

- Release to private septic/leach fields (3a)
  - Treated effluent from domestic sewage treatment plants discharged to surface waters, re-injected into aquifers (recharge), recycled/reused (irrigation or domestic uses) (3b)
  - Overflow of untreated sewage from storm events and system failures directly to surface waters (3b)
- Transfer of sewage solids ("biosolids") to land (e.g., soil amendment/fertilization)
  - "Straight-piping" from homes (untreated sewage discharged directly to surface waters)
  - Release from agriculture: spray drift from tree crops (e.g., antibiotics)
  - Dung from medicated domestic animals (e.g., feed) CAFOs (confined animal feeding operations)
- Direct release to open waters via washing/bathing/swimming
  - Discharge of regulated/controlled industrial manufacturing waste streams
  - Disposal/release from clandestine drug labs and illicit drug usage

- Future potential for release from molecular pharming (production of therapeutics in crops)
- Release of drugs that serve double duty as pest control agents: examples: 4-aminopyridine, experimental multiple sclerosis drug - used as avicide; warfarin, anticoagulant → rat poison; azacholesterol, antilipidemics → avian/rodent reproductive inhibitors; certain antibiotics → used for orchard pathogens; acetaminophen, analgesic  $\rightarrow$  brown tree snake control; caffeine, stimulant  $\rightarrow$  coqui frog control
- 10 Ultimate environmental transport/fate:
  - most PPCPs eventually transported from terrestrial domain to aqueous domain
  - phototransformation (both direct and indirect reactions via UV light)
  - physicochemical alteration, degradation, and ultimate mineralization
  - volatilization (mainly certain anesthetics, fragrances)
  - some uptake by plants
  - respirable particulates containing sorbed drugs (e.g., medicated-feed dusts)