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STREAM POLLUTION IN THE COOSA VALLEY OF NORTHWEST GEORGIA

by

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Foreword

This report provides a double reinforcement of the efforts of Georgia Tech's Northwest Georgia Branch to expedite the development of the Coosa Valley's industrial potentials. In this particular instance, the special capabilities of two outstanding members of Tech's research staff -- one a senior member of the Industrial Development Division's staff in Atlanta, the other Head of the Department of Applied Biology -- have been combined to provide the further analysis of water sites required.

Dr. Whitlatch's earlier industrial site study had revealed a number of tracts of land which might prove to be excellent water sites -- that is, sites which offered access to sizable volumes of cooling or process water. At the same time, his survey indicated that the extent of pollution of the water in some instances was such that it appeared doubtful that the sites could be developed for industrial use unless the quality of the water could be improved.

At this point Dr. Ingols was called in, as a water quality expert, to determine the extent of the pollution problems and to recommend any action he considered necessary to make the sites usable. The present report was jointly authored to combine the water and site knowledge of the two staff members.

Although a direct outgrowth of the contract research which the Industrial Development Division has had underway in the Coosa Valley for almost two years, this particular study was financed as part of the Division's continuing program of research. Through this combination of funds and the capabilities of the Northwest Georgia Branch staff, the Division's staff in Atlanta, and the special capabilities of other divisions of the Engineering Experiment Station and academic departments, the full resources of Georgia Tech are being utilized wherever possible to further industrial development programs throughout the State.

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INTRODUCTION

The report on Coosa Valley industrial sites, published in 1962 (ref. 1), indicated that several of the sites in this 11-county area of northwest Georgia are on streams whose waters were then recognized as being more or less polluted by raw sewage and/or industrial wastes. As a consequence, the potentials of these sites for water-using industries were tentatively appraised, with final recommendation of their utility dependent on future investigation of the degree of pollution.

The present report is an effort to further define the potentials of some of these water sites on the basis of field studies of the pollution conditions existing in those streams during the summer of 1962. A total of eight sites, on four streams within a four-county area, were carefully selected to permit investigation of as wide a range of pollution conditions as possible over the broadest possible area, yet provide data on site areas that otherwise appear to have good to excellent industrial potentials.

These investigations, under the direction of Dr. Robert S. Ingols, Director of the School of Applied Biology of Georgia Tech, included field visits to each site for taking of samples and for making observations of the waters of the streams. The observations involved an evaluation of the flora and fauna as indicators of the water quality. The samples were taken for laboratory determinations of the concentration of pollution as revealed by micro flora and fauna and of chemical quality, including pH, hardness, alkalinity, dissolved oxygen, and biochemical oxygen demand (BOD) where a known pollution source existed upstream.

At the conclusion of these field and laboratory studies, Dr. Ingols prepared a report on the suitability of each site for development by a water-using industry. This report presents Dr. Ingols' findings for the individual sites against a brief descriptive background of each site's location and physical situation.

BARTOW COUNTY

Cartersville

The Etowah River in the Cartersville area has its course to the south of that city, flowing from east to west. Its flow here is regulated upstream by the nearby Allatoona Dam (Corps of Engineers) which impounds the river's water for hydroelectric generation. The regulated minimum daily flow rate is 164 million gallons (250 cubic feet per second or cfs).

Conyers Development Corporation. In late 1961, the Conyers Development Corporation opened for development a new area of several hundred acres lying partly within the southeast city limits of Cartersville and extending to the Etowah River. The more northerly part of the area within the city limits, consisting of some 400 acres, is presently being developed into an industrial district (160 acres) and a residential subdivision (see ref. 1, pp. 15-16). The 400 or so acres that lie south of the city limits to the river range from distinctly hilly to relatively flat areas, and several of the latter are of sufficient acreage for adaptation to the needs of sizable industries requiring large-volume water supplies. The eastern extensions of the Conyers land, in its frontage along the river, are near the city water treatment plant.

Directly upstream from the city water plant is a run-of-river dam of a minerals grinding plant located at that point. The dam, which has a fall of approximately five meters, has three turbine wheels which are operated continuously to supply electric power to this mineral products plant. From this dam upstream to Allatoona Dam, the quantity of flow is controlled by the discharge from Lake Allatoona; over this distance are barite, ocher and other mining and ore-washing operations that reportedly (ref. 2 and 3) discharge their waste waters into the river.

During periods of low discharge from Lake Allatoona, no excess water flows over the dam's spillway, and at minimum flow all of the water goes through the turbine.

The Cartersville water treatment plant has its intake downstream from the mill dam, with the intake well receiving its water from the lower level of the river. The water quality at the water plant is markedly affected by the condition of the lower stratum of water which is discharged at Lake

Allatoona. There, at the intake to the turbines, the lake water as sampled in the summer of 1962 had a temperature of 17°C and a dissolved oxygen of 3.5 mg/1.[1/] Between the lake and the city water plant, the mining operations appear to add considerable turbidity to the river water but, otherwise, there is no essential change in the water quality. The turbidity, in fact, aids in the coagulation of water at the water treatment plant during periods when the discharge from the lake is clear, but the sludge removed is somewhat more voluminous than it would be if the water were not turbid.

The dissolved oxygen value of 3.5 mg/1 at the mill dam indicates that quiesence from the dam has a strong effect upon the reaeration capacity of the water in the Etowah River. At the temperature of 18°C, the 3.5 mg/1 represents only 36% of saturation for the dissolved oxygen. Observations of the dissolved oxygen at low and high flows have shown that reaeration occurs to the same extent between Allatoona Dam and the mill dam.

Conclusions. If an industry using water and discharging organic wastes were to add its pollution load to the Etowah River at a point shortly downstream from the water plant, a further drop in dissolved oxygen could be expected in the river water. Because the dissolved oxygen at this point in the river is only 36% of saturation, the location here of a water-polluting industry which would cause a further decrease in the dissolved oxygen level would be unwise, since it is impossible without creating a condition intolerable to fish. A similar situation where organic industrial waste pollutes a river with low dissolved oxygen below a power impoundment has been reported in considerable detail from Rock Hill, South Carolina (see ref. 4).

Some pollution presently is entering the Etowah River from a very small creek which flows through Cartersville and discharges above the intake of the city water plant.

Some of the changes in mineral content of the river water at the water plant site are caused by the Allatoona Dam, not by the mining operations. As indicated by samples taken at the dam and the water plant for the determination of the mineral content of the river water, manganese is shown to be

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1/ A dissolved oxygen concentration of 5 mg/1 is deemed essential for fish propagation (see ref. 6, p. 1272). This concentration is a required minimum of many states for streams classified as A-1.

discharged in solution from the dam, whereas the water plant operators have blamed the mining operations.

Ladds

Henderson and Keown Tracts. Although there are some additional good site possibilities along the Etowah River immediately downstream from the Conyers property (see ref. 1, p. 21), the most favorable site situation is in the vicinity of Ladds, 1½ miles southwest of Cartersville. Here, at the crossing of the Etowah River by the Seaboard Air Line Railroad, are the Henderson and Keown tracts, totaling some 230 acres, that afford excellent sites for the development of one or more heavy industries requiring water in large volume (see ref. 1, p. 23). The tracts are separated by the river and bounded on their southerly sides by State Highway 113 to Rockmart. Both tracts are quite level and relatively close to city utilities.

The dissolved oxygen in the water of the Etowah River, as observed at the bridge crossing of State Highway 113, has recovered very largely from the extremely low values observed several miles upstream at the Cartersville water plant. The water here at Ladds, as observed at both low and high flows, has a dissolved oxygen value of 7.2 mg/1 or approximately 75% to 80% of saturation. This value affords only a small margin of safety for accepting further pollution, because even a small decrease in the concentration of dissolved oxygen would be lower than is essential for game fish.

At these Ladds sites the Etowah River shows a broad fluctuation in its daily flow. During the night and early morning hours, it is a relatively small river with a flow of 10 cubic meters per second (approximately 229 million gallons per day or mgd) but, during the afternoon, the flow increases to a maximum of 125 cubic meters per second (approximately 2,868 mgd). With respect to the mining operations upstream, there is the interesting fact that the turbidity of the river's water is much less during periods of low flow and low turbulence than during periods of high flow and high turbulence. The high turbulence carries the turbidity and may even scour the mud that is deposited during the lowest flows. The turbidity of a sample of water taken during high turbulence has been determined at 350 mg/1 dirt. Although the soluble chemical quality of the water is not affected by this degree of turbidity, it does affect the usefulness of the water for many purposes.

Conclusions. If industry located at these Ladds sites can obtain water at reasonable cost, the disposal of waste water into the Etowah River would be possible, provided there is a sufficient detention period to permit self-purification of the wastes before disposal to the stream. Since the night flow of the Etowah River past Cartersville is not reflected by any visible movement of water as observed from the U. S. Highway 411 South bridge, approximately midway between Cartersville and Rome, there would have to be a protracted period of detention for organic wastes.

The total quantity of water in the Etowah River at Ladds is adequate to support one or more sizable industries. The water is soft, although turbid, and, during the summer months when sampled, still contained traces of manganese from Lake Allatoona. In planning any industrial development here, some land area near the river should be reserved for holding ponds and other facilities for treatment of wastes prior to disposal to the river. Treatment will be necessary to prevent excessive degradation in quality of the river water, with odor production, during the low flow periods of week ends when power operations are suspended at Allatoona Dam (see Table 2), even though normally the Etowah River may show considerable recovery in water quality before it reaches Rome. Since the first high flow or power discharge of water from Allatoona Dam may push any low-quality water ahead of it to Rome, the maintenance of high-quality water downstream from the Ladds sites is highly desirable.

Ringgold

South Chickamauga Creek, from which Ringgold obtains its city water supply, is a relatively small stream since this is the upper reaches of its drainage basin. Over the years, the stream has exhibited wide fluctuations in its year-round flow and, in recent periods of minimum flow, temporary damming of the creek has been necessary to maintain sufficient water level to the intake of the city water plant near the east edge of the city. At a nearby downstream location is a textile plant that also is dependent upon the creek for both water and waste disposal. As suggested in the earlier site report (ref. 1, p. 42), the further industrial usage of South Chickamauga Creek is dependent on the results of a comprehensive review of its stream-flow history to demonstrate adequate dependability and minimum flow and upon investigations of the sources and degree of pollution of the stream, particularly downstream from the city.

Rollins and Brock Tracts. Among the most favorable industrial sites seen in the Ringgold area is the 80-acre Rollins farm, about 1½ miles east of Ringgold between U. S. Highway 41 and South Chickamauga Creek (see ref. 1, p. 45). The farm is mainly a broad knoll of open pastureland that slopes gently to the creek bottoms. Since this location is upstream from the city water plant intake, the initial site investigations recognized the necessity for caution in disposing any industrial wastes to this stream (see ref. 1, p. 41). The present investigations have confirmed this fact. Since there is very little fall in the creek between the large flood plains through which it flows east of the city and the city water treatment plant, this physiographic condition would be highly detrimental to the recovery of the stream from any pollution. This fact, in combination with the periodic extremely low flows experienced by this creek, means that no water-consuming industry should be located on the Rollins farm or elsewhere upstream from the water treatment plant, unless all waste waters can be returned to the creek in a condition satisfactory for human consumption.

Downstream from Ringgold, north of a bend in South Chickamauga Creek, is the Ross Brock farm of several hundred acres, mainly broad, rolling, open pasture and field lands. This property is considered quite adaptable for large industrial developments requiring water in volume (ref. 1, p. 66).

In this downstream stretch of South Chickamauga Creek, the overall flow has been improved by the waters from Little Chickamauga Creek, but there is pollution from city sewage and industrial wastes which, in the earlier site investigations, was considered possibly too severe to permit usage of the creek water. The present investigations, however, have determined that the water quality was reasonably good at the time of sampling in the summer of 1962. Although an informant at the Brock site stated that the creek, at times, was visibly colored by industrial wastes, there were no dyes in the sample nor were any observed in the creek. The dissolved oxygen content of 7.6 mg/l was adequate, and there was very little BOD (biochemical oxygen demand) -- less than five parts per million.

Conclusions. On the basis of observed conditions and knowledge of the extremely low flows of South Chickamauga Creek in the recent past, the entire upstream area from Ringgold, including the Rollins and Edgman-Bandy tracts, is not recommended for industrial development where water usage and industrial waste disposal are dependent upon the creek as source.

Downstream from Ringgold, the Brock farm and other areas would be suitable for water-using industries, provided that adequate waste-water treatment is used before discharge to South Chickamauga Creek. Raw water from the creek commonly exceeds 100 parts per million hardness, so that treatment may be necessary before its use in manufacturing processes. (See Table 1.)

Table 1

ANALYSIS OF WATER OF CHICKAMAUGA CREEK, NEAR RINGGOLD, GEORGIA
(in parts per million)

	Raw Water	Finished Water
Silica (SiO_2)	9.2	8.5
Iron (Fe)	.03	.01
Manganese (Mn)	.00	.00
Calcium (Ca)	33	14
Magnesium (Mg)	8.6	8.2
Sodium (Na) . . . . } Potassium (K) . . . . }	1.6	1.7
Carbonate (CO_3)	0	7
Bicarbonate (HCO_3)	140	62
Sulfate (SO_4)	2.5	7.9
Chloride (Cl)	2.0	2.4
Fluoride (F)	.1	.1
Nitrate (NO_3)	.9	.9
Dissolved solids	130	80
Hardness as $CaCO_3$		
Total	118	69
Noncarbonate	3	6

Analysis by U. S. Geological Survey

CHATTOOGA COUNTY

Summerville

Summerville is in the valley of the Chattooga River, a sizable stream with a recorded minimum flow of 25 million gallons a day. It flows southwesterly through Lyerly, some seven miles distant, and continues its southwesterly course across the Alabama line to join the Coosa River. The Chattooga River enters the north side of the county only a few miles northwest of the textile mill town of Trion.

Selman Tract. Probably the best industrial land in Chattooga County is the several hundred acres of the William Selman holdings located just north of the Summerville city limits and only a short distance south of Trion (see ref. 1, p. 79). A part of this property fronts along the Chattooga River, while other parts are served by the Central of Georgia Railway and U. S. Highway 27. All city utilities are within reach. Thus, the property is very favorably situated for industrial development. Unfortunately, the river is severely polluted by industrial wastes, and this places a definite handicap on the use of the property by water-using industry.[1/] "When viewed at the Selman property in the fall of 1961, the river was a bluish-black and obviously unfit for manufacturing use, except possibly cooling. If and when sufficient local action can be generated to get this river cleaned up, a valuable asset will be restored to the Summerville area." (Ref. 1, pp. 75-76.)

The observations and results of sampling done for this report in the summer of 1962 clearly confirm the observations made during the 1961 site survey. At the Selman tract, the Chattooga River (as observed from the small county bridge near the north border of that property) was found by Dr. Ingols to have a "foul appearance, very little dissolved oxygen, and a heavy sludge blanket at the bottom of the river. It is, therefore, already a very severely polluted stream."

1/ An official of one of the industries contributing heavily to the pollution of the Chattooga River in this area advised the Summerville News on February 8, 1962, that his company is aware of this pollution and "definitely plans to correct its share of the pollution of Chattooga River."

By the time the Chattooga River reaches the U. S. Highway 27 bridge on the east edge of Summerville (some four miles downstream from the above county bridge), the river water is clear, although colored with a recognizable blue dye color, and the river bottom is covered with slime formations. At this point, there is no dissolved oxygen in the water and the stream is sterile insofar as fish life is concerned.

Lyerly

Ralph Cook Property. The Ralph Cook property of some 150 acres is southwest of the Lyerly city limits and, in part, is only a 100 yards or so from the Chattooga River (ref. 1, p. 97). Despite its location on the Central of Georgia Railway and State Highway 114, the property is considered to have only limited industrial possibilities since the tract would be difficult to develop. At the time of the site investigations in 1961, it was believed the polluted condition of the Chattooga River, as observed in the Summerville area, would persist to here and that its waters would be unfit for industrial use on the Cook property.

However, Dr. Ingols found that by the time the Chattooga River reaches the vicinity of Lyerly, the quality of the water has improved very markedly. At the county bridge over the river, near the Cook tract, the river water was observed to be deep and sluggish. A sample of the river water taken there showed that algae were present and that the dissolved oxygen content was very satisfactory. This part of the river is not influenced by the Weiss Reservoir (see below) at normal summer operating elevations, according to the Alabama Power Company whose dam forms the reservoir.

Conclusions. It is obvious that the present severe pollution of the Chattooga River at Summerville must be eliminated before the river water can serve as a definite attraction for large-volume water-using industry. Nor does the current pollution justify any further disposal of industrial wastes to the river there, simply because it is already serving as an open sewer.

At Lyerly, the present favorable report on the water quality of the Chattooga River in the vicinity of the Cook property considerably enhances the possibility for its development for a water-using industry.

FLOYD COUNTY

Rome

Rome is situated at the junction of the Oostanaula and Etowah rivers which join there to form the Coosa River. The course of the Coosa River from Rome is generally westward until well beyond the Alabama line. Near Leesburg, Alabama, the recently completed Weiss Dam of the Alabama Power Company impounds the Coosa River, forming an extensive reservoir that reaches upstream to about Coosa, approximately seven miles west of Rome. In the Coosa area are the large steam power generating installation of the Georgia Power Company (Plant Hammond) and the paper mill of the Rome Kraft Company, with its allied paper-fabricating plant of Inland Container.

Only two possible river sites have been noted along the Coosa River west of Rome, and both of these are in the vicinity of Coosa.

Weathers Tract. The Frank Weathers farm of 138 acres is not directly on the Coosa River but is about one-half mile north of the river from the Plant Hammond operations. The Weathers tract is so situated (see ref. 1, p. 169) that water could be pumped to the property from the river through a water line with intake near Plant Hammond or directly from a creek that backs up from the river along the east side of the property. Both the nearby Georgia Power steam plant and Rome Kraft paper mill have intakes on the Coosa River almost immediately south of the Weathers tract, with their waste disposal farther downstream. A similar downstream disposal point would have to be used for any waste discharge from the Weathers tract.

Heath Mountain Area. The second possible site along the Coosa River is about 1½ to two miles west of Coosa where the land widens sufficiently between the river and Heath Mountain (see ref. 1, p. 173). Here, where the land south of the River Road slopes gently to the river, a strip up to about one-half mile wide and some two miles long offers a reasonably good situation for development of heavy, water-using industry. However, in the 1961 site investigations, it was recognized that "the utility of this river site will depend largely on the quality of water that can be obtained from the Coosa River this far downstream from Rome. The projected new sewage disposal plant at Rome should help in clearing up the river water, although there are industrial wastes and other pollution that are affecting the quality of the Coosa River waters at this point." (Ref. 1, p. 173). The present investigation of the Coosa River in the stretch between Coosa and the Heath Mountain site has confirmed the foregoing observation and has provided a very interesting study.

When the Weiss Reservoir is operated at pool level elevations of 563 to 565 feet above mean sea level, as it was during the summer of 1962, the reservoir extends upstream to about where Georgia Power's Plant Hammond and Rome Kraft paper mill have their water intakes and waste disposal lines. Above this point of intake and discharge, the Coosa River is a body of water flowing at the rate of 50 miles a day, whereas the water movement within the reservoir is at the rate of only two miles per day. Before the reservoir was created, because of this 50-mile-per-day flow of the Coosa River, there was no need for treatment of the paper mill wastes. At that time the mill had a single line that produced only about one-half the volume of organic matter now being wasted. Further, there was then no use of the river which was offended by any change in water quality that occurred. Any excessive damage to water quality was prevented by the river's strong flow, with the resultant turbulence providing dissolved oxygen by reaeration, while tributaries along the Coosa River provided further dilution.

Since the development of the Weiss Reservoir, this favorable situation on the Coosa River in the Coosa area has been greatly altered. Dr. Ingols' discussions with the technical personnel charged with water pollution control at the Rome Kraft mill reveal that the water quality in the upper reaches of the Weiss Reservoir is so poor as to cause great concern to them. (Also see ref. 7.) Intensive studies by the paper mill's own water quality control group, by the Water Control Commission in Alabama, and by the United States Public Health Service have indicated that there is a slow but steady degradation in water quality from the point of the power plant and paper mill discharges. The rate of river flow below this point is less than three miles per day or a total of only 10 to 12 miles in five days. During this period, the organic matter of the mill waste is decomposed and yields a final dissolved oxygen of 1.0 mg/l at the surface, on some days. This concentration is only 12% of oxygen saturation and is insufficient to support most species of fish. A lower dissolved oxygen content at depth may cause offensive odors. The added organic matter of the paper mill waste, along with an increased water temperature due to the power plant discharges, brings about this unfavorable water quality situation.

While Dr. Ingols has not yet been able to personally evaluate the data of Rome Kraft's water control studies, his discussions with the company's technical personnel indicate that corollary observations as to the effects of weather and/or river turbidity upon the present pollution situation have not been made. Nevertheless, on the basis of his direct field observations and the comments of the Rome Kraft technical personnel, Dr. Ingols believes that the following discussion of the many unfavorable factors contributing to this pollution situation may help to explain his conclusions.

As the temperature of the water is raised, the rate of biological activity is increased. Further, the water of the reservoir is so quiet, with essentially no turbulence, that a layer of water two feet below the surface has no tendency to roll into contact with the air at the surface nor for the aerated surface layer to roll downward. This steady laminar flow is contrary to the normal pattern of turbulence in a river and the usual diurnal overturn due to night and day changes in temperatures. In addition to the higher rate of biological activity, this lack of turbulent movements creates a thermal density stratification that horizontally limits the volume of water into which the dissolved oxygen can diffuse. As a consequence of this stratification of the water, it is apparent that on clear days with their intense sunlight algae in the uppermost foot or two of the surface layer can partially reverse the tendency for the dissolved oxygen to decrease, but during periods of little or no sunlight a severe degradation can occur in the water of this surface layer. The higher levels of dissolved oxygen have been observed at the minimal depths rather than at depths of three to four feet below the surface. This may result from poor light penetration due to the presence of soil particles added to the water by surface run-off during rain storms.

Along with this relationship of artificial temperature increase and the natural changes due to turbidity, water stratification and clouds, an additional factor which may contribute to the severity of the degradation of water quality is the manner of operation of the power turbines at Allatoona Dam on the Etowah River. For two days of each week during the summer period, as shown in Table 2, the discharges from Lake Allatoona range between 250 and 290 cubic feet per second (cfs). This means that, at times, the Coosa River at the site of the paper mill waste discharge receives very little flow from the Etowah River. Although the average flow for the other five days of the week appears adequate, it should be remembered the average daily flow is not a uniform daily flow since, for 16 hours each day, the flows are only approximately 250 cfs. Thus, for a large part of those days, the Etowah River is contributing very little water to the Coosa River.

The present degradation of water quality in the Weiss Reservoir in the Coosa area is all the more disturbing when it is realized that such deterioration of quality occurs in spite of the extensive water treatment facilities installed at the Rome Kraft mill. The Mead Corporation, parent company of Rome Kraft, is one of the leaders in the paper mill industry in pioneering the development and use of a treatment device of advanced engineering design, in conjunction with extensive waste treatment lagoons of classical design. As a consequence of these installations at the Rome Kraft mill, 80% of the organic matter wasted from their paper-making operation is now being removed from the mill's waste waters before discharge into the reservoir. Under this present practice, the two paper-making lines now in operation add less organic matter to the waters of the reservoir than was added by the single paper line operated by Rome Kraft during its initial years of production.

Conclusions. It is apparent from the above discussion that, under existing circumstances, the possibilities for locating any sizable water-using industry on the Weathers tract at Coosa will be restricted by the problems of waste disposal. Any plans to discharge into Coosa River (i. e., Weiss Reservoir) at or below the point of present discharges of the paper mill and power plant should be carefully checked as to the probable effect upon water quality, especially with respect to the comments given in the following paragraphs.

The development of the Heath Mountain stretch of the river by any water-polluting industry also should proceed with great caution. Any additional organic load that is added to the Weiss Reservoir at this location (three miles downstream from the paper mill discharge) may so

Table 2

DAILY DISCHARGE RECORDS OF
ETOWAH RIVER AT ALLATOONA DAM, ABOVE CARTERSVILLE, GEORGIA
(in cubic feet per second)

	Discharge	
Date	July	August
1962		
1	272	1190
2	1760	1220
3	1730	1230
4	264	289
5	1710	289
6	1740	2120
7	264	2080
8	264	2130
9	1460	2160
10	1950	2190
11	1940	264
12	1900	272
13	1850	2610
14	256	2550
15	256	2510
16	2370	2560
17	2390	2590
18	2360	272
19	2350	280
20	2330	1770
21	256	1730
22	256	1660
23	2360	1650
24	2410	1670
25	2440	
26	2430	
27	2400	
28	280	
29	280	
30	1200	
31	1220	

Source: Corps of Engineers data.

greatly accelerate and intensify the degradation of water quality as to adversely affect the recreational development of the entire reservoir.

Part of the above conclusions on restricting the industrial development of the Heath Mountain site area may be modified later by the construction and operation at Rome of water pollution control facilities now under design for that city. Early this year (1963), the Georgia Water Control Council, according to newspaper report (ref. 5), cited the City of Rome as creating a public health hazard by dumping raw sewage into the Coosa River. However, it probably will be several years before Rome's planned sewage treatment system can be put into operation, thus serving to relieve the above-noted problem of dissolved oxygen deficiency now prevailing in Weiss Reservoir. Even then, the mineral nutrients added by the wastes from the City of Rome sewage disposal plant may be sufficient to maintain the present level of water quality degradation. In other words, while the water now flowing in the river past the point of discharge of the paper mill waste has a normal content of dissolved oxygen, the future removal of organic matter by the City of Rome sewage disposal plant may not be enough to change the extent of dissolved oxygen loss in the reservoir.

One final, general observation is indicated by the present investigations. The writers feel strongly that the developers of reservoirs for hydroelectric power should be made to realize the severe damage that will occur in water quality in a reservoir when the impoundment results in a rate of flow too limited for the proper assimilation of organic wastes. There is the further and urgent necessity for a greater public recognition of heat as a water pollutant and especially the detrimental effects on water quality resulting from the discharge of hot water into streams and reservoirs by power plants and other industrial installations. As Hoak points out, the chief concern of the proponents of control of stream temperatures is the ultimate danger in the anticipated continuing steady increase in thermal loads, particularly from the steam-electric industry whose installed capacity tends to double every decade (see ref. 6, p. 1269).

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