Exhibit No.:
Witness: Charles D. Morris
Type of Exhibit: Direct Testimony
Issue: Plant Expenditures; Prudence; Alternative Selection
Sponsoring Party: St. Joseph Industrials
Case No.: WR-2000-281 et al.

MISSOURI PUBLIC SERVICE COMMISSION

UTILITY DIVISION

MISSOURI-AMERICAN WATER COMPANY

CASE NO. WR-2000-281

PREPARED DIRECT TESTIMONY OF

CHARLES D. MORRIS, Ph.D., P.E.

April 3, 2000

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Missouri-American Water Company Tariff Sheets Designed to Implement General Rate Increases for Water and Sewer Service provided to Customers in the Missouri Service Area of the Company	))))))	**WR-2000-281 et al.**

AFFIDAVIT OF CHARLES D. MORRIS

STATE OF MISSOURI)
) ss
COUNTY OF Phelps)

Charles D. Morris, of lawful age, on his oath states: That he has reviewed the attached written testimony in question and answer form, all to be presented in the above case, that the answers in the attached written testimony were given by him; that he has knowledge of the matters set forth in such answers; that such matters are true to the best of his knowledge, information and belief.

Charles D. Morris

Subscribed and sworn to before me this 31 day of March, 2000.

Notary Public

Joanne Richards
Notary Public-Notary Seal
State of Missouri
Phelps County
My Commission Exp. 05/18/2000

[SEAL]

My Commission expires: May 18, 2000

PREPARED DIRECT TESTIMONY OF
CHARLES D. MORRIS

Q. Please state your name and business address.

A. My name is Charles D. Morris. My business address is Department of Civil Engineering, 108 Butler-Carlton Hall, 1870 Miner Circle, University of Missouri-Rolla, Rolla, Missouri, 65409-0030.

Q. What is your occupation?

A. I am an associate professor of civil engineering at the University of Missouri-Rolla campus. I am also the owner of a consulting engineering firm called Hydro-Engineers.

Q. Please summarize your educational background.

A. I received my Bachelor of Science and Master of Science degrees in Civil Engineering at the University of Missouri-Columbia in 1967 and 1968. In 1978, I received my Ph.D. in Civil Engineering at the University of Illinois, Urbana-Champaign, Illinois. Since 1978, I have been teaching Civil Engineering courses at the University of Missouri-Rolla, primarily courses in hydrology and hydraulics and water resources, including design of water and wastewater treatment plants. Presently, I am an Associate Professor of the UMR faculty.

Q. What is your work experience?

A. After receiving my Masters Degree, I was employed at NASA, Cape Kennedy, Florida, as an Aerospace Engineer, where I worked on the Apollo project. I was responsible for hydraulic systems in manned vehicle test facilities including testing of manned vehicles under simulated conditions of outer space.

I served active duty with the rank of Lieutenant in the U. S. Public Health Service as a Sanitary Engineer. As a Sanitary Engineer, I was involved in developing facility plans and designs for water and wastewater treatment plants.

Following my duty with the U. S. Public Health Service, I entered the University of Illinois as a Ph.D. student. I joined Clark, Dietz & Associates, a consulting engineering firm, as an engineer in the Water Resources Division. I progressed to Division Director and Vice President, Water Resources Division. As such, my responsibilities included serving as a firm-wide technical consultant on hydrology, hydraulics, water and wastewater treatment, and engineer-in-charge of a number of design projects ranging from water

treatment plants to wastewater treatment facilities. This work also included the preparation of numerous feasibility studies.

While at Clark, Dietz & Associates I worked on designing numerous water treatment plants (a partial list follows: Rend Lake, Danville, Lebanon, Summerfield, Mascoutah, Greenville, and Zoin in Illinois; and Jackson, and Gulfport in Mississippi).

In 1975, I was employed as an Associate Professional Scientist at the Illinois State Water Survey where I did flood studies, water supply studies, water quality studies, and hydrologic modeling.

Then in 1977 I was employed as a Principal Engineer in the Water Resources Division of Camp, Dresser & McKee. There I designed water and wastewater treatment plants, including feasibility studies, was responsible for surface water hydrology, and provided professional and technical services for a number of projects involved in surface water hydrology, hydraulics, water and wastewater facilities.

Today, in addition to my teaching and research responsibilities at the University of Missouri-Rolla campus, I serve as a consultant to various consulting engineering and law firms through my firm, Hydro-Engineers, and provide professional and technical services and expert testimony. A partial list of organizations for which I have provided technical services or expert testimony are: The United States Department of Justice, the U. S. Army Corps of Engineers, the U. S. Geological Survey, the Missouri Public Service Commission, Camp, Dresser and McKee, Inc., Exxon Chemical Corporation, Thompson & Coburn, LLP, Limbaugh, Limbaugh & Russell, and Shook Hardy & Bacon, LLP. An additional listing of expert appearances is attached as Appendix B. For the past several summers I have worked as an Engineering Manager for the St. Louis Metropolitan Sewer District providing professional and technical services in stormwater management.

Q. Are you a professional engineer?

A. Yes, I am a registered professional engineer in the states of Missouri, Illinois, and Louisiana.

Q. What professional affiliations do you maintain?

A. I am a member of the American Society of Civil Engineers, National Society of Professional Engineers, Missouri Society of Professional Engineers, International Water Resources Association, American Water Resources Association, American Society of Engineering Educators, Chi Epsilon and Sigma Xi.

Q. Have you prepared a statement of your professional qualifications and background?

A. Yes. I have attached a copy of my professional resume to this testimony as Appendix A.

Q. On whose behalf are you appearing in this proceeding?

A. I am appearing on behalf of a group of industrial intervenors in the St. Joseph, Missouri service area of the Missouri American Water Company.

Q. What is the purpose of your direct testimony in this preceding?

A. The purpose of my direct testimony is to address Missouri American Water Company's (MAWC's) prudence and judgment in their selection of treatment plant alternatives and expenditures for the new treatment plant and its appurtenances in the St. Joseph service territory.

Q. Upon what information is your testimony based?

A. My testimony is based on my extensive experience in the design of water treatment plants, as well as studies that I have reviewed and investigations that I have made while examining the prudence and reasonableness of MAWC's decision to construct a new groundwater supply and water treatment facility to provide service in the St. Joseph district. My testimony will also report my opinion on and analysis of MAWC's "St. Joseph Water Treatment Plant, Economic Evaluation of Improvement Alternatives," dated February 1996 ("1996 Report"). In reviewing these documents, studies and investigations, I did not perform designs, detailed cost estimates based on designs, or other detailed engineering relative to this testimony due to the time and budget constraints. I did examine all responses to data requests that were provided to me or made available through the Public Counsel for prudence of design, reasonableness, necessity, and preliminary cost estimates.

Q. What other documents did you review in conducting your analysis and preparing your testimony?

A. I have reviewed the 1996 Report. I have reviewed the direct testimony of Mr. John S. Young filed on behalf of MAWC. I have reviewed a number of data request responses from MAWC received through March 28, 2000. However, not all data requested has been supplied.

I have also reviewed MAWC's "Design of Filter Improvements BP 91-12, Evaluation of Alternatives", dated May 21, 1991 ("1991 Report").[1] The 1991 Report describes the improvements asserted to be necessary to the existing surface water supply and treatment facilities so as to upgrade the facilities to current standards and increase capacity to 30 million gallons per day. The 1991 Report includes cost estimates that were used as the basis for my estimates of the prudent cost to renovate the existing surface water treatment plant.

[1]The 1991 Report, as provided to me by MAWC, consists of four (4) packets: (1) Proposed Capital Budget Project Design New Filters, dated November 20, 1990 and referencing an earlier 1988 Comprehensive Planning Study; (2) a Memorandum to File from S. E. Creel re Design of Filter Improvements, dated January 23, 1991; (3) a document titled "Design of Filter Improvements BP 91-12 Evaluation of Alternatives" dated May 21, 1991; and (4) a Memorandum from S. E. Creel to R. G. Lee re Design of Filter Improvements, dated May 28, 1991.

I have also interviewed officials of the Missouri Department of Natural Resources concerning technical issues related to the new groundwater supply and treatment plant near St. Joseph and with respect to additional issues related to the existing surface water supply and treatment plant. My investigations included physical inspections of the new groundwater supply and treatment facilities and of the existing surface water supply and treatment facilities at which time numerous photographs were taken.

Q. Have you attached a copy of any of these materials to your testimony?

A. Yes I have. A copy of the 1991 Report as provided to me by MAWC is attached as Schedule 1 (CDM-1). I am advised that the 1996 Feasibility Report is already on file at the Commission, having been attached to MAWC's Application in Case No. WA-97-46. To avoid needless reproduction expense, paper use and burden to the Commission, I would respectfully request that Report be received by reference. Although certain portions of the 1996 Report are more relevant than others, I would respectfully designate this entire report as relevant to this inquiry.

Q. Please summarize your conclusions regarding MAWC's prudence in the selection of the treatment plant alternative?

A. In my professional opinion, the construction of a new water source and treatment facility by MAWC to replace the existing surface water supply and treatment facility was not prudent. Rather than being based on sound economics, that choice in my opinion was incorrectly based on a decision to abandon an existing and operational water treatment plant in reaction to the 1993 flood. Once that decision to abandon had been made, however, I believe that MAWC's subsequent estimates of the costs of renovating the existing surface water supply and treatment facilities were inflated in order to justify this decision.

Parts of the existing water plant in St. Joseph are over 100 years old. As disclosed by the 1991 Report, an extended renovation and refurbishment of that plant was planned and appeared to have received tentative approval of company management. However, in 1993, a flood occurred on the Missouri River. During my inspection of the existing facility, I was told by MAWC personnel that existing dikes or berms surrounding the plant protected the plant from that flood. However, floodwater from the Missouri infiltrated

the ballast roadbed beneath the railroad that flanks the plant on its rear or East side. That railroad roadbed ballast allowed river water to bypass the protective berms and flood the plant from the rear, taking it off line for approximately four (4) days.

In reviewing this situation, it has appeared to me that in reaction to this flood MAWC made a corporate decision to construct a new water plant outside the flood plain and abandon the old facility even though the risk of future flooding at the existing plant could have been fully addressed along with other phased renovations.

Q. Please continue with your explanation.

A. In 1996, MAWC estimated that the cost of renovation and flood protection of the existing surface water facilities at St. Joseph would cost $78 million. In comparison, estimates for the construction of a entirely new water treatment plant, wellfield, raw and finished water lines was projected to be $73.5 million. This presented an invalid and misleading comparison.

In my opinion, MAWC's $78 million cost estimate to renovate the existing surface water plant facilities at the existing site was too high and was unjustified. Furthermore, MAWC incorrectly included in its renovation estimates the costs of residual handling and ozone facilities and thereby inflated the renovation estimate still further. These costs should have not been included in the cost estimate when comparing alternatives because it is not known whether such facilities will be required, and in my opinion only required costs should be included when comparing costs of alternatives. Therefore, MAWC's estimated cost of $73.5 million for the new plant, raw and finished water lines and wellfield should more properly have been compared to $58 million renovation cost for the existing plant with a surface water supply using MAWC's own cost estimates. Had this comparison been made properly, renovation and additional flood protection at the existing facility is clearly the most economical alternative by a difference of not less than $15.5 million. This result using their estimates is from the 1996 Report. This difference is significant and will ultimately be requested from ratepayers. This is a significant difference in cost using MAWC's own estimates

Secondly, in my opinion, even this $58 million estimate is inflated. As discussed later in this testimony, a more realistic cost estimate of $40.3 million represents the **high end** of a range of cost estimates for existing plant flood protection and renovation that could have proved to be even lower.

Comparing the cost of the remote groundwater plant at $75.3 million against the **high end** of the range of renovation and flood protection costs for the existing facility that I have estimated results in a difference in cost of $33.2 million making the remote groundwater plant significantly more expensive by 82 percent.

Therefore, there is no economic justification for selecting the new groundwater source and treatment plant alternative.

Q. How was your cost estimate of $40.3 million for the renovation of the existing facility prepared?

A. This estimate of 40.3 million for the existing surface water plant includes all the components necessary to treat water at the existing site and provide flood protection, design cost and land acquisition. The treatment plant, as the

water flows through it, consists of a water intake from the river, pre-sedimentation clarifiers, superpulsator clarifiers, filters, clearwell, and storage. The water intake takes water from the river and delivers it to the plant. The pre-sedimentation clarifier removes the sediment from the river water and the superpulsator clarifier removes more material from the water and the filters make the final removal of materials from the water. At various stages in the process, chemicals are added to the water to produce the final treated water product.

My estimate refers to MAWC's own 1996 estimate of such costs, previously identified as the 1996 Report. Specifically, the alternative identified as I-A -- surface water at existing site - non-phased -- was referenced in estimating the cost of the refurbishment of the existing treatment plant. Although referencing MAWC's own estimates, I then applied my professional training and experience as well as the observations that I made at the existing facility to correct and adjust that estimate.

According to the 1996 Report, MAWC estimated a 1998 expenditure of $18 million for replacement/renovation of existing

filters, superpulsators, and the pre-sedimentation clarifier. MAWC projected a 1999 expenditure of $12.1 million for renovation of the chemical and operations building, the transfer pump stations, and the clearwell. Together, these two items total to $30.1 million.

Additionally, I used the cost that MAWC estimated from the Capital Budget portion of the 1991 Report and an earlier (1988) comprehensive planning study (also included in the 1991 Report) that recommended construction of new filters. The 1991 Report confirmed the need for the construction of new filters at the existing plant rather than renovation of the existing filters because of assertions of piping constraints, hydraulic constraints, difficulties in keeping the facilities in service during renovation, contributing to the high cost of renovation.

When completed, these improvements would have provided MAWC and its St. Joseph ratepayers facilities with sufficient operational flexibility to allow maintenance, and a treatment process that is more easily operated, monitored and controlled to provide optimum treatment of the finished water. As a side benefit, these improvements would also

have freed up space at the plant for potential future needs such as treatment residual dewatering facilities. The total cost in the 1991 Report was estimated to be $26.6 million. I then applied a reasonable inflation rate based on data from Engineering News Record and my experience with construction cost, for the period of 1991-1996 of 13.2% to develop the $30.1 million for renovation of the treatment plant.

Q. How did you arrive at the estimated cost for the rest of the treatment facilities?

A. Based on my experience, I estimated $2.7 million for design and land acquisition. Additional land may be needed for the renovation process, for storage of construction materials, and for expansion of units and the possibility of some future alluvial wells. I also included in my estimate the costs of a new main river intake structure, and the associated pumps and piping at a projected cost of $3 million. Additionally, I included $2.5 million as an estimate of the cost for grading work on the existing access road and flood proofing for the plant, residual clarifier and pipelines. Finally I included a $2 million contingency allowance for miscellaneous cost in the estimate. Summing these numbers

yields a total cost of $40.3 million. In making my evaluation, I made several "worst case" cost assumptions and also included the contingency fund that I noted above. Because of these factors, I believe that this $40.3 million figure is on the high end of a reasonable range of costs that would actually be incurred if this work was to be done. As a result of this evaluation, the cost of the work in floodproofing and renovation/replacement that would have been called for, if properly planned and supervised, could be accomplished for no more than that figure and probably less.

Q. From this analysis did you form any opinions as to the prudence of MAWC's decision to construct the new groundwater supply and treatment facilities?

A. Yes, in my professional opinion, construction of the new groundwater source and treatment facility was neither necessary nor prudent and was most likely based on a decision to abandon the existing water treatment plant site after the 1993 flood **without** detailed studies of the engineering and economic feasibility of making that move to a remote site and using ground water for the source of water. Moreover,

once MAWC committed to the remote site, it appears that reasonable engineering and economic reason was abandoned.

Q. Can you provide and example where this engineering and economic reason was abandoned?

A. Yes. For example, although we requested MAWC to provide us with copies for review of all feasibility and engineering studies connected with their decision, they provided no detailed engineering or economic justification for the decision to utilize a groundwater supply. The materials that were provided only made reference to the asserted advantages of some improvement in bacteriological quality, temperature constancy, together with an increase in hardness that would be associated with groundwater. In my experience and in this circumstance, however, any claimed benefits associated with groundwater may have been obtained by alternative and far less costly means.

Q. Many inadequacies exist as defined by the design guide for community public water supplies issued January 1990 at the existing surface water supply and treatment facilities. With all of these inadequacies, why not build a new plant rather than renovate the existing?

A. Because in St. Joseph we have a fully functional surface water processing plant that is in the flood plain of the Missouri river and which has been taken off line one time in its life by a flood. Given the experience of 1993, additional flood protection is certainly prudent, but can be adequately accomplished and the plant protected with an insignificant risk of future flooding. It should not have been determined to be abandoned without strong justification.

The fact that a plant is old does not mean that it is worthless. Continuing maintenance and refurbishment/replacement are needed for particular parts of the plant as is demonstrated by MAWC's apparent plans to carry out such activities **before the 1993 flood occurred**. In my opinion, **all** the existing inadequacies can be fixed by replacing/refurbishing/rebuilding the subject units. The estimated **total** cost of replacing the subject units was estimated to be $30.1 million and as discussed earlier it is possible that this cost may be even less than $30.1 million if a more detailed engineering study would determine that more components could be refurbished rather than replaced.

Q. Is it usually cheaper to build a new plant than refurbish an old existing water treatment plant? Then if this is true, why renovate the existing plant?

A. Let me take two cases and compare them. In one case, an existing plant occupies a site where there is room to construct an entirely new plant and it would be unnecessary to run several miles of redundant raw water line, construct an entirely new water source, and then construct several miles of redundant finished water line in order to tie to the existing water distribution system. In that circumstance, and further assuming that substantial renovation/replacement of the existing facility was needed, it might well be "cheaper" to construct a "new" water processing plant than renovate or replace the old one in situ. That is, however, not the case in St. Joseph.

In St. Joseph it is incorrect to look alone at the cost of the plant without looking at the totality of the cost.

Q. Why is is this true for the St. Joseph district in the circumstances here presented?

A. The renovation of just the existing treatment plant is estimated to be $30.1 million and the cost to build just the

new treatment plant is estimated to be $28.8 million as stated in the 1996 Report. But this would result in a new plant that was neither connected to a water source as input nor connected to the distribution system for output. Such a plant would be useless. In this case, looking at the **total** cost of the entire treatment facilities **inclusive** of sourcing costs, supply piping and output piping, the total cost of the treatment facilities is far less if the existing plant were renovated. Here, the total costs (water treatment plant - $30.1 million; intake, flood proofing, etc. - $10.2 million) to renovate the existing facilities are estimated to be $40.3 million compared to the cost of the new facilities with all necessary appurtenances at roughly $75 million (water treatment plant - $28.8 million; groundwater wells, supply and finished water pipelines, etc. - $44.7 million). Thus, in this circumstance, it clearly would have been less expensive for the utility and, ultimately, for its ratepayers to renovate the existing facilities rather than to build new facilities because the groundwater collection system and the pipeline transportation system are not needed.

Q. What about the point that the existing plant should not be renovated because it is subjected to flooding?

A. The existing plant is built on the bank of and in the flood plain of a major source of water, i.e., a major river, as is the case for many water treatment plants throughout the United States. Until 1993 the plant was not flooded because adequate protection measures were in place. Indeed, even with the extraordinary levels of the 1993 flood, overtopping of the existing levies was not the cause of plant flooding. By reaching to a level sufficient to infiltrate the railroad right of way and roadbed adjacent to the plant on the East, the level of the 1993 flood revealed a weakness in the plant's flood defenses. That weakness could have been addressed. Flood protection could be reinforced generally by additional levee and flood wall construction completely around the perimeter of the existing plant and raising the elevation of the entrance road.

Q. If State regulations and DNR's Public Drinking Program requires that to the extent "practicable and economical," a renovated plant must not be located on a site that is subject to a significant risk from floods that would cause a

breakdown of the public water system, then how can the existing plant be renovated using a levee?

A. Because the regulations are reasonable. "To the extent practicable and economical" means there must be practicable methods to protect against flooding, such as a levee and raising the road, and an economical justification, such as a cost saving of approximately 50% to produce the same quality and quantity of drinking water reliably.

Q. Why do you think the existing plant should have been renovated rather than moving to a new site for the water treatment?

A. Most importantly, the existing site can be economically protected against flooding. If the site were protected against the 1993 flood, which is now the "Flood of Record," the risk from flooding would be insignificant. The risk of flooding as occurred in 1993 is estimated by the Corps of Engineers in any year to be a probability of less than two tenths of one percent, which is insignificant. Also, by using the existing site a significant cost savings could have been realized. This cost savings is estimated to be approximately $33.2 million. In my opinion, this cost

savings and risk meet the criteria: "to the extent practicable and economical".

Q. What was the potential saving based on the actual construction cost for the new facilities?

A. Based on the information provided by MAWC, the actual construction cost of $75.445 million less my estimated conservative renovation cost of $40.3 million gives a potential savings of not less than $35.15 million.

Q. Have you calculated rates that would result from inclusion of only your conservative estimated cost?

A. No I have not. That analysis will be provided by another witness, Mr. Harwig, to whom I have provided these calculations.

Q. If MAWC had chosen to renovate the existing plant as you recommend, would all those expenditures be made in one annual period?

A. Had that choice been made, the renovation of the existing plant would likely have been done in several phases. This would naturally result in a mitigation of the rate impact

that the inclusion of such costs for ratemaking would otherwise cause. These "phases" for the conservative costs of the renovations that I believe would be needed have been provided to Mr. Harwig who, I am advised, will provide the Commission with appropriate rate calculations reflecting this periodic segmentation.

Q. Is this a recommendation of a "phase in"?

A. I suppose, but it really would result from attempting to model the sequence and timing of the renovation-associated expenditures at the existing plant site in recognition that those activities would necessarily need to be consistent with the continuing operation of the treatment plant.

Q. Does that complete your testimony at this time?

A. Yes it does at this time. Should additional information become available, I would respectfully reserve the ability to supplement or revise this testimony.

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EDUCATION

Ph.D. Civil Engineering, University of Illinois, 1978
M.S. Civil Engineering, University of Missouri, 1968
B.S. Civil Engineering, University of Missouri, 1967

Ph.D. Dissertation:
"A Stochastic Model for an Intermittent Hydrologic Process," October 1978, Ph.D. Dissertation, University of Illinois, Urbana, Illinois, Dr. Ven T. Chow, Advisor.

M.S. Thesis:
"Integrating-Float Method Used for Discharge Measurement in Turbulent Flow," June 1968, M.S. Thesis, University of Missouri, Columbia, Missouri, Dr. Henry Liu, Advisor.

ACADEMIC EXPERIENCE

1986 -	Associate Professor of Civil Engineering, Engineering, University of Missouri-Rolla
1982 - 1986	Associate Professor of Civil Engineering; Associate Director, Institute of River Studies, University of Missouri-Rolla
1978 - 1982	Assistant Professor of Civil Engineering; Associate, Institute of River Studies, University of Missouri-Rolla
1975 - 1977	Associate Professional Scientist, Illinois State Water Survey, University of Illinois, Urbana, Illinois
1970 - 1972	Research Assistant, University of Illinois, Urbana, Illinois
1967 - 1968	Research Assistant, University of Missouri, Columbia, Missouri

PROFESSIONAL ENGINEERING EXPERIENCE

1997 - 1999 Engineering Manager, St. Louis Metropolitan Sewer District, St. Louis, Missouri (Summers)

1977 – 1978 Principal Engineer, Water Resources Division, Camp Dresser & McKee, Champaign, Illinois

1972 – 1975 Division Director, Vice President, Water Resources Division, Clark, Dietz and Associates, with responsibilities as technical consultant on hydraulics and hydrology, firm wide, Urbana, Illinois

1968 – 1970 Active Duty, Lieutenant, U.S. Public Health Service, Sanitary Engineer, Cincinnati, Ohio. (Lt. Commander, Inactive Reserve, 1972 to present)

1968 – 1970 Aerospace Engineer, NASA, Cape Kennedy Florida, (military leave of absence with military service in U.S. Public Health Service)

Professional Engineering Design Experience: :(partial list)
Project manager and professional-engineer-in-charge for the following projects:

Regional Water treatment plant-Rend Lake, Illinois
Water treatment plant-Danville, Illinois
Regional Water treatment plant-Lebanon, Summerfield, Mascoutah, Illinois
Water treatment plant-Greenville, Illinois
Water treatment plant-Zion, Illinois
Regional Wastewater treatment plants-Kankakee County, Illinois
Wastewater treatment plant-Naperville, Illinois
Wastewater treatment plant-Metropolis, Illinois
Wastewater treatment plant-Momence, Illinois

PROFESSIONAL REGISTRATION Registered Professional Engineer in the states of Missouri, Illinois, and Louisiana

PROFESSIONAL SOCIETIES Chi Epsilon, Sigma Xi, American Society of Civil Engineers, National Society of Professional Engineers, Missouri Society of Professional Engineers (President of Rolla Chapter, 1987), International Water Resources Association, American Water Resources Association, American Society of Engineering Educators

AWARDS

Exxon Chemical Company Responsible Care Award for Polymer Weir Design, 1999

Missouri Society of Professional Engineers Award for Outstanding Achievement, 1990

U.S. Government, Department of Health, Education and Welfare, Award for Service in Developing an Environmental Survey, U.S. Public Health Service, 1970.

EXTERNAL FUNDING

Research Grants – Principal Investigator:

A Graphic, GIS Based Hydraulic Analysis Computer Program for the Metropolitan St. Louis Sewer District, 1998, Horner and Shifrin, Inc., $122,073, C.D. Morris (100%)

Selection of a Hydraulic Analysis Computer Program, 1997, Horner and Shifrin, Inc./Metropolitan St. Louis Sewer District, $23,488, C.D. Morris (100%)

Analysis and Verification of an Approach for Basin Outlet Structure Modification, 1997, Horner and Shifrin, Inc./Metropolitan St. Louis Sewer District, $47,889, C.D. Morris (100%)

A Study of the Application of the SCS Method to Small Urban Basins, 1997, Metropolitan St. Louis Sewer District, $20,336, C.D. Morris (100%)

SWWM Modeling of Six urban Basins, 1997, Metropolitan St. Louis Sewer District, $16,697, C.D. Morris (100%)

Inlet Grate Capacities, 1996, University of Nebraska, $42,660, C.D. Morris (100%)

"Analysis of Existing Detention Basin," Metropolitan St. Louis Sewer District, St. Louis, Missouri, 1996, $13,452, C.D. Morris (100%)

"Analysis of PI Factors," Metropolitan St. Louis Sewer District, St. Louis, Missouri, 1996, $19,840, C.D. Morris (100%)

Scupper Interception Efficiency - Extended with additional study cost, 1994, Missouri Highway and Transportation Department, $13,206, C. D. Morris (100%).

A Plan for Assessing Changes in Operation of the Upper Main Stem Reservoir on the Missouri River, 1994, Emergency Management Agency, $6,000, C.D. Morris (100%)

Scupper Interception Efficiency, 1993, Missouri Highway and Transportation Department, $45,713, C. D. Morris (100%)

"A Feasibility Study on the Use of A Porous Rock Dike for a Fish Screen, Phase III" Associated Electric Corporative, Inc., Springfield, Missouri, 1987. ($34,499), C.D. Morris (100%)

"A Feasibility Study on the Use of A Porous Rock Dike for a Fish Screen, Phase II" Associated Electric Corporative, Inc., Springfield, Missouri, 1987. ($34,868), C.D. Morris, (100%)

"A Feasibility Study on the Use of A Porous Rock Dike for a Fish Screen, Phase I" Associated Electric Corporative, Inc., Springfield, Missouri, 1986. ($33,198), C.D. Morris, (100%)

"A Preliminary Overview of Cannon Dam's Hydropower Operations," U.S. Army Corps of Engineers, St. Louis District, 1986. ($9,995), C.D. Morris, (100%)

"Leak Impact Study," Williams Pipe Line Company, Tulsa, Oklahoma, 1986. ($46,920), C.D. Morris, (100%)

"Downstream Review, Harry S. Truman Dam and Reservoir," U.S. Army Corps of Engineers, Kansas City District, 1983. ($228,461), C.D. Morris, (100%)

"Quantitative Aspects of Water Resource Management for the State of Missouri," Annual Cooperative Program - Missouri Water Resources Research Center, Office of Water Policy, U.S. Dept. of Interior, Washington, D.C., 1983. ($31,717), C.D. Morris, (100%)

"Quantifying Minor Sediment Sources, Bank Erosion and Flood Plain Scour, GREAT III," U.S. Army Corps of Engineers, St. Louis District, 1982. ($77,260), C.D. Morris, (100%)

"Investigate the Thermal Effect of the Regulation Pool on Discharges," U.S. Army Corps of Engineers, St. Louis District, 1981. ($9,997), C.D. Morris, (100%)

"Pipeline Leak Investigation," Missouri Department of Natural Resources, Jefferson City, Missouri. 1981. ($12,341), C.D. Morris, (100%)

"Investigate the Potential for Nitrogen Supersaturation at Clarence Cannon Dam and Reservoir, Salt River, Missouri," U.S. Army Corps of Engineers, St. Louis District, 1980. ($9,900), C.D. Morris, (100%)

"A Sediment Analysis at Various Stations on the Mississippi and Missouri Rivers," U.S. Army Corps of Engineers, St. Louis District, 1980. ($9,844), C.D. Morris, (100%)

"Concurrent Flooding Probabilities for the Lower Meramec Basin, U.S. Army Corps of Engineers, St. Louis District, 1980. ($37,250), C.D. Morris, (100%)

"Determination of Conditional Probabilities of Flooding on the Meramec River," U.S. Army Corps of Engineers, St. Louis District, 1979. ($2,000), C.D. Morris, (100%)

"Surge Analysis for a Well Field Network," Camp, Dresser & McKee, 1979. ($21,203), C.D. Morris, (100%)

REFEREED PUBLICATIONS

Morris, C.D., "Turbulent Energy Dissipation in Flow Through Porous Media," Journal of Hydraulic Engineering, Hydraulics Division, A.S.C.E., submitted for publication.

Morris, C.D., and Keyvan Asghari, "Finite Element Analysis of Two-Dimensional Overland Flow," Journal of Hydrologic Engineering, A.S.C.E., accepted for publication, 1998.

Morris, C.D., "An Integrated Approach to Urban Runoff Modeling", British Hydrological Society, Hydrology in a Changing Environment, Wiley, 1998.

Gorwin, Dirk L. and Morris, Dr. Charles, "Ineffective Overbank Flow in One-Dimensional Models", Water Resources and the Urban Environment, A.S.C.E. Annual Conference on Water Resources Planning and Management, Chicago, Illinois, June1998.

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"Analysis of Existing Detention Basin," by Charles D. Morris, University of Missouri-Rolla for the Metropolitan St. Louis Sewer District, St. Louis, Missouri, 1996.

"Analysis of PI Factors," by Charles D. Morris, University of Missouri-Rolla for the Metropolitan St. Louis Sewer District, St. Louis, Missouri, 1996.

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"Leak Impact Study," by Charles D. Morris, Civil Engineering Department, University of Missouri-Rolla, final report to Williams Pipe Line Company, Tulsa, Oklahoma, 1986.

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"Investigation of Station Skew Values with the Objective of Generalized Prediction," presented at the Workshop on Land/Water Problems in Urbanizing Areas, Water Resources Center, University of Illinois, May 16, 1978.

"Water Supply Resources for the City of Joliet, Illinois, prepared for the City of Joliet, 1975.

"Comprehensive Water and Sewer Plan for Kankakee County, Illinois," prepared for the Kankakee County Regional Planning Commission, 1974.

"Metro-Area Wastewater Management Study for Aroma, Bourbonnais, Kankakee, Limestone Townships," prepared for the Kankakee County Regional Planning Commission, 1974.

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CONFERENCE PRESENTATIONS

"An Integrated Approach to Urban Runoff Modeling", International Conference on Hydrology in A Changing Environment, University of Exeter, Exeter England, July, 1998.
"Design Across the Curriculum – Incorporating Team Projects," UM-Rolla Transfer Conference, University of Missouri-Rolla, November 18, 1994.

"Turbulent Energy Dissipation in Flow Through Porous Media," Thirteenth Symposium on Turbulence, Rolla, Missouri September 21-23, 1992.

"Probability of Concurrent Flooding Using Bivariate Probabilities", International Symposium on Flood Frequency and Risk Analyses, Baton Rouge, LA, May, 1986.

"Small Hydropower Potential in Missouri," International Conference on Hydropower, A.S.C.E., Las Vegas, Nevada, September, 1985.

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"Preliminary Investigation of Small Hydropower Potential for the Central Ozark Region in Missouri," U.M.R./D.N.R. Conference on Energy, University of Missouri-Rolla, October 1981.

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"A Stochastic Precipitation Simulator," prepared for International Symposium Urban Storm Runoff, University of Kentucky, Lexington, KY, July 1980.

INVITED LECTURES

"Role of Trenchless Technology in Addressing the Infrastructure Needs in the Next Millennium", Chaired panel discussion, Trenchless Technology Symposium, University of Missouri-St. Louis, St. Louis, Missouri, January 7, 1999.

"Pumping Station Design Workshop," various lectures on pump selection and layout, water and wastewater pump station design, etc. Chicago, IL, April 19-21, 1982 and Dallas, TX, May 4, 1982.

"General Considerations of the Federal Statutory/Regulatory Constraints on Development of Small-Scale Hydropower" presented at the National Conference of State Legislators, Jefferson City, MO, February 23, 1982.

"Using Digitized Contour Information in Hydrologic Modeling," A.C.S.M.-A.S.P. Symposium, U.S. Geological Survey, Rolla, Missouri, 1982.

"Water Resources Issues," Agribusiness Club of St. Louis, September 14, 1981.

"Water Awareness Forum," East Central Junior College, Union, MO, September 14, 1981.

"Stochastic Modeling," Florida Section of A.S.C.E., Tampa, FL, July 16, 1981.

"Technical Problems of Flood Plain Management," presentation at Conference on Some Emerging Water Issues, Columbia, MO, November 19, 1979.

"Concurrent Flooding Frequency Analysis," presented to the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California, August 1979.

"Investigation of Station Skew Values with the Objective of Generalized Prediction," presented at the Workshop on Land/Water Problems in Urbanizing Areas, Water Resources Center, University of Illinois, May 16, 1978.

TECHNICAL CONSULTANT
(Partial List)

U.S. Geological Survey, Rolla, Missouri

Camp, Dresser & McKee, Inc.; Clearwater, Tampa, and Orlando Florida offices

W.V.P. Consulting Engineers, Inc., St. Louis, Missouri.

GHA Lockjoint, Inc. Parsippany, New Jersey

Juneau Associates, Inc., Granite City, Illinois

Pickett, Ray & Silver, Inc., St. Peters, Missouri

Metropolitan St. Louis Sewer District, St. Louis, Missouri

City of Rolla, Rolla, Missouri

Farnsworth & Polk, Denver, Colorado

Farnsworth & Wylie, Bloomington, Illinois

Exxon Chemical Company, Mount Belvieu, Texas

Exxon Chemical Company, Baton Rouge, Louisiana

EXPERT WITNESS
(Partial List)

U.S. Army Corps of Engineers, Kansas City District

Ward & Reeves, Attorneys at Law, Caruthersville, Missouri

Thompson and Mitchell, Attorneys at Law, St. Louis, Missouri

R.P. O'Connell, Inc., Attorney at Law, Quincy, Illinois

Limbaugh, Limbaugh, Russell and Syler, Attorneys at Law , Cape Girardeau, Missouri

Lewis, Blickhan, Longlett & Timmerwilke, Attorneys at Law, Quincy, Illinois

Heiskell, Donelson, Bearman, Adams, Williams & Kirsch, Attorneys at Law, Knoxville, Tennessee

Brown & James, P.C., Attorneys at Law, St. Louis, Missouri

Lewis, Rice & Fingersh, St. Louis, MO

U.S. Justice Department, Washington, D.C.

Brinker & Doyen, L.L.P., Attorneys at Law, Clayton, Missouri

Goffstein, Raskas, Pomerantz, Kraus, Sherman, Ruthmeyer & Susman, L.L.C., Clayton, Missouri

Ottsen, Mauze', Leggat & Belz, L.C., Attorneys at Law, St. Louis, Missouri

Amelung, Wulff & Willenbrock, Attorneys at Law, St. Louis, Missouri

Schulz, Bender, Maher, Lee, Sexton & Hill, P.C., Attorneys at Law, Gladstone, Missouri

Shook, Hardy & Bacon, LLP., Law Offices, Kansas City, Missouri

Thompson & Colburn, Attorneys at Law, St. Louis, Missouri

City of Jefferson, Missouri, Mr. Alan Gardner, Esq., (Water rate case before the Missouri Public Service Commission)

Expert Witness - Dr. Morris

2000

Rhodes v. Schlagel – Settled 1/28/00
Mr. Michael G. Norris, Attorney
Norris, Keplinger & Herman, L.L.C.

1999

Harold Lewis, et al. vs. Greater Missouri Builders, Inc., et al. – Defendant – 9/28/99
Mr. Lawrence R. Smith, Attorney
Brinker & Doyen, L.L. P.

Henkens vs B.F.T., Inc. et. Al. – Plaintiff – 7/12/99
Robert Susman, Attorney
Goffstein, Raskas, Pomerantz, Sherman, Ruthmeyer & Susman

Brian K. Murray, Jr., et al, vs Missouri Highway & Transportation Commission – Plaintiff - Pending
Donald Hale, Attorney

Harold Lewis, et al., vs Greater Missouri Builders, Inc. – Defendant - 6/30/99
Lawrence R. Smith, Attorney
Brinker & Doyen, L.L. P.

Big Country Acres, et al. v. Dan McBride, et. ux. - Defendant – Dismissed
Robert J. Wulff, Attorney
Amelung, Wulff & Willenbrock

O'Rouke et. ux. v. The Chemithon Corp. – Plaintiff - Settled
Lamar Ottsen, Jr., Attorney
Ottsen, Mauze', Leggat & Belz, L.C.

1998

Hamilton vs. Pulaski County – Plaintiff - Settlement
Steelman & Gaunt
David Steelman, Attorney

Kaw Valley v. Cottages of Kansas City East, L.P., et al. – Plaintiff - Settlement
Margaret Lineberry, Attorney
Shook, Hardy & Bacon, L.L.P.

Brenda Sellers v. Burlington Railroad Co.- Plaintiff - Settlement
Don Hale, Attorney

James R.Scott Case - Defendant
Raymond Legg, Attorney, Missouri State Public Defender

1997

Gildehaus v. Meyer – Defendant - (7/22/97)
Thomas L. Bell, Attorney
Amelung, Wulff & Willenbrock

Volner vs. Essex – Plaintiff – Settlement
Joseph P. Cunningham III, Attorney
Cunningham, Rayfield & Bouchard, PC

1996

Union Electric v. City of Jefferson – Defendant – Settlement
Mr. Jeffrey O. Parshall
Knight, Ford, Wright, Atwill, Parshall & Baker

Childers v. Electric Energy, ET AL. - Defendant
Ms. Melissa Griggs, Attorney
Burroughs, Hepler, Broom, MacDonald, & Hebrank Law Offices

Sooter vs. American Standard Insurance Co., et al. – Plaintiff - Pending
Mr. J. William Turley
Williams, Robinson, Turley, White & Rigler

Loesing vs. American Family Insurance – Defendant - (2-5-96)
Mr. John M. McIlroy, Jr., Attorney
McIlroy & Millan

1995

Heitman v. Farm Bureau – Defendant - Dismissed
Wasinger, Parham, Morthland, Terrell & Wasinger
John B. Morthland, Attorney

1994

James R. Scott Case - Defendant
Mr. Jeffrey M. Estes
Missouri Public Defender

1990

In the matter of Capital City Water Company, Jefferson City, for Authority to File Tariffs Increasing Rates for Water Service Provided to Customers in the Missouri Service Area of the Company; Case No. WR-90-118. Allen Garner, City Counselor.

American Water Works Service Company, Inc.

1025 Laurel Oak Road • P. O. Box 1770 • Voorhees, New Jersey 08043 • (609) 346-8201

November 20, 1990

File No. 683-8362

BP No. 91-12

Date Approved 12-1-90

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
PROPOSED CAPITAL BUDGET PROJECT
DESIGN NEW FILTERS

Reference: 1988 Comprehensive Planning Study

SUBJECT OF STUDY

Design of filters, control room and laboratory for the St. Joseph treatment plant.

RECOMMENDATIONS

It is recommended that funds be authorized for design of new filters, laboratory and control room for the St. Joseph treatment plant which will be constructed with a phased approach.

ESTIMATED COST

Total Estimated Cost	$462,500
Prior Expenditure	$ 62,500
Proposed 1991 Expenditure (Design)	$300,000
Proposed 1992 Expenditure (Design)	$100,000

URGENCY

This project is needed to insure that future plant production is reliable and meets all applicable water quality standards.

R. H. Moon - Vice President

BUDGET PROJECT REVIEW

DEPARTMENT	BY	DATE
ENGINEERING		11/26/90
WATER QUALITY		11/26/90
		12/5/90
OTHER		

RECOMMENDED FOR APPROVAL:

12/5/90

REGIONAL VICE PRESIDENT

MAWC-St. Joseph District
Proposed 1991 BP
Design New Filters
November 20, 1990

ADEQUACY

The recommended project will be adequate to allow permitting and receipt of construction bids so that funds can be requested for construction of the first phase in 1992.

Anticipated 1991/1992 Design Forecast

January, 1991	$5,000	January, 1992	$40,000
February	5,000	February	30,000
March	10,000	March	20,000
April	20,000	April	10,000
May	30,000		
June	30,000		
July	30,000		
August	30,000		
September	30,000		
October	30,000		
November	40,000		
December	40,000		

Forecast represents a project bill schedule and should be adjusted as necessary for cash expenditures.

MAWC-St. Joseph District
Proposed 1991 BP
Design New Filters
November 20, 1990

DISCUSSION

The existing filter facilities at St. Joseph consist of 24 concrete filters with a rated capacity of 21.3 mgd. Eight filters were constructed in 1913, ten in 1925 and six in 1956 and all have sand and gravel media.

The original eight filters are operated with manual gate valves. There are no surface wash or air wash facilities. The filter beds are manually water jetted during each backwash cycle. The original strainer bottoms have been replaced with Leopold tile underdrains. The filter gallery has an open channel drain for all backwash waste water. Gallery access is available only through hatches in the operating floor. There is no loss-of-head or rate-of-flow equipment.

Filter units 9 through 18 are operated by means of hydraulic cylinder actuated gate valves, except for the rinse valve which is operated by manual handwheel. Loss-of-head and rate-of-flow equipment is inoperable. The original strainer filter bottoms are still in use. There are no facilities for surface wash or air wash, but the filter beds are manually water-jetted during backwash. The gallery is accessible through the gallery of filters 19 through 24 or through hatches in the operating floor.

Filters 19 through 24 are equipped with hydraulically operated butterfly valves. The filters have Leopold bottoms and a fixed surface wash system. The filter gallery is accessible from an outside stairway as well as from hatches in the operating floor. Loss-of-head and rate-of-flow equipment is inoperable.

The filtered water is collected from all of the filter units by one 36-inch pipe which conveys the water to the transfer pump suction well. There is no alternate path of flow for the filtered water and there are no isolating valves on the filtered water line.

Filter capacity must be provided to meet projected maximum day demands of 25 mgd. Also, the existing filters are in need of major renovations to modernize piping, controls and instrumentation to present day standards. Renovation of the existing filters would not be possible unless excess filter capacity were constructed at another location to enable taking the older units out of service for the length of time needed for renovation. The existing filters contain limitations in configuration, piping and equipment which would make renovation costly and would result in less reliable and

MAWC-St. Joseph District
Proposed 1991 BP
Design New Filters
November 20, 1990

less efficient filters as opposed to construction of new units. Even with extensive renovations there is no guarantee that the existing filters would produce water that will meet new regulations.

Project A-4 of the 1988 Comprehensive Planning Study recommends design and construction of a new filter building, filters, control room and laboratory facilities to enable the plant to produce water of satisfactory quality and quantity to meet the future needs of the St. Joseph District customers. This memorandum recommends that the necessary design funds be provided to permit design of the filter building in 1991 and 1992. The design will be developed to allow phased construction of the project beginning in 1992.

J. A. Schweitzer

J. S. Young, Jr.

JAS/sld
11/19/90

American Water Works Service Company, Inc.

1025 Laurel Oak Road • P.O. Box 1770 • Voorhees, New Jersey 08043 • (609) 346-8201

January 23, 1991

M E M O R A N D U M

To: File

From: S. E. Creel

Re: Design of Filter Improvements
Missouri-American Water Company
St. Joseph District
Initial Meeting Trip Report

An initial project meeting was held at St. Joseph on January 16 and 17 to discuss filter improvement alternatives, get Water Company input, and develop a specific plan and schedule. The Region was represented by R. Moon and J. Wilner. System Engineering was represented by J. Young, Jr. and S. Creel. Handouts were presented at the meeting for discussion, and are enclosed.

The necessary filter capacity was agreed to be 28 mgd in response to the maximum day system delivery which exceeded 25 mgd in 1988. Financial constraints require the improvements to be constructed in stages, with 12 mgd of filtration capacity planned for the first stage. Filter improvements are the highest priority item. The filters are to be designed as filter-adsorbers for use with granular activated carbon (GAC). The need for sand or garnet beneath the GAC will be determined after additional input from the Region, review of state regulations, and pilot testing of filter media configurations. Flow controlled filter to waste capability will be provided.

The improvements are also to include laboratory and control room facilities. The main lab will include a separate area for microbiological work, office space for a future laboratory technician, and adequate storage space. A smaller separate laboratory area will be available for the operator to conduct process monitoring. Offices will be provided for the Production Superintendent, Assistant Superintendent, and Water Quality Superintendent. A multipurpose area will be provided for files, office machines, and storage and review of plant drawings. A lunchroom for production department employees will be provided. Restrooms and lockers will be provided for both genders.

Available area at the plant site is limited by topography, railroads, and the floor plain. One of the initial efforts will be

to develop a comprehensive layout of plant improvements to assist in locating facilities and prioritizing the improvements.

The following alternatives were discussed:

1. Renovation and high rating of all existing filters.

2. Construction of some new filters, and renovation of others.

3. Replacement of all filters.

It was agreed that the three alternatives were to be evaluated in depth.

The following sites for construction were discussed:

1. Boiler Room Site

2. Sedimentation Basin No. 1

3. Sedimentation Basin No. 3

4. Filter Building Extension to the South

Sedimentation Basin No. 3 and extending the filter building to the south appear to be the most feasible locations for construction of new filters. Thee two sites will be evaluated in depth. The boiler room and Sedimentation Basin No. 1 sites are significantly inferior locations for filter construction for several reasons including incompatible elevations and the need for long, large diameter pipelines. All sites will be discussed in the analysis of alternatives and construction locations.

Concepts for the three alternatives will be developed such that construction cost estimates can be prepared allowing the alternatives to be compared. A local general contractor will assist in the preparation of the cost estimates to reflect local construction conditions.

The three alternatives, with construction costs, will be presented to the Water Company and Region for discussion and selection of the most favorable alternative. A detailed design concept will then be developed around the selected alternative. The detailed concept will be presented to the Water Company and Region. After incorporating their comments, the detailed concept will be presented to the board of Directors.. With the Board's concurrence, the concept will then be presented to the Missouri Department of Natural Resources, and the Public Utility Commission to gain their support early in the project. At that point, a Request for Proposal (RFP) can be issued to several selected consultants.

Listed below is a preliminary schedule for the project:

Mid-March - Presentation of alternative concepts with construction costs; select concept of choice.

April - Present detailed concept to Water Company and Region. Present concept to Board of Directors.

May - Present concept to DNR and PUC.

End of May - Issue RFP, assuming only minor comments.

Spring 1992 - Completed Design.

The Water Company will investigate the availability of the railroad property south of the Filter Building. They will forward the soil boring logs for the 1 MG clearwell. State regulations will also be forwarded that pertain to construction of facilities. The Water Company will also make an initial contact with the local contractor in regards to cost estimating.

SEC/sld

cc: H. W. Cole - MAWC - St. Joseph
J. Buhman - MAWC - St. Joseph
R. H. Moon - Mid-America Region
J. W. Wilner - Mid-America Region
C. A. Blanck - Mid-America Region

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT

DESIGN OF FILTER IMPROVEMENTS BP 91-12
EVALUATION OF ALTERNATIVES
May 21, 1991

EXECUTIVE SUMMARY

Several alternatives for filtration improvements at St. Joseph have been identified and investigated. Six concepts appeared to be the most promising and were developed with conceptual drawings and preliminary cost estimates. The alternatives were evaluated on several criteria, including capital cost, water quality concerns, reliability, maintainability, overall operation, and compatibility with future plant improvements. The summary of the evaluation is presented below.

Chemical feed improvements, new laboratory facilities, and general plant support facilities such as offices and restrooms were previously recommended in the 1988 Comprehensive Planning Study. The evaluation highlighted the need for additional improvements related to filtration that are needed in all of the alternatives. These improvements are a replacement Transfer Pump Station and additional clearwell storage. Also, pretreatment improvements may be required to properly prepare the water for filtration to obtain effective turbidity removal.

Three concepts included renovation of some or all of the existing filters (Concept 1(a), Concept 1(b), Concept 2(a)). Compromises with respect to filter run length and effectiveness of granular activated carbon are necessary in renovating the existing

filters. However, a primary flaw of the existing filters is the dimensional limitations of the pipe gallery, especially in 18 of the 24 filters. Even with substantial improvements, the gallery would remain a hazardous area to work and maintain filter piping, instrumentation, and valves. While filter galleries at other American System plants have been successfully renovated, the galleries were more spacious or the piping was able to be radically changed to provide access. In terms of capital cost, the filter renovation options were found to be just as expensive, or only marginally less expensive than constructing new facilities. A listing of the project costs is presented in Page 5. Renovation of the existing filters is not recommended.

Alternative 2(b) includes construction of ten filters with abandonment of the existing filters. The transfer pump station, clearwell, and filters would be constructed south of the existing filters adjacent to the basins and railroad tracks. No pretreatment improvements are included in this alternative. The facilities proposed in this alternative generally meet the evaluation criteria. However, there are some constraints. First, the proposed building site is not owned by the Water Company. Cooperation of the Railroad and county would be necessary to acquire the property. Secondly, large settled water flumes in Basins No. 2 and 3 must be constructed to convey water to the filters. The flumes would be subject to freezing and subsequent damage as experience with existing flumes at the plant has shown.

Thirdly, constructing facilities at this location extends the area that must be covered by the operator. Lastly, this site is hemmed in by the railroad, the basins, the existing filters, and the Chemical Building which limits access and precludes future expansion. This alternative has a total project cost of $12,100,000 but with the stated limitations, is the secondary recommendation.

Concept 3(a) locates filters, transfer pump station, and clearwell in Basin No. 3 and includes flocculation and sludge removal facilities in Basin No 1. This alternative has a higher capital cost than Concept 2(b), but offers several tangible advantages. Elimination of Basin No. 3 would curtail the floc shearing conditions resulting from the three foot hydraulic jump from Basin No. 2 to Basin No. 3. Secondly, the pretreatment improvements proposed in Basin No. 1 would complement the existing equipment in Basin No. 2, providing some added reliability in pretreatment. Thirdly, the more centralized location of the facilities enhances plant operation. Lastly, the proposed construction site offers space for future expansion of clearwell and filters. This point is particularly important at this site because of the space constraints. Alternative 3(a) is the primary recommendation despite the total project cost of $14,100,000 because of the significant advantages of the Basin No. 3 filter construction location.

Concept 3(b) includes the filters, clearwell, and transfer pump station constructed within Basin No. 3 as in Concept 3(a).

However, complete replacement of pretreatment facilities is proposed with construction of Superpulsators clarifiers. This alternative addresses all of the existing treatment plant's deficiencies, but at a total project cost of $19,200,000. Pilot filtration studies should be conducted to better define the source of filtration ineffectiveness. If serious pretreatment problems are identified in the filterability study, this alternative may be the recommended approach.

In summary, Concepts 3(a) with a total project cost of $14,100,000 is the preferred alternative. Concept 2(b) has an estimated total project cost of $12,100,000 and is also recommended for consideration. Pilot filtration studies should be initiated immediately to determine the extent of pretreatment deficiencies. The pilot study results may require additional consideration of the Concept 3(b) with construction of Superpulsator clarifiers.

COST SUMMARY OF ALTERNATIVES

Concept 1(a);	Highrate Filters 1-24	$ 13,700,000
Concept 1(b);	Highrate Filters 9-24	$ 11,200,000
Concept 2(a);	Construct 4 Filters	$ 14,300,000
Concept 2(b);	Construct 10 Filters	$ 12,100,000
Concept 3(a);	Construct 9 Filters and Basin No. 1 Improvements	$ 14,100,000
Concept 3(b);	Construct 9 Filters and Superpulsators	$ 19,200,000

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT

DESIGN OF FILTER IMPROVEMENTS
EVALUATION OF ALTERNATIVES

I. TREATMENT PLANT DEFICIENCIES
  A. Filter Deficiencies
    1. Regulatory Compliance / Operation Concerns
      a. No rate of flow indication/control
      b. No loss of head indication
      c. No filter effluent turbidity monitoring
      d. Lack of / or inadequate filter to waste capability
      e. Questionable effluent quality
      f. Open drain in 8 filters
      g. Direct connection: effluent to drain in 16 filters
      h. Questionable piping: filter influent/surface wash to wash supply/filter effluent in 6 filters
      i. No surface wash in 16 filters
      j. Strainer bottoms in 10 filters
      k. No documentation of filter operation

    2. Reliability / Safety / Maintenance
      a. Critical pipe headers without isolation valves or bypasses: Filter effluent to clearwell, wash supply, drain
      b. Extremely corrosive atmosphere in pipe gallery
      c. Hazardous access to piping and valves in 18 filters
      d. High velocities in washwater valves of 24 filters
      e. Pipe gallery meets definition of "confined space"
      f. Dimensions of gallery limit access for men and equipment for maintenance
      g. Obsolete valves in 18 filters

    3. Labor intensive operations
      a. Operation of manual valves in 8 filters
      b. No filter automation in 24 filters

  B. Other Treatment Facility Deficiencies
    1. Regulatory Compliance / Operation Concerns
      a. Questionable pretreatment directly impacts filter effluent quality
      b. Poor process control
      c. No level control in basins
      d. High velocities in settled water line
      e. Marginal lime storage capacity

f. Inadequate laboratory facilities
g. Inadequate post-filtration CT
h. Poor hydraulics from filters to Transfer Well
i. High cost washwater supply

2. Reliability / Safety / Maintenance
a. Limited redundancy for Basin No. 2
b. Basin icing is hazardous to men and equipment
c. No bypass around Transfer Well

3. Labor Intensive Operations
a. Basin level control
b. Basin sludge blow-off
c. Dry alum system
d. Polymer feed system
e. Lime system
f. Chlorine cylinder handling
g. Maintenance of basin deicing lines
h. Process monitoring is time consuming due to dispersed locations of facilities

II. DEFINE IMPROVEMENT ALTERNATIVES FOR EVALUATION
A. Upgrading Existing Filters
B. New Facility Constraints
1. Sites
2. Hydraulics
3. Constructability
3. Operating Concerns
4. Impact on Future Improvements
5. Capital cost

III. EVALUATION OF ALTERNATIVES
A. Concept 1 - Highrate Existing Filters
1(a). Highrate 24 Filters
1(b). Highrate 16 Filters

B. Concept 2 - New Construction Adjacent to Basins
2(a). Construct 4 Filters
2(b). Construct 10 Filters

C. Concept 3 - Construct 10 Filters in Basin No. 3
3(a). Flocculation and Sludge Removal in Basin 1
3(b). Superpulsators and Chemical Bldg in Basin 2

D. Cost Estimate
1. Concept Cost Estimates
2. Individual Item Costs

Concept 1(a) Highrate Filters No. 1-24

SCOPE OF WORK

Filters 1-8: Complete replacement of gallery piping, valves, ceiling, ladders. Installation of drain, air wash, and filter to waste systems. Waterproof and dehumidify gallery. Install electric valve actuators. Provide filter operation instrumentation and controls including semi-automatic backwash operation. Raise gullet wall and replace wash troughs and filter media.

Filters 9-24: Replace valves and pipe supports. Paint all piping. Install air wash and filter to waste systems. Replace filter bottoms in Filter No. 9-18. Waterproof and dehumidify gallery. Install electric valve actuators. Provide filter operation instrumentation and controls including semi-automatic backwash operation. Raise gullet wall and replace wash troughs and filter media.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Filter to waste sump
Washwater storage tank
Chemical Building Addition
Laboratory, support facilities

ISSUES

1. Filter runs may be shortened by limited loss of head
2. Reliability / Safety / Maintenance concerns of pipe gallery
3. Process control, reliability, maintenance concerns of basins are not addressed.

COST ESTIMATE

High Rate Filters 1-24	5,600,000
Transfer Pump Station	1,500,000
Clearwell	1,100,000
Filter to waste sump,piping	220,000
Washwater storage tank	160,000
Chemical Building addition	1,200,000
Laboratory,office facility	700,000
	$ 10,480,000
Engineering design	740,000
Engineering supervision	600,000
	11,820,000
Omissions and contingencies 10%	1,048,000
	12,868,000
Interest	800,000
	13,668,000
SAY	$ 13,700,000

Concept 1(b) Highrate Filters No. 9-24

SCOPE OF WORK

Filters 9-24: Replace valves and pipe supports. Paint all piping. Install air wash and filter to waste systems. Replace filter bottoms in Filter No. 9-18. Waterproof and dehumidify gallery. Install electric valve actuators. Provide filter operation instrumentation and controls including semi-automatic backwash operation. Raise gullet wall and replace wash troughs and filter media.

Renovate Filter 1-8 Area: This area and a portion of the adjacent structure are to be remodeled for use as a laboratory, office, control room, and general support facility.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Filter to waste sump
Washwater storage tank
Chemical Building Addition

ISSUES

1. Very low EBCT of 4 minutes with use of GAC
2. Filter runs may be shortened by limited loss of head, and filter rate of 3.5 gpm/sf
3. Reliability / Safety / Maintenance concerns of pipe gallery
4. Process control, reliability, maintenance concerns of basins are not addressed.

COST ESTIMATE

High Rate Filters 9-24		3,800,000
Transfer Pump Station		1,500,000
Clearwell		1,100,000
Filter to waste sump,piping		220,000
Washwater storage tank		160,000
Chemical Building addition		1,200,000
Laboratory,office facility		500,000
	$	8,480,000
Engineering design		600,000
Engineering supervision		600,000
		9,680,000
Omissions and contingencies 10%		848,000
		10,528,000
Interest		700,000
		11,228,000
SAY	$	11,200,000

Concept 2(a) Construct 4 New Filters

SCOPE OF WORK

Filters 9-24: Replace valves and pipe supports. Paint all piping. Install air wash and filter to waste systems. Replace filter bottoms in Filter No. 9-18. Waterproof and dehumidify gallery. Install electric valve actuators. Provide filter operation instrumentation and controls including semi-automatic backwash operation. Raise gullet wall and replace wash troughs and filter media. Total filter capacity to be 16 MGD.

Construct 4 Filters: Four new filters are to be constructed above the proposed clearwell. Filter capacity is to be 12 MGD.

Renovate Filter 1-8 Area: This area and a portion of the adjacent structure are to be remodeled for use as a laboratory, office, control room, and general support facility.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Filter to waste sump
Washwater storage tank
Chemical Building Addition

ISSUES

1. Reliability / Safety / Maintenance concerns of pipe gallery
2. Process control, reliability, maintenance concerns of basins are not addressed.

COST ESTIMATE

Upgrade Filters 9-18		2,300,000
Upgrade Filters 19-24		1,500,000
Transfer Pump Station, Clearwell, and 4 filters		4,700,000
Settled water flumes,piping		210,000
Filter to waste sump,piping/Filt 9-24		220,000
Filter to waste sump,piping/Filt 25-28		170,000
Washwater storage tank		160,000
Chemical Building addition		1,200,000
Laboratory,office facility		500,000
	$	10,960,000
Engineering design		770,000
Engineering supervision		600,000
		12,330,000
Omissions and contingencies 10%		1,096,000
		13,426,000
Interest		850,000
		14,276,000
SAY	$	14,300,000

Concept 2(b) Construct 10 Filters

SCOPE OF WORK

Construct 10 Filters: Ten new filters are to be constructed above the proposed clearwell. Filter capacity is to be 28 MGD.

Renovate Filter 1-8 Area: This area and a portion of the adjacent structure are to be remodeled for use as a laboratory, office, control room, and general support facility.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Filter to waste sump
Washwater storage tank
Chemical Building Addition

ISSUES

1. Process control, reliability, maintenance concerns of basins are not addressed.

COST ESTIMATE

Transfer Pump Station, Clearwell, and 4 filters		4,700,000
Construct 6 additional filters		2,400,000
Settled water flumes,piping		210,000
Filter to waste sump,piping		170,000
Chemical Building addition		1,200,000
Laboratory, support facility		500,000
	$	9,180,000
Engineering design		650,000
Engineering supervision		600,000
		10,430,000
Omissions and contingencies 10%		918,000
		11,348,000
Interest		700,000
		12,048,000
SAY	$	12,100,000

Concept 3(a) Construct 9 Filters, Basin 1 Improvements

SCOPE OF WORK

Basin No. 1 Improvements: Two stage flocculation and continuous sludge removal equipment is to be installed in Basin No. 1. Basin No. 2 is then used for settling only.

Construct 9 Filters in Basin No. 3: Nine filters, a clearwell, and transfer pumping station are to be constructed within Basin No. 3. The laboratory/support facilities building is to be constructed adjacent to the treatment buildings.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Chemical Building Addition

ISSUES

1. Process control, reliability, maintenance concerns of basins are not fully addressed.

COST ESTIMATE

Construct flocculation in Basin No 1		730,000
Construct sludge removal in Basin 1		1,200,000
Transfer Pump Station, Clearwell, and 4 filters		4,900,000
Construct 5 additional filters		2,100,000
Chemical Building addition		1,200,000
Laboratory,office facility		700,000
	$	10,830,000
Engineering design		760,000
Engineering supervision		600,000
		12,190,000
Omissions and contingencies 10%		1,083,000
		13,273,000
Interest		800,000
		14,073,000
SAY	$	14,100,000

Concept 3(b) Construct 9 Filters, Superpulsators

SCOPE OF WORK

Basin No.2 Improvements:High rate Superpulsator clarifiers with a capacity of 28 MGD are to be constructed within Basin No. 2. Chemical facilities are to be provided adjacent to the Superpulsators.

Construct 9 Filters in Basin No. 3: Nine filters, a clearwell, and transfer pumping station are to be constructed within Basin No. 3. The laboratory/support facilities building is to be constructed adjacent to the treatment buildings.

Construct Additional Facilities
Transfer Pump Station
Clearwell
Laboratory, support facility

ISSUES

All significant treatment facility issues are addressed in this alternative

COST ESTIMATE

Construct Superpulsators and Chemical Building		7,100,000
Flumes		50,000
Transfer Pump Station, Clearwell, and 4 filters		4,900,000
Construct 5 additional filters		2,100,000
Laboratory, support facility		700,000
		$ 14,850,000
Engineering design		1,000,000
Engineering supervision		700,000
		16,550,000
Omissions and contingencies 10%		1,485,000
		18,035,000
Interest		1,100,000
		19,135,000
SAY	$	19,200,000

2. Individual Item Costs

1.COMPLETE UPGRADING OF FILTERS NO 1-8 $ 1,800,000

-Removal, and replacement of operating floor above pipe gallery
-Removal of all existing piping and valves in gallery
-Replacement of concrete floor in gallery
-Complete repiping of filters with flanged ductile iron pipe:
    *16-inch drain
    *30-inch settled water header
    *12-inch settled water laterals to each filter
    *24-inch clearwater header
    *8-inch filter effluent laterals to each filter
    *16-inch washwater header
    *12-inch washwater laterals to each filter
    *Two 8-inch filter to waste headers, 8-inch lateral to each filter
    *6-inch air wash header and laterals to each filter
-Each filter will have electrically actuated butterfly valves:
    *16-inch drain
    *12-inch settled water
    *8-inch filter to waste
    *8-inch filter isolation
    *12-inch washwater
    *6-inch air wash
    *8-inch filter effluent rate of flow controller
-Install dehumidification ductwork in gallery
-Waterproof concrete walls in gallery
-Replace 6 ladders in gallery
-Raise each gullet wall by 12-inches
-Replace all filter troughs
-Replace filter media, and gravel
-Install air wash distributors in each filter
-Install instrumentation for each filter

COMPLETE UPGRADING OF FILTERS 9-18 $ 2,300,000

-Note that only two filters may be out of service at a time
-Replace existing valves with electrically actuated butterfly valves:
    *14-inch drain
    *10-inch settled water
    *8-inch filter to waste
    *10-inch filter isolation
    *12-inch washwater
    *8-inch air wash
    *10-inch filter effluent rate of flow controller
-Modify filter effluent piping as shown on drawings
-Install filter to waste piping as shown on drawings

-Replace all pipe supports in pipe gallery
-Paint all piping in gallery
-Provide dehumidifier and install dehumidification ductwork in gallery
-Waterproof concrete walls in gallery
-Raise each gullet wall by 12-inches
-Replace all filter troughs
-Remove false filter bottoms, install Leopold clay tile bottoms
-Replace filter media, and gravel
-Install air wash distributors in each filter
-Install instrumentation for each filter

2a. MINOR UPGRADING OF FILTERS 9-18 $ 180,000
-Replace filter effluent rate of flow controller with pneumatic actuated valve
-Install minor instrumentation for each filter

3. COMPLETE UPGRADING OF FILTERS 19-24 $ 1,500,000
-Note that only two filters may be out of service at a time
-Same work as described in (2) for filters 9-18, excluding installation of Leopold clay tile filter bottoms

3a. MINOR UPGRADING OF FILTERS 19-24 $ 100,000
-Same work as described in (2a) for filters 19-24

4. 36-INCH FILTER EFFLUENT LOOP FROM EXISTING FILTERS $840,000
-See CONCEPT 1 - SITE PLAN for routing of piping from south end of existing filter building to existing 40,000 gallon clearwell/transfer pump sump

5. CONSTRUCT SECOND WASHWATER TANK - CONCEPT 1 $ 160,000
-A second 100,000 gallon steel washwater tank is to be constructed adjacent to the existing tank

6. RENOVATE FILTER 1-8 AREA FOR LAB, SUPPORT FACILITY $500,000
-See LAB, OFFICE, CONTROL RM - PLANS AND SECTION. The area adjacent to Filters 1-8 that now houses the operators lab, chlorine facilities, and main lab, along with Filters 1-8 would be demolished and abandoned as required. The resulting space will be renovated for laboratories, a control room, offices, lunch room, locker room and restrooms. The existing roof structure would remain with a drop ceiling for the new facilities.

7. CONSTRUCT TRANSFER PUMP STATION - CONCEPT 1 $ 1,500,000

-A new transfer pump station will be constructed to pump filtered water into the 1 million gallon concrete clearwell. The existing 40,000 gallon clearwell/transfer pump station will be retired. The five existing transfer pumps will be modified and reused in the new pump station.

8. CONSTRUCT 400,000 GALLON CLEARWELL - CONCEPT 1 $ 1,100,000

-An additional clearwell is to be constructed adjacent to the new transfer pump station. The structure will be below grade, founded on caissons.

9. CONSTRUCT ADDITION TO EXISTING CHEMICAL BUILDING $ 1,200,000

-The existing Chemical Building will be expanded. The building's size will be doubled with an addition identical to the existing building.

10. CONCEPT 1 - FILTER TO WASTE SUMP AND PUMP, AND YARD PIPING $ 220,000

-Construct 10-foot diameter by 15 foot deep filter to waste sump equipped with a 1000 gpm, 5HP pump. Install yard piping shown on the CONCEPT 1 - SITE PLAN drawing.

11. CONCEPT 2 - CONSTRUCT FACILITIES SOUTH OF EXISTING FILTERS $ 4,700,000

-Construct a Transfer Pump Station, a clearwell, and four filters. Note that the 800,000 gallon clearwell is to be built in its entirety in the first phase of construction. Four filters are to be constructed above the clearwell in the first phase of construction also.

11a. CONCEPT 2 - CONSTRUCT SIX ADDITONAL FILTERS $ 2,400,000

-Six additional filters are to be constructed above the clearwell in the second phase of construction.

12. CONCEPT 2 - CONSTRUCT CONCRETE FLUMES IN BASINS 2 AND 3 $ 210,000

-Concrete flumes are to be constructed in Basins 2 and 3 to carry settled water from the basins to the existing and new filters. The flumes will be supported from below with columns.

13. CONCEPT 2 - FILTER TO WASTE SUMP, YARD PIPING $ 170,000

-Construct 10-foot diameter by 15 foot deep filter to waste sump equipped with a 1000 gpm, 5HP pump. Install yard piping shown on the CONCEPT 2 - SITE PLAN drawing.

14. CONCEPT 3A,3B - CONSTRUCT FACILITIES WITHIN BASIN 3 $ 4,900,000

-In this concept, improvements are to be made in phases. The first phase is improvements in Basin 1 (Concept 3A - see Items 16, 17) or improvements in Basin 2 (Concept 3B - see Item 19) The second phase is the construction of a transfer pump station, clearwell, and four filters within Basin 3. Note the floor of the basin and portions of the basin walls are to be removed.

14a. CONCEPT 3A,3B - CONSTRUCT FIVE ADDITIONAL FILTERS $ 2,100,000

-The third phase includes the construction of five additional filters above the clearwell.

15. CONCEPT 3A,3B - CONSTRUCT LAB,OFFICE, AND CONTROL BUILDING $ 700,000

-The construction of a masonry building to house offices,laboratories, a control room, lunch room, locker room, and restrooms is to be constructed adjacent as shown on CONCEPT 3A - SITE PLAN. This building would be constructed as part of the third phase of improvements.

16. CONCEPT 3A - CONSTRUCT RAPID MIX AND FLOCCULATION IN BASIN 1 $ 730,000

-Two rapid mix tanks would be constructed within Basin 1. Each tank is to be equipped with a vertical turbine mixer. Twenty six vertical turbine mixers (flocculators) are to be installed in the south end of Basin 1, with 13 mixers in each of two stages. The mixers are to be supported on beams with columns to the basin floor. Fiberglass baffles are located between each set of six mixers and between the first and second stage of mixers.

17. CONCEPT 3A - CONSTRUCT SLUDGE REMOVAL EQUIPMENT IN BASIN 1 $ 1,200,000

-Four circular sludge rakes are to be installed in Basin 1. The floor of the basin must be contoured with fill concrete and grout to accommodate the rakes. A 16-inch sludge withdrawal line is to be installed for each rake to remove the sludge through the west side of the basin for disposal to the river.

18. CONCEPT 3A - CONSTRUCT FLUMES: BASIN 1 TO 2 $ 50,000

-Construct flumes from Basin 1 to Basin 2.

19. CONCEPT 3B - CONSTRUCT CLARIFIER / CHEMICAL BUILDING

$7,100,000

-High rate clarifiers (Superpulsators) are to be constructed within Basin 2. Included with the clarifiers is a chemical storage and feed area. The clarifiers and chemical equipment are housed in a masonry building. This work is the first phase of Concept 3B. Yard piping shown in CONCEPT 3B - CLARIFIER / CHEMICAL BUILDING - PLANS AND SECTIONS is to be included in this item.

American Water Works Service Company, Inc.

1025 Laurel Oak Road • P.O. Box 1770 • Voorhees, New Jersey 08043 • (609) 346-8201

May 28, 1991

BP 91-12

To: R. G. Lee

From: S. E. Creel

Re: Design of Filter Improvements
Missouri-American Water Company
St. Joseph District
Evaluation of Alternatives - Trip Report

A meeting was held May 22 and 23 at St. Joseph to select a concept for filter improvements. Those in attendance were R. Moon, J. Wilner, and C. Blanck of the Region; H. Cole, J. Buhman, J. Cole, and D. Hines of the Water Company; S. Creel of System Engineering.

Since the initial meeting in January, several alternatives for filter improvements had been studied with six alternatives being identified as the most promising. These alternatives were incorporated into complete concepts with preliminary drawings and construction costs. A local contractor has assembled preliminary construction costs that reflect material and labor costs of the area for each of the alternatives. The development of the in-depth construction costs has resulted in a two month delay in the project.

The concepts were comprehensive in scope and included all planned treatment plant improvements such as chemical storage and feed improvements, and a laboratory and general support facility. Additional improvements have been identified in the study of alternatives that were not addressed in the 1988 Comprehensive Planning Study. Additional clearwell storage is needed for disinfection and flow equalization. Clearwell storage would also be used for filter wash water storage with construction of new filters. A new, deeper transfer pump station is needed to pump water from a new clearwell to the existing above ground clearwell. The existing transfer pump station is a reliability bottle-neck as it cannot be taken out of service. It was agreed that all of these improvements are necessary in each of the filtration concepts.

The conceptual drawings for the six concepts and a summary report were presented at the meeting. The summary report is enclosed. Renovation of existing filters was addressed in various ways in three of the concepts (Concepts 1a, 1b, and 2a). The

filter piping and gallery size limitations cannot be adequately addressed. Critical pipe headers cannot be replaced and keep the plant in operation. Many extended plant shutdowns would be necessary to drain lines and replace valves. The gallery would become even more crowded than at present with the addition of filter to waste piping and valves. The costs of these alternatives ranged from $11,200,000 to $14,300,000 if constructed in a single phase. Phasing the work would add approximately $1,000,000 to each concept for carryover improvements to the existing filters, and for additional engineering design, supervision, and interest costs.

Another concept (Concept 2b) includes construction of filters, clearwell, and pump station in the area bounded by the existing filters, railroad tracks, basins, and Chemical Building. The site is very constrained and the only way to get settled water to the filters is through large flumes constructed within Basin 2 and Basin 3. This consequence is unacceptable because of the potential for damage to the flumes from ice. There is a history of ice related damage to the existing flumes in the basins. Also, the only area available for expansion from this site is the existing filters, which would require expensive complete demolition prior to construction of any facilities. The single phase project cost is $12,100,000. The project cost for a two phase project is $13,000,000 with a first phase cost of $9,500,000.

Concept 3a locates new filters, clearwell, and pump station within Basin 3. To provide reliability and replace lost settling area, flocculation and sludge removal must be installed in Basin 1. The single phase project cost is $14,100,000. A three phase construction cost of $15,000,000 is foreseen. This alternative eliminates the floc shear from the three foot hydraulic jump from Basin 2 to Basin 1. There is ample room for expansion of clearwell and additional filters at this site. Also, the proposed pretreatment improvements in Basin 1 provide needed reliability and better pretreatment performance.

Concept 3b proposes construction of Superpulsator clarifiers in Basin 2 or Basin 1 rather than the flocculation and sludge removal improvements proposed in Concept 3a. The summary report proposes construction of 28 MGD of Superpulsator clarifier capacity as the first phase of construction. Discussion at the meeting focused on constructing 15-20 MGD of Superpulsator clarifier capacity in the first phase, with additional Superpulsator capacity constructed in the fourth phase. In this approach, the pretreatment and filters would all be under roof. In addition to eliminating the maintenance and operating difficulties associated with the thick ice cover of the existing basins, there are several other advantages of the Superpulsator clarifiers over the existing basins. The costs of this concept are presented below:

1992-1993	Construct 2 Superpulsators, Chemical Building	$7,400,000
1994-1995	Construct 4 filters, clearwell pump station, laboratory	$6,900,000
1997-1998	Construct additional filters	$3,000,000
		$17,300,000
2000	Construct 2 Superpulsators	$3,800,000
		$21,300,000

The consensus of the meeting was Concept 3b offered several tangible advantages over the other alternatives at a moderate cost. The improvements can be made in logical phases. The case can be made to the public that the improvements are needed not only to improve reliability and expand plant capacity, but to meet new water quality standards.

In any approach where improvements are phased, carryover improvements to the existing filters must be made. These improvements are likely to include media replacement and installation of some instrumentation (effluent turbidity, flow, loss of head). The State must approve the phased approach, and may allow some leniency in regards to installing instrumentation since the existing filters would be phased out.

After additional consideration of Concept 3b by the Region, System Engineering will begin preparation of a detailed design concept based on Concept 3b. Following the region's endorsement, the Concept 3b plan will be presented at the July Board of Directors meeting. Following their approval, the plan will be presented to Missouri DNR and PUC for their input and endorsement. With this schedule, design will start in September with completion in early spring 1992.

cc: R. Moon - Mid-America Region
J. Wilner - Mid-America Region
C. Blanck - Mid-America Region
H. Cole - MAWC-St. Joseph

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September 17, 1991

File No. 683-8362

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
REVISED CAPITAL BUDGET PROJECT 91-12
DESIGN NEW FILTERS

Reference: 1989 Comprehensive Planning Study; and Budget project memorandum BP 91-12 dated November 20, 1990

Budget Estimated Cost	$462,500
Prior Expenditure	62,500
Budget 1991 Expenditure	300,000
Budget 1992 Expenditure	100,000
Revised Estimated Cost	$970,000
Prior Expenditures	62,500
Revised 1991 Expenditure	107,500
Revised 1992 Expenditure	800,000

It is recommended the authorized budget be revised upward to reflect increased project scope. Construction of new filters will affect other treatment and pumping processes, requiring an extensive plant renovation. A four phase improvement plan includes interim improvements to existing facilities, construction of Superpulsator clarifiers and pretreatment chemical systems, construction of a baffled clearwell, transfer pump station, new filters, and support facility including a laboratory.

Funds are requested to perform design of the second phase of the project which includes the Superpulsator clarifiers and pretreatment chemical improvements. The second phase design effort will include engineering to ensure coordination with remaining phases, while detailed design of those phases will be deferred until required.

BUDGET PROJECT REVIEW

DEPARTMENT	BY	DATE
ENGINEERING		9-18-91
WATER QUALITY		9/18/91

OTHER

RECOMMENDED FOR APPROVAL:

REGIONAL VICE PRESIDENT 9/26/91

MAWC-St. Joseph District
Revised BP 91-12
Design New Filters

The 1989 Comprehensive Planning Study recommended construction of new filters. A study of alternatives has confirmed that construction of new filters rather than renovation of existing filters is warranted because of pipe gallery constraints, hydraulic constraints, difficulty keeping the facilities in service during renovation, and the high cost of renovation.

Substantial treatment plant improvements are required at the St. Joseph Main Station. The purpose of the improvements is to improve the process performance, increase reliability, and increase filtration capacity. The filter effluent turbidities routinely exceed the Surface Water Treatment Rule standard. The filters and the pretreatment process both contribute to the poor performance.

Flocculation and sedimentation is presently conducted in three large basins. Flocculation and sludge collection equipment is installed in only one of the basins. The basins require frequent repairs near the water line; and are susceptible to damage from ice. Substantial labor is expended in maintaining deicer lines, and breaking ice in the basins. Covering the basins is not a feasible method of preventing the ice buildup.

The study of filter improvement alternatives has produced a recommended four phase improvement program as listed below:

Phase 1 - (1991-1992) Interim improvements to coagulation and filtration

Phase 2 - (1992-1994) Construction of Superpulsator clarifiers and pretreatment chemical facility

Phase 3 - (1995-1996) Construction of four filters, clearwell, transfer pump station, and laboratory and other support facilities

Phase 4 - (1997-1998) Construction of six additional filters

Interim improvements to filters and other facilities (Phase 1), are necessary to maximize performance of the existing process until all proposed improvements are placed into operation. The Superpulsator clarifiers are proposed to be constructed prior to the filters, and are to be fitted within Basin No. 2 along with pretreatment chemical facilities as Phase 2. These facilities will be enclosed within buildings, allowing year round access for maintenance and monitoring. Filters, clearwell,and the transfer pump station are to be constructed in within Basin No. 3 as Phase 3 and Phase 4.

The improvements will provide facilities with sufficient operational flexibility to allow maintenance and a treatment process that is more easily operated, monitored and controlled to provide optimum treatment. The consolidation of facilities will also free up space at the plant for potential future needs such as treatment residuals dewatering facilities.

MAWC-St. Joseph District
Revised BP 91-12
Design New Filters

The preliminary cost estimates, including inflation, are listed below:

Phase 1 - $500,000
Phase 2 - $12,500,000
Phase 3 - $9,300,000
Phase 4 - $4,300,000

$ 26.6 Million

The cost estimates include monies for an aggressive community relations program running throughout the design and construction of the facilities to garner public support for the improvements.

ANTICIPATED 1991-1992 DESIGN FORECAST

Expenditures through July, 1991	$100,000
August	15,000
September	15,000
October	10,000
November	10,000
December	20,000
January, 1992	20,000
February	20,000
March	50,000
April	70,000
May	75,000
June	125,000
July	120,000
August	100,000
September	100,000
October	50,000
November	35,000
December	35,000

Forecast represents a project bill schedule and should be adjusted as necessary for cash expenditures.

Steven E. Creel

SEC/s

MISSOURI-AMERICAN WATER COMPANY
ST. JOSEPH DISTRICT
DESIGN TREATMENT PLANT IMPROVEMENTS

Detailed Cost Estimate

Item	Category	Amount
Comprehensive Planning Study	Company	$ 62,500
Preliminary Design (AWWS)	Company	62,500
Design-Phase 2	Contract	735,000
Design Liaison	Company	30,000
Interest	Company	30,000
Permitting	Contract	10,000
Community Relations	Contract	40,000
TOTAL		$970,000

SEC/s
9/17/91

27.6 Million