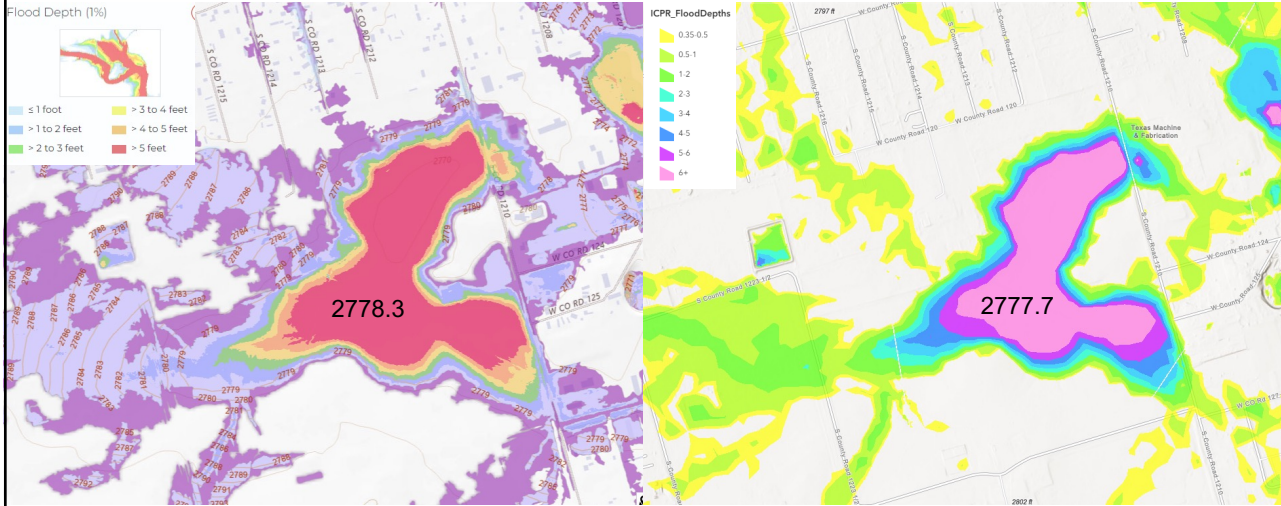
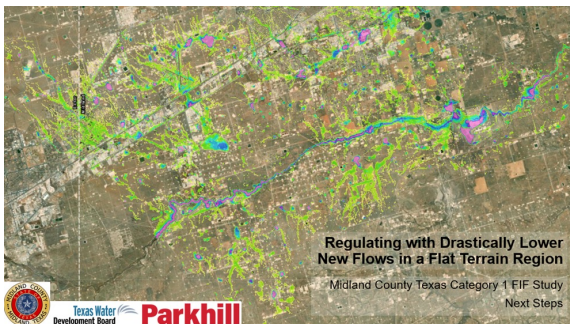


Playas and Conflicting 2d Studies Bringing Order Out of Chaos



Parkhill



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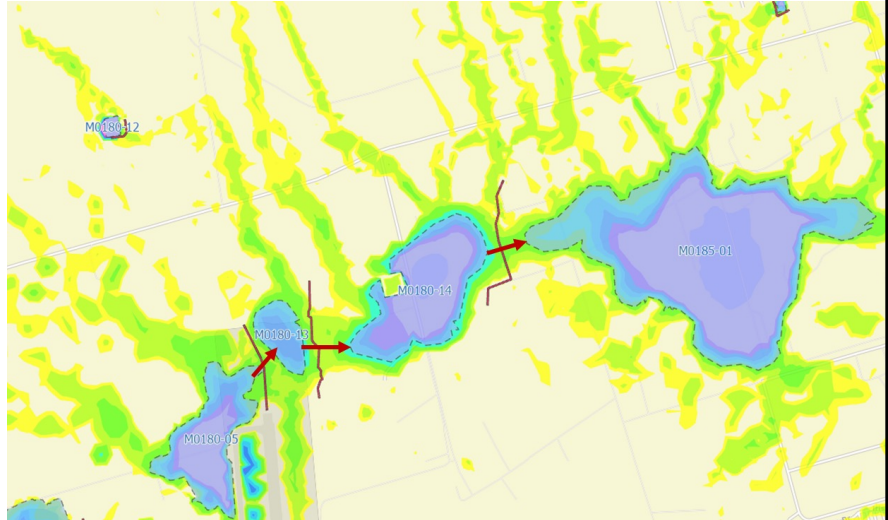


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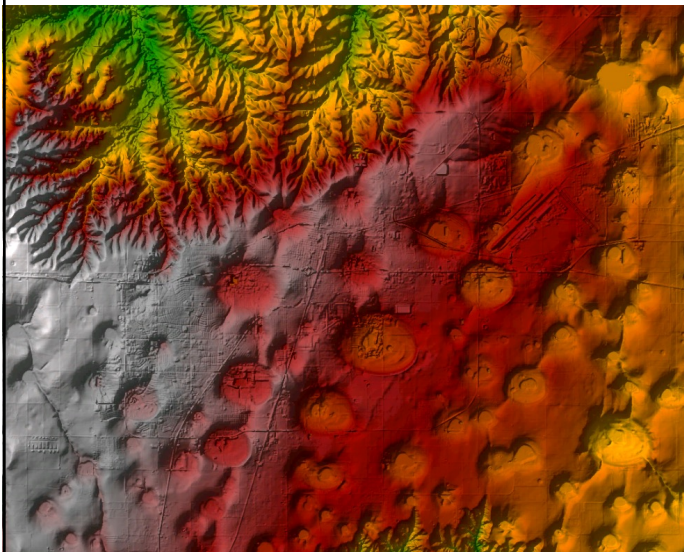


Topics of Presentation

1. Local terrain and hydrologic characteristics
2. Adoption of 2d Study
 - Additional Regulatory Flood Study
 - To BLE or Not to BLE?
3. Draft Drainage Manual
 - How Playas Function
 - Which Depressions Need Volume Protection
 - How to Protect Volume
 - Detention Requirements
 - Required Easements



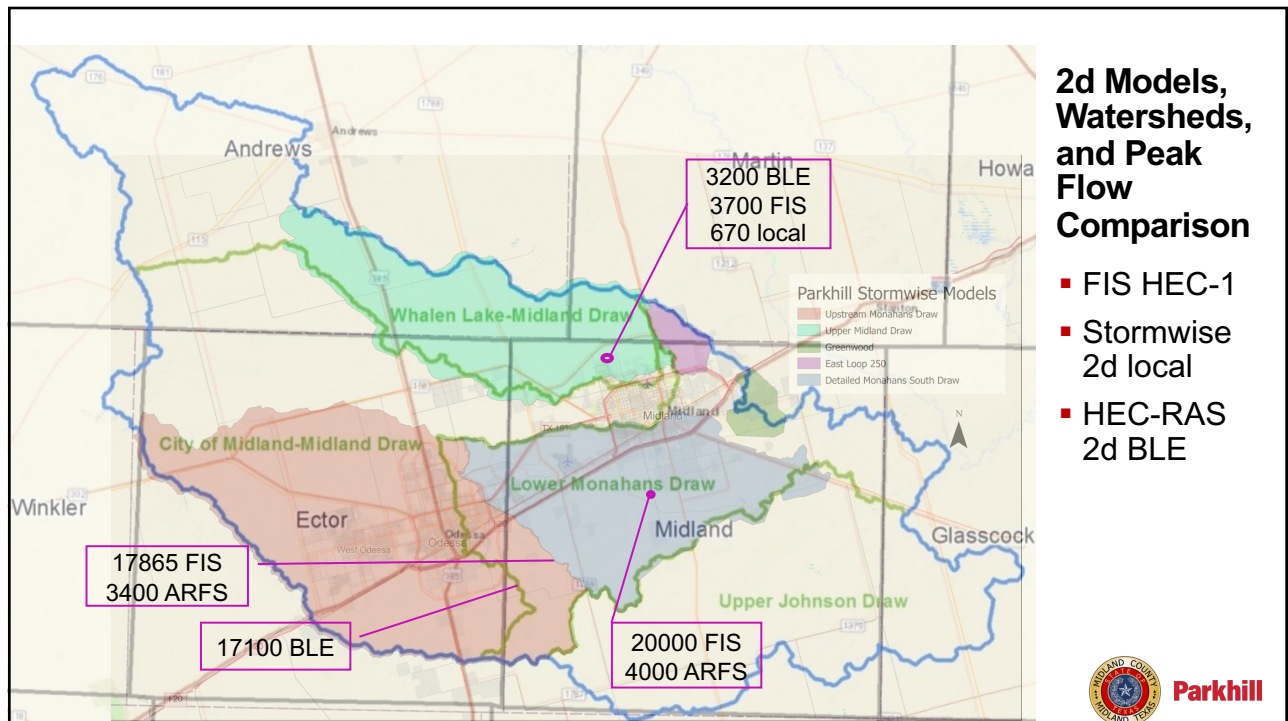
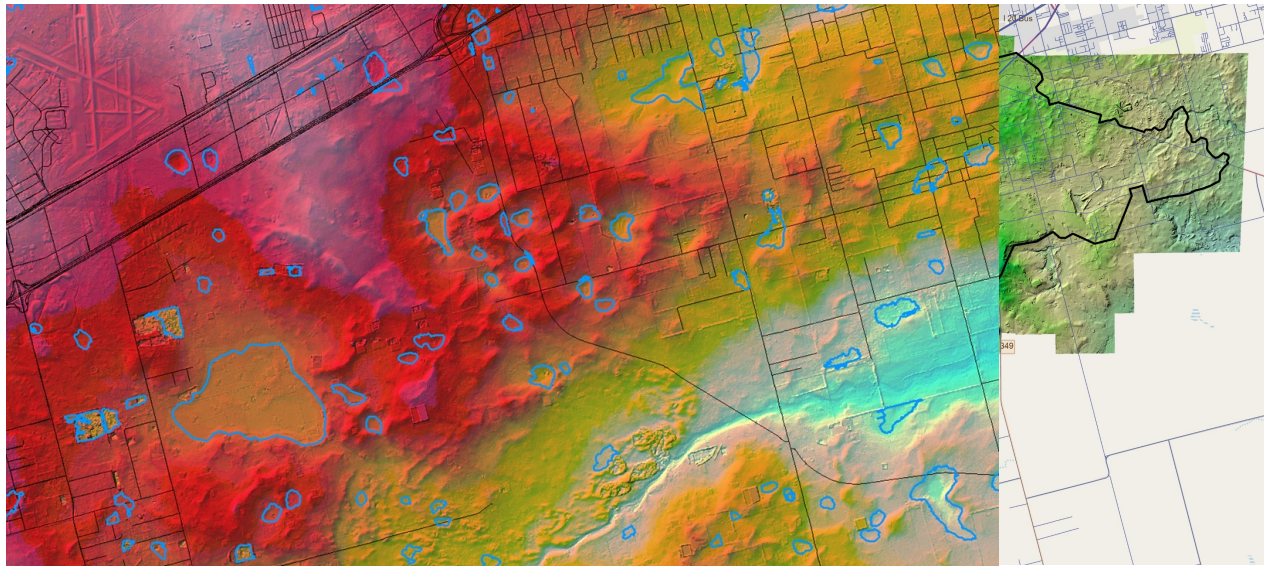
Best Defined Playas are in the Northern Portion of the Llano Estacado



Look like ice cream scoops out of a table
Some more than 2 miles across
Canyons on north and south



Midland and Ector Terrain Harder to Study and Regulate



2d Models, Watersheds, and Peak Flow Comparison

- FIS HEC-1
- Stormwise 2d local
- HEC-RAS 2d BLE

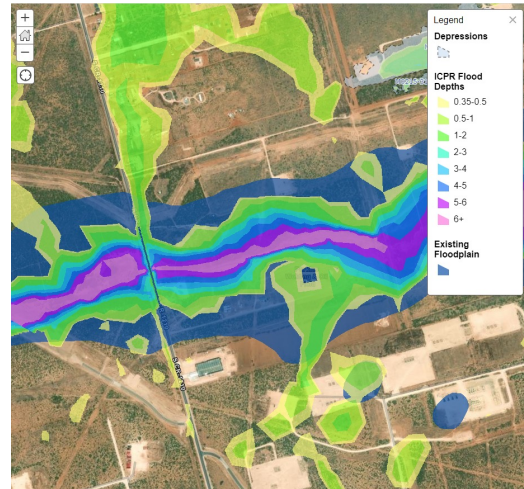
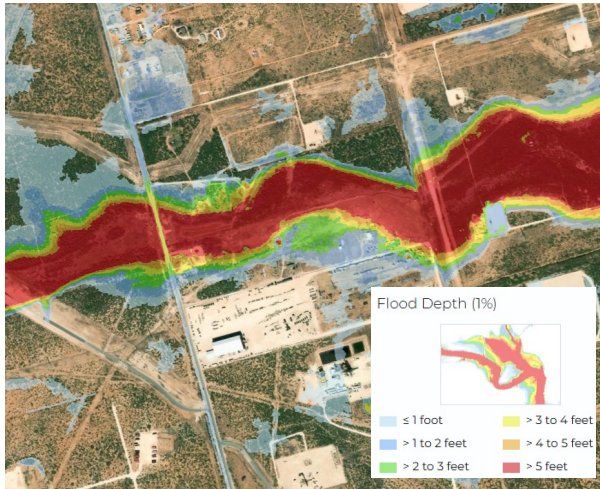


BLE vs StormWise Future Land Use Riverine Zone AE – Lower Flows, Smaller Flood Extents Monahans Draw



BLE HEC-RAS Flow Rate ~17,000 cfs

StormWise Study 4,000 cfs, with FIS



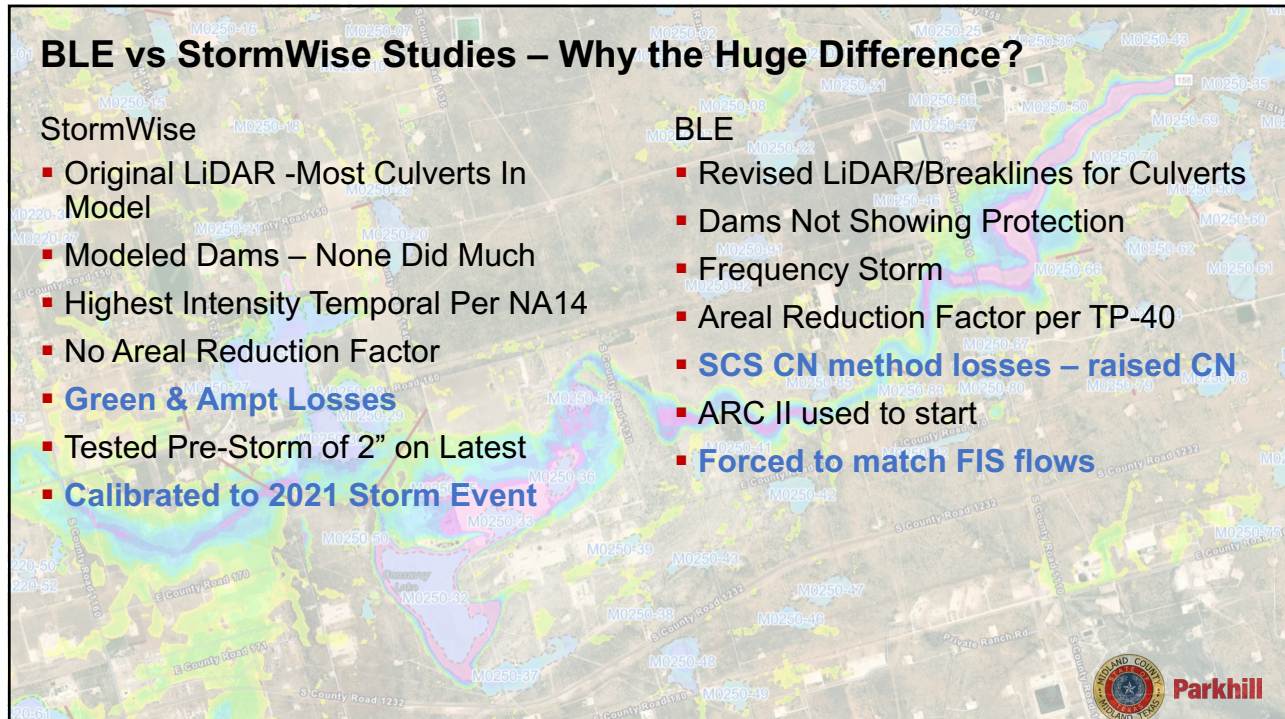
BLE vs StormWise Studies – Why the Huge Difference?

StormWise

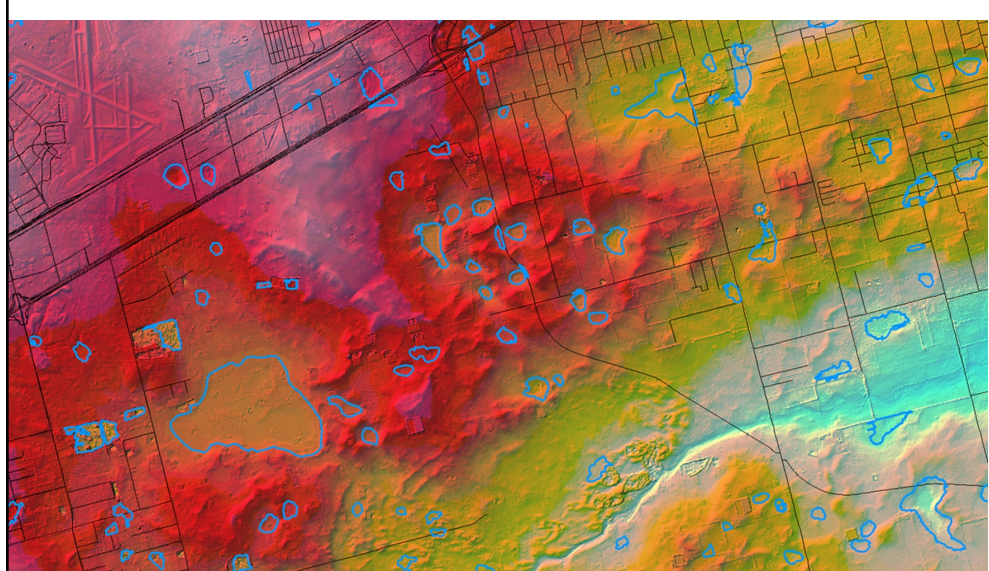
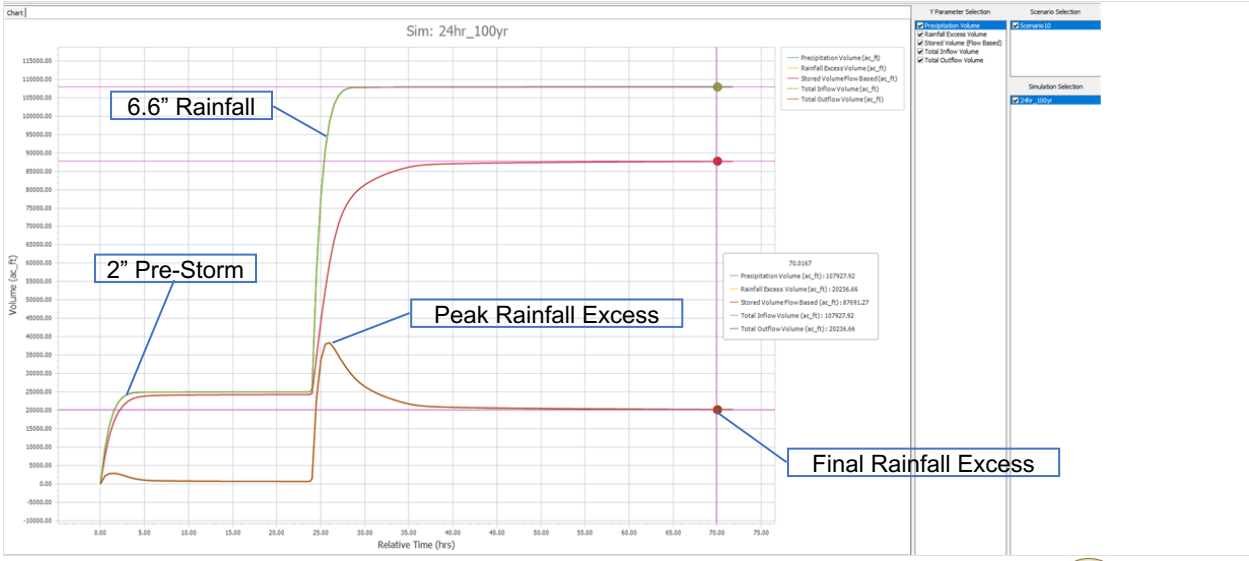
- Original LiDAR -Most Culverts In Model
- Modeled Dams – None Did Much
- Highest Intensity Temporal Per NA14
- No Areal Reduction Factor
- **Green & Ampt Losses**
- Tested Pre-Storm of 2" on Latest
- **Calibrated to 2021 Storm Event**

BLE

- Revised LiDAR/Breaklines for Culverts
- Dams Not Showing Protection
- Frequency Storm
- Areal Reduction Factor per TP-40
- **SCS CN method losses – raised CN**
- **ARC II used to start**
- **Forced to match FIS flows**



Impact of Infiltration Throughout the Simulation - StormWise



FIS based on USGS 7.5-min topo with 5' contours.

- Misses much storage < 5 feet deep.

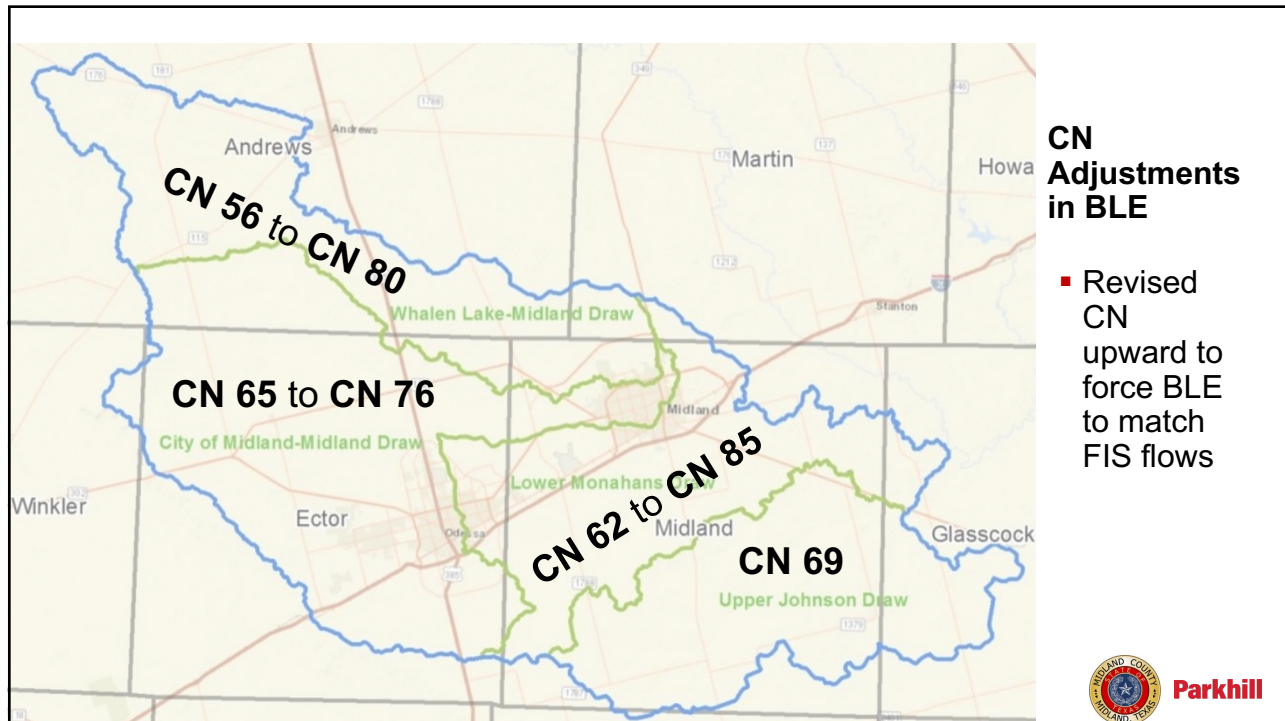
1d limitations

- Accurate model would have drainage area and reservoir route through every playa.
- FIS lumps estimated storage in one fake playa in each subarea.
- No gages to calibrate
- No adjustments for depressions not on topo

FIS hydrology overestimates flows.

FIS 1d Hydrology Could Not Account for All Depression Storage in Midland / Odessa Area





1.2 Additional Regulatory Flood Studies

1.2.1 ADOPTION OF ADDITIONAL REGULATORY FLOOD STUDIES

- Midland County may adopt **Additional Regulatory Flood Studies (ARFSs)** for floodplain management. These studies will be 2d hydraulic analyses but may include supplemental 1d analyses. Developers are required to consider and account for both FEMA FIS and ARFS. **ARFSs are considered best available BFE and floodway data** as described in 44 CFR 60.3(b)(4).
- A report titled "Midland County Monahans and South Draw Flood Planning" dated 2024 is hereby adopted for use in evaluation of runoff in Monahans and South Draw watersheds in Midland County. This report is supplemented by StormWise models of those watersheds, and available through GIS layers.
- Other ARFSs may be adopted by Midland County by action of the Commissioner's Court or by Director of Public Works. A list of adopted ARFSs and the date of the study will be maintained by the Midland County Public Works Director.
- Adopted ARFSs may be revised to account for new development or improved data. The revision may be adopted by the Public Works Director.
- FEMA's Base Level Engineering (BLE) is not adopted as Best Available Information. However, the BLE 1% annual chance flood elevations and inundation limits may be used for regulatory guidance as allowed by FEMA in any portion of Midland County where it exists, that is not covered by an adopted ARFS.**

1.2.2 USE OF ADDITIONAL REGULATORY FLOOD STUDIES

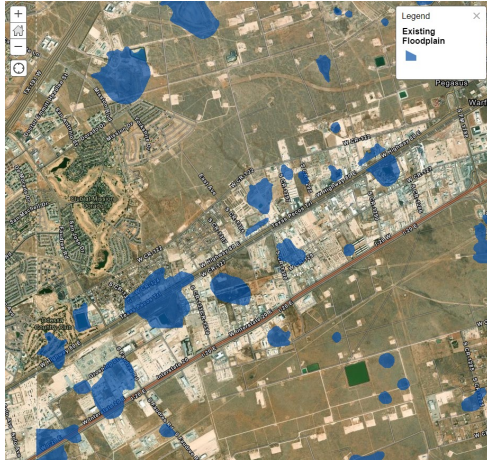
- Any proposed development and subdivision drainage study must consider both the Flood Insurance Study and any ARFS adopted for the watershed in which the site is located.
- If the ARFS contains recommendations for drainage improvements near or in the site, the drainage study must assess the feasibility of implementing them with the development.



ARFS Provides 1% Flood Elevations For Depressions and Flow Paths In and Out of Them

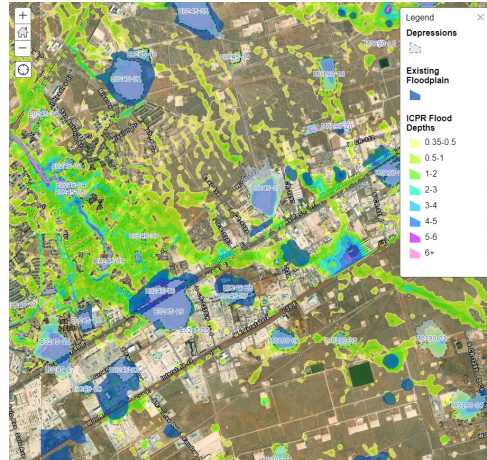
FIS 1990's Land Use

Missing Playa Inflow and Overflow Routes



New Study Fully Developed Land Use

Shows Much More Flood Prone Area

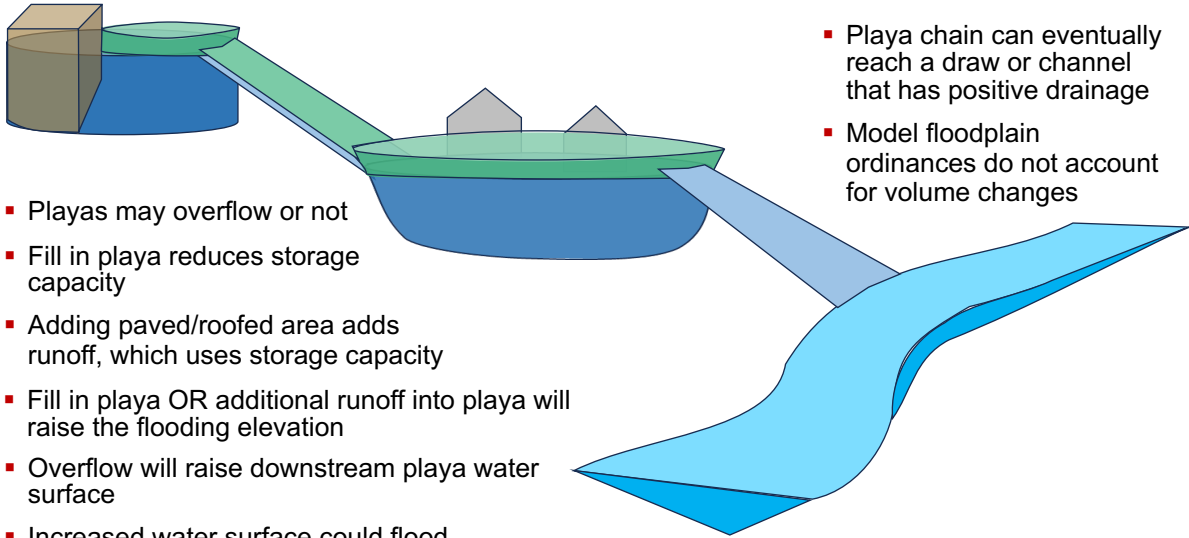


2.1.3 Required Elevations for Construction in FIS or ARFS 1% Extents

1. These elevations are requirements for newly constructed **buildings and to infrastructure that serves the public** such as electrical generation equipment.
2. Where the FEMA FIRM shows a **BFE that is higher than the ARFS 1% elevation, the FEMA BFE is the controlling elevation. Elsewhere the ARFS 1% elevation controls** for the required construction elevation.
3. Building finished floor elevations and equipment lowest elevations are required to be **1 foot above the controlling FIS or ARFS 1% elevation.**
4. If the ARFS is newer than the FIS and the **ARFS 1% elevation is lower than the FIS BFE, Midland County may choose to approve a construction elevation equal to the higher of a) ARFS elevation +1 foot or b) FIS BFE.**

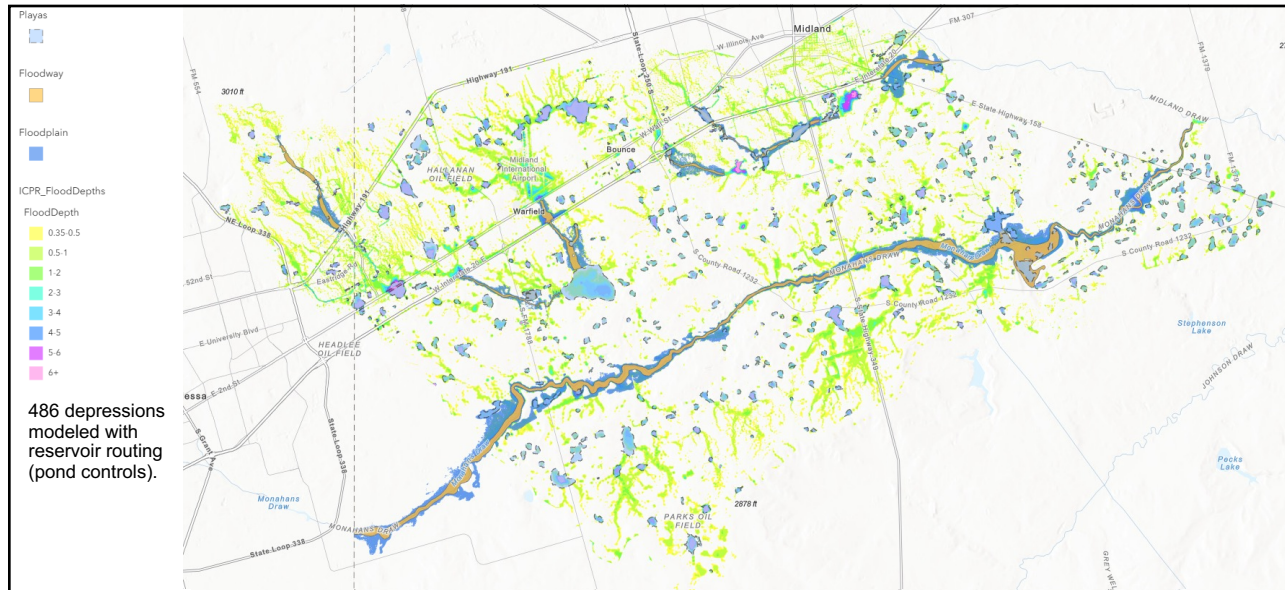


We Will Also Need to Protect Volume in Depressions



- Playas may overflow or not
- Fill in playa reduces storage capacity
- Adding paved/roofed area adds runoff, which uses storage capacity
- Fill in playa OR additional runoff into playa will raise the flooding elevation
- Overflow will raise downstream playa water surface
- Increased water surface could flood structures

- Playa chain can eventually reach a draw or channel that has positive drainage
- Model floodplain ordinances do not account for volume changes



Which Depressions Should be Protected with Volume Regulations?



Table 2.1 Depression Volume Protection Criteria

Description of Feature	Inundation on ARFS or BLE	Flood Depth	Ponded Volume	Topographic Appearance	Hydrology in 1% Event	Why Not Protected
Definitely not protected as depression						
Natural depression, playa or excavated area	Present, does not overflow	Any, (generally <2')	< 2 ac-ft	Closed contour	Captures flow from limited area	Not significant storage, but if used as retention, becomes protected
Depression in flow path or draw, not floodway	Flowing water location	1-2' deeper than adjacent flow path	< 5 ac-ft	Closed contour within defined open contour path	Flow up and downstream of depression fairly similar	Protect flow path with easement instead
Closed basin on FIRM only	Not Shown	< 0.5 feet (below plot cutoff)	Very small or none	Not a depression, or very shallow	Very minor	Not a depression, or < 0.5 feet deep
Bare lot with topsoil blown away	Any	Any	Any	Usually confined to one property	Accidental creation of retention	No pre-development storage
Frac ponds	Shown or not	Any	Any	Usually raised above grade	Not capturing flow from outside of pond	Not a drainage feature
Roadway / development blocks flow path	Any	Any	Any	Natural flow path up and downstream	Any	Not natural playa or manmade basin
Shallow flow path	May be broken but form a path	< 2' with areas below plot minimum	Any	Shows flow path rather than playa typical shape	Any	Not depression storage



Types of Depressions Whose Volume Will Not Be Protected



Frac ponds and depressions that capture <2 acre-feet of runoff



Ponding created by roadway, or other unintentional storage.



FIS floodplain (dark blue) denotes closed contours, but many do not capture runoff due to sandy soils or lack of contributing watershed.



Table 2.1 Depression Volume Protection Criteria

Description of Feature	Inundation on ARFS or BLE	Flood Depth	Ponded Volume	Topographic Appearance	Hydrology in 1% Event	Why protected
Definitely protected as depression						
Closed basin on FIRM and ARFS	Present	Any	Any	Depression	Captures flow	Protect depressions on FIRM if they capture runoff
Detention or retention basin	May not be shown	Any	Any	Manmade geometry	Captures flow	Serves the development it is in
Playa or Excavated Area	Present	>3 feet	AND > 10 ac-ft	Clearly on route of a flow path (blocked by a berm or not)	Does or could capture significant inflow; flow out is reduced or none	Providing storage that benefits downstream areas
Depression in flow path or draw	Flowing water location with depth > 1'	3' deeper than depth at overflow end	> 10 ac ft	Closed contours look like playa with overflow	Outflow much less than inflow	Functions as playa rather than flow path

Not all depressions are natural - "excavated areas", AKA caliche pits, are often mapped as Zone A and could be protected. Exact depth and volume to for included playas is not finalized.



GIS Selection of Depth > 3' and Volume > 10 ac-ft

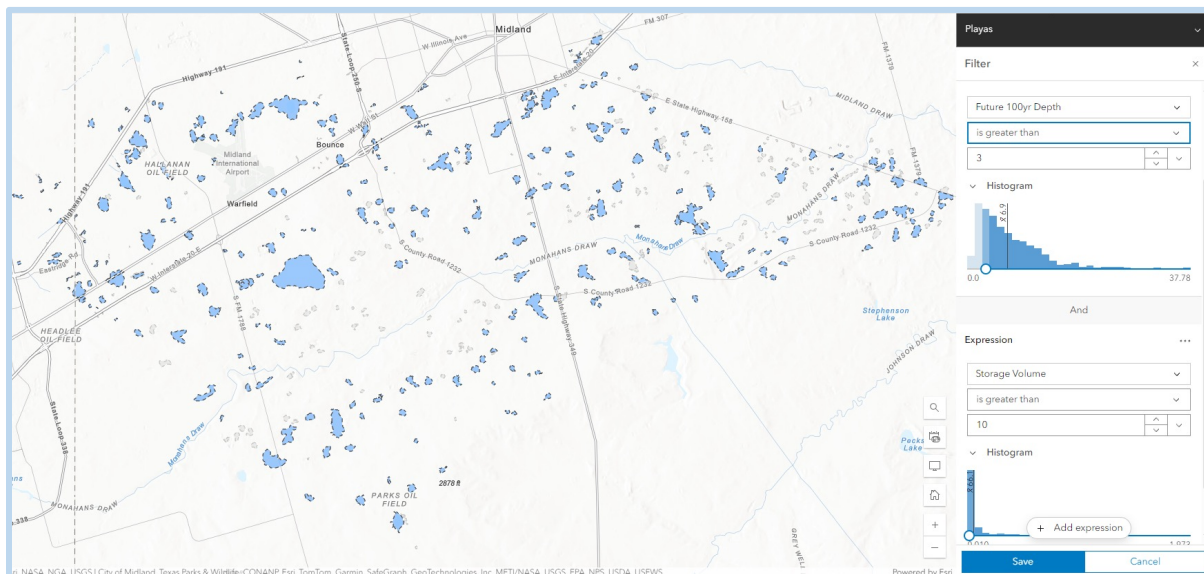


Table 2.2 Protected Depression Computation Requirements

Depression Overflows	Situation	Requirements	Drainage Study Must Prove:
Yes	Overflow to a draw or channel with positive drainage	No increase in <u>overflow peak flow rate</u> is allowed. No <u>decrease in depression storage</u> is allowed.	Overflow location is elevated and shaped to release less or equal than pre-developed peak. Storage volume below overflow is the same or larger.
Yes	Overflow to another depression	No increase in <u>overflow volume or peak flow rate</u> is allowed.	Excavation is provided to offset any fill in the depression and also any increased runoff volume to the depression. Overflow location is shaped to release less or equal than pre-developed peak.
No	Depression has buildings or public roadways below the computed water surface elevation	No <u>increase in water surface elevation</u> is allowed.	Excavation is provided to offset any fill and also any increased runoff volume.
No	Depression has no structures or roadways below the computed water surface, and a single landowner	Landowner can reshape and increase water surface elevation if desired. <u>No overflow is allowed. No roadways or structures can be below the new water surface.</u>	Storage equal to or greater than volume of runoff into depression is provided offsite or in the depression (below the overflow elevation and below all existing structures, roads or other critical features).
No	Depression has no structures or roadways below the computed water surface, and more than one landowner	All landowners can agree to a plan described for single landowner.	Same as previous, plus landowners must provide signed letter of agreement to drainage and grading plans to County.



Rule 1 for Playas– Cut and Fill Balance Below the Regulatory Elevation

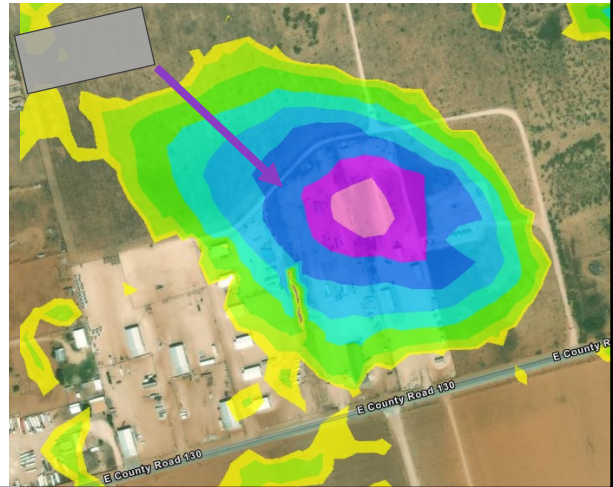
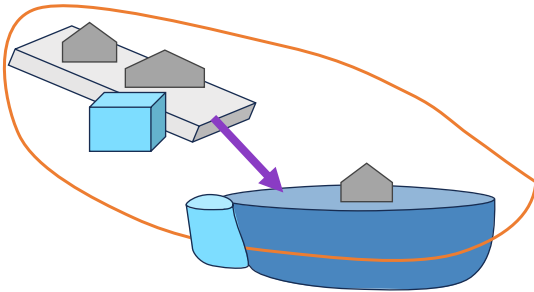
- 1st – Don’t fill in the depression!
- 2nd – It’s generally OK to reshape the bottom, though it will alter the potential for aquifer recharge.
- Can’t deepen below a groundwater level
- Extreme excavation has obvious drawbacks
- Playas generally have clay bottoms which won’t make good fill material



Most Conservative Approach to Depressions – No Rise



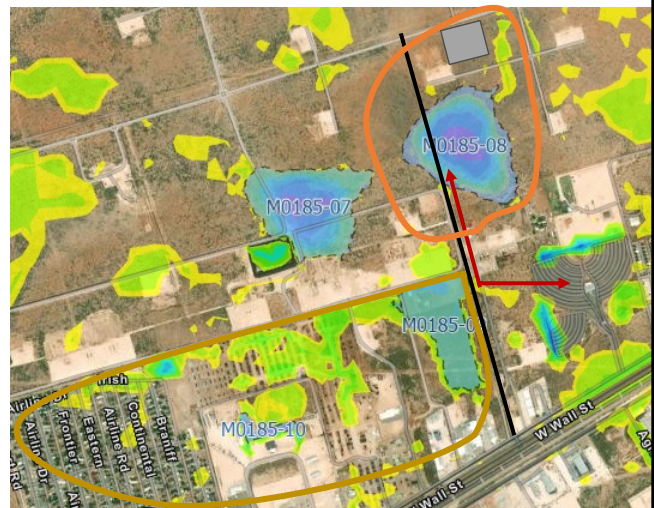
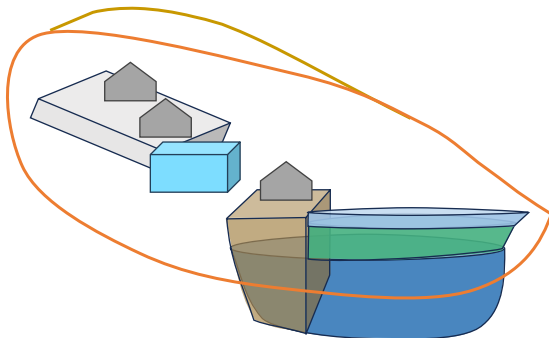
- A road or building is below the regulatory flood elevation
- Cut/fill balance in playa below regulatory elevation
- Provide excavation/retention = increased runoff below 1% elev
- Get easements on depression and retention
- Adequate flow capacity to playa
- Don't divert drainage area into watershed



Depression Has Extra Storage – Can it be Used?



- No buildings, public roads below current 1% WSEL
- Fill or additional drainage area allowed
- Provide enough retention to prevent overflow
- Easements on depression and retention
- Playa M0185-08 does not overflow, nothing floods
- Avalon Drive to be extended
- Divert flow into playa M0185-08

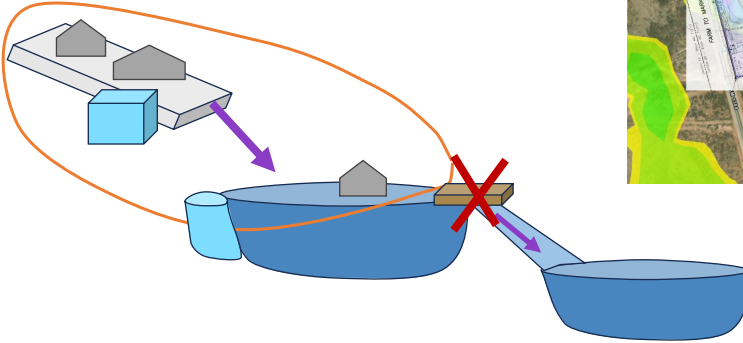


Overflow to Another Depression

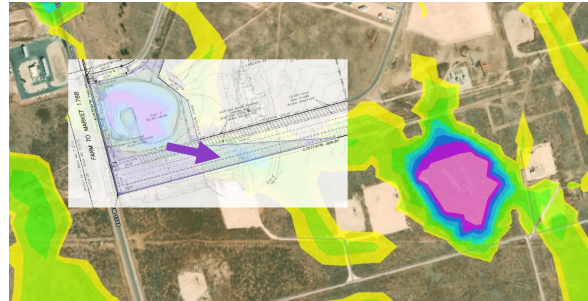
With or without road or building below the 1% flood elevation

Do not increase flow or volume out of depression

Do not block or reduce overflow capacity



Example of Easements to Protect Basin and Overflow Route

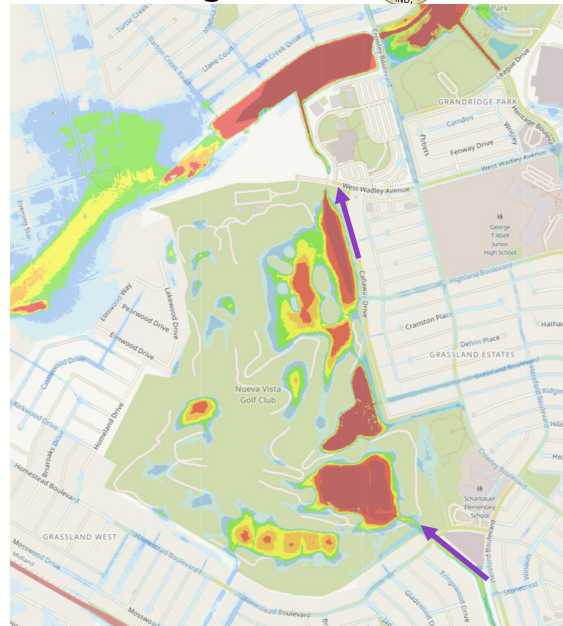
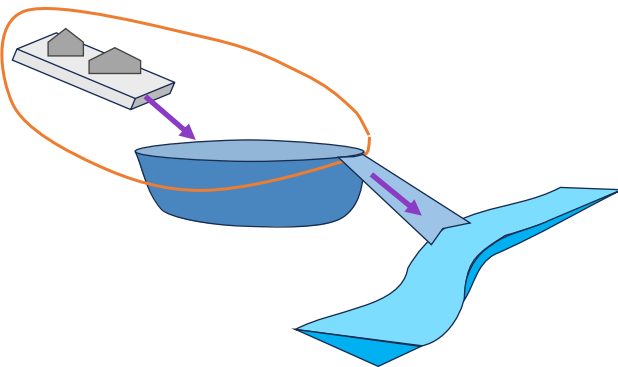


Overflow to Draw or Channel with Positive Drainage

Do not increase flow out of depression

Do not reduce depression storage volume

No need to retain increased runoff volume

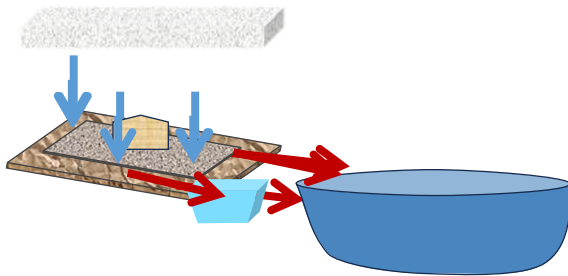


Retention vs Detention For Developments

Full Retention of All Runoff is NOT Required for Depressions

Retention of INCREASED Runoff is Required

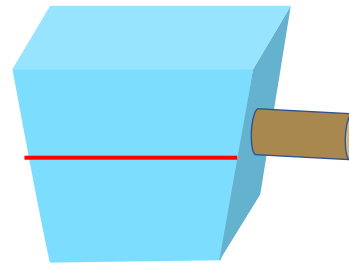
- Assume 40% infiltrates
- 60% runs off
- After development, 85% runs off
- Retain the 25% extra runoff



Detention has an Outlet Pipe or Channel

Retention is the Storage Below the Overflow

Often no Outfall Depth So We Get Pure Retention



Hydrographs –Retention Protects Volume; Detention Protects Peak Flow

- Retention (left) May Fill Before Peak is Reached, Not Protecting Downstream Flow Path from Increases Peak Flow
- Detention (right) Releases all the Runoff Volume, Not Protecting Downstream Depression from Increased Volume

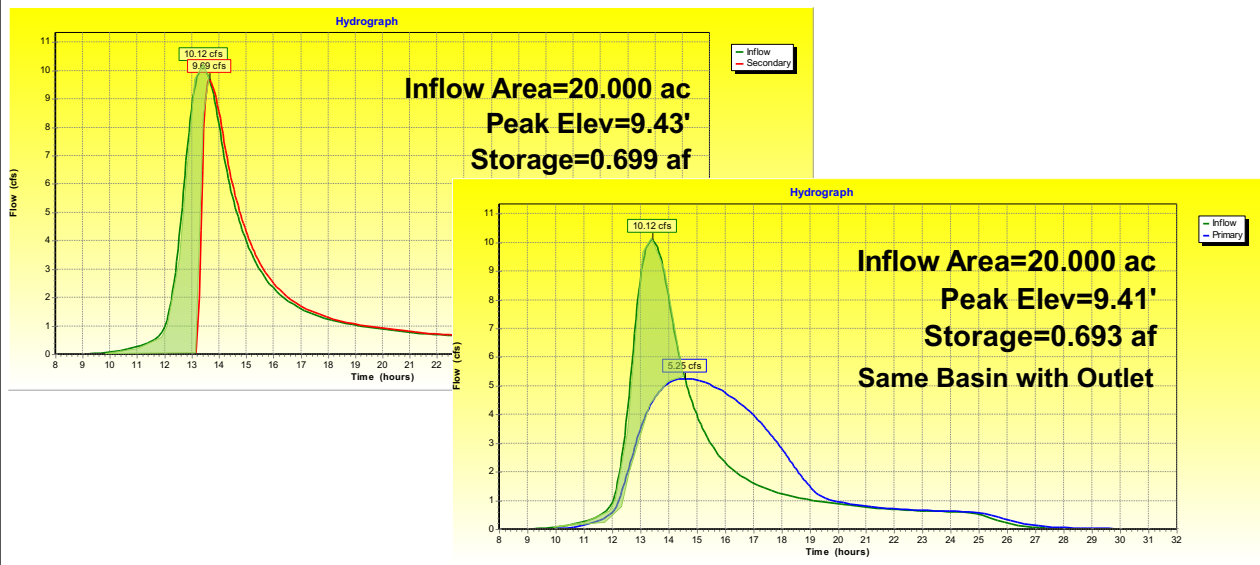
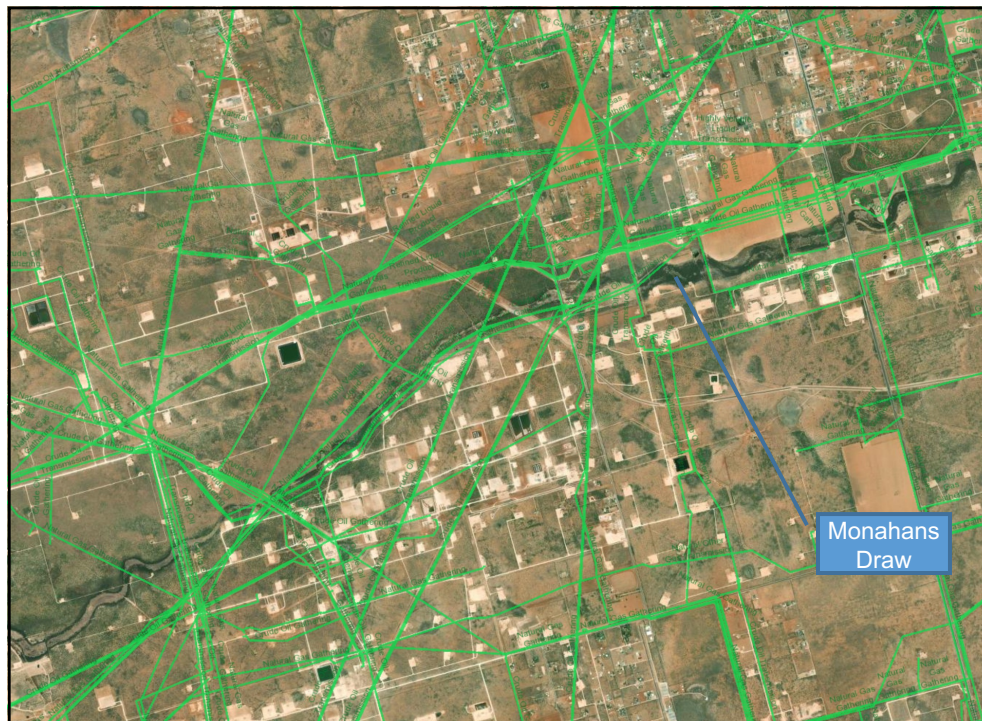


Table 2.3 Detention for Sites with Positive Drainage (non-depression)

No	Size of Development	Detention required	Drainage Study Must Prove:
Directly to Monahans or Johnson Draw or to Midland or Jal Draw downstream of Midland	Any	No	Runoff enters the draw without flooding anything on the way.
Directly to Monahans or Johnson Draw or to Midland or Jal Draw upstream of Midland	Any	Yes	Detention sized to reduce project outflow to existing peak flow.
Lower South Draw, channel, street or tributary	Greater than 5 acres, or part of a larger plan of development greater than 5 acres.	Yes	Detention sized to reduce project outflow to existing peak flow.
Lower South Draw, channel, street or tributary	Less than 5 acres	No	None required.
Upper South Draw	Any	*Retention	*See Section 1.3.3. Upper South Draw fills playas which are protected depressions.

- Replaces downstream assessment
- No detention required next to 4 main draws, if downstream of cities



Why We are Using Easements Instead of Excavating Channels

Pipelines!
Installing channels or storm drains entails crossing a web of pipelines



2.5 Required Drainage Easements

2.5.1 FLOODWAY EASEMENTS

1. If the subdivision is crossed by a regulatory FEMA floodway or if an adopted ARFS contains a floodway, the **floodway limits shall be dedicated as drainage easement** and shown on the plat.
2. Where there is both an ARFS floodway and a FIS floodway, **the newer study will be used** for the easement location and width.

2.5.2 DEPRESSION EASEMENTS

1. **Protected depressions** as defined in these regulations **shall be protected with a drainage easement** on any plat that coincides with their limits.
2. The limits of the easement shall be at least **as large as the inundation at the computed future developed water surface elevation**. This elevation can be from the ARFS, the FIS (whichever is newer) or from a developer-supplied study.
3. If the development includes **reshaping** of the depression, the easement can be based on the proposed inundation limits.

2.5.3 FLOW PATH EASEMENTS

1. The ARFS will show flow depths along various channels, streets, depression overflow routes and flow paths that have positive drainage, most of which have no established floodway. Flow depths less than a cut-off value will not be plotted, leading to gaps in the plotted results. Flow paths may best be identified using LIDAR surface data.
2. **Depressions known to overflow must be provided with flow path easements** from the overflow location to the next depression or draw downstream.
3. If a **public road has a sag** where it crosses a flow path, the **property owner on both sides shall provide an easement** located at the low point of the roadway. Easements shall be at least fifty (50) feet by fifty (50) feet.
4. In addition to overflow routes, those **channels, flow paths and tributaries with flood depths in excess of two (2) feet** need to be protected with easements. If the plotted flow path has gaps, the easement must protect the entire route.



Parkhill

Conclusions

Unique topography in Midland County makes drainage study and regulation challenging
BLE is not accurate for adoption here by Midland County
Depressions require volume protection
Flow paths need easements

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