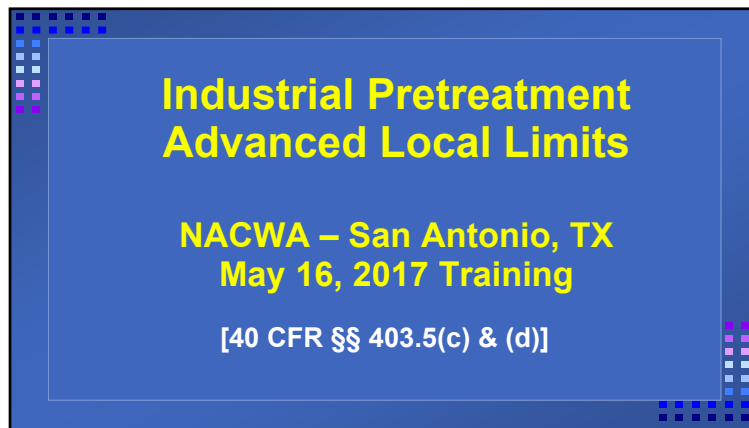




- **Who is required to develop and enforce local limits?**
 - All POTWs required to have a Pretreatment Program
 - All POTWs with existing pass through and/or interference problems.
- Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program available from EPA.
- PRELIM software available from EPA
- **Why are they considered pretreatment standards?**
 - Because it says so in § 403.5(d) - “Local limits shall be deemed pretreatment standards for the purpose of section 307(d) of the Act”
 - The consequence of such is that a user violating a local limit can be brought up on charges of violating the Clean Water Act.
- **Why are local limits required and what are they?**
 - § 403.5(c) - requires POTW to develop specific, technically-based, IU discharge standards to implement the general and specific prohibitions of Part 403 to protect the POTW. Local limits are also intended to...NEXT SLIDE

“Technically Based Local Limits”

- ❑ Eleventh Commandment:
“Thou Shalt Neither Covet Nor
Steal Thy Neighbor’s Local Limits”**
- ❑ Keep in mind the definition of “local”
[i.e. site specific...YOUR site]**
- ❑ Local limits should support and
accommodate the strengths and
weaknesses of each POTW**

•We talk about “technically” based local limits all the time. What are technically based local limits? Most importantly, what are NOT technically based local limits.

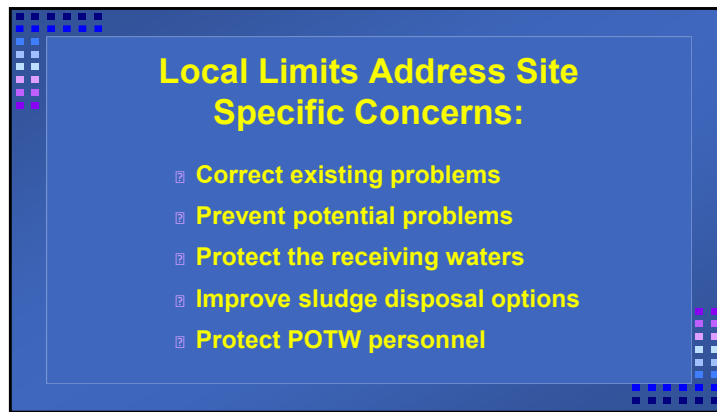
• They are NOT the list of limits established by the neighboring town, that you absconded with and placed in your own SUO. They might have been technically based in the town next door, but they lost all their technical merit when they crossed the POTW boundary.

•Do you incinerate your sludge? Then you will not have to worry about violating the standard. If you land apply your sludge, the standard is an issue.

• Is your POTW brand new and state of the art or is it ancient and hanging on by a thread?

•Is your BOD limit 30 or 4? Do you discharge to the Mississippi River or a dry ditch?

•And please remember, local limits development should never be the remedy for a poorly operated POTW. If you have an influent BOD of 225 and 40% BOD removal, the lack of a local limit for BOD is not the problem and don’t let any operations manager try to tell you it is.....



- **Correct existing problems**

- Determine removal efficiency providing justification to further limit pollutants, perhaps merely from the major contributors of the specific pollutants.

- **Prevent potential problems...**

- of treatable pollutants, by not exceeding
 - removal efficiency determined by allowable loading
 - level(s) known to cause toxicity
- of “incidental removal” pollutants
 - passing through/interfering
- in the collection system and/or plant
 - oils/grease.

- **Protect receiving waters**

- Achieve by correcting any existing problems and preventing potential problems.

- **Improve sludge option disposals**

- Land application/composting as opposed to disposal.

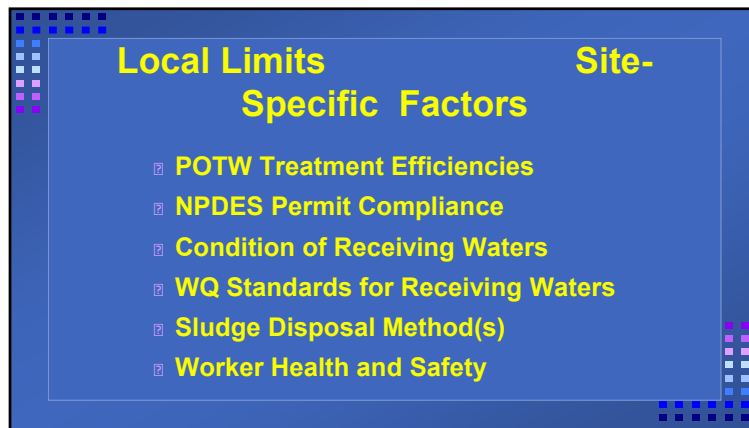
- **Protect POTW personnel**

- slug discharge plans
- limits set at exposure levels.

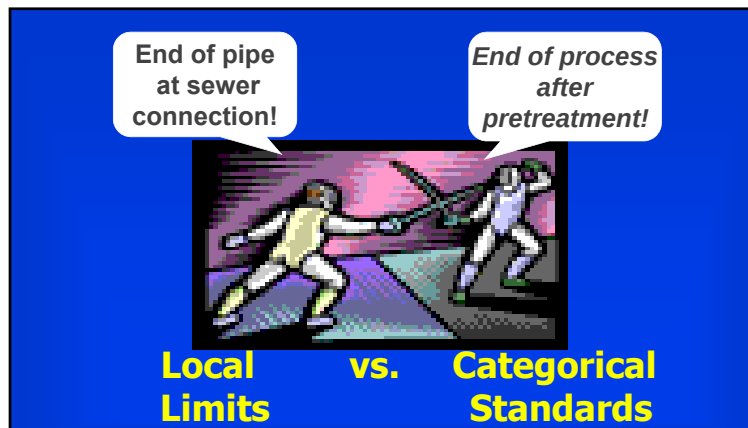
- **Local limits are not intended to validate the lack of proper operation and maintenance at a POTW treatment plant.**

- **Potential benefits include:**

- increasing POTW treatment efficiency; and
- cutting O&M costs.



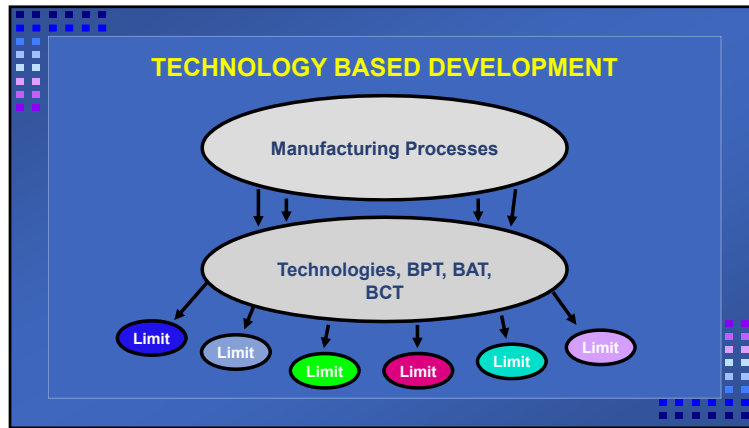
- Is your POTW in compliance?
- Is your receiving water on your state's 303(d) impaired waters list?
- Is your receiving water subject to a Total Maximum Daily Load?
- Does your POTW discharge to a drinking water source or outstanding resource waters?

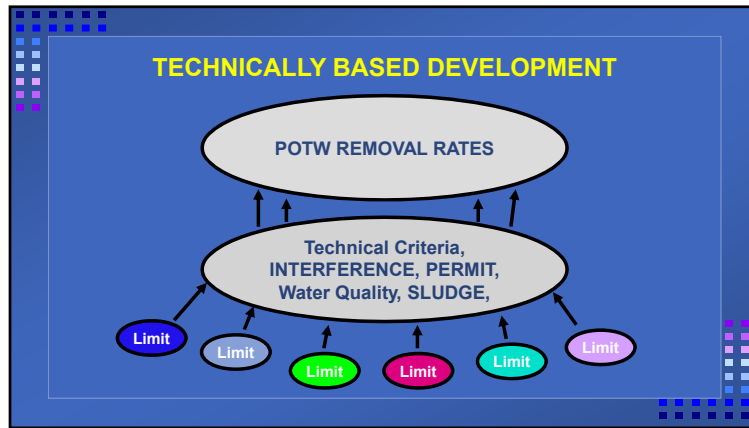


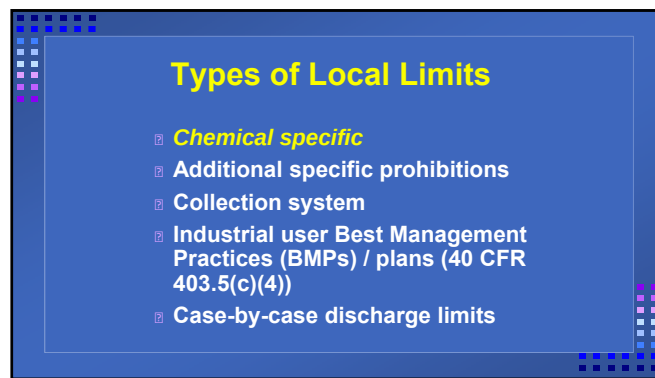
- Categorical standards and local limits are complementary types of pretreatment standards.
- Categorical standards are developed to achieve uniform water pollution control nationwide for selected pollutants and industries. Categorical standards apply only to regulated wastestreams for industries subject to categorical standards.
- Local limits are intended to prevent site-specific POTW and environmental problems due to non-domestic dischargers. Local limits apply at the point of discharge to the POTW and include all types of wastewaters. Limits apply at each connection to the sewer.

	Categorical Stds.	Local Limits
Developed:	By EPA	(Control Auth) POTW
Objective:	Uniform National Control of certain IUs	POTW/Receiving Water Protection
Regulates:	Industries specified in Clean Water Act	All non-domestic dischargers
Pollutants:	Priority Pollutants (toxic & non-conventional only)	Any Pollutant
Basis:	Technology Based	Technically based on site-specific factors
Apply:	At the End of regulated process(es)	Depends on development method

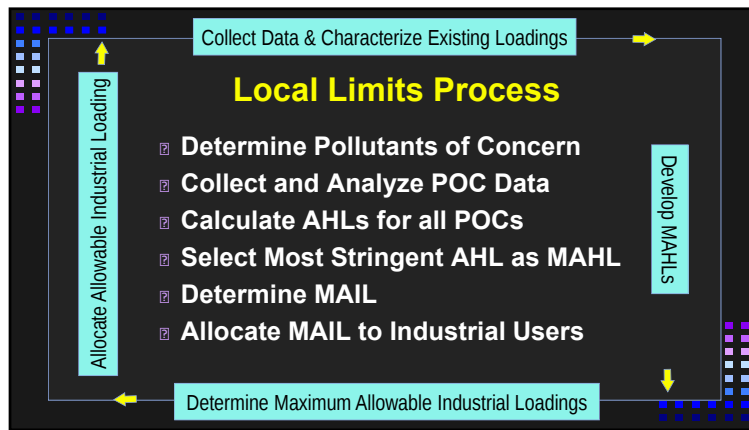
- This is a summary which might help you distinguish the roles of each of these very important limitations...

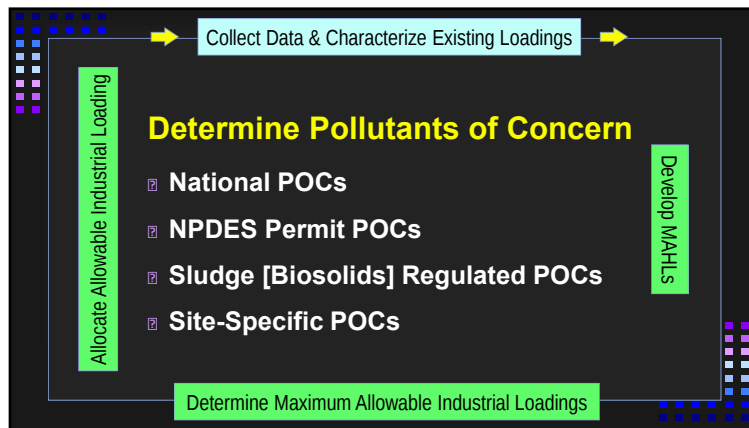






- **Additional prohibitions could include:**
- **Chemical specific local limits is the focus of our presentation today**
 - Type of limit typically associated with the term “local limits”
 - Quantitative evaluation of pollutant contributions and fate
- There are other local limits, however, such as
- Noxious or malodorous liquids, gases, or solids creating a public nuisance
 - Wastestreams which impart color and pass through the POTW treatment plant
 - Storm water, roof runoff, swimming pool drainage, etc.
 - Any removed substance from pretreatment of wastewater
 - Wastewater containing radioactive wastes or isotopes.
- **Collection system limits**
 - Identify pollutants which may cause:
 - fire explosion hazards, or
 - worker health and safety concerns
 - Pollutants present evaluated/modeled to determine expected concentration in air
 - EPA Manual, Guidance to Protect POTW Workers from Toxic and Reactive Gases and Vapors available.
- **Industrial user management practice plans**
 - Required development of practices for handling chemicals/waste. Includes:
 - chemical management plans, best management plans, slug control/accidental discharge, waste minimization plans.
 - Added in Pretreatment Streamlining regulations as part (c)(4) of 40 CFR 403.5...now if adopted they become Pretreatment Standards.
- **Case-by-case**
 - Numeric limits imposed based on best professional judgment and available technologies. (Common for groundwater clean up projects. Often set limits for BTEX or will specify that activated carbon treatment must be used.)





- **The POTW must also characterize existing contributions (i.e., loadings) from all different types of sources.** These include:
 - Industrial Users
 - Control Authority and IU monitoring data is acceptable
 - Commercial Sources
 - Small flow IUs individually, but collectively may make up a significant portion of the total IU flow
 - Consider sampling representative locations that are indicative of commercial contributions
 - Hauled Waste
 - Can be a significant contribution depending on what is being discharged, and how many haulers discharge
 - Domestic Loadings
 - Site specific data from a representative portion of the POTW's collection system is preferred
 - Literature values may be used.
- **Data used shall be representative.**
- **After collecting data,** the POTW should compare total loadings from all sources with the total loading at the POTW influent and determine if reasonable.
 - Within an order of magnitude may be reasonable
 - May need to re-evaluate data and collect additional samples if discrepancies are too great.

Pollutants of Concern [POC]

- ▣ Any pollutant which might be reasonably discharged and capable of causing:
 - pass through
 - interference
 - sludge contamination
 - POTW worker health/safety risks

National Pollutants of Concern

- EPA Identified 15 pollutants often found in POTW effluent and sludge
 - Assume all 15 to be POCs unless Approval Authority agrees otherwise
- EPA recommends POTW screening for these 15 using data from:
 - POTW influent, effluent and sludge
 - Industrial User discharges

National EPA POCs		
Arsenic	Lead	Silver
Cadmium	Mercury	Zinc
Chromium	Molybdenum	BOD ₅
Copper	Nickel	TSS
Cyanide	Selenium	Ammonia

- The 10 pollutants in white were first identified in the 1987 Local Limits Guidance. Keep in mind the objectives of the Pretreatment program, one is the beneficial re-use of sludge, land application.
- EPA has added molybdenum and selenium because they are part of the federal biosolids regulations for land application of sludge.
- EPA also added the conventional pollutants Biochemical Oxygen Demand, total suspended solids and ammonia nitrogen because many POTWs have ongoing problems with excessive loadings of these pollutants.

NPDES Potential POCs

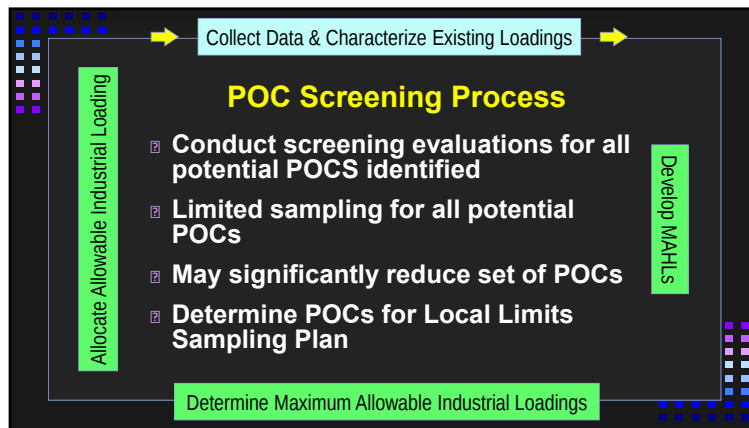
- ▣ NPDES Permit pollutants
 - Limited in NPDES Permit
 - NPDES “monitoring only” pollutants
- ▣ Any pollutant that has caused POTW violations or operational problems
 - Including conventional pollutants or phosphorus
- ▣ Any pollutant responsible for failure of Whole Effluent Toxicity [WET] test

Biosolids Regulated POCs

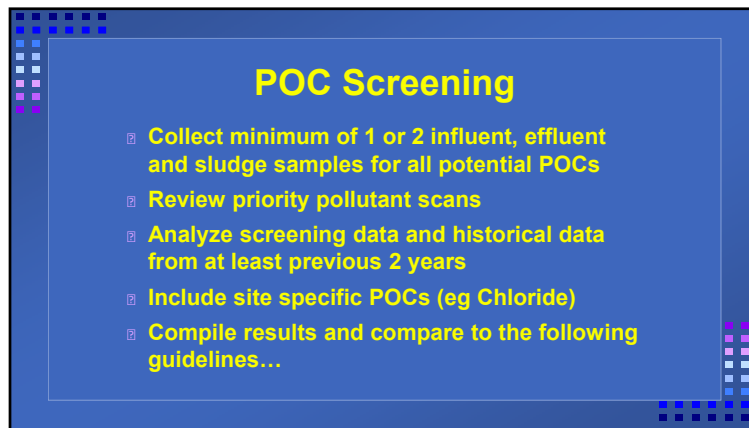
- ▣ Land Application: [40 CFR Part 503]
 - Arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc
- ▣ Surface Disposal: [40 CFR Part 503]
 - Arsenic, chromium, nickel
- ▣ Incineration: [40 CFR 61 and 503]
 - Beryllium, mercury, lead, arsenic, cadmium, chromium, nickel
- ▣ Any State regulated pollutants

Site Specific Potential POCs

- ☐ **POTW Interference [no NPDES violations]**
- ☐ **Pollutants detected in Priority Pollutant Scan**
- ☐ **Reclaim Water [Effluent] Reuse Limits**
- ☐ **Air Quality Standards [NESHAP, NAAQS]**
- ☐ **POTW Receiving Water Issues:**
 - **Public/Private Drinking Water Supply**
 - **Outstanding Resource Waters**



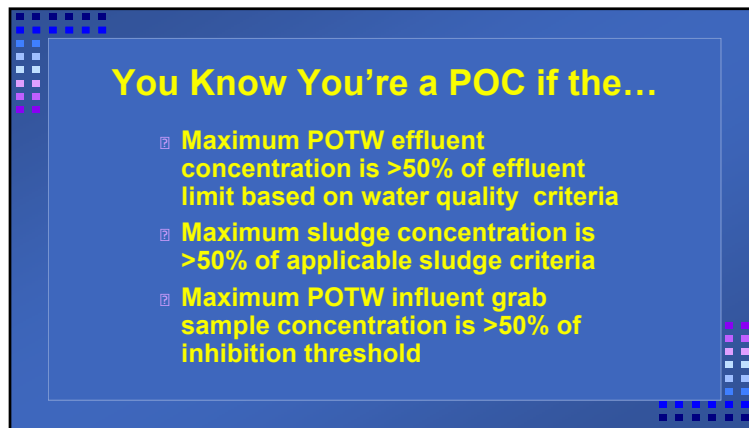
- Before undertaking the extensive collection and analysis of sampling data for the development of local limits a POTW should conduct a screening to determine which POC should be included in the full headworks analysis.
- 40 CFR Part 403.8(f)(4)...must develop local limits or demonstrate they are not necessary.
- The outcome of the screening process will provide a technical basis to prove that no further action is necessary on certain pollutants.

A blue rectangular slide with a decorative border of small squares in the top-left and bottom-right corners. The title "POC Screening" is centered at the top in yellow. Below it is a bulleted list of five items, each preceded by a small square icon.

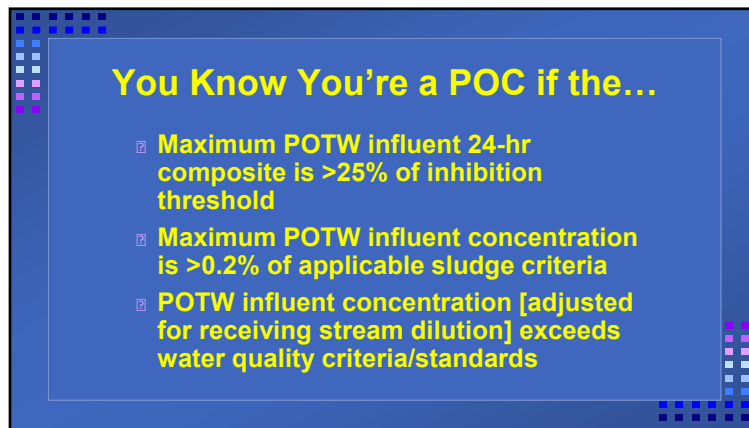
POC Screening

- Collect minimum of 1 or 2 influent, effluent and sludge samples for all potential POCs
- Review priority pollutant scans
- Analyze screening data and historical data from at least previous 2 years
- Include site specific POCs (eg Chloride)
- Compile results and compare to the following guidelines...

- Intent of this part of the guidance is to say that this screening is for site specific POCs, and not stuff like the 15 national POCs or NPDES permit limit POCs



- EPA Guidance.....
- Again site specific POCs
- Not a black & white line, fairly arbitrary cut-offs



- EPA Guidance



Local Limits Data Used to:

- ☐ Identify/confirm presence of pollutants
- ☐ Determine POCs
- ☐ Determine current POTW loadings
- ☐ Calculate % Removal Efficiencies
- ☐ Determine site-specific inhibition values
- ☐ Estimate loadings from IUs, domestic/uncontrollable sources, etc.

Removal Rate Formula:

Removal Rate [Efficiency] (as decimal) =

$$\frac{\text{Influent (mg/l)} - \text{Effluent (mg/l)}}{\text{Influent (mg/l)}}$$

Note....mass in pounds/day can also be used for this calculation

- The removal rate value is a very important component of the MAHL calculation so we need to know how to calculate that too.....
- Removal rate is also sometimes called removal efficiency or % efficiency or even daily removal efficiency or DRE.
- The formula is the Influent concentration minus the effluent concentration divided by the influent concentration times 100.....
- Of course, to turn it into a percentage add the times 100 part at the end.....

Calculate % Removal Rate

If a POTW has an influent BOD of 234 mg/l and an effluent BOD of 4.2 mg/l, what is the %removal rate (efficiency)?

$$\frac{234 \text{ mg/l} - 4.2 \text{ mg/l}}{234 \text{ mg/l}} \times 100 = 98.2\%$$

•Let's take some data from a real POTW and calculate a removal rate...It will only take a minute....

•**CLICK**

•Just use the formula from the previous slide and plug in the information on this slide to calculate the removal rate...

•Finished???

•**CLICK**

•234 minus 4.2

•**CLICK**

•divided by 234 times 100

•**CLICK**

•equals 98.2% removal

Importance of RR Values

Same POTW: 15.0 mg/l NPDES BOD Limit
5.0 MGD Flow

RR	MAHL [lbs]
92.4%	8,230
93.4%	9,477
94.4%	11,170
95.4%	13,598

RR	MAHL [lbs]
96.4%	17,375
97.4%	24,058
98.4%	39,094
99.4%	104,250

•We just calculated the removal rate....now let's see why this number is so important and why we want to make sure we have sampled, analyzed and interpreted the data to our best advantage....

•This chart summarizes the BOD Maximum Allowable Headworks Loading for a typical small POTW....5.0 MGD and a 15 mg/l NPDES permit limit for BOD

•The chart starts with 92.4% removal and increases in 1% increments...

•The MAHL increase between 92.4% and 93.4% is modest....The MAHL increase between 98.4% and 99.4% is phenomenal....

•Oh what a difference 1% can make.....or even 0.1 % when you get up above 95%

•Please note that often for BOD and TSS, the Approval Authority will require that the Pretreatment Coordinator use POTW Design Criteria for BOD and

TSS rather than the Pass-Through NPDES Permit Limit calculation that uses the % removal, but it is important to know what a difference removal rates can make and this example certainly shows that!

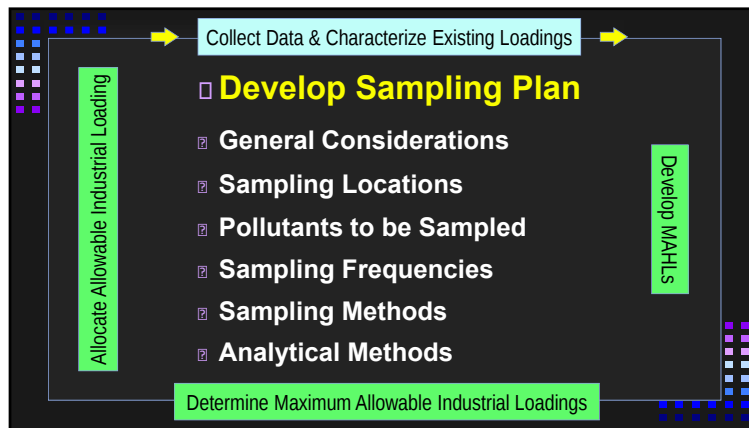
Importance of RR Values

Same POTW: 0.002 mg/l Cadmium Limit
5.0 MGD Flow

RR	MAHL [lbs]
46.0%	0.154
56.0%	0.190
66.0%	0.245

RR	MAHL [lbs]
76.0%	0.348
86.0%	0.596
96.0%	2.085

- We've looked at a BOD example, now let's take a quick look at an example of how important removal rates are for metals, too.
- Here we have our same POTW that just happens to be on a very, very small stream so their NPDES permit limit for cadmium is 0.002 mg/l or 2 ppb....
- Let's look at the removal rates with differences of 10% in the chart. As you can see there's not a whole lot of difference until you get up to the 76% value, but look at the difference between 86% and 96%.....Wow....
- So as we look at the various ways to calculate removal efficiencies just keep in mind how much the MAHL may change with just a small difference in the % removal especially in the high 90 percent range....



- Now that you've determined your POTWs Pollutants of concern, you need to develop a sampling plan to generate sufficient data to conduct Headworks Analyses calculations.
- The Sampling Plan should address:
 - Sampling locations for the variety of pollutants of concern
 - Pollutants to be sampled at each location
 - Sampling frequencies for the various locations and pollutants
 - Sampling methods appropriate for the conditions and the use of the data AND
 - The analytical methods that will be employed to generate the data

But First we'll discuss a few general considerations....

General Considerations:

- ❑ NPDES Monitoring: “Daily” [Mon-Fri]
 - Use all NPDES Data for POC
 - “Composite Times” of NPDES samples
 - If only effluent analysis is NPDES required, look at resources for doing influent, too
- ❑ Don’t sample on same day of week for every POC sampling event [You’ll see why later...]
- ❑ Quarterly Sampling * 5 yrs = 20 data points

•Daily analyses usually required in NPDES permits for parameters like BOD, TSS and ammonia. Use all of your required NPDES samples for your headworks analysis calculations --- (unless some reason not to use some of the data???).

•Keep in mind that for NPDES sampling if the composite sample comes off at 7 am on Monday and is called Monday’s sample....it really is mostly Sunday’s sample and a Sunday influent may be very different from the rest of the week. Most all of your industries are shut down. Make sure you know the composite times of your POTW’s samples....It will help you make good decisions as to which day to sample to get a truly representative influent and effluent.

•We just talked about how the Monday influent may be mostly Sunday’s sample so make sure you are not doing all of your HWA metals sampling on the first Monday in each month or the first Monday in each quarter. Consider taking your HWA samples on different days. Sure it will be a little more complicated to keep up with, but as you’ll see a little later in the presentation, it may make a world of difference in your MAHLs.

•NPDES permits may or may not require influent metals monitoring (highly variable state to state & region to region)....**but** you may have weekly effluent metals monitoring. Look at the cost of doing the influent to match

every effluent sample. It may be worth it in the long run.

- If you sample quarterly for five years, you'll have 20 datapoints for your next POC.

General Considerations: Know When NOT to Sample

- ❑ High Flow Conditions
- ❑ POTW Upset
- ❑ POTW Power Failure
- ❑ Equipment Break-Down or PM
- ❑ Holidays [Week of Christmas/July 4th]
- ❑ Don't be so "compulsive" that you can't be flexible with POC sampling

•Although it is very important to know when to take your POC samples...it is just as important to know when NOT to take your HWA samples.

•Most of these are no-brainers, but you'd be surprised at how many folks have ignored these "unrepresentative" situations and taken the sample anyway just because "I always take my monthly POC samples on the first Wednesday of each month...." That may be true... but if Hurricane Fran just came through the previous Monday I believe I'd consider changing my schedule just this once.

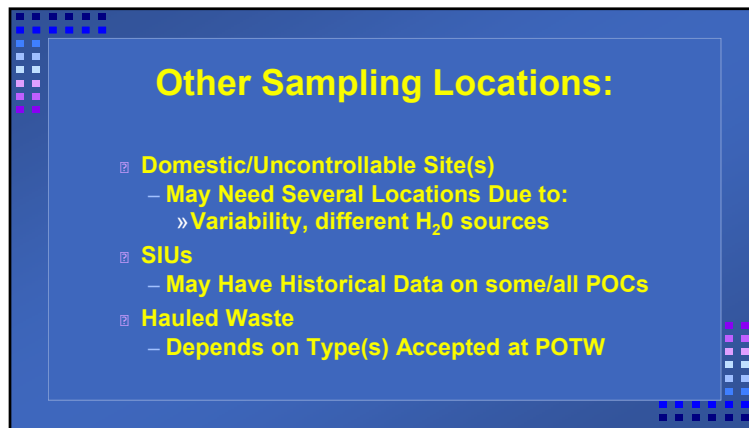
•The sampling does not have to be conducted on a certain day...just one sample in a certain time period. The first Wednesday in July probably isn't a very good time either, especially if you have industries that may be shut down for the whole week.

POTW Sampling Locations

- ▣ POTW Influent*
 - Before mixing with any recycle streams
- ▣ POTW Effluent*
- ▣ Aerobic/Anaerobic Digester*
 - “Acclimation” values
- ▣ Biosolids to Disposal*
 - 40 CFR Part 503 Annual Report Data
- ▣ Activated Sludge
 - “Acclimation” values



- Also even though this may sound like a no-brainer...Make sure your influent is *really* your *influent*. Many POTW recycle streams return to the head of the POTW or into the influent wet well. Guess what else...any time you drain a tank it may go straight back to the influent wet well. !
- Good POC sampling data can also protect the PT coordinator from taking heat for plant problems. I know when YOUR POTW has problems, you NEVER hear the ORC say “One of YOUR industries dumped something on us”. It may very well be recycle stream slugs or an operational mistake that actually caused the problem.
- Sludge samples taken for the 40 CFR Part 503 required Annual sludge report can also be used to calculate local limits.
- Little information on digester inhibition is available in the literature. Site specific data will be able to demonstrate acclimation values which can be compared to the literature values.
- Likewise, acclimation values from activated sludge can be compared to the literature values.



Other Sampling Locations:

- Domestic/Uncontrollable Site(s)
 - May Need Several Locations Due to:
 - » Variability, different H₂O sources
- SIUs
 - May Have Historical Data on some/all POCs
- Hauled Waste
 - Depends on Type(s) Accepted at POTW

- The uncontrollable load to the POTW is also a very important calculation and it is worth the extra effort to determine the appropriate concentration.
- EPA published “Domestic” waste values in the Local Limits Guidance. However, most POTWs who have done extensive site-specific uncontrollable sampling consider the EPA values to be high for most pollutants.
- Draw domestic/commercial/uncontrollable samples from points that isolate residential and commercial sources
- Newer sections of town will have higher copper while older ones will have higher zinc levels.
- If more than one drinking water system operates within POTW service area, they may add different chemicals to control corrosion so you’ll never several sites

Pollutants to Be Sampled:

- ☐ **"The EPA 15"-National POCs**
- ☐ **POTW Site Specific POCs**
- ☐ **Organic "Priority Pollutants"**
 - POTW Influent/Effluent Only
- ☐ **% Solids in Sludge**
- ☐ **TCLP pollutants**
 - Sludge for Landfill Disposal

Sampling Days for Initial Local Limits Development				
Parameter	POTW			Domestic/ Uncontrollable
	Influent	Effluent	Sludge	
Organic PP	1 - 2	1 - 2	1	1 - 2
National POC	7 - 14	7 - 14	2	7
Site Sp. POC	7 - 14	7 - 14	2	7
% Solids			2	
TCLP [Landfill]			1	

- Sampling to support the initial development of local limits may need to be collected quickly to provide the data necessary to identify POCs, determine MAHLs and implement local limits.
- POTWs with design flow of <50 MGD should sample for at least 7 consecutive days
- POTWs with design flow >50 MGD should sample for 10-14 days over a period of 2 weeks to 2 months
- This table is EPA minimum recommendation
- The limited number of sampling events may not generate enough data to calculate the POTWs efficiency at removing every pollutant in this influent. In such cases, some Approval Authorities may allow-or even require the use of literature values if they believe a POTWs sampling is less accurate than those values.

Table 4-2: Minimum Recommended Sampling Frequencies for Ongoing Local Limits Analysis and Evaluation

Parameter	Location	Less than 5 MGD	5 – 10 MGD	10 – 50 MGD	Greater than 50 MGD
Pollutants for which local limits were adopted	Influent, Effluent, Sludge	Once every 3 months	Once every 3 months	Once every 3 months	Once every 2 months
Pollutants for which MAHLs were calculated, but for which no local limits were adopted	Influent, Effluent, Sludge	Once every 12 months	Once every 6 months	Once every 6 months	Once every 3 months
Organic Priority Pollutants	Influent	Once per year	Once per year	Once per year	Once every 6 months
TCLP Pollutants (1), sludge	Sludge	Once per year	Once per year	Once per year	Once per year
Sludge percent solids and specific gravity (2)	Sludge	Once every 6 months	Once every 4 months	Once every 3 months	Once every 2 months

(1) Conducted if sludge is (or is likely to be) disposed of in a landfill.
(2) The sludge regulations at 40 CFR Part 503 already require the percentage of solids to be determined every day that sludge is applied to land.

Sampling Frequencies

- ☐ Sampling should be random and representative of different days, months and IU production schedules
- ☐ POC Sampling schedule should ensure collection of samples that are representative of weather conditions that affect POTWs
- ☐ POTW Sampling should account for hydraulic detention [retention] times

POC Sampling Methods: “Paired” Samples Sampling

- ❓ “Pair” Influent/Effluent Samples According to Detention Time (DT)
 - “Delayed” Composite Samplers OR
 - IF DT is ~24 Hrs, or ~48 Hrs, or ~72 Hrs
 - » Just Use Regular “Daily” Composite Results and “Match Them”
 - » i.e. 24 hour DT... Monday’s influent is “paired” with Tuesday’s effluent

• “Paired” samples are taken according to the detention time of your POTW so that you will actually be comparing the influent with the same exact effluent. The detention time is the amount of time it takes for the wastewater to travel through your treatment plant. Obviously the higher the flow the shorter the detention time, the lower the flow the longer the detention time.

• One way to get paired samples is to set up a delayed composite sampler at the effluent....for instance if the detention time in your plant is 12 hours you can set up your 24 hour composite sampler at the effluent 12 hours after the influent composite was started and take it off accordingly. That way you are theoretically sampling the same exact wastewater....

• Or if your detention time is approximately 24 hours or approximately 48 hours or approximately 72 hours you can just take any results from parameters that you run “daily” and “match” the influent with the appropriate effluent...

• Of course if you want paired samples for parameters that you usually only catch once a week, you may be forced to do some special sampling and/or analysis.

• With a 48 hour detention time and “paired” metals samples you might have Tuesday’s influent analyzed for metals and also have Thursday’s effluent analyzed for metals.

POC SAMPLING: “Paired” Samples Sampling

DETENTION TIME (DT) FORMULA:

$$\text{POTW Detention Time [in hours]} = \frac{24 \text{ [hr/day]} * \text{POTW Tank Volumes [MG]}}{\text{Actual POTW Flow [MGD]}}$$

- So if you wanted to try some “paired” sampling how would you go about finding out the detention time of *your* POTW?
- This is the detention time formula....
- 24 hours per day times the POTW tank volumes divided by the actual flow....
- Please note that you use the ACTUAL POTW Flow for this calculation NOT the design flow.....and also please note that the flows on the top and bottom of the formula MUST be in the same units...either both in Million Gallons or both in what I call “plain old gallons”....
- If you use this exact formula for detention time your answer will be in HOURS...Please note that the 24 hours per day value is a constant in this formula.
- Don’t just think you can look up the detention time in your POTW O&M Manual...that detention time is usually based on design flow and you won’t be right unless your plant is at design capacity....and if your plant is running at design capacity you’ve got bigger problems than calculating a new headworks analysis. Besides you won’t need a new headworks if you are at design capacity because your Approval Authority won’t let you make any more sewer connections or issue any more pretreatment permits at that point.

Math Exercise: Calculate Detention Time

- ❑ **Tank Volumes** [look in POTW O&M Manual]
 - **Primary Clarifiers = 0.40 MG**
 - **Aeration Tanks = 1.40 MG**
 - **Final Clarifiers = 0.60 MG**
 - **Chlorine Contact Tank = 0.105 MG**
- ❑ **Permitted Flow = 4,000,000 gpd**
- ❑ ***Actual* Flow = 2,250,000 gpd**

- Here is the information you need to calculate the detention time.....
- So go on to the next slide in your handout and do the calculations there...I'll give you a couple of minutes

Calculate Detention Time [DT]

$$TV = 0.4 + 1.4 + 0.6 + 0.105 = 2.505 \text{ MG}$$

$$\text{Actual Flow} = \frac{2,250,000 \text{ gpd}}{1,000,000 \text{ gal/MG}} = 2.250 \text{ MGD}$$

$$DT = \frac{24 \text{ (hr/day)} * \text{Tank Volume [MG]}}{\text{Actual Flow [MGD]}}$$

$$DT = \frac{24 \text{ (hr/day)} * 2.505 \text{ MG}}{2.250 \text{ MGD}} = 26.72 \text{ hours}$$

- Okay what was the tank volume? **CLICK** 2.505 million gallons
- And what flow are we going to use? The actual flow, right.
- If you'll note I just put the permitted flow in there to trick you...**CLICK**...and I gave you the flow in plain old gallons instead of million gallons to make you have to think...**CLICK** Just divide plain old gallons by one million to get MG
- So the actual flow we will use is 2.250 MGD
- CLICK CLICK**
- Here's the formula and we'll plug our numbers in...
- CLICK**
- That's 24 hours per day times 2.505 MG
- CLICK**
- divided by 2.250 MGD
- CLICK**
- That's 26.72 hours detention time.
- Now in this particular case, if you wanted to do some paired sampling would you really have to set up a delayed sampler or could you just take the normal data and match it up....With a detention time so close to 24 hours you could just match up your daily results...

Calculate Paired Samples

My POTW DT is 72 Hours....So what????

DAY	INF	EFF	%RR
Fri			
Mon	50	78	-56%
Fri			
Mon	36	48	-33%

DAY	INF	EFF	%RR
Fri	325		
Mon		78	76%
Fri	294		
Mon		48	84%

MAHL = 0 pounds Nickel

MAHL = 19.8 pounds Nickel

POTW Flow = 3.5 MGD NPDES Nickel Limit = 136 ug/l

•Just a note before we take a closer look here....All of these nickel values are in ug/l or ppb.

•First calculate the removal rates for the chart on the left side of the slide. Here we have a dedicated PT coordinator who always takes all of his POC metals samples on Monday....He wants to start the week off right and get that important task out of the way. But he hasn't been to this session and he has ignored the fact that he has a 72 hour detention time in his POTW. [Give about one minute here]

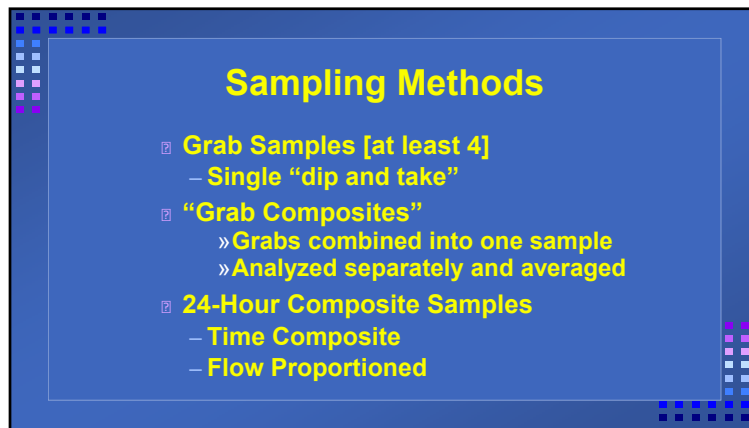
•**CLICK CLICK**

•He appears to be manufacturing nickel at this POTW!!! But let's take a look at the influent concentrations that really match his effluents...WE're going to put Friday's influent with Monday's effluent. Now calculate the removal rates for the chart on the right side of the slide. [Give about one minute here] **CLICK CLICK**

•VIOLA.. We get an Average of 80% removal with our paired samples.....

•And don't forget the bottom line...let's look at the resulting MAHLs for these two calculations...On the left side we have **CLICK HELLO!** A ZERO MAHL and with our paired samples **CLICK** we've got 19.8 pounds....all because the PT coordinator understands the wastewater treatment process and headworks analysis.

- Just another one of the tricks of the trade.....another trick to prevent unnecessary pretreatment and allow your POTW to best utilize its resources...



- The purpose of any sampling is to accurately typify the contents of the wastestream being sampled. No where is this more important than when sampling for local limits.
- Samples of wastewater typically are one of three types: flow proportioned composites, time composites or grab samples.
- Each type has its use in the local limits development process, but the 24 hour Flow proportioned samples are the most representative and most accurate for this purpose.
- 24 Hour Flow proportional should be used when ever feasible for all pollutants except those that require grab samples
- Local Limits POC data is used by the Pretreatment Coordinator to support decisions/calculations concerning the Maximum Allowable Headworks Loading [MAHL] for all pollutants of concern. The MAHL is the starting point and controlling factor for POTW compliance, POTW protection, and all SIU permit limits. Thus, this sampling is, in some ways, the most important data generated under the pretreatment program since all technically based local limits and individual SIU permit limits are derived from the MAHL. It is critical that the analytical data used in these small data sets be accurate.

Typical Wastewater Sample Types	
Grab Sample	Composite Sample
pH	BOD/CBOD
Cyanide	COD
Total Phenol	TSS/TDS
Oil and Grease	Nutrients [Nitrogen/Phosphorus]
Sulfides	Metals [except 1669 ↓ level]
Flashpoint	Whole Effluent Toxicity
Volatile Organic Compounds [Method 624]	Acid Extractable/Base Neutral Organics [Method 625]

- Please don't misunderstand this slide. You do not HAVE to collect a composite sample for the parameters listed under composite but you MUST collect a grab sample for those listed under the grab sample heading.

POC Sampling Methods: Whole Effluent Toxicity

- ❑ **Several 24-Hour Composites Used For WET**
 - **Coordinate POC Analyses with WET.....**
 - » **POTW Influent and Effluent**
 - ❑ **Metals**
 - ❑ **Cyanide**
 - ❑ **Nutrients**
 - ❑ **Organics**
 - » **Aeration Tank Samples for Inhibition, Too!!!**

•Now lets' talk about POC sampling as it relates to Whole Effluent Toxicity sampling.

•So you ask....what in the world does Whole Effluent Toxicity have to do with Headworks Analysis....The lab worries about whole effluent toxicity, that's not a pretreatment issue.....Well if we're really trying to determine that no pass through has occurred...then we need to look at the bioassay test results...and we need to look at other parameters at the same time.

•You'd be surprised at how many towns conduct Whole Effluent Toxicity sampling completely separate from all other parameter sampling. They use a separate composite sampler and don't run anything on that sample except bioassay.

•Why in the world wouldn't you want to coordinate POC sampling with your Whole Effluent Toxicity testing.....it just makes sense to have all of that data on the same samples...

•Don't forget about the aeration tank samples to examine inhibition values for your activated sludge or nitrification process. It would be great to have those samples during the same time period, also.

40 CFR Part 136

- ❑ **EPA regulation governing all NPDES and PT program wastewater analyses**
 - **Approved analytical methods**
 - **Required preservation, containers, holding times**
- ❑ **Recent Amendments removed some of the older Std. Methods editions**

- The NPDES and the pretreatment regulations require that all wastewater sample be analyzed by methods and requirements contained in 40 CFR Part 136.
- These analytical methods should also be used in the development of local limits.
- Principal reason is to allow the comparison of local limits and categorical standards to determine which are more stringent as required by the General Pretreatment Regulations.

EPA Approved Analytical Method

- ❓ Any method not specifically listed in 40 CFR Part 136 is prohibited for NPDES and PT analyses
- ❓ Careful with organic analyses.... [Methods 6010, 8260, etc. are NOT approved for wastewater]
- ❓ Required Sludge methodology is listed in 40 CFR Part 503 [Not 40 CFR Part 136]

•Remember: Not All methods in Standard Methods are approved for use in 40 CFR Part 136 and not all EPA methods are approved for wastewater

•Organics analyses are the world's worse. Commercial labs often use the solid waste methods for wastewater analyses. BE sure to refer back to 40 CFR Part 136 when you are reviewing your data to make sure the proper method was used. EPA Method 624 & 1624 is the approved method for wastewater volatile organics and EPA method 625 & 1625 is the approved method for wastewater semi-volatiles.

POC Analytical Methods

- ❓ **Detection Limit (DL) a.k.a.
Lower Reporting Level (LRL) a.k.a.
Practical Quantitation Limit (PQL)**
- ❓ **What does this mean.....**
 - **Trouble if *you* don't understand
what you need and want.....**

- These three terms mean essentially the same....and you need to realize that.

- If you don't ask for specific lower reporting levels...your commercial lab will give you what they think you ought to have....and what they think you ought to have is probably a “one size fits all” lower reporting level. Many labs have only one instrument to analyze metals and it will usually have the same lower reporting level everyday no matter what...

- The PT Coordinator MUST know the value of using certain detection limits. As we're getting ready to talk about, you may need to use different labs for different types of samples...

POC Analytical Methods: Metals, Metals Everywhere

- ❑ **“REGULAR LEVEL” METALS ANALYSES**
 - Flame Atomic Absorption [AA]
 - ICP [“Plasma”]
- ❑ **“LOW LEVEL” METALS ANALYSES**
 - Graphite Furnace Atomic Absorption
 - ICP/MS [Plasma Mass Spec]

•Let's say your chromium NPDES limit is 50 ug/l.....and of course you need to prove compliance with that limit on your DMR or State Report. A lower reporting level [or detection limit] of 10 ug/l is just fine for those purposes and “regular level” metals analyses can get you that. Regular level metals instruments would include flame atomic absorption and also a plasma instrument

•However, you can get much lower detection limits from graphite furnace atomic absorption units and plasma mass specs....

•So why should this laboratory decision matter to a Pretreatment Coordinator???

“Regular Level” Metals Removal Rate Example

- ❓ Chromium Influent = 11 ug/l
- ❓ Chromium Effluent = <10 ug/l
 - Some States will let you use ½ DL on the effluent value.....[10 * ½ = 5 ug/l]

$$\frac{11 - 5}{11} * 100 = 54.5 \% \text{ RR}$$

[OR EPA Median Literature Value of 82%]

VERSUS.....

- Let’s look at a specific example, still using chromium....
- Remember our chromium NPDES limit is 50 ug/l....but now we’re talking about POC data and headworks analysis calculations...
- That’s a different story altogether....
- Here are the results of “regular level” metals analysis...Remember what we now know about the important of removal rates...
- Our influent sample was 11 ug/l and our effluent sample was <10 ug/l...we’re in great shape with the NPDES permit limit, BUT what kind of removal rate can we get with these numbers. If we use 10 for the effluent value , heaven forbid, we’ll get [whopee] 9.1% removal....But good old DWQ will usually let us use half of the detection limit for the effluent....and that would give us 54.5% removal. The median literature value from EPA’s Local Limits guidance manual is 82% which is a little better BUT.....
- |

“Low Level” Metals Removal Rate Example

- ❑ Same POC Samples analyzed by ICP-MS
- ❑ Chromium Influent = 11 ug/l
- ❑ Chromium Effluent = 0.70 ug/l

$$\frac{11 - 0.70}{11} * 100 = 93.6\% \text{ RR}$$

[Oh what a difference ICP/MS makes!]

•What if we have our same influent and effluent samples analyzed with an ICP Mass Spec????

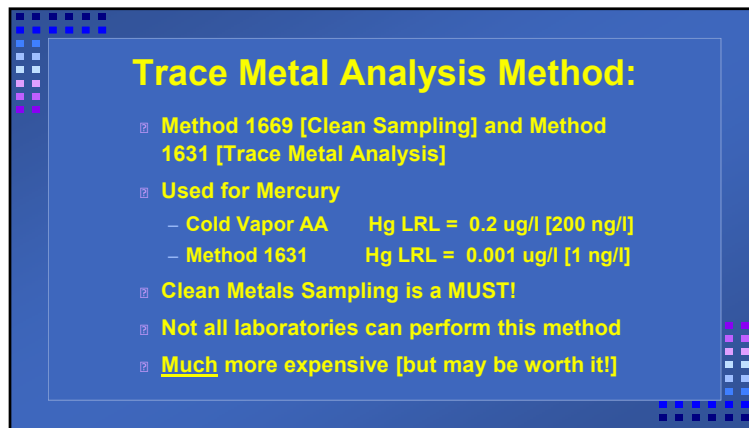
•We still get the same 11ug/l for our influent, but look at the effluent value we got.....The lab actually measured an effluent value of 0.7 ug/l. If we plug those values into our removal efficiency formula we get a whopping 93.6 % removal rate for chromium.....

SAME POTW... SAME SAMPLES....

5.0 MGD Flow and 0.050 mg/l Effluent Limit

Source/ Type of Metals Analysis	Removal Rate %	Allowable Influent Chromium	Chromium MAHL (pounds)
“Regular Level”	54.5%	0.11 mg/l	4.6
Median Literature	82%	0.28 mg/l	11.7
“Low Level”	93.6%	0.78 mg/l	32.5

- There is nothing that says you must have your NPDES samples analyzed by the same lab that does your POC samples.
- Have the NPDES samples run at “regular level”....Consider sending out your POC samples to a lab with low level metals capabilities. Maybe your commercial lab has regular level and low level instruments. Have you ever asked them, “How low can you go?”
- Recognize that low level analyses may be more costly, but this slide shows that a PT coordinator can truly be penny wise and “pounds” foolish!
- My...my and to think that a smart pretreatment coordinator can go from a MAHL of 4.6 pounds of chromium to a MAHL of 32.5 pounds of chromium just by knowing how to have the samples analyzed...A pretreatment coordinator like that would be worth their weight in gold [and chromium]!!!
- The flip side of that is truly scary. The pretreatment coordinator that does NOT understand the importance of removal rates and how to have POC samples analyzed may be stuck with the 4.6 pound MAHL...unnecessarily, because this POTW is doing a spectacular job removing chromium. But only low level analyses can prove it.



Trace Metal Analysis Method:

- ▣ Method 1669 [Clean Sampling] and Method 1631 [Trace Metal Analysis]
- ▣ Used for Mercury
 - Cold Vapor AA Hg LRL = 0.2 ug/l [200 ng/l]
 - Method 1631 Hg LRL = 0.001 ug/l [1 ng/l]
- ▣ Clean Metals Sampling is a MUST!
- ▣ Not all laboratories can perform this method
- ▣ Much more expensive [but may be worth it!]

- They tell you not to even breathe around the sample container if you have amalgam fillings. You should also choose sampling folks who do not smoke. You have to have 2 people to catch the sample...[the clean hands, dirty hands routine] and all 1631 samples must be grab samples because even a composite sampler cannot be cleaned sufficiently to not contaminate the sample...

Something Else to Consider..

<i>INF</i>	<i>EFF</i>	<i>RR %</i>
12.5	<0.5	96.0
14.0	<0.5	96.4
10.8	<0.5	95.4
15.5	<0.5	96.8
	ADRE	96.15

<i>INF</i>	<i>EFF</i>	<i>RR %</i>
12.5	<0.1	99.2
14.0	<0.1	99.3
10.8	<0.1	99.1
15.5	<0.1	99.4
	ADRE	99.25

MAHL = 1516 pounds NH_3N **MAHL = 7784 pounds NH_3N**

POTW Flow = 3.5 MGD NPDES $\text{NH}_3\text{-N}$ Limit = 2.0 mg/l

- Detection limits issues aren't just limited to metals and just in case you thought they were...take a look at this ammonia-nitrogen data.
- The only difference in these two MAHLs is the ammonia nitrogen detection limit used by the laboratory.
- **CLICK CLICK**
- Just as an aside, I don't know of many industries who would be happy to learn that they had an ammonia limit in their SIU permit or were having to pretreatment for ammonia just because the POTW was not using the lowest detection limit possible for a particular parameter....
- Just another one of the tricks of the trade.....a trick to prevent pretreatment and allow your POTW to best utilize its resources...your POTW was designed to treat ammonia...

POC Data Review

- ❑ **Review POC Sampling Plan Data**
 - **Is the POC Data Valid? Does it Make Sense?**
 - **Is the Pollutant Present in the Influent?**
 - » If not, can it be an internal POTW process?
 - **Is the POTW....Compliant? Noncompliant?**
- ❑ **Look at historical removal efficiencies**
 - **How do they compare with what YOU got?**
- ❑ **Audit Laboratory [POTW and Commercial]**

1. **Review POC Data** Does the data show that you are “manufacturing” a pollutant at your POTW? In other words you don’t have any in the influent but you’ve sure got some in the effluent.
2. UPTC knows of situation where wastewater treatment polymer was contaminated with ppm levels of certain metals. The POTW was dosing themselves...
3. Unknown PT coordinator has chemical phosphorus removal at their POTW....were feeding sodium aluminate like crazy...still high phosphorus in effluent...very low removal efficiencies. ORC blaming situation on industry discharging something that was interfering with process...Nohole in underground chemical feed line....happy PT coordinator!
4. **2. Look at historical removal efficiencies...** Have your removal rates decreased dramatically over the past few years??? If so, why??? Have your influent values increased also?
3. There can also be some serious QA/QC issues with certain laboratories...both POTW and commercial. Make sure that a laboratory QA/QC problem is not the source of your low removal rates.
- 4.

REVIEW DATA SET

? Review Data and Look for.....

- Unusually low Daily Removal Efficiency
- Pattern of increasing effluent values with no similar influent increase
- Corresponding inf/eff extreme values
- CHECK YOUR MATH [and computer's math]
 - » unit conversions [$0.0873 \text{ mg/l} = 87.3 \text{ ug/l}$]
- Will “pairing” make it better???

•When you start calculating your removal efficiencies, make sure you take a real close look at your data. If you have an unusually low or unusually high DRE or daily removal efficiency look at the influent and effluent data points....OR do you see a pattern of increasing effluent values with no similar influent increases??

•DO you have treatment problems at your POTW. Were your solids handling facilities in full operation or did it rain for 3 straight months so that you could not land apply your sludge...or was your incinerator down for an extended period of time and you were just pumping the sludge around in circles at the POTW??

•How about extreme influent and effluent values in a data set....lab problem? Slug load to the POTW?

•CHECK YOUR MATH [and your computer's math...] You do still know how to use a pencil, paper and a calculator, right? Yes, we did do pretreatment calculations before Excel spreadsheets! You'll have a real nice removal rate if you entered 873 ug/l instead of 87.3 ug/l for your influent value...[it will be a “nice” removal rate...it will be wrong but it will be “nice”...!]

•Remember the paired data discussion? Look at your data to see if “pairing” it will make it better....

DATA EXCLUSION

- ❓ **Technical or Operational Problems at POTW**
 - Fix it.....then take extra POC samples
- ❓ **Negative Daily Removal Efficiency**
 - Maybe.....why? Paired Resample?
- ❓ **QA/QC Problems in the Lab**
 - All influent and effluent samples BDL
 - » Elevated Detection Limits?
 - Metals, Metals Everywhere?
 - “Impossible Values”
 - Reanalyze [if possible] or Resample

•Unfortunately we cannot just throw out all of the data that we don't like., but there are some very valid reason for data exclusion.

•If you have a serious operational problem at the POTW...fix it..then take some extra POC samples. But first and foremost the PT coordinator must be involved enough to know that there was a POTW problem!

•WE discussed previously that Influent Below Detection Limit data sets must be excluded for certain calculations such as the Average Daily Removal Efficiency and deciles.

•If you have lots of negative DREs look carefully before excluding them. Remember the paired data exercise. Find out WHY they were negative.

•If you think you have a problem in your laboratory try to have the sample reanalyzed...Remember most metals have a holding time of up to 6 months.

•As you review your data for possible exclusions....again, look for the patterns...What are the odds?????

Data Review

Actual POC BOD Values*:

Date:	Influent	Effluent
1-9-01	< 2.0 mg/l	<2.0 mg/l
1-10-01	175 mg/l	<2.0 mg/l
1-11-01	256 mg/l	<2.0 mg/l
1-16-01	209 mg/l	<2.0 mg/l

**From Commercial Laboratory, not POTW Laboratory*

- Well, well, well....here we have an interesting situation.
- Have any of you ever seen a POTW INFLUENT BOD of less than 2.0 mg/l. I think not. Why are we treating it if it is coming in the door at less than 2??? The POTW called the commercial laboratory about the result and they “rechecked” the data but did not find a problem. That’s the trouble with most commercial laboratories, they may know wastewater laboratory procedures but they know absolutely NOTHING about wastewater treatment....Or they would have never reported this value!!!!!! More than likely there was a sample switch during log-in or during the analysis itself.
- Which is why the Pretreatment coordinator must know about the laboratory and the wastewater treatment processes and pretreatment....
- You’ve heard me say this before...the pretreatment coordinator is truly the only person forced to “look at the whole picture” and take a holistic approach to the facility...We’ve got to know about everything or we can’t do our jobs adequately.

PICK THE NUMBER!!!!

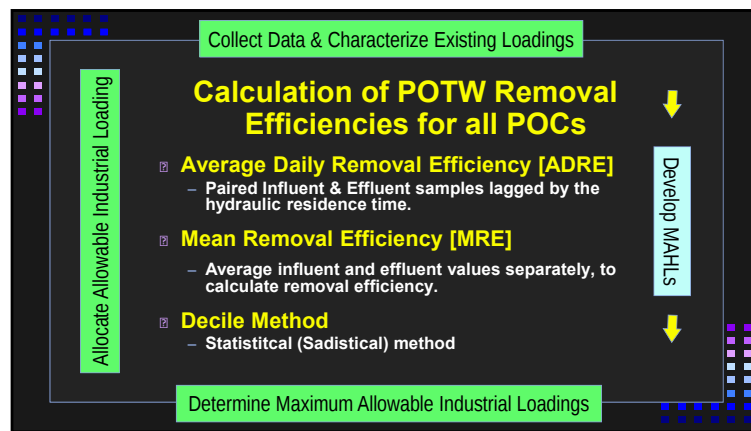
98.43% or 98%?

98.78% or 98.8%?

95.5% or 96%?



- So what numbers shall we choose?
- Look carefully before you “round off” a number during a headworks analysis.
- You may have just “dropped” part of a pound of nickel...



- This is where software like EPA's PRELIM are most useful.
- **The most stringent criteria for each pollutant must be used to determine allowable loading.**
- Applicable Environmental Criteria
 - NPDES permit limits
 - Applicable water quality standards/criteria
 - Pollutant inhibition levels
 - Sludge disposal or reuse limitations.
- **Ideally mass balance will be demonstrated, POTW pollutant removal rates are consistent, and reasonable MAHLs are calculated**
 - “In about 99.9 percent of the cases, this is false.”
- **Potential problems encountered may include:**
 - Pollutant detected in the influent at levels slightly above the detection limit and undetected in the effluent, resulting in an indeterminable removal efficiency(may not be representative).
 - Solution
 - delegate responsibility for determining MAHLs to subordinate personnel;
 - work with testing lab to achieve lower detection limits; and/or
 - demonstrate why literature values should be used in lieu of actual data.
 - pollutant detected at a higher concentration in the effluent, than in the influent(i.e., negative removal efficiencies).
 - Solution
 - verify sampling locations, condition of sampling equipment (not contaminated) and testing procedures, QA/QC, and reporting of results; and/or
 - perform inplant monitoring to identify where problem initiates within the plant and identify potential options for resolving.
 - MAHL indicating an enormous, atypical mass of a pollutant can be safely treated.
 - examine what criteria(literature, actual) was used to calculate the value to insure the calculation was performed appropriately.
 - What if there is no limiting criteria for a certain pollutant of concern?
- **The average daily removal efficiency (ADRE) calculation relies on the premise that an**

influent sample paired with a lagged effluent sample accurately reflects removal efficiency. Under steady state conditions, the best way to determine the removal efficiency is to sample the influent and effluent on the same day and assume that the difference between the two values is the amount normally removed. However, accuracy is theoretically increased if the influent and effluent samples are lagged by the hydraulic residence time of wastewater within the treatment plant.

- In addition, POTWs may have historical data only for the effluent, or historical data of influent and effluent samples that were not lagged for detention time when sampling. In these cases, the **mean removal efficiency (MRE)** calculation is employed.
- Mean removal efficiency does not indicate how often the derived removal efficiency was achieved.
- The **decile method** requires at least nine daily removal efficiency values based on paired sets of influent and effluent data. However, instead of averaging the daily removal efficiency values, the decile method sorts daily removal efficiency data from highest to lowest and calculates the percentage of the daily removal efficiency above or below a specified removal efficiency.

Average Daily Removal Efficiency (ADRE)

$$R_{potw} = \frac{\sum_{n=1}^N [(I_n - E_{potw,n}) / I_n]}{N}$$

- R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)
- I_n = WWTP influent pollutant concentration at headworks , mg/L
- $E_{potw, n}$ = WWTP effluent pollutant concentration
- n = paired observations, numbered 1 to N

- As shown in the formula, a series of daily removal efficiencies based on paired headworks influent, I_n , and WWTP effluent data, $E_{wwtp, n}$, is calculated first. This series of removal efficiencies is then summed and divided by the total number of paired observations, N , to yield the removal efficiency across the entire wastewater treatment plant (from headworks to plant effluent), R_{wwtp} .

Hypothetical Zinc loadings

Sample Day	Influent Load (lbs)	Effluent Load (lbs)	DRE %
1	518.22	111.41	78.50
2	163.98	173.99	-6.10
3	110.15	97.64	11.36
4	1739.93	474.41	72.73
5	2301.00	97.88	95.75
6	170.48	105.15	38.32
7	473.16	132.67	71.96
8	314.19	148.96	52.59
9	306.68	132.69	56.73
ADRE			52.43

- This table represents a series of sampling events for zinc taken at a hypothetical POTW. The influent and effluent samples were lagged in time by the theoretical mean hydraulic residence time of the POTW. Individual estimates of the daily removal efficiency (DRE) expressed as a percentage are shown in the right hand column. Summing the individual DREs and dividing by the number of observations gives the average daily removal efficiency in the bottom right hand corner. 0.5243 which is multiplied by 100 to produce the percentage. To calculate the removal efficiency from headworks to secondary treatment influent, R_{sec} , use paired headworks influent, I_n , and secondary treatment influent data, I_{sec} , n . To calculate the removal efficiency from headworks to tertiary treatment influent, R_{ter} , use paired headworks influent, I_n , and primary treatment effluent data, I_{ter} , n .

Average Daily Removal Efficiency (ADRE)

$$R_{potw} = \frac{\sum_{n=1}^N (I_n - E_{potw,n}) / I_n}{N}$$

$$R_{potw} = \frac{\frac{518.22 - 111.41}{518.22} + \text{etc}}{9} \times 100 = 52.43\%$$

- Using the formula gives the result as a decimal 0.5243 which is multiplied by 100 to produce the percentage.

Mean Removal Efficiency (MRE)

- ? Average all influent values
- ? Average all effluent values
- ? Calculate %removal using the influent value and the effluent value

- In addition, POTWs may have historical data only for the effluent, or historical data of influent and effluent samples that were not lagged for detention time when sampling. In these cases, the **mean removal efficiency (MRE)** calculation is employed.
- However, the unpaired historical data used in the MRE calculation also has drawbacks because significant changes in the POTW's industrial base, such as the opening or closing of an industry or the installation of significantly more efficient pretreatment equipment units or source control, can introduce bias into the calculation. Current levels of POTW influent should be compared to historical levels to determine if they are of the same general magnitude.

Mean Removal Efficiency (MRE)

$$R_{potw} = \frac{\overline{I_r} - \overline{E_{potw,t}}}{\overline{I_r}}$$

- R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)
- I_r = WWTP influent pollutant concentration at headworks, mg/l
- $E_{potw,t}$ = WWTP effluent pollutant concentration, mg/l
- t = plant effluent samples, numbered 1 to T
- r = plant influent samples, numbered 1 to R

- As shown in the equation, instead of averaging observed paired removal efficiencies, the MRE calculation *first* averages (symbolized in the equation by the overbars) all plant influent values, I_r , and all plant effluent values, $E_{wwtp,t}$, separately and then calculates removal efficiency across the entire wastewater treatment plant (from headworks to plant effluent), R_{wwtp} .
- The MRE can also be used to calculate averages all headworks influent, I_r , and all secondary treatment influent data, or tertiary treatment influent data if required for internal plant process control. These calculations are not normally used in local limit calculations however.

Hypothetical Zinc loadings

Sample Day	Influent Load (lbs)	Effluent Load (lbs)	
1	518.22	111.41	
2	163.98	173.99	
3	110.15	97.64	
4	1739.93	474.41	
5	2301.00	97.88	
6	170.48	105.15	
7	473.16	132.67	
8	314.19	148.96	
9	306.68	132.69	
MRE	677.53	163.87	75.81

- To calculate the MRE we use the same data. However in this example the influent and effluent data do not need to be taken in lagged pairs and there does not have to be the same number of influent and effluent samples.

Mean Removal Efficiency (MRE)

$$R_{potw} = \frac{\overline{I_r} - \overline{E_{potw,t}}}{\overline{I_r}}$$

$$R_{potw} = \frac{677.53 - 163.87}{677.53} = 0.75814 \times 100 = 75.81\%$$

- The mean influent and effluent data from the last table are inserted in the formula to give a MRE of 0.7581 which represents a 75.81% removal rate.

Decile Method

- ❑ Requires at least nine daily removal efficiency values based on paired sets of influent and effluent data.
- ❑ Sort daily removal efficiency data from lowest to highest and calculate the percentage of removal efficiencies above or below the specified removal efficiency.

- Mean removal efficiency does not indicate how often the derived removal efficiency was achieved. The **decile method** requires at least nine daily removal efficiency values based on paired sets of influent and effluent data. However, instead of averaging the daily removal efficiency values, the decile method sorts daily removal efficiency data from lowest to highest and calculates the percentage of the daily removal efficiency above or below a specified removal efficiency. The methodology is similar to a data set median. A median divides an ordered data set into two equal parts: half the data set is above the median, and the other half is below. The decile method is similar except it divides the ordered data set into 10 equal parts. Therefore, 10 percent of the data set is below the first decile, 20 percent of the data set is below the second decile, etc. The fifth decile is equivalent to the data set median.

Hypothetical Zinc Loadings

Sample Day	Influent Load (lbs)	Effluent Load (lbs)	DRE %	Deciles
2	163.98	173.99	-6.10	1 st =10%
3	110.15	97.64	11.36	2 nd =20%
6	170.48	105.15	38.32	3 rd =30%
8	314.19	148.96	52.59	4 th =40%
9	306.68	132.69	56.73	5 th =50%
7	473.16	132.67	71.96	6 th =60%
4	1739.93	474.41	72.73	7 th =70%
1	518.22	111.41	78.50	8 th =80%
5	2301.00	97.88	95.75	9 th =90%

- In this table the same set of paired data is arranged from highest to lowest. The methodology is similar to a data set median. A median divides an ordered data set into two equal parts: half the data set is above the median, and the other half is below. Where nine sets of samples are involved the direct deciles are calculated. If there are more than 9 samples a mathematical procedure as shown in appendix R of the new local limits manual must be performed to calculate the decile values.

Decile Method

- ? **Similar to a data set median but divides the data set into 10 equal parts.**
- ? **10% of the data is below the 1st decile, 20% is below the 2nd decile and so on.**
- ? **The 5th decile = data set median.**
- ? **This hypothetical POTW has an overall plant removal efficiency R_{potw} of 56.73% less than half the time**

- The decile method is similar to the data set median method except it divides the ordered data set into 10 equal parts. Therefore, 10 percent of the data set is below the first decile, 20 percent of the data set is below the second decile, etc. The fifth decile is equivalent to the data set median.
- As illustrated at the fifth decile or median, this hypothetical POTW has an overall plant removal efficiency, R_{wwtp} , of 56.73 percent less than half of the time. As illustrated in the third decile, the POTW achieves a pollutant X removal efficiency of below 38.32 percent less than 30 percent of the time. If concerned about recurring effluent limitation violations due to plant operation variation, the POTW may decide, based on historical knowledge, to use the more conservative third decile, instead of the median fifth decile, as the removal efficiency. However, POTWs should be aware that a lower removal efficiency will lead to a lower, more protective, effluent-based local limits but higher, less protective, sludge-based local limits.

**Method Removal Rate Comparisons
Same Data Set**

ADRE	52.43%
MRE	75.81%
5th DECILE	56.73%

Removal Efficiencies Derived from Sludge Data

- For conservative pollutants such as metals, POTWs can use sludge data to estimate removal efficiency, R_{potw} .
- Sludge data should be used in place of effluent data when a POTW has influent data above detection, but does not have adequate effluent data above detection.

- For conservative pollutants, such as metals, the portion removed during WWTP processes ends up in the sludge. Therefore, for conservative pollutants, POTWs can also use sludge data to estimate removal efficiency across the entire plant, R_{wwtp} . Sludge data should be used in place of effluent data when a POTW has influent data above detection but does not have adequate effluent data above detection, or believes sludge data provide more representative removal efficiencies.

Removal Efficiencies Derived from Sludge Data

- ❑ **Data Required for Sludge Removal Efficiencies**
 - Sludge flow to disposal in MGD
 - Percent solids of sludge to disposal
 - Sludge pollutant concentration in mg/kg
 - Specific gravity of sludge in kg/L
 - WWTP average flow in MGD
- ❑ **Paired data used for ADRE approach**
- ❑ **Mean of individual data used for MRE approach**

- To calculate sludge removal efficiencies data on average sludge flow to disposal, average percent solids, average pollutant concentrations in mg/kg, sludge specific gravity and WWTP average flow in MGD are required to be collected.

Plant Removal Efficiency from Sludge Data using ADRE Method

$$R_{potw} = \frac{\sum_{i=1}^N [S_n * (PS/100) * Q_{sldg} * G_{sldg}] / (I_n * Q_{potw})}{N}$$

- ☐ R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)
- ☐ I_n = WWTP influent pollutant concentration at headworks, mg/L
- ☐ PS = Percent solids of sludge to disposal,
- ☐ Q_{sldg} = Total sludge flow to disposal, MGD
- ☐ Q_{potw} = WWTP flow, average, MGD
- ☐ G_{sldg} = Specific gravity of sludge (kg/L)
- ☐ S_n = Sludge pollutant concentration, mg/kg
- ☐ n = paired observations, numbered 1 to N

- As shown, ADRE and MRE methods can be used to calculate removal efficiency across the entire plant, R_{wwtp} , by comparing the sludge and headworks pollutant loading (lbs/day).
- Sludge loading is calculated by multiplying the sludge concentration, S , by the sludge flow rate, Q_{sldg} , specific gravity, G_{sldg} , and percentage solids, PS . Influent pollutant loading is calculated by multiplying the influent concentration, I , by the WWTP flow rate, Q_{wwtp} . I , the influent pollutant concentration, should be a monthly average in order to be compared with sludge pollutant concentration, which accounts for pollutants that have accumulated for 20 to 30 days.

Plant Removal Efficiency From Sludge Data Using MRE Method

$$R_{potw} = \frac{[S_u * 8.34 * (PS / 100) * Q_{sldg} * G_{sldg}]}{I_r * 8.34 * Q_{potw}}$$

- ☐ R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)
- ☐ I_r = WWTP influent pollutant concentration at headworks, mg/L
- ☐ PS = Percent solids of sludge to disposal,
- ☐ Q_{sldg} = Total sludge flow to disposal, MGD
- ☐ Q_{potw} = WWTP flow, average, MGD
- ☐ G_{sldg} = Specific gravity of sludge (kg/L)
- ☐ 8.34 = unit conversion factor
- ☐ S_u = Sludge pollutant concentration, mg/kg
- ☐ u = sludge samples, numbered 1 to U
- ☐ r = influent samples numbered 1 to R

- Since most POTWs will not have monthly average influent pollutant concentrations, the MRE method is often the more suitable technique when using this method.

Guidance On Using Different Methodologies

- ❓ **MRE recommended over the ADRE by EPA if less than 10 pairs are available.**
- ❓ **Decile approach allows for comprehensive view, and considers daily removal efficiency variation.**
- ❓ **Individual decile estimates, depending on how conservative the POTW wants to be, can be less precise than the ADRE and MRE estimates.**

- EPA offers the following guidance on implementing the three different methodologies:
- EPA recommends the MRE over the ADRE method because it is generally less sensitive to extreme daily removal efficiencies. Although requiring more data, the decile approach allows for a more comprehensive view of the ADRE and MRE because it provides an entire frequency distribution and allows for explicit incorporation of daily removal efficiency variation. Although an overall depiction of the POTW removal efficiency frequency is gained in the decile method, an individual decile estimate, depending on how conservative the POTW wants to be in establishing removal efficiencies, can be less precise than the MRE and ADRE estimates.

Options for Managing Sampling Results Below the Method Detection Level (“BDL”) in Removal Efficiency Calculations

If only a few data values are BDL:	If most data values are BDL:
Option 1: Use surrogate value of $\frac{1}{2}$ ML.	Option 1: Re-evaluate the need for a local limit for the pollutant. (However, if the pollutant is one of the 15 EPA POCs an AHL should be developed.)
Option 2: Discard the few samples below the ML. (Influent and effluent data should be discarded in pairs.)	Option 2: Use removal rate data from other plants. (LL Manual Section 5.1.4.)
OTHER OPTIONS:	
Use other statistical methods: Regression order statistics, probability plotting and maximum likelihood estimations are discussed in Appendix Q of EPA LL Manual	

- A POTW’s monitoring program will probably yield some sampling results that indicate a pollutant was below the method detection limit (MDL), or “non-detectable,” in the analyzed sample. The manner in which the POTW uses these data in local limits development process can significantly affect the MAHLs calculation. This table details the different options available to POTW users.
- In general, the surrogate method results in a greater bias when calculating the mean or standard deviation. In addition, the surrogate method’s relative performance worsens as the proportion of non-detects increases.
- Surrogate Method observations:
 - The use of zero assumes a pollutant level which is always lower than the actual value.
 - The use of the detection limit assumes the pollutant level is always higher than then actual value
 - One half of the detection limit is a compromise between the two extremes.
- Option – use sludge data for when the influent is OK, but the effluent

is non-detect

Negative Removal Efficiencies

Causes:

- POTW's do not operate at steady state
- Analytical problems (e.g., false positives with CN⁻)
- Data not paired with POTW detention time
- Contaminated treatment chemicals

❓ *Negative removal efficiencies should always be investigated* – Should not be dismissed unless there is adequate technical justification

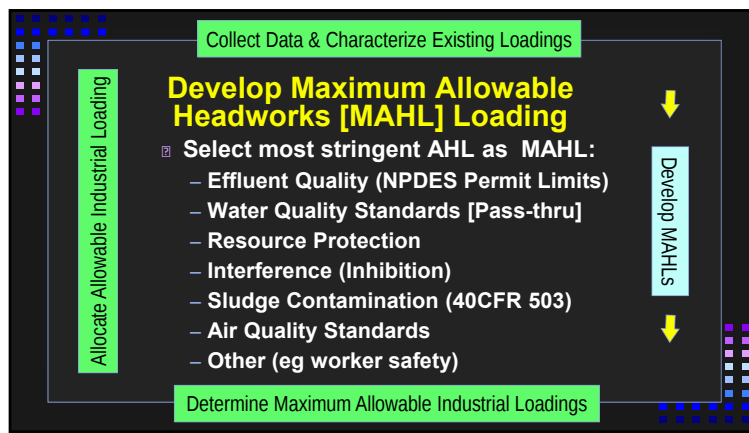
❓ *Handle non-detect samples as previously discussed*

- Negative removal efficiencies are attributable to the fact that POTWs do not operate in a steady state. Deviations from steady state occur because of variability in POTW influent, recycle streams and performance, accumulation of pollutants in POTW sludge, and incidental generation of pollutants by POTW operations. However, negative removal efficiencies should not be summarily dismissed as outliers to normal POTW operation. Reflecting valuable operating data, such as temporary operational problems, negative daily removal efficiencies (DREs) (or for the MRE method, influent and effluent values that would calculate as negative DREs) should be retained in the data set unless there is adequate technical justification (bad sampling or analytical technique, etc.) to remove them.

Using EPA's Default Removal Efficiencies

- ❑ EPA recommends site specific data
- ❑ If site specific data are inadequate, removal efficiencies for some pollutants from other POTWs or studies are given in the Local Limits Guidance Manual
 - **Caution** EPA data is from 1977 studies
 - EPA uses the most restrictive (lowest) values

- Removal efficiencies are based largely on site-specific conditions such as climate, POTW operation and maintenance, plant conditions, and sewage characteristics. Therefore, EPA recommends that site-specific data be used to calculate removal efficiencies. However, some POTWs still do not have adequate site specific data to calculate removals after conducting site-specific sampling and using analytical methods that achieve the lowest detection levels possible. In these instances, POTWs can selectively use removal efficiencies reported by other POTWs or by studies that have been published in professional journals or by EPA.



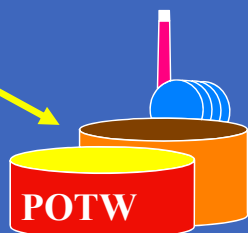
- This is where software like EPA's PRELIM are most useful.
- **The most stringent criteria for each pollutant must be used to determine allowable loading.**
- Applicable Environmental Criteria
 - NPDES permit limits
 - Applicable water quality standards/criteria
 - Pollutant inhibition levels
 - Sludge disposal or reuse limitations.
- **Ideally mass balance will be demonstrated, POTW pollutant removal rates are consistent, and reasonable MAHLs are calculated**
 - “In about 99.9 percent of the cases, this is false.”
- **Potential problems encountered may include:**
 - Pollutant detected in the influent at levels slightly above the detection limit and undetected in the effluent, resulting in an indeterminable removal efficiency(may not be representative).
 - Solution
 - delegate responsibility for determining MAHLs to subordinate personnel;
 - work with testing lab to achieve lower detection limits; and/or
 - demonstrate why literature values should be used in lieu of actual data.
 - pollutant detected at a higher concentration in the effluent, than in the influent(i.e., negative removal efficiencies).
 - Solution
 - verify sampling locations, condition of sampling equipment (not contaminated) and testing procedures, QA/QC, and reporting of results; and/or
 - perform inplant monitoring to identify where problem initiates within the plant and identify potential options for resolving.
 - MAHL indicating an enormous, atypical mass of a pollutant can be safely treated.
 - examine what criteria(literature, actual) was used to calculate the value to insure the calculation was performed appropriately.
 - What if there is no limiting criteria for a certain pollutant of concern?
- An **AHL** is the maximum pollutant loading corresponding to the individual environmental

criterion for which it was developed. An AHL is calculated for each applicable criterion: pass through, sludge contamination, air quality standards, and the various forms of interference (biological treatment inhibition, sludge digestion inhibition). The AHLs for each POC are calculated based on the various suitable environmental criteria, plant flow rates, and plant removal efficiency. After calculating a series of AHLs for each POC, the lowest AHL is chosen as the MAHL. Local limits development uses a mass balance approach to determine the AHLs for a POTW based on the environmental and treatment plant criteria. With the mass-balance approach, the POTW calculates the amount of loading received at the POTW headworks that will still meet the environmental or treatment plant criteria that apply to each pollutant. Steady-state equations are used for conservative pollutants because the amount of pollutant loading is “conserved” throughout the treatment plant, unlike non-conservative pollutants, portions of which are “lost” through volatilization or degradation. Conservative pollutants are removed through sludge adsorption alone, while non-conservative pollutants may be removed through degradation or volatilization in addition to sludge adsorption. Because losses through degradation and volatilization do not contribute to pollutant loadings in sludge, it is not valid to assume that all non-conservative pollutants removed during plant treatment are transferred to sludge. Therefore, for non-conservative pollutants, different equations are used to calculate AHLs based on sludge criteria.

Effluent-Quality Based AHLs (NPDES limits)

Maximum loading L
in (lb/day)

Max Effluent loading E =
NPDES limit $C \times \text{flow } Q$
(MGD) $\times 8.34$ lbs/day



Sludge loading S
in (lb/day)

$$L = E + S \quad \longrightarrow \quad \text{since: } S = \text{Plant RR} \times L$$

and $E = C \times Q \times 8.34$

$$L = C \times Q \times 8.34 + (\text{Plant RR} \times L)$$

$$L = C \times Q \times 8.34 / (1 - \text{Plant RR})$$

- Conversion of the formula.

Effluent-Quality Based AHLs

$$AHL_{npdes} = \frac{(8.34)(C_{npdes})(Q_{potw})}{(1 - R_{potw})}$$

- ❓ **AHL_{npdes} = Allowable headworks loading based on NPDES permit requirements, lbs/day**
- ❓ **C_{npdes} = NPDES permit limit, mg/L**
- ❓ **Q_{potw} = WWTP flow, average, MGD**
- ❓ **R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)**
- ❓ **8.34 = conversion factor**

• One of the most effective means of restricting the discharge of toxic substances into waters of the United States is through a NPDES permit limit. As illustrated in this slide, the AHL based on NPDES Permit limit, L_{npdes} , is the pollutant loading at the NPDES Permit Limit, $C_{npdes} * Q_{wwtp}$, divided by the portion of the pollutant not removed by the plant, $(1 - R_{wwtp})$. The NPDES permit limit can appear in many forms—specific effluent limitations, water quality based pollutant limits, whole effluent toxicity—and is commonly expressed as milligrams per liter and specified usually as a daily maximum and/or monthly average discharge limit. In performing the calculation, please note that if a POTW has both a daily maximum and a monthly average NPDES permit limit, the AHL need only be determined for the daily maximum unless the POTW has had NPDES permit monthly average violations since the last local limits analysis. POTWs should use actual average WWTP flow data for Q_{wwtp} and not design flows.

• POTWs that discharge to drinking water supply zones should consider developing local limits based on maximum contaminant levels (MCLs) for drinking water protection. POTWs should adjust primary and secondary MCLs to final MCLs that account for the pollutant removals that are achieved by drinking water treatment plants. Since a drinking water plant will remove a certain percentage of the pollutant from the source water before delivering it to customers, the source water can have a concentration greater

•than the MCL and then be treated down to the MCL before consumption or use.

AHL Based on Water Quality Criteria

$$AHL_{wq} = \frac{8.34[C_{wq}(Q_{str} + Q_{potw}) - (C_{str} * Q_{str})]}{(1 - R_{potw})}$$

- ☐ **AHL_{wq} = Allowable headworks loading based on water quality, lbs/day**
- ☐ **C_{str} = Receiving stream background concentration, mg/L**
- ☐ **C_{wq} = State WQS or EPA WQC, mg/L**
- ☐ **Q_{str} = Receiving stream (upstream) flow, MGD**
- ☐ **Q_{potw} = WWTP flow, average, MGD**
- ☐ **R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)**
- ☐ **8.34 = conversion factor**

•In general, POTWs will not have NPDES permit limits for all of the POCs established during the local limits analysis. In such cases, a POTW should base its effluent-quality-based AHL on state Water Quality Standards (WQS) or federal Water Quality Criteria (WQC). State environmental agencies have developed WQS that set maximum allowable pollutant levels for their water bodies, specific to the receiving stream reach's designated uses. Even though the POTW's NPDES permit may not contain a numeric effluent limit for a POC, the permit should contain narrative provisions requiring compliance with state WQS and prohibiting the discharge of any toxic pollutants in toxic amounts.

•As illustrated in the slide, the AHL based on water quality criteria, L_{wq} , is calculated as the hypothetical pollutant loading to the water body at the water quality limit, $C_{wq}(Q_{str} + Q_{wwtp})$, adjusted for the background loading of the water body, $C_{str} * Q_{str}$, and divided by the portion of the pollutant not removed by the plant ($1 - R_{wwtp}$). C_{str} , the receiving stream background concentration, can be an average background stream concentration. Q_{str} , the receiving stream (upstream) flow, should be either the 7Q10 or 1Q10 flow based on the particular criteria used. Q_{wwtp} , the average WWTP flow, should be based on actual plant data and not design flows. Under most water quality based analysis, Equation 5.6 is sufficient and consequently is the only one presented here. Another method, using a five-step process based on the one described in EPA's *Technical Support Document For Water Quality-based Toxics Control* (EPA, 1991a).

•In general, WQS and WQC are classified into three groups: freshwater aquatic life protection, saltwater aquatic life protection, and human health protection. Freshwater and saltwater aquatic life criteria include chronic and acute toxicity criteria. Chronic toxicity

•criteria are designed to protect aquatic organisms from long term effects over the organisms' lifetime and across generations of organisms, while acute toxicity criteria generally are designed to protect organisms against short-term lethality. EPA offers the

•following guidance on the use of WQS and WQC.

• **Hardness, pH, and Temperature Dependence.** WQS and WQC for some metals depend on the hardness of the receiving water. If the agency has not factored this in, then the POTW

•should obtain from the agency the appropriate hardness value for its receiving stream and use this value to determine the applicable WQS or WQC. *Formulas for the common*

pollutants that are affected by hardness can be found in footnote E to Appendix B. In addition, WQS or WQC for some inorganic pollutants (e.g., ammonia) are pH- and/or temperature-dependent and should be treated similarly. If the state has not established site-specific values the POTW should contact the state permitting authority to obtain appropriate temperature and pH values for its receiving stream, and then use these to calculate WQS or WQC for AHL calculations.

- **Converting Dissolved Metals to Total Metals.**

- WQS and WQC for some metals may be expressed in the dissolved form. Most metals measurements, however, are reported in the total or total recoverable form. Total and total recoverable metals concentrations are always at least as high as dissolved metals concentrations because a fraction of the metal has sorbed to particulate matter in the water. If dissolved metals WQS or WQC are used to develop local limits that are expressed in the total metals form, local limits will be more stringent than if total metals concentrations are used for the WQS. Therefore, POTWs should convert dissolved metals WQS or WQC into the total metals form before using them to calculate water-quality based AHLs (see Exhibit 5-1).

- **Exhibit 5-1: How to Convert Dissolved to Total Metals**

- NPDES permit writers often use metals translators to convert dissolved water quality standards or criteria to total recoverable equivalents. Translators are specific to each metal and may be 1) the theoretical partitioning coefficients; 2) experimentally determined through site-specific translator studies; or 3) the U.S. EPA conversion factors used to convert dissolved metals criteria to total metals criteria (EPA, 1996). For establishing an AHL, EPA recommends the theoretical partitioning coefficient to calculate metal translators detailed in Appendix S.
- [For more information, see *The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion* (EPA/823-B-96-007).]
- **Chronic and Acute Criteria Guidance.** Chronic and acute criteria should be used in the calculation of AHLs to protect receiving water quality. POTWs should not develop a monthly average limit based solely on chronic criteria or a daily maximum limit based exclusively on acute criteria. AHLs should be calculated based on chronic and acute criteria and the more stringent criterion used for comparison with other AHLs. In general, chronic criteria will almost always be more stringent than acute criterion for a given pollutant.
- **Stream Flow Guidance.** To calculate limits based on chronic WQS, the receiving stream flow should be consistent with what the POTW's state recommends for chronic criteria, such as 7Q10 flows. To calculate limits based on acute criteria, the POTW should also use the state-recommended receiving stream flow (e.g., 1Q10). POTWs should consult with their state water quality agencies to confirm the correct flow values.

- **Resource Protection: Drinking Water, Watershed, Aquifer and Groundwater Protection Zones**

- POTWs that discharge to drinking water supply zones should consider developing local limits based on maximum contaminant levels (MCLs) for drinking water protection. POTWs should adjust primary and secondary MCLs to final MCLs that account for the pollutant removals that are achieved by drinking water treatment plants. Since a drinking water plant will remove a certain percentage of the pollutant from the source water before delivering it to customers, the source water can have a concentration greater than the MCL and then be treated down to the MCL before consumption or use.
- In addition to drinking water standards, POTWs should be aware of any criteria from state and local aquifer, groundwater, and watershed programs. Final MCLs and aquifer, groundwater, or aquifer protection criteria can be used in place of water quality criteria, *C_{wq}*, in the equation to calculate AHLs based on resource protection.

Resource Protection AHLs

? POTWs that discharge to groundwater resources such as:

- Water recharge projects
- Saline intrusion barriers
- Underground injection projects

May be subject to individual State WQ laws

• Many State water quality protection laws that are the basis for POTW permits protect all waters of the State including groundwater. Some POTWs have discharges that have the potential to impact groundwater resources such as water reclamation projects to recharge groundwater, saline intrusion barriers (to minimize the intrusion of saline groundwater into fresh groundwater) or disposal of treated effluent via underground injection control (UIC) wells. Potential groundwater impacts can also be of concern in effluent dominated streams in arid regions of the country. Therefore, groundwater protection may need to be considered during local limits development. Some examples of groundwater protection requirements that might need to be considered in local limits development include the following:

- *Aquifer Protection Permits and Water Reuse Permits.* Arizona issues aquifer protection permits and water reuse permits to POTWs that discharge to effluent-dominated streams or reuse the water for irrigation or other uses. The effluent limits in these permits are

designed to protect diminishing groundwater resources and to assure adequate effluent quality for the reuse activity.⁷

•⁷ Communication with John E. Watson, City of Phoenix Water Services Division, February 12, 2003.

•• State NPDES Permits. New York State law specifies groundwater effluent discharge limitations to protect groundwater quality. When an effluent may have an impact on groundwater, State Pollutant Discharge Elimination System permits include effluent limits to protect groundwater.⁸

•• Underground Injection Control (UIC) Program Permits. The Miami-Dade County POTW system disposes effluent into underground injection wells. The POTW is required to comply with UIC permits as well as its NPDES permits. The most stringent standards are being used in local limits calculations.⁹

•UIC, groundwater, or aquifer protection criteria can be used in place of NPDES permit limit (C_{npdes}) in Equation 5.5 to calculate AHLs based on resource protection.

Inhibition Based AHLs

□ Secondary and Tertiary Treatment Unit Inhibition

- No inhibition problems in the past
- Past inhibition problems
 - » May have difficulty in determining plant inhibition values
 - » Site specific data are preferred

• Pollutants levels in a POTW's wastewater or sludge may cause operational problems for biological treatment processes involving secondary and tertiary treatment. Disruption of a POTW's biological processes is referred to as inhibition and can interfere with a POTW's ability to adequately remove biochemical oxygen demand (BOD) and other pollutants. A POTW should assess any past or present operational problems related to inhibition and follow the protocol outlined below:

• **No Past Inhibition Problems at POTW.**

• POTWs may not need to calculate AHLs to protect against inhibition since current loadings are acceptable to the treatment work's biological processes. However, suggest a POTW still calculate AHLs based on biological process inhibition criteria to prevent future loadings that may cause inhibition. In this case, the POTW may choose to substitute pollutant concentrations which either have occurred in the applicable biological process or are currently in its influent and have not caused inhibition, in place of process inhibition values that have been reported in studies published by EPA or in professional journals. If the inhibition turns out to be the limiting criteria, it should be looked at closely and used with caution ---

• *Inhibition criteria for select secondary treatment units (such as activated sludge and trickling filters) and one tertiary treatment unit (nitrification) are presented in Appendix H of the new manual.*

- **Past Inhibition Problems at POTW.** POTWs should calculate AHLs based on inhibition criteria. In most cases, a POTW will not have site-specific inhibition data and will need to use process inhibition values that have been reported in studies published by EPA or in professional journals. *Inhibition criteria for select secondary treatment units (such as activated sludge and trickling filters) and one tertiary treatment unit (nitrification) are presented in Appendix H of the new manual.*

- Site-specific data are preferred to literature data because they more accurately measure pollutant concentrations that cause inhibition. Sometimes based on laboratory studies using pure cultures, literature values can indicate inhibition at much lower concentrations than in actual biological treatment environments for four main reasons: 1) organic chemicals are combining with the metals and reducing metal availability to the microbes; 2) activated sludge environments generally have a variety of organisms present that may not be as sensitive to metal concentrations; 3) metals can chelate toxic organics, reducing their toxicity to nitrifiers; 4) acclimated biological treatment populations can accept higher concentrations of metal and organic toxins.

AHLs Based On Secondary and Tertiary Treatment Inhibition

$$AHL_{sec} = \frac{(8.34)(C_{inhib2})(Q_{potw})}{(1 - R_{sec})}$$

$$AHL_{ter} = \frac{(8.34)(C_{inhib3})(Q_{potw})}{(1 - R_{ter})}$$

L_{sec} = AHL based on secondary treatment inhibition, lbs/day
 L_{ter} = AHL based on tertiary treatment inhibition, lbs/day
 C_{inhib2} = Inhibition criteria for secondary treatment, mg/L
 C_{inhib3} = Inhibition criteria for tertiary treatment, mg/L
 Q_{potw} = WWTP flow, MGD
 R_{sec} = Removal efficiency from headworks to secondary treatment influent (as decimal)
 R_{ter} = Removal efficiency from headworks to tertiary treatment influent (as decimal)
 8.34 = unit conversion factor

- The first equation is used to calculate inhibition-based AHLs for secondary treatment processes such as aerated lagoons, stabilization ponds, activated sludge, rotating biological contactors, and trickling filters. The second equation is used to calculate inhibition-based AHLs for tertiary treatment for various processes to remove nitrogen, phosphorus, suspended solids, organics, metals, and dissolved solids. L_{sec} , the AHL based on secondary treatment unit inhibition, is calculated by dividing the pollutant loading to the secondary treatment unit at the inhibition criteria, $C_{inhib2} * Q_{wwtp}$, by the portion of the pollutant not removed before secondary treatment, $(1 - R_{sec})$. A similar equation is used for tertiary treatment. The WWTP flow rate, Q_{wwtp} , should be calculated using actual average flow data and not design flow.

Inhibition Based AHLs - Sludge Digester Inhibition

conservative pollutants:

$$AHL_{dgstr} = \frac{(8.34)(C_{dgstinhib})(Q_{dgstr})}{R_{potw}}$$

non-conservative pollutants:

$$AHL_{dgstr} = (L_{infl}) * \frac{C_{dgstinhib}}{C_{dgstr}}$$

L_{dgstr} = AHL based on sludge digestion inhibition, lbs/day

L_{infl} = POTW influent loading, lbs/d

$C_{dgstinhib}$ = Sludge digester inhibition criteria, mg/L

C_{dgstr} = Existing pollutant level in sludge, mg/L

Q_{dgstr} = Sludge flow to digester, MGD

R_{potw} = Plant removal efficiency from headworks to plant effluent (as decimal)

8.34 = unit conversion factor

- Sludge digestion is also a biological process that can be upset if pollutants are allowed to accumulate to toxic levels. Plant-specific sludge digestion inhibition thresholds, like inhibition of secondary treatment, are difficult to know. *Literature data on sludge digester inhibition criteria are listed in Appendix H of the new manual.* The preponderance of sludge digestion inhibition levels are for anaerobic digesters. Less is known about the effect of metals on aerobic digestion. Using the steady-state mass balance approach across the influent to the digester, the top equation calculates the AHL based on sludge digestion inhibition, L_{dgstr} , for conservative pollutants such as metals. L_{dgstr} is calculated by dividing the pollutant loading at the inhibition criteria to the digester, $C_{dgstinhib} * Q_{dgstr}$, by the removal efficiency across the entire WWTP, R_{wwtp} . For non-conservative pollutants, L_{dgstr} is found by multiplying the POTW influent loading, L_{infl} , by the ratio of the sludge digester inhibition criteria, $C_{dgstinhib}$, and the level of the POC in the sludge, C_{dgstr} .

Sludge-Quality Based AHLs

Land application

Surface disposal

Landfill

Incineration

Hazardous Waste
Requirements

TCLP Criteria

- In February 1993, EPA issued regulations governing the use or disposal of sewage sludge. Pollutant levels were established for three disposal alternatives: land application, surface disposal, and incineration. The pollutant levels, however, are different for each alternative. In addition to the federal standards, states may have sludge standards that are more stringent or that regulate more pollutants. Therefore, POTWs should check with their state environmental agencies to confirm the applicable standards. Regardless of how a POTW disposes of sludge, EPA encourages POTWs to consider using land application “clean sludge” values from 40 CFR 503.13 in their calculation of AHLs. Use of these
- criteria can improve a POTW’s opportunities for the beneficial use of sludge, which is one of the goals of the National Pretreatment Program. Moreover, the land application standards have a more extensive list of pollutants than either surface disposal or incineration and would help control discharges of toxic pollutants that these disposal alternatives overlook.

Sludge-Quality Based AHLs

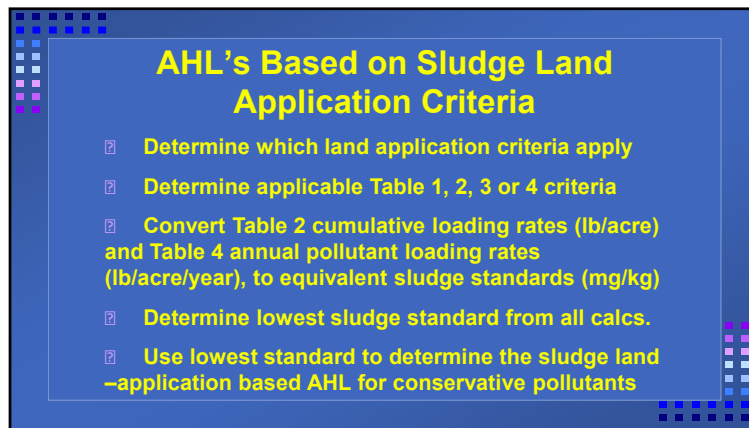
Land Application Requirements in 40 CFR 503.13

Biosolid End Use	Table 1 Ceiling Limits mg/kg		Table 2 Cumulative Limits (lb/acre)		Table 3 Clean Sludge Pol. Conc (mg/kg)		Table 4 Annual Limits (lb/acre/yr)
Applied to agricultural land, forest, public contact site, reclamation site	X	and	X	or	X		
Applied to lawn or garden	X			and	X		
Sold or given away in bag or container	X			and	X	or	X

• Land Application

- Federal sludge use or disposal regulations, found at 40 CFR Part 503, establish limitations for nine common metals (arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc) that are primarily controlled by the Pretreatment program. As shown in Appendix D, land application limitations were established as four types and are known by the table number in which they appear:
- Table 1: Ceiling Concentrations (mg/kg) establishes the maximum concentration that can be in sludge when it is land applied.
- Table 2: Cumulative Pollutant Loading Rates (lb/acre) establishes the limits that cannot be exceeded over the lifetime of the disposal site.
- Table 3: Pollutant Concentrations (mg/kg) sets levels considered “clean” sludge and is subject to less restrictive reporting requirements.
- Table 4: Annual Pollutant Loading Rates (lb/acre/year) establishes maximum loadings that can be applied in any given year.

- As illustrated in the Table, sludge standards are applied based on biosolid end use. For all biosolid quality types, POTWs must comply with Table 1 ceiling concentrations. If its biosolids are applied to agricultural land, forest, a public-contact site, or a reclamation site, a POTW must comply with either the cumulative loading rates in Table 2 or the monthly average pollutant concentrations in Table 3. If its biosolids are applied to a lawn or home garden, the sludge pollutant concentration may not exceed the monthly average pollutant concentrations in Table 3. If its biosolids are sold or given away in a bag or other container for land application, the POTW must comply with monthly average pollutant concentrations in Table 3 or the annual pollutant loading rates in Table 4.



- To calculate AHLs based on sludge land application criteria, a POTW should:
- Determine which of the land application criteria applies to its biosolid by using Table shown in previous slide.
- Determine the applicable Table 1, 2, 3, and 4 criteria in Appendix D for each POC.
- Convert the applicable Table 2 cumulative loading rates (lb/acre), *C cum*, and applicable Table 4 annual pollutant loading rates (lb/acre/year), *Cann*, to equivalent sludge standard (mg/kg), *Cslgstd*, using this equation and the one in the next slide respectively.
- Determine the lowest sludge standard, *Cslgstd*, derived from these two formulae, Table 1 Ceiling Concentrations, Table 3 Monthly Average Pollutant Concentrations, and suitable state sludge standards.
- Use AHL formula with the lowest sludge standard, *Cslgstd*, to determine the sludge land-application-based AHL for conservative pollutants.

**Converting Cumulative Loading Rates from
Table 2 to Dry Sludge Concentrations**

$$C_{slgstd} = \frac{(C_{cum})(SA)}{3046 (SL)(Q_{bla})(PS / 100)(G_{slg})}$$

- ▣ C_{slgstd} = Equivalent sludge standard, mg/kg dry sludge
- ▣ C_{cum} = Federal or State land application cumulative pollutant loading rate (lbs/acre over the site life)
- ▣ G_{slg} = Specific gravity of sludge (kg/L)
- ▣ PS = Percent solids of sludge to disposal
- ▣ Q_{bla} = Sludge flow to bulk land application (agricultural, forest, public contact, or reclamation site), MGD
- ▣ SA = Site area, acres SL = Site life, years
- ▣ 3046 = unit conversion factor

- The values for site life, SL , and site area, SA , are determined by a POTW's sludge management plan. The POTW determines how long the sites will be used and how much land or acreage is needed for disposal of the total annual volume of sludge generated. Generally, the amount of land needed is determined by dividing the total annual sludge production (tons) by the agronomic application rate for nitrogen (tons/acre) based on the crop grown.
- While EPA recommends using clean sludge levels, under no circumstances should values greater than the Table 1 ceiling concentrations be used for C_{slgstd} , even if the POTW intends to bulk its sludge prior to disposal.

Converting Annual Loading Rates from Table 4 to Dry Sludge Concentrations

$$C_{slgstd} = \frac{(C_{ann})(SA)}{3046 (SL)(Q_{la})(PS/100)(G_{sldg})}$$

- ▣ C_{slgstd} = Equivalent sludge standard, mg/kg dry sludge
- ▣ C_{ann} = Federal or State land application annual pollutant loading rate (in lbs/acre/yr)
- ▣ G_{sldg} = Specific gravity of sludge (kg/L)
- ▣ PS = Percent solids of sludge to disposal
- ▣ Q_{la} = Sludge flow to non-bulk land application, MGD
- ▣ SL = Site life, years
- ▣ 3046 = unit conversion factor

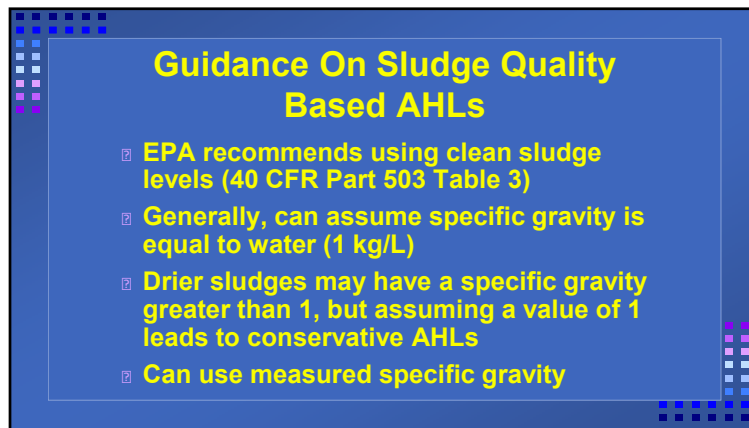
- Generally, POTWs can assume the specific gravity of sludge, G_{sldg} , equals that of water (1 kg/L). For a typical wet sludge containing about 5 percent solids, PS , the specific gravity of the sludge does not differ significantly from that of water. However, drier sludges such as dewatered sludges with 30 percent solids may have a specific gravity of 1.1 or greater. In these circumstances if the specific gravity is not considered, AHLs will be understated and any local limits based on these AHLs may be unnecessarily conservative. Therefore, the POTW can measure the specific gravity of its sludge to correct for the error introduced as the percent solids rises. If the POTW does not have data on the specific gravity of its sludge, it should assume conservatively that the specific gravity is 1 kg/L.
- If the POTW's data for sludge flow to disposal are expressed in dry metric tons per day (or can be converted to dry metric tons per day), a specific gravity factor is not needed. An equation for calculating an AHL using dry metric tons per day is provided in Appendix U of the new manual.
- Table 1 sludge ceiling concentrations are instantaneous maximum concentrations, while the "clean sludge" criteria in Table 3 are monthly average concentrations. Either one can be used to establish local limits as monthly averages because of protracted residence time for sludge digestion and disposal. If the limit is considered a monthly average, however, a daily maximum limit will need to be established based on more temporal conditions such as pass through.

AHLs Based on Sludge Land Application and Surface Disposal Criteria (for conservative pollutants)

$$AHL_{sl dg} = \frac{(8.34)(C_{st gstd})(PS / 100)(Q_{sl dg})(G_{sl dg})}{R_{p orw}}$$

- ▣ $AHL_{sl dg}$ = Allowable headworks loading, lbs/day
- ▣ $C_{st gstd}$ = Sludge standard, mg/kg dry sludge
- ▣ PS = Percent solids of sludge to disposal,
- ▣ $Q_{sl dg}$ = Total sludge flow to disposal, MGD
- ▣ $R_{p orw}$ = Plant removal efficiency from headworks to plant effluent (as decimal)
- ▣ $G_{sl dg}$ = Specific gravity of sludge (kg/L)
- ▣ 8.34 = unit conversion factor

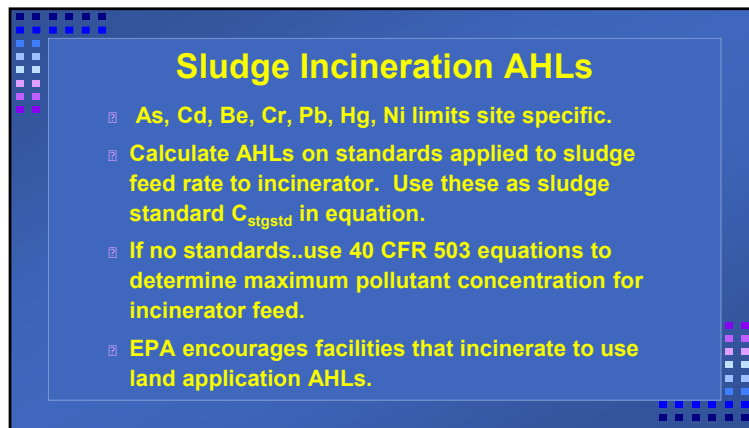
- As shown in this slide, the AHL for land application, $Lsl dg$, is the pollutant loading of sludge at the sludge standard, $(Csl gstd) * (PS/100) * (Qsl dg) * (Gsl dg)$, divided by the overall plant removal rate, $Rwwtp$.
- Sludge surface disposal occurs at dedicated disposal sites, surface impoundments, waste piles, monofills, or dedicated beneficial use sites. The difference between surface disposal and land application is that land application is performed at rates that do not exceed the agronomic rates of the fertilizer value of the sludge. For a more extensive discussion of surface disposal see the sludge regulations at 40 CFR 503.20. Surface disposal regulates only three metals (arsenic, chromium, and nickel) at levels near the “clean sludge” levels for land application. The standards apply to sludge disposed at facilities without a liner or a leachate collection system. AHLs based on sludge surface disposal quality should be calculated in the following manner:
- Table 1 (40 CFR 503.23) sludge surface disposal criteria should be used directly as the sludge standard, $Cst gstd$, in this equation for conservative pollutants.
- If the sewage sludge unit is less than 150 meters from the property line, Table 2 (40 CFR 503.23) sludge disposal criteria, based upon distance from the property line, should be used directly as the sludge standard, $Cst gstd$, in this equation for conservative pollutant.
- In addition, POTWs should be aware that surface disposal regulations allow for site-specific limits. Site owners or operators may have requested surface disposal criteria from the permitting authority in place of the Table 1 or Table 2 sludge surface disposal standards. Therefore, the POTW should check with the disposal site owner/operator to determine standards that apply. If the state has developed more stringent sludge disposal standards for surface disposal, the POTW needs to use those standards in its calculation of AHLs when using this equation.



Guidance On Sludge Quality Based AHLs

- ☐ EPA recommends using clean sludge levels (40 CFR Part 503 Table 3)
- ☐ Generally, can assume specific gravity is equal to water (1 kg/L)
- ☐ Drier sludges may have a specific gravity greater than 1, but assuming a value of 1 leads to conservative AHLs
- ☐ Can use measured specific gravity

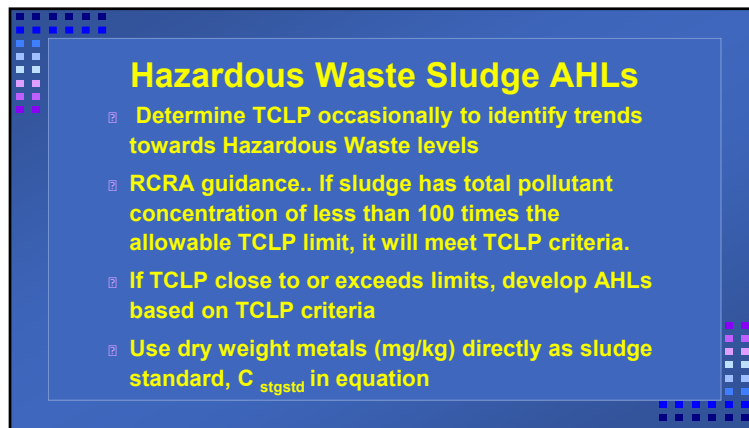
- General recap



Sludge Incineration AHLs

- As, Cd, Be, Cr, Pb, Hg, Ni limits site specific.
- Calculate AHLs on standards applied to sludge feed rate to incinerator. Use these as sludge standard C_{stgstd} in equation.
- If no standards..use 40 CFR 503 equations to determine maximum pollutant concentration for incinerator feed.
- EPA encourages facilities that incinerate to use land application AHLs.

- Incineration, the third method of sludge disposal, regulates arsenic, cadmium, beryllium, chromium, lead, mercury, and nickel. Limits are site-specific and based on feed rate, stack height (dispersion factor), incinerator type, and control efficiency. EPA offers the following guidance on incineration-based AHLs:
- POTWs that dispose of their sludge through incineration should determine AHLs based on the calculated sludge standards that apply to the sludge feed to the incinerator. These standards may have been calculated by the owner/operator of the incinerator (and listed in a sludge disposal agreement), the state, or EPA from the equations provided in 40 CFR Part 50, and should be expressed in mg/kg dry sludge. These standards should be used directly as the sludge standard, C_{stgstd} , in Equation 5.9 to determine the AHL.
- If no sludge standards have been calculated for the sludge feed to the incinerator, POTWs should use the 40 CFR Part 503 equations (provided in Appendix U) to determine the maximum pollutant concentrations for the incinerator feed. These standards should be used directly as the sludge standard, C_{stgstd} , in Equation 5.9 to determine the AHL. As a general rule, an AHL for incineration will be an order of magnitude or greater than an AHL based on land application. As stated earlier, EPA encourages facilities that incinerate their sludge to base their sludge disposal AHL on land application requirements since this provides the maximum flexibility for sludge reuse.



Hazardous Waste Sludge AHLs

- ▣ Determine TCLP occasionally to identify trends towards Hazardous Waste levels
- ▣ RCRA guidance.. If sludge has total pollutant concentration of less than 100 times the allowable TCLP limit, it will meet TCLP criteria.
- ▣ If TCLP close to or exceeds limits, develop AHLs based on TCLP criteria
- ▣ Use dry weight metals (mg/kg) directly as sludge standard, C_{stgstd} in equation

- **Hazardous Waste Requirements**

- Whether a POTW's sewage sludge is a hazardous waste may be determined by using EPA's TCLP test. If determined to be hazardous waste, sludge must be disposed of according to expensive RCRA requirements. POTWs cannot dispose of sludge determined to be hazardous waste in solid waste landfills designated for non-hazardous waste. In general, POTWs will not generate sludge that exceeds TCLP limits.
- However, since the costs and liabilities associated with the management and disposal of hazardous sludge are high, POTWs may find it advantageous to periodically run the TCLP test on their sludge to identify any trends of increasing pollutant concentrations that may lead the sludge to be considered hazardous waste. The POTW should compare the quality of its sludge with the limits in the TCLP and, as necessary, set local limits to help ensure that the pollutant levels in its sludge do not exceed TCLP levels.
- According to RCRA guidance, if a municipal sludge has a total pollutant concentration of less than 100 times the allowable TCLP limit, the sludge will likely meet the TCLP criteria establishing characteristic wastes. *If TCLP test results are close to or exceed the TCLP limit, the POTW needs to develop AHLs based on TCLP criteria.* To develop TCLP-based AHLs, the POTW should:
 - Determine the dry weight metals and toxic organics concentrations (in mg/kg dry sludge) that would be protective against sludge being classified as hazardous based on the TCLP test from monitoring data. The POTW can collect site-specific data for both total pollutant concentrations in the sludge and TCLP concentrations (10-12 data pairs) and use these data to correlate TCLP concentrations with total concentrations in the sludge.
 - Use these dry-weight, correlation-based, concentrations directly as the sludge standard, C_{stgstd} , in the equation to determine the AHL.

Air Quality Based AHLs

$$AHL_{air} = \frac{0.0022(C_{airstd})}{R_{vol}}$$

AHL_{air} = AHL based air emission standards, lbs/day

L_{infl} = POTW influent loading, lbs/d

C_{airstd} = Air emissions standard, g/day

$$AHL_{air} = (L_{infl}) * \frac{C_{airstd}}{C_{air}}$$

C_{air} = Existing air emissions, g/day

R_{vol} = Pollutant removal by volatilization (as decimal)

0.0022 = Unit conversion factor

- POTWs that have been regulated as air pollution sources and have air emissions standards for specific toxics may need to consider calculating AHLs for those toxics. AHLs based on air emissions standards can be calculated using either the top equation, which uses the air standard and removal efficiency by volatilization, or the lower equation, which uses air standard and existing air emissions. The POTW can conduct air emissions sampling or conduct modeling to predict existing air emissions, C_{air} . POTWs can determine pollutant removal efficiency by volatilization, R_{vol} , by examining sampling data of influent, effluent, sludge, and air and determining the portions of the total removal efficiency associated with adsorption to the sludge, biodegradation, and volatilization. In addition, POTWs can model the removal process to predict pollutant removal efficiency by volatilization.

AHLs for Conventional Pollutants

? BOD/TSS

- EPA recommends the POTW's rated average design capacity plus any improvements should be used as a "monthly average" based MAHL

? Ammonia

- Use design loading rates as the MAHL

? Oil and Grease

- 100mg/l local limit widely adopted for mineral O&G (*basis is not site-specific/technical*)
- A level of animal FOG at which deposition in a sewer pipe is negligible would be the basis for a collection system MAHL

•**BOD/TSS** One of the most commonly documented industry-related causes of POTW effluent violations is the discharge of excessive conventional pollutants, particularly BOD and TSS (see Exhibit 5-5). As stated earlier in the chapter on POC development, POTWs should develop MAHLs for all NPDES-permitted conventional pollutants and understand the degree to which the plant is loaded. In fact, some EPA regions require any wastewater treatment plant that operates at 80 percent of any NPDES permitted conventional pollutant MAHL for three months of the calendar year to calculate a MAIL and establish local limits for those pollutants. To establish MAHLs for BOD and TSS, EPA recommends the following:

- The POTW's rated average design capacity, along with any improvements subsequent to construction that have increased plant capacity, should be used as a "monthly average"- based MAHL. The treatment works is designed to have the capacity to consistently treat a specified amount of conventional pollutants to acceptable levels for discharge. A copy of the approved design capacity may be available from the State as part of the design or operating manual for the POTW.

- The POTW's peak loading capacity should be used as the "daily maximum"- based MAHL. Based on a peaking factor, peak loading capacity reflects the plant's ability to handle diurnal, wet weather, or seasonal peaks.

- EPA recognizes that sometimes average design capacity and the corresponding peak loading factor may be too conservative when

considering the industrial allocation of conventional pollutants. Therefore, the POTW can provide a technically defensible argument for establishing a MAHL for the plant. These arguments could include the following:

- Performing mass balance calculations on the entire plant for the current condition, and scale up the plant loading until loading rates for individual processes exceed design guidelines, including solids handling facilities.
- Verifying capacity of hydraulic structures.
- Performing detailed modeling of biological process capacity under current loading conditions using software (e.g., BioWin by EnviroSim). Calibrate the model to current conditions and then increase loading rates to estimate failure.
- Determining maximum biological process loading compared to typical design guidelines -including aeration equipment capacity, basin sizing, mixing energy, secondary clarifier sizing, return activated sludge/waste activated sludge capacity, nutrient removal capacity, winter and peak operation.
- Evaluating current operating conditions. For example, a plant with three activated sludge trains is operating reliably at 2/3 of its design loading with only one train in service.
- Stress testing of individual processes. Increase loading through a single process train until failure is recognized.
- Benchmarking against similar plants and processes.
- Pilot or bench-scale testing of unit operations that have been determined to possibly be a bottleneck for plant capacity.
- Smaller plants should incorporate a safety factor in developing the BOD/TSS MAHL for the plant using these methods.

•**AMMONIA** If the POTW was designed to remove ammonia through specific processes such as nitrification and denitrification, breakpoint chlorination, or ammonia stripping, the engineering specifications that establish design loading rates should be used as the MAHL.

•**OIL & GREASE** Most POTWs have adopted 100 mg/L as their local limit for fat, oil and grease (FOG). The basis of the 100 mg/L limit is an April 1975 EPA document

titled *Treatability of Oil and Grease Discharged to Publicly Owned Treatment Works*.[^] This study found a dilution of at least 2X occurs in collection systems and that influent to biological treatment systems should contain less than 75 mg/L and preferably less than 50 mg/L oil and grease of mineral or petroleum origin to prevent interference. The 100 mg/L was recommended as the value that prevents interference based on the dilution. ^{urse} ge <#>

- To develop a technically-based FOG limit to protect the collection system, empirical data (observations and measurements) are needed to document problems and contributing factors. The empirical data along with generally available pretreatment and control measures for FOG become the technical basis for the limit proposed. To collect data, the POTW identifies collection system sections that have a critical low slope (relatively flat) profile and may be subject to low temperatures. Data are collected that identify FOG levels corresponding to deposition rates of solidified oil and grease. The level of oil and grease at which deposition is negligible would be the basis for the collection system MAHL.

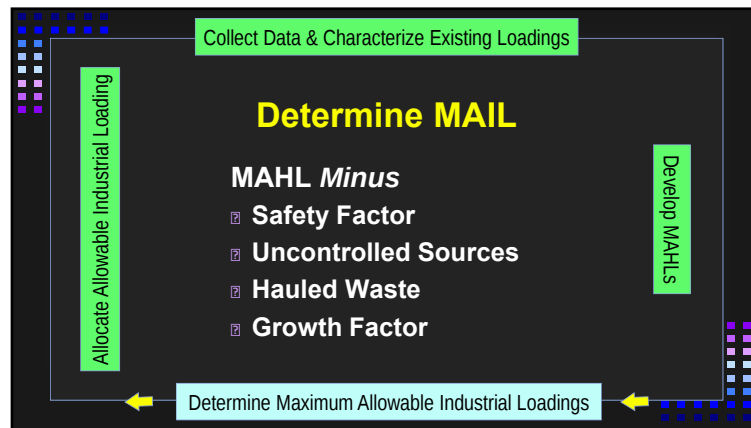
Actual Loading vs. MAHLs EPA Guidance

Local limits should be established:

- Where the average actual loading of a pollutant is > 60% of the MAHL, or:
- Where the maximum actual loading is > 80% of the MAHL any time in the 12 month period preceeding the analysis
- For BOD and TSS: Where the monthly average influent loading is > 80% of design capacity any one month in the 12 months before the headworks analysis

- When comparing actual loadings against the MAHLs for toxic pollutants, local limits should be set where the average actual loading of a pollutant exceeds 60 percent of the MAHL, or where the maximum actual loading exceeds 80 percent of the MAHL any time in the 12- month period preceding the analysis. For BOD5, TSS, and ammonia, a local limit would be established where the monthly average influent loading reaches 80 percent of average design capacity for the pollutant during any one month in the 12-month period preceding the analysis. The approach used for toxic pollutants is more conservative because most POTWs are not designed to treat toxic pollutants.
- These are guidelines and not hard and fast criteria for determining when a local limit needs to be adopted. There may be other factors which need to be considered such as the effect of eliminating a limit on users that have installed treatment. For example, you may have a number of industries that have installed treatment to reduce copper levels so that the current loading of copper is only about 50% of the MAHL. What will those industries do if the local limit for copper is eliminated? Will they eventually start discharging more copper because they don't need to maintain their treatment systems

as rigorously?



- After identifying the MAHL for each pollutant, the next step is to determine the maximum allowable industrial loading.
- **Safety factor** - need to account for:
 - future industrial and residential growth;
 - variability of the data used and default/literature criteria potentially used;
 - potential slug loadings; and
 - stability of plant operations.
 - Applies to the entire allowable loading, not just industrial
 - Usually set between 10-30 percent but higher factors may be justified
 - POTW must provide justification for factor chosen.
- In some instances, the domestic/background loadings will be higher than the MAHL, with or without application of a safety factor. In these situations, POTW service area-wide P2 strategies may be implemented to reduce the “uncontrollable” contributions.

Maximum Allowable Industrial Loading (MAIL) Calculation

$$MAIL = MAHL(1 - SF) - (L_{unc} + HW + GA)$$

- **MAIL** = Maximum allowable industrial loading, lbs/day
- **MAHL** = Maximum allowable headworks loading, lbs/day
- **SF** = Safety factor, if desired
- **L_{unc}** = Loadings from uncontrolled sources
(uncontrolled sources = domestic + some commercial + I&I)
- **HW** = Loadings from hauled waste, if not regulated through the local limits
- **GA** = Growth allowance.

- The first objective in allocating local limits after the MAHLs have been calculated is to determine how much of each MAHL is available for industrial and other controllable sources (i.e., determine Maximum Allowable Industrial Loadings or MAILs). The MAILs developed by the POTW represent the amount of pollutant loadings the POTW can receive from controlled sources -- industrial users and possibly some commercial users -- that the POTW chooses to control through local limits. Discharges from some waste haulers may be regulated by POTWs and so may be considered controlled sources.

Safety Factor

The safety factor decision should consider the following factors:

- ❑ The variability of the POTW's data
- ❑ The amount of data the POTW used in its development of MAHLs
- ❑ The quality of the POTW's data
- ❑ How much literature data the POTW used

- A safety factor is site specific and depends on local conditions. Some Approval Authorities may have mandatory safety factors. At a minimum, EPA generally recommends a 10 percent safety factor. the safety factor depends on the following elements: The variability of the POTW's data. The amount of data the POTW used in its development of MAHLs.
- The quality of the POTW's data. How much literature data the POTW used.

Safety Factor (continued)

- ? The history of compliance with the parameter
- ? The potential for IU slug loadings (e.g., as a result of chemical spills)
- ? The number and size of each IU with respect to the POTW's flow

- The history of compliance with the parameter. The potential for IU slug loadings (e.g., as a result of chemical spills). The number and size of each IU with respect to the POTW's flow. The POTW may use different safety factors for different pollutants.

Uncontrolled Sources

- ❑ Domestic users
- ❑ Some or all of the commercial users
- ❑ Inflow and Infiltration [I&I]
- ❑ Storm water (if combined sewers)
 - A minimum of at least 7 separate samples should be taken to assess variation in uncontrollable sources
 - The number of sampling sites depends on the size of the collection system

- Some sources of pollutant loadings to the POTW are considered uncontrolled. They include domestic users, I&I, storm water, and some or all of a POTW's commercial dischargers. Since the POTW does not control the loadings that these users discharge (except through the general and specific prohibitions in the POTW's sewer use ordinance [SUO]), the POTW needs to subtract their loadings from its MAHLs before it can determine the loadings available for IUs that will be controlled. The POTW should determine the uncontrolled loadings from its local limits monitoring program.

Uncontrolled Loading Calculation

$$L_{UNC} = (C_{UNC})(Q_{UNC})(8.34)$$

- L_{UNC} = Uncontrolled loading, lbs/day
- C_{UNC} = Uncontrolled pollutant concentration, mg/l
- Q_{UNC} = Uncontrolled flow, MGD
- 8.34 = Unit conversion factor

Q_{UNC} = WWTP average flow (MGD) minus permitted SIU flow (MGD) which should be known for all SIUs (or use potable water use measurements).

- Site-specific monitoring of the uncontrolled discharges should be conducted at sewer trunk lines that receive wastewater from only uncontrolled sources. Concentrations obtained from these locations should be multiplied by the POTW's total uncontrolled flow to determine total loadings from uncontrolled sources. *EPA strongly encourages POTWs to use site-specific data for uncontrolled loadings whenever possible. In Appendix V of the new manual are data on pollutant concentrations found in typical domestic wastewater discharges, which can be used if site-specific data are not available.* Readers should note that domestic wastewater values may not be representative of the uncontrolled discharges in their systems, so these data should be used with extreme care.
- Note – Need to stress that since the uncontrolled portion is generally such a high percentage of the total flow, small changes can wind up having a big impact on the local limits

Hauled Waste

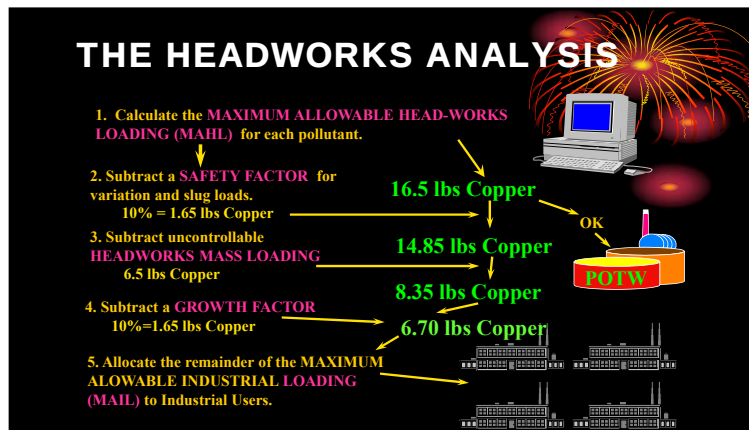
- If the POTW does not intend to regulate hauled wastes through local limits, the loading from these sources should be included with the uncontrolled sources.
- Should sample hauled wastes to insure that they:
 - are not hazardous
 - are not greater than expected (i.e., not greater than background concentrations if treated as uncontrollable)
 - will not pose risks to workers

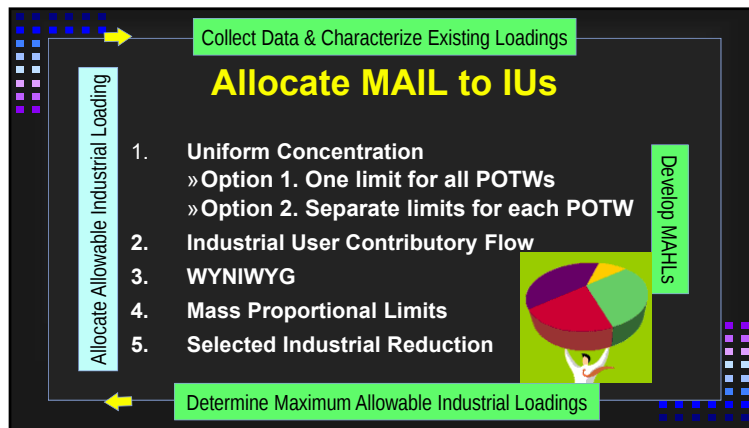
- POTWs that do not regulate waste haulers through local limits should determine the loads they receive from hauled waste and subtract these loads from their MAHLs before determining their MAILs. Data on the pollutant concentrations and flows from waste haulers can be collected by sampling hauled waste brought to the treatment works. POTWs should regularly sample these loads to ensure that they are not hazardous waste, do not contain toxic pollutants in amounts greater than expected or greater than local limits, and will not pose risks to the treatment plant or its workers. In addition, POTWs should be aware that hauled waste subject to categorical limitations must meet those limits when accepted at the POTW and that pretreatment standards apply equally to wastes hauled from IUs.

Growth Allowance

- ❑ If growth is anticipated, a portion of the MAHL should be reserved.
- ❑ Growth allowance is separate from a safety factor
- ❑ Growth can come from new or expanding IUs, shopping malls, industrial parks, or new housing developments
- ❑ Most common for BOD, TSS, and other pollutants the POTW was designed to remove

- A POTW that anticipates a significant amount of growth in the near future can consider holding in reserve a small portion of its MAHLs for this growth. This expansion/growth allowance is separate from the safety factor. Growth can come from new IUs moving into the POTW's service area or existing IUs expanding their operations, the development of a shopping mall or the opening of other commercial businesses in a new office park, or the construction of a new housing development. The expansion and growth allowance is most commonly justified for BOD, TSS, and other pollutants the POTW was designed to remove. By holding in reserve some of the maximum allowable headworks loading, the POTW has a portion to allocate to the new discharges and may not need to revise its existing IU permits or its sewer use ordinance (SUO). A POTW should annually re- value its local limits, however, so a growth allowance may not be necessary.





- **Uniform concentration**

- The same concentration applies to all IUs
- Determined by taking the MAIL and dividing it by the total industrial flow and a conversion factor.

- **Industrial contributory flow**

- Only those that contribute the pollutant above domestic/background levels are limited
- Single concentration applied
- Determined by taking the MAIL and dividing it by a conversion factor and the total flow of only industries discharging the particular pollutant.
- (Note: IUs not contributing the pollutant above domestic/background levels can discharge the pollutant but are limited by said domestic/background levels.)

- **WYNIWYG**

- Assuming no other limitations or prohibitions apply to the discharge and that BMPs are being implemented, this is the “what you need is what you get” approach. Limits can be either concentration or mass based.

- **Mass proportion**

- Allocation in proportion to IU loading.

- **Selected industrial reduction**

- Requires different percent reductions/increases for all affected IUs to achieve the desired percentage.

- **Limits should not be set so high as to encourage poor management practices.**

MAIL Allocation Methods

- ☐ MAIL Allocation Method is very important decision made by Pretreatment Coordinator
 - Significant impacts on regulated community
 - Impacts on economic development of city
- ☐ Method chosen should be “best fit” for POTW-specific (or pollutant specific) situation
 - Size of PT program, # of SIUs discharging a specific pollutant, “size of the MAHL

Can More than One Method be Used?

- ❓ EPA does NOT dictate allocation method
- ❓ Any allocation method can be selected as long as it is:



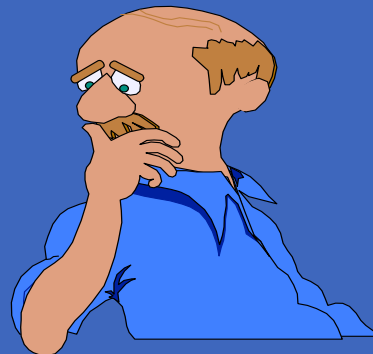
Protective, Enforceable, and Reasonable

- ❓ One or more allocation methods can be used (different allocation methods for different pollutants)

- A POTW may select any allocation and implementation method that results in enforceable local limits which prevent pass through and interference and comply with the prohibitions in the federal regulations. The POTW should choose the allocation approach that best fits its own situation. It may choose one approach for some pollutants and another approach for other pollutants, depending on the amount of loading available to IUs and the number of IUs discharging a given pollutant. For example, if only 3 of a POTW's 10 IUs discharge silver, the POTW may prefer to allocate its allowable industrial silver loading among the 3 IUs that discharge silver so that these IUs receive more achievable limits. At the same time, if all of the users discharge copper, the POTW may choose to allocate the MAIL for copper to all of the users on a uniform basis. All regulated IUs should receive at least a background allocation for copper and all other POCs

Limit Duration

- ❓ **Daily maximums
(most common)**
- ❓ **Monthly averages
(permit based)**
- ❓ **Instantaneous maximums
(grab samples)**



•When applying its local limits, a POTW needs to determine the appropriate limit duration. The POTW may establish limits that are daily maximums, monthly averages, or instantaneous maximums. In general, local limits derived from MAHLs based on long-term criteria should be established as monthly average local limits, while local limits derived from MAHLs based on other criteria should be established as instantaneous or daily limits. Presented below are guidance on these types of limits.

•Daily Maximums

•In general, the limits developed based on most criteria can be applied as daily maximums. POTWs should generally develop daily maximum limits for all regulated pollutants. For example, MAHLs that are determined by NPDES permit limits expressed as daily maximums should also be considered daily maximums. When the prevention of pass through is based on calculations using Water Quality Standards (or Criteria) the limit should be considered a daily maximum since the calculation is based on either the receiving stream's 1Q10 or 7Q10, both of which are short-term phenomena. Another short-term condition that leads to a daily maximum limit is the MAHL based on biological inhibition for both secondary and tertiary treatment. The residence times for secondary and tertiary treatment is relatively short so any MAHLs associated with them should be considered a daily maximum.

•Monthly Averages

•A MAHL determined by an NPDES permit limit that was expressed as a monthly average would be considered a monthly average. Sludge inhibition and sludge disposal MAHLs, however, are quite different. Residence times in digesters and storage facilities is commonly 20 to 30 days or more. Consequently, to change the concentration to any appreciable degree, any discharge at the MAHL level would have to be maintained for three to four weeks. This, of course, lends itself to a monthly average type limit. However, if the POTW were to establish an MAHL as a monthly average it would then need to ensure that those conditions sensitive to daily fluctuations are protected by a daily maximum limit. To avoid having to develop two limits the POTW could consider any MAHL based on sludge digestion inhibition or sludge disposal as a daily maximum limit. Any monthly average enforced as a daily maximum would automatically be protective of long term effects.

•Instantaneous Maximums

•Instantaneous limits should be developed for pollutants that cannot be composited. A limit derived from a MAHL based on 1-hour acute toxicity water quality criteria may not be protective if it is implemented as a maximum daily average instead of as an instantaneous limit. However, if the instantaneous limit is converted to a maximum daily limit using a statistical procedure that accounts for the variation in concentrations over a 24-hour period, the maximum daily limit should be adequately protective. The EPA Technical Support Document (TSD) approach, described in the *Technical Support Document for Water Quality Based Toxics Control* (EPA, 1991a), accounts for these variations. Therefore, if MAHLs based on WQS are developed using the EPA TSD approach, daily maximum and monthly average limits can be obtained from the calculations.

ALLOCATION APPROACHES:

1. Uniform Concentration

- ▣ Same pollutant concentration limit applies to every controlled (permitted) discharger
 - Even those that do not discharge the pollutant
- ▣ Method prevalent throughout most of the country
- ▣ Quick and Easy!
- ▣ Calculation uses the pounds formula
 - Total flow of permitted dischargers in MGD, MAIL in pounds, solve for mg/l

Allocation Approaches: Uniform Concentration

$$\text{Limit (mg/l)} = \frac{\text{MAIL in POUNDS per Day}}{\text{Total Controllable flow (MGD) x 8.34}}$$



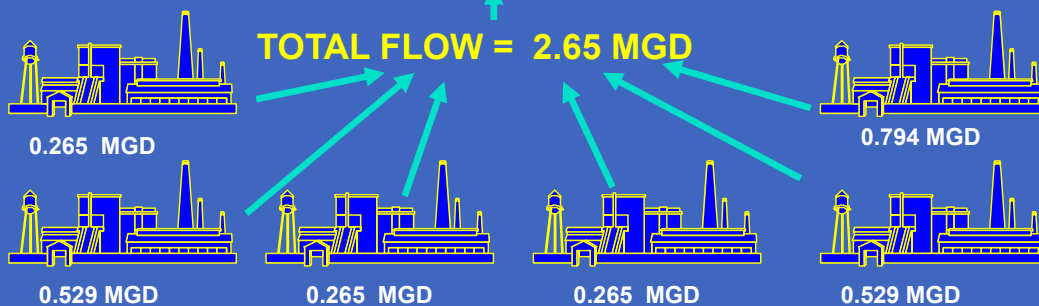
- This method of allocating MAILs for conservative pollutants yields one limit per pollutant that applies to every controlled discharger. It requires that the MAIL for each pollutant be divided by the total flow from all controlled dischargers, even those that do not discharge the pollutant. These limits are concentration based
- Can take a uniform concentration limit and individually convert them to masses in the permit for all of the users

Uniform Concentration Allocation

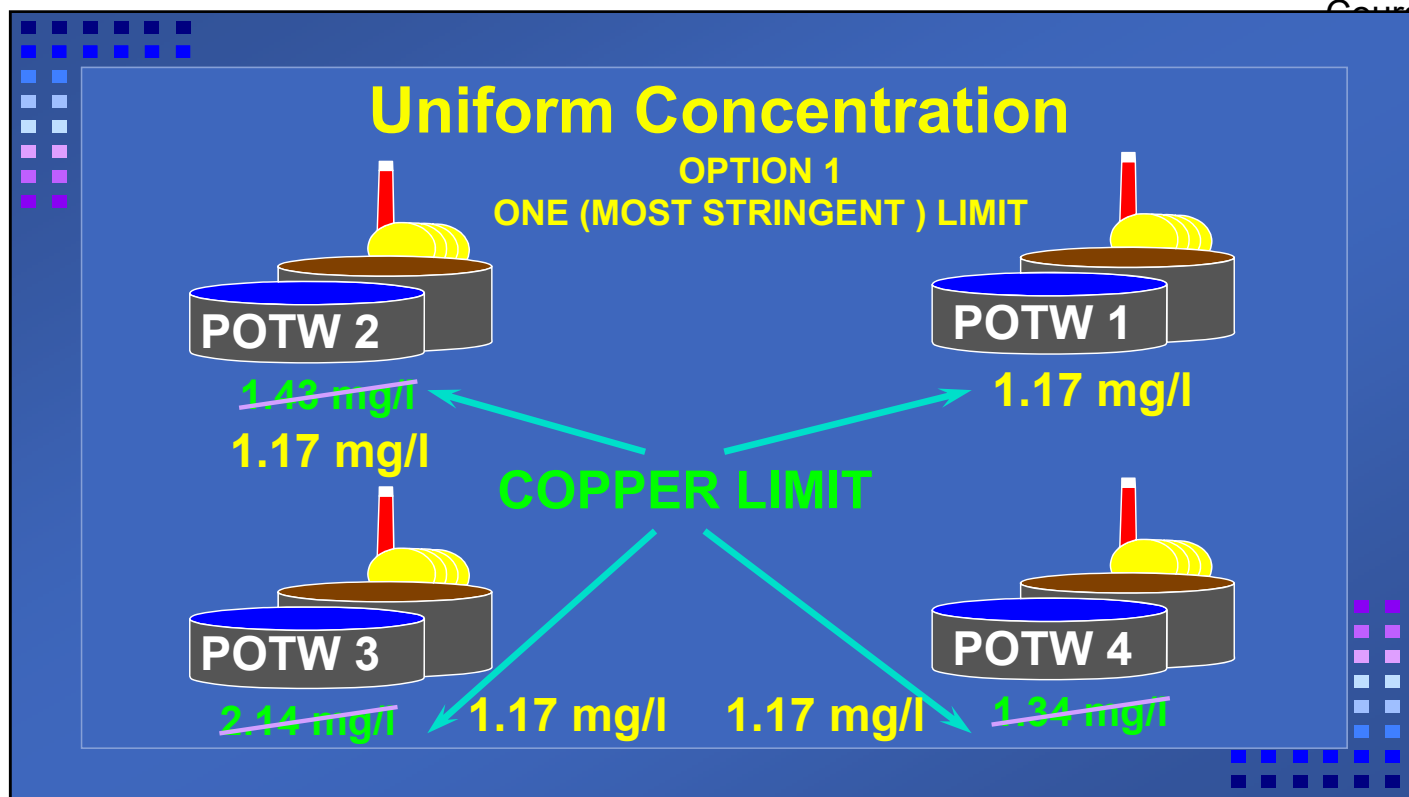
MAIL = 11.01 pounds COPPER)

↓
ALLOCATE ONE LIMIT BASED ON FLOW FROM ALL SIUs

$$= 11.01 \text{ lbs} / (2.65 \pm 8.34) = 0.50 \text{ mg/l}$$



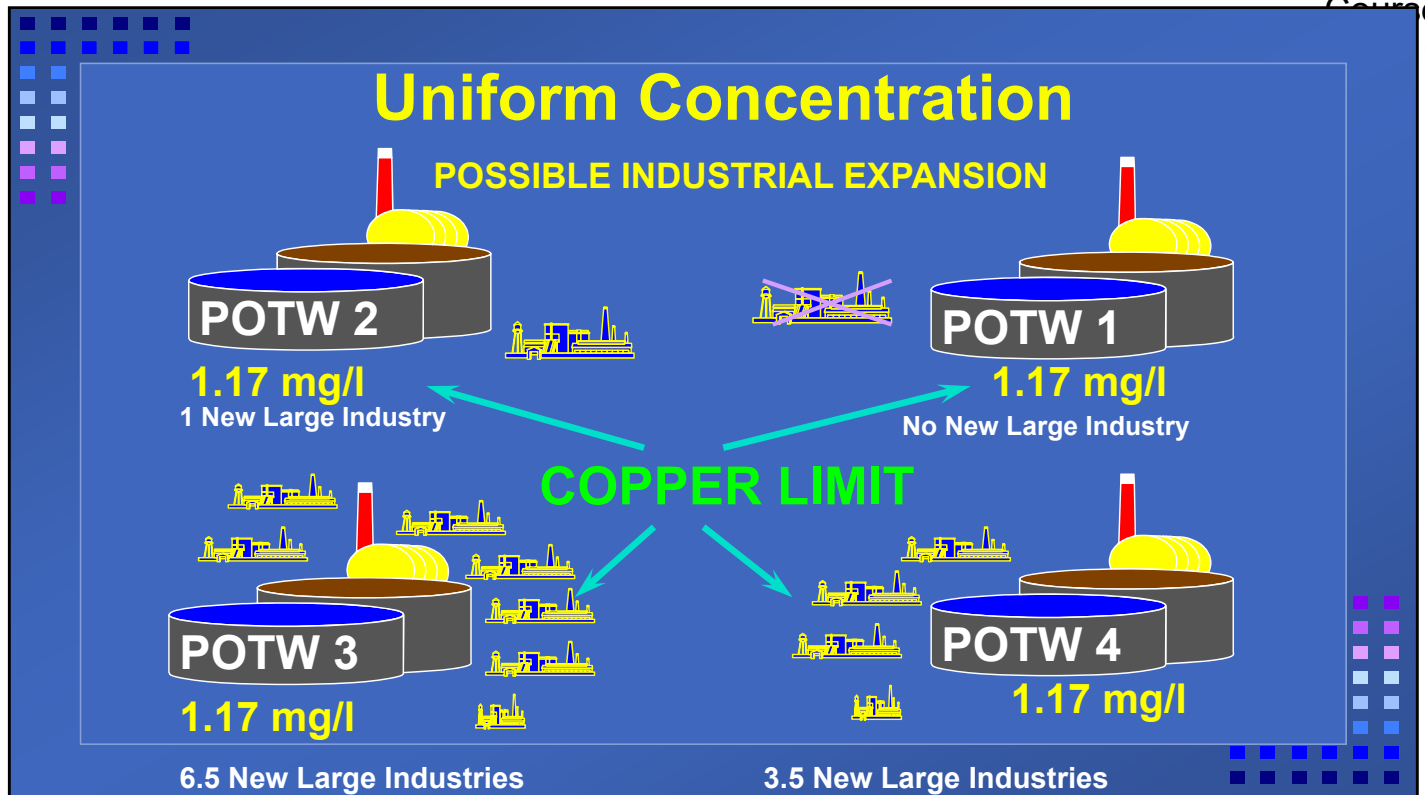
- For ease of calculation the 6 industrial user flows are known in liters per day. Total flow from all SIUs is 10 million liters per day. After deduction of a uncontrollable factor, a safety factor, a growth factor and a hauled waste factor from the calculated MAHL for copper, a Maximum Allowable Industrial Loading (MAIL) of 5 million mg of copper is arrived at. Uniform allocation of 5 million milligrams of copper to 10 million liters of industrial flow results in a uniform allocation concentration of 0.5 mg/l.



- Where more than one POTW exists in the same pretreatment program, MAHLs and MAILs must be calculated for each POC for each POTW. In the example displayed here four POTWs exist in the same program, the copper MAHL is calculated for each POTW and then the most stringent limit is applied to all 4 POTWs.

Option 1 Advantages

- ❑ No economic advantages to any industry
- ❑ Easy to calculate and apply
- ❑ Allows for industrial growth in certain areas of the municipality
- ❑ Wastewater can be switched from one POTW to another
- ❑ Sewer Use Ordinance contains limits that apply to ALL users

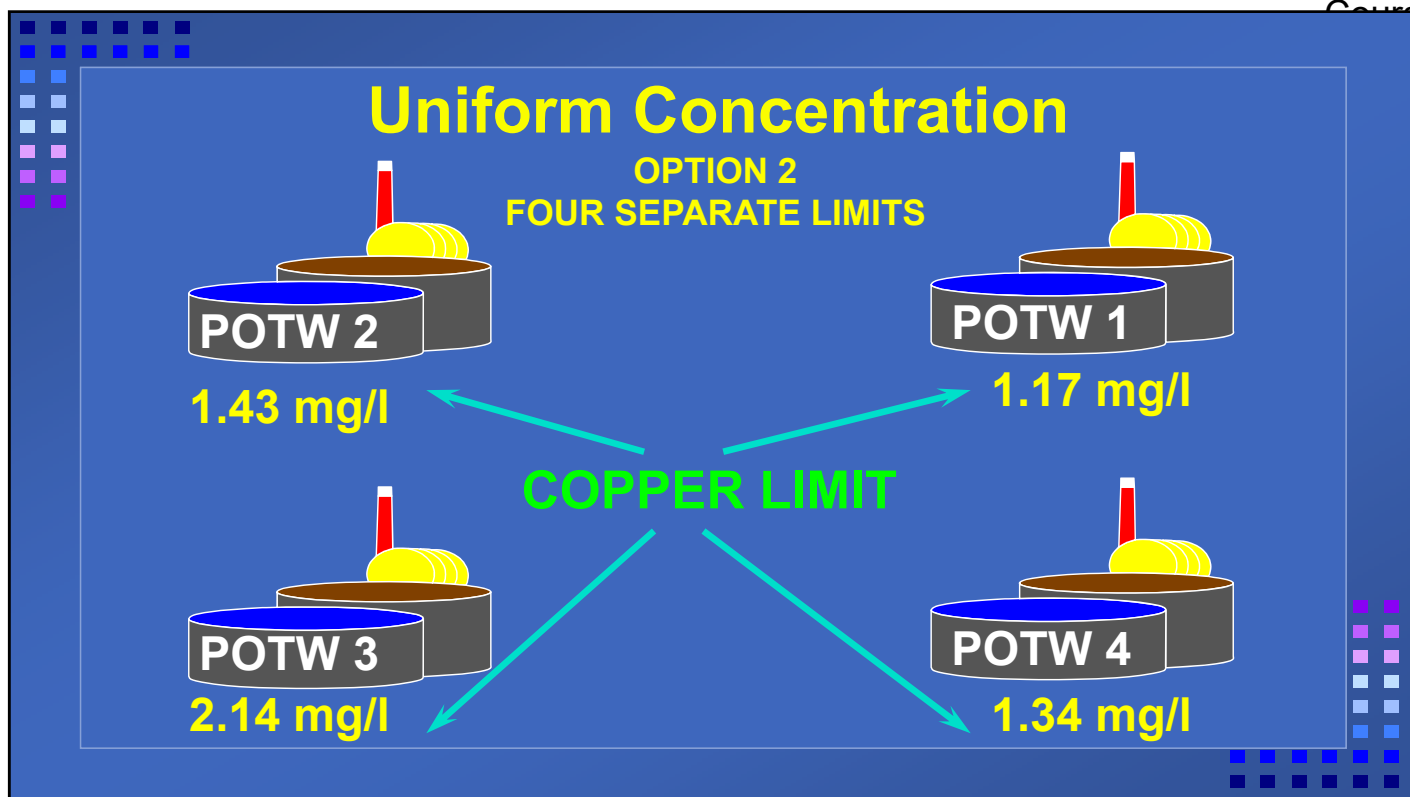


- Because three of the four POTWs are overprotected by the most stringent MAIL from the fourth POTW, extra industrial users can move into the three collection system areas served by the three POTWs without compromising the local limit for copper. The IP program should calculate the extra loading that is available at each POTW and restrict industrial growth to that loading value. In this example, different amounts of SIUs can move into the three POTW collection system areas depending on their discharge loading for copper.

Option 1 Disadvantages

- ? Limits may be overly stringent for some industries
- ? Inflexible, no consideration given for actual POC discharges
- ? Overprotection of the POTW
- ? Penalizes water conservation
- ? Can create unnecessary noncompliance

- Disadvantages as explained in the slide. Penalizes water conservation as the limit is concentration based and thus reduction of flow necessitates increased treatment to maintain the same concentration levels. Unnecessary noncompliance can be experienced when an industry discharging to a POTW that is known to be “overprotected” exceeds the local limit developed by the most stringent POTW.
- Allocation trading could be used to alleviate this problem.



- Independent limits are developed for each POTW.

Option 2 Advantages

- ❑ Better allocation of the different MAILs
- ❑ POTWs not overprotected
- ❑ Limits are fair to all SIUs
- ❑ Easy to calculate and apply

- Self explanatory

Option 2 Disadvantages

- ❑ **POTW appears to grant economic advantages to industries in certain areas and penalize those in others**
- ❑ **Enforcement problems arise if wastewater from one industry can be switched from one POTW to another**

- Problems arise when SIUs are close to each other and have widely different local limits. May lead to economic disadvantages. Enforcement problems arise if the wastewater from one POTW can be redirected to another POTW. If wastewater is redirected to the POTW with the minimum limit it could result in NPDES violations or interference.

Option 2 Disadvantages

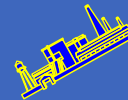
- ❑ **Penalizes water conservation**
- ❑ **Minimal Industrial Growth Allowed**
- ❑ **Industrial Pretreatment Program more complex to administer with different limits for each pollutant**
- ❑ **SUO complex**

- No incentive to conserve water is demonstrated as the limit is concentration based only. Growth factor controls industrial growth levels. Program must ensure that the correct pollutant limits are included in the permits for each POTW user. Sewer Use Ordinance (SUO) would either contain a description of all POTW collection systems and applicable limits or could refer to a separate document (headworks loading study?) by reference.

Allocation Approaches

2. Industrial User Contributory Flow

- ❑ Calculate total flow from SIUs that have a pollutant in their discharges at greater than background levels
- ❑ Divide MAIL by this flow
- ❑ New concentration based limit applies ONLY to selected SIUs



- **IU contributory flow.** This method is similar to the uniform method described above, except that the MAILs are divided by the flow from only the controlled dischargers that have a pollutant in their discharges at greater than background levels. The concentration-based limits apply only to those users.
- Need to stress that you need to subtract out at least a background allocation for each pollutant for the non-contributory users.

Industrial User Contributory Flow

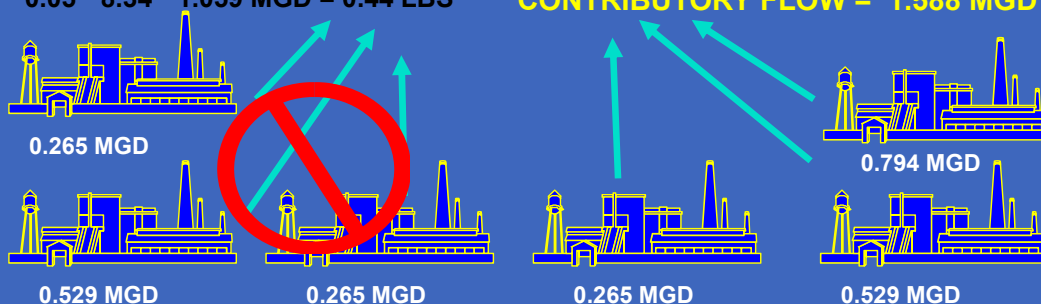
MAIL = 11.01 POUNDS COPPER

ALLOCATE ONE LIMIT BASED ON FLOW FROM INDUSTRIES THAT
DISCHARGE POLLUTANT ABOVE BACKGROUND LEVELS

$$= (11.01 - 0.44) / (8.34 * 1.588) = 0.80 \text{ mg/l}$$

$$0.05 * 8.34 * 1.059 \text{ MGD} = 0.44 \text{ LBS}$$

CONTRIBUTORY FLOW = 1.588 MGD



Industrial User Contributory Flow

- ❓ **SIUs that discharge at or below the background level are given a background allocation**
- ❓ **Sometimes a different allocation can be justified based on actual sample data**

- Any user that discharges at or below the background level is given a background allocation (unless a different allocation can be justified based on actual sample data). This can be calculated for each pollutant using the uncontrolled concentration for that pollutant and the flow of that pollutant from the “non-contributing” industries.
- If these methods are used, all IUs that are not given a limit for a particular pollutant are held to background levels for that pollutant. Holding the IUs to a background concentration is often implemented incorrectly. It is important to realize that the concept of “background concentrations” should not result in an over-allocation of the MAIL.
- Note – Need to talk about use of background allocations for non-contributory flows. Since are assigning a background allocation, that becomes the limit for that user (we would say that the background should then be listed in the permit as the limit). But since the background is an average, you might be setting up the user for periodic violations and so might want to give a higher than background allocation depending on how much data are available and how confident you are about future discharges.

$$C_{LIM} = \frac{L_{MAIL} - L_{BACK}}{(Q_{CONT})(8.34)}$$

C_{LIM} = Concentration limit for all users discharging a pollutant, mg/l

L_{MAIL} = MAIL, lbs/day

L_{BACK} = Total background loading allocation for all users for which no contributory flow limit is being established for that pollutant, lbs/day

Q_{CONT} = Flow from all industrial and other controlled sources discharging the pollutant, MGD

- This is the formula given in the new manual

Advantages

- ☐ Common discharge limit established for all users identified as discharging a given pollutant
- ☐ MAIL apportioned more efficiently only to SIUs discharging the pollutant above background levels
- ☐ Limits usually higher than uniform method
- ☐ Unnecessary noncompliance reduced

Disadvantages

- ❑ Need accurate flow and pollutant data for each SIU
- ❑ Penalizes water conservation
- ❑ SUO cannot contain limits

Cautions: Concentration Based Limits

- ▣ **Appears Fair on a Concentration Basis**
[Look at the pounds, though!]
- ▣ **Be Careful.....**
 - If your SIU develops an ambitious water conservation program, they may “conserve” themselves right into noncompliance
 - “I’d like a million gallons at that concentration, please.....”

Allocation Approaches

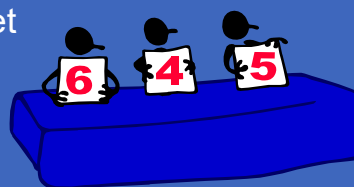
3. What You Need is What You Get WYNIWYG

- IU Limits Set on Case-by-Case Basis
- Limits Can Be Based on:
 - IU current loading
 - IU Ability to Pretreat Pollutants
 - Other technically based factor
- Limits: Concentration or Mass based

- Now let's talk about "Win E Wig" method....What you Need Is What You Get".... The limits can be concentration based or mass-based (pounds).
- This type of allocation relies on the POTW's judgment of how much of the MAIL to allocation to each controlled discharger.
- Assuming no other limitations or prohibitions apply to the discharge and that BMPs are being implemented, this is the "what you need is what you get" approach.
- Limits are based on historical data and performance and can be concentration based or mass-based.

MAIL ALLOCATION METHODS: “W.Y.N.I.W.Y.G.”

- ❑ “What You Need Is What You Get”
- ❑ Essentially a “pollutant trading” system with the POTW in complete control of the “trades”
- ❑ Permit Limit Determination
 - Review historical data
 - Determine limit/value that can be met *on a consistent basis*
 - Add a “safety factor”



- It is essentially a “pollutant trading” process, with the POTW in complete control of the trades.
- Typically about 3 or 4 years of data is reviewed and a limit is chosen based on a value that can be met consistently by the facility when it is being operated efficiently.
- A safety factor is then added to that value.....and the site-specific limit has then been determined!

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Uniform Concentration vs. WYNIWYG

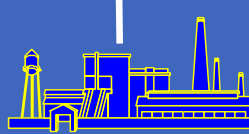
ALLOCATE ONE CONCENTRATION LIMIT BASED
ON FLOW FROM ALL SIUs

$$= 2.5 \text{ pounds Nickel} / (0.3 \text{ MGD} * 8.34) = 1.0 \text{ mg/l}$$

TOTAL FLOW = 300,000 gpd



0.10 MGD



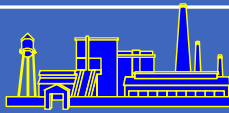
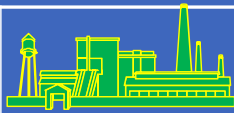
0.10 MGD



0.10 MGD

- Now let's look back again at the uniform concentration method we talked about a few minutes ago and compare it to WYNIWYG.
- We have 3 SIUs all with flows of 100,000 gallons per day or 0.1 MGD.
- We have taken the MAIL which in this case is 2.5 pounds for nickel...then divided it by the total flow of all Significant Industrial Users in the town also using a factor to convert pounds to mg/l concentration...and everyone gets 1.0 mg/l...
- The calculation takes about 2 minutes and the PT Coordinator gets a 1.0 mg/l limit for all industries discharging to the POTW.

UNIFORM CONCENTRATION versus.....

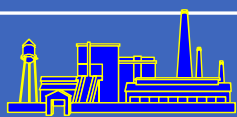
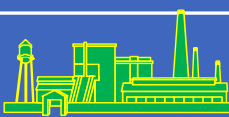
MAIL = 2.5 lbs Nickel			
Industry	Food Processing	Metal Finishing	Textile
Discharge	0.05 mg/l	1.5 mg/l	0.11 mg/l
Uniform Limit	1.0 mg/l	1.0 mg/l (\$\$\$\$\$)	1.0 mg/l
2.5 Pounds Ni Permitted	0.834 lbs	0.834 lbs	0.834 lbs

•But the uniform concentration method does not really consider what each of these industries is actually discharging. The food processor has very little nickel in their discharge, but their permit limit is 1.0 mg/l or ppm., just like everyone else. They will never use that “false capacity” between their actual discharge of 0.05 mg/l and their limit of 1.0 mg/l.

The textile mill is discharging twice the concentration of the food processor but is still no where near the uniform nickel limit of 1.0 mg/l.

And we have the metal finishing facility who does nickel plating and cannot quite meet the uniform limit, so he will be required to install additional pretreatment in order to meet that....and it will not be cheap!

“What You Need Is What You Get”

MAIL = 2.5 lbs Nickel			
Industry	Food Processing	Metal Finishing	Textile
Discharge	0.05 mg/l	1.5 mg/l	0.11 mg/l
WYNIWYG Limit	0.1 mg/l	2.38 mg/l (Categorical Std)	0.2 mg/l
2.23 Pounds Ni Permitted	0.08 lbs	1.98 lbs	0.17 lbs

- Now let's take a look at what WYNIWYG might do for this situation....We've still got our same industries, same flows...but very different limits...
- We've still given the food processor a limit that is twice what he discharges....and we've done the same thing for the textile mill.
- And now because of our “Trading system” the metal finisher has the 40 CFR Part 433 Federal Categorical PT standard as a limit. It is a technology based standard that he can meet...with no additional costs required.
- Please note that the PT coordinator has actually allocated out LESS total nickel with this system than with the uniform concentration system. (2.5 vs. 2.23 pounds)

WYNIWYG Cautions:

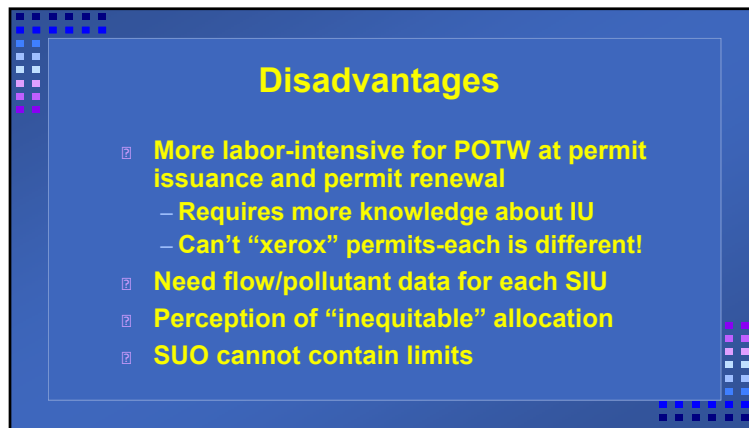
- ☐ POTW needs to assure that sum of allocated loadings is not > MAIL
 - Must have mechanism to track loading allocated to each IU
 - Compare total allocations to MAIL
- ☐ POTW should provide for at least background allocation for each pollutant for each IU

WYNIWYG Allocation Table

- ▣ Includes Limits and/or Background "Allocations" for each IU and pollutant
- ▣ Tracks POTW Loadings
 - SIU/IU Permitted Loadings
 - Uncontrollable [Domestic/Commercial]
 - Available MAHL/MAIL
- ▣ Update Required with every new IU Permit/Permit Modification

Advantages

- ☐ MAIL apportioned more efficiently
 - Only to SIUs discharging pollutant above background levels
 - No “unused” POTW capacity
- ☐ Limits higher than uniform method
 - Avoids setting excessively stringent or unachievable limits
- ☐ Provides flexibility
- ☐ Unnecessary noncompliance reduced



Disadvantages

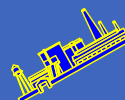
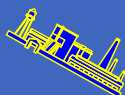
- More labor-intensive for POTW at permit issuance and permit renewal
 - Requires more knowledge about IU
 - Can't "xerox" permits-each is different!
- Need flow/pollutant data for each SIU
- Perception of "inequitable" allocation
- SUO cannot contain limits

- Hard to explain to new industry that is used to "grocery list" limits!

WYNIWYG Allocations	
<u>PROS</u>	<u>CONS</u>
- Equitable method for all SIUs - Most representative of actual POTW capabilities - Reduces cost of compliance for most SIUs - Properly administered, it is technically defensible	- Complicated method to administer - Requires detailed tracking system - Requires detailed support documentation for allocations - Compliance evaluation is specific to individual permits

Allocation Approaches

4. Mass Proportional Limits



- For each pollutant, allocate the MAIL as a different mass or concentration limit depending on each industrial user's present mass discharge

- This method allocates MAILs to each controlled discharger in proportion to the discharger's loading of that pollutant. To calculate the limits, the ratio of the MAIL to the current headworks loading of a pollutant is multiplied by each controlled discharger's loading of that pollutant

Mass Proportional Formula

$$L_{ALL_X} = \frac{L_{CURR_X}}{L_{CURR_T}} (MAIL - L_{BACK})$$

L_{ALL_X} = Allowable loading allocated to user (lbs/day)

L_{CURR_X} = Current loading from user (lbs/day)

L_{CURR_T} = Total current loading to POTW from controlled sources in lbs/day

L_{MAIL} = MAIL, lbs/day

L_{BACK} = Total background loading allocation for all users for which no contributory flow limit is being established for that pollutant, lbs/day

- Formula to calculate the allowable loading to a user expressed as a mass per day.

Formula for Conversion of Mass to Concentration Limit

$$C_{LIM_X} = \frac{L_{ALL_X}}{(Q_X)(8.34)}$$

C_{LIM_X} = Discharge limit for user X, mg/l

L_{ALL_X} = Allowable loading allocated to user X, lbs/day

Q_X = Discharge flow from user X, MGD

- Formula to convert the mass limit to a concentration based limit if required.

Mass Proportion Limits

MAIL = 10M mg
COPPER/DAY

ACTUAL LOADING =
8M mg COPPER/DAY

ALLOCATE SEPARATE LIMITS TO EACH INDUSTRY BASED ON
PRESENT LOADING OF EACH INDUSTRY X 10/8

=1.25 TIMES



50,000 X 1.25 = 62,500 mg
/1M = (0.06 mg/l)



4M X 1.25 = 5.0M mg
(5,000,000/3,000,000 = 1.67
mg/l)



50,000 X 1.25 = 62,500mg
62,500/2M = (0.03 mg/l)



800,000 X 1.25 = 1M mg
(1.0 mg/l)



100,000 X 1.25 = 125,000
mg (0.13 mg/l)



3M X 1.25 = 3,750,000 mg
(3,750,000/2,000,000 = 1.88
mg/l)

- Contribution from each SIU (8 million milligrams) of copper is less than the calculated MAIL. Extra allowance (2 million milligrams of copper) is equally distributed to each SIU based on their present loadings. Each industry is allowed 1.25 times its actual loading and concentration based limits are calculated in this example.

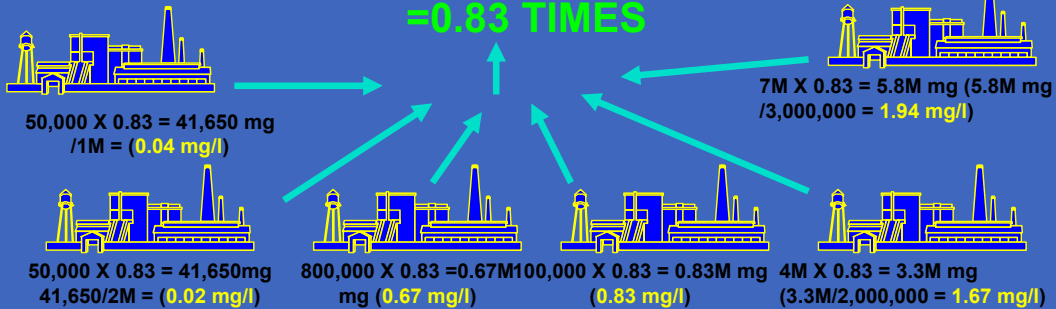
Mass Proportion Limits (2)

MAIL = 10M mg
COPPER/DAY

ACTUAL LOADING =
12M mg COPPER/DAY

ALLOCATE SEPARATE LIMITS TO EACH INDUSTRY BASED ON PRESENT
LOADING OF EACH INDUSTRY X 10/12

=0.83 TIMES



- When the total mass loading from each industry exceeds the MAIL, each industry has its loading reduced by the appropriate amount, (in this example a reduction of 2 million milligrams per day) spread over each industry according to its present loading.

Advantages

- ❑ **Local limits relate to SIUs present discharge rate**
- ❑ **Different limit derived for each pollutant for each SIU discharging that particular pollutant**
- ❑ **Limits may be expressed in permit as concentration or mass based**
- ❑ **Promotes water conservation**

- Local limits are calculated based on the SIUs present discharge rate for each POC. Limits may be expressed as concentration or mass based. Limits must be included in each SIUs permit and cannot be put in the SUO. Mass limits promote water conservation as increased concentration is allowed as the flow decreases.

Disadvantages

- ❓ **Requires detailed understanding of each user's effluent**
- ❓ **May penalize users that are presently pretreating their wastes when others are not**
- ❓ **Limits for new users are difficult to derive and have to be estimated at startup**

- Must have detailed knowledge of SIUs flow and average discharge loading for all POCs. Industries that are pretreating their wastewater to a significant extent may be penalized by this method if existing limits have to be reduced. New SIUs present a problem as no data is available on their potential discharge loadings. May need to issue short term (1 year) permit until data can be accumulated.

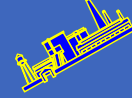
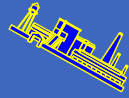
Disadvantages 2

- ❑ **No discharge limits put in the SUO**
- ❑ **Industrial pretreatment program cumbersome due to individual limit calculations for all users**
- ❑ **Limits may be difficult to implement**
- ❑ **Extra industrial user expense for flow monitoring equipment**

- No limits can be included in the SUO as this applies to all users. IP program involves a lot of calculations for each SIU to ensure that the MAIL is not exceeded. Implementation may become difficult where mass limits are applied.

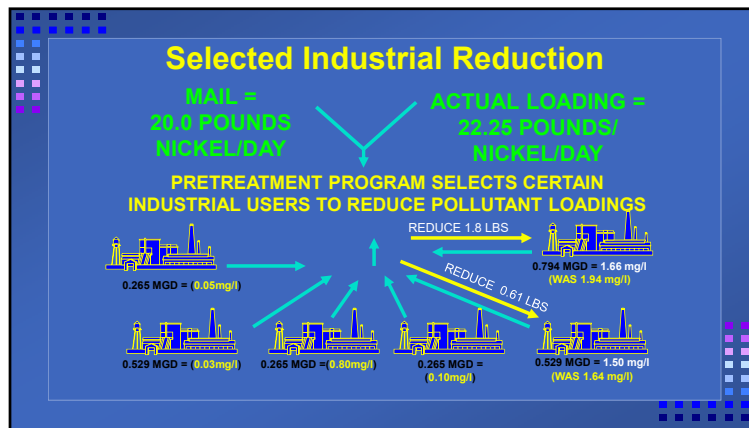
Allocation Approaches

5. Selected Industrial Reduction



- **Current headworks loading exceeds the MAIL for a particular pollutant**
- **POTW requires selected SIUs to reduce their discharge of that pollutant on a case-by-case basis**

- *A potw may set IU-specific limits case by case.* This type of allocation relies on the POTW's judgment of how much of the MAIL to allocate to each controlled discharger. The POTW needs to ensure that the sum of the allocated loadings does not exceed the MAIL and that it provides for at least a background allocation for each pollutant for each user, unless a lower allocation can be justified by sampling data. To ensure that it does not allocate more than the MAIL, the POTW should develop a mechanism that tracks the loading allocated to each IU and compares the total to the MAIL.



Advantages

- ❑ **Method cost effectively reduces pollutant loadings by imposing reductions on only the significant dischargers of a pollutant on a case by case basis**
- ❑ **Reductions based on wastewater treatability information**
- ❑ **Technology based limitations may be developed**

- This type of allocation relies on the POTW's judgment of how much of the MAIL to allocate to each controlled discharger. The limits can be based on the discharger's current loading, its need for a continued loading allocation, its ability to apply pretreatment to achieve certain discharge pollutant levels (i.e., treatability), or any other factor that the POTW determines is relevant.

Advantages

- ▢ **POTW focuses local limits strategy for a particular pollutant on selected industries for which available technology will bring about the greatest pollution abatement for the least amount of money**
- ▢ **Allows the POTW to identify similar industries and require them to achieve similar levels of pretreatment**

Disadvantages

- ? **POTW's method for selecting industries for pollutant reduction will be subject to close examination and involvement by users**
- ? **Proceed with caution!**
- ? **The method requires a detailed understanding of each user's production processes and effluent constituents**

- Industry will want considerable input into the allocation reduction and the POTW must have a lot of data to back up its decisions.

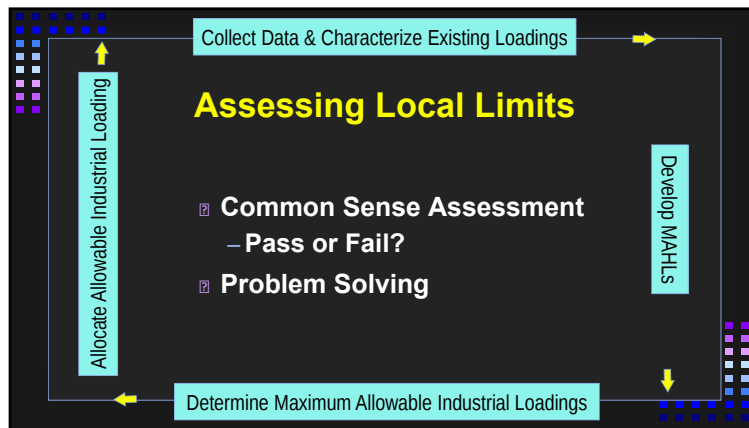
Disadvantages 2

- ❑ Discharge limits cannot be put in the SUO
- ❑ Industrial pretreatment program becomes cumbersome due to individual limit calculations for all users
- ❑ Extra industrial user expense for flow monitoring equipment

Creative Allocation Methods Hampton Roads Sanitation District [VA]

Monthly Average Discharge Limitations in mg/l						
	0 to 10,000 gpd	10,000 to 20,000 gpd	20,000 to 30,000 gpd	30,000 to 40,000 gpd	40,000 to 200,000 gpd	200,000 to 400,000 gpd
Cadmium	0.5	0.4	0.3	0.2	0.1	0.05
Chromium	10.0	8.0	6.0	4.0	2.0	1.0
Copper	10.0	8.0	6.0	4.0	2.0	1.0
Lead	5.0	4.0	3.0	2.0	1.0	0.5
Nickel	5.0	4.0	3.0	2.0	1.0	0.5
Zinc	10.0	8.0	6.0	4.0	2.0	1.0
Limits for SIUs >400,000 gpd are established on a case-by-case basis						

- They have 15 POTWs in their district.....so they had to get real creative in order to be able to implement local limits....and this is what they came up with!



- **Required as part of NPDES Permit application**
[40 CFR § 403.5(c)(1)].
- **Changes in POTW treatment plant process(es)**
 - altering existing equipment
 - installing new equipment
 - installing new technology.
- **POTW treatment plant non-compliance issues**
 - pass through/inhibition
 - sludge disposal problems.
- **Availability of additional monitoring data**
 - New data indicates the need for new or revised local limits.
- **Changes in environmental criteria**
 - NPDES limits
 - water quality standards/criteria
 - sludge limits.
- **Local limits must be evaluated for each separate POTW treatment plant.** (In many cases, the POTW adopts the most stringent limit for each pollutants rather than setting different limits for different plants.)
- **POTWs that revise local limits that are less stringent than previous limits must submit these to the Approval Authority for approval.** More stringent limits are not considered substantial and do not require approval.

Common Sense Assessment

- ❓ Are the limits technologically achievable?
- ❓ Can compliance with the limits be determined?
- ❓ Do the limits make sense based on actual POTW conditions and compliance experience?



• After a POTW has developed and allocated its local limits, it should determine whether they pass a “common sense test.” An effective public participation process can help with this assessment, but the POTW should not rely on outside comment to ensure that the proposed final limits make sense. If a POTW implements local limits that are not sensible, its IUs and other controlled dischargers may be asked to meet unreasonable limits, and the POTW may have to enforce a limit that is more stringent than necessary. Some of the questions a POTW should ask to determine if its limits pass the “common sense” test are:

- **Are the limits technologically achievable?** Are IUs and other controlled dischargers likely to meet these limits with currently available forms of pretreatment and pollution prevention (e.g., process modifications)? Remember that local limits are meant to protect the POTW and the environment and therefore are not specifically based on technological achievability
- **Can the POTW and dischargers determine compliance with the local limits?** Are the limits above sampling method detection levels? If the limits are below the detection level of the most sensitive analytical method, neither the POTW nor the IUs will be able to definitively determine compliance.
- **Are the limits sensible in light of actual conditions at the**

treatment plant and past compliance experience? For example, if the POTW is currently violating its NPDES limit for copper but the local limits analysis indicates that the POTW can accept its current influent loading and maintain compliance with that limit, the calculations and the past experience are in conflict, and the POTW should determine the reason(s) for the inconsistency.

Limits Fail Common Sense Test

- ? **Reassess development process**
- ? **Check for correct environmental criteria**
- ? **Check removal rates**
- ? **Uncontrolled pollutant concentrations**
- ? **Lack of data and use of literature values**
- ? **Conduct additional sampling at lower MDLs**

- If a POTW's calculated limits do not pass the "common sense test," the POTW may need to reassess its limits development process or investigate other options for reducing pollutant loads (e.g., source reduction measures). Besides the environmental criteria used in the calculations, the two pieces of data that can have the greatest impact on the local limits calculations are the removal rates and the
- uncontrolled pollutant concentrations. A reassessment of the limits development process may show that several of the limits are affected by a lack of data and the use of literature values. By conducting additional sampling (possibly using lower detection limits), a POTW may obtain better data and so be able to calculate more appropriate limits.

Reducing Pollutant Load to POTW

- ❑ Add commercial facilities to program (voluntary or mandatory BMPs)
- ❑ Investigate source reduction
- ❑ Public education programs
- ❑ Limit hauled waste
- ❑ Reduce infiltration/inflow
- ❑ Replace existing piping
- ❑ Check chemicals used by IUs, POTWs and water suppliers



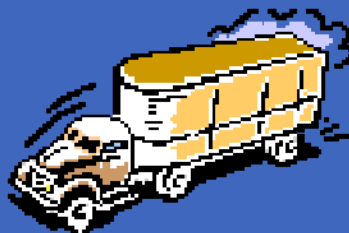
•Despite the POTW's best efforts to obtain the best data available for the calculations, the local limit calculated for a specific pollutant may at times be unreasonable and warrant other actions to establish valid limits. Other options for reducing pollutant loads to the POTW include: Adding other commercial facilities to the set of controlled dischargers and requiring those facilities to reduce the load in their discharges. For example, the POTW's MAHL for silver could be less than the uncontrolled loading resulting in a negative local limit. In this case, it may be appropriate to add other silver dischargers (e.g., photoprocessors) to the group of IUs to be controlled, possibly reducing the uncontrolled loading significantly enough to calculate a reasonable limit. Instituting a public education program to reduce problem discharges from domestic and other non-industrial (e.g., dental offices) sources. Some POTWs have worked with area dental associations to help educate dentists about proper disposal practices for mercury amalgam. Other POTWs have held hazardous waste disposal days to reduce the amount of household hazardous wastes discharged into sewers. Limiting acceptance of hauled waste to fewer loads, smaller loads, or lower pollutant levels. If hauled wastes contribute significantly to uncontrolled loadings, the POTW may need to stop accepting hauled waste. Conducting an I&I reduction program. Although I&I will generally contain lower

•concentrations of most pollutants than typical domestic sewage, it may contribute loadings that can increase problems with limits calculations.

Encouraging the replacement of piping that contributes significant loads of copper and iron. Carefully examining impurities in chemicals used by industry, POTWs and water suppliers.

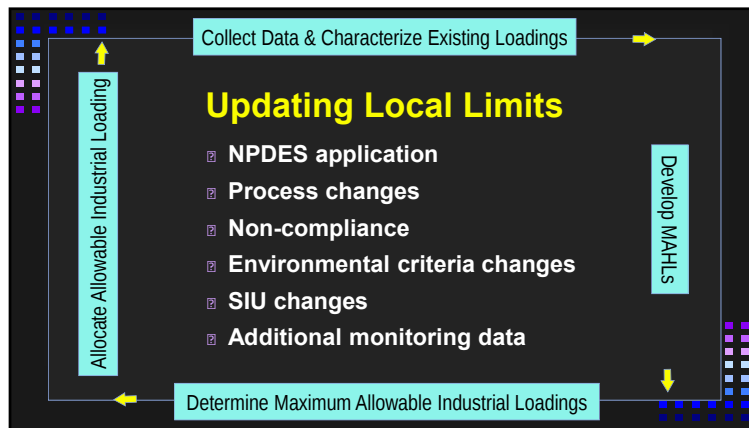
Drastic Measures !!

□ Change sludge disposal methods



□ Expand POTW

- A POTW that cannot develop reasonable local limits may need to consider changing sludge disposal methods (if sludge is the limiting factor) or, in the long term, expanding the capacity of its treatment plant, especially for pollutants such as BOD, TSS, or ammonia. In any event, a POTW that is experiencing difficulty developing reasonable limits should contact its Approval Authority to discuss possible solutions.



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NPDES Permit renewal/revisions

- 40 CFR 122.44(j)(2)(ii) requires NPDES permit to contain a condition to provide a written technical evaluation of the need to revise local limits following permit re-issuance
- Annual or detailed re-evaluation of local limits can meet this requirement

- Conditions change over time, and these changes may make it necessary to revise some or all of a POTW's local limits. Periodic re-evaluation of its local limits will help the POTW ensure that the limits are effective in protecting the treatment works, its workers, the local collection system, and the environment from the effects of interference and pass through. POTWs will need periodically to re-evaluate their local limits to ensure that they remain protective, or to determine whether they should be revised, reallocated, or developed for additional pollutants. According to 40 CFR 122.44(j)(2)(ii), NPDES permits must contain a condition to provide a written technical evaluation of the need to revise local limits following permit reissuance. Either the annual or the detailed re-evaluation of local limits can be used to meet this requirement, depending on the conditions at the POTW.

POTW Process Changes:

- ☐ New or modified POTW or increased service area
- ☐ POTW process or operation significantly changed
- ☐ Flow significantly changed
- ☐ Sludge disposal method changed



Review of Compliance History

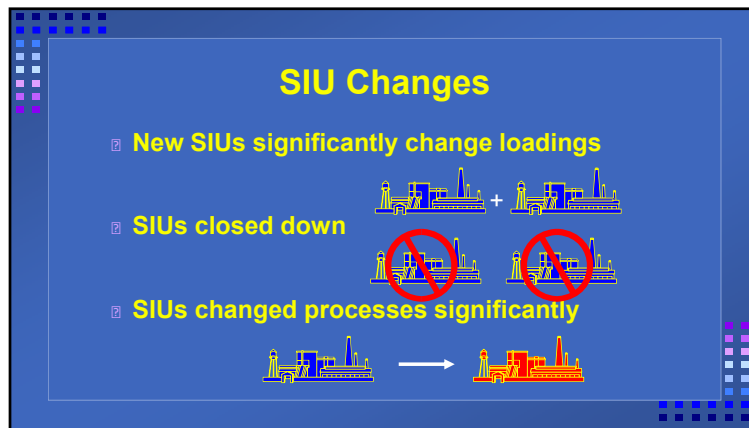
- ❓ **Review compliance over past year to determine if Local Limits remain Protective of the POTW**
- ❓ **If violations have occurred, take action against noncompliant SIUs or develop new or revise local limit concerned**

- As part of its annual review, the POTW should also consider its compliance record over the previous year to determine whether the local limits it has set provide sufficient protection from pass through and interference. If the treatment works has violated its NPDES permit or sludge disposal standards, has caused or contributed to violations of water quality standards in its receiving waters, or has experienced interference of its treatment processes, the POTW's local limits may not be adequately protective. Unless it has identified as the cause of the violation a specific, unusual incident that is unlikely to recur, the POTW should investigate the violation's cause and take appropriate enforcement action against any noncomplying IUs. Alternatively, the POTW should revise the local limit, or establish a local limit if none exists for the pollutants that caused the violations.

Environmental changes

- ▣ New or revised NPDES limits
- ▣ State water quality standards changed
- ▣ Any other new data not available during the last local limits development effort





Additional Monitoring Data

- ❓ **POTW should compare current headworks loading with all POC MAHLs on an annual basis regardless of whether a local limit for each POC was adopted - Comparison may be on a mass basis or concentration**



- A POTW reviews its local limits every year when it develops its annual Pretreatment Program Report. This annual review compares current headworks loadings with the maximum allowable headworks loading (MAHL) and examines any recent violations. The annual review is intended as a quick check for any obvious signs that local limits may not be adequately protective. Detailed re-evaluations are undertaken every 5 years as part of a POTW's NPDES permit application. The re-evaluation includes a an in-depth look at all the data, criteria, and assumptions on which local limits are based to determine whether any changes affecting the local limits have occurred.

Comparison of Loading with MAHLs for Pollutants with no Developed Local Limit	
IF	THEN
Loading > MAHL	Develop Limit for POC Investigate cause
Loading > threshold (first time)	Increase monitoring OR develop limit
Loading > threshold (second time)	Establish limit/increase monitoring
Loading < threshold	Keep pollutant under review

- In its annual report to the Approval Authority, a POTW should identify its maximum daily and maximum monthly average headworks loadings during the previous year for each POC for which it calculated a MAHL—regardless of whether a local limit for each POC was adopted. **The current loading of the pollutant at the POTW's headworks exceeds the MAHL.** EPA recommends that the POTW establish a local limit for the pollutant, investigate the cause of elevated loading, increase its IU monitoring, identify any noncomplying industries, and consider undertaking pollution prevention efforts. **The current loading exceeds the established threshold value for the first time (i.e., the loading was below the threshold value during the year before).** EPA recommends the POTW increase monitoring for the POC, or establish a local limit for it. **The current loading exceeds the established threshold value for the second time.** EPA recommends establishing a local limit and increasing monitoring for the POC. **The current loading is below the established threshold.** EPA recommends that the POTW*
- review the pollutant's loading as part of its preparation of next year's annual report.

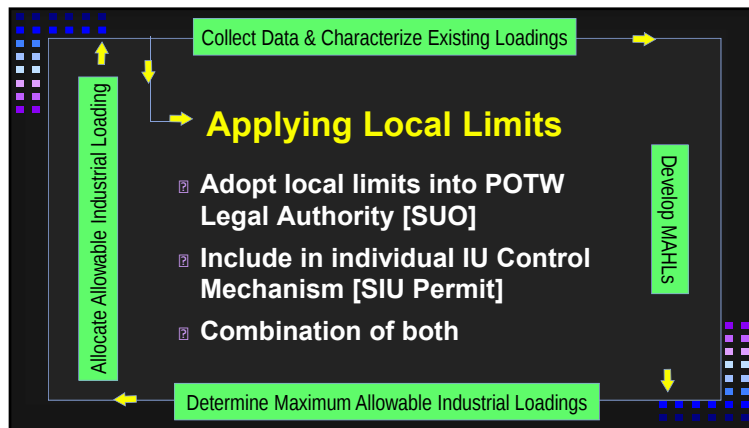
Comparison of Loading with MAHLs for POCs with Developed Local Limit	
<u>IF</u>	<u>THEN</u>
Loading > MAHL	Revisit Limit Investigate cause Consider P2
Loading ↑ from last year (e.g. 55% to 75% MAHL)	Investigate Increase monitoring OR Develop new limit
Loading < threshold	Keep pollutant under review

The Re-evaluation Process

- ❑ **Assess Current Conditions**
- ❑ **Collect and Analyze Data**
- ❑ **Recalculate existing or Determine New MAHLs.**
- ❑ **Re- allocate new MAILs and implement the Local Limits**



- The detailed re-evaluation of local limits is a four-step process: 1. Assess current conditions to determine whether existing MAHLs should be recalculated or reallocated, or additional local limits should be developed. Also determine which pollutants need to be further evaluated and for which criteria. (If only re-allocation of existing MAHLs is needed, skip to step 4.) 2. Based on the pollutants and criteria identified in step 1, determine whether existing data are sufficient. If not, develop and implement a local limits sampling plan, then analyze the data collected. 3. Recalculate the MAHLs of pollutants for which local limits have been developed and determine MAHLs for new pollutants. 4. Implement the local limits. This step may include the reallocation of existing MAILs, if required.



- Local limits development must be submitted to the Approval Authority for review and approval.
- Once developed, local limits are applied to IUs through the SUO, the permits, or both. Typically, both avenues are used.
- In summary.....Local Limits.....
- Don't steal 'em
- Do your monitoring and headworks homework....
- Make 'em technical and fair and
- Use your pollutant capacities and POTW capabilities wisely....



- Prohibitions
- Categorical Standards
- Local Limits
- Evaluate/Determine/Apply most stringent at monitoring location.

