CA WASTEWATER

Script 3 — The Safe Drinking Water Act and the Established Contaminants

Recording script. Target ~10–15 minutes at a normal reading pace. Headers, bracketed notes, and timing estimates are for your reference and are not read aloud.

1. **The Safe Drinking Water Act [~3 min]**
   Every number, limit, monitoring schedule, and report traces back to one federal law: the Safe Drinking Water Act.

   First passed in 1974, the act protects the nation's public drinking water. It put the EPA in charge of setting national health standards for drinking water and made those standards legally enforceable. For each contaminant, the EPA either sets a maximum contaminant level, or, where a number isn't practical, a required treatment technique, which is a treatment process you perform instead.

   The Act lets the states run the program themselves. A state can assume primacy if its own rules are at least as strict as the federal ones and will enforce them. Most states, including California, have primacy.

   The agency that holds primacy in California is the State Water Resources Control Board's Division of Drinking Water. California also has its own Safe Drinking Water Act, written into the state Health and Safety Code, with the detailed rules residing in Title 22 of the California Code of Regulations. Because California has primacy, Title 22 must be at least as strict as the federal rules, and on many contaminants, it's stricter.

   So how does this affect you as a Water Treatment professional? It's the operating permit that lets your system run. It's the MCLs and treatment techniques you must meet, and the monitoring and reporting schedules you follow to prove it. It's the inspections and sanitary surveys that ensure you're operating the way you're supposed to. It's the annual Consumer Confidence Report you send your customers, plus the public notification you owe them when something goes wrong. It's the requirement that a certified operator be in charge, which is the whole reason the T5 certificate you're studying for exists.

   Every aspect of what you do traces back to this one Act.

2. **How a Contaminant Gets Regulated [~3 min]**
   Before touching on specific contaminants, it helps to understand how any contaminant becomes a regulated number in the first place.

   Every contaminant starts with a health goal called the maximum contaminant level goal, or MCLG. The MCLG is the level in drinking water at which no known or expected health effect occurs, with a margin of safety. It is a goal, not a rule and there is no violation for missing it. For a contaminant that causes cancer, the MCLG is usually set at zero, because no exposure is considered risk-free.

The enforceable number is the maximum contaminant level, or MCL. The EPA sets the MCL as close to the MCLG as is feasible, with feasible being the key word. Feasible is defined by the best available technology, or BAT, which is the best proven treatment a system could reasonably install, weighed against cost. The gap between an MCLG of zero and an MCL of some value is the compromise between the health ideal and what treatment can achieve at a reasonable cost.

Sometimes you cannot set an MCL at all, either because you cannot reliably measure the contaminant down at the level you care about, or because the contaminant enters after the water leaves the plant. In those cases, the rule sets a treatment technique instead. A treatment technique is a process rather than a number. For example, the Surface Water Treatment Rules require filtration and disinfection performance instead of a *Cryptosporidium* MCL, and the Lead and Copper rule requires corrosion control treatment instead of a lead or copper MCL at the tap.

But how do we know a system is meeting these limits? Most of the chemical contaminants such as the inorganics, the volatile and synthetic organics, and the radionuclides, are monitored under the Standardized Monitoring Framework. At a high level, the Framework organizes all of that monitoring into a predictable schedule built on nine-year compliance cycles, each made up of three, three-year periods. A system that keeps testing clean can earn reduced monitoring, and in some cases waivers, while a system with detected values samples more often. The point of the Framework is to make monitoring consistent and predictable instead of contaminant-by-contaminant guesswork.

3. Nitrate [~3 min]

Of all the contaminants in this script, nitrate is the exception, and it is worth understanding why. Where arsenic and the radionuclides erode into groundwater naturally from rock and soil, nitrate is largely caused by human-made pollution. It comes from nitrogen fertilizer, animal feedlots, manure, septic systems, and wastewater. In California, nitrate is one of the two most regulated inorganic chemicals, along with arsenic.

What sets nitrate apart is that it is an acute health concern. Nearly every other chemical contaminant in this script is a chronic, lifetime-exposure concern, but nitrate can harm the public within days. In infants under six months, it interferes with the blood's ability to carry oxygen, causing MetHb, often referred to as blue baby syndrome.

Systems monitor for nitrate differently depending on the source. Groundwater systems sample annually while surface water systems sample quarterly. For groundwater, a single sample at or above half the MCL moves the system to quarterly sampling, and it can return to annual after four straight quarters back below the MCL. A surface water system already samples quarterly, but it can decrease to annually after four straight quarters below half the MCL. In both cases a single sample at or above half the MCL bumps you to quarterly.

The acute nature of nitrate drives both the MCLs and the response. The MCLs, all measured as nitrogen, are:

- 10 milligrams per liter for nitrate,
- 1 milligram per liter for nitrite, and
- 10 milligrams per liter for nitrate and nitrite combined

A routine sample over the MCL triggers a confirmation sample within twenty-four hours and, if the average of the two still exceeds the MCL, is a violation. Because the risk is acute it requires a Tier 1 public notification and a warning that the water must not be given to infants under six months or used to prepare formula. A boil water notice is not appropriate since boiling only concentrates it.

Nitrate is a dissolved anion, so it cannot be filtered out like a particle. The primary treatment methods are ion exchange and reverse osmosis. Ion exchange requires brine disposal, and long operational runtimes can lead to the release of stored nitrate from the resin. Reverse osmosis works well but can be costly to operate and creates a large amount of wastewater. Electrodialysis is a third option but is complex and generally suited to smaller systems. A system can also use blending as a valid non-treatment technique by diluting a high-nitrate source with a cleaner one to bring the combined water under the MCL.

4. **The Arsenic Rule [~3 min]**

Arsenic is a naturally occurring semi-metal in rock and soil. It gets into water mostly by erosion of natural deposits within the ground, which is why it shows up in groundwater more often than surface water. There are historic man-made sources too, such as runoff from old orchards that used arsenic-based pesticides, and wastes from glass and electronics manufacturing.

Arsenic is a known carcinogen, linked over a lifetime of exposure to cancer of the bladder, lung, and skin, plus non-cancer effects like skin damage and circulatory problems. Because it is a carcinogen, the MCLG is zero. Arsenic's MCL is 10 parts per billion.

The chronic nature of arsenic shapes how compliance is judged and how you respond. Systems routinely sample every three years for ground water, or annually for surface water. If a sample comes back above the MCL, you confirm it, notify the State, and increase to quarterly sampling. From there, compliance is judged on the running annual average of those quarterly results. If the annual average exceeds the MCL, that's a violation. Additionally, if a single result is high enough to carry the annual average over the MCL by itself, you're immediately out of compliance. Either way, a violation means a Tier 2 public notification, issued within thirty days and repeated every three months until the problem is resolved. Lastly, a confirmed MCL exceedance of more than ten times the MCL may result in the State requiring you to immediately take the source out of service, with written approval required before it returns to service.

For treatment, the rule names seven BATs including activated alumina, coagulation and filtration, ion exchange, lime softening, reverse osmosis, electrodialysis, and oxidation and filtration. One caveat ties these treatments together: they all remove arsenic in its arsenate, or plus-five, form. Arsenic in the plus-three form does not remove well, so a system must usually oxidize the water first to convert the plus-three arsenic into the removable plus-five form. A system can also use blending as a valid non-treatment technique by diluting a high-arsenic source with a cleaner one to bring the combined water under the MCL.

5. **The Radionuclides Rule [~1 min]**
   Radionuclides are radioactive contaminants and, like arsenic, are mostly a natural groundwater problem, occurring from the erosion of natural deposits of radioactive minerals. The regulated ones are combined radium, gross alpha particle activity, uranium, and beta particle and photon radioactivity.

   Radionuclides are a public health risk because they're carcinogens. Each one carries a MCLG of zero, meaning there is no safe level of exposure. The health risks are chronic and build up over time, the same as arsenic.

   Radionuclide monitoring starts with four consecutive quarters of sampling at each source. That initial average sets the system's long-term schedule. If it comes back below the detection limit, the system samples just once every nine years. If it's detectable, but no more than half the MCL, once every six years. If it's above half the MCL but still at or below the MCL, once every three years. And if that initial average is over the MCL, the system stays on quarterly sampling until it strings together four straight quarters back at or below the limit.

   For treatment, ion exchange and reverse osmosis are the primary methods across the board, with lime softening as another option for radium and uranium.

6. **Close [~1 min]**
   The thread through this script is the difference between the health goal and the enforceable number, and the feasibility-and-technology compromise that sets the gap between them. Nitrate, arsenic, and the radionuclides are the settled end of that spectrum: the numbers have held for years and are stable. The moving targets are the subject of the next script.