



FLOOD CONTROL
DISTRICT OF
MARICOPA COUNTY

**Stormwater Sampling
Management Plan**

Version 2.0
July 1, 1998

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DISTRICT

OF
MARICOPA
COUNTY

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Management Plan

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Purpose:

This stormwater sample management plan is written to show the methods and guidelines that the District will use in stormwater sampling and data management. The Field Sampling Protocol will remain a separate document designed for the field technicians' use. However, it is part of the overall Sample Management Plan.

The Stormwater Sample Management Plan will include the following items:

- Sample Plan
- QA/QC Program
- Sampling Protocol/SOPs
- Analyses, detection limits
- Procedures
- QC sampling
- QA/QC Program
- Chain of custody
- Maintenance / calibration logs
- Description of sampling sites
- EPA sampling guidance for grab and composite samples
- Cleaning

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1.0 PURPOSE

The purpose of the Stormwater Sample Management Plan is to provide information about the District's stormwater sampling program and about the methods and procedures used for the collection of samples.

In 1999, the EPA will notify the District and Maricopa County that we are required to obtain an NPDES stormwater permit to discharge during Phase II of the stormwater program. It is expected that the permit will be effective in 2002. The requirements for the permit have not yet been finalized, but may be similar to the requirements in the 1990 Phase I regulation. Upon issuance of the permit requirements, this Plan will be revised to reflect any new sampling activities. This document summarizes the current program in 1998.

2.0 LOCATIONS AND SITE DESCRIPTIONS

2.1 Site Location

Currently the District monitors ten fixed land-based sites. (The Dreamy Draw site will be added later in 1998.) Three sites will be acquired from USGS on October 1, 1998 and four Glendale sites will be sampled beginning in summer 1998.

Phoenix SR-03

Located approximately 1/4 mile north of the Salt River on 35th Avenue. The contributing sub basin is approximately 1363 acres, and the outlet is a 75-inch concrete pipe. The drainage basin is mainly industrial.

Phoenix SR-45

Located on the south bank of the Salt River at 40th Street. The contributing sub basin is approximately 120 acres, and the outlet is a 54-inch concrete pipe. The drainage basin is mainly industrial.

Phoenix SR-49

Located on the north bank of the Salt River at 67th Avenue. The contributing sub basin is approximately 5,000 acres, and the outlet is a 96-inch concrete pipe. The drainage basin is mainly undeveloped.

Phoenix IB-08

Located on the north bank of Indian Bend Wash on the east side of 40th Street. The contributing sub basin is approximately 609 acres, and the outlet is a 66-inch concrete pipe. The drainage basin is mainly residential.

Phoenix ACDC and 43rd Avenue

Located on the north side of the Arizona Canal Diversion Channel, just west of 43rd Avenue. The contributing sub-basin is 3.4 acres and the outlet is a gutter depression that discharges over the top wall and into the ACDC. The drainage basin is commercial. This site will be the District's Responsibility on October 1, 1998.

Phoenix Salt River and 27th Avenue

Located on the south bank of the Salt River along the 27th Avenue alignment. The contributing sub-basin is 44.8 acres and the outlet is a 96-inch corrugated pipe. The drainage basin is industrial. This site will be the District's responsibility on October 1, 1998.

Mesa 1

Located on Horne and Sixth Streets. The contributing sub basin is approximately 193 acres, and the outlet is a 36-inch concrete pipe. The drainage basin is an older residential area with irrigated lots.

Mesa 2

Located on Broadway Road approximately 1/8 mile west of Lindsay Road. The contributing sub basin is approximately 145 acres, and the outlet is a 72-inch concrete pipe. The drainage basin is mainly a mobile home park located north of Broadway Road and east of the Consolidated Canal.

Mesa 3

Located on Fighter Aces Drive, approximately 1/4 mile north of McKellips Road on Falcon Drive, which is located approximately 1/2 mile east of Greenfield Road. The contributing sub basin is approximately 171 acres, and the outlet is a 48-inch concrete pipe. The drainage basin is developed and undeveloped parts of Falcon Field Airport.

Mesa 4

Located on Horne and Grandview Avenue just before discharge into a large retention basin. The contributing drainage area is approximately 66 acres, and the outlet is a 54-inch concrete pipe. The drainage basin is a housing subdivision built after 1980.

Mesa 5

Located on Dobson Road approximately 1/4 mile south of Broadway Road. The contributing drainage area is approximately 63 acres, and the outlet is a 30-inch concrete pipe. The drainage basin is mainly commercial business.

Glendale 1 – OLIVE

Located on 67th Avenue just north of Olive Avenue. The contributing drainage area is approximately 18 acres, with an outlet channel controlled by a weir. The drainage basin is mainly residential. This site will be the District's responsibility on October 1, 1998.

Glendale 2 – INDUSTRIAL PARK

Located between Glen Harbor Boulevard and New River channel, approximately one-half mile north of Glendale Avenue. Drainage area is ~~unknown at this time~~ 30 acres. The outlet is a 54-inch concrete pipe. The drainage basin is mainly industrial.

Glendale 3 – BUTLER

Located on 56th Drive south of Olive Avenue. Drainage area is ~~unknown at this time~~ 30 acres. The outlet is a small channel. The drainage basin is mainly residential.

Glendale 4 – ARROW

120 acres

Located on the north bank of Skunk Creek near 79th Avenue alignment. Drainage area is ~~unknown at this time~~. The outlet is a 54-inch concrete pipe. The drainage basin is mainly commercial.

Glendale 5 – CITRUS

60 acres

Located on the east bank of the 71st Avenue Drainage Channel at the Grovers Avenue alignment. The drainage area is ~~unknown at this time~~. The outlet is a 42-inch corrugated pipe. The drainage basin is mainly residential.

~~South Mountain~~

Located on Central Avenue in South Mountain Park past the park offices. The drainage area is approximately 1120 acres, and the outlet is a 72-inch corrugated metal pipe. The drainage area is undeveloped parkland.

~~Dreamy Draw~~

Located in Dreamy Draw Park in the outlet from the dam. The drainage area is 832 acres. The sampling point has not yet been chosen. The drainage area is mainly undeveloped mountain preserve.

CY 2000.

Five additional sites in Scottsdale will be added during ~~Fiscal Year 1998-1999~~. Tempe's three sites likely will be added during calendar year 1999. Future updates of this document will reflect any additions.

2.2 Site Specific Information

Site	Drainage Area (acres)	Pipe Diameter (inch)	Pipe Slope (ft/ft)	Roughness Coefficient
Phoenix SR-03	1363	75	0.0009 ¹	0.013
Phoenix SR-49	5000	90	0.0024 ¹	0.013
Phoenix SR-45	794	54	0.0023 ¹	0.013
Phoenix IB-08	609	66	0.0032 ¹	0.013
Phoenix ACDC/43rd Ave	3.4	N/A	N/A	N/A
Phoenix Salt/27th Ave	42	96	N/A	N/A
Mesa 1	193	36	0.0029 ²	0.013
Mesa 2	145	72	0.0011 ²	0.013
Mesa 3	171	48	0.0014 ²	0.013
Mesa 4	66	54	0.0040 ²	0.013
Mesa 5	62	30	0.0014 ²	0.013
Glendale 1	27	N/A	N/A	0.013
Glendale 2	N/A	54	N/A	0.013
Glendale 3	N/A	N/A	N/A	N/A
Glendale 4	N/A	96	N/A	0.013
Glendale 5	N/A	42	N/A	0.013
South Mountain	1120	72	0.040	0.014
Dreamy Draw	832	N/A	N/A	N/A
¹ City of Phoenix Stormdrain As-Builts				
² City of Mesa				

2.3 Field Equipment

NPDES Water Quality Sites

The NPDES sites maintained by the District use Sigma automatic sampling equipment. Equipment in Mesa is the Sigma 800SL Sampler with integral flowmeter. A dialout alarm and modem are exclusive from the sampler unit. Equipment in Phoenix is the Sigma 900 MAX Sampler with integral flowmeter, modem, and dialout alarm.

The five sites in Mesa have electric power supplied by Salt River Project and telephone service provided by US West. The four sites in Phoenix do not have commercial power, but are powered by battery charged by solar panel. The sites have telephone service provided by US West.

Non NPDES Water Quality Sites

Automatic sampling equipment used in non-NPDES compliance situations use the Isco 3230/4230 flowmeter and Isco 3700 sampler.

Currently, Isco samplers are in use at the Phoenix SR-45 and Phoenix IB-08 NPDES locations to capture grab samples to evaluate first flush pollution.

3.0 SAMPLING PROGRAM

3.1 Sampling

A sampling event occurs when rainfall and flow are detected at a sample site. The parameters for sampler initiation are presented in the following table.

SITE	RAINFALL (inch)	LEVEL (inch)
Mesa 1	0.05	0.5
Mesa 2	0.05	0.5
Mesa 3	0.05	0.5
Mesa 4	0.05	0.5
Mesa 5	0.05	0.5
Phoenix SR-03	0.05	0.5
Phoenix SR-45	0.05	0.5
Phoenix SR-49	0.05	0.5
Phoenix Salt/27th Ave	0.05	0.5
Phoenix ACDC/43rd Ave	0.05	0.5
Phoenix IB-08	0.05	0.5
Glendale 1	0.05	0.5
Glendale 2	0.05	0.5
Glendale 3	0.05	0.5
Glendale 4	0.05	0.5
Glendale 5	0.10	NA
South Mountain	0.05	1.0
Dreamy Draw Dam	0.05	1.0

Grab samples, composite samples, and quality control samples are taken by the technicians and the automatic equipment.

3.1.1 Grab Samples

Grab sampling is a technique used to collect samples that are not amenable to collection through the composite sample. Pollutants such as oil and grease, volatile organic compounds, and fecal bacteria are best taken as grab samples. It is best to collect samples for these analyses directly from the discharge where the sampler intake tubing is located.

In four of the Mesa samplers and in some of the Phoenix samplers, the sample collection points are in manholes in busy streets, making it difficult if impossible to collect grab samples directly.

When feasible, grab samples will be collected from the point where the sampler intake tubing is located. Any deviation from this procedure will be noted on the stormwater sampling report.

Grab sample procedures are continually evolving. Any changes to the grab sample procedure will be noted in future additions of this document.

3.1.2 Composite Samples

A flow-weighted composite sample is also collected for each site. The flow-weighted sample is collected via the automatic sampling equipment. In the Sigma sampling equipment, the composite sample is collected in jars three through eight.

Four individual samples are collected in each jar, for a total of 24 aliquots collected. Each aliquot is collected based on a pre-set amount of flow passing across the flow sensor.

Each of the 24 aliquots in the six jars is placed in a large vessel for compositing. Once the individual aliquots are together, individual pre preserved bottles are filled. This procedure is most often done at the contract laboratory, but is sometimes done by the sampling technicians at the Instrumentation Lab.

3.1.3 Quality Control Samples

Quality control (QC) samples are taken to measure contamination of samples and equipment that may have been introduced by sampling techniques, and to check the accuracy of the contract laboratory. Four types of QC samples are taken: travel blanks, field duplicates, equipment blanks, and field blanks.

Travel blanks assess contamination during transport of the volatile organic samples to the laboratory. Field duplicates assess the accuracy of the laboratory analyses. Equipment blanks measure the effectiveness of cleaning of the sampling equipment. Field blanks measure contamination during the sampling process.

3.2 Representative Storm

A representative storm has the following characteristics:

	Rainfall (inch)	Duration (hours)
SUMMER (June - Sept.)	0.2 - 0.8	2.2 - 6.5
WINTER (Oct. - May)	0.2 - 0.7	5.2 - 15.6

with no rainfall 72 hours prior to the representative event.

Sampling equipment is setup to begin sampling if the 0.05 inches of rain is received within 60 minutes. This plan works well because sometimes equipment fails and sampling opportunities are missed.

3.3 Analyses of Samples

Since the sampling program began in 1993, the District has sampled for the same general set of constituents, with analyses being updated as necessary. Each sample is currently analyzed for approximately 160 analytes or compounds.

The following is a list of the analyses/methods:

BOD5, Fecal Coliform, Fecal Streptococci, Oil & Grease, EPA 624 (purgeables), COD, Chloride, TDS, TSS, Ammonia, Nitrates, Nitrites, Organic Nitrogen, Kjeldahl Nitrogen, Phosphorous total/dissolved/ortho, Total Organic Carbon, Alkalinity, Hardness, Sulfate, Metals total/dissolved

(Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Tl, Zn), EPA 608 (organochlorine pesticides), EPA 625 (Base/Neutral/Acid compounds).

3.4 Detection Limits

The detection limits for the analyses have been determined from the State Surface Water Quality Standards. Limits are based on the most stringent requirement for all applicable water uses.

3.5 Surface Water Quality Standards

The reader is referred to Title 18, Chapter 11 of the Arizona Administrative Code, "Department of Environmental Quality, Water Quality Standards," for Arizona State Surface Water Quality Standards.

Surface water quality standards are developed by ADEQ. Standards differ and are based on the designated uses of a water course or water body.

4.0 QUALITY ASSURANCE / QUALITY CONTROL

The Quality Assurance / Quality Control (QAQC) program for the District's sampling is designed to ensure that the samples collected are of high quality and that the laboratory analyzing the samples is producing quality results. The program consists of sampling procedures, quality control samples, data review and validation, and equipment maintenance.

4.1 Lab QA/QC Procedures

The contract laboratory has a full set of Quality Assurance procedures that cover all aspects of operations from building maintenance, sample log in, sample tracking, and sample analysis. A copy of the document is available at the District.

4.2 Sample QA/QC Procedures

The sample QAQC procedures include aspects of preparedness and sampling.

4.2.1 Preparedness

Sample equipment, bottles, and forms are all set up at each sampling site prior to a storm event. This helps to ensure that the proper laboratory bottles and sampler jars are at each site before a storm event occurs. By preparing for an event ahead of time, the possibility of filling incorrect bottles or mislabeled bottles can be avoided. All equipment is readied within five days after the previous storm event.

Readying a site includes:

- Placing clean, labeled sample jars in the sampling unit.
- Placing clean, labeled grab sample bottles at each site.
- Setting the sampler program in a ready position for the next event.
- Cleaning the intake tubing.
- Checking for hardware problems.
- Correcting hardware problems that surfaced during a previous event.

4.2.2 Field QAQC Samples

Four types of QAQC samples are taken: Travel Blanks, Field Duplicates, Equipment Blanks, and Field Blanks.

Travel Blanks are samples that accompany EPA 624, Volatile Organics samples. One set of travel blanks is placed in each cooler that contains VOC samples. The lab supplies the travel blanks and they are not opened during the sampling process. Travel blanks measure contamination that may occur during transportation to the lab.

The frequency for this sample will be one travel blank for each cooler containing other VOC samples.

Field Duplicates are samples taken when a normal sample is taken. The Field Duplicate and Normal sample results are compared to measure errors introduced by the laboratory. Because most of the sample volume collected by the automatic equipment is required for a full analysis, Field Duplicates will be split from one composite sample and analyzed for the minimum NPDES parameters.

The frequency of this sample will be one per rain event or ten percent, whichever is greater.

Equipment Blanks are samples taken immediately after the equipment has been cleaned. The Equipment Blanks will be taken on the sample intake tubing and the glass sampler jars used in the automatic sampler equipment. Deionized water is used as the medium. Deionized water is poured into the glassware or pumped through the intake tubing directly into laboratory sample containers. Samples will be analyzed for all NPDES pollutants.

The frequency of this sample will be ten percent per rain event.

Field Blanks are samples taken with the other samples during a sampling event. The procedure for completing a field blank is the fill prepared and preserved sample bottles and filling each with deionized water. The samples are submitted as any other sample and analyzed for the entire NPDES suite.

The frequency of this sample will be one per municipality, (one in Phoenix, one in Mesa, one in Glendale, and one in Scottsdale.)

4.3 Cleanliness

The cleanliness of the equipment is vital to ensuring that contamination is not introduced from a controllable factor. Both the intake tubing and the sample jars are cleaned to ensure no sample contamination.

Equipment cleaning consists of the following steps:

1. Disconnect intake tubing on sampling unit
2. Pump tap water through the tubing.
3. Pump Liquinox® mixed with tap water through the line.
4. Pump copious amounts of tap water through line.
5. Pump nitric acid through line.
6. Pump deionized water through line.
7. Pump methanol through line.
8. Rinse deionized water through line.

NOTE: See the Field Sampling Protocol for the necessary volumes.

Glassware cleaning consists of the following steps:

1. Wash the container with Liquinox® solution using a wire brush to clean sides.
2. Thoroughly rinse containers with tap water.
3. Rinse the container with nitric acid.
4. Rinse the container with deionized water.
5. Rinse with methanol.
6. Thorough final rinse with deionized water.

NOTE: See the Field Sampling Protocol for the necessary volumes.

4.4 Calibrations

Equipment calibrations will be conducted periodically to ensure that the automatic sampling equipment is operating properly. Calibrations of the flow measuring devices (pressure transducers) and sample intake volume are conducted at least twice per year.

For reference, a log of the calibration will be kept. The information to be kept in the log should include at least the following:

- Date of the calibration
- Time of calibration
- Person(s) doing calibration
- Depth of water to which PT probe is submerged
- Volume of water pumped to calibrate sampler delivery volume

A log sheet is in the Field Sampling Protocol manual for recording maintenance and calibration information. One sheet is completed for each site, each time it is visited.

4.5 Chain of Custody

A Chain of Custody form is completed for each sample collection event. The contract laboratory provides the form. All individuals in whose physical possession the samples fall sign the form.

4.6 Field Records

A field notebook is kept to record all activities at each site. Information such as sampling events times and dates, calibration activities, and maintenance activities are recorded in the book.

4.7 Data Review and Validation

Data review and validation uses all of the sampling data received for an event. Checks of the holding times, proper chain of custody procedures, preservation, sample data, QC sample data, and lab QC data are made to determine the validity of the data.

An attached Laboratory Data Review sheet shows the steps involved in verifying data. A review sheet will be completed and attached to each data set. For stormwater sampling, a data set would include first flush grab and composite samples at one site.

Any circumstances in which the data does not meet the criteria on the review sheet or data that seems questionable is reported to the laboratory for resolution.

4.7.1 Data Qualifiers

Beginning with samples taken after July 1, 1998, data qualifiers will be used in the data and database when data are reviewed. The following qualifiers will be used.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

J - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

N - The analysis indicates the present of an analyte for which there is presumptive evidence to make a "tentative identification."

NJ - The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence of absence of the analyte cannot be verified.

4.8 Data Retrieval and Storage

There are two primary types of data collected in the stormwater monitoring program: Water Quality and Discharge/Ambient Conditions.

4.8.1 Water Quality Data

The water quality data is a direct result of the samples collected during a storm from grab and composite samples. The samples are analyzed for the pollutants listed previously in section 3.3. Data is reported from the contract laboratory as hard copy and electronic file on disk.

All reports from the contract laboratory are reviewed when received as described in Section 4.7 above.

The numerical data is currently entered into a Microsoft Excel spreadsheet. Electronic data is provided on disk in the Excel format. The hard copies of the laboratory reports are retained at the District offices. Attached to all reports is a Quality Control Report, which is kept separately at the District offices.

4.8.2 Discharge/Ambient Data

Along with the water quality data, a number of parameters are collected and retained as part of the overall storm data. Data collected in this category includes:

Rainfall

Maximum 5-minute rainfall intensity

Runoff quantity sampled
Total storm runoff
Peak discharge
Days since last measurable rain
Storm Duration
Land use characteristics
Basin size

Flow and rainfall data is downloaded by telephone line or direct connection with field equipment. Data is checked to ensure integrity.

4.9 Preventative Maintenance

Maintenance of the equipment will be on a scheduled, periodic basis. A regular six-month and annual maintenance will be done.

The six-month maintenance will consist of:

1. Calibrate the depth sensor.
2. Calibrate the pumped sample volume.
3. Check and clean raingages of debris.
4. Inspect sample intake line, connections, cables, pump tubing, batteries, solar panels, and battery charging system.

The annual maintenance will include the six month maintenance, and:

1. Replace sample intake tubing.
2. Replace sampler pump tubing.
3. Rinse new intake tubing with deionized water.

Since equipment failures tend to increase with time, more frequent maintenance may be required. Any repairs and replacements will be made as necessary. In addition, an Equipment Blank sample may indicate the need for tubing replacement before scheduled replacement.

4.10 Record Keeping

All records will be kept at the District offices, except for the field notebook kept at each site. Calibration and field records are kept in the Instrumentation Lab. Chains of custody, laboratory reports, and flow data are kept in the District Administration Building.

4.11 Equipment Replacement

As mentioned previously, equipment failures increase with age. It is the District's policy to replace equipment that is no longer functional. All equipment is first repaired for reuse. If a problem persists, the equipment will be replaced.

References

Environmental Sampling and Analysis for Technicians, Csuros, Maria, Lewis Publishers, 1994

NPDES Storm Water Sampling Guidance Document, U.S. Environmental Protection Agency, Document number EPA 833-B-92-001, July 1992.

City of Phoenix Part II NPDES Permit Application, Woodward Clyde Consultants, 1992.

LABORATORY DATA REVIEW

Date of Review:		By:	
Sample Location:			
Sample Date:		Sample Time:	
FCD Sample ID Number(s)			
Laboratory Sample ID Number(s)			
Does this review include other samples at this or other locations?	Y	N	
If YES, list the sites and Sample IDs included			
Laboratory Used:			
Lab Contact:		Phone:	

Preservation				
Sample Type:	NPDES	Surface Water	Soil	Other: (Specify)
Samples Cooled to 4°C:		Y	N	
Samples at proper pH:		Y	N	
Chain of Custody Followed:		Y	N	

Laboratory Handling	Extraction / Digestion / Preparation			
	Method	Extraction Date	Limit	Within Limit?
EPA 608 / Pesticides			14 days	
EPA 625 / BNA			14 days	
Metals				
Bacterial Samples				

