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Mike -

I have reviewed the various guidelines that have been located to date and have adjusted and expanded the table that was prepared by FCD in 2007 in preparation for this task. The attached document serves as a review of the current guidelines that were readily located and provides an overview. Data from numerous states was collected and reviewed as well as a number of state and county personnel contacted in regards to the regulation of sand and gravel mining.

The data included in this report will serve as the basis for updating the Maricopa County guidelines and making recommendations for possible changes to the current draft guidelines. If you have questions please call me at (480) 275-5077.

Sincerely;

Gary E. Freeman, PhD, PE  
President

# **Review of Documents and Existing Sand and Gravel Guidelines for Maricopa County Arizona - DRAFT**

## ***Introduction***

River Research & Design, Inc. (R2D) was tasked to review the existing County sand and gravel guidelines as well as draft guidelines developed by JE Fuller Hydrology and Geomorphology, Inc. (2004) with an eye towards updating, simplifying, and clarifying the draft guidelines such that they could be adopted by the County. This task not only includes a literature review and comparison but interviews with County personnel applying the guidelines and firms applying for permits under the draft guidelines.

During the process guidelines and rules were also reviewed from a variety of sources. These sources included the draft guidelines by Fuller (2004), regulations from Colorado regarding reclamation of sand and gravel mines, guidelines from Adams County, Colorado, guidelines from the U.S. Army Corps of Engineers for areas of Maricopa County from 1980 and 1987, guidelines from the Corps for Oklahoma, as well as guidelines from the State of Missouri for in-stream mining and other documents.

The review of the current guidelines includes a significant amount of work previously performed by Flood Control District staff in preparing the original portion of Table A-1. This basic data and form has been extended and augmented by the inclusion of additional materials and by the addition of guideline information for reclamation requirements in Table A-1.

The guidelines from Alaska were included since they had a comprehensive list of agencies they had contacted in the preparation of their guidelines (albeit from the early 1990's) and contained significant guidelines for the mining and reclamation of gravel pits. While true that the discussions of ice roads and the ground being frozen during the peak flow period so as to make most scour calculations irrelevant are out of the experience of most engineers in Maricopa County, the guidelines otherwise offer some valuable comparisons.

The Alaskan review of other states data and requirements is included in Appendix D as it was helpful in determining which of the departments in the various states handled sand and gravel mining regulation and reclamation. While the material is dated it provides a good start for updating the list of the various agencies and regulatory bodies and was a valuable reference in this study as to which agency to contact in order to find additional information in the various states. It also provides a backdrop to view how laws and regulations have changed over the last 15+ years since the study was performed.

## **Available Data Collection**

Data from a number of agencies were gathered primarily via an Internet search but also through contact with agency personnel that deal with sand and gravel mining regulation in a number of states. The most comprehensive of these documents are summarized in Table A-1. (Appendix A) A wide variety of documents were reviewed in preparation of Table A-1 but many contained no new information or were not detailed enough to provide anything not already shown in the table or did not have enough data to make their inclusion worth the space it would require. The documents shown in Table A-1 were among the best documents found to date dealing with the issues impacting sand and gravel mining operations.

The various reclamation requirements were also reviewed and a comparison similar to that in Table A-1 is included in Table A-2 (both in Appendix A). Most, if not all, states have reclamation plan requirements. The reclamation plan requirements vary from simple to complex but nearly every state allows the determination of expected use and the adaptation of the mining reclamation plan to be adapted to the expected future use. All of the plans are subject to review and approval of state and/or local authorities.

The state laws, regulations and guidelines (if any) were reviewed for other western states and counties. A summary of the various laws, regulations and guidelines (if any) is listed in Table C-1 for the western states (Appendix C). The states included in the table include California, Nevada, Oregon, Washington, Idaho, Colorado, Utah, New Mexico and Texas. A number of counties were contacted regarding regulations and guidelines. A combined set of guidelines that was very helpful was found that was produced for Washington and Oregon. This document is used by both states as a source for best management practices for mine reclamation and is a good source of information. For more information see the Oregon or Washington section in Table C-1.

The documents reviewed range from Corps documents from the 1980's for streams in Maricopa County to the document from the Alaska Fish and Game Department and regulations from Virginia. The Alaskan guidelines include some good reclamation guidelines that may be useful for deep pits in the portions of Maricopa County with high water tables.

Documents from Ohio, Oklahoma, and Missouri are also included in the table since they offer some additional perspectives on regulations in other parts of the country. Some of these areas are obviously areas where vegetation establishes easily and can be more of a problem if not maintained. Such is not the case in Maricopa County with the exception of areas where salt cedar readily grows and crowds out more desirable vegetation. After the review of documents a total of twelve documents were included in Table A-1.

## **Review of Selected Available Data**

The data from the various sources made it clear that Maricopa County has the most detailed guidelines that were found to date – especially in relation to floodplain boundaries and locations within the floodplain and floodway. The Maricopa County guidelines were also the only ones that mentioned erosion hazard zones. The most pertinent data found for sand and gravel mining regulation is summarized in Table A-1 of Appendix A. Data from many of the states reviewed as well as links to their statutes and regulations are included in Appendix C.

### **U.S. Army Corps of Engineers**

Three sets of documents from the Corps were reviewed and included in Table A-1 (Appendix A). Two of the studies are specific to Arizona and one was for Oklahoma. The Arizona reports were dated July 1980 and January 1987 and were for the Salt/Gila Rivers and the Skunk/New/Agua Fria Rivers respectively. The Arizona methods require an engineering analysis while the Oklahoma guidelines allow mining without an engineering analysis if the guidelines are followed.

The Corps guidelines for Arizona call for mining to be limited to the depth of the thalweg (minimum channel elevation) while the Oklahoma guidelines call for mining to be limited such that it doesn't induce channel shift or scour holes in the river or upstream bed. The mining lateral setbacks (for pits outside the channel) include 100 feet and not below a 10:1 slope from the thalweg for the Salt/Gila and 500 ft and not below the same 10:1 slope for the Skunk/New/Agua Fria unless the bank is stabilized to 10 ft below the thalweg. The setback for the floodway for the Skunk/New/Agua Fria is the same as for the channel with the same exception for bank protection. The setbacks for the Oklahoma guidelines call for a minimum setback of 25 ft except for small streams (less than 50' in width) when the setback can be reduced to 10 ft.

The upstream setbacks inside the floodway are 200 ft (Salt/Gila) or 500 ft from a structure plus 100 times the pit depth with a minimum of 200 ft from property line (Skunk/New/Agua Fria). The upstream setback in the floodplain is 200 ft unless the banks are stabilized with a toe down of 10 ft below the thalweg. This same setback applies to the downstream floodway setbacks for the Skunk/New/Agua Fria. No setbacks are mentioned in the Oklahoma guidelines.

### **Adams County Colorado**

The Adams County guidelines (1987) require differing setbacks from the river depending on the type and amount of bank protection used. The standard setback is 400 feet on the Platt River but can be as low as 100 feet if protection is provided both inside and outside the pit wall.

### **Pima County**

The current Pima County regulations specify that mining is permitted if the “depth, width length or combination thereof [are not] so as to present a hazard to structures, including roads, bridges, culverts, and utilities, the banks of the water courses or to another property

or adversely affect groundwater recharge. No guidelines were available but were rumored to be under development.

### **Virginia**

The Virginia Guidelines deal primarily with setbacks and slopes. The setbacks required are 50 ft (both sides) from the stream bank with a 3:1 or flatter completed slope and a 1:1 maximum inactive slope. The excavations must be screened from view by a berm, plantings or 100 ft of undisturbed natural forest or by natural topography.

### **Ohio**

The Ohio guidelines call for a minimum of 50 ft setbacks from all property boundaries and stream setbacks of from 50 to 120 feet depending on the size and classification (i.e. wild and scenic) of the river with final grades of less than 18 degrees considered stable (approx. 3:1).

### **Missouri**

The Missouri guidelines are relatively simple but apply primarily to in-stream mining operations specifying a 10 ft undisturbed buffer to stream banks and prohibiting mining below the water surface if flowing or below the thalweg is dry. Mining within “Outstanding State Resource Waters” is prohibited.

### **Alaska (promulgated by Fish & Game Department)**

Mining is not encouraged in non-braided rivers but mining on other types is accepted if not in active channels with a few exceptions regarding low gradient streams where deep pits may be viable in the long term for winter fish habitat. Setbacks are specified for both low flow buffers and flood flow buffers. Low flow buffers are equal to the edge of a flow 1.6 ft above the summer low flow water surface elevation or a point having a horizontal distance from the summer low flow water’s edge equal to one-half the width of the channels top at channel full (bank-full) discharge. High or flood flow buffers are 50 ft for small streams 116 ft for medium streams and 165 ft for large streams for scaper operations. For pit operations the setbacks are 258 ft for small streams, 495 ft for medium streams and 825 ft for large rivers with a minimum height setback equal to water surface elevation during the 10 year flood. The Alaska report has a good state by state summary although it is somewhat dated at this point. The list of states and data that responded to their survey has been included in Appendix D.

### **Masterplans**

Two jurisdictions (Adams County and Maricopa County) reference master plan documents for lateral and vertical alignments of the river systems. Mining in Adams County is prohibited below the river thalweg unless the mining is in accordance with an approved master plan for the river. This is also true under Maricopa County’s draft (2004) guidelines

A number of other states and counties were reviewed in an effort to find the most up to date and relevant Data. The results of most of the areas reviewed are included in Appendix C. While few of the states or counties had very specific guidelines on mining most (if not all)

of the states surveyed have reclamation guidelines. The comparison of mining reclamation is included in Table A-2 (Appendix A).

## **Results of the Review**

### **Mining Guidelines**

It appears from the various guidelines and regulations that there are two approaches to river setbacks. One method is to determine a setback distance and make no exceptions. The other approach is to allow mining activities to move closer to the river in exchange for bank protection. Under this approach the more sure the bank protection or the smaller the stream the closer the pit can come to the river.

Most of the states not discussed above have very limited regulations or guidelines for sand and gravel mining placing the burden and responsibility on individual counties or cities to either allow, regulate, or prohibit sand and gravel mining in their respective jurisdictions. This regulation has primarily occurred as problems impacting the counties or cities have arisen.

### **Maricopa County Guidelines**

The Maricopa County Guidelines are the most detailed found. The adopted (1994) guidelines are not any more complex than the Adams County guidelines for example but are very similar in complexity. The 2004 draft guidelines on the other hand not only deal with floodways and floodplains but with erosion hazard zones. The inclusion of erosion hazard zones adds a significant complication to the determination of pit setbacks and permissible mining areas. The 2004 guidelines are also very complex with multiple options that must be sorted through to make sure you are in compliance with the guidelines. The 2009 interim guidelines are not as complex but put most of the burden on the applicant to show the lack of offsite impacts. They are also not fully developed at this time but are a good start towards the development of guidelines and show significant thought has gone into how to approach regulation of sand and gravel mines.

The current (1994) guidelines for Maricopa County incorporate most of those from the Corps studies that preceded them. There are three sets of guidelines prepared by Maricopa County – the adopted guidelines are the 1994 guidelines with a draft set from 2004 that were not adopted and an interim set under development from early 2009. These are all compared in Table A-1 but are summarized here for ease in comparison.

The currently adopted guidelines (which are the only guidelines that have been adopted by the Board of Supervisors and thus technically the governing guidelines) call for setbacks of 100 ft for each ft of pit depth upstream for both floodplain and floodway and 50 ft for every ft of pit depth downstream for both floodways and floodplains. The lateral setbacks are specified at 50 ft for pits with a depth greater than 10 ft and no setbacks specified for pits less than 10 ft in depth. The approved slopes are 10H:1V for both upstream and downstream faces and 3:1 for side slopes unless an engineering analysis shows a stability factor exceeding 1.5 for steeper slopes. The maximum pit depth is specified as 10 feet

without an engineering analysis with no maximum depth specified with an engineering analysis.

The 1994 guideline setbacks require large parcels of land before mining can be performed on an economic scale. Parcels of 40 acres are likely not viable for sand and gravel mining using these setback requirements. A 15 ft deep pit requires a 1500 ft set back from the upstream boundary and a 750 ft setback from the downstream boundary. This combination of 2250 ft for setbacks is nearly a half mile of setbacks and would require a parcel with dimensions of almost a half mile before a 15 ft pit could be excavated in the floodway. These setback requirements make small parcels of little value unless they can be combined into long group of parcels that can overcome the setback requirements.

Setbacks for floodplain excavations under the 2004 guidelines differ from those for floodway excavations and a minimum of 1) 25 ft from any erosion hazard zone, 2) 100 ft from the main channel bank, 3) 500 ft from any bridge or utility crossing, and 4) at a property line, 25 ft plus 3 times the depth of the pit at that location.

The upstream setbacks for a floodway are 50 ft for each ft of pit depth or 500 ft from any utility for upstream setbacks unless the excavation crosses an erosion hazard line which calls for a setback determined by a line drawn at a specified angle from the channel centerline. The minimum floodway setback for downstream is the maximum of 500 ft from a bridge or utility unless the pit crosses an erosion hazard line which calls for a setback based on a line drawn at an angle from the channel centerline. The minimum setback from a property line in the floodway is 25 ft plus 3 times the pit depth.

The maximum excavation depth in the floodway under the 2004 guidelines is limited to the lower of the watercourse master plan elevation, the FEMA minimum channel elevation or a baseline established by FCDMC or applicant. The maximum depth in a floodplain is determined by drawing a 10:1 line from the toe of the main channel bank to the inside toe of the pit.

The 2004 Draft guidelines require a 500 ft setback from any utilities but have reduced the upstream setback in the absence of utilities to half of the 1994 guidelines or 50 ft per ft of pit depth. It also appears to have reduced the downstream setback from 50 ft per ft of pit depth in the 1994 guidelines to 25 ft plus 3 time the pit depth. This reduces the total setbacks for the above 15 ft pit from 2250 ft to 820 ft ( $50 \times 15 + 25 + 3 \times 15$ ). This is a significant reduction and allows significantly more parcels to be mined as long as they are not near utility or bridge crossings which require the minimum setback at 500 feet.

The 2009 interim guidelines require a sediment transport study to determine the impacts of the pit to offsite properties and infrastructure. This eliminates the arbitrary setting of limits that are the same for all size rivers and all sediment types. The impact of this change is not clear at this point but does allow a case by case evaluation of mining applications.

The 2009 guidelines also allow the berming of pits in the floodplain (as opposed to the floodway where no berms are allowed) which removes them from the floodplain and allows mining without flood control regulation as long as berm construction meets the County standards. The guidelines put the burden on the applicant to show the lack of impacts offsite. The options on the floodplain offer either a berm around the pit or a full engineering study to show no adverse impacts leave the property.

### **Comparison of Maricopa County Guidelines with Other Counties**

The adopted Maricopa County Guidelines are relatively complex in comparison to other guidelines but not extremely more complex in relation to other guidelines that were reviewed. The 2004 guidelines are very complex and are by far the most complex set reviewed in this study. The 2009 interim guidelines are not complete but put the effort to eliminate impacts to others by mine operators.

The regulation used by Adams County with fixed setbacks probably do not make sense in Maricopa County given the varying size of waterways in the County, the extent of existing mining and the channelization that has occurred over time in conjunction with the mining and surrounding development. The interim guidelines appear to be an attempt to find a simpler way to regulate mining than could be done under the fixed setback rules of the adopted guidelines while trying to better protect the waterways in the County.

The approach of the interim guidelines in using sediment transport modeling to analyzing the adverse impacts appears to be a better approach for analyzing significant mining within the floodways. The berming of pits in the floodplain and requiring bank protection appears to be a good idea that will allow excavation within the floodplains to proceed without extensive modeling and analysis. The mining of small parcels will continue to be severely limited due to setback requirements to contain head and tailcuts on the property if no berms are constructed.

A companion review of historical mining on the Salt and Agua Fria River systems indicates that a masterplan for the major river systems in Maricopa County could set a blueprint for the future alignment and depth of the river channel desired. It is likely too late to accomplish this task on most of the Salt River between about 35<sup>th</sup> Avenue and Granite Reef Dam for example but the Agua Fria and Hassayampa are candidates as well as the Gila River below the Salt River confluence. The river systems that have not been too extensively impacted by large mining operations to date are thus candidates for a masterplan approach. This has been discussed by the Flood Control District and the Arizona Rock Products Association (ARPA) for the Agua Fria River but has not, as yet, been implemented. The development of this type of document for the larger rivers and washes in the county would allow the more rapid determination of whether a proposed mine is going to be of assistance to the County in obtaining the desired river channel capacity or a problem that will require the permittee or the County to rectify future problems caused by the mining operation.

## **Reclamation Guidelines**

Reclamation guidelines are much more numerous than mining guidelines and appear to have been promulgated to better control the end result of mining pits across the nation. This requirement has also likely been a requirement to meet federal requirements for the protection of water and streams. A few reclamation guidelines are compared in Table A-2 for some of same entities that are included in Table A-1 as well as others. Where no guidelines were found for entities included in Table A-1 they were replaced by other entities with detailed reclamation requirements. Nearly all of the various states require reclamation plans to be completed prior to the excavation of sand and gravel from floodplains and most states require reclamation plans no matter where the mine is located. Some states do exempt small operations while others have no exceptions from reclamation plan requirements.

Corps and FEMA regulations prevent the stockpiling of material within the floodway or the storage of equipment where it will block flood flows. This tends to reduce reclamation requirements in floodways. Wetlands must be protected under Corps regulations and water quality not impaired by operations under EPA regulations. These are in addition to state and local requirements.

The various reclamation plans nearly all include slope requirements for final grades so as to insure stability of the site and limit sediment movement offsite. The stability of the final slopes and resistance to water erosion and geotechnical failures are both addressed in numerous jurisdictions. Required slopes are primarily in the 2h:1v or 3h:1v range with a few exceptions for swimming areas, rock faces, or other special features / requirements.

The reclamation plans, for the most part, require topsoil to be removed, stored and replaced upon the completion of mining. This is, however, almost always dependent on the future use of the site. If the site is to be returned to forest or used for agriculture, wildlife or other use where the soil is necessary, the jurisdiction requires the removal, protection and replacement of the material or of substitute material if the topsoil is insufficient or of low quality. If the ultimate use is something that doesn't require topsoil it often may be removed and not replaced.

The final slope of a mined area is also subject to future use in most states. If the land is to be farmed, for example, the final slope must be compatible with typical farming operations. If the area is to be wildlife habitat the slopes must be conducive to proper revegetation and be such that the animals can traverse the slopes. Nearly all states require the slopes to be geotechnically stable.

Nearly every state requires a bond for the reclamation of the mining site. The amounts vary fairly widely with some states having fixed amounts on a per acre basis while other states are allowed to require differing bond amounts based on the costs to reclaim the individual pit. The range in the requirements reviewed ranged from \$750 per acre in Alaska to \$2,500 in Idaho. The required bond is \$2,000 per acre in Arizona.

The impact to water resources is also of concern to most states but requirements vary widely based on the geologic conditions found in the state. Missouri, for example, talks about how to handle tar sands and reduce the impact of the tar on fish and wildlife habitat in the old pits. Virginia requires a baseline study and an evaluation on probable impacts to the hydrologic system if mining occurs below the groundwater table. Their document goes into groundwater hydrology in some depth as a result. California requires the operators to pay for any monitoring by the regional water quality board if such monitoring is deemed necessary. Most other states require operators to comply with other regulations and use care to avoid introducing large amounts of sediment into the waters leaving the site. States generally require streams to be restored to a state similar to pre-mining if in-stream mining is allowed.

Revegetation is another area where the states allow latitude depending on the future land use. Just as in the replacement of topsoil the ultimate land use usually determines if revegetation is necessary at all. If it is required most states call for the use of the vegetation that will have the best chance of survival and the use of fertilizer and other soil additives that will aid in the establishment of the vegetation. A common requirement is for new cover to be similar to natural cover in the area in terms of density and cover if not in type of vegetation.

### ***Approved Sediment Transport Models***

The only agency that was found that required specific sediment transport models to be used in the development of mining plans was Maricopa County. The states do not indicate preferences as to the models used but appear to leave that up to the local agencies or applicants. No documentation could be found where a particular model was required to be used for any other agency. Some of the counties were just starting to look at sediment transport modeling and others have not, as yet, responded to inquiries. No official documentation of model preferences was found among the counties contacted.

### ***Streamlined Permits in Other States***

Several of the other states have streamlined permitting for small pits. Virginia, for example allows field approval for mines where the permitted acreage is less than 50 acres, there are no homes closer than 500 ft to the proposed mine, there are no requests for public hearing, the mine is not within one mile of a public water supply (well or reservoir), no current or previous environmental problems are associated with the site, no special permits are required (Corps, DEQ, or state permits), no overburden or tailings disposal facilities will be constructed except a berm with a slope not to exceed 18 degrees (3:1), and no underground workings are proposed or will be encountered. If not all 9 criteria are met portions of the permit can be field approved to speed approval.

Virginia also has a provision for pits of less than 10 acres in size if all of a set of general guidelines are carefully followed. No variation from the standards is allowed and a rather detailed list of requirements is given in section 2.4 of their guidance document.

The Corps' Oklahoma guidelines allow mining to proceed without a permit (as far as the Corps jurisdiction) if the guidelines are carefully followed.

Oregon has several exemptions from regulations for small pits. One is for pit that disturb less than 1 acre annual and produce 5,000 cubic yards or less if the material is not used onsite. An exemption is available for pits where the material is used onsite by the owner or tenant for primary purpose of construction, reconstruction or maintenance or roads on parcel of an adjacent parcel owned by the same owner unless it disturbs more than 5 acres. Excavations in highway rights of way are exempt if used on highway and excavation from the bed or banks of rivers is exempt under mining but controlled under the State Land Department under requirements for salmon habitat protection.

Arizona law exempts mines that disturb less than 5 acres from reclamation plans but otherwise has little regulation on sand and gravel mining in the state. Several states do exempt very small pits from regulation if the material is used on-site by the owner, for example, or if the mining is done for governmental use by governmental employees and equipment.

## ***Maricopa County Guidelines***

### **County Regulations and Floodplain Regulation**

The existing county regulations were reviewed from the viewpoint of the regulation of sand and gravel mining. The regulations were compared with the contents of the various versions of the guidelines in Table B-1 (Appendix B). The 2007 County regulations are relatively clear in their requirements but obviously expect to be supported by the Sand and Gravel Mining Guidelines for detail. The three versions of the County guidelines are compared with the County regulations in Table 3. The state laws and regulations give very little guidance in regard to sand and gravel mining and no specifics other than for reclamation plans. The pertinent Arizona law is included in the preliminary pages of Appendix B

### **Recommendations**

The County regulations for sand and gravel mining make it clear that coordination with the Flood Control District is required. There is some confusion that has to be worked through to get an understanding of how the various sections interact with one another. Mining is regulated under Section 800 (item 19) and Section 800 states that it applies to everywhere except AE floodways but Section 802 (floodplains) after incorporating Section 800 standards states that:

“3. A Floodplain Use Permit for the extraction of sand and gravel or other materials within AE Floodway Fringe shall be granted under the same conditions as Section 801.

This causes some confusion since it requires imposing the floodway restrictions on the floodplain lands as well as in the floodplains in addition to the 800 standards. This can, however; likely be clarified in the sand and gravel mining guidelines.

### ***State Mining Law***

Since the state mining laws place almost no constraints on sand and gravel mining (a condition not uncommon among the states reviewed) the regulations are likewise limited. They are included in the introductory pages of Appendix B. The only regulation comes in regard to reclamation plans and these requirements are included in the table in Appendix B along with the requirements of the County regulations.

The state law does allow counties to regulate mines under an “aggregate mining operations district standards regulation”. (ARS 27-447)

The lack of state regulation was a common theme among counties and agencies from other states that were contacted.

