# Deer Island Wastewater Treatment Plants Impact on Antibiotic Resistance

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# Public Health Implications

- One of the three biggest global public health threats of the 21st century
- Infections by resistant bacteria have twice the mortality rate of sensitive strains
- Cost estimate: $35 billion/year in U.S.

# Flow of Antibiotics into the Aquatic Environment

animal husbandry

agriculture

prescriptions

aquaculture

animal waste

general population

hospitals

landfills

leaching

surface run-off

sewage

aquatic environment

# High Concentration of Antibiotics in Wastewater

| Animal Waste (µg/L) | Hospital Waste Water (µg/L) | Municipal Waste Water (µg/L) | Surface Water (µg/L) |
|---|---|---|---|
| 140-10,000 | 1-150 | <0.1- 6 | <.01-1.7 |

Adapted from Al-Ahmad (1999), Boxall (2003), Szewzyk (2000), and Kolpin (2002)

# Removal of Antibiotics by Wastewater Treatment?

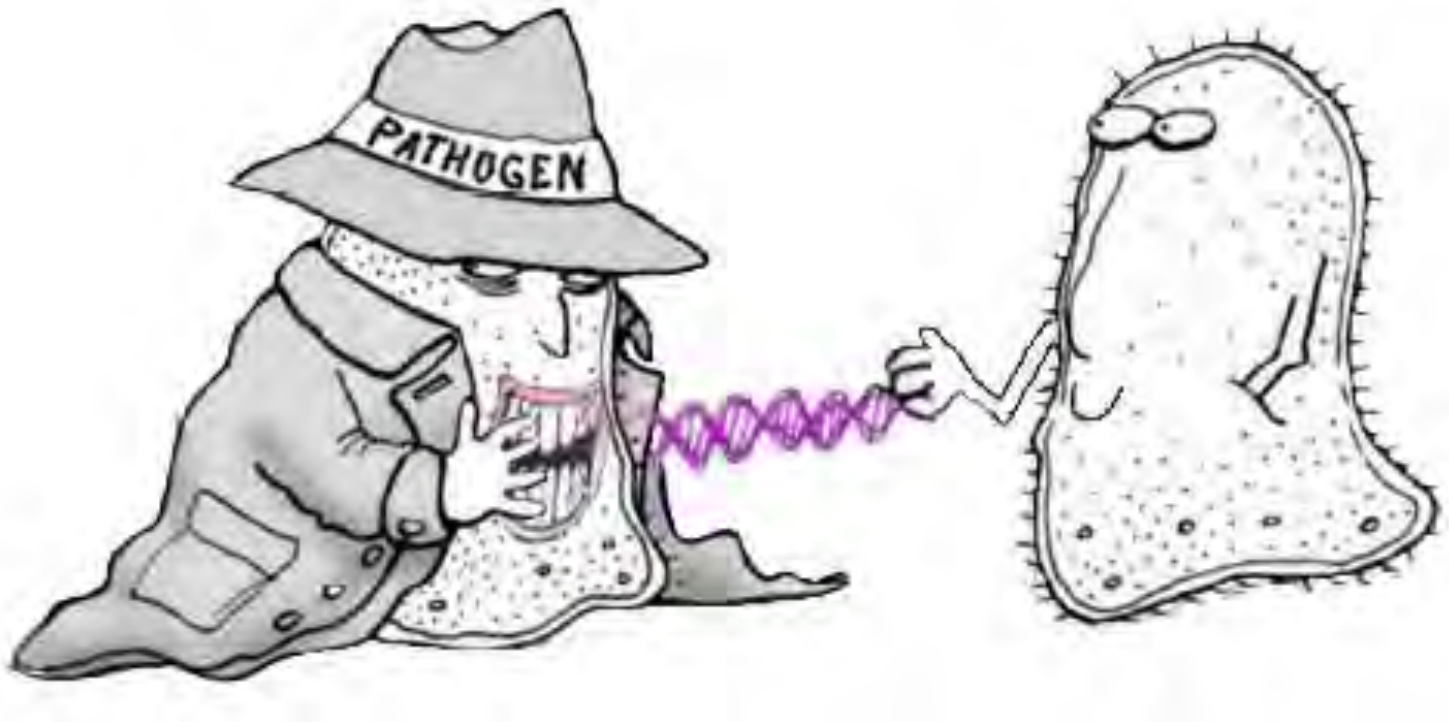
- Not designed to remove antibiotics
- Absorption to activated sludge
  - raises issues related to the reuse of residuals

# High Concentration of Bacteria in Wastewater

- Seawater: $1x10^7$ /ml
- Soil: $1x10^9$ /ml
- Wastewater: $1x10^{11}$ /ml

# Why Should We Care if Nonpathogenic Bacteria are Resistant to Antibiotics?

**Horizontal Gene Transfer**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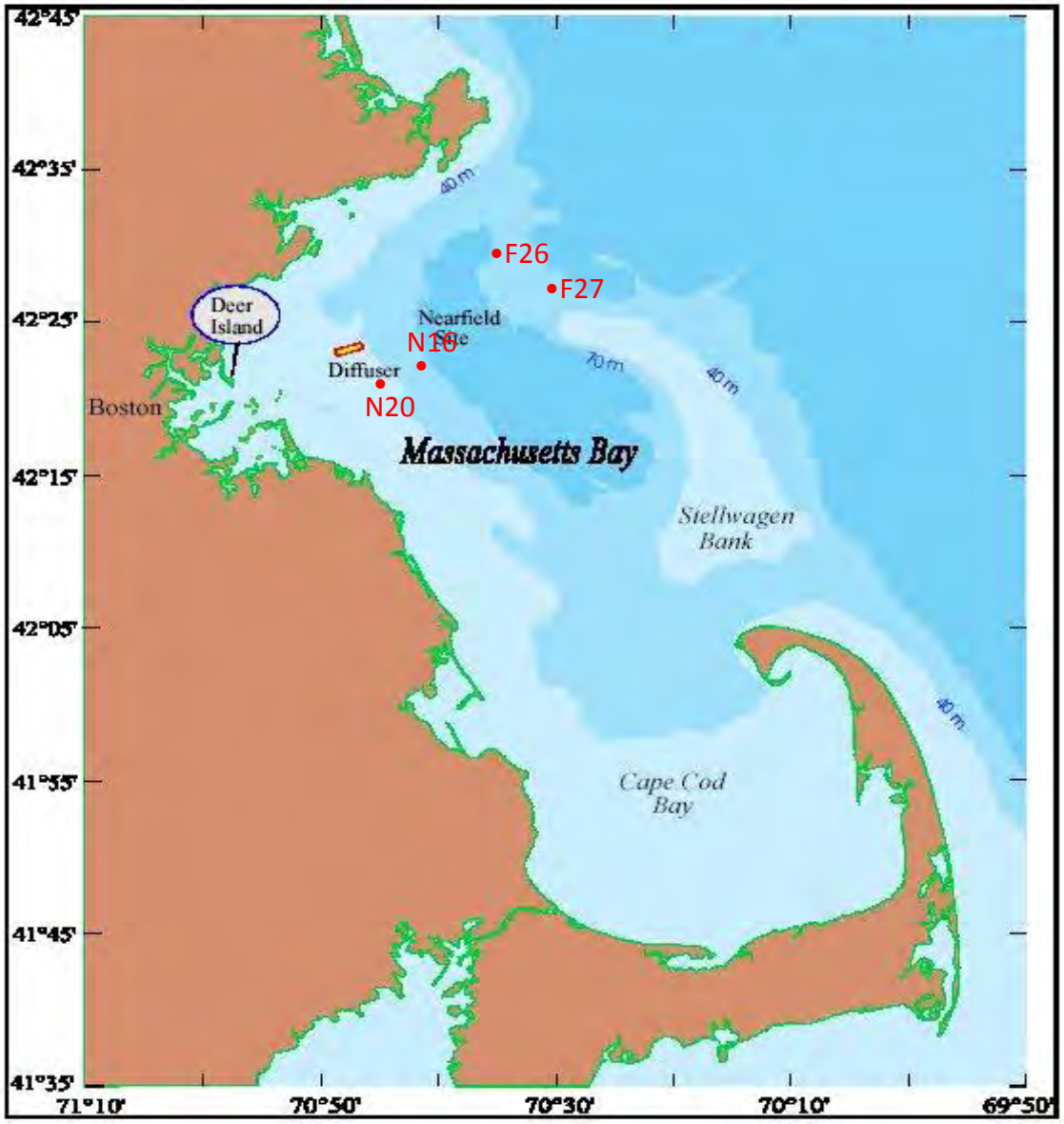
# Sampling Sites



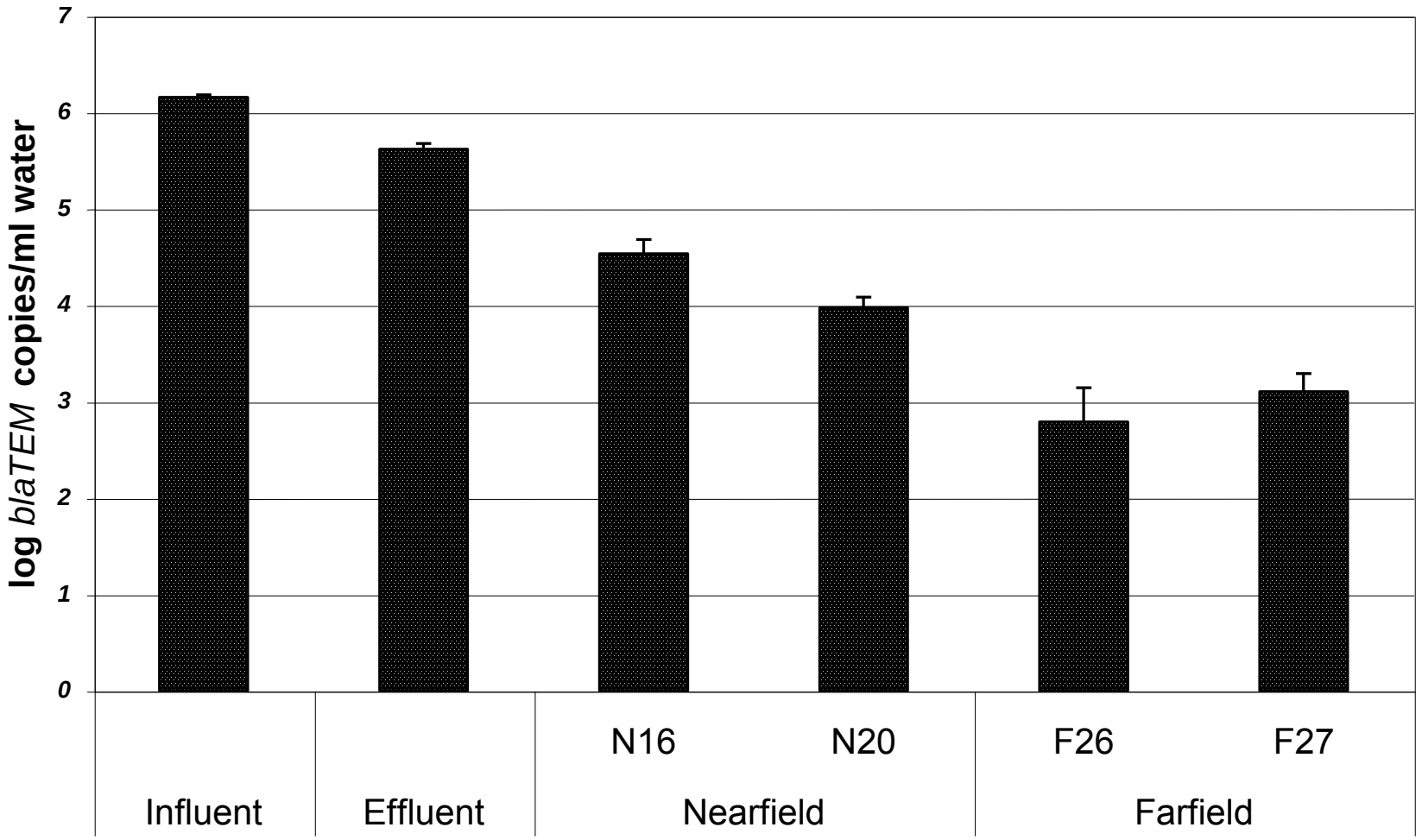
# Sample Analysis

- DNA extracted
- Real Time PCR

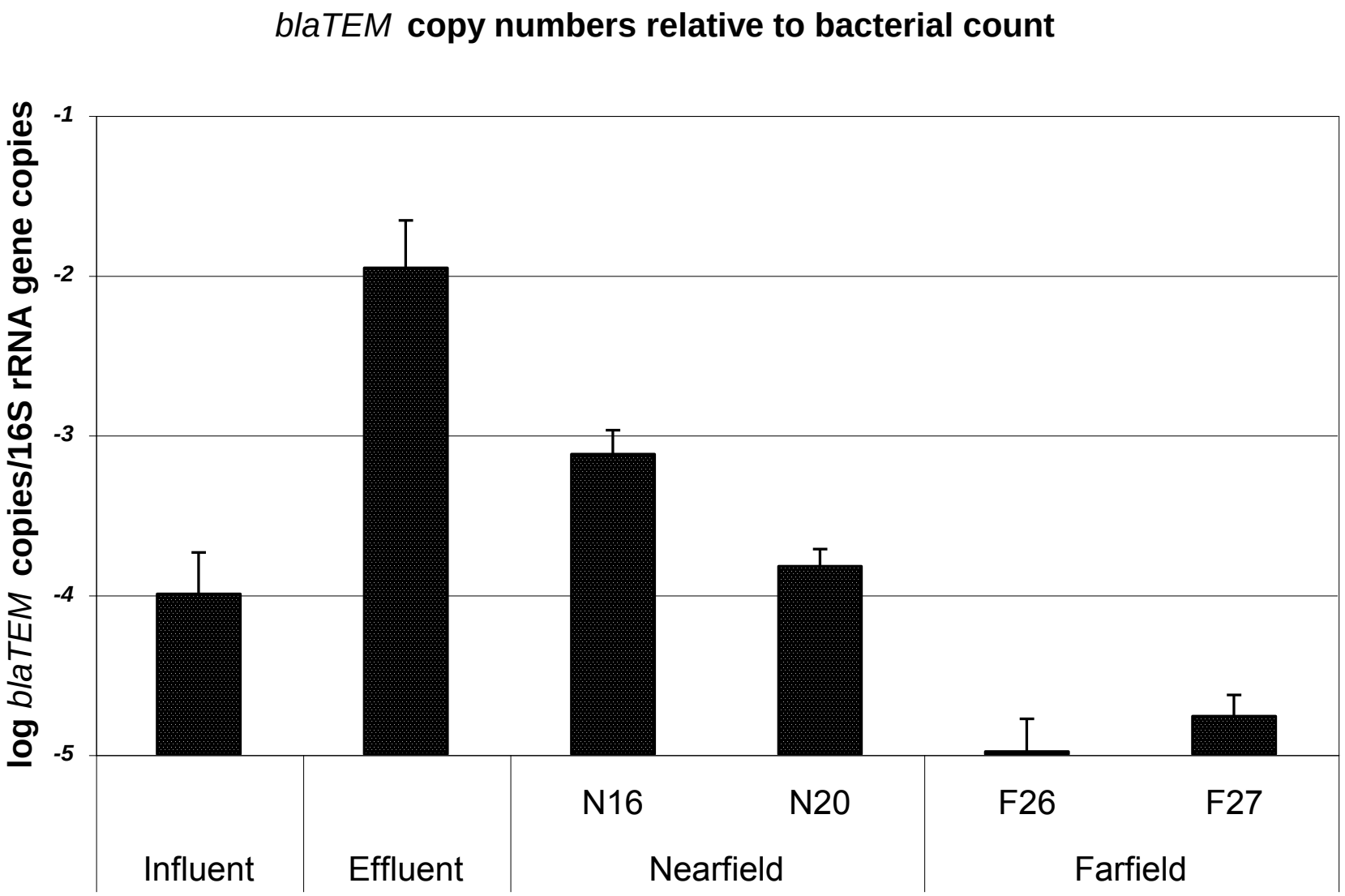
# Concentration of Bacteria

| | Copies 16S rRNA genes/ml water (bacteria) |
|---|---|
| **Influent** | $9.2 \times 10^{10} \pm 4.1 \times 10^{10}$ |
| **Effluent** | $8.1 \times 10^{9} \pm 1.1 \times 10^{10}$ |
| **Nearfield** | $5.6 \times 10^{7} \pm 3.5 \times 10^{7}$ |
| **Farfield** | $8.5 \times 10^{7} \pm 4.8 \times 10^{7}$ |

# *blaTEM* Genes per ml of Water

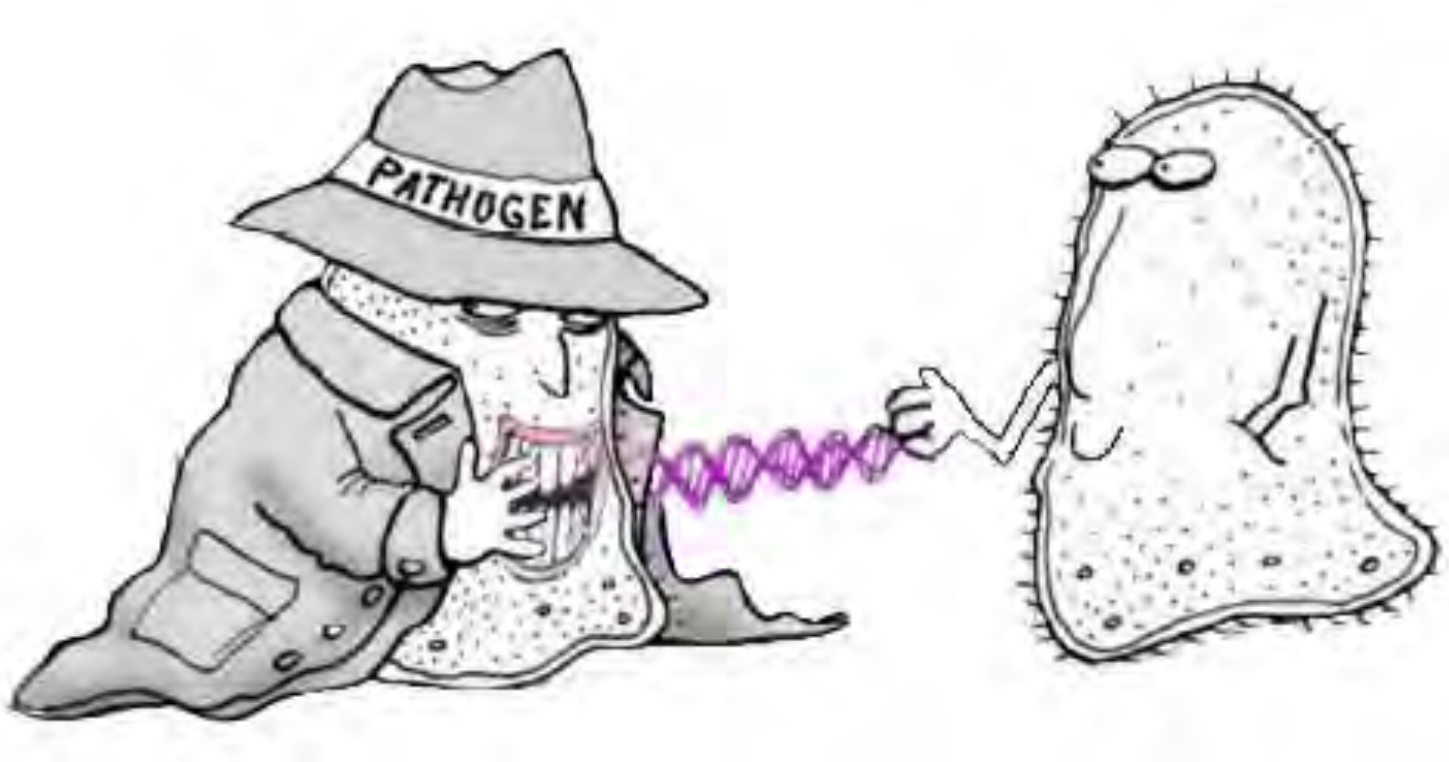


# *blaTEM* Genes Relative to



# Conclusions

- Sewage treatment decreases concentrations of antibiotic resistance genes
- Through sewage effluent, antibiotic resistance genes are introduced into the environment in higher concentrations than occur naturally
- This creates reservoirs of increased resistance potential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