Why Cannabis and Wastewater
1996

1st state to legalize for medical use
33 states have passed laws legalizing Marijuana

- 11 states and DC have made it legal for recreational use
- 22 states allow for medical use only
Some quick facts

Of the estimated **22 million pounds** of marijuana grown each year in the United States, nearly **80 percent** comes from California, Tennessee, Kentucky, Hawaii, and Washington.
During California's growing season, outdoor grows consume roughly **60 million gallons** of water a day—**50 percent more** than is used by all the residents of San Francisco.
An estimated one-third of America's pot crop is grown indoors.
Nationwide, the electricity used by indoor grows is enough to power 1.7 million homes.

That's equivalent to the output of 7 large power plants.
MARIJUANA: A WATER GUZZLER

ONE marijuana plant growing in a national forest uses 900 gallons of water per plant per growing season.

In 2017, more than 1.25 million plants were found growing in California national forests.

That equates to at least 1.1 billion gallons of water used by illegal marijuana grows.
• 240 GAL OF WATER FOR 1 LB OF CANNABIS

• 1500 GAL OF WATER FOR 1 LB OF BEEF
• 1 GAL OF WATER PER ALMOND
• 5 GAL OF WATER PER HEAD OF BROCCOLI
• 75 GAL OF WATER FOR 1 LB OF AVACADO
Lots of water and electricity
Indoor Cultivation Techniques

PLAIN DIRT  COCO FIBER  HYDRO  AERO  AQUA
WHAT IS N:P:K

Nitrogen
Phosphorus
Potassium

These are the macro nutrients required for all cannabis cultivation. PH levels are 5.5 to 6.5
SOIL GROWING PROCESS

1. Seed Selection
   - Indica
   - Sativa
2. Germination
   - 24 hrs
3. Planting
4. Vegetation stage
   - 6-7 days
   - 3-4 weeks
   - 4-5 weeks
   - 7-8 weeks
   - Around 10 weeks
5. Flowering Stage
   - Male
   - Female
6. Harvest
7. Drying
   - 10-14 days
   - 18°C
8. Storing
SOIL GROWING
PRO’S AND CON’S

PRO’S
Cheaper Start Up
Easier For Beginners
Less Forgiving

CON’S
Lower Yield
Mineral/Nutrient Balance
Moisture and PH Levels
COCO FIBER GROWING PROCESS

PRO'S

CON'S
COCO FIBER
PRO’S AND CON’S

PRO’S
Almost as Easy as Soil
Higher Yield
Cleaner Process
Fewer Bugs

CON’S
Requires Special Fertilizers
More Costly
Additional Knowledge
HYDROPONIC GROWING PROCESS

- Nutrient Solution
- Styrofoam Platform
- Air Stone
- Air Pump
HYDROPONIC PRO’S AND CON’S

PRO’S

- Higher crop yields
- Fewer insects
- More efficient water use
- Faster maturity rate

CON’S

- Higher start up cost
- Requires more skill and knowledge
- Water born plant disease
AEROPONICS
PRO’S AND CON’S

**PRO’S**
- Fast plant growth
- Easy system maintenance
- Plants require less nutrients

**CON’S**
- Requires regular cleaning
- High technical knowledge
- High start up cost
AQUAPONIC GROWING CYCLE

PLANTS
PLANTS ABSORB THE NITRATES AS NUTRIENTS

BACTERIA CONVERT AMMONIA INTO NITRITES AND THEN NITRATES

GROW BED

FISH BREATHE IN OXYGEN AND BREATHE OUT CARBON DIOXIDE

FISH PRODUCE AMMONIA-RICH WASTE

PUMP
AQUAPONICS
PRO’S AND CON’S

PRO’S
- No nutrient solution
- Entire process is organic

CON’S
- PH level
- Keeping fish alive
WHAT ARE THE ENVIRONMENTAL CONCERNS

- MATERIALS USE
- INDOOR AIR QUALITY
- GHG EMISSIONS
- WATER CONSUMPTION
- ODOR CONTROL
- WATERSHED IMPACT
- EFFLUENT DISCHARGE
- REGULATORY COMPLIANCE
- SOLID WASTE GENERATION
- ENERGY CONSUMPTION
- LAND USE
- REDUCED WATER AVAILABILITY
WHAT GENERATES WASTEWATER

- Municipal Water
  - Cleaning
  - Cooling Dehumidification
- Filtration System
- Reservoir or Fertigation System
- PUMP
- Irrigation System
- Plants
- Runoff
- Discharge
Nutrient mixes, NPK
Fertilizers and Pesticides
Flushing and cleaning irrigation System
Cleaning irrigations tanks
Cleaning chemicals
Cooling and Dehumidification
Nutrient Mixes NPK

• Each Item/ingredient brings in its own mix

• Different mixtures are used at different times in the growing cycle
  • Concern for single crop grows
  • Rotating harvest should have a fairly consistent output to the wastewater stream
### SOIL Feeding Schedule

Use your preferred FoxFarm potting soil when transplanting seedlings into larger containers. We recommend a two-gallon size or larger. **FOR BEST RESULTS:** Feed up to two times per week. Maintain a pH of 5.8 to 6.8 to prevent nutrient lockout and reduce stress on plants. Never mix pure concentrates together; always add water first. Should plants show signs of stress or color irregularities, flush your system. When using coco-based media, flush every two weeks during the flowering cycle as coco has a tendency to retain unwanted salt residue more than peat-based soils.

#### Feed up to Twice per Week

**PER GALLON OF WATER**

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<th>Week</th>
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#### SCHEDULE ADJUSTMENTS

**EXTEND VEGETATIVE CYCLE:** Repeat Week 4.

**EXTEND FLOWERING CYCLE:** Repeat Week 12.

#### CONVERSIONS

<table>
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<tr>
<th>Conversion</th>
<th>Value 1</th>
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<tr>
<td>1/4 tsp = 1.25 mL</td>
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<td>1 tsp = 5 mL</td>
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<td>3 tsp = 15 mL</td>
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* * *
WHAT GENERATES WASTEWATER

TN = 2%
Phosphate = 8%
Potash (salt) = 4%
Minerals = 0.2%
Fertilizers and Pesticides

• Not used in aqua or aeroponic systems

• If dumped irresponsibly, could result in an issue

• Pesticides should not be a part of final product
  • Means 100% should be in the waste stream or inert
Flushimg / Cleaning Irrigation Lines

• Common in all commercial systems

• Varies in size and complexity based on grow operation

• Should be done on a regular basis

• Source of high loads of contamination
Cleaning irrigations tanks

• Common in all commercial systems

• Should be done on a regular basis

• Source of high loads of contamination
Cleaning chemicals

- Sterilizers are used
  - Biological killers
  - Not good in high concentrations for wastewater system

- Could be Organic (used as needed)
  - Garlic Spray
  - Pyrethrin spray

- Fungi kills plants easily
  - Top priority for cleaning
  - Shows up in wastewater when High BOD and low pH

• High in Phosphates
• High nitrogen levels
• Contains algae and bacteria
• High waste volume
• High TSS
• High Oil/Grease
• Treated as medical waste in some states
WASTE DISPOSAL

- Store and haul
- Pump and haul
- Compost
- In House Treatment
What options exist to mitigate the wastewater?

Disposal (no treatment)

Treatment and disposal
- Aerators
- Membrane BioReactors
- Batch Reactors
- Filters

Creating multiple waste streams
- Low Strength to Septic
- High Strength trucked off site
TREATMENT AND DISPOSAL

• Limits Size of the Facility

• High Maintenance

• Waste needs to be heavily monitored
  • Changes in the operation require monitoring
  • In a single grow operation, monitoring needs to happen more often as plants change stages
Phosphate Removal

• Great Plant Fertilizer

• Can trigger algea blooms when to high
  • Blocks sunlight in water, killing plants
  • Kills oxygen in water resulting in fish death
• Toxic to people, plants and animals
Phosphate Removal
Nitrogen Removal

- Dietary requirement for all organisms
  - Plants are 7.5% nitrogen
  - Atmosphere is 79% nitrogen
- Organic vs. Inorganic
- Ammonia not in the waste stream (lowers need for aeration)
- Nitrogen is typical in the form of nitrates for cannabis wastestreams
Nitrogen Removal

- Dissolved Nitrogen
- Biological removal
  - Requires anoxic environment
  - May use organic material to provide carbon source
Regulator Questions

• What is the daily design flow?
• What is the waste strength?
• Crop rotation or single harvest?
• Side streaming?
• Do they recycle?
• How is the solid waste disposed?
Consumptive water use and water quality have been preliminarily identified as significant aspects for indoor cannabis cultivation.

Neither a sector-specific water use baseline nor production unit theoretical minimum is currently available.
For 2017 the combined rates for water and wastewater were $6.88 per 1,000 gallons

USE? DISPOSAL?
Figure 5: Irrigation water recapture process
RECAPTURE AND REUSE

REVERSE OSMOSIS

APPLIED PRESSURE

SALT WATER

Contaminants

PURE WATER

FRESH WATER

Semi-Permeable Membrane

Direction of water flow
RECAPTURE AND REUSE

Diagram:
- Contaminated water enters the system.
- The water passes through an Activated Carbon Filter.
- The treated water exits the filter and is collected.
- The diagram illustrates the process of recapturing and reusing contaminated water.
THE BOTTOM LINE ON CANNABIS WASTEWATER

- Recapture and reuse grow water
- Use an efficient grow process
- Automat growing process
- Sample often
- Collect more data
- Follow best practices guidelines
Special Thanks

• WOSSA

• Jim King

• Marijuana Venture
• Big Buds
• High Times
• Cannabis Business Times
• Cannabistech.com
• Maximumyield.com
• Urbangro-inc