Crystal Lake Environmental Study – Plain English Summary

Tom Kindred and ChatGPT

May 22, 2025

Background to this Plain English Summary:

In 2024, the Lake Water Quality Committee approached Peter Leavitt from the University of Regina to conduct a lake bottom core and provide his findings. The core was taken in July of 2024. On May 21, 2025, the committee received the research paper from Peter Leavitt, which provided his findings. Due to the extreme technical nature of the paper, it was hard for the committee to fully understand.

The paper was presented to ChatGPT along with instructions to summarize the paper in plain English. ChatGPT produced a summary document and was then asked to expand on certain points it had made. Below is a consolidated document from various inquiries with ChatGPT.

What's the Study About?

Scientists examined mud layers (sediments) from the bottom of Crystal Lake, Saskatchewan. These sediments act like a time capsule, preserving traces of algae, bacteria, and chemicals. By analyzing them, scientists can understand how the lake's ecosystem has changed over the past ~150 years—especially in response to human activity.

How the Scientists Studied the Lake

They analyzed:

- **Fossil pigments** – Color molecules from algae and bacteria indicate past productivity. More pigments mean more algae.
- **Carbon (C) and nitrogen (N) content** – Show how much and what kind of organic matter entered the lake (from algae, plants, or farms).
- **Stable isotopes** – Help trace whether nutrients came from natural sources, bogs, or human activity.

Key Findings

1. Algae Growth Has Increased Over Time

- Around 30 cm deep in the mud (likely dating to the early-to-mid 1900s), there's a noticeable rise in algae, especially green algae and cryptophytes.
- This suggests the lake became more biologically productive—i.e., more plant life in the water.

2. The biggest increases were in spring algae

- Algae that thrive in spring and low-light conditions increased the most.
- Summer algae and cyanobacteria showed smaller changes.

3. Recent changes (last few decades) are small.

- The top sediment layers (from the last 10–30 years) show only minor increases in algae.
- These changes may reflect how well pigments are preserved, rather than actual new growth.

4. Oxygen levels in deep water were low but not extreme.

- Occasional signs of low oxygen in deep water were found, but not to the point of supporting oxygen-free bacteria.

What Might Be Causing These Changes?

There are **two main theories**, likely working together:

A. Human Activity Around the Lake

- Farming and cottage development probably introduced more nutrients (like nitrogen) into the lake.
- These nutrients feed algae, boosting growth and making the water greener.

B. Loss of Surrounding Bogs

- In the past, bogs sent dark, organic-rich water into the lake. This blocked sunlight, limiting algae growth.
- As these bogs were drained or dried, the water became clearer—allowing more algae to grow, but less organic matter to settle at the bottom.
- Shifts in carbon and nitrogen levels in the sediments support this theory.

What Does It Mean for the Lake?

- The lake is **more productive** now than it was in the distant past—meaning more algae and aquatic plant life.
- These changes are likely linked to **human activities** around the lake—especially farming, cottaging, and possibly the draining of nearby bogs.

There's no sign of a recent major decline or crisis in lake health, but the ecosystem has **definitely changed** over the last century.

What's Still Uncertain?

- Exact dates for when changes occurred are not yet confirmed—they're waiting on lab results from Winnipeg.
- It's unclear how much of the change was due to farming/cottaging versus bog loss—it's likely both played a role.

Bottom Line

Over the last 150 years, Crystal Lake has become more productive, with increased algae growth. This change likely began in the early-to-mid 1900s and appears linked to human land use (like farming and cottaging) and the loss of surrounding bogs. The ecosystem has clearly shifted, though there's no sign of a recent ecological crisis.

Next Steps

- Await radiocarbon dating to pinpoint when each change happened.
- Investigate historical land use and bog drainage using old photos and records to better understand the timeline and impact.

What Does This Mean for Our Lake? More Specifics!

✅ The Lake Is Changing—But Not in Crisis

Crystal Lake has gradually become more biologically active over the past 150 years. That means more algae and aquatic plant life—but **not necessarily a sign of pollution or poor water quality.** It's more of a **slow shift** than a sudden problem.

👩‍🌾 Human Activities Have Likely Played a Role

Farming, cottage development, and changes to nearby wetlands (like bogs being drained) seem to have influenced the lake. These activities can:

- Add nutrients like nitrogen to the water (which algae love)
- Make the lake clearer by reducing bog runoff—letting more sunlight in, which helps algae grow

So even if there hasn't been heavy pollution, **normal land use changes around the lake may be enough to affect its ecosystem.**

🧪 The Lake Is Not "Dead"—Just Different

Some people worry when they hear about more algae—but what's happening here is more subtle:

- **No massive algae blooms or oxygen crashes**
- **No evidence of toxic conditions or major ecological breakdown**
- Just a **long-term shift in balance**, with more algae-friendly conditions than 100 years ago

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🧭 What Can We Do Going Forward?

This study isn't a warning siren—but it **gives us a chance to be proactive**. Here's how the community might respond:

- **Protect nearby wetlands** to help keep the lake balanced
- **Use fertilizer carefully** near the lake (on lawns or fields)
- **Watch for signs of worsening algae blooms** in the summer—early warning of tipping points

- **Support further research**—including dating the changes and mapping historic land use

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🧩 Still Some Unknowns

The full story isn't clear yet. Scientists are still waiting for exact dates of when changes occurred, and more local history (photos, land records) could help explain the timing and causes.

⚖️ Bottom Line

Crystal Lake is still healthy overall, but its ecosystem has clearly changed—likely due to a mix of land development and wetland loss. Understanding these slow shifts can help the community **protect what we love about the lake** before problems start.

ChatGPT Comments About Possible Connections to Increased TKN in Lake Samples and Increased Ammonia Levels in Water Wells Around the Lake

Tom Kindred May 22, 2025

Question to ChatGPT:

We have detected ammonia in our water wells around the lake. The lake has high levels of Total Kjeldahl Nitrogen (TKN). The TKN level is around 0.62 mg/l lately. In 1983 it was as high as 1.206 mg/l. Would any of the above scientific findings from the attached report give some reasons as to if there could be a linkage to TKN levels?

ChatGPT Response:

Yes, Tom—**the scientific findings from the Crystal Lake sediment study do suggest possible links to Total Kjeldahl Nitrogen (TKN) levels** in both the lake and, indirectly, nearby water wells. Let's break it down in practical terms:

🧪 What TKN Measures

TKN is a measure of:

- **Organic nitrogen** (from decaying plants, algae, manure, sewage, etc.)
- **Ammonia** (NH_3/NH_4^+), which can come from fertilizers, septic systems, and decaying organic matter.

Your data:

- **1983 TKN: 1.206 mg/L**
- **Recent TKN: ~0.62 mg/L**

This shows a **decrease**, but still a **moderate level**—and the detection of **ammonia in nearby wells** is noteworthy.

🔗 Possible Links from the Study

Here's how the sediment study connects to TKN and your well water:

1. Increased Algae = More Organic Nitrogen

- As algae production increased (especially mid-1900s onward), more algae die and sink.

- When algae break down, they release organic nitrogen and **ammonia**.
- This contributes directly to TKN in the lake water.

2. Shifts in Nitrogen Sources

- The study found changing **nitrogen isotope signals**, suggesting that nitrogen sources shifted from **bogs and natural plants** to **agriculture and human-related inputs** (like fertilizer or septic systems).
- This supports the idea that **runoff or leaching from land use** could be contributing nitrogen forms—including ammonia—to both the lake and groundwater.

3. Bogs Used to Buffer Nitrogen

- Bogs can act like a sponge, absorbing and slowly releasing organic matter.
- As surrounding bogs were lost or drained, their filtering and buffering role weakened.
- That may have allowed more **direct transport of nitrogen to the lake and groundwater**, raising both TKN and well ammonia levels.

4. Ammonia in Groundwater = Possible Septic or Fertilizer Leaching

- Ammonia detected in **wells** could mean:
  - Septic system leakage
  - Fertilizer from lawns or fields
  - Or even breakdown of organic nitrogen in shallow groundwater influenced by the lake's hydrology

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🔍 What You Might Do With This

You could ask scientists or a hydrogeologist:

- **Could lake water or lake-adjacent groundwater be moving into our well water zones?**
- **Is there a pattern in ammonia detection that matches areas of farming or older septic systems?**
- **Would groundwater tracing or well testing for isotopes help confirm the nitrogen source?**

And yes, if sediment signals show that nitrogen has been coming from land-based human activity (and not just algae), it's very reasonable to think the **TKN trends and well ammonia are part of the same story**.

Questions for Peter Leavitt and Team

🔬 About the Science and Data

1. **When will the exact dates (from the sediment core) be available?**
   → Understanding when the big changes happened is crucial for linking them to local history.
2. **How confident are you in the link between bog loss and algae growth?**
   → Ask for more detail on how strong the evidence is for this connection.
3. **Could natural climate changes (e.g., warming or rainfall) be part of the cause?**
   → It's important to know how much is from humans vs. natural change.
4. **What does the pigment preservation issue mean for the recent record?**
   → This helps clarify whether recent changes are real or just "noise" in the data.

🧭 About Local Impact and Management

5. **Is the lake at risk of crossing a threshold—like harmful algae blooms or oxygen loss?**
   → Are we near a tipping point, or is the system still stable?
6. **What actions would help slow or reverse these changes?**
   → Practical steps like wetland protection, better runoff control, etc.
7. **Can these changes be reversed or managed without major intervention?**
   → Helps weigh the urgency and cost of any response.
8. **Are there signs of similar changes in nearby lakes?**
   → Useful for seeing if this is a local issue or part of a regional pattern.

🔍 About Linkage to TKN in Lake Samples and Ammonia in Wells

9. **Could lake water or lake-adjacent groundwater be moving into our well water zones?**
10. **Is there a pattern in ammonia detection that matches areas of farming or older septic systems?**
11. **Would groundwater tracing or well testing for isotopes help confirm the nitrogen source?**

🧠 About What's Next

9. **What further research would give the clearest answers?**
   → Could include drone mapping of old bog areas, interviews with long-time residents, more core samples, etc.
10. **Can we work with you (or other scientists) to track future changes?**
    → Shows interest in becoming part of long-term stewardship and science.