Importance Factors For Water Supply Wells

(Wellhead Protection Area Delineation)

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This technical memorandum presents our recommendations on a methodology for defining the importance factors for each of your water supply wells. As you will recall from the most recent board meeting (held on July 25th), the importance factors are needed so that we can delineate special wellhead protection areas for each well. The goal of delineating special wellhead protection areas is to provide an "optimally sized" management area. An "optimally sized" management area has the two following features:

- It is large enough to give the water purveyor time to replace the water source if replacement is needed.
- It is not so large that it becomes unfeasible to implement management or contingency plans.

Meaning of Importance Factors

The importance factors are related to the response time to a contamination event. You can think of the response time as the period of time that you would need to replace a well if a contamination event were to make it unusable. As we discuss below, options for replacing the lost well can vary according to such factors as (1) how important the well is for providing year-round or seasonal water supply; (2) the capability of your distribution system to move higher flow rates from other water supply wells; and (3) your ability to obtain water from another purveyor.

At the recommendation of CH2M HILL, the Board agreed during the July 25th meeting to use a time-of-travel (TOT) of 1 year (12 months) as the base time period for delineating the special wellhead protection areas. The importance factor for an individual well is related to the one-year TOT and to the response time at that well as follows:

$$\text{Importance Factor} = \text{Response Time} / 12 \text{ months}$$

An importance factor of less than 1.0 indicates that the response time is less than one year. A value greater than 1.0 indicates the response time is longer than one year. When we use the groundwater flow model to delineate a given well, we will actually tell the model to delineate for a time duration equal to the response time. For example, if the importance factor for a well is 0.5, then the model will delineate a 6-month (1/2 year) wellhead protection area. However, for the purposes of presenting the delineation, the delineated

management area will be called a Special Wellhead Protection Area having a one-year time-of-travel and an importance factor of 0.5.

Methodology for Selecting Importance Factor Values

CH2M HILL believes that it is important to use a specific set of methods for selecting the response times and importance factors at each well. The use of a common set of methods by all SAJB members for all 98 wells is important in order for the size and extent of the delineated management zone to be defensible to the public.

Table 1 summarizes the methodology for selecting the values and provides a range of values that are recommended for the special wellhead protection areas. The table consists of 15 scenarios that are distinguished by the following considerations:

- **The use of the well.** The following three types of uses are considered.
    - **Primary supply.** Describes wells that are used each month of the year.
    - **Secondary supply.** These operate at least 6 months of the year. They supplement the primary wells and serve a broader demand period than seasonal peak demands.
    - **Peaking supply.** These wells operate during less than 6 months of the year. Their primary purpose is to meet peak daily demands during the hottest months of the year.
- **The availability of water from other purveyors.** Agreements and facilities may be in place for obtaining water from other water purveyors. This also considers whether water has historically been received from other purveyors.
- **The design of the distribution system.** Consideration is given to the degree to which the distribution system is capable of handling an increase in pumping at other wells.

Table 1 lists the response times and the importance factors for each of the 15 scenarios. As indicated in the table, the time element does not necessarily need to describe the response time (which measures the ability to replace a well). Instead, it could be the duration of time that the water purveyor wishes to have available to conduct planning work in response to a contamination event. For primary wells, which are used year-round, the desired planning time may be much longer than the actual time that the purveyor is capable of bringing an alternate source online under emergency circumstances. For peaking wells, which are used only on a seasonal basis, the response time and the planning time may be similar.

The rationale behind the derivation of the response times and importance factors contains the following elements:

1. The highest importance factors are for the primary wells. Progressively lower factors are used for secondary and peaking wells, respectively.
2. Primary wells have importance factors no lower than 1.0. This means that the special wellhead protection area represents the area contributing water to the well during a 1-year (or longer) time period.

3. Secondary and peaking wells are allowed to have importance factors less than 1.

4. The minimum importance factor for any scenario is 0.1. This corresponds to a 30-day (one-month) time-period for delineation.

5. Importance factors are increased if other purveyor-owned wells can not supply the water. The importance factors are further increased if agreements and facilities are not currently in place to replace the volume of water that is needed.

6. Importance factors are increased if the distribution system is limited in its ability to convey increased flow from alternate sources (whether those water sources are purveyor-owned or are provided by another purveyor).

7. The maximum importance factor is 5.0, which corresponds to a 5-year time-period for delineation. Delineations for longer time periods would result in areas that are too large to be feasibly managed.

Assumptions incorporated into the methodology are:

1. The flow volume provided by the lost well needs to be replaced in full. This assumption is incorporated into all 15 scenarios listed in Table 1. If this assumption is unrealistic for a given well or purveyor, then the importance factors can be adjusted downwards (but not below 0.1).

2. If the necessary volume of water can presently be obtained from other purveyors, then the distribution system is assumed to be capable of delivering this flow. This assumption is incorporated into scenarios 5, 10, and 15.

3. If there is no existing alternate water source (either a purveyor-owned well or a source owned by another purveyor), then the distribution system is assumed to require additional capital expenditures. This assumption is incorporated into scenarios 4, 9, and 14.

TABLE 1
Methodology and Rationale for Response Times and Importance Factors
SAJB Wellhead Protection Program

Scenario	Well Use [(a)]	Is The Necessary Flow Obtainable From Other Wells? [(b)]	Can The Necessary Flow Be Obtained From Other Purveyors? [(c)]	Distribution System Capabilities [(d)]	Response Time or Planning Time (months)	Importance Factor [(e)]
1	Primary	Yes	---	Capable	≤ 12	1.0
2	Primary	Yes	---	Limited	12 - 36	1.0 - 3.0
3	Primary	Yes	---	Incapable	24 - 60	2.0 - 5.0
4	Primary	No	No	Limited or Incapable	24 - 60	2.0 - 5.0
5	Primary	No	Yes	Capable	12 - 24	1.0 - 2.0
6	Secondary	Yes	---	Capable	9 - 12	0.75 - 1.0
7	Secondary	Yes	---	Limited	12 - 36	1.0 - 3.0
8	Secondary	Yes	---	Incapable	24 - 60	2.0 - 5.0
9	Secondary	No	No	Limited or Incapable	18 - 60	1.5 - 5.0
10	Secondary	No	Yes	Capable	6 - 12	0.5 - 1.0
11	Peaking	Yes	---	Capable	3 - 6	0.25 - 0.5
12	Peaking	Yes	---	Limited	6 - 36	0.5 - 3.0
13	Peaking	Yes	---	Incapable	12 - 36	1.0 - 3.0
14	Peaking	No	No	Limited or Incapable	6 - 36	0.5 - 3.0
15	Peaking	No	Yes	Capable	1 - 12	0.1 - 1.0

(a) Well uses are defined as follows:
Primary: Used on a year-round (or nearly year-round) basis
Secondary: Helps with summer peak demands, but also used at other times.
Peaking: Used exclusively for peak demand periods.
(b) It is assumed that the lost pumping volume needs to be replaced.
(c) Dashes indicate that this question is not relevant (i.e., capacity is available at other wells).
"Yes" entry assumes that agreements and facilities are in place and that supply is available.
(d) Distribution system capabilities are defined as follows:
Capable: Pumping loss at this well can be replaced by pumping from another well without exceeding capacity of distribution system at other wells.
Limited: Pumping increases may not be possible at other wells without exceeding capacity of distribution system. May depend on season during which pumping needs to be increased at other wells.
Incapable: System would require capital improvements before increasing pumping at other wells.
(e) Equals response time divided by one year.