



Environmental Protection and Growth Management Department  
**POLLUTION PREVENTION, REMEDIATION AND AIR QUALITY DIVISION**  
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## **EAR SECTION STANDARD OPERATING PROCEDURE FOR DEWATERING (Revision 2, Effective August 1, 2008)**

### **INTRODUCTION**

As required by Broward County Code (Code), any person(s) wishing to conduct dewatering activities at or within a one-quarter-mile radius of a contaminated<sup>1</sup> site must notify and receive approval from the Broward County Environmental Protection and Growth Management Department (Department) prior to implementation. The County's notification requirements for these dewatering activities are outlined in Section 27-355(4) of the Code, which states:

"Prior to any persons conducting dewatering operations at or within a one-quarter-mile radius of a contaminated site, written notification shall be given to [the Department] and shall include, at a minimum:

- Justification for the need for dewatering;
- Water treatment and disposal plans;
- Effect of the dewatering and disposal procedures on the contaminant plume;
- Monitoring program; and
- Where required and authorized by Chapter 471, F.S. [Florida Statutes] or Chapter 492, F.S., applicable portions of dewatering plans shall be signed and sealed by a registered professional engineer or a registered professional geologist."

Approval of such activities is required by Section 27-353(i) of the Code, which states:

"Dewatering operations at or within a one-quarter-mile radius of a contaminated site shall not be conducted without [Department] approval."

### **APPLICABILITY**

This Standard Operating Procedure (SOP) and the requirements detailed herein are applicable to dewatering operations within Broward County. "Dewatering" refers to any technique that is employed to lower groundwater level. These requirements apply solely to reviews that are conducted by Broward County Environmental Assessment and Remediation (EAR) Staff for the purpose of ensuring that dewatering operations at or within one-quarter mile of contaminated sites will not result in the exacerbation, migration, or improper treatment of contamination. Please note that additional requirements for dewatering have been established by other agencies and may be established by other Sections within the Department.

**Exemption:** Dewatering operations conducted to facilitate underground storage tank upgrades and replacements necessary to meet the Performance Standards for Category-A and Category-B Storage Tanks of Section 27-307(b), Broward County Code, and Section 62-761.510, Florida Administrative Code (F.A.C.), are exempt from the EAR Section Dewatering Plan review and approval process. To qualify for this exemption, a **Notice of Intent to Dewater** must be provided to EAR Section staff at least 5 business days prior to dewatering. The Notice of Intent to Dewater must agree to the following conditions:

1. Dewatering duration must not exceed a total of 3 calendar days (72 hours). If intermittent dewatering is performed, this duration should be considered to be the sum of all continuous pumping periods;

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<sup>1</sup> "Contaminant" is defined in Section 27-352, Broward County Code

2. Sheetpile must be installed to a depth not less than 8 feet below the bottom of wellpoint screens;
3. Effluent must be monitored to ensure compliance with turbidity standards, as applicable; and
4. If conducted within a tank farm area known to be contaminated, dewatering effluent must be properly treated and monitored to comply with water quality standards prior to discharge. Treatment system specifications, laboratory analytics, field notes, and other relevant documentation should be maintained by the party responsible for performing the dewatering.

Any exceptions to conditional items 1 and 2 of this exemption will require the Department's approval of a Dewatering Plan submitted per this SOP. If contamination is encountered during the tank upgrade which has not been previously reported to the Department, dewatering must cease and the Department must be notified in accordance with the requirements of Code Section 27-355.

## PROCEDURE

**A flow chart which demonstrates this SOP is depicted in Exhibit I, attached.** Please note that Exhibit I does not address the afore referenced tank upgrade exemption.

### I. Need for EAR Section Approval of Dewatering Operations

- A. For sites located beyond one-quarter mile of a contaminated site in Broward County, the Development Management Division does not include a "No Dewatering Permitted" clause in construction plan approvals. Dewatering may proceed at such sites; however, it is recommended that EAR Section staff be notified for confirmation.
- B. In instances where dewatering is proposed within a contaminated area (i.e., where it is known that groundwater contains contaminants above applicable standards) but where no other contaminated sites are located within one-quarter mile, a Dewatering Plan must be submitted to the EAR Section of the Department for review and approval prior to implementation of dewatering activities; however, the Dewatering Plan should only contain the following:
  1. The contaminated site information outlined in Section II.A. of this SOP for the dewatering location,
  2. The information outlined in Section II.B. of this SOP, and
  3. Proper certification as required by Section II.E. of this SOP.A Dewatering Report to document the dewatering is also required by Section IV of this SOP.
- C. For sites that are located within one-quarter mile of a contaminated site, a Dewatering Plan in accordance with Section II of this SOP must be submitted to the EAR Section of the Department for review and approval prior to implementation of dewatering activities. Dewatering will not be approved under any conditions for operations that may create a drawdown greater than 0.1 foot at a contaminant plume boundary. The Dewatering Plan must meet the requirements established in Section II of this SOP.

### II. Dewatering Plan Requirements

- A. **Contaminated locations at and/or within one-quarter mile of the proposed dewatering project must be identified.** At the time of this writing, the Broward County contaminated sites database is available on the internet at [http://www.broward.org/pprd/contaminated\\_sites.htm](http://www.broward.org/pprd/contaminated_sites.htm), and a corresponding map is located at <http://www.broward.org/pprd/moi00604.pdf>.

The following items should be included in the Dewatering Plan:

1. Site Number and address for each contaminated site,
2. Contaminant type for each contaminated site,
3. Most recent contaminant plume maps for all groundwater-contaminated sites located within a quarter-

- mile radius from the proposed dewatering location (if available),
4. Tables of the most recent groundwater analytical data for the nearest groundwater-contaminated site (if available), and
  5. A map, drawn to scale, that depicts the particular dewatering location on the site (designation of the site boundaries in general is not adequate) and the locations of identified contaminant plumes.

If contaminant plume maps and data are not available through hardcopy file review with the Department, the Florida Department of Environmental Protection, or the OCULUS petroleum document website (at the time of this writing, located at <http://dwmedms.dep.state.fl.us/Oculus/servlet/login>), then document this fact in the Dewatering Plan and assume that the contaminant plume is confined to the property boundary of the particular contaminated site.

**B. The following information must be provided regarding the scope of the proposed dewatering activities:**

1. Purpose of dewatering (i.e., an explanation of why dewatering is necessary),
2. Dewatering technique (i.e., wellpoint, deep well, open hole, etc.),
3. Anticipated dewatering flow rate,
4. Total dewatering duration,
5. Method of effluent discharge,
6. Controls (i.e., settling tank, turbidity curtain, etc.) and a monitoring program employed to ensure that effluent will comply with applicable water quality standards, including turbidity.
7. If conducted in a contaminated area, engineering specifications for dewatering effluent treatment (i.e. air-stripper, carbon filtration, etc.) and details for an analytical monitoring program to ensure that effluent will meet water quality standards established by Section 27-195, Broward County Code. Please note that Certification by a Florida-registered Professional Engineer, specifically, is required for treatment specifications by Section II.E. of this SOP.
8. A description of any proposed controls, including engineering specifications for sheetpile or recharge system. Certification by a Florida-registered Professional Engineer is required for applicable sheetpile specifications by Section II.E. of this SOP.

**C. Dewatering plans must contain a technical justification that is adequate to demonstrate the proposed scope of dewatering (as required in Section II.B.) will not affect contaminant plumes.** There are two (2) acceptable methods for providing this technical justification:

1. **Manual estimations of the dewatering radius of influence by utilizing SFWMD data or approved aquifer test data to calculate Sichardt's equation.** As a "first pass" of technical justification, Sichardt's equation may be used to determine the radius of influence associated with the dewatering project as discussed in Section II.C.1.b. of this SOP. Details of Sichardt's equation, including an example calculation, are also included as **Exhibit III** to this SOP. The calculation must utilize 1) data from South Florida Management Water District's (SFWMD) Technical Publication 92-05 entitled, "A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida" (1992), or 2) data provided by an aquifer test conducted in accordance with Section II.C.1.a. of this SOP.
  - a. Aquifer test performance and data collection must be consistent with the following guidance: Freeze and Cherry (1979), Fetter (1980), Kruseman and Derrider (1990), or Driscoll (1986). EAR Staff will use AQTESOLV (for Windows) to verify aquifer parameters that are generated from hand calculations and/or computer modeling analysis of aquifer tests. Aquifer Test Data may be collected in one of three (3) ways:
    - (1) Historical aquifer test data from the EAR Section's in-house database may be obtained by contacting David Vanlandingham, P.E., at (954) 519-1478 or [dvanlandingham@broward.org](mailto:dvanlandingham@broward.org). The information contained in the EAR Aquifer Test database has been reviewed by EAR

- Section staff for quality assurance.
- (2) Other historical aquifer test data may be submitted if the test was performed within one-quarter mile of the proposed dewatering location and:
    - (a) Groundwater elevations were measured in at least three (3) observation wells (not including the test well) with varying distances from the recovery well,
    - (b) Data is collected from the beginning of the test until near steady-state conditions are achieved, and
    - (c) Unconfined aquifer conditions and partially penetrating wells were considered in analysis of the aquifer test data<sup>2</sup>.
  - (3) Perform an aquifer test at the proposed dewatering location. Notification must be provided using Exhibit II and written approval must be obtained from EAR staff prior to implementation of the aquifer test. Approvals may be granted through email or facsimile. The test data will be acceptable if the conditions of Section II.C.1.a.(2) are met; in addition,
    - (a) observation wells are to be installed in a line between the dewatering locations and the nearest identified contaminant plume<sup>3</sup>, and
    - (b) one of the observation wells is located at the edge of the proposed dewatered area.
- b. Utilizing Sichardt's equation, a manual (hand) calculation may be performed to determine the projected radius of influence associated with the proposed dewatering activity and the flow rate necessary to produce the required drawdown. This calculation is detailed in Exhibit III accompanying this SOP.
- (1) If the calculated value of radius of influence is less than the distance to the edge of the nearest contaminant plume, the Dewatering Plan may be approved (an example approval letter is provided in Exhibit IV).
  - (2) If the radius of influence is greater than the distance to the edge of the nearest contaminant plume, then the dewatering scope of work must be revised or hydraulic controls (for instance, sheetpile or artificial groundwater mounding via recharge trenches or wells) must be proposed and justified. If hydraulic controls are proposed, computer modeling must be performed in accordance with Section II.C.2. of this SOP, as manual calculations which consider hydraulic controls are not available<sup>4</sup>.

- 2. Groundwater modeling within a three-dimensional computer model utilizing SFWMD data or approved aquifer test data.** The model framework must utilize 1) data from South Florida Water Management District's (SFWMD) Technical Publication 92-05 entitled, "A Three Dimensional Finite Difference Groundwater Flow Model of the Surficial Aquifer System, Broward County, Florida" (1992), or 2) aquifer test data obtained in accordance with in Section II.C.1.a. of this SOP.

All models, regardless of the software used to construct them, are to be properly documented. The Division will use Visual MODFLOW Pro to verify all modeling analyses. Any Dewatering Plan that includes computer modeling must also contain the following information, as applicable:

- a. A compact disc with a copy of all model data including all necessary input, support, and output files.

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<sup>2</sup> If these conditions are not met, the test data may be reanalyzed by the applicant via a method that will consider unconfined aquifer and partially penetrating well scenarios.

<sup>3</sup> These observation points may also be used to meet the requirements of groundwater monitoring, as outlined in Section II.D. of this SOP.

<sup>4</sup> The manual calculation method cannot be used for sites where artificial groundwater mounding is proposed as a hydraulic control. Artificial groundwater mounding as a means of hydraulic control may only be justified through computer modeling as outlined in Section II.C.S. of this SOP.

- b. Map file used as base coverage in .dxf or .bmp format.
- c. Model domain including the number of columns, rows, and layers. Grid spacing must also be documented for areas of the model with increased cell resolution.
- d. Model extent including X-axis, Y-axis, and Z-axis minimum and maximum. Also include coordinates (Lat/Lon, UTM, State Plane) if the model extent are referenced to specific geographic locations. The model should cover a sufficient area as to allow for a true representation of ground water flow during dewatering without undue influence from boundary conditions.
- e. Model units for length, time, conductivity, pumping rate, mass, and concentration as applicable.
- f. Surface elevation and bottom elevation of all layers. If layer elevation is not a constant, then submit a spreadsheet containing x, y, z data in either .txt or .xls format or as a Surfer® .grd file.
- g. Conductivity values of all layers including Kx, Ky, and Kz. If conductivity data vary within a layer then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable. If layer elevation is not a constant, then submit a spreadsheet containing x, y, z data in either .txt or .xls format or as a Surfer® .grd file.
- h. Specific Storage (Ss) and Specific Yield (Sy) values of all layers. If Ss and/or Sy data vary within a layer, then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable.
- i. Porosity and effective porosity values of all layers. If porosity and/or effective porosity data vary within a layer, then submit a file in .txt, .xls, or .shp format. Also include all data interpolation information as applicable.
- j. Pumping well specifications including exact map coordinates, screened interval, pump rate, and pumping duration.
- k. Head observation well specifications including exact map coordinates, screened interval, observation point elevation, and all water table elevation measurements.
- l. Concentration well specifications including exact map coordinates, screened interval, contaminant being monitored, observation point elevation, and all concentration measurements.
- m. The type (constant head, rivers, general head, drains, walls, etc.) and model-grid location for all boundary conditions including an explanation of their selection and description of their input parameters. Boundary conditions should be defined as to not artificially influence ground water flow in the dewatering area or nearby contaminated sites.
- n. Acknowledgment that the model ignores recharge to maintain a conservative estimate of dewatering influence.
- o. Particle tracking information including number of particles, initial particle locations, and release times if applicable. All particles are to be tracked in the forward direction.
- p. If Zone Budget is used to estimate a dewatering flow rate, then the number and model-grid location of zones and output information must be included, as applicable. The type of model run (Steady State Flow or Transient Flow) must also be specified. The Division recommends running the model using only documented boundary conditions under Steady State Flow to determine initial heads. Transient Flow should be used for the duration of proposed dewatering.
- q. The time steps utilized during Transient Flow model runs.
- r. Figures showing model output as both Head Equipotentials and Drawdown at the end of the proposed dewatering period for each modeled layer.
- s. A figure identifying the 0.1-foot and 0.01-foot drawdown contours at the end of dewatering.

**D. The Dewatering Plan must propose a groundwater monitoring program subject to the following:**

- 1. Should a manual estimation of the radius of influence performed in accordance with Section II.C.1. of this SOP indicate that the radius of influence is less than the distance to the nearest contaminant plume, no monitoring program is required (an example approval letter is provided in Exhibit IV).
- 2. Should modeling performed in accordance with Section II.C.2. of this SOP indicate that the closest groundwater contaminant plume is outside of the 0.01-foot drawdown contour, no monitoring program is required (an example approval letter is provided in Exhibit IV).

3. Should modeling performed in accordance with Section II.C.2. of this SOP indicate the closest groundwater contaminant plume lies between the 0.01-foot and 0.1-foot drawdown contours, a monitoring program is required (Exhibit IV will be modified by the Division to reflect specific requirements). The monitoring program must include:
  - a. A table of groundwater elevation data collected from a minimum of three observation points, placed on a line between the dewatering location and the nearest contaminant plume. Data shall be collected:
    - (1) Prior to initiating dewatering activities to establish baseline elevations. Locations that are tidally influenced may require more than one baseline monitoring event.
    - (2) Daily during the first week of dewatering activities, and weekly thereafter until dewatering operations cease. The applicant should make every effort to collect data at the same time of day to reduce the influence of daily fluctuations.
  - b. A map, drawn to scale, detailing the observation point locations relative to the dewatering project, and
  - c. A map, drawn to scale, including water table elevations from observation points and an indication of ground water flow direction.
4. Should a manual estimation of the radius of influence performed in accordance with Section II.C.1. of this SOP indicate that the radius of influence is greater than the distance to the nearest contaminant plume, or should modeling performed in accordance with Sections II.C.2. of this SOP indicate that the closest contaminated plume lies within the 0.1-foot drawdown contour, dewatering will **not** be approved by the Division. The Dewatering Plan may be revised or hydraulic controls (i.e., sheetpile cofferdam or artificial groundwater mounding via recharge) must be proposed and justified. If, in this event, hydraulic controls are proposed, computer modeling must be performed in accordance with Section II.C.2. of this SOP, as manual calculations that consider hydraulic controls are not available<sup>5</sup>.

**E. All applicable portions of Dewatering Plans must be certified by a registered Professional Engineer or a registered Professional Geologist, as provided in Chapter 471, F.S., or Chapter 492, F.S.**

**F. The Dewatering Plan must contain the contact information for the entity that is assuming responsibility for the specified conditions of the Department's approval. The company name, a representative name, address, and phone number should be included, as applicable.**

**G. There is no review fee or "application" for the Dewatering Approval.** Simply submit a certified original of the Dewatering Plan to the Department, to the attention of David Vanlandingham, P.E., at this letterhead address.

**III. EAR staff shall have a period of ten business days to review Dewatering Plans submitted pursuant to this SOP and to provide comment and/or approval.**

**IV. A Dewatering Report must be submitted within thirty (30) days of completion of approved dewatering activities to document actual flow rates and field monitoring data, including any monitoring conducted pursuant to Sections II.B.6., II.B.7, and II.D. of this SOP.**

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<sup>5</sup> The manual calculation method cannot be used for sites where artificial groundwater mounding is proposed as a hydraulic control. Artificial groundwater mounding as a means of hydraulic control may only be justified through computer modeling as outlined in Section II.C.2. of this SOP.

## References

Chapter 27 of the Code of Ordinances of Broward County, Florida. Tallahassee, Florida: Municipal Code Corporation, 2001.

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Freeze, R. Allan, and Cherry, John A. *Groundwater*. Englewood Cliffs, New Jersey: Prentice Hall, 1979.

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