Chapter 2 Source Water Assessments

2.1 SWAP Plan Content

In order to be approved, a state plan needs to contain the following four sections:

- A description of the approach the state will take to implement a SWAP, including the goals for the state SWAP plan consistent with the national goals of protecting and benefiting public water supplies.
- A description of how the state achieved public participation in developing the SWAP plan.
- A description of how the state will make the results of assessments available to the public.
- A description of how the state will implement its chosen approach to the SWAP.

2.2 Description of North Carolina's SWAP Approach

In North Carolina, to meet the requirements of the SDWA Amendments an estimated 8,000 public water supply systems with over 11,000 intakes will undergo a source water assessment. Because of the scope of this task and recognizing the limited time and resources available for completion of the work, source water assessments will be completed in a tiered approach as described in this section. North Carolina's SWAP program efforts will rely heavily on Geographic Information Systems (GIS) to use information effectively. GIS allows databases to be linked to points on a map and overlaid on top of one another, such as public water supply intakes, streams, geology, land use, roads, permitted waste disposal sites, Superfund sites, etc.

All PWS intakes have already been delineated or will be delineated according to the procedures described in Section 2.5 of this chapter. A contaminant inventory will be completed for all PWS intakes as described in Section 2.6. Finally, a determination of susceptibility will be completed as described in Section 2.7. These PWS intakes include community, non-transient non-community, and transient non-community systems as defined and described in Section 2.3.

2.3 Scope of North Carolina's SWAP Efforts

As previously stated all PWS systems in North Carolina will have source water assessments performed. For a water supply system to be considered a public water supply it must serve 15 or more connections or 25 or more people more than 60 days out of the year. If the people served are year-round residents it is a community water system (e.g. towns, subdivisions, mobile home parks, rest homes, prisons) and the state requires approval of the well site and of plans and specifications. If the system does not serve year round residents then the system is a non-community water system. If the same 25 or more people on the water system are served for six months or more then the system is a non-transient non-community (NTNC) water system (e.g. schools, factories, workplaces) and the state requires approval of the well site and of plans and specifications. If the population served by the water system changes more frequently, then the system is a transient non-community (TNC) system (e.g. restaurants, welcome centers, churches) and the state does not require well site and plans and specification approval.

2.3.1 Inventory of Public Water Supply Systems

At the time of submitting this SWAP plan for public comment and review the PWS Section's Inventory of public water supply systems was listed as follows:

Type of PWS System	No. of Systems Surface Water	No. of Systems Ground Water
Community	140	1,940
Non-transient non-community	6	629
Transient non-community	5	5,359
Total	151	7,928

The approximate number of PWS surface water intakes is 245. The approximate number of ground water PWS wells is 11,500. The number of PWS systems and intakes in North Carolina will be verified during the implementation of the SWAP plan.

2.4 North Carolina's Drinking Water State Revolving Fund Intended Use Plan Phase I: Set-Aside Accounts

North Carolina received the full ten percent of its Drinking Water State Revolving Fund (DWSRF) allotment for development and implementation of a SWAP program. The state has completed an Intended Use Plan - Phase I: Set-Aside Accounts, which describes the use of the funds for development and implementation the SWAP plan. The set asides funded by DWSRF but not construction related include: Program Administration, Technical Assistance to Small Systems, Administration of the Public Water Supply Supervision Program, and Local Assistance and Other State Programs (including funding for Wellhead Protection and SWAP activities).

The PWS Section involved stakeholders in a detailed process to determine the priorities for the DWSRF. The five issues determined to have the highest priority for current action in the state are 1) technical assistance, 2) capacity development, 3) delineation and assessment of source water protection areas, 4) transient system compliance, and 5) wellhead protection.

2.5 Delineation of Source Water Assessment Areas

For the purpose of performing source water assessments delineation means defining what land area constitutes the area contributing water to a public water supply intake. Also, this delineated source water area contains the contaminant sources that may potentially be a threat to a drinking water supply. EPA's source water assessment guidance suggests that states with approved Wellhead Protection programs delineate source water areas for ground water PWS systems using methods described in that program. EPA's source water assessment guidance suggests for surface water PWS intakes that states delineate the topographic boundary of the entire watershed area upstream of a PWS system's intake. North Carolina's Water Supply Watershed

Protection rules classify all water supply watersheds. Further explanation of ground and surface water delineation methods is provided in the following two sections of this plan.

2.5.1 Delineation of Surface Water Public Water Supply Sources

As described previously, the state worked with local governments in determining the location of all surface water intakes and existing land uses within the water supply watersheds. This information, in conjunction with information on the types and location of wastewater discharges, was used to determine the appropriate classification of the over 200 surface water intakes in the state.

All surface water intakes were located on the ground and on US Geological Survey topographic quads. The water supply watershed boundaries were delineated (except WS-V waters as previously noted) and the boundaries of the critical and protected areas were delineated and digitized. These data are included in the NC Corporate Database maintained by the Center for Geographic Information and Analysis (See Appendix I, Figures 1,2, and 3). The source water delineations for surface water supplies will include the entire watershed as delineated in the WSWP program for all water supply watersheds.

For protection of the surface water PWS intakes in North Carolina, a segmentation of the water supply watersheds was implemented through the WSWP rules. A critical area (See Appendix H) and protected area (see Appendix H) are delineated for each surface water intake. Within these delineated areas local governments adopt ordinances that limit land uses. For WS-I watersheds, all of the area is considered critical area and the WSWP rules prohibit development in these watersheds. Critical Areas for all other water supply watersheds are defined as the area within mile of the water supply intake measured from the normal pool of elevation for a reservoir or mile and draining to a river intake. For WS- II, and III watersheds the Protected Area is defined as rest of the watershed. However, Protected Areas for WS-IV watersheds are defined as the area within 5 miles and draining to water supplies as measured from the normal pool of elevation for a reservoir or 10 miles upstream and draining to a river intake. In 1995, the state allowed local governments to request that the 10 mile Protected Area of a WS-IV watershed be measured run-of-river rather than a 10 mile arc measurement.

Five surface water PWS intakes in North Carolina are classified as WS-V by the WSWP rules. These WS-V waters are used by industry to supply their employees with drinking water or are waters formerly used as water supply. The WS-V waters are protected as water supplies and are generally upstream of and draining to Class WS-IV waters. There are no categorical restrictions on watershed development or treated wastewater discharges required by the WSWP rules and local governments are not required to adopt watershed protection ordinances. The state has not performed any watershed delineation for these PWS intakes. The PWS Section will be responsible for the delineation of these source waters using the method for delineation of WS-IV watersheds as a model.

2.5.2 Delineation of Ground Water Public Water Supply Sources

For PWS intakes relying on ground water, the delineation of source water assessment areas will be in accordance with North Carolina's EPA approved Wellhead Protection Program. The calculated fixed radius method will be the principal method employed to delineate SWAP assessment areas (A_{SWAP}) around each ground water intake. The calculated fixed radius method

will serve as the minimum or baseline delineation method for the SWAP plan (See Appendix I, Figure 4). More sophisticated methods defined in the Wellhead Protection Program may be employed by the state, local governments or PWS systems in an effort to more accurately define the area contributing water to the well system. The state will review delineations provided by local governments or PWS systems that employ acceptable alternative delineation methods. Resulting alternative delineation areas will be incorporated into the SWAP if the state concludes that the use of the more sophisticated method was appropriate.

The calculated fixed radius method is a simplified method employed in North Carolina's Wellhead Protection Program for calculating the wellhead protection area surrounding a well or wellfield. For the purposes of the SWAP, these assessment areas (A_{SWAP}) are synonymous with wellhead protection areas as defined in the state's Wellhead Protection Program.

Size of the Contributing Area (A_C)

The first step in calculating the SWAP assessment areas is to determine the size of the contributing area (A_C) to the well or wellfield. The contributing area is the land area from which water pumped from the well is derived, and is sometimes referred to as the capture zone. This is also the area through which contaminants can be reasonably expected to move toward and reach the water well or wellfield. The calculated fixed radius method requires only the pumping rate (Q) and the recharge rate (W) for the pumping well in order to calculate the size of the contributing area. The contributing area is calculated as follows:

$$A_C = \frac{Q}{W}$$

where: A_C = contributing area in square miles,
Q = maximum daily pumping rate in gallons per day, and
W = average recharge rate in gallons per day per square mile.

The maximum daily pumping rate in gallons per day is determined from information on well yield and maximum daily length of operation of the well. State regulations require that all public water-supply wells have 24-hour drawdown tests to determine well yield, or the maximum sustained pumping rate possible for a well. Also, state regulations require that the yield of the well provide the average daily demand in 12 hours. The well yield in gallons per minute determined from the drawdown test is multiplied by 720 (number of minutes in 12 hours) to determine the maximum permitted yield in gallons per day. This is equal to the maximum daily pumping rate (Q), assuming that the well is pumped at its yield 12 hours per day. Information regarding average recharge rates will be derived from published information.

Size of the SWAP Assessment Area (A_{SWAP})

Estimates of the size of the contributing area can be obtained using the equation given above. However, because of the complex nature of ground water flow and contaminant transport, it is not be possible to define exact contributing area boundaries around each well. Two factors that affect the shape of the contributing area and its position and orientation with respect to a pumping well are the hydraulic gradient and aquifer transmissivity. The variation in aquifer

transmissivity is important in determining the shape of the contributing area for a supply well. In areas where the hydraulic gradient and the aquifer transmissivity are essentially the same in all directions, as in most of the Coastal Plain, the shape of the contributing area depends primarily on the hydraulic gradient. Where the water table is nearly flat,as near the water-table divide in broad interstream areas of low relief, the contributing area is approximately circular. Where the hydraulic gradient is moderate to steep, the contributing area is approximately elliptical, being oriented in the direction of ground water movement.

Determining the shape of the contributing area in the Piedmont and Mountains is more difficult because transmissivity is generally not the same in all directions and hydraulic gradients tend to be steep. Under non-pumping conditions, hydraulic gradients and ground water movement are controlled primarily by the land-surface topography. Under pumping conditions, orientation of the contributing area is controlled primarily by the orientation of the dominant vertical fracture set, which may or may not be parallel to the topographic slope. Where the bedrock in the Piedmont and Mountains is distinctly foliated, or has a layered structure due to mineral segregation into parallel layers, the principal vertical fractures are commonly oriented in the same direction as the foliation. Differences in transimissivity in different directions result in elliptically shaped contributing areas in the Piedmont and Mountains. Transmissivity tends to be largest in the direction parallel to the dominant vertical fracture set. Where transmissivity is twice as great in the direction of the dominant vertical fracture set as at right angles to it, the contributing area will be an ellipse twice as long in the direction of the fracture set as in the short axis. In some areas, the transmissivity parallel to the dominant fracture set may be five or more times that at right angles, resulting in contributing area ellipses with lengths five or more times their widths. Due to the limited availability of this type of information, a 2-to-1 ratio of transmissivity is assumed for all PWS wells.

Incorporating a 2 to 1 ratio of transmissivity values will result in an elliptically shaped contributing area twice as long as wide (i.e., an elliptical contributing area with the semimajor axis twice as long as the semimajor axis). To compensate for not knowing the orientation of the ellipse, a circle with radius equal to the semimajor axis of the ellipse is drawn around the well. The area of the resulting circular SWAP assessment area is two times the contributing area, or:

$$A_{SWAP} = 2\,A_C = \frac{2Q}{W}$$

More sophisticated delineation methods acceptable under the state's Wellhead Protection Program may be employed by the state, local governments or PWS systems. The state, within time constraint and budgeted resources, will review delineations provided by local governments or PWS systems that employ acceptable alternative delineation methods. Resulting alternative delineation areas will be incorporated into the SWAP if the state concludes that the use of the more sophisticated method is appropriate and more accurately defines the area contributing water to the well or well system. Information concerning North Carolina's approved Wellhead Protection Program can be found in Section 1.5 of this plan and in **The North Carolina Wellhead Protection Guidebook** available from the Division of Environmental Health, Public

Water Supply Section. A discussion of ground water in North Carolina is included in Appendix A.

Step-by-Step Procedure for the Calculated Fixed Radius Method

Locate the position of the well using a global positioning system (GPS) accurate to 5 meters.

Determine the maximum daily pumping rate (Q) in gallons per day. The maximum daily pumping rate in gallons per day isdetermined from information on well yield and daily length of operation of the well. Refer to the Well-Construction Record form prepared by the well driller, or other record, to determine the yield of the well. State regulations require that all public water-supply wells have 24-hour drawdown tests to determine well yield, or the maximum sustained pumping rate possible for a well. The well yield in gallons per minute determined from the drawdown test is multiplied by 720 (number of minutes in 12 hours) to determine the maximum permitted yield in gallons per day.

Using published information, determine the ground water recharge rate (W) in gallons per day per square mile for the area in which the well is located. If the well is on a boundary between areas having different recharge rates, use the smaller rate.

Use the maximum daily pumping rate (Q) and the recharge rate (W) to calculate the size of the contributing area (A_C) in square miles using the following equation:

$$A_C = \frac{Q}{W}$$

Multiply the contributing area (A_C) in square miles by 2.0 to determine the area of the SWAP Assessment Area, (A_{SWAP}).

$$A_{SWAP} = 2\,A_C = \frac{2Q}{W}$$

Determine the radius (r_{SWAP}) of the SWAP Assessment Area calculated in Step 5 with the following equation:

$$r_{SWAP} = \sqrt{\frac{A_{SWAP}}{p}} = \sqrt{\frac{2Q}{pW}}$$

Plot the circle on a well-location map generated in a geographic information system (GIS). The area within this circle is the designated SWAP assessment area.

Example:
Consider a well with a reported value for well yield of 200 gallons per minute determined during a drawdown test. The maximum daily pumping rate (Q) is equal to well yield of 200 gallons per minute multiplied by 720, or 144,000 gallons per day. Assume an average recharge rate (W) of 300,000 gallons per day per square mile. The size of the contributing area (A_C) determined is 0.48 square miles. The size of the SWAP assessment area (A_{SWAP}) is twice the contributing area, or 0.96 square miles. The radius (r_{SWAP}) of the circular SWAP assessment area is 0.55 miles or 2,919 feet.

2.5.2.a Delineation of Recharge Areas Not Adjacent to Ground Water Intakes

In some situations water pumped from a well may originate in recharge areas located many miles from the well or well field rather than the immediately surrounding area. For example, in addition to leakage through overlying confining units, recharge to confined Coastal Plain aquifers may originate in the aquifers' outcrop areas located many miles to the west. Another example would be deep fractures that are connected to sources of water which are great distances from the pumping well. For the purpose of conducting the SWAP it is neither technologically nor economically feasible to accurately define non-adjacent recharge areas. Additionally, the distances and travel times required for contaminants originating in an aquifers' outcrop area to reach a water supply well should be sufficient to allow for attenuation of the contaminants. Therefore, non-adjacent recharge areas will not be considered in the source water assessment of ground water sources of drinking water.

2.5.2.b Conjunctive Delineation for Source Water Assessments

There are hydrogeologic settings where there is a significant hydraulic connection between a stream or lake and an underlying aquifer. Alluvial sand and gravel deposits within the flood plains and terraces of river valleys may function as high yield aquifers and are sometimes used to produce municipal supplies. Ground water in these deposits typically exhibits a strong degree of hydraulic connection with the stream. Ground water that occurs in fractured rocks in mountainous areas is also typically strongly connected to streams. Most of the flow in a mountain stream results from ground water discharge. Most of the water that infiltrates into fractured rocks above the stream valley will eventually discharge to the stream.

In North Carolina, streams are normally areas of ground water discharge. The water table slopes toward the stream, so that the hydraulic gradient of the aquifer is toward the stream. However, under certain conditions, water may move from the stream to the aquifer. The hydraulic gradient

in an aquifer next to a stream may be reversed during floods resulting in water flowing from the stream into the aquifer. The pumping of wellsin the vicinity of a surface water body may also reverse the natural hydraulic gradient and thereby induce infiltration of the surface water into the aquifer and subsequently into the pumping well. A well whose WHPA intersects a surface water body in good hydraulic connection with the surficial aquifer may have a surface water component.

To establish a source water protection area to protect public water supplies (PWSs) from all significant potential contaminant sources, it is important to determine if the PWS is providing water from both ground water and surface water sources. Conjunctive delineation of source water protection areas is the integrated delineation of the zone of ground water contribution and the area of surface water contribution to a public water supply. Conjunctive delineations for public water supply intakes supplied by ground water but which have a surface water component will be as described in the following two subsections of this report.

Ground Water Under the Direct Influence of S urface Water (GWUDI)

The realization that ground water supplied by a PWS well may include a surface water component is recognized in the term ground water closely connected to surface water,? which is used in some water protection programs. This term is similar to the term ? ground water under the direct influence of surface water, which is a performance standard indicating that water withdrawn from a well contains a specific indicator or indicators, for example, giardia, of the presence of a surface water component. In North Carolina's SWAP plan a conjunctively delineated area for a PWS well classified as a GWUDI well will be the combined area of a circle based on the calculated fixed radius method and the resulting upgradient watershed of the intersected surface water. Most of these wells are located in the western part of the state and are located in WS-I, II, and III watersheds so the segmentation will be as described in Section 2.7.2 of the plan.

Springs

Springs can be defined as an area where the water table intersects the ground surface. Ground water may have flowed many miles before appearing on the surface to form a particular spring. A conjunctively delineated source water protection area for a PWS system using a spring as its source will include the entire watershed area upgradient of the spring.

2.6 Inventory of Significant Potential Contaminant Sources

A complete discussion of SWAP data management strategy is outlined in Chapter 3 of the plan. A brief summary of the state's approach to the inventory of PCSs follows.

As a first step each Source Water Assessment Program needs to conduct a review of relevant, available sources of existing data at federal, state and local levels. Given that over 11,000 intakes are subject to the requirements of the SWAP, this averages out to approximately 14 intakes per day over 3-1/2 years for which delineation, contaminant inventory, and susceptibility analysis must be done. It is apparent from this, and supported in the guidance, that existing data will be the primary data source for this program. Appendix F contains a summary of the databases that will be utilized to identify PCSs.

The EPA's Source Water Assessment Program guidelines call for states to identify regulated contaminants within each delineated area to determine the susceptibility of public water intakes to those identified contaminants. North Carolina also needs to identify what potential sources of contaminants of concern will be considered significant. The guidelines allow the state to exercise its discretion in selecting unregulated contaminants. Raw water contaminants regulated under the Safe Drinking Water Act (those with a Maximum Contaminant Level and those regulated by Surface Water Treatment Rules, Cryptosporidium) must be included in the inventory. Additionally, North Carolina may include contaminants that the state has determined may present a threat to public health.

2.7 Susceptibility Determination - North Carolina's Overall Approach

The state has determined that the overall susceptibility determination for each PWS intake should be based on two key components; a contaminant rating and an inherent vulnerability rating. Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. A contaminant rating refers to an evaluation of the density and location of potential sources of contamination. For a public water supply to be determined susceptible, a potential contaminant source must be present and the existing conditionsof the PWS intake location must be such that a water supply could become contaminated.

North Carolina will determine susceptibility of a public water supply in two stages. First, an evaluation of the inherent vulnerability of an intake will be completed based on a matrix of source water characteristics. Then an evaluation of the density of potential sources of contamination, their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area will be completed to determine a contaminant rating. Therefore, the state will determine the susceptibility of each public water supply intake will be based on an "inherent vulnerability rating" and a "contaminant rating."

The state intends to conduct susceptibility determinations by individual intake. However, on a case-by-case basis where assessment areas overlap, the state will consider the percentage and configuration of the overlap area. The state may determine that the aggregate assessment area of multiple intakes/wells will be more appropriate and conservative for conducting source water assessments.

A more detailed description of the susceptibility determination procedure for both surface and ground water sources of public water supply is outlined in Section 2.7.1 and 2.7.2 respectively. PWS intakes designated as 'springs' will be delineated and assessed in accordance with the methodology described for a WS-I watershed. However, all springs shall be given an inherent vulnerability rating of higher.

To provide for evaluation of the susceptibility determination procedure early in the SWAP implementation process, several PWS intakes will be selected to represent different physiographic regions of the state and different types of water intakes (surface/ground water sources, large/small systems, etc.). An evaluation of the adequacy of the susceptibility determinations for Phase I and Phase II assessments will be completed by regional office PWS Section staff based on professional knowledgeand experience and any relevant historical monitoring data or system operational information. Based on the results of this pilot study the susceptibility determination approach may be refined. Furthermore, as the SWAP

implementation evolves there will be the opportunity for more detailed evaluations of susceptibility to occur for some water intakes if better inherent vulnerability rating or contaminant rating data becomes available within the constraints of program resources and deadlines.

2.7.1 Ground Water Intakes Susceptibility Determination Procedure

The following process will be followed for susceptibility determination of all community, non-transient non-community, and transient non-community public water supply intakes in North Carolina relying on ground water:

Ground Water Phase I - Step 1: Delineation

Delineate the area contributing water to the well or well field using the calculated fixed radius method acceptable under North Carolina's EPA approved Wellhead Protection Program (See Section 2.5.2).

Ground Water Phase I - Step 2: Inherent Vulnerability

Determine the **Inherent Vulnerability Rating** of the ground water public water supply intakes according to the vulnerability matrix in Table 2. The inherent vulnerability refers to the geologic/hydrogeologic characteristics or existing conditions of the delineated area of the PWS intake. The intake characteristics included are: a) aquifer rating, b) unsaturated zone rating, and c) well integrity/well construction rating. A brief description of each factor follows:

Aquifer Rating

The aquifer rating (Table 1) involves a qualitative assessment of the water transmitting characteristics of the aquifer. The aquifer rating is determined by assigning to each aquifer supplying a PWS a relative rating of higher, moderate, or lower vulnerability. Relative differences in aquifer vulnerability are based on a review of relevant literature, expert opinion from the SWAP Steering and Advisory Committees, and confirmed with historical data. Factors considered in rating aquifer vulnerability include hydraulic conductivity, degree of confinement, dilution, and sorption potential. The attenuative capacity of the unsaturated zone is not considered in the determination of aquifer ratings.

Table 1. Aquifer Rating Based on Water Transmitting Characteristics

Aquifer/Ground Water Source	Rating
Coastal Plain Aquifers:	
Deep Confined (e.g. Kinston area)	Lower
Shallow Confined (e.g. Pamlico Co.)	Moderate
Unconfined (e.g. Castle Hayne Outcrop area)	Higher
Piedmont and Mountain Aquifers:	
Triassic Basins (e.g. Sanford-Durham)	Moderate
Fractured Rock Aquifers	Higher
Other:	
Metamudstones and meta-argillites of the Carolina Slate Belt	Higher
Areas with Wells Cased to Less Than 20 Feet	Higher
Ground water under the direct influence of surface water	Higher
Sand Hills Area	Higher

Unsaturated Zone Rating

The state plans to determine the unsaturated zone rating in cooperation with the USGS under a joint funding agreement beginning in February 1999. As described in the USGS proposal titled Rating of Unsaturated Zone and Watershed Characteristics of Public Water Supplies in North Carolina, the unsaturated zone rating will be based on the combination of selected factors that contribute to the likelihood that contaminants from surface and shallow sources will follow the path of aquifer recharge and reach the water table. Contributing factors, in the form of GIS spatial data layers, will include land use/land cover, vertical hydraulic conductance of the unsaturated zone, land-surface slope. Land cover influences the amount of precipitation that infiltrates into the subsurface. Land use describes the activities that take place on the surface or in the shallow subsurface and the type of contaminants that may be present as a result of those activities. This factor will represent nonpoint source contaminants in the overall inherent vulnerability rating scheme for North Carolina's SWAP plan.

Well Integrity/Construction Rating

Rules governing the location, construction, repair and abandonment of wells were adopted by the state in 1976. However, since that time there has been no active statewide inspection program to monitor compliance with the rules. There are 22 counties in the state with local well construction ordinances that are required to be equivalent to the state standards. However the counties have different levels of resources available for program

implementation and oversight. Additionally, the inspections that were conducted often involved examination of the well after construction was complete. Construction details such as casing depth, grouting depth and screened interval are often not available

For the SWAP, the state will assume that well construction/integrity for all wells is not adequate. Therefore, all wells will be assigned a higher vulnerability well integrity factor, in Phase I of the assessments. The state intends to ask each PWS system owner to voluntarily provide documentation on well integrity/construction for possible refinement of the Phase I assessments. If adequate information to document good well construction/integrity is submitted by the system, the state will revise the well construction/integrity rating accordingly.

Table 2 includes the intake characteristics that will be evaluated and rated for the inherent vulnerability for each PWS intake that relies on ground water:

Table 2. Inherent Vulnerability Rating of Ground Water Public Water Supply Intakes

Intake Characteristics*	Higher Vulnerability	Moderate Vulnerability	Lower Vulnerability
Aquifer Rating	***10*** **	***5***	***- 1***
Unsaturated Zone Rating	***10***	***5***	***1***
Well Integrity/Construction Rating	***5***	***3***	***1***
Totals	***25-18***	***17-15***	***14-1***

Ground Water Intake **Inherent Vulnerability Rating**:_____

* Relative ratings are based on SWAP Steering and Advisory committees' expert opinion.
** The scoring may need to be adjusted during SWAP plan implementation to obtain results that accurately represent differences in inherent vulnerability for ground water intakes. These adjustments will be based on pilot study results and initial assessment results reviews.The purpose of the adjustments is to ensure meaningful source water assessment results which can be translated into benefits to the systems and the general public. The state is not going to adjust the assessments results to fit a pre-determined distribution (e.g. normal or even).

The determination of the aquifer ratings and the unsaturated zone ratings of higher, moderate, or lower was based on a review of relevant literature, expert opinion from the SWAP Steering and Advisory Committees, and confirmed with historical data.
The Aquifer Rating and the Unsaturated Zone rating are generally deemed to be of equal importance and independent of one another. However, in the case of a deep confined aquifer

setting, the unsaturated zone rating is deemed to be of significantly less relevance to the overall inherent vulnerability of the ground water supply. Therefore, in Table 2 the combination of a lower aquifer rating (See Table 1, Coastal Plain, deep confined aquifer) with any unsaturated zone rating and well integrity/construction rating always results in a lower inherent vulnerability rating.

Ground Water Phase I - Step 3: Contaminant Rating

Complete the contaminant inventory statewide using known, available electronic databases (See Section 2.6). Databases containing information about known PCSs include but are not limited to those listed in Table 3.

Table 3. Databases Containing Information about Known Potential Contaminant Sources

RCRA Generators	NC Inactive Hazardous Waste Sites
PIRF (Pollution Incident Database)	Underground Storage Tanks
Non-Discharge Permitted Facilities	Animal Waste Operations
CERCLA NPL Sites	Solid Waste Landfills
SARA Title III Sites	RCRA TSDF? s
Transportation - Roads - Rail facilities	Leaking Underground Storage Tanks

Assign each PCS contained within these and other identified applicable databases to a risk category of higher, moderate, or lower risk. PCSs for which an existing regulatory program has been established will receive a rating of **higher** risk. A list of PCSs such as the list included in Appendix B will be used to assign a risk rating to acceptable non-regulated PCS databases identified during the development and implementation of the SWAP.

Assessments of the degree of risk (i.e. higher, moderate, lower) associated with each PCS identified on the list included in Appendix B of this report can be assigned based on the following factors: 1) toxicity of the contaminants, 2) overall threat to public health (acute versus chronic health effects), 3) potential for human exposure and the characteristics of the population exposed, and 4) degradability of the contaminant if released to the environment (i.e. fate and transport).

For each ground water PWS intake, define an inner Zone A with an area equal to half the area of the delineated assessment area. Using Table 4, determine the number of PCSs that occur within each risk category and according to their location, either in Zone A or the remaining delineated area. Determine the **Contaminant Rating** for each ground water PWS system by summing the totals for each risk category.

Table 4. Phase I Determination of Contaminant Rating for Ground Water Intakes

Contaminant Sources in :	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Zone A (the inner ? of the delineated area)	(No. of sources_____) **≥ 1** Score: *(1 or 0)*	(No. of sources_____) **> 5** Score: *(1 or 0)*	(No. of sources_____) **> 50** Score: *(1 or 0)*
Delineated Area (Zone A plus the remaining delineated area)	(No. of sources_____) **> 10** Score: *(1 or 0)*	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: *(1 or 0)*

For each category, score "1" if the number of contaminants exceeds the indicated threshold or score "0" if the number of contaminants is less than the threshold. Total all the scores (1 or 0) for each category. Note, the highest possible score is 6.

Contaminant Rating:

Higher	*(6 - 4)*
Moderate	*(3 - 2)*
Lower	*(≤ 1)*

Upon completion of Step 3, there will be a final **Contaminant Rating** of higher, moderate, or lower for each ground water PWS intake.

The determination of the thresholds in Table 4 for the number of sources was based on best professional judgement pertaining to the expected density of contaminant sources in delineated source water areas. The thresholds for the number of sources may need to be adjusted during SWAP plan implementation to obtain results that represent actual differences in contaminant ratings for PWS intakes. These will be based on pilot study results and initial assessment results reviews. The purpose of the adjustments is to ensure meaningful source water assessment results which can be translated into benefits to the systems and the general public. The state is not going to adjust the assessments to fit a pre-determined distribution (e.g. normal or even). Adjustments may be made so that ratings are not inconsistent with site specific knowledge of PWS Section Field Engineers and Hydrogeologists.

There was consideration given to the potential significance of a single higher risk PCS in close proximity to a PWS system's intake. In recognition of this potential significance a score of "1" is included in the contaminantrating scheme for a single higher risk PCS in close proximity to the intake. The Contaminant Rating score is based on the cumulative number of higher, moderate, and lower risk PCSs.

Ground Water Phase I - Step 4: Susceptibility Determination

Combine the results of Step 2 (**Inherent Vulnerability Rating**) and Step 3 (**Contaminant Rating**) to produce a **Phase I Susceptibility Rating** of higher, moderate, or lower **(H, M, or L)** for each ground water PWS intake. Use Table 5 to determine the Susceptibility Rating.

Table 5. Susceptibility Rating for Ground Water Sources of Public Water Supply by Combining the Inherent Vulnerability and Contaminant Ratings.

Contaminant Rating	Inherent Vulnerability Rating		
	Higher	Moderate	Lower
Higher	H	H	M
Moderate	H	M	M
Lower	M	M	L

The state determined that a moderate rating for Susceptibility would be assigned to the combinations of Lower Contaminant and Moderate Inherent Vulnerability ratings as well as Lower Inherent Vulnerability and Moderate Contaminant ratings. This Moderate Susceptibility rating was chosen as the more conservative combination.

Ground Water Phase I - Step 5: Distribution of Phase I Assessments

Provide each ground water PWS system with a draft map of their delineated assessmentarea(s) showing PCSs identified within these assessment areas. The information for each water system's source assessment(s) will be tabulated and summarized in a consistent format, or short report. This report will include information explaining the assessment and the PWS system's susceptibility rating. PWS systems will then have the opportunity to voluntarily correct and/or add to information contained in these maps. Specifically, PWS systems will be asked to review, verify, and add information on PCSs. The state will use the information received from the PWS systems to refine the Phase I source water assessments. Revised Phase I assessments will be provided to PWS systems.

Source Water Assessments for Ground Water Transient, Non -Community Public Water Supply Systems

There are more than 5,300 of Transient non-community ground water PWS systems in North Carolina. These systems are required to monitor for acute (immediate) contaminants not chronic (long term) contaminants since the same people do not typically drink the water over time. Because it may not be possible within budget and time constraints to assess source waters with the same level of exactness and detail, EPA's SWAP guidance encourages states to consider a tiered approach to assessments. Therefore, the state has determined that transient, non-community PWS systems will undergo Phase I assessments only.

Ground Water Phase II - Step 1: Priority Rating

The Phase I Susceptibility Determination procedure does not provide for a detailed examination of individual PCSs. In Phase II of the procedure, PCSs will be more thoroughly evaluated to refine their potential to contaminate ground water sources of drinking water. This review of the identified PCSs will include an examination of permit information and other required records of individual facilities. A result of this review process will likely be changes in risk categorization for some of the facilities identified as PCSs. The state considers this component in the development of Source Water Assessments to be valuable and useful to PWS system owners when allocating resources to source water protection activities.

It is the desire of the state to conduct a more detailed Susceptibility Determination for all community and non-transient non-community water intakes relying on ground water that were rated **higher** in the Phase I Susceptibility Determinations. However, at the time of the SWAP plan development, it is not known whether budget and time constraints will allow for a Phase II Susceptibility Determination to be completed for all of these intakes because it is not known how many will rate higher. Therefore, upon completion of the Phase I Susceptibility Determinations, community and non-transient non-community water intakes will undergo a Phase II Susceptibility Determination according to the following prioritization:

1. Any intake where a regulatory agency has determined that a contamination event has occurred and adversely affected the source water,

2. Intakes rated **higher** for **Inherent Vulnerability** *and* **higher** for **Contaminant Rating,**

3. Intakes rated **higher** for **Contaminant Rating** *and* **moderate** for **Inherent Vulnerability,** and

4. Intakes rated **higher** for **Inherent Vulnerability** *and* **moderate** for **Contaminant Rating**.

Additionally, for any ground water PWS intake where information becomes available indicating further evaluation is warranted, a Phase II Susceptibility Determination may also be performed.

If deemed necessary by the state in order to disaggregate the results, a ranking of all PWS ground water intakes rated higher susceptibility in Phase I will be conducted to establish a prioritization

for Phase II Susceptibility Determinations. A ranking of these intakes will be based on mathematically combining the inherent vulnerability and contaminant ratings received in the Phase I Susceptibility Determinations. If PWS ground water intakes are ranked, the Phase II assessments will be done for as many of the **higher** ranked intakes as budgeted resources and time will allow. However, the actual number of Phase II Susceptibility Determinations will depend on time constraints and budgeted program resources.

Ground Water Phase II - Step 2: Contaminant Rating

Phase II Susceptibility Determinations will incorporate information received from PWS systems for refinement of the Phase I assessments that will have been completed. Additionally, the PCSs risk categories will be refined by utilizing a more detailed contaminant source database analysis including an examination where available of the permit information, compliance history of the facility, types of contaminants, and quantity of materials or waste managed. Logical statutory or regulatory thresholds for lower, moderate, and higher classifications will be sought. Where they do not exist, such as with non-regulated potential contaminants, available database parameters such as quantity or number of contaminants will be ranked against similar facilities and lower, moderate, or higher classifications assigned according to the relative position on the ranked list.

This step will include an evaluation of the differences in the risk potential of the same types of facilities. For example, by examining available database information such a compliance history, type of contaminants, and quantity of contaminants, an individual facility may be placed in a higher, moderate, and lower risk category. Table 6 illustrates several additional examples of how PCSs may be separated into relative risk categories for contaminating ground water intakes.

During the implementation of the SWAP the PWS Section will continue to depend on the expertise provided by other state agencies within DENR and federal agencies. Specifically, these agencies will guide the PWS Section's use of existing state and federal databases to characterize potential sources of contamination.

Table 6. Examples of Potential Contaminant Sources Separated into Relative Risk Categories.

Potential Contaminant Sources (Higher Risk)	Potential Contaminant Sources (Moderate Risk)	Potential Contaminant Sources (Lower Risk)
RCRA Large Quantity Generators	RCRA Small Quantity Generators	RCRA Conditionally Exempt Small Quantity Generators
RCRA TSDF? s with multiple violations / known releases	RCRA TSDF? s violations of waste storage requirements / no known releases	RCRA TSDF? s in compliance / no known releases
CERCLA NPL sites Record of Decision - requires ground water, surface water, or soil remediation; not yet completed	CERCLA NPL sites Record of Decision - indicates potential for contamination of public water supplies is low	CERCLA NPL sites Clean-up completed. No further action required.

Ground Water Phase II - Step 3: Susceptibility Rating

As performed in the Phase I assessment procedure, combine the results of the **Inherent Vulnerability Rating** and the **Phase II Contaminant Rating** to produce a **Phase II Susceptibility Rating** of higher, moderate, or lower **(H, M, or L)** for each ground water PWS system assessed in the Phase II procedure (See Table 5).

Ground Water Phase II - Step 4: Distribute Assessment Results

Provide each ground water PWS system with a map of their delineated assessment area(s) showing modified risk ratings and locations of PCSs within these assessment areas. The information for each water system's assessment will be tabulated and summarized in a consistent format, or short report. This report will include information explaining the assessment and the PWS system's susceptibility rating. The results of the assessmentswill be made available to the public as described in the public participation portion of this plan (See Chapter 4).

2.7.2 Surface Water Intakes Susceptibility Determination Procedure

Over 200 public water supply intakes use surface water. The followingprocess will be followed for determining the susceptibility to contamination of these public water intakes relying on surface water in North Carolina:

Surface Water Phase I Step 1: Delineation

Through the existing Water Supply Watershed Protection Program surface water supplies have been located on USGS topographic quadrangle maps. The critical, protected, and watershed areas are delineated for each water supply watershed in the state.

Surface Water Phase I - Step 2: Inherent Vulnerability

Determine the **Inherent Vulnerability Rating** of all surface water intakes according to the vulnerability matrix in Table 7. The intake characteristic factors included are: a) water supply watershed classification, b) intake location, c) raw water quality, and d) watershed characteristics evaluation. A brief description of each factor follows:

Watershed Classification

In North Carolina all surface water PWS intakes are located in water supply watersheds that are classified in regulations as WS-I, II, III, IV, or V. The Water Supply Watershed Protection Rules adopted in 1992 required that all local governments having land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps, and a management plan. All local governments subject to the regulations have submitted ordinances in compliance with the statutory deadlines. The inherent vulnerability ratings for watershed classification are based on differences between watershed classes including: size of the watershed, development activities, and allowable waste treatment and disposal practices.

Intake Location

All surface water PWS intakes are located in streams, large multi-purpose impoundments (Class 3), or small water supply impoundments (Class 1 or 2). The inherent vulnerability ratings for intake location are based on differences between the reaction time for a water plant in the case of a contamination event or spill in a stream versus an impoundment and includes the allowable activities on surface water impoundments, e.g. single use versus multiple uses allowed.

Raw Water Quality

The water plants submit monthly data to the PWS Section Central Office that includes daily turbidity and total coliform analyses. From water treatment experience, it is known that there is an increased likelihood of the presence of Cryptosporidium and other water-borne microorganism with higher turbidity. Therefore, turbidity and total coliform bacteria are good indicators of raw water quality. In Subchapter 18C of the North Carolina Administrative Code, Rules Governing Public Water Systems, Section .0710 sets standards for sedimentation time required for raw water based on turbidity and coliform values. The higher the values for turbidity and total coliform the greater the sedimentation time required before the raw water can enter the water treatment plant. The seven highest daily values from each of twelve months will be averaged for both turbidity and total coliform. The averaged turbidity and total coliform values for each surface water intake will then be compared to the values in Table 7. This method of using the highest seven daily values in each month will allow for comparisons to be made that minimize the influence of the existence of on-site raw water storage facilities on turbidity.

Watershed Characteristics Evaluation

The state plans to determine the watershed characteristics ratings in cooperation with the USGS under a joint funding agreement beginning in February 1999. As described in the USGS proposal titled Rating of Unsaturated Zone and Watershed Characteristics of Public Water Supplies in North Carolina, the watershed characteristics ratings will be based on the combination of selected factors that may contribute to the likelihood that contaminants follow the path of overland flow and reach the public water supply system intake. Contributing factors, in the form of GIS spatial data layers, will include land cover, land use, and precipitation. The land cover categories provide information concerning the runoff characteristics within a watershed. The land use categories describe the type of contaminants that may be present due to activities that take place on the surface or in the shallow subsurface. This factor will represent nonpoint source contaminants in the overall "inherent vulnerability rating" scheme for North Carolina's SWAP plan. The amount of precipitation over a given watershed influences the amount of overland flow in that watershed.

Table 7 includes the intake characteristics that will be evaluated and rated for the inherent vulnerability for each PWS intake that relies on surface water:

Table 7. Inherent Vulnerability of Surface Water Intakes

Intake Characteristics*	Higher Vulnerability	Moderate Vulnerability	Lower Vulnerability
Watershed Classification	WS-IV, WS-V ***10***	WS-III, WS-II ***5***	WS-I ***1***
Intake Location	Direct Stream ***8***	Class 3 Impoundments ***4***	Class 1 and 2 Impoundments ***2***
Raw Water Quality (water plant data)	**T.U. > 100 or T coliform > 2000 ***5***	T.U. >25 or T coliform > 1000 ***3***	T.U. ≤ 25 and T coliform ≤ 1000 ***1***
Watershed Characteristics Evaluation	***10***	***5***	***1***
***DWQ Use Support Rating**	Use Threatened	Partially Supporting	Fully Supporting
Totals	***33 - 21***	***13 - 20***	***5 - 12***

Surface Water Intake **Inherent Vulnerability Rating**:_____

* Relative ratings are based on SWAP Steering and Advisory committees expert opinion.
** The thresholds for Turbidity units (NT) and Total coliform (colonies/100 ml) may need to be adjusted during SWAP plan implementationto obtain results that accurately represent differences in inherent vulnerability for surface water intakes. These adjustments will be based on pilot study results and initial assessment results reviews.

The purpose of the adjustments is to ensure meaningful source water assessment results which can be translated into benefits to the systems and the general public.

The state is not going to adjust the assessments results to fit a pre-determined distribution (e.g. normal or even). *** This factor will not be used in calculating the inherent vulnerability rating but is included for additional information for the water system and the general public.

The determination of the ranges for inherent vulnerability ratings of higher, moderate, or lower was based on best professional judgement. These ranges may need to be adjusted to accurately represent differences in inherent vulnerability for surface water intakes. These adjustments will be based on pilot study results and initial assessment results reviews. The purpose of the adjustments is to ensure meaningful source water assessment results which can be translated into benefits to the systems and the general public. The state is not going to adjust the assessments to fit a pre-determined distribution (e.g. normal or even). Adjustments may be made so that ratings are not inconsistent with site specific knowledge of PWS Section Field Engineers and Water Plant Consultants.

Surface Water Phase I - Step 3: Contaminant Rating

Complete the contaminant inventory statewide using known, available electronic databases (See Section 2.6). Databases containing information about known PCSs include but are not limited to those listed in Table 8.

Table 8. Databases Containing Information about Known Potential Contaminant Sources

RCRA Generators	NC Inactive Hazardous Waste Sites
NPDES Permitees	Underground Storage Tanks
NPDES Stormwater Permitees	Leaking Underground Storage Tanks
CERCLA NPL Sites	Solid Waste Landfills
SARA Title III Sites	RCRA TSDF's
Sanitary Sewer Systems - land application - treatment plant	Transportation - Roads - Rail facilities - Marinas
Animal Operations	

Assign each PCS contained within these and other identified applicable databases to a risk category of lower, moderate, or higher risk. PCSs for which an existing regulatory program has been established will receive a rating of **higher** risk. A list of PCSs such as the list included in Appendix B will be used to assign a risk rating to acceptable non-regulated PCS databases identified during the development and implementation of the SWAP.

Assessments of the degree of risk (i.e. higher, moderate, lower) associated with each PCS identified on the list included in Appendix B of this report can be assigned based on the following factors: 1) toxicity of the contaminants, 2) overall threat to public health (acute versus chronic health effects), 3) potential for human exposure and the characteristics of the population

exposed, and 4) degradability of the contaminant if released to the environment (i.e. fate and transport).
Using Table 9 for WS-II and III watersheds or Table 10 for WS-IV, and V watersheds determine the number of PCSs that occur within each risk category (i.e. lower, moderate, or higher risk) and within each delineated assessment area (e.g. critical area, protected area etc.). Determine the **Contaminant Rating** for each surface water PWS system by summing the totals for each risk category.

For WS-I watersheds, all of the area is considered critical area. Because the WSWP rules prohibit development in these watersheds, the existence of one PCS will result in a contaminant rating of higher.

Table 9. Phase I Determination of Contaminant Rating for WS - II, III Watershed Public Water Supply Intakes

Contaminant Sources in :	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Critical Area	(No. of sources_____) **≥ 1** Score: *(1 or 0)*	(No. of sources_____) **> 5** Score: *(1 or 0)*	(No. of sources_____) **> 50** Score: *(1 or 0)*
Watershed Area **(within 1000 feet as measured from the streambank)**	(No. of sources_____) **> 10** Score: *(1 or 0)*	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: (1 or 0)
Watershed Area **(within the delineated watershed area beyond 1000 feet as measured from the streambank)**	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: *(1 or 0)*	(No. of sources_____) **> 1000** Score: *(1 or 0)*

For each category, score "1" if the number of contaminants exceeds the indicated threshold or score"0" if the number of contaminants is less than the threshold. Total the scores (1 or 0 for each category). Therefore, the highest possible score is a 9.

Determine the **Contaminant Rating** for each PWS intake in a Water Supply Watershed I, II, or III as follows:

Higher	*(9 - 6)*
Moderate	*(5 - 3)*
Lower	*(≤ 2)*

Table 10. Phase I Determination of Contaminant Rating for WS - IV and V Watershed Public Water Supply Intakes

Contaminant Sources in :	Number of Higher Risk PCSs	Cumulative Number of Higher and Moderate Risk PCSs	Cumulative Number of Higher, Moderate and Lower Risk PCSs
Critical Area	(No. of sources_____) **≥ 1** Score: *(1 or 0)*	(No. of sources_____) **> 5** Score: *(1 or 0)*	(No. of sources_____) **> 50** Score: *(1 or 0)*
Protected Area (within 1000 feet as measured from the streambank)	(No. of sources_____) **> 10** Score: *(1 or 0)*	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: *(1 or 0)*
Protected Area (within the delineated protected area beyond 1000 feet as measured from the streambank)	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: *(1 or 0)*	(No. of sources_____) **> 1000** Score: *(1 or 0)*
Watershed Area (in the watershed for the next 25 miles upstream from the protected area or to the first dam structure and within 1000 feet as measured from the streambank)	(No. of sources_____) **> 100** Score: *(1 or 0)*	(No. of sources_____) **> 500** Score: *(1 or 0)*	(No. of sources_____) **> 1000** Score: *(1 or 0)*

For each category, score "1" if the number of contaminantsexceeds indicated threshold. If the number of contaminants is less than the threshold score "0." Total all the scores (1 or 0 for each category). Therefore, the highest possible score is a 12.

Determine the **Contaminant Rating** for each PWS intake in a Water Supply Watershed IV or V as follows:

Higher	*(12 - 9)*
Moderate	*(8 - 4)*
Lower	*(≤ 3)*

The distance of 1,000 feet as measured from the streambank was chosen because it would include NPDES discharges within the watershed. The determination of the thresholds in Tables 9 and 10, for the number of sources was based on best professional judgement pertaining to the expected density of contaminant sources in delineated source water areas. The thresholds for the number of sources may need to be adjusted during SWAP plan implementation to obtain results that represent actual differences in contaminant ratings for PWS intakes. These adjustments will be based on pilot study results and initial assessment results reviews. The purpose of the adjustments is to ensure meaningful source water assessment results which can be translated into benefits to the systems and the general public. The state is not going to adjust the assessments to fit a pre-determined distribution (e.g. normal or even). Adjustments may be made so that ratings are not inconsistent with site specific knowledge of PWS Section field engineers and water plant consultants.

There was consideration given to the significance of one higher risk PCS in close proximity to a PWS system's intake. Therefore, in recognition of this significance a score of "1" is included in the contaminant rating scheme for one higher risk PCS in close proximity to the intake. The Contaminant Rating score is based on the cumulative number of higher, moderate, and lower risk PCSs. This decision was based on two factors, 1) most of the PCSs in Phase I may be rated higher risk, and 2) less evaluation of PCSs actual threat to drinking water supplies is proposed in the Phase I source water assessments.

Upon completion of Step 3, there will be a final **Contaminant Rating** of higher, moderate, or lower for each surface water PWS system.

Surface Water Phase I - Step 4: Susceptibility Rating

Combine the results of Step 2 (**Inherent Vulnerability Rating**) and Step 3 (**Contaminant Rating**) to produce a **Phase I Susceptibility Rating** of higher, moderate, or lower **(H, M, or L)** for each surface water PWS system. Use Table 11 to determine the Susceptibility Rating.

Table 11. Phase I Susceptibility Rating for Surface Water Sources of Public Water Supply by Combining the Inherent Vulnerability and Contaminant Ratings.

Contaminant Rating	Inherent Vulnerability Rating		
	Higher	**Moderate**	**Lower**
Higher	**H**	**H**	**M**
Moderate	**H**	**M**	**M**
Lower	**M**	**M**	**L**

The state determined that a moderate rating for Susceptibility would be assigned to the combinations of Lower Contaminant and Moderate Inherent Vulnerability ratings as well as

Lower Inherent Vulnerability and Moderate Contaminant ratings. This Moderate Susceptibility rating was chosen because it is more conservative.

Surface Water Phase I - Step 5: Distribution of Phase I Assessments

Provide each surface water PWS system with a draft map of their delineated assessment area(s) showing PCSs identified within these assessment areas. The information for each water system's assessment will be tabulated and summarized in a consistent format, or short report. This report will include information explaining the assessment and the PWS intake's susceptibility rating. PWS systems will then have the opportunity to correct and/or add to information contained in these maps. Specifically, PWS systems will be asked to voluntarily review, verify, and add information on PCSs. The state will use the information received from the PWS systems to refine the Phase I assessments. Revised Phase I assessments will be provided to PWS systems.

Source Water Assessments for Surface Water Transient, Non -Community Public Water Supply Systems

There are five transient, non-community surface water PWS systems in North Carolina. These systems are required to monitor for acute (immediate) contaminants not chronic (long term) contaminants since the same people do not typically drink the water over time. Because it may not be possible within budget and time constraints to assess source waters with the same level of exactness and detail, EPA's SWAP guidance encourages states to consider a tiered approach to assessments. Therefore, the state has determined that transient, non-community PWS systems will undergo Phase I assessments only.

Surface Water Phase II Step 1: Priority Rating

The Phase I Susceptibility Determination procedure does not provide for a detailed examination of individual PCSs. In Phase II of the procedure, PCSs will be more thoroughly evaluated to refine their potential to contaminate surface water sources of drinking water. This review of the identified PCSs will include an examination of permit information and other required records of individual facilities. A result of this review process will likely be changes in risk categorization for some of the identified PCS facilities. The state considers this component in the development of Source Water Assessments to be valuable and useful to PWS system owners when allocating resources to source water protection activities.

It is the desire of the state to conduct a more detailed Susceptibility Determination for <u>all</u> community and non-transient non-community water intakes relying on surface water that were rated **higher** in the Phase I Susceptibility Determinations. However, at the time of the SWAP plan development, it is not known whether budget and time constraints will allow for a Phase II Susceptibility Determination to be completed for all of these intakes because it is unknown how many will rate higher. Therefore, upon completion of the Phase I Susceptibility Determinations, community and non-transient non-community water intakes will undergo a Phase II Susceptibility Determination according to the following prioritization:

1. Any intake where a regulatory agency has determined that a contamination event has occurred and adversely affected the source water,

2. Community surface water intakes in WS- IV water supply watersheds.

3. Intakes rated **higher** for **Inherent Vulnerability** *and* **higher** for **Contaminant Rating,**

4. Intakes rated **higher** for **Contaminant Rating** *and* **moderate** for **Inherent Vulnerability,** and

5. Intakes rated **higher** for **Inherent Vulnerability** *and* **moderate** for **Contaminant Rating**.

Additionally, for any surface water PWS intake where information becomes available indicating further evaluation is warranted, a Phase II Susceptibility Determination may also be performed.

If deemed necessary by the state to disaggregate the results, a ranking of all PWS surface water intakes rated higher susceptibility in Phase I will be conducted to establish a prioritization for Phase II Susceptibility Determinations. A ranking of these intakes will be based on mathematically combining the inherent vulnerability and contaminant ratings received in the Phase I Susceptibility Determinations. If PWS surface water intakes are ranked, the Phase II assessments will be done for as many of the **higher** ranked intakes as budgeted resources and time will allow. However, the actual number of Phase II Susceptibility Determinations will depend on time constraints and budgeted program resources.

Surface Water Phase II - Step 2: Contaminant Rating

Phase II Susceptibility Determinations will incorporate information received from PWS systems for refinement of the Phase I assessments that will have been completed. Additionally, the PCSs risk categories will be refined by using a more detailed contaminant source database analysis including an examination of the permit information, compliance history of the facility, types of contaminants, and quantity of materials or waste managed. Logical statutory or regulatory thresholds for lower, moderate, and higher classifications will be sought. Where they do not exist, such as with non-regulated potential contaminants, available database parameters such as quantity or number of contaminants will be ranked against similar facilities and lower, moderate, or higher classifications assigned according to the relative position on the ranked list.

This step will include an evaluation of the differences in the risk potential of the same types of facilities. For example, by examining available database information such a compliance history, types of contaminants, and discharge volumes, an individual NPDES facility may be placed in a higher, moderate, and lower risk category. Table 6 (See Section 2.7.1) illustrates several additional examples of how PCSs may be separated into relative risk categories for contaminating surface water intakes.
During the implementation of the SWAP the PWS Section will continue to depend on the expertise provided by other state agencies within DENR and federal agencies. Specifically, these agencies will guide the PWS Section's use of existing state and Federal databases to characterize potential sources of contamination.

In the Phase II contaminant rating of any WS-IV intake, an evaluation of potential sources of contamination outside the Watershed Area defined in Table 10 may be included to account for

the characteristics of specific contaminants and thereceiving stream. For any PWS intake where information becomes available indicating further evaluation is warranted, additional work may be completed within the constraints of program resources and deadlines.

Surface Water Phase II - Step 3: Susceptibility Rating

As performed in the Phase I assessment procedure, combine the results of the **Inherent Vulnerability Rating** and the **Phase II Procedure Contaminant Rating** to produce a **Phase II Susceptibility Rating** of higher, moderate, or lower **(H, M, or L)** for each surface water PWS intake assessed in the Phase II procedure (see Table 11) .

Surface Water Phase II - Step 4: Distribute Assessment Results

Provide each surface water PWS system with a map of their delineated assessment area(s) showing modifiedrisk ratings and locations of PCSs within these assessment areas. The information for each water system's assessment will be tabulated and summarized in a consistent format, or short report. This report will include information explaining the assessment and the PWS system's susceptibility rating. The results of the assessments will be made available to the public as described in the public participation portion of this plan (See Chapter 4).