

Engineering Alternatives Analysis (EAA) Guidance Document

North Carolina Division of Water Resources

NOTE: The N.C. Division of Water Resources (DWR) will not accept an NPDES application for a new or expanding wastewater treatment plant discharge unless all the required application requirements are submitted. A complete NPDES application will include the following items:

NPDES Application Form (in triplicate)
Application Fee
Engineering Alternatives Analysis (in triplicate)
Local Government Review Form (non-municipals only)

Failure to submit all of the required information will result in return of the incomplete package. If you have any questions about these requirements, contact the NPDES Unit staff. Contact names, application forms, applicable fees, and guidance documents are available on the NPDES website at <http://portal.ncdenr.org/web/wq/swp/ps/npdes>. Completed applications should be mailed to: NCDENR/DWR/NPDES Complex Permitting Unit, 1617 Mail Service Center, Raleigh, NC 27699-1617.

Background

The NPDES permit program was enacted in 1972 as part of the Clean Water Act. The original goal of the program was to eliminate all point source discharges to surface waters by 1985. Although this goal was not achieved, the NPDES program continues to strive toward it. In that light, **an Engineering Alternatives Analysis (EAA) is required with any NPDES application for a new or expanding wastewater treatment plant discharge**, in accordance with 15A NCAC 2H.0105(c)(2). In order for an NPDES application to be approved, the EAA must provide complete justification for a direct discharge to surface water alternative, and demonstrate that direct discharge is the most environmentally sound alternative selected from all reasonably cost-effective options [per 15A NCAC 2H.0105(c)(2)].

The purpose of this EAA Guidance Document is to provide guidance to the regulated community for the evaluation of wastewater disposal alternatives. The impetus behind this comprehensive guidance was based on the following: 1) a majority of new NPDES applications were being returned as incomplete due to inadequate EAA submissions; and 2) a few recent court cases resulted in unfavorable rulings for the NPDES discharger due in part to inadequate EAAs. DWR most frequently returns EAAs as incomplete due to inadequate flow justification, inadequate alternatives evaluations, and/or lack of documentation/references used to design and cost alternatives.

Please note that this guidance document is designed primarily for domestic wastewater discharges. For other proposed discharges such as water treatment plant discharges from ion exchange and reverse osmosis units, some alternative disposal options may not be technologically feasible. Within this guidance document, we have attempted to point out where such technological limitations may exist. You are urged to review NPDES permitting guidance documents on the NPDES website, which discuss some of the limited disposal options for some discharges.

Please note that if a proposed municipal expansion is subject to SEPA Environmental Assessment (EA)/Environmental Impact Statement (EIS) requirements, the EAA requirements should be incorporated into the SEPA document. In addition, the NPDES Unit cannot accept an application for a new/expanding NPDES discharge until departmental review of the SEPA document is complete and a Finding of No Significant Impact (FONSI) has been submitted to the State Clearinghouse for circulation.

The following step-by-step outline should be used for the preparation of all EAA submissions. If an EAA submission lacks any of these basic elements, the NPDES application will be returned as incomplete.

STEP 1. Determine if the proposed discharge will be allowed

Before beginning any engineering evaluation of alternatives, you must first determine if the proposed wastewater discharge will be allowed. Otherwise, time and money may be spent needlessly for an EAA preparation that will ultimately be rejected on the basis of existing water quality restrictions. There are several potential restrictions to a wastewater discharge to surface waters, including:

- Zero flow stream restrictions [15A NCAC 2B.0206(d)(2)] apply to oxygen-consuming waste in zero-flow streams. In order to determine streamflow at the proposed discharge location, contact the U.S. Geological Survey at 919-571-4000.
- Receiving stream classification restrictions [e.g., ORW, WS, SA, NSW, and HQ class waters have various discharge restrictions or require stricter treatment standards]. Stream classifications are available on the the DWR Classification and Standards/Rule Review Branch website: (<http://portal.ncdenr.org/web/wq/ps/csu>), while wastewater discharge restrictions for various stream classifications are presented in state regulations [15A NCAC 2B.0200].
- Basinwide Water Quality Plans. These basin-specific plans list NPDES permitting strategies that may limit wastewater discharges to particular streams within the basin due to lack of stream assimilative capacity, etc. Basin plans are available on the DWR website, or you may contact the DWR Basinwide Planning Branch (<http://portal.ncdenr.org/web/wq/ps/bpu>).
- Impaired waters and TMDLs. Certain waterbodies listed as impaired on the 303(d) list and/or subject to impending TMDLs may have wastewater discharge restrictions. The list of 303(d) impaired waters is located on the DWR website, or you may contact the DWR Modeling and Assessment Branch (<http://portal.ncdenr.org/web/wq/ps/mtu>).
- Presence of Endangered Species. If endangered species are present in the proposed discharge location, there may be wastewater discharge restrictions. Endangered species information may be included in the Basinwide Water Quality Plan, or you may contact the U.S. Fish and Wildlife Service (919-856-4520), N.C. Wildlife Resources Commission (919-733-3633), or the N.C. Natural Heritage Program (919-733-7701).

Municipal applicants.

As a public service, the NPDES Unit will evaluate whether a proposed municipal discharge is considered allowable. The municipality needs to initiate this review by submitting a letter request for Speculative Effluent Limits to the NPDES Unit. You must obtain streamflow estimates for the proposed discharge location to ensure that the receiving stream is not subject to zero flow restrictions. Low flow data (specifically, drainage area, summer and winter 7Q10, average flow and 30Q2 flow statistics) can be obtained for a nominal fee from the U.S. Geological Survey in Raleigh at 919-571-4000. The low flow data must be submitted with the speculative limits request letter. If the proposed discharge appears to be allowable, the NPDES Unit will prepare speculative effluent limits for a maximum of 2 flows and 2 discharge locations using water quality models. The municipality can then use the speculative limits to prepare preliminary engineering design and cost estimates for the direct discharge alternative within the EAA. In limited instances where complex water quality models are necessary to develop speculative limits and determine potential water quality impacts, some municipalities have undertaken the modeling effort (with DWR review) in order to expedite this portion of the NPDES permit review process.

Non-municipal applicants.

Due to staff constraints, the NPDES Unit cannot prepare speculative limits for non-municipal applicants. Thus, it is your responsibility to make your own determination as to whether the proposed discharge might be allowed by the Division, by evaluating the water quality factors listed above. It is highly recommended that you discuss the proposed discharge with the applicable DWR Regional Office and/or NPDES Unit staff, who may be able to provide input on the likelihood of a new/expanding discharge. As a first step, you must obtain streamflow estimates for the proposed discharge location to ensure that the receiving stream is not subject to zero flow restrictions. Low flow data (specifically, drainage area, the summer and winter 7Q10, average flow and 30Q2 flow statistics) can be obtained for a nominal fee from the U.S. Geological Survey in Raleigh at 919-571-4000. The low flow data must be submitted with the EAA, and will be used by the permit writer to develop permit limits. You must also verify that the proposed action

(i.e., construction of a wastewater treatment plant and its appurtenances) is consistent with local zoning and/or subdivision ordinances. You will need to request the local government(s) to complete a **Local Government Review Form (Attachment A)**, and include the signed and notarized form with your NPDES application package.

All applicants.

If you conclude that the proposed discharge will pass the “allowable discharge” criteria, then begin the EAA preparation by summarizing the following general information about the proposed project:

- Provide a description of the proposed project. If the project will be constructed in phases, provide a schedule for constructing each additional phase, and provide the projected flow per phase (see STEP 2).
- Applicant name, mailing address, phone number, contact person
- Facility name, address, county, phone number, contact person
- EAA preparer’s name, mailing address, phone number, contact person

STEP 2. Provide reasonable projections for population and flow

Residential Population Projections.

Facilities requesting an NPDES discharge permit for new or expanding domestic wastewater discharges must document the population to be served within the service area over a 20-year planning period. The NC State Demographics unit provides population data for each county and municipality and can be accessed on the Internet at <http://www.demog.state.nc.us>. If 20-year population projections for specific areas are not available, a linear extrapolation of population trends from the past decade should be used. Any deviation from a linear projection method must be clearly justified. If population projections include future annexations, include a proposed annexation schedule as well as any annexation requirements that must be met.

Municipal Flow Projections.

Justification of flow as well as a demonstration of need shall be provided. Mere speculation is not sufficient. Flow projections should represent average anticipated flows, since permit flow limits are based on monthly averages. Peaking factors used to design various components of the wastewater collection system (e.g., collector sewers, interceptor sewers, pumping stations) should not be used in the justification of the average anticipated flow. For municipal wastewater dischargers, flow must be justified using the Clean Water Loan Program (CWLP) Guidance for Preparing Engineering Reports available on the Internet at <http://portal.ncdenr.org/web/wi/cleanwater/er>. Exceptions to these flow criteria may be approved on a case-by-case basis provided adequate justification is supplied.

- Current Flow- Provide current flows including residential, commercial, industrial, and infiltration/inflow (I/I) based on actual flow data or water billing records. Current residential flow and current commercial flow may be based on water billing records minus a 10% consumptive loss. Current industrial flow may be based on dual metering to determine consumptive losses.
- Future Residential Flow- Provide 20-year residential flows based on projected residential growth. Multiply the projected growth in residential population by 70 gallons per day per capita.
- Future Commercial Flow- Provide 20-year commercial flows based on projected residential growth. Multiply the projected growth in residential population by 15 gallons per day per capita.
- Future Industrial Flow- Provide flow for future documented industrial flow. A nominal allowance for future unplanned industrial expansions may be considered by the Division, provided the basis is clearly justified and current land-use plans and local zoning allow for such industrial growth.

Non-Municipal Flow Projections.

Flow may be justified in accordance with 15A NCAC 2H .0219(1) for various activities (e.g., new subdivisions, new schools, various commercial activities). For other proposed discharges (e.g., groundwater remediation, water treatment plant filter backwash, industrial facilities), the flow projections will be based on engineering design considerations and/or production projections rather than population projections.

STEP 3. Evaluate technologically feasible alternatives

Since a goal of the Clean Water Act is to minimize or eliminate point source discharges to surface waters, any proposal for a new or expanding wastewater discharge must include evaluation of wastewater disposal alternatives in addition to direct discharge. Particularly for dischargers of domestic wastewater, this evaluation should investigate the feasibility of the following wastewater disposal alternatives:

- Connection to an existing wastewater treatment plant (public or private)
- Land application alternatives, such as individual/community onsite subsurface systems, drip irrigation, spray irrigation
- Wastewater reuse
- Surface water discharge through the NPDES program
- Combinations of the above

In order for the applicant to eliminate a wastewater disposal alternative, you must either show that the alternative is technologically infeasible, or that it would be cost prohibitive to implement relative to a direct discharge alternative. Please note that for some alternatives, it might be easier to prove an alternative is not viable based on high cost rather than technological feasibility. For example, for a large municipal expansion that would require several hundred acres for a land application alternative, it might be easier to simply assume that the required acreage could be purchased and calculate the present value costs (including current market land costs) for this option, rather than evaluating whether land application is technologically infeasible due to lack of available land and/or poor soil conditions. For those alternatives identified as technologically feasible, you must develop and compare costs, based on a preliminary level design effort (see STEP 4).

The Division recognizes that wastewater disposal alternatives may be limited for some non-domestic wastewater scenarios, and a full alternatives evaluation may not be warranted. If there is some question as to whether an alternative may be eliminated, contact the NPDES Unit staff. Some scenarios that might not require a full alternatives evaluation include:

- Water Treatment Plant Discharges. Discharges from water treatment plants (WTPs) that utilize a membrane technology (e.g., reverse osmosis, nanofiltration) or ion exchange system tend to generate highly concentrated wastestreams. These wastestreams are not amenable to land application and do not have to be evaluated for this alternative. However, since these wastestreams can also have a toxic impact on a receiving freshwater system, proposed new discharges from these WTPs to freshwaters will not be considered for an NPDES permit unless you can demonstrate that the environmental impacts would be minimal based on dilution modeling. You should investigate whether the wastewater can be piped to a stream with sufficient dilution, or whether a local WWTP might accommodate this discharge. Please note that discharges from WTPs that utilize greensand filtration or conventional technology produce a wastestream that is not saline, therefore no disposal alternatives can be automatically ruled out as infeasible for these other WTPs. Refer to the NPDES website for permitting strategies for reverse osmosis, ion exchange, greensand filtration, and conventional WTPs.
- Groundwater Remediation System Discharges. You will need to evaluate whether WWTP connection, land application, infiltration galleries, in-situ groundwater remediation wells, or closed-loop groundwater remediation wells are viable disposal alternatives. While land application might be a feasible alternative in rural areas, it would not be a feasible alternative in downtown Charlotte, where there is no land available for wastewater application. In this instance, you may simply state that land application is infeasible based on land constraints within the city. You will also need to evaluate connection to an existing WWTP (in accordance with Alternative A), since there are some municipalities that have accepted this wastestream in the past. If the municipality will not accept the wastestream, the connection alternative is also

considered technologically infeasible. Please note that in-situ and closed-loop groundwater remediation wells are permissible well types and further guidance is available through the Aquifer Protection Section.

Aside from these exceptions, you should proceed with the alternatives evaluation in accordance with the following requirements. If you have any questions about these requirements, contact the NPDES Unit staff.

Alternative A. Connection to an Existing Wastewater Treatment System.

You must evaluate the feasibility of connecting to an existing wastewater treatment system served by a municipality or other entity holding a valid NPDES or Non-Discharge Permit. All connection options should include an evaluation of a gravity line and/or force main with pump station(s).

1. **Existing Sewerage System:**
 - (a) Identify whether there are existing sewer lines within a five-mile radius, or consider a greater radius if cost effective for the project size.
 - (b) Provide a preliminary indication of flow acceptance from existing municipal or private WWTPs under consideration for connection. If a municipal or private WWTP cannot accept the wastewater, include a letter documenting such and consider this alternative technologically infeasible.
 - (c) If an existing sewerage system will accept the wastewater, evaluate the piping/pumps/resources necessary to connect to the existing wastewater treatment plant. Attach a topographic map or a site drawing showing the physical route of this alternative. Conduct a Present Value Cost Analysis per STEP 4.
2. **Planned Sewerage System:** Determine if a regional sewerage system within a five mile radius is projected to be available within the next five years to receive waste from the project site. If applicable, determine availability date and flow acceptance projection from appropriate authority.

Alternative B. Land Application.

Land application disposal alternatives include individual/community onsite subsurface systems, drip irrigation, and spray irrigation.

1. Provide an estimate of the best case hydraulic loading rate based on County Soil Surveys or from a soil evaluation performed by a soil scientist. **Include calculations showing the hydraulic loading rate and the total area of land needed for the land disposal system, including buffers.**
2. Assess the availability of land. If insufficient land is available onsite, assume that the necessary land can be purchased and estimate the land purchase cost based on local real estate prices. Alternatively, provide documentation to demonstrate that insufficient land is available for sale in the project area (include letters from adjacent property owners indicating no interest in selling property).
3. Provide a description of the wastewater treatment system and the non-discharge application system. Include a site plan showing the proposed layout, the application area, any existing structures, proposed structures, and other uses within the site.
4. Explain the proposed reuse plan if reclaimed water will be used by a third party.
5. Conduct a Present Value Cost Analysis per STEP 4. For the reclaimed water system include the potential revenue generated by selling the water.
6. Provide all calculations, documentation and maps as necessary to support assumptions and conclusions.
7. Note: The design of land application systems must meet the treatment and design requirements specified in 15A NCAC 2T .05 or 15A NCAC 18A.1900.
8. Note: Proposed discharges from groundwater remediation systems must evaluate the potential for an infiltration gallery treatment alternative.

Alternative C. Wastewater Reuse.

You must evaluate reusing all or a portion of the wastewater generated. Some municipalities are currently reusing wastewater within the confines of their WWTP property for irrigation, toilet flushing, backwashing, etc., while other municipalities have established progressive reuse programs for residential irrigation. Reuse applications might include golf course irrigation, crop irrigation (e.g., hardwood or pine plantation, grasses), athletic field irrigation, landscape uses, and commercial/industrial uses. Some of these reuse applications will be evaluated under Alternative B, Land Application. The design of reclaimed water systems must meet the treatment and design requirements specified in 15A NCAC 2U.

Alternative D. Direct Discharge to Surface Waters.

1. No new or expanding (additional) discharge of oxygen-consuming waste will be allowed to surface waters of North Carolina if both the summer 7Q10 and 30Q2 streamflows are estimated to be zero, in accordance with 15A NCAC 2B.0206(d). Private applicants must contact the USGS in Raleigh at 919-571-4000 and obtain (generally for a nominal fee), the receiving streamflow data (s7Q10, 30Q2, annual average streamflow) at the proposed discharge location. This information must be included in the EAA, and will be used to develop permit limits.
2. All direct discharge systems of oxygen-consuming wastes should be evaluated both with tertiary filtration [BOD5= 5 mg/l, NH3-N= 1 mg/l] and without, and assuming a weekly sampling regime.
3. Provide a description of the proposed wastewater treatment facilities, including a schematic diagram of the major components and a site plan of the treatment facility with outfall line(s).
4. Provide documentation of the availability of required land and/or easement agreements.
5. Conduct a Present Value Cost Analysis per STEP 4.
6. Note: All direct discharge treatment systems must comply with Reliability Requirements specified in 15A NCAC 2H.0124.

Alternative E. Combination of Alternatives.

You should evaluate the possibility of a combination of wastewater alternatives that would minimize or eliminate a direct discharge alternative. For example, consider whether the facility can operate a land application system during the dry season when streamflows are at their lowest and provide less dilution, and operate an NPDES discharge system during the wet season when soils may not be as amenable to land application and the receiving stream provides its greatest dilution.

STEP 4. Evaluate economic feasibility of alternatives

To provide valid cost comparisons among all technologically feasible wastewater alternatives identified in STEP 3, a 20-year Present Value of Costs Analysis (PVCA) must be performed. A preliminary design level effort is considered appropriate for comparing feasible options and their associated costs. For the PVCA cost comparison, all future expenditures are converted to a present value cost at the beginning of the 20-year planning period. A discount rate is used in the analysis and represents the time value of money (the ability of money to earn interest). Present value is also referred to as "present discounted value" or "present worth".

The PVCA should include all monetary costs associated with construction, startup and annual operation and maintenance of a facility. All unit cost information must be provided, and costs must be referenced. Costs can be referenced in paragraph format by summarizing the sources utilized (e.g., vendor quotes, realtor land quotes, past bids, Means Construction Index, etc). Vender quotes received for treatment units or other components, as well as realtor land quotes, shall be included as well. For each treatment alternative identified as technologically feasible, costs should include, but not be limited to, the following:

Capital Costs

- Land acquisition costs
- Equipment costs
- Labor costs
- Installation costs
- Design costs

Recurring Costs

- Operation and maintenance costs (with replacement costs)

- Laboratory costs assuming a weekly monitoring regime for discharge systems and a monthly regime for non-discharge systems
- Operator and support staff costs
- Residual disposal costs
- Connection fees and subsequent user fees
- Permit and compliance fees
- Utility costs (power, water, etc.)

Lost Opportunity Costs

PVCA Calculation Method.

The following standard formula for computing the present value must be used in all cost estimates made under this evaluation:

$$PV = C_o + \sum_{t=1}^n \frac{C_t}{(1+r)^t}$$

Where:

- PV = Present value of costs.
- C_o = Costs incurred in the present year.
- C_t = Costs incurred in time t.
- t = Time period after the present year (The present year is t = 0)
- n = Ending year of the life of the facility.
- r = Current EPA discount rate. EPA adjusts this rate annually on October 1, and it can be accessed from the Internet at <http://www.nccgl.net/fap/cwsrf/201gui.html>.

If recurring costs are the same in years 1 through 20, then C_t=C and the formula reduces to:

$$PV = C_o + C \left[\frac{(1+r)^n - 1}{r(1+r)^n} \right]$$

As an example, assuming capital costs (C_o) of \$2 million, annual recurring costs (C) of \$40,000, and a discount rate (r) of 5.625%, the 20-year (n=20) present value of costs would equal:

$$\begin{aligned}
 PV &= \text{capital costs} + \text{recurring costs} \times \frac{[(1+0.05625)^{20} - 1]}{[0.05625(1+0.05625)^{20}]} \\
 PV &= \$2,000,000 + \$40,000 \times [1.98/0.168] \\
 PV &= \$2,000,000 + \$471,428 \\
 PV &= \$2,471,428
 \end{aligned}$$

PVCA Summary Table.

The EAA must include a Summary Cost Table, which summarizes present worth costs developed for all technologically feasible wastewater alternatives. The summary should include a breakdown of capital costs and recurring costs. In some situations, the Division may require the applicant to refine cost estimates for some alternatives, or possibly collect actual soil data to better characterize the land application alternative. Ultimately, the final determination on cost effectiveness is made by the Division with consideration of monetary costs as well as potential environmental impacts.

Attachment A. Local Government Review Form

General Statute Overview: North Carolina General Statute 143-215.1 (c)(6) allows input from local governments in the issuance of NPDES Permits for non-municipal domestic wastewater treatment facilities. Specifically, the Environmental Management Commission (EMC) may not act on an application for a new non-municipal domestic wastewater discharge facility until it has received a written statement from each city and county government having jurisdiction over any part of the lands on which the proposed facility and its appurtenances are to be located. The written statement shall document whether the city or county has a zoning or subdivision ordinance in effect and (if such an ordinance is in effect) whether the proposed facility is consistent with the ordinance. The EMC shall not approve a permit application for any facility which a city or county has determined to be inconsistent with zoning or subdivision ordinances unless the approval of such application is determined to have statewide significance and is in the best interest of the State.

Instructions to the Applicant: Prior to submitting an application for a NPDES Permit for a proposed facility, the applicant shall request that both the nearby city and county government complete this form. The applicant must:

- Submit a copy of the permit application (with a written request for this form to be completed) to the clerk of the city and the county by certified mail, return receipt requested.
- If either (or both) local government(s) fail(s) to mail the completed form, as evidenced by the postmark on the certified mail card(s), within 15 days after receiving and signing for the certified mail, the applicant may submit the application to the NPDES Unit.
- As evidence to the Commission that the local government(s) failed to respond within 15 days, the applicant shall submit a copy of the certified mail card along with a notarized letter stating that the local government(s) failed to respond within the 15-day period.

Instructions to the Local Government: The nearby city and/or county government which may have or has jurisdiction over any part of the land on which the proposed facility or its appurtenances are to be located is required to complete and return this form to the applicant within 15 days of receipt. The form must be signed and notarized.

Name of local government _____
(City/County)

Does the city/county have jurisdiction over any part of the land on which the proposed facility and its appurtenances are to be located? Yes [] No [] If no, please sign this form, have it notarized, and return it to the applicant.

Does the city/county have in effect a zoning or subdivision ordinance? Yes [] No []

If there is a zoning or subdivision ordinance in effect, is the plan for the proposed facility consistent with the ordinance? Yes [] No []

Date _____ Signature _____
(City Manager/County Manager)

State of _____, County of _____

On this _____ day of _____, _____, personally appeared before me, the said

name _____ to me known and known to me to be the person described in and who executed the foregoing document and he (or she) acknowledged that he (or she) executed the same and being duly sworn by me, made oath that the statements in the foregoing document are true.

My Commission expires _____.(Signature of Notary Public) _____
Notary Public (Official Seal)