

# MEETING MINUTES

GROUNDWATER WASTEWATER DISCHARGE CITIZEN ADVISORY COMMITTEE

MONDAY, JANUARY 27, 2025

ROPEWALK ROOM

26 COURT ST • PLYMOUTH, MA 02360

**Called to Order:** 6:01 PM

**Members Present:** David Golden (chair), Josh Bows, Bill Doyle (arrived at 6:20 pm), Martin Enos, Rose Forbes (Clerk), Hampton Watkins (Vice Chair)

**Members Absent:** Mark Champagne

**Others in Attendance:** Bill Coyle (Department of Public Works [DPW]), David Gould (Energy & Environment), Kendra Martin (DPW), Kim Tower (Energy & Environment), and members of the public including Tom Browning, Patty Dystar, Tom Fugazzi, Mike Hanlon, Matt Hoagland, and Mark Withington.

## MEETING MINUTES

Mr. David Golden emailed the November 25, 2024 meeting minutes today and tabled the vote on the minutes until the February 24, 2025 meeting.

## OUTSTANDING ACTION ITEMS

Mr. David Golden asked Mr. Hampton Watkins and Ms. Rose Forbes to review the compiled list of outstanding action items (see Attachment 1). Rose Forbes explained the action items were generated during previous meetings and some emails but she may be unaware of additional requests made by CAC members, specifically if those requests were sent via email. She requested CAC members let her know if there are additional action items not shown in Attachment 1. Those action items with a “pending” status were discussed during the meeting; notes/updates are provided in Attachment 1.

## ENERGY AND ENVIRONMENT STAFF PRESENTATIONS – DAVID GOULD/KIM TOWER

Ms. Kim Tower and Mr. David Gould gave a presentation entitled “Overview Nutrient Management and Harbor Water Quality.” The presentation is available on the Town of Plymouth website at <https://www.plymouth-ma.gov/1262/Wastewater-Treatment-Plant-Groundwater-D>.

Hampton Watkins mentioned the largest septic outfall into the ocean is from Deer Island Treatment Plant and does not seem to have much impact. He also stated that ocean discharge outfalls in New Bedford and Marion are being upgraded. He asked if there were any other reasons besides costs and engineering challenges that the Plymouth outfall could not be extended further into the ocean instead of discharging to the infiltration beds. David Gould responded the costs would be huge and will have agricultural impacts. The extended outfall would need to discharge treated water to the south and further into the deeper ocean water.

Marty Enos stated the Town is not in violation of any current State or Federal standard with the current ocean outfall and asked if the discharge concerns are related to shellfishing. David Gould replied that moving the treated water discharge to the infiltration beds will allow for both commercial and recreational shellfishing, reduce the impact on Eel Grass, and help meet the forthcoming Total Maximum Daily Load (TMDL) limits. Marty Enos

responded the shellfish are doing well and expressed concerned about the groundwater quality and risks to the Eel River if the discharge is moved from the ocean to the infiltration beds. Bill Doyle stated that Plymouth does not have Class A waters which precludes shellfish from being sold to the European market.

#### **PUBLIC COMMENT**

Mr. Tom Fugazzi followed up from his question during the last CAC meeting regarding the dye test conducted for the treated wastewater discharge to the ocean outfall and asked if there was a similar analysis conducted for the Eel River. DPW staff stated there was no dye test done for the Eel River.

Mr. Mark Withington from Eel River Watershed Association (ERWA) offered his assistance with answering questions related to the EWRA. He asked if the current wastewater treatment plant has tertiary treatment. Kendra Martin replied the plant is considered advanced secondary treatment due to the sequencing batch reactor technology (SBR) and the Town is moving forward with tertiary treatment although no decisions have been made on the technology to be used.

Mr. Matt Hoagland stated the phosphorus appears to be the limiting nutrient but does the limiting nutrient switch to nitrogen during certain times of the year? Ms. Kim Tower stated the limiting nutrient does switch back and forth between nitrogen and phosphorus and that the limiting nutrient in ponds is usually phosphorus and is usually nitrogen in rivers.

Ms. Patty Dysart (EWRA) asked what needs to be done at the wastewater treatment plant to upgrade to tertiary treatment. Kendra Martin responded that no decision has been made yet but tertiary technologies such as ultraviolet radiation, disc filters, etc are being evaluated.

Mr. Mark Withington asked if different locations such as Site 101 are being evaluated as alternatives for discharging treated wastewater. Kendra Martin responded that Site 101 will be evaluated.

Mr. Mark Withington asked if the Town of Plymouth allocated funds for tertiary treatment. Kendra Martin responded that tertiary treatment is planned and is being evaluated.

Mr. Mike Hanlon asked for a copy of Kim Tower's presentation. Kim Tower stated she will provide the presentation. Note the presentation is available at <https://www.plymouth-ma.gov/1262/Wastewater-Treatment-Plant-Groundwater-D>.

Mr. Mark Withington asked if the Town of Plymouth is planning to discontinue using the ocean outfall and discharge all the treated wastewater to the infiltration beds; and, if so, can this be done gradually instead of all at once. Kendra Martin replied the Town is looking to shift the priority to the infiltration beds rather than the ocean outfall and can explore a gradual discharge scenario. Bill Coyle stated he will talk to Neal Price about implementing a gradual shift in discharge from the ocean outfall to the infiltration beds but it may depend on the permit issued by MassDEP.

Mr. David Golden asked Kendra Marting and David Gould if they have any concerns with shifting discharge from the ocean outfall to the infiltration beds. David Gould responded he would have less concern if tertiary treatment is implemented since it will help to reduce nutrient loading to meet the new TMDL requirements.

**NEW BUSINESS/OLD BUSINESS**

Mr. David Golden asked if there was any additional old business. There was none.

Mr. David Golden asked if there was any new business. Marty Enos handed out three items: (1) a letter written by Mr. Lothrop Withington III related to when the wastewater treatment plant was being considered (Attachment 2); (2) a summary of tertiary treatment technologies (Attachment 3); and, (3) an article by an EPA employee regarding groundwater contamination (Attachment 4). The items are attached to these minutes.

**MEETING SCHEDULE**

The next meeting is scheduled for February 24, 2025 in the Rope Walk Room.

**Adjourned:** 8:09 PM

Respectfully Submitted,  
Rose Forbes, Clerk

Date of Request	Action Item	Requestor Name	Responsible Party	Status	Comments
30-Sep-24	Josh Bows asked how new developments are considered in the hydrogeologic evaluations in the Alternatives Analyses as part of the Environmental Impact assessment being conducted by Horsley Witten Group. Neal Price noted he will evaluate the impact of hydraulic mounding on new developments.	Josh Bows	Neal Price	Pending	
30-Sep-24	CAC members asked for more information on: (1) private wells present within the area potentially impacted by the wastewater discharge in the infiltration beds; (2) plans for additional treatment of phosphorus and other contaminants; (3) an additional alternative for extending the outfall; and (4) additional review of alternative location 101. Neal Price stated he will address these requests.	CAC members	Neal Price	Pending	
30-Sep-24	Rose Forbes asked if Weston and Sampson, who is responsible for developing the wastewater management plan including sampling, could attend a future CAC meeting to provide a general overview of their activities.	Rose Forbes	David Golden	Completed	Nathan Michael from Weston & Sampson presented at the 25 Nov 24 CAC meeting
30-Sep-24	CAC asked when the draft Environmental Impact Report (EIR) will be ready for review	CAC members	Neal Price	Pending	Jan or Feb 2025
30-Sep-24	Rose Forbes requested a monthly update on any new activities at the wastewater treatment plant as related to the development of the EIR since the previous meeting.	Rose Forbes	Bill Coyle	Ongoing	Only one update has been provided
30-Sep-24	Hampton Watkins requested baseline environmental data from Kendra Martin (DPW Water and Wastewater Engineer) including data from from Camp, Dresser, and McKee (CDM) and Woodard & Curran (W&C).	Hampton Watkins	Kendra Martin	Completed	Kim Tower provided the data on 25 Sep 2024
30-Sep-24	Schedule site visit to wastewater treatment plant	CAC members	David Golden	Completed	Site visit held on 22 Oct 2024
30-Sep-24	Add "meeting minutes" as an agenda item for future meetings	CAC members	David Golden	Completed	
30-Sep-24	Provide August and September meeting minutes by 18 Oct	CAC members	David Golden	Completed	
30-Sep-24	Provide septage records as a compressed file; David to ask Kendra Martin	CAC members	David Golden	Completed	
30-Sep-24	Request Jonathan Hobill from MassDEP attend future CAC meeting	CAC members	Doug Pinard	Pending	
20-Nov-24	Rose Forbes asked the following questions in an email dated 20 Nov to Bill Coyle and then to Doug Pinard. (1) If the infiltration beds were constructed as part of the original design of the wastewater treatment plant, why wasn't the wastewater discharge to the ocean outfall diverted to the infiltration beds at that time? Or, another way of asking the question is, why did the Town of Plymouth continue to discharge the treated effluent to the ocean outfall instead of using the new infiltration beds? (2) Why is the Town now looking to change the effluent discharge location from the ocean outfall to the infiltration beds. I remember the reasons Neal presented (i.e. energy cost savings, replenish the portion of the aquifer, and maybe more stringent discharge requirements by EPA and NOAA?) but I'm unclear as to what started this ball rolling so to speak. Who from the Town said the discharge should be changed from the ocean to the infiltration beds? (3) Can you please provide the influent and effluent data for the treatment plant for the last year?	Rose Forbes	Doug Pinard	Completed	Responses from Bill Coyle/Doug Pinard. (1) The Town of Plymouth original permit was for full Groundwater Discharge, and it is my understanding that an appeal was filed by the Eel River Watershed Association ("ERWA"), claiming violations of the groundwater and surface water quality standards. This appeal was heard, and a judgment was made to split the discharge of effluent, 1.75MGD daily to Plymouth Harbor and .75 to the infiltration beds. (current permit). (2) Again, my understanding in 2018 it was determined by the previous DPW director that due to several discharge permit violation to the harbor that the Town look into other opportunities of effluent discharge. (3) Data provided included 2023 average daily flow per month and total flow per month. No chemical data provided.
25-Nov-24	If the treated wastewater discharge is moved from the harbor outfall to the treatment plant infiltration beds, will the treated wastewater discharge to the Eel River and end up in the harbor?	Tom Fugazzi	Doug Pinard	Completed	Doug Pinard to ask Neal Price from Horsley & Witten
25-Nov-24	David Golden asked CAC members to send questions/requests through him so he could relay them to the appropriate individual	David Golden	CAC members	Ongoing	
25-Nov-24	Provide a spreadsheet summary of the waste trucking manifests (septage records) over the last five years to include origin and volume	David Golden	Doug Pinard	Pending	What date did David Golden send info/spreadsheet to CAC?
25-Nov-24	Hampton Watkins to share with the CAC members the baseline environmental data provided by Kim Tower (see 30 Sep 2024)	Rose Forbes	Hampton Watkins and David Golden	Pending	What date did David Golden send info/spreadsheet to CAC?
25-Nov-24	Provide all chemical data for the wastewater influent and effluent and associated monitoring well data	Rose Forbes	Doug Pinard/Kendra Martin	Pending	
27-Nov-24	Provide more specific information on what the regulatory violations occurred at ocean outfall/discharge. Was it a specific analyte that exceeded the regulations or were there multiple analytes or field parameters (pH, DO, temp)? How many violations were there, when did they occur, and what was the frequency? Are the violations still occurring? If not, what changes were made to avoid the violations? And further, if the wastewater quality was violating certain regulations, why is this not an issue for groundwater discharge into a sole source drinking water aquifer? In other words, if it's not okay to discharge to the ocean, why is it okay to discharge to groundwater?	Rose Forbes	David Golden/Bill Coyle	Pending	reference 27 Nov 2024 email
27-Nov-24	Note: This history is confusing and I'm not sure we are all on the same page as to specifically why the discharge location change is being proposed and what the impact will be if 3 MGD (or potentially 5 MGD) is sent to the infiltration beds. The CWMP presentation added more complication to these issues. How can the CWMP proceed without a decision on the wwtp discharge?				
27-Nov-24	Provide more information on the Eel River Watershed Association (ERWA) appeal claiming violations of the groundwater and surface water quality standards. Will the ERWA challenge a decision to change the infiltration discharge to 3 MGD? Provide a copy of the ERWA appeal and the subsequent judgement. Does the EWRA still exist? Has anyone contacted them regarding the proposal to discharge 3 MGD to the WWTP?	Rose Forbes	David Golden	Pending	reference 27 Nov 2024 email



LOTHROP WITHINGTON III  
15 CASWELL LANE  
PLYMOUTH, MASSACHUSETTS 02360  
JUNE - 1995

To: Board of Selectmen  
and CAC members

From: Cricket Withington

This is going to be a very long letter so to save you some reading time, my purpose in writing is to tender my resignation from the CAC and to explain my reasons.

Contrary to the beliefs of some, the only reason I volunteered to serve on the CAC is that I felt that no one was looking out for the best interests of the town. CDM had no guidance from either the CAC or the Selectmen. They were given the consent decree and told to "take care of it." No one asked what the Town wanted. People believed and still believe that we are required to build a sewer treatment plant. This is not true.

When I first met with George Crombie, DEP, I expressed my concerns that the Town of Plymouth's best interest were being overlooked. I was assured that we had free reign and that we could make a decision ranging from an election to accept no more wastewater to building the then proposed 4+ MGD plant.

The indirect guidance that we at the CAC received from the Selectmen was that the concerns of the Town were costs, environmental concerns, and a desire to attract industry.

The first task of the CAC was to estimate the wastewater flows the Town could expect in the next twenty years. In arriving at the flow estimates the CAC elected to require on site treatment in every case possible except one. That was in the case of industrial growth. The flows projected by CDM were in fact lower than those projected by OED. The CAC elected to accept the estimates by OED because the OED agreed that the appropriate site for the facility and discharge was the industrial park since they were the main reason for the plant. The submission by the CAC to the Selectmen stated that we would support the flows suggested by the OED provided that the industrial park accept the facilities.

It was not long after the Selectmen voted to accept the flows suggested by the OED that the OED then opposed the placement of the facilities in the park.

All was not lost in that the studies of CDM had shown that of all the sites being screened the industrial park site was rated as the highest. The CAC supported the location of the treatment facility and the discharge site in North Plymouth. The reason for the



selection of this area, as stated, was that the industrial growth was to be the main reason for the need for wastewater treatment in the next twenty years. In addition there was concern that the existing residential users could not afford the price tag of new facilities. By locating the facilities in the North Plymouth area the users, by regionalizing the systems, would be the industrial commercial growth in the industrial park area and not the down town users. T1:29 PM they would then bear the cost because the facilities were regionalized and there could be discrimination and the existing users, both residential and commercial would not be injured by the great expenses anticipated.

We as a committee were reassured that the site in the industrial park could meet all of our needs even up to 3MGD. CDM was asked to study other North Plymouth sites but CDM stated that it was not necessary because the industrial park site could undoubtedly handle any demands that we could put on it. At the 11th, no, at the 12th hour we were told that the site was inappropriate for discharge of the 3 MGD, or even the 1.25 MGD. A mistake by CDM?

The committee than asked for a back up site in the North Plymouth Industrial park area suggesting the route 80/route 44 triangle for either the well or the facilities. No studies were ever shown to us but we were told, in all probability without studies, that these sites were inappropriate. CDM refused to explore other Industrial Park solutions yet we now find that site 101 can accept 1.25 MGD without even impacting the North Plymouth Well. A mistake by CDM?

The sites presented by CDM to the CAC were limited to A and MM. What choice did the committee have at the twelfth hour? Pick one of these sites, create its own solution based on the only information that CDM had provided, or exceed the time allotted by the consent decree? No one liked any of the CAC solutions and therefor the committee created their own. A decision that was not 11 to 1 but was 9 of 12 was made without the benefit of a full exploration of alternatives. The vote was on the lesser of evils. Two of the votes in favor were by representatives of Kingston and Duxbury.

I have been prepared to advocate for the Town's building of a treatment facility provided that the costs (economic and environmental) were borne by the users, and that the Town had explored and understood the options. I do not believe that alternatives to the Town constructing a new wastewater treatment plant(s) have been explored, nor do I believe, as previously stated, that studies of North Plymouth sites have been either comprehensively performed or done without prejudice.

Before the Town spends 40 million dollars, or 5.5 million dollars a year to attract industry, information must be provided that this type of expense will accomplish the desired results. It is obvious that if the Town elects to spend this type of money the pay-back, by increasing our tax base, will never occur. The cost/benefit comparison cannot justify this expense. As I have stated, if you want to generate a tax base to pay for only one million dollars of annual expenses you have to add 50 million dollars of taxable

7.1



property to the tax roles at 20 dollars per thousand. This proposal requires about 5.5 million dollars per year or would require 275 million dollars of addition to the tax roles.

I am far from convinced that the provision of wastewater facilities will attract industry, or the industry that we are interested in attracting. If it turns out to be true that sewers are stunting growth (and not the existence of the well), the Town should undertake a study of attracting industry, not by building a plant, but by other economic means such as on site treatment funded by tax breaks; Small cluster plants built by users as they became necessary; Or, funded conservation measures to reduce the taxing of our existing plant.

7.2

As for the environmental impacts, it is my understanding that the discharge of effluent at either the Industrial Park site or site 101 will have considerably less of an impact on the environment than at site A.

CDM stated in its first studies that any discharge into the Eel River system would cause an unacceptable growth of vegetation. Now with additional studies they indicate no appreciable damage. Which determination is correct? A mistake by CDM?

7.3

Everyone is entitled to make mistakes, but if there is a chance of error, the Town must determine if the potential damage is too great a risk to undertake. For even if you monitor the river for two or three years, CDM states that the full effect will not impact the river for 5 years. We therefore must monitor the river for five years and then if negative impacts on the river and the fish and wildlife are discovered, where will the effluent from our 40 million dollar plant go? Even if we shut off the flow into the river we must live with five more years of pollution until the ground purges itself of the existing pollutants.

I am not good at quitting or not following through with something that I have begun. I am also not good at compromising my beliefs. Since I do not believe that the process was either unbiased or in the best interest of the Town I can no longer represent this alternative to either the finance committee or the town meeting. I have done my best in the past to present a sterile history of the proceedings, but I do not believe in the proposal and can no longer represent it.

It is important for the Town that any decision made be made with the best interest of the Town as its sole criteria.

I am firmly convinced that:

1. The most expensive and environmentally damaging solution to wastewater treatment is the centralization of the treatment process.
2. The best solution is, wherever possible, that each generator of wastewater be responsible for disposing of their own waste on site. The Town has negligible costs, responsibility for illegal use of the wastewater system is easily fixed, and there are no



maintenance costs to the Town. The environment is treated far more kindly by multiple discharge sites controlled by the new Title 5.

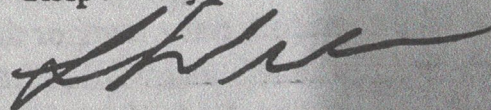
3. Of the two, economics and environmental, environmental is by far the more important, because once an ecosystem is destroyed, it cannot be regained.

4. As far as the economic ramifications of the proposal, I do not see the cost/benefit, but I do see an impact on the present users, the taxpayers, all to benefit as yet unknown industry. If wastewater treatment is the major attractant to Plymouth, then the industry we will attract will be businesses that need wastewater treatment and are not the type of industry we want to attract. Use other methods to attract industry.

5. I also believe that pressures other than the best interests of the Town are moving this process.

I am prepared to discuss alternatives other than those presented, and am sorry that this was not done by our consultants.

Respectfully presented,

A handwritten signature in dark ink, appearing to be 'J. H. ...', written over a horizontal line.

I thank you for the trust you placed in me in appointing me to the CAC, and the CAC in placing their faith in my by electing me chairman.



3/19/24  
mug  
gathup

- **What is tertiary treatment of wastewater?**

Tertiary treatment of wastewater is the third stage of the wastewater treatment process, following primary and secondary treatment. This stage is designed to further improve the quality of the water before it is discharged back into the environment. Tertiary treatment typically involves advanced physical, chemical, and biological processes, such as filtration, disinfection, and nutrient removal, to remove remaining contaminants and pollutants from the water. The goal of tertiary treatment is to ensure that the treated wastewater meets strict water quality standards and is safe for human health and the environment.

- **How effective is tertiary treatment of wastewater?**

Tertiary treatment of wastewater is very effective in improving the quality of treated water. It can remove a wide range of contaminants and pollutants that may still be present after primary and secondary treatment processes. Tertiary treatment can achieve high levels of removal of suspended solids, organic matter, nutrients (such as nitrogen and phosphorus), pathogens, and a variety of other pollutants.

The effectiveness of tertiary treatment can vary depending on the specific technologies and processes used, as well as the quality of the influent wastewater. Advanced filtration and disinfection methods, such as membrane filtration, UV disinfection, and chemical precipitation, are often employed in tertiary treatment to achieve high levels of water quality.

Overall, tertiary treatment is an essential step in the wastewater treatment process to ensure that the treated water meets regulatory standards for discharge into the environment or for reuse purposes. When properly designed and operated, tertiary treatment can significantly reduce the environmental impact of wastewater discharge and protect public health.

- **What pollutants are removed during tertiary treatment of wastewater?**

During tertiary treatment of wastewater, a wide range of pollutants and contaminants are removed to further improve the water quality. Some of the pollutants and contaminants that are commonly targeted and removed during tertiary treatment include:

- Suspended solids: Remaining solids and particles in the water are further filtered out to reduce turbidity and improve clarity.
- Organic matter: Advanced biological treatment processes and chemical oxidation methods target and remove remaining organic compounds, reducing biochemical oxygen demand (BOD) and chemical oxygen demand (COD) levels.
- Nutrients: Phosphorus and nitrogen, which can contribute to eutrophication and harmful algal blooms in receiving water bodies, are often targeted and removed through processes such as chemical precipitation and biological nutrient removal.
- Pathogens: Tertiary treatment includes disinfection processes, such as



chlorination, UV irradiation, and ozonation, to kill or deactivate remaining disease-causing microorganisms such as bacteria, viruses, and parasites.

- **Trace contaminants:** Emerging contaminants, pharmaceuticals, personal care products, industrial chemicals, and other trace pollutants are also targeted and removed through advanced oxidation processes or adsorption onto activated carbon.

By removing these pollutants during tertiary treatment, the treated water can meet stringent regulatory standards for discharge into the environment or for reuse applications such as irrigation or industrial processes.

- **How effective is the use of filtration in tertiary wastewater treatment?**

Filtration is a highly effective treatment process in tertiary wastewater treatment for removing suspended solids, particles, and other contaminants from the water. There are various types of filtration systems used in tertiary treatment, including sand filters, multimedia filters, membrane filters, and activated carbon filters. Each type of filtration system has its own advantages and effectiveness in removing different types of pollutants.

Sand filters are commonly used in wastewater treatment plants and are effective in removing suspended solids, organic matter, and some pathogens. They function by allowing water to pass through a bed of sand, which traps and removes particles and other impurities.

Membrane filtration, such as ultrafiltration and reverse osmosis, is a more advanced type of filtration that can effectively remove even smaller particles, bacteria, viruses, and dissolved contaminants from the water. Membrane filtration systems can achieve high levels of water quality and are often used for water reuse applications.

Activated carbon filters are effective in removing organic compounds, chlorine, and trace contaminants from the water. The porous surface of activated carbon can adsorb a wide range of pollutants, improving the taste and odor of the water. Overall, the use of filtration in tertiary wastewater treatment is effective in improving the quality of treated water by removing a wide range of contaminants. Filtration systems can be tailored to specific treatment objectives and can significantly enhance the overall treatment efficiency and performance of the wastewater treatment plant.

- **What is the best technology to use for tertiary treatment of wastewater?**

The best technology can vary depending on the specific characteristics of the wastewater, treatment goals, and effluent quality requirements. There is no one-size-fits-all solution, and the selection of technologies should be based on a thorough understanding of the wastewater composition and treatment objectives. Some commonly used technologies for tertiary treatment of wastewater include:

- Filtration: Filtration technologies such as sand filters, multimedia filters, membrane filtration, and activated carbon filters can effectively remove suspended solids, particles, pathogens, and contaminants from the water.

- Disinfection: Disinfection processes such as chlorination, UV irradiation, ozonation, and advanced oxidation processes can kill or deactivate remaining pathogens and microorganisms in the water.
- Nutrient removal: Biological nutrient removal, chemical precipitation, and advanced treatment processes can effectively remove nutrients such as phosphorus and nitrogen, which can contribute to environmental pollution and eutrophication.
- Advanced oxidation processes: Processes such as ozonation, UV/H<sub>2</sub>O<sub>2</sub>, and Fenton's reaction can be used to degrade organic compounds, trace contaminants, and emerging pollutants in the water.
- Membrane bioreactors (MBRs): MBR technology combines biological treatment with membrane filtration to effectively remove suspended solids, organic matter, and pathogens from the water.
- Constructed wetlands: Constructed wetlands can be used for tertiary treatment to enhance the removal of pollutants through natural processes such as filtration, adsorption, and biological uptake.

The selection of the best technology for tertiary treatment of wastewater should consider factors such as treatment efficiency, energy consumption, operational costs, maintenance requirements, and the specific treatment goals of the plant. It is advisable to conduct a detailed analysis and pilot studies to determine the most suitable technology or combination of technologies for achieving the desired treatment outcomes. Consulting with water treatment experts and engineers can help in selecting the optimal technology for tertiary treatment based on site-specific conditions and objectives.



million and estimates that removal of all hazardous wastes at that cost more than \$12 million. "I haven't located that dump in the area," says Roland Kasting, a resident near by. "There's a vast reservoir right underneath us. The laws on this chemical are going to get worse and worse to be everywhere."

#### IN MICH.

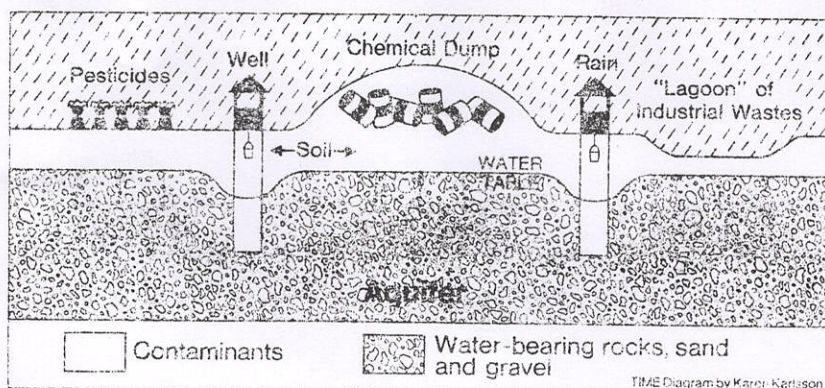
Years of local agitation and action by the State of Michigan, but now is being done by Hooker Corp. (which also left contamination of Canal) to help dispose of 1 million cu yds. of chemical wastes and contaminated soil on the edge of property on the edge of Lake Michigan. The cleanup may be too late for any residents in the community (pop. 2,396) of Gracious, Wis. along the shores of White Lake. Water officials estimate that 1 million gal. of ground water have been contaminated with deadly chemical wastes. Ground flow of contamination is a mile wide and more than a mile deep. Moreover, each heavy rainfall adds 800 lbs. of chemical residue into the lake, which, in turn, pollutes Lake Michigan.

Hooker used to play in the dump before it was closed. Where rusting pipes leaked a tarry substance soft asphalt. The site still consists of 100 different compounds, including by spontaneous reactions discarded chemicals. They include chlorocyclopentadiene, more commonly known as C-56. Toxicologists found a C-56 derivative in the lake fish.

Hooker's suit of a lawsuit filed by the residents agreed to build a huge vault for wastes. It has dug a hole 13 ft. deep and 300 yds. long. The bottom of the excavation were formed with sand, which would have chemicals to filter down to the bottom 80 ft. or less below the surface. Hooker is lining the vault with thick walls of compacted clay. The vault will rise five stories into the air. "It's a monument to stupidity," snorts a resident, a leader in the long fight for Hooker to clean up its act.

Hooker officials do not deny their mistake, but they rightly point out that the problem was made before the hazards were understood. The company is spending \$5 million to correct the problem by sinking a series of "purge" wells to draw water from the contaminated area and pipe it back underground. Hooker has also built a pipeline to carry uncontaminated water to houses on Blueberry Hill where wells are threatened. In addition, the company is paying the months' wages of these residents.

Don Hall, the Hooker official



## Deep Concern: Ground Water

At the very top of the environmental scientists' list of concerns about pollution damage is something that most Americans probably believe to be safely beyond the reach of contamination: ground water. This is water that lies buried from a few feet to a half mile or more beneath the land's surface in stretches of permeable rock, sand and gravel known as aquifers. In the U.S. there is five times as much water in such subterranean reservoirs as flows through all its surface lakes, streams and rivers in a year. While most ground water is believed to remain pure, concern is rising because it is one of nature's greatest nonrenewable resources. Unlike surface water or the air, ground water is all but impossible to purify once it has become chemically polluted.

Ground water is not exposed to the natural purification systems that recycle and cleanse surface water; there is no sunlight, for example, to evaporate it and thereby remove salts and other minerals and chemicals. Nor can ground water be counted upon to clean itself as it moves through the earth, for it scarcely "flows" at all. Says Eckardt C. Beck, the EPA's assistant administrator for water and waste management: "Ground water can take a human lifetime just to traverse a mile. Once it becomes polluted, the contamination can last for decades."

In the past, ground water was kept pure because the soil at the earth's surface could be counted on to act as a filtration system, a kind of geological "kidney" that would scrub out bacteria and other insoluble contaminants placed on or in the ground before they could seep down to the water table, the ground water's upper limit. But this filtration system does not reliably screen out the waste chemicals that now leach into the soil from a variety of sources, including cropland that has been sprayed with pesticides, and industrial dumps like the pools into which liquid chemicals are placed so that the water they contain will evaporate.

The EPA has located 181,000 such "lagoons" at industrial and municipal waste disposal sites around the country. In a study of 8,200 of them, the agency found that 72% were just holes in the ground, not lined with concrete or other materials to prevent the chemicals from leaching into the soil; 700 of these unlined lagoons were within a mile of wells tapping ground water.

Bacterial wastes, such as the effluent from the nation's estimated 16.6 million residential septic tanks and cesspools, can be filtered fairly simply out of drinking water. But chemical contaminants are another matter. Says EPA Administrator Douglas Costle: "We are not even sure if, not to mention how, chemical contaminants can be removed. It takes sophisticated testing just to determine if there are chemicals present at all."

The most serious cases of ground-water pollution confirmed so far have been in the Northeast states, where the problem is largely the result of surface dumping of industrial wastes, and in California from agricultural chemicals. But awareness of the vulnerability of ground water is still so new that EPA officials do not really know how far the fouling of the aquifers has spread. Says Costle: "We cannot even begin to say how much of our drinking water, actual or potential, may have been contaminated. We are going to be doing a lot of detective work."



EPA Official Douglas Costle