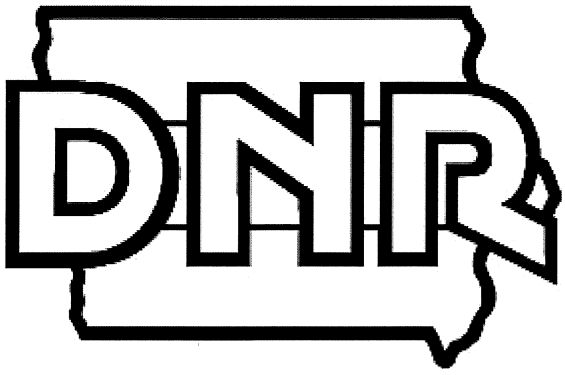

Technical Bulletin No. 23

GUIDELINES FOR WELL INTERFERENCE COMPENSATION

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Technical Bulletin No. 23

GUIDELINES FOR WELL INTERFERENCE COMPENSATION

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Technical Bulletin No. 23

GUIDELINES FOR WELL INTERFERENCE COMPENSATION

I. INTRODUCTION.

A. Scope.

This technical bulletin provides guidelines for resolving well interference conflicts. It supplements rules in the Iowa Administrative Code, Department of Water, Air and Waste Management [900], hereafter referred to as the rules. Relevant portions of the rules include Chapter 49 which deals with non-public water wells and Chapters 50-54 which deal with water rights allocation. Chapter 54 specifically deals with well interference compensation.

The circumstances which give rise to well interference conflicts are varied and often complex. These guidelines attempt to deal with a variety of situations. However, it is not feasible to address all possible situations. Therefore, deviation from specific guidelines will be considered on a case-by-case basis.

B. What Is Well Interference?

Well interference is the drop of water level in a well caused by pumping from another well (see Figure 1). Pumping water from a quarry or gravel pit may also cause well interference. Well interference can occur whenever more than one well pumps from the same source of groundwater. In most situations, well interference does not cause any problems because the water-level drop is not enough to affect the operation of other wells. However, when a well fails or well performance is significantly diminished due to well interference, the well owner may seek compensation to correct the problem. It should be noted that most well failures are not due to well interference. Well failure is more commonly caused by a variety of other factors such as pump failure or well screen encrustation.

C. Basic Groundwater Terms.

An aquifer is a geologic formation which will yield water of usable quantity to a well. A geologic formation which cannot yield water of usable quantity to a well is called an aquitard or confining bed. In relative terms, water flows readily through an aquifer but slowly through an aquitard.

Aquifers are classified as being either confined or unconfined as illustrated in Figure 2. Confined aquifers are sandwiched between aquitards, and the water is under hydrostatic pressure. When a well taps a confined aquifer, water rises in the well to a level above the top of the aquifer. Wells drilled into confined aquifers

Figure 1

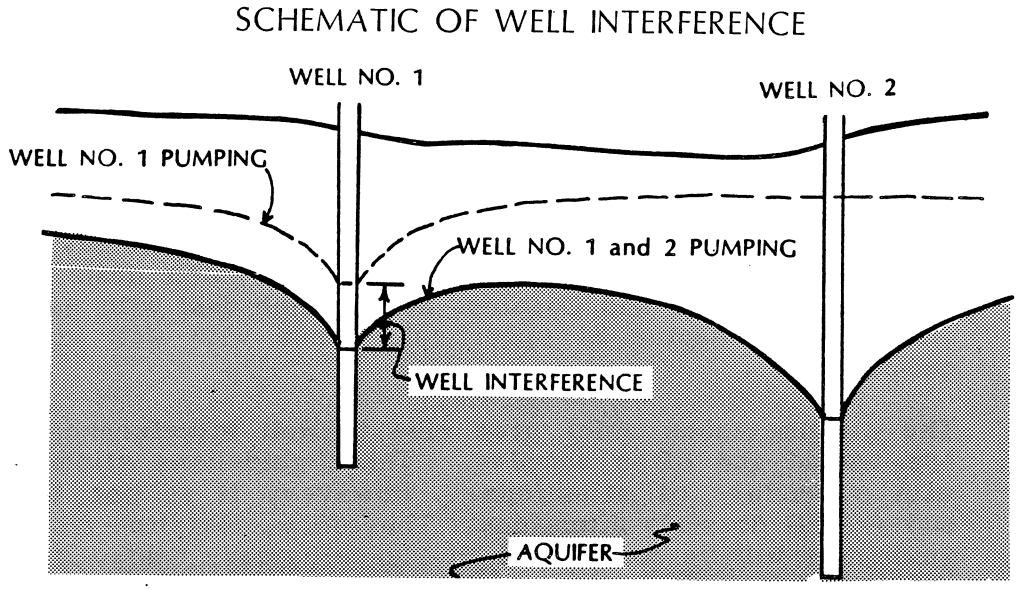
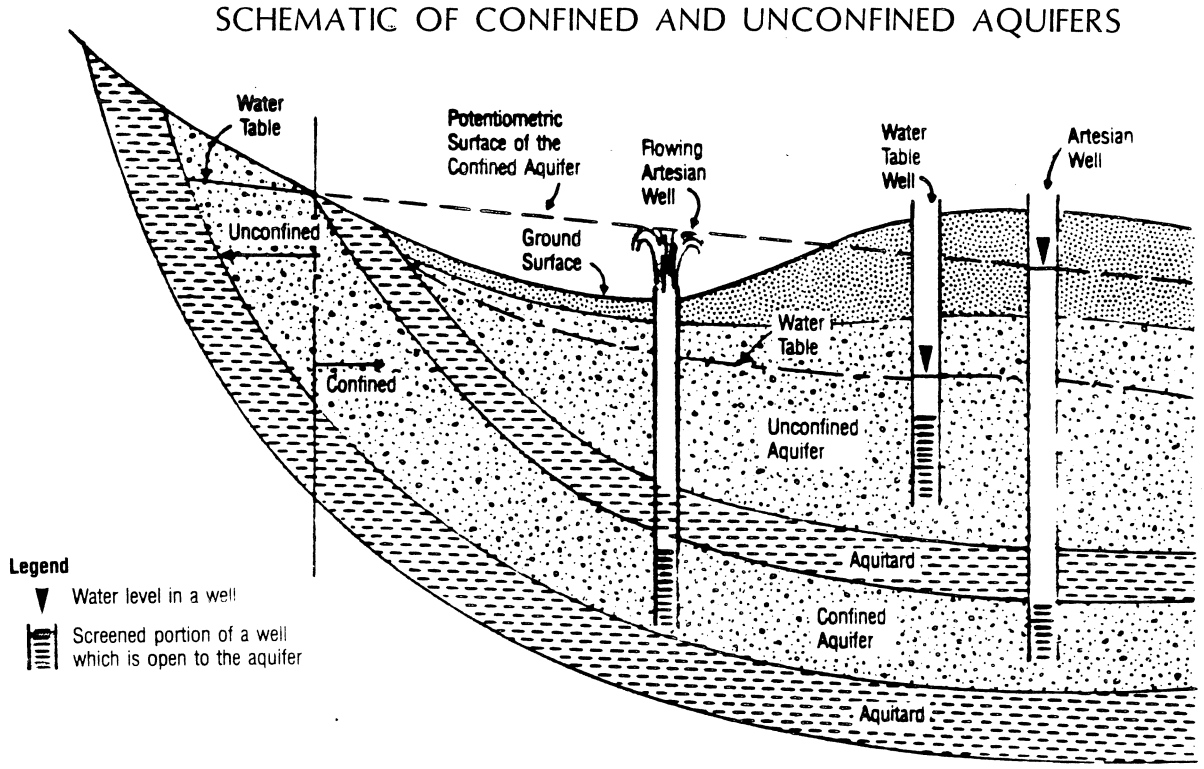


Figure 2



are called artesian wells. When water flows from an artesian well without pumping, it is called a flowing artesian well or flowing well.

Water in an unconfined aquifer is not under hydrostatic pressure, and the water level is below the top of the aquifer. Unconfined aquifers are usually located near the surface and not overlain by an aquitard. Wells in unconfined aquifers are commonly called water-table wells.

Aquifers exist within the bedrock and overlying soil material. Bedrock aquifers are also called consolidated aquifers. Aquifers in soil materials overlying bedrock are called unconsolidated or surficial aquifers. Sandstones and fractured limestones are common consolidated aquifers. Sand and gravel deposits are common unconsolidated aquifers.

D. Regulation of Groundwater Use.

Iowa law provides that groundwater (as well as surface water) is public water and public wealth of the people of the state. The Iowa Department of Water, Air and Waste Management (hereafter referred to as the department) is responsible for managing the water resources of the state. The department does not regulate uses of water of less than 25,000 gallons per day. A permit from the department is required for the use of more than 25,000 gallons of water per day. If a permitted water use causes a nonregulated well to fail due to well interference, the department may include conditions for resolving well interference problems in the water use permit.

E. Methods for Resolving Well Interference Conflicts.

When a well interference conflict involves a complaint by a nonreulated well owner against a permitted water user, the conflict may be resolved only through informal negotiations or administrative procedures. In other situations, conflicts may be resolved only by informal negotiations or by the courts. In most cases, informal settlements of well interference conflicts will take less time and be less expensive than administrative procedures or litigation. Informal resolution of well interference conflicts are encouraged whenever possible.

F. Who Is Eligible for Compensation as Determined by Administrative Procedures?

As mentioned above, administrative resolution of well interference conflicts is only available in situations where a permitted water user is suspected of causing well interference in a nonregulated well.

Eligibility for compensation depends on the conditions when the permitted and nonregulated wells (or other withdrawal facility)

were constructed or experienced a significant change in the use. A physical change to a well may be considered a significant change (e.g., installing a new well at a different location, installing a higher capacity pump, etc.). Consideration will be given to water uses which existed prior to the development of a new well or significant change in use in an existing well. The following general eligibility criteria reflect this consideration.

- To be eligible for compensation, the nonregulated well must have been in existence before construction of the permitted well or before a significant change in the permitted use caused a well interference problem.

- A nonregulated well owner is not eligible for compensation in instances where well interference has existed in the past but was not a problem until aggravated by changes in the well such as an increased pumping rate or a deteriorated well efficiency (e.g., a clogged well screen).

II. SUGGESTED PROCEDURES FOR INFORMAL SETTLEMENT OF WELL INTERFERENCE PROBLEMS.

Step 1: Identify Probable Well Interference.

Repeated sudden losses of water or poor well performance whenever a nearby well is pumped are likely indications of well interference. Such situations often occur when a well causing interference is first installed or is put into operation after an extended idle period.

When water level declines are gradual, well interference is less obvious. Well interference may not be a problem until aggravated by drought conditions.

Keeping track of water levels in a well is a good way to identify well interference. Methods for measurement of water levels in a well are described in Appendix A. Water-level measurements in a well should be made when the well is not pumping. Several measurements should be made several minutes apart until the water level in the well stabilizes. Consecutive measurements which are relatively stable (say within one inch or 0.1 foot) indicate reliable measurements which are not affected by previous pumping. Water levels should be measured at times when no well interference is suspected and, for comparison, at times when well interference is suspected.

Documentation of conditions at the time of water level measurements is important. Documentation of similar conditions in neighboring wells may also be useful. Conditions which should be documented include: time of pumping by the suspected cause of well interference, rainfall since the last measurement, time and date of the measurement, and anything else that may affect water levels in the well.

If water levels are significantly lower only during periods when a nearby well is pumping, well interference would appear likely. If water levels gradually decline over time, it may be an indication of well interference. If it can be shown that the rate of water-level decline increases when a nearby well, quarry, or gravel pit is pumping, the evidence of well interference is more conclusive.

Step 2: Notify Party Responsible for Well Interference.

When a well interference problem is identified or suspected, the party or parties suspected of causing the problem should be notified. If the cause of interference is not known, the department can be contacted for information on permitted water uses in the area. All parties can then work together to resolve the problem.

Step 3: Collect Supporting Data.

The type of data necessary to support a well interference claim was discussed in Step 1. This includes:

- water level measurements over time in the affected well; and,

- pumping times from the well, quarry, or gravel pit suspected of causing interference.

This information in itself may be suitable for verifying a well interference problem, and may also be useful in administrative resolution of conflicts. In less obvious cases, additional work may be needed to assess well interference. Such work may include:

- an evaluation of hydrogeologic factors (for example, do the wells draw from the same aquifer?); and,

- test pumping as described in Section III.A., pages 6-14.

It is recommended that a registered professional engineer or hydrogeologist be retained for such additional work.

Step 4: Evaluate Supporting Data.

In cases of obvious well interference, evaluation of data may simply involve determining the difference in water levels in the affected well between periods of pumping and nonpumping in the well causing interference. Evaluation of hydrogeologic data and test pumping results in less obvious cases should be done by a registered professional engineer or hydrogeologist. Consideration should be given to worst-case conditions. For example, what will conditions be during a drought? Section III.B., pages 14-16, lists criteria for verifying that well interference has a significant adverse effect on the nonregulated well.

Step 5: Informal Settlement.

If well interference is verified as having a significant adverse effect on the nonregulated well, several options for resolving the problem may be available. Section III.C., pages 16-18 describes these settlement options. Guidelines for appropriate compensation for settlement options which involve modification or replacement of the nonregulated well are given in Section III.D., pages 18-21. The parties are encouraged to execute a legally binding agreement. It is also recommended that informal settlements be registered with the department. This will provide the department with a basis for handling any recurring complaints. Also, settlements which do not involve compensation (such as a reduced pumping rate or scheduled pumping by the permittee) may be made a condition of the water use permit.

III. GUIDELINES FOR USE IN ADMINISTRATIVE RESOLUTION OF WELL INTERFERENCE CONFLICTS.

Procedures for administrative resolution of well interference conflicts are given in the Iowa Administrative Code, Water, Air and Waste Management [900], Chapter 54. Figure 3 is a flow chart of the procedure for determining if significant adverse well interference is verified. Figure 4 is a flow chart of settlement procedures when well interference is verified. In the administrative procedure, the owner of the nonregulated well affected by well interference is called the complainant and the owner of the permitted well which is suspected of causing well interference is referred to as the permittee. A party applying for a water use permit is referred to as the applicant.

Situations giving rise to well interference are diverse. It is not feasible to develop guidelines that address all possible situations. Variance from the guidelines will be considered on a case-by-case basis.

The following guidelines will be used for administrative resolution of well interference conflicts. These guidelines may also be useful in informal resolution of well interference conflicts.

A. Guidelines for Test Pumping.

Test pumping of both the permitted and nonregulated wells may be required to make an accurate assessment of well interference. These guidelines describe general procedures and considerations for conducting test pumping. Actual conditions may require modified test procedures. It should be noted that costs of test pumping are to be borne by parties to the conflict.

Test pumping involves measurement of water levels in wells and measurement of pumping rates. A registered well driller,

Figure 3 WELL INTERFERENCE DETERMINATION

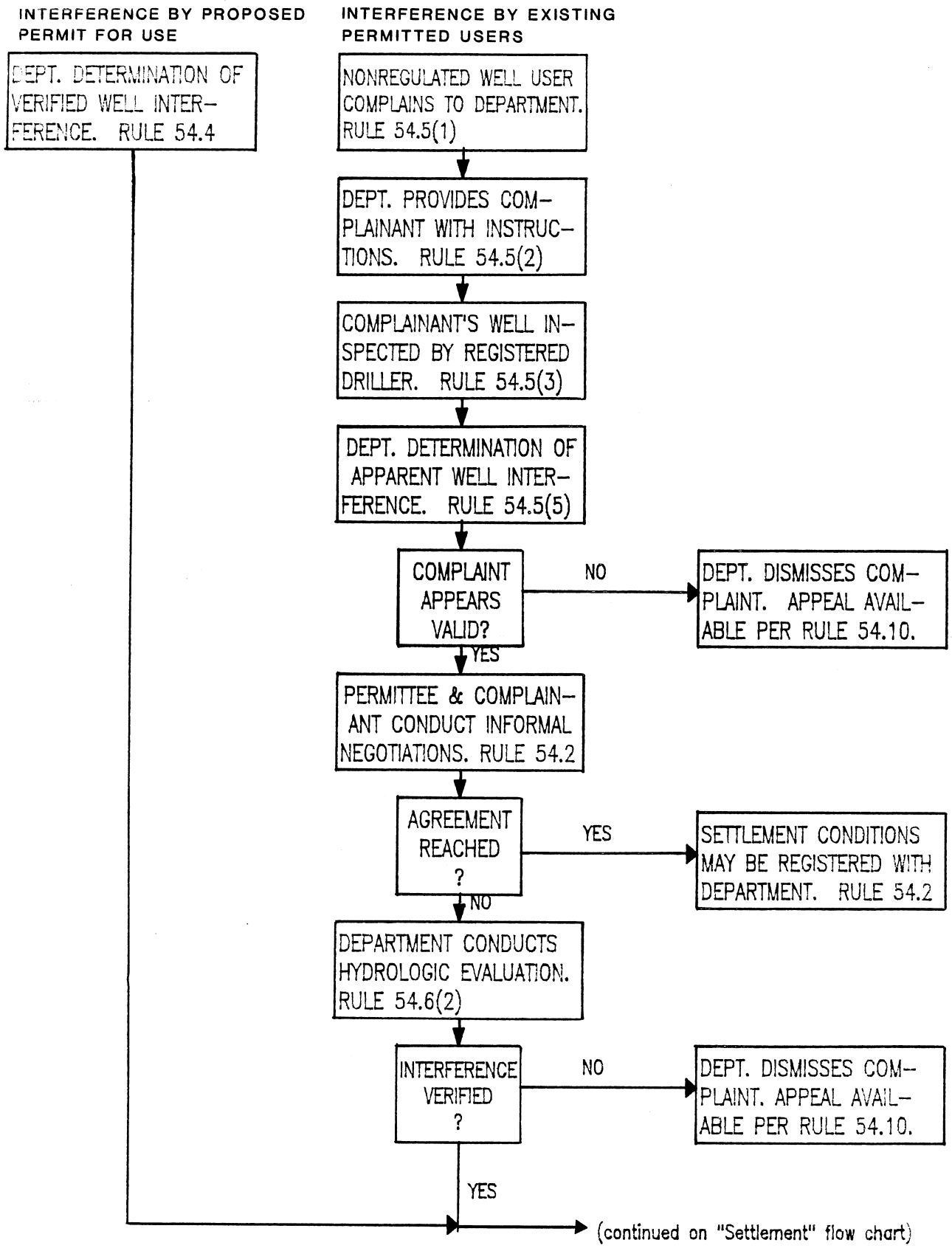
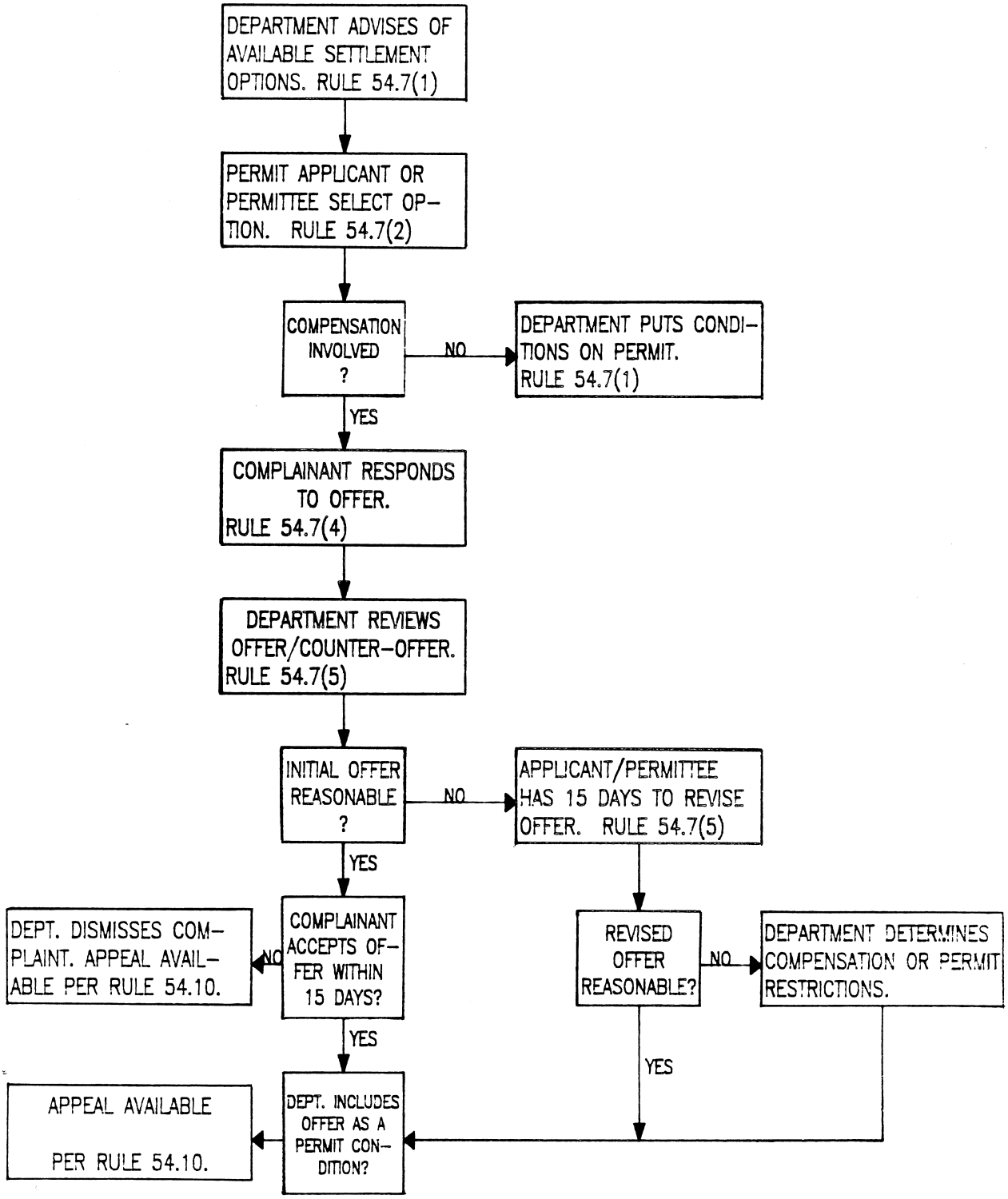


Figure 4

WELL INTERFERENCE SETTLEMENT

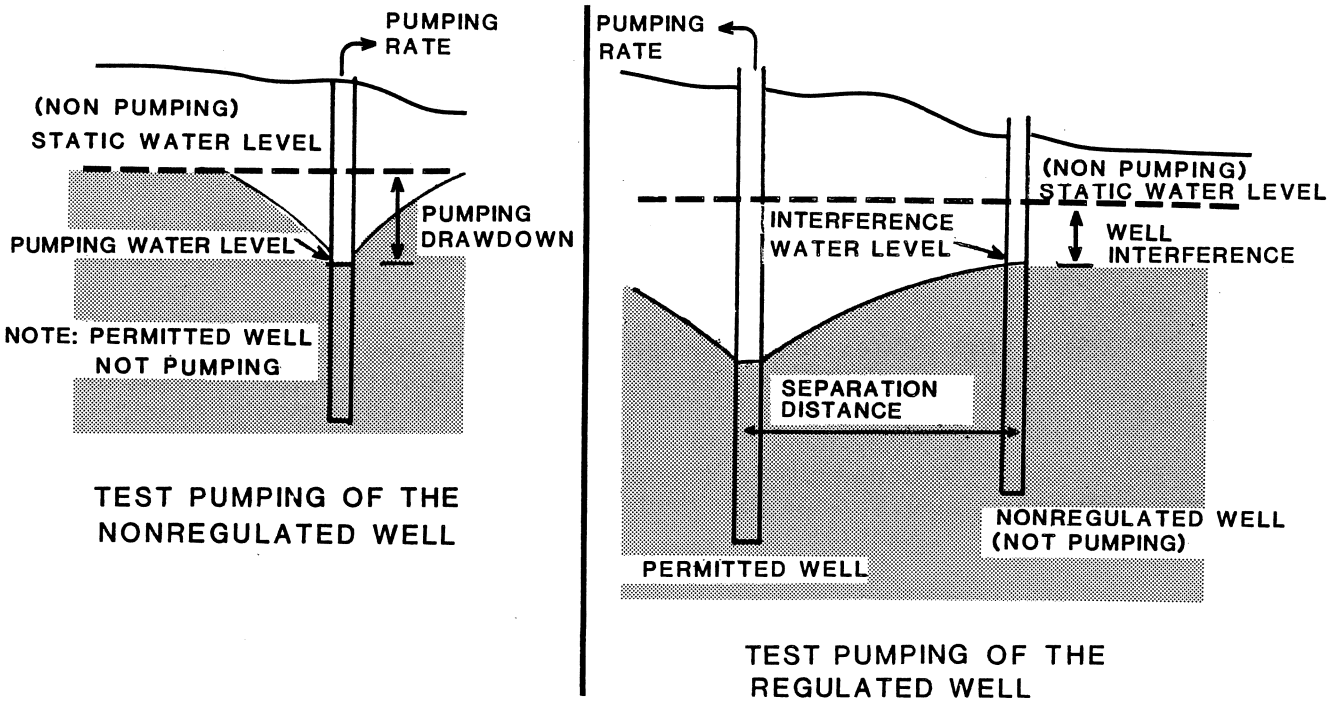


registered professional engineer, or hydrogeologist should be retained for performance of test pumping. During the test, water-level measurements should be made as accurately as possible, typically within one-eighth inch or 0.01 foot. Methods of water-level and pumping-rate measurements are given in Appendices A and B.

Figure 5 illustrates the information needed from test pumping.

Figure 5

INFORMATION FROM TEST PUMPING



1. <u>Controlled Test Pumping of a Nonregulated Well.</u>

   a. <u>Purpose</u>:

      Test pumping of a nonregulated well is needed to measure the drawdown caused by pumping the well and to determine the pumping rate without well interference.

   b. <u>Test Needs</u>:

      (1) An access to the well for water-level measurements.

      (2) Water-level measurement equipment (see Appendix A).

(3) A pumping discharge location as far from the well as possible and downhill (e.g., yard hydrants).

(4) A means for measuring pumping rates (see Appendix B).

c. Conditions Prior to Pumping:

Stable water levels without the effect of well interference are desired in the nonregulated well prior to test pumping. If a stable water level is not reached, a clearly defined trend is needed (i.e., a modest, constant rate of decline). The following guidelines attempt to provide these conditions.

(1) The permitted well(s) which is suspected of causing well interference should not have pumped for at least six hours (preferably longer) prior to test pumping the nonregulated well. The time of last pumping should be recorded.

(2) The nonregulated well should not be pumped for at least one hour prior to test pumping. The time of last pumping should be recorded.

(3) Water-level measurements in the nonregulated well should be made at ten minute intervals for at least one hour prior to test pumping. Measurements should be continued and test pumping delayed until three consecutive measurements remain within one inch or 0.1 foot of each other, if necessary, for up to another hour.

d. Conditions During Test Pumping:

(1) The time pumping begins in the nonregulated well should be recorded.

(2) Water-level measurements should be made at ten minute intervals for at least one hour and continued until three consecutive measurements remain within one inch or 0.1 foot of each other. If the water level in the well does not stabilize and continues to deline, pumping should continue and measurements taken for a total of up to four hours. The time at which measurements are taken should be recorded along with the measured water level.

(3) The pumping rate should be measured at approximately 5, 20 and 60 minutes after pumping is begun and near the end of the test.

(4) If the pump loses suction (pumps air), the time of such happening should be recorded.

2. Controlled Test Pumping of a Permitted Well.

a. Purpose:

Test pumping of the permitted well is needed to accurately measure well interference in the nonregulated well or wells. Data collected in accordance with the following guidelines can be used to determine aquifer properties, which are needed to predict pumping effects under other conditions (i.e., distance, duration, rate, precipitation deficiency, etc.). Data from other nearby observation wells may greatly assist in such determinations and should be collected in accordance with procedures specified for nonregulated wells, when possible.

b. Test Needs:

(1) Access to the nonregulated and permitted wells for water-level measurements.

(2) Water-level measurement equipment.

(3) A discharge location as far from the pumping well as possible and downhill.

(4) A means for measuring pumping rate.

c. Conditions Prior to Pumping:

Constant water levels in the nonregulated and permitted wells or clearly defined trends are desired prior to test pumping. The following guidelines attempt to ensure these conditions.

(1) The permitted well should not be pumped for at least six hours before the test begins. The time of last pump shutoff should be recorded.

(2) Water-level measurements in the permitted well should be made at 20 minute intervals for at least two hours prior to pumping. The last three consecutive measurements should be within two inches or 0.2 foot of each other or pumping should be delayed and measurements continued for up to another two hours.

(3) The nonregulated well should not be pumped for at least two hours prior to pumping the permitted well. The time of last pump shutoff should be recorded.

(4) Measurements of water level in the nonregulated well should be made at ten minute intervals for at least two hours prior to pumping the permitted well. The last three measurements should be within one inch or 0.1

foot of each other or pumping should be delayed and measurements continued for up to another two hours.

d. Conditions During Test Pumping:

(1) The time pumping begins in the permitted well should be recorded.

(2) The pumping rate should be at the maximum rate desired for the permitted use which is possible using the existing pump. A constant pumping rate should be maintained, if possible.

(3) Water levels in the nonregulated well(s) should be measured at the following intervals after pumping is begun:

- 30 second intervals from start of test to 3 minutes.

- 1 minute intervals from 3 minutes to 8 minutes.

- 2 minute intervals from 8 minutes to 20 minutes.

- 5 minute intervals from 20 minutes to 45 minutes.

- 15 minute intervals from 45 minutes to 2 hours.

- 30 minute intervals from 2 hours to 4 hours.

- 1 hour intervals from 4 hours to 12 hours.

- 2 hour intervals thereafter.

(4) Pumping rate and water level in the permitted well should be measured at intervals of approximately 5, 10, 20, 30, and 60 minutes after pumping is begun and at two hour intervals thereafter.

(5) No pumping of a nonregulated well must occur during the test pumping. The permittee may need to provide a temporary water supply for the nonregulated well owner(s) during test pumping.

(6) Test pumping should continue for a minimum of 24 hours. If water levels in both the nonregulated and permitted wells remain constant (within one inch or 0.1 foot) over a four hour period and the maximum pumping duration of the permitted well is less than or equal to 24 hours, pumping may stop at 24 hours. If not, pumping should be continued for the shorter of: 48 hours or such time as water levels remain constant as described above.

e. Conditions After Test Pumping:

(1) The time at which pumping of the permitted well is stopped should be recorded.

(2) Water-level measurements in the nonregulated and permitted wells should be made for six hours after pumping is stopped at the intervals described in d.(3) and (4).

(3) No pumping of any of the wells must be allowed during the six hour recovery period described in (2) above.

3. Simplified Test Pumping.

As an alternative to controlled test pumping, a simplified, less accurate procedure may be used if approved by the department. The department will grant approval of simplified test pumping only if significant cost savings over controlled test pumping can be documented. One such procedure is essentially the same as the controlled test pumping described above except for less frequent measurements. At minimum, a measurement of static water level prior to pumping and measurement of water level near the end of the pumping are required. However, water level measurements at the suggested time intervals for at least an hour before and during the first hour of test pumping are strongly recommended. The pumping rate should be measured near the beginning and end of the test pumping at minimum.

Another simplified procedure may be the collection of recovery data only, such as described in Section III.A.2.e. Pumping rates and durations prior to collection of recovery water-level data must be known if this procedure is utilized. Several water level measurements at half hour intervals should be made prior to pump shutdown. Recovery water level measurements should continue until consecutive measures remain relatively constant.

A simplified procedure will not provide as much data for predicting worst-case conditions. Therefore, the permittee will remain liable for future well interference if well interference is proven to be greater than the amount resolved based on a simplified test pumping procedure.

4. Test Pumping Involving Multiple Permitted Wells.

Possible test pumping procedures for situations where more than one permitted well is suspected of causing well interference in a nonregulated well are described below.

a. Controlled test pumping of each permitted well, as described in Item 2 above, is the most accurate method for

determining well interference caused by each permitted well. When this approach is taken, the pumping condition of the wells not being tested should remain constant. That is, the wells not being tested should maintain a constant pumping rate or not pump at all.

b. In situations where the aquifer is relatively uniform, test pumping of one permitted well may be done. The results from this test could then be used to calculate well interference from other permitted wells. This approach is not as accurate as controlled test pumping described above; therefore, the permittees will remain liable for future well interference if it is proven to be greater than the amount resolved based on this approach.

c. Simplified test pumping may be performed where all the permitted wells are pumped at once or are pumped under actual pumping conditions which would likely cause the most well interference. Well interference caused by each permitted well could then be estimated using known pumping rates, pumping durations, and separation distances. Again, the permittees will remain liable for future well interference if it is proven to be greater than the amount resolved based on this procedure.

5. **Long-Term Water-Level Declines.**

Well interference may result from long-term water-level declines caused by continued withdrawals for permitted uses, such as the dewatering of a quarry or gravel pit. In such cases, normal test pumping procedures may not be effective. Instead, an assessment of well interference may be possible using the following kinds of information:

- continued periodic measurement of water level in the nonregulated well;

- records of water levels and pumping conditions from the permitted use; and,

- assessment of geologic conditions.

B. **Criteria for Verifying Well Interference.**

A well interference problem will be verified if either of the following criteria is met.

1. **The Nonregulated Well is or Will Be Unable to Provide a Sufficient Supply of Water Due to Well Interference.**

Test pumping and/or hydrologic calculations will provide a determination of the amount of well interference. Two values of well interference which may be determined are:

- actual measured well interference; and,

- predicted worst-case well interference.

If an actual measured value is not available, the predicted worst-case value will be utilized in assessing well interference.

Well interference in the nonregulated well will be assessed with respect to pumping water level and interference water level as illustrated in Figure 6. The pumping water level is measured when well interference is not a factor as determined from procedures in Section III.A.1., pages 9-10. Interference water level is the pumping water level minus the measured or calculated well interference determined from procedures in Section III.A.2.-5., pages 11-14.

Steps for assessing well interference follow.

a. If the non-pumping water level with the permitted well(s) idle is below the pump suction level, well interference cannot normally be verified; unless, data are available to prove that well interference would be a problem if the well were reconstructed according to criteria in Section IV.B.1., page 22.

b. If the interference water level is above the protected water level specified in Rules 49.6 and 49.7 for wells constructed before July 1, 1986, or subrule 49.6(10) as described in Section IV.B.1., page 22 for wells constructed after July 1, 1986, well interference is not verified.

c. If the above criteria are not applicable and the interference water level is below the pump suction level, well interference is verified.

2. **Well Interference is Shown to Significantly Diminish Well Performance.**

This criterion is intended to apply to situations where the interference water level is above the pump suction level (Figure 6), but the increased pumping lift causes other problems. These problems may be:

- an insufficient pumping rate; or,

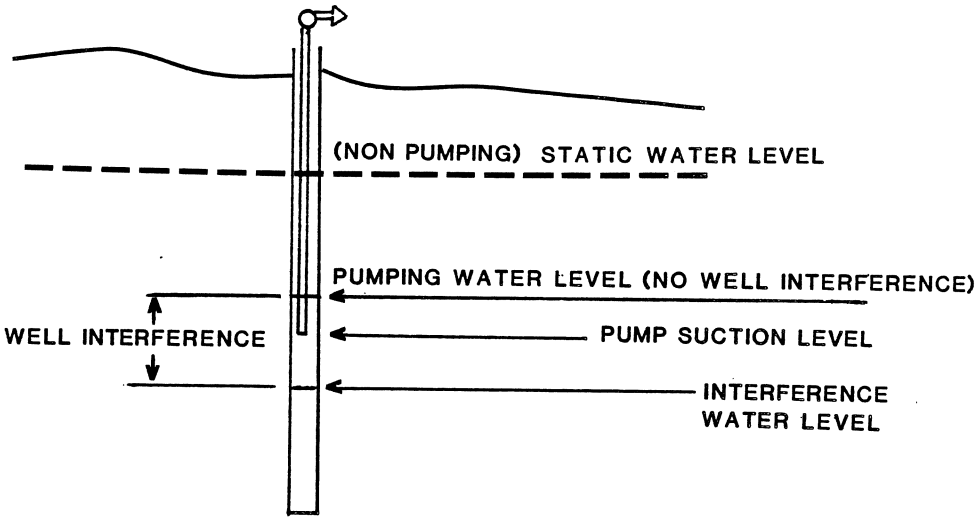
- inefficient pump operation.

Determination of such problems caused by well interference will be made on a case-by-case basis. Additional information may be required to make this determination including:

- the pump performance curve;

Figure 6

CONDITIONS USED TO VERIFY WELL INTERFERENCE



NONREGULATED WELL

NOTE: Pump suction level equals the top of a flowing well.

- measurement of the pumping rate from the nonregulated well while the permitted well(s) is pumping; and,

- measurement of the pump discharge pressure and electric current consumption in the nonregulated well.

C. Options for Resolving Problems Caused by Well Interference.

Settlement options can be classified into three general categories as follows:

- reduction of well interference;

- reduction of pumping drawdown in the nonregulated well; and,

- modifying or replacing the nonregulated well.

1. Reduction of Well Interference.

Theoretically, well interference is proportionate to pumping rate. For example, if well interference is 10 feet and the pumping rate in the permitted well is reduced by 30 percent, well interference would be reduced by three feet. The addition of storage facilities may make an otherwise unacceptable reduction in pumping rate possible.

Scheduling of pumping by the permittee may be another solution to well interference. Well interference increases with pumping duration. Therefore, shorter pumping periods may reduce well interference. It may be possible to schedule pumping during non-use periods of the nonregulated well. It also may be possible to suspend pumping during critical conditions like a drought. Again, addition of storage facilities may make scheduling of pumping an acceptable alternative.

The alternatives involving reduction of well interference will not involve compensation. They will involve placing conditions in the water use permit.

2. **Reduction of Pumping Drawdown in the Nonregulated Well.**

Reducing the pumping rate of the nonregulated well will reduce the pumping drawdown. Pumping drawdown will decline roughly proportional to pumping rate. If the nonregulated well pumps at a higher rate than is needed or storage facilities are added, then a lower pumping rate may be acceptable.

Well loss is the drop in water level from just outside the well to inside the well. Excessive well loss may be caused by the aquifer just outside the well becoming clogged with fine material, by a clogged or encrusted well screen, or by sediment in the bottom of the well, all of which will restrict water movement. In some cases, well rejuvenation by means such as cleaning, surging and acid treatment may significantly reduce well loss.

Measures taken to reduce the pumping rate in a nonregulated well for mitigation of well interference are eligible for compensation from the owner of the permitted well. Well rejuvenation is not eligible for compensation, except as noted in Section III.D.4.b.(3) on page 20.

3. **Modifying or Replacing the Nonregulated Well and/or Pumping Facilities.**

The only acceptable measures for resolving well interference problems may involve modification to or replacement of the nonregulated well. Modifications may include, but are not limited to:

- lowering the pump suction setting;

- replacing the pump;

- modifying the pump;

- installing a pump in a previously flowing well;

- deepening the well; and,

- replacing well casing or well screen to accommodate a pump.

Replacement may include constructing a new well or providing a connection to another water supply such as a rural water system, municipal system, the permittee's system, or other neighboring system.

D. Guidelines for Determining a Reasonable Offer.

These guidelines are for determining a reasonable offer in situations where a well interference problem has been verified and the method selected for resolving the problem involves compensation. A reasonable offer is addressed in terms of: standards for remedial work, liability for cost of remedial work, and adequacy of costs.

Remedial work can be classified as:

- minor repairs;

- major reconstruction;

- new well construction; or,

- connection to another water system.

Subsections 1. through 3. below specify general standards for remedial work and cost liability. Subsections 4. through 6. give special considerations for different types of remedial work. Adequacy of costs will be determined by the department based on available information.

1. General Standards for Remedial Work.

a. Well construction and major reconstruction should comply with applicable well construction standards, as described in Chapter 49 of the rules.

b. Remedial work should provide a water supply system which, in general, is as reliable as the original system was without well interference. Remedial work will not be required beyond that necessary to conform with subrule 49.6(10) as described in Section IV.B., pages 22-23.

c. Measures taken to resolve a well interference problem should consider predicted worst-case conditions as described in Section III.B.1., pages 14-15. However, if the remedial work required to resolve worst-case conditions is substantially more than would be needed to resolve measured well interference, the permittee or applicant has the option of providing compensation for the extra work or not. If the permittee or applicant elects to provide compensation to resolve less than predicted worst-case well interference, the permittee or applicant will

remain liable for future well interference which is proven to be greater than the amount resolved in the original settlement.

d. Remedial work should ensure that the pump is properly sized for the anticipated operating conditions. Proper sizing includes ability to pump at a sufficient rate and duration to meet the given needs and operating with high relative efficiency under normal operating conditions.

2. **General Criteria for Cost Liability.**

The nonregulated well owner's cost for well inspection and test pumping are eligible for compensation. All costs for remedial work necessary to resolve a verified well interference problem are eligible for compensation, except as noted below.

a. When the existing well does not comply with applicable well construction standards (Chapter 49 of the rules), costs which are required to bring the well "up to standards" are not eligible for compensation.

b. Costs for work requested by the nonregulated well owner which results in upgrading the nonregulated water supply are not eligible for compensation.

c. Costs for legal fees are not eligible for compensation.

d. Operation and maintenance costs of the water supply system are not eligible for compensation.

e. Costs of the well rejuvenation are not eligible for compensation, except as provided in paragraph III.D.4.b.(3) on page 20.

f. Costs due to temporary loss of water for such things as hauling water and going to a laundromat are not eligible for compensation, unless the permittee refuses to comply with an emergency order by the department.

3. **Water Quality Considerations.**

If resolution of a well interference problem involves obtaining water from a different source, the quality of the water from the new source must, in general, be equal to or better than the water from the old source or must meet appropriate water quality standards, whichever is less restrictive. When a new source is to be utilized, water samples from both the new source and old source must be analyzed for nitrate, bacteria, iron and hardness. Analyses of other constituents may be required if just reason is demonstrated. Costs for analyses are eligible for compensation. If treatment facilities must be added to meet the above criteria, the initial installation cost of such facilities is eligible for compensation.

4. **Minor Repairs.**

a. **Definition:**

Minor repairs include any remedial measure to an existing water supply system which does not involve structural changes to the well. Examples of minor repairs are:

- lowering the pump or drop pipe;

- modifying or replacing the pump;

- adding storage facilities; and,

- well rejuvenation, such as cleaning, surging, and acid treatment.

b. **Special Conditions:**

(1) When only minor repairs are necessary, an existing well does not have to be brought "up to standards" except as noted in Subrule 49.6(7).

(2) When minor repairs involve lowering the pump or drop pipe, the pump or drop pipe should be lowered as far as practical. The entire cost of this will be eligible for compensation.

(3) If the department determines that well rejuvenation which does not involve structural changes to the well, in itself, may solve the problem of not being able to maintain a sufficient water supply, then the permittee(s) will be given the option of requiring the complainant to take appropriate action to rejuvenate the well or not. The cost of such well rejuvenation shall be paid by the complainant but will be eligible for compensation if the well still fails to provide a sufficient water supply.

5. **Major Reconstruction.**

a. **Definition:**

Major reconstruction involves structural changes to a well such as deepening the well, enlarging the well diameter, or removing/replacing well casing or well screen.

b. **Special Conditions:**

Well location standards (Rule 49.5) will not be enforced when remedial work involves major reconstruction of the existing well.

6. New Well Construction or Connection to Another System.

a. Definition:

New well construction is self-explanatory. Connection to another water system may include: a rural water system, municipal system, the permittee's system, or another neighboring system.

b. Special Conditions:

(1) Well location standards (Rule 49.5) must be enforced. If the old well did not meet well location standards, costs for connecting a new well to the distribution system are not eligible for compensation.

(2) If the old well did not meet well construction standards as discussed in Section III.D.2.a., page 19, other than well location, costs which would have been required to bring the old well "up to standard" will be deducted from the costs which would otherwise be eligible for compensation.

(3) The nonregulated well owner may reject an offer for connection to another system if the life-cycle costs can be proven to be substantially more than for another alternative (such as construction of a new well).

(4) The old well must be abandoned in accordance with Rule 49.13, the cost of which is eligible for compensation.

IV. NONREGULATED WELL CONSTRUCTION STANDARDS AND GUIDELINES WHICH APPLY TO WELL INTERFERENCE COMPENSATION.

A. Standards for Well Construction and Major Reconstruction.

The Iowa Administrative Code 900--Chapter 49 entitled "Nonpublic Water Wells" specifies construction standards for new well construction and major reconstruction. The standards are primarily concerned with prevention of contaminants from entering the well including: location of wells with respect to potential contaminant sources, minimum well depths, prevention of surface drainage from entering the well, and proper well abandonment. When compensation is required for construction of a replacement well or major reconstruction of an existing well, work must comply with these standards. Work necessary to bring an existing well "up to standards" is not eligible for compensation.

Subrule 49.6(10) includes guidelines for new well construction which must be followed to be eligible for future well interference compensation. Section B below discusses these guidelines in more detail.

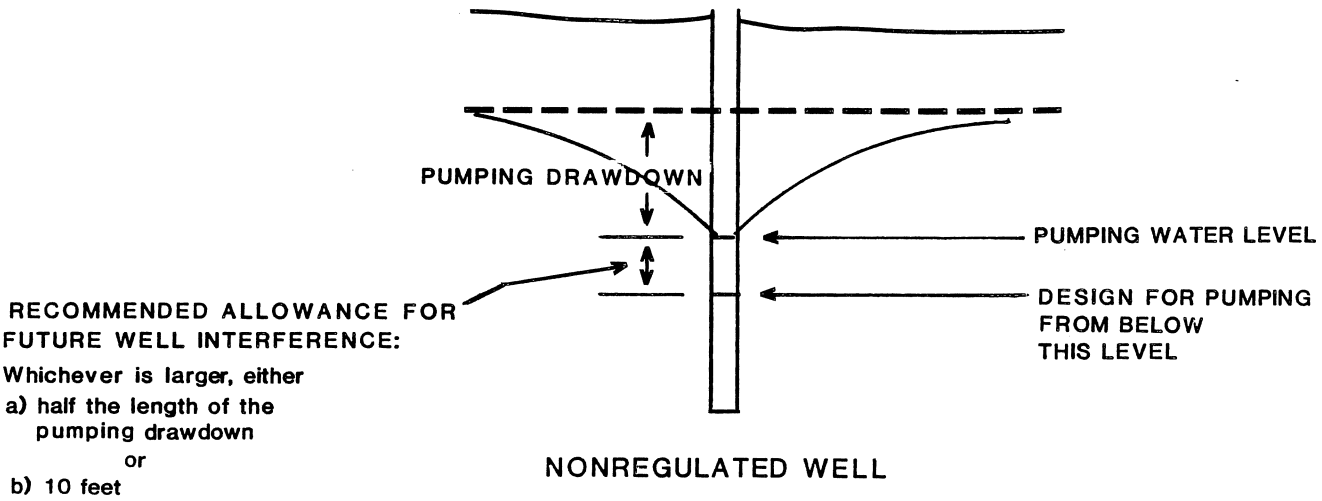
B. Guidelines for New Construction of Nonregulated Wells to be Eligible for Future Well Interference Compensation.

1. Protected Water Levels.

Nonregulated wells constructed after July 1, 1986, should be constructed to allow for future well interference of 10 feet or 50 percent of the pumping drawdown in the well, whichever is greater, based on the design capacity of the new well (see Figure 7). However, in no situation must the non-pumping water level be protected below the top of a confined aquifer or half the normal saturated thickness of an unconfined aquifer. Shallow aquifers which are only slightly confined may be classified as unconfined aquifers for this purpose. Consideration should be given to future conditions such as drought and reduced well efficiency.

Figure 7

WELL INTERFERENCE ALLOWANCE FOR NEW WELL CONSTRUCTION



These guidelines will be used as a basis for verifying well interference in nonregulated wells which are constructed or undergo major reconstruction after July 1, 1986. It is strongly recommended that these guidelines be followed in areas with a large potential for groundwater development.

2. **Flowing Wells.**

New flowing wells should be constructed to accommodate a pump capable of supplying a sufficient water supply when the static water level is at the top of the confined aquifer, or a hundred feet below the surface, whichever is higher.

APPENDIX A

Water-Level Measurements in Wells

The measurement of water levels in wells is essential to resolving well interference problems. Access to the well must first be obtained. New wells and wells which undergo major reconstruction are required to be equipped with an access port having a minimum diameter of three-fourths inch. The access port must be fitted with a threaded cap or plug and allow insertion of a measuring device such as described below.

1. **Steel Tape Method.**

   A lead weight is attached to a steel measuring tape (such as a surveyor's tape). The lower several feet of the tape are wiped dry and coated with carpenter's chalk or keel. The tape is then let down the well until a part of the chalked section is below water and a one foot mark is held exactly on top of the well casing or other measuring point. The tape is then pulled out and the reading of the wetted line on the tape is subtracted from the foot mark at the measuring point. This gives the depth to water from the measuring point.

2. **Electric Sounder Method.**

   An electric sounder consists of a pair of insulated wires connected to an ammeter or light and batteries on one end and a contact electrode on the other end (see Figure A-1). Several manufactured electric sounders are available. The end with the electrode is lowered into the well. When the electrode touches water, it completes the circuit as indicated by a deflection of the ammeter needle or the light. The location on the wire is marked at the measuring point, such as the top of the well casing. The electrode is then removed and the distance from the mark on the wire to the electrode is measured. That distance is the distance from the measuring point to the water level in the well.

3. **Air Line Method.**

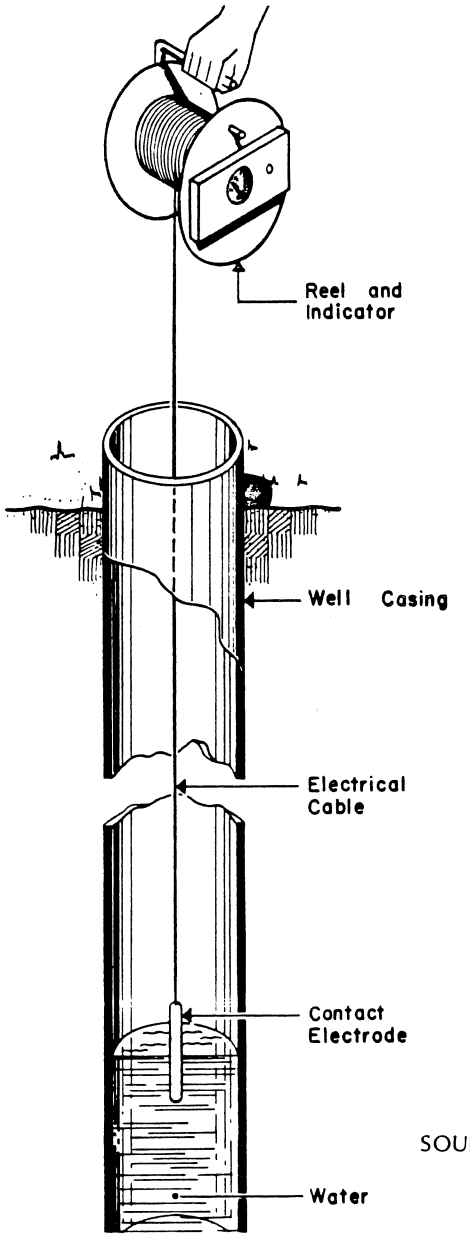
   This method consists of placing a small diameter pipe or tube into the well to a depth below the water level (see Figure A-2). An air pump and pressure gauge are attached to the upper end of this air line. The air pump is operated until the pressure remains constant. This reading indicates the pressure of water above the end air line. If pressure is in pounds per square inch (psi), multiplying by 2.31 will give feet of water above the end of the air line. To convert this to depth to water from the top of the well casing, subtract the height of water above the end of the air line from the distance from the top of the well casing to the bottom of the air line.

4. **"Popper" Method.**

   A weighted line is lowered down the well until contact with the water is heard. The line is jerked up and down for verifying the point of water

Figure A-1

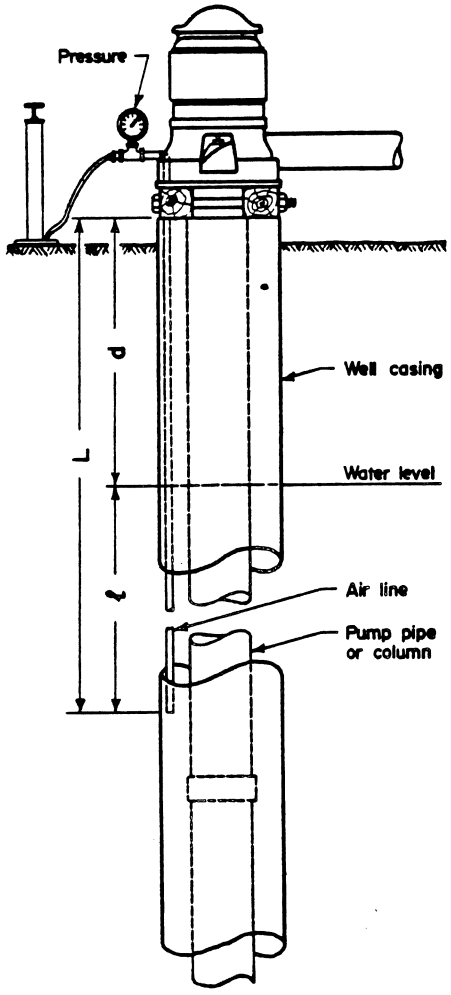
ELECTRIC SOUNDER METHOD OF WATER LEVEL MEASUREMENT



SOURCE: "Groundwater and Wells", 1975.
Johnson Division, UOP Inc.

Figure A-2

AIR LINE METHOD FOR MEASURING WATER LEVEL IN A WELL



SOURCE: "Groundwater and Wells", 1975.
Johnson Division, UOP Inc.

contact. The line is marked at the measuring point and is then withdrawn from the well. The distance from the weighted end of the line to the marked point is measured and equals the depth from the measuring point to the water level in the well. This method will not work in wells which are pumping.

5. **Continuous Water Level Recorders.**

Continuous water level recorders are available which operate with floats, electrodes, or sonar. Some recorders are available with spring-driven or battery-operated clocks. Other recorders require an electrical power source.

APPENDIX B

Pumping Rate Measurements

Numerous methods of measuring pumping rates are available. Many are described in the book by Johnson Division, UOP Inc., entitled "Ground Water and Wells", 1966 and 1975. A simple method of measuring pumping rate is measuring the time for a known volume of water to pass through a water meter or fill a bucket or other container of known volume. The volume divided by the time gives pumping rate.

APPENDIX C

Well Inspection Form

IOWA DEPARTMENT OF NATURAL RESOURCES

WATER RIGHTS PROGRAM

WATER WELL INSPECTION REPORT

PART A — WELL LOCATION

NAME
☐ OWNER ☐ AUTHORIZED AGENT

TELEPHONE NUMBER
OFFICE ( )
HOME ( )

MAILING ADDRESS

Place an 'X' on the attached map showing the exact location of your well.

COUNTY	TOWNSHIP NAME	TOWNSHIP NR.	RANGE NR.	SECTION	FRACTION 1/4	1/4	1/4

PART B — WELL CONSTRUCTION

NAME OF COMPANY WHICH DRILLED WELL

DATE COMPLETED | DRILLED DEPTH | PRESENT DEPTH

CASING

MATERIAL
☐ STEEL
☐ PLASTIC
☐ CONCRETE
☐ WOOD
☐ OTHER _____

HEIGHT ABOVE (BELOW) LAND SURFACE

DIAMETER (inches)

LENGTH (feet)

INTERVAL FROM _____ FEET TO _____ FEET

DRILLING METHOD (if known)
☐ MUD ROTARY ☐ CABLE TOOL ☐ DUG
☐ AIR ROTARY ☐ BORED/AUGERED
☐ OTHER _____

SCREEN

☐ YES ==> Complete all of this section.
☐ NO ==> Complete this item only.
OPEN HOLE FROM _____ FEET TO _____ FEET.

DIAMETER (inches)

LENGTH (feet)

MATERIAL
☐ STAINLESS STEEL
☐ GALVANIZED STEEL
☐ PLASTIC
☐ OTHER _____

INTERVAL FROM _____ FEET TO _____ FEET

NONPUMPING WATER LEVEL BELOW (ABOVE) LAND SURFACE
_____ FEET
_____ DATE MEASURED
_____ HOW MEASURED (steel tape, etc.)

PUMP

TYPE
☐ SUBMERSIBLE
☐ JET, SHALLOW
☐ JET, DEEP
☐ RECIPROCATING
☐ CENTRIFUGAL
☐ OTHER _____

AGE (years)

PUMPING RATE (gpm)

PUMP SETTING - SUBMERSIBLE (below ground level) feet

DROP PIPE LENGTH - NONSUBMERSIBLE (below ground level) feet

PUMPING WATER LEVEL BELOW LAND SURFACE
_____ FEET
_____ DATE MEASURED
_____ HOW MEASURED (steel tape, etc.)

FLOWING WELL
☐ YES ☐ NO

PART C — WELL CONDITION

NOTE: Attach additional sheets as needed

CASING ☐ CRACKED ☐ FILLED WITH SEDIMENT ☐ HOLES ☐ ENCRUSTED ☐ OTHER _____		COMMENT (describe method of inspection)
SCREEN (if one exists) ☐ ENCRUSTED ☐ RUSTED/CORRODED ☐ PLUGGED ☐ OTHER _____		COMMENT (describe method of inspection)
PUMP ☐ ENCRUSTED ☐ ELECTRICAL PROBLEM ☐ RUSTED/CORRODED ☐ OTHER _____		COMMENT (describe method of inspection)
DROP PIPE ☐ RUSTED/CORRODED ☐ PLUGGED ☐ HOLES/CRACKS ☐ WATER LEAKS ☐ OTHER _____		COMMENT (describe method of inspection)
DISTRIBUTION ☐ PLUGGED LINES ☐ BREAK ☐ VACUUM IN LINES ☐ OTHER _____		COMMENT (describe method of inspection)
OTHER (describe method of inspection)		

PART D — SIGNATURES

WELL OWNER OR AGENT	DATE	DRILLER	DATE

COMPLAINT QUESTIONNAIRE

Please answer all questions by providing as much information as possible. Attach any documents involved, such as receipts, work lists, bids, etc.

1) Describe the problem _____

_____

_____

_____

_____

2) Suspected cause of the problem _____

_____

3) Past well problems? - Explain _____

_____

_____

4) Have you corrected the problem? - Explain _____

_____

5) How do you feel this problem can be fairly resolved? _____

_____

6) Have you complained before? _____ When? _____

To whom? _____

7) General comments _____

_____

_____

_____

8) Describe all uses of water _____

_____

_____

9) What is the minimum acceptable pumping rate? _____

10) Is storage provided? _____ If yes, describe the type and volume of storage.

_____

11) Attach a copy of the pump performace curve, if available