

WATERSHED RESOURCES LESSON

Watershed & Water Resources Management: Decisions, Leadership, & Policies



TOPIC: Watershed and Water Resources Management Decisions, Leadership, and Policies

AUTHOR: BWD

CLASS TIME NEEDED:

This instructional unit may be scheduled as an activity for 2-3 class periods, a 2-3 week investigation, or as a semester research project. Procedural details for the 2-3 class periods lesson scenario are provided below. To expand the lesson to a 2-3 week lesson, instruct students to research additional options for or alternative approaches to aspects of the proposed development (e.g. investigate local LID projects, online research, etc. See Materials & Source Options p. 2-3). The lesson becomes more active with the semester project scenario in which local planning commission members, city planning and/or stormwater staff, environmental special interest groups, and/or landowners are invited to the classroom to speak about their roles in public hearings. Students also attend a public hearing or a planning commission meeting. A semester-long lesson scenario could include student involvement in their community's development project approval process and investigation of a real, local development. The students would conduct their own stakeholder research, and then present their views or recommendations at an actual planning commission meeting or public hearing. Prior to participating in the actual meeting or hearing, students could rehearse their presentations by staging a mock meeting/hearing in the classroom. The students will feel ownership of their recommendations for the proposed project and feel they are contributing to their community. They may even provide input that leads to the incorporation of low-impact features to a development in their own neighborhood!

SUBJECT/GRADE LEVEL: Physical Science/Biology/Earth Science/Environmental Science 9th-12th

ARKANSAS SCIENCE STANDARDS:

Physical Science - PSI-LS2-7, PSI-LS4-5, PSI-ESS2-1, PSI-ESS3-1, PSI6-ETS1-1, PSI6-ETS1-2, PSI6-ETS1-3, PSI6-ETS1-4

Biology – BI-LS2-1, BI-LS2-2, BI-LS2-6, BI-LS2-7, BI-LS4-6, BI3-ETS1-3, BI3-ETS1-4, BI-ESS2-2, BI-ESS2-4, BI-ESS2-5, BI-ESS3-5, BI6-ETS1-2, BI6-ETS1-3, BI-ESS3-1, BI-ESS3-2, BI-ESS3-3, BI-ESS3-4, BI-ESS3-6, BI7-ETS1-1, BI7-ETS1-4

Earth Science - ES-ESS2-2, ES-ESS2-5, ES2-ETS1-1, ES2-ETS1-3, ES-ESS3-1, ES-ESS3-2, ES-ESS3-4, ES3-ETS1-1, ES3-ETS1-2, ES3-ETS1-4

Environmental Science - EVS-ESS2-2, EVS-ESS2-3, EVS-ESS2-5, EVS-ESS2-6, EVS-ESS3-5, EVS1-ETS1-1, EVS-LS2-1, EVS-LS2-2, EVS-LS2-6, EVS-LS2-8, EVS3-ETS1-3, EVS-ESS3-1, EVS-ESS3-2, EVS-ESS3-3, EVS-ESS3-4, EVS-ESS3-6, EVS-LS2-7, EVS-LS4-6, EVS4-ETS1-3

LEARNING PERFORMANCE TARGET(S): (learning expectations for this lesson; combines a science practice, crosscutting concept and core idea embedded in the lesson)

STUDENTS WILL BE ABLE TO:

Research policies and practices pertaining to development and water quality.

Describe the public hearing process.

Analyze different roles and opinions of area stakeholders.

Recommend options pertaining to specific aspects of the proposed development based on needs of various stakeholders.

SCIENCE AND ENGINEERING PRACTICES:

Lab work, field work, acquire data, graphing, planning and carrying out investigations, analyzing and interpreting data, asking questions and defining problems.

CROSSCUTTING CONCEPTS:

Structure and Function, Stability and Change

CCSS CONNECTIONS: (include mathematical concepts and reading, writing, speaking and listening opportunities in the lesson)

All exist throughout the lesson.

ELA/Literacy

Mathematics

MATERIALS & SOURCE OPTIONS:

1. Copy of the script for each student (pp. 7-8)
2. Costumes (if desired)
3. Proposed project print-out for each student (pp. 5-6)
4. **Arkansas Department of Environmental Quality (ADEQ) Laws & Regulations** - <https://www.adeq.state.ar.us/regs/>
5. **Arkansas Forests and Drinking Water** Reports and Findings - <https://arforestsandwater.com/>
6. **Beaver Watershed Alliance (BWA) Watershed Protection Strategy** - <https://www.beaverwatershedalliance.org/>
7. **City of Fayetteville AR Streamside Protection** - <https://www.fayetteville-ar.gov/1214/Streamside-Protection>
8. **Fayetteville Natural Heritage Association (FNHA)** - <http://www.fayettevillenatural.org>
 - Research Resources - <http://www.fayettevillenatural.org/about/one-stop-download-center/>
 - Green Infrastructure Planning: Linking Arkansas Communities - <http://www.fayettevillenatural.org/wp-content/uploads/2015/03/2008-2009-Green-Infrastructure-Planning-Linking-Arkansas-Communities-Report1.pdf>
 - Green Infrastructure In Our Communities - <https://www.youtube.com/watch?v=pv4LgkH3Wx0&feature=youtu.be>
9. **Illinois River Watershed Partnership (IRWP) Watershed Management Plan** - <http://www.irwp.org/water-quality-monitoring/watershed-based-plan/>
10. **Northwest Arkansas Open Space Plan** - <https://www.nwaopenspace.com/>
11. **Public Meetings:** City Councils and Planning Commissions
 - Bentonville - <https://www.bentonvillear.com/>
 - Fayetteville - <https://www.fayetteville-ar.gov/>
 - Rogers - <https://www.rogersar.gov/>
 - Springdale - <http://www.springdalear.gov/>
12. **United States Environmental Protection Agency (USEPA) Summary of the Clean Water Act (1972)** - <https://www.epa.gov/laws-regulations/summary-clean-water-act>

13. **University of Arkansas Community Design Center (UACDC) Low Impact Development (LID): A Design Manual for Urban Areas (UACDC LID Manual) (See Lesson-Decisions, Leadership, & Policies: Watershed & Water Resources Management SUPPLEMENT - bwdh2o.org)**
 - Beaver Water District/Resources/Brochures & Booklets Webpage Link: www.bwdh2o.org/wp-content/uploads/2012/03/Low_Impact_Development_Manual-2010.pdf
 - Purchase from the University of Arkansas Community Design Center at: uacdc.uark.edu.
14. **University of Arkansas Cooperative Extension Service (UACES) Water In Arkansas - <https://www.uaex.edu/environment-nature/water/>**
 - Arkansas Water Quality Policy - Water Quality Policy - <https://www.uaex.edu/environment-nature/water/quality/policies.aspx>
 - NWA Stormwater Program - <https://www.uaex.edu/environment-nature/water/stormwater/nwastormwater/>
15. **(Optional)** Classroom discussion with Stakeholder Representatives (e.g. Local Developer, Planning Commissioner, City Planning Department or Stormwater Management Staff, Environmental Special Interest Group member, etc. . .) come to your class to speak about development and alternative options for development

TEACHER PREPARATION:

Basic Lesson:

- Give the students some background on public hearings (See **New Development Project Approval Process** pg. 5).
- Point out a few of the issues that might be involved with this project (Review the **Issue/Fact Sheet** pg. 5).
- Provide the students with the visual display of the proposed project site (**Site Maps** pg. 6)
- Access the UACDC LID Design Manual PDF LESSON SUPPLEMENT (See Materials & Sources 13, top of this page) or purchase from UACDC (uacdc.uark.edu, explain how the manual is set up, and point out the glossary (pages 214-221) at the end of the manual.
- Have the students create a visual display of how the project could be constructed differently.
- Assign **Stakeholder Roles*** from the script to individual students or groups of students, with one student per group appointed to represent and speak for their group during the Mock Hearing.

*STAKEHOLDER ROLES FOR MOCK HEARING & PRESENTATIONS

Downstream Land Owner	Planning Commission Chair	Environmental Special Interest Group
Business Owners	Planning Commission City	Representatives
Neighborhood Residents	Stormwater Staff Developer	Members City Planning Department Staff

- After reading the script (pp. 7-8), have the groups display/present new concept(s), or recommended changes to the proposed development plan (other than those noted in the hearing) and use this fresh input to aid in discussion.

BACKGROUND INFORMATION/CONTENT:

Students will analyze a proposed development near a creek, investigate alternatives, and present their proposal option(s) to the group.

OPTIONS for alternative development plans – Online search topics (See Materials & Sources p. 2-3):

- Low Impact Development (LID)
- Water Quality Policies and Practices
- Streamside-, Source Water-, & Watershed Protection Strategies
- City Council or Planning Commission Public Hearing to witness the entire process in action
- Local LID development site visits (list provided pp. 8-9) to view/compare/contrast hard engineering vs. soft engineering features

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NEW DEVELOPMENT PROJECT APPROVAL PROCESS

A proposal for a new development project must go through multiple agencies for review before being approved. Representatives from state and federal agencies will visit the project site and make their determinations about various factors involved with the site. The project proposal is then posted for public notice. The public is allowed to request a hearing to comment on or provide input for the project. At the public hearing, all agencies, businesses, organizations, and citizens are given the opportunity to speak. All information gathered at the hearing contributes to the decision-making process pertaining to recommendations for project modification(s) or final approval. This lesson will guide students through a city public hearing in which project approval is decided and project designers are instructed to obtain proper, required permits from state and federal agencies.

ISSUE/FACT SHEET:

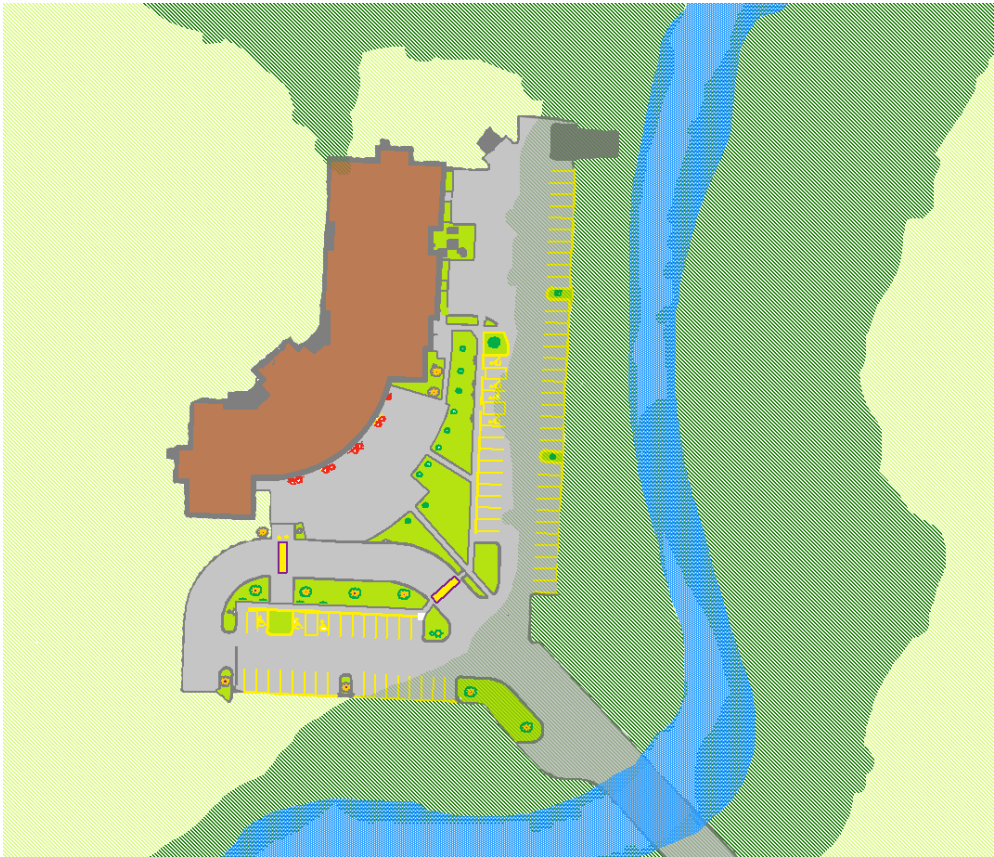
This development will . . .

- Provide an economic boost to the area by providing jobs and sales tax income
- Enable residents to drive less and bike/walk more due to the proximity of the new development
- Increase:
 - City Infrastructure Installation and Maintenance Expense (Sewer, Sidewalks, Streets, Utilities)
 - City Services Expense (Ambulance, Fire, Police, etc . . .)
 - Tax Rates (Potentially) to Pay for Added Expense for City Services, Infrastructure Maintenance, Stormwater Management
 - Traffic
 - Air Pollution from Building and Combustion Engine Emissions (CO₂, Petroleum Compounds, Particulates, etc . . .)
 - Impervious Cover (Compacted Soils, Pavement, Roof Surface Area, etc . . .)
 - Urban Heat Island Effect
 - Water Pollution - Point Source and Non-Point Source
 - Habitat and Riparian Buffer Removal/Loss for the Area
 - Stream and Ground Temperature Due to Removal of Canopy
 - Stormwater Runoff & Flash Flooding
 - Erosion
- Decrease:
 - Air, Land, and Water Quality
 - Species Diversity – Animal, Bird, Insect, Plant, Reptile
 - Groundwater Recharge
 - River/Stream/Spring Base Level (Minimum Flow)

SITE: Before Development



SITE: Proposed Development



MOCK PUBLIC HEARING SCRIPT

(Planning Commission Chair)

A development is being proposed that will include commercial businesses, roads, and parking lots. We're meeting to discuss and hear opinions on the development. We'll be hearing from downstream landowners, neighborhood residents, business owners, the developer, the planning commission chair, planning commission members, city planning department staff, environmental special interest group representatives, and city stormwater staff.

(Developer)

We're proposing a large development of roads, parking lots, and several businesses. Please look at the visual display of our proposed development. You will see that our plans include the clearing of land next to a stream and the addition of red dirt fill to the project area to elevate the construction surface above the floodplain. We're very excited at the prospect that this project will be beneficial for everyone in many ways. Residents will be able to stay closer to home when doing their business, which will save them time and energy. This is a good thing for the environment because area residents will not have to drive as much. You'll see more citizens walking or riding bicycles, which is good for the environment and their health. This project will also help the city by creating new jobs and increasing the sales tax revenue. We're open to suggestions on fine-tuning our proposed development plan. Thank you for your input.

(Environmental Special Interest Group Representative)

We have concerns regarding floodplain alteration and the amount of impervious cover being built. The impervious cover will increase the amount of stormwater runoff into the stream. Stormwater runoff also picks up and transports surface pollutants. Filling the floodplain will constrict larger flow volumes to the stream channel instead of allowing the flow to slow down, spread out, and soak in to the floodplain. Pollutant concentrations and amplified erosion potential associated with greater hydrologic load will have a dramatic negative impact on the stream and its water quality. Also, the removal of the riparian zone (trees, bushes, and grasses) will lead to:

- Further exacerbation of problems and costs associated with erosion
- Decreased pre-stream sediment and pollutant filtering (pollutants from the runoff will directly enter the stream)
- Increased stream water temperature or thermal pollution without adequate tree canopy to shade the stream.
- The trees provide shade, which also regulates ground temperature. Removal of the existing tree canopy will lead to increased ground temperature.

(City Stormwater Staff) OPTION 1 COMMENTS

We believe that this development will cause major damage to the stream not only at this location but will also affect properties downstream for miles. The increase in the impervious cover will produce a greater amount of stormwater runoff and we will see more flooding. If the developer wants to pursue this option, s/he must provide evidence, from computer models of the changes to downstream water levels, that downstream properties will not be adversely impacted by this development. We believe that other options* (p. 2-3) for aspects of this development should be explored.

(City Stormwater Staff) OPTION 2 COMMENTS

Staff has reviewed the proposed development and conducted hydrologic analysis of the impact on the surrounding community. Our analysis indicates that this development will cause increased flooding and erosion for several miles downstream. Several acres of forest are being replaced by impervious cover, such as parking lots and rooftops. It is apparent from our analysis that the proposed stormwater facilities do not protect downstream property owners from damage. We recommend the proposal be tabled until alternatives that provide the needed protection are investigated.

(Planning Commission Staff) OPTION 1 COMMENTS

This development as proposed meets the technical requirements of our planning regulations. However, staff does not believe that it meets the intent of protecting natural streams within the City. There has to be some way in which all involved can benefit from this opportunity. Please feel free to offer your opinion on what options* (p. 2-3) are available.

(Planning Commission Staff) OPTION 2 COMMENTS

Staff has reviewed the proposed development and finds it to meet the technical requirements of the zoning ordinance and development regulations. However, according to the Mayor's proclamation dated April 22, 1970, it is the priority

of this city to fully protect its natural environment. Subsequent mayors have respected this proclamation. In our analysis, we find that this development falls short of our city's priority in several areas including:

- Removal of several acres (or dozens) of mature trees without proper mitigation
- Degradation of several hundred linear feet of riparian buffer without proper mitigation
- Likely degradation of water quality and aquatic diversity due to removal of riparian trees and channelizing of the stream

Staff's recommendation is that modifications be made to the proposed development to address these needs of the city.

(Downstream Landowner)

I'm worried about this development causing land and water problems in the long run. The increase in the amount of water will cause a loss of some of my pastureland due to erosion from flooding. How can I be sure that I won't lose pastureland from erosion?

(Neighborhood Residents)

We're concerned also because we have a walking path beside this stream and our children play in the stream. This is a great recreational area for everyone in these neighborhoods. We're afraid the erosion will damage our walking path and the new stormwater runoff will pollute our stream and our children might be harmed when playing there. There has to be some way to compromise on this development.

(Business Owners)

We're in favor of this development because there will be new opportunities for business and we feel that our business would be successful out here where there is very little competition. This area is going to develop eventually, so why not go ahead and get started?

(Planning Commission Member)

We understand the concerns that have been expressed. We feel like this is a good opportunity to develop this area. There are many neighborhoods in this area and to have new businesses come here would help the people in this part of town. The residents in this area would travel less to shop or do their business. This will save in energy used in transportation and reduce air pollution. This development will also increase the sales tax revenue for the city and those extra funds could go to fund new projects in the city. Some projects might include road improvements, parks and recreation department, and other beneficial programs. However, as staff has pointed out, there are serious issues with this development. We must look at options* (p. 2-3) that will work with the environment *and* allow this development.

(Developer) OPTION 1 COMMENTS

We're certainly willing to listen to any options* (p. 2-3) that are financially possible for our development. We'd like to develop the best project that would benefit all stakeholders involved in this area. Thank you in advance for your input.

(Developer) OPTION 2 COMMENTS

We are willing to listen to options* (p. 2-3) that are financially possible for our development. We consider ourselves to be good neighbors. However, regarding the issues raised we have the following responses:

- Regarding destruction of the walking path and recreation area; the proposed development is on private property. Informal walking paths and recreation can potentially cause personal injury. In addition, we believe these informal and unsupervised areas will become havens for criminals and become detrimental to our development. We are not willing to take on the liability of inviting the public, especially unsupervised children onto our property for horseplay.
- Regarding protection of the natural streams within the city; as you have stated, we have met the technical requirements of the planning regulations. Our engineer has taken extensive and expensive measures to assure us that those regulations were met. It is our opinion that those requirements are sufficient to protect both the natural and the built environment.

(Mayor and Commissioners)

You have heard the respective comments for the stakeholders in the room. Do I have a motion from the commission?

After a motion is made and seconded, then the commission discusses among itself the merits of the development. Then the mayor calls for a vote.

LOCAL LOW IMPACT DEVELOPMENT SITES IN NWA

Low-Impact Development (LID) is an innovative, effective and ecologically-based approach to the management of storm water runoff associated with land development. LID infrastructure uses techniques to mimic the pre-construction natural hydrology of the area. These design features allow for the capture, storage, infiltration, evaporation and percolation of would-be runoff that would otherwise contribute to the overload and deterioration of local water bodies in the watershed.

To fully appreciate the stark differences in functionality of LID vs. non-LID sites, one must visit these sites and analyze the outflows associated with LID vs. non-LID sites.

In Northwest Arkansas, LID sites can be found ranging from small residential projects to large commercial ones. Upon visiting one of these LID sites, one will appreciate the interconnectivity of the techniques employed to keep our natural water bodies from being inundated with excess storm water runoff.

BENTON COUNTY:

- Habitat Trails in Rogers is a green affordable neighborhood consisting of 17 Habitat for Humanity homes situated just off Old Wire Road within walking distance to Wire Elementary school
<http://uacdc.uark.edu/project.php?project=18>
http://places.designobserver.com/media/pdf/Habitat_Trails_445.pdf
http://uacdc.uark.edu/books/excerpts/5Habitat_Trails_Book.pdf
- LEED Gold-Certified Beaver Water District Administration Center at 301 N. Primrose Road, Lowell, AR has an abundance of green and LID features such as pervious pavement in the parking areas and retention areas to allow runoff to percolate into the ground
http://www.bwdh2o.org/files/45/Beaver_Water_District_Admin_Center_Brochure.pdf
- The IRWP Rain Garden Horsebarn Rd and 52nd Street Bridge, Rogers, AR
<http://www.irwp.org/assets/conservation/rain-garden/MainSign.pdf>
- The Bentonville Rain Garden at Crystal Bridges trailhead at "A" Street
<http://www.facebook.com/media/set/?set=a.10150202993264121.312335.128813264120>

WASHINGTON COUNTY:

- LEED Gold-Certified Arvest Bank - 1164 East Joyce Boulevard, Fayetteville AR 72703 has features such as pervious pavement, bioswales to catch surface water and underground cisterns to capture rainwater coming off of the roof.
<http://www.ozarksunbound.com/arvest-bank-on-joyce-in-fayetteville-named-a-leed-goldbuilding-announcement/14978>
<http://www.fayettevilleflyer.com/2011/03/30/arvest-bank-officially-receives-gold-leedcertification/>
- Eco Modern Flats - 130 South Hill Avenue, Fayetteville, AR 72701 is a completely green renovation of an existing apartment complex that employs rainwater collection and cistern systems to irrigate the landscaping and community garden. Non-native plant species have been removed and replaced with native and drought-tolerant species
<http://www.fayettevilleflyer.com/2011/03/30/arvest-bank-officially-receives-gold-leedcertification/>
- The Gatehouse green roofs are atop two roofs in "The Gardens," the tailgating area on the south side of the University of Arkansas campus, to reduce the amount of storm water that washes off of the roof
<http://architecture.uark.edu/525.php>
<http://architecture.uark.edu/500.php>

OTHER NOTABLES :

- Fayetteville Public Library - 401 W. Mountain St., *Fayetteville, AR 72701*
<http://www.faylib.org/information/pdf/GreenBldgFlyer2008.pdf>
http://www.faylib.org/new_library/leed_info.asp
- Sam's Club - 3081 N. Highway 112, *Fayetteville, AR 72704*
<http://www.walmartrealty.com/EconomicDevelopment/FeaturedProjects.aspx>
<http://www3.samsclub.com/NewsRoom/Press/488>
http://www.braewater.com/about/news/sams_club_is_rainwater_harvesting
- The Botanical Gardens of the Ozarks - 4703 N. Crossover Road, Fayetteville, Arkansas 72764
<http://www.bgozarks.org/>
- Block Street between Dickson and the Fayetteville Square
http://www.sustainablecitiesinstitute.org/view/page.basic/blog/feature.blog/fayetteville_ar
http://www.accessfayetteville.org/government/strategic_planning/projects/Downtown_Master_Plan.cfm
- Hill Place Apartments at 6th and Hill in Fayetteville
754 South Royal Oak Parkway, Fayetteville, AR 72701-6302
<http://www.hillplaceapts.com/impact.aspx>