

Reintroduction to Leachate Recirculation

**SOLID WASTE ADMINISTRATOR'S ASSOCIATION
Winter Training 2022 / February 16, 2022**

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Presentation Outline

- ▶ General Introduction
- ▶ Liquid Reintroduction Methods
- ▶ Monitoring Considerations
- ▶ Leachate Recirculation Results
- ▶ Recirculation to Energy

GENERAL INTRODUCTION



Solid Waste Regulations Developed To:

▶ Protect Groundwater Quality

- Clay, synthetic liners
- Leachate collection

▶ Limit Leachate Generation

- Clay, synthetic covers
- Smaller working areas
- Reach intermediate slopes quickly

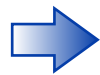
THE "DRY-TOMB" APPROACH

An Alternative...

THE WET LANDFILL APPROACH

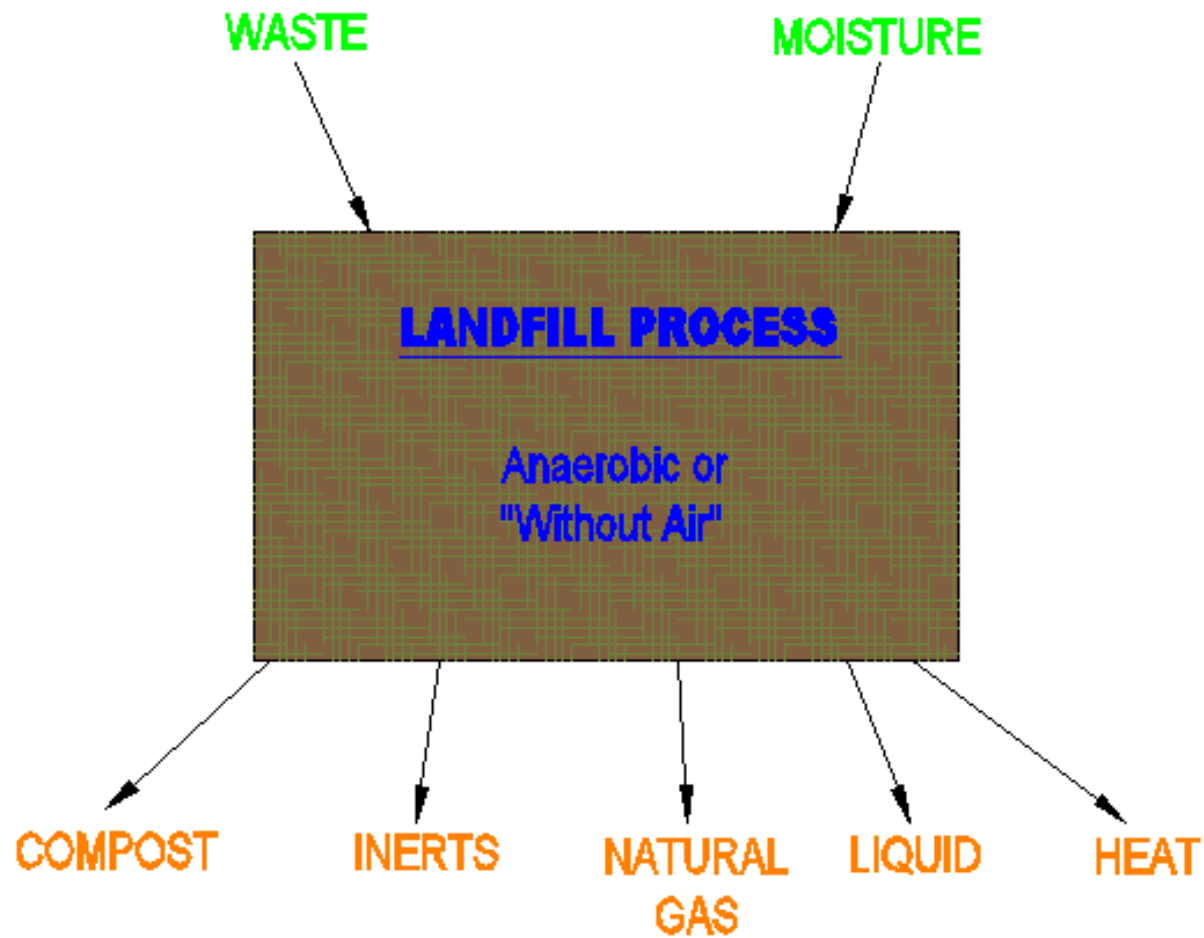
- ▶ Leachate Recirculation – State Approval
 - ▶ Bioreactor – Federal Approval

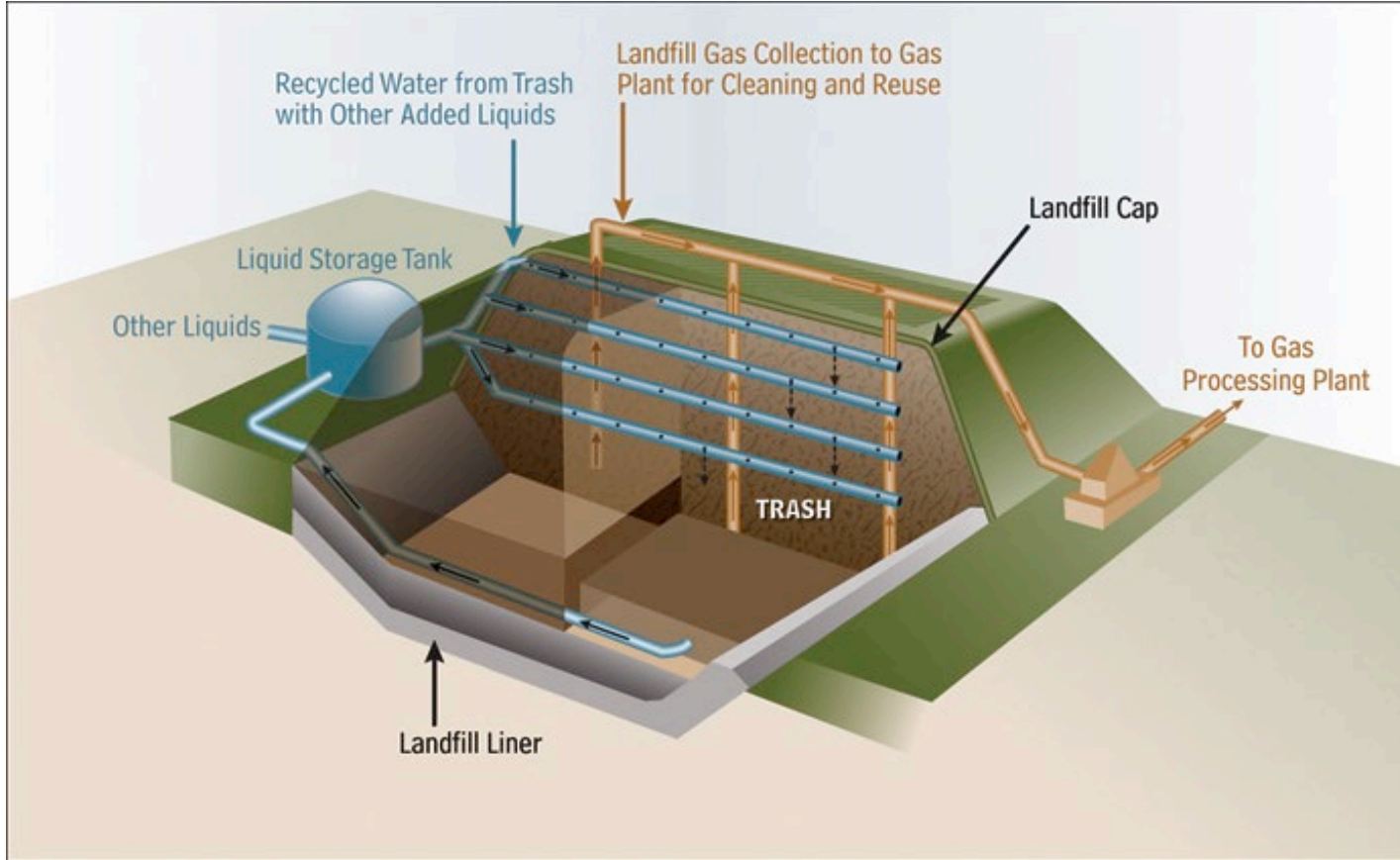
Complete Waste Stabilization by Post-Closure



**POTENTIAL TO REDUCE POST-
CLOSURE FINANCIAL ASSURANCE
OBLIGATION**

What is a Wet Landfill?





Definitions:

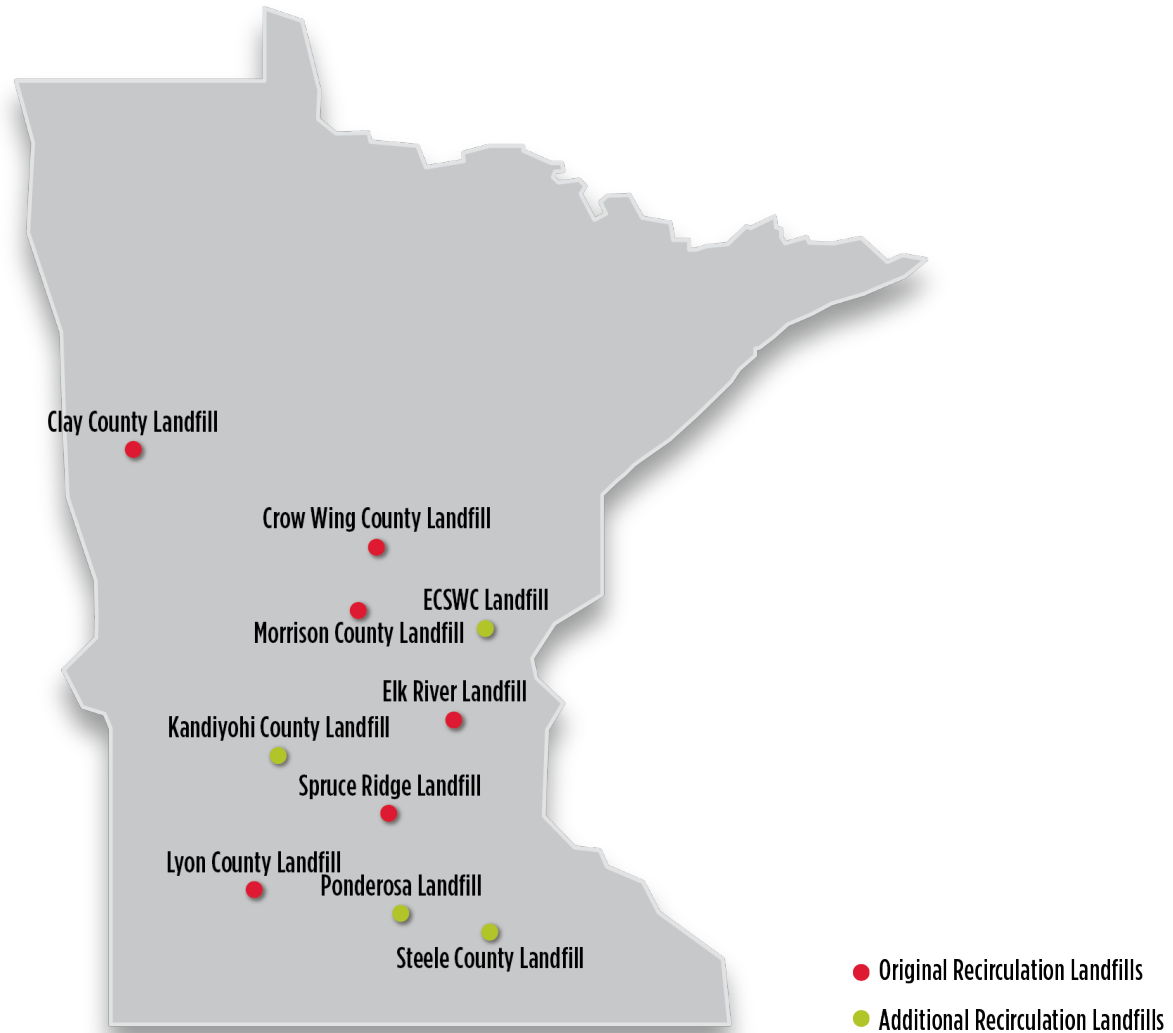
- ▶ **Leachate:** MR 7035.0300 “Leachate” means liquid that has percolated through solid waste and has extracted dissolved or suspended materials from it.
- ▶ **Leachate Recirculation:** Reintroduction of collected leachate and landfill gas condensate into the waste mass.
- ▶ **Bioreactor:** (USEPA) A MSW Landfill where liquids and possibly air are added to enhance the microbial process to degrade and stabilize the waste.

Recirculation Stimulates Microbial Activity in the Waste While Site is Open and Engineering Controls are New

▶ Activity Dependent Upon:

- Moisture
- Oxygen Content
- Temperature
- pH
- Waste Particle Size/Density
- Nutrient Availability

Minnesota Recirculation Landfills



Short-Term Benefits

- ▶ Waste/Leachate Stability
- ▶ Leachate Volume Storage/Reduction
- ▶ Additional Leachate Treatment
- ▶ Enhanced LFG/GHG
- ▶ Accelerated Waste Settlement
 - Airspace Recapture
 - Permit/Construction Savings
- ▶ Leachate Management Savings

Long-Term Benefits

▶ Reduced Post-Closure Cost & Liability

- Leachate Quality
- Leachate Generation
- Landfill Gas Generation
- Settlement

▶ Consider Alternate Cap and Mining

- Reduce Closure Costs
- Airspace/Material Recovery

Concerns

- ▶ Leachate Distribution
- ▶ Decreased LFG Collection Efficiency
- ▶ Leachate Ammonia
- ▶ Seeps
- ▶ Increased LFG Generation
- ▶ Odors
- ▶ Slope Stability

LIQUID REINTRODUCTION METHODS



Method of Liquid Addition

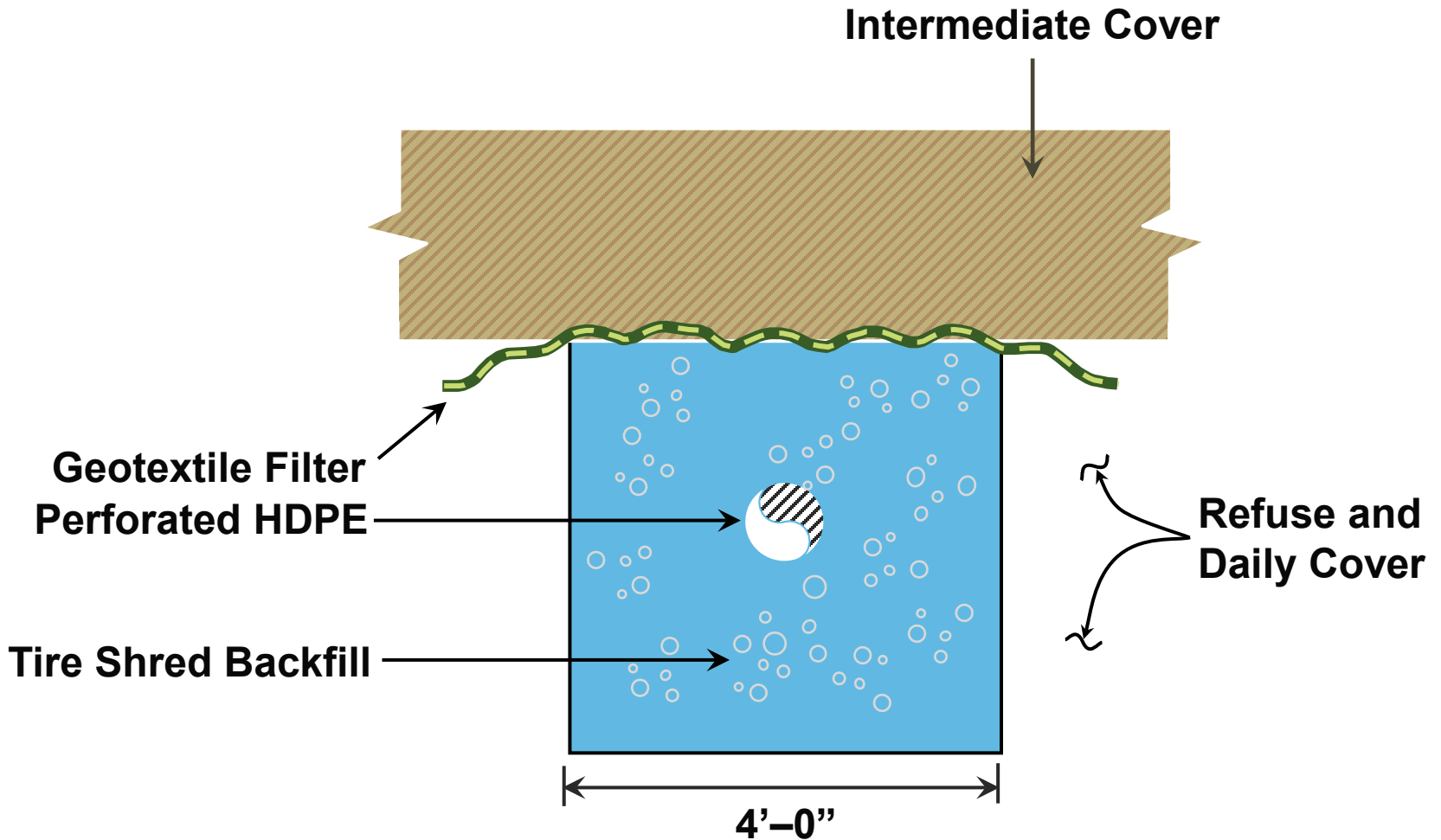
- ▶ Spray Application to Waste at Working Face
- ▶ Spray Application on Intermediate Cover
 - ▶ (i.e. Compost)
- ▶ Infiltration Ponds/Cells
- ▶ Vertical Injection Wells
- ▶ Horizontal Trenches
- ▶ Granular Beds

Spray Application to Working Face





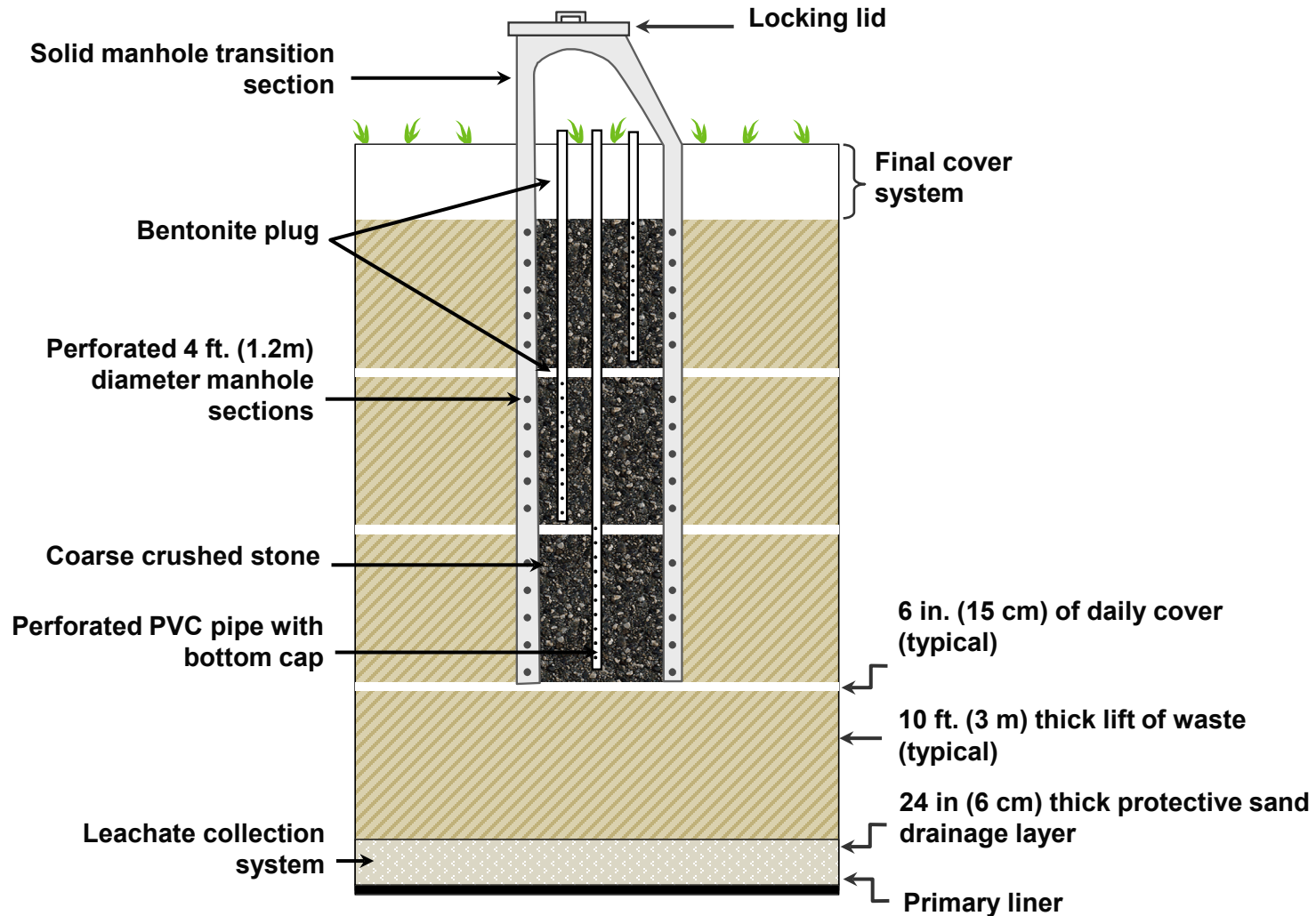
Recirculation Lateral Trench Cross Section



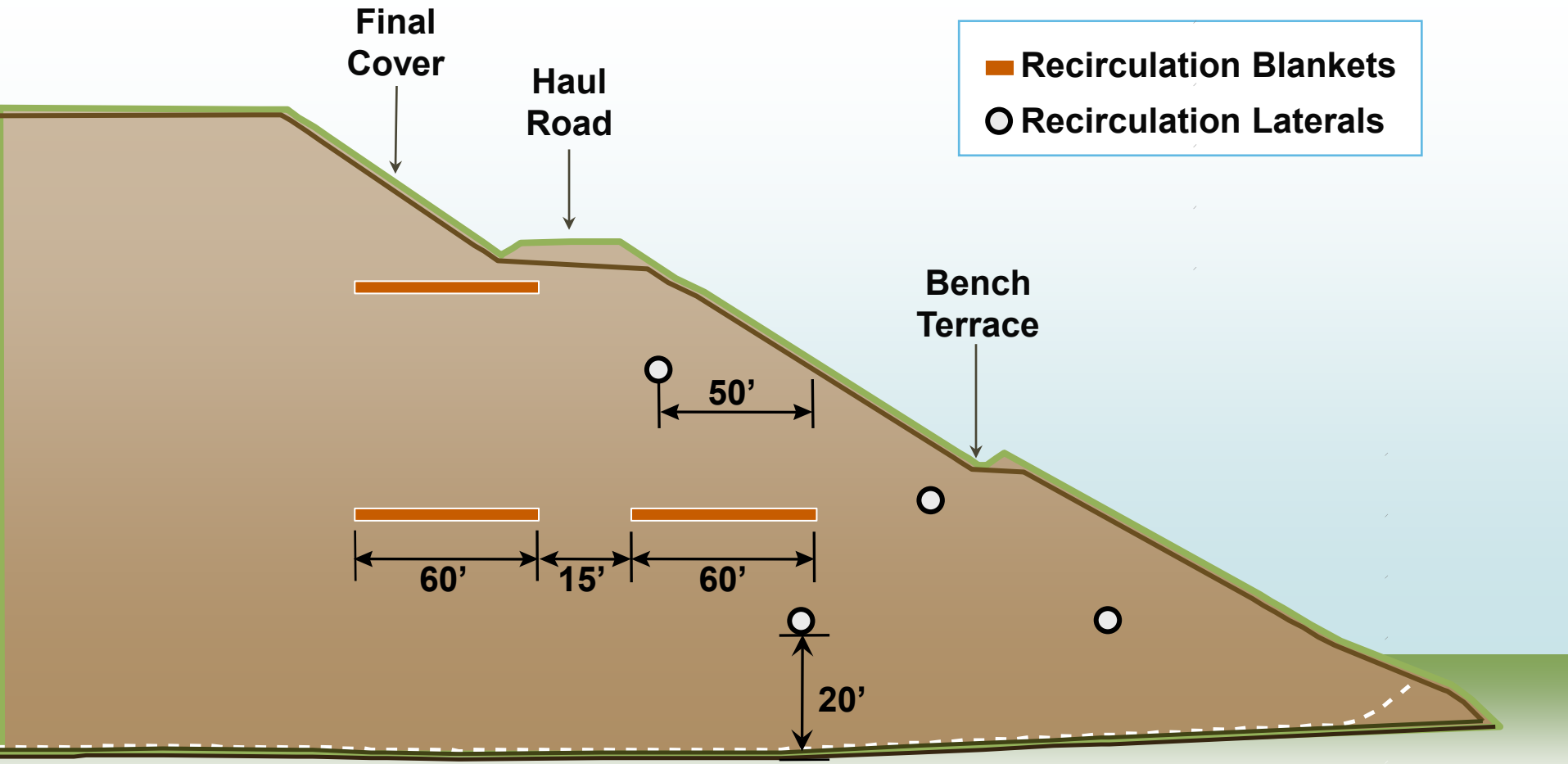




Typical Leachate Recirculation Well



Lateral and Blanket Section



MONITORING CONSIDERATIONS



Monitoring Considerations

- ▶ Inspections
 - Seeps, Ponding
 - Pumps, Floats, Valves
 - Settlement/Stability
- ▶ Contingency Action Planning
- ▶ Leachate Quality
- ▶ Leachate Head
- ▶ Leak Detection
- ▶ LFG

LECHATE RECIRCULATION RESULTS



Crow Wing County Landfill, SW-376

- ▶ Recirculation Volumes
- ▶ Leachate Analysis
- ▶ Leachate Generation
- ▶ AUFs
- ▶ Settlement
- ▶ Moisture Impact on LFG

Leachate Recirculation Summary

Years Recirculating	Volume Recirculated	Tonnage Received	Gallons per Ton
1998 – 2021	74,650,000 gallons	1,068,000	69.9
Annual Ranges	0.4 - 5.7 million gallons	33,000 – 54,000	13.1 – 130.2
Field Capacity			93 - 261

Crow Wing Leachate Analysis

Parameter	1997 Cell 1 & 2	2009 Cell 1 & 2	2021 Cell 1 & 2	2009 Cell 3	2021 Cell 3	MCL	HRL/ HBV
Acetone	560 – 4,300	190 – 1,300	< 100 - 163.2	ND – 600	< 100 - 100.8	NS	3,000
Benzene	11 – 17	ND	< 5 - 7.8	ND	< 5	5	2
Methyl Ethyl Ketone	1,500 – 4,000	ND – 1,300	< 50	ND – 520	< 50 - 66.9	NS	4,000
1,4 Dichlorobenzene	ND – 14	8.8 – 15	< 5	7.7 – 14	5.60 - 8.00	75	50
Ethyl Benzene	96 – 110	6.5 – 10	< 5 - 12.2	17 – 45	7.4 - 18.8	700	40
Ethyl Ether	130 – 270	ND – 19	5.8 - 9.9	ND – 42	8.1 - 12.2	NS	200
Isopropyl benzene	14 – 40	ND	< 5	ND	< 5	NS	NS
Naphthalene	ND – 27	19 – 30	< 10 – 15.9	11 – 27	10.90 – 33.7	NS	70
Toluene	430 – 1,000	5.2 – 21	< 5	ND – 21	< 5 - 16.1	1,000	70
Xylenes	100 – 210	8.2 – 15	< 15 - 19.7	14 – 51	< 16.5 - 35.3	10,000	300

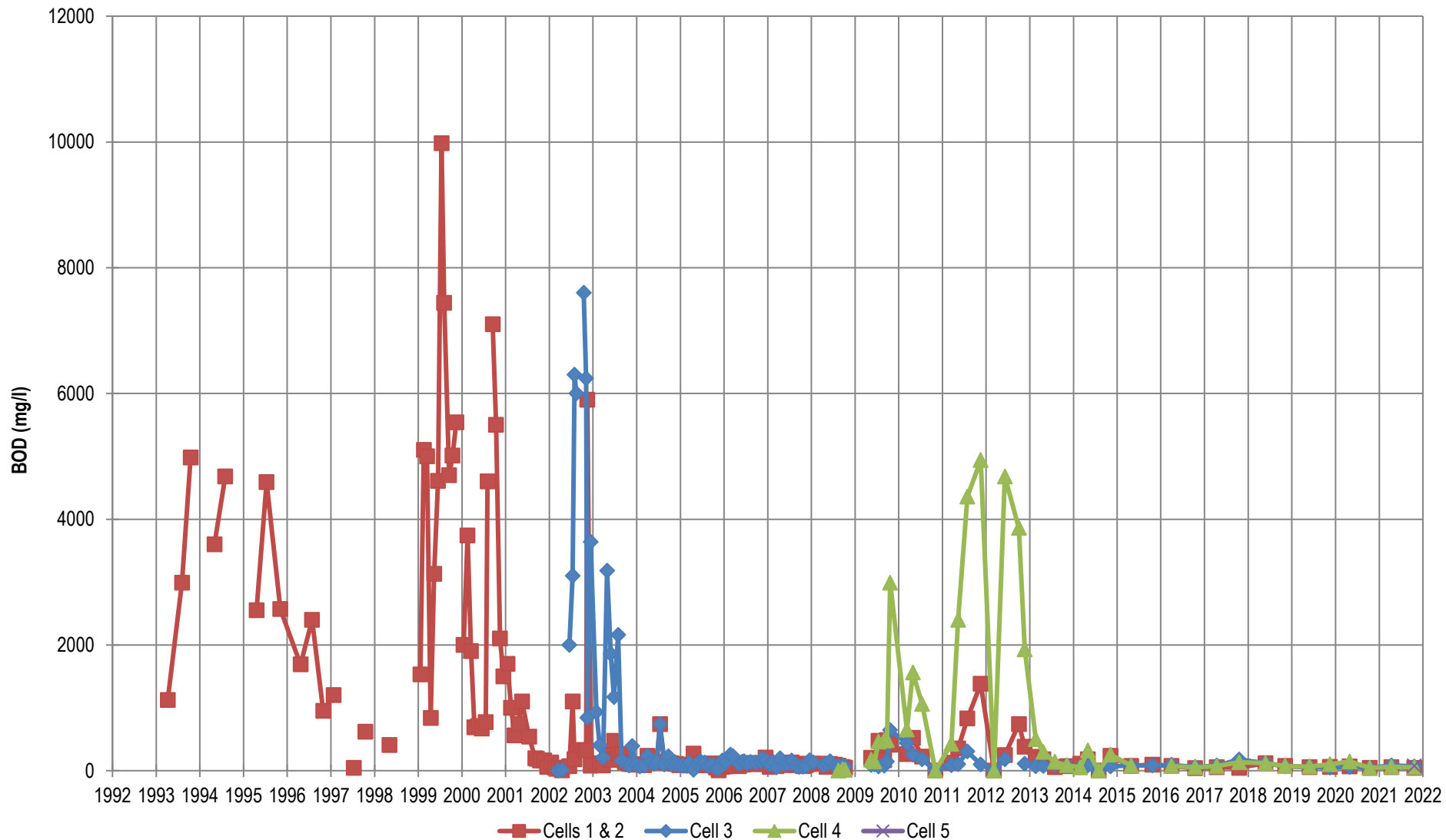
Note: Units ug/l

Crow Wing Leachate Analysis

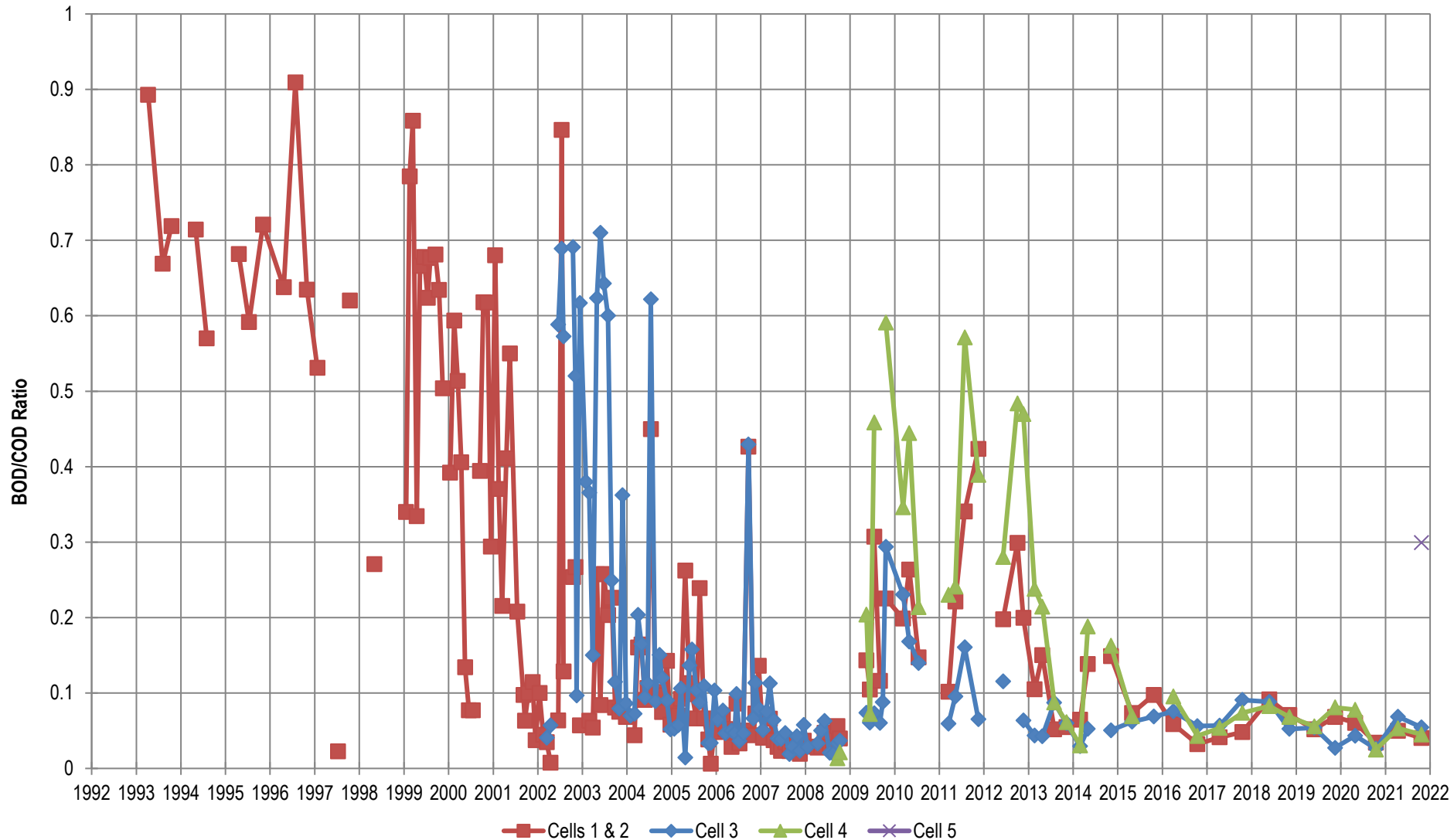
Parameter	1997 Cell 1 & 2	2009 Cell 1 & 2	2021 Cell 1 & 2	2009 Cell 3	2021 Cell 3	MCL	HRL/RAA
Arsenic	11 – 21	79.9 – 110	47.5 – 48.5	50.9 – 113	53.0 – 55.4	10	NS
Barium	490 - 650	245 - 502	213 - 302	240 - 535	282 - 296	2,000	2,000
Cadmium	ND	ND -1.9	< 0.40	2.2 – 2.63	< 0.40	5	0.5
Chromium	ND – 10	38.4 – 63.8	45 – 78.8	64.9 – 84.2	61.4 – 67.5	100	100
Lead	ND	ND	< 0.50 – 1.7	ND – 2.7	< 0.50	15	NS
Mercury	ND	ND	< 0.20	ND	< 0.20	2	NS
Selenium	ND	16.5 – 25.2	< 0.5	15.3 – 25.9	< 2.5 - < 20	50	30
Boron	3,000 – 4,300	6,920 – 18,200	8,570 – 9,910	9,600 – 10,200	9,580 – 10,100	NS	500
Nickel	110 – 200	149 – 284	158 – 201	195 – 210	168 – 176	NS	100

Note: Units ug/l

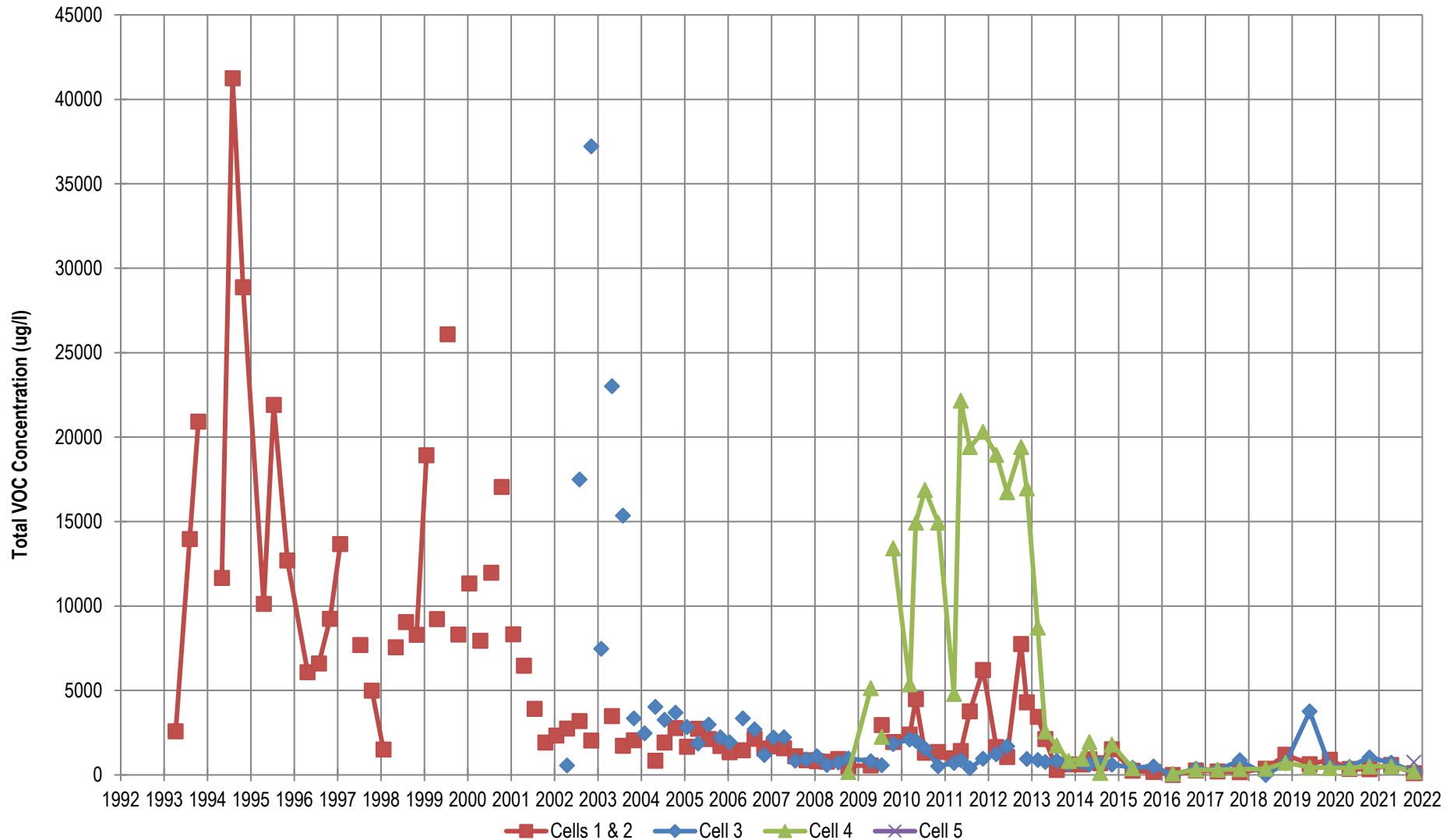
Untreated Leachate BOD Concentration



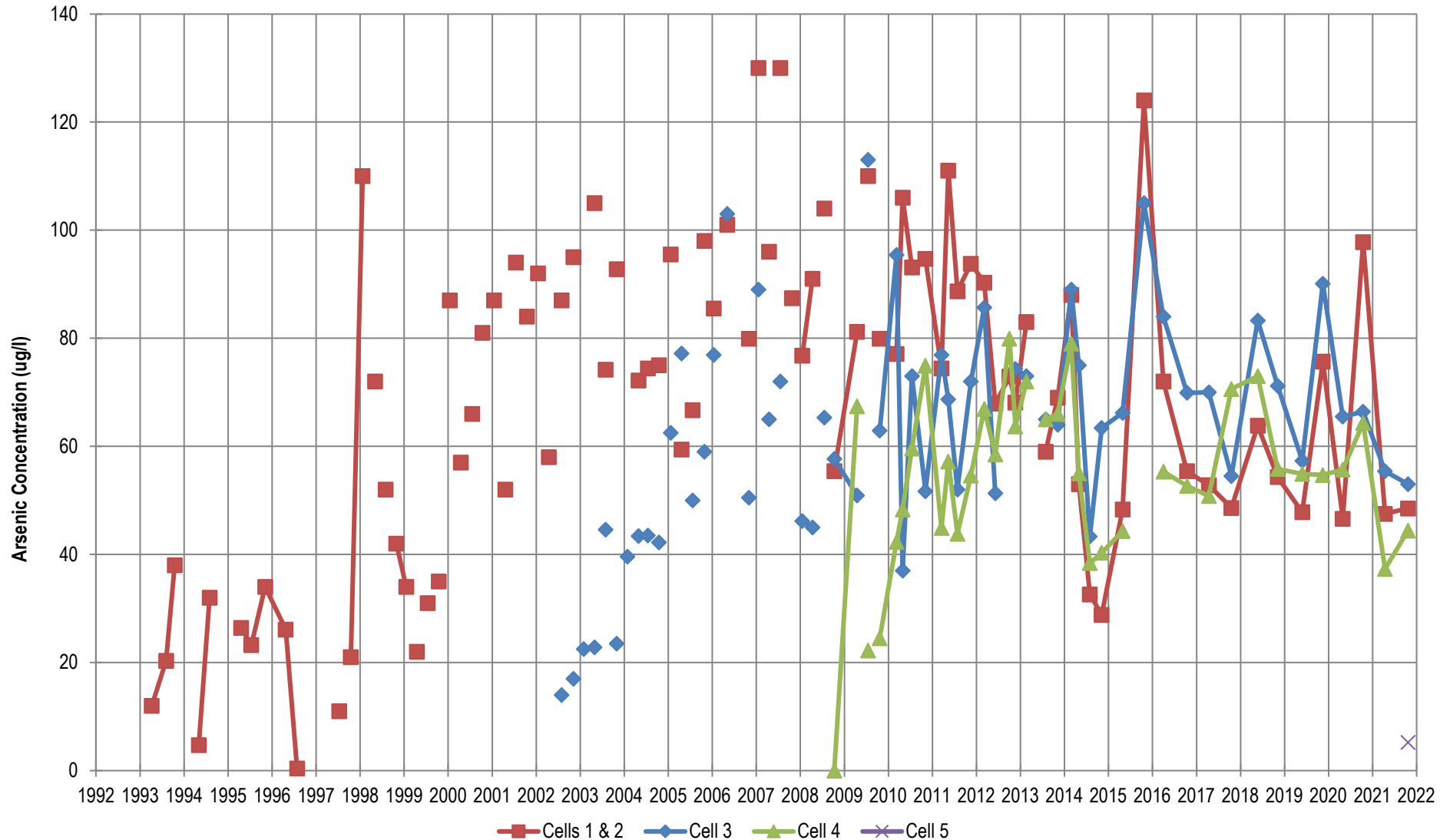
Untreated Leachate BOD/COD Ratio



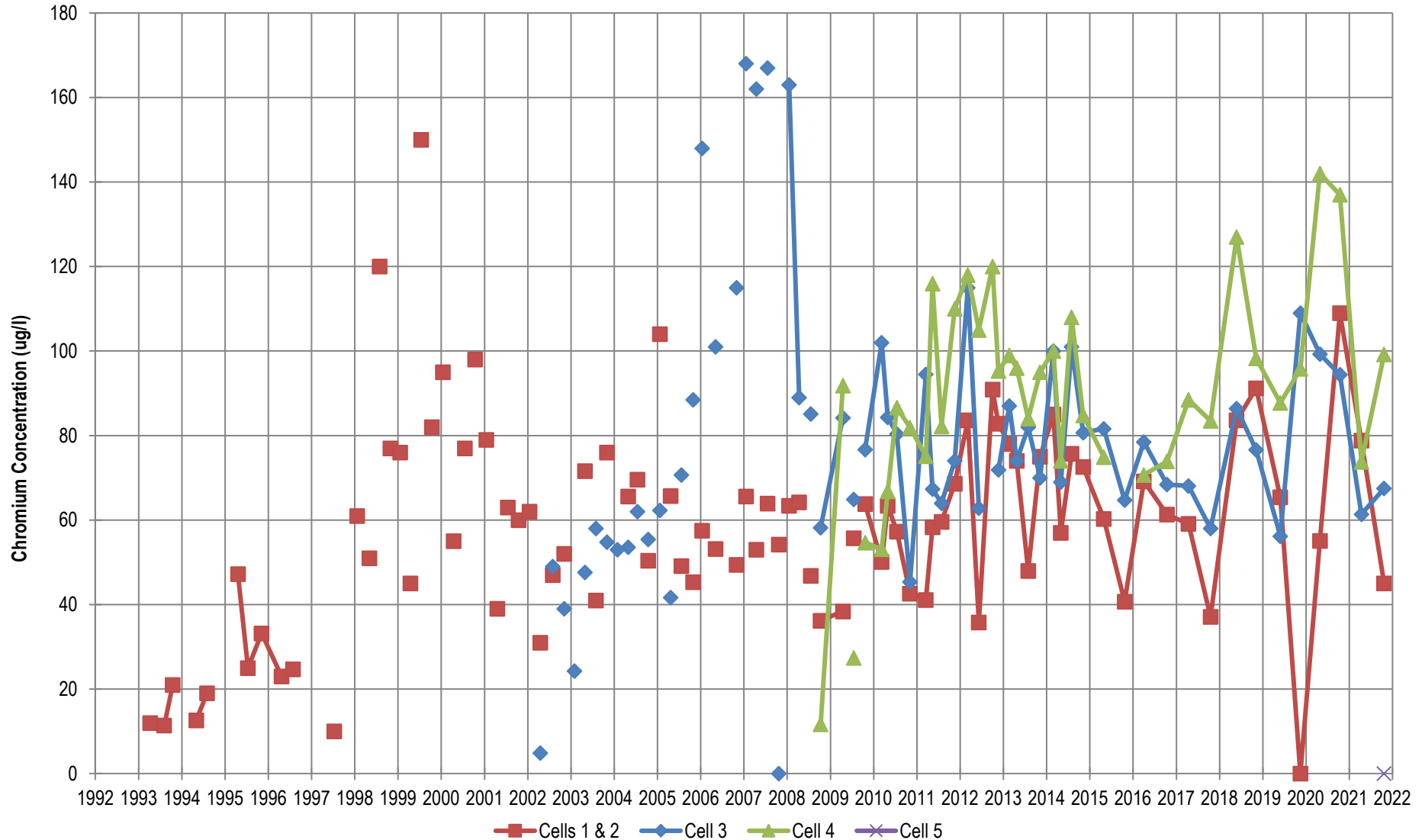
Untreated Leachate Total VOC Concentration



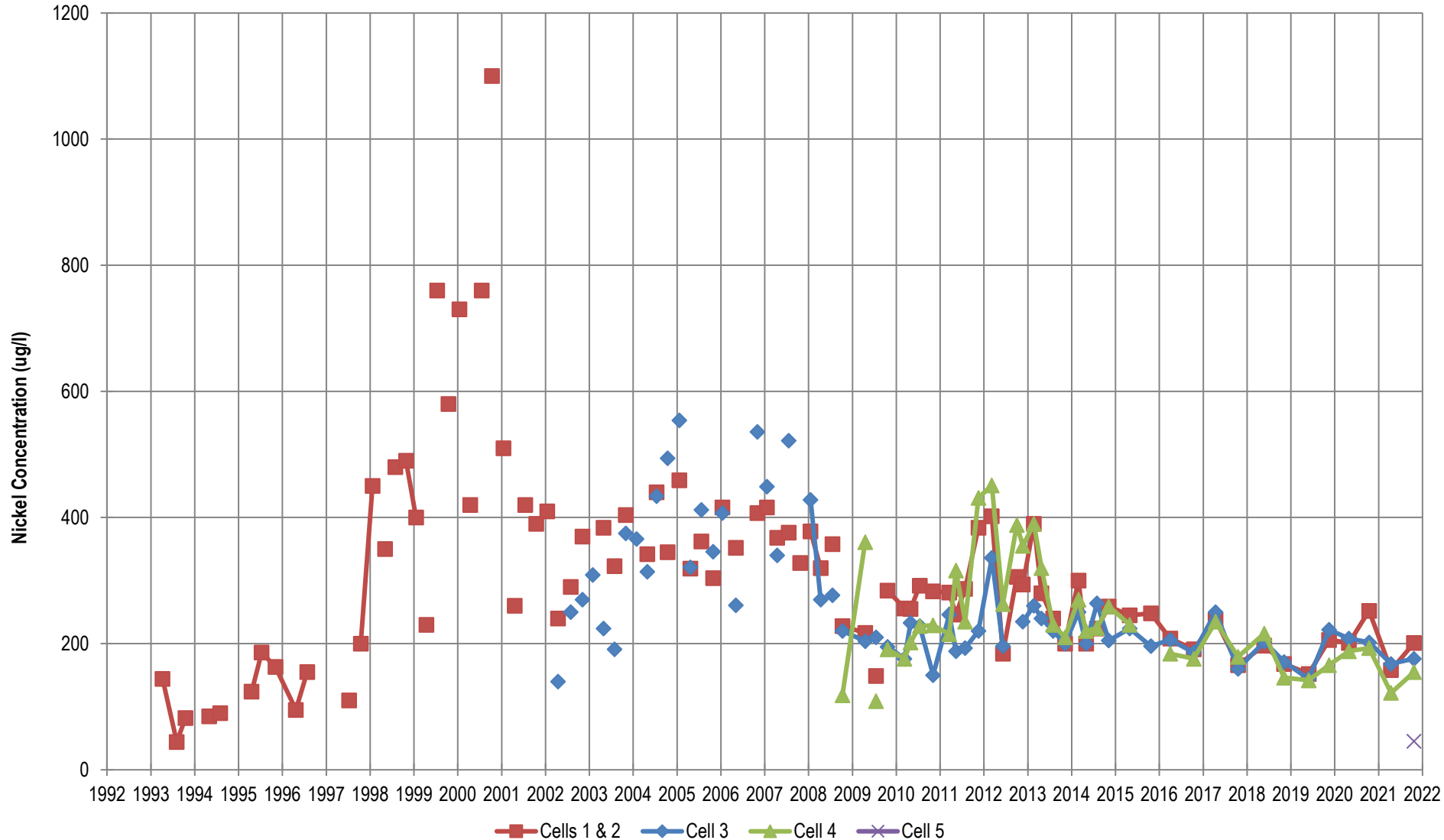
Untreated Leachate Arsenic Concentration



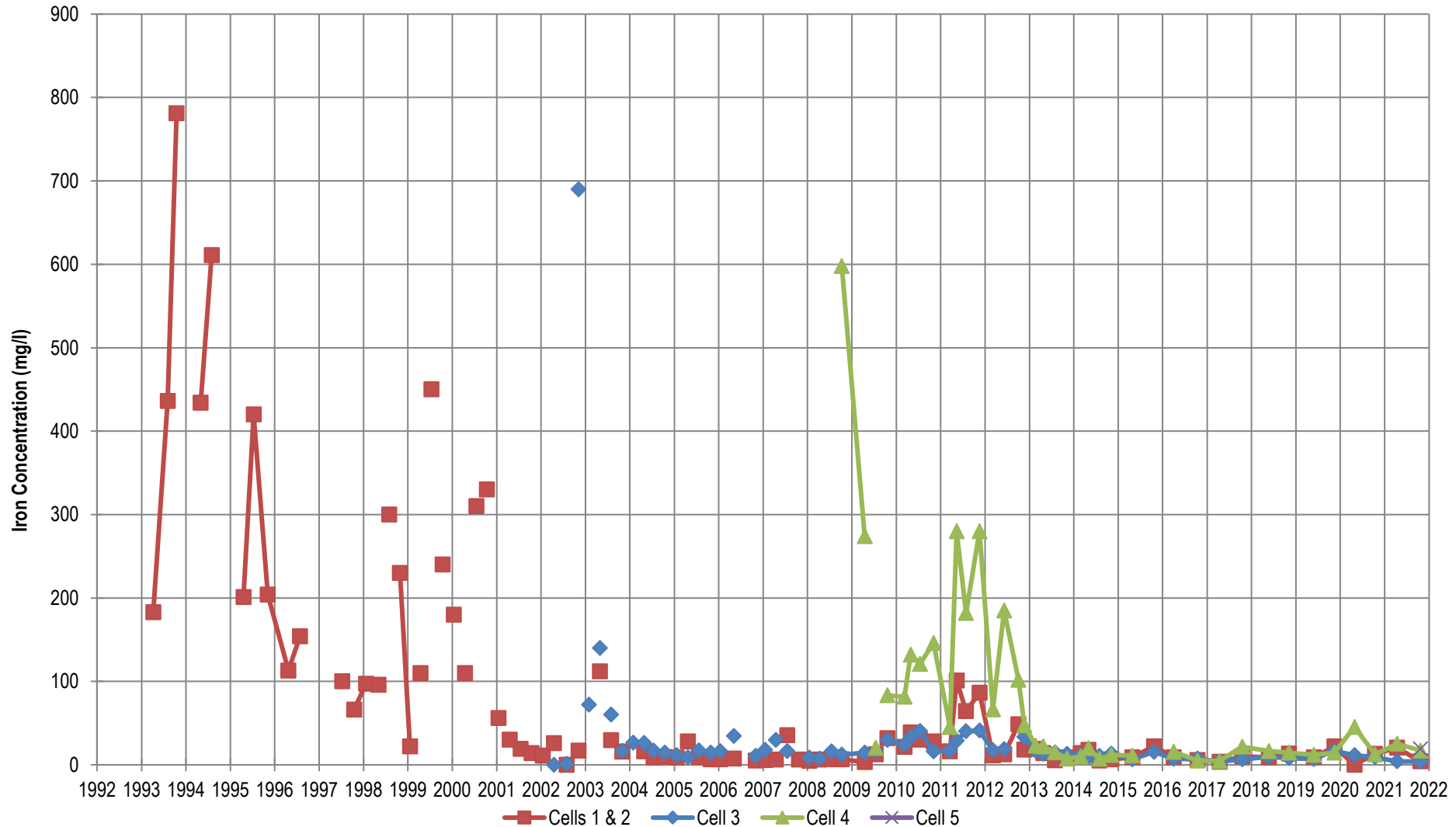
Untreated Leachate Chromium Concentration



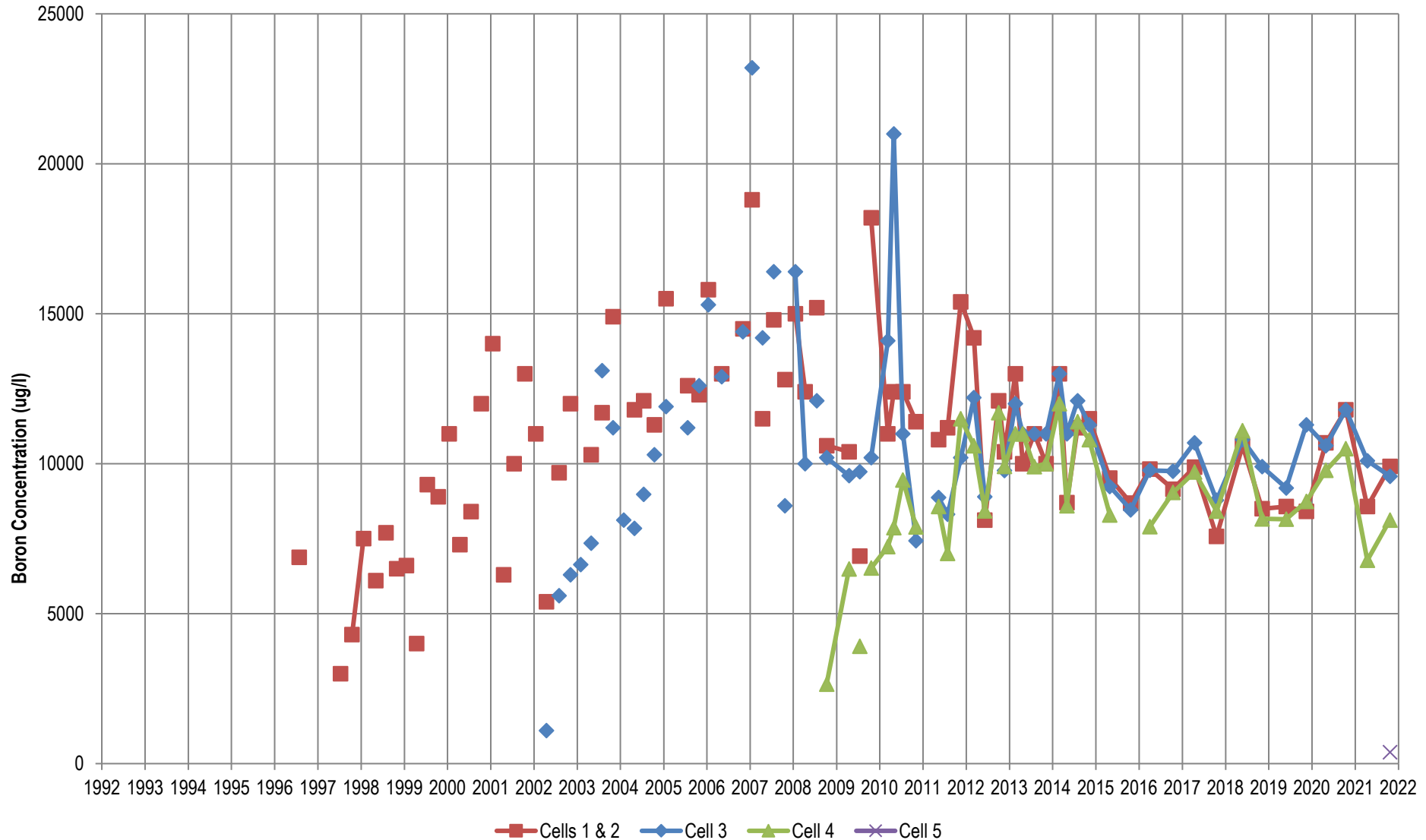
Untreated Leachate Nickel Concentration



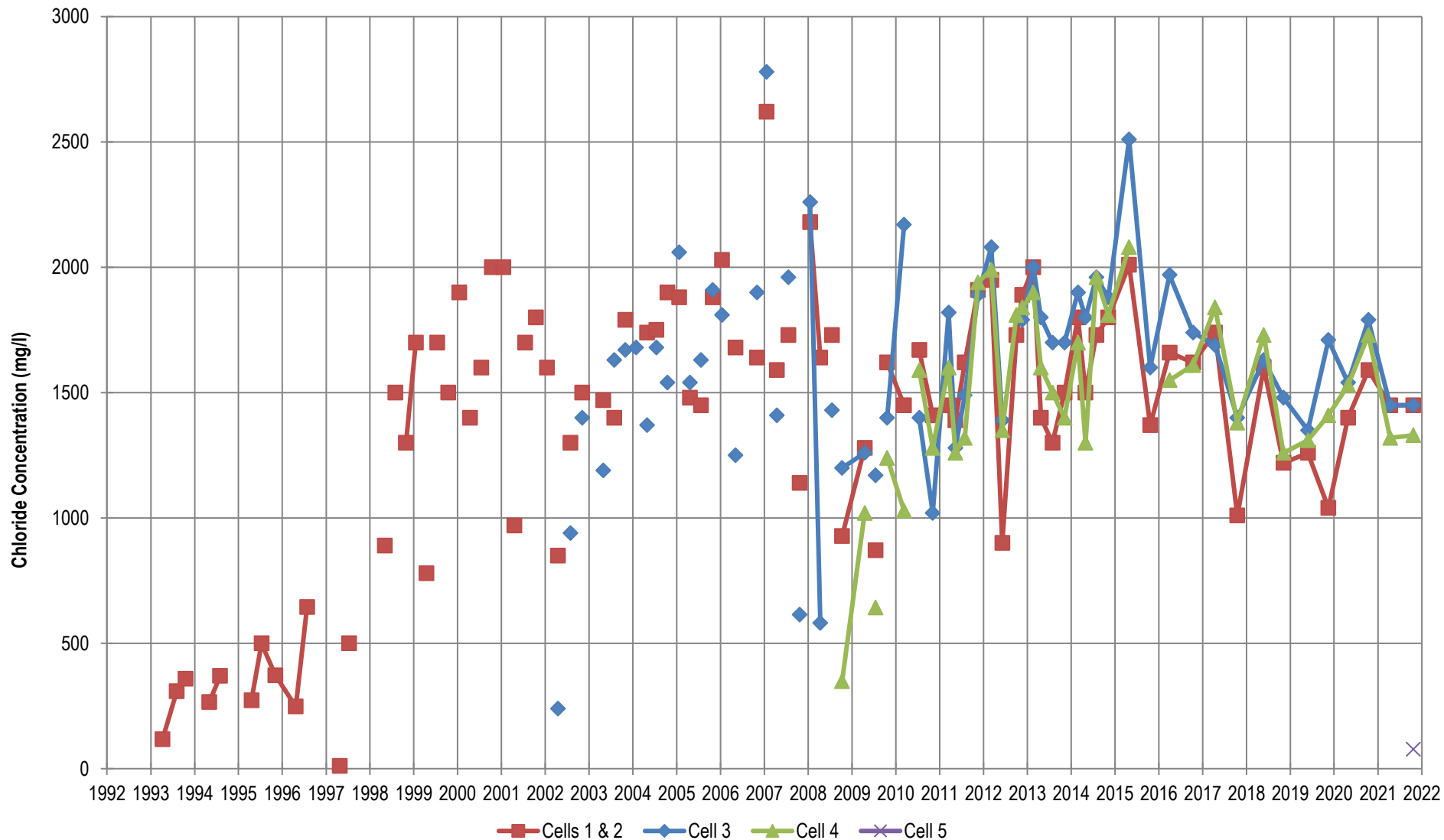
Untreated Leachate Iron Concentration



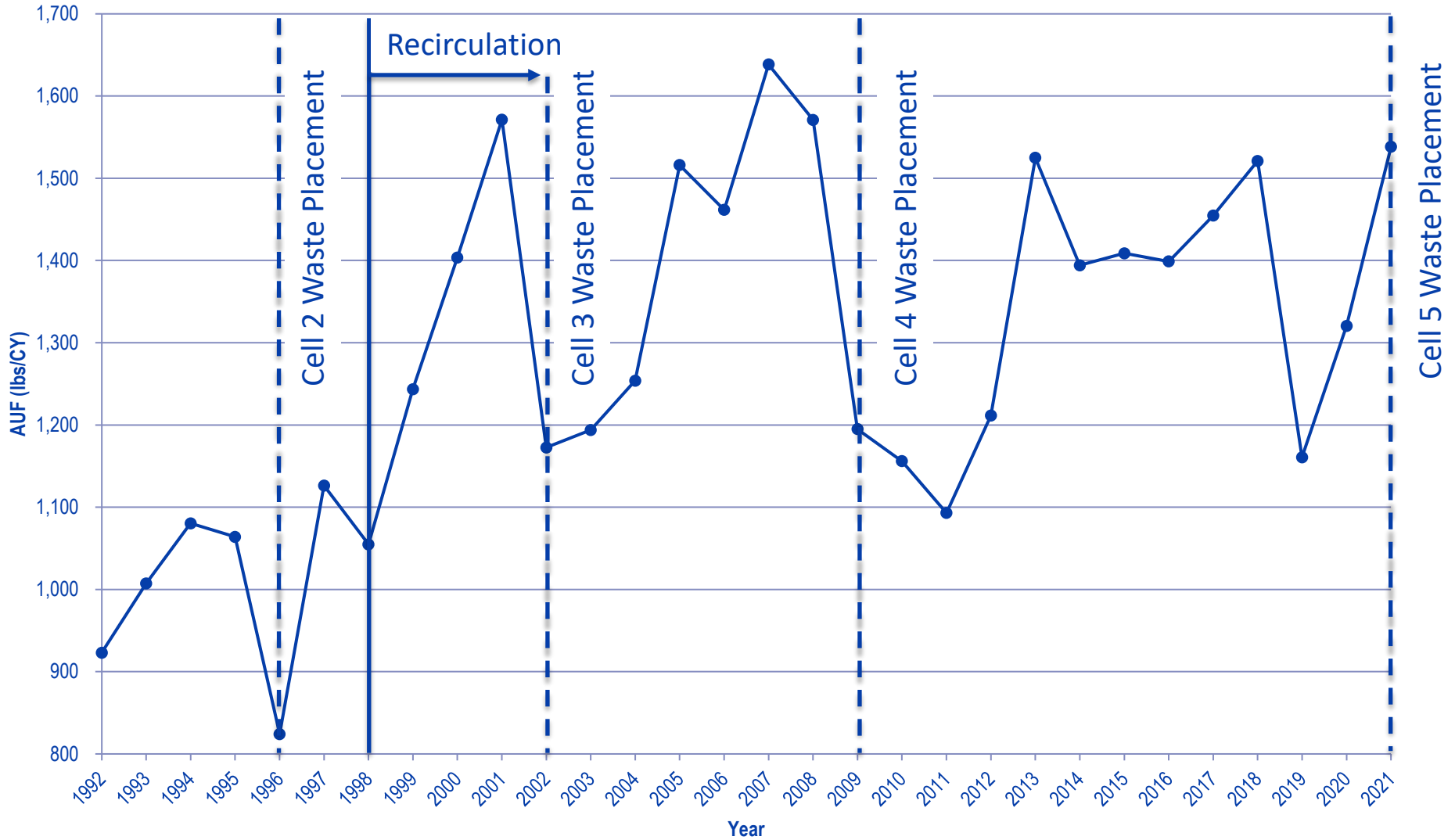
Untreated Leachate Boron Concentration



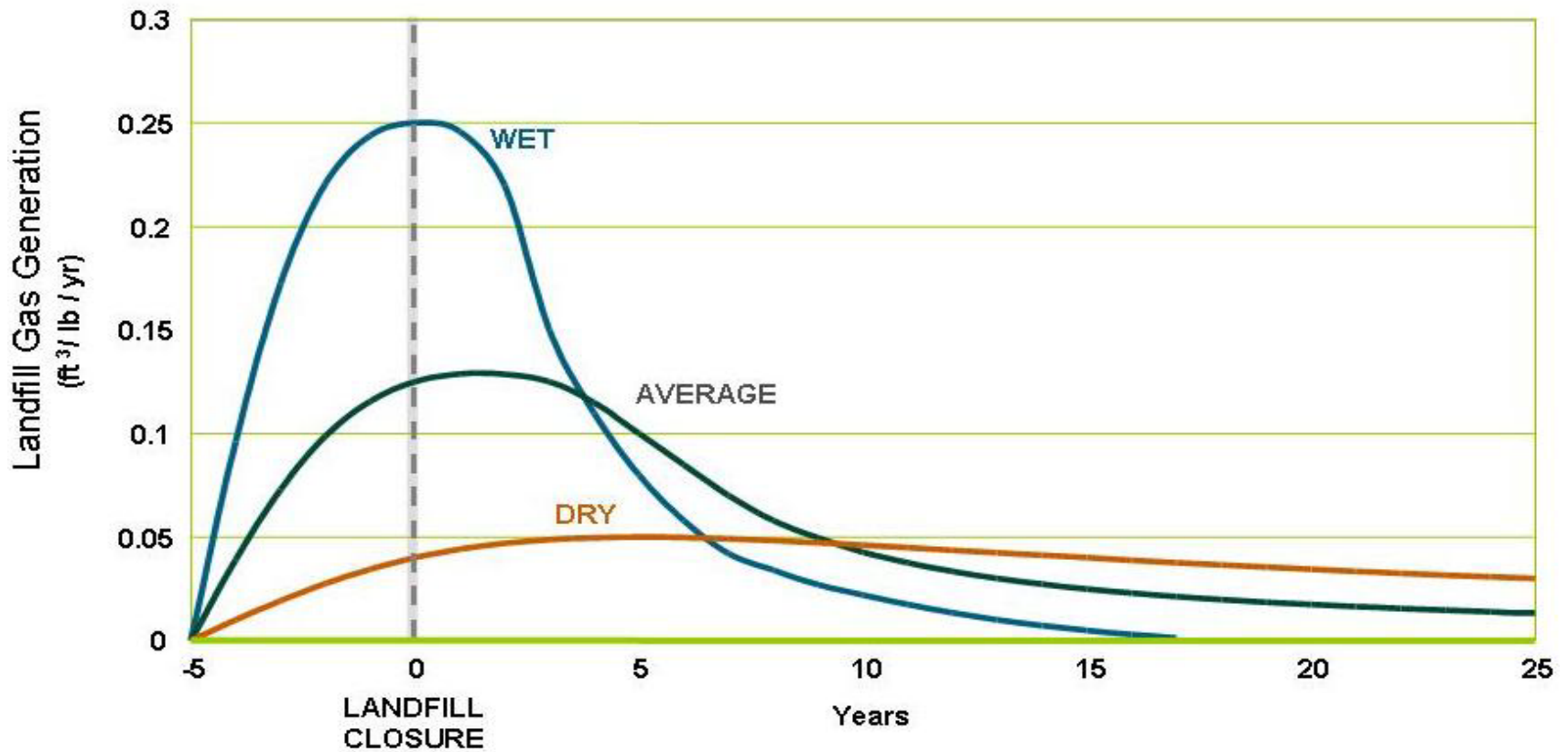
Untreated Leachate Chloride Concentration



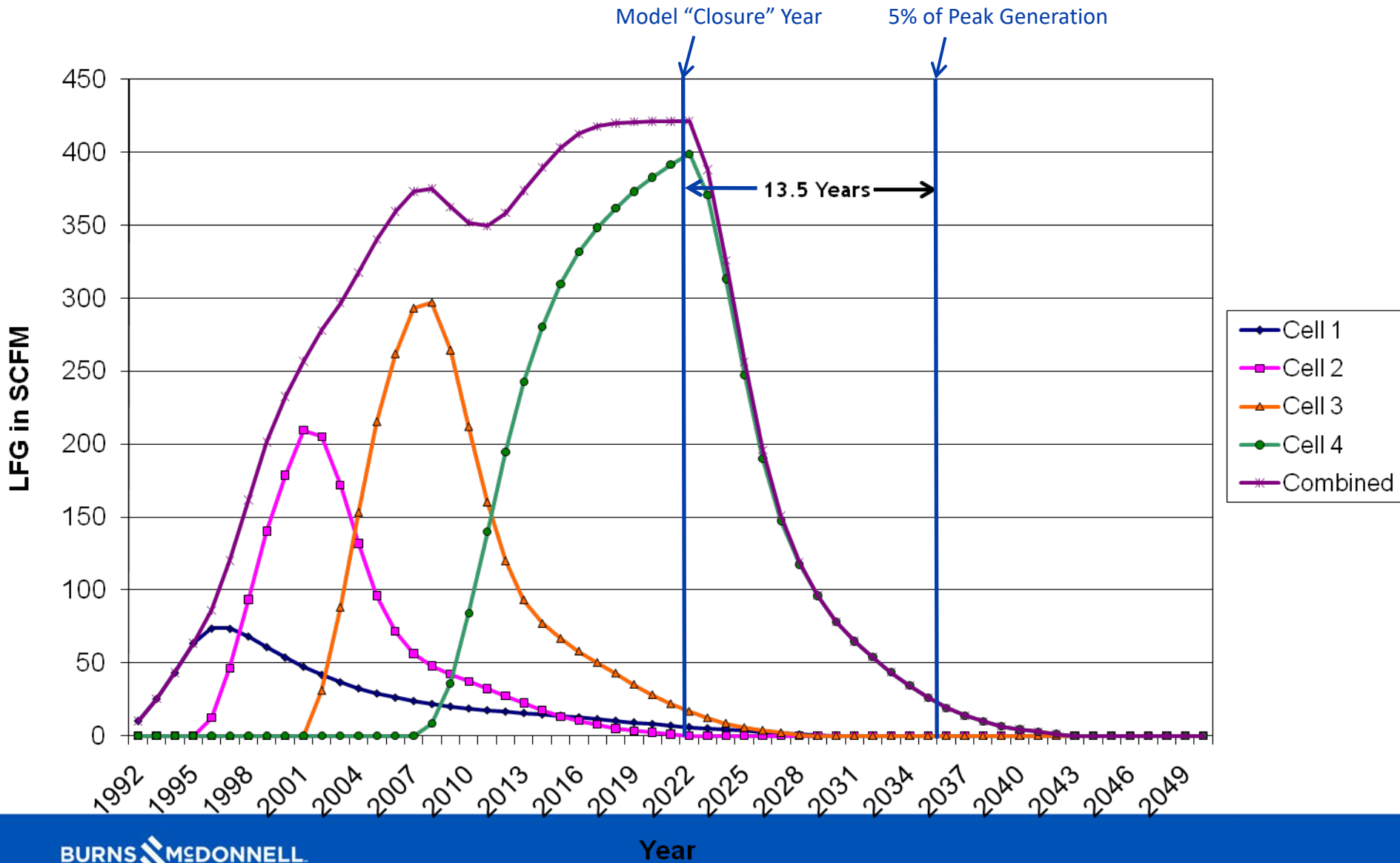
Annual Airspace Utilization Factor



Accelerating LFG Production



Composite LFG Generation Curve



RECIRCULATION TO ENERGY



Beneficial Re-Use

- ▶ Onsite use: LFG Fueled Boiler
 - Offset propane use





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