# Appendix B

# National Municipal Wastewater Inventory and Infrastructure, 1940 to 2016


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Note: Values of -9.0 in the tables indicate that data was not available for the particular year and category of waste treatment.

**Table B-1.** POTW facility inventory *(Count)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | -9.0 | -9.0 | -9.0 | 2938.0 | 0.0 | 2630.0 | 0.0 | 0.0 | 2938.0 | 0.0 |
| 1950 | 11784.0 | 0.0 | 5156.0 | 3099.0 | 0.0 | 3529.0 | 0.0 | 0.0 | 3099.0 | 0.0 |
| 1962 | 11698.0 | 0.0 | 2262.0 | 2717.0 | 0.0 | 6719.0 | 0.0 | 0.0 | 2717.0 | 0.0 |
| 1968 | 14051.0 | 0.0 | 1564.0 | 2435.0 | 0.0 | 10042.0 | 0.0 | 10.0 | 2435.0 | 10.0 |
| 1972 | 19355.0 | 142.0 | 2265.0 | 2530.0 | 64.0 | 13893.0 | 0.0 | 461.0 | 2594.0 | 461.0 |
| 1973 | -9.0 | -9.0 | 1532.0 | 2723.0 | -9.0 | 16015.0 | -9.0 | 795.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | 3032.0 | -9.0 | 16987.0 | -9.0 | 992.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 2838.0 | -9.0 | 2719.0 | 2451.0 | -9.0 |
| 1978 | 14850.0 | 985.0 | 91.0 | 1306.0 | 2972.0 | 6608.0 | 2187.0 | 701.0 | 4278.0 | 2888.0 |
| 1980 | 15522.0 | 1361.0 | 272.0 | 1043.0 | 2300.0 | 7852.0 | 2443.0 | 251.0 | 3343.0 | 2694.0 |
| 1982 | 15662.0 | 1600.0 | 237.0 | 1036.0 | 2083.0 | 7946.0 | 2529.0 | 231.0 | 3119.0 | 2760.0 |
| 1984 | 15580.0 | 1726.0 | 202.0 | -9.0 | -9.0 | 8070.0 | -9.0 | -9.0 | 2617.0 | 2965.0 |
| 1986 | 15541.0 | 1762.0 | 149.0 | -9.0 | -9.0 | 8403.0 | -9.0 | -9.0 | 2112.0 | 3115.0 |
| 1988 | 15708.0 | 1854.0 | 117.0 | -9.0 | -9.0 | 8536.0 | -9.0 | -9.0 | 1789.0 | 3412.0 |
| 1992 | 15613.0 | 1981.0 | 0.0 | -9.0 | -9.0 | 9086.0 | -9.0 | -9.0 | 868.0 | 3678.0 |
| 1996 | 16024.0 | 2032.0 | 0.0 | -9.0 | -9.0 | 9388.0 | -9.0 | -9.0 | 176.0 | 4428.0 |
| 2016 | 18303.0 | 2369.0 | 0.0 | -9.0 | -9.0 | 9738.0 | -9.0 | -9.0 | 61.0 | 6135.0 |

**Table B-2.** Resident population served by POTWs

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 70800000.0 | 0.0 | 32200000.0 | 18500000.0 | 0.0 | 20100000.0 | 0.0 | 0.0 | 18500000.0 | 0.0 |
| 1950 | 91762001.0 | 0.0 | 35268437.0 | 24599743.0 | 0.0 | 31893821.0 | 0.0 | 0.0 | 24599743.0 | 0.0 |
| 1962 | 118300000.0 | 0.0 | 14600000.0 | 42200000.0 | 0.0 | 61500000.0 | 0.0 | 0.0 | 42200000.0 | 0.0 |
| 1968 | 140100000.0 | 0.0 | 10100000.0 | 44100000.0 | 0.0 | 85600000.0 | 0.0 | 300000.0 | 44100000.0 | 300000.0 |
| 1972 | 141722242.0 | 825000.0 | 4939928.0 | 50502813.0 | 1376059.0 | 76270812.0 | 2257101.0 | 5550529.0 | 51878872.0 | 7807630.0 |
| 1973 | -9.0 | -9.0 | 3200000.0 | 54600000.0 | -9.0 | 105000000.0 | -9.0 | 2700000.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 32523000.0 | -9.0 | 45733000.0 | 40271000.0 | -9.0 |
| 1978 | 155227000.0 | 2197000.0 | 3640000.0 | 18747000.0 | 25333000.0 | 56256000.0 | 30937000.0 | 18117000.0 | 44080000.0 | 49054000.0 |
| 1980 | 158337000.0 | 3599000.0 | 2307000.0 | 19101714.0 | 18214286.0 | 62680000.0 | 47518000.0 | 4917000.0 | 37316000.0 | 52435000.0 |
| 1982 | 163525000.0 | 4172000.0 | 1876000.0 | -9.0 | -9.0 | 67609000.0 | 50853000.0 | 5411000.0 | 33604000.0 | 56264000.0 |
| 1984 | 170643000.0 | 5514000.0 | 1273000.0 | -9.0 | -9.0 | 70656000.0 | -9.0 | -9.0 | 33675000.0 | 59525000.0 |
| 1986 | 163319000.0 | 5679000.0 | 1605000.0 | -9.0 | -9.0 | 72285000.0 | -9.0 | -9.0 | 28815000.0 | 54935000.0 |
| 1988 | 177536335.0 | 6079611.0 | 1367172.0 | -9.0 | -9.0 | 77954544.0 | -9.0 | -9.0 | 26484096.0 | 65650912.0 |
| 1992 | 180614290.0 | 7764363.0 | 0.0 | -9.0 | -9.0 | 82907949.0 | -9.0 | -9.0 | 21712715.0 | 68229263.0 |
| 1996 | 189710899.0 | 7660876.0 | 0.0 | -9.0 | -9.0 | 81944349.0 | -9.0 | -9.0 | 17177492.0 | 82928182.0 |
| 2016 | 274722315.0 | 14163722.0 | 0.0 | -9.0 | -9.0 | 102321429.0 | -9.0 | -9.0 | 5513147.0 | 152724017.0 |

**Table B-3.** Wastewater flow *(million gallons per day)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 11682.0 | 0.0 | 5313.0 | 3052.5 | 0.0 | 3316.5 | 0.0 | 0.0 | 3052.5 | 0.0 |
| 1950 | 15140.7 | 0.0 | 5819.3 | 4059.0 | 0.0 | 5262.5 | 0.0 | 0.0 | 4059.0 | 0.0 |
| 1962 | 19519.5 | 0.0 | 2409.0 | 6963.0 | 0.0 | 10147.5 | 0.0 | 0.0 | 6963.0 | 0.0 |
| 1968 | 23116.5 | 0.0 | 1666.5 | 7276.5 | 0.0 | 14124.0 | 0.0 | 49.5 | 7276.5 | 49.5 |
| 1972 | 23384.2 | 136.1 | 815.1 | 8333.0 | 227.0 | 12584.7 | 372.4 | 915.8 | 8560.0 | 1288.3 |
| 1973 | -9.0 | -9.0 | 528.0 | 9009.0 | -9.0 | 17325.0 | -9.0 | 445.5 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 5437.5 | -9.0 | 7545.9 | 12653.6 | 7007.1 |
| 1978 | 26799.5 | 362.5 | 600.6 | 3415.0 | 3737.4 | 10138.7 | 4732.1 | 3813.2 | 7152.4 | 8545.3 |
| 1980 | 25510.0 | 438.3 | 380.7 | 3035.4 | 2895.1 | 9882.1 | 8654.9 | 751.6 | 6157.1 | 8651.8 |
| 1982 | 27202.7 | 490.9 | 309.5 | 2474.5 | 2825.4 | 11009.5 | 9377.5 | 714.7 | 5300.6 | 10092.2 |
| 1984 | 27305.0 | 600.0 | 210.0 | -9.0 | -9.0 | 11047.0 | -9.0 | -9.0 | 5335.0 | 10113.0 |
| 1986 | 27956.8 | 608.0 | 264.8 | -9.0 | -9.0 | 12140.0 | -9.0 | -9.0 | 4580.0 | 10364.0 |
| 1988 | 29293.5 | 1003.1 | 225.6 | -9.0 | -9.0 | 12862.5 | -9.0 | -9.0 | 4369.9 | 10832.4 |
| 1992 | 29801.4 | 1281.1 | 0.0 | -9.0 | -9.0 | 13679.8 | -9.0 | -9.0 | 3582.6 | 11257.8 |
| 1996 | 31302.3 | 1264.0 | 0.0 | -9.0 | -9.0 | 13520.8 | -9.0 | -9.0 | 2834.3 | 13683.1 |
| 2016 | 45329.2 | 2337.0 | 0.0 | -9.0 | -9.0 | 16883.0 | -9.0 | -9.0 | 909.7 | 25199.5 |

**Table B-4.** Influent wastewater flow normalized to population served *(gallons per person per day, default = 165)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 165.0 | -9.0 | 165.0 | 165.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | -9.0 |
| 1950 | 165.0 | -9.0 | 165.0 | 165.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | -9.0 |
| 1962 | 165.0 | -9.0 | 165.0 | 165.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | -9.0 |
| 1968 | 165.0 | -9.0 | 165.0 | 165.0 | -9.0 | 165.0 | -9.0 | 165.0 | 165.0 | 165.0 |
| 1972 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 | 165.0 |
| 1973 | -9.0 | -9.0 | 165.0 | 165.0 | -9.0 | 165.0 | -9.0 | 165.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 167.2 | -9.0 | 165.0 | 314.2 | -9.0 |
| 1978 | 172.6 | 165.0 | 165.0 | 182.2 | 147.5 | 180.2 | 153.0 | 210.5 | 162.3 | 174.2 |
| 1980 | 161.1 | 121.8 | 165.0 | 158.9 | 158.9 | 157.7 | 182.1 | 152.9 | 165.0 | 165.0 |
| 1982 | 166.4 | 117.7 | 165.0 | -9.0 | -9.0 | 162.8 | 184.4 | 132.1 | 157.7 | 179.4 |
| 1984 | 160.0 | 108.8 | 165.0 | -9.0 | -9.0 | 156.3 | -9.0 | -9.0 | 158.4 | 169.9 |
| 1986 | 171.2 | 107.1 | 165.0 | -9.0 | -9.0 | 167.9 | -9.0 | -9.0 | 158.9 | 188.7 |
| 1988 | 165.0 | 165.0 | 165.0 | -9.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | 165.0 |
| 1992 | 165.0 | 165.0 | -9.0 | -9.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | 165.0 |
| 1996 | 165.0 | 165.0 | -9.0 | -9.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | 165.0 |
| 2016 | 165.0 | 165.0 | -9.0 | -9.0 | -9.0 | 165.0 | -9.0 | -9.0 | 165.0 | 165.0 |

**Table B-5.** Influent $CBOD_5$ load *(metric tons per day)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 9507.5 | 0.0 | 4324.0 | 2484.3 | 0.0 | 2699.2 | 0.0 | 0.0 | 2484.3 | 0.0 |
| 1950 | 12322.5 | 0.0 | 4736.1 | 3303.4 | 0.0 | 4282.9 | 0.0 | 0.0 | 3303.4 | 0.0 |
| 1962 | 15886.2 | 0.0 | 1960.6 | 5666.9 | 0.0 | 8258.7 | 0.0 | 0.0 | 5666.9 | 0.0 |
| 1968 | 18813.6 | 0.0 | 1356.3 | 5922.1 | 0.0 | 11495.0 | 0.0 | 40.3 | 5922.1 | 40.3 |
| 1972 | 19031.5 | 110.8 | 663.4 | 6781.9 | 184.8 | 10242.2 | 303.1 | 745.4 | 6966.7 | 1048.5 |
| 1973 | -9.0 | -9.0 | 429.7 | 7332.1 | -9.0 | 14100.1 | -9.0 | 362.6 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 3764.0 | -9.0 | 6141.4 | 10177.0 | 5392.0 |
| 1978 | 21252.8 | 295.0 | 488.8 | 2511.0 | 3210.0 | 8222.0 | 3419.0 | 3107.0 | 5721.0 | 6526.0 |
| 1980 | 20528.9 | 356.7 | 309.8 | 4700.0 | 2356.2 | 7810.0 | 6498.0 | 598.0 | 5011.1 | 7041.3 |
| 1982 | 21170.4 | 399.5 | 251.9 | -9.0 | -9.0 | 8623.0 | 7030.0 | 586.0 | 4280.0 | 7616.0 |
| 1984 | 23395.3 | 488.3 | 170.9 | -9.0 | -9.0 | 9448.0 | -9.0 | -9.0 | 4917.0 | 8371.0 |
| 1986 | 23927.4 | 494.8 | 215.5 | -9.0 | -9.0 | 10378.0 | -9.0 | -9.0 | 4325.0 | 8514.0 |
| 1988 | 23840.8 | 816.4 | 183.6 | -9.0 | -9.0 | 10468.3 | -9.0 | -9.0 | 3556.5 | 8816.1 |
| 1992 | 24254.2 | 1042.7 | 0.0 | -9.0 | -9.0 | 11133.5 | -9.0 | -9.0 | 2915.7 | 9162.3 |
| 1996 | 25475.7 | 1028.8 | 0.0 | -9.0 | -9.0 | 11004.1 | -9.0 | -9.0 | 2306.7 | 11136.2 |
| 2016 | 36891.7 | 1902.0 | 0.0 | -9.0 | -9.0 | 13740.4 | -9.0 | -9.0 | 740.3 | 20508.9 |

**Table B-6.** Effluent $CBOD_5$ load *(metric tons per day)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 6343.7 | 0.0 | 4324.0 | 1614.8 | 0.0 | 404.9 | 0.0 | 0.0 | 1614.8 | 0.0 |
| 1950 | 7525.8 | 0.0 | 4736.1 | 2147.2 | 0.0 | 642.4 | 0.0 | 0.0 | 2147.2 | 0.0 |
| 1962 | 6882.9 | 0.0 | 1960.6 | 3683.5 | 0.0 | 1238.8 | 0.0 | 0.0 | 3683.5 | 0.0 |
| 1968 | 6931.9 | 0.0 | 1356.3 | 3849.3 | 0.0 | 1724.2 | 0.0 | 2.0 | 3849.3 | 2.0 |
| 1972 | 6767.9 | 0.0 | 663.4 | 4408.2 | 92.4 | 1536.3 | 30.3 | 37.3 | 4500.6 | 67.6 |
| 1973 | -9.0 | -9.0 | 429.7 | 4765.8 | -9.0 | 2115.0 | -9.0 | 18.1 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 518.0 | -9.0 | 307.1 | 4360.0 | 324.0 |
| 1978 | 5509.8 | 0.0 | 488.8 | 1487.0 | 1167.0 | 1596.0 | 362.0 | 409.0 | 2654.0 | 771.0 |
| 1980 | 5188.3 | 0.0 | 309.8 | 2316.0 | 1178.1 | 1469.0 | 752.0 | 75.0 | 2881.4 | 528.1 |
| 1982 | 4379.9 | 0.0 | 251.9 | -9.0 | -9.0 | 1539.0 | 582.0 | 32.0 | 1975.0 | 614.0 |
| 1984 | 3943.9 | 0.0 | 170.9 | -9.0 | -9.0 | 1135.0 | -9.0 | -9.0 | 2030.0 | 608.0 |
| 1986 | 3923.5 | 0.0 | 215.5 | -9.0 | -9.0 | 1279.0 | -9.0 | -9.0 | 1834.0 | 595.0 |
| 1988 | 4460.0 | 0.0 | 183.6 | -9.0 | -9.0 | 1570.2 | -9.0 | -9.0 | 2045.0 | 661.2 |
| 1992 | 4033.7 | 0.0 | 0.0 | -9.0 | -9.0 | 1670.0 | -9.0 | -9.0 | 1676.5 | 687.2 |
| 1996 | 3812.2 | 0.0 | 0.0 | -9.0 | -9.0 | 1650.6 | -9.0 | -9.0 | 1326.4 | 835.2 |
| 2016 | 4024.9 | 0.0 | 0.0 | -9.0 | -9.0 | 2061.1 | -9.0 | -9.0 | 425.7 | 1538.2 |

**Table B-7.** $CBOD_5$ removal efficiency *(Percent)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *100%* | *0%* | *35%* | *50%* | *85%* | *90%* | *95%* | *42.5%* | *92.5%* |
| 1940 | 33.3 | -9.0 | -9.0 | 35.0 | -9.0 | 85.0 | -9.0 | -9.0 | 35.0 | -9.0 |
| 1950 | 38.9 | -9.0 | -9.0 | 35.0 | -9.0 | 85.0 | -9.0 | -9.0 | 35.0 | -9.0 |
| 1962 | 56.7 | -9.0 | -9.0 | 35.0 | -9.0 | 85.0 | -9.0 | -9.0 | 35.0 | -9.0 |
| 1968 | 63.2 | -9.0 | -9.0 | 35.0 | -9.0 | 85.0 | -9.0 | 95.0 | 35.0 | 95.0 |
| 1972 | 64.4 | -9.0 | -9.0 | 35.0 | 50.0 | 85.0 | 90.0 | 95.0 | 35.4 | 93.6 |
| 1973 | -9.0 | -9.0 | -9.0 | 35.0 | -9.0 | 85.0 | -9.0 | 95.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 86.2 | -9.0 | 95.0 | 57.2 | 94.0 |
| 1978 | 74.1 | 100.0 | 0.0 | 40.8 | 63.6 | 80.6 | 89.4 | 86.8 | 53.6 | 88.2 |
| 1980 | 74.7 | -9.0 | -9.0 | 50.7 | 50.0 | 81.2 | 88.4 | 87.5 | 42.5 | 92.5 |
| 1982 | 79.3 | 100.0 | 0.0 | -9.0 | -9.0 | 82.2 | 91.7 | 94.5 | 53.9 | 91.9 |
| 1984 | 83.1 | -9.0 | -9.0 | -9.0 | -9.0 | 88.0 | -9.0 | -9.0 | 58.7 | 92.7 |
| 1986 | 83.6 | -9.0 | -9.0 | -9.0 | -9.0 | 87.7 | -9.0 | -9.0 | 57.6 | 93.0 |
| 1988 | 81.3 | -9.0 | -9.0 | -9.0 | -9.0 | 85.0 | -9.0 | -9.0 | 42.5 | 92.5 |
| 1992 | 83.4 | -9.0 | -9.0 | -9.0 | -9.0 | 85.0 | -9.0 | -9.0 | 42.5 | 92.5 |
| 1996 | 85.0 | -9.0 | -9.0 | -9.0 | -9.0 | 85.0 | -9.0 | -9.0 | 42.5 | 92.5 |
| 2016 | 89.1 | -9.0 | -9.0 | -9.0 | -9.0 | 85.0 | -9.0 | -9.0 | 42.5 | 92.5 |

**Table B-8.** Influent $CBOD_5$ load normalized to population served *(lbs $CBOD_5$ per person per day, default = 0.296)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 0.296 | -9.000 | 0.296 | 0.296 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | -9.000 |
| 1950 | 0.296 | -9.000 | 0.296 | 0.296 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | -9.000 |
| 1962 | 0.296 | -9.000 | 0.296 | 0.296 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | -9.000 |
| 1968 | 0.296 | -9.000 | 0.296 | 0.296 | -9.000 | 0.296 | -9.000 | 0.296 | 0.296 | 0.296 |
| 1972 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 | 0.296 |
| 1973 | -9.000 | -9.000 | 0.296 | 0.296 | -9.000 | 0.296 | -9.000 | 0.296 | -9.000 | -9.000 |
| 1974 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 |
| 1976 | -9.000 | -9.000 | -9.000 | -9.000 | -9.000 | 0.255 | -9.000 | 0.296 | 0.557 | -9.000 |
| 1978 | 0.302 | 0.296 | 0.296 | 0.295 | 0.279 | 0.322 | 0.244 | 0.378 | 0.286 | 0.293 |
| 1980 | 0.286 | 0.219 | 0.296 | 0.542 | 0.285 | 0.275 | 0.301 | 0.268 | 0.296 | 0.296 |
| 1982 | 0.285 | 0.211 | 0.296 | -9.000 | -9.000 | 0.281 | 0.305 | 0.239 | 0.281 | 0.298 |
| 1984 | 0.302 | 0.195 | 0.296 | -9.000 | -9.000 | 0.295 | -9.000 | -9.000 | 0.322 | 0.310 |
| 1986 | 0.323 | 0.192 | 0.296 | -9.000 | -9.000 | 0.317 | -9.000 | -9.000 | 0.331 | 0.342 |
| 1988 | 0.296 | 0.296 | 0.296 | -9.000 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | 0.296 |
| 1992 | 0.296 | 0.296 | -9.000 | -9.000 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | 0.296 |
| 1996 | 0.296 | 0.296 | -9.000 | -9.000 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | 0.296 |
| 2016 | 0.296 | 0.296 | -9.000 | -9.000 | -9.000 | 0.296 | -9.000 | -9.000 | 0.296 | 0.296 |

**Table B-9.** Influent $CBOD_5$ concentration *(mg/L, default = 215.0 mg/L)*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 215.0 | -9.0 | 215.0 | 215.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | -9.0 |
| 1950 | 215.0 | -9.0 | 215.0 | 215.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | -9.0 |
| 1962 | 215.0 | -9.0 | 215.0 | 215.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | -9.0 |
| 1968 | 215.0 | -9.0 | 215.0 | 215.0 | -9.0 | 215.0 | -9.0 | 215.0 | 215.0 | 215.0 |
| 1972 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 | 215.0 |
| 1973 | -9.0 | -9.0 | 215.0 | 215.0 | -9.0 | 215.0 | -9.0 | 215.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 182.9 | -9.0 | 215.0 | 212.5 | 203.3 |
| 1978 | 209.5 | 215.0 | 215.0 | 194.2 | 226.9 | 214.2 | 190.9 | 215.2 | 211.3 | 201.7 |
| 1980 | 212.6 | 215.0 | 215.0 | 409.0 | 215.0 | 208.8 | 198.3 | 210.2 | 215.0 | 215.0 |
| 1982 | 205.6 | 215.0 | 215.0 | -9.0 | -9.0 | 206.9 | 198.0 | 216.6 | 213.3 | 199.4 |
| 1984 | 226.3 | 215.0 | 215.0 | -9.0 | -9.0 | 225.9 | -9.0 | -9.0 | 243.5 | 218.7 |
| 1986 | 226.1 | 215.0 | 215.0 | -9.0 | -9.0 | 225.8 | -9.0 | -9.0 | 249.5 | 217.0 |
| 1988 | 215.0 | 215.0 | 215.0 | -9.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | 215.0 |
| 1992 | 215.0 | 215.0 | -9.0 | -9.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | 215.0 |
| 1996 | 215.0 | 215.0 | -9.0 | -9.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | 215.0 |
| 2016 | 215.0 | 215.0 | -9.0 | -9.0 | -9.0 | 215.0 | -9.0 | -9.0 | 215.0 | 215.0 |

**Table B-10.** Effluent $CBOD_5$ concentration *[mg/L]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *0.0* | *215.0* | *139.75* | *107.5* | *32.25* | *21.5* | *10.75* | *123.63* | *16.12* |
| 1940 | 143.5 | -9.0 | 215.0 | 139.8 | -9.0 | 32.3 | -9.0 | -9.0 | 139.8 | -9.0 |
| 1950 | 131.3 | -9.0 | 215.0 | 139.8 | -9.0 | 32.3 | -9.0 | -9.0 | 139.8 | -9.0 |
| 1962 | 93.2 | -9.0 | 215.0 | 139.8 | -9.0 | 32.3 | -9.0 | -9.0 | 139.8 | -9.0 |
| 1968 | 79.2 | -9.0 | 215.0 | 139.8 | -9.0 | 32.3 | -9.0 | 10.8 | 139.8 | 10.8 |
| 1972 | 76.5 | 0.0 | 215.0 | 139.8 | 107.5 | 32.3 | 21.5 | 10.8 | 138.9 | 13.9 |
| 1973 | -9.0 | -9.0 | 215.0 | 139.8 | -9.0 | 32.3 | -9.0 | 10.8 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 25.2 | -9.0 | 10.8 | 91.0 | 12.2 |
| 1978 | 54.3 | 0.0 | 215.0 | 115.0 | 82.5 | 41.6 | 20.2 | 28.3 | 98.0 | 23.8 |
| 1980 | 53.7 | 0.0 | 215.0 | 201.6 | 107.5 | 39.3 | 23.0 | 26.4 | 123.6 | 16.1 |
| 1982 | 42.5 | 0.0 | 215.0 | -9.0 | -9.0 | 36.9 | 16.4 | 11.8 | 98.4 | 16.1 |
| 1984 | 38.2 | 0.0 | 215.0 | -9.0 | -9.0 | 27.1 | -9.0 | -9.0 | 100.5 | 15.9 |
| 1986 | 37.1 | 0.0 | 215.0 | -9.0 | -9.0 | 27.8 | -9.0 | -9.0 | 105.8 | 15.2 |
| 1988 | 40.2 | 0.0 | 215.0 | -9.0 | -9.0 | 32.3 | -9.0 | -9.0 | 123.6 | 16.1 |
| 1992 | 35.8 | 0.0 | -9.0 | -9.0 | -9.0 | 32.3 | -9.0 | -9.0 | 123.6 | 16.1 |
| 1996 | 32.2 | 0.0 | -9.0 | -9.0 | -9.0 | 32.3 | -9.0 | -9.0 | 123.6 | 16.1 |
| 2016 | 23.5 | 0.0 | -9.0 | -9.0 | -9.0 | 32.3 | -9.0 | -9.0 | 123.6 | 16.1 |

**Table B-11.** Influent $CBOD_U$ load *[metric tons per day]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 11409.0 | 0.0 | 5188.9 | 2981.2 | 0.0 | 3239.0 | 0.0 | 0.0 | 2981.2 | 0.0 |
| 1950 | 14786.9 | 0.0 | 5683.3 | 3964.1 | 0.0 | 5139.5 | 0.0 | 0.0 | 3964.1 | 0.0 |
| 1962 | 19063.4 | 0.0 | 2352.7 | 6800.3 | 0.0 | 9910.4 | 0.0 | 0.0 | 6800.3 | 0.0 |
| 1968 | 22576.3 | 0.0 | 1627.6 | 7106.5 | 0.0 | 13794.0 | 0.0 | 48.3 | 7106.5 | 48.3 |
| 1972 | 22837.8 | 132.9 | 796.0 | 8138.2 | 221.7 | 12290.6 | 363.7 | 894.4 | 8360.0 | 1258.2 |
| 1973 | -9.0 | -9.0 | 515.7 | 8798.5 | -9.0 | 16920.2 | -9.0 | 435.1 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 4516.8 | -9.0 | 7369.6 | 12212.4 | 6470.4 |
| 1978 | 25503.4 | 354.0 | 586.6 | 3013.2 | 3852.0 | 9866.4 | 4102.8 | 3728.4 | 6865.2 | 7831.2 |
| 1980 | 24634.7 | 428.1 | 371.8 | 5640.0 | 2827.5 | 9372.0 | 7797.6 | 717.6 | 6013.3 | 8449.6 |
| 1982 | 25404.5 | 479.4 | 302.3 | -9.0 | -9.0 | 10347.6 | 8436.0 | 703.2 | 5136.0 | 9139.2 |
| 1984 | 28074.3 | 586.0 | 205.1 | -9.0 | -9.0 | 11337.6 | -9.0 | -9.0 | 5900.4 | 10045.2 |
| 1986 | 28712.8 | 593.8 | 258.6 | -9.0 | -9.0 | 12453.6 | -9.0 | -9.0 | 5190.0 | 10216.8 |
| 1988 | 28609.0 | 979.7 | 220.3 | -9.0 | -9.0 | 12561.9 | -9.0 | -9.0 | 4267.8 | 10579.3 |
| 1992 | 29105.0 | 1251.2 | 0.0 | -9.0 | -9.0 | 13360.2 | -9.0 | -9.0 | 3498.9 | 10994.8 |
| 1996 | 30570.9 | 1234.5 | 0.0 | -9.0 | -9.0 | 13204.9 | -9.0 | -9.0 | 2768.1 | 13363.4 |
| 2016 | 44270.0 | 2282.4 | 0.0 | -9.0 | -9.0 | 16488.5 | -9.0 | -9.0 | 888.4 | 24610.6 |

**Table B-12.** Effluent $CBOD_U$ load *[metric tons per day]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 8922.4 | 0.0 | 5188.9 | 2583.7 | 0.0 | 1149.8 | 0.0 | 0.0 | 2583.7 | 0.0 |
| 1950 | 10943.4 | 0.0 | 5683.3 | 3435.6 | 0.0 | 1824.5 | 0.0 | 0.0 | 3435.6 | 0.0 |
| 1962 | 11764.5 | 0.0 | 2352.7 | 5893.6 | 0.0 | 3518.2 | 0.0 | 0.0 | 5893.6 | 0.0 |
| 1968 | 12689.4 | 0.0 | 1627.6 | 6158.9 | 0.0 | 4896.9 | 0.0 | 6.0 | 6158.9 | 6.0 |
| 1972 | 12558.1 | 0.0 | 796.0 | 7053.1 | 147.8 | 4363.2 | 86.1 | 111.8 | 7201.0 | 197.9 |
| 1973 | -9.0 | -9.0 | 515.7 | 7625.4 | -9.0 | 6006.7 | -9.0 | 54.4 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 1471.1 | -9.0 | 921.2 | 6976.0 | 939.6 |
| 1978 | 11620.7 | 0.0 | 586.6 | 2379.2 | 1867.2 | 4532.6 | 1028.1 | 1227.0 | 4246.4 | 2255.1 |
| 1980 | 10685.4 | 0.0 | 371.8 | 3705.6 | 1885.0 | 4172.0 | 2135.7 | 225.0 | 4610.2 | 1531.5 |
| 1982 | 9581.9 | 0.0 | 302.3 | -9.0 | -9.0 | 4370.8 | 1652.9 | 96.0 | 3160.0 | 1748.9 |
| 1984 | 8439.7 | 0.0 | 205.1 | -9.0 | -9.0 | 3223.4 | -9.0 | -9.0 | 3248.0 | 1763.2 |
| 1986 | 8550.9 | 0.0 | 258.6 | -9.0 | -9.0 | 3632.4 | -9.0 | -9.0 | 2934.4 | 1725.5 |
| 1988 | 9869.3 | 0.0 | 220.3 | -9.0 | -9.0 | 4459.5 | -9.0 | -9.0 | 3272.0 | 1917.5 |
| 1992 | 9418.1 | 0.0 | 0.0 | -9.0 | -9.0 | 4742.9 | -9.0 | -9.0 | 2682.5 | 1992.8 |
| 1996 | 9232.0 | 0.0 | 0.0 | -9.0 | -9.0 | 4687.7 | -9.0 | -9.0 | 2122.2 | 2422.1 |
| 2016 | 10995.2 | 0.0 | 0.0 | -9.0 | -9.0 | 5853.4 | -9.0 | -9.0 | 681.1 | 4460.7 |

**Table B-13.** $CBOD_U$ removal efficiency *[Percent]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *100%* | *0%* | *13.3%* | *33.3%* | *64.5%* | *76.3%* | *87.5%* | *23.3%* | *81.9%* |
| 1940 | 21.8 | -9.0 | -9.0 | 13.3 | -9.0 | 64.5 | -9.0 | -9.0 | 13.3 | -9.0 |
| 1950 | 26.0 | -9.0 | -9.0 | 13.3 | -9.0 | 64.5 | -9.0 | -9.0 | 13.3 | -9.0 |
| 1962 | 38.3 | -9.0 | -9.0 | 13.3 | -9.0 | 64.5 | -9.0 | -9.0 | 13.3 | -9.0 |
| 1968 | 43.8 | -9.0 | -9.0 | 13.3 | -9.0 | 64.5 | -9.0 | 87.5 | 13.3 | 87.5 |
| 1972 | 45.0 | -9.0 | -9.0 | 13.3 | 33.3 | 64.5 | 76.3 | 87.5 | 13.9 | 84.3 |
| 1973 | -9.0 | -9.0 | -9.0 | 13.3 | -9.0 | 64.5 | -9.0 | 87.5 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 67.4 | -9.0 | 87.5 | 42.9 | 85.5 |
| 1978 | 54.4 | 100.0 | 0.0 | 21.0 | 51.5 | 54.1 | 74.9 | 67.1 | 38.1 | 71.2 |
| 1980 | 56.6 | -9.0 | -9.0 | 34.3 | 33.3 | 55.5 | 72.6 | 68.6 | 23.3 | 81.9 |
| 1982 | 62.3 | 100.0 | 0.0 | -9.0 | -9.0 | 57.8 | 80.4 | 86.3 | 38.5 | 80.9 |
| 1984 | 69.9 | -9.0 | -9.0 | -9.0 | -9.0 | 71.6 | -9.0 | -9.0 | 45.0 | 82.4 |
| 1986 | 70.2 | -9.0 | -9.0 | -9.0 | -9.0 | 70.8 | -9.0 | -9.0 | 43.5 | 83.1 |
| 1988 | 65.5 | -9.0 | -9.0 | -9.0 | -9.0 | 64.5 | -9.0 | -9.0 | 23.3 | 81.9 |
| 1992 | 67.6 | -9.0 | -9.0 | -9.0 | -9.0 | 64.5 | -9.0 | -9.0 | 23.3 | 81.9 |
| 1996 | 69.8 | -9.0 | -9.0 | -9.0 | -9.0 | 64.5 | -9.0 | -9.0 | 23.3 | 81.9 |
| 2016 | 75.2 | -9.0 | -9.0 | -9.0 | -9.0 | 64.5 | -9.0 | -9.0 | 23.3 | 81.9 |

**Table B-14.** Effluent $CBOD_U$ concentration *[mg/L; $CBOD_U = BOD_5 \times (CBOD_U:BOD_5)$]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default $CBOD_U$:CBOD* | | *0.0* | *1.2* | *1.6* | *1.6* | *2.84* | *2.84* | *3.0* | *1.6* | *2.9* |
| *Default:* | | *0.0* | *258.0* | *223.60* | *172.0* | *91.59* | *61.06* | *32.25* | *197.80* | *46.76* |
| 1940 | 201.8 | -9.0 | 258.0 | 223.6 | -9.0 | 91.6 | -9.0 | -9.0 | 223.6 | -9.0 |
| 1950 | 190.9 | -9.0 | 258.0 | 223.6 | -9.0 | 91.6 | -9.0 | -9.0 | 223.6 | -9.0 |
| 1962 | 159.2 | -9.0 | 258.0 | 223.6 | -9.0 | 91.6 | -9.0 | -9.0 | 223.6 | -9.0 |
| 1968 | 145.0 | -9.0 | 258.0 | 223.6 | -9.0 | 91.6 | -9.0 | 32.3 | 223.6 | 32.3 |
| 1972 | 141.9 | 0.0 | 258.0 | 223.6 | 172.0 | 91.6 | 61.1 | 32.3 | 222.2 | 40.6 |
| 1973 | -9.0 | -9.0 | 258.0 | 223.6 | -9.0 | 91.6 | -9.0 | 32.3 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 71.5 | -9.0 | 32.3 | 145.6 | 35.4 |
| 1978 | 114.5 | 0.0 | 258.0 | 184.0 | 132.0 | 118.1 | 57.4 | 85.0 | 156.8 | 69.7 |
| 1980 | 110.7 | 0.0 | 258.0 | 322.5 | 172.0 | 111.5 | 65.2 | 79.1 | 197.8 | 46.8 |
| 1982 | 93.1 | 0.0 | 258.0 | -9.0 | -9.0 | 104.9 | 46.6 | 35.5 | 157.5 | 45.8 |
| 1984 | 81.7 | 0.0 | 258.0 | -9.0 | -9.0 | 77.1 | -9.0 | -9.0 | 160.8 | 46.1 |
| 1986 | 80.8 | 0.0 | 258.0 | -9.0 | -9.0 | 79.0 | -9.0 | -9.0 | 169.3 | 44.0 |
| 1988 | 89.0 | 0.0 | 258.0 | -9.0 | -9.0 | 91.6 | -9.0 | -9.0 | 197.8 | 46.8 |
| 1992 | 83.5 | 0.0 | -9.0 | -9.0 | -9.0 | 91.6 | -9.0 | -9.0 | 197.8 | 46.8 |
| 1996 | 77.9 | 0.0 | -9.0 | -9.0 | -9.0 | 91.6 | -9.0 | -9.0 | 197.8 | 46.8 |
| 2016 | 64.1 | 0.0 | -9.0 | -9.0 | -9.0 | 91.6 | -9.0 | -9.0 | 197.8 | 46.8 |

**Table B-15.** Influent NBOD load *[metric tons per day; NBOD = 4.57 x TKN]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 6123.3 | 0.0 | 2784.9 | 1600.0 | 0.0 | 1738.4 | 0.0 | 0.0 | 1600.0 | 0.0 |
| 1950 | 7936.3 | 0.0 | 3050.3 | 2127.6 | 0.0 | 2758.4 | 0.0 | 0.0 | 2127.6 | 0.0 |
| 1962 | 10231.5 | 0.0 | 1262.7 | 3649.8 | 0.0 | 5319.0 | 0.0 | 0.0 | 3649.8 | 0.0 |
| 1968 | 12116.9 | 0.0 | 873.5 | 3814.1 | 0.0 | 7403.4 | 0.0 | 25.9 | 3814.1 | 25.9 |
| 1972 | 12257.2 | 71.4 | 427.2 | 4367.9 | 119.0 | 6596.5 | 195.2 | 480.1 | 4486.9 | 675.3 |
| 1973 | -9.0 | -9.0 | 276.8 | 4722.2 | -9.0 | 9081.2 | -9.0 | 233.5 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 2850.2 | -9.0 | 3955.3 | 6632.6 | -9.0 |
| 1978 | 14047.4 | 190.0 | 314.8 | 1790.1 | 1959.0 | 5314.4 | 2480.4 | 1998.8 | 3749.1 | 4479.2 |
| 1980 | 13371.5 | 229.7 | 199.5 | 1591.1 | 1517.5 | 5179.9 | 4536.6 | 394.0 | 3227.4 | 4535.0 |
| 1982 | 14258.8 | 257.3 | 162.3 | -9.0 | -9.0 | 5770.8 | 4915.4 | 374.6 | 2778.4 | 5290.0 |
| 1984 | 14312.4 | 314.5 | 110.1 | -9.0 | -9.0 | 5790.5 | -9.0 | -9.0 | 2796.4 | 5300.9 |
| 1986 | 14654.1 | 318.7 | 138.8 | -9.0 | -9.0 | 6363.4 | -9.0 | -9.0 | 2400.7 | 5432.5 |
| 1988 | 15354.7 | 525.8 | 118.2 | -9.0 | -9.0 | 6742.1 | -9.0 | -9.0 | 2290.5 | 5678.0 |
| 1992 | 15620.9 | 671.5 | 0.0 | -9.0 | -9.0 | 7170.5 | -9.0 | -9.0 | 1877.9 | 5901.0 |
| 1996 | 16407.7 | 662.6 | 0.0 | -9.0 | -9.0 | 7087.2 | -9.0 | -9.0 | 1485.6 | 7172.3 |
| 2016 | 23760.1 | 1225.0 | 0.0 | -9.0 | -9.0 | 8849.5 | -9.0 | -9.0 | 476.8 | 13208.8 |

**Table B-16.** Effluent NBOD load *[metric tons per day; NBOD = 4.57 x TKN]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 5145.5 | 0.0 | 2784.9 | 1248.0 | 0.0 | 1112.6 | 0.0 | 0.0 | 1248.0 | 0.0 |
| 1950 | 6475.2 | 0.0 | 3050.3 | 1659.5 | 0.0 | 1765.4 | 0.0 | 0.0 | 1659.5 | 0.0 |
| 1962 | 7513.7 | 0.0 | 1262.7 | 2846.8 | 0.0 | 3404.2 | 0.0 | 0.0 | 2846.8 | 0.0 |
| 1968 | 8591.1 | 0.0 | 873.5 | 2975.0 | 0.0 | 4738.1 | 0.0 | 4.4 | 2975.0 | 4.4 |
| 1972 | 8273.3 | 0.0 | 427.2 | 3406.9 | 92.8 | 4221.8 | 42.9 | 81.6 | 3499.8 | 124.6 |
| 1973 | -9.0 | -9.0 | 276.8 | 3683.3 | -9.0 | 5812.0 | -9.0 | 39.7 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 1824.1 | -9.0 | 672.4 | 5173.4 | -9.0 |
| 1978 | 7525.8 | 0.0 | 314.8 | 1396.2 | 1528.0 | 3401.2 | 545.7 | 339.8 | 2924.3 | 885.5 |
| 1980 | 6916.3 | 0.0 | 199.5 | 1241.0 | 1183.7 | 3315.1 | 998.1 | 67.0 | 2517.4 | 884.3 |
| 1982 | 7167.8 | 0.0 | 162.3 | -9.0 | -9.0 | 3693.3 | 1081.4 | 63.7 | 2167.2 | 1145.1 |
| 1984 | 7030.9 | 0.0 | 110.1 | -9.0 | -9.0 | 3705.9 | -9.0 | -9.0 | 2181.2 | 1033.7 |
| 1986 | 7143.3 | 0.0 | 138.8 | -9.0 | -9.0 | 4072.6 | -9.0 | -9.0 | 1872.5 | 1059.3 |
| 1988 | 7327.0 | 0.0 | 118.2 | -9.0 | -9.0 | 4315.0 | -9.0 | -9.0 | 1786.6 | 1107.2 |
| 1992 | 7204.6 | 0.0 | 0.0 | -9.0 | -9.0 | 4589.1 | -9.0 | -9.0 | 1464.7 | 1150.7 |
| 1996 | 7093.2 | 0.0 | 0.0 | -9.0 | -9.0 | 4535.8 | -9.0 | -9.0 | 1158.8 | 1398.6 |
| 2016 | 8611.3 | 0.0 | 0.0 | -9.0 | -9.0 | 5663.7 | -9.0 | -9.0 | 371.9 | 2575.7 |

**Table B-17.** NBOD removal efficiency *[Percent]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *100%* | *0%* | *22%* | *22%* | *36%* | *78%* | *83%* | *22%* | *80.5%* |
| 1940 | 16.0 | -9.0 | -9.0 | 22.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | -9.0 |
| 1950 | 18.4 | -9.0 | -9.0 | 22.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | -9.0 |
| 1962 | 26.6 | -9.0 | -9.0 | 22.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | -9.0 |
| 1968 | 29.1 | -9.0 | -9.0 | 22.0 | -9.0 | 36.0 | -9.0 | 83.0 | 22.0 | 83.0 |
| 1972 | 32.5 | -9.0 | -9.0 | 22.0 | 22.0 | 36.0 | 78.0 | 83.0 | 22.0 | 81.6 |
| 1973 | -9.0 | -9.0 | -9.0 | 22.0 | -9.0 | 36.0 | -9.0 | 83.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | 83.0 | 22.0 | -9.0 |
| 1978 | 46.4 | -9.0 | -9.0 | 22.0 | 22.0 | 36.0 | 78.0 | 83.0 | 22.0 | 80.2 |
| 1980 | 48.3 | -9.0 | -9.0 | 22.0 | 22.0 | 36.0 | 78.0 | 83.0 | 22.0 | 80.5 |
| 1982 | 49.7 | 100.0 | 0.0 | -9.0 | -9.0 | 36.0 | 78.0 | 83.0 | 22.0 | 78.4 |
| 1984 | 50.9 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |
| 1986 | 51.3 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |
| 1988 | 52.3 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |
| 1992 | 53.9 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |
| 1996 | 56.8 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |
| 2016 | 63.8 | -9.0 | -9.0 | -9.0 | -9.0 | 36.0 | -9.0 | -9.0 | 22.0 | 80.5 |

**Table B-18.** Effluent NBOD concentration *[mg/L; NBOD = 4.57 x TKN]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *0.0* | *138.47* | *108.0* | *108.0* | *88.62* | *30.46* | *23.54* | *108.0* | *27.0* |
| 1940 | 116.4 | -9.0 | 138.5 | 108.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | -9.0 |
| 1950 | 113.0 | -9.0 | 138.5 | 108.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | -9.0 |
| 1962 | 101.7 | -9.0 | 138.5 | 108.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | -9.0 |
| 1968 | 98.2 | -9.0 | 138.5 | 108.0 | -9.0 | 88.6 | -9.0 | 23.5 | 108.0 | 23.5 |
| 1972 | 93.5 | 0.0 | 138.5 | 108.0 | 108.0 | 88.6 | 30.5 | 23.5 | 108.0 | 25.5 |
| 1973 | -9.0 | -9.0 | 138.5 | 108.0 | -9.0 | 88.6 | -9.0 | 23.5 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 88.6 | -9.0 | 23.5 | 108.0 | -0.3 |
| 1978 | 74.2 | 0.0 | 138.5 | 108.0 | 108.0 | 88.6 | 30.5 | 23.5 | 108.0 | 27.4 |
| 1980 | 71.6 | 0.0 | 138.5 | 108.0 | 108.0 | 88.6 | 30.5 | 23.5 | 108.0 | 27.0 |
| 1982 | 69.6 | 0.0 | 138.5 | -9.0 | -9.0 | 88.6 | 30.5 | 23.5 | 108.0 | 30.0 |
| 1984 | 68.0 | 0.0 | 138.5 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |
| 1986 | 67.5 | 0.0 | 138.5 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |
| 1988 | 66.1 | 0.0 | 138.5 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |
| 1992 | 63.9 | 0.0 | -9.0 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |
| 1996 | 59.9 | 0.0 | -9.0 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |
| 2016 | 50.2 | 0.0 | -9.0 | -9.0 | -9.0 | 88.6 | -9.0 | -9.0 | 108.0 | 27.0 |

**Table B-19.** Influent $BOD_U$ load *[metric tons per day; $BOD_U = CBOD_U + NBOD$]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 17532.4 | 0.0 | 7973.8 | 4581.2 | 0.0 | 4977.4 | 0.0 | 0.0 | 4581.2 | 0.0 |
| 1950 | 22723.2 | 0.0 | 8733.6 | 6091.7 | 0.0 | 7897.9 | 0.0 | 0.0 | 6091.7 | 0.0 |
| 1962 | 29294.9 | 0.0 | 3615.4 | 10450.1 | 0.0 | 15229.4 | 0.0 | 0.0 | 10450.1 | 0.0 |
| 1968 | 34693.3 | 0.0 | 2501.1 | 10920.6 | 0.0 | 21197.3 | 0.0 | 74.3 | 10920.6 | 74.3 |
| 1972 | 35095.0 | 204.3 | 1223.3 | 12506.1 | 340.8 | 18887.1 | 558.9 | 1374.5 | 12846.9 | 1933.4 |
| 1973 | -9.0 | -9.0 | 792.4 | 13520.7 | -9.0 | 26001.4 | -9.0 | 668.6 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 7367.0 | -9.0 | 11325.0 | 18845.0 | -9.0 |
| 1978 | 39550.8 | 544.0 | 901.4 | 4803.3 | 5811.0 | 15180.8 | 6583.2 | 5727.2 | 10614.3 | 12310.4 |
| 1980 | 38006.2 | 657.8 | 571.3 | 7231.1 | 4345.0 | 14551.9 | 12334.2 | 1111.6 | 9240.6 | 12984.6 |
| 1982 | 39663.3 | 736.7 | 464.6 | -9.0 | -9.0 | 16118.4 | 13351.4 | 1077.8 | 7914.4 | 14429.2 |
| 1984 | 42386.8 | 900.5 | 315.2 | -9.0 | -9.0 | 17128.1 | -9.0 | -9.0 | 8696.8 | 15346.1 |
| 1986 | 43366.9 | 912.5 | 397.4 | -9.0 | -9.0 | 18817.0 | -9.0 | -9.0 | 7590.7 | 15649.3 |
| 1988 | 43963.7 | 1505.5 | 338.6 | -9.0 | -9.0 | 19304.1 | -9.0 | -9.0 | 6558.3 | 16257.3 |
| 1992 | 44725.9 | 1922.7 | 0.0 | -9.0 | -9.0 | 20530.7 | -9.0 | -9.0 | 5376.8 | 16895.8 |
| 1996 | 46978.5 | 1897.1 | 0.0 | -9.0 | -9.0 | 20292.1 | -9.0 | -9.0 | 4253.7 | 20535.7 |
| 2016 | 68030.1 | 3507.4 | 0.0 | -9.0 | -9.0 | 25338.1 | -9.0 | -9.0 | 1365.2 | 37819.4 |

**Table B-20.** Effluent $BOD_U$ load *[metric tons per day; $BOD_U = CBOD_U + NBOD$]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 14067.9 | 0.0 | 7973.8 | 3831.7 | 0.0 | 2262.4 | 0.0 | 0.0 | 3831.7 | 0.0 |
| 1950 | 17418.6 | 0.0 | 8733.6 | 5095.1 | 0.0 | 3589.9 | 0.0 | 0.0 | 5095.1 | 0.0 |
| 1962 | 19278.2 | 0.0 | 3615.4 | 8740.4 | 0.0 | 6922.3 | 0.0 | 0.0 | 8740.4 | 0.0 |
| 1968 | 21280.5 | 0.0 | 2501.1 | 9133.9 | 0.0 | 9635.0 | 0.0 | 10.5 | 9133.9 | 10.5 |
| 1972 | 20831.4 | 0.0 | 1223.3 | 10460.1 | 240.7 | 8584.9 | 129.0 | 193.4 | 10700.8 | 322.4 |
| 1973 | -9.0 | -9.0 | 792.4 | 11308.7 | -9.0 | 11818.6 | -9.0 | 94.1 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 3295.2 | -9.0 | 1593.6 | 12149.4 | -9.0 |
| 1978 | 19146.5 | 0.0 | 901.4 | 3775.4 | 3395.2 | 7933.8 | 1573.8 | 1566.8 | 7170.7 | 3140.6 |
| 1980 | 17601.7 | 0.0 | 571.3 | 4946.6 | 3068.6 | 7487.1 | 3133.7 | 292.0 | 7127.5 | 2415.8 |
| 1982 | 16749.8 | 0.0 | 464.6 | -9.0 | -9.0 | 8064.1 | 2734.3 | 159.7 | 5327.2 | 2893.9 |
| 1984 | 15470.6 | 0.0 | 315.2 | -9.0 | -9.0 | 6929.3 | -9.0 | -9.0 | 5429.2 | 2796.9 |
| 1986 | 15694.2 | 0.0 | 397.4 | -9.0 | -9.0 | 7704.9 | -9.0 | -9.0 | 4806.9 | 2784.8 |
| 1988 | 17196.3 | 0.0 | 338.6 | -9.0 | -9.0 | 8774.4 | -9.0 | -9.0 | 5058.6 | 3024.7 |
| 1992 | 16622.7 | 0.0 | 0.0 | -9.0 | -9.0 | 9332.0 | -9.0 | -9.0 | 4147.2 | 3143.5 |
| 1996 | 16325.2 | 0.0 | 0.0 | -9.0 | -9.0 | 9223.5 | -9.0 | -9.0 | 3281.0 | 3820.7 |
| 2016 | 19606.6 | 0.0 | 0.0 | -9.0 | -9.0 | 11517.1 | -9.0 | -9.0 | 1053.0 | 7036.4 |

**Table B-21.** Removal efficiency $BOD_U$ *[Percent]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| Default: | | 100% | 0% | 16.4% | 29.4% | 54.5% | 76.9% | 85.9% | 22.9% | 81.4% |
| 1940 | 19.8 | -9.0 | -9.0 | 16.4 | -9.0 | 54.5 | -9.0 | -9.0 | 16.4 | -9.0 |
| 1950 | 23.3 | -9.0 | -9.0 | 16.4 | -9.0 | 54.5 | -9.0 | -9.0 | 16.4 | -9.0 |
| 1962 | 34.2 | -9.0 | -9.0 | 16.4 | -9.0 | 54.5 | -9.0 | -9.0 | 16.4 | -9.0 |
| 1968 | 38.7 | -9.0 | -9.0 | 16.4 | -9.0 | 54.5 | -9.0 | 85.9 | 16.4 | 85.9 |
| 1972 | 40.6 | -9.0 | -9.0 | 16.4 | 29.4 | 54.5 | 76.9 | 85.9 | 16.7 | 83.3 |
| 1973 | -9.0 | -9.0 | -9.0 | 16.4 | -9.0 | 54.5 | -9.0 | 85.9 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 55.3 | -9.0 | 85.9 | 35.5 | -9.0 |
| 1978 | 51.6 | -9.0 | -9.0 | 21.4 | 41.6 | 47.7 | 76.1 | 72.6 | 32.4 | 74.5 |
| 1980 | 53.7 | -9.0 | -9.0 | 31.6 | 29.4 | 48.5 | 74.6 | 73.7 | 22.9 | 81.4 |
| 1982 | 57.8 | -9.0 | -9.0 | -9.0 | -9.0 | 50.0 | 79.5 | 85.2 | 32.7 | 79.9 |
| 1984 | 63.5 | -9.0 | -9.0 | -9.0 | -9.0 | 59.5 | -9.0 | -9.0 | 37.6 | 81.8 |
| 1986 | 63.8 | -9.0 | -9.0 | -9.0 | -9.0 | 59.1 | -9.0 | -9.0 | 36.7 | 82.2 |
| 1988 | 60.9 | -9.0 | -9.0 | -9.0 | -9.0 | 54.5 | -9.0 | -9.0 | 22.9 | 81.4 |
| 1992 | 62.8 | -9.0 | -9.0 | -9.0 | -9.0 | 54.5 | -9.0 | -9.0 | 22.9 | 81.4 |
| 1996 | 65.2 | -9.0 | -9.0 | -9.0 | -9.0 | 54.5 | -9.0 | -9.0 | 22.9 | 81.4 |
| 2016 | 71.2 | -9.0 | -9.0 | -9.0 | -9.0 | 54.5 | -9.0 | -9.0 | 22.9 | 81.4 |

**Table B-22.** Effluent $BOD_U$ concentration *[mg/L; $BOD_U = CBOD_U + NBOD$]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *0.0* | *396.5* | *331.6* | *280.0* | *180.2* | *91.5* | *55.8* | *305.8* | *73.8* |
| 1940 | 318.1 | -9.0 | 396.5 | 331.6 | -9.0 | 180.2 | -9.0 | -9.0 | 331.6 | -9.0 |
| 1950 | 303.9 | -9.0 | 396.5 | 331.6 | -9.0 | 180.2 | -9.0 | -9.0 | 331.6 | -9.0 |
| 1962 | 260.9 | -9.0 | 396.5 | 331.6 | -9.0 | 180.2 | -9.0 | -9.0 | 331.6 | -9.0 |
| 1968 | 243.2 | -9.0 | 396.5 | 331.6 | -9.0 | 180.2 | -9.0 | 55.8 | 331.6 | 55.8 |
| 1972 | 235.3 | 0.0 | 396.5 | 331.6 | 280.0 | 180.2 | 91.5 | 55.8 | 330.2 | 66.1 |
| 1973 | -9.0 | -9.0 | 396.5 | 331.6 | -9.0 | 180.2 | -9.0 | 55.8 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 160.1 | -9.0 | 55.8 | 253.6 | -0.3 |
| 1978 | 188.7 | 0.0 | 396.5 | 292.1 | 240.0 | 206.7 | 87.9 | 108.5 | 264.8 | 97.1 |
| 1980 | 182.3 | 0.0 | 396.5 | 430.5 | 280.0 | 200.1 | 95.7 | 102.6 | 305.8 | 73.8 |
| 1982 | 162.7 | 0.0 | 396.5 | -9.0 | -9.0 | 193.5 | 77.0 | 59.0 | 265.5 | 75.8 |
| 1984 | 149.7 | 0.0 | 396.5 | -9.0 | -9.0 | 165.7 | -9.0 | -9.0 | 268.8 | 73.1 |
| 1986 | 148.3 | 0.0 | 396.5 | -9.0 | -9.0 | 167.7 | -9.0 | -9.0 | 277.3 | 71.0 |
| 1988 | 155.1 | 0.0 | 396.5 | -9.0 | -9.0 | 180.2 | -9.0 | -9.0 | 305.8 | 73.8 |
| 1992 | 147.4 | 0.0 | -9.0 | -9.0 | -9.0 | 180.2 | -9.0 | -9.0 | 305.8 | 73.8 |
| 1996 | 137.8 | 0.0 | -9.0 | -9.0 | -9.0 | 180.2 | -9.0 | -9.0 | 305.8 | 73.8 |
| 2016 | 114.3 | 0.0 | -9.0 | -9.0 | -9.0 | 180.2 | -9.0 | -9.0 | 305.8 | 73.8 |

**Table B-23.** Influent TSS load *[metric tons per day]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 9507.5 | 0.0 | 4324.0 | 2484.3 | 0.0 | 2699.2 | 0.0 | 0.0 | 2484.3 | 0.0 |
| 1950 | 12322.5 | 0.0 | 4736.1 | 3303.4 | 0.0 | 4282.9 | 0.0 | 0.0 | 3303.4 | 0.0 |
| 1962 | 15886.2 | 0.0 | 1960.6 | 5666.9 | 0.0 | 8258.7 | 0.0 | 0.0 | 5666.9 | 0.0 |
| 1968 | 18813.6 | 0.0 | 1356.3 | 5922.1 | 0.0 | 11495.0 | 0.0 | 40.3 | 5922.1 | 40.3 |
| 1972 | 19031.5 | 110.8 | 663.4 | 6781.9 | 184.8 | 10242.2 | 303.1 | 745.4 | 6966.7 | 1048.5 |
| 1973 | -9.0 | -9.0 | 429.7 | 7332.1 | -9.0 | 14100.1 | -9.0 | 362.6 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 4425.4 | -9.0 | 6141.4 | 10298.3 | -9.0 |
| 1978 | 21811.1 | 295.0 | 488.8 | 2779.4 | 3041.7 | 8251.5 | 3851.3 | 3103.4 | 5821.1 | 6954.7 |
| 1980 | 20761.6 | 356.7 | 309.8 | 2470.4 | 2356.2 | 8042.7 | 7043.9 | 611.7 | 5011.1 | 7041.3 |
| 1982 | 22139.2 | 399.5 | 251.9 | -9.0 | -9.0 | 8960.2 | 7632.0 | 581.6 | 4314.0 | 8213.6 |
| 1984 | 22222.5 | 488.3 | 170.9 | -9.0 | -9.0 | 8990.7 | -9.0 | -9.0 | 4341.9 | 8230.6 |
| 1986 | 22753.0 | 494.8 | 215.5 | -9.0 | -9.0 | 9880.3 | -9.0 | -9.0 | 3727.5 | 8434.9 |
| 1988 | 23840.8 | 816.4 | 183.6 | -9.0 | -9.0 | 10468.3 | -9.0 | -9.0 | 3556.5 | 8816.1 |
| 1992 | 24254.2 | 1042.7 | 0.0 | -9.0 | -9.0 | 11133.5 | -9.0 | -9.0 | 2915.7 | 9162.3 |
| 1996 | 25475.7 | 1028.8 | 0.0 | -9.0 | -9.0 | 11004.1 | -9.0 | -9.0 | 2306.7 | 11136.2 |
| 2016 | 36891.7 | 1902.0 | 0.0 | -9.0 | -9.0 | 13740.4 | -9.0 | -9.0 | 740.3 | 20508.9 |

**Table B-24.** Effluent TSS load *[metric tons per day]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 5782.1 | 0.0 | 4324.0 | 1242.2 | 0.0 | 215.9 | 0.0 | 0.0 | 1242.2 | 0.0 |
| 1950 | 6730.4 | 0.0 | 4736.1 | 1651.7 | 0.0 | 342.6 | 0.0 | 0.0 | 1651.7 | 0.0 |
| 1962 | 5454.7 | 0.0 | 1960.6 | 2833.5 | 0.0 | 660.7 | 0.0 | 0.0 | 2833.5 | 0.0 |
| 1968 | 5237.7 | 0.0 | 1356.3 | 2961.0 | 0.0 | 919.6 | 0.0 | 0.8 | 2961.0 | 0.8 |
| 1972 | 4953.1 | 0.0 | 663.4 | 3390.9 | 55.4 | 819.4 | 9.1 | 14.9 | 3446.4 | 24.0 |
| 1973 | -9.0 | -9.0 | 429.7 | 3666.0 | -9.0 | 1128.0 | -9.0 | 7.3 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 354.0 | -9.0 | 122.8 | 4119.3 | -9.0 |
| 1978 | 3628.7 | 0.0 | 488.8 | 1389.7 | 912.5 | 660.1 | 115.5 | 62.1 | 2302.2 | 177.6 |
| 1980 | 3133.7 | 0.0 | 309.8 | 1235.2 | 706.9 | 643.4 | 211.3 | 12.2 | 2004.4 | 176.0 |
| 1982 | 2934.9 | 0.0 | 251.9 | -9.0 | -9.0 | 716.8 | 229.0 | 11.6 | 1725.6 | 240.6 |
| 1984 | 2832.7 | 0.0 | 170.9 | -9.0 | -9.0 | 719.3 | -9.0 | -9.0 | 1736.8 | 205.8 |
| 1986 | 2707.8 | 0.0 | 215.5 | -9.0 | -9.0 | 790.4 | -9.0 | -9.0 | 1491.0 | 210.9 |
| 1988 | 2664.0 | 0.0 | 183.6 | -9.0 | -9.0 | 837.5 | -9.0 | -9.0 | 1422.6 | 220.4 |
| 1992 | 2286.0 | 0.0 | 0.0 | -9.0 | -9.0 | 890.7 | -9.0 | -9.0 | 1166.3 | 229.1 |
| 1996 | 2081.4 | 0.0 | 0.0 | -9.0 | -9.0 | 880.3 | -9.0 | -9.0 | 922.7 | 278.4 |
| 2016 | 1908.1 | 0.0 | 0.0 | -9.0 | -9.0 | 1099.2 | -9.0 | -9.0 | 296.1 | 512.7 |

**Table B-25.** TSS removal efficiency *[Percent]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *100%* | *0%* | *50%* | *70%* | *92%* | *97%* | *98%* | *60%* | *97.5%* |
| 1940 | 39.2 | -9.0 | -9.0 | 50.0 | -9.0 | 92.0 | -9.0 | -9.0 | 50.0 | -9.0 |
| 1950 | 45.4 | -9.0 | -9.0 | 50.0 | -9.0 | 92.0 | -9.0 | -9.0 | 50.0 | -9.0 |
| 1962 | 65.7 | -9.0 | -9.0 | 50.0 | -9.0 | 92.0 | -9.0 | -9.0 | 50.0 | -9.0 |
| 1968 | 72.2 | -9.0 | -9.0 | 50.0 | -9.0 | 92.0 | -9.0 | 98.0 | 50.0 | 98.0 |
| 1972 | 74.0 | -9.0 | -9.0 | 50.0 | 70.0 | 92.0 | 97.0 | 98.0 | 50.5 | 97.7 |
| 1973 | -9.0 | -9.0 | -9.0 | 50.0 | -9.0 | 92.0 | -9.0 | 98.0 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | 98.0 | 60.0 | -9.0 |
| 1978 | 83.4 | -9.0 | -9.0 | 50.0 | 70.0 | 92.0 | 97.0 | 98.0 | 60.5 | 97.4 |
| 1980 | 84.9 | -9.0 | -9.0 | 50.0 | 70.0 | 92.0 | 97.0 | 98.0 | 60.0 | 97.5 |
| 1982 | 86.7 | 100.0 | 0.0 | -9.0 | -9.0 | 92.0 | 97.0 | 98.0 | 60.0 | 97.1 |
| 1984 | 87.3 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |
| 1986 | 88.1 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |
| 1988 | 88.8 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |
| 1992 | 90.6 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |
| 1996 | 91.8 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |
| 2016 | 94.8 | -9.0 | -9.0 | -9.0 | -9.0 | 92.0 | -9.0 | -9.0 | 60.0 | 97.5 |

**Table B-26.** Effluent TSS concentration *[mg/L; default Influent TSS = 215.0 mg/L]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *0.0* | *215.0* | *107.5* | *64.5* | *17.2* | *6.45* | *4.3* | *86.0* | *5.38* |
| 1940 | 130.8 | -9.0 | 215.0 | 107.5 | -9.0 | 17.2 | -9.0 | -9.0 | 107.5 | -9.0 |
| 1950 | 117.4 | -9.0 | 215.0 | 107.5 | -9.0 | 17.2 | -9.0 | -9.0 | 107.5 | -9.0 |
| 1962 | 73.8 | -9.0 | 215.0 | 107.5 | -9.0 | 17.2 | -9.0 | -9.0 | 107.5 | -9.0 |
| 1968 | 59.9 | -9.0 | 215.0 | 107.5 | -9.0 | 17.2 | -9.0 | 4.3 | 107.5 | 4.3 |
| 1972 | 56.0 | 0.0 | 215.0 | 107.5 | 64.5 | 17.2 | 6.5 | 4.3 | 106.4 | 4.9 |
| 1973 | -9.0 | -9.0 | 215.0 | 107.5 | -9.0 | 17.2 | -9.0 | 4.3 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 17.2 | -9.0 | 4.3 | 86.0 | -0.3 |
| 1978 | 35.8 | 0.0 | 215.0 | 107.5 | 64.5 | 17.2 | 6.5 | 4.3 | 85.0 | 5.5 |
| 1980 | 32.5 | 0.0 | 215.0 | 107.5 | 64.5 | 17.2 | 6.5 | 4.3 | 86.0 | 5.4 |
| 1982 | 28.5 | 0.0 | 215.0 | -9.0 | -9.0 | 17.2 | 6.5 | 4.3 | 86.0 | 6.3 |
| 1984 | 27.4 | 0.0 | 215.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |
| 1986 | 25.6 | 0.0 | 215.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |
| 1988 | 24.0 | 0.0 | 215.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |
| 1992 | 20.3 | 0.0 | -9.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |
| 1996 | 17.6 | 0.0 | -9.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |
| 2016 | 11.1 | 0.0 | -9.0 | -9.0 | -9.0 | 17.2 | -9.0 | -9.0 | 86.0 | 5.4 |

**Table B-27.** Influent POC load *[metric tons per day; POC = TSS x (POM:TSS) x (C:DW)]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 3137.5 | 0.0 | 1426.9 | 819.8 | 0.0 | 890.7 | 0.0 | 0.0 | 819.8 | 0.0 |
| 1950 | 4066.4 | 0.0 | 1562.9 | 1090.1 | 0.0 | 1413.4 | 0.0 | 0.0 | 1090.1 | 0.0 |
| 1962 | 5242.4 | 0.0 | 647.0 | 1870.1 | 0.0 | 2725.4 | 0.0 | 0.0 | 1870.1 | 0.0 |
| 1968 | 6208.5 | 0.0 | 447.6 | 1954.3 | 0.0 | 3793.3 | 0.0 | 13.3 | 1954.3 | 13.3 |
| 1972 | 6280.4 | 36.6 | 218.9 | 2238.0 | 61.0 | 3379.9 | 100.0 | 246.0 | 2299.0 | 346.0 |
| 1973 | -9.0 | -9.0 | 141.8 | 2419.6 | -9.0 | 4653.0 | -9.0 | 119.6 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 1460.4 | -9.0 | 2026.6 | 3398.4 | -9.0 |
| 1978 | 7197.6 | 97.4 | 161.3 | 917.2 | 1003.8 | 2723.0 | 1270.9 | 1024.1 | 1921.0 | 2295.0 |
| 1980 | 6851.3 | 117.7 | 102.2 | 815.2 | 777.5 | 2654.1 | 2324.5 | 201.9 | 1653.6 | 2323.6 |
| 1982 | 7305.9 | 131.8 | 83.1 | -9.0 | -9.0 | 2956.9 | 2518.6 | 191.9 | 1423.6 | 2710.5 |
| 1984 | 7333.4 | 161.1 | 56.4 | -9.0 | -9.0 | 2966.9 | -9.0 | -9.0 | 1432.8 | 2716.1 |
| 1986 | 7508.5 | 163.3 | 71.1 | -9.0 | -9.0 | 3260.5 | -9.0 | -9.0 | 1230.1 | 2783.5 |
| 1988 | 7867.5 | 269.4 | 60.6 | -9.0 | -9.0 | 3454.5 | -9.0 | -9.0 | 1173.6 | 2909.3 |
| 1992 | 8003.9 | 344.1 | 0.0 | -9.0 | -9.0 | 3674.0 | -9.0 | -9.0 | 962.2 | 3023.6 |
| 1996 | 8407.0 | 339.5 | 0.0 | -9.0 | -9.0 | 3631.3 | -9.0 | -9.0 | 761.2 | 3674.9 |
| 2016 | 12174.2 | 627.7 | 0.0 | -9.0 | -9.0 | 4534.3 | -9.0 | -9.0 | 244.3 | 6767.9 |

**Table B-28.** Effluent POC load *[metric tons per day; POC = TSS x (POM:TSS) x (C:DW)]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 3137.5 | 0.0 | 1426.9 | 819.8 | 0.0 | 890.7 | 0.0 | 0.0 | 819.8 | 0.0 |
| 1940 | 1944.0 | 0.0 | 1426.9 | 453.4 | 0.0 | 63.7 | 0.0 | 0.0 | 453.4 | 0.0 |
| 1950 | 2266.9 | 0.0 | 1562.9 | 602.9 | 0.0 | 101.1 | 0.0 | 0.0 | 602.9 | 0.0 |
| 1962 | 1876.1 | 0.0 | 647.0 | 1034.2 | 0.0 | 194.9 | 0.0 | 0.0 | 1034.2 | 0.0 |
| 1968 | 1799.8 | 0.0 | 447.6 | 1080.8 | 0.0 | 271.3 | 0.0 | 0.2 | 1080.8 | 0.2 |
| 1972 | 1724.5 | 0.0 | 218.9 | 1237.7 | 20.2 | 241.7 | 2.7 | 3.3 | 1257.9 | 6.0 |
| 1973 | -9.0 | -9.0 | 141.8 | 1338.1 | -9.0 | 332.8 | -9.0 | 1.6 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 104.4 | -9.0 | 27.0 | 1503.5 | -9.0 |
| 1978 | 1244.1 | 0.0 | 161.3 | 507.2 | 333.1 | 194.7 | 34.1 | 13.7 | 840.3 | 47.7 |
| 1980 | 1069.0 | 0.0 | 102.2 | 450.8 | 258.0 | 189.8 | 62.3 | 2.7 | 731.6 | 45.3 |
| 1982 | 994.5 | 0.0 | 83.1 | -9.0 | -9.0 | 211.5 | 67.5 | 2.6 | 629.8 | 70.1 |
| 1984 | 955.5 | 0.0 | 56.4 | -9.0 | -9.0 | 212.2 | -9.0 | -9.0 | 633.9 | 53.0 |
| 1986 | 902.8 | 0.0 | 71.1 | -9.0 | -9.0 | 233.2 | -9.0 | -9.0 | 544.2 | 54.3 |
| 1988 | 883.6 | 0.0 | 60.6 | -9.0 | -9.0 | 247.1 | -9.0 | -9.0 | 519.2 | 56.7 |
| 1992 | 747.4 | 0.0 | 0.0 | -9.0 | -9.0 | 262.7 | -9.0 | -9.0 | 425.7 | 59.0 |
| 1996 | 668.1 | 0.0 | 0.0 | -9.0 | -9.0 | 259.7 | -9.0 | -9.0 | 336.8 | 71.7 |
| 2016 | 564.3 | 0.0 | 0.0 | -9.0 | -9.0 | 324.3 | -9.0 | -9.0 | 108.1 | 132.0 |

**Table B-29.** POC removal efficiency *[Percent]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default:* | | *100%* | *0%* | *44.7%* | *66.8%* | *92.8%* | *97.3%* | *98.7%* | *55.8%* | *98.0%* |
| 1940 | 38.0 | -9.0 | -9.0 | 44.7 | -9.0 | 92.8 | -9.0 | -9.0 | 44.7 | -9.0 |
| 1950 | 44.3 | -9.0 | -9.0 | 44.7 | -9.0 | 92.8 | -9.0 | -9.0 | 44.7 | -9.0 |
| 1962 | 64.2 | -9.0 | -9.0 | 44.7 | -9.0 | 92.8 | -9.0 | -9.0 | 44.7 | -9.0 |
| 1968 | 71.0 | -9.0 | -9.0 | 44.7 | -9.0 | 92.8 | -9.0 | 98.7 | 44.7 | 98.7 |
| 1972 | 72.5 | -9.0 | -9.0 | 44.7 | 66.8 | 92.8 | 97.3 | 98.7 | 45.3 | 98.3 |
| 1973 | -9.0 | -9.0 | -9.0 | 44.7 | -9.0 | 92.8 | -9.0 | 98.7 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | 98.7 | 55.8 | -9.0 |
| 1978 | 82.7 | -9.0 | -9.0 | 44.7 | 66.8 | 92.8 | 97.3 | 98.7 | 56.3 | 97.9 |
| 1980 | 84.4 | -9.0 | -9.0 | 44.7 | 66.8 | 92.8 | 97.3 | 98.7 | 55.8 | 98.0 |
| 1982 | 86.4 | 100.0 | 0.0 | -9.0 | -9.0 | 92.8 | 97.3 | 98.7 | 55.8 | 97.4 |
| 1984 | 87.0 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |
| 1986 | 88.0 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |
| 1988 | 88.8 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |
| 1992 | 90.7 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |
| 1996 | 92.1 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |
| 2016 | 95.4 | -9.0 | -9.0 | -9.0 | -9.0 | 92.8 | -9.0 | -9.0 | 55.8 | 98.0 |

**Table B-30.** Effluent POC concentration *[mg/L; POC = TSS x (POM:TSS) x (C:DW); default effluent POC = 70.95 mg/L; C:DW=0.44 mg C/mg DW]*

| Year | Total | No Discharge | Raw | Primary | Advanced Primary | Secondary | Advanced Secondary | Advanced Treatment | Less than Secondary | Greater than Secondary |
|---|---|---|---|---|---|---|---|---|---|---|
| *Default POM:TSS (mg/mg)* | | *0.00* | *0.75* | *0.83* | *0.83* | *0.67* | *0.67* | *0.50* | *0.83* | *0.585* |
| *Default Effluent POC (mg/L)* | | *0.0* | *70.95* | *39.24* | *23.54* | *5.07* | *1.90* | *0.95* | *31.39* | *1.38* |
| 1940 | 44.0 | -9.0 | 71.0 | 39.2 | -9.0 | 5.1 | -9.0 | -9.0 | 39.2 | -9.0 |
| 1950 | 39.6 | -9.0 | 71.0 | 39.2 | -9.0 | 5.1 | -9.0 | -9.0 | 39.2 | -9.0 |
| 1962 | 25.4 | -9.0 | 71.0 | 39.2 | -9.0 | 5.1 | -9.0 | -9.0 | 39.2 | -9.0 |
| 1968 | 20.6 | -9.0 | 71.0 | 39.2 | -9.0 | 5.1 | -9.0 | 0.9 | 39.2 | 0.9 |
| 1972 | 19.5 | 0.0 | 71.0 | 39.2 | 23.5 | 5.1 | 1.9 | 0.9 | 38.8 | 1.2 |
| 1973 | -9.0 | -9.0 | 71.0 | 39.2 | -9.0 | 5.1 | -9.0 | 0.9 | -9.0 | -9.0 |
| 1974 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 |
| 1976 | -9.0 | -9.0 | -9.0 | -9.0 | -9.0 | 5.1 | -9.0 | 0.9 | 31.4 | -0.3 |
| 1978 | 12.3 | 0.0 | 71.0 | 39.2 | 23.5 | 5.1 | 1.9 | 0.9 | 31.0 | 1.5 |
| 1980 | 11.1 | 0.0 | 71.0 | 39.2 | 23.5 | 5.1 | 1.9 | 0.9 | 31.4 | 1.4 |
| 1982 | 9.7 | 0.0 | 71.0 | -9.0 | -9.0 | 5.1 | 1.9 | 0.9 | 31.4 | 1.8 |
| 1984 | 9.2 | 0.0 | 71.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |
| 1986 | 8.5 | 0.0 | 71.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |
| 1988 | 8.0 | 0.0 | 71.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |
| 1992 | 6.6 | 0.0 | -9.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |
| 1996 | 5.6 | 0.0 | -9.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |
| 2016 | 3.3 | 0.0 | -9.0 | -9.0 | -9.0 | 5.1 | -9.0 | -9.0 | 31.4 | 1.4 |

**Table B-31.** Influent and effluent characteristics for $CBOD_5$, $CBOD_U$, TKN, and $BOD_U$

***5-day Carbonaceous BOD ($CBOD_5$)***

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Factor |
|---|---|---|---|---|
| 1. No Discharge | 215.00 | 0.00 | 100.0 | 1.000 |
| 2. Raw | 215.00 | 215.00 | 0.0 | 1.000 |
| 3. Primary | 215.00 | 139.75 | 35.0 | 1.000 |
| 4. Advanced Primary | 215.00 | 107.50 | 50.0 | 1.000 |
| 5. Secondary | 215.00 | 32.25 | 85.0 | 1.000 |
| 6. Advanced Secondary | 215.00 | 21.50 | 90.0 | 1.000 |
| 7. Advanced Treatment | 215.00 | 10.75 | 95.0 | 1.000 |
| 8. <Secondary (No.3 + No.4) | 215.00 | 123.63 | 42.5 | 1.000 |
| 9. >Secondary (No.6 + No.7) | 215.00 | 16.12 | 92.5 | 1.000 |

***Ultimate Carbonaceous BOD ($CBOD_u$)*** *Conversion Factor = $CBOD_U$:$BOD_5$ ratios*

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Factor |
|---|---|---|---|---|
| 1. No Discharge | 258.00 | 0.00 | 100.0 | 1.000 |
| 2. Raw | 258.00 | 258.00 | 0.0 | 1.200 |
| 3. Primary | 258.00 | 223.60 | 13.3 | 1.600 |
| 4. Advanced Primary | 258.00 | 172.00 | 33.3 | 1.600 |
| 5. Secondary | 258.00 | 91.59 | 64.5 | 2.840 |
| 6. Advanced Secondary | 258.00 | 61.06 | 76.3 | 2.840 |
| 7. Advanced Treatment | 258.00 | 32.25 | 87.5 | 3.000 |
| 8. <Secondary (No.3 + No.4) | 258.00 | 197.80 | 23.3 | 1.600 |
| 9. >Secondary (No.6 + No.7) | 258.00 | 46.76 | 81.9 | 2.900 |

***Total Kjedhal Nitrogen (TKN)*** *Organic-N + $NH_3$-N*

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Fact |
|---|---|---|---|---|
| 1. No Discharge | 0.30 | 0.00 | 100.0 | 1.000 |
| 2. Raw | 30.30 | 30.30 | 0.0 | 1.000 |
| 3. Primary | 30.30 | 23.63 | 22.0 | 1.000 |
| 4. Advanced Primary | 30.30 | 23.63 | 22.0 | 1.000 |
| 5. Secondary | 30.30 | 19.39 | 36.0 | 1.000 |
| 6. Advanced Secondary | 30.30 | 6.67 | 78.0 | 1.000 |
| 7. Advanced Treatment | 30.30 | 5.15 | 83.0 | 1.000 |
| 8. <Secondary (No.3 + No.4) | 30.30 | 23.63 | 22.0 | 1.000 |
| 9. >Secondary (No.6 + No.7) | 30.30 | 5.91 | 80.5 | 1.000 |

***Nitrogenous BOD*** *NBOD = 4.57 x TKN* *Conversion factor = 4.75 mg $O_2$ per g N*

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Factor |
|---|---|---|---|---|
| 1. No Discharge | 138.47 | 0.00 | 100.0 | 4.570 |
| 2. Raw | 138.47 | 138.47 | 0.0 | 4.570 |
| 3. Primary | 138.47 | 108.01 | 22.0 | 4.570 |
| 4. Advanced Primary | 138.47 | 108.01 | 22.0 | 4.570 |
| 5. Secondary | 138.47 | 88.62 | 36.0 | 4.570 |
| 6. Advanced Secondary | 138.47 | 30.46 | 78.0 | 4.570 |
| 7. Advanced Treatment | 138.47 | 23.54 | 83.0 | 4.570 |
| 8. <Secondary (No.3 + No.4) | 138.47 | 108.01 | 22.0 | 4.570 |
| 9. >Secondary (No.6 + No.7) | 138.47 | 27.00 | 80.5 | 4.570 |

***Ultimate BOD ($BOD_u$)*** *$CBOD_u$ + NBOD*

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Factor |
|---|---|---|---|---|
| 1. No Discharge | 396.47 | 0.00 | 100.0 | 1.000 |
| 2. Raw | 396.47 | 396.47 | 0.0 | 1.000 |
| 3. Primary | 396.47 | 331.61 | 16.4 | 1.000 |
| 4. Advanced Primary | 396.47 | 280.01 | 29.4 | 1.000 |
| 5. Secondary | 396.47 | 180.21 | 54.5 | 1.000 |
| 6. Advanced Secondary | 396.47 | 91.52 | 76.9 | 1.000 |
| 7. Advanced Treatment | 396.47 | 55.79 | 85.9 | 1.000 |
| 8. <Secondary (No.3 + No.4) | 396.47 | 305.81 | 22.9 | 1.000 |
| 9. >Secondary (No.6 + No.7) | 396.47 | 73.76 | 81.4 | 1.000 |

**Table B-32.** Influent and effluent characteristics for TSS and POC

***Total Suspended Solids (TSS)*** *TSS = Volatile SS + Non-volatile SS (fixed) = Organic SS + Inorganic SS*

| Type Category | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Fact |
|---|---|---|---|---|
| 1. No Discharge | 215.00 | 0.00 | 100.0 | 1.000 |
| 2. Raw | 215.00 | 215.00 | 0.0 | 1.000 |
| 3. Primary | 215.00 | 107.50 | 50.0 | 1.000 |
| 4. Advanced Primary | 215.00 | 64.50 | 70.0 | 1.000 |
| 5. Secondary | 215.00 | 17.20 | 92.0 | 1.000 |
| 6. Advanced Secondary | 215.00 | 6.45 | 97.0 | 1.000 |
| 7. Advanced Treatment | 215.00 | 4.30 | 98.0 | 1.000 |
| 8. <Secondary (No.3 + No.4) | 215.00 | 86.00 | 60.0 | 1.000 |
| 9. >Secondary (No.6 + No.7) | 215.00 | 5.38 | 97.5 | 1.000 |

***Particulate Organic Carbon (POC)***

*POC = TSS x [(POM:TSS) x C:DW)]*

*POM:TSS = fraction of Particulate Organic Matter (Volatile SS:TSS)*

*C:DW = Carbon: Dry Weight = 0.44 mg C per mg DW*

*Conversion Factor = (POM:TSS) x (C:DW)*

| Type Category | POM:TSS | Influent mg/L | Effluent mg/L | Removal Percent | Conversion Factor |
|---|---|---|---|---|---|
| 1. No Discharge | 0.00 | 70.95 | 0.00 | 100.0 | 0.330 |
| 2. Raw | 0.75 | 70.95 | 70.95 | 0.0 | 0.330 |
| 3. Primary | 0.83 | 70.95 | 39.24 | 44.7 | 0.365 |
| 4. Advanced Primary | 0.83 | 70.95 | 23.54 | 66.8 | 0.365 |
| 5. Secondary | 0.67 | 70.95 | 5.07 | 92.8 | 0.295 |
| 6. Advanced Secondary | 0.67 | 70.95 | 1.90 | 97.3 | 0.295 |
| 7. Advanced Treatment | 0.50 | 70.95 | 0.95 | 98.7 | 0.220 |
| 8. <Secondary(No.3 + No.4) | 0.83 | 70.95 | 31.39 | 55.8 | 0.365 |
| 9. >Secondary(No.6 + No.7) | 0.58 | 70.95 | 1.38 | 98.0 | 0.257 |

**Table B-33.** Middle population projections of POTW loads of $CBOD_5$, $CBOD_U$, NBOD and $BOD_U$, 1996-2050

| Year | Population | Population Served Percent | Effluent $CBOD_5$ mt/day | Load $CBOD_5$ % Removal | Effluent $CBOD_u$ mt/day | Load $CBOD_u$ % Removal | Effluent NBOD mt/day | Load NBOD % Removal | Effluent $BOD_u$ mt/day | Load $BOD_u$ % Removal |
|---|---|---|---|---|---|---|---|---|---|---|
| 1940 | 132164569 | 53.5% | 6344 | 33.3% | 8922 | 21.8% | 5146 | 16.0% | 14068 | 19.8% |
| 1950 | 151325798 | 60.6% | 7526 | 38.9% | 10943 | 26.0% | 6475 | 18.4% | 17419 | 23.3% |
| 1962 | NA | NA | 6883 | 56.7% | 11765 | 38.3% | 7514 | 26.6% | 19278 | 34.2% |
| 1968 | NA | NA | 6932 | 63.2% | 12689 | 43.8% | 8591 | 29.1% | 21281 | 38.7% |
| 1972 | NA | NA | 6768 | 64.4% | 12558 | 45.0% | 8273 | 32.5% | 20831 | 40.6% |
| 1978 | 219555000 | 70.7% | 5510 | 74.1% | 11621 | 54.4% | 7526 | 46.4% | 19147 | 51.6% |
| 1982 | 230075000 | 71.7% | 4380 | 79.3% | 9582 | 62.3% | 7168 | 49.7% | 16750 | 57.8% |
| 1988 | 227258220 | 78.1% | 4460 | 81.3% | 9869 | 65.5% | 7327 | 52.3% | 17196 | 60.9% |
| 1992 | 246928467 | 73.1% | 4034 | 83.4% | 9418 | 67.6% | 7205 | 53.9% | 16623 | 62.8% |
| 1996 | NA | NA | 3812 | 85.0% | 9232 | 69.8% | 7093 | 56.8% | 16325 | 65.2% |
| 1997 | 267645000 | 72.6% | 3853 | 85.2% | 9375 | 70.1% | 7208 | 57.1% | 16583 | 65.5% |
| 1998 | 270002000 | 73.4% | 3877 | 85.4% | 9478 | 70.3% | 7294 | 57.5% | 16772 | 65.8% |
| 1999 | 272330000 | 74.3% | 3899 | 85.6% | 9579 | 70.6% | 7378 | 57.8% | 16957 | 66.1% |
| 2000 | 274634000 | 75.1% | 3919 | 85.8% | 9678 | 70.9% | 7460 | 58.2% | 17138 | 66.4% |
| 2001 | 276918000 | 75.9% | 3938 | 86.0% | 9774 | 71.1% | 7541 | 58.5% | 17315 | 66.7% |
| 2002 | 279189000 | 76.7% | 3954 | 86.3% | 9868 | 71.4% | 7620 | 58.9% | 17489 | 67.0% |
| 2003 | 281452000 | 77.5% | 3970 | 86.5% | 9960 | 71.7% | 7698 | 59.2% | 17658 | 67.3% |
| 2004 | 283713000 | 78.4% | 3983 | 86.7% | 10050 | 71.9% | 7775 | 59.6% | 17825 | 67.6% |
| 2005 | 285981000 | 79.2% | 3996 | 86.9% | 10139 | 72.2% | 7851 | 59.9% | 17990 | 67.9% |
| 2006 | 288269000 | 80.0% | 4006 | 87.1% | 10226 | 72.5% | 7926 | 60.3% | 18152 | 68.2% |
| 2007 | 290583000 | 80.8% | 4016 | 87.3% | 10313 | 72.8% | 8000 | 60.6% | 18313 | 68.5% |
| 2008 | 292928000 | 81.6% | 4025 | 87.5% | 10398 | 73.0% | 8074 | 61.0% | 18472 | 68.8% |
| 2009 | 295306000 | 82.5% | 4032 | 87.7% | 10482 | 73.3% | 8148 | 61.3% | 18631 | 69.1% |
| 2010 | 297716000 | 83.3% | 4037 | 87.9% | 10566 | 73.6% | 8221 | 61.7% | 18787 | 69.4% |
| 2011 | 300157000 | 84.1% | 4042 | 88.1% | 10648 | 73.8% | 8294 | 62.0% | 18942 | 69.7% |
| 2012 | 302624000 | 84.9% | 4045 | 88.3% | 10730 | 74.1% | 8366 | 62.4% | 19096 | 70.0% |
| 2013 | 305112000 | 85.7% | 4046 | 88.5% | 10809 | 74.4% | 8437 | 62.7% | 19247 | 70.3% |
| 2014 | 307617000 | 86.6% | 4046 | 88.7% | 10887 | 74.6% | 8507 | 63.1% | 19395 | 70.6% |
| 2015 | 310134000 | 87.4% | 4044 | 88.9% | 10963 | 74.9% | 8576 | 63.4% | 19540 | 70.9% |
| 2016 | 312658000 | 88.2% | 4040 | 89.1% | 11037 | 75.2% | 8644 | 63.8% | 19681 | 71.2% |
| 2017 | 315185000 | 88.2% | 4073 | 89.1% | 11126 | 75.2% | 8714 | 63.8% | 19840 | 71.2% |
| 2018 | 317711000 | 88.2% | 4106 | 89.1% | 11215 | 75.2% | 8784 | 63.8% | 19999 | 71.2% |
| 2019 | 320231000 | 88.2% | 4138 | 89.1% | 11304 | 75.2% | 8853 | 63.8% | 20158 | 71.2% |
| 2020 | 322742000 | 88.2% | 4171 | 89.1% | 11393 | 75.2% | 8923 | 63.8% | 20316 | 71.2% |
| 2021 | 325239000 | 88.2% | 4203 | 89.1% | 11481 | 75.2% | 8992 | 63.8% | 20473 | 71.2% |
| 2022 | 327720000 | 88.2% | 4235 | 89.1% | 11569 | 75.2% | 9060 | 63.8% | 20629 | 71.2% |
| 2023 | 330183000 | 88.2% | 4267 | 89.1% | 11656 | 75.2% | 9129 | 63.8% | 20784 | 71.2% |
| 2024 | 332626000 | 88.2% | 4298 | 89.1% | 11742 | 75.2% | 9196 | 63.8% | 20938 | 71.2% |
| 2025 | 335050000 | 88.2% | 4330 | 89.1% | 11827 | 75.2% | 9263 | 63.8% | 21090 | 71.2% |
| 2026 | 337454000 | 88.2% | 4361 | 89.1% | 11912 | 75.2% | 9330 | 63.8% | 21242 | 71.2% |
| 2027 | 339839000 | 88.2% | 4391 | 89.1% | 11996 | 75.2% | 9396 | 63.8% | 21392 | 71.2% |
| 2028 | 342208000 | 88.2% | 4422 | 89.1% | 12080 | 75.2% | 9461 | 63.8% | 21541 | 71.2% |
| 2029 | 344560000 | 88.2% | 4452 | 89.1% | 12163 | 75.2% | 9526 | 63.8% | 21689 | 71.2% |
| 2030 | 346899000 | 88.2% | 4483 | 89.1% | 12246 | 75.2% | 9591 | 63.8% | 21836 | 71.2% |
| 2031 | 349227000 | 88.2% | 4513 | 89.1% | 12328 | 75.2% | 9655 | 63.8% | 21983 | 71.2% |
| 2032 | 351544000 | 88.2% | 4543 | 89.1% | 12410 | 75.2% | 9719 | 63.8% | 22129 | 71.2% |
| 2033 | 353853000 | 88.2% | 4573 | 89.1% | 12491 | 75.2% | 9783 | 63.8% | 22274 | 71.2% |
| 2034 | 356157000 | 88.2% | 4602 | 89.1% | 12573 | 75.2% | 9847 | 63.8% | 22419 | 71.2% |
| 2035 | 358457000 | 88.2% | 4632 | 89.1% | 12654 | 75.2% | 9910 | 63.8% | 22564 | 71.2% |
| 2036 | 360756000 | 88.2% | 4662 | 89.1% | 12735 | 75.2% | 9974 | 63.8% | 22709 | 71.2% |
| 2037 | 363056000 | 88.2% | 4691 | 89.1% | 12816 | 75.2% | 10037 | 63.8% | 22853 | 71.2% |
| 2038 | 365358000 | 88.2% | 4721 | 89.1% | 12897 | 75.2% | 10101 | 63.8% | 22998 | 71.2% |
| 2039 | 367666000 | 88.2% | 4751 | 89.1% | 12979 | 75.2% | 10165 | 63.8% | 23144 | 71.2% |
| 2040 | 369980000 | 88.2% | 4781 | 89.1% | 13060 | 75.2% | 10229 | 63.8% | 23289 | 71.2% |
| 2041 | 372303000 | 88.2% | 4811 | 89.1% | 13142 | 75.2% | 10293 | 63.8% | 23435 | 71.2% |
| 2042 | 374636000 | 88.2% | 4841 | 89.1% | 13225 | 75.2% | 10358 | 63.8% | 23582 | 71.2% |
| 2043 | 376981000 | 88.2% | 4871 | 89.1% | 13308 | 75.2% | 10422 | 63.8% | 23730 | 71.2% |
| 2044 | 379339000 | 88.2% | 4902 | 89.1% | 13391 | 75.2% | 10488 | 63.8% | 23878 | 71.2% |
| 2045 | 381713000 | 88.2% | 4933 | 89.1% | 13475 | 75.2% | 10553 | 63.8% | 24028 | 71.2% |
| 2046 | 384106000 | 88.2% | 4964 | 89.1% | 13559 | 75.2% | 10619 | 63.8% | 24178 | 71.2% |
| 2047 | 386522000 | 88.2% | 4995 | 89.1% | 13644 | 75.2% | 10686 | 63.8% | 24331 | 71.2% |
| 2048 | 388962000 | 88.2% | 5026 | 89.1% | 13731 | 75.2% | 10754 | 63.8% | 24484 | 71.2% |
| 2049 | 391431000 | 88.2% | 5058 | 89.1% | 13818 | 75.2% | 10822 | 63.8% | 24640 | 71.2% |
| 2050 | 393931000 | 88.2% | 5090 | 89.1% | 13906 | 75.2% | 10891 | 63.8% | 24797 | 71.2% |

**Table B-34.** Inventory of POTW facilities in 1972 in the United States *(USEPA, 1972)*

| | Flow Range (MGD) | | | | | | |
|---|---|---|---|---|---|---|---|
| Facility Type | 0-1 | 1-5 | 5-10 | 10-25 | >25 | Unknown | Total |
| None (Raw) | 141 | 9 | 0 | 0 | 4 | 2111 | 2265 |
| Minor | 17 | 4 | 3 | 0 | 0 | 20 | 44 |
| Primary | 1523 | 312 | 60 | 1 | 76 | 558 | 2530 |
| Settling tank (no details) | 92 | 16 | 0 | 0 | 6 | 17 | 131 |
| Septic tank | 252 | 3 | 0 | 0 | 1 | 394 | 650 |
| Imhoff tanks | 624 | 19 | 1 | 0 | 2 | 36 | 682 |
| Mechanical cleaned tanks474 | 264 | 59 | 1 | 60 | 40 | 898 | |
| Plain, hop-bottom tanks48 | 3 | 0 | 0 | 3 | 2 | 56 | |
| Unknown | 33 | 7 | 0 | 0 | 4 | 69 | 113 |
| Intermediate | 18 | 21 | 4 | 0 | 14 | 7 | 64 |
| Secondary | 10839 | 1220 | 172 | 2 | 156 | 1646 | 14035 |
| Other | 547 | 19 | 4 | 0 | 3 | 285 | 858 |
| Activated sludge | 1151 | 306 | 80 | 1 | 82 | 123 | 1743 |
| Extended aeration | 1568 | 44 | 4 | 1 | 4 | 102 | 1723 |
| High rate trickling filter | 1231 | 417 | 37 | 0 | 36 | 77 | 1798 |
| Standard rate trickling filter | 1414 | 201 | 22 | 0 | 8 | 93 | 1738 |
| Intermediate sand filter | 483 | 4 | 1 | 0 | 0 | 77 | 565 |
| Land application | 70 | 6 | 1 | 0 | 0 | 65 | 142 |
| Oxidation pond | 3638 | 115 | 6 | 0 | 3 | 705 | 4467 |
| Unknown filter | 249 | 37 | 7 | 0 | 2 | 39 | 334 |
| Unknown | 488 | 71 | 10 | 0 | 18 | 80 | 667 |
| Tertiary | 373 | 44 | 6 | 1 | 5 | 32 | 461 |
| Unknown category | 18 | 21 | 4 | 0 | 14 | 7 | 64 |
| TOTAL | 12911 | 1610 | 245 | 4 | 255 | 4374 | 19399 |

**Table B-35.** Population served (millions) by POTW facilities in 1972 in the United States *(USEPA, 1972)*

| | Flow Range (MGD) | | | | | | |
|---|---|---|---|---|---|---|---|
| Facility Type | 0-1 | 1-5 | 5-10 | 10-25 | >25 | Unknown | Total |
| None (Raw) | 0.2 | 0.2 | 0.0 | 0.0 | 1.8 | 3.1 | 5.3 |
| Minor | 0.1 | 0.1 | 0.2 | 0.0 | 0.0 | 0.7 | 1.1 |
| Primary | 3.5 | 5.4 | 2.6 | 0.2 | 21.8 | 12.4 | 45.9 |
| Settling tank (no details) | 0.2 | 0.3 | 0.0 | 0.0 | 1.0 | 0.6 | 2.1 |
| Septic tank | 0.2 | 0.1 | 0.0 | 0.0 | 0.4 | 0.4 | 1.1 |
| Imhoff tanks | 1.1 | 0.2 | 0.0 | 0.0 | 0.5 | 0.1 | 1.9 |
| Mechanical cleaned tanks | 1.7 | 4.5 | 2.6 | 0.2 | 16.1 | 4.7 | 29.8 |
| Plain, hop-bottom tanks | 0.2 | 0.2 | 0.0 | 0.0 | 1.8 | 0.0 | 2.2 |
| Unknown | 0.1 | 0.1 | 0.0 | 0.0 | 2.0 | 6.6 | 8.8 |
| Intermediate | 0.1 | 0.4 | 0.2 | 0.0 | 5.1 | 0.1 | 5.9 |
| Secondary | 22.0 | 19.2 | 8.6 | 1.4 | 46.1 | 5.0 | 102.3 |
| Other | 0.3 | 0.2 | 0.1 | 0.0 | 0.2 | 1.4 | 2.2 |
| Activated sludge | 4.1 | 5.4 | 4.0 | 0.3 | 29.1 | 0.4 | 43.3 |
| Extended aeration | 1.4 | 0.5 | 0.6 | 1.1 | 0.4 | 0.1 | 4.1 |
| High rate trickling filter | 4.9 | 7.0 | 1.7 | 0.0 | 4.8 | 1.2 | 19.6 |
| Standard rate trickling filter | 4.4 | 2.9 | 1.0 | 0.0 | 0.7 | 0.3 | 9.3 |
| Intermediate sand filter | 0.3 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.6 |
| Land application | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.2 | 0.5 |
| Oxidation pond | 4.7 | 1.3 | 0.2 | 0.0 | 0.3 | 0.8 | 7.3 |
| Unknown filter | 0.6 | 0.7 | 0.3 | 0.0 | 2.8 | 0.1 | 4.5 |
| Unknown | 1.2 | 1.0 | 0.5 | 0.0 | 7.8 | 0.4 | 10.9 |
| Tertiary | 0.5 | 0.7 | 0.2 | 0.2 | 1.1 | 0.1 | 2.8 |
| Unknown category | 0.1 | 0.4 | 0.2 | 0.0 | 5.1 | 0.1 | 5.9 |
| TOTAL | 26.4 | 26.0 | 11.8 | 1.8 | 75.9 | 21.4 | 163.3 |

**Table B-36.** Data sources for trends in municipal wastewater treatment, 1940-2016

1940 Population served data from FWPCA (1970). Inventory of municipal wastewater facilities from NCWQ (1976). Data not available for no-discharge category; assumed zero for calculation of totals.

1950 Population served data and inventory of municipal wastewater facilities from USPHS (1951). Data not available for no-discharge category; assumed zero for calculation of totals.

1962 Population served data and inventory of municipal wastewater facilities from USEPA (1974). Data not available for no-discharge category; assumed zero for calculation of totals.

1968 Population served data and inventory of municipal wastewater facilities from USEPA (1974) and USDOI (1970). Data not available for no-discharge category; assumed zero for calculation of totals.

1972 Population served data from ASIWPCA (1984). Inventory of municipal wastewater facilities from EPA (1972). Significant differences in population served data between USEPA (1972) (102.3 million) and ASIWPCA (1984) (76.3 million) for secondary treatment. USEPA (1972) includes population served by oxidation ponds (7.5 million, 4467 facilities) and land application (0.5 million, 142 facilities) in the total population served of 102.3 million for "secondary" treatment. ASIWPCA (1984) reports 76.2 million served by secondary with no break-down of categories of facilities given. To be consistent with trends in population served by secondary plants reported for 1968 (85.6 million) and 1978 (56.3 million), the population served data from ASIWPCA (1984) is used to estimate wastewater flow, influent and effluent loading of $BOD_5$ for 1972.

1973 Population served data and inventory of municipal wastewater facilities from USEPA (1974). Data not available for no-discharge category; assumed zero for calculation of totals.

1974 Inventory of municipal wastewater facilities from NCWQ (1976). Population served data not available for any category.

1976 Population served data and inventory of municipal wastewater facilities from USEPA (1976). Data not available for raw population served and effluent flow. Data not available for no-discharge category; assumed zero for calculation of totals.

1978 Population served data, inventory of municipal wastewater facilities, wastewater effluent flow (as 1000 $m^3$/day), influent and effluent $BOD_5$ loading data from USEPA (1978). Effluent flow from USEPA (1978) converted from 1000 $m^3$/day to mgd using conversion factor of 0.2642. Population served by raw discharge reported as 364,000 persons in Table 10 of the EPA (1978) Needs Survey. To be consistent with trends in population served by raw discharge for data reported for 1968 (10.1 million), 1972 (4.9 million), 1980 (2.3 million) and 1982 (1.9 million), the value for 1978 given in Table 10 appears to be in error by factor of 10. The population served by raw discharge for 1978 is increased by a factor of 10 to 3.64 million for this study. Data reported in USEPA (1978) for effluent flow, influent and effluent $BOD_5$ loading for raw discharge, computed from erroneous population served data, is not used. The number of facilities reported in USEPA (1978) as raw discharge systems (n=91) is not consistent with trend of 2,265 raw facilities reported for 1972 and 237 raw facilities reported for 1982. There is a possible factor of 10 error in Needs Survey data table since n=910 raw facilities would be consistent with the decreasing trend in the number of raw facilities from 1972 to 1982.

1980 Population served data, inventory of municipal wastewater facilities, wastewater effluent flow (as 1000 $m^3$/day), influent and effluent $BOD_5$ loading data and percent $BOD_5$ removal from USEPA (1980). Effluent flow from USEPA (1980) converted from 1000 $m^3$/day to mgd by conversion factor of 0.2642. Data not available for raw effluent flow.

1982 Population served data, inventory of municipal wastewater facilities, wastewater effluent flow (as 1000 $m^3$/day), influent and effluent $BOD_5$ loading data, and percent $BOD_5$ removal from USEPA (1982). Effluent flow from USEPA (1982) converted from 1000 $m^3$/day to mgd by conversion factor of 0.2642. Data not available for raw effluent flow.

1984 Population served data, inventory of municipal wastewater facilities, wastewater effluent flow (as mgd), influent and effluent $BOD_5$ loading data, and percent $BOD_5$ removal from USEPA (1984). Data not available for raw effluent flow.

1986 Population served data, inventory of municipal wastewater facilities, wastewater effluent flow (as mgd), influent and effluent $BOD_5$ loading data, and percent $BOD_5$ removal from USEPA (1986). Data not available for raw effluent flow.

1988 Population served data and inventory of municipal wastewater facilities from USEPA (1989).

1992 Population served data and inventory of municipal wastewater facilities from USEPA (1993).

1996 Population served data and inventory of municipal wastewater facilities from USEPA (1997).

2016 Projection of population served and inventory of municipal wastewater facilities for the year 2016 from USEPA (1997).

**Table B-37.** Municipal wastewater treatment categories presented in Appendix B tables

| | |
|---|---|
| Total | Sum of all treatment categories |
| No Discharge | Municipal wastewater treatment facilities that do not discharge effluent to surface waters; most no-discharge facilities are oxidation or stabilization ponds designed for evaporation and or infiltration; no discharge also includes facilities designed for recycling and reuse or spray irrigation systems. |
| Raw | Collection system only; no treatment provided; effluent = influent |
| Primary | Primary treatment |
| Advanced Primary | Advanced primary treatment |
| <Secondary | Less than secondary is the sum of primary + advanced primary |
| Secondary | Secondary treatment |
| Advanced Secondary | Advanced secondary treatment |
| Advanced Treatment | Advanced treatment (tertiary, AWT) |
| >Secondary | Greater than secondary is the sum of advanced secondary + advanced treatment |

### Data Sources

The primary data sources for the analysis of POTW wastewater trends included the municipal wastewater inventories published by the USPHS from 1940 through 1968 (USPHS, 1951; NCWQ, 1976; USEPA, 1974) and USEPA's Clean Water Needs Surveys (CWNS) conducted from 1973 through 1996 (USEPA, 1976, 1978, 1980, 1982, 1984, 1986, 1989, 1993, 1997). Each data source reported the number of municipal wastewater treatment plants and the population served by raw, primary, advanced primary, secondary, advanced secondary and advanced treatment levels of wastewater treatment.

Where data was available to differentiate primary from advanced primary and advanced secondary from advanced treatment, the data was added to define "less than secondary" and "greater than secondary" categories. For some of the USEPA Needs Surveys, facility inventories and population served data was compiled as "less than secondary" and "better than secondary"; data was not available to differentiate primary and advanced primary or advanced secondary and advanced treatment levels of wastewater treatment. The USEPA Clean Water Needs Surveys also compiled effluent flow, influent and effluent loading, and percent removal of $BOD_5$ in the reports for 1978, 1980, 1982, 1984, and 1986. For the years in which this data was not available, wastewater effluent flow, influent and effluent $BOD_5$, $CBOD_u$, TKN, NBOD, $BOD_u$, TSS, and POC loading data was estimated based on (a) population served; (b) constant normalized flow rate of 165 gallons per capita per day (gpcd); (c) influent $BOD_5$ of 215 mg/L and effluent $BOD_5$ removal efficiencies; (d) effluent ratios of $CBOD_u$: $BOD_5$; (e) influent TKN of 30.3 mg/L and effluent TKN removal efficiencies; (f) influent TSS of 215 mg/L and effluent TSS removal efficiencies; and (g) effluent ratios of the particulate organic fraction of TSS and a constant ratio of carbon:dry weight (C:DW).

### Constant Per Capita Flow Rate

The constant per capita flow rate of 165 gpcd is based on the mean (n=5) of the total population served and total wastewater flow data compiled in the USEPA Clean Water Needs Surveys for 1978 through 1986 (see Table B-4). The rate of per capita flow, ranging from 160 to 173 gpcd, includes residential (55 percent), commercial and industrial (20 percent), stormwater (4 percent) and infiltration and inflow (20 percent) components of wastewater flow (see AMSA, 1997). The constant per capita flow rate of 165 gpcd used in this study to estimate trends of municipal wastewater flow and loading is identical to the typical United States average (165 gpcd) within the wide range (65-290 gpcd) of municipal water use that accounts for residential, commercial and industrial, and public water uses in the United States (see Metcalf and Eddy, 1991). Public wastewater flow, obviously related to public water withdrawals, can range from 70 to 130 percent of the rate of water withdrawal with a reasonable assumption being that wastewater flow is approximately equal to withdrawals by water supplies (Steel, 1960).

### Influent $BOD_5$

The influent $BOD_5$ concentration of 215 mg/L, consistent with many other estimates of raw wastewater strength (e.g., AMSA, 1997; Tetra Tech, 1999; Metcalf and Eddy, 1991), is based on the mean (n=5) nationally aggregated ratio of the total influent $BOD_5$ loading rate normalized to total wastewater flow reported in the USEPA Clean Water Needs Surveys for 1978 through 1986 (see Table B-9). The influent concentration, ranging from 209 to 229 mg/L for these years, includes the residential, commercial and industrial and infiltration and inflow contributions to the total influent $BOD_5$ load to municipal wastewater treatment plants. Using the influent $BOD_5$ concentration of 215 mg/L and the normalized flow rate of 165 gpcd, the normalized influent $BOD_5$ loading rate (0.296 lb $BOD_5$ per person per day) accounts for the nationally aggregated mixture of domestic, commercial and industrial and infiltration and inflow components of wastewater. The loading rate used in this analysis is almost a factor of two greater than the typical textbook value for the "population equivalent" (PE) of 1 PE = 0.17 lb $BOD_5$ per person per day. Typical textbook values account for only the average per capita residential load contributed by combined stormwater and domestic wastewater; the industrial and commercial component is not included (Fair et al., 1971).

### Effluent $BOD_5$

The effluent $BOD_5$ loading rates, estimated using removal efficiencies typically assigned for NPDES permit limits and wastewater treatment plant design assumptions, are based on an influent concentration of 215 mg/L and removal efficiencies (as percentage) assigned to each level of treatment. The $BOD_5$ removal efficiencies assumed for primary (35 percent), advanced primary (50 percent), and less than secondary (42.5 percent), although somewhat lower than removal efficiencies reported for primary (41 percent), advanced primary (64 percent), and less than secondary (54-57 percent) based on PCS data compiled for the USEPA Clean Water Needs Surveys for 1976, 1978, and 1982, are consistent with typical textbook values reported for $BOD_5$ removal efficiency for primary treatment plants (see Metcalf and Eddy, 1991).

The $BOD_5$ removal efficiencies assumed for secondary (85 percent), advanced secondary (90 percent), advanced waste treatment (95 percent), and better than secondary (92.5 percent) are comparable to removal efficiencies for secondary (82-86 percent), advanced secondary (89-92 percent), advanced waste treatment (87-94 percent), and better than secondary (94 percent) based on PCS data compiled in the Clean Water Needs Surveys for 1976, 1978, and 1982. The removal efficiencies for secondary, advanced secondary and advanced waste treatment used in this study, consistent with textbook design values, are based on an influent concentration of 215 mg/L and the ranges of removal efficiencies and effluent concentrations of $BOD_5$ used to define these treatment categories in the USEPA Clean Water Needs Survey for 1978 (USEPA, 1978).

Secondary treatment was defined in the 1978 Needs Survey by a $BOD_5$ effluent concentration of 30 mg/L with the removal efficiency ranging from 84 to 89 percent (USEPA, 1978). Advanced secondary was defined by an effluent $BOD_5$ range of 10-30 mg/L, and advanced waste treatment was defined by an effluent $BOD_5$ concentration less than, or equal to, 10 mg/L (USEPA, 1978). Assuming a mean influent concentration of 215 mg/L, a mid-range effluent concentration of 20 mg/L for advanced secondary, and 10 mg/L for advanced waste treatment, $BOD_5$ removal efficiencies were assigned as 90 percent for advanced secondary and 95 percent for advanced waste treatment.

### Ultimate BOD

Influent and effluent loading rates of the ultimate carbonaceous BOD ($CBOD_u$) were estimated from the $BOD_5$ loads and conversion ratios of ultimate to 5-day BOD ($CBOD_u$:$CBOD_5$) defined for each level of municipal treatment (Leo et al., 1984; Thomann and Mueller, 1987). Since it is impossible to determine whether historical $BOD_5$ effluent loads included the suppression of nitrification (see Hall and Foxen, 1984), it is assumed that $BOD_5$ is approximately equal to $CBOD_5$ (see Lung, 1998).

Loading rates for the nitrogenous component of oxygen demand (NBOD) are estimated from the influent concentration and removal efficiencies of oxidizable nitrogen (TKN) for each level of treatment and the oxygen:nitrogen ratio of 4.57 g $O_2$ per g N. Removal efficiencies for TKN are based on data compiled by: (a) Gunnerson et al. (1982) for primary (22 percent); (b) advanced primary (22 percent) assumed the same as primary, and (c) secondary (36 percent). TKN removal efficiencies assigned for (d) advanced secondary (78 percent); and (e) advanced treatment (83 percent) are within the $25^{th}$ and $75^{th}$ percentile ranges of data compiled for advanced secondary (72-92 percent) and advanced treatment (79-95 percent) from AMSA (1997). Less than secondary removal efficiencies are assigned as the mean of primary and advanced primary removal percentages. Better than secondary removal efficiencies are assigned as the mean of advanced secondary and advanced treatment removal percentages.

The total ultimate BOD ($BOD_u$) load is calculated as the sum of the ultimate carbonaceous ($CBOD_u$) and nitrogenous (NBOD) components of the effluent load of oxygen demanding substances. Table B-31 summarizes the influent and effluent concentrations and removal efficiencies assumed for calculation of the loads of $BOD_5$, $CBOD_u$, TKN, NBOD and $BOD_u$.

### Projection of Effluent Load Trends from 1996-2050

Projections of effluent loading trends for ultimate BOD are based on (a) U.S. Census Bureau "middle" population projections from 1996-2050 (U.S. Census, 1996); (b) constant wastewater inflow rate of 165 gpcd; (c) constant $BOD_u$ influent concentration of 396.5 mg/L; and (d) linear extrapolations of the percentage of projected population served by POTWs and removal efficiencies for $BOD_5$, $CBOD_u$, NBOD and $BOD_u$ estimated for 1996 and 2016 using data obtained from the 1996 Clean Water Needs Survey (USEPA, 1997). It is assumed that the estimated design $BOD_u$ removal efficiency (65 percent in 1996 and 71 percent in 2016) and the proportion of the United States population served by POTWs (72 percent in 1996 and 88 percent in 2016) can be extrapolated linearly from 1996 to 2016. After 2016 it is assumed that these percentages remain constant over time from 2016 to 2050 as 71 percent removal efficiency for $BOD_u$ and 88 percent of the projected population served by POTWs.

### Influent TSS and POC

The influent TSS concentration of 215 mg/L, consistent with other estimates of raw wastewater strength (e.g., Tetra Tech, 1999; Metcalf and Eddy, 1991), is based on the mean influent concentration from 60 wastewater facilities reported in AMSA (1997). The influent concentration of POC (70.95 mg/L) was estimated from the particulate organic matter (POM) (volatile suspended solids) fraction of influent TSS (POM:TSS=0.75) for "medium" strength raw wastewater and a C:DW ratio of 0.44 mg C (mg DW)$^{-1}$ (Metcalf and Eddy, 1991).

### Effluent TSS and POC

Removal efficiencies for TSS are based on data compiled by (a) Gunnerson et al. (1982) for primary (50 percent); (b) NRC (1993) for advanced primary (70 percent); and mean removal efficiencies computed from data reported by AMSA (1997) for (c) secondary (92 percent); (d) advanced secondary (97 percent); and (e) advanced treatment (98 percent). Less than secondary removal efficiencies are assigned as the mean of primary and advanced primary removal percentages. Better than secondary removal efficiencies are assigned as the mean of advanced secondary and advanced treatment removal percentages. Effluent concentrations of POC are estimated from particulate organic matter (volatile suspended solids) fractions of TSS for primary and advanced primary (0.83), secondary and advanced secondary (0.67) obtained from Clark et al. (1977). Data was not available to define the organic matter fraction of TSS for effluent from advanced treatment; a value of 0.5 was assumed as a reasonable characterization of the organic matter fraction of effluent TSS. The organic component of effluent TSS was converted to POC using a constant C:DW ratio of 0.44 mg C . (mg DW)$^{-1}$ (Metcalf and Eddy, 1991). Table B-32 summarizes the influent and effluent concentrations and removal efficiencies assumed for calculation of the loads of TSS and POC.

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