**Invitation to Bid**
**Water Treatment Chemicals**

**Addendum 1**

**February 18, 2026**

**Contract Update:**

The Public Entity Crimes Statement is attached. Per The Invitation to Bid, Section 19.2, Bidders shall submit this in conjunction with the bid.

**Responses to Questions:**

**1. Question:** Question about the Copper Sulfate 50 lb. bag delivery quantities; do you know an estimate of how much will be requested for each delivery? I show we (Thatcher) only did one delivery back in July 2025 of 24,000 lbs. Are you anticipating something similar or more frequent for 2026-2027?

**Response:** The amounts required vary due to various external factors. The Authority expects the amount to increase slightly this year due to the drought, potentially to 30,000 lbs.

**2. Question:** May we please see the current supplier and price for these items listed on the bid?

**Response:** The Notice of Intended Decision and bid tabulations for 2023, 2024 and 2025 are attached to this addendum.

**3. Question:** Could you please confirm the typical order quantity for item #1 copper sulfate and item #2 copper sulfate solution?

**Response:** The amounts required vary due to various external factors. The Authority expects the amount to increase slightly this year due to the drought, potentially to 30,000 lbs.

**4. Question:** Could you please confirm the actual annual usage for item #1 copper sulfate and item #2 copper sulfate solution in 2024 and 2025?

**Response:** Last year the Authority used about 15,000 lbs of Item#1 but expect to use more due to drought conditions this year. There was no usage of Item #2 in 2025 to use more due to drought conditions this year

**5. Question:** If different than that listed on the previous bid tabulation, what is the current price for item #1 copper sulfate and item #2 copper sulfate solution?

**Response:** The price has not changed from the previous bid tabulation.

**6. Question:** Will the Authority use both item #1 copper sulfate and item #2 copper sulfate solution or will they simply choose one or the other for use given the overlapping function of each product?

**Response:** The Authority uses both products if conditions require, most of our usages is Item #1 but if our algae counts get high we use Item #2.

**7. Question:** Please provide instructions on how to submit a product sample, including the address, site person's name, and phone number.

**Response:** Product samples should be no less than ¼ pound and delivered to the 9415 Town Center Parkway, Lakewood Ranch, FL 34202. Samples must arrive prior to the bid opening – March 5, 2026 at 10:00 AM EST.

**8. Question:** Could you please confirm the actual usage of Powdered Activated Carbon (PAC) for the last 12 months?

**Response:** About 2 million lbs.

**9. Question:** Could you confirm the current supplier, product and price for PAC?

**Response:** Supplier: Jacobi Carbons, Inc. Product: AquaSorb CB1-MW. Price: $3,680/ton

**10. Question:** If we were to submit a PAC product for consideration that had a minimum 500 iodine, but has data backing up its effectiveness, would it be considered or immediately thrown out?

**Response:** Only PACs with a minimum iodine number of 800 will be considered.

**11. Question:** Please confirm whether a 200 g sample will be sufficient.

**Response:** Per the Bid Document, Powered Activated Carbon samples may not be less than ¼ pound.

**12. Question:** Regarding the delivery schedule, the bid document states that the bidder must deliver all items within five working days from receipt of a delivery request from the Authority. Could you please confirm whether this implies that delivery may be required within five days of the bid award, should the Authority issue a request at that time?

**Response:** Yes, however pursuant to the Section 3 of the Contract, "Vendor shall deliver the chemicals within 5 business days after the Authority provides Vendor with a purchase order." Purchase orders are issued upon contract execution, but the award of the contract is slated to be considered by the Board on April 1, 2026.

**13. Question:** Please also confirm whether the stated volume requirement of 750 MT applies to one year only, or covers the entire 1+3-year contract period?

**Response:** 750 tons is an estimate of the annual (1 year) quantity of PAC that will be ordered.

**14. Question:** Kindly share last year bid tabulation and last testing result of powdered activated carbon and who was awarded after testing.

**Response:** The bid tabulation for 2025 is attached to this addendum. Powdered activated carbon is not awarded until after testing has occurred and was last bid in 2023, bid tabulation attached.

**15. Question:** Last 2 years average usage (of PAC).

**Response:** The 2 year average usage of PAC is 1.5 million lbs (2024-1.2 million, 2025-2million)

**16. Question:** Can the Affidavit of Compliance have to be signed by an officer of our LLC, or does it have to be signed by a member entity?

**Response:** Per the Invitation to Bid, page 7 -8, "*A bid by a limited liability company must be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature*."

**17. Question:** In an effort to not take any exceptions in our bid submission, can we guarantee that we will register to do business in Florida upon award, or do we have to register prior to our bid being submitted.

**Response:** Per the Invitation to Bid, page 7, "*Bidder must demonstrate that it is authorized to do business in the state of Florida by providing a copy of the bidder's registration with the Florida Department of State, Division of Corporations showing that the status of the business is active."*

**18. Question:** Is it possible to request a 7 calendar day lead time for delivery of Powdered Activated Carbon?

**Response:** No.

**19. Question:** Is the spill response plan & procedure due with the bid submittal or upon award?

**Response:** This would be due upon award, prior to the first delivery.

**20. Question:** Exhibit D "Bid Form Provided by Vendor" is blank – do we need to provide our own unique bid form, or is something missing

**Response:** The bid form is included in the Invitation to Bid, Part B, pages 12-14. All Bidders are required to use this form.

**21. Question:** What is your actual usage for 2025 or average annual usage (for PAC)?

**Response:** About 2 million lbs.

**22. Question:** Are there heavy usage periods (for PAC) during the year or is usage mostly steady year round.

**Response:** The Authority has heavy usage during early spring to late summer, roughly 2-3 tractor trailer loads a week.

**23. Question:** If multiple PAC Products are offered, should a second complete bid package be submitted? Or just the price page?

**Response:** Bidders may include multiple PAC products on the same Bid Form. Please note that all PAC bids must be accompanied with a sample and if a Bidder is submitting multiple PAC product samples, they must include a check or money order for $500 per additional sample payable to Peace River Manasota Regional Water Supply Authority.

# Public Entity Crimes Statement

SWORN STATEMENT PURSUANT TO SECTION 287.133, 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 sworn statement is submitted to the Peace River Manasota Regional Water Supply Authority by

_____
(Print individual's name and title)

for _____
(Print name of entity submitting sworn statement)

whose business address is _____

and (if applicable) its Federal Employer Identification Number (FEIN) is _____
(If the entity has no FEIN, include the Social Security Number of the individual signing this sworn statement:

_____).

2. I understand that a "public entity crime" as defined in Paragraph 287.133(1)(g), Florida Statutes, 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 of the United States, including, but not limited to, any bid or contract for goods or services to be provided to any public entity or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, or material misrepresentation.

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 any 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 an "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means:

a) A predecessor or successor of a person convicted of a public entity crime; OR

b) 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 a "person" as defined in Paragraph 287.133(1)(e), Florida Statutes, means any natural person or 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 for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with a public entity. The term "person" includes those officers, directors, 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. **(Indicate which statement applies.)**

____ Neither the entity submitting this sworn statement, nor any of its officers, directors, 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 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 subsequent to July 1, 1989. However, there has been a subsequent proceeding before a Hearing Officer of the State of Florida, Division of Administrative Hearings and the Final Order entered by the Hearing Officer 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 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 THIS FORM IS VALID THROUGH DECEMBER 31 OF THE CALENDAR YEAR IN WHICH IT IS FILED. I ALSO UNDERSTAND I AM REQUIRED TO INFORM THE PUBLIC ENTITY PRIOR TO ENTERING INTO A CONTRACT IN EXCESS OF THE THRESHOLD AMOUNT PROVIDED IN SECTION 287.017, FLORIDA STATUTES, FOR CATEGORY TWO OF ANY CHANGE IN THE INFORMATION CONTAINED IN THIS FORM.

_____
(Signature)

STATE OF _____

COUNTY OF _____

The foregoing instrument was acknowledged before me by means of ☐ physical presence or ☐ online

notarization, this _____ by _____ of _____

_____organized under the laws of the State of Florida, on behalf

of the company, who is personally known to me or has produced _____

as identification.

_____
NOTARY PUBLIC-STATE OF FLORIDA

Name typed, printed, or stamped: _____

My commission expires: _____

**NOTICE OF INTENDED DECISION FOR AWARD OF PURCHASE CONTRACT - PEACE RIVER MANASOTA REGIONAL WATER SUPPLY AUTHORITY WATER TREATMENT CHEMICALS**

**Recommended Action -** **Accept bids and award Contracts for Purchase of Water Treatment Chemicals to the recommended lowest, responsible, and responsive bidders.**

Water treatment chemicals were bid in accordance with the Authority's Procurement Policy. Bids were received and opened on March 6, 2023.

Staff recommends the Authority Board of Directors award purchase contracts to the lowest, responsible, and responsive bidders as listed below at the Authority Board meeting on April 5, 2023. Bid tabulation is attached.

| Bid Item | Chemical | Recommended Bidder | New Cost |
|---|---|---|---|
| No. 1 | 12% Sodium Hypochlorite | Allied Universal Corp. | $1.43/lb. |
| No. 2 | Sodium Hydroxide 50% Solution | Univar Solutions | $885/dry ton |
| No. 3 | Copper Sulfate | Brenntag Mid-South | $2.028/lb. |
| No. 4 | Copper Sulfate Solution | TMB Water | $10.75/gallon |
| No. 5 | Powered Activated Carbon (PAC) | Jacobi Carbons, Inc. | $3,680/ton |

**Failure to file a protest within the time prescribed in section 120.57(3), Florida Statutes, or failure to post the bond or other security required by law within the time allowed for filing a bond shall constitute a waiver of proceeding under chapter 120, Florida Statutes.**

**Posted: March 17, 2023**

**Peace River Manasota Regional Water Supply Authority**
**Water Treatment Chemicals 2023**
**Bid Opening: March 6, 2023 @ 2:00 pm**
**9415 Town Center Parkway, Lakewood Ranch, FL 34202**

| **Company Name** | **Item No. 1** 12% Sodium Hypochlorite ($/gal) **Total Bid Amount:** | **Item No. 2** 50% Sodium Hydroxide Solution ($/dry ton) **Total Bid Amount:** | **Item No. 3** Copper Sulfate ($/lb.) **Total Bid Amount:** | **Item No. 4** Copper Sulfate Solution ($/gal) **Total Bid Amount:** | **Item No. 5** Powdered Activated Carbon ($/ton) **Total Bid Amount:** |
|---|---|---|---|---|---|
| USALCO, LLC - NO BID | | | | | |
| Allied Universal Corporation | 1.43 | 1,163.98 | | | |
| Jacobi Carbons | | | | | 3,680.00 |
| TMB Water | | | 2.25 | 10.25 | |
| Thatcher Chemicals of Florida | | | 2.25 | | |
| Carbon Activated Corporation | | | | | 2,580.00 |
| Donau Carbon US | | | | | 1,980.00 |
| Odyssey Manufacturing | 1.69 | 1,300.00 | | | |
| Univar Solutions | | 885.00 | | | |
| Earth Science Labs | | | | 12.75 | |
| CarbPure Technologies | | | | | 2,660.00 T<br>4800.00 TRA |
| Brenntag Mid-South | | 894.00 | 2.028 | 14.99 | |
| Chemical Systems of Orlando | | | 2.347 | | |
| Calgon Carbon Corporation | | | | | 2,880.00 |

**Bids Opened By:** Rachel Kersten, Agency clerk
**Name & Title**

Rachel Kersten
**Signature**

**Witnessed By:** Richard Anderson, Director of operations
**Name & Title**

**Signature**

**Peace River Facility Chemical Bids**
**Carbon Testing Performance Factors**
**March 2023**

| Carbon Name | SAMPLE CODE *(see note a)* | PAC Dose *(see note b)* (mg/l) | Bid cost per ton ($) | Performance Factor *(see note c)* | Effective Cost ($) | Rank *(see note d)* | Sieve Test (%<400) | MSDS Minimum Iodine | Iodine Lab Test |
|---|---|---|---|---|---|---|---|---|---|
| Carbon Activated Corp. | A | 47.05 | $2,580 | 1.73 | $4,455 | 2 | 90 (325) | 800 | |
| Jacobi | B | 27.25 | $3,680 | 1.00 | $3,680 | 1 | 99 (325) | 950 | 956 |
| Carb Pure T RA | C | 41.95 | $4,800 | 1.54 | $7,389 | 6 | 100 (325) | 800 | 906 |
| Donau Carbon Water Carb 800 | D | 69.9 | $1,980 | 2.57 | $5,079 | 4 | 90 (325) | 800 | |
| Calgon WPH1000 | E | 48 | $2,880 | 1.76 | $5,073 | 3 | 97 (325) | 1000 | 1180 |
| Carb Pure T | F | 65.6 | $2,660 | 2.41 | $6,404 | 5 | 93 (325) | 800 | 1114 |
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**Notes**

**a)** Samples were sent as blind samples to the lab, only the Authority was aware of their true identities.

**b)** Samples analyzed by Engineering Performance Solutions, Inc. of Jacksonville, Florida in a matrix of raw Peace River water spiked with synthetic organic taste and odor compounds. Dose indicated was the dose required to reduce the taste and odor compounds to target levels in an established timeframe.

**c)** Performance factor is established to be 1.0 for the lowest dose that achieved the desired performance metric. This is the baseline dose for comparison and becomes the denominator in the quotient that then defines every other sample identified as: Performance Factor X = (Dose X)/(Baseline Dose)

**d)** *Indicates - Failed to achieve 70% removal at 70 mg\L dose rate.

**NOTICE OF INTENDED DECISION FOR AWARD OF PURCHASE CONTRACT - PEACE RIVER MANASOTA REGIONAL WATER SUPPLY AUTHORITY WATER TREATMENT CHEMICALS**

**Recommended Action -** **Accept bids and award Contracts for Purchase of Water Treatment Chemicals to the recommended lowest, responsible, and responsive bidders.**

Water treatment chemicals were bid in accordance with the Authority's Procurement Policy. Bids were received and opened on March 12, 2024.

Staff recommends the Authority Board of Directors award purchase contracts to the lowest, responsible, and responsive bidders as listed below at the Authority Board meeting on April 3, 2024. Bid tabulation is attached.

| Bid Item | Chemical | Recommended Bidder | New Cost |
|---|---|---|---|
| No. 1 | 12% Sodium Hypochlorite | Allied Universal Corp. | $1.56/lb. |
| No. 2 | Copper Sulfate | Thatcher Chemical | $2.01/lb. |

**Failure to file a protest within the time prescribed in section 120.57(3), Florida Statutes, or failure to post the bond or other security required by law within the time allowed for filing a bond shall constitute a waiver of proceeding under chapter 120, Florida Statutes.**

**Posted: March 18, 2024**

**Peace River Manasota Regional Water Supply Authority**
**Water Treatment Chemicals 2024**
**Bid Opening: March 12, 2024 @ 10:00 am**
**9415 Town Center Parkway, Lakewood Ranch, FL 34202**

| **Company Name** | **Time Opened** | **Item No. 1** 12% Sodium Hypochlorite ($/gal) **Total Bid Amount:** | **Item No. 2** Copper Sulfate ($/lb.) **Total Bid Amount:** |
|---|---|---|---|
| Univar | 10:00 AM | no bid | no bid |
| Allied Universal | 10:01 AM | $1.56/gal | no bid |
| Thatcher | 10:02 AM | no bid | $2.01 /lb |
| Chemical Systems | 10:03 AM | no bid | $2.011/lb |
| Brenntag Mid-South | 10:04 AM | $1.69/ gal | $2.72/lb |
| Odyssey Mfg. Company | 10:05 AM | $1.65/gal | no bid |
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**Bids Opened By:** Ann Lee, Finance & Budget Sr. Manager
**Name & Title**

**Signature**

**Witnessed By:** Cheryl Grantham, Senior Accountant
**Name & Title**

**Signature**

**NOTICE OF INTENDED DECISION FOR AWARD OF PURCHASE CONTRACT - PEACE RIVER MANASOTA REGIONAL WATER SUPPLY AUTHORITY WATER TREATMENT CHEMICALS**

**Recommended Action -** **Accept bids and award Contracts for Purchase of Water Treatment Chemicals to the recommended lowest, responsible, and responsive bidders.**

Water Treatment chemicals were bid in accordance with the Authority's Procurement Policy. Bids were received and opened on March 11, 2025.

Staff recommend the Authority Board of Directors award purchase contracts to the lowest, responsible, and responsive bidders as listed below at the Authority Board meeting on April 2, 2025. Bid tabulation is attached.

| Bid Item | Chemical | Recommended Bidder | Unit Cost |
|---|---|---|---|
| No. 1 | Aluminum Sulfate | Thatcher Chemical of Florida | $318.87/dry ton |
| No. 2 | 19% Aqua Ammonia | Tanner Industries | $0.9743/gallon |
| No. 3 | Coagulant Aid (Water Treatment) | KED Group | $1.87/lb |
| No. 4 | Coagulant Aid (Sludge Dewatering) | CedarChem a Solenis Company | $1.47/lb |
| No. 5 | 12% Sodium Hypochlorite | Allied Universal | $1.64/gallon |

**Failure to file a protest within the time prescribed in section 120.573, Florida Statutes, or failure to post the bond or other security required by law within the time allowed for filing a bond shall constitute a waiver of proceeding under chapter 120, Florida Statutes.**

**Posted: March 14, 2025**

**Peace River Manasota Regional Water Supply Authority**
**Water Treatment Chemicals 2025**
**Bid Opening: March 11, 2025 @ 10:00 am**
**9415 Town Center Parkway, Lakewood Ranch, FL 34202**

| **Company Name** | **Time Opened** | **Item No. 1** Aluminum Sulfate ($/dry ton) **Total Bid Amount:** | **Item No. 2** 19% Aqua Ammonia ($/gallon) **Total Bid Amount:** | **Item No. 3** CoAg Aid:Water Treatment ($/lb) **Total Bid Amount:** | **Item No. 4** CoAg Aid- Sludge Dewater ($/solution lb.) **Total Bid Amount:** | **Item No. 5** 12% Sodium Hypochlorite ($/gal) **Total Bid Amount:** |
|---|---|---|---|---|---|---|
| Pencco | 10:00 AM | no bid | no bid | no bid | no bid | no bid |
| Brenntag Mid-South | 10:00 AM | no bid | no bid | no bid | no bid | no bid |
| Allied Universal | 10:01 AM | no bid | no bid | no bid | no bid | $1.64/gallon |
| Tanner Industries | 10:03 AM | no bid | $.9743/ gallon | no bid | no bid | no bid |
| Odyssey Manufacturing | 10:04 AM | no bid | no bid | no bid | no bid | $1.82/gallon |
| Thatcher Chemical of Florida | 10:05 AM | $318.87/dry ton | no bid | no bid | no bid | no bid |
| Univar | 10:06 AM | no bid | no bid | no bid | no bid | no bid |
| C & S Chemicals | 10:06 AM | $363.98/dry ton | no bid | no bid | no bid | no bid |
| Chemtrade Chemicals | 10:07 AM | $495/dry ton | no bid | no bid | no bid | no bid |
| KED | 10:08 AM | no bid | no bid | $1.87/lb | $1.66/lb | no bid |
| CedarChem a Solenis Company | 10:15 AM | no bid | no bid | $2.13/lb | $1.47/lb | no bid |
| | | | | | | |

**Bids Opened By:** Ann Lee, Finance & Budget Sr. Manager
**Name & Title**

**Signature**

**Witnessed By:** Katie Gilmore, Director of Operations
**Name & Title**

**Signature**

| supplier | polymer tested | polymer pump speed | sludge flow rate | price/lb | Performance Factor | Effective Cost per/lb | NOTES |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| CEDARCHEM LLC. Solenis | Praestol Products K 122 L-NA Flocculant | 10% | 60% | 1.47 | 1.00 | | Consistent Floc & solids with the floc getting slightly larger at the highest flow rate but not to a detriment of operation. No caking of the belts. Press ran satisfactorily. |
| | | 17% | 80% | | | 1.47 | |
| | | 21% | 100% | | | | |
| | | | | | | | |
| KED | EK 44 PWG | 12% | 60% | 1.66 | 1.24 | | Consistent Floc & solids, no caking of the belts. Press ran satisfactorily. |
| | | 20% | 80% | | | 2.05 | |
| | | 28% | 100% | | | | |
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# POWDERED ACTIVATED CARBON PERFORMANCE FACTORS FOR THE PEACE RIVER REGIONAL WATER SUPPLY FACILITY

**As commisioned by:**
Peace River/Manasota Regional Water Supply Authority

**Prepared by:**
Engineering Performance Solutions, LLC
3161 St. Johns Bluff Rd. Suite 3
Jacksonville, FL 32246
Phone: 904-645-7775

**Report #: 19.749.0323**

**03.16.2023**

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## SCOPE

Engineering Performance Solutions (EPS) specializes in assisting water utilities with the selection of their treatment chemicals in addition to conducting routine water quality monitoring. One particular specialty lies in the analyses of taste- and odor-causing compounds and in this case specifically, 2-methylisoborneol (MIB) and geosmin. Activated carbon (i.e., PAC and GAC) is commonly used among water treatment facilities to remove these displeasing compounds. Although, PAC and GAC are often purchased based on indices such as iodine number, phenol value, molasses number, and tannin value, these properties however have not correlated well with performance. Therefore, this necessitates that activated carbons be selected based on testing versus specifications. These results are received through performance based testing, which is developed specifically for each utility.

With agreement between the Peace River Manasota Regional Water Supply Authority (Authority) and EPS, a proposal was authorized by the Authority on 03/06/23 to perform the following:

**Evaluation of Carbons and Design of Performance Factors** - The scope of the project, as defined by the Authority, was to analyze 6 PACs provided by the Authority under simulated full-scale conditions at the Peace River Water Treatment Plant. The PAC profiling work was to include both MIB and geosmin 4-point dose removal curves and resulting performance factors

## BACKGROUND

The occurrence of tastes and odors in drinking water is a serious problem for water utilities in the United States and throughout the world. According to a taste and odor survey by the American Water Works Association, of 377 water utilities questioned, 43% reported both taste and odor episodes exceeding one week and 16% had serious odor problems that occurred seasonally (Suffet et al., 1996). These offensive tastes and odors in potable water may arise in the raw water supply, during the treatment process (i.e., chlorination), or from microbial growth in the distribution system. The focus of this work was on compounds that manifest tastes and odors in raw water supplies; specifically 1,2,7,7-tetramethyl-bicyclo-heptan-2-ol (2-methylisoborneol or MIB) and trans-1,10-dimethyl-trans-9-decalol (geosmin), which impart an earthy/musty odor (Herzing et al., 1977; Lalezary et al., 1986b; Pendleton et al., 1997).

Many water utilities rely on conventional water treatment methods, such as coagulation-sedimentation and rapid sand filtration, to contend with tastes and odors. However, conventional treatment and other common treatment technologies, such as air stripping and oxidation, are ineffective for removing MIB and geosmin (Lalezary et al., 1984; Lalezary et al., 1986a). Chlorine oxidation was shown to be unsuccessful in removing MIB and geosmin by Lalezary et al. (1986b). In addition, chlorine can temporarily mask the musty/earthy odors, and, in some cases, enhance

them and subsequently manifest them back in the distribution system when the chlorine residual dissipates.

Many researchers have studied methods besides conventional treatment for the removal of tastes and odors. A common method found for successfully removing these tastes and odors to acceptable concentrations is the application of activated carbon (Herzing et al., 1977; Lalezary et al., 1986a; Vik et al., 1988; Chen et al., 1997; Pendleton et al., 1997; Gillogly et al., 1998). Carbon is very effective for removing these compounds due to its high specific surface area (500 – 1800 $m^2/g$), large adsorption capacity, high degree of surface reactivity, and porosity.

The Peace River facility currently utilizes PAC to combat taste and odors and seeks to enhance their dosage requirements by using the PAC performance based testing conducted by EPS. This surface water treatment facility receives water from the nearby Peace River, which is fed by upstream lakes (i.e., Lake Hancock and several water bodies from the Polk County area). The Authority currently has two manmade unlined off stream reservoirs (approximately 30 - 35 ft. deep) which allows for settling of the Peace River water prior to delivery into the Authority's treatment system.

## METHOD

Dosing regimen of the powdered activated carbon, plant flow, chemical additions and other specifications were originally collected during a prior site visit to the Peace River Facility, as well as phone conversations and email correspondence from last year's project. Updated information for this year's project was collected via phone conversations and mail between EPS personnel and the Authority's System Operations Manager Mr. Richard Anderson.

In conducting these experiments, raw water from Reservoir 2 was collected from the effluent flume in an attempt to provide a more representative raw water sample. This sample was later chilled and shipped to EPS via overnight delivery. The water was received the next morning (03.09.2023), and was refrigerated at 4 °C. Just prior to conducting the analyses the raw water was returned to room temperature. Geosmin and MIB standards from the chemical supplier Supelco (Bellefonte, PA: part numbers 47522-U and 47523-U) were used to achieve the MIB and geosmin concentrations of interest within the raw water.

The resulting design for the project was as follows:

1. Due to the lack of historical MIB and geosmin occurrence data of the Authority's raw water source, an estimate had to be made of the concentrations that could potentially be experienced. Authority representatives thought it best to evaluate concentrations based on historical data seen at the nearby Manatee County Water Treatment Facility. It was communicated by the Authority for this report to mimic the higher

concentrations as seen by Manatee County (60 ng/L of MIB and 30 ng/L of geosmin). Both MIB and geosmin were dosed collectively for each jar test for two reasons: (1) to simulate competition between the compounds and (2) to mimic full-scale interactions where the two typically coexist in the environment. The initial concentrations of these compounds will not impact the dose removal curve of the PAC studies, as the generation of these curves is independent of starting concentration (Gillogly et al, 1998).

2. The occasional caustic soda addition prior to PAC addition had no significant discernable impact on percent removal of MIB and geosmin by PAC in previous studies; therefore it was not included in this study.

3. The jar tests were run with a contact time of 20 minutes. The procedure for the jar tests is part of the AWWA PAC Standard (AWWA B600).

In each scenario for the Peace River facility, PAC doses of 10, 30, 50, and 70 mg/L along with a blank (i.e., no PAC added), were used to generate dose removal curves for MIB and geosmin. All samples were measured in duplicate via Solid Phase Microextraction (SPME)/Gas Chromatography/Mass Spectrometer (GC/MS) using method 6040 D of the Standard Methods for the Examination of Water and Wastewater 22$^{nd}$ Edition. The averaged detailed results used to generate the dose removal curves contained herein can be found in the attached quality assurance/quality control (QA/QC) report in Appendix A. For graphing purposes all results below the Minimum Reporting Limit (MRL) of 1.0 ng/L was reported at 0.99 ng/L

## RESULTS

Figures 1 and 2 shown below represent the graphical results of the 6 PACs (labeled A to F) for percent removal of geosmin and MIB, respectively (Appendix B contains these very same figures only detailed and enlarged).

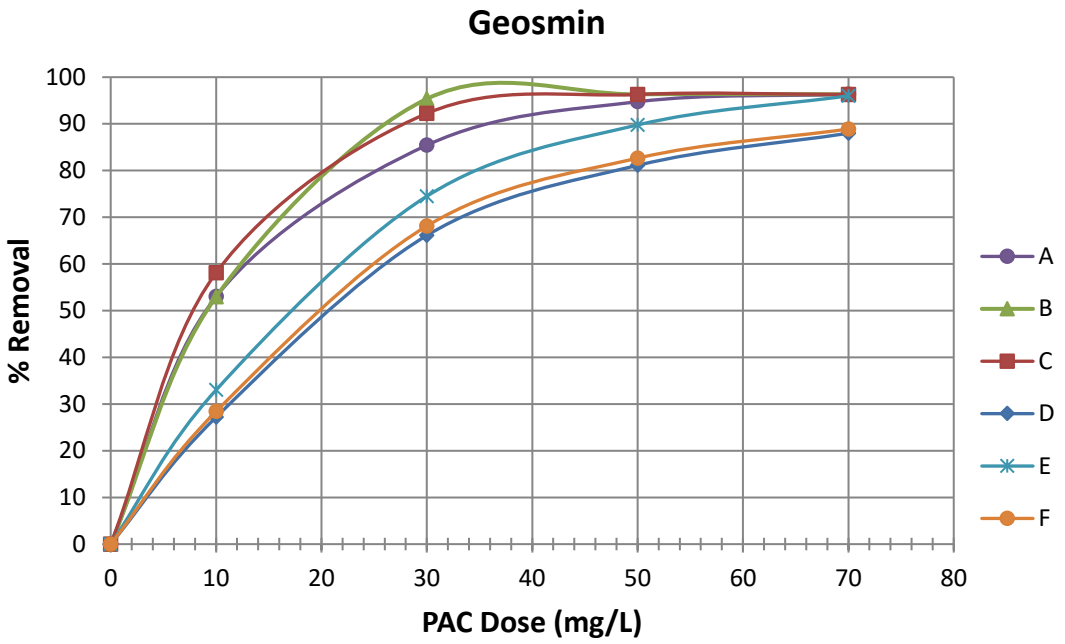


**Figure 1. Peace River/Manasota Regional Water Supply Facility Geosmin Dose Removal Curve**

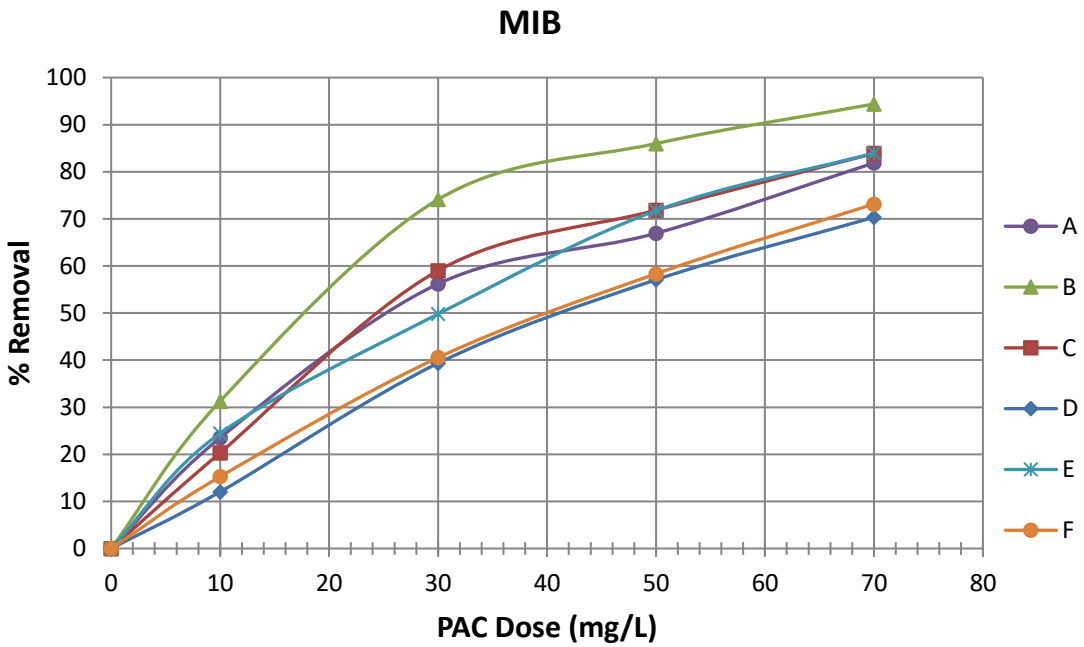


**Figure 2. Peace River/Manasota Regional Water Supply Facility MIB Dose Removal Curve**

## DISCUSSION

Figure 1 depicts geosmin dose removal curves for 6 PACs provided by the Authority. For the same PAC dose, the spread of performance for the 6 PACs were very diverse. All of the carbons reached 70% removal at doses less than 35 mg/L. This high success rate is not uncommon since geosmin is typically more easily removed from conventional water treatment practices versus its counterpart, MIB.

Figure 2 represents MIB dose removal curves with the same 6 PACs provided by the Authority. In this case, the curves were just as diverse as in Figure 1, and the PAC dose required to remove MIB is clearly higher. In the case of geosmin, all of the carbons achieved 70% removal at carbon doses below 32 mg/L, whereas with MIB, all of the carbons were able to remove 70% at doses below 70 mg/L.

The performance factor ranking utilized the following scenario and is discussed further in the Conclusions:

1. MIB was chosen as the primary factor over geosmin due to its persistence in the effluent versus its counterpart.

2. 70% removal of MIB was sufficient to capture the majority of the MIB with typical PAC dosages.

## CONCLUSIONS

Six PACs were compared for their ability to remove MIB and geosmin (spiked to approximately 60 ng/L and 30 ng/L respectively) from Reservoir 2 raw water collected on 03.08.23. PAC doses were chosen with a contact time of 20 minutes based on previous studies (Report # 19.1.0603.Final-Amended). Dose removal curves were generated for MIB and geosmin with the Authority's raw water. With this data, performance factors were then generated to compare the PACs. These performance factors could then be used to determine a weighted PAC cost that incorporates performance and cost of the carbon.

The calculation for the performance factors are as follows:

1. The performance factor for each PAC was determined by using 70% MIB removal as the target. For instance, if the Facility required the influent concentration of 30 ng/L to be reduced to 9 ng/L which is below the OTC (Odor Threshold Concentration), this would require 70% removal.

2. Based on the figure attached in the report, construct a horizontal line across the figure at 70% removal until it intersects each PAC (Figure 3 provides an approximation of the method). At the intersection construct a vertical line down to the x-axis. Each vertical line will provide the PAC dose required to remove 70% of the MIB. EPS increased the precision of this method by

adjusting the x-axis values in Microsoft Excel and the results are shown in Table 1 below.

3. Divide the dose for each PAC that achieves the target removal (i.e., 70%) by the smallest dose of the PAC that achieves the target removal. This determines the relative performance factors. For example,

    - B = 27.25 / 27.25 = 1.00
    - C = 41.95 / 27.25 = 1.54

4. Finally, by multiplying the performance factor by the cost submitted by each carbon vendor, the best PAC based on performance and cost can be chosen.

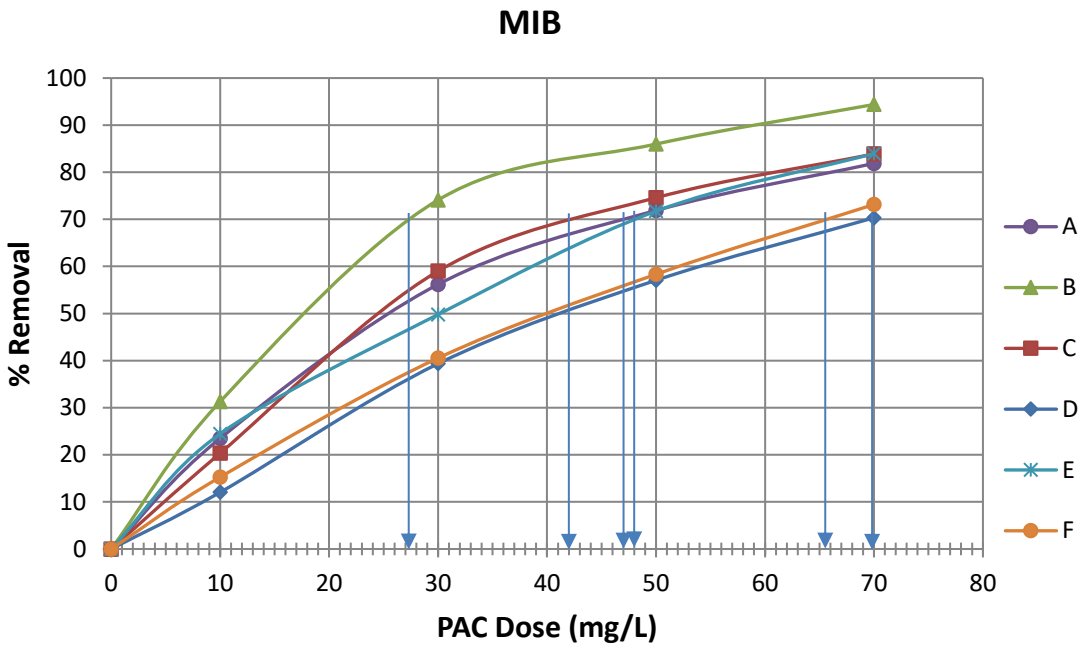


**Figure 3. Example of Performance Factor Calculation at 70% MIB Removal for Peace River**

**Table 1. Performance Factors Required to Meet 70% MIB Removal**

| PAC | PAC Dose (mg/L) | Performance Factor |
|---|---|---|
| A | 47.05 | 1.73 |
| B | 27.25 | 1.00 |
| C | 41.95 | 1.54 |
| D | 69.90 | 2.57 |
| E | 48.00 | 1.76 |
| F | 65.60 | 2.41 |

*Note that changes in raw water quality (e.g., seasonal changes) or activated carbon quality could influence the results presented. Finally, the trends and performance depicted here are specific to the Peace River Facility only.*

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## APPENDIX A QA/QC REPORT

| A | MIB | | | | | Geosmin | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 64.81 | 62.56 | 63.7 | 2.5 | 0 | 27.06 | 26.87 | 27.0 | 0.5 | 0 |
| 10 | 47.11 | 50.34 | 48.7 | 4.7 | 23.5 | 12.19 | 13.16 | 12.7 | 5.4 | 53.0 |
| 30 | 27.09 | 28.71 | 27.9 | 4.1 | 56.2 | 3.95 | 3.91 | 3.9 | 0.7 | 85.4 |
| 50 | 20.71 | 21.41 | 21.1 | 2.4 | 66.9 | 1.40 | 1.44 | 1.4 | 2.0 | 94.7 |
| 70 | 11.50 | 11.59 | 11.5 | 0.5 | 81.9 | 0.99 | 0.99 | 1.0 | 0.0 | 96.3 |
| **B** | **MIB** | | | | | **Geosmin** | | | | |
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 64.81 | 62.56 | 63.7 | 2.5 | 0 | 27.06 | 26.87 | 27.0 | 0.5 | 0 |
| 10 | 46.45 | 41.08 | 43.8 | 8.7 | 31.3 | 12.25 | 13.12 | 12.7 | 4.8 | 53.0 |
| 30 | 15.93 | 17.05 | 16.5 | 4.8 | 74.1 | 1.29 | 1.22 | 1.3 | 3.9 | 95.3 |
| 50 | 8.36 | 9.49 | 8.9 | 9.0 | 86.0 | 0.99 | 0.99 | 1.0 | 0.0 | 96.3 |
| 70 | 3.39 | 3.77 | 3.6 | 7.5 | 94.4 | 0.99 | 0.99 | 1.0 | 0.0 | 96.3 |
| **C** | **MIB** | | | | | **Geosmin** | | | | |
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 64.81 | 62.56 | 63.7 | 2.5 | 0 | 27.06 | 26.87 | 27.0 | 0.5 | 0 |
| 10 | 52.47 | 49.00 | 50.7 | 4.8 | 20.3 | 11.24 | 11.36 | 11.3 | 0.8 | 58.1 |
| 30 | 26.63 | 25.59 | 26.1 | 2.8 | 59.0 | 2.01 | 2.18 | 2.1 | 5.7 | 92.2 |
| 50 | 18.61 | 17.26 | 17.9 | 5.4 | 71.8 | 0.99 | 0.99 | 1.0 | 0.0 | 96.3 |
| 70 | 10.56 | 9.96 | 10.3 | 4.1 | 83.9 | 0.99 | 0.99 | 1.0 | 0.0 | 96.3 |
| **D** | **MIB** | | | | | **Geosmin** | | | | |
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 61.35 | 64.36 | 62.9 | 3.4 | 0 | 24.78 | 25.26 | 25.0 | 1.4 | 0 |
| 10 | 56.46 | 54.11 | 55.3 | 3.0 | 12.0 | 18.94 | 17.50 | 18.2 | 5.6 | 27.2 |
| 30 | 37.30 | 38.94 | 38.1 | 3.1 | 39.4 | 8.04 | 8.92 | 8.5 | 7.3 | 66.1 |
| 50 | 25.80 | 28.18 | 27.0 | 6.2 | 57.1 | 4.99 | 4.46 | 4.7 | 7.9 | 81.1 |
| 70 | 18.48 | 18.83 | 18.7 | 1.3 | 70.3 | 2.97 | 3.04 | 3.0 | 1.6 | 88.0 |
| **E** | **MIB** | | | | | **Geosmin** | | | | |
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 61.35 | 64.36 | 62.9 | 3.4 | 0 | 24.78 | 25.26 | 25.0 | 1.4 | 0 |
| 10 | 46.53 | 48.44 | 47.5 | 2.8 | 24.5 | 16.31 | 17.22 | 16.8 | 3.8 | 33.0 |
| 30 | 30.96 | 32.15 | 31.6 | 2.7 | 49.8 | 6.27 | 6.49 | 6.4 | 2.4 | 74.5 |
| 50 | 17.75 | 17.79 | 17.8 | 0.2 | 71.7 | 2.54 | 2.58 | 2.6 | 1.1 | 89.8 |
| 70 | 10.64 | 9.51 | 10.1 | 7.9 | 84.0 | 0.99 | 0.99 | 1.0 | 0.0 | 96.0 |
| **F** | **MIB** | | | | | **Geosmin** | | | | |
| Concentration (mg/L) | Amount 1 | Amount 2 | Average (ng/L) | % RSD | MIB % Removal | Amount 1 | Amount 2 | Average (ng/L) | % RSD | Geosmin % Removal |
| 0 | 61.35 | 64.36 | 62.9 | 3.4 | 0 | 24.78 | 25.26 | 25.0 | 1.4 | 0 |
| 10 | 51.42 | 55.10 | 53.3 | 4.9 | 15.3 | 17.26 | 18.57 | 17.9 | 5.2 | 28.4 |
| 30 | 37.24 | 37.50 | 37.4 | 0.5 | 40.5 | 8.07 | 7.88 | 8.0 | 1.7 | 68.1 |
| 50 | 25.11 | 27.27 | 26.2 | 5.8 | 58.3 | 4.20 | 4.48 | 4.3 | 4.6 | 82.7 |
| 70 | 16.63 | 17.13 | 16.9 | 2.1 | 73.1 | 2.79 | 2.77 | 2.8 | 0.5 | 88.9 |

## References

| Analyte | Method Reporting Limit | Target | Found | % Recovery | Control Limit |
|---|---|---|---|---|---|
| **MIB (ng/L)** | 1.0 ng/L | 5.00 | 5.17 | 103 | 80-120% |
| **Geosmin (ng/L)** | 1.0 ng/L | 5.00 | 4.86 | 97 | 80-120% |

| Analyte | Method Reporting Limit | Target | Found | % Recovery | Control Limit |
|---|---|---|---|---|---|
| **MIB (ng/L)** | 1.0 ng/L | 10.00 | 9.70 | 97 | 80-120% |
| **Geosmin (ng/L)** | 1.0 ng/L | 10.00 | 10.54 | 105 | 80-120% |

| Analyte | Method Reporting Limit | Target | Found | % Recovery | Control Limit |
|---|---|---|---|---|---|
| **MIB (ng/L)** | 1.0 ng/L | 25.00 | 26.05 | 104 | 80-120% |
| **Geosmin (ng/L)** | 1.0 ng/L | 25.00 | 25.25 | 101 | 80-120% |

| Analyte | Method Reporting Limit | Target | Found | % Recovery | Control Limit |
|---|---|---|---|---|---|
| **MIB (ng/L)** | 1.0 ng/L | 50.00 | 49.62 | 99 | 80-120% |
| **Geosmin (ng/L)** | 1.0 ng/L | 50.00 | 49.68 | 99 | 80-120% |

## Method Blanks

| Analyte | Method Detection Limit | Blank Concentration |
|---|---|---|
| **MIB (ng/L)** | 1.0 ng/L | <1.0 |
| **Geosmin (ng/L)** | 1.0 ng/L | <1.0 |

<Below the reporting limit

## APPENDIX B

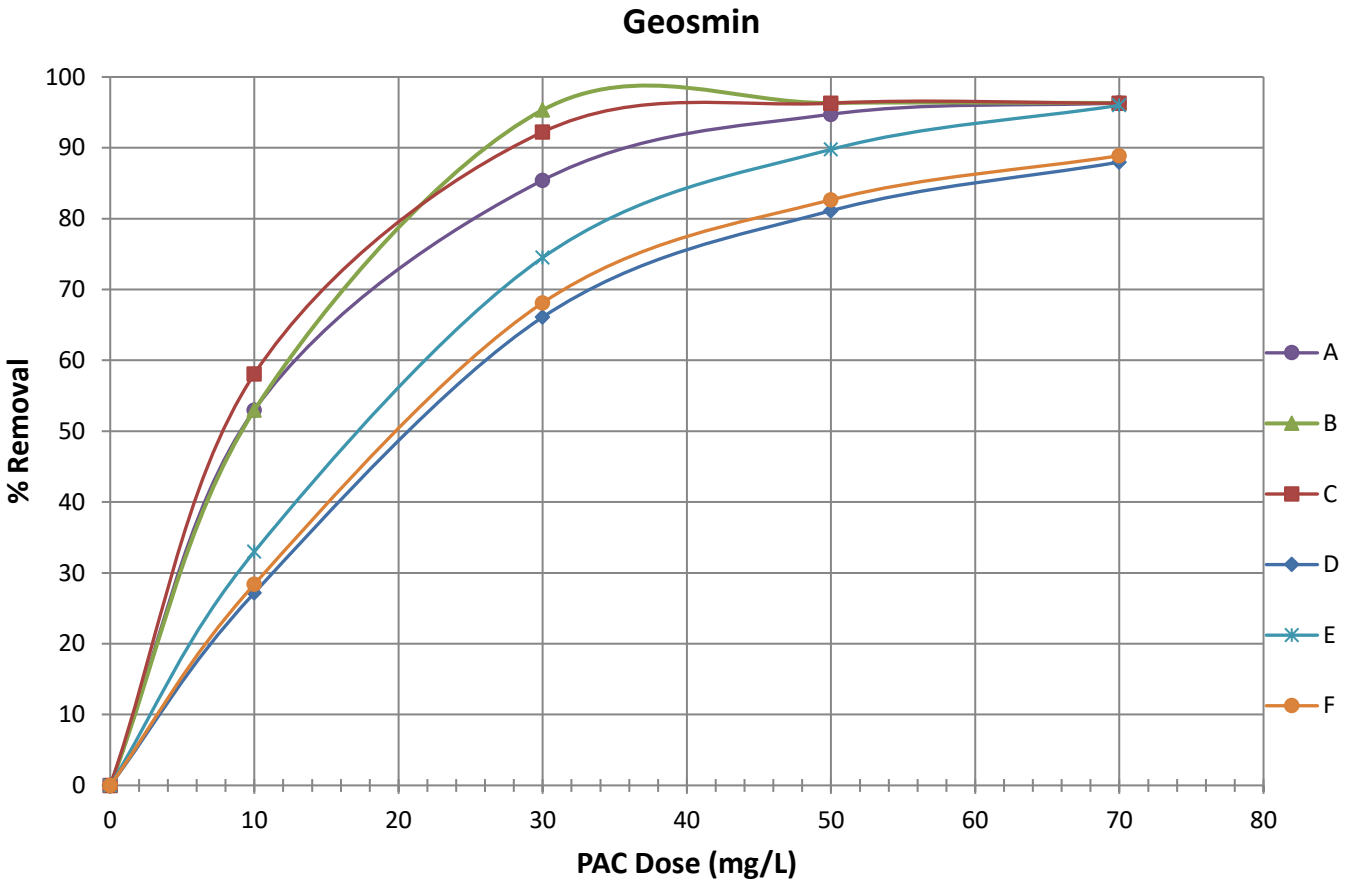


**Figure 1. Peace River/Manasota Regional Water Supply Facility Geosmin Dose Removal Curve**



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**APPENDIX B, continued**

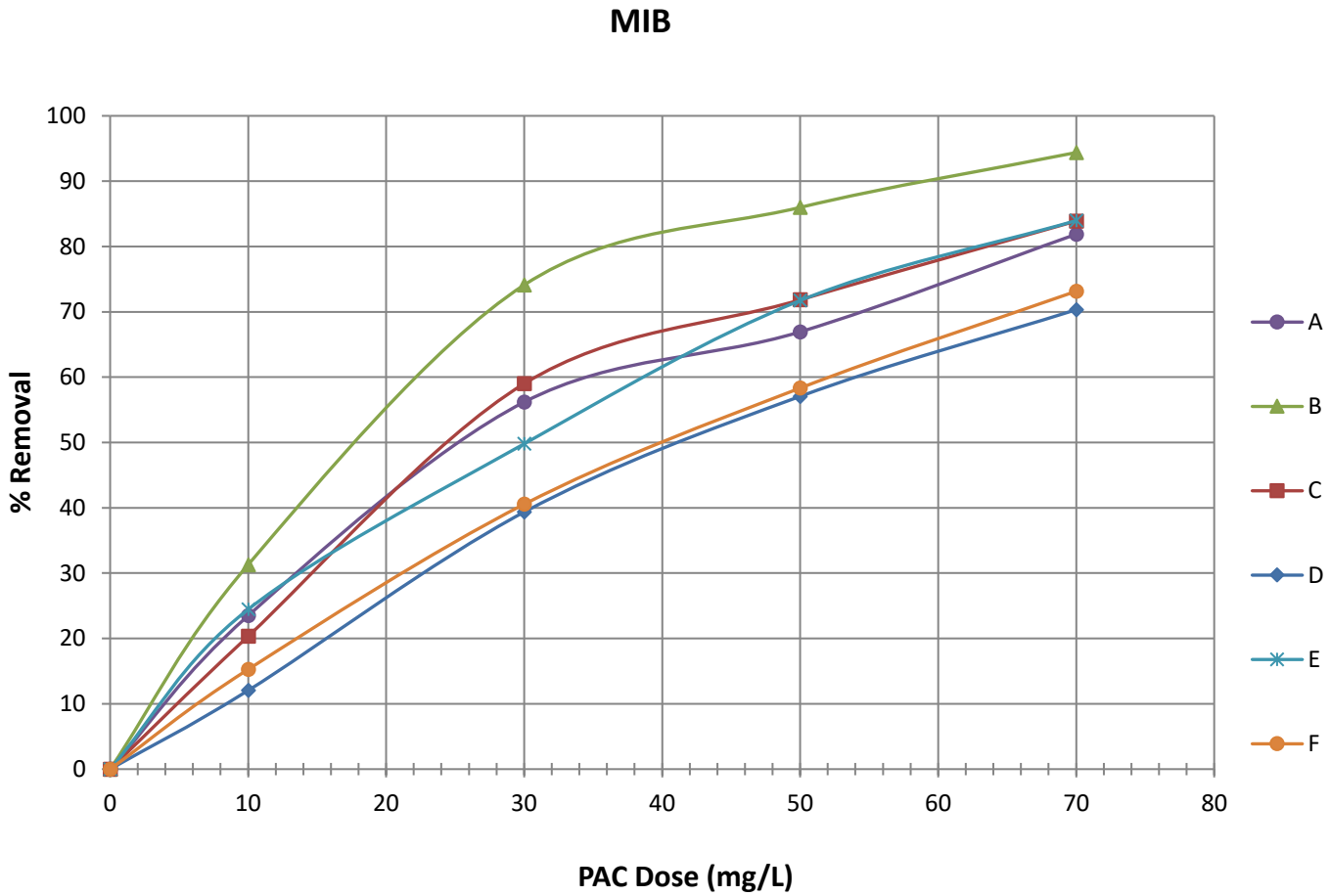


**Figure 2. Peace River/Manasota Regional Water Supply Facility MIB Dose Removal Curve**



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