PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT
TECHNICAL POLICY


POLICY NAME: Permitting Guidelines for Sand, Gravel and Other Excavation Operations Located within Flood and/or Erosion Hazard Areas

PURPOSE: To clarify Chapter 16.52 of the Floodplain Management Ordinance (Ordinance) by listing and explaining the information required to demonstrate conformance with provisions of the Chapter for either the development of a new excavation operation, the expansion or modification of an existing operation, or the annual renewal of a previously issued permit for an excavation operation.

BACKGROUND: Chapter 16.52 of the Ordinance establishes requirements specific to excavation operations within regulatory floodplains, floodways and erosion hazard areas. Among these provisions is a requirement for excavation operators to obtain a Floodplain Use Permit (FPUP) for the initial operation, and to renew their FPUP annually. Historically, the District’s enforcement of the renewal requirement has been inconsistent. The District has begun cataloguing those operations that may be active in order to ensure they are operating in compliance with the Ordinance. Concurrently, the District has evaluated what information should be submitted in support of an application for an annual FPUP renewal in order to ensure that the active operation is in conformance with the Ordinance. This policy outlines and discusses the information required for this submittal.

The District also periodically receives FPUP applications for the development of new excavation operations, or for the expansion or modification of existing operations. This policy also outlines and discusses the information required for a submittal to justify proposals for new, expanded or modified excavation operations, and establishes a burden of proof on such projects that is proportional to the potential impact to the adjacent or included watercourse. (e.g. there should be greater justification for an operation within the floodway than for one in the floodway fringe). In addition, this policy establishes a greater burden of proof for excavations in or near regional or major watercourses due to the potential for increased flood damages should pit capture occur.

The development of these policy criteria ensures consistency and continuity with respect to the District’s review of floodplain use permit applications, while ensuring the protection of public’s health, safety and welfare.

POLICY:

Table 025-1 of this policy establishes submittal requirements for a new excavation operation or an expansion/modification to an existing operation. The Table is organized by size of adjacent or included watercourse, and location of the operation (either new or proposed for modification/expansion) relative to flood and erosion hazards associated with the watercourse. The District uses the location of the operation relative to the hazard areas as a decision criterion due to the distinctly different types of protection and analyses required to prevent pit capture and to demonstrate that operation does not cause adverse off-site impacts as measured at property lines, per Section 16.26.020 (encroachment) and 16.52.A (channel stability) of the Ordinance.

A. EXCAVATION OPERATION LOCATION SCENARIOS:

The Table establishes submittal requirements to document the control of pit capture and minimization of impacts for the following scenarios:
1. **In-Channel or Floodway Excavation** – where emphasis will be on understanding and controlling the effects of the operation on sediment supply with the aim of protecting adjacent properties, levees, and upstream and downstream channel structures from damage due to aggradation/degradation of the watercourse;

2. **Floodway Fringe Excavation** – where emphasis will be on the design/construction of levees to protect the operation from flooding, to prevent pit capture due to flows outflanking the levees, and to ensure the operation does not exceed the encroachment standard of Section 16.26.020, as measured at property lines;

3. **Erosion Hazard Area Excavation** – where emphasis will be on the design/construction of erosion protection to prevent pit capture due to lateral migration of the channel of the adjacent watercourse toward the operation;

4. **Floodway Fringe and Erosion Hazard Area Excavation** – where emphasis will be on the design/construction of works to prevent pit capture due to watercourse migration or to prevent levees from being outflanked by flood flows, and ensure the operation does not exceed the encroachment standard of Section 16.26.020, as measured at property lines.

**B. WATERCOURSE SIZE CLASSIFICATIONS:**

The District uses watercourse size as a decision criterion due to a concern with correlated increase in potential flood damage on larger watercourses if the pit gets captured and a headcut forms. The larger watercourses tend to have more significant infrastructure across or adjacent to them, such as roadways, utilities, etc. that could be adversely affected by the headcut formed after pit capture. In addition, the longer duration of a hydrograph for large watercourses increases the duration that damaging flows could occur; along with the potential for other impacts to the pit, such as from seepage through the pit wall. The Table establishes submittal requirements for the following watercourse classes:

1. **Regional Watercourse** is defined as the Santa Cruz River, Rillito Creek, Pantano Wash, Tanque Verde Creek, San Pedro River, and the Canada del Oro Wash and any watercourse with a base flood peak discharge of greater than 10,000 cfs.

2. **Major Watercourse** has a base flood peak discharge ranging from 2,000 cfs up to 10,000 cfs.

3. **Minor Watercourse** has a base flood peak discharge ranging from 100 cfs up to 2,000 cfs.

4. **Sheet Flood Area** is an area of flooding with depths of one foot or less during the base flood even though a clearly defined channel does not exist and the path of the flooding is often unpredictable and indeterminate.

5. **Alluvial Fan** is a land feature formed by deposition of stream sediments as a watercourse flows into an area with a flatter channel slope. These areas exhibit unstable channel geometry, channel location, and flow distribution during the base flood.

**C. SUBMITTAL REQUIREMENTS:**

The information the District requires to support an application for a new operation, or an expansion or modification of an existing operation, is presented in Table 025-1. This Table covers the four location scenarios and five watercourse classes discussed above. Full descriptions of the individual submittal requirements, identified by alpha characters, can be found in Section I.

The information required for submittal to the District to support a request for a renewal of an FPUP for an existing operation is presented and discussed in Section II. Submittal requirements for a request for FPUP renewal are not directly based on location of operation or size of watercourse, and are therefore not included in Table 025-1.
TABLE 025-1
SUBMITTAL REQUIREMENTS FOR A FLOODPLAIN USE PERMIT FOR A NEW EXCAVATION OPERATION OR AN EXPANSION / MODIFICATION OF AN EXISTING OPERATION

<table>
<thead>
<tr>
<th>Region</th>
<th>Watercourse</th>
<th>In-Channel / Floodway Excavation</th>
<th>Floodway Fringe and Erosion Hazard Area Excavation</th>
<th>Floodway Fringe Excavation</th>
<th>Erosion Hazard Area Excavation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Assume Pit Capture; Minimize u/s &amp; d/s Scour Effects</td>
<td>Prevent Pit Capture by channel migration or levee outflanking</td>
<td>Prevent Pit Capture by levee outflanking</td>
<td>Prevent Pit Capture by channel migration</td>
</tr>
</tbody>
</table>

Section I. Submittal Requirements for a New Excavation Operation or an Expansion/Modification of an Existing Operation:

A. Excavation Operations Plan – This plan consists of the following discrete documents, and shall be sealed by an Arizona registered civil engineer:

1. Site Plan – Using a recent aerial photo of the site, drawn at a scale of not less than 1 inch = 400 feet, show the following, as applicable:
   i. property boundaries,
   ii. all known easements and other encumbrances,
   iii. the flow line of the watercourse, associated 100-year floodplain, direction and magnitude of 100-year discharge, and erosion hazard area,
   iv. identification and location of regulated riparian habitat,
   v. footprint and identification of existing and proposed operations including structures, processing facilities, access routes, stockpile areas, ponds, and pit,
   vi. all improvements required pursuant to Criteria C-E & G-I, including levees, bank protection, etc.

2. Grading Plan – Upon a scaled drawing containing property boundaries show the following, as applicable:
   i. 100-year floodplains and erosion hazard areas,
   ii. the extent of all disturbances associated with the operation including maximum planned extent and depth of the excavation,
   iii. all cuts and fills and associated slope grades (horizontal to vertical),
   iv. improvements required pursuant to Criteria C-E & G-I,
   v. that portion of the site that, due to its proximity to the flood and erosion hazards, requires an Arizona registered civil engineer or land surveyor to verify that development is occurring as approved.
   vi. constructed works to address onsite and offsite local drainage issues.

3. Site Phasing Plan – Using the Grading Plan, as described above, show the planned progression of site development during the anticipated life of the pit, leading to complete pit closure in accordance with the Reclamation Plan, and any associated infrastructure that is needed to protect each phase from flood and erosion hazards.

4. Monitoring Plan – Provide an inspection schedule, a list of features and/or improvements to inspect, and minimum criteria indicative of proper operation for each feature and/or improvement. This applies to all engineered features and/or improvements which are needed to protect the excavation operation from flood and/or erosion hazards.
This requirement applies to all operations proposed within a regulatory floodplain or erosion hazard area, and is authorized pursuant to Section 16.20.020.A of the Ordinance.

B. Mining Reclamation Plan – The Mining Reclamation Plan is required in order to ensure that specific measures exist to maintain the safety of the facility after closure with respect to flood and/or erosion hazards. This Plan shall address the long-term stability and maintenance of any required flood/erosion control works, and shall show in sufficient detail the ultimate condition of the pit at final closure in order to ensure conveyance through the watercourse is maintained. The requirements of this Plan are in addition to, and do not supersede any State reclamation plan requirements. This Plan shall include at a minimum:

1. A description of the condition of the pit at closure (e.g. backfilled and re-vegetated, or open and stable, with appropriate pedestrian and vehicular barriers and means to prevent ponding of local drainage),
2. Proposed finished contour elevations, minimum elevations of any backfilled excavations, and cross-sections showing finished side slopes and backfilled elevations
3. A closure plan which identifies all elements of the Grading Plan, and their status upon closure,
4. A measurable timeframe for the mine reclamation activities to be accomplished,
5. A riparian habitat mitigation plan, if more than 1/3 of an acre of regulated riparian habitat is disturbed by the operation; and
6. Bonding or financial assurance of compliance, including description of performance assurance requirements for compliance with Floodplain regulations.

This requirement applies to all operations proposed within a regulatory floodplain or erosion hazard area, and is authorized pursuant to Sections 16.52 F. and 16.30 of the Ordinance (for riparian disturbance).

C. Hydrologic Analysis – Present the technical basis for the 100-year flood peak discharge ($Q_p$) and time of concentration ($t_c$) for the re. Determine 100-year flow hydrograph if sediment transport analysis is required. Analysis shall be performed in accordance with the current editions of the following Technical Policies: TECH-010: Rainfall Input for Hydrologic Modeling; TECH-015: Hydrologic Model Selection for Peak Discharge Determination; and TECH 114: Content of Drainage Reports for PDD. This requirement applies to all operations proposed within a regulatory floodplain or erosion hazard area, and is authorized pursuant to Sections 16.52.A and E; and 16.16.050.C of the Ordinance.

D. Floodplain Delineation – Determine the lateral extent of the 100-year floodplain in accordance with the current edition of Technical Policy: TECH-016 Hydraulic Model Selection for Floodplain Delineation, so that excavation operations can be located to avoid this area or improvements can be constructed to mitigate the associated flood and/or erosion hazards. This requirement applies to all operations proposed within a regulatory floodplain or erosion hazard area, and is authorized pursuant to Sections 16.52.E and 16.16.050.C of the Ordinance.

E. Erosion Hazard Area Delineation – Determine that portion of the land adjacent to the watercourse that is subject to flow-related erosion hazards so that excavation operations can be located to avoid these areas or so that improvements can be constructed to mitigate the erosion hazard. The determination shall address unusual conditions that could affect erosion potential, and shall be developed in accordance with the current edition of Technical Policy: TECH-012 – Engineering Analysis Requirements for Determining Alternative Safe Erosion Hazard Setback Limits. Within active alluvial fans, all operations located within young soils (young defined as soils less than 5,000 years of age) will be considered to be located within an erosion hazard area, even if the operation lies outside of the default erosion hazard setback of the nearest watercourse. The presence of young soils in an active alluvial area is considered an unusual condition by the District. The alternate erosion hazard setback is the extent of the young soils. This requirement applies to all operations proposed within a regulatory floodplain or erosion hazard area except for in-channel excavations, and is authorized pursuant to Sections 16.52.E; and 16.16.050 of the Ordinance.

F. Sediment Supply, Transport, and Long-Term Scour Analysis – When an in-channel operation is proposed, an analysis of the excavation operations impact on channel stability or sediment transport rates shall be provided. This Sediment Supply Analysis shall include:
1. If the Sediment Supply Analysis demonstrates that the reach of the watercourse is aggrading, the following information shall be submitted:
   i. The evaluation of a safe aggregate mining withdrawal rate such that long term degradation is avoided,
   ii. A thalweg profile of adjacent channel(s), referenced to NAVD88. This profile shall establish the maximum depth of excavation within the channel and adjacent overbanks
   iii. The construction of low training works at the downstream end of the pit to capture flows induced to flow through the pit, and to return them to the natural channel downstream of the pit.

2. If the Sediment Supply Analysis demonstrates that the reach of the watercourse is degrading, a Long-Term Scour Analysis shall be submitted to demonstrate that the in-channel excavation will not result in channel instability, which includes:
   i. A long-term sediment transport analysis to determine the interaction of the sediment supply with the operation both during operation of the pit and after pit closure,
   ii. The evaluation of the need for operator constructed grade controls and/or flow diversion works to ensure stream stability,
   iii. The evaluation of the adjacent or nearby properties, structures, and improvements to ensure that operation of the facility pursuant to the approved Excavation Operation Plan will not form an upstream headcut or cause degradation of the watercourse downstream that causes a hazard to any structure, including but not limited to roads, bridges, culverts, levees, grade-control structures, bank protection, and underground utilities.

This requirement applies only to in-channel operations, and is authorized pursuant to Sections 16.52.A. 16.52.C. and 16.52.E of the Ordinance.

G. Maximum Anticipated Scour Depth (MASD)- When improvements (levees, buildings, etc) are located within the floodplain and/or erosion hazard area, the need for erosion protection must be evaluated. Erosion protection may be required due to the tendency of the flood flows to scour around the foundations of these improvements, and/or due to the tendency of the channel to migrate towards these improvements. In order to ensure the improvements will remain stable during the 100-year flood, they shall be constructed with a foundation which incorporates a toe-down depth equal to or greater than the MASD. Note that local abutment scour components may be appropriate for upstream portions of the operation’s levee system if it protrudes abruptly into the 100-year floodplain. Evaluation of the MASD shall use hydraulic characteristics that are representative of the erosion hazard, as follows:
1. If the improvements are located within the erosion hazard area of an adjacent channel, the average channel hydraulic characteristics shall be used, and the MASD shall be measured from below the bottom of the adjacent channel;
2. If the improvements are located within the floodplain, but outside of the erosion hazard area of the adjacent channel, average overbank hydraulic characteristics may be used, and the MASD may be measured from below the ground surface of the overbank area.
3. If both hazards are present, the more restrictive MASD values shall apply.

This requirement applies to operations in the floodway fringe and erosion hazard areas, and is authorized pursuant to Section 16.52.A of the Ordinance.

H. Levees – For operations proposed within the 100-year floodplain, a levee system to prevent pit inundation and/or pit capture during the 100-year flood shall be provided. Design consideration shall include:
1. Top of levee shall be at the base flood elevation plus 3 feet, and shall taper down to ground level at a 3:1 slope or through a distance of 10 feet, whichever is greater;
2. The flood-side of the levee must be protected against erosion down to the MASD calculated for the levee.
   i. If dumped rock riprap is proposed for erosion protection, riprap stability shall be demonstrated in accordance with Figure 9.1 of the SMDDFM, titled: Riprap Design Chart, or in accordance with other approved methods.
   ii. If the levee is located within the erosion hazard area, the velocity to be used in conjunction with Figure 9.1 or other approved method shall be the appropriate channel velocity for the 100-year flood
   iii. If levee is located outside of the erosion hazard area, average overbank flow velocity may be used with Figure 9.1 or other approved methods,
iv. Increased velocity around the nose of the abutment for portions of levee which protrude into the flow field shall be accounted for in erosion protection design. This requirement applies only to operations in the floodway fringe, and is authorized pursuant to Section 16.52.A of the Ordinance.

I. Protection from Lateral Migration of the Watercourse – For operations proposed within the erosion hazard area, erosion protection to prevent pit capture by lateral migration of the watercourse shall be provided. Design considerations shall include:

1. The erosion protection shall extend down to the MASD;
2. The erosion protection shall extend up to the Regulatory Flood Elevation (Base Flood Elevation plus 1 foot), unless the proposed operation is also with the 100-year floodplain, then the erosion protection shall extend to the Base Flood Elevation plus 3 feet.
3. If the erosion protection is on a slope steeper than 1:1, or is designed to retain more than 4 feet of soil behind it during conditions of maximum scour, the design for the erosion protection shall be sealed by an Arizona registered structural engineer.

This requirement applies only to operations in the erosion hazard area, and is authorized pursuant to Section 16.52.A of the Ordinance.

J. Encroachment Analysis – For operations proposed within the 100-year floodplain, an analysis demonstrating that the operation will not increase flood depth and/or flow velocity greater than the standard established in Section 16.26.020 of the Ordinance shall be provided. The following standards shall be applied to this analysis:

1. The presence of the operation within the floodplain shall not cause an increase in the water surface elevation of the 100-year flood of more than 0.1 feet, as measured at property boundary lines.
2. The presence of the operation within the floodplain shall not cause an increase in flow velocities of the 100-year flood of more than 10%, as measured at property lines.
3. For operations proposed solely within the overbank floodplain, the encroachment analysis shall isolate the effect of the encroachment to only the overbank portion of the hydraulic cross-section.

This requirement applies only to operations in the floodway and floodway fringe, and is authorized pursuant to Section 16.08.220 of the Ordinance.

K. Zero-Rise Certification – For operations proposed within the floodway, the encroachment analysis described as Criteria J shall be provided, except that the standard that shall be applied is that no rise (i.e., 0.0 ft) in water surface elevation of the base flood is allowed. An Arizona registered civil engineer shall certify that the operation will cause no increase in water surface elevations. This requirement applies only to operations in the floodway, and is authorized pursuant to Section 16.52.B and 16.24.020 of the Ordinance.

L. Seepage Analysis – For operations proposed along regional watercourses, a seepage analysis shall be provided that demonstrates that the pit walls will not fail due to piping of bank material during the passage of the 100-year flood, or the passage of sustained multi-day or seasonal flow events. Analysis shall include:

1. Analysis of maximum piping flow assuming maximum pit depth, maximum flood level, and minimum distance from edge of pit to the 100-year floodplain or erosion hazard area;
2. Analysis of percent fines within the bank material which separates the pit from the hazard area;
3. Analysis incorporating results of L.1 and L.2 above to demonstrate insignificant piping of bank material during passage of the 100-year event.

This requirement applies only to operations along regional watercourses, except in-channel operations, and is authorized pursuant to Section 16.52.A of the Ordinance.

M. Slope Stability Analysis - When any structures such as a flood control levee, erosion control barrier, grade control structure, building (four walls and a roof), or any off-property development is located less than 3 times the proposed pit depth, measured from the bottom edge of the nearest portion of the pit to the base of the structure, an evaluation of the long-term stability of the proposed slope of the pit walls shall be provided. This applies to those portions of the pit located within the flood and/or erosion hazard area. This evaluation shall be
used to establish safe distances from the top edge of the pit to the structure, and shall consider the proposed finished slope of the pit under conditions of maximum saturation. This evaluation shall also be considered in the seepage analysis (item L), if required, since the configuration of the stable slope may reduce the maximum piping flow path. Evaluation of the long-term stability of the proposed slope of the pit walls shall use a computer based 2-D Limit equilibrium analysis, with the following parameters specified:

1. Search multiple circular trial surfaces using Simplified Bishop, Janbu, Morgenstern-Price, Spencer or similar Method of Slices model to find the minimum Factor of Safety (FS) for the conditions modeled.
2. Composite slip surface can be utilized if justified by field conditions.
3. Consider 3:1, 2:1, 1.5:1 and 1:1 slopes.
4. Consider any slope with Factor of Safety (FS) ≥ 1.5 as acceptable.
5. Seismic FS need not be considered.
6. Soil input to analysis to consist of Ø and C (Mohr-Coulomb) and can be estimated from published data for similar materials, field data, lab data, and/or back calculated from existing slope geometries.
7. Critical slope height for stability analysis expected to be the greatest vertical height in the pit from toe to crest unless special conditions exist.
8. Analysis to be completed for both the absence (dry/unsaturated) and presence of groundwater (saturated).
   i. Groundwater is expected to be present as the result of flooding of the pit by overtopping, seepage out of the slope from the presence of water in the river channel, water in the pit from local recharging activities raising regional groundwater levels and drawdown conditions created by post-flood event pumping out of the pit.
   ii. Pore water pressure impacts on slope stability to be accounted for by the analytical method used. Most common method is to establish/assume a phreatic surface/groundwater table.
   iii. Identify and evaluate impacts to slope stability from any upstream/downstream structures affecting river runoff during storm events and/or groundwater levels in the pit such as dams and recharge facilities.

N. Covenants – Property owners of land which contain an excavation operation shall be required to sign an indemnification agreement holding the County and the District harmless for any damage that may occur on or off the property caused by the excavation operation.

This requirement applies to all operations and is authorized pursuant to Section 16.20-.040.B.5 of the Ordinance.

O. Review Fees – A Floodplain Use Permit application for excavation operations shall be accompanied by the appropriate fees. This requirement applies to all operations and is authorized pursuant to Section 16.53.G of the Ordinance.

P. Other Permits – Submittal shall include documentation demonstrating that all other necessary permits, including but not limited to Pima County Development Services Permits and Clean Water Act permits, have been requested for the proposed excavation operation.

This requirement applies to all operations and is authorized pursuant to Section 16.20.020.D of the Ordinance.

Section II. Submittal Requirements for Request for Annual FPUP Renewal for an Active Excavation Operation:

Annual FPUP renewals are required for excavation operations that operate within floodplain, floodway, erosion hazard area, or regulated riparian area. If an FPUP was issued for an incidental reason, such as for access through a riparian area or floodplain, but the FPUP does not contain conditions regarding the excavation operation itself, then annual renewal is not required.

Q. Annual Update of the Excavation Operation Plan – The request for FPUP renewal shall be accompanied by the following information in order to demonstrate compliance with all conditions of the FPUP:
   1. A recent aerial photo of the operation, presented at a scale of not less than 1 inch = 400 feet.
   2. A copy of the Site Plan, drawn at a scale of not less than 1 inch = 400 feet annotated to show the current limits of the operation, and the area excavated during the past year,
3. A copy of the Grading Plan annotated to show the current limits of the operation with pit bank slopes and depths provided. If the FPUP for the operation contains engineered setbacks or slope stability requirements (e.g. erosion hazard areas, setback to mitigate slope stability concerns, etc.), an Arizona registered civil engineer or land surveyor shall ensure that compliance with respect to slopes and depth is maintained. If default values are used, the owner may certify that the operation remains in compliance.

4. As-built plans, sealed by an Arizona registered civil engineer for any new infrastructure required to protect the excavation from flood hazards that was built during the past year.

5. A brief report, signed by the owners of the operation, attesting to the following:
   i. The operation is currently in compliance with terms and conditions of the current FPUP,
   ii. The approximate amount of material that has been removed during the past year,
   iii. A description of all unusual conditions experienced during the past year (e.g. floods, failure and repair of protective works, etc), and the impact these conditions have on the Site Phasing Plan or ultimate footprint of the excavation operation.
   iv. Inspection report, prepared by an Arizona registered civil engineer which documents that any drainage infrastructure necessary to protect the excavation operation from flood and/or erosion hazards has been inspected, and based on this inspection is anticipated to perform as expected. If drainage infrastructure is not present, this subpart is not applicable.

6. Identification of any proposed changes to the Excavation Operation Plan. The District will determine if any proposed change to the Excavation Operation Plan should be reviewed as a modification that is subject to the requirement of Section I.

R. Renewal Review Fee - Floodplain Use Permit renewal application for excavation operations shall be accompanied by the appropriate fees. This requirement applies to all operations and is authorized pursuant to 16.53.G.

APPROVED BY:

[Signature]
Suzanne Shields
Director

Original Policy Approved: 11/7/11
Date(s) Revised: