



State of Oregon  
Department of  
Environmental  
Quality

**SANITARY SURVEY of ON-SITE SEWAGE**  
**DISPOSAL SYSTEMS in DETROIT and IDANHA**

Oregon Department of Environmental Quality  
1102 Lincoln St., Suite 210  
Eugene, OR. 97401  
July, 2003

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## Executive Summary

The Communities of Detroit and Idanha are served by existing on-site sewage disposal systems. Many of the existing on-site sewage disposal systems are cesspools and other types or configurations of systems not considered under current standards to adequately treat wastewater before disposal into the soil. Many of the existing undeveloped lots are not large enough to support new development utilizing on-site sewage treatment and disposal systems.

The communities have been exploring wastewater treatment and disposal options that would replace the existing on-site sewage disposal systems including the construction of a joint community sewage treatment plant and collection system. Because of the geographic location of the communities, there are obstacles to the initiation of a joint system that include project cost, the prohibition of new sewer outfalls into surface waters in this area, and the lack of documentation that quantifies failing on-site sewage disposal systems.

The Oregon Department of Environmental Quality entered into a partnership with Detroit and Idanha to assist them in conducting a sanitary survey to document failing on-site sewage disposal systems. During the sanitary survey a large number of old systems that include cesspools located on very small lots were found. High densities of on-site sewage disposal systems that do not utilize advanced treatment technologies have been shown to reduce the quality of both groundwater and surface water.

To avoid future public health hazards and offer increased protection of the water resources existing in and around the communities of Detroit and Idanha, the following recommendations are offered:

- Utilize enhanced treatment alternatives that can increase the removal of nutrients from wastewater and that are capable of treating higher-strength wastewaters to a level that is protective of public health and the environment.
- Utilize treatment technologies that among other considerations, use groundwater and surface water as design boundaries to protect those resources from degradation.
- Establish a maintenance entity capable of managing whatever sewage treatment and disposal system alternatives are selected to ensure that they are operated and maintained in a way that is protective of public health and the environment.
- Inventory and utilize suitable treated wastewater disposal sites in order to decrease wastewater loading in densely developed areas.
- Eliminate existing gray water discharges to the ground surface and waters of the state.

## Introduction

The Communities of Detroit and Idanha are located in the Upper North Santiam River Canyon adjacent to both Detroit Lake and the North Santiam River approximately 50 miles east of Salem, Oregon. Both communities have expanded their developed lots to the limits imposed by these water bodies, and to the limits imposed by the steeper slopes encountered north and east of the communities. Much of the undeveloped property remaining is too wet, too steep, or too small for development.

Residential, commercial and other public buildings in both communities are served by existing on-site sewage disposal systems. Although both anecdotal and documented evidence of failing on-site sewage disposal systems in these communities exist, no evidence of area-wide failures has been documented to date. The Marion County Community Development Department and the Oregon Department of Environmental Quality have records of on-site sewage disposal system failures in this area in the form of both written complaints and permits issued to repair failed systems. In some cases, small lots that are already fully developed have hampered effective long term repair solutions. In response to inquiries from Oregon Economic and Community Development Department (OECDD) staff, the Oregon Department of Environmental Quality offered written comments related to concerns about failing on-site systems in these communities in letters dated September 20, 1994 and October 28, 1993 (Appendix 1). These comments supported finding an alternative to the existing on-site sewage disposal systems.

The communities of Detroit and Idanha are exploring wastewater treatment options that would replace the existing on-site sewage disposal systems. One of the options being considered is to construct a joint community sewage treatment plant and collection system.

Both communities are located in the North Santiam sub-basin of the Willamette Basin. Special Policies and Guidelines related to water quality protection apply to this basin. These Special Policies and Guidelines may be found Oregon Administrative Rule (OAR) 340-041-0470. Because new wastewater discharges into the North Santiam River are prohibited by OAR 340-041-0470 (1) (c), treated wastewater disposal must be accomplished on land and may include irrigation or subsurface disposal. A permit proposed for a community sewage treatment system utilizing such disposal with a capacity of 5,000 gallons per day or more will be subject to public notice and a review by the Oregon Environmental Quality Commission (EQC). Before the proposed permit for the facility can be issued, the EQC must make findings that include:

- That all groundwater quality protection requirements of OAR 340-040-0030 are met. Neither the Department nor the Commission shall grant a concentration limit variance as provided in OAR 340-040-0030, unless the Commission finds that all appropriate groundwater quality protection requirements and compliance

monitoring are met and there will be no measurable change in the water quality of the surface water that would be potentially affected by the proposed facility.

- That the proposed, new domestic sewage treatment facility will provide a preferable means of sewage collection, treatment and disposal as compared to individual on-site sewage disposal systems. To be preferable, the Commission shall find that one of the following criteria applies:
  - The new sewage treatment facility will eliminate a significant number of failing individual on-site sewage disposal systems that cannot be otherwise reliably and cost-effectively repaired;
  - or
  - The new sewage treatment facility will treat domestic sewage that would otherwise be treated by individual on-site sewage disposal systems, from which the cumulative impact to groundwater is projected to be greater than that from the new facility;
  - or
  - If an individual on-site sewage disposal system, or several such systems, would not normally be utilized, a new sewage treatment facility may be allowed if the Commission finds that the social and economic benefits of the discharge outweigh the possible environmental impacts.

The two communities requested help from the Oregon Department of Environmental Quality (DEQ) in conducting a sanitary survey to document the extent of failing on-site sewage disposal systems located within the city limits of the communities. The Department's Environmental Partnerships for Oregon Communities (EPOC) program was selected to assist the communities with the sanitary survey and a partnership was formed between the communities and DEQ on December 9, 2002. The results of the sanitary survey are intended to provide DEQ and the EQC with a basis for evaluating a WPCF permit application from the communities of Detroit and Idanha with respect to the requirements found in OAR 340-041-0470.

## **Background**

In 1992, the communities of Detroit and Idanha started discussions related to replacing the existing on-site sewage disposal systems with a joint community sewage collection and treatment system. Many of the existing on-site sewage disposal systems are reported to be cesspools and other types or configurations of systems not considered under current standards to adequately treat wastewater before disposal into the soil. In 1995, the Cities of Detroit and Idanha contracted with a consultant to prepare a feasibility study for sewage collection and treatment facilities. The feasibility study and subsequent addendum concluded that the use of "both approved and substandard on-site sewage systems in the area has raised concerns about public health and water quality, especially during the peak recreation period from June to September when the area population increases dramatically" (Curran-McLeod, Inc., 1996).

On July 25, 2002 the sewage collection, treatment and disposal alternative proposed by the communities underwent a value engineering analysis (Tetra Tech/ KCM, 2002) and based on those findings, a new alternative was discussed and submitted to DEQ for a preliminary review. That review noted that the chosen alternative would be subject to review by the EQC and that one of the considerations would be related to the existence of area wide on-site sewage disposal system failures (Appendix 1). OECDD was also interested in additional documentation of failures in order to evaluate compliance issues as they relate to project funding.

Tax lot maps of Detroit and Idanha are presented in Appendix 5. The building lot sizes for those portions of Idanha located in Linn County are variable, but the majority of the lots are approximately 0.5 acres or less. Those lots located on the northeast side of the North Santiam River and located in Marion County generally range between 0.1 and 0.25 of an acre.

In Detroit, some of the lots located northeast of Highway 22 are approximately 0.3-0.5 of an acre in size, but the majority are in the 0.1-0.25 acre range. Those lots located southwest of Highway 22, including the Detroit business district and lake front properties are approximately 0.1-0.25 of an acre in size. Many of the developed lots located in the business district of Detroit are built upon or covered by asphalt to, or near the limits of the property boundaries.

Information obtained from the OECDD and the cities of Detroit and Idanha for the resident populations, number of residences, and number of commercial facilities existing in the two communities is summarized in Table 1.

**Table 1. Residential Population, Number of Residences, and Commercial Facilities in Detroit and Idanha**

Community	2001 Population Estimate	2000 Census Population	Year 2003 Residences	Commercial Facilities
City of Detroit	260	262	377	18
City of Idanha	230	232	83	14

The commercial facilities located in Detroit include three restaurants, four stores, three motels, one bed and breakfast, one gas station, two marinas (each with small stores and housing, and one with a bar and recreational vehicle spaces), three offices, and one school currently used as a community center. The commercial facilities located in Idanha include a city park restroom facility, a coffee stand, a market, six offices with employee restrooms, three manufacturing facilities with employee restrooms, one apartment complex that includes five apartments and two laundry machines, and one recreational

vehicle park that includes recreational vehicle spaces, three manufactured dwellings and a laundry.

The populations of both communities increase during the recreation season beginning in May or June and lasting through September. Most of the business patronage also occurs during this season as a result of increased traffic on Highway 22, fishermen and other tourists staying at the nearby state parks and campgrounds.

Climatic information for the two Cities is summarized in Table 2.

**Table 2. Climatic Data for the Cities of Detroit and Idanha\***

Measurement	Detroit	Idanha
Elevation	1,564'	1,718'
Monthly Ave. High Temperature	82°F	82°F
Monthly Ave. Low Temperature	33°F	33°F
Coldest Month	January	January
Hottest Month	August	August
Driest Month	July	July
Wettest Month	December	December
Average Annual Precipitation	89.62" (a)	89.62" (a)

\* Data obtained from the Oregon Economic and Community Development Department and the Oregon Climate Service, OSU.

(a). Measurements taken at the Detroit Dam.

## Methods

Plans to conduct the sanitary survey and begin public education and outreach activities to increase participation in the survey were initiated in December of 2002. The City of Detroit, the City of Idanha, North Santiam Canyon Economic Development Corporation staff, and DEQ staff participated jointly in these plans. DEQ/EPOC staff prepared a sanitary survey questionnaire and letter of introduction (Appendix 2) that was intended to acquaint the residents of each community with the sanitary survey in an effort to increase participation. The questionnaire included space for the respondent to enter their name, address, and telephone number so that appointments could be made to conduct the survey on their property. These materials were mailed by each community along with individual utility bill invoices. DEQ staff prepared a memorandum consisting of written responses to questions anticipated to be generated by residents of the communities as a result of the questionnaire mailing (Appendix 2).

A public meeting was held on February 19, 2003 to outline the intent and potential consequences of the sanitary survey to residents of the communities. Representatives from the Marion County Community Development Department, DEQ, and the Mayors of both Detroit and Idanha were present to answer questions from the public in an open forum. In an effort to increase participation in the sanitary survey, representatives from



the regulatory agencies reinforced the desire to minimize any enforcement-related activity resulting from the discovery of failing systems. Procedures that would be used during the survey were also discussed.

Community members from both Detroit and Idanha volunteered to conduct house to house inspections and dye testing of those residences or businesses whose owners responded to the questionnaire and allowed property entry. A field recording form and a written procedure on how to conduct the sanitary survey was prepared by DEQ/EPOC staff to assist the volunteers in conducting the survey (Appendix 3). Water-soluble fluorescent dye in both the yellow/green and the red formulations (Kingscote Chemicals, 3334 S. Tech Blvd., Miamisburg, OH. 345342) was introduced into a laundry drain standpipe during a laundry cycle. While the laundry machine was running, dye was introduced into a toilet and flushed five or six times. Product information and Material Safety Data sheets for these dye products are included in Appendix 4.

A DEQ Sanitarian registered both in Oregon and with the National Environmental Health Association participated in the survey to provide the required oversight, inspect questionable on-site sewage systems, and to help categorize questionable systems. The categories used to classify the systems are described as:

- Failing: Examples of failing systems included any dye or sewage noted on the ground surface, standing water with a sewage odor associated with it, or spongy ground that puddles sewage in footprints. Any dye or sewage noted on, or in down slope road cuts, banks, ditches, surface waters or culverts indicated a nearby failing system.
- Unknown: No information about the system was obtained and/or no failure noted.
- Existing Non-conforming: If it was determined from the property owner or by another means of verification indicating that the system is a buried drum, cesspool, pit or other type of system that does not meet existing construction standards, but is NOT failing (as defined in OAR 340-071-0100 (60)), the system was placed in this category. Also included were systems that are being subjected to vehicular traffic or other activities that may cause failure.
- Suspected Failure: Systems that are only being used seasonally, but are anecdotally known to experience failure when used. Also other systems that may experience failure intermittently but were not reported or observed as failing during the sanitary survey.

The locations of properties where existing on-site sewage disposal systems were evaluated as part of the sanitary survey are presented in Appendix 5. The initial field work began on March 21 and March 22, 2003. Because of the amount of rain that fell on those two dates, observations of dye and other indications of failing systems were hampered and further field work was suspended until June, 2003.

The field work was completed on June 6-7, June 20-21, and June 27-28 of 2003. In addition to enhancing observation of the existing systems, conducting the field work in June allowed additional time to increase participation in the survey, allowed evaluation of the systems when the seasonal population of the communities were nearly at a maximum, and allowed observation of some of the commercial facilities when they were open for business.

## Results

Historical precipitation data for Detroit Lake and precipitation data for the first six months of 2003 are presented in Table 3. The monthly average precipitation from January to June 2003 is consistent with past averages except for March and June. There was approximately twice the precipitation in March 2003 and approximately one-tenth the precipitation in June 2003 than in previous years. Because of the March spike, the total precipitation for this period was approximately seven inches more than historical values.

**Table 3. Monthly Precipitation Data (inches) Measured at Detroit Lake Dam\***

Year	January	February	March	April	May	June	Six Month Total
2003	16.26	7.42	21.16	8.04	3.60	0.35	56.83
2002	17.99	6.16	11.09	7.87	3.53	2.70	49.34
Ave. for 1971 to 2000	12.46	11.00	9.45	7.31	5.56	3.51	49.29

\*Data obtained from the Oregon Climate Service, Oregon State University.

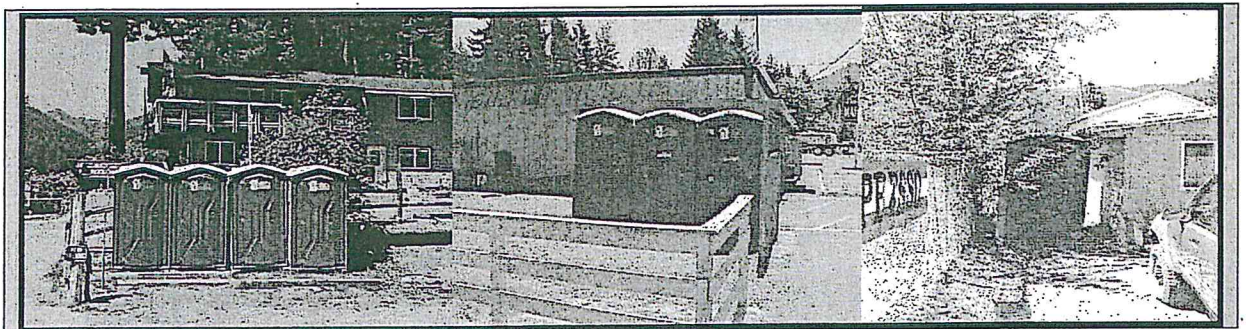
**Table 4. Sanitary Survey Results**

Survey Measurement	Detroit	Idanha
Total Water Connections	395	97
Total Commercial Connections	18	14
Total Residential Connections	377	83
Total Number of Properties Surveyed in Field	93	51
Number of Participants not Full Time Residents	29	6
Total Number of Surveyed Failures	4	4
Number Surveyed Systems That are Unknowns	61	31
Number of Surveyed Existing Nonconforming Systems	25	9
Number of Surveyed Suspected System Failures	3	7
% Participation in Field Survey	24	53
% Participants not Full Time Residents	31	12
% Surveyed Failures	4	8
% Surveyed Unknown	66	61
% Surveyed Existing Nonconforming	27	18
% Surveyed Suspected Failures	3	14

Results of the sanitary survey are summarized in Table 4. The initial field work for the sanitary survey began on March 21, 2003 during the period when the highest precipitation occurred. This factor was expected to contribute to higher groundwater levels and saturated soil conditions that were expected to result in a higher number of observed system failures. Observations made during the March sanitary survey did not support those expectations. The extremely wet conditions during March made observation of existing systems difficult. In addition, the number of tourists and seasonal residents had not begun to arrive in significant numbers so many of the systems evaluated during that time had not been in use.

In both communities many of the Unknown systems were either those for which no information could be found and were not failing, or newer systems that have been constructed as repairs to failing systems over the years. The repaired systems consist of septic tanks and disposal trenches that have usually been constructed undersized because of spatial restrictions. They were not observed to be failing, but they have been constructed without the use of advanced treatment technologies and will probably not offer long term environmental protection because of development densities.

Many of the systems noted as Existing Nonconforming were being impacted by pavement, vehicular traffic, or had foundations and other structures constructed over them. Paving or soil compaction resulting from vehicular traffic reduces pore space in the soil. Together with the restricted potential for gas exchange, reduced pore space adversely affects the ability of the soil microorganisms to aerobically treat wastewater and may inhibit movement of water through the soil. Most of the other Existing Nonconforming systems appeared to be cesspools or other receptacles receiving raw sewage without receiving initial treatment through a septic tank. These systems were not observed to be failing on the survey dates, but because of the age or configuration of the systems, coarse and rapidly permeable soils, and the existing high development density cannot be expected to provide treatment of sewage to a level that is protective of public health and waters of the state.



**Figure 1.** Portable toilets for public use reduce flows to commercial on-site sewage disposal systems.

There were indications of Suspected Failing systems that because of system siting or impacts resulting from paving or vehicular traffic may not be performing well during the wet season when groundwater levels are highest or during periods of peak use. Many of the commercial facilities located in the Detroit business district are suspected to be periodically failing. Some of these systems must be carefully operated until other alternatives are presented. Interviews conducted with owners of the businesses indicate that extraordinary measures are taken during the wet season and peak tourist season to prevent more frequent problems with the systems. Evidence of this is found in several locations in the area (Figure 1).

Although many of the sanitary survey questionnaires were completed and returned, only 24% of the owners of developed properties in Detroit participated in the field evaluations. Four percent of the systems evaluated in Detroit were observed to be Failing, and all of those consisted of either broken sewer pipes or deliberate graywater discharge to the ground surface. Some of these discharges were occurring very close to surface waters and it is likely that that wastewater discharge to these surface waters occurs during high rainfall events. Three percent of the systems in Detroit were suspected to be periodically failing due to the age and/or poor construction of the system or due to the location of the system. Many systems that were included in the Unknown and especially the Existing Nonconforming categories would be failing if they were being subjected to normal household water usage all year. Seasonal residents made up 31% of those who participated in the field evaluation.

An evaluation of the returned questionnaires from property owners who did *not* participate in the field evaluations also indicated a high percentage of seasonal residents. Most of the systems evaluated in the questionnaires returned from property owners who did not participate in the field evaluation fell into the Existing Nonconforming category. It is likely that exclusion of those systems from the field survey contributed to a lower observed failure rate.

The commercial facilities located in the Detroit survey area conduct most of their business during the May through September season and some even close for the remainder of the year. Systems connected to these commercial facilities were notably stressed during the survey period and there is no doubt that if these commercial facilities were operated all year long without measures being taken to reduce flow or wastewater strength to the sewage disposal systems, the observed failure rate among these systems would have been very high. As a result of the effects of the wastewater loading-demands placed on some of these commercial systems in Detroit, periodic hydraulic failures occur that, in at least in one instance, results in a non-permitted discharge into a storm drain that empties into Detroit Lake very near a public boat ramp and marina facility. The systems as they currently exist have been cobbled together as repairs over the years with the main intent of trying to make do until a better solution is found off lot. None have been constructed using enhanced treatment technologies to remove nutrients or reduce the higher organic loads associated with food-service establishments.

In Idanha the population is made up of far fewer seasonal residents and of the 53% participation in the field evaluations, 88% were full-time residents. Eight percent of the existing systems were found to be Failing, and as in Detroit, all of those were either broken sewer pipes or deliberate graywater discharge to the ground surface. Many of the Existing Nonconforming systems were either single or multiple pits and cesspools. In many cases graywater was discharged to one cesspool and blackwater was discharged to another cesspool. For most of the systems categorized as Unknown in Idanha nothing could be found in the field or in the records regarding the location or configuration of the systems and they are suspected of being Existing Nonconforming systems. This is in contrast to the very few Unknown systems that had been repaired and therefore did not result in the observation of dye. Existing Nonconforming systems represent a potential threat to public health and waters of the state.

Idanha has fewer large commercial facilities than are found in Detroit, but there is a recreational vehicle park located very near the North Santiam River. This RV park is reported to have multiple systems located on a bench adjacent the North Santiam River. For business reasons, the RV park was vacant during the sanitary survey except for two occupied manufactured dwellings and the sewage disposal systems could not be tested. None of these systems appear to have been constructed utilizing advanced technology designed to minimize nutrient loadings to the drainfield and ultimately to surface waters. RV holding tanks often contain biocides that include formaldehyde to inhibit the growth of pathogens while being stored in the RV holding tank. Many RV parks do not provide a means of segregating RV holding tank waste from the domestic waste being discharged to the on-site sewage treatment and disposal system. Introducing RV holding tank waste containing biocides to the on-site sewage disposal system can result in a microorganism die-off that reduces or eliminates the capability of the system to adequately treat the wastewater. In addition to killing the beneficial microorganisms needed for treating wastewater, these biocides can enter both groundwater and surface water leading to pollution of those resources. With the exception of the recreational vehicle park, most of the commercial facilities in Idanha are office or shop facilities with employee restrooms. The domestic wastewater generated in these commercial facilities is of residential strength and the wastewater flows are very low.

## Discussion

Properly sited, designed, operated, and maintained on-site sewage treatment and disposal systems can be an effective solution for treating both residential and commercial domestic wastewater to standards that are protective of public health and the environment (USEPA, 2002). The results of the sanitary survey conducted in Detroit and Idanha reveal densely developed, very small lots that have poorly designed on-site sewage disposal systems that are apparently not receiving operation and maintenance management until there is a problem with the system.

The City of Detroit has a number of tourist facilities including several restaurants, lounges, and lodging accommodations that may be generating sewage that is more difficult to treat. These facilities generate larger volumes of wastewater that may contain

more grease and other higher waste strength components, and the high use of public restrooms in the lounges may elevate nitrogen concentrations in the wastewater. The sewage disposal systems connected to these facilities have not been designed for this use and can be only partially effective in treating and disposing of this wastewater. Evidence of efforts to reduce flow to these systems can be seen in the common use of portable toilets for patron use, and in the measures taken such as tarping the drainfield by some business owners to reduce the amount rain that falls over the system during the winter months. Because of groundwater infiltration into septic tanks that are not water tight or because the drainfield is hydraulically saturated, some septic tanks must be pumped excessively to prevent sewage from appearing on the ground surface or backing up into the building. There is no area left on these commercial properties to expand or alter the existing sewage disposal systems to improve capacity and treatment capabilities. Continued use of these existing systems will result in persistent problems that will become more serious with time increasing the risk to the environment and public health.

When the on-site sewage disposal systems in Detroit and Idanha were constructed, little thought was given to properly siting the systems other than to assure that sewage did not rise to the ground surface creating nuisance conditions and direct exposure to pathogens. The systems were designed to dispose of wastewater, and generally little consideration was given to effective nutrient or pathogen reduction prior to discharge other than to maintain what was considered to be a safe distance from any drinking water wells. Operation and maintenance practices appear limited until systems cause problems in the dwelling or business or ponds on the property causing odors. Many residents could not identify where their system is located.

Only a few system failures were observed during the survey either because of property owner non-participation, the presence of coarse, rapidly or moderately permeable soils existing on the property, or seasonal fluctuations in population. However, the existence of the permeable soils and the seasonal population fluctuation may be masking existing problems with the systems because there may not be the visual indications or odors associated with sewage on the ground surface. Biomat formation in disposal trenches is the primary mechanism for reducing pathogens and nutrients from septic tank effluent before effluent migration into the soil and ultimately to groundwater. Biomat formation in the disposal trenches evaluated in this sanitary survey may not effectively mature because of the seasonal use of the systems. Cesspools or disposal pits receiving raw sewage may have no effective biomat at all and introduce pathogens and nutrients well below the soil zone where effective treatment and removal occurs. This is even more likely during the times when they are periodically inundated by high groundwater. These conditions can promote rapid infiltration of inadequately treated wastewater into soil that in much of the survey area is coarse textured. Coarse textured soil does not impart significant additional treatment to the wastewater and consequently groundwater pollution may result (Reneau et al., 1989; Gold and Sims, 2000). Periods of saturated soil conditions will allow sewage to mix with groundwater before being adequately treated.

In addition to containing pathogens, septic tank effluent contains other constituents that may adversely affect human health or the environment. Total Kjeldahl Nitrogen (TKN) is

a measure of organic nitrogen together with ammonia nitrogen ( $\text{NH}_3\text{-N}$ ). TKN in septic tank effluent has been reported to fall between 30 and 80 milligrams per liter (mg/l). The concentration of TKN in effluent from residential septic tanks in Oregon was measured to be 59.4 mg/l (Bushman, 1996) and values of approximately 60 mg/l TKN have been routinely noted by DEQ staff reviewing discharge monitoring reports. TKN is considered to be completely converted to nitrate-nitrogen ( $\text{NO}_3\text{-N}$ ) in the soil. The amount of denitrification in the soil has been reported to fall between 0 and 30 percent, however actual denitrification values are dependent on the amount of carbon in the soil and a recent study suggests that denitrification of  $\text{NO}_3$  in the soil may be minor (DeSimone and Howes, 1998).

Detrimental environmental effects of nitrate include eutrophication of surface waters that result in algal blooms that may cause a decline in water quality. Using a value of 60 mg/l TKN, an average daily flow of 150 gallons per day per dwelling, and the number of water connections in the communities of Detroit and Idanha, the existing on-site sewage disposal systems are calculated to be contributing 13,284 pounds per year of  $\text{NO}_3\text{-N}$  to groundwater and Detroit Lake. Using a normal lake capacity value of 455,000 acre feet of water obtained from the Oregon Department of Water Resources, a  $\text{NO}_3\text{-N}$  concentration in the lake of 0.011 mg/l can be calculated (Appendix 6). Replacing the existing on-site sewage disposal systems with advanced treatment technologies presents an opportunity to remove this nitrogen contribution from the lake.

Nitrate in groundwater is associated with human health concerns such as methemoglobinemia, carcinogenesis, and birth defects. Because of the adverse health effects associated with  $\text{NO}_3$ , the Maximum Contaminant Level (MCL) for  $\text{NO}_3\text{-N}$  in groundwater is 10 mg/l. Groundwater levels in much of the surveyed area are close to the ground surface during the months when precipitation is greatest. Because residents in both communities are connected to community drinking water systems, private drinking water wells are not used. Since residents are not incurring expenses associated with treating drinking water from domestic water wells in order to prevent illness, an urgent need for improved sewage treatment and disposal methods may not seem apparent. However, increased  $\text{NO}_3\text{-N}$  concentrations in groundwater below on-site sewage disposal systems has been documented (DeSimone and Howes, 1998; Hantzsche and Finnemore, 1993; Shaw and Turyk, 1994; Tinker, 1991). Given the prevalence of older on-site sewage disposal systems in Detroit and Idanha that have been constructed deep in the soil and without consideration given to effective pathogen and nutrient reduction, there is the potential for groundwater contamination from  $\text{NO}_3\text{-N}$  emanating from these systems.

To estimate  $\text{NO}_3\text{-N}$  concentrations in groundwater beneath a typical lot located on Third Street in Detroit, calculations were performed using models described in Hantzsche and Finnemore (1993) and in Kimsey (1997). Calculations using these models are presented in Appendix 6. Both models assume complete mixing in the aquifer. In addition to using the parameters used in the Hantzsche and Finnemore model, the Kimsey model includes soil hydraulic conductivity, hydraulic gradient, mixing depth, and aquifer width in the calculation. Hydraulic conductivity values of 0.3 ft/day and 300 ft/day are used to calculate minimum and maximum estimated  $\text{NO}_3\text{-N}$  concentrations in groundwater.

Other parameters were estimated from the literature (Kimsey, 1997). Results of the calculations using a 150 GPD wastewater flow, a TKN concentration of 60 mg/l, a 0.23 acre lot size, annual precipitation of 89.62 inches, and a NO<sub>3</sub>-N concentration in precipitation of 0.24 mg/l are presented in Table 5. Calculated NO<sub>3</sub>-N concentrations do not exceed the MCL for NO<sub>3</sub>-N in groundwater; however the calculations suggest that there is an impact to groundwater from on-site sewage disposal systems located in Detroit and Idanha. Replacing the existing on-site sewage disposal systems with advanced treatment technologies presents an opportunity to mitigate this impact to groundwater.

CRITERIA FOR CALCULATION

**Table 5. Calculated NO<sub>3</sub>-N Concentrations in Groundwater Beneath a Typical Developed Lot in Detroit.**

Input Parameters	Model Used	
	Hantzsche and Finnemore	Kimsey
Daily Wastewater Volume (GPD)	150	150
TKN of Wastewater (mg/l)	60	60
Annual Precipitation (inches/yr)	89.62	89.62
[NO <sub>3</sub> ] of Precipitation (mg/l)	0.24	0.24
Acreage	0.23	0.23
Assumed De-nitrification in Soil (%)	0	0
Hydraulic Conductivity (ft/day)	NA	0.3 or 300
Hydraulic Gradient	NA	0.0019
Depth of Mixing (ft)	NA	20
Aquifer Width (ft)	NA	110
NO <sub>3</sub> -N Concentration in Groundwater (mg/l)	5.56	5.53 (0.84)

To avoid future public health hazards and offer increased protection of the water resources existing in and around the communities of Detroit and Idanha, the following recommendations are offered:

- Utilize enhanced treatment alternatives that can increase the removal of nutrients from wastewater and that are capable of treating higher-strength wastewaters to a level that is protective of public health and the environment.
- Utilize treatment technologies that among other considerations, use groundwater and surface water as design boundaries to protect those resources from degradation.
- Establish a maintenance entity to manage all sewage treatment and disposal systems in the area to ensure that the systems are operated and maintained in a way that is protective of public health and the environment.
- Inventory and utilize suitable treated wastewater disposal sites in order to decrease wastewater loading in densely developed areas.
- Eliminate existing gray water discharges to the ground surface and waters of the state.

The communities of Detroit and Idanha are dependent on the recreational uses associated with Detroit Lake and communities located downstream of the lake depend on the water stored in the reservoir for drinking water. Improving the sewage treatment capabilities in

*IMP*



Detroit and Idanha will help ensure a safe drinking water supply for the downstream water users as well as maintaining the lake for optimum recreational and commercial use.

Appendix 1. Previous DEQ Correspondence

September 20, 1994

Oregon

DEPARTMENT OF  
ENVIRONMENTAL  
QUALITY

Mr. Laird Bryan  
Community Development Division  
Oregon Economic Development Department  
775 Summer Street NE  
Salem, OR 97310

Western Region -  
Salem Office

Re: WQ-Cities of Idanha, Detroit  
Joint Sewer System  
Marion County  
Feasibility Study

Dear Mr. Bryan:

We understand that the Cities of Idanha and Detroit have applied to your agency for a grant to determine the feasibility of providing a community sewerage system to serve the two cities and surrounding area. The Department was asked to comment on the potential public health and environmental impacts associated with urbanized development supported by individual septic tank systems.

In a letter dated October 28, 1994, to the City of Detroit (attached), the Department expressed concern with dense development on septic systems. The letter strongly supports the replacement of the individual septic systems with a community system adequately sized to serve the needs of Detroit and the surrounding area. Though there are differences in the soils, density of development and the number of sewerage sources, the Department has very similar concerns for the City of Idanha.

However, in the case of Idanha, the Department has obtained data that indicates pollution of surface waters is occurring in the North Santiam River above Detroit Lake. The City of Salem has reported water quality data to the Department that includes total coliform results at Hoover Park in excess of 150 colonies per 100 mls. Several results approached 100 colonies per 100 mls. While this does not violate instream water quality standards, it indicates the presence of one or more sources of fecal bacteria immediately upstream from the park.



750 Front St. NE  
Suite 120  
Salem, OR 97310  
(503) 378-8240  
(503) 378-3684 TDD  
DEQ/WVR-101 1-91

Mr. Laird Bryan  
September 20, 1994  
Page 2

The Department will support any action that would reduce this pollution potential.  
If you have any questions, please call me at (503)378-8240, extension 239.

Sincerely,

*Mark E Hamlin*

Mark E. Hamlin  
Environmental Specialist  
Western Region-Salem Office

MEH:klw  
X:\meh\idanha1.let

Attachment

cc: ~~WQ~~ Division, DEQ  
Idanha City Council, P.O. Box 430, Idanha, OR 97350  
Detroit City Council, P.O. Box 589, Detroit, OR 97342

October 28, 1993

DEPARTMENT OF  
ENVIRONMENTAL  
QUALITY

Oregon Community Development Representative  
c/o Detroit City Council  
City of Detroit  
P.O. Box 589  
Detroit, OR 97342

Willamette Valley Region

Re: WQ-City of Detroit  
Concerns of Urbanizing  
Development using  
Individual Septic Tank  
Systems on Small Lots  
Marion County

Dear Sir:

We understand that the City of Detroit has applied to your agency for a grant to determine the feasibility of providing a community sewerage system to serve the City and the surrounding area. As part of that grant application, the City has requested the Department of Environmental Quality to comment on health and environmental concerns associated with current urbanized development supported by individual septic tank systems.

Our concerns are:

Residential Use:

The residential use in the City of Detroit is both recreational homes and year-around residents developed on lots as small as 5,000 square feet. The average lot size in the City is 8,600 square feet. There are 135 residential structures located between Highway 20 and Detroit Lake. Based on the average lot size of 8,600 square feet, the estimated peak residential sewage flow in the City of Detroit between Highway 20 and Detroit Lake is 60,750 gallons of sewage per day on 26.6 acres, or 2,279 gallons of sewage loading per acre per day.

Commercial use:

There are 25 commercial and public facilities in Detroit, including 3 restaurants; 5 motels/bed & breakfast; 2 recreational vehicle parks; and grocery stores, a bakery, a service station, a high school/grade school complex, and other retail services. The restaurants, motels/bed & breakfast, and recreational vehicle parks are located on 5.5 acres. The estimated peak flow from these 10 commercial facilities is 25,200 gallons of sewage per day.

Barbara Roberts  
Governor



750 Front St. NE  
Suite 120  
Salem, OR 97310  
(503) 378-8240  
DEQ/WVR-101 1-91

Therefore, these commercial facilities are contributing an average peak loading rate of 4,582 gallons of sewage per acre per day.

This high density of residential and commercial development has the potential to impact the quality of groundwater and Detroit Lake and, more importantly, expose the citizens and the visitors of Detroit to immediate public health hazards, when system failures occur.

Soils in the area are typically gravelly loams grading to cobbly sandy loams with weak, fine, granular, and subangular blocky structure. The upper strata are 30 to 60 percent rounded gravels, cobbles, and stones by volume; the lower strata are 40-75 percent. The soil material is derived from colluvium, glacial till, and alluvium. The permeability of the soils is rated from rapid to moderate. This soil type is well drained and, as such, was considered acceptable through the 1960's for the use of cesspools or seepage pits for disposal of sewage. Based on the use of cesspools and/or seepage pits, the City of Detroit was platted for small urban-sized lots (average lot size 5,000-7,000 square feet). Research has shown that while cesspools/seepage pits may drain water effectively, very little treatment of the sewage occurs. Additionally, when systems "appear" to be working properly, the rapid to moderate permeability of these soils allow a large percentage of the sewage-generated nitrogen and other pollutants to migrate rapidly and to enter the groundwater and ultimately to the waters of Detroit Lake.

Since the 1972, Oregon Administrative Rules governing on-site sewage disposal have prohibited the use of cesspools/seepage pits as an acceptable method of sewage disposal. The size of the lots in the City of Detroit makes installation of adequately sized septic tank and standard disposal systems very difficult. Old undersized sewage disposal systems abound, and when they need repair, there is no room to install an adequate replacement system. The Department has no confidence that continued use of rural technology such as individual septic tanks and drainfields on urban sized properties, such as are found in the City of Detroit, will provide sewage disposal service adequate to protect public health and prevent contamination of ground and surface waters.

City of Detroit  
October 28, 1993  
Page 3

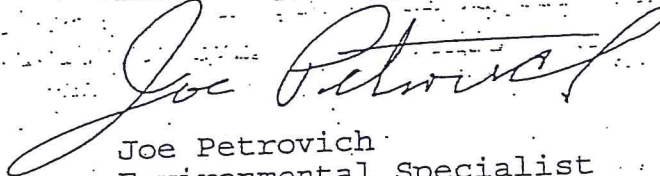
We do not have any documented data which indicates groundwater or surface water pollution from the City of Detroit. This relates to neither our Department nor the City, having funding to undertake an investigative study. Based on our experience with other communities having similar, or less, density, we have concerns that the City has exceeded its safe capacity for use of individual septic tank and drainfields for sewage disposal. Information from the Marion County Community Development Department indicates that since January 1, 1991, they have issued 10 repair permits in the City of Detroit. This pattern continues to repeat. In this year, we are again involved with two restaurants in the City again experiencing failing septic systems. One had sewage running into the adjacent storm sewers and ultimately to Detroit Lake; the other involved overloaded sewage disposal trenches that had surfaced to the ground. Neither system has room for an adequately sized system; no repair area exists; both systems had attempted prior repairs; and the latest repair attempts, in our view, will be short term solutions. This is fairly typical of repairs in the City of Detroit. As in most cases, repair systems are being constructed in the same area as, or over the top of, the old systems, because of the urban lot sizes. It is likely that there are other systems that are failing that we, or the City, are not aware of at this time.

Considering the small residential lot sizes and the number of high volume commercial enterprises, such as restaurants, recreational vehicle parks, mobile home parks, and motels, it is apparent that continued reliance on individual septic tank systems will have a detrimental effect on the economic and recreational future of this community. Further, while water quality degradation has not been documented, the concentration of septic systems in this small area certainly has all the elements necessary to cause water quality problems in the future. Therefore, our Department strongly supports the phase out of individual septic tank systems and replacement with a community system adequately sized and designed to serve the urban needs of the City of Detroit and the recreational needs of the area surrounding Detroit Lake.

City of Detroit  
October 28, 1993  
Page 4

If you have any questions regarding our concerns expressed  
in this letter, please call me at my Salem Office at  
378-8240.

Sincerely,



Joe Petrovich  
Environmental Specialist  
Western Region-Salem

JAP:bkb  
x:\jap\detroit.ltr

cc: Don Woodley, Marion County Community  
Development Department  
Barbara Burton, Wastewater Control Section





# Oregon

John A. Kitzhaber, M.D., Governor

Department of Environmental Quality

Western Region - Salem Office

750 Front St. NE, Ste. 120

Salem, OR 97301-1039

(503) 378-8240

(503) 378-3684 TTY

October 25, 2002

Mr. Patrick D. Curran, P.E.  
Curran-McLeod, Inc.  
6655 S.W. Hampton Street, Suite 210  
Portland, OR 97223

RE: WQ-Preliminary Review of  
Detroit/Idanha Sewer Project

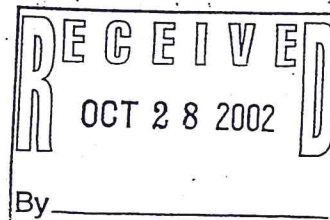
Dear Mr. Curran:

We have completed a preliminary review of the alternatives considered in your August 26, 2002 letter for the Detroit/Idanha Sewer Project. The recommended alternative was to design an advanced wastewater treatment system employing Membrane Technology and infiltrating the highly treated effluent into very rapidly drained riverbank gravels via infiltration cells constructed adjacent to the North Santiam River near where the North Santiam River enters Detroit Lake. We have never received a proposal such as this before and since any review we make may have applications for future proposals throughout the Three Basin Area, we called together staff from our Northwest Region and our Water Quality HQ Programs to consider your recommendation. The following is the uniform consensus views our joint evaluation of your proposal.

As noted in your August 26, 2002 letter, to proceed with your recommended alternative would require you to receive approval from the Oregon Environmental Quality Commission (EQC). The applicable rules that you would need to satisfy to obtain approval would be OAR 340-041-0470(7)(c). These rules require that the EQC would need to:

- a. Grant approval for a groundwater concentration limit variance.
- b. Make a finding that the new system would either eliminate a significant number of failing on-site systems that likely could not be repaired, or make a finding that the new system would result in a less cumulative impact to groundwater than the existing use of on-site systems.

Because of the proposed near proximity of the infiltration cells to the North Santiam River, we believe the EQC would also need to be satisfied that these discharges would have little potential to cause impacts to any water quality standards in the projected discharge zones where the groundwater flows would connect into the North Santiam River and potentially the upper reaches of Detroit Lake.



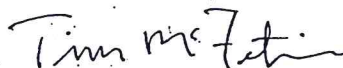
With regard to item b. above, our Western Region On-site Program has contacted Marion County, who is our contract agent to administer the On-site Program in the Detroit/Idanha areas. The purpose of this contact was to determine if any records or documentation exists as to area-wide failures of on-site systems, impacts to surface waters from on-site systems that may be indirectly discharging to storm water systems, or reports of groundwater contamination from the existing use of on-site systems in these areas. Marion County reports that while they do have some records on repairs of on-site systems, most have been successful and they not aware of an area-wide failure of on-site systems in these communities. They also advised that they do not have records or documentation of surface water or groundwater impacts from the current use of on-site systems in these communities.

While the Department acknowledges the high treatment capability of the treatment technology proposed, we currently do not have an assessment of what level of impact there would be to the North Santiam River and upper reaches of Detroit Lake assuming that the high infiltration rate loadings would soon laterally connect with these waters.

Accordingly, while you are free to approach the EQC to consider your proposal, we would recommend that you first document if the current area-wide use of on-site systems is having any significant impacts to surface and groundwaters and evaluate if the proposed use of the infiltration cells would likely have any measurable impacts to water quality standards in the North Santiam and upper reaches of Detroit Lake. Without such documentation and evaluations, we believe it may be very difficult for the EQC to make the finding they need to in order to approve your proposal.

If you have any questions regarding the contents of this letter, please contact me at the Salem DEQ office. Phone: 503-378-8240, extension: 235. If I am unavailable, contact Gary Messer at extension: 264.

Sincerely,



Timothy C. McFetridge, P.E.  
Senior Environmental Engineer

cc: City of Detroit, PO Box 589, Detroit, OR 97342  
City of Idanha, PO Box 430, Idanha, OR 97350  
Laird Bryan, OECDD, Salem  
Bill Mason/Randy Trox/Mike Wolf, Eugene DEQ  
Ed Woods, Water Quality Division, Portland DEQ  
Bob Baumgartner, DEQ Northwest Region

# Sanitary Survey Questionnaire

The communities of Detroit and its surrounding areas need your help. Please complete this form if you are a business, school, or other organization that provides water service to the public.

## Appendix 2. Sanitary Survey Questionnaire Form, Introduction Letter, and Responses to Anticipated Questions

1. Are there any problems with your water supply system or the water quality?

Yes  No

If Yes, please describe your problems below:

Problem category:

- |   |   |
|---|---|
| <input type="checkbox"/> Low chlorine or bromine levels | <input type="checkbox"/> Reduced water volume |
| <input type="checkbox"/> Stagnated water                | <input type="checkbox"/> Bad taste and odor   |
| <input type="checkbox"/> Other                          |   |

2. How often do you check your water supply system?

Check at least once a month  Yes  No  Other

3. Has anyone ever had a problem with your water supply system?

4. How often do you check your water supply system?

5. Has anyone ever had a problem with your water supply system?

6. Are there any other water quality problems you would like to report?

7. Please describe the problem below:

Yes  No

# Sanitary Survey Questionnaire

The communities of Detroit and Idanha need your help. Please complete as much of the following survey as you can. We appreciate your support.

1. Are you aware that Detroit and Idanha are investigating the need for a community sewer system for the cities?

Yes    No

2. Any problems with your septic system in the past 6 years?

Yes    No

If Yes, please indicate your problems below:

## Problem History

- |   |   |
|---|---|
| <input type="checkbox"/> Slow drainage of Plumbing Fixtures | <input type="checkbox"/> Restricted Water Usage |
| <input type="checkbox"/> Saturated Soil                     | <input type="checkbox"/> Backs-up into house    |
| <input type="checkbox"/> Odors                              |   |
| <input type="checkbox"/> Other _____                        |   |

Date of last occurrence \_\_\_\_\_

Season When Most Problems Occur    Winter    Spring    Summer

Fall

Date Septic System last pumped? \_\_\_\_\_

Pumping Frequency? \_\_\_\_\_

Describe all known repairs to the septic system:

3. Are the laundry, bath, or sink wastes (gray water) separate from the septic system?

Yes    No

4. Is there a well on the property?

Yes    No

Where is the nearest well?

5. Would you be concerned if the Sanitary Survey indicated that failing systems were posing a threat to public health?

Yes    No

6. Please list any suggestions you have for the sewer project?

The following are some things that the Survey Teams will be observing/looking for:

- Any ground surface wetness? Odors?
- Any unusually heavy grass or vegetative growth?
- Any close-by drainage ways?

The survey team will dye test your septic system free of charge. If no dye is detected on the ground surface or waters of the state, your onsite system will not be considered as failing for the purposes of the sanitary survey. However, the absence of visible dye does not guarantee that your system is currently functioning properly or that it will continue to function properly.

**Name:**

---

**Address:**

---

**City:**

---

**Telephone:**

---

**Email:**

---

January 28, 2003

Resident of Detroit & Idanha:

The Cities of Detroit and Idanha will be conducting a survey of the onsite (septic) systems throughout the communities in late winter/early spring of 2003. The purpose of this Sanitary Survey is to determine the type and location of onsite systems located within the communities and to determine whether or not these systems are functioning properly. The survey is being conducted on a house-to-house basis by local residents under the supervision of DEQ staff. A visual inspection will be done of the premises and a dye test of the system will be performed free of charge. The property owner will be notified of the results of the survey. If surfacing dye is detected this test will indicate your onsite system is failing. If no dye is detected on the ground surface or waters of the state, your onsite system will not be considered as failing for the purposes of the sanitary survey. However, the absence of visible dye does not guarantee that your system is currently functioning properly or that it will continue to function properly.

Due to the human health concerns associated with a malfunctioning onsite system, the property owner may be asked to obtain the necessary permits and make necessary repairs to the system if the system is determined to be malfunctioning. However, there will be no formal enforcement action taken against the property owner by either the Marion County Environmental Health Department, the City of Detroit, the City of Idanha, or the Department of Environmental Quality should the property owner delay repair actions while the communities pursue a centralized community sewer system.

A town hall meeting has been scheduled for Wednesday, February 19, 2003 at the Detroit Lakes Charter School. The meeting will start at 7:00 PM and will include a discussion of the special water quality rules for the North Santiam sub-basin, and the need for the sanitary survey. There will be time available to answer questions from the audience.

If you have any questions regarding *permitting* procedures or onsite *system design* and operation, you can contact either of the following:

Marion County Community Development Department  
Building Inspection Section  
Environmental Health  
P.O. Box 1455  
Salem, OR. 97309-5036  
503-588-5147

Gary Artman  
Department of Environmental Quality  
1102 Lincoln St., Suite 210  
Eugene, OR 97401  
514-686-7838 X 256



Date: January 21, 20

**To:** Detroit/Idanha Community Sewer Project Work Group  
**From:** Gary Artman, DEQ-EPOC  
**Subject:** Possible Responses to Questions Generated by the Detroit/ Idanha Sanitary Survey Questionnaire and Information Mailing

I have tried to anticipate potential questions that will be generated by the sanitary survey information mailing. As requested by the communities, I offer the following possible replies:

1. Why is the sanitary survey being conducted?

The communities of Detroit and Idanha have been in the process of pursuing construction of a community sewerage system for several years. One of the legal requirements that need to be fulfilled in the North Santiam sub-basin in order to continue the project is approval of the project by the Environmental Quality Commission (EQC). One of the issues that the EQC must consider is that the communities demonstrate that the proposed system will provide a preferable means of sewage collection, treatment and disposal compared to the individual on-site sewage disposal systems that currently exist.

To be preferable, the commission must find that the proposed sewage system will eliminate a significant number of failing individual on-site systems that cannot be reliably and cost-effectively repaired, **or**

That the impact to groundwater from the proposed community system will be less than the cumulative impact from the existing individual on-site systems **or**

A new sewage treatment system *may* be allowed if the Commission finds that the social and economic benefits of the discharge outweigh the possible environmental impacts.

Without a finding that there are a significant number of failing individual on-site systems, it will be difficult to demonstrate to the EQC that a proposed new community system would be preferable to the existing on-site systems serving your community.

2. Do I have to participate in the sanitary survey?

You do not have to participate in the sanitary survey. Participation is voluntary and is being performed at the request of the communities of Detroit and Idanha. However, it is essential for the members of the community to participate. Without the participation and support from members of the community, the sewer project will be difficult to complete.

If you choose not to participate, the chances of the project moving forward will be diminished.

3. What will happen during the sanitary survey?

The survey is being conducted on a house-to-house basis by local residents under the supervision of DEQ staff. A visual inspection will be done of the premises and a dye test of the system will be performed free of charge. It usually necessary to enter the building in order to introduce dye into the system. The property owner will be notified of the results of the survey. If surfacing dye is detected this test will indicate your onsite system is failing.

4. What if my system is found to be failing during the sanitary survey?

The property owner will be notified of the results of the survey. Due to the human health concerns associated with malfunctioning onsite systems, the property owner may be asked to obtain the necessary permits and make necessary repairs to the system if the system is determined to be malfunctioning.

The intent is not to find failing systems to enforce against, but to use any failing systems discovered during the sanitary survey to strengthen the community's position when presenting their proposal to the Environmental Quality Commission (EQC) for consideration.

5. Will I be subject to an enforcement action if a failing system is found on my property?

The intent is not to find failing systems to enforce against. DEQ intends to use the results of the study to strengthen the cities position before the EQC. DEQ does not wish to initiate enforcement actions against property owners as long as the communities of Detroit and Idanha are pursuing a community sewer system.

This does not mean that an indefinite amnesty is being offered. It is the responsibility of the property owner to assure that their system is being operated in compliance with the State of Oregon Environmental laws.

PROPERTY SURVEY DATA SHEET

PROPERTY ADDRESS

DATE

OWNER

TYPE

INTL

DRAINAGE/SEWERAGE

SYSTEM

Appendix 3. Property Survey Data Sheet and  
Procedures for Conducting a Sanitary Survey

[Empty table area for data entry]

Is it  Yes  No

Is it  Yes  No

Is it  Yes  No

Is it  Yes  No

Is it  Yes  No

# PROPERTY SURVEY DATA SHEET

PROPERTY ADDRESS \_\_\_\_\_

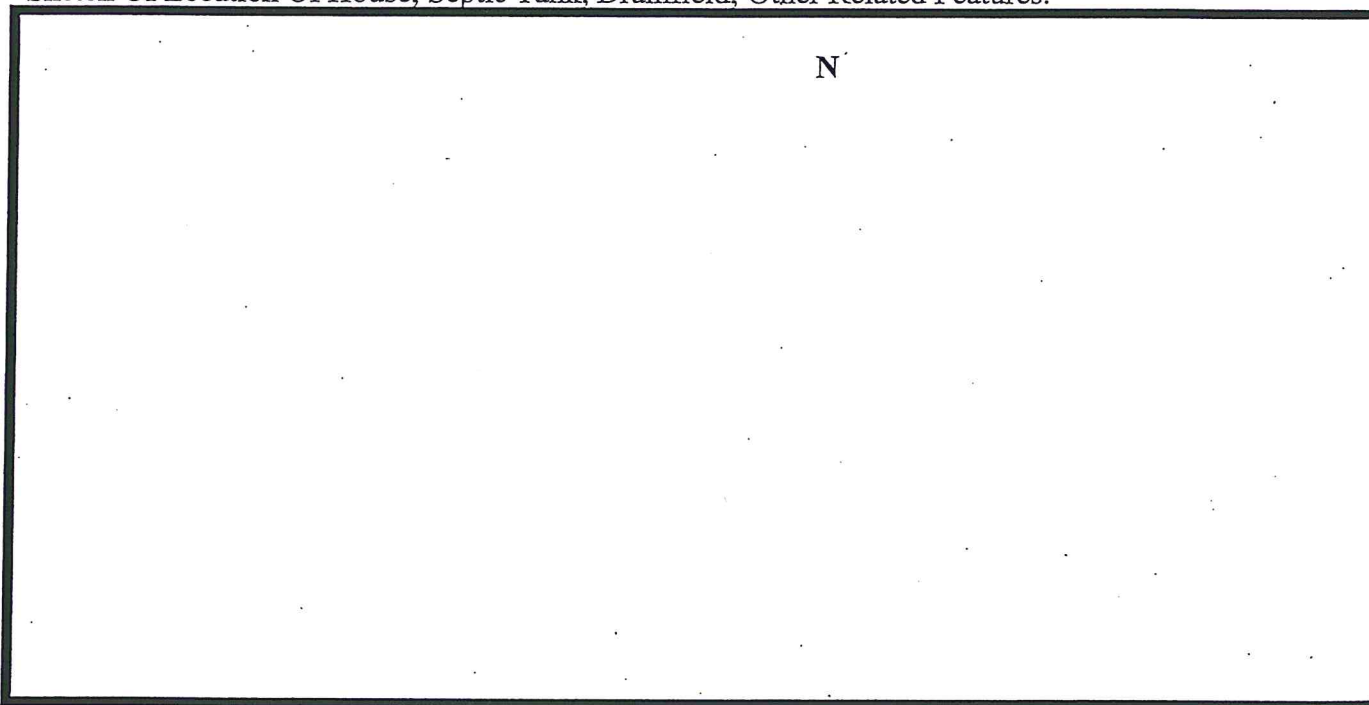
DATE \_\_\_\_\_

OWNER \_\_\_\_\_

PERSON INTERVIEWED \_\_\_\_\_

BRIEF DESCRIPTION OF SEWAGE SYSTEM \_\_\_\_\_

Sketch Of Location Of House, Septic Tank, Drainfield, Other Related Features:



Dye Test?  Yes  No

Dye Introduced in:

Toilet  Washing Machine Standpipe  Bathroom Sink  Kitchen Sink

Other \_\_\_\_\_

Assessment:  Failing  Unknown  Existing Non-conforming  Suspected Failure

## Procedures for Conducting a Sanitary Survey

- 1) Separate returned questionnaire's by street, area ect... for easy reference in the field.
- 2) Make sure that each team has a sufficient supply of field data sheets and several copies of blank questionnaires. Several pencils should be carried and if desired, plastic gloves. Heavy shoes or boots should be worn to minimize wet feet. Be careful when entering residences with dirty/muddy shoes.
- 3) Enter property and introduce yourself to the property owner. If the property owner wishes to proceed with the survey, and has not completed the questionnaire, help them fill one out at this point. Explain to them that you will be dye testing their system and ask if they would walk the property with you to help identify the septic system component locations after the dye has been introduced. You can work in any questions at this time for example "how has your system been working" or "has the system been backing up into the house" or "do your plumbing fixtures drain slowly" or "do you know if your laundry machine is connected to your system" ect... Ask the property owner if you can return to the site in a day or two if needed to further observe the results of the dye test.

#### 4) **Conduct the dye test:**

**NOTE:** The dye product itself is water soluble and is not harmful if you get some on your hands or on any of the plumbing fixtures. The dye will either be in tablet or liquid form and can be messy if splashed all over the place, but will clean up easily with water. Care should be taken to minimize splashing when introducing dye so that there will be minimal cleanup requirements. The dye can be carried in plastic zip lock bags in between testing.

- i) Introduce dye into a laundry drain standpipe if accessible. Run a laundry cycle. If no laundry standpipe is accessible, introduce dye into a laundry or kitchen sink and run water for 5 to 10 minutes.
- ii) While the laundry machine is running, introduce dye into a toilet and flush five or six times. Need to check dye labels for amount to add.

5) Invite the property owner to accompany you outside of the residence to help you locate components of the sewage disposal system.

i) **What to look for:**

- Use the plumbing vent pipe visible on the roof of the building to help identify where the plumbing leaves the house. Generally, the largest of these pipes is often above the point where the waste drain passes through the foundation. The location of the septic tank should be in a fairly straight line from the exit point of the drain and about 5 to 10 feet out from the foundation. If you have located the septic tank, is there any dye or surfacing sewage (or water with a sewage odor) over the tank? This is a FAILURE.
- Look for very lush, green grass that is growing in a pattern unlike the grass growing around it. This may be the disposal area. The lush grass by itself does **not** indicate failure, but may help locate the disposal area.
- Look for surfacing dye (indicates FAILURE), standing water with a sewage odor associated with it (FAILURE) or spongy ground that puddles sewage in your footprints (FAILURE).
- If there are any down slope road cuts, banks, ditches, surface waters (stream, lake ect...) or culverts, look for dye, open drain pipes or sewage being discharged or weeping out from the side of the bank. If any of these are seen, it is a FAILURE.
- Check for open pipes discharging into vegetation such as clumps of blackberries. If any dye or sewage is noted, mark as a FAILURE.
- Look for any fresh soil disturbances or vehicle tire ruts for evidence of dye or surfacing sewage. If found, mark as a FAILURE.

6) Sketch the location of the house, septic tank, disposal area, roads, and any areas where a failure has been noted. This sketch is not an artist drawing, just include the features as you see them but be sure to label them. Record all information on the Property Survey Data Sheet.

**NOTE:** Dye may not be evident on the first day and return sites visits may need to be conducted.

7) Mark the appropriate assessment box as:

- i) FAILING: discussed above
- ii) UNKNOWN: if there is no information about the system and/or no failure is noted.
- iii) EXISTING NON-CONFORMING: if we know from the property owner or can verify on site that the system is a buried drum, cesspool, pit or other type of system that does not meet existing standards, but is NOT failing (per legal definition), mark this box. Also include systems that are being subjected to vehicular traffic or other activities that may cause failure.
- iv) SUSPECTED FAILURE: systems that are only being used seasonally, but are anecdotally known to experience failure when used. Also other systems that may experience failure intermittently but were not reported or observed as failing during the sanitary survey.

SECTION 4.00 - MATERIAL SAFETY DATA SHEET

Appendix 4. Fluorescent Dye Technical Data

SECTION 4.00 - MATERIAL SAFETY DATA SHEET

PRODUCT INFORMATION

MANUFACTURED BY: KODAK CHEMICALS

3342 TOWN BLVD.

MIAMI, FL 33133

CHEMICAL NAME: NOT APPLICABLE

CHEMICAL FORMULA: NOT APPLICABLE

CHEMICAL FAMILY: FLUORESCENT DYE PRODUCT

HAZARDOUS INGREDIENTS

NONE PER 29 CFR 1910.120

PHYSICAL DATA

PHYSICAL STATE: LIQUID

COLOR AND APPEARANCE: YELLOW BROWN, WITH RED APPEARANCE UNDER

SPECIFIC GRAVITY: APPROXIMATELY 1.0

VAPOR DENSITY: (AIR = 1.0) APPROXIMATELY 1.0

VAPOR PRESSURE: (MM HG) APPROXIMATELY 1.0

EVAPORATION RATE: (WATER = 1.0) APPROXIMATELY 1.0

BOILING POINT: (MM HG) APPROXIMATELY 100°C

MELTING POINT: (MM HG) APPROXIMATELY 10°C

FREEZING POINT: (MM HG) APPROXIMATELY 10°C

DENSITY: (MM HG) APPROXIMATELY 1.0

FIRE HAZARD

CONDITIONS OF STORAGE: NON-FLAMMABLE

NEEDS OF EXTINGUISHING: WATER, CO<sub>2</sub>, ALKALINE, DRY CHEMICAL

FLASH POINT: (METHOD) NOT APPLICABLE

UPPER AND LOWER LIMITS: NOT APPLICABLE

LOWEST ALARM LIMIT: NOT APPLICABLE

AUTO-IGNITION TEMPERATURE: NOT APPLICABLE

HAZARDOUS COMBUSTION PRODUCTS: NOT APPLICABLE

UNUSUAL FIRE OR EXPLOSION DATA: NOT APPLICABLE

EXPLANATION HAZARD

SENSITIVITY TO SHOCK: NON-FLAMMABLE

SENSITIVITY TO STATIC ELECTRICAL CHARGE: NOT APPLICABLE

REACTIVITY DATA

PRODUCT STABILITY: STABLE

IN CONTACT WITH WATER: NONE KNOWN

CONDITIONS OF STORAGE: NOT APPLICABLE

HAZARDOUS REACTION WITH WATER: NONE KNOWN



**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FLT YELLOW/GREEN™ LIQUID CONCENTRATE**

**PAGE 1 OF 3**

**MSDS PREPARATION INFORMATION**

PREPARED BY: T. P. MULDOON

(937) 886-9100

DATE PREPARED: 1/01/02

**PRODUCT INFORMATION**

MAUNFACTURED BY: KINGSCOTE CHEMICALS

3334 S. TECH BLVD.

MIAMISBURG, OHIO 45342

CHEMICAL NAME NOT APPLICABLE

CHEMICAL FORMULA NOT APPLICABLE

CHEMICAL FAMILY AQUEOUS DYE PRODUCT

**HAZARDOUS INGREDIENTS**

NONE PER 29 CFR 1910.1200

**PHYSICAL DATA**

PHYSICAL STATE LIQUID

ODOR AND APPEARANCE YELLOW/GREEN, WITH NO APPARENT ODOR

SPECIFIC GRAVITY APPROXIMATELY 1.05

VAPOR DENSITY (mm Hg @ 25° C) ~23.75

VAPOR DENSITY (AIR =1) ~0.6

EVAPORATION RATE (Butyl Acetate = 1) ~1.8

BOILING POINT 100 degrees C (212 degrees F)

FREEZING POINT 0 degrees C (32 degrees F)

pH 8.0 OR ABOVE

SOLUBILITY IN WATER HIGHLY SOLUBLE

**FIRE HAZARD**

CONDITION OF FLAMMABILITY NON-FLAMABLE

MEANS OF EXTINCTION WATER FOG, CARBON DIOXIDE, OR DRY CHEMICAL

FLASH POINT AND METHOD NOT APPLICABLE

UPPER FLAMABLE LIMIT NOT APPLICABLE

LOWER FLAMABLE LIMIT NOT APPLICABLE

AUTO-IGNITION TEMPERATURE NOT APPLICABLE

HAZARDOUS COMBUSTION PRODUCTS NOT APPLICABLE

UNUSUAL FIRE HAZARD NOT APPLICABLE

**EXPLOSION HAZARD**

SENSITIVITY TO STATIC DISCHARGE NOT APPLICABLE

SENSITIVITY TO MECHANICAL IMPACT NOT APPLICABLE

**REACTIVITY DATA**

PRODUCT STABILITY STABLE

PRODUCT INCOMPATIBILITY NONE KNOWN

CONDITIONS OF REACTIVITY NOT APPLICABLE

HAZARDOUS DECOMPOSITION PRODUCTS NONE KNOWN

**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FLT YELLOW/GREEN™ LIQUID CONCENTRATE**

**PAGE 2 OF 3**

**TOXICOLOGICAL PROPERTIES**

SYMPTOMS OF OVER EXPOSURE FOR EACH POTENTIAL ROUTE OF ENTRY:  
INHALLATION, ACUTE NO HARMFUL EFFECTS EXPECTED.  
INHALATION, CHRONIC NO HARMFUL EFFECTS EXPECTED.  
SKIN CONTACT WILL TEMPORARILY GIVE SKIN A YELLOW/GREEN COLOR.  
EYE CONTACT NO HARMFUL EFFECTS EXPECTED.  
INGESTION URINE MAY BE A YELLOW/GREEN COLOR UNTIL THE DYE  
HAS BEEN WASHED THROUGH THE SYSTEM.  
EFFECTS OF ACUTE EXPOSURE NO HARMFUL EFFECTS EXPECTED  
EFFECTS OF CHRONIC EXPOSURE NO HARMFUL EFFECTS EXPECTED  
THRESHOLD OF LIMIT VALUE NOT APPLICABLE  
CARCINOGENICITY NOT LISTED AS A KINOWN OR SUSPECTED CARCINOGEN BY  
IARC, NTP OR OSHA.  
TERATOGENICITY NONE KNOWN  
TOXICOLOGY SYNERGISTIC PRODUCTS NONE KNOWN

**PREVENTATIVE MEASURES**

PERSONAL PROTECTIVE EQUIPMENT  
GLOVES RUBBER  
RESPIRATORY USE NISOH APPROVED DUST MASK IF DUSTY CONDITIONS  
EXIST.  
CLOTHING PROTECTIVE CLOTHING SHOULD BE WORN WHERE  
CONTACT IS UNAVOIDABLE.  
OTHER HAVE ACCESS TO EMERGENCY EYEWASH.

**PREVENTATIVE MEASURES (CONT.)**

ENGINEERING CONTROLS NOT NECESSARY UNDER NORMAL CONDITIONS, USE LOCAL  
VENTILATION IF DUSTY CONDITIONS EXIST.  
SPILL OR LEAK RESPONSE CLEAN UP SPILLS IMMEDIATELY, PREVENT FROM  
ENTERING DRAIN. USE ABSORBANTS AND PLACE ALL  
SPILL MATERIALS IN WASTE DISPOSAL CONTAINER. FLUSH  
AFFECTED AREA WITH WATER.  
WASTE DISPOSAL INCINERATE OR REMOVE TO A SUITABLE SOLID WASTE  
DISPOSAL SITE, DISPOSE OF ALL WASTES IN ACCORDANCE  
WITH FEDERAL, STATE AND LOCAL REGULATIONS.  
HANDELING PROCEDURES AND EQUIPMENT NO SPECIAL REQUIREMENTS.  
STORAGE REQUIREMENTS STORE AT ROOM TEMPERATURE BUT ABOVE THE FREEZING  
POINT OF WATER.  
SHIPPING INFORMATION KEEP FROM FREEZING.

**FIRST AID MEASURES**

FIRST AID EMERGENGY PROCEDURES  
EYE CONTACT FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES. GET  
MEDICAL ATTENTION IF IRRITATION PERSISTS.  
SKIN CONTACT WASH SKIN THOROUGHLY WITH SOAP AND WATER. GET

**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FLT YELLOW/GREEN™ LIQUID CONCENTRATE**

**PAGE 3 OF 3**

MEDICAL ATTENTION IF IRRITATION DEVELOPS.  
INHALATION IF DUST IS INHALED, MOVE TO FRESH AIR. IF BREATHING IS  
DIFFICULT GIVE OXYGEN AND GET IMMEDIATE MEDICAL  
ATTENTION.

INGESTION DRINK PLENTY OF WATER AND INDUCE VOMITING. GET  
MEDICAL ATTENTION IF LARGE QUANTITIES WERE  
INGESTED OR IF NAUSEA OCCURS. NEVER GIVE FLUIDS OR  
INDUCE VOMITING IF THE PERSON IS UNCONSCIOUS OR  
HAS CONVULSIONS.

**SPECIAL NOTICE**

ALL INFORMATION, RECOMMENDATIONS AND SUGGESTIONS APPEARING HEREIN  
CONCERNING THIS PRODUCT  
ARE BASED UPON DATA OBTAINED FROM MANUFACTURER AND/OR RECOGNIZED  
TECHNICAL SOURCES;  
HOWEVER, KINGSCOTE CHEMICALS MAKES NO WARRANTY, REPRESENTATION OR  
GUARANTEE AS TO THE  
ACCURACY, SUFFICIENCY OR COMPLETENESS OF THE MATERIAL SET FORTH HEREIN. IT  
IS THE USER'S  
RESPONSIBILITY TO DETERMINE THE SAFETY, TOXICITY AND SUITABILITY OF HIS OWN  
USE, HANDLING, AND  
DISPOSAL OF THE PRODUCT. ADDITIONAL PRODUCT LITERATURE MAY BE AVAILABLE  
UPON REQUEST. SINCE  
ACTUAL USE BY OTHERS IS BEYOND OUR CONTROL, NO WARRANTY, EXPRESS OR  
IMPLIED, IS MADE BY  
KINGSCOTE CHEMICALS AS TO THE EFFECTS OF SUCH USE, THE RESULTS TO BE  
OBTAINED OR THE SAFETY AND  
TOXICITY OF THE PRODUCT, NOR DOES KINGSCOTE CHEMICALS ASSUME ANY LIABILITY  
ARISING OUT OF USE  
BY OTHERS OF THE PRODUCT REFERRED TO HEREIN. THE DATA IN THE MSDS RELATES  
ONLY TO SPECIFIC  
MATERIAL DESIGNATED HEREIN AND DOES NOT RELATE TO USE IN COMBINATION WITH  
ANY OTHER MATERIAL  
OR IN ANY PROCESS.

**END OF MATERIAL SAFETY DATA SHEET**

**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FWT RED™ 200 LIQUID**

**PAGE 1 OF 3**

**MSDS PREPARATION INFORMATION**

PREPARED BY: T. P. MULDOON  
(937) 886-9100  
DATE PREPARED: 1/1/02

**PRODUCT INFORMATION**

MANUFACTURED BY: KINGSCOTE CHEMICALS  
3334 S. TECH BLVD.  
MIAMISBURG, OHIO 45342  
CHEMICAL NAME NOT APPLICABLE  
CHEMICAL FORMULA NOT APPLICABLE  
CHEMICAL FAMILY XANTHENE DYE FORM

**HAZARDOUS INGREDIENTS**

DESCRIPTION % T.L.V. C.A.S. #  
TRIMELLITIC ACID ~5.0 NONE 528-44-9  
LD/50, SPECIES LC/50, SPECIES  
ORAL (MOUSE) 2500 MG/KG NONE AVAILABLE  
DERMAL (RABBIT) NOT AVAILABLE NOT AVAILABLE

**PHYSICAL DATA**

PHYSICAL STATE LIQUID  
ODOR AND APPEARANCE DARK RED LIQUID WITH MILD ODOR  
SPECIFIC GRAVITY ~1.15  
VAPOR DENSITY (mm Hg @ 25° C) NOT APPLICABLE  
VAPOR DENSITY (AIR =1) NOT APPLICABLE  
EVAPORATION RATE (Butyl Acetate = 1) NOT APPLICABLE  
BOILING POINT ~ 100 degrees. C (212 degrees. F)  
FREEZING POINT ~ 10 degrees C (14 degrees F)  
pH 10.4 TO 10.8  
SOLUBILITY IN WATER VERY SOLUBLE

**FIRE HAZARD**

CONDITION OF FLAMMABILITY NON-FLAMABLE  
MEANS OF EXTINCTION WATER FOG, CARBON DIOXIDE, DRY CHEMICAL, WEAR  
SCBA  
FLASH POINT AND METHOD NOT APPLICABLE  
UPPER FLAMABLE LIMIT NOT APPLICABLE  
LOWER FLAMABLE LIMIT NOT APPLICABLE  
AUTO-IGNITION TEMPERATURE NOT APPLICABLE  
HAZARDOUS COMBUSTION PRODUCTS BURNING MAY PRODUCE OXIDES OF CARBON &  
NITROGEN  
UNUSUAL FIRE HAZARD NOT APPLICABLE

**EXPLOSION HAZARD**

SENSITIVITY TO STATIC DISCHARGE NOT APPLICABLE  
SENSITIVITY TO MECHANICAL IMPACT NOT APPLICABLE

**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FWT RED™ 200 LIQUID**

**PAGE 2 OF 3**

**REACTIVITY DATA**

PRODUCT STABILITY STABLE

PRODUCT INCOMPATIBILITY DO NOT MIX WITH ACIDS

CONDITIONS OF REACTIVITY NOT APPLICABLE

HAZARDOUS DECOMPOSITION PRODUCTS SEE HAZARDOUS COMBUSTION PRODUCTS

**TOXICOLOGICAL PROPERTIES**

SYMPTOMS OF OVER EXPOSURE FOR EACH POTENTIAL ROUTE OF ENTRY:

INHALLATION, ACUTE TRIMELLITIC ACID MAY CAUSE IRRITATION

INHALATION, CHRONIC NOT KNOWN

SKIN CONTACT MAY BE IRRITATING TO THE SKIN. WILL CAUSE  
TEMPORARY STAINING OF THE SKIN ON CONTACT.

EYE CONTACT MAY CAUSE IRRITATION

INGESTION URINE MAY BE A RED COLOR UNTIL THE DYE HAS BEEN  
WASHED THROUGH THE SYSTEM.

EFFECTS OF ACUTE EXPOSURE DIRECT CONTACT MAY CAUSE IRRITATION TO THE EYES,  
SKIN, AND RESPIRATORY TRACT.

EFFECTS OF CHRONIC EXPOSURE NOT KNOWN

THRESHOLD OF LIMIT VALUE NOT APPLICABLE

CARCINOGENICITY NOT LISTED AS A KNOWN OR SUSPECTED CARCINOGEN BY  
IARC, NTP OR OSHA.

TERATOGENICITY NONE KNOWN

MUTAGENICITY CONFLICTING EVIDENCE AS TO MUTAGENICITY OF THE  
DYE CONTAINED IN THIS PRODUCT.

TOXICOLOGY SYNERGISTIC PRODUCTS NONE KNOWN

**PREVENTATIVE MEASURES**

PERSONAL PROTECTIVE EQUIPMENT

GLOVES RUBBER

RESPIRATORY NONE REQUIRED UNDER NORMAL CONDITIONS

EYE PROTECTION GOGGLES

CLOTHING PROTECTIVE CLOTHING SHOULD BE WORN WHERE  
CONTACT IS UNAVOIDABLE.

OTHER HAVE ACCESS TO EMERGENCY EYEWASH.

ENGINEERING CONTROLS NOT NECESSARY UNDER NORMAL CONDITIONS, USE LOCAL  
VENTILATION IF DUSTY CONDITIONS EXIST.

SPILL OR LEAK RESPONSE CONTAIN AND CLEAN UP SPILL IMMEDIATELY, PREVENT  
FROM ENTERING FLOOR DRAINS. SWEEP POWDERS AND  
PLACE IN WASTE DISPOSAL CONTAINER, FLUSH AFFECTED  
AREA WITH WATER.

WASTE DISPOSAL INCINERATE OR REMOVE TO A SUITABLE SOLID WASTE  
DISPOSAL SITE, DISPOSE OF ALL WASTES IN ACCORDANCE  
WITH FEDERAL, STATE AND LOCAL REGULATIONS.

HANDELING PROCEDURES AND EQUIPMENT NO SPECIAL REQUIREMENTS.

STORAGE REQUIREMENTS STORE AT ROOM TEMPERATURE BUT ABOVE THE FREEZING  
POINT OF WATER

SHIPPING INFORMATION KEEP FROM FREEZING

**BRIGHT DYES™ MATERIAL SAFETY DATA SHEET  
FWT RED™ 200 LIQUID**

**PAGE 3 OF 3**

**FIRST AID MEASURES**

FIRST AID EMERGENCY PROCEDURES

EYE CONTACT FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES. GET MEDICAL ATTENTION IF IRRITATION PERSISTS.

SKIN CONTACT WASH SKIN THOROUGHLY WITH SOAP AND WATER. GET MEDICAL ATTENTION IF IRRITATION DEVELOPS.

INHALATION IF DUST IS INHALED, MOVE TO FRESH AIR. IF BREATHING IS DIFFICULT GIVE OXYGEN AND GET IMMEDIATE MEDICAL ATTENTION.

INGESTION DRINK PLENTY OF WATER AND INDUCE VOMITING. GET MEDICAL ATTENTION IF LARGE QUANTITIES WERE INGESTED OR IF NAUSEA OCCURS. NEVER GIVE FLUIDS OR INDUCE VOMITING IF THE PERSON IS UNCONSCIOUS OR HAS CONVULSIONS.

**SPECIAL NOTICE**

ALL INFORMATION, RECOMMENDATIONS AND SUGGESTIONS APPEARING HEREIN CONCERNING THIS PRODUCT

ARE BASED UPON DATA OBTAINED FROM MANUFACTURER AND/OR RECOGNIZED TECHNICAL SOURCES;

HOWEVER, KINGSCOTE CHEMICALS MAKES NO WARRANTY, REPRESENTATION OR GUARANTEE AS TO THE

ACCURACY, SUFFICIENCY OR COMPLETENESS OF THE MATERIAL SET FORTH HEREIN. IT IS THE USER'S

RESPONSIBILITY TO DETERMINE THE SAFETY, TOXICITY AND SUITABILITY OF HIS OWN USE, HANDLING, AND

DISPOSAL OF THE PRODUCT. ADDITIONAL PRODUCT LITERATURE MAY BE AVAILABLE UPON REQUEST. SINCE

ACTUAL USE BY OTHERS IS BEYOND OUR CONTROL, NO WARRANTY, EXPRESS OR IMPLIED, IS MADE BY

KINGSCOTE CHEMICALS AS TO THE EFFECTS OF SUCH USE, THE RESULTS TO BE OBTAINED OR THE SAFETY AND

TOXICITY OF THE PRODUCT, NOR DOES KINGSCOTE CHEMICALS ASSUME ANY LIABILITY ARISING OUT OF USE

BY OTHERS OF THE PRODUCT REFERRED TO HEREIN. THE DATA IN THE MSDS RELATES ONLY TO SPECIFIC

MATERIAL DESIGNATED HEREIN AND DOES NOT RELATE TO USE IN COMBINATION WITH ANY OTHER MATERIAL

OR IN ANY PROCESS.

**END OF MATERIAL SAFETY DATA SHEET**

# WATER TRACING DYE FLT YELLOW/GREEN PRODUCTS

Division of Kingscote Chemicals

## TECHNICAL DATA BULLETIN

Bright Dyes Yellow/Green products are specially formulated versions of Xanthene dye, certified by NSF International to ANSI/NSF Standard 60 for use in drinking water. This dye is the traditional fluorescent water tracing and leak detection material and has been used for labeling studies from the beginning of the century. It may be detected visually, by UV light and by appropriate fluoremetric equipment. Today it is most often used visually. This dye has been used by the military to mark downed pilots for search and rescue operations over large water bodies. Visually the dye appears yellow/green, depending on its concentration and under UV light as lime green.

Based on biochemical oxygen demand (BOD) studies, the dye is biodegradable with 65% of the available oxygen consumed in 7 days. The dye is resistant to absorption on most suspended matter in fresh and salt water. However, compared to Bright Dyes FWT Red products it is significantly less resistant to degradation by sunlight and when used in fluoremetry, stands out much less clearly against background fluorescence. As always the suitability of these products for any specific application should be evaluated by a qualified hydrologist or other industry professional.

<b>General Properties</b>	<b>Tablets</b>	<b>Liquids</b>	<b>Powders</b>
Detectability of active ingredient <sup>1</sup>	Visual <100 ppb	Visual <100 ppb	Visual <100 ppb
Maximum absorbance wavelength <sup>2</sup>	490/520 nm	490/520 nm	490/520 nm
Appearance	Orange convex 1.6cm diameter	Reddish, brown aqueous solution	Orange fine powder
NSF (Max use level in potable water)	6.0 ppb	10.0 ppb	1.0 ppb
Weight	1.35 gms ± 0.05		
Dissolution Time <sup>3</sup>	50% < 3 minutes 95% < 6 minutes		50% < 3 minutes 95% < 6 minutes
Specific Gravity		1.05 ± 0.05 @ 25° C	
Viscosity <sup>4</sup>		1.8 cps	
pH		8.5 ± 0.5 @ 25° C	
<b>Coverage of Products</b>	<b>One Tablet</b>	<b>One Pint Liquid</b>	<b>One Pound Powder</b>
Light Visual	605 gallons	125,000 gallons	1,200,000 gallons
Strong Visual	60 gallons	12,500 gallons	120,000 gallons

Caution: These products may cause irritation and/or staining if allowed to come in contact with the skin. The use of gloves and goggles is recommended when handling this product, as with any other dye or chemical.

To our best knowledge the information and recommendations contained herein are accurate and reliable. However, this information and our recommendations are furnished without warranty, representation, inducement, or license of any kind, including, but not limited to the implied warranties and fitness for a particular use or purpose. Customers are encouraged to conduct their own tests and to read the material safety data sheet carefully before using.

<sup>1</sup> In deionized water in 100 ml flask. Actual detectability and coverage in the field will vary with specific water conditions.

<sup>2</sup> No significant change in fluorescence between 6 and 11 pH.

<sup>3</sup> (One tablet, 1 gram of powder), in flowing deionized water in a 10 gallon tank.

<sup>4</sup> Measured on a Brookfield viscometer, Model LV, UL adapter, 60 rpm @ 25° C.

**Kingscote Chemicals, 3334 S. Tech Blvd., Miamisburg, Ohio 45342**  
**Telephone: (937) 886-9100 Fax: (937) 886-9300 Web: www.brightdyes.com**

## **WATER TRACING DYE FWT RED PRODUCTS**

Division of Kingscote Chemicals

### **TECHNICAL DATA BULLETIN**

Bright Dyes FWT Red products are specially formulated versions of Rhodamine WT dye for convenient use in water tracing and leak detection studies. This bright, fluorescent red dye is certified by NSF International to ANSI/NSF Standard 60 for use in drinking water. It may be detected visually, by ultraviolet light and by appropriate fluorometric equipment. Today it is most often used visually. Visually the dye appears bright pink to red, depending on its concentration and under ultraviolet light as bright orange.

The dye is resistant to absorption on most suspended matter in fresh and salt water. Compared to Bright Dyes FLT Yellow/Green products it is significantly more resistant to degradation by sunlight and when used in fluorometry, stands out much more clearly against background fluorescence. As always the use and suitability of these products for any specific application should be evaluated by a qualified hydrologist or other industry professional.

<b>General Properties</b>	<b>Cakes</b>	<b>Cones</b>	<b>Donuts</b>
Detectability of active ingredient <sup>1</sup>	Visual <100 ppb	Visual <100 ppb	Visual <100 ppb
Maximum absorbance wavelength <sup>2</sup>	550/588 nm	550/588 nm	550/588 nm

Caution: These products may cause irritation and/or staining if allowed to come in contact with the skin. The use of gloves and goggles is recommended when handling this product, as with any other dye or chemical.

To our best knowledge the information and recommendations contained herein are accurate and reliable. However, this information and our recommendations are furnished without warranty, representation, inducement, or license of any kind, including, but not limited to the implied warranties and fitness for a particular use or purpose. Customers are encouraged to conduct their own tests and to read the material safety data sheet carefully before using.

<sup>1</sup> In deionized water in 100 ml flask. Actual detectability and coverage in the field will vary with specific water conditions.

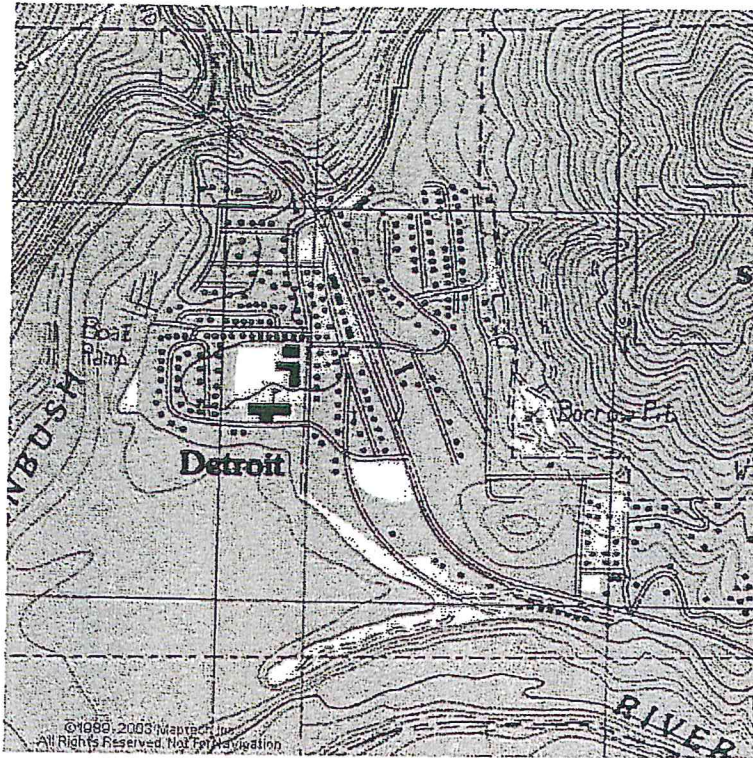
<sup>2</sup> No significant change in fluorescence between 6 and 11 pH.

**Kingscote Chemicals, 3334 S. Tech Blvd., Miamisburg, Ohio 45342**  
**Telephone: (937) 886-9100 Fax: (937) 886-9300 Web: [www.brightdyes.com](http://www.brightdyes.com)**

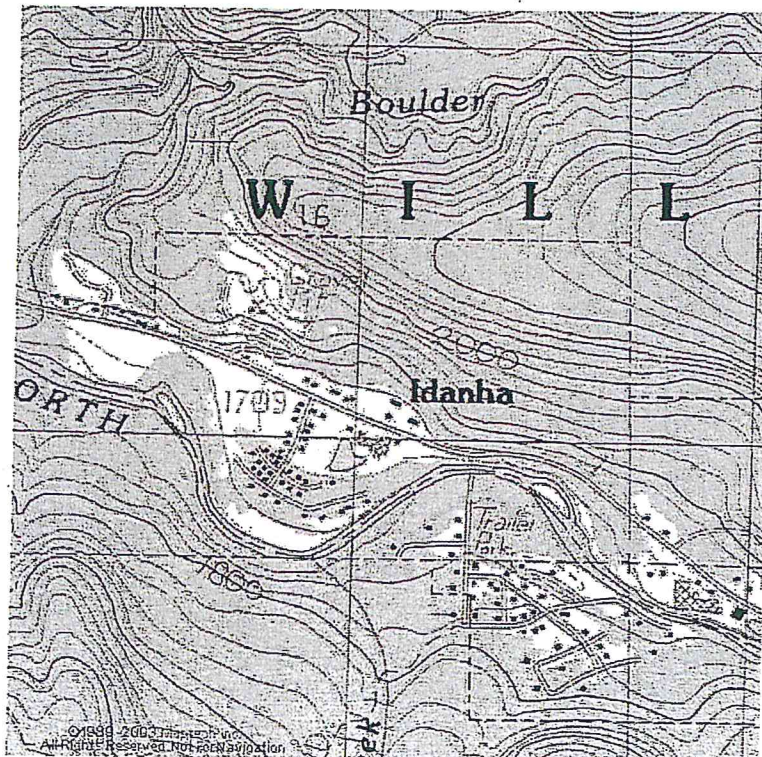


Appendix 5. Vicinity Maps Showing the  
Communities of Detroit, Idanha and the  
Properties Evaluated

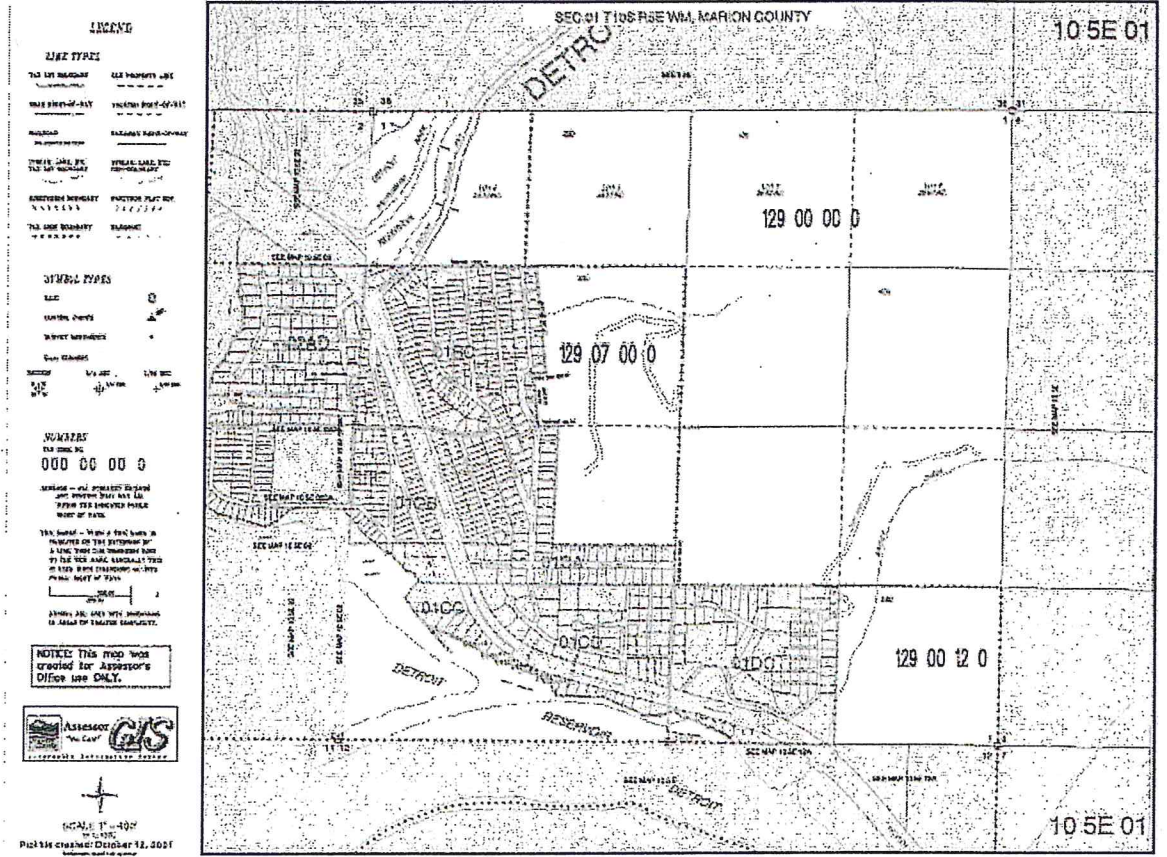
Vicinity Map of Detroit, Oregon.



Vicinity Map of Idanha, Oregon.



**Lots Surveyed in Detroit, Oregon**  
 (Note: Lots Surveyed are shaded in gray)



**LEGEND**

**LINE TYPES:**

--- UNLIT ROADWAY --- GAS PROPERTY LINE

--- PAVED ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

**SYMBOL TYPES**

--- RAIL ---

--- FENCE ---

--- POWER POLE ---

--- SIGN ---

--- CURB ---

--- DITCH ---

--- DRAIN ---

--- EASEMENT ---

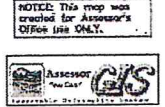
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**NUMBERS**

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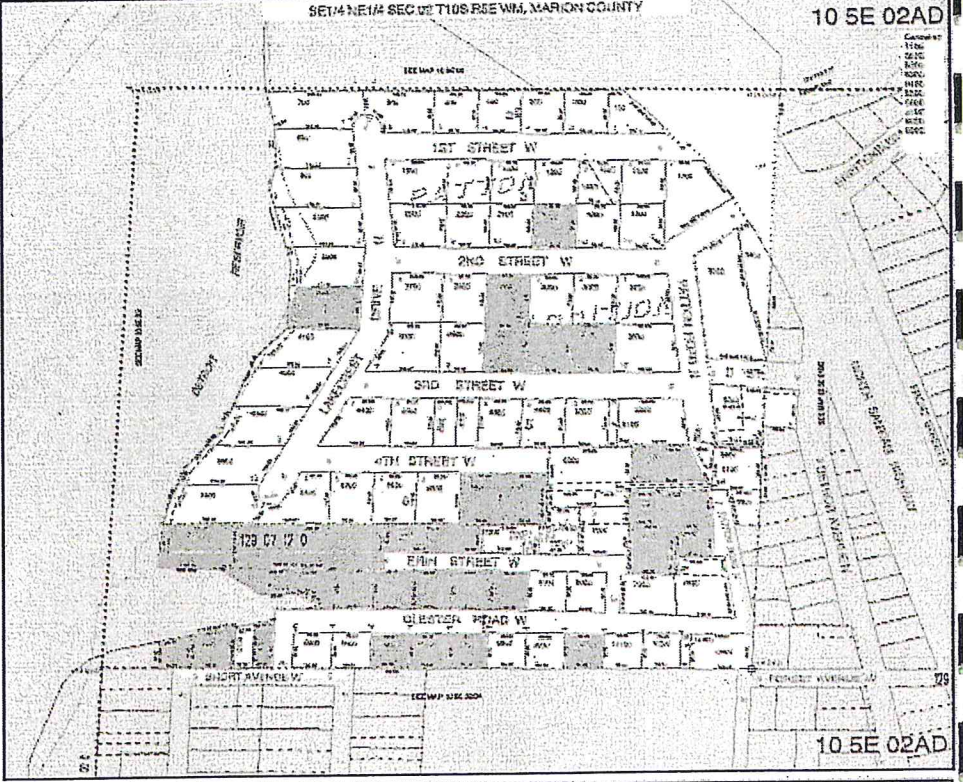
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**NOTICE:** This map was created for Assessor's Office use ONLY.



**SCALE 1" = 100'**

Printed created: June 04, 2009



**LEGEND**

**LINE TYPES:**

--- UNLIT ROADWAY --- GAS PROPERTY LINE

--- PAVED ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

--- UNLIT ROADWAY --- UNLIT ROADWAY

**SYMBOL TYPES**

--- RAIL ---

--- FENCE ---

--- POWER POLE ---

--- SIGN ---

--- CURB ---

--- DITCH ---

--- DRAIN ---

--- EASEMENT ---

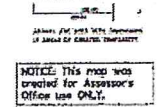
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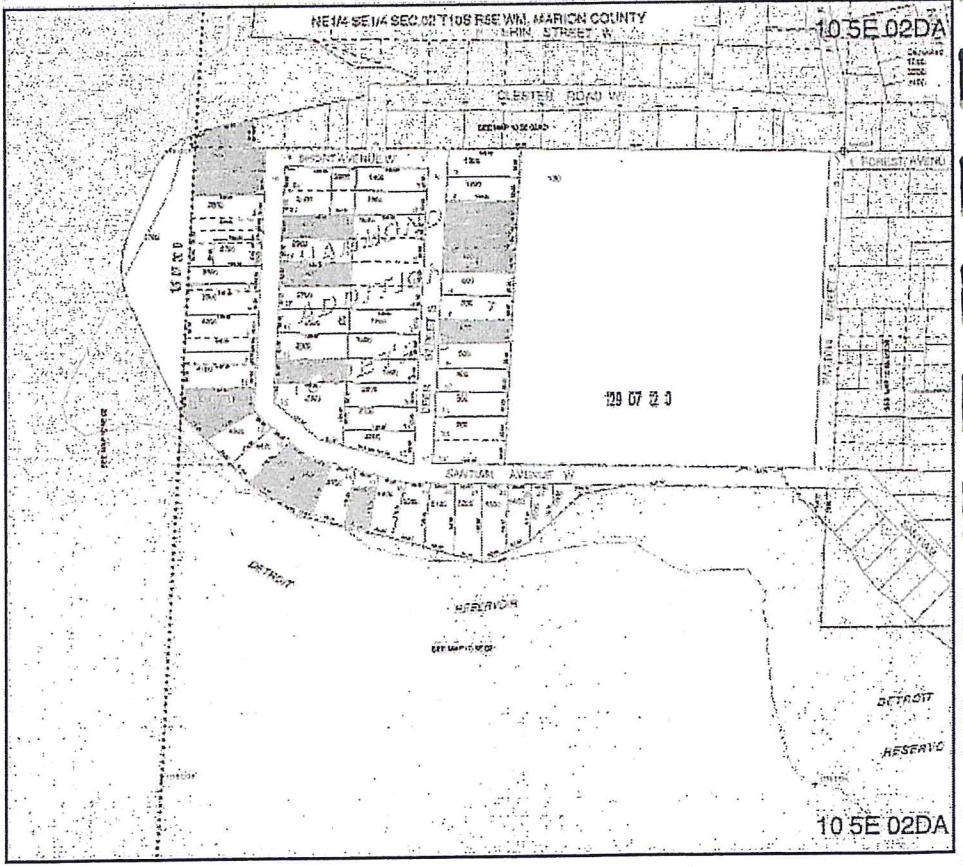
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**NOTICE:** This map was created for Assessor's Office use ONLY.



**SCALE 1" = 100'**

Printed created: February 12, 2008



**LEGEND**

**LINE TYPES**

THE CITY BOUNDARY	ALL PROPERTY LINES
PAVED DRIVEWAYS	UNPAVED DRIVEWAYS
PAVED ALLEYS	UNPAVED ALLEYS
PAVED SIDE STREETS	UNPAVED SIDE STREETS
PAVED PARKWAYS	UNPAVED PARKWAYS
PAVED AVENUES	UNPAVED AVENUES
PAVED HIGHWAYS	UNPAVED HIGHWAYS

**SYMBOL TYPES**

ALL

UNPAVED DRIVEWAYS

UNPAVED ALLEYS

UNPAVED SIDE STREETS

UNPAVED PARKWAYS

UNPAVED AVENUES

UNPAVED HIGHWAYS

**NUMBERS**

THE CODE IS

000 00 00 0

NOTICE - ALL ADDRESS NUMBERS AND PROPERTY LINES ARE FROM THE LATEST AVAILABLE RECORDS OF THIS OFFICE.

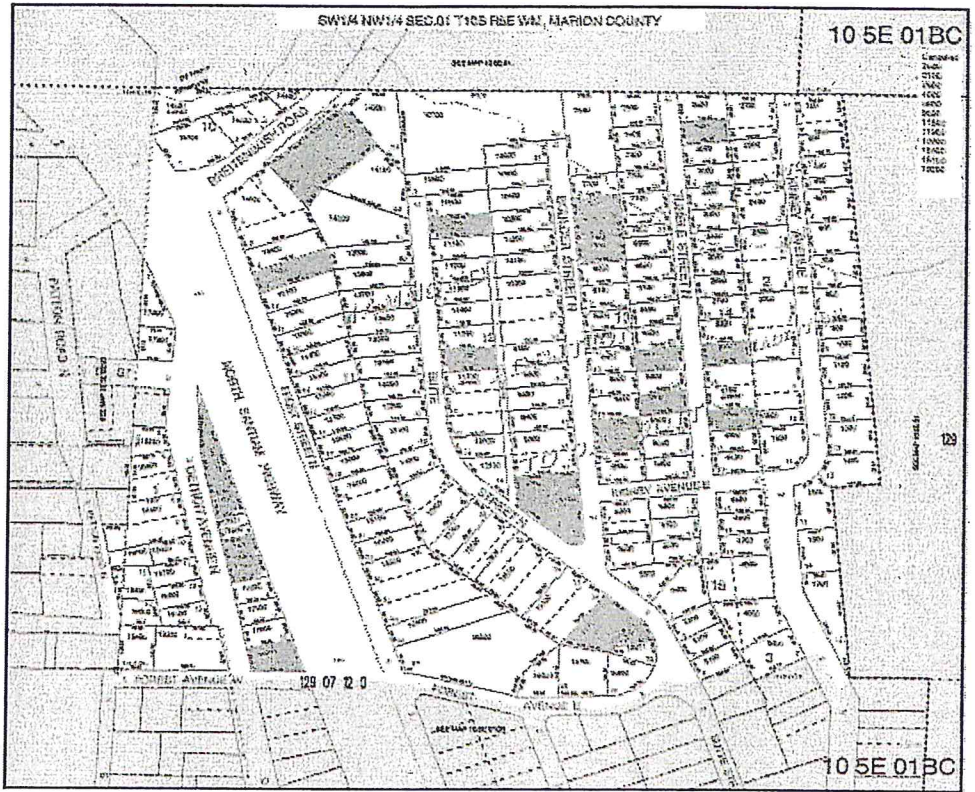
THE BOUNDARY LINES OF THIS MAP ARE BASED ON THE BEST AVAILABLE INFORMATION AND ARE NOT GUARANTEED TO BE EXACTLY CORRECT. THE OFFICE DOES NOT WARRANT THE ACCURACY OF THESE LINES.

NOTICE: This map was created for Assessor's Office use ONLY.

Assessor GIS

SCALE: 1" = 100'

Plot file created: JULY 01, 2002



**LEGEND**

**LINE TYPES**

THE CITY BOUNDARY	ALL PROPERTY LINES
PAVED DRIVEWAYS	UNPAVED DRIVEWAYS
PAVED ALLEYS	UNPAVED ALLEYS
PAVED SIDE STREETS	UNPAVED SIDE STREETS
PAVED PARKWAYS	UNPAVED PARKWAYS
PAVED AVENUES	UNPAVED AVENUES
PAVED HIGHWAYS	UNPAVED HIGHWAYS

**SYMBOL TYPES**

ALL

UNPAVED DRIVEWAYS

UNPAVED ALLEYS

UNPAVED SIDE STREETS

UNPAVED PARKWAYS

UNPAVED AVENUES

UNPAVED HIGHWAYS

**NUMBERS**

THE CODE IS

000 00 00 0

NOTICE - ALL ADDRESS NUMBERS AND PROPERTY LINES ARE FROM THE LATEST AVAILABLE RECORDS OF THIS OFFICE.

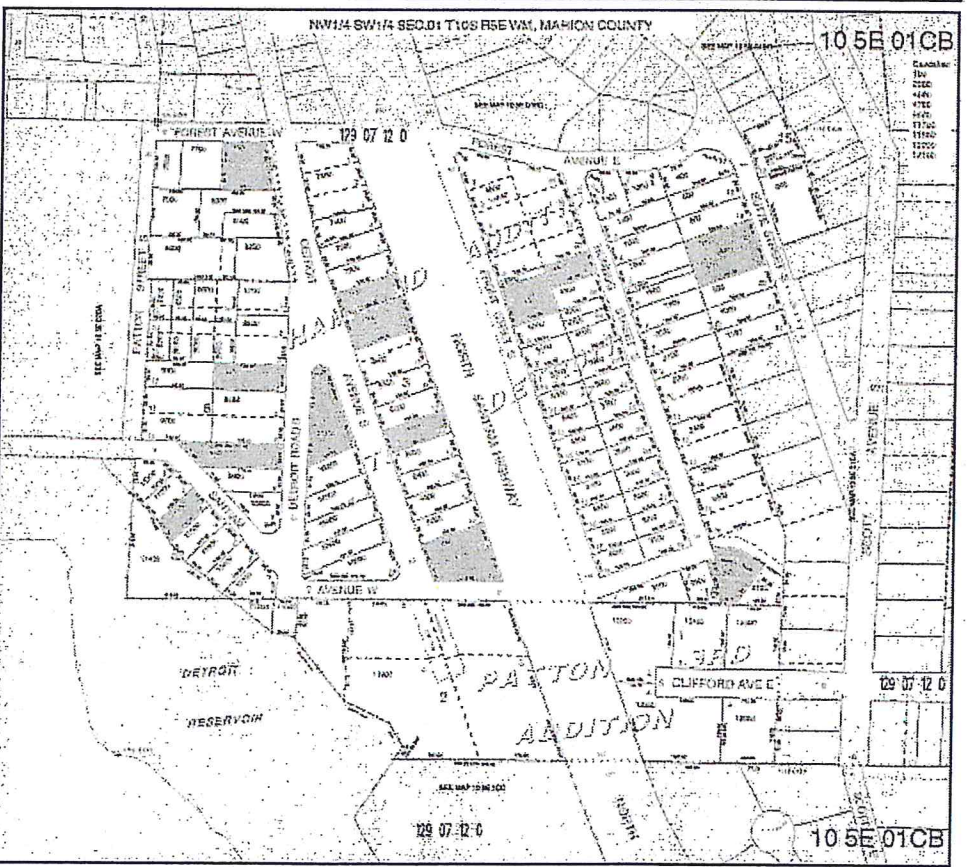
THE BOUNDARY LINES OF THIS MAP ARE BASED ON THE BEST AVAILABLE INFORMATION AND ARE NOT GUARANTEED TO BE EXACTLY CORRECT. THE OFFICE DOES NOT WARRANT THE ACCURACY OF THESE LINES.

NOTICE: This map was created for Assessor's Office use ONLY.

Assessor GIS

SCALE: 1" = 100'

Plot file created: JULY 01, 2002



**LEGEND**

**LINE TYPES**

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

**SYMBOL TYPES**

ALL      □

STREET RIGHTS      □

UTILITY RIGHTS      □

CLIP CORNERS      □

SECTION      □

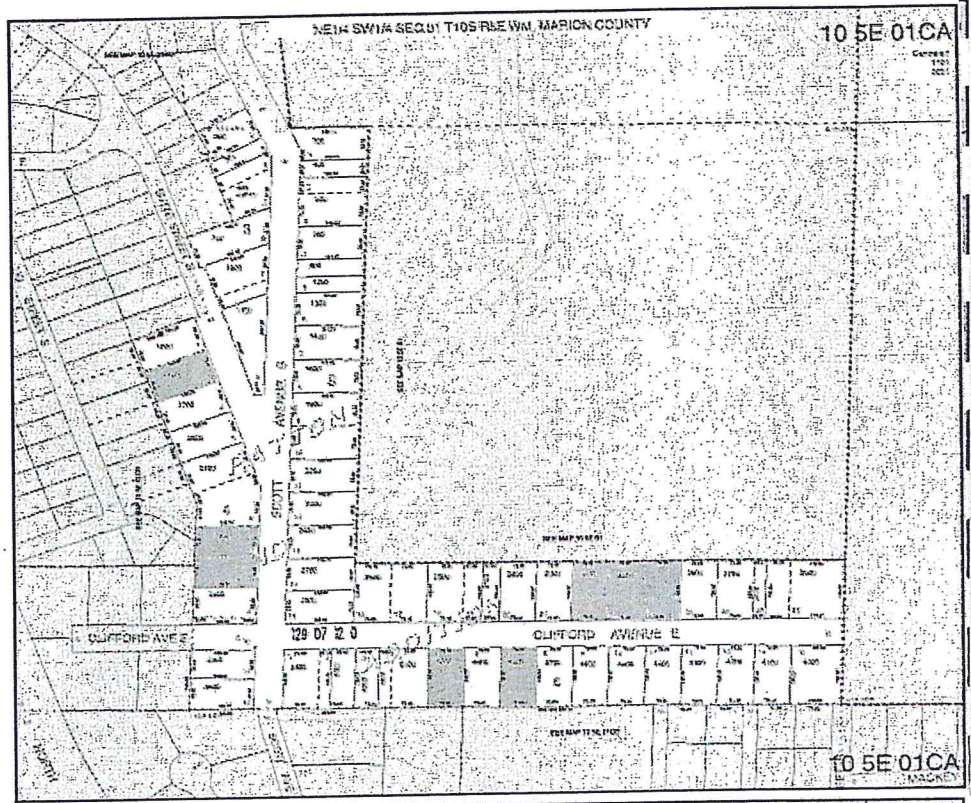
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**NUMBERS**

THE SET NO.      000 00 00 0

**NOTICE:** This map was created for Assessor's Office use ONLY.

Assessor's Office GIS



**LEGEND**

**LINE TYPES**

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

THE SET BOUNDARY      THE PROPERTY LINE

**SYMBOL TYPES**

ALL      □

STREET RIGHTS      □

UTILITY RIGHTS      □

CLIP CORNERS      □

SECTION      □

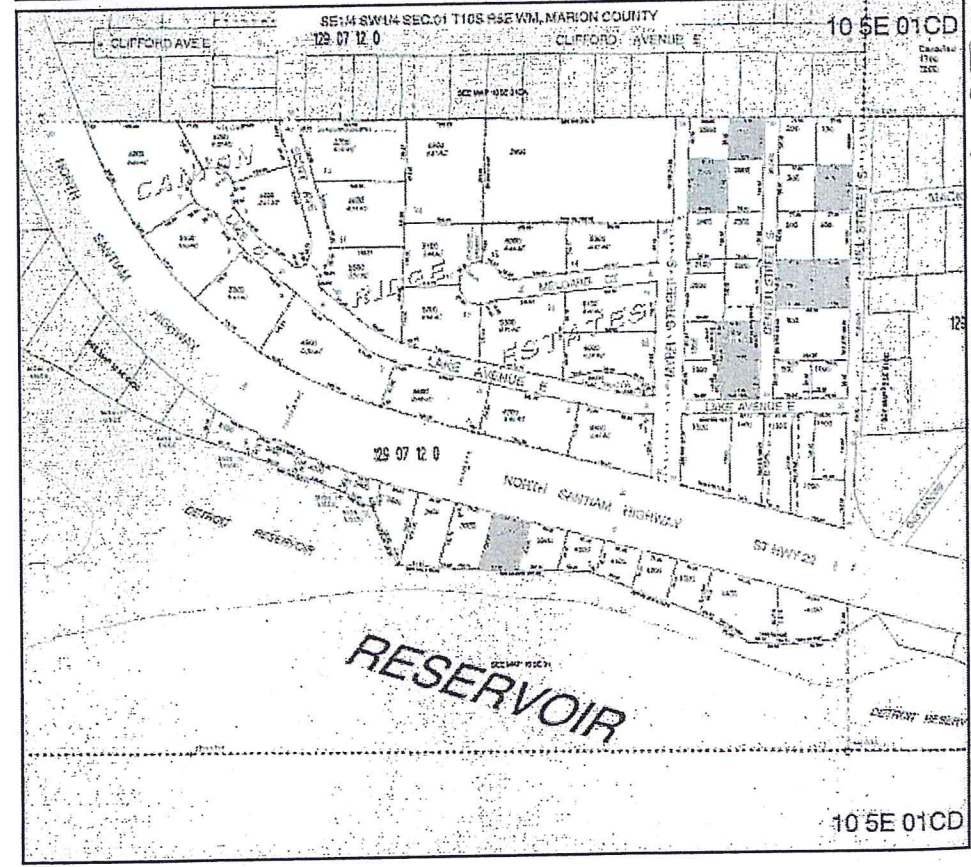
THE SET BOUNDARY      □

**NUMBERS**

THE SET NO.      000 00 00 0

**NOTICE:** This map was created for Assessor's Office use ONLY.

Assessor's Office GIS



**LEGEND**

**LINE TYPES:**

TOE LINE BOUNDARY      OLD PROPERTY LINE

ROAD RIGHT-OF-WAY      TRACT BOUNDARY

BOUNDARY      BOUNDARY

WATER LAKES, POND, STREAM, RIVER      WETLANDS

BOUNDARY      BOUNDARY

TOE LINE BOUNDARY      BOUNDARY

**SPECIAL TYPES:**

WATER      S

WETLANDS      W

TOE LINE BOUNDARY      T

BOUNDARY      B

**SUBJECT:**

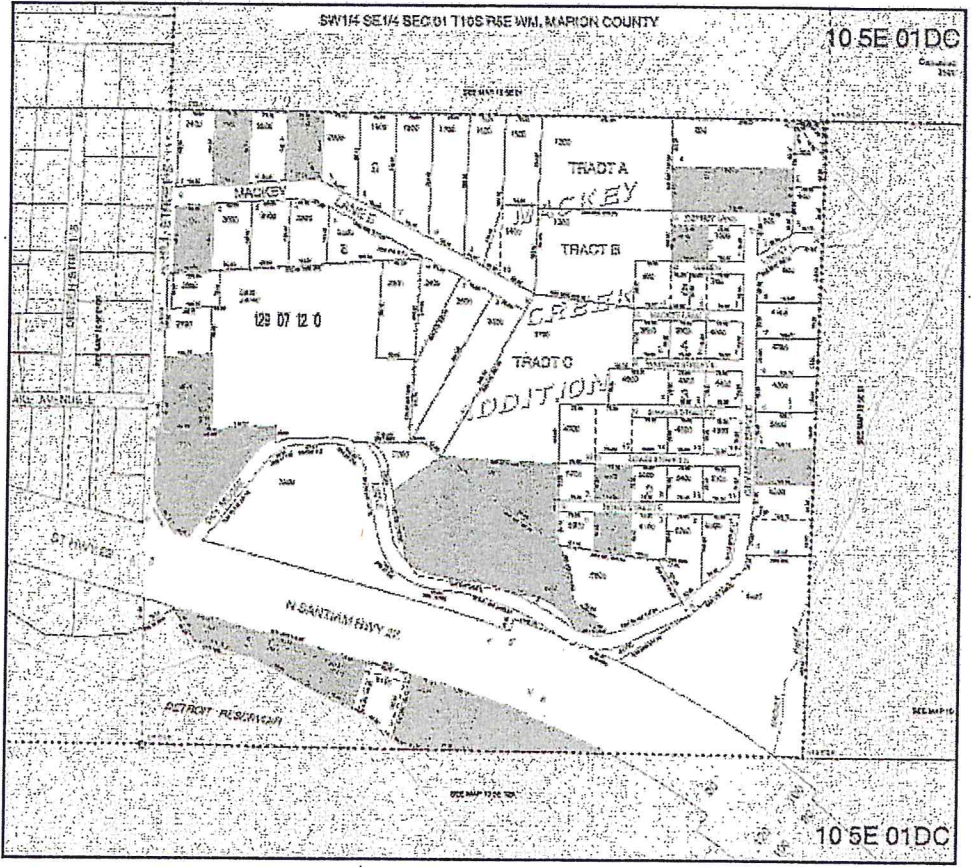
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**NOTICE:** This map was created for Assessor's Office use ONLY.



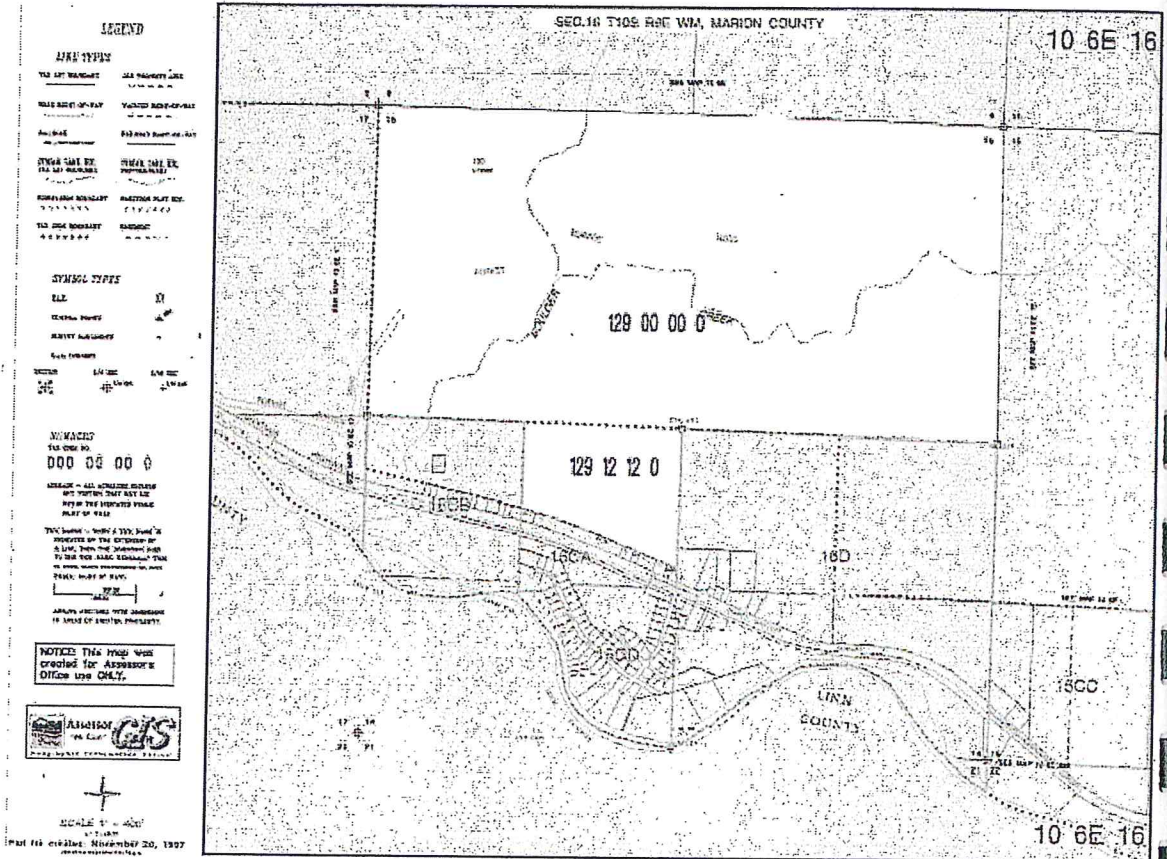
**SCALE:** 1" = 100'

Date created: September 24, 2009



# Lots Surveyed in Idanha, Oregon

(Note: Lots Surveyed are shaded in gray)





**LEGEND**

**LINE TYPES**

---	OLD PROPERTY LINE
- - -	INDICATED BOUNDARY
---	EXISTING ROAD
---	EXISTING RAILROAD
---	EXISTING CANAL
---	EXISTING DITCH
---	EXISTING POWER LINE
---	EXISTING TELEPHONE LINE
---	EXISTING WATER MAIN
---	EXISTING SEWER MAIN
---	EXISTING GAS MAIN

**SYMBOL TYPES**

( )	WELL
( )	WATER TOWER
( )	WATER TANK
( )	WATER PUMP
( )	WATER VALVE
( )	WATER METER
( )	WATER MAIN
( )	SEWER MAIN
( )	GAS MAIN
( )	POWER LINE
( )	TELEPHONE LINE

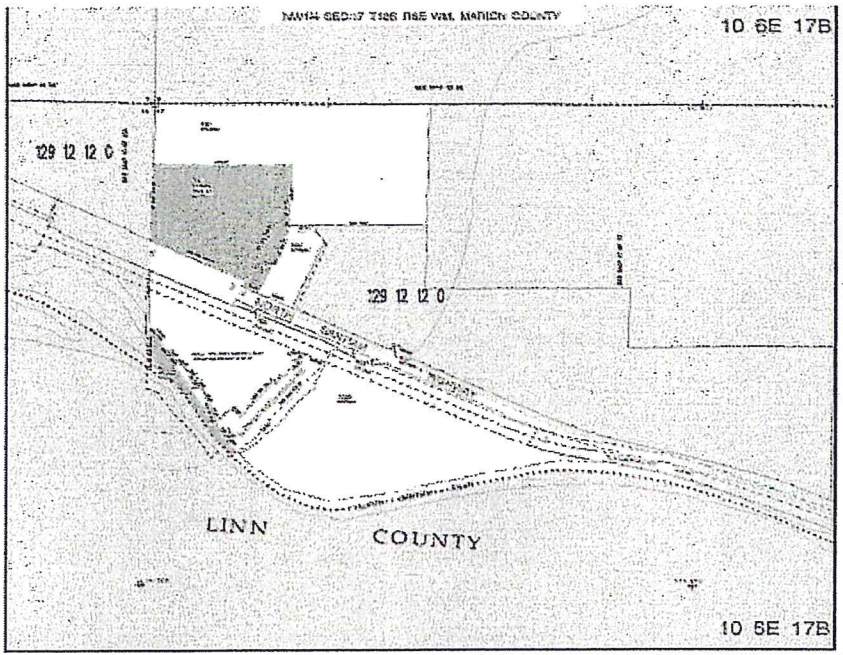
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NOTICE: THIS MAP WAS CREATED FOR ASSISTANT'S OFFICE USE ONLY.

ESRI  
ArcView  
GIS  
Geographic Information System

SCALE: 1" = 100'  
MAY 06, 1997



**LEGEND**

**LINE TYPES**

---	OLD PROPERTY LINE
- - -	INDICATED BOUNDARY
---	EXISTING ROAD
---	EXISTING RAILROAD
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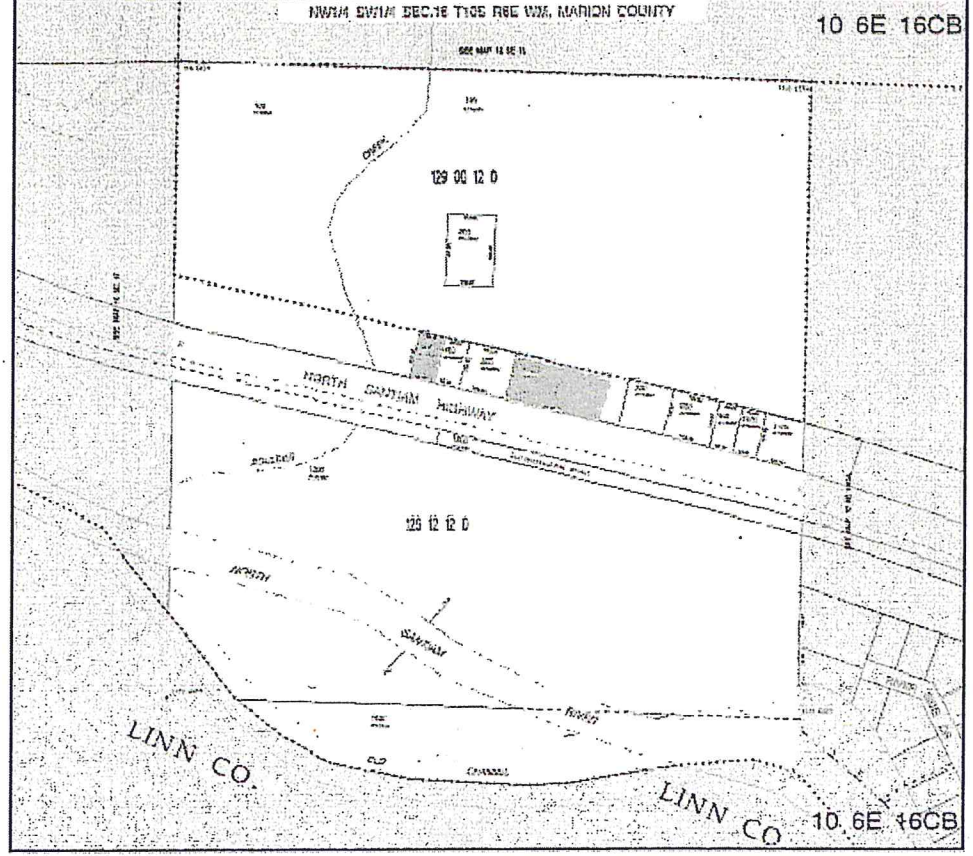
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ESRI  
ArcView  
GIS  
Geographic Information System

SCALE: 1" = 100'  
MAY 06, 1997



**LEGEND**

**LINE TYPES**

THE LOT BOUNDARY	SEE PROPERTY TAX
ROAD RIGHT-OF-WAY	TRACTED RIGHT-OF-WAY
RAILROAD	RAILROAD RIGHT-OF-WAY
UTILITY LINE, ETC.	UTILITY LINE, ETC.
ADJACENT JURISDICTION	PORTION PLAT BOX
THE CITY BOUNDARY	SUBURBAN

**SYMBOL TYPES**

SEE	SEE
SYMBOL POINTS	SYMBOL POINTS
SYMBOL BOUNDARIES	SYMBOL BOUNDARIES

**NUMERIC**

THE CODE NO.

000 00 00 0

LEGEND - ALL SYMBOLS DESCRIBE THE PROPERTY THAT ARE ALL FROM THE INDICATED SOURCE.

FOR MORE INFORMATION, SEE THE LEGEND OF THE CITY OF MARION, IOWA, TO THE CITY OF MARION, IOWA.

ADJUST AND SEE THE PROPERTY TO BE ADJUSTED TO THE CITY OF MARION, IOWA.

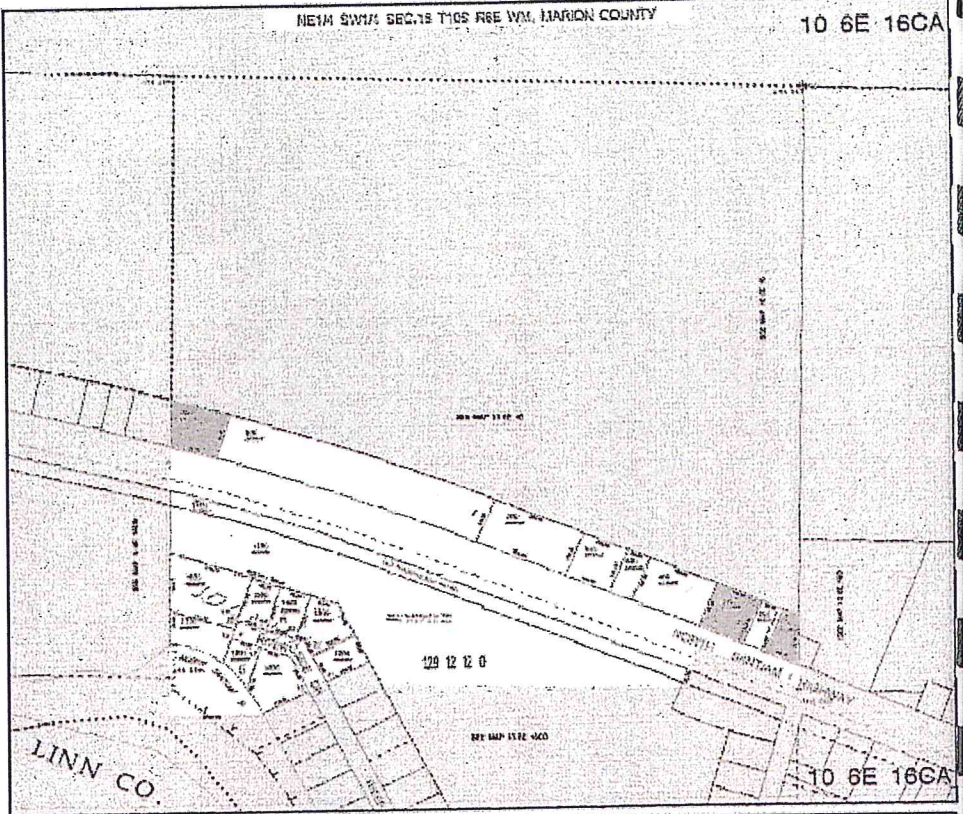
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**LEGISLATION**

**GIS**

**SCALE 1" = 100'**

Map File: 200004141, 2000



**LEGEND**

**LINE TYPES**

THE LOT BOUNDARY	SEE PROPERTY TAX
ROAD RIGHT-OF-WAY	TRACTED RIGHT-OF-WAY
RAILROAD	RAILROAD RIGHT-OF-WAY
UTILITY LINE, ETC.	UTILITY LINE, ETC.
ADJACENT JURISDICTION	PORTION PLAT BOX
THE CITY BOUNDARY	SUBURBAN

**SYMBOL TYPES**

SEE	SEE
SYMBOL POINTS	SYMBOL POINTS
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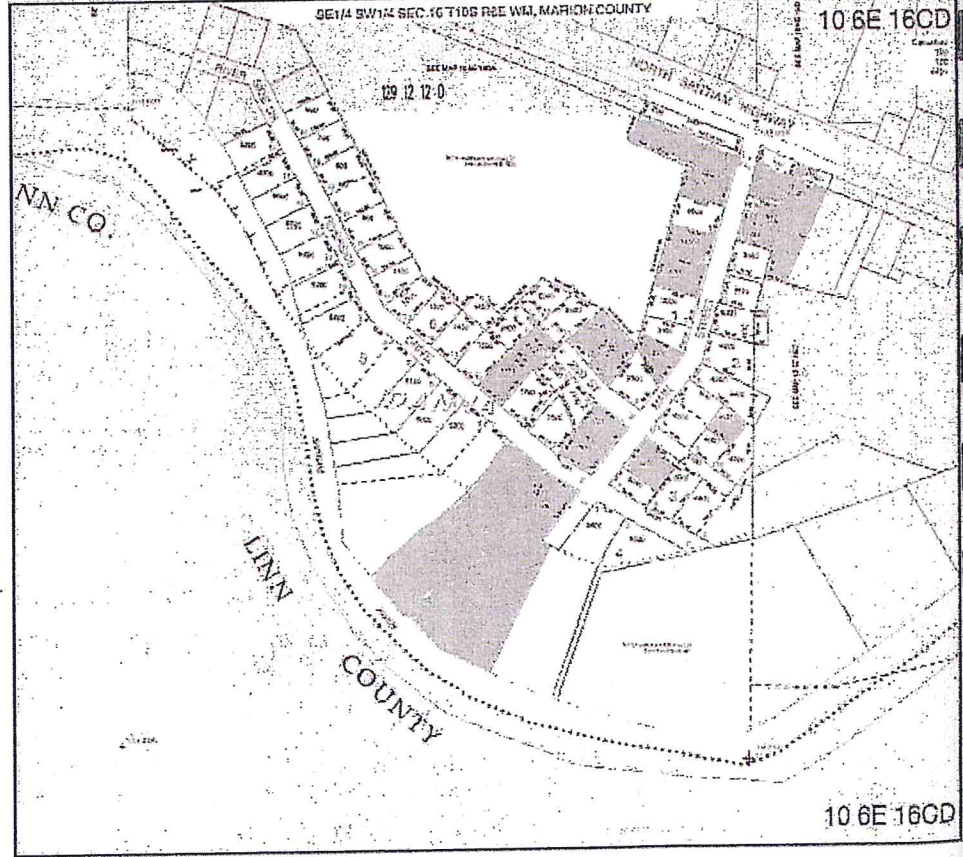
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**LEGISLATION**

**GIS**

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Map File: 200004141, 2000



**LEGEND**

**LINE TYPES**

1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY

**SYMBOL TYPES**

1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY

**NUMBERS**

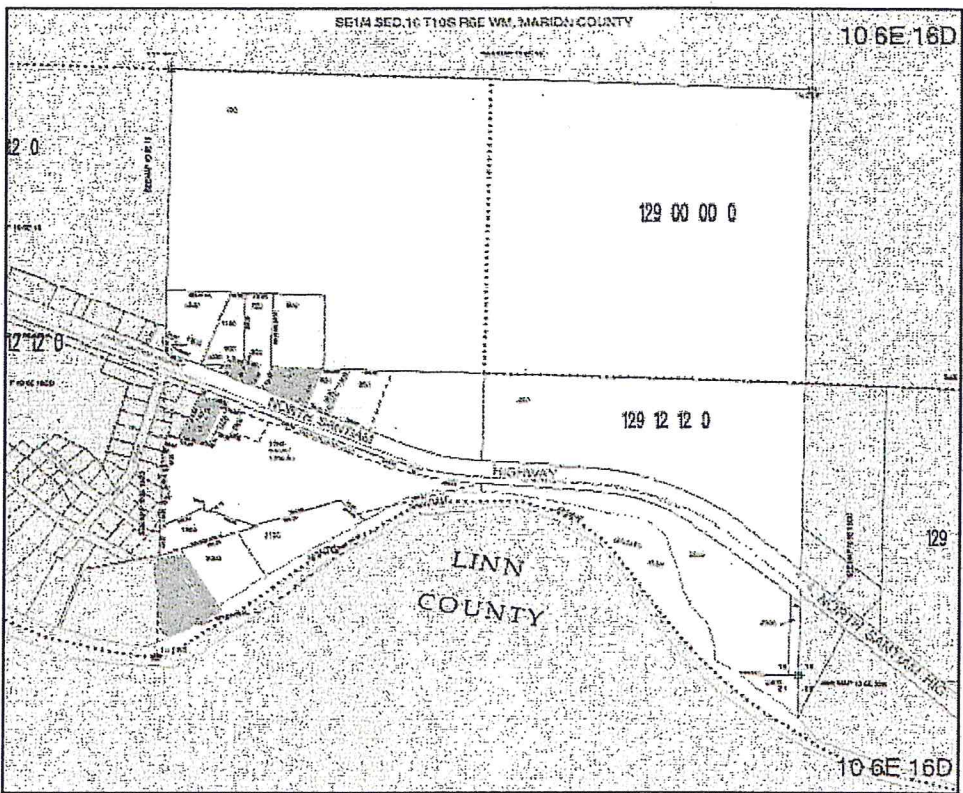
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**ASSASSON GIS**

SCALE 1" = 100'

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**LEGEND**

**LINE TYPES**

1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY

**SYMBOL TYPES**

1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
1/4" 1/4" BOUNDARY	1/4" 1/4" BOUNDARY
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**NUMBERS**

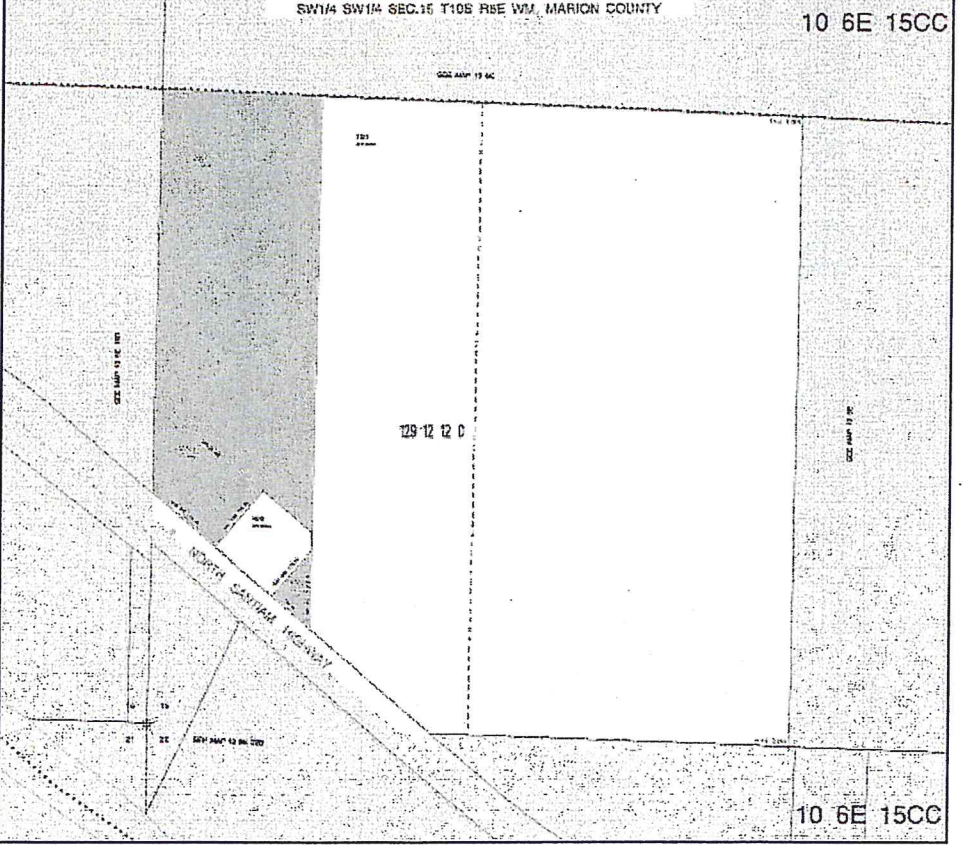
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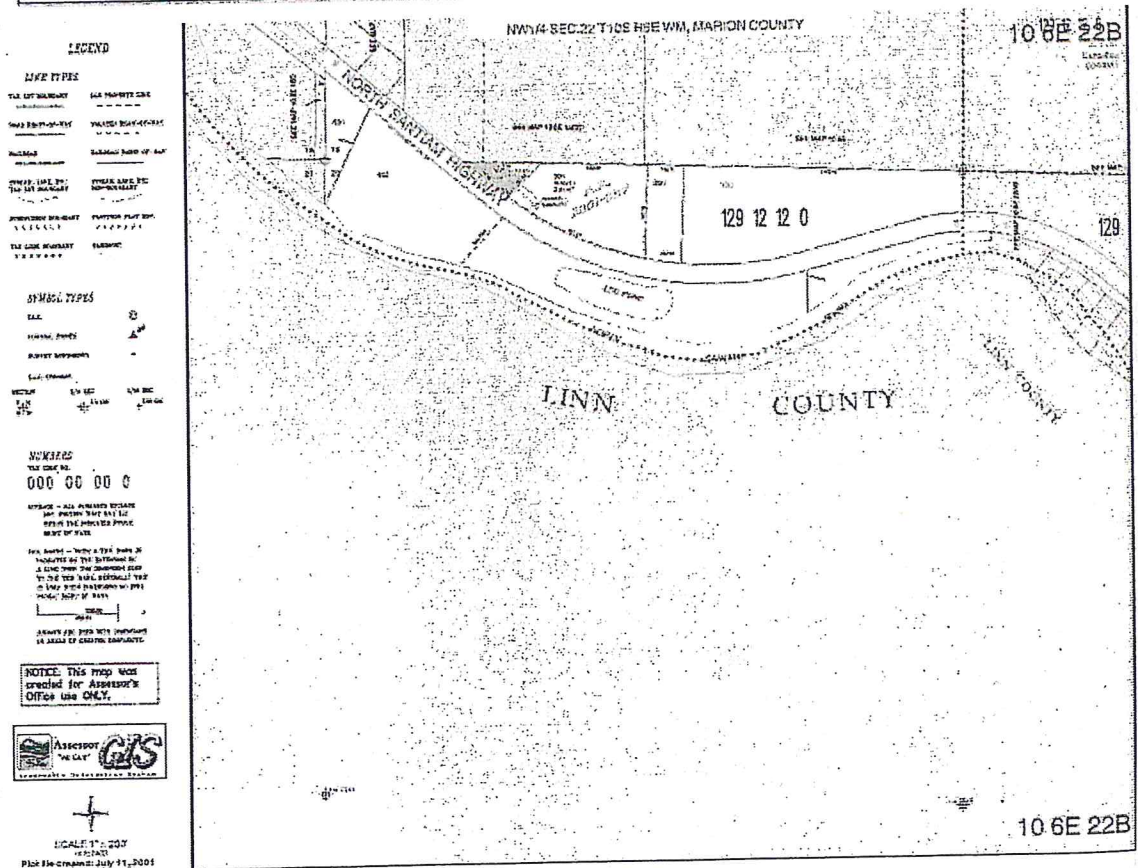
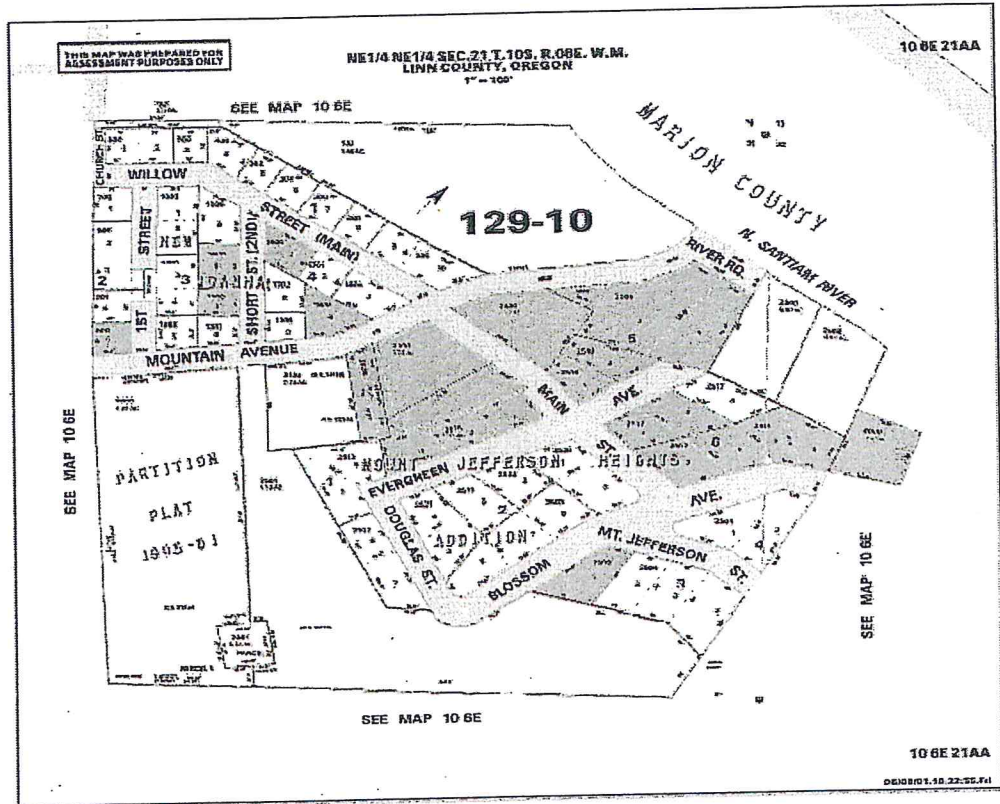
NOTICE: This map was created for Assessor's Office use ONLY.

**ASSASSON GIS**

SCALE 1" = 100'

Plot file created: May 05, 1997





Appendix 6. Modeling Calculations  
for Nitrate-Nitrogen Concentrations  
in Groundwater and Surface Water

**I. Potential Nitrate-Nitrogen Concentration in Detroit Lake Resulting From Existing On-Site Sewage Disposal Systems:**

Assumptions: 150 gallons of wastewater/day/residence.

60 mg/l NO<sub>3</sub>-N in wastewater.

454,000 ac-ft normal storage volume in lake (from Oregon State Water Resources Department).

395 of water connections in Detroit, 97 water connections in Idanha.

- a)  $(150 \text{ gal})(60 \text{ mg/l})(3.785 \text{ l/gal}) / (1000 \text{ mg/g})(454 \text{ g/\#}) = 27$  pounds of NO<sub>3</sub>-N/year/on-site system.
- b)  $(27\# \text{ NO}_3\text{-N/on-site system})(492 \text{ on-site systems}) = 13,284$  pounds of NO<sub>3</sub>-N/yr into Detroit Lake.
- c)  $(13,284\#)(454 \text{ g/\#})(1000 \text{ mg/g})(1 \text{ gal}/3.785 \text{ l/gal}) / (455,000 \text{ ac/ft})(325,851 \text{ gal/ac-ft}) = \underline{0.011 \text{ mg/l NO}_3\text{-N}}$

**II. NO<sub>3</sub>-N Concentration in Groundwater:**

- a) **Hantzsche and Finnemore Model:**

$$N_r = IN_w(1-d) + RN_b / (I+R)$$

Daily Wastewater Volume (GPD)	I	150
TKN of Wastewater (mg/l)	N <sub>w</sub>	60
Annual Precipitation (inches/yr)	R	89.62
[NO <sub>3</sub> ] of Precipitation (mg/l)	N <sub>b</sub>	0.24
Acreage		0.23
Assumed Denitrification in Soil (%)	d	0
Wastewater Effluent Loading (inches/yr)		8.766940612
Modeled [NO <sub>3</sub> ] in Groundwater Under Evaluation Site)	N <sub>r</sub>	<u>5.565019435</u>

b) Kimsey Model:

- 1)  $V_r = AdR(7.48 \text{ gal/ft}^3)/(365 \text{ days/yr})(12 \text{ in/ft})$
- 2)  $N_1 = V_r N_r + V_w N_w(1-d)/V_r + V_w$
- 3)  $V_1 = V_r + V_w$
- 4)  $Q = KibWa(7.48 \text{ gal/ft}^3)$
- 5)  $N_{gw} = QN_b + V_1 N_1/Q + V_1$

Area (sq. ft.)	Ad	10018	
Annual Precipitation (inches/yr)	R	89.62	
Recharge (GPD)	Vr	1533.35714	
[NO <sub>3</sub> ] of Precipitation (mg/l)	Nr	0.24	
Assumed Denitrification in Soil (%)	d	0	
Daily Wastewater Volume (GPD)	Vw	150	
TKN of Wastewater (mg/l)	Nw	60	
Sum of [NO <sub>3</sub> ] From Precipitation and Wastewater (mg/l)	N1		<u>5.565073206</u>
Hydraulic Conductivity (ft./day)	K	0.3	
Hydraulic Gradient	i	0.0019	
Depth of Mixing (ft.)	b	20	
Aquifer Width (ft.)	Wa	110	
Volume of GW Moving Under Site (gal/day)	Q		9.37992
[NO <sub>3</sub> ] From Upslope GW (mg/l)		0	
[NO <sub>3</sub> ] of Goundwater (mg/l)	Ngw		<u>5.53423561</u>

## Appendix 7. References

Bushman, Jennifer. 1996. Transport and Transformation of Nitrogen Compounds in Effluent From Sand Filter Septic System Drainage Fields. M.S. Thesis, Oregon State University. 78 pp.

Curran-McLeod, Inc. 1996. Upper North Santiam River Canyon Sewage Treatment Feasibility Study including Addenda. Curran-McLeod, Inc., Consulting Engineers. 655 SW Hampton, Suite 210, Portland, OR. 97233.

DeSimone, Leslie A., and Brian Howes. 1998. Nitrogen Transport and Transformations in a Shallow Aquifer Receiving Wastewater Discharge: A Mass Balance Approach. *Water Resources Research*, vol. 34, No. 2, pp. 271-285.

Gold, Arthur, and J.T. Sims. 2000. Research Needs in Decentralized Wastewater Treatment and Management: A Risk-Based Approach to Nutrient Contamination. National Research Conference Proceeding: Risk-Based Decision Making for On-Site Wastewater Treatment. pp. 1-43.

Hantzsche, Norman, and Finnemore. 1993. Predicting Ground-Water Nitrate-Nitrogen Impacts. *Ground Water*, vol. 30, No. 4, pp. 490-499.

Kimsey, Melanie. 1997. Estimating Potential Impacts to Groundwater Quality From Nitrogen Loading. Proceedings: 9<sup>th</sup> Northwest On-Site Wastewater Short Course and Equipment Exhibition. pp. 143-157.

Reneau, R.B., C. Hagedorn, and M.J. Degen. 1989. Fate and Transport of Biological and Inorganic Contaminants from On-Site Disposal of Domestic Wastewater. *Journal of Environmental Quality*, vol. 18, No. 2, pp. 135-144.

Shaw, B., and N. B. Turyk. 1994. Nitrate-N Loading to Groundwater From Pressurized Mound, In Ground and At Grade Septic Systems. Proceedings of the National Symposium on Individual and Small Community Sewage Systems. pp. 504-513. American Society of Agricultural Engineers. 2950 Nile Rd., St. Joseph, Michigan. 49085-9659.

Tetra Tech/KCM, Inc. 2002. Final Report, Value Engineering Study, Conceptual Design Review, Detroit/Idanha Regional Sewer Project. Tetra Tech/ KCM, Inc. 7080 SW Fir Loop, Portland, OR. 97223-8022.

Tinker, John. 1991. An analysis of Nitrate-Nitrogen in Ground Water Beneath Unsewered Subdivisions. *Ground Water Monitoring Review*, vol. 10-11, pp. 141-150.



U.S. Environmental Protection Agency. 2002. Onsite Wastewater Treatment Systems Manual. EPA/625/R-00/008. pg. 3-22. U. S. Environmental Protection Agency, Washington DC.