Goal

Develop recommendations for monitoring pharmaceuticals
High Concern
moderate or high impact

Moderate Concern
low impact

Low Concern
limited impact

Possible Concern
uncertainty as to impact

Bay Levels greater than Observed Effects

Bay Levels greater than Predicted No-Effect Concentration
Less than Observed Effects

Bay Levels less than Predicted No-Effect Concentration

Uncertainty
Insufficient data
Alternative Flame Retardants
- Bisphenols
- Other PFASs (Fluorinated Chemicals)
- Pesticides, Plasticizers, Microplastic Siloxanes, SDPAs, UV-BZTs, and others

None currently

Moderate Concern
- PFOS
- PFOA, Long-Chain Carboxylates
- Fipronil
- Nonylphenol

Low Concern
- PBDEs and HBCD
- Pyrethroids*
- Personal Care & Cleaning
- PBDDs / PBDFs

Pharmaceuticals
- Alternative Flame Retardants
- Bisphenols
- Other PFASs (Fluorinated Chemicals)
- Pesticides, Plasticizers, Microplastic Siloxanes, SDPAs, UV-BZTs, and others

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Moderate Concern
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Wastewater Pathway

- **Sources**
  - Excretion
  - Improper disposal

- Transported via wastewater

- Biologically potent
Pharmaceuticals affect aquatic wildlife

- Anti-depressants change fish behavior
- Antibiotics affect algae growth
- Antibiotic resistance
Pharmaceuticals monitored previously

- 2006: Lower South Bay
- 2008-2009: San Jose
- 2009-2010 Bay-wide
Alternative Flame Retardants
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High Concern
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Field samples collected 2016-2017

- 7 voluntary participants (anonymous)
- Grab and composite samples
  - Influent
  - Secondary and tertiary final effluent
- Analyzed for 104 compounds
- Standard RMP QA/QC review
Data presentation outline

Household

1. Influent

Wastewater Treatment Plant

2. Effluent

3. Bay Surface Water
Influent loads similar between plants

- Concentrations ranges within order of magnitude

<table>
<thead>
<tr>
<th>Facility</th>
<th>Metformin Influent Concentration (ng/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>60,000</td>
</tr>
<tr>
<td>B</td>
<td>120,000</td>
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<tr>
<td>C</td>
<td>180,000</td>
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<tr>
<td>D</td>
<td>180,000</td>
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<td>E</td>
<td>180,000</td>
</tr>
<tr>
<td>F</td>
<td>180,000</td>
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</table>
Top drugs in loads of mg/capita/day

- Metformin (anti-diabetic)
- Caffeine
- Painkillers
  - Acetaminophen
  - Ibuprofen
  - Naproxen
Effluent loads similar between plants

- Conc. ranges mostly within order of magnitude
Top compounds in effluent

• Metformin (anti-diabetic)

• Valsartan (high blood pressure)

• Furosemide and hydrochlorothiazide (Diuretics)

• Sulfamethoxazole (Antibiotic)
Removal efficiencies

- Vary between compounds and plants

![Bar chart showing removal efficiencies of Caffeine and Acetaminophen](chart.png)

- **Caffeine**
  - High (>80%)
  - Concentration (ng/L) in influent: 1,000,000
  - Concentration (ng/L) in effluent: ND

- **Acetaminophen**
  - High (>80%)
  - Concentration (ng/L) in influent: 1,000,000
  - Concentration (ng/L) in effluent: ND
Removal efficiencies

- Vary between compounds and plants

<table>
<thead>
<tr>
<th>Concentration (ng/L)</th>
<th>Caffeine</th>
<th>Acetaminophen</th>
<th>Metoprolol</th>
<th>Carbamazepine</th>
</tr>
</thead>
<tbody>
<tr>
<td>influent</td>
<td>High (&gt;80%)</td>
<td>Low (&lt;50%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>effluent</td>
<td>ND</td>
<td>ND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vary between compounds and plants.
Bay water concentrations

• Effluent will be diluted
• Compare to ecotoxicity thresholds to determine risks
Prioritization criteria

Bay Water Conc. \[\rightarrow\] 1. Previous monitoring studies
2. Predicted based on modeled effluent

\[
\text{Ratio:} \quad \frac{\text{Bay Water Conc.}}{\text{Ecotoxicity Threshold}} > 0.1
\]
Predicted Bay water concentration

- Hydrodynamic model
- Effluent diluted in Bay water
17 Pharmaceuticals prioritized

- **Antibiotics** – azithromycin, ciprofloxacin, clarithromycin, erythromycin, ofloxacin, and sulfamethoxazole
- **Antidepressants** – amitriptyline, fluoxetine, and sertraline
- **Anti-convulsant** – carbamazepine
- **Painkillers** – codeine, ibuprofen, and oxycodone
- **Antihistamine** – diphenhydramine
- **Anti-diabetic** – metformin
- **High blood pressure** – metoprolol and propranolol
Clarithromycin

• Antibiotic (infections – lungs, ear, sinuses, skin)

• Marine PNEC = 0.015 ng/L
  - Marine diatom
  - Freshwater PNEC = 230 ng/L

• 100% detection frequency
  - Effluent 155 ng/L

• Bay water concentration
  - Predicted (2016): 0.6 - 10 ng/L
  - Previous monitoring (2010) <1.5 - 18 ng/L
Pharmaceuticals next steps

• 17 prioritized compounds
• Emerging Contaminants Strategy priority
State-wide drug take-back program

California Signs Drug, Needle Take-back Program into Law

- Signed Sept. 30
- Implementation: 2021

Senator Hanna-Beth Jackson
(SB 212 author)

Governor Jerry Brown
Prevent unnecessary contamination

DON'T RUSH TO FLUSH MEDS in the BIN. We All WIN!

mountainview.gov
Thank You!

Special thank you to
7 wastewater facilities and BACWA

Draft Report in Review
Contact me:
diana@sfei.org

Final Report
End of October