Water Treatment Plant"*** Worked under Thad Buckley Camp, Dresser, McGee — City of Boca Raton Admin Team Jeff Manning (954) 448-3807 — Chris Helfrich – Director of Utilities (561)338-7301 Ed Hause (954) 605-9789 — Norm Wellings-Operations Director (561) 338-7300	**$49.75M**
Bonita Springs Water Reclamation Facility, Bonita Springs, FL CH2MHill — Bonita Springs Utilities Don Klose - East Coast Mgr (813) 918-6266 — Director	**$6M**

Bonita Springs Water Reclamation Facility, Bonita Springs, FL – cont'd Fred May - Senior PM (941) 875-1592 Pat Jennings (239) 992-0711 Katos Watson – PM (239) 707-6173 Gary - Project Supt (239) 707-6172	
Poole & Kent Company of Florida **Wastewater/Water Treatment Plants** **Project / Job Details:**	**1997 - 2011** **Project Value**
G.T. Lohmeyer WWTP Effluent Pump Station - Ft. Lauderdale, FL CH2MHill Camp, Dresser McGee Chief Operator Larry Bower - PMT Jeff Manning John McGeary (954) 520-1713 (954) 448-3807 (954) 523-1002	**$8M**
Palm Beach County Membrane Plant No. 9 - Boca Raton, FL Palm Beach County Utilities Bill Latinsky (561) 541-0754	**$25M**
Tequesta Water Treatment Plant - Tequesta, FL Reese, Macon & Associates (561) 433-3226 Bill Reese (561) 248-3226 wreese@Arcadis-us.com Jim Macon Dale Scott – PM	**$5.5 M**
Sawgrass WWTP Expansion and Biosolids Facility - Sunrise, FL Camp, Dresser, McGee (954) 776-1731 City of Sunrise Larry Martin – Senior PM (941) 656-5211 Chris Helfrich - Finance Jim Crane – S FL Mgr Walter Garrard – Adm Control Ben Cinquegrana – Project Inspector Chuck Irvine – Adm Control Robert Trautman – Project Inspector Tony Yates – Adm Control	**$24M** *This reflects a $4M change order*
Springtree Water Treatment Plant - Sunrise, FL Montgomery Watson - Engineer City of Sunrise Albert Weidner – Project Inspector (954) 572-2424 Chris Helfrich - Finance Howard Rupper – Chief Operator Walter Garrard – Adm Control Chuck Irvine – Adm Control Tony Yates – Adm Control	**$16M**
Alexander Orr Water Treatment Plant - Miami, FL Miami Dade Utilities Murray Grant – Utilities Director Alfredo Sanchez – Field Inspector	**$14.2M**
Alexander Orr Lime Kiln Improvements - Miami, FL Miami Dade Utilities Murray Grant – Utilities Grant Alfredo Sanchez – Field Inspector	**$2.5M**
Tripp & Associates **Responsibility – Project Superintendent** **Projects / Job Detail**	**1995 – 1997** **Project Value**
Turbine Generator Facility Superstructure 42'Wx82'Lx60' Tall steel I-Beam structure with 30 ton gantry crane. Mid-elevation concrete operating floor around 10.5 mil-amp steam turbine generator on pedestal base with lower level grading deck for switchgear and lubrication system. Structure enclosed with concrete block with formed columns and beams. Building featured 110 ton chilled water ventilation system with code 850 (fire) smoke or steam discharge system. **Condenser Cooling Tower Circulation Pumps and Piping** Paired 26" steel pipes on steel support frames (20' off ground) with expansion support guides. From turbine generator building to cooling tower. Installed three base mounted split-case horizontal circulation pumps with steel suction piping and stainless strainers and wall embedded sleeve.	**$1.7M**

Condenser Cooling Tower Circulation Pumps and Piping – cont'd Hutcheon Engineers 4431Embarcadero Dr West Palm Beach, FL (561) 845-0665 Robert Howl, Kirk Drost, Anthony Sulkowski Sugar Cane Growers Co-Op – Belle Glade (561) 996-5556 Vice President: Jose Alvarez New Construction Control: Bob Mattox	
Tripp & Associates **Responsibility – Project Superintendent** **Projects / Job Detail**	**1995 – 1997** **Project Value**
Belle Glade Transfer Station Project #SWA 95-240/JMD, Palm Beach, FL **Solid Waste Authority** Project consisted of two concrete structure contained truck scales with approach slabs on either side of scale house/administration building with overhead concrete double tee porch. Transfer building 100'x120' formed concrete structure with steel building upper structure. Split-level structure with two semi-truck drive-thru lanes with approach aprons and axle scales. HDR Engineering, Inc Tampa, FL Neal Poteet (813) 282-2383 SWA Engineer Jack Mesojedec P.E. Brent Headberg - Project Inspector (561) 640-4000	**$3.3M**
Process Water Pumping Station and Transfer Main Project consisted of open pumped excavation. Poured in place concrete 14'x35'x25' depth structure with 16' walls on 36" ballast foundation. 60" influent slide gate and FMC revolving self -cleaning screen filter with two 100HP vertical pumps discharging into 16" PVC ½ mile long transfer main to sand filters. Sugar Cane Growers Cooperative of Florida 1995 Mill Expansion 160 Airport Rd Belle Glade, FL Global Tech, Inc. P.O. Box 2487 Boca Raton, FL (561) 368-2713	**$380K**
Filtered Mud Recovery System Project consisted of two skid mounted transfer pump stations with all steel discharge piping draining to them. These stations transferred mud slurry to main exterior steel mixing tack with vari-speed centrifugal pumps transferring back through steel piping to primary filters.	**$550K**
Widell & Associates **Responsibility – Project Superintendent** **Projects / Job Detail**	**1987 – 1995** **Project Value**
Hood Road Water Treatment Plant Modifications, Palm Beach Gardens, FL **Seacoast Authority** Project consisted of demolition of the existing valve-less filter train system dewatering and installs tapping saddle on existing 60" R.C.P. connecting to two vari-speed high service pumps in cans with discharge yard piping. Demolition of existing steel precipitator and concrete foundation construction of new 70' concrete accelerator softener tank. Relocated lime system on existing high service pumps. Reese, Macon and Associates, Inc. 6415 Lake Worth Rd, Suite 307 Lake Worth, FL Bill Reese P.E. James Macon P.E.	**$1.87M**

Reclaimed Water Facility, Palm Beach Gardens, FL **Seacoast Utility Authority PGA Wastewater Treatment Plant** Project consisted of new filter feed pump and yard piping to tertiary filters. New chlorine handling facility. 375 linear ft. of 30" D.I.P. through storage ponds #11 and #12. 30'Lx16'Wx16'D pump station with 150HP pumps and jockey pump. 24" discharge header and force main through plant. Engineering Concepts in Design, Inc. 1080 E. Indiantown Road, Suite 202 Jupiter, FL John C. Whitmer P.E. Eric Crawford P.E.	**$961K**
Widell & Associates **Responsibility – Project Superintendent** **Projects / Job Detail**	**1987 – 1995** **Project Value**
WWTP Expansion Sludge Treatment Facility, Broward County, FL Project consisted of concrete building containing sludge boilers, sludge transfer pumps and gas-blowers with connecting piping to two floating cover sludge digesters with mixing cannons inside. Steel gas piping was laid to existing digesters with new cannons. Camp, Dresser & McKee, Inc. James Holly - Assistant Engineer (305) 776-1731	**$7.82M**
Wastewater Effluent Irrigation Facility, City of Pompano Beach, FL Project consisted of two million gallon Crom ground storage tank that was given the ***Award of Excellence for Distinguished Architectural Treatment in Pre-Stressed Concrete Tank Construction*** by Portland Cement Association. An esthetic matching control building with chemical equipment. A Parkson four well sand filter. A multi-horsepower irrigation pump station approximately one mile of 16" D.I.P. distribution main south through golf course. Eckler Engineering Don Eckler P.E. (954) 755-1351 Robert Ruthmeyer - Field Inspector	**$3.25M**
Wastewater Treatment Plant Expansion, City of Royal Palm Beach, FL Project consisted of 200' oval racetrack aeration basin with two 60' clarifiers and combination contact tank with deep well pump station. Responsibilities began with structural and mechanical foreman but completing the project as superintendent. Craig A. Smith & Assoc, Inc. (954) 782-8222	**$2.7M**
Tripp & Associates **Responsibility – Project Superintendent** **Projects / Job Detail**	**1984 – 1987**
S & M Distributors (Farmers Market) Pompano Beach, FL 35,000 sq. ft. steel building; re-skin and divide into storage coolers with insulation and refrigeration. Addition of 3,800 sq. ft. ripening rooms on north truck loading dock.	
J.R. Brooks and Son 18400 SW 256th St. Homestead, FL 3,800 sq. ft. foundation and fabrication of steel tubing mainframe and mid rack of insulated/refrigeration steel building for tropical produce ripening. Mike Hevener Operations Manager (305) 247-3544	
Winn Dixie Shopping Center Expansion (30,300 sq. ft.) – Royals Properties, Inc. Turn-key completion of Scotty's Hardware, Cato's Clothing.	
Thriftway Food Supermarket, Clewiston, FL Rebuild 25% structural concrete and 40% of roof trusses as result of fire damage.	
Glades Middle School – Airport Rd, Belle Glade, FL 5,500 sq. ft. boys and girls locker room addition to existing gym.	
Big B Ranch – State Rd 27 (South Bay Sugar Cane Grower) Single story 6,100 sq. ft. CBS office and storage building	
Bernie Little Beer Distributors – Belle Glade, FL Steel building addition. Piling foundation and forklift ramp and new cooler area.	

Consolidated Chemical, Inc. – Lake Harbor, FL Fairbanks-Morris truck scale and gauge house. Stand up wall fertilizer storage Building.	
Timesaver Convenience Store & Covered Fuel Island – Belle Glade, FL Kirchman Oil Corp – State Rd 80 & Tabit Rd., Belle Glade, FL (561) 996-2033	
Timesaver Convenience Store & Covered Fuel Island – South Bay, FL Kirchman Oil Corp – State Rd 80 & Tabit Rd., Belle Glade, FL (561) 996-2033	
Western Auto Plaza 32,000 sq. ft. two-story commercial building addition. Owner: Tom Bonavita	
Widell & Associates **Responsibility – Mechanical and/or Structural Foreman** **Projects / Job Detail**	**1978 – 1984**
Water and Wastewater Plants, South Broward Utility Company **Waitz and Frye Consulting Engineers** Under piping and encasement, yard piping, onsite lift station and discharge main.	
Wastewater Treatment Plant, Port La Belle, FL Installed transfer pumps and yard piping. Installed Hoffman blowers and air piping to diffuser manifold of main multi-tank.	
Wastewater Treatment Expansion, Collier City, FL **PRC Engineering, Inc. (813) 774-4999** Installed and aligned race-track aerator. Basin mixer shaft units and yard piping at splitter box. Installed vacuum units piping basin tile blocks of Dehydro process (sludge dewatering) Infilco basin.	
Wastewater Treatment Plant Softener Expansion, Pembroke Pines, FL After Tampa tank erected two accelerator mixing tanks on Widell foundations, we complete sludge blow-off piping and valves and yard piping.	
Sewage Re-pump Station, City of Ft. Lauderdale, FL **Williams, Hatfield and Stoner, Inc.** Assembly of by-pass pumps and piping. Gutting station. Installed new pumps, motor, bases and new flanged suction and discharge piping.	
Water Treatment Plant, City of South Bay, FL **Barker, OSHA and Anderson - 860 U.S. Highway 1, West Palm Beach, FL (561) 683-3301** Assembly of two ozone generators and associated piping. Yard piping between structures, filter gallery flanged piping. Chlorine equipment and piping.	
Wastewater Treatment Plant Expansion, Clewiston, FL **U.S. Sugar Corp, Clewiston, FL** **Gee and Jensen Inc. 1 Harvard Circle, West Palm Beach, FL (561) 683-3301** Replacement of bridges, gearboxes and mixers in both accelator units. Yard piping from new ground storage tanks to high service pumps. Wellpoint system installation. Equipment operating of hydraulic crane, trac-hoe and loader.	
Ground Storage and Re-pump Station, City of South Bay, FL **Barker, OSHA and Anderson - 860 U.S. Highway 1, West Palm Beach, FL (561) 683-3301** 1,600 sq. ft. concrete pump house with two split-case hi-service electric pumps and diesel stand-by. 1,500 gallon hydro tank and foundation Crom ground storage tank. Yard piping and chlorine equipment.	
Wastewater Treatment Plant Expansion, City of South Bay, FL **Barker, OSHA and Anderson - 860 U.S. Highway 1, West Palm Beach, FL (561) 683-3301** Assembly of both clarifier mechanisms and complete tertiary filter unit. Assembly of R.B.C. disk units and covers. Equipment operator.	
Water Treatment Plant – Filter Modification **U.S. Sugar Corp, Clewiston, FL** **Gee and Jensen Inc. 1 Harvard Circle, West Palm Beach, FL (561) 683-3301** Filter media removal and replacement. Surface sweeping threaded piping modification.	

Wastewater Pump Station, City of Palm Beach, FL
Hutcheon Engineers 4431 Embarcadero Dr., West Palm Beach, FL (561) 845-0666
Form setter, rebar placement, concrete placement and finishing. Assembly of flanged and mechanical joint piping. Installed Flytt pumps and bases. Installed chlorine equipment. Assembled ozone filtering units and piping. Combination excavator and Bantam truck-crane operator.

Grumman Eco-Systems **Responsibility – Millwright and 20 Ton Hydraulic Crane Operator** **Job Detail**	**1976 – 1978**

Assembly of 24 motor / gearbox / propeller mixing units of three aeration basins. Assembly and leveling of three 170' clarifier mechanisms. Assembly of pumps and piping for two sludge return stations. Installation, leveling and alignment of four diesel turbine generators and discharge silencers.

Mac Pherson's Marine Services, Inc. **Responsibility – Marine Mechanic** **Job Detail**	**1969 – 1976**

Factory trained and authorized mechanic for outboard, sterndrive and inboard gas/diesel propulsion. Shop and dockside repairs, installation and maintenance. Skilled in powerboat and sail seamanship. Past member (Flag Lieutenant) U.S. Power Squadron, Delray Beach, FL.

On-Going & Completed Project Experience & Reference List

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Project Name	Owner	Address	Contract Contact	Email Address	Phone #	Nature of Work	X	% Cmplt	Orig. Days	Final Days	Orig. $	Current / Final $	Projected/ Actual SC
City of Ft. Lauderdale FiveAsh Water Treatment Plant Filter Rehabilitation - Phase 2	City of Ft. Lauderdale	4321 NW 9th Ave, Ft. Lauderdale, FL	Scott A. Teschky	steschky@fortlauderdale.gov	954-828-6195	Replacement of existing Media and Underdrain Inspection for Filters 1-4, 6,9,14,15, 17-22.		100%	870	540	3,301,397	3,301,397	12/30/2023
Broward County 2A Effluent Pipe Replacement	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	Remove & Replace (2) existing 48" Effluent Pipes from 2A Units 1 & 2		50%	360	360	406,900	406,900	2/3/2024
Town of Lantan WTP Resin Replacement & Improvements	Town of Lantana	510 W Pine Street, Lantana, FL 33462	Jerry Darr	jdarr@lantana.org	Office: 561-540-5758	Construction of Improvements WTP rehabilitation of (3) AIX Vessels & (2) IXS System. Updates to the PLC & AIX/IXS Controls Software. Filter Valve Replacement		20%	590	590	2,404,000	2,404,000	2/9/2025
City of Sunrise - Sawgrass WTP Train A RAD WAS Pump Replacement	City of Sunrise	10770 W Oakland Park Blvd, Sunrise, FL 33351	Guarionex De Los Santos	gdelossantos@sunrisefl.gov	Office: 954-888-6077 CellL 954-789-8709	Construction of Train A RAS & WAS Pump Replacement		40%	365	365	1,655,600	1,655,600	5/2/2024
Miami Dade Alexander Orr WTP Bulk Sodium Hypochlorite Feed & Storage Facility	Miami Dade County	3071 SW 38th Ave Miami, FL 33233	Alejandro Echeverry	alejandro.echeverry@miamidade.gov	Office: 786-552-8444 Cell: 786-893-5425	Construction new Sodium Hypo Storage & Feed System. Replace existing Chlorine Gas & Pilot Sodium Hypo Storage & Feed System.		30%	575	575	4,362,930	4,362,930	2/18/2025
City of Homestead Racetrack Water Tower Booster Pump Station	City of Homestead	100 Civic Court Homestead, FL 33030	Hamley Pacheco, P.E.	hpacheco@cityofhomestead.com	305-224-4484	Construction of Booster Pump Station		80%	195	195	899,900	899,900	1/30/2024
Broward County WTP 2A Lime Slaker Replacement	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@browrd.org	954-831-0983	Replace of one (1) existing Lime Slaker System from 2A WTP.		100%			404,600	404,600	11/30/2022
Broward County Replace Chemical Storage Tanks	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	2A WTP - FRP Sodium Hypochlorite 14,380 Gallon Bulk Storage Tank - Remove, replace and dispose. North Regional WTP - HDPE 6,550 Gallon Bulk Storage Tank - Remove, Replace and dispose. 3C WTP - Remove and properly dispose of the existing Ammonia Gas Equipment and Install new Liquid Ammonium Sulfate(LAS) equipment in the existing Ammonia Gas Room. 2A WTP - FRP Storage Tanks - Repair Four (4) Tanks and perform structural concrete and coating repairs to an existing Containment Sump Pit. MPS - 458 & MPS 460 - 500Gallon Double Wall UL - 142 Storage Tanks - Install Two (2) Storage Tanks.		100%			456,051	456,051	1/19/2023
Plantation East WTP Chemical Storage	City of Plantation	400 NW 73rd Ave Plantation, FL 33317	Brett Miller	bmiller@plantation.org	Office: 954-326-7634	Construction of five (5) chemical storage and feed facilities within the membrane building at the East WTP.		100%	525	525	3,476,000	3,476,000	12/30/2023
Town of Lantan WTP High Service Pump Improvements	Town of Lantana	510 W Pine Street, Lantana, FL 33462	Jerry Darr	jdarr@lantana.org	Office: 561-540-5758	Build new Electrical & VFD Building and Remove and Replace (3) Existing High Service Pumps.		100%	365	365	1,448,000	1,448,000	8/30/2022
Broward County - Ravenswood S/S Pipe Replacement	Broward County	5440 Ravenswood Road, Dania Beach, FL 33312	Ahmad Ali	ahali@broward.org	Office: 954-357-6373 Cell: 954-850-8510	S/S Pipe Replacement and Rerouting		100%	90	90	519,500	519,500	8/29/2023
Pembroke Pines "WTP Lime Feed System Refurbishment, SCC Valve Insertion & Mag-Flow Meter Insertion" (IFB # PSUT-20-13)	City of Pembroke Pines	601 City Center Way Pembroke Pines, FL 33025	George Wrves	gwrves@ppines.com	Office: 954-518-9040 Direct: 954-518-9045 Cell: 904-237-3533	Rehab. the existing Lime Feed System including (2) Lime Slakers, (2) Slurry Tanks & (4) Slurry Pumps; Install 30" Valves in the existing 30" Softener (SCC) Eff Lines w/ (1) 30" Line Stop; Add Access Ports & Cleanouts to the 30" SCC Effiuent Line; and Insertion Electromagnetic Flowmeter in the 30" treated water line.		100%	365	365	3,078,188	3,078,188	6/30/2022

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Project Name	Owner	Address	Contract Contact	Email Address	Phone #	Nature of Work	X	% Cmplt	Orig. Days	Final Days	Orig. $	Current / Final $	Projected/ Actual SC
Hialeah WTP Lime Slaker Replacement & Chemical Bldg Rehabilitation	Miami-Dade County	3071 SW 38th Ave Miami, FL 33146	Luis E. Rojas	Luis.Rojas@miamidade.gov	Tel: 786-552-4374 Cell: 786-402-1292	Remove & Replace (2) 4,000 lb/Day Lime Slaker Units, (4) New Lime Slurry Pumps, Slurry Tanks & Mixers, All New Electrical & Controls. Concrete Repairs, Structural Rehab & New Coating Systems.		100%	270	600	4,932,211	4,932,211	5/20/2023
Broward County 1A & 2A Lime Slaker Replacememt	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	Oasgar@broward.org	954-831-0983	Replaced existing Integrity paste-Type lime Slaker Electrical & Controls (1) at WTP 1A & (1) at WTP 2A					573,900	618,900	5/11/2022
Pembroke Pines Water Treatment Facility Improvements (PSUT-19-03)	City of Pembroke Pines	601 City Center Way Pembroke Pines, FL 33025	George Wrves	gwrves@ppines.com	Office: 954-518-9040 Direct: 954-518-9045 Cell: 904-237-3533	Install New Air Scour System on (16) Greenleaf Filter Cell, Including New Blower & Air Distribution Header throughout the WTP, Electrical & I&C. All New WTP SCADA System.		100%	270	400	2,879,686	2,879,686	8/30/2021
Broward County - 3B Facility Chlorination System	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Alicia Dunne	Dunne, Alicia <ADUNNE@broward.org>	954.831.0793	Installation of New Sod-Hypo Chlorite & LAS Chemical Systems & New Tank Mixing System		100%	330	330	879,400	879,400	3/4/2021
Broward County - Retail Master PS 221 Rehabilitation	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Ulrich Cordon; William P. (Pat) Mitchell	UCORDON@broward.org WMITCHELL@broward.org	Ulrich: 954-831-0998 Pat: 954-831-0958 Pat: Cell 954-553-5565	Rehab. of Existing PS 221, Including: Gen-Set, Fuel Tank, Well-Wet Concrete Rehab., New Electrical & Controls, Rehab Architectural		100%	480	480	2,380,605	2,550,074	11/24/2021
Broward County - Reuse Expansion	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Jeff Greenfield, Broward PM, Dylan Riedel, Prime Contractor PM.	jgreenfield@broward.org; Dylan Riedel <DylanR@pkflorida.com>	Jeff Greenfield 954-804-3397; Dylan Riedel 305-849-4303	Furnish & Install (2) 2,500 kW Gen-Sets, (64) Dyna-Sand Reuse Filters, (2) Auto-Backwash Strainers, (5) FRP Tanks, (12) Re-Use & Filter Pumps		100%	720	720	10,667,830	10,667,830	9/30/2021
Broward County Lime Slaker System Replacement WTP 1A	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	Replaced (1) Existing Integrity Paste-Type Lime Slaker, Electrical & Controls at WTP 1A.		100%	210	210	294,900	294,900	12/30/2020
Collier County - Emergency Chlorine Scrubber Replacement	Collier County	3339 Tamiami Trl E, Suite 303	Alicia Abbott	Alicia.Abbott@colliercountyfl.gov	239-877-3961	Removal & Replacement of Existing Chlorine Gas Scrubber System		100%	240	240	328,000	328,000	5/26/2020
Broward County - Distric 2A Ground Stoarge Tank	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Mark Ludwigson A/E, Jeff Greenfield, Broward PM, Dylan Riedel, Prime Contractor PM.	jgreenfield@broward.org; Dylan Riedel <DylanR@pkflorida.com>; mludwigson@carollo.com	Jeff Greenfield 954-804-3397; Dylan Riedel 305-849-4303; Mark L Cell (561) 868-6403, (954) 295-8189	Installation of 5MG Crom Tank, Including 42" & 54" UG Piping & Valves, Site Work & (2) 42" x 100' Mixing Tank Systems Inside Tank.		100%	540	540	3,632,000	3,632,000	10/31/2020
Lime Slaker #3 Replacement	City of Pembroke Pines	8300 S Palm Drive	Paul Thompson	Thompson, Paul <pthompson@ppines.com>	954-518-9097	Replaced (1) Existing Integrity Paste-Type Lime Slaker		100%	270	270	209,728	209,728	11/30/2019
Broward County WTP 1A & 2A Treatment Unit Rehabilitations	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	Rehabilitation of Existing Lime Treatment Unit #2 at WTP 1A; Lime Treatment Unit #2 at WTP 2A and Lime Treatment Unit #1 at WTP 2A.		100%	270	270	1,833,010	1,900,010	12/30/2019
Broward County WTP 1A Treatment Unit #2 Rehabilitation	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	Rehabilitation of Existing Lime Treatment Unit #2 at WTP 1A.		100%	90	90	704,010	704,010	7/19/2019
Broward County WTP 2A Treatment Unit #1 & #2 Rehabilitation	Broward County	2555 W Copans Road, Pompano Beach FL 33069	Oscar Asgar	oasgar@broward.org	954-831-0983	Rehabilitation of Existing Lime Treatment Unit #2 at WTP 2A. Rehabilitation of Existing Lime Treatment Unit #1 at WTP 2A.		100%	270	270	1,129,000	1,196,000	12/30/2019
Peele-Dixie Check Valve R&R	City of Fort Lauderdale	Peele-Dixie WTP	DJ Tanner, Don Hering	DJ Tanner' <dj@fc-spec.com>	DJ - 603-548-5376, Don - 954-483-9497	Remove & Replace (1) 16" Check Valve		100%	10	14	35,000	35,000	2/14/2019
Greenleaf Filter Valve Replacement	Town of Davie	3500 NW 76th Ave, Hollywood FL 33024	Stanley Ebanks	stanley_ebanks@davie-fl.gov; DJ Tanner' <dj@fc-spec.com>	Stanley - 954-822-3991	Remove & Replace (4) 10" & (4) 18" BFV's w/ Air Operator in an existing "Green Leaf" Package Filter		100%	30	30	118,000	118,000	2/26/2019
SDWWTP - CCC Gate Replacement	Miami-Dade County	8950 SW 232 Street	Don Miller, Daniel Lizarazo	don.miller@miamidade.gov, Daniel.Lizarazo@miamidade.gov	Don 717-461-0779; Daniel 305-205-0902	Remove & Replace (11) 60" Rodney Hunt Cast Iron Sluice Gates		100%	262	320	946,917	946,917	11/30/2018
SDWWTP - Effluent Wet Well #1 & #2	Miami-Dade County	8950 SW 232 Street	Don Miller, Daniel Lizarazo	don.miller@miamidade.gov, Daniel.Lizarazo@miamidade.gov	Don 717-461-0779; Daniel 305-205-0902	Replaced All Mech Piping & (2) 48" BFV Seals		100%	120	120	412,000	412,000	5/30/2018

On-Going & Completed Project Experience & Reference List

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Project Name	Owner	Address	Contract Contact	Email Address	Phone #	Nature of Work	X	% Cmplt	Orig. Days	Final Days	Orig. $	Current / Final $	Projected/ Actual SC
GT Lohmeyer WWTP Effluent Pump #1, #4 & #5 Rehab. & Check Valve Replacement	City of Fort Lauderdale	1765 SE 18th St	Justin P. Murray	JMurray@FortLauderdale.gov	954-828-4122	Removal & Replace (2) 1250 HP & (1) 1750 HP Effluent Pump Rotating Mechanisms & 36" Check Valves		100%	240	240	570,000	620,703	9/7/2018
Sodium Hypo & CO2 Injection System	City of Pembroke Pines	8300 S Palm Drive	David Stambaugh CGA, George Wrves City of Pembroke Pines	dstamaugh@cgasolutions.com, Wrves, George <gwrves@ppines.com>	David S 561-681-5271, George Wrves (954) 518-9045 Office, (904) 237-3533 Cell	Installation of New CO2 System & New Sodium Hypochlorite Feed System		100%	270	330	1,828,640	1,828,640	1/30/2019
Broward County Air Stations #1 & #25	Broward County	115 S Andrews Ave	Juan Cacasus	jcatasus@broward.org	954-3576177	Sitework, Concrete & Install (2) Pre-Fabricated Air Monitoring Stations		100%	120	------	514,900	514,900	6/30/2019
Greenleaf Filter Replacement	City of Tamarac	10101 State St	Anthony Licata	Anthony Licata <Anthony.Licata@tamarac.org>	954-597-3777	Filter Media, Metal Repair Work & Recoating of Existing Steel Tank Interior		100%	120	210	529,000	662,000	1/30/2018
Hydrotreator #3 & #4 Rehab.	City of Fort Lauderdale	100 N. Andrews Ave	Omar Castellon	ocastellon@fortlauderdale.gov	954-828-5064	Replace Existing 30" Influent Piping Mag-Flow Meters, Piping & Butter-Fly Valves.		100%	270	390	399,000	544,401	2/15/2018
20" & 16" Bermad Valve Rehabilitation & Replacement	City of Port St. Lucie	10700 Glades Cut-Off	Robert Whritenhour	robert.whritenour@fc-spec.com	(407) 579-5000	Rehab (6) & Replace (1) 16" & 20" Bermand Control Valve & WWTP		100%	60	60	75,000	75,000	2/7/2017
Replacement of 90" BFV North District WWTP	Miami-Dade Water & Sewer Department	2575 NE 156 St, North Miami 33160	Robert Whritenhour	robert.whritenour@fc-spec.com	(407) 579-5000	Replaced Existing 90" BFV on Main Ocean Outfall - Install Labor & Equipment - Owner Furnished Materials		100%	360	360	100,000	100,000	7/30/2016
Relocation of 48" Plug Valve	Miami-Dade Water & Sewer Department	3800 NW 180th Street, Opa Locka 33055	Robert Whritenhour	robert.whritenour@fc-spec.com	(407) 579-5000	Service Contract for OEM		100%	120	120	60,000	60,000	5/30/2016
WTP#2 Filter Replacement	Palm Beach County	Pineherst Drive, Lake Worth	Vince Riccobono		(561) 493-6143	New 18 MGD Sand & Anthrecite Filters	X	100%	720	900	13,900,000	14,500,000	
South District WWTP Cogeneration Improvements - Design-Build	Miami-Dade Water & Sewer Department	SDWWTP - Miami FL	Humberto Codespodi		(305) 274-9272	See Attached Detail CV - Thad Buckley	X	100%	720	720	19,500,000	21,500,000	
South District WWTP HLD Upgrade to 285-mgd Filter System	Miami-Dade Water & Sewer Department	SDWWTP - Miami FL	TJ Potok		(305) 274-9272	See Attached Detail CV - Thad Buckley	X	100%	1800	1440	135,000,000	127,000,000	
South District WWTP Fat, Oil & Grease Septage Facility	Miami-Dade Water & Sewer Department	SDWWTP - Miami FL	TJ Potok		(305) 274-9272	See Attached Detail CV - Thad Buckley	X	100%	720	800	17,000,000	16,800,000	
Belle Glade Wastewater Treatment Plant Improvements	Palm Beach County	Belle Glade, FL	Jackie Michaels		(561) 493-6000	See Attached Detail CV - Thad Buckley	X	100%	540	600	1,650,000	1,699,000	
Hollywood Water Treatment Plant Electrical Power Generator System Expansion	City of Hollywood	Hollywood WTP - Hollywood Blvd - FL	Jetu Petel		(954) 921-3930	See Attached Detail CV - Thad Buckley	X	100%	540	540	1,750,000	1,710,000	
Hollywood Water Treatment Plant Membrane Replacement	City of Hollywood	Hollywood WTP - Hollywood Blvd - FL	Jetu Petel		(954) 921-3930	See Attached Detail CV - Thad Buckley	X	100%	360	300	1,700,000	1,752,000	
Wastewater Repump Stations A, B & E Rehabilitation	City of Fort Lauderdale	Various Locations	Walt Schwartz		(954) 426-6311	See Attached Detail CV - Thad Buckley	X	100%	720	720	11,000,000	11,256,000	
G.T. Lohmeyer WWTP Pumping System Improvements	City of Fort Lauderdale	Eisenhower Blvd	Walt Schwartz		(954) 426-6311	See Attached Detail CV - Thad Buckley	X	100%	720	800	8,300,000	8,670,000	
Waste Management CNG Fueling Facility, Waste Management	Waste Management	Pompanp Beach, FL				See Attached Detail CV - Thad Buckley	X	100%	270	270	1,820,000	1,820,000	
Peele-Dixie Membrane Plant, City of Fort Lauderdale, FL	City of Fort Lauderdale	State Road 7, Fort Lauderdale, FL	Janeen Wietgrefe	Jwietgrefe@hazenandsawyer.com	(954) 987-0066	See Attached Detail CV - Thad Buckley	X	100%	860	1080	26,500,000	27,300,00	
Southern Regional WWTP Oxygen System Upgrade	City of Hollywood	Hollywood WWTP - Taft Street - FL	Jetu Petel		(954) 921-3930	See Attached Detail CV - Thad Buckley	X	100%	600	680	10,300,000	10,500,000	
Fiveash Water Treatment Plant Upgrades - Phase 1	City of Fort Lauderdale	Powerline Road, Fort Lauderdale FL	George Brown	Brown, George A. <gbrown@hazenandsawyer.com>	(954) 987-0066	See Attached Detail CV - Thad Buckley	X	100%	1080	1080	12,040,000	12,500,000	
Fiveash Water Treatment Plant Filter Rehabilitation	City of Fort Lauderdale	Powerline Road, Fort Lauderdale FL	George Brown	Brown, George A. <gbrown@hazenandsawyer.com>	(954) 987-0066	See Attached Detail CV - Thad Buckley	X	100%	270	360	1,800,000	2,400,000	
G.T. Lohmeyer WWTP Effluent Pump Station	City of Fort Lauderdale	Eisenhower Blvd	Walt Schwartz		(954) 426-6311	See Attached Detail CV - Thad Buckley	X	100%	270	360	1,800,000	2,400,000	
Glades Road WTP 40-mgd Membrane Softening Process Addition	City of Boca Raton	Glades Road WTP	Frank Brinson Chris Helfrich	Frank Brinson fbrinson@mccaffertybrinson.com Chelfrich@myboca.us	(954) 797-7100 (561) 338-7300	See Attached Detail CV - Thad Buckley	X	100%	1260	1440	48,200,000	49,600,000	

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Updated **7/11/2024 10:08**

Project Name	Owner	Address	Contract Contact	Email Address	Phone #	Nature of Work	X	% Cmplt	Orig. Days	Final Days	Orig. $	Current / Final $	Projected/ Actual SC
Glades Road Sodium Hypochlorite Generation System	City of Boca Raton	Glades Road WTP	Frank Brinson	Frank Brinson fbrinson@mccaffertybrinson.com	(954) 797-7100	See Attached Detail CV - Thad Buckley	X	100%	540	540	3,804,000	4,002,300	

X - As PM, VP or RM of P&K/MWHC See Attached Resume

SEE ATTACHED FOR ADDITION RELATED PROJECTS

Ron DeSantis, Governor

Melanie S. Griffin, Secretary

Florida dbpr

STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE PLUMBING CONTRACTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES

BUCKLEY, THADDEUS R

RF ENVIRONMENTAL SERVICES, INC.
4840 NE 11TH AVE
FORT LAUDERDALE FL 33334

LICENSE NUMBER: CFC1429319

EXPIRATION DATE: AUGUST 31, 2024

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Melanie S. Griffin, Secretary

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STATE OF FLORIDA
DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE GENERAL CONTRACTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES

BUCKLEY, THADDEUS R

RF ENVIRONMENTAL SERVICES, INC.
4840 NE 11TH AVE
FORT LAUDERDALE FL 33334

LICENSE NUMBER: CGC1518671

EXPIRATION DATE: AUGUST 31, 2024

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DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE MECHANICAL CONTRACTOR HEREIN IS CERTIFIED UNDER THE
PROVISIONS OF CHAPTER 489, FLORIDA STATUTES

BUCKLEY, THADDEUS R

RF ENVIRONMENTAL SERVICES, INC.
4840 NE 11TH AVE
FORT LAUDERDALE FL 33334

LICENSE NUMBER: CMC1250334

EXPIRATION DATE: AUGUST 31, 2024

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DEPARTMENT OF BUSINESS AND PROFESSIONAL REGULATION

CONSTRUCTION INDUSTRY LICENSING BOARD

THE POLLUTANT STORAGE SYSTEMS CONTRACTOR HEREIN IS CERTIFIED UNDER THE PROVISIONS OF CHAPTER 489, FLORIDA STATUTES

BUCKLEY, THADDEUS R

RF ENVIRONMENTAL SERVICES, INC.
4840 NE 11TH AVE
FORT LAUDERDALE FL 33334

LICENSE NUMBER: PCC1256939

EXPIRATION DATE: AUGUST 31, 2024

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Permeate pressure

Project name	Hollywood FL-NF
Client Name	TBA
Calculated by	kirk.lai@nitto.com
HP pump flow	1596.55 gpm
Feed pressure	103.2 psi
Feed temperature	26.5 °C
Feed Water pH	7.20
Chemical dose, mg/l	None
Pumping specific energy	1.07 kWh/kgal
Pass NDP	39.7 psi
Average flux	13.7 gfd

Permeate flow/train	1389.00 gpm
Total plant product flow	9723.00 gpm
Number of trains	7.00
Raw water flow/train	1596.55 gpm
Permeate recovery	87.00 %
Membrane age	0.0 years
Flux decline,per year	5.0 %
Fouling factor	1.00
SP increase, per year	7.0 %
Inter-stage pipe loss	3.000 psi
Feed type	Brackish Well Non-Fouling
Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Flow / Vessel Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Stagewise Pressure Boost	Stagewise Pressure Exhaust	Stagewise Pressure Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	913.5	49.9	21.3	14.7	15.2	18.4	1.14	47.0	0.0	0	88.0	42.0	ESNA1-LF-LD	224	32 x 7M
1-2	274.0	42.7	25.6	15.4	8.4	17.4	1.13	25.0	0.0	0	76.6	75.0	ESNA1-LF-LD	64	16 x 4M
1-3	162.9	25.6	15.4	12.2	3.0	14.0	1.17	25.0	0.0	0	70.6	270.6	ESNA1-LF2-LD	48	16 x 3M
1-4	38.8	41.0	34.6	4.7	11.3	7.3	1.05	25.0	0.0	0	56.4	978.0	ESNA1-LF2-LD	30	6 x 5M

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1	Concentrate 2	Concentrate 3	Concentrate 4
Hardness, as CaCO3	256.90	256.90	26.261	594.3	986.5	1574.5	1800.4
Ca	94.40	94.40	9.929	218.4	362.5	577.7	659.7
Mg	5.10	5.10	0.351	11.8	19.6	31.8	36.9
Na	45.00	45.00	16.903	94.6	148.8	219.6	233.0
K	3.40	3.40	1.819	6.7	10.2	14.1	14.0
Ba	0.020	0.020	0.002	0.0	0.1	0.1	0.1
Sr	1.000	1.000	0.119	2.3	3.7	6.0	6.9
Fe+2	0.700	0.700	0.073623	1.619	2.688	4.284	4.892
CO3	0.36	0.36	0.009	2.0	5.9	16.3	21.6
HCO3	322.10	322.10	55.376	716.2	1162.2	1835.6	2084.2
SO4	32.00	32.00	1.400	74.3	123.6	202.4	236.8
Cl	41.00	41.00	12.898	88.0	140.0	211.2	229.1
F	0.30	0.30	0.203	0.5	0.8	1.0	0.9
OH	0.00	0.00	0.001	0.0	0.0	0.0	0.0
SiO2	7.60	7.60	2.348	16.3	26.0	39.3	42.7
CO2	29.23	29.23	29.23	29.23	29.23	29.23	29.23
NH3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	**552.98**	**552.98**	**101.43**	**1232.77**	**2006.07**	**3159.54**	**3570.85**
pH	**7.20**	**7.20**	**6.46**	**7.53**	**7.73**	**7.91**	**7.96**

Saturations	Raw Water	Feed Water	Permeate Water	Concentrate	Limits
CaSO4 / Ksp * 100, %	1	1	0	17	400
SrSO4 / Ksp * 100, %	1	1	0	11	1200
BaSO4 / Ksp * 100, %	36	36	1	358	10000
SiO2 Saturation, %	6	6	2	30	140
CaF2 / Ksp * 100, %	1	1	0	46	50000
Ca3(PO4)2	0.0	0.0	0.0	0.0	2.4
CCPP, mg/l	7.77	7.77	-62.42	1084.76	0
Langelier index	0.06	0.06	-2.35	2.39	2.8
Ionic strength	0.01	0.01	0.00	0.07	
Osmotic pressure, psi	4.5	4.5	0.9	28.5	
TDS / Osmotic pressure, mg/l.psi	123.1	123.1	111.7	125.9	

Permeate pressure

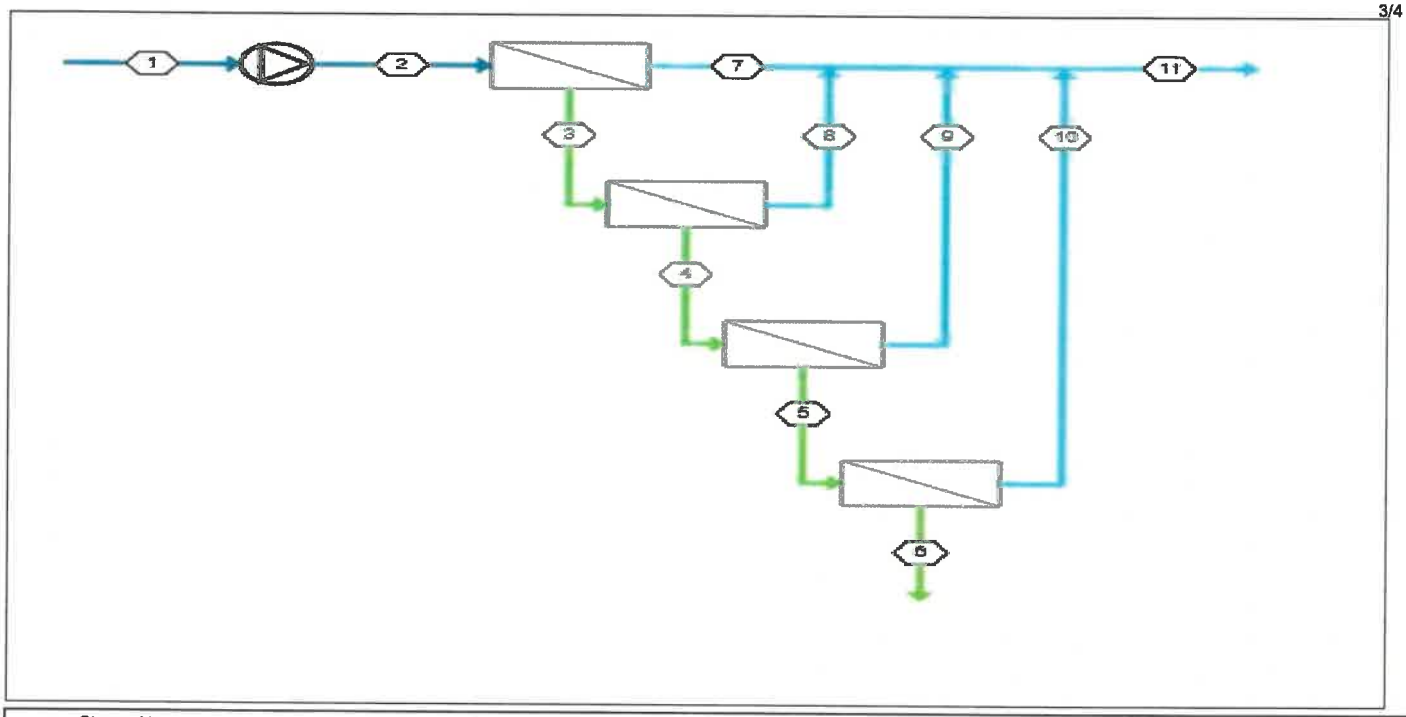
Project name	Hollywood FL-NF
Client Name	TBA
Calculated by	kirk.lai@nitto.com
HP pump flow	1596.55 gpm
Feed pressure	103.2 psi
Feed temperature	26.5 °C
Feed Water pH	7.20
Chemical dose, mg/l	None
Pumping specific energy	1.07 kWh/kgal
Pass NDP	39.7 psi
Average flux	13.7 gfd

Permeate flow/train	1389.00 gpm
Total plant product flow	9723.00 gpm
Number of trains	7.00
Raw water flow/train	1596.55 gpm
Permeate recovery	87.00 %
Membrane age	0.0 years
Flux decline,per year	5.0 %
Fouling factor	1.00
SP increase, per year	7.0 %
Inter-stage pipe loss	3.000 psi
Feed type	Brackish Well Non-Fouling
Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Flow / Vessel Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Stagewise Pressure Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	913.5	49.9	21.3	14.7	15.2	18.4	1.14	47.0	0.0	0	88.0	42.0	ESNA1-LF-LD	224	32 x 7M
1-2	274.0	42.7	25.6	15.4	8.4	17.4	1.13	25.0	0.0	0	76.6	75.0	ESNA1-LF-LD	64	16 x 4M
1-3	162.9	25.6	15.4	12.2	3.0	14.0	1.17	25.0	0.0	0	70.6	270.6	ESNA1-LF2-LD	48	16 x 3M
1-4	38.8	41.0	34.6	4.7	11.3	7.3	1.05	25.0	0.0	0	56.4	978.0	ESNA1-LF2-LD	30	6 x 5M

Pass-Stage	membrane no.	Feed Pressure	Pressure Drop	Conc Osmotic pressure	NDP	Permeate Water Flow	Permeate Water Flux	Recovery	Beta	TDS	Permeate (Stagewise cumulative) Econd (@ 25.0 °C)	Ca	Na	Cl
		psi	psi	psi	psi	gpm	gfd	(%)		mg/l	mg/l	mg/l	mg/l	mg/l
1-1	1	103.2	3.39	5.0	51.2	5.1	18.4	10.2	1.10	23.8	32.0	0.945	4.561	3.358
1-1	2	99.8	2.89	5.5	46.3	4.6	16.6	10.3	1.10	26.3	35.4	1.048	5.037	3.713
1-1	3	97.0	2.47	6.2	43.2	4.3	15.5	10.7	1.11	28.8	38.8	1.154	5.513	4.068
1-1	4	94.5	2.09	6.9	40.3	4.0	14.4	11.2	1.11	31.6	42.5	1.270	6.024	4.452
1-1	5	92.4	1.75	7.8	37.7	3.7	13.5	11.8	1.12	34.7	46.5	1.399	6.587	4.876
1-1	6	90.6	1.45	8.8	35.2	3.5	12.6	12.5	1.13	38.1	51.1	1.545	7.214	5.350
1-1	7	89.2	1.19	10.0	32.8	3.3	11.7	13.2	1.14	42.0	56.2	1.714	7.921	5.886
1-2	1	85.0	2.70	11.2	48.7	4.8	17.4	11.3	1.11	55.3	73.2	2.322	10.161	7.641
1-2	2	82.3	2.26	12.7	45.0	4.5	16.0	11.8	1.12	61.0	80.7	2.571	11.180	8.418
1-2	3	80.1	1.88	14.3	41.4	4.1	14.7	12.3	1.12	67.5	89.2	2.858	12.336	9.303
1-2	4	78.2	1.55	16.3	37.9	3.7	13.5	12.8	1.13	75.0	99.0	3.190	13.657	10.317
1-3	1	73.6	1.26	18.9	31.2	3.9	14.0	15.3	1.16	201.5	298.1	27.515	31.637	24.275
1-3	2	72.4	0.98	22.0	27.2	3.4	12.3	15.7	1.17	232.3	343.5	31.859	36.196	27.868
1-3	3	71.4	0.75	25.5	23.1	2.9	10.4	15.8	1.10	270.6	399.5	37.272	41.767	32.286
1-4	1	67.6	2.54	26.5	16.4	2.0	7.3	5.0	1.05	583.8	860.9	80.807	89.269	69.276
1-4	2	65.1	2.36	27.4	13.1	1.6	5.8	4.2	1.04	663.4	977.8	91.987	101.071	78.561
1-4	3	62.7	2.22	28.0	10.1	1.2	4.5	3.3	1.03	754.2	1156.5	104.766	114.455	89.114
1-4	4	60.5	2.11	28.4	7.4	0.9	3.3	2.5	1.02	857.9	1290.4	119.411	129.677	101.144
1-4	5	58.4	2.03	28.6	5.1	0.6	2.3	1.8	1.02	977.1	1442.5	136.280	147.081	114.929

Permeate pressure



Stream No.	Flow (gpm)	Pressure (psi)	TDS (mg/l)	pH	Econd (µS/cm) (@ 25.0 °C)
1	1597	0	553	7.20	790
2	1597	103	553	7.20	790
3	683	88.0	1233	7.53	1727
4	409	76.6	2006	7.73	2660
5	246	70.6	3160	7.91	3991
6	207	56.4	3571	7.96	4451
7	914	47.0	42.0	6.10	56.2
8	274	25.0	75.0	6.36	99.0
9	163	25.0	271	6.86	400
10	38.8	25.0	978	7.40	1444
11	1389	25.0	101	6.46	143

Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	103.2 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	0.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	1.00
Pumping specific energy	1.07 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	39.7 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	913.5	49.9	21.3	14.7	15.2	18.4	1.14	47.0	0.0	0	88.0	42.0	ESNA1-LF-LD	224	32 x 7M
1-2	274.0	42.7	25.6	15.4	8.4	17.4	1.13	25.0	0.0	0	76.6	75.0	ESNA1-LF-LD	64	16 x 4M
1-3	162.9	25.6	15.4	12.2	3.0	14.0	1.17	25.0	0.0	0	70.6	270.6	ESNA1-LF2-LD	48	16 x 3M
1-4	38.8	41.0	34.6	4.7	11.3	7.3	1.05	25.0	0.0	0	56.4	978.0	ESNA1-LF2-LD	30	6 x 5M

**********Calculation of Investment and Water Cost**********

Open analysis record	1389.00 gpm
Specific investment	5,030.71 USD/gpm
Investment	6,987,658.00 USD
Plant life	15.0 years
Membrane life	5.0 years
Interest rate	4.5 %
Membrane cost	800.00 USD/element
Plant factor	90.0 %
Number of elements	366.0
Power cost	0.200 USD/kWhr
Inhibitor cost	2.20 USD/lb
Power consumption	1.07 kWhr/kgal
Inhibitor cost	3.0 mg/l
Maintenance (% of investment)	3.0 %
Acid cost	0.15 USD/lb
Acid dosing	0.00 mg/l

**********Calculation Results**********

Capital cost	0.17 USD/kgal
Power cost	0.21 USD/kgal
Chemicals cost	0.02 USD/kgal
Membrane replacement cost	0.02 USD/kgal
Maintenance (% of investment)	0.08 USD/kgal
Total water cost	0.51 USD/kgal

Permeate pressure

Project name	Hollywood FL-NF
Client Name	TBA
Calculated by	kirk.lai@nitto.com
HP pump flow	1596.55 gpm
Feed pressure	105.0 psi
Feed temperature	26.5 °C
Feed Water pH	7.20
Chemical dose, mg/l	None
Pumping specific energy	1.09 kWh/kgal
Pass NDP	41.4 psi
Average flux	13.7 gfd

Permeate flow/train	1389.00 gpm
Total plant product flow	9723.00 gpm
Number of trains	7.00
Raw water flow/train	1596.55 gpm
Permeate recovery	87.00 %
Membrane age	1.0 years
Flux decline,per year	5.0 %
Fouling factor	0.95
SP increase, per year	7.0 %
Inter-stage pipe loss	3.000 psi
Feed type	Brackish Well Non-Fouling
Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	906.9	49.9	21.6	14.6	15.3	18.1	1.14	47.0	0.0	0	89.7	44.9	ESNA1-LF-LD	224	32 x 7M
1-2	271.9	43.1	26.1	15.3	8.5	17.2	1.13	25.0	0.0	0	78.2	79.1	ESNA1-LF-LD	64	16 x 4M
1-3	166.8	26.1	15.7	12.5	3.1	14.2	1.17	25.0	0.0	0	72.1	273.9	ESNA1-LF2-LD	48	16 x 3M
1-4	43.5	41.8	34.6	5.2	11.5	7.9	1.05	25.0	0.0	0	57.6	912.4	ESNA1-LF2-LD	30	6 x 5M

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1	Concentrate 2	Concentrate 3	Concentrate 4
Hardness, as CaCO3	256.90	256.90	27.618	588.2	965.0	1540.2	1791.3
Ca	94.40	94.40	10.440	216.1	354.6	565.1	656.3
Mg	5.10	5.10	0.370	11.7	19.2	31.1	36.8
Na	45.00	45.00	17.643	93.1	144.3	212.3	228.1
K	3.40	3.40	1.887	6.6	9.8	13.5	13.5
Ba	0.020	0.020	0.003	0.0	0.1	0.1	0.1
Sr	1.000	1.000	0.125	2.2	3.6	5.9	6.9
Fe+2	0.700	0.700	0.077418	1.603	2.629	4.19	4.867
CO3	0.36	0.36	0.010	2.0	5.6	15.5	21.1
HCO3	322.10	322.10	58.042	714.1	1139.0	1796.1	2062.1
SO4	32.00	32.00	1.471	73.6	121.0	198.3	236.3
Cl	41.00	41.00	13.456	86.7	136.0	204.9	225.3
F	0.30	0.30	0.209	0.5	0.8	1.0	0.9
SiO2	7.60	7.60	2.454	16.1	25.3	38.1	42.0
CO2	29.23	29.23	29.23	29.23	29.23	29.23	29.23
NH3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	**552.98**	**552.98**	**106.19**	**1224.31**	**1961.91**	**3085.92**	**3534.33**
pH	**7.20**	**7.20**	**6.48**	**7.53**	**7.72**	**7.90**	**7.96**

Saturations	Raw Water	Feed Water	Permeate Water	Concentrate	Limits
CaSO4 / Ksp * 100, %	1	1	0	17	400
SrSO4 / Ksp * 100, %	1	1	0	11	1200
BaSO4 / Ksp * 100, %	36	36	1	358	10000
SiO2 Saturation, %	6	6	2	29	140
CaF2 / Ksp * 100, %	1	1	0	42	50000
Ca3(PO4)2	0.0	0.0	0.0	0.0	2.4
CCPP, mg/l	7.77	7.77	-62.21	1072.20	0
Langelier index	0.06	0.06	-2.29	2.38	2.8
Ionic strength	0.01	0.01	0.00	0.07	
Osmotic pressure, psi	4.5	4.5	1.0	28.2	
TDS / Osmotic pressure, mg/l.psi	123.1	123.1	111.7	126.0	

Permeate pressure

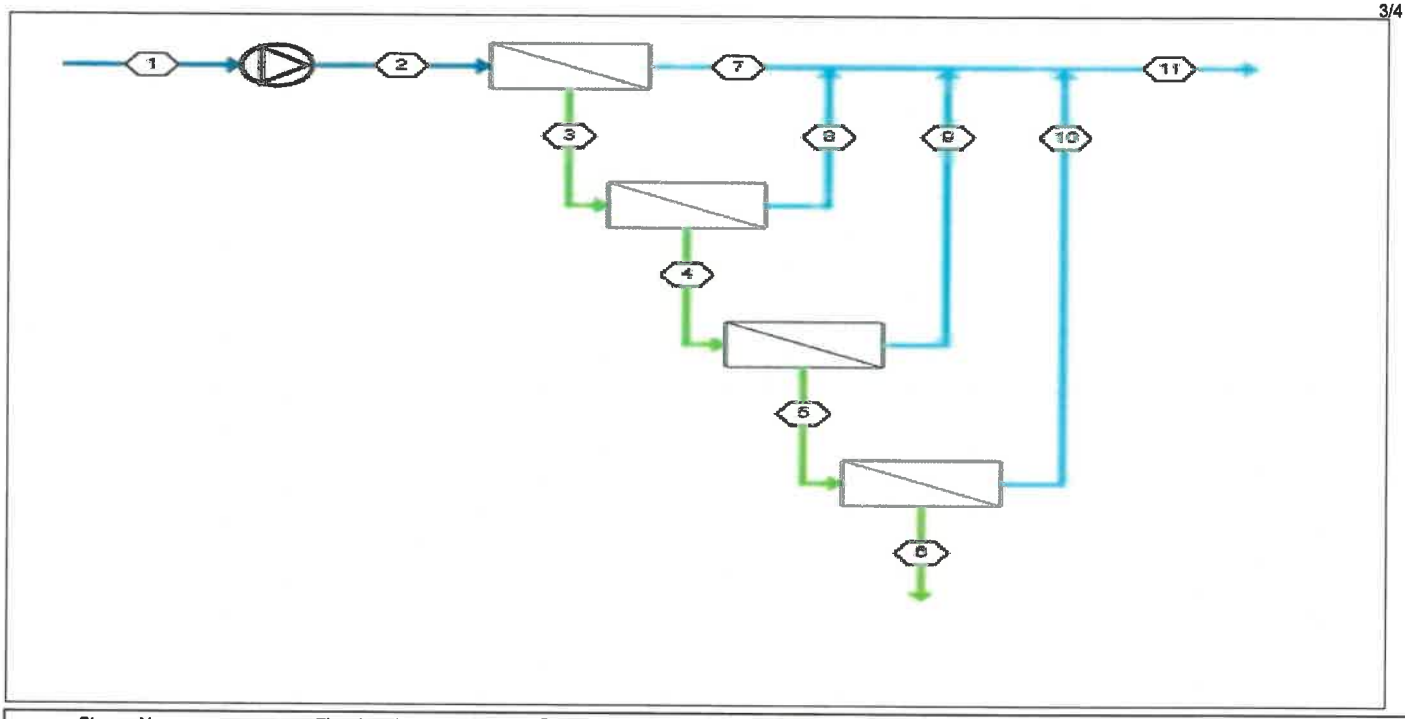
Project name	Hollywood FL-NF
Client Name	TBA
Calculated by	kirk.lai@nitto.com
HP pump flow	1596.55 gpm
Feed pressure	105.0 psi
Feed temperature	26.5 °C
Feed Water pH	7.20
Chemical dose, mg/l	None
Pumping specific energy	1.09 kWh/kgal
Pass NDP	41.4 psi
Average flux	13.7 gfd

Permeate flow/train	1389.00 gpm
Total plant product flow	9723.00 gpm
Number of trains	7.00
Raw water flow/train	1596.55 gpm
Permeate recovery	87.00 %
Membrane age	1.0 years
Flux decline,per year	5.0 %
Fouling factor	0.95
SP increase, per year	7.0 %
Inter-stage pipe loss	3.000 psi
Feed type	Brackish Well Non-Fouling
Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	906.9	49.9	21.6	14.6	15.3	18.1	1.14	47.0	0.0	0	89.7	44.9	ESNA1-LF-LD	224	32 x 7M
1-2	271.9	43.1	26.1	15.3	8.5	17.2	1.13	25.0	0.0	0	78.2	79.1	ESNA1-LF-LD	64	16 x 4M
1-3	166.8	26.1	15.7	12.5	3.1	14.2	1.17	25.0	0.0	0	72.1	273.9	ESNA1-LF2-LD	48	16 x 3M
1-4	43.5	41.8	34.6	5.2	11.5	7.9	1.05	25.0	0.0	0	57.6	912.4	ESNA1-LF2-LD	30	6 x 5M

Pass-Stage	membrane no.	Feed Pressure	Pressure Drop	Conc Osmotic pressure	NDP	Permeate Water Flow	Flux	Recovery	Beta	TDS	Permeate (Stagewise cumulative) Econd (@ 25.0 °C)	Ca	Na	Cl
		psi	psi	psi	psi	gpm	gfd	(%)		mg/l	mg/l	mg/l	mg/l	mg/l
1-1	1	105.0	3.39	5.0	53.1	5.0	18.1	10.1	1.10	25.7	34.7	1.027	4.950	3.634
1-1	2	101.6	2.90	5.5	48.1	4.6	16.4	10.2	1.10	28.4	38.2	1.137	5.454	4.008
1-1	3	98.7	2.48	6.1	45.0	4.3	15.3	10.6	1.10	31.1	41.8	1.249	5.952	4.380
1-1	4	96.2	2.10	6.8	42.2	4.0	14.4	11.1	1.11	34.0	45.6	1.371	6.487	4.781
1-1	5	94.1	1.77	7.7	39.5	3.7	13.4	11.7	1.12	37.2	49.9	1.507	7.073	5.222
1-1	6	92.4	1.47	8.7	37.1	3.5	12.6	12.4	1.13	40.8	54.6	1.660	7.723	5.714
1-1	7	90.9	1.20	9.9	34.7	3.3	11.8	13.2	1.14	44.9	59.9	1.837	8.455	6.270
1-2	1	86.7	2.74	11.1	50.6	4.8	17.2	11.1	1.11	58.9	78.0	2.492	10.822	8.126
1-2	2	84.0	2.30	12.4	46.9	4.4	15.9	11.5	1.12	64.8	85.7	2.750	11.864	8.922
1-2	3	81.7	1.92	14.0	43.3	4.1	14.7	12.0	1.12	71.5	94.4	3.046	13.040	9.823
1-2	4	79.7	1.59	15.9	39.9	3.7	13.5	12.5	1.13	79.1	104.4	3.387	14.376	10.850
1-3	1	75.2	1.30	18.4	33.2	4.0	14.2	15.1	1.16	206.6	305.7	28.419	32.281	24.773
1-3	2	73.9	1.01	21.4	29.4	3.5	12.5	15.7	1.17	236.7	349.9	32.700	36.676	28.250
1-3	3	72.8	0.78	24.8	25.3	3.0	10.8	16.0	1.17	273.9	404.4	38.021	42.022	32.505
1-4	1	69.1	2.62	25.9	18.6	2.2	7.9	5.2	1.05	566.2	834.9	78.984	86.026	66.815
1-4	2	66.4	2.42	26.8	15.1	1.8	6.4	4.5	1.04	638.0	940.4	89.178	96.566	75.131
1-4	3	64.0	2.26	27.5	12.0	1.4	5.1	3.7	1.04	718.7	1110.1	100.652	108.330	84.438
1-4	4	61.8	2.14	28.0	9.2	1.1	3.9	3.0	1.03	809.4	1227.7	113.591	121.478	94.867
1-4	5	59.6	2.04	28.3	6.8	0.8	2.9	2.2	1.02	911.6	1358.8	128.208	136.203	106.577

Permeate pressure



Stream No.	Flow (gpm)	Pressure (psi)	TDS (mg/l)	pH	Econd (µS/cm) (@ 25.0 °C)
1	1597	0	553	7.20	790
2	1597	105	553	7.20	790
3	690	89.7	1224	7.53	1713
4	418	78.2	1962	7.72	2605
5	251	72.1	3086	7.90	3905
6	207	57.6	3534	7.96	4413
7	907	47.0	44.9	6.13	59.9
8	272	25.0	79.1	6.38	104
9	167	25.0	274	6.86	404
10	43.5	25.0	912	7.37	1360
11	1389	25.0	106	6.48	150

Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	105.0 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	1.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.95
Pumping specific energy	1.09 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	41.4 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Flow / Vessel Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Stagewise Pressure Boost	Stagewise Pressure Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	906.9	49.9	21.6	14.6	15.3	18.1	1.14	47.0	0.0	0	89.7	44.9	ESNA1-LF-LD	224	32 x 7M
1-2	271.9	43.1	26.1	15.3	8.5	17.2	1.13	25.0	0.0	0	78.2	79.1	ESNA1-LF-LD	64	16 x 4M
1-3	166.8	26.1	15.7	12.5	3.1	14.2	1.17	25.0	0.0	0	72.1	273.9	ESNA1-LF2-LD	48	16 x 3M
1-4	43.5	41.8	34.6	5.2	11.5	7.9	1.05	25.0	0.0	0	57.6	912.4	ESNA1-LF2-LD	30	6 x 5M

**********Calculation of Investment and Water Cost**********

Open analysis record	1389.00 gpm
Specific investment	5,030.71 USD/gpm
Investment	6,987,658.00 USD
Plant life	15.0 years
Membrane life	5.0 years
Interest rate	4.5 %
Membrane cost	800.00 USD/element
Plant factor	90.0 %
Number of elements	366.0
Power cost	0.200 USD/kWhr
Inhibitor cost	2.20 USD/lb
Power consumption	1.07 kWhr/kgal
Inhibitor cost	3.0 mg/l
Maintenance (% of investment)	3.0 %
Acid cost	0.15 USD/lb
Acid dosing	0.00 mg/l

**********Calculation Results**********

Capital cost	0.17 USD/kgal
Power cost	0.21 USD/kgal
Chemicals cost	0.02 USD/kgal
Membrane replacement cost	0.02 USD/kgal
Maintenance (% of investment)	0.08 USD/kgal
Total water cost	0.51 USD/kgal

Permeate pressure

Project name	Hollywood FL-NF
Client Name	TBA
Calculated by	kirk.lai@nitto.com
HP pump flow	1596.55 gpm
Feed pressure	106.9 psi
Feed temperature	26.5 °C
Feed Water pH	7.20
Chemical dose, mg/l	None
Pumping specific energy	1.11 kWh/kgal
Pass NDP	43.3 psi
Average flux	13.7 gfd

Permeate flow/train	1389.00 gpm
Total plant product flow	9723.00 gpm
Number of trains	7.00
Raw water flow/train	1596.55 gpm
Permeate recovery	87.00 %
Membrane age	2.0 years
Flux decline,per year	5.0 %
Fouling factor	0.90
SP increase, per year	7.0 %
Inter-stage pipe loss	3.000 psi
Feed type	Brackish Well Non-Fouling
Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Flow / Vessel Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Stagewise Pressure Boost	Stagewise Pressure Exhaust	Perm. Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	900.8	49.9	21.7	14.5	15.4	17.8	1.14	47.0	0.0	0	91.5	47.7	ESNA1-LF-LD	224	32 x 7M
1-2	269.9	43.5	26.6	15.2	8.7	16.9	1.13	25.0	0.0	0	79.8	83.1	ESNA1-LF-LD	64	16 x 4M
1-3	170.3	26.6	16.0	12.8	3.2	14.4	1.18	25.0	0.0	0	73.7	277.4	ESNA1-LF2-LD	48	16 x 3M
1-4	48.0	42.6	34.6	5.8	11.7	8.4	1.05	25.0	0.0	0	59.0	861.1	ESNA1-LF2-LD	30	6 x 5M

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1	Concentrate 2	Concentrate 3	Concentrate 4
Hardness, as CaCO3	256.90	256.90	28.960	582.6	945.7	1508.3	1782.4
Ca	94.40	94.40	10.947	214.1	347.5	553.4	652.9
Mg	5.10	5.10	0.389	11.6	18.8	30.5	36.6
Na	45.00	45.00	18.359	91.6	140.1	205.4	223.3
K	3.40	3.40	1.951	6.5	9.5	13.0	13.1
Ba	0.020	0.020	0.003	0.0	0.1	0.1	0.1
Sr	1.000	1.000	0.131	2.2	3.6	5.7	6.8
Fe+2	0.700	0.700	0.081172	1.588	2.577	4.103	4.841
CO3	0.36	0.36	0.011	1.9	5.3	14.5	20.7
HCO3	322.10	322.10	60.657	696.5	1108.8	1744.7	2043.6
SO4	32.00	32.00	1.542	72.9	118.6	194.5	235.8
Cl	41.00	41.00	13.996	85.5	132.4	198.9	221.7
F	0.30	0.30	0.215	0.5	0.7	0.9	0.9
SiO2	7.60	7.60	2.556	15.9	24.6	37.0	41.4
CO2	29.23	29.23	29.23	29.23	29.23	29.23	29.23
NH3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	552.98	552.98	110.84	1200.73	1912.62	3002.74	3501.79
pH	7.20	7.20	6.50	7.52	7.71	7.89	7.95

Saturations	Raw Water	Feed Water	Permeate Water	Concentrate	Limits
CaSO4 / Ksp * 100, %	1	1	0	17	400
SrSO4 / Ksp * 100, %	1	1	0	11	1200
BaSO4 / Ksp * 100, %	36	36	1	357	10000
SiO2 Saturation, %	6	6	2	29	140
CaF2 / Ksp * 100, %	1	1	0	39	50000
Ca3(PO4)2	0.0	0.0	0.0	0.0	2.4
CCPP, mg/l	7.77	7.77	-61.98	1061.27	0
Langelier index	0.06	0.06	-2.23	2.37	2.8
Ionic strength	0.01	0.01	0.00	0.07	
Osmotic pressure, psi	4.5	4.5	1.0	27.9	
TDS / Osmotic pressure, mg/l.psi	123.1	123.1	111.8	126.1	

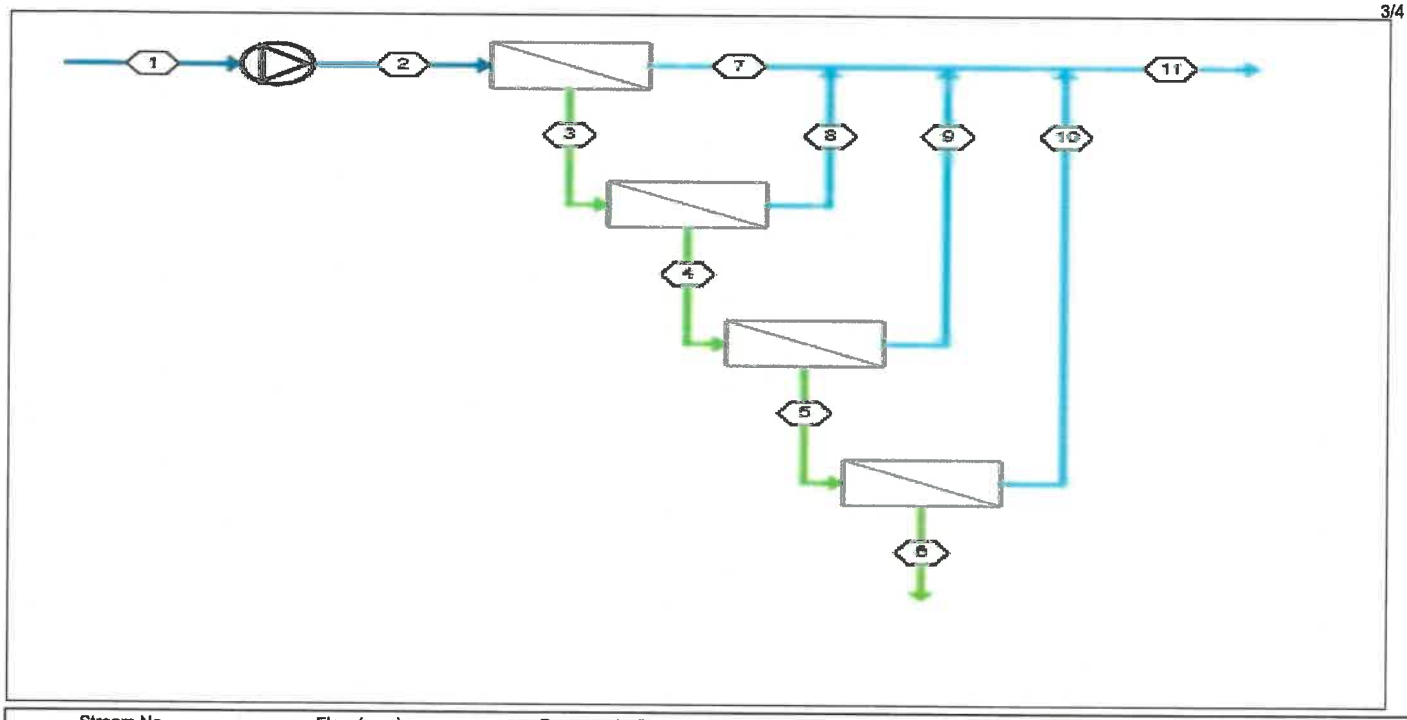
Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	106.9 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	2.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.90
Pumping specific energy	1.11 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	43.3 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	900.8	49.9	21.7	14.5	15.4	17.8	1.14	47.0	0.0	0	91.5	47.7	ESNA1-LF-LD	224	32 x 7M
1-2	269.9	43.5	26.6	15.2	8.7	16.9	1.13	25.0	0.0	0	79.8	83.1	ESNA1-LF-LD	64	16 x 4M
1-3	170.3	26.6	16.0	12.8	3.2	14.4	1.18	25.0	0.0	0	73.7	277.4	ESNA1-LF2-LD	48	16 x 3M
1-4	48.0	42.6	34.6	5.8	11.7	8.4	1.05	25.0	0.0	0	59.0	861.1	ESNA1-LF2-LD	30	6 x 5M

Pass-Stage	membrane no.	Feed Pressure	Pressure Drop	Conc Osmotic pressure	NDP	Permeate Water Flow	Flux	Recovery	Beta	TDS	Permeate (Stagewise cumulative) Econd (@ 25.0 °C)	Ca	Na	Cl
		psi	psi	psi	psi	gpm	gfd	(%)		mg/l	mg/l	mg/l	mg/l	mg/l
1-1	1	106.9	3.39	5.0	55.1	5.0	17.8	9.9	1.10	27.8	37.4	1.111	5.348	3.914
1-1	2	103.5	2.91	5.5	50.1	4.5	16.2	10.0	1.10	30.6	41.1	1.227	5.878	4.307
1-1	3	100.6	2.49	6.1	47.0	4.2	15.2	10.4	1.10	33.4	44.8	1.345	6.398	4.696
1-1	4	98.1	2.12	6.8	44.1	4.0	14.3	10.9	1.11	36.4	48.8	1.473	6.954	5.112
1-1	5	96.0	1.78	7.6	41.5	3.7	13.4	11.5	1.12	39.7	53.2	1.616	7.561	5.569
1-1	6	94.2	1.48	8.6	39.1	3.5	12.6	12.3	1.13	43.5	58.1	1.777	8.234	6.078
1-1	7	92.8	1.22	9.8	36.7	3.3	11.8	13.1	1.14	47.7	63.7	1.961	8.988	6.650
1-2	1	88.5	2.77	10.9	52.6	4.7	16.9	10.8	1.11	62.6	82.8	2.664	11.484	8.612
1-2	2	85.8	2.34	12.2	48.9	4.4	15.7	11.3	1.11	68.6	90.7	2.930	12.546	9.423
1-2	3	83.4	1.96	13.7	45.4	4.0	14.6	11.8	1.12	75.4	99.6	3.235	13.739	10.338
1-2	4	81.5	1.63	15.5	42.0	3.7	13.5	12.3	1.13	83.2	109.7	3.585	15.087	11.375
1-3	1	76.8	1.34	17.9	35.3	4.0	14.4	15.0	1.16	211.6	313.3	29.326	32.911	25.262
1-3	2	75.5	1.04	20.8	31.6	3.6	12.8	15.7	1.17	241.1	356.5	33.564	37.159	28.636
1-3	3	74.4	0.80	24.2	27.5	3.1	11.1	16.2	1.18	277.4	409.6	38.811	42.298	32.748
1-4	1	70.6	2.69	25.3	20.8	2.3	8.4	5.5	1.05	551.9	813.9	77.599	83.333	64.783
1-4	2	68.0	2.47	26.3	17.2	1.9	6.9	4.8	1.05	617.4	910.1	86.985	92.838	72.307
1-4	3	65.5	2.30	27.1	14.0	1.6	5.6	4.1	1.04	690.2	1072.7	97.441	103.324	80.632
1-4	4	63.2	2.17	27.7	11.1	1.2	4.5	3.4	1.03	770.9	1177.7	109.070	114.872	89.828
1-4	5	61.0	2.06	28.1	8.5	1.0	3.4	2.7	1.03	860.4	1292.9	122.009	127.592	99.989

Permeate pressure



Stream No.	Flow (gpm)	Pressure (psi)	TDS (mg/l)	pH	Econd (µS/cm) (@ 25.0 °C)
1	1597	0	553	7.20	790
2	1597	107	553	7.20	790
3	696	91.5	1201	7.52	1691
4	426	79.8	1913	7.71	2550
5	255	73.7	3003	7.89	3815
6	207	59.0	3502	7.95	4378
7	901	47.0	47.7	6.16	63.7
8	270	25.0	83.1	6.40	110
9	170	25.0	277	6.87	410
10	48.0	25.0	861	7.34	1294
11	1389	25.0	111	6.50	157

Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	106.9 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	2.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.90
Pumping specific energy	1.11 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	43.3 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Flow / Vessel Conc	Flux	DP	Flux Max	Beta	Stagewise Pressure Perm.	Stagewise Pressure Boost	Stagewise Pressure Exhaust	Stagewise Pressure Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	900.8	49.9	21.7	14.5	15.4	17.8	1.14	47.0	0.0	0	91.5	47.7	ESNA1-LF-LD	224	32 x 7M
1-2	269.9	43.5	26.6	15.2	8.7	16.9	1.13	25.0	0.0	0	79.8	83.1	ESNA1-LF-LD	64	16 x 4M
1-3	170.3	26.6	16.0	12.8	3.2	14.4	1.18	25.0	0.0	0	73.7	277.4	ESNA1-LF2-LD	48	16 x 3M
1-4	48.0	42.6	34.6	5.8	11.7	8.4	1.05	25.0	0.0	0	59.0	861.1	ESNA1-LF2-LD	30	6 x 5M

**********Calculation of Investment and Water Cost**********

Open analysis record	1389.00 gpm
Specific investment	5,030.71 USD/gpm
Investment	6,987,658.00 USD
Plant life	15.0 years
Membrane life	5.0 years
Interest rate	4.5 %
Membrane cost	800.00 USD/element
Plant factor	90.0 %
Number of elements	366.0
Power cost	0.200 USD/kWhr
Inhibitor cost	2.20 USD/lb
Power consumption	1.07 kWhr/kgal
Inhibitor cost	3.0 mg/l
Maintenance (% of investment)	3.0 %
Acid cost	0.15 USD/lb
Acid dosing	0.00 mg/l

**********Calculation Results**********

Capital cost	0.17 USD/kgal
Power cost	0.21 USD/kgal
Chemicals cost	0.02 USD/kgal
Membrane replacement cost	0.02 USD/kgal
Maintenance (% of investment)	0.08 USD/kgal
Total water cost	0.51 USD/kgal

Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	108.9 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	3.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.86
Pumping specific energy	1.13 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	45.2 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	895.3	49.9	21.9	14.4	15.5	17.6	1.14	47.0	0.0	0	93.5	50.5	ESNA1-LF-LD	224	32 x 7M
1-2	268.0	43.8	27.1	15.1	8.8	16.7	1.12	25.0	0.0	0	81.6	87.2	ESNA1-LF-LD	64	16 x 4M
1-3	173.5	27.1	16.2	13.0	3.3	14.5	1.18	25.0	0.0	0	75.3	281.0	ESNA1-LF2-LD	48	16 x 3M
1-4	52.3	43.3	34.6	6.3	11.9	8.8	1.05	25.0	0.0	0	60.5	821.7	ESNA1-LF2-LD	30	6 x 5M

Ion (mg/l)	Raw Water	Feed Water	Permeate Water	Concentrate 1	Concentrate 2	Concentrate 3	Concentrate 4
Hardness, as CaCO3	256.90	256.90	30.286	577.6	928.5	1479.2	1773.5
Ca	94.40	94.40	11.446	212.2	341.2	542.6	649.6
Mg	5.10	5.10	0.407	11.5	18.4	29.9	36.5
Na	45.00	45.00	19.054	90.3	136.4	199.0	218.6
K	3.40	3.40	2.013	6.3	9.2	12.5	12.7
Ba	0.020	0.020	0.003	0.0	0.1	0.1	0.1
Sr	1.000	1.000	0.138	2.2	3.5	5.6	6.8
Fe+2	0.700	0.700	0.084878	1.574	2.53	4.024	4.817
CO3	0.36	0.36	0.012	1.9	5.1	13.9	20.2
HCO3	322.10	322.10	63.220	694.4	1087.1	1707.4	2021.8
SO4	32.00	32.00	1.612	72.3	116.5	191.0	235.4
Cl	41.00	41.00	14.521	84.4	129.2	193.5	218.2
F	0.30	0.30	0.220	0.5	0.7	0.9	0.8
SiO2	7.60	7.60	2.656	15.7	24.0	36.0	40.7
CO2	29.23	29.23	29.23	29.23	29.23	29.23	29.23
NH3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	552.98	552.98	115.39	1193.33	1873.83	2936.52	3466.26
pH	7.20	7.20	6.52	7.52	7.70	7.88	7.95

Saturations	Raw Water	Feed Water	Permeate Water	Concentrate	Limits
CaSO4 / Ksp * 100, %	1	1	0	17	400
SrSO4 / Ksp * 100, %	1	1	0	11	1200
BaSO4 / Ksp * 100, %	36	36	1	357	10000
SiO2 Saturation, %	6	6	2	28	140
CaF2 / Ksp * 100, %	1	1	0	36	50000
Ca3(PO4)2	0.0	0.0	0.0	0.0	2.4
CCPP, mg/l	7.77	7.77	-61.76	1048.88	0
Langelier index	0.06	0.06	-2.18	2.36	2.8
Ionic strength	0.01	0.01	0.00	0.07	
Osmotic pressure, psi	4.5	4.5	1.0	27.6	
TDS / Osmotic pressure, mg/l.psi	123.1	123.1	111.8	126.2	

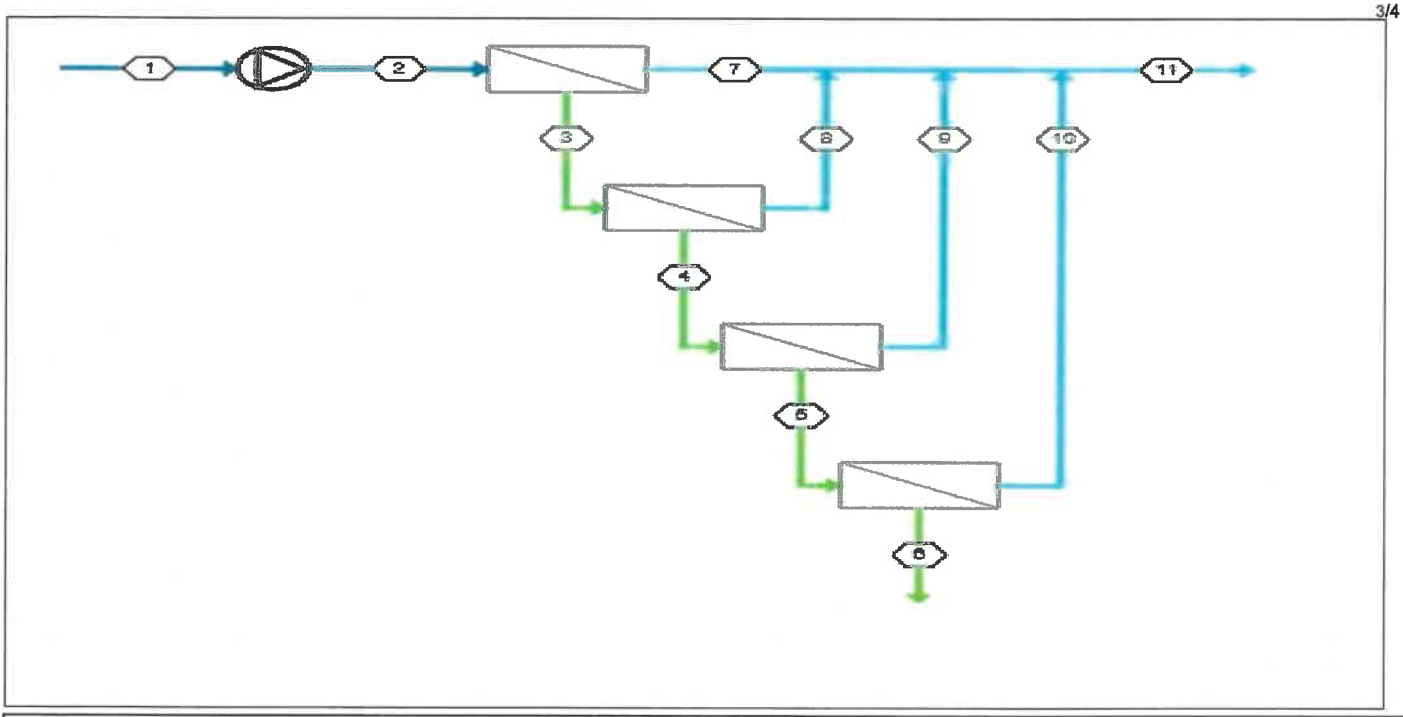
Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	108.9 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	3.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.86
Pumping specific energy	1.13 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	45.2 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Exhaust	Conc	Perm. TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	895.3	49.9	21.9	14.4	15.5	17.6	1.14	47.0	0.0	0	93.5	50.5	ESNA1-LF-LD	224	32 x 7M
1-2	268.0	43.8	27.1	15.1	8.8	16.7	1.12	25.0	0.0	0	81.6	87.2	ESNA1-LF-LD	64	16 x 4M
1-3	173.5	27.1	16.2	13.0	3.3	14.5	1.18	25.0	0.0	0	75.3	281.0	ESNA1-LF2-LD	48	16 x 3M
1-4	52.3	43.3	34.6	6.3	11.9	8.8	1.05	25.0	0.0	0	60.5	821.7	ESNA1-LF2-LD	30	6 x 5M

Pass-Stage	membrane no.	Feed Pressure	Pressure Drop	Conc Osmotic pressure	NDP	Permeate Water Flow	Flux	Recovery	Beta	Permeate (Stagewise cumulative) TDS	Econd (@ 25.0 °C)	Ca	Na	Cl
		psi	psi	psi	psi	gpm	gfd	(%)		mg/l	mg/l	mg/l	mg/l	mg/l
1-1	1	108.9	3.39	5.0	57.2	4.9	17.6	9.8	1.10	29.8	40.1	1.196	5.751	4.198
1-1	2	105.5	2.91	5.5	52.1	4.5	16.0	9.9	1.10	32.8	44.0	1.319	6.306	4.609
1-1	3	102.6	2.50	6.1	49.0	4.2	15.1	10.3	1.10	35.7	47.9	1.443	6.847	5.012
1-1	4	100.1	2.13	6.7	46.2	3.9	14.2	10.8	1.11	38.8	52.1	1.577	7.423	5.444
1-1	5	98.0	1.80	7.6	43.6	3.7	13.4	11.5	1.12	42.3	56.6	1.725	8.050	5.915
1-1	6	96.2	1.50	8.5	41.1	3.5	12.6	12.2	1.12	46.1	61.7	1.893	8.743	6.439
1-1	7	94.7	1.23	9.7	38.8	3.3	11.9	13.1	1.14	50.5	67.4	2.086	9.518	7.028
1-2	1	90.5	2.80	10.8	54.7	4.7	16.7	10.6	1.10	66.3	87.6	2.837	12.143	9.095
1-2	2	87.7	2.38	12.0	51.0	4.3	15.6	11.1	1.11	72.4	95.6	3.112	13.224	9.921
1-2	3	85.3	2.00	13.5	47.5	4.0	14.5	11.6	1.12	79.3	104.7	3.425	14.432	10.848
1-2	4	83.3	1.67	15.2	44.1	3.7	13.5	12.1	1.12	87.2	114.9	3.784	15.790	11.894
1-3	1	78.6	1.37	17.5	37.5	4.0	14.5	14.9	1.16	216.7	320.8	30.242	33.533	25.747
1-3	2	77.2	1.08	20.3	33.8	3.6	13.1	15.7	1.17	245.6	363.1	34.438	37.641	29.026
1-3	3	76.2	0.83	23.7	29.8	3.2	11.5	16.4	1.18	281.0	414.9	39.618	42.589	33.003
1-4	1	72.3	2.75	24.8	23.1	2.5	8.8	5.7	1.05	541.1	798.0	76.663	81.180	63.174
1-4	2	69.6	2.53	25.8	19.4	2.1	7.4	5.1	1.05	601.5	886.7	85.407	89.849	70.060
1-4	3	67.1	2.34	26.6	16.1	1.7	6.1	4.4	1.04	668.1	984.2	95.060	99.317	77.607
1-4	4	64.7	2.19	27.3	13.1	1.4	5.0	3.8	1.04	741.1	1138.8	105.693	109.630	85.855
1-4	5	62.5	2.07	27.8	10.4	1.1	4.0	3.1	1.03	821.1	1242.1	117.380	120.837	94.850

Permeate pressure



Stream No.	Flow (gpm)	Pressure (psi)	TDS (mg/l)	pH	Econd (µS/cm) (@ 25.0 °C)
1	1597	0	553	7.20	790
2	1597	109	553	7.20	790
3	701	93.5	1193	7.52	1679
4	433	81.6	1874	7.70	2504
5	260	75.3	2937	7.88	3739
6	207	60.5	3466	7.95	4341
7	895	47.0	50.5	6.18	67.4
8	268	25.0	87.2	6.42	115
9	174	25.0	281	6.88	415
10	52.3	25.0	822	7.33	1243
11	1389	25.0	115	6.52	163

Permeate pressure

Project name	Hollywood FL-NF	Permeate flow/train	1389.00 gpm
Client Name	TBA	Total plant product flow	9723.00 gpm
Calculated by	kirk.lai@nitto.com	Number of trains	7.00
HP pump flow	1596.55 gpm	Raw water flow/train	1596.55 gpm
Feed pressure	108.9 psi	Permeate recovery	87.00 %
Feed temperature	26.5 °C	Membrane age	3.0 years
Feed Water pH	7.20	Flux decline,per year	5.0 %
Chemical dose, mg/l	None	Fouling factor	0.86
Pumping specific energy	1.13 kWh/kgal	SP increase, per year	7.0 %
Pass NDP	45.2 psi	Inter-stage pipe loss	3.000 psi
Average flux	13.7 gfd	Feed type	Brackish Well Non-Fouling
		Pretreatment	Conventional

Pass-Stage	Perm. Flow	Flow / Vessel Feed	Conc	Flux	DP	Flux Max	Beta	Perm.	Stagewise Pressure Boost	Exhaust	Perm. Conc	TDS	Membrane Type	Membrane Quantity	PV# x Elem #
	gpm	gpm	gpm	gfd	psi	gfd		psi	psi	psi	psi	mg/l			
1-1	895.3	49.9	21.9	14.4	15.5	17.6	1.14	47.0	0.0	0	93.5	50.5	ESNA1-LF-LD	224	32 x 7M
1-2	268.0	43.8	27.1	15.1	8.8	16.7	1.12	25.0	0.0	0	81.6	87.2	ESNA1-LF-LD	64	16 x 4M
1-3	173.5	27.1	16.2	13.0	3.3	14.5	1.18	25.0	0.0	0	75.3	281.0	ESNA1-LF2-LD	48	16 x 3M
1-4	52.3	43.3	34.6	6.3	11.9	8.8	1.05	25.0	0.0	0	60.5	821.7	ESNA1-LF2-LD	30	6 x 5M

**********Calculation of Investment and Water Cost**********

Open analysis record	1389.00 gpm
Specific investment	5,030.71 USD/gpm
Investment	6,987,658.00 USD
Plant life	15.0 years
Membrane life	5.0 years
Interest rate	4.5 %
Membrane cost	800.00 USD/element
Plant factor	90.0 %
Number of elements	366.0
Power cost	0.200 USD/kWhr
Inhibitor cost	2.20 USD/lb
Power consumption	1.07 kWhr/kgal
Inhibitor cost	3.0 mg/l
Maintenance (% of investment)	3.0 %
Acid cost	0.15 USD/lb
Acid dosing	0.00 mg/l

**********Calculation Results**********

Capital cost	0.17 USD/kgal
Power cost	0.21 USD/kgal
Chemicals cost	0.02 USD/kgal
Membrane replacement cost	0.02 USD/kgal
Maintenance (% of investment)	0.08 USD/kgal
Total water cost	0.51 USD/kgal

Hydranautics RO/NF Limited System Performance Warranty: Prorated Replacement

Project Name: **The City of Hollywood Florida Reload**

Buyer: **TBD**

Date (Prepared/Submitted to Customer):_____

This Limited Integrated Membrane System Performance Warranty is provided to **TBD** (the "Buyer") and is made by HYDRANAUTICS ("Hydranautics"), a California corporation, in connection with the Buyer's purchase of Hydranautics product(s) and the component parts thereof, as more fully described and defined in that certain sales contract ("Contract") of even date herewith. This Warranty is made and executed by Hydranautics and the Buyer as of the date set forth hereinbelow, and is effective as of the date of execution by the last to sign of the parties hereto (the "Effective Date"), subject to the terms, conditions and limitations set forth herein.

I. ACRONYMS AND DEFINITIONS

The following acronyms as used herein shall mean:

ASTM:	ATSM International
AWWA:	American Water Works Association
Feedwater:	The flow entering the pressure vessels that contain Covered Product
NTU:	Nephelometric Turbidity Units
RO:	Reverse Osmosis
NF:	Nanofiltration
$SDI_{(15)}$:	Silt Density Index, fifteen (15) minute test with Millipore AAWP pads
TDS:	Total Dissolved Solids as measured using the American Water Works Association ("AWWA") standard methods
TSB:	Technical Service Bulletin. TSBs referenced in this Warranty may be viewed and downloaded at http://www.membranes.com. TSBs specifically incorporated into this Warranty by reference are attached hereto as Attachment "B."

II. ACKNOWLEDGEMENTS OF BUYER

By executing and accepting this Warranty, Buyer acknowledges to Hydranautics the following:

A. Buyer understands and agrees that it is Buyer's sole responsibility to ensure that the RO system in which Covered Product is installed, is capable of being operated in a manner that satisfies the: (i) Feedwater Quality; (ii) Operating; and (iii) Design Conditions as set forth herein;

B. Buyer has read and understands the terms, conditions, and limitations of this Warranty;

C. Buyer has read and understands the Technical Service Bulletins ("TSBs") attached hereto as Attachment "B," and will comply with the procedures, recommendations and good use practices described therein. Buyer agrees to conform with all reasonable diligence to the requirements set forth in TSBs 105, 107, 108 and 118, and hereby acknowledges that in the event that Buyer's failure to reasonably comply with the requirements and recommendations set forth therein cause damage to Covered Product(s), to the extent that Covered Product(s) performance is permanently impaired or operational life is substantially shortened; then Hydranautics will be relieved of its obligations to perform the remedies set forth herein and this Warranty will be voided.

D. Buyer understands that this Warranty is ***not*** effective unless an authorized representative of both Hydranautics and Buyer have affixed their respective signatures in the place provided below, signifying their mutual acceptance of the provisions, terms, conditions and limitations of this Warranty.

Buyer's Initials _____

Hydranautics Corporate Headquarters: 401 Jones Road, Oceanside, CA 92058, USA
Toll Free: 1-800-CPA-PURE **Phone:** +760-901-2500 **Fax:** +760-901-2578 **Email:** info@hydranautics.com **Website:** www.membranes.com

III. LIMITED WARRANTY ON WORKMANSHIP AND MATERIALS

Hydranautics warrants Covered Product as free from defects in workmanship and materials for a period not to exceed **twelve (12) months** months from the date of delivery to Buyer; provided however, that Covered Product are used and maintained in accordance with this Warranty. Covered Product which are not free from defects, will be repaired or replaced, at Hydranautics sole option, in accordance with the provisions of this Warranty.

IV. LIMITED PERFORMANCE WARRANTY

Hydranautics warrants Covered Product shall produce the permeate output and the permeate quality as set forth in Attachment "A," subject to the terms, conditions and limitations of this Limited Performance Warranty (the "Warranty").

V. WARRANTY TERM

This Warranty shall commence on whichever of the following events occurs first: (i) Beneficial Use (by train); or (ii) six (6) months following last delivery; or (iii) plant acceptance whichever occurs first; and shall terminate **36** months following commencement (the "Warranty Term"). Buyer shall record the date of the warranty start date as set forth in this Article V., maintain such records, and make such records available to Hydranautics in the event of a warranty claim. For purposes of this Article V., the above terms shall have the following meaning:

A. "Beneficial Use" means – The Owner is being enriched from the installed RO membrane elements by operating the plant or individual trains in which the membrane elements are installed for the purpose producing water and where the water produced is being sold or otherwise produced or consumed for the benefit of either the Buyer or the Owner, whether within specification or not.

B. "six (6) months following last delivery" means – six months following the last date of delivery to Buyer under the delivery terms (Incoterms) set forth in the main purchase contract, as evidenced by the shipping documents.

C. "plant acceptance" means – the date on which the plant or system in which Covered Product are installed successfully completed acceptance testing and the Buyer received or the Owner issued a written acceptance certificate.

VI. WARRANTY TERMS AND CONDITIONS

This Warranty is expressly conditioned on Buyer's compliance with the following terms and conditions.

A. FEEDWATER QUALITY CONDITIONS

Feedwater quality shall be measured after all pre-treatment chemicals have been added and following cartridge filtration.

1) Turbidity must be below the value specified in Attachment A.
2) Feedwater $SDI_{(15)}$must be below the value specified in Attachment A.
3) Covered Product whose performance is impared due to scale formation are not covered under this Warranty.
4) Feedwater temperature shall not exceed 113°F (45°C).
5) The feedwater shall contain no oil or grease. Total hydrocarbons shall be below 100 ppb.
6) Feedwater shall contain no chlorine, hypochlorous, hypochlorite ion or other oxidizing agents.

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B. RECORDS

As a condition precedent for enforcement of Hydranautics' obligations under this warranty, Buyer agrees to maintain records in accordance with the following requirements, hereinafter collectively "Records":

1) Buyer shall maintain records of SDI measurements at a frequency of not less than three (3) measurements per day while Covered Product is in operation for the term of this Warranty. SDI pads should be maintained for three (3) months for reference and shall be made available to Hydranautics on request in the event a warranty claim is filed. Turbidity records shall be continuous for the term of this Warranty.

2) Buyer shall enter one (1) set of operating data, per operating train, per day, into the Hydranautics' RO Data Normalization Program, which may be downloaded at http://www.membranes.com. Data may be entered on working days only, however, data must be entered for each day of operation. Buyer agrees to enter all data and information required by ROData including, but not necessarily limited to: feed water temperature, feed water pH, feed water conductivity, permeate conductivity, concentrate flow, permeate flow, feed pressure, permate pressure, concentrate pressure, feed water SDI and feed water turbidity.

3) Additionally, Buyer shall maintain a daily operations log for the system or trains, in the event the system is not operated at full capacity, in which Covered Products are installed and operating. The operations log shall record any and all plant operational events, including but not limited to: (i) system or train start-up dates and times; (ii) system or train shut-down dates and times; (iii) changes in the type, brand or concentration of chemicals used; (iv) the dates when Covered Products were cleaned as well as the type and brand of cleaning chemicals used and the procedures employed.

4) Additionally, Buyer shall maintain records showing the serial number of each RO Covered Product and the location and position of each Covered Product in the pressure tubes. If RO Covered Products are installed in the system by a party other than the Buyer, it is the Buyer's responsibility to obtain the loading records from the party loading Covered Products.

5) Upon reasonable advance notice, Buyer agrees to grant Hydranautics' employees access to the system and the operating records required herein at any time during normal business hours. Hydranautics' representative(s) shall be notified of any membrane cleanings and replacement element loading within a reasonable timeframe. An up-to-date copy of the data disc(s) produced by the Data Normalization Program, or other plant operating data, shall be provided to Hydranautics upon request. An up-to-date copy of the data disc(s) produced by Hydranautics' RO Data Normalization Program shall be sent to Hydranautics with seven (7) business days of request.

C. OTHER WARRANTY CONDITIONS

As a condition precedent for the enforcement of this Warranty, Buyer acknowledges and agrees to the following provisions:

1) Hydranautics shall have the right to review the system design, operating instructions, and the operation of Covered Products, including pre-treatment and cleaning procedures and chemicals used to validate Buyer's compliance with the terms and conditions of this Warranty.

2) This Warranty shall not be assigned or transferred by the Buyer without the prior written consent of Hydranautics, such consent to not be unreasonably withheld.

Buyer's failure to strictly adhere to the express conditions set forth in Article VI, Warranty Terms and Conditions, will void this Warranty.

Buyer's Initials _____

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VII. ENFORCEMENT OF WARRANTY

A. In the event that Covered Product fails to perform to warranted values, Buyer shall notify Hydranautics within ten (10) days of the discovery of such failure by contacting a local Hydranautics representative.

B. Upon request, Buyer shall forward to Hydranautics the Records required by paragraph VI.B, within seven (7) business days of receipt of such request. Buyer's failure to provide Hydranautics with Records will prohibit Hydranautics from validating Buyer's warranty claim. In such event, Hydranautics shall be relieved of all of its obligations under this Warranty.

C. If the performance issue cannot be resolved during the site visit or over the telephone, Hydranautics may request Buyer to return Covered Product(s) for performance evaluation, under TSB 116 Returned Goods Authorization, to validate Buyer's warranty claim and to confirm that the conditions of this Warranty have been satisfied. Except as may otherwise be specifically required under the terms set forth in this Warranty, Buyer shall enforce the Warranty in accordance with the procedures set forth in TSB 116, Returned Goods Autorization. Failure to comply with the procedures set forth in TSB 116 shall relieve Hydranautics of its obligations to perform under this Warranty.

D. Buyer is solely responsible for all packing and shipment costs and risk of loss for all Covered Product shipped by Buyer to Hydranautics. Hydranautics is solely responsible for all packing and shipments costs and risk of loss for Covered Product shipped to Buyer until delivery to Buyer's facility.

VIII. BUYER'S EXCLUSIVE REMEDY

The sole obligation of Hydranautics and the sole and exclusive remedy of Buyer is limited to and is fully discharged by Hydranautics repairing or replacing Covered Product; or adding new Covered Product to achieve Warranted Performance, subject to the limitation that Hydranautics is only responsible for a replacement or repair value based on the terms provided in Attachment A, Section V.

Hydranautics reserves the right to remove membranes and replace membranes with either tighter or looser rejection membranes in order to achieve the specified permeate water quality. This would include and not be limited to the use of more ESNA1-LF2-LD membranes to achieve a higher total permeate hardness level or installing more ESNA1-LF-LD or ESPA4-LD membranes to achieve lower iron level.

IX. LIMITATIONS ON HYDRANAUTICS LIABILITY

Hydranautics' total liability under this Warranty shall not exceed the replacement value, based on the pro-rata balance of the unrealized warranty term, of one set of membrane elements per train; excluding any Covered Product or portions thereof that are replaced due to defects in material or workmanship. Covered Product, or portions thereof, that are replaced due to defects in material or workmanship will be covered as new Covered Product, although all warranty obligations will expire at the end of the Warranty Term, as set forth herein, including any remaining term of the workmanship and material warranty.

IN NO EVENT SHALL HYDRANAUTICS BE LIABLE FOR PROSPECTIVE PROFITS OR SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES, INCLUDING BUT NOT LIMITED TO, LOST TIME, LOST PROFITS, LOST SALES, OPERATING COSTS, PLANT DOWNTIME, OR DAMAGES RESULTING FROM DELAYED SHIPMENT OR MAILING, OR THIRD PARTY CLAIMS, ARISING FROM A WARRANTY CLAIM, SALE OF A COVERED PRODUCT, OR FOR ANY DELAY OR FAILURE TO PERFORM DUE TO CAUSES BEYOND ITS REASONABLE CONTROL, INCLUDING, BUT NOT LIMITED TO, ACTS OF GOD, STRIKES, RIOTS, ACTS OF WAR, EPIDEMICS, FAILURE OF SUPPLIERS TO PERFORM, GOVERNMENTAL REGULATIONS, POWER FAILURES, EARTHQUAKES, OR OTHER DISASTERS), OR FROM ANY BREACH OF WARRANTY OR CONTRACT BY HYDRANAUTICS IN CONNECTION WITH AN WARRANTY CLAIM OR THE SALE OF A COVERED PRODUCT TO BUYER, EVEN IF HYDRANAUTICS HAS BEEN PREVIOUSLY ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. HYDRANAUTICS' TOTAL LIABILITY, WHETHER IN CONTRACT OR TORT OR OTHERWISE, ARISING OUT OF ITS SALE OF COVERED PRODUCT, OR ANY WARRANTY CLAIM

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SHALL NOT EXCEED THE REPLACEMENT VALUE OF ONE SET OF COVERED PRODUCT PER TRAIN, EXCLUDING ANY COVERED PRODUCT OR PORTIONS THEREOF THAT ARE REPLACED DUE TO DEFECTS IN MATERIAL OR WORKMANSHIP.

X. WARRANTY DISCLAIMERS

THIS WARRANTY SUPERSEDES AND REPLACES ANY PREVIOUS WARRANTY MADE OR OFFERED TO THE BUYER BY HYDRANAUTICS, EXCEPT FOR THOSE SET FORTH IN THE CONTRACT FOR SALE TO WHICH THIS LIMITED SYSTEM PERFORMANCE WARRANTY IS ATTACHED. HYDRANAUTICS DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE WITH RESPECT TO ANY GOODS PURCHASED BY YOU FROM HYDRANAUTICS. BUYER ASSUMES ALL RISKS AND LIABILITIES RESULTING FROM THE USE OF ANY COVERED PRODUCT DELIVERED HEREUNDER. EXCEPT AS SPECIFICALLY SET FORTH HEREIN, NO WARRANTY IS MADE FOR THE FITNESS OF ANY COVERED PRODUCT FOR ANY PARTICULAR PURPOSE.

XI. MISCELLANEOUS

A. Unless otherwise provided for in this Warranty, no agent, employee, or representative of Hydranautics has any authority to bind Hydranautics to any other affirmation, representation, or warranty concerning Covered Products. Unless an affirmation, representation or warranty is specifically included in this Warranty, it shall not be enforceable by Buyer.

B. To the extent that ANY term set forth in this Warranty is in conflict with any other agreement between the parties, the terms of this Warranty shall control, particularly regarding, but not limited to, the Limitations on Hydranautics Liability set forth in Section IX hereof.

C. This Warranty shall be governed by and construed according to the laws of California, USA.

The EFFECTIVE DATE OF THIS WARRANTY shall be the latest date of execution by the last to sign of the parties hereto.

FOR HYDRANAUTICS:	**FOR BUYER:**
Signature:	Signature:
Name:	Name:
Title:	
Date:	Date:

Buyer's Initials _____

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Attachment "A" to
HYDRANAUTICS RO/NF LIMITED SYSTEM PERFORMANCE WARRANTY

Project Name:**The City of Hollywood Florida Reload**

Buyer: **TBD**

Date (Prepared/Submitted to Customer):_____

I. WARRANTED PERFORMANCE

The following parameters, and *only the following parameters*, are guaranteed under this Warranty.

PARAMETER	WARRANTED VALUE
a. Permeate Output (Capacity):	**14 MGD Total for the system 7 trains each at 2 MGD Capacity**
b. Permeate Quality:	
TDS	**200 mg/l**
HCO3	25 – 75 mg/l
Iron	0.15 mg/l
Total Hardness	Greater than 20 mg/l as CaCO3

II. DESIGN CONDITIONS

Warranted Performance as defined in Section I. is expressly conditioned on Covered Product being operated under the Design Conditions provided below. Buyer understands and hereby agrees that operation of Covered Product under conditions other than the Design Conditions will result in performance that is different from Warranted Performance and that such different result does not indicate a defect in Covered Product.

The Design Conditions are:

a.	Maximum design feedwater ion concentrations are as follows:								
Calcium	Ca^{2+}	**94.4**	mg/l		Bicarbonate Alk	HCO_3^-	**322.1**	mg/l
Magnesium	Mg^{2+}	**5.1**	mg/l		Carbonate	CO_3^{2-}	**0.36**	mg/l
Sodium	Na^+	**45.0**	mg/l		Sulfate	SO_4^{2-}	**32.0**	mg/l
Potassium	K^+	**3.4**	mg/l		Chloride	$C1^-$	**41.0**	mg/l
Barium	Ba^{2+}	**0.02**	mg/l		Fluoride	F^-	**0.3**	mg/l
Strontium	Sr^{2+}	**1.0**	mg/l		Nitrate	NO_3^-	**0.0**	mg/l
Iron	Fe^{2+}	**0.7**	mg/l		Silica	SiO_2	**7.60**	mg/l
Ammonium	NH_4^+	**0**	mg/l		Boron	B	**0.0**	mg/l

b.	Feedwater TDS	**553.0** mg/l Total Dissolved Solids as Sum of Ions
c.	Feedwater pH	**7.20** pH Units
d.	Feedwater TOC	**0.0** mg/l
e.	Feedwater Temperature Range	**26.5** Degrees Celsius

III. SYSTEM DESCRIPTION

Each train of the reverse osmosis system consists of:

First pass:

a.	**32** Pressure Vessels, each Pressure Vessel houses **7** membrane elements – First Stage
b.	**16** Pressure Vessels, each Pressure Vessel houses **7** membrane elements – Second Stage
c.	**6** Pressure Vessels, each Pressure Vessel houses **7** membrane elements – Third Stage

Buyer's Initials _____

Hydranautics Corporate Headquarters: 401 Jones Road, Oceanside, CA 92058, USA
Toll Free: 1-800-CPA-PURE **Phone:** +760-901-2500 **Fax:** +760-901-2578 **Email:** info@hydranautics.com **Website:** www.membranes.com

Please refer to applicable IMSDesign projection for additional details.

Total Number of trains: first pass 7; and second pass 0

Model and Total number of Covered Product Installed: **2016 ESNA1-LF-LD + 546 ESNA1-LF2-LD= 2562**

Membrane Model	Total Quantity
ESNA1-LF-LD first stage	**1568**
ESNA1-LF-LD 2nd stage first 4 positions	**448**
ESNA1-LF2-LD 2nd stage last 3 positions	**336**
ESNA1-LF2-LD 3rd stage 5 positions	**210**

IV. OPERATING PARAMETERS

A. The system and single train element flux rate shall not exceed the design value at any time during RO operation.

B. Maximum recovery shall not exceed **87** % in the first pass.

C. Pressure drop across a pressure vessel shall never exceed 60 psig (4.1bar).

D. Feedwater $SDI_{(15)}$ shall be maintained at less than or equal to 3.0 $SDI_{(15)}$ 95% of the time and maximum of 4.0.

E. Feedwater Turbidity shall be maintained at less than or equal to 0.2 NTU 95% of the time and maximum of 0.3 NTU.

F. The applied operating pressure shall at no time exceed the maximum pressure rating of the Covered Product as set forth in TSB105.

G. The membrane element shall not, at any time, be exposed to permeate back pressure (where permeate static pressure exceeds feed static pressure) including during shut-down, greater than 0.35 bar (5 psig.)

H. At no time shall Covered Product be subjected to pressurization/depressurization at a rate greater than zero point seven (0.7) bar (10 psig) per second.

I. Covered Product which experience structural or mechanical damaged as a result of Buyer's failure to meet these operating conditions are not covered under this warranty.

V. LIMITATION OF WARRANTY: BUYER'S REPLACEMENT COSTS

Hydranautics' total liability under the Warranty is limited by Buyer's responsibility for the cost of a prorated percentage replacement of the Covered Product. The prorated replacement cost to Buyer will be calculated according to a monthly prorated rate as set forth above in Article V, Warranty Term. The replacement price for each element of the Covered Product shall be the original contract price adjusted by (a) +1% per year for each year of the cumulative replacement or (b) the total positive escalation of the USA Producer Price Index (PPI) **Series Id:** PCU325211325211, whichever is greater. **Industry**: Plastics material and resins mfg. **Product:** plastics material and resins mfg. prorated to the date of the replacement (the "Replacement Price").

Buyer's Initials _____

Hydranautics Corporate Headquarters: 401 Jones Road, Oceanside, CA 92058, USA
Toll Free: 1-800-CPA-PURE **Phone:** +760-901-2500 **Fax:** +760-901-2578 **Email:** info@hydranautics.com **Website:** www.membranes.com

1.08 SYSTEM OPERATON AND MAINTENANCE

A. The Owner agrees to operate the membrane softening system in accordance with the MEM's operating and maintenance instructions. The OWNER further agrees to provide a continuous supply of clean raw water to the system with water quality similar to that indicated above and the following additional operating guidelines (to be filled in by the MEM):

Maximum cleaning solution temperature: 45 / 113 degrees C / F (see TSB 107 for pH / temperature limits)
Maximum feed water SDI: < 4.0 (based on 15 minutes) and < 3.0 greater than 95% of the time
Maximum feed water: 10.0 pH
Minimum feed water: 2.0 pH
Maximum cleaning solution: 12.0 pH @ 25 C (see TSB 107 for pH / temp limits)
Minimum cleaning solution: 1.0 pH @ 25 C (see TSB 107 for pH / temp limits)
Maximum cleaning solution flow pressure drop across pressure vessel: 60 psi
Maximum flow of cleaning solution: 55 gpm/vessel

B. The OWNER agrees to clean the membranes in strict conformance with the MEM's instructions regarding methods, cleaning agents, and frequency.

C. The OWNER agrees to calculate the normalized system performance on a monthly basis using the MEM's standard normalization software available as of the date of Award or similar normalization software submitted by the MEM and approved by the OWNER and ENGINEER. The OWNER agrees to provide the MEM with monthly performance analysis reports using the MEM's normalization software.

Technical Service Bulletin

January 2020 TSB107.26

Foulants and Cleaning Procedures for composite polyamide RO/NF Membrane Elements

This bulletin provides general information about the usual foulants affecting the performance of Hydranautics' Composite Polyamide Reverse Osmosis (RO) membrane elements and the removal of these foulants. The information in this bulletin applies to 4-inch, 6-inch, 8-inch, 8.5-inch, and 16-inch diameter RO membrane elements.

Note: The Composite Polyamide type of RO membrane elements may not be exposed to chlorinated water under any circumstances. Any such exposure will cause irreparable damage to the membrane. Absolute care must be taken following any disinfection of piping or equipment or the preparation of cleaning or storage solutions to ensure that no trace of chlorine is present in the feedwater to the RO membrane elements. If there is any doubt about the presence of chlorine, perform chemical testing to make sure. Neutralize any chlorine residual with a sodium bisulfite solution, and ensure adequate mixing and contact time to accomplish complete dechlorination. Dosing rate is 1.8 to 3.0 ppm sodium bisulfite per 1.0 ppm of free chlorine.

Note: It is recommended that all RO membrane cleaning operations should be closely coordinated with Hydranautics during the RO membrane element warranty period. Hydranautics field service personnel are available to be on site for cleaning assistance, should the need arise. Please contact Hydranautics for current charges for this service.

Note: The use of cationic surfactants should be avoided in cleaning solutions, since irreversible fouling of the membrane elements may occur. In regards to any proprietary chemicals, Hydranautics position is that the vendor of these proprietary chemicals is responsible for guaranteeing their product is compatible with Hydranautics membranes. Thus, the chemical vendor would be solely responsible for the financial and other impacts a negative interaction may have.

If additional information is needed, please contact the Technical Services Department at:

HYDRANAUTICS
401 Jones Rd.
Oceanside, CA 92058
Tel# (760) 901-2500
Fax# (760) 901-2578
e-mail: hy-info@nitto.com
Internet: www.membranes.com

RO Membrane Fouling and Cleaning

During normal operation over a period of time, RO membrane elements are subject to fouling by suspended or sparingly soluble materials that may be present in the feedwater. Common examples of foulants are:

- Calcium carbonate scale
- Sulfate scale of calcium, barium or strontium
- Metal oxides (iron, manganese, copper, nickel, aluminum, etc.)
- Polymerized silica scale
- Inorganic colloidal deposits
- Mixed inorganic/organic colloidal deposits
- NOM organic material (Natural Organic Matter)
- Man-made organic material (e.g. antiscalant/dispersants, cationic polyelectrolytes)
- Biological (bacterial bioslime, algae, mold, or fungi)

The nature and rapidity of fouling depends on a number of factors, such as the quality of the feedwater and the system recovery rate. Typically, fouling is progressive, and if not controlled early, will impair the RO membrane element performance in a relatively short time. Cleaning should occur when the RO shows evidence of fouling, just prior to a long-term shutdown, or as a matter of scheduled routine maintenance. The elements shall be maintained in a clean or "nearly clean" condition to prevent excessive fouling by the foulants listed above. Under normal circumstances, some fouling is allowed as long as the normalized parameters listed below are not allowed to deviate more than the "Typical" values . In specific cases, such as industrial and municipal wastewaters where fouling is more extreme, it may be necessary to allow for greater deviation in normalized parameters as listed under "High Fouling". In such extreme cases, the deviation in normalized parameters should be based on the stabilized performance which may occur after a week of operation.

	Typical	High Fouling
normalized permeate flow decrease	10%	20%
normalized permeate quality	10%	20%
normalized pressure drop	15%	30%

Cleaning should be carried out as soon as is practical to maintain the elements in a clean or "nearly clean" condition. Effective cleaning is evidenced by the return of the normalized parameters to their initial, Start-up, value. In the event you do not normalize your operating data, the above values still apply if you do not have major changes in critical operating parameters.

Of special note are wastewaters which have high concentrations of soluble organic compounds. Historical studies have shown that it is common to have an initial sharp drop in normalized flow and decrease of salt passage, which are characterized by 10-20% decrease over a 2-4 week time period.[1] After this initial rapid decline, the normalized flow will decline marginally over the next 6-12 months. Reasearch has shown that the initial drop is due to the adsorption of organics onto the membrane surface. Once the membrane surface is saturated with the mono-layer of organic, this effect no longer has significant impact on membrane performance. Aggressive cleaning can recover much of this loss, but studies show the gain is only short-lived and the system will quickly return to its previous performance. Thus, it is recommended that decisions to clean be based on the decline rate after this initial stabilization.

The operating parameters that have to stay constant are permeate flow, permeate back-pressure, recovery, temperature, and feed TDS. If these operating parameters fluctuate, then it is highly

[1] UNDERSTANDING RO MEMBRANE FOULING AT WASTEWATER TREATMENT PLANTS", Craig R Bartels and Rich Franks, AWWA/AMTA Membrane Technology Conference, Glendale, AZ, 2012.

recommended that you normalize the data to determine if fouling is occurring or if the RO is actually operating normally based on the change in a critical operating parameter. Hydranautics offers a free normalization software program called ROData, which can be downloaded from our web site at www.membranes.com.

Monitoring overall plant performance on a regular basis is an essential step in recognizing when membrane elements are becoming fouled. Performance is affected progressively and in varying degrees, depending on the nature of the foulants. Table 1 "RO Troubleshooting Matrix" provides a summary of the expected effects that common foulants have on performance.

RO cleaning frequency due to fouling will vary by site. A rough rule of thumb as to an acceptable cleaning frequency is once every 3 to 12 months. If you have to clean more than once a month, you should be able to justify further capital expenditures for improved RO pretreatment or a re-design of the RO operation. If the cleaning frequency is every one to three months, you may want to focus on improving the operation of your existing equipment but further capital expenditure may be harder to justify.

It is important to clean the membranes when they are only lightly fouled, not heavily fouled. Heavy fouling can impair the effectiveness of the cleaning chemical by impeding the penetration of the chemical deep into the foulant and in the flushing of the foulant out of the elements. If normalized membrane performance drops 30 to 50%, it may be impossible to fully restore the performance back to baseline conditions.

When inorganic or polyelectrolyte coagulants are used in the pretreatment process, there can often be incomplete reaction of the coagulant and thus insufficient formation of a filterable floc. The user should ensure that excessive amounts of coagulant are not fed to the RO system, as it can lead to fouling. Polyelectrolyte fouling can often be very difficult to remove and result in higher than expected feed pressure. Excessive amounts of inorganic coagulant can be measured by using SDI filter equipment. In the case of iron, the iron on the SDI filter pad should typically be 3 µg/pad and never above 5 µg/pad. In regards to polymer coagulants, the user should discuss the concern with their chemical supplier and have them ensure that the chemical will not adversely affect the membrane.

In addition to the use of turbidity and SDI, particle counters are also very effective to accurately measure the suitability of the feedwater for NF/RO elements. The measure of particles greater than 2 microns in size should be < 100 particles per millilitre.

One RO design feature that is commonly overlooked in reducing RO cleaning frequency is the use of RO permeate water for flushing foulants from the system. Soaking the RO elements during standby with permeate can help dissolve scale and loosen precipitates, reducing the frequency of chemical cleaning.

What you clean for can vary site by site depending on the foulant. Complicating the situation frequently is that more than one foulant can be present, which explains why cleanings frequently require a low pH and high pH cleaning regimen.

Note: The membrane elements shall not be exposed to feed water containing oil, grease, or other foreign matter which proves to chemically or physically damage the integrity of the membrane.

Table 1: RO Troubleshooting Matrix

(Pressure Drop is defined as the Feed pressure minus the Concentrate pressure)

Possible Cause	Possible Location	Pressure Drop	Feed Pressure	Salt Passage
Metal Oxide Fouling (e.g. Fe,Mn,Cu,Ni,Zn)	1st stage lead elements	Rapid increase	Rapid increase	Rapid increase
Colloidal Fouling (organic and/or inorganic complexes)	1st stage lead elements	Gradual increase	Gradual increase	Slight increase
Mineral Scaling (e.g. Ca, Mg, Ba, Sr)	Last stage tail elements	Moderate Increase	Slight increase	Marked increase
Polymerized Silica	Last stage tail elements	Normal to increased	Increased	Normal to increased
Biological Fouling	Any stage, usually lead elements	Marked increase	Marked increase	Normal to increased
Organic Fouling (dissolved NOM)	All stages	Gradual increase	Increased	Decreased
Antiscalant Fouling	2nd stage most severe	Normal to increased	Increased	Normal to increased
Oxidant damage (e.g Cl_2, ozone,$KMnO_4$)	1st stage most severe	Normal to decreased	Decreased	Increased
Hydrolysis damage (out of range pH)	All stages	Normal to decreased	Decreased	Increased
Abrasion damage (carbon fines, etc)	1st stage most severe	Normal to decreased	Decreased	Increased
O-ring leaks (at interconnectors or adapters)	Random (typically at feed adapter)	Normal to decreased	Normal to decreased	Increased
Glue line leaks (due to permeate back-pressure in service or standby)	1st stage most severe	Normal to decreased	Normal to decreased	Increased
Glue line leaks (due to closed permeate valve while cleaning or flushing)	Tail element of a stage	Increased (based on prior fouling & high delta P)	Increased (based on prior fouling & and high delta P)	Increased

Discussion on Foulants

Calcium Carbonate Scale: Calcium carbonate is a mineral scale and may be deposited from almost any feedwater if there is a failure in the antiscalant/dispersant addition system or in the acid injection pH control system that results in a high feedwater pH. An early detection of the resulting calcium carbonate scaling is absolutely essential to prevent the damage that crystals can cause on the active membrane layers. Calcium carbonate scale that has been detected early can be removed by lowering the feedwater pH to between 3.0 and 5.0 for one or two hours. Longer resident accumulations of calcium carbonate scale can be removed by a low pH cleaning with a citric acid solution.

Calcium, Barium & Strontium Sulfate Scale: Sulfate scale is a much "harder" mineral scale than calcium carbonate and is harder to remove. Sulfate scale may be deposited if there is a failure in the antiscalant/dispersant feed system or if there is an over feed of sulfuric acid in pH adjustment. Early detection of the resulting sulfate scaling is absolutely essential to prevent the damage that crystals can cause on the active membrane layers. Barium and strontium sulfate scales are particularly difficult to remove as they are insoluble in almost all cleaning solutions, so special care should be taken to prevent their formation.

Calcium Phosphate Scale: This scale is particularly common in municipal waste waters and polluted water supplies which may contain high levels of phosphate. This scale can generally be removed with acidic pH cleaners. Calcium phosphate scaling potential is currently modelled in our IMSD software. As a rule of thumb, contact Hydranautics technical department if phosphate levels in the feed are 5 ppm or higher.

Metal Oxide/Hydroxide Foulants: Typical metal oxide and metal hydroxide foulants are iron, zinc, manganese, copper, aluminum, etc. They can be the result of corrosion products from unlined pipes and tanks, or result from the oxidation of the soluble metal ion with air, chlorine, ozone, potassium permanganate, or they can be the result of a pretreatment filter system upset that utilizes iron or aluminum-based coagulant aids.

Polymerized Silica Coating: A silica gel coating resulting from the super-saturation and polymerization of soluble silica can be very difficult to remove. It should be noted that this type of silica fouling is different from silica-based colloidal foulants, which may be associated with either metal hydroxides or organic matter. Silica scale can be very difficult to remove by traditional chemical cleaning methods. Contact Hydranautics technical department if the traditional methods are unsuccessful. There does exist harsher cleaning chemicals, like ammonium biflouride, that have been used successfully at some sites but are considered rather hazardous to handle and can damage equipment.

Colloidal Foulants: Colloids are inorganic or mixed inorganic/organic based particles that are suspended in water and will not settle out due to gravity. Colloidal matter typically contains one or more of the following major components: iron, aluminum, silica, sulfur, or organic matter.

Dissolved NOM Organic Foulants: The sources of dissolved NOM (Natural Organic Matter) foulants are typically derived from the decomposition of vegetative material into surface waters or shallow wells. The chemistry of organic foulants is very complex, with the major organic components being either humic acid or fulvic acid. Dissolved NOMs can quickly foul RO membranes by being absorbed onto the membrane surface. Once absorption has occurred, then a slower fouling process of gel or cake formation starts. It should be noted that the mechanism of fouling with dissolved NOM should not be confused with the mechanism of fouling created by NOM organic material that is bound up with colloidal particles.

Microbiological Deposits: Organic-based deposits resulting from bacterial slimes, fungi, molds, etc. can be difficult to remove, particularly if the feed path is plugged. Plugging of the feed path makes it difficult to introduce and distribute the cleaning solutions. To inhibit additional growth, it is important to clean and sanitize not only the RO system, but also the pretreatment, piping, dead-legs, etc. The membranes, once chemically cleaned, will require the use of a Hydranautics approved biocide and an extended exposure requirement to be effective. For further information on biocides, refer to Hydranautics Technical Service Bulletin TSB-110 "Biocides for Disinfection and Storage of Hydranautics Membrane Elements".

Selection and Use of Cleaning Chemicals

There are a number of factors involved in the selection of a suitable cleaning chemical (or chemicals) and proper cleaning protocol. The first time you have to perform a cleaning, it is recommended to contact the manufacturer of the equipment, the RO element manufacturer, or a RO specialty chemical and service supplier. Once the suspected foulant(s) are identified, one or more cleaning chemicals will be recommended. These cleaning chemical(s) can be generic or can be private-labeled proprietary chemicals. Typically, the generic chemicals can be of technical grades and are available from local chemical supply companies. The proprietary RO cleaning chemicals can be more expensive, but may be easier to use and you cannot rule out the advantage of the intellectual knowledge supplied by these companies. Some independent RO service companies can determine the proper chemicals and cleaning protocol for your situation by testing at their facility a fouled element pulled from your system.

It is not unusual to use a number of different cleaning chemicals in a specific sequence to achieve the optimum cleaning. Typically, a high pH cleaning is used first to remove foulants like oil or biological matter, followed by a low pH cleaning to remove foulants like mineral scale or metal oxides/hydroxides fouling. There are times that order of high and low pH cleaning solutions is reversed or one solution only is required to clean the membranes. Some cleaning solutions have detergents added to aid in the removal of heavy biological and organic debris, while others have a chelating agent like EDTA added to aid in the removal of colloidal material, organic and biological material, and sulfate scale. An important thing to remember is that the improper selection of a cleaning chemical, or the sequence of chemical introduction, can make the foulant worse.

Hydranautics recommends that the membrane system operator thoroughly investigate the signs of fouling before they select a cleaning chemical and a cleaning protocol. Some forms of fouling (iron deposits and scaling commonly associated with well waters) may require only a simple low pH cleaning. However, for most complex fouling phenomena, Hydranautics recommends the following sequence:

1. Flushing with permeate with addition of non oxidizing biocide (DBNPA or similar type) at the end of the flushing
2. High pH CIP – Temperature versus pH as per recommendations in this TSB
3. Flushing with permeate until pH on the brine side is below pH 8.5
4. Low pH CIP
5. Acid flushing with permeate and non oxidizing biocide (DBNPA or similar type)

General Precautions in Cleaning Chemical Selection and Usage

- If you are using a proprietary chemical, make sure the chemical has been qualified for use with your Hydranautics membrane by the chemical supplier. The chemical supplier's instructions should not be in conflict with Hydranautics recommended cleaning parameters and limits listed in this Technical Service Bulletin.
- If you are using generic chemicals, make sure the chemical has been qualified for use with your Hydranautics membrane in this Technical Service Bulletin.
- Use the least harshest cleaning regimen to get the job done. This includes the cleaning parameters of pH, temperature, and contact time. This will optimize the useful life of the membrane.
- Clean at the recommended target temperatures to optimize cleaning efficiency and membrane life.
- Use the minimal amount of chemical contact time to optimize membrane life.

- Be prudent in the adjustment of pH at the low and high pH range to extend the useful life of the membrane. A "gentle" pH range is 4 to 10, while the harshest is 2 to 12.
- Oil and biologically -fouled membranes should not use a low pH clean-up first as the oil and biological matter will congeal.
- Cleaning and flushing flows should usually be in the same direction as the normal feed flow to avoid potential telescoping and element damage. In certain cases, where heavy feed end fouling has occurred, reverse flow cleaning may be more effective in removing the foulant. In these cases, please see TSB-125 "Reverse Direction Cleaning of RO Membrane Elements" and follow all recommended guidelines to prevent element damage.
- When cleaning a multi-stage RO, the most effective cleaning is one stage at a time so cleaning flow velocities can be optimized and foulants from upstream stages don't have to pass through down-stream stages.
- Flushing out detergents with higher pH permeate can reduce foaming problems.
- Verify that proper disposal requirements for the cleaning solution are followed.
- If your system has been fouled biologically, you may want to consider the extra step of introducing a sanitizing biocide chemical before and after a successful cleaning. Biocides can be introduced before and immediately after cleaning, periodically (e.g. once a week), or continuously during service. You must be sure that the biocide is compatible with the membrane, does not create any health risks, is effective in controlling biological activity, and is not cost prohibitive.
- For safety reasons, make sure all hoses and piping can handle the temperatures, pressures and pH's encountered during a cleaning.
- For safety reasons, always add chemicals slowly to an agitated batch of make-up water.
- For safety reason, always wear safety glasses and protective gear when working with chemicals.
- For safety reasons, don't mix acids with caustics. Thoroughly rinse the 1st cleaning solution from the RO system before introducing the next solution.

Selecting a Cleaning Solution

Table 2 lists the recommended generic chemical solutions for cleaning an RO membrane element based on the foulant to be removed. See section below on Description of Cleaning Solutions and Table 4 for cleaning solution formulations.

Important: It is recommended that the SDS of the cleaning chemicals be procured from the chemical supplier and that all safety precautions be utilized in the handling and storage of all chemicals.

Table 2: Hydranautics Recommended Chemical Cleaning Solutions

Foulant	Gentle Cleaning Solution	Harsher Cleaning Solution
Calcium carbonate scale	1	4
Calcium, barium or strontium sulfate scale	2	4
Metal oxides/hydroxides (Fe, Mn, Zn, Cu, Al)	1	5
Inorganic colloidal foulants	1	4
Mixed Inorganic/organic colloidal foulants	2	6
Polymerized silica coating	None	7
Biological matter	2 or 3	6
NOM organic matter (naturally occurring)	2 or 3	6

Table 3 "Hydranautics Recipes for Cleaning Solutions" offers instructions on the volumes of bulk chemical to be added to 100 U.S. gallons (379 liters) of make-up water. Prepare the solutions by proportioning the amount of chemicals to the amount of make-up water to be used. Make-up water quality should be of RO permeate or deionized (DI) quality, and be free of chlorine and hardness (See Table 4 below). Before forwarding the cleaning solution to the membranes, it is important to thoroughly mix it, adjust the pH according to the target pH, and stabilize the temperature at the target temperature. Unless otherwise instructed, the cleaning design parameters are based on a chemical recirculation flow period of one hour and an optional chemical soak period of one hour.

Table 5 "Hydranautics Maximum pH and Temperature Limits for Cleaning" highlights the maximum pH and temperature limits for specific membranes, after which irreparable membrane damage can occur. A suggested minimum temperature limit is 70 °F (21 °C), but cleaning effectiveness and the solubility of the cleaning chemical is significantly improved at higher temperatures.

Description of Cleaning Solutions

Note: The notation (w) denotes that the diluted chemical solution strength is based on the actual weight of the 100% pure chemical or active ingredient.

Solution 1: This is a low pH cleaning solution of 2.0% (w) citric acid ($C_6H_8O_7$). It is useful in removing inorganic scale (e.g. calcium carbonate, calcium sulfate, barium sulfate, strontium sulfate) and metal oxides/hydroxides (e.g. iron, manganese, nickel, copper, zinc), and inorganic-based colloidal material. Note: Citric acid is available as a powder.

Solution 2: This is a high pH cleaning solution (target pH of 10.0) of 2.0% (w) of STPP (sodium tripolyphosphate) ($Na_5P_3O_{10}$) and 0.8% (w) of Na-EDTA (sodium salt of ethylaminediaminetetraacetic acid). It is specifically recommended for removing calcium sulfate scale and light to moderate levels of organic foulants of natural origin. STPP functions as an inorganic-based chelating agent and detergent. Na-EDTA is an organic-based chelating cleaning agent that aids in the sequestering and removal of divalent and trivalent cations and metal ions. STPP and Na-EDTA are available as powders.

Solution 3: This is a high pH cleaning solution (target pH of 10.0) of 2.0% % (w) of STPP (sodium tripolyphosphate) ($Na_5P_3O_{10}$) and 0.025% (w) Na-DDBS ($C_6H_5(CH_2)_{12}$-SO_3Na) (sodium salt of dodecylbenzene sulfonate). It is specifically recommended for removing heavier levels of organic foulants of natural origin. STPP functions as an inorganic-based chelating agent and detergent. Na-DDBS functions as an anionic detergent.

Solution 4: This is a low pH cleaning solution (target pH of 2.5) of 0.5% (w) of HCL (hydrochloric) acid. It is useful in removing inorganic scale (e.g. calcium carbonate, calcium sulfate, barium sulfate, strontium sulfate and metal oxides/hydroxides (e.g. iron, manganese, nickel, copper, zinc) and inorganic-based colloidal material. This cleaning solution is considered to be harsher than Solution 1. HCL acid, a strong mineral acid, is also known as muriatic acid. HCL acid is available in a number of concentrations: (18 ^{0} Baume = 27.9%), (20 ^{0} Baume = 31.4%), (22 ^{0} Baume = 36.0%).

Solution 5: This is a lower pH cleaning solution (natural pH is between pH 4 and 6. No pH adjustment is required) 1.0% (w) of $Na_2S_2O_4$ (sodium hydrosulfite). It is useful in the removal of metal oxides and hydroxides (especially iron fouling), and to a lesser extent calcium sulfate, barium sulfate and strontium sulfate. Sodium hydrosulfite is strong reducing agent and is also known as sodium dithionite. The solution will have a very strong odor so proper ventilation is required. Sodium hydrosulfite is available as a powder.

Solution 6: This is a high pH cleaning solution (target pH of 11.5) of 0.1% (w) of NaOH (sodium hydroxide) and 0.03% (w) of SDS (sodium dodecylsulfate). It is useful in the removal of organic foulants of

natural origin, colloidal foulants of mixed organic/inorganic origin, and biological material (fungi, mold, slimes and biofilm). SDS is a detergent that is an anionic surfactant that will cause some foaming. This is considered to be a harsh cleaning regimen. ***Note: Do not exceed maximum pH and temp limits for specific elements. See Table 5.***

Solution 7: This is a high pH cleaning solution (target pH of 11.5) of 0.1% (w) of NaOH (sodium hydroxide). It is useful in the removal of polymerized silica. This is considered to be a harsh cleaning regimen. *Note: Do not exceed maximum pH and temp limits for specific elements. See Table 5.*

Important: It is recommended that the SDS of the cleaning chemicals be procured from the chemical supplier and that all safety precautions be utilized in the handling and storage of all chemicals.

Table 3: Hydranautics Recipes for Cleaning Solutions

The quantities listed below are to be added to 100 U.S.gallons (379 liters) of dilution water. Dilution water should meet the water quality standards in Table 4.

Cleaning Solution	Bulk Ingredients	Quantity	Target [1] pH Adjustment	Target [1] Temp.
1	**Citric acid** (as 100% powder)	17.0 pounds (7.7 kg)	No pH adjustment is Required.	104 °F (40 °C)
2	**STPP** (sodium tripolyphosphate) (as 100% powder) **Na-EDTA** (Versene 220 or equal) (as 100% powder)	17.0 pounds (7.7 kg) 7.0 pounds (3.18 kg)	Adjust to pH 10.0 with sulfuric or hydrochloric acid.	104 °F (40 °C)
3	**STPP** (sodium tripolyphosphate) (as 100% powder) **Na-DDBS** Na-dodecylbenzene sulfonate	17 pounds (7.7 kg) 0.21 pounds (0.1 kg)	Adjust down to pH 10.0 with sulfuric or hydrochloric acid.	104 °F (40 °C)
4	**HCl acid** (hydrochloric acid (as 22^0 Baume or 36% HCL)	0.47 gallons (1.78 liters)	Slowly adjust pH down to 2.5 with HCL acid. Adjust pH up with sodium hydroxide.	95 °F (35 °C)
5	**Sodium hydrosulfite** (as 100% powder)	8.5 pounds (3.86 kg)	No pH adjustment is required.	95 °F (35 °C)
6	**NaOH** (sodium hydroxide) (as 100% powder) (or as 50% liquid) **SDS** (sodium dodecylsulfate)	0.83 pounds (0.38 kg) 0.13 gallons (0.49 liters) 0.25 pounds (0.11 kg)	Slowly adjust pH up to 11.5 with sodium hydroxide. Adjust pH down to 11.5 by adding HCL acid.	86 °F (30 °C)
7	**NaOH** (sodium hydroxide) (as 100% powder) (or as 50% liquid)	0.83 pounds (0.38 kg) 0.13 gallons (0.49 liters)	Slowly adjust pH up to 11.5 with sodium hydroxide. Adjust pH down to 11.5 by adding HCL acid.	86 °F (30 °C)

[1] - *Note: These pH and temperature targets are recommendations only. For maximum pH and temperature limits for specific elements. See Table 5.*

Table 4. Recommendations for Make-up Water Quality for Cleaning and Flushing.

Parameter	Units
Chlorine Free	0 ppm
pH	6.5.-7.5
Hardness	
RO permeate, DI, or Soft water	< 30 ppm as $CaCO_3$
Calcium (Ca)	< 5 ppm
Iron (Fe)	< 0.05 ppm
Manganese (Mn)	< 0.02 ppm
Aluminium (Al)	< 0.05 ppm
Silica (SiO_2)	
Reactive silica	< 10 ppm
Colloidal silica	< 0.1 ppm
Particle Size	< 5 microns
Turbidity	< 0.5 NTU
Silt Density (SDI_{15})	< 1
Total Organic Carbon (TOC)	< 1 ppm
Fats, Oils and Grease	0 ppm

Table 5a: Hydranautics pH and Temperature Limits for Cleaning Standard Membranes

Membrane Family	Continuous Operation		Maximum Cleaning Temp			
	< 45 °C	≤ 35 °C	50 °C	≤ 45 °C	≤ 35 °C	≤ 25 °C
NANO-SW	3 to 8.5	3 to 9	Contact Hydranautics Technical Department	Contact Hyd Tech Dept	1 to 10.5	1 to 11.5
ESNA	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
ESPA	3 to 10	2 to 10.6	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
ESPAB	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 11.5	1 to 12.5
LFC	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
CPA	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11.5	1 to 12	1 to 13
SWC	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 12	1 to 13

Note: The above cleaning parameters denote the maximum temperature limits for a corresponding range of pH. Cleaning operations performed at the extremes may result in a more effective cleaning, but can shorten the useful life of the membrane due to hydrolysis. To optimize the useful life of a membrane, it is recommended to use the least harshest cleaning solutions and minimize the contact time whenever possible. The pH of the feed stream or cleaning solution should be closely monitored and controlled. The pH meters used to measure and control pH should be regularly calibrated to ensure accuracy. It is typical to re-circulate cleaning chemicals through the RO for 1 hour. At the pH limits shown above, cleaning exposure at temperatures less than 40 °C is limited to 60 minutes, at temperatures greater than 40 °C exposure is limited to 30 minutes. Extended soaking is possible, but at less aggressive pH levels.

Table 5b Hydranautics pH and Temperature Limits for Cleaning PRO Series Membranes

Membrane Family	Continuous Operation		Maximum Cleaning Temp			
	< 45 °C	≤ 35 °C	50 °C	≤ 45 °C	≤ 35 °C	≤ 25 °C
PRO-XS	3 to 8.5	3 to 9	Contact Hydranautics Technical Department	Contact Hyd Tech Dept	1 to 10.5	1 to 11.5
PRO-XT1	3 to 9.5	2 to 10	Contact Hydranautics Technical Department	2 to 10.5	1 to 11	1 to 12
PRO-XT2	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 12	1 to 13
PRO-LF	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 12	1 to 13
PRO-XP	3 to 10.5	2 to 11	Contact Hydranautics Technical Department	2 to 11	1 to 12	1 to 13

Note: The above cleaning parameters denote the maximum temperature limits for a corresponding range of pH. Cleaning operations performed at the extremes may result in a more effective cleaning, but can shorten the useful life of the membrane due to hydrolysis. To optimize the useful life of a membrane, it is recommended to use the least harshest cleaning solutions and minimize the contact time whenever possible. The pH of the feed stream or cleaning solution should be closely monitored and controlled. The pH meters used to measure and control pH should be regularly calibrated to ensure accuracy. It is typical to re-circulate cleaning chemicals through the RO for 1 hour. At the pH limits shown above, cleaning exposure at temperatures less than 40 °C is limited to 60 minutes, at temperatures greater than 40 °C exposure is limited to 30 minutes. Extended soaking is possible, but at less aggressive pH levels.

Table 6a: Cleaning Flow Rates per RO Pressure Tube (Non LD Elements = 26 mil spacer)

(Pressures are not to exceed 60 psi (4 bar) at inlet to tubes.)

Element Diameter	GPM	LPM
4-inches – Non LD Elements	9 to 12	34 to 45
6-inches – Non LD Elements	18 to 24	68 to 91
8-inches – Non LD Elements	36 to 48	136 to 182
8.5-inches – Non LD Elements	40 to 52	151 to 197
16-inches – Non LD Elements	144 to 192	545 to 727

Table 6b: Cleaning Flow Rates per RO Pressure Tube (LD Elements = 34 mil spacer)

(Pressures are not to exceed 60 psi (4 bar) at inlet to tubes.)

Element Diameter	GPM	LPM
4-inches – LD Elements	10 to 13	38 to 49
8-inches – LD Elements	40 to 53	151 to 201
8.5-inches – LD Elements	45 to 59	170 to 223

Note: In cases where the pressure drop in the membrane elements is excessively high, the cleaning flow rates should be limited to 1/3 of the normal cleaning flow rate initially. This will help prevent the element from telescoping and the feed spacer from migrating. As the foulant is removed, the cleaning flow can slowly be brought up to normal cleaning flow rates. When flushing system before and after cleaning flow rates should be half of values listed in Table 6.

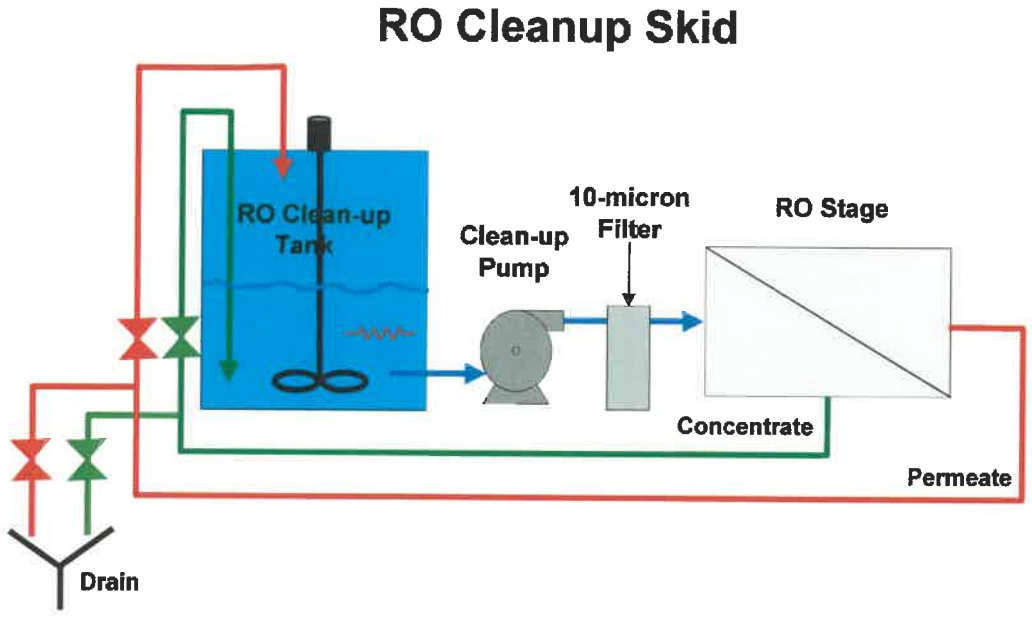
Table 7: Cleaning Solution Volume Requirement per RO Element

Element Size	Volume of Cleaning Solution* (These volumes do not include initial 20% of volume dumped to drain and volumes required for piping, filters, etc)	
(inches)	(US Gallons)	(Liters)
4 x 40	2.5	9.5
6 x 40	5	19
8 x 40	9	34
8.5 x 40	10	38
16 x 40	36	136

(*) These are the minimum values recommended for sizing of the cleaning tank. Actual volume used during cleaning can be higher as more than one cleaning tank volume may be required in case of heavy fouling.

RO Cleaning Skid

The successful cleaning of an RO on-site requires a well designed RO cleaning skid. Normally this skid is not hard piped to the RO skid and uses temporary hosing for connections. It is recommended to clean a multi-stage RO one stage at a time to optimize cross-flow cleaning velocity. The source water for chemical solution make-up and rinsing should be clean RO permeate or DI water and be free of hardness, transition metals (e.g. iron), and chlorine (See Table 4 above). Components must be corrosion proof. Major cleaning system components are:



- RO Cleaning Tank: This tank needs to be sized properly to accommodate the displacement of water in the hose, piping, and RO elements. The **Table 7** above denotes the amount of chemical solution that needs to be made for a single RO element. The tank should be designed to allow 100 % drainage, easy access for chemical introduction and mixing, a recirculation line from the RO Cleaning Pump, proper venting, overflow, and a return line located near the bottom to minimize foam formation when using a surfactant.

- RO Cleaning Pump: This pump needs to be sized to develop the proper cross-flow velocity to scrub the membrane clean. The maximum recommended pressure is 60 psi (4 bar) at the inlet to the pressure vessels to minimize the production of permeate during cleaning and reduce the convective redeposition of foulant back on to the membrane surface. Table 6 above denotes the flow rate ranges for each pressure tube. The high pressure pump shold not be used for cleaning.

- RO Cleaning Cartridge Filter: Normally 5 to 10-micron and is designed to remove foulants that have been displaced from the cleaning process.

- RO Tank Heater or Cooler: The maximum design temperature for cleaning is 113^0 F (45^0 C). It should be noted that heat is generated and imparted by the RO Cleaning Pump during recirculation. A less expensive option to consider for heating the cleaning solution is adding a return line from the discharge of the Clean-Up Pump back to the Cleaning Tank, which is plumbed to the bottom of the tank to reduce foaming and air introduction, but this can take a long time.

- RO Tank Mixer: This is recommended to get optimal mixing of chemical, though some designers rely solely on the slow introduction of chemical while maintaining a recirculation through the RO Cleaning Pump back to the tank.

- Instrumentation: Cleaning system instrumentation should be included to monitor flow, temperature, pressure, and tank level.

- Sample Points: Sample valves should be located to allow pH and TDS measurements off the RO Cleaning Pump discharge and the concentrate side recirculation return line. Permeate can be measured at the RO skid sample valves.

- Permeate Return Line: A small amount of the cleaning solution can permeate through the membranes and so a permeate-side return line back to the RO Cleaning Tank is required. The permeate return line should not be combined with the concentrate return line. If the permeate return line is combined with the concentrate line, there is the possibility that the permeate side of the membrane and the permeate lines may be exposed to contaminated cleaning solution. The permeate return line should terminate at a point above the cleaning solution tank level to avoid exposing the permeate side of the membranes or the permeate lines to the contaminated cleaning solution.

- Concentrate Return Line: The concentrate return line should terminate near the bottom of the cleaning tank to avoid foam formation in the cleaning tank caused by the introduction of air.

  Important: The permeate line and any permeate valves must always be open to atmospheric pressure during the cleaning and flushing steps or damage to RO elements can occur. If the permeate line is closed, the permeate pressure can build up and become higher than the feed-side pressure of the tail elements. This can result in excessive permeate back-pressure which can damage the membrane glue lines in the tail elements. At no time should the elements be exposed to permeate back pressure (where permeate static pressure exceeds feed static pressure) greater than 0.35 bar (5 psig.)

RO Membrane Element Cleaning and Flushing Procedures

The RO membrane elements can be cleaned in place in the pressure tubes by recirculating the cleaning solution across the high-pressure side of the membrane at low pressure and relatively high flow. A cleaning unit is needed to do this. RO cleaning procedures may vary dependent on the situation. The time required to clean a stage can take from 4 to 8 hours. It is recommended to take data for RO performance normalization just before and immediately after the cleaning to evaluate the efficiency of cleaning. It may also be beneficial to start the RO rack after first cleaning step (alkaline or acid) and collect data for normalization to evaluate efficiency of each cleaning step separately.

A general procedure for cleaning the RO membrane elements is as follows:
NOTE: The permeate valves should ALWAYS remain open when cleaning or flushing the elements. If the permeate valve is closed, the pressure on the permeate line will equalize to the feed pressure. This is likely greater than the concentrate pressure, which will result in the permeate pressure being greater than on the feed side of the tail element. This may result in membrane delamination and performance failure.

1. Perform a low pressure flush at 60 psi (4 bar) or less of the pressure tubes by pumping clean water from the cleaning tank (or equivalent source) through the pressure tubes to drain for several minutes to displace any feed/brine solution from RO membranes. Flush water should be clean water of RO permeate or DI quality and be free of hardness, transition metals, and

chlorine. Flushing flow rates should normally be half of the cleaning flow rates listed in Table 6.

2. Mix a fresh batch of the selected cleaning solution in the cleaning tank. The dilution water should be clean water of RO permeate or DI quality and be free of hardness, transition metals, and chlorine. The temperature and pH should be adjusted to their target levels. Check and record also the conductivity, turbidity and Iron concentration of freshly prepared cleaning solution.

3. Circulate the cleaning solution through the pressure tubes for the desired period of time. At the start of circulation, send the displaced water to drain so you don't dilute the cleaning chemical and then divert up to 20% of the most highly fouled cleaning solution to drain before returning the cleaning solution back to the RO Cleaning Tank. For the first 5 minutes, slowly throttle the flow rate to 1/3 of the maximum design flow rate. This is to minimize the potential plugging of the feed path with a large amount of dislodged foulant.. For the second 5 minutes, increase the flow rate to 2/3 of the maximum design flow rate, and then increase the flow rate to the maximum design flow rate. If required, readjust the pH back to the target when it changes more than 0.5 pH units. Temperature of cleaning solution should be controlled and kept at maximum allowed value during the whole cleaning cycle for best cleaning efficiency. After each circulation step, check the conductivity, turbidity and Iron content of cleaning solution. If these will increase significantly compared to the initial startup values, the cleaning solution shall be drained and new solution prepared to continue with cleaning to improve cleaning efficiency.

Note: *Do not exceed maximum pH and temperature limits for specific elements. See Table 5.*

4. A soak and recirculation sequence is sometimes used during cleaning. The soak time can be from 0.5 to 8 hours depending on the manufacturer's and/or chemical supplier's recommendations. Typically, the cleaning consists of 30 minutes circulation followed by a 30 minutes soaking cycle, followed by another 30 minutes of circulation. Caution should be used to maintain the proper temperature and pH during the whole cleaning cycle.Soaking time does increase the chemical exposure time of the membrane.

Note: *Do not exceed maximum pH and temperature limits for specific elements. See Table 5.*

5. Upon completion of the chemical cleaning steps, a low pressure Cleaning Rinse with clean water (RO permeate or DI quality and free of hardness, transition metals, and chlorine) is required to remove all traces of chemical from the Cleaning Skid and the RO Skid. Drain and flush the cleaning tank; then completely refill the Cleaning Tank with clean water for the Cleaning Rinse. Rinse the pressure tubes by pumping all of the rinse water from the Cleaning Tank through the pressure tubes to drain. A second cleaning can be started at this point, if required. Cleaning rinse flows should be half of those used for cleaning as listed in Table 6.

6. Once the RO system is fully rinsed of cleaning chemical with clean water from the Cleaning Tank, a Final Low Pressure Clean-up Flush can be performed using pretreated feed water. The permeate line should remain open to drain. Feed pressure should be less than 60 psi (4 bar). This final flush continues until the flush water flows clean and is free of any foam or residues of cleaning agents. This usually takes 15 to 60 minutes. The operator can sample the flush water going to the drain for detergent removal and lack of foaming by using a clear flask and shaking it. A conductivity meter can be used to test for removal of cleaning chemicals, such that the flush water to drain is within 10-20% of the feed water conductivity. A pH meter can also be used to compare the flush water to drain to the feed pH.

7. Once all the stages of a train are cleaned, and the chemicals flushed out, the RO can be restarted and placed into a Service Rinse. The RO permeate should be diverted to drain until it meets the quality requirements of the process (e.g. conductivity, pH, etc.). It is not unusual for it to take from a few hours to a few days for the RO permeate quality to stabilize, especially after high pH cleanings.

Alternative Cleaning Procedures

Other methods of recovering membrane performance are available and may be considered. Hydranautics does not guarantee the effectiveness of these alternative procedures nor does Hydranautics accept responsibility for any adverse effect such procedures may have on membrane performance. However, Hydranautics is aware of instances where these procedures have proven to be very effective.

1. Electro Magnetic Fields (EMF). Claims have been made that the introduction of a continuous electromagnetic field (EMF) around the RO membranes during operation will reduce the tendency for the membranes to foul and will particularly reduce their tendency toward scaling. (Reference : Ng, H. Y. and Winters, H., *A Novel 16-Inch RO System for Water Reuse and Desalination*. Israel Desalination Society Annual Conference, 19-20 December, 2006.)

2. Direct Osmosis at High Salinities (DO-HS) is a process of daily backwashing of BWRO during normal operation of desalination plant in which about 7% NaCl pulse is intentionally introduced for 6-12 seconds into the suction stream of high pressure pump without stopping the pump. As the high salinity plug proceeds through the RO system, the reverse osmosis flow is momentarily changed to a direct osmosis flow and permeate is sucked back through to the feed side of the membrane. This process, if conducted regularly, may lift foulants, dehydrate bacteria, and sweep out debris by increased flow velocity from the membrane surface to the brine outlet. (Reference: USA Patent 7658852, Pat. Singapore, Australia, Israel WEB: www.membrane-recovery.com.)

3. Proprietary Cleaning Chemicals. There exist several RO cleaning chemical suppliers with a number of proprietary formulations designed to address specific types of fouling. These formulations are typically based on generic chemical formulations that have been enhanced or modified through the suppliers' own research and development. (see web sites for specific chemical companies)

4. Air Scouring. It is known that two-phase (air bubbles and water) can increase shear forces and improve the removal of foulants from a membrane surface. This has been used more in the cleaning of individual elements.

5. Reverse Direction Cleaning. When the fouling is located primarily at the feed end of the RO system, it is sometimes more effective to do reverse direction cleaning. There are certain precautions that must be taken to ensure that damage to the membrane elements does not occur. Please see TSB-125 "Reverse Direction Cleaning of RO Membrane Elements" for the guidelines on this.

6. NaCl light salinity cleaning. As compared to the DO-HS above, NaCl light salinity is usually dosed at 1% weight of total cleaning volume. Dissolve the NaCl into the CIP tank and it can be used in 2 different ways. First, as an NaCl solution by itself to use as a pre-cleaner prior to standard High / Low pH solutions or, Second, as a supplement to High / Low pH solutions. NaCl increases osmotic pressures of solution to suppress the production of permeate while cleaning.