✓ 9-8-06 20.8

VARIANCE REQUEST

Iowa Department of Natural Resources

1. Date	: 2/25/93	13. Decision:	Approved
2. Review Engineer	: Terry Kinscheuman	Date:	2/26/93
3. Date Received	: 2/15/93		
4. Facility Name	: Johnston WWTP	14. Appeal:	
5. County Number	: 77	Date:	
6. Program Area	: CP		
7. Facility Type	: CO8		
8. Subject Area	: 371		
9. Rule Reference	: 567-64.2(9)a		
10. Design Std. Ref.	: 20.8.1 and 20.8.3		
11. Consulting Engr.	: Veenstra and Kimm		
12. Variance Rule	: 567 - 64.2(9)c		

15. Description of Variance Request

Chlorine will be mixed with the wastewater within a pipe contact chamber by the turbulence of wastewater as it moves through a pipe. The chlorine will be mixed within 20 seconds rather than be flash mixed within 3 seconds. The City of Johnston is proposing to disinfect the wastewater after storage just prior to land application.

16. Consulting Engineer's Justification

Complete mixing will occur within 15 feet of the point of application. A detention time of 15 minutes is still achieved after the mixing has occurred. The piping arrangement prevents short circuiting. A 40 to 1 length to width ratio will be provided. Fecal coliform levels in the pond will be relatively low.

16. Consulting Engineer's Justification (cont.)

17. Department's Justification

The system should be okay with some operational parameters. The wastewater will be sprayed in close proximity to a nature trail. Recommended Parameters for operation and construction.

1. Maintain chlorine residual of 0.5 mg/l after 15 minutes of contact time. This is already required by Design Standard 21.1.6.6.
2. Maintain fecal coliform levels below 2.2 MPN/100 ml. This is achievable with a properly designed and operated land application system. Sanborn ± typically reports no detectable coliform levels. The literature indicates that flesh mixing is superior in providing disinfection.
3. The piping also must be designed to prevent cross-connections.

18. Precedents Used

19. Staff Reviewer	:	Terry Kirschenmann	Date: 2/25/93
20. Supervisor	:		Date: 2/25/93
21. Authorized by	:		Date: 2/26/93

STATE OF IOWA

RECORD COPY

File Name Johnston Sewage

Senders Initials TLK

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

February 25, 1993

Mr. Robert E. Hays
6221 Merle Hay Road
P.O. Box 410
Johnston, Iowa 50131

RE: Johnston Treatment Plant Irrigation System - Disinfection Facilities
Johnston, Iowa
CS192046 01

Dear Mr. Hays:

The Iowa Department of Natural Resources in accordance with Subrule 567-64.2(9)c of the Iowa Administrative Code has considered and approved Veenstra and Kimm's February 15, 1993, request for variances from Iowa Design Standards 20.8.1 and 20.8.3. Chapter 20 of Iowa's design standard requires a specific configuration for the chlorine contact tank as well as flash mixing. The use of a 16 inch lagoon transfer pipe and the discharge piping and hose of the irrigation system to provide a minimum contact period of 15 minutes at a pumping rate of 450 gpm is proposed. Also, the chlorine will be mixed within the 16 inch diameter pipe from the turbulent wastewater flow 20 seconds downstream from the point of application. Our approval of your request is conditioned on the following:

1. A chlorine residual of O.5 mg/l shall be maintained after a minimum contact time of 15 minutes.

2. The disinfection system and storage facilities must be operated to provide an effluent fecal coliform level no greater than 2.2 MPN/100 ml.

3. The elevation of the overflow weir at the irrigation pumping station must be placed at least 6 inches above the berm of Reservoir No. 1 to eliminate the possibility of a cross connection.

We trust your wastewater disinfection facilities for the spray irrigation system will adequately protect public health. Should you have any questions, please call. My telephone number is 515/281-8869.

Sincerely,

Darrell McAllister, Chief
Water Quality Bureau
Iowa Department of Natural Resources

cc: Field Office 5
Veenstra and Kimm, Inc., West Des Moines
Mark Lee, Johnston

VEENSTRA & KIMM, INC.

February 10, 1993

Terry Kirschenman
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

JOHNSTON, IOWA
JOHNSTON TREATMENT PLANT IRRIGATION SYSTEM
DISINFECTION PROCEDURE

This letter is a follow up to our meeting of February 5, 1993 regarding the disinfection facilities to be provided at the Johnston Treatment Plant as a part of the irrigation system project. The City of Johnston intends to install facilities to allow compliance with Design Standard 21.1.6.6. The 15 minutes of detention time will be provided in the pipe between the large pond and the point of application. The City also evaluated providing the required 15 minutes of detention time in the 8-inch pipe between the irrigation pump and the first application header. Based on a cost evaluation it was determined that the cost of the modifications to utilize the entire piping was much lower than the cost to increase only the 550 feet of irrigation pipe.

The detention time will be accomplished by modifications to the original design. These modifications are shown on the enclosed revised plan drawing. The modifications include increasing the effluent transfer pipe from 10-inch diameter to 16-inch diameter to provide for 9 minutes of detention time. The additional 6 minutes of detention time is provided in the discharge header and irrigation hose. The calculation of the detention time at the design pumping rate of 450 gpm is as follows:

Pipe (in.)	Length (ft.)	Detention (min.)
16" transfer pipe	387	8.98
8" discharge pipe	800	4.64
4" irrigation hose	1,250	1.81
TOTAL		15.43

• 300 West Bank • 1601 Twenty-second Street • West Des Moines, Iowa 50266-1488 • 515-225-8000 •
• WATS 800-241-8000 • • FAX 515-225-7848 •

To provide isolation of the chlorinated effluent from the small pond, the 18-inch pipe between the small pond and the pump manhole will be plugged. The effluent transfer line will discharge directly to the pump manhole rather than into the 18-inch transfer pipe as originally designed. A 12-inch bypass pipe will be provided from the pump manhole to the 18-inch pipe between the plug and small pond. This 12-inch overflow is necessary to prevent overtopping of the pump manhole. The flow rate to the pump manhole is controlled by the 10-inch valve on the new effluent transfer pipe. Because the water level in the large pond is above the top of the pump manhole overtopping of the manhole is possible. The 1-inch pvc chlorinator line will be extended from the existing chlorination manhole to the effluent transfer line near the transfer pump station.

It is anticipated that the chlorinator modifications will be accomplished using maintenance funds from the sanitary sewer utility. The disinfection system at the treatment plant is a gas chlorinator system. The disinfection system will be placed in operation. The City is currently evaluating whether to rehabilitate the gas chlorinator or to utilize a liquid chlorine application system.

The City of Johnston would request approval from the Iowa Department of Natural Resources to award contract for the Johnston irrigation system. Award of contract has been scheduled for February 15, 1993. It is critical that contract be awarded on that date to allow for delivery of the irrigation equipment in mid to late April. In order to dewater the large pond in 1993 the irrigation system operation will need to begin by May 1, 1993.

If you have any questions or comments concerning the project, please contact us at 225-8000.

VEENSTRA & KIMM, INC.

H. R. Veenstra Jr.

HRVJr.:das
168126
Enclosure
cc: City of Johnston

VEENSTRA & KIMM, INC.

February 15, 1993

Terry Kirschenman
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

JOHNSTON, IOWA
JOHNSTON TREATMENT PLANT IRRIGATION SYSTEM
REQUEST FOR VARIANCES

The Johnston Treatment Plant and the proposed Johnston Treatment Plant Irrigation System are not in conformance with several of design standards of the Iowa Department of Natural Resources with respect to land application systems. The City of Johnston believes that the existing Johnston Treatment Plant and the improvements proposed for the irrigation system provide an equivalency to the design standards for the areas where conformance with the design standard is not achieved.

This letter is to request specific variances from the design standards for several aspects of the Johnston Treatment Plant. The request for variance is based on the concept of the existing and proposed facilities providing equivalency to the design standards.

Design Standard 21.1.6.6 requires disinfection with a contact time of at least 15 minutes and a residual chlorine concentration of 0.5 mg/l. The revised design provides for the 15 minutes of detention in the piping between the point of application and the point of irrigation. Chapter 20 of the design standards requires a specific configuration for the chlorine contact tank. This letter is to request a variance from the configuration requirements of Chapter 20 with respect to the disinfection system at the Johnston Treatment Plant.

• 300 West Bank • 1601 Twenty-second Street • West Des Moines, Iowa 50266-1488 • 515-225-8000 •
• WATS 800-241-8000 • • FAX 515-225-7848 •

The revised design includes injection of chlorine in the effluent transfer pipe near the existing effluent manhole. The chlorine will be injected with an injector extending at least 8 inches into the 16-inch diameter pipe. The chlorine will remain within the piping for an isolated minimum period of at least 15 minutes. The primary purposes of the serpentine requirement of the chlorine contact tank is to ensure good mixing of the disinfectant with the wastewater and to ensure that short circuiting does not take place. For the most part the serpentine requirement is to simulate a plug flow reactor. A straight pipe provides the ideal plug flow reactor and eliminates any short circuiting. With respect to the short circuiting requirement the pipe provides an improved level of performance over the serpentine chamber with a minimum of 40 to 1 length to width ratio. The second issue addressed with respect to the serpentine chamber is mixing. The chlorine solution will be injected in the wastewater at a point where the maximum distance from the point of application to the wastewater is no more than 8 inches. At 450 gpm, the velocity in the 16-inch pipe is approximately 0.75 feet per second. With the relatively short distance of only 8 inches from the point of application to the most distant point of the wastewater, mixing will occur within a matter of a few feet downstream of the pipe. It is anticipated that the complete mixing will occur within approximately 15 feet of the point of application. At the design pumping rate of 450 gpm, the detention time is a minimum of 15.4 minutes. Assuming that 15 feet of the pipe is used for mixing, the 15 minute detention following mixing is still achieved. Measurements of the contents of both the small pond and large pond show that fecal coliform levels during non-ice cover periods are relatively low. The fecal coliform reduction is the result of natural ultraviolet light. Irrigation and disinfection will occur only during those periods when ice cover is not present. It is anticipated that the natural fecal coliform levels in the large pond contents will be relatively low. The initial mixing of the chlorine in the wastewater will provide for adequate mixing to achieve the required disinfection. The isolated straight pipe provides an equivalent plug flow and an equivalent mixing to that which would be achieved in a serpentine rectangular chamber.

The existing small reservoir and large reservoir do not comply with the requirements of the design standards in several aspects with respect to the geometry and piping of the ponds. The design standards were developed to ensure adequate treatment and flexibility with the minimum treatment requirements required in Chapter 21. The Johnston Treatment Plant includes an extended aeration activated sludge plant providing complete secondary treatment in advance of storage. Over the past 12 months the average CBOD in the effluent from the treatment units to the storage pond has been less than 5 mg/l. The water quality discharged from the treatment facility to the storage pond is significantly better than the minimums required under Chapter 21.

The design standard under Chapter 21 provides that the maximum depth shall not exceed 10 feet. The existing large storage reservoir has a maximum operating depth of 16 feet. This storage pond has an average BOD of less than 5 mg/l. The large storage pond is used solely for storage rather than for any treatment. The 10-foot maximum water depth was established to take into consideration that treatment may be experienced in a storage pond if the preliminary treatment only complies with the minimum requirements. The Johnston Treatment Plant large storage reservoir has operated satisfactorily at maximum water depths as great as 16 feet for several years with no adverse consequences including no odors or low dissolved oxygen levels. Because treatment is not being experienced in the large storage pond the depth limitation is not a critical criteria for the large storage reservoir. The City of Johnston would request a variance from the design standards under Chapter 21 for the depth limitation of 10 feet.

Chapter 21 provides that the minimum draw off shall be at the 2-foot level. The draw off for the existing Johnston Treatment Plant is located at the bottom of the storage reservoir. The purpose for establishing the 2-foot minimum for the draw off is two-fold. First, it is believed that by establishing a 2-foot minimum that sludge and other heavy deposits accumulating in the bottom of the reservoir would not be drawn into the piping. Second, a minimum 2-foot draw off assists in maintaining a minimum water level for a wet bottom lagoon facility.

The draw off for the large reservoir connects to the same piping which is used for the transfer pumps to fill the large reservoir from the small reservoir. These transfer pumps operate at a flow rate of approximately 2,000 gpm. These transfer pumps achieve a much higher velocity which flushes any solids accumulation away from the entrance to the draw off pipe. Because all of the treated effluent first must pass through Cell 1 the majority of settleable solids will be deposited in the bottom of Cell 1. For the Johnston treatment reservoir it is not believed that any significant solids accumulation will develop near the bottom draw off pipe at the transfer pump station. The concerns with respect to maintaining a 2-foot minimum are not applicable to the existing Johnston treatment facility large storage reservoir. The City of Johnston would request a variance to allow for the use of the existing draw off pipe located at the bottom of the large storage reservoir and for the use of only a signle draw off pipe.

Design Standard 21.1.7.3 provide that there shall be a minimum of two storage cells with the capability of series and parallel operation. The Johnston Treatment Plant contains two storage cells. Due to the geometry of the original construction, series and parallel operation and complete isolation of the lagoon cells is not possible. The bottom elevations of the two cells are at the same level. The small reservoir has a high water level which is

significantly lower than the large reservoir. Converting the existing facility to comply with the requirements for series and parallel operation under Design Standard 21.1.7.3 is not possible with the existing facility. The purpose of Design Standard 21.1.7.3 is to achieve reliability in operation. This reliability is achieved under the design standard by utilizing multiple storage cells with the flexibility of using series or parallel operation or isolation of the cells. One of the primary aspects of the series and parallel operation requirements is to provide flexibility when treatment may be a factor in the storage cells. Because the mechanical plant provides complete treatment this factor is not a concern for the Johnston facility.

The Johnston Treatment Plant is designed for the small reservoir and large reservoir to operate in series. Parallel operation is not possible with the different water levels. The City of Johnston does not believe that parallel operation is critical provided that the reliability can be guaranteed. The primary concern with respect to Design Standard 21.1.7.3 should be maintaining a reliable operation rather than the exact geometry of the storage cells. Changes to the design flow configuration of the plant would be utilized only under the conditions when one lagoon cell is out of service. Because of the nature of the lagoon cells they will be taken out of service only by overt actions of the operating staff which can be well planned. In the event that the small reservoir is taken out of service it is necessary to convey the flow from the chlorination manhole to the large reservoir. This can be accomplished only by pumping. Over the past 16 years of operation, the small reservoir has been out of service on only one occasion. This occurred shortly after the initial construction when the bottom of the lagoon was dried and sealed. In the event that the small cell is taken out of service a portable submersible pump can be installed in the chlorination manhole and pump the flow over the embankment to discharge into the large cell. The first step to taking the small cell out of service would be to dewater the cell. After the cell is dewatered a plug can be installed in the sewer.

In the event the large cell is out of operation it is necessary to convey the flow from the small cell to the irrigation pump. Because of the large size of Cell 2, it is unlikely that it would be removed from service and if removed would be out of service for a significant period of time. The first step to removing the large cell from service would be to dewater the cell. At the time the large cell is drawn down, the pipe from the transfer pump station effluent manhole to the large cell can be plugged. A temporary pump can then be installed in the transfer pump station to discharge into the manhole in the embankment of the large cell which feeds the irrigation system. The transfer pumps would not be used for this purpose because the 2,000 gpm of flow would flood the downstream piping.

By utilizing a portable pump the City of Johnston is able to achieve the flexibility and reliability to continue operation with either the small cell or the large cell out of service. The City believes that this achieves the same required degree of reliability which is equivalent to the intended reliability set forth in Design Standard 21.1.7.3. The City of Johnston requests a design variance from the requirement of the capability of series and parallel operation of the two storage ponds.

The same procedure used to obtain reliability also provides for the cell isolation requirement under Design Standard 18C.5.5.2. The City of Johnston would request a variation from the cell isolation requirements of Design Standard 18.5.5.2.

Design Standards Chapter 13 is applicable to raw wastewater pump stations at treatment plants and wastewater pump stations in collection systems where continued operation of the facility is required. Many provisions of the design standards under Chapter 13 are not applicable to the post-treatment irrigation pump. Because of the treated nature of the effluent a vertical turbine pump can be utilized. Chapter 13 does not contemplate the use of a vertical turbine pump, as such a pump is not applicable for raw wastewater applications. Continuous operation of the irrigation system is not critical. There is adequate storage available in the two storage ponds to provide for periods of non-operation of the facility. The City of Johnston would request a determination that the specific requirements of Chapter 13 of the Design Standards are not applicable to the irrigation pump.

If you have any questions or comments concerning the project, please contact us at 225-8000.

VEENSTRA & KIMM, INC.

H. R. Veenstra Jr.

HRVJr.:das
168118
cc: City of Johnston

VEENSTRA & KIMM, INC.

February 16, 1993

Terry Kirschenman
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Avenue
Des Moines, Iowa 50319

JOHNSTON, IOWA
JOHNSTON TREATMENT PLANT IRRIGATION SYSTEM
RESPONSE TO COMMENTS

This letter is in response to the telephone discussion of February 15, 1993 regarding the design of the Johnston Treatment Plant Irrigation System. This letter is in response to the four items discussed on February 15, 1993. In response to the four comments, the following is offered in response:

1. The first item raised concerns regarding the mixing in the 16-inch effluent transfer pipe. The water velocity at 450 gpm in the 16-inch transfer pipe is approximately 0.7 feet per second. The Reynolds number for the flow in the 16-inch pipe will be approximately 60,000. Generally laminar flow is considered to take place only at Reynolds numbers of 2,000 or lower with complete turbulent flow taking place at Reynolds numbers greater than 4,000. A single pipe line diffusor inserted to the midpoint of the pipe is general considered adequate for pipes to 30-inch diameter according to EPA design guidelines and up to 36-inch diameter pipe as set forth by George White in "Handbook of Chlorination". White also indicated that when the Reynolds number is 2,000 or greater the solution becomes completely and intimately mixed throughout the pipe in a length of 10 diameters, or approximately 13.3 feet. A chlorine injection will also take place at a point just downstream of the 10-inch by 6-inch increaser and the partially closed 10-inch gate valve. Although the pipe flow itself creates sufficient turbulence for complete mixing in a short distance, the partially closed valve and increaser will further assist in providing the complete mix. Our evaluation would indicate that the complete mixing will occur relatively quickly as laminar flow will not be present in the pipe at a flow rate of 450 gpm.

• 300 West Bank • 1601 Twenty-second Street • West Des Moines, Iowa 50266-1488 • 515-225-8000 •
• WATS 800-241-8000 • • FAX 515-225-7848 •

2. The Iowa Department of Natural Resources expressed concern regarding access to the 48-inch wet well which was originally proposed for the irrigation pump. The Iowa Department of Natural Resources also expressed an interest of having the capability of installing a second pump. To accommodate these concerns we are evaluating a modification in the original design. The modification would involve the installation of a new 72-inch diameter manhole to serve as the wet well for irrigation pumping. The manhole would be located immediately adjacent to the existing 48-inch manhole to take advantage of the existing electrical power and control facilities. The skid mounted vertical turbine pump would be installed on the top of the 72-inch manhole The skid mounted assembly would include a 20-inch diameter or larger hatch for access to the wet well. This hatch could also accommodate a second pump on an interim basis. This second hatch could accommodate a submersible pump and possibly a second vertical turbine pump. Although it is unlikely that a second vertical turbine pump would be installed that would theoretically be possible. Normally the same equipment which would be used to lift the second vertical turbine pump in place would be used to first pull the first vertical turbine pump. Normally if a pump substitution were required the second pump would be installed in the location designed for pump installation.

   The bypass line in the vertical turbine pump station would be set at approximately elevation 813 to 813.5 and would discharge directly into the embankment of the small reservoir. The point of discharge would be above the normal high water level. As indicated on February 15, 1993 the high water level in the small reservoir can be kept below the overflow elevation by use of the automatic flow level control pump operation circuitry provided in the motor control center. The estimated cost for this modification is in the range of $600. If this modification is acceptable we will proceed to implement the change into the contract.

3. The Iowa Department of Natural Resources expressed concern regarding access to the recreation trails during the irrigation season. The City of Johnston will agree to install access control gates on the recreation trail. The final design of the control gates will need to be resolved over the next few days in consultation with Green Meadows who owns and operates the recreation trails. The control gates may either be installed as a part of the construction contract or installed separately by City personnel. Details of the control gates will be submitted as soon as they have been developed.