MEMORANDUM

To: Lew Dodgion, Administrator/Dick Reavis, Bureau Chief

From: John Nelson, Water Permits Branch

Subject: Groundwater Study Requirements

Date: January 28, 1991

In putting together the groundwater study requirements the following steps should be followed:

I) Determine which groundwater basins may be subject to possible degradation from septic systems.

   1) I have developed a model using the basin groundwater storage and the surface recharge. This model creates a density limit for each basin that would trigger the need for the groundwater study. Based on the model the density limits for each basin are found in attachment 1.

   2) Once any portion of groundwater basin has an approved septic system density equal to or greater than the density noted in attachment 1 a groundwater study would be required.

II) Prior to performing the study the area of the study must be determined by a hydrologist. The area of the study shall be determined using as a minimum the following survey requirements.

   1) Locate the area that is proposed for development using septic systems.

   2) Determine the area of the aquifer that will be impacted the most by the development of proposed septic system.

   3) Determine other source areas that will contribute contaminates to the areas identified above.

   The area to be studied shall include the combination of the three areas mentioned above.

EXHIBIT G - WESTERN WATER
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III) Evaluate the existing water quality of the area to be studied and characterize the ground-water regime.

1) Groundwater samples must be obtained for the shallow aquifers in each area. Also the groundwater elevations shall be reported.

2) The groundwater shall be sampled for Nitrates, Chlorides, and Total Dissolved Solids.

IV) A conceptual model shall be developed of the study area.

1) The geologic and hydrologic setting of the area must be described. Existing reports such as the U.S.G.S. and Nevada Division of Water Resources should be referenced.

2) Data from domestic wells and monitoring wells must be used to update existing information and to determine the present conditions.

3) Geologic conditions must be evaluated to determine the influence on vertical and horizontal groundwater movement.

4) The Mixing of recharge and septic effluent discharge must be evaluated.

V) Next a numerical model must be developed to simulate the response of an aquifer both hydraulically and chemically to stresses on a set of contiguous blocks. The blocks shall be arranged in rows and columns which comprise the model grid. Each block in the grid shall be no longer than 500 feet by 500 feet. The input data for the model shall have the following parameters and may require additional parameters if necessary.

1) Groundwater elevation data:

2) Transmissivity and Storage Coefficient:

3) Nitrate Concentration in the Groundwater:

4) Contribution of existing septic systems:

VI) The model shall then be run for the following simulations with a minimum time period of 50 years:

1) Simulate for approved septic systems which have not been constructed to date.

2) Simulate for proposed development with all previously approved septic systems.

3) In areas where the existing groundwater depth is less then 100 feet from the natural ground surface, perform a groundwater mounding analysis.

Attachment 1

POLICY FOR DETERMINATION OF MAXIMUM NUMBER OF RESIDENCES ON SEPTIC SYSTEMS PER SQUARE MILE TO BE PERMITTED WITHOUT REQUIRING A GROUNDWATER STUDY TO DETERMINE IMPACT ON GROUNDWATER QUALITY

I. INTRODUCTION

The maximum number of residences on septic systems which will be permitted per square mile without a prior groundwater study has been determined for each of the 232 hydrographic areas in the State of Nevada. Results of this determination are available from the Bureau of Water Pollution Control. Once this predetermined residence number is projected to be exceeded in a given area, a groundwater study will be required before the Nevada Division of Environmental Protection will approve additional septic systems. The groundwater study will be used to determine the impact of proposed septic facilities on existing water quality; approvals may be issued or denied on that basis.

II. THE GOVERNING EQUATION DEFINED

The premise used in determining the number of residences which will trigger the requirement for a groundwater study is based on the following two—part governing equation:

- Total contamination equals contamination contributed to the total aquifer recharge plus contamination contributed to the groundwater in storage where:
- The total contamination is proportional to the total number of residences on a septic system,
- Groundwater in storage equals groundwater stored in upper 100' of saturated alluvium,
- The volume available for assimilating (diluting) septage is the volume of the total aquifer recharge plus groundwater in storage, and
- The total number of septic systems equals the number of septic systems affecting recharge volume plus the number of septic systems affecting storage volume.

Based on the above premise and on the assumptions and calculations outlined in Parts III, IV, and V below, the governing equation is defined as follows:

$$\text{Number of septic systems} = \frac{(0.2)\,(\text{ppt recharge AF}) + (.02)\,(\text{storage AF})}{.392\ \text{AF/yr/residence}}$$

III. GENERAL ASSUMPTIONS AND DEFINITIONS

General assumptions and definitions inherent in the premise for the governing equation are listed below.

1. All contamination being considered is derived from septic systems; therefore, total contamination is related to the total number of residences on septic systems.

2. Total nitrogen has been selected as the constituent of primary concern with respect to impacts on groundwater quality from septic systems. This is based on known contaminants and groundwater studies done in Nevada to date.

3. An estimate of maximum residential flow is 350 gallon/s per day, which is equivalent to 0.392 acre—ft/year/residence.

4. Based on the EPA Design Manual for Onsite Wastewater Treatment and Disposal Systems, the concentration of total nitrogen which enters a leach field varies from 35 to 100 mg/l. As a conservative approach to groundwater protection, 100 mg/l total nitrogen was chosen as input to the leach field.

5. As a conservative estimate for use in the governing equation, the accepted limit of total nitrogen in groundwater used for drinking water is 10 mg/l.

6. All of the 100 mg/l of total nitrogen is available to be converted to nitrogen as nitrate. The drinking water standard for nitrate is 10 mg/l (Federal Safe Drinking Water Act).

7. The abbreviation for "precipitation" is defined as "ppt".

8. The abbreviation for "acre—feet per year" is defined as "AFY", and "acre—feet" is defined as "AF".

IV. ASSUMPTIONS AND CALCULATIONS RELATING TO THE NUMBER OF SEPTICS LIMITED BY RECHARGE CONSIDERATIONS (The First Factor in the Governing Equation)

A. Assumptions

1. A 50% decrease in concentration of septic effluent in the unsaturated zone was assumed (e.g., plant uptake, possible dilution, etc.). Therefore the possible concentration of the discharge from a septic system which could reach the groundwater was assumed to be 50 mg/l.

2. Precipitation recharge has a total nitrogen content of zero.

3. If precipitation recharge is assumed to have a nitrogen content of zero, then all nitrogen in recharge to groundwater must come from septic systems. If a septic system has an output of 50 mg/l, but 10 mg/l is the acceptable limit (IV.A.l), then the ratio of permissible septic recharge to precipitation recharge must be 1:5, or 0.20. Therefore, septic recharge equals (0.20) (precipitation recharge).

B. Calculations

In the determination of the first factor in the governing equation, which addresses the relationship of the total number of residences on septic systems to the contamination in the total recharge to the aquifer, the following relationships were employed:

Septic recharge = (number of septic systems) (output/septic)
= (number of septic systems) (0.392 AFY);

Septic recharge/precipitation recharge = 1/5 = 0.20; and,
Septic recharge = (0.20) (precipitation recharge).

Consequently,

$$\# \text{ septics} = \frac{(0.20)\ (\text{ppt recharge AFY})}{0.392\ \text{AFY/residence}}$$

V. ASSUMPTIONS AND CALCULATIONS RELATING TO THE NUMBER OF SEPTICS LIMITED BY AQUIFER STORAGE CONSIDERATIONS (The Second Factor in the Governing Equation)

A. Assumptions

1. A Constant volume of aquifer storage is assumed, with negligible interbasin flow.

2. Groundwater in storage may have a background value of total nitrogen of 0-5 mg/l.

3. Because 10 mg/l is the "trigger" limit of nitrogen in groundwater used for drinking (111.5), and water in storage may have up to 5 mg/l background concentration
(V.A.2 above), the maximum concentration of nitrogen which could be added to water in storage is 5 mg/l. Therefore, some number less than 5 mg/l must be used in the calculations to provide an adequate means of pollution prevention. In this instance, 2 mg/l was chosen as a limit for nitrogen added to groundwater in storage.

4. When calculating the effect of nitrogen from septic systems on the ground water in aquifer storage, no decrease in concentration of septic effluent in an unsaturated zone was assumed.

5. If a septic system has an output of 100 mg/l (III.4), but 2 mg/l is the acceptable concentration to be added to ground water in storage (V.A.3 above), then the ratio of permissible septic nitrogen to aquifer storage nitrogen must be 2:100, or 0.02. Therefore, septic nitrogen contributed to groundwater in storage = (0.02) (groundwater in storage).

B. Calculations

In the determination of the second factor in the governing equation, which addresses the relationship of the total number of residences on septic systems to the contamination groundwater in storage in the aquifer, the following relationships were employed:

> Total nitrogen of groundwater in storage = nitrogen contributed from septic systems + background nitrogen of ground water in storage;
>
> Concentrations of nitrogen from septic systems and background nitrogen concentrations are proportional to the respective associated fluid volumes;
>
> Nitrogen contributed from septic systems = (number of septic systems) (output from septic systems) = (number of septic systems) (.392 AF);
>
> Concentration of septic nitrogen/background concentration of groundwater in storage = 1/50 = 0.02; and,
>
> Septic nitrogen contributed to groundwater in storage = (.02) (groundwater in storage).

Consequently,

$$\text{The number of septics} = \frac{(0.02)\ (\text{AF storage})}{0.392\ \text{AF}}$$

VI. HIGH AND LOW END LIMITATIONS

The values obtained for the number of residences on septic systems per square mile which will trigger the requirement for a groundwater study prior to approval of additional septic systems have been limited by NDEP on both the high and low ends. Most of the residence numbers fell between 50 and 200; consequently, 50 and 200 were chosen as end—member values. Basins with residence numbers of less than 50 were raised to 50; basins with very high numbers were scaled down to a limit of 200 residences per square mile. This was judged by NDEP to be a fair balance between maximizing groundwater protection in areas of high population pressures, and minimizing the burden on growth in under populated areas.

Basin	ρ		Area Name
1	131		Pueblo Valley
2	100		Continental Lake Valley
3	72		Gridley Lake Valley
4	50	*	Virgin Valley
5	200	*	Sage Hen Valley
6	50	*	Guano Valley
7	200	*	Swan Lake Valley
8	51		Massacre Lake Valley
9	130		Long Valley
10	66		Macy Flat
11	50	*	Coleman Valley
12	86		Mosquito Valley
13	200	*	Warner Valley
14	50	*	Surprise Valley
15	50	*	Boulder Valley
16	62		Duck Lake Valley
17	50	*	Pilgrim Flat
18	50	*	Painter Flat
19	133		Dry Valley
20	85		Sano Valley
21	111		Smoke Creek Desert
22	144		San Emidio Desert
23	51		Granite Basin
24	68		Hualapai Flat
25	50	*	High Rock Lake Valley
26	96		Mud Meadow
27	89		Summit Lake Valley
28	136		Black Rock Desert
29	184		Pine Forest Valley
30	200	*	Kings River Valley
31	196		Desert Valley
32	200	*	Silver State Valley
33	200	*	Quinn River Valley
34	200	*	Little Owyhee River Area
35	50	*	South Fork Owyhee River Area
36	101		Independence Valley
37	50	*	Owyhee River Area
38	50	*	Bruneau River Area
39	200	*	Jarbidge River Area
40	50	*	Salmon Falls Creek Area
41	50	*	Goose Creek Area
42	116		Marys River Area
43	131		Starr Valley Area
44	119		North Fork Area
45	163		Lamoille Valley
46	113		South Fork Area
47	100		Huntington Valley
48	108		Dixie Creek-Tenmile Creek Area
49	103		Elko Segment
50	110		Susie Creek Area

Basin	ρ		Area Name
51	112		Maggie Creek Area
52	105		Marys Creek Area
53	117		Pine Valley
54	104		Crescent Valley
55	99		Carico Lake Valley
56	111		Upper Reese River Valley
57	105		Antelope Valley
58	104		Middle Reese River Valley
59	108		Lower Reese River Valley
60	102		Whirlwind Valley
61	109		Boulder Flat
62	103		Rock Creek Valley
63	112		Willow Creek Valley
64	99		Clovers Area
65	98		Pumpernickel Valley
66	76		Kelley Creek Area
67	79		Little Humboldt Valley
68	98		Hardscrabble Area
69	78		Paradise Valley
70	74		Winnemucca Segment
71	81		Grass Valley
72	77		Imlay Area
73	72		Lovelock Valley
74	131		White Plains
75	101		Bradys Hot Springs Area
76	181		Fernley Area
77	116		Fireball Valley
78	139		Granite Springs Valley
79	155		Kumiva Valley
80	143		Winnemucca Lake Valley
81	149		Pyramid Lake Valley
82	152		Dodge Flat
83	50	*	Tracy Segment
84	99		Warm Springs Valley
85	118		Spanish Springs Valley
86	105		Sun Valley
87	120		Truckee Meadows
88	170		Pleasant Valley
89	200	*	Washoe Valley
90	0	**	Lake Tahoe Basin
91	188		Truckee Canyon Segment
92	138		Lemmon Valley
93	142		Antelope Valley
94	87		Bedell Flat
95	85		Dry Valley
96	50	*	Newcomb Lake Valley
97	149		Honey Lake Valley
98	200	*	Skedaddle Creek Valley
99	70		Red Rock Valley
100	92		Cold Spring Valley

* Adjusted for maximum of 200 and minimum of 50. ** In the Lake Tahoe Basin no septic systems are allowed.

Basin	ρ		Area Name	Basin	ρ		Area Name
101	199		Carson Desert	151	143		Antelope Valley
102	80		Churchill Valley	152	156		Stevens Basin
103	72		Dayton Valley	153	200	*	Diamond Valley
104	200	*	Eagle Valley	154	107		Newark Valley
105	117		Carson Valley	155	114		Little Smoky Valley
106	111		Antelope Valley	156	117		Hot Creek
107	127		Smith Valley	157	145		Kawich Valley
108	200	*	Mason Valley	158	109		Emigrant Valley
109	80		East Walker Area	159	88		Yucca Flat
110	97		Walker Lake Valley	160	87		Frenchman Flat
111	97		Alkali Valley	161	148		Indian Springs Valley
112	51		Mono Valley	162	163		Pahrump Valley
113	67		Huntoon Valley	163	154		Mesquite Valley
114	50	*	Teels Marsh Valley	164	133		Ivanpah Valley
115	50	*	Adobe Valley	165	171		Jean Lake Valley
116	94		Queen Valley	166	120		Hidden Valley
117	121		Fish Lake Valley	167	136		Eldorado Valley
118	74		Columbus Salt Marsh Valley	168	146		Three Lakes Valley
119	88		Rhodes Salt Marsh Valley	169	113		Tikapoo Valley
120	85		Garfield Flat	170	163		Penoyer Valley
121	97		Soda Spring Valley	171	169		Coal Valley
122	66		Gabbs Valley	172	166		Garden Valley
123	50	*	Rawhide Flats	173	160		Railroad Valley
124	141		Fairview Valley	174	139		Jakes Valley
125	156		Stingaree Valley	175	133		Long Valley
126	83		Cowkick Valley	176	200	*	Ruby Valley
127	54		Eastgate Valley Area	177	188		Clover Valley
128	139		Dixie Valley	178	170		Butte Valley
129	172		Buena Vista Valley	179	154		Steptoe Valley
130	116		Pleasant Valley	180	161		Cave Valley
131	184		Buffalo Valley	181	165		Dry Lake Valley
132	60		Jersey Valley	182	161		Delamar Valley
133	96		Edwards Creek Valley	183	177		Lake Valley
134	142		Smith Creek	184	152		Spring Valley
135	153		Ione Valley	185	173		Tippett Valley
136	130		Monte Cristo Valley	186	134		Antelope Valley
137	200	*	Big Smoky Valley	187	124		Goshute Valley
138	148		Grass Valley	188	172		Independence Valley
139	165		Kobeh Valley	189	138		Thousand Springs Valley
140	109		Monitor Valley	190	50	*	Grouse Creek Valley
141	144		Ralston Valley	191	176		Pilot Creek Valley
142	200	*	Alkali Spring Valley	192	105		Great Salt Lake Desert
143	121		Clayton Valley	193	69		Deep Creek Valley
144	144		Lida Valley	194	61		Pleasant Valley
145	110		Stonewall Flat	195	122		Snake Valley
146	152		Sarcobatus Flat	196	161		Hamlin Valley
147	122		Gold Flat	197	103		Escalante Desert
148	178		Cactus Flat	198	168		Dry Valley
149	117		Stone Cabin Valley	199	200	*	Rose Valley
150	107		Little Fish Lake Valley	200	187		Eagle Valley

*** Adjusted for maximum of 200 and minimum of 50. ** In the Lake Tahoe Basin no septic systems are allowed.**

Basin	ρ		Area Name
201	160		Spring Valley
202	200	*	Patterson Valley
203	200	*	Panaca Valley
204	94		Clover Valley
205	147		Lower Meadow Valley Wash
206	88		Kane Springs Valley
207	168		White River Valley
208	133		Pahroc Valley
209	114		Pahranagat Valley
210	141		Coyote spring Valley
211	151		Three Lakes Valley
212	119		Las Vegas Valley
213	100		Colorado Valley
214	183		Piute Valley
215	122		Black Moutains Area
216	165		Garnet Valley
217	98		Hidden Valley
218	161		California Wash
219	141		Muddy River Springs Area
220	162		Lower Moapa Valley
221	146		Tule Desert
222	165		Virgin River Valley
223	97		Gold Butte Area
224	97		Greasewood Basin
225	200	*	Mercury Valley
226	94		Rock Valley
227	75		Fortymile Canyon
228	50	*	Oasis Valley
229	99		Crater Flat
230	200	*	Amargosa Desert
231	51		Grapevine Canyon
232	105		Oriental Wash

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