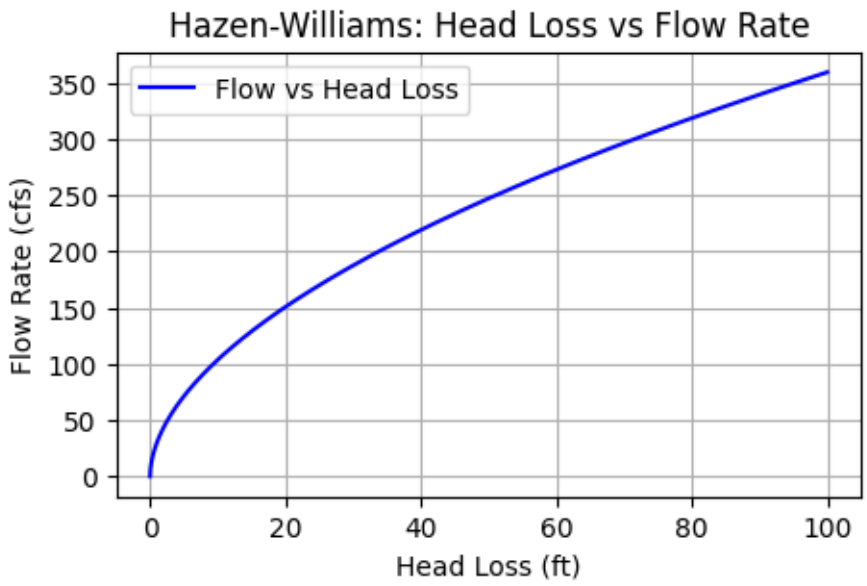
ES4-P1

February 16, 2025

[66]:
```python
# ES4 Problem 1
# Hazen Williams US Customary
def flowhw(coef, diameter, slope):
    import math
    area = 0.25 * math.pi * diameter**2
    radius = diameter / 4.0
    flowhw = 1.318 * coef * area * (radius**0.63) * (slope**0.54)
    return flowhw

import matplotlib.pyplot as plt
# Parameters
length = 10000  # ft
diameter = 5  # ft
ch = 145  # Hazen-Williams coefficient (Enamel/epoxy look up online)
# Initialize variables
howMany = 10000  # search region
head_loss_values = [0 for i in range(howMany)]
for i in range(howMany):
    head_loss_values[i]=i/100 # search increment
flow_values = []
# Calculate flow rates for each head_loss
for head_loss in head_loss_values:
    slope = head_loss / length
    flow_values.append(flowhw(ch, diameter, slope))
# Plot head_loss vs flow
plt.figure(figsize=(5, 3))
plt.plot(head_loss_values, flow_values, label="Flow vs Head Loss", color="blue")
plt.title("Hazen-Williams: Head Loss vs Flow Rate")
plt.xlabel("Head Loss (ft)")
plt.ylabel("Flow Rate (cfs)")
plt.grid(True)
plt.legend()
plt.show()
```



[67]:
```python
def find_closest_index(lst, target):
    return min(range(len(lst)), key=lambda i: abs(lst[i] - target))

# Example Usage
target_value = 295
index = find_closest_index(flow_values, target_value)
print(f"The index of the closest value to {target_value} is {index}.")
print(f"The closest value is {flow_values[index]}.")
print(f"The head loss is {head_loss_values[index]}.")
```

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The index of the closest value to 295 is 6944.
The closest value is 295.0094006816501.
The head loss is 69.44.
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