

NC Land Application of Residuals Wastewater Operator Need-to-Know

(approved 2020)

I. What Are Residuals?

- 1-1. Describe each of these materials:
 - a. Wastewater treatment residuals
 - i. Domestic
 - ii. Industrial
 - b. Water treatment residuals
- 1-2. Understand the difference between biological residuals and non-biological residuals.
- 1-3. Describe the following properties and characteristics of residuals:
 - a. Total solids
 - i. Organic solids
 - ii. Inorganic solids
 - b. Pathogens
 - c. Nutrients
 - d. Metals
 - e. Synthetic organic chemicals
 - f. Soluble salts
- 1-4. Be familiar with the pH scale and understand the concepts of acidity and alkalinity.
- 1-5. List the options for use or disposal of residuals.
- 1-6. Explain why the US Environmental Protection Agency (EPA) and the NC Division of Water Resources (DWR) consider land application and distribution of residuals “beneficial reuse”.
- 1-7. List the concerns associated with land application and distribution of residuals.

II. How are Residuals Regulated?

- 2-1. Identify the federal regulations governing the use of residuals and the significance of the rules being self-implementing.
- 2-2. List the materials that are regulated under 40 CFR Part 503.
- 2-3. List the materials that are not regulated under 40 CFR Part 503.
- 2-4. Identify the state regulations that govern land application and distribution of residuals permits.
- 2-5. Identify the materials that are regulated under 15A NCAC 2T.
- 2-6. Identify the materials that are not regulated under 15A NCAC 2T.
- 2-7. Describe the following materials and understand the difference between them: “residuals”, “sludge”, “sewage sludge”, and “biosolids”.

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- 2-8. Identify the regulations that govern the certification of land application of residuals operators.
- 2-9. Identify the commission that oversees the operator certification program.
- 2-10. Identify the department and division of state government that administers the operator certification program.
- 2-11. List the requirements for renewing an operator certification and know how often it must be renewed.
- 2-12. Identify the department and division of state government that issue land application and distribution of residuals permits.
- 2-13. List the different types of residuals permits.
- 2-14. Explain the importance of reading and understanding the permit.
- 2-15. Explain the difference between “bagged” and “bulk” residuals.
- 2-16. Understand the importance of a soil scientist to the permitting process for Class B residuals.
- 2-17. Define the terms “dedicated site” and “non-dedicated site” and explain the operational differences.
- 2-18. Explain when groundwater sampling is required as part of the permitting requirements for residuals.
- 2-19. Be familiar with the standard parts of a land application or distribution of residuals permit.
- 2-20. Know the standard time period for which permits are issued and the time-frame required for permit renewal.
- 2-21. Explain how a “non-discharge system” must be operated and maintained.

III. Residuals Quality – Can We Apply?

- 3-1. Know the pollutants (metals) in residuals that have been identified by EPA and DWR as being of significant concern.
- 3-2. Explain the three types of pollutant (metals) limits found in NCAC 15A 2T:
 - a. Ceiling Concentration Limits
 - b. Monthly Average Concentration Limits
 - c. Cumulative Pollutant Loading Rate
- 3-3. Know which pollutant (metals) limits above apply to Class A or Class B residuals.
- 3-4. Explain the importance of municipal pretreatment programs in relation to pollutants (metals) and how they affect the quality of residuals.

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- 3-5. Explain why pathogen reduction is required prior to land application or distribution of biological residuals.
- 3-6. Explain the difference between Class A and Class B pathogen reduction requirements.
- 3-7. Define “vector attraction” as it relates to biological residuals.
- 3-8. Be familiar with the in-plant vector attraction reduction options.
- 3-9. Know the details of the vector attraction reduction alternatives that can be met in the field.
- 3-10. List the three standards of quality that residuals must meet to be considered Class B residuals.
- 3-11. List the three standards of quality that residuals must meet to be considered Class A residuals.

IV. Residuals (Sludge) Generation and Processing

- 4-1. Explain why residuals must be processed before they are land applied or distributed.
- 4-2. Explain the difference between primary and secondary sludge.
- 4-3. Identify methods used to thicken residuals prior to land application or distribution.
- 4-4. Be familiar with the following stabilization methods and know which level(s) of pathogen reduction each is capable of achieving:
 - a. aerobic digestion
 - b. anaerobic digestion
 - c. composting
 - d. lime stabilization
 - e. heat drying
- 4-5. Explain the difference between raw and stabilized residuals.
- 4-6. Know the typical pH value of residuals coming from a municipal facility after aerobic or anaerobic digestion.
- 4-7. Explain how lime stabilization affects the pH of the processed residuals.
- 4-8. Explain the difference between thickening and dewatering.
- 4-9. Identify the most commonly used methods of residuals dewatering.
- 4-10. Identify the range of percent solids for liquid, dewatered (cake), and dried residuals.
- 4-11. Understand how processing methods can affect the end-product characteristics of residuals.
- 4-12. Explain why residuals storage may be necessary.

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V. Evaluating Residuals Quality (Calculations)

- 5-1. Know how to find and use data from a residuals analysis.
- 5-2. Know how to convert from a wet weight concentration (mg/L) to a dry weight concentration (mg/kg).
- 5-3. Know how to convert from a dry weight concentration (mg/kg) to a wet weight concentration (mg/L).
- 5-4. Know how to convert dry weight concentrations (mg/kg) to pounds per dry ton (lbs/dry ton).
- 5-5. Know how to convert gallons to dry tons based on the percent solids of the residuals.
- 5-6. Know how to convert dry tons to gallons based on the percent solids of the residuals.
- 5-7. Know how to calculate dry tons per acre.
- 5-8. Know how to calculate annual and cumulative pollutant loading rates.
- 5-9. Know how to calculate field acreage.
- 5-10. Know how to calculate the geometric mean for seven residuals samples.

VI. Application Rates – How Much Can We Apply?

- 6-1. Define agronomic rate.
- 6-2. Define Realistic Yield Expectation (RYE) and know how to obtain it.
- 6-3. List the primary and secondary macronutrients and three micronutrients.
- 6-4. Understand the difference between macronutrients and micronutrients.
- 6-5. Explain why agronomic rates are usually based on nitrogen.
- 6-6. Identify the forms of nitrogen found in residuals.
- 6-7. Explain the process of mineralization.
- 6-8. List the forms of nitrogen that are plant available and describe how they behave in the soil.
- 6-9. Know the steps involved in calculating the agronomic rate based on nitrogen.
- 6-10. Explain why harvesting and removal of the crop is important.
- 6-11. Explain why application rates must sometimes be based on the liming potential of the residuals.
- 6-12. Define Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP) and explain their importance.

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- 6-13. Explain why it is often necessary to apply the agronomic rate in split applications.
- 6-14. Describe the difficulties associated with application of wet residuals.

VII. Application Rate Calculations

- 7-1. Calculate the concentration (mg/kg) of Plant Available Nitrogen (PAN) in residuals from a residuals analysis.
- 7-2. Calculate the pounds per dry ton (lbs/dry ton) of PAN in the residuals.
- 7-3. Calculate the agronomic loading rate in dry tons per acre (dry tons/ac).
- 7-4. Given the agronomic loading rate, calculate the number of acres required to land apply residuals produced annually.
- 7-5. Knowing the agronomic loading rate (dry tons/ac) and the amount of PAN in residuals (lbs PAN/dry ton), calculate pounds of PAN per acre (lbs PAN/ac).
- 7-6. Using soil test recommendations, calculate application rates based on Agricultural Lime Equivalent (ALE) and Calcium Carbonate Equivalent (CCE).
- 7-7. Calculate Sodium Adsorption Ratio (SAR) using data from a residuals analysis.
- 7-8. Using soil test data, calculate Exchangeable Sodium Percentage (ESP).

VIII. Land Treatment System / Beneficial Use / Application / Timing

- 8-1. Define “setback” and identify features requiring setbacks.
- 8-2. Be familiar with the following soil and site properties and how they relate to land application system function:
 - a. soil texture
 - b. soil structure
 - c. infiltration
 - d. percolation and permeability
 - e. soil depth and restrictive horizons
 - f. seasonal high water table
 - g. topography (slope and landscape position)
 - h. soil pH
- 8-3. Know the restrictions that limit where you can land apply Class B and bulk Class A residuals.
- 8-4. Explain how a seasonal high water table affects residuals operations.

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- 8-5. Explain the importance of maintaining proper soil pH and describe how to maintain it.
- 8-6. Explain how applying high pH residuals can affect treatment processes in the soil.
- 8-7. Describe the role of vegetation in the land treatment system.
- 8-8. List factors that influence crop selection/suitability and management.
- 8-9. List common annual crops and perennial crops and list advantages and disadvantages of each in the operation of land application systems.
- 8-10. Know the waiting period between the application of Class B residuals to a field and when animals can be allowed to graze on that field.
- 8-11. Be familiar with the harvesting and grazing restrictions that must be imposed when Class B residuals are land applied.
- 8-12. Describe the difficulties associated with application of residuals containing high nitrate levels to forage crops.
- 8-13. Describe issues to consider when planning a haul route.
- 8-14. Describe the factors that influence application scheduling for agricultural crops.
- 8-15. List considerations of application events with the landowner/farmer.
- 8-16. Know the restrictions that limit when you can land apply Class B and bulk Class A residuals.
- 8-17. Describe the effect of the weather (especially rainfall and frozen soils) on land application activities.
- 8-18. Explain the relationship between the scheduling of residuals application and the quality of the crop.
- 8-19. Describe strategies for managing odors at the land application site.
- 8-20. Be familiar with the physical, chemical, and biological treatment processes that occur at the land treatment system.
- 8-21. Describe practices to prevent runoff and erosion.
- 8-22. Identify where an operator can obtain advice and useful information regarding agricultural operations.

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IX. Transport and Application Equipment and Methods

- 10-1. Describe the type of transport and application equipment associated with the handling of dewatered and liquid residuals.
- 10-2. List the two methods of land application of residuals: surface and subsurface.
- 10-3. Explain the difference between incorporation and injection.
- 10-4. Identify the circumstances under which residuals would be surface applied to a site.
- 10-5. Identify the circumstances under which the residuals should be incorporated into the soil.
- 10-6. Identify circumstances under which residuals would be applied using a high floatation self-propelled applicator and list advantages and disadvantages of this application method.
- 10-7. Identify circumstances under which residuals would be applied using spray irrigation and list advantages and disadvantages of this application method.
- 10-8. Explain the importance of calibrating land application equipment.
- 10-9. Be familiar with calibration methods and procedures.

X. General Operation and Maintenance

- 9-1. Understand the importance of an Operation and Maintenance Plan and identify the components it must contain.
- 9-2. Understand the need to have a copy of the permit on site during application.
- 9-3. Know the steps that must be included in a spill response plan, and where written copies of the plan should be kept.
- 9-4. Understand the importance of reporting emergencies, spills, and failures. Know the corrective measures that should be taken to minimize impacts on public health and the environment.
- 9-5. Explain the importance of completing the landowner agreement form.
- 9-6. List the responsibilities of the landowner and explain why it is important to communicate these responsibilities.
- 9-7. Define the terms Operator in Responsible Charge (ORC) and Back-up Operator in Responsible Charge (Back-up ORC) and list their responsibilities.
- 9-8. Describe the responsibilities of the permittee with regards to designating an ORC and Back-up ORC(s) for a land application of residuals permit.

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XI. Health and Safety

- 12-1. Understand the responsibilities of the employer, the site supervisor, and the employee regarding safety in the work place.
- 12-2. Know the types of hazards and injuries associated with a land application site.
- 12-3. List the types of personal protective equipment needed on and around a land application site.
- 12-4. Define the term "confined space" and describe the procedures for entering a confined space.
- 12-5. List the possible confined spaces at a land application operation.
- 12-6. Describe the personal hygiene practices that should be used.
- 12-7. Describe the proper procedure for lifting and carrying heavy objects.
- 12-8. Describe the importance of lockout/tagout procedures.
- 12-9. Explain the safety precautions required around land application vehicles, both on the road and off the road.
- 12-10. Identify the importance of adhering to all traffic laws, speed limits, and weight limits in a land application operation.
- 12-11. Describe the hazards related to the following types of equipment and know the safety procedures that must be used around them:
 - a. Tractors
 - b. Vacuum/pressure equipment
 - c. Hydraulic equipment
 - d. Power take off equipment

XII. Public Relations and Education

- 13-1. Explain the importance of public relations when managing a land application project.
- 13-2. Understand the importance of handling complaints in a timely and professional manner.

XIII. Monitoring and Reporting

- 11-1. Explain the value of records as a tool in operating and planning the land application of residuals.

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- 11-2. Identify the records and forms that must be kept as required by the land application permit and the time-period for which they must be maintained.
- 11-3. Know the units of measurement that must be used on required reports.
- 11-4. Explain the reporting procedures that are required for land application and the deadlines for submission of reports for EPA and NC DWR.
- 11-5. Understand the importance of reporting emergencies, spills, or failures and know the corrective measures that should be taken to minimize impact on the public health and the environment.
- 11-6. Describe the need for non-compliance notification.

XIV. Sampling Procedures

- 14-1. Define the following types of residuals samples:
 - a. composite sample
 - b. grab sample
 - c. representative sample
- 14-2. Know the proper procedures when sampling residuals for:
 - a. Nutrients / metals
 - b. Pathogens
 - c. Vector attraction reduction
 - d. TCLP
- 14-3. Explain the correct procedure for collecting residuals samples from tanks, lagoons, compost piles, or stockpiles.
- 14-4. Describe the proper procedure for preserving and shipping residuals samples.
- 14-5. Describe the correct sampling procedures for soils.

XV. Inspections and General Conditions

- 15-1. Describe the inspection that the permittee or designee is required to conduct prior to a land application event.
- 15-2. Understand the authority of Division of Water Resources representatives to inspect any land application sites or facilities covered by the permit.

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Chapter 16. Enforcement and Disciplinary Actions

- 16-1. Understand that the Environmental Management Commission (EMC) delegates its enforcement authority, established in the NC General Statutes, to the Division of Water Resources.
- 16-2. Be familiar with the types of enforcement actions that the Division of Water Resources can take against a permittee for violation of the permit.
- 16-3. Understand the responsibilities of the ORC and the permittee to each other.
- 16-4. Know the reasons why the WPCSOCC may take disciplinary action against a certified operator and the possible types of disciplinary action.
- 16-5. Understand that permittees and certified operators can face criminal prosecution and penalties for willful and knowing violations and actions.
- 16-6. Explain the concept of professional ethics and the importance of professional ethics in the environmental field.