

CASE STUDY

Airport Drainage Solutions

Optimizing the future of airports with a drainage master plan.

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Introduction

Airport master plans are required by the Federal Aviation Administration (FAA) and are prepared as detailed studies to document the short-, medium-, and long-term developmental needs to support future aviation demands and growth. An airport master plan focuses on a 20-year interval, identifying the issues and needs for the airport to address during that timeframe. Formally documenting and evaluating these needs provides the airport with a roadmap for future operational and financial success.

A comprehensive drainage master plan (DMP) complements the overall airport master plan. In the DMP, drainage deficiencies are identified, improvements are developed and critically evaluated, and programmed to meet the goals identified in the airport master plan and FAA regulations. Timelines and capital improvement budgets are then provided, and regulatory permitting challenges are discussed for the needed drainage infrastructure.

Planning for future growth of the airport must accommodate drainage needs; however, special attention should be given to ensure the drainage does not cause adverse impacts to adjacent and nearby riparian landowners. Surface water ponding on runways and taxiways can result in reduced safety to aircraft. Inadequate, poorly functioning, or poorly located drainage infrastructure such as culverts, swales and retention basins can also attract wildlife or pose safety problems themselves to aircraft that inadvertently leave the runways and taxiways.

At Dibble, our Flood Control Practice is not staffed by airport engineers that dabble in drainage; we are skilled, experienced drainage engineers that

understand airports. We offer drainage solutions specific to your airport for future planning needs as well as the development of detailed construction documents; all in compliance with FAA regulations and guidelines.

A good drainage master plan is specifically tailored to the airport and its surrounding community, proactively seeking stakeholder input to help establish the DMP's goals. As such, a robust stakeholder outreach program is important to thoroughly identifying deficiencies and mitigating them with well-considered, cost-effective solutions.

We work *with* and on behalf of airport staff to develop and implement a comprehensive Public Involvement Plan which includes a variety of methods such as presentations, handouts, and location-dependent, open-house-style workshops for one-on-one conversations with stakeholders.



Example of Drainage Issues (Sedona Airport)

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Public involvement activities engage stakeholders giving them an opportunity to learn about the project and provide input for potential impacts to their use and operations. Stakeholder involvement is a priority and encouraged throughout the entire process.

Plan of Action

Although each DMP is unique, we have found great success by following a three-step approach:

1. Data Collection and Analysis of Existing Conditions
2. Alternative Analysis of Proposed Conditions
3. Final Master Drainage Plan, Phase Implementation, and Cost Programming

Data Collection

The DMP begins with a kick-off meeting and document collection. This meeting is conducted to solicit specifics of problems from the people who know them best and obtain valuable documents, such as the airport master plan and any previous analyses and designs that were conducted. Information about existing drainage deficiencies and flood hazards are discussed and documented.

A topographic survey of the area and field data collection are often performed to produce a representation of the existing features of the airport and surrounding areas.

Knowing the Existing Conditions

A Hydrologic and Hydraulic (H&H) analysis is then performed to quantify the amount of stormwater generated during storm events and the response of the airport's existing drainage infrastructure. This analysis may be performed using traditional 1-dimensional hydrology software, such as HEC-1, to determine the quantity of stormwater runoff. One-dimensional hydraulic software, such as HEC-RAS and SWMM, are often used to determine correct culvert, storm drain, and/or channel sizes.

Recently, 2-dimensional (2-D) H&H modeling approach is becoming more common. Software programs such as HEC-RAS 2D and FLO-2D are powerful tools Dibble is experienced at employing. 2D modeling combines both hydrology and hydraulics in one model and provides significantly more detail to 1) better understand existing drainage patterns and quantities, and 2) to limit unneeded "over-designing" of drainage

infrastructure due to its better accuracy, which is more cost effective. 2D modeling can also offer additional valuable information, such as how best to employ low-impact development (LID) techniques for storm water harvesting.

Modeling is a critical step in the development of a well-informed DMP; however, Dibble is keenly aware that all models must agree with reality. We always "ground truth" the results by again soliciting comments from stakeholders to ensure the results are accurate.



Example of FLO-2D Results

Alternatives Analysis

Once the existing flood hazards are known, an alternative analysis is then conducted to correct the deficiencies. Alternatives are also developed to reflect the future conditions identified in the Airport Master Plan. This may include such topics as new airside and landside buildings, airfield and apron projects, and significant underground utility improvements. FAA/airport tenant requirements are considered, as well as aesthetics and/or historically sensitive areas of the airport. Flood hazards with similarities are grouped together into specific improvements areas to solve multiple problems with common causes, which provides a cost-effective solution.

Because we partner with our airport clients, we ensure that design concepts developed for alternatives are selected to be practical and constructible. Each improvement option is vetted during the master plan process, with an eye towards the final design. With the use of more accurate 2-D modeling, more efficient alternative evaluations can be presented.

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The development of alternatives provides the greatest return on client investment as all options are considered. The preliminary list of alternatives is presented to the airport stakeholders at a public or private meeting, intended to solicit input.

To ensure that every stakeholder’s voice is heard and to take the subjectivity out of the evaluation of alternatives, a numerically weighted matrix is created to evaluate each option. Dibble collaborates with the stakeholders to identify the evaluation categories to be included in the matrix. Specific scoring criteria are also jointly identified. Both categories and criteria are given a weighted priority, based on their perceived importance. An example matrix is shown below.

Scoring Completed by: Dibble Engineering

Category	Feature	Category Weight	Feature Weight
Effectiveness		35	100
	Increase in public safety		25
	Effectiveness		30
	Breadth of mitigation provided in hazard area		25
	Passive vs. active intervention systems		20
Cost		35	100
	Initial cost		65
	Likely Maintenance Costs		35
Public Acceptance		15	100
	Conformance with GCN, stakeholder and public feedback		50
	Maintains or improves aesthetic value		50
Constructability / Construction Phasing		15	100
	Independence from other projects		30
	Allows for phasing with immediate benefit of initial phases		25
	Ease of Construction		20
	Impact on Airport Operations		15
	Permitting Effort		10
Total		100	

Example of an Alternative Scoring Matrix

The scoring results of each alternative are discussed between Dibble and the stakeholders. The results are evaluated for feasibility to ensure all stakeholders agree with the final decision.

Implementation

Final Master Plan, Phase Implementation, and Cost Analysis

Once the preferred alternatives for the drainage improvements have been agreed upon, they are documented in the final DMP. Documentation includes the engineer’s opinion of probable construction cost for each alternative, and the phasing implementation and likely permitting requirements for each, all of which align with the airport master plan’s planning periods of short-, medium-, or long term.

Conclusion

Airport Drainage Master Plans are wise investments in an airport’s overall planning efforts. They identify existing deficiencies to be mitigated and outline the drainage improvements needed to implement the Airport Master Plan. Drainage improvement alternatives are designed to be FAA compliant and involving stakeholders in each step of the process ensures the selected alternatives have stakeholder approval and support. The improvements are established so costs align with the airport’s budget, and project phasing is achievable.

“Thanks for your work on this project, I couldn’t be happier with the results.”

-Chris Andres, City of Chandler, Chandler Municipal Airport Drainage Study

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DMP Project Success



Project Name: Arizona Department of Transportation (ADOT) – Grand Canyon National Park Airport, Drainage Master Plan

Location: Tusayan, Arizona

Issue: In 2017, ADOT obtained a grant from the FAA to develop a DMP and Water Use Study. The DMP was needed to evaluate drainage patterns, identify deficiencies, and develop solutions to prevent future flooding at the airport in accordance with current FAA standards. Additionally, the DMP was developed to evaluate the feasibility of capturing, storing, treating stormwater for use as potable to meet the airport’s growing demands. The results found that stormwater harvesting is a practical option for the airport.

Solution: In coordination with airport stakeholders, Dibble produced a DMP that identified drainage deficiencies and alternatives to mitigate each issue. Needed drainage improvements are as follows:

- Infield culvert relocations out of RSA/TSA’s
- Installation of a perforated storm drain along a taxiway to lower a perched water table
- Improvement of local drainage near the aircraft apron
- Relocation of a nearby wetland at the end of the runway to accommodate the needed runway extension and mitigate wildlife a significant attractant



Project Name: City of Phoenix – Phoenix Sky Harbor International Airport, Airport Drainage Master Plan Update

Location: Phoenix, Arizona

Issue: The Phoenix Sky Harbor Airport needed to update their DMP to be used as a planning and programming tool for coordination of construction of the storm drainage system in conjunction with extensive airport infrastructure upgrades planned for the next 10 to 20 years.

Solution: Dibble developed the Airfield Drainage Master Plan Update (DMPU) for PHX. Work consisted of verifying and updating existing storm drain facilities information within the airport operating area and areas of proposed expansion; investigating and identifying drainage issues through the development of a detailed storm water system computer model; developing recommended storm drainage infrastructure; creating schematics of the approved projects; and developing system cost and phasing.

Additional Airport DMP Projects:

- Phoenix-Mesa Gateway Airport Authority, East Side Airport Drainage Master Plan
- Sedona Airport Drainage Master Plan
- Ak-Chin Airport Economic Development Zone Drainage Study

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