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Subject: To add to the Subcommittee A1:
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Hi Daniel (and Paul),

As discussed in previous meetings, along with our work on determining the physical parameters of CBL, we should have a section addressing the other major determinant of its longevity: its rate of trash intake and the human factors which shape it into the future. I've written a draft for this section (Section 4) and I've attached it here in Word format.

Note: in subsequent drafts the section will have endnotes and material in its Appendix.

See you tomorrow,

Ken

Ken Eklund, writerguy

Creator of
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Section 4: Human Factors Affecting Landfill Size/Capacity/Longevity

Assessing Human Factors

Although the physical parameters of Coffin Butte Landfill play a role in its longevity (“operating life”), human factors drive the actual outcome, because they determine the inflow of material that fills up the landfill’s permitted volume (and shape that volume itself). Unlike the physical factors, human factors – by which we mean decisions and agreements such as business and legal obligations, legislation, enforcement, civic action and attitudes, technological advances, risk assessments and risk taking, individual and collective values and choices, and so on – have the power to shift the landfill’s operating life very quickly. Estimations of the operating life of the Coffin Butte Landfill necessarily rely on assessments and assumptions about the entire system that feeds waste to the landfill, and this wider system is created by, motivated by, operated by, and continuously being changed by human factors.

When mapping possible futures, experts use different methods to assess human factors than they do for physical factors. “Scenario planning” poses *what if* questions to anticipate future possibilities. “Futures signaling” looks for events that indicate coming trends or movements. Using these futurecasting methods is important because for many people, cognitive biases limit their view of the future to be a mere extension of the present, with only incremental changes, even though their actual experience is of a world in which radical and disruptive changes are occurring at an ever-faster rate. “Imagination training” can be a useful tool to be more successful at discerning these patterns of change.

The Climate Change Imperative, and Methane

People all over the world are growing increasingly concerned about the threat the uncontrolled release of greenhouse gases poses to the ecosystems that human societies depend upon. The 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27) took place from 6 to 20 November this year, and hosted more than 100 Heads of State and Governments and over 35,000 participants who engaged in high-level meetings and key negotiations regarding climate action.ⁱ UN Secretary-General António Guterres said that more needs to be done to drastically reduce emissions now. “The world still needs a giant leap on climate ambition... we can and must win this battle for our lives.” He urged the world not to relent “in the fight for climate justice and climate ambition.”ⁱⁱ

In the United States, this fight is focused on the release of methane, a potent greenhouse gas. The US is one of the world’s top 10 methane emitters, and methane emissions are a major contributor to climate change, “which is why President Biden is taking critical, commonsense steps at home to reduce methane across the economy.” Last year the US announced that it was joining with more than 100 world governments to meet a Global Methane Pledge and reduce

the world's methane emissions 30% from 2020 levels by 2030. Humans produce the bulk of methane pollution, and atmospheric concentrations of methane have been trending upward for more than a decade, with 2020 seeing the biggest one-year jump on record.

Through the 2021 Methane Emissions Reduction Plan, the US government is using all available tools – “commonsense regulations, catalytic financial incentives, transparency and disclosure of actionable data, and public and private partnerships – to identify and cost-effectively reduce methane emissions from all major sources.” As part of this Plan, in a carrot-and-stick manner, the EPA has begun to both catalyze multi-pronged action against, and assess penalties for, the release of methane into the atmosphere.

Landfills are major sources of greenhouse gas emissions. Landfilling inherently creates methane as a natural byproduct of the decomposition of organic material in landfills. Landfill gas is composed of roughly 50 percent methane (the primary component of natural gas), 50 percent carbon dioxide (CO₂) and a small amount of non-methane organic compounds. Methane and carbon dioxide are odorless; “landfill smell” is from the trace non-methane organic compounds.

In the past methane pollution has been difficult to quantify. For landfills, historically the EPA has relied on theoretical calculations to estimate pollution, but these mathematical models by definition produce estimates, not exact data – useful at a national level but less so at a per-landfill level. In response, other organizations have engineered their own models that are more useful for assessing emissions at a particular landfill. In recent years, focus has shifted to better direct measurement technologies for more accurate and transparent emissions reporting.

Using area measurement tools deployed on satellites, aircraft, and towers, the Environmental Defense Fund has shown that landfill outputs are generally higher than EPA calculations indicate. Carbon-Mapper, a joint public-private enterprise, focuses on identifying super-emitters, because a previous flyover project across California discovered that only 1% of sites produced 50% of methane emissions, and the largest emissions were from landfills. Carbon-Mapper plans to launch two satellites in 2023, building to a suite of 20 satellites eventually; these will join other systems such as Kayrros, a French company, and MethaneSAT, a subsidiary of the EDF.

These developments all signal a changed operating environment for Coffin Butte Landfill, one in which its greenhouse gas emissions move from being unknown and unexamined to being an open number impacting waste flows, operating costs, regulatory fines, corporate investment levels, public action, and more. Coffin Butte Landfill may be a particular target for negative effects, because its wet environment converts waste to methane quickly. This section details several Scenarios which explore these impacts upon the landfill's anticipated operating life.

It's important to note here that landfill methane poses a lesser-of-evils situation. The best-case environmental outcome for methane, once it is generated from municipal solid waste, is for it to oxidize into carbon dioxide, i.e., for it to transition from a quick-acting high-impact greenhouse

gas into a slower-acting, durable greenhouse gas. Methane is not “destroyed” nor does it become carbon neutral. Therefore, the best way to mitigate landfill methane is never to create it in the first place, i.e., to divert waste, especially organic waste, from ever entering a landfill. This is a fundamental logic at work with landfill methane now and into the future.

Scenarios

A. Climate Crisis Legislation

Scenario: the methane-corrective measures imposed on the oil/gas industry are extended into the landfill industry, focusing on incentives to prevent methane from being emitted but including penalties for methane pollution. This extension happens in the year 2024.

In this scenario, as they are doing in the oil/gas industry, federal and state environmental agencies offer billions of dollars in incentives tailored to catalyze efforts that can curtail landfill methane.

In this scenario, federal and state environmental agencies announce and implement financial penalties (fines) for methane release to the atmosphere. As is currently happening in the oil/gas industry, these penalties are eased in over a four-year period, and cap at a rate around \$1550 per metric ton in 2022 dollars.

In general, the effect of this carrot + stick scenario on Coffin Butte Landfill’s operating life would be to lengthen it. The incentives would attract recyclers and other entities to target the high-organic sector of the landfill’s intake (about a quarter of total intake mass) for diversion away from the landfill, and the penalties would bring the landfill operator into alignment with this diversion (and reduction of profit). This would be a sea change in the wasteflow, creating knock-on opportunities to create circular economies for other types of waste, motivated by environmental concerns, economic efficiencies, and other reasons.

It’s also possible that this scenario would shorten the operating life of Coffin Butte Landfill, even precipitously, if the prospective penalties for incoming waste (plus the penalties for methane emissions from waste already emplaced) cut unacceptably into the profit schema of the landfill owner. The likelihood of this eventuality depends upon the actual methane output of the landfill, which is currently undocumented.

The signal for this scenario is strong, because it is based upon the stated goals of the US government, its commitments to climate action to the world, and goals and provisions already in place with the US 2021 Methane Emissions Reduction Plan.

Another legislative scenario to mention briefly, related to the climate crisis: efforts to limit atmospheric carbon widen to non-methane sources in the US, in the form of a carbon tax and/or subsidies for rail electrification. This scenario would disrupt the current operations in the Coffin

Butte wasteshed, by establishing new incentives to transport waste by rail rather than truck. This scenario is likely to extend the operating life of Coffin Butte Landfill, which has no rail connection and depends on trucking for its inflow. If entities can transport waste more economically by rail to cleaner landfills or to regional waste reclamation centers, that would cut inflow to Coffin Butte Landfill.

B. Climate Crisis Legal Action

Scenario: Environmentally engaged citizens sue governmental agencies (and investors sue corporations) for failing to act on the climate crisis. These lawsuits compel action to reduce emissions of greenhouse gases, which in turn boost efforts to divert material, especially food and other high organic waste, from being landfilled at Coffin Butte Landfill. In this scenario, these lawsuits have the potential to occur across the wasteshed.

Signals for this scenario set exist in plenty. Groups of environmentally engaged citizens are already pursuing lawsuits against states and nations; such cases appear regularly in the news as current ones wind their way through the courts and new ones are filed. Climate activism is already widespread in Oregon and the landfill's wasteshed includes areas disposed politically toward this kind of legal action. Benton County is more likely than most to be targeted for this kind of lawsuit, as its population generally prioritizes environmental concerns and the County has not shown concern over greenhouse gas emissions in its administration of Coffin Butte Landfill.

This scenario would further extend the operating life of the landfill if methane studies show that Coffin Butte Landfill is a worse polluter than alternative landfills in drier climates (if Coffin Butte Landfill converts waste to methane more quickly, for example). The legal action would then not only divert high-organic material out of the wastestream, but divert unsorted waste away from Coffin Butte Landfill to less-polluting alternatives.

C. Climate Crisis Environmental Activism

Scenario: Environmental activists accelerate their efforts to increase accountability for, and limit waste intake at, Coffin Butte Landfill. These efforts consist mostly of expansion to the current level of civic engagement but also branch out as protests and other direct action when civic engagement cannot produce the depth and velocity of change required for environmental protection.

This scenario is similar to, and operates in tandem with, the "legal action" scenario, and has a similar effect of reducing intake at the landfill. Activism happens more quickly however, so the primary impact of this scenario is as an across-the-board accelerant and forcer for all the environmentally motivated changes being discussed in this section.

Signals for environmental activism's impact on the operating life of Coffin Butte Landfill are very strong. Environmental activism has already caused the single most impactful event on the operating life of Coffin Butte Landfill in its history: activists stopped the expansion of the Riverbend Landfill in Yamhill County, which effectively doubled trash intake at Coffin Butte Landfill to its current high level. Local activism is why the County has assembled its Workgroup studying the future of solid waste management in Benton County, and local activists feature prominently in the work done by the Workgroup so far.

D. Climate Crisis Effects Upon Landfill Operating Life

Scenarios: effects of the climate crisis itself circle back to affect the operating life of Coffin Butte Landfill, by increasing the incidence of wildfires, floods, droughts, and other disruptions to the landfill's extensive infrastructure; by causing rapid and novel shifts in population migrations and attitudes; by posing threats to the landfill's operational status itself.

Signals for this set of scenarios are strong. Worldwide, the number and severity of climate events and disasters is growing, made more extreme by climate-crisis effects. Locally, in 2020 the Beachie Creek–Lionshead wildfire generated about a third of a million tons of debris for Coffin Butte Landfill. The region continues to slide into multi-year drought, which extends the fire season in an area already at risk with high forest fuel loads. The Willamette Valley now has a regular "smoke season." Rain events are growing in severity, increasing chances for flood events in the landfill's watershed and on the landfill itself. As a creator of flammable methane, the landfill has clear potential for a major fire event; it has caught fire in the past, which on one occasion called for a large fire response and took over 24 hours to bring under control.

Despite these trends, the Pacific Northwest is seen as a haven for those elsewhere who have been even more severely impacted by heat, fire, flood and other disasters.

In the main, climate crisis events are likely to shorten the landfill's operating life. Fires and flooding have the potential to generate debris flows that will consume capacity, as would a population boost from climate refugees relocating into the watershed.

The most extreme scenarios shorten the landfill's operating life precipitously. The landfill itself could have a flooding event, where leachate cannot be pumped out fast enough or overflows its collection ponds for example, with effects unknown upon the landfill's ability to continue operations. Wildfire is a clear existential threat, as landfills are full of both incendiary methane and flammable material; landfill fires can burn deep, are difficult to fight and have been known to burn for years and take over a hundred million dollars to extinguish.

These events concatenate: a storm event, for example, might knock out power to the landfill for an extended period, which then leads to a flood event as pumps cannot operate. An earthquake could cause both a power outage, which collapses the landfill's ability to operate its methane extraction system, and multiple wildfires, which threaten to ignite the uncontrolled methane. In

such scenarios, the landfill is not a direct threat to human life and thus not a priority for firefighters or other emergency action, so any incident can snowball.

E. Longevity: Post-Operational Costs

Climate legislation, activism, crisis events, and so on are all increasing the burden of monitoring and maintaining public safety for the decades required after the landfill ceases operations. It's estimated that the landfill will continue to produce significant amounts of methane for 20 years after it closes, for example. If that methane is incurring penalties, who will be paying them? If trees need to be prevented from growing on the landfill cover, who will be performing that maintenance? And so on, through a growing list of like questions.

Scenario: As a clearer picture of the landfill's post-operational burden emerges, it sparks action to cut the landfill's waste intake. This effort may be initiated by the County, in an effort to both reduce the landfill's pollution impacts and to put off the day when responsibility for the landfill is transferred to the County; it may be initiated by citizens, in an effort to both reduce the pollution impacts and to delay transition to another waste management scheme; it may be initiated by the landfill owner, in an effort to delay incurring expensive post-operation environmental mitigations, and/or to keep alive the legal option to file for expansion.

Signals for this scenario include the current litigation at Riverbend Landfill in Yamhill County, where the landfill owner is trying to avoid closing the landfill by taking in a minimal amount of trash per year, and county citizens are suing to force the landfill to close.

F. Unforeseen Novel Effects

The scenarios listed above have signals that are easy to discern, and they manifest in more or less familiar ways. The level of change at work here, however, signals the strong possibility for novel and unforeseen effects, especially concatenating ones. In the same way that COVID manifested itself in a myriad of ways that were difficult to anticipate, the climate crisis is causing changes with ripple effects that have yet to become apparent.

These effects inject (more) uncertainty into the agreements and infrastructure of the landfill's watershed, which in turn steers the entities in the watershed toward reducing their waste flows and increasing the resilience of their waste management by seeking other options. The unforeseen effects of climate change are likely to increase the landfill's operating life.

G. Contractual Obligations

From day to day the wasteflow to Coffin Butte Landfill is governed by business contracts that Republic Services holds with various entities; the landfill's watershed is defined and redefined by these contracts. Republic Services will not provide detail about these contracts, citing their

proprietary nature, so the wasteflow's net effect upon the operating life of the landfill is undocumented.

Imagination Training

When thinking about the future, it's common for people to manifest a cognitive bias toward the status quo, to think the future is settled as an extension of the present. This bias can manifest itself even when change is clearly underway. To counteract this bias, it's useful to require the arguments FOR the continuation of the status quo (rather than just accepting it as being unquestioningly able to continue).

To refute the idea that measures to prevent methane leaks will be extended from the oil/gas industry to the landfill industry, for example, would require a line of reasoning as to why those measures wouldn't be extended into the landfill industry (which is known to leak methane).

Another example: minimizing the role of environmental activism (as a human factor in the landfill's operating life) would require a line of reasoning as to why such activism will not continue to grow at its current pace.

Imagination training is also useful in exposing areas where data still holds sway, even though it is now known to be limited or obsolete, i.e., where an old idea perseveres purely through momentum or inertia. An example would be the methane emissions level at Coffin Butte Landfill: to persist in relying on an obsolete EPA estimate would require a line of reasoning as to why that estimate should hold sway over modern direct measurements.

ⁱ Endnotes to come.

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Appendix C: Human Factors Data

Appendix data to come