LAKE BALLINGER Watershed Study

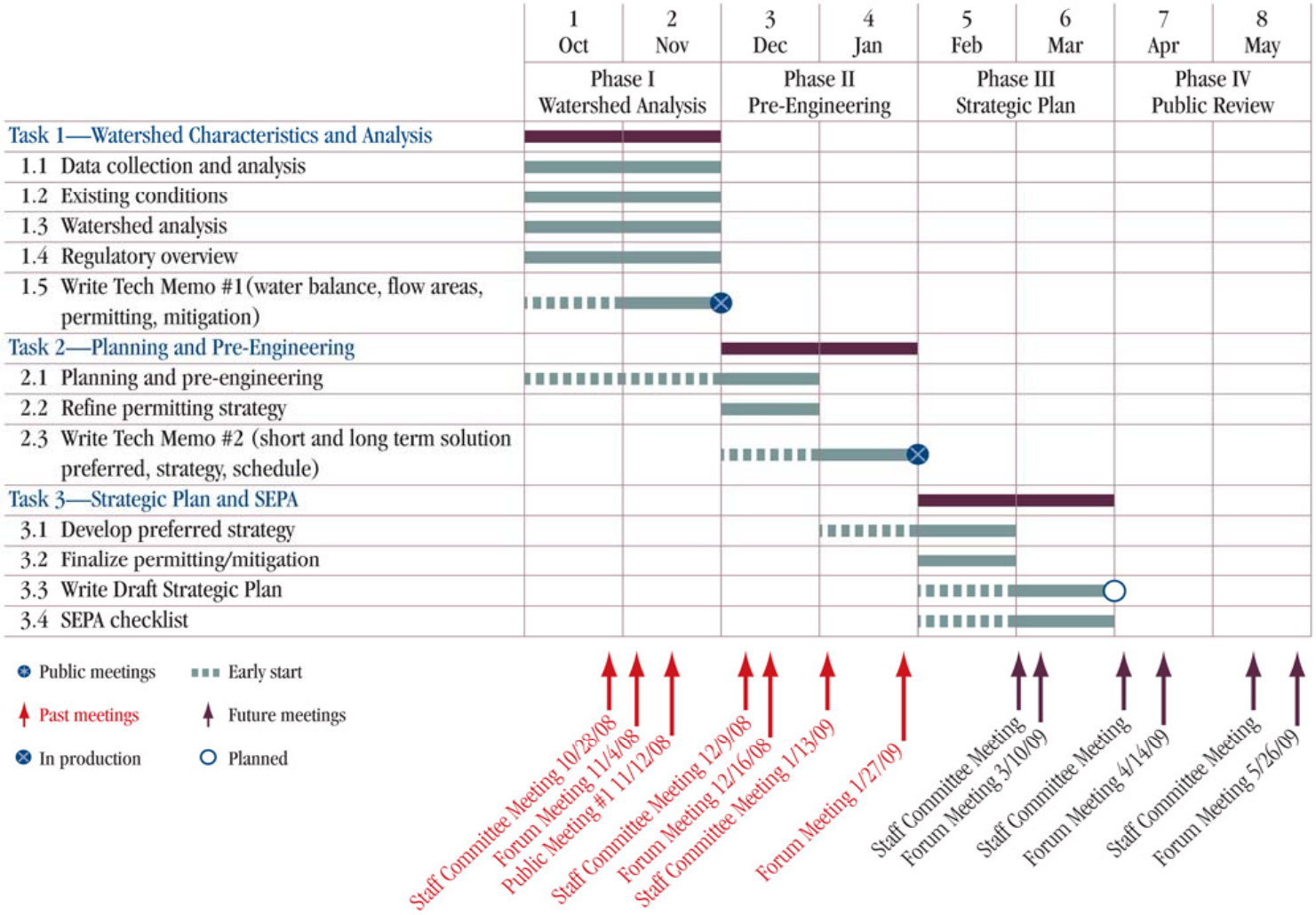
Lake Ballinger and McAleer Creek Watershed

Strategic Action Plan

Forum Briefing #2

January 27, 2009

Project Schedule & Scope Review



Agenda

- Watershed Issues
- Approach and Methodology
- Results of Watershed Characterization
- Results of Planning/Pre-Engineering Analysis
- Next Steps

Watershed Issues

	Goals/Objectives
Lake	
• Flooding	Reduce high flows and flood damage
• Water quality/habitat	Improve water quality; reduce phosphorous; achieve "fishable/ swimmable water"
Downstream	
• Flooding	Reduce high flows and flood damage
• Water quality/habitat	Reduce high flows, scour and pollutants; improve habitat

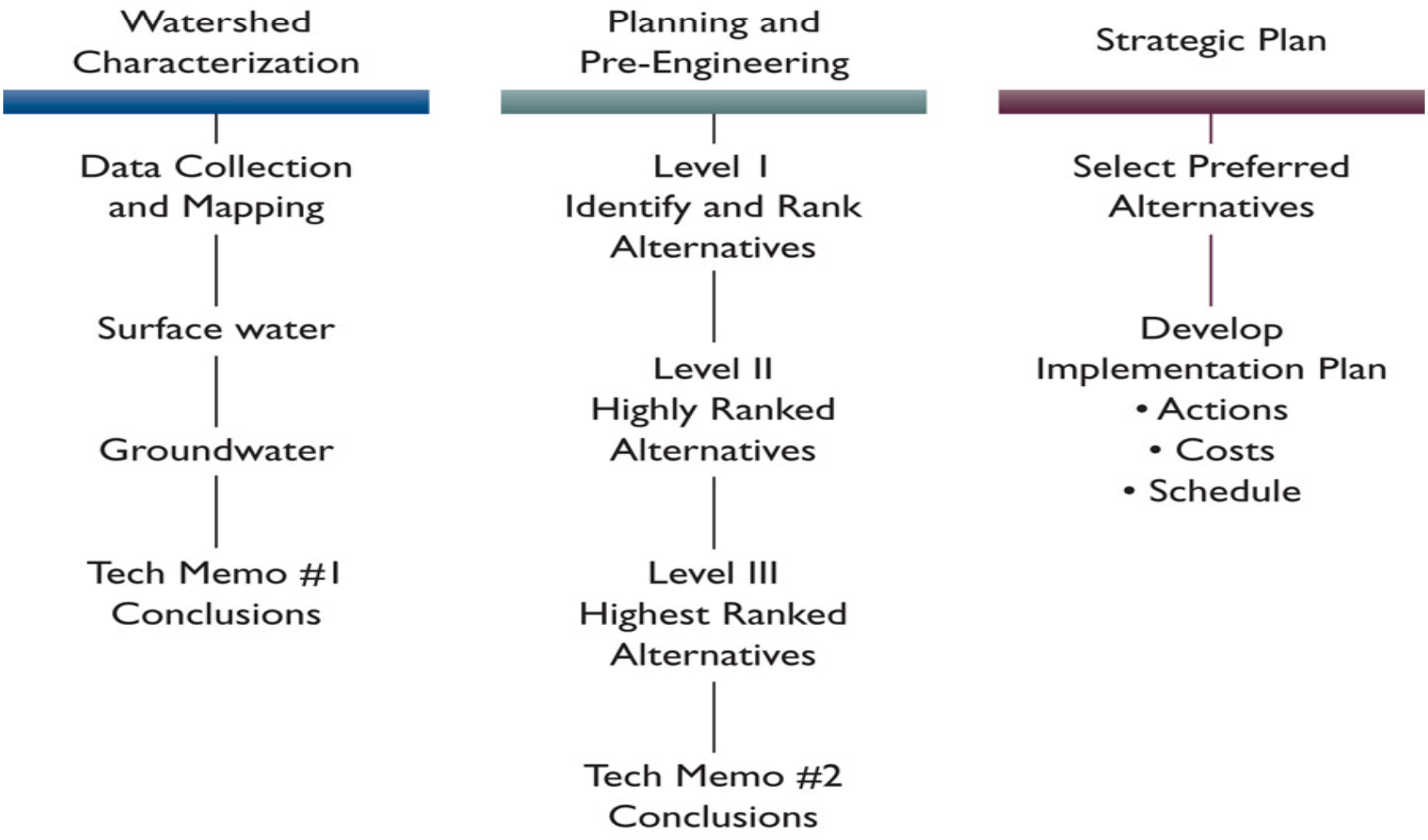
"unmitigated impacts"

Probable Causes

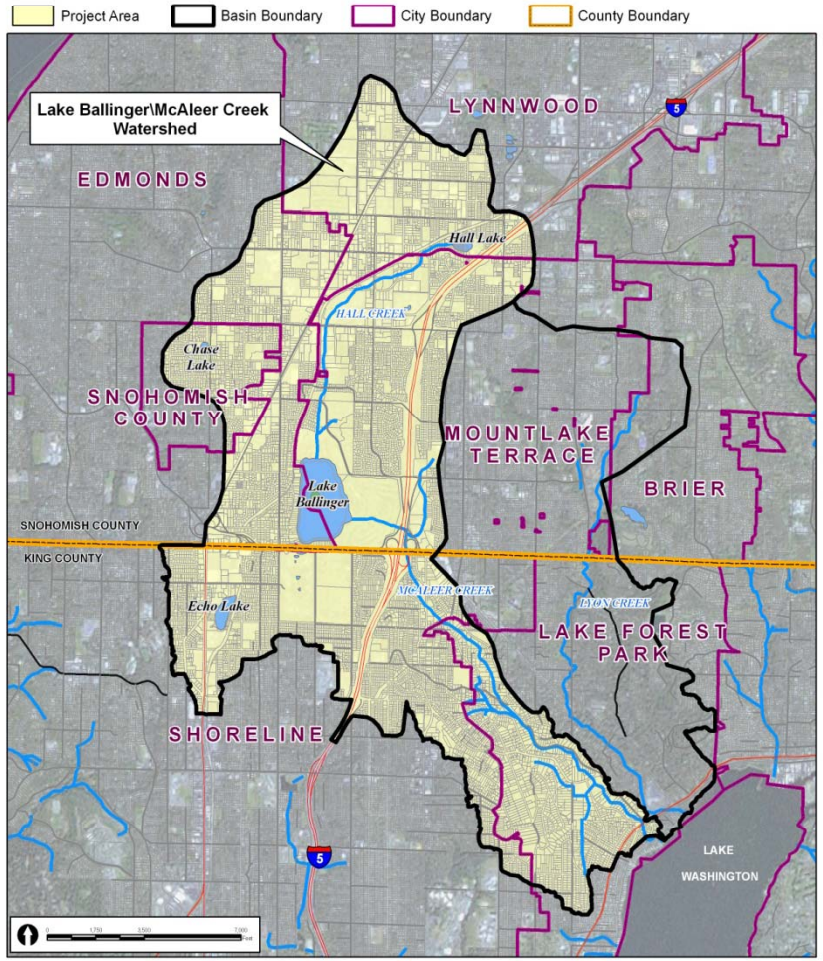
- Cutting trees
- Removing natural soils and vegetation
- Eliminating floodplains and wetlands
- Destruction/removal of natural habitat
- Uncontrolled runoff from development
- Outdated/ineffective regulations
- Lack of runoff treatment
- Increased impervious surfaces from dense zoning and land use
- Undersized SWM facilities
- Lack of maintenance
- Lack of source controls/BMPs

"urbanization"

Approach and Methodology



Watershed Characterization



- **Watershed**
  - Area: 5,250 acres (8.20 sq. mi.)
  - Length: Approximately 6 miles
  - Height: 440 feet
  - Slope: 1.4 % above lake
    1.8 % below lake
  - Impervious: 38%
- **Lake Ballinger**
  - Lake Surface Area: 104 acres (0.16 sq. mi.)
  - Depth: 20-35 feet
  - Basin Area: 3,568 acres (5.57 sq. mi.)
  - Percentage of Watershed: 68%
  - Impervious: 40%
  - Elevation: 276.5-277.6 feet
  - Distance to Lake Washington: 3 miles

Key Findings: Surface Water/Groundwater Studies

- **Lake Ballinger Watershed has been altered:**
  - **Impervious area increased; reducing infiltration and increasing runoff.**
  - **Forests removed; reducing evapotranspiration and increasing runoff.**
  - **Net Result:**
    - **43% increase of water entering the lake**

      (~2,134 acre-feet/year or 1 foot over 3.3 square miles)

- **Downstream culvert conveyances are undersized:**
  - **Lyon Creek culverts can pass the 2-year event (100 cfs).**
  - **McAleer Creek culverts can pass the 50-year event (296 cfs).**
  - **Peak flows from Lyon Creek contribute to downstream flooding in McAleer Creek.**

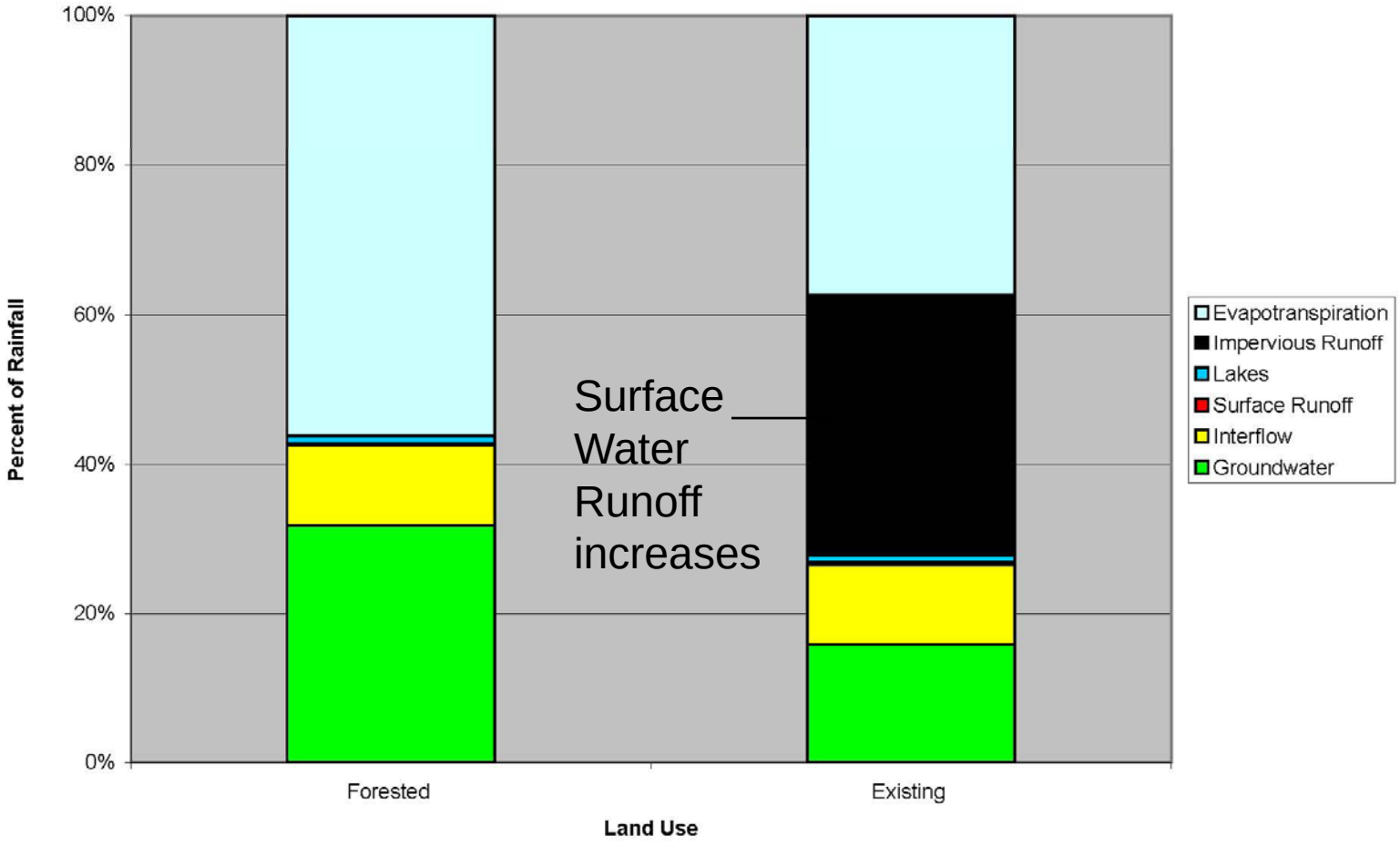
Key Finding:
Surface Water/Groundwater Studies Continued

- **Groundwater directly discharges into Lake Ballinger and lower McAleer Creek**
  - **Porous soils exist north and west of the Lake Ballinger for infiltration**
  - **Lake Ballinger: lake level is quick to rise and slow to lower**

- **Water quality in lake and stream has been degraded.**
  - **Lake Ballinger currently meets TMDL for phosphorus levels**
  - **Summer algae blooms occur, impacting desired lake uses**

Conclusion: *Watershed has been so substantially altered and cannot be restored to its pre-developed state without eliminating impervious surfaces and restoring native vegetation and soils.*

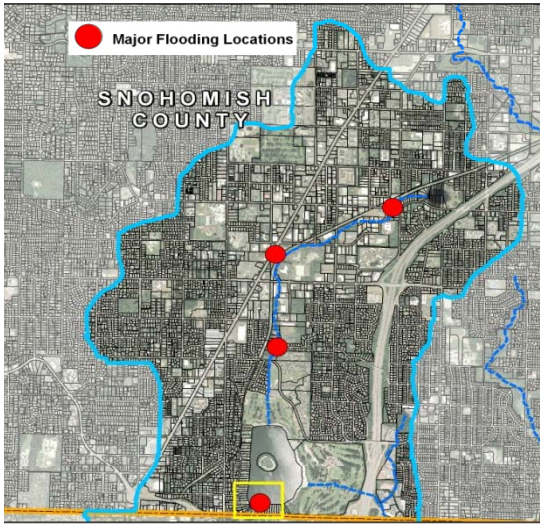
Lake Ballinger Watershed Water Balance Has Been Altered

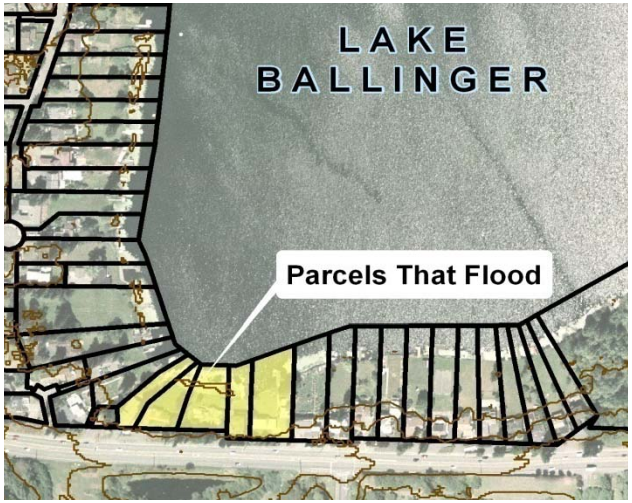


Lake/Upstream Flooding: What is the problem?

- **Flooding of residences and roads:**
  - 2 major floods in last 10 yrs

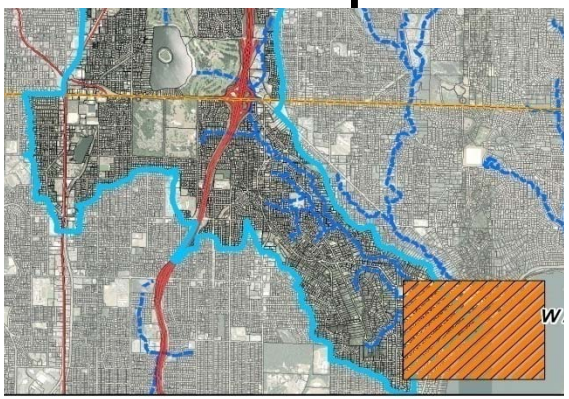
- **December 2007 Flood:**
  - Lake Ballinger Elevation=280.6 ft
  - 5 lots, 3 homes on Lake flooded
  - Numerous docks flooded
  - 6-8 lots on Hall Creek flooded
  - Preliminary damage estimate:
    ~ $50K - $200K



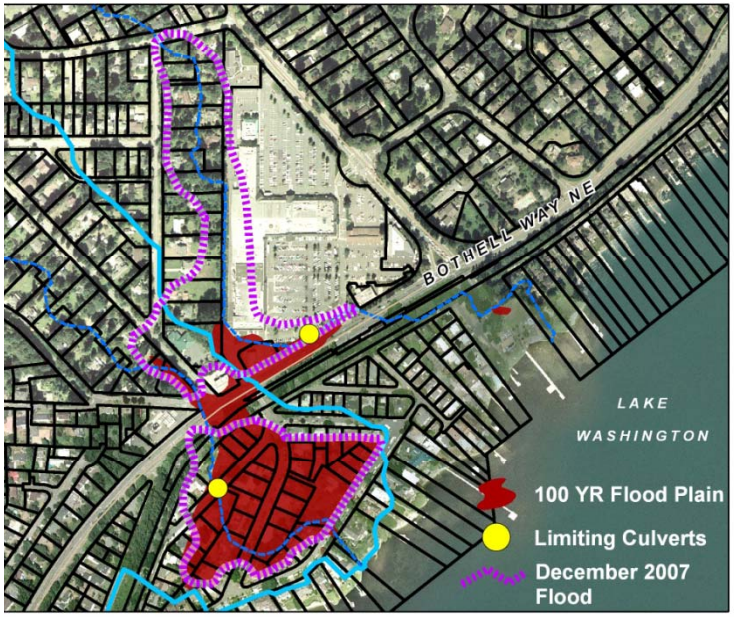


Downstream Flooding: What is the problem?

- **Flooding of public, commercial and residential properties:**
  - 2 major floods in last 10 yrs



- **December 2007 Flood:**
  - 40 lots flooded
  - 20 homes damaged
  - Preliminary damage estimate: ~ $16.5M



Lake/Upstream Flooding: Service Levels*

- **# 1:** Prevent homes from flooding

  (Keep Lake below 279.3 ft: *2.9 ft below 100 yr event*)

- **# 2:** Prevent yards from flooding

  (Keep Lake below 277.4 ft: *4.8 ft below 100 yr event*)

**Note: 100 yr event = lake level of ~282.2 ft*

Downstream Flooding: Service Levels

- **# 1:** Prevent homes from flooding

  (Keep water out of living spaces during 100-year event)

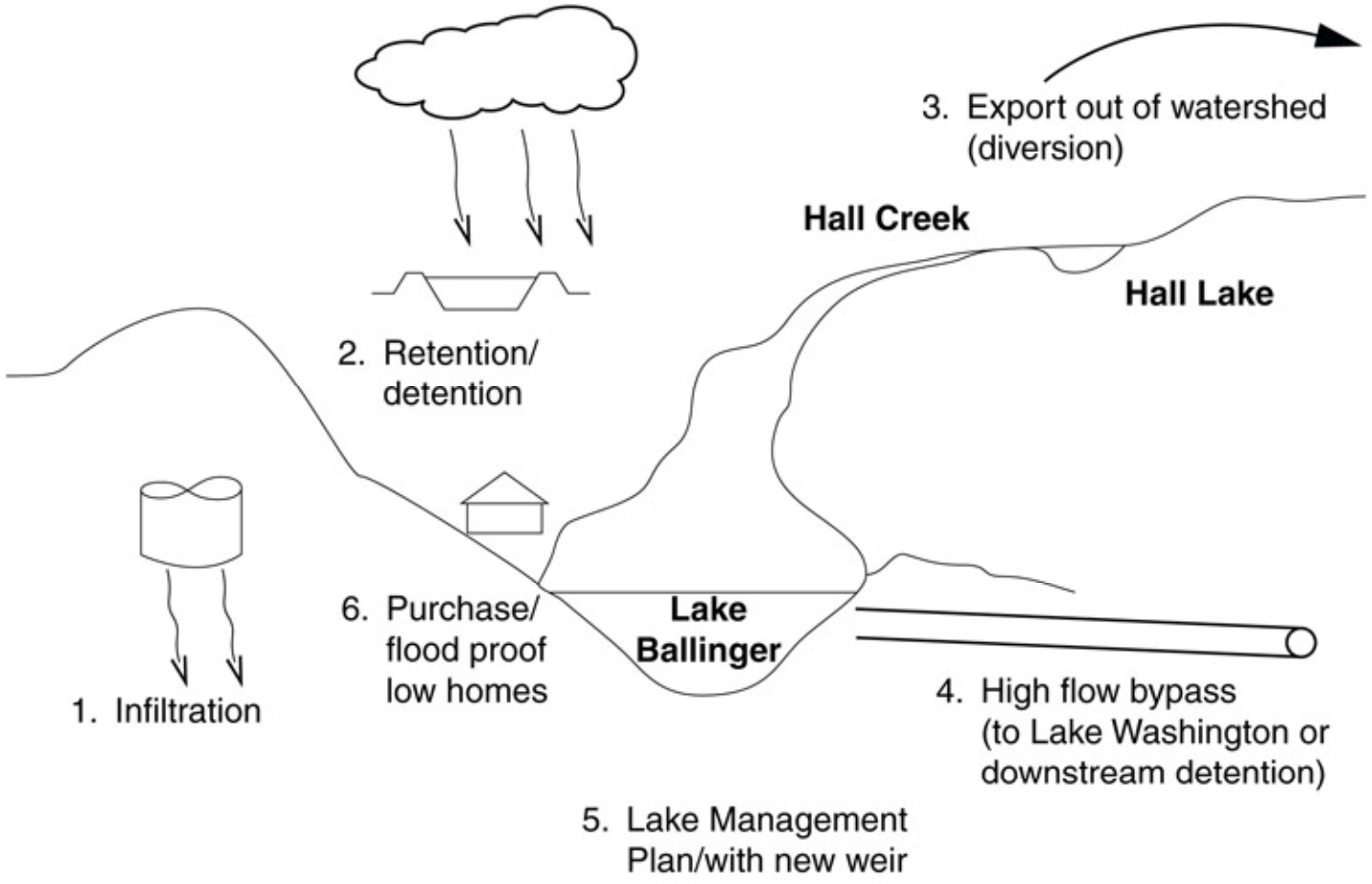
- **# 2:** McAleer Creek and Lyon Creek culverts able to pass the 100-year event*

**McAleer Ck = 325 cfs; Lyon Ck = 307 cfs (cubic feet / second)*

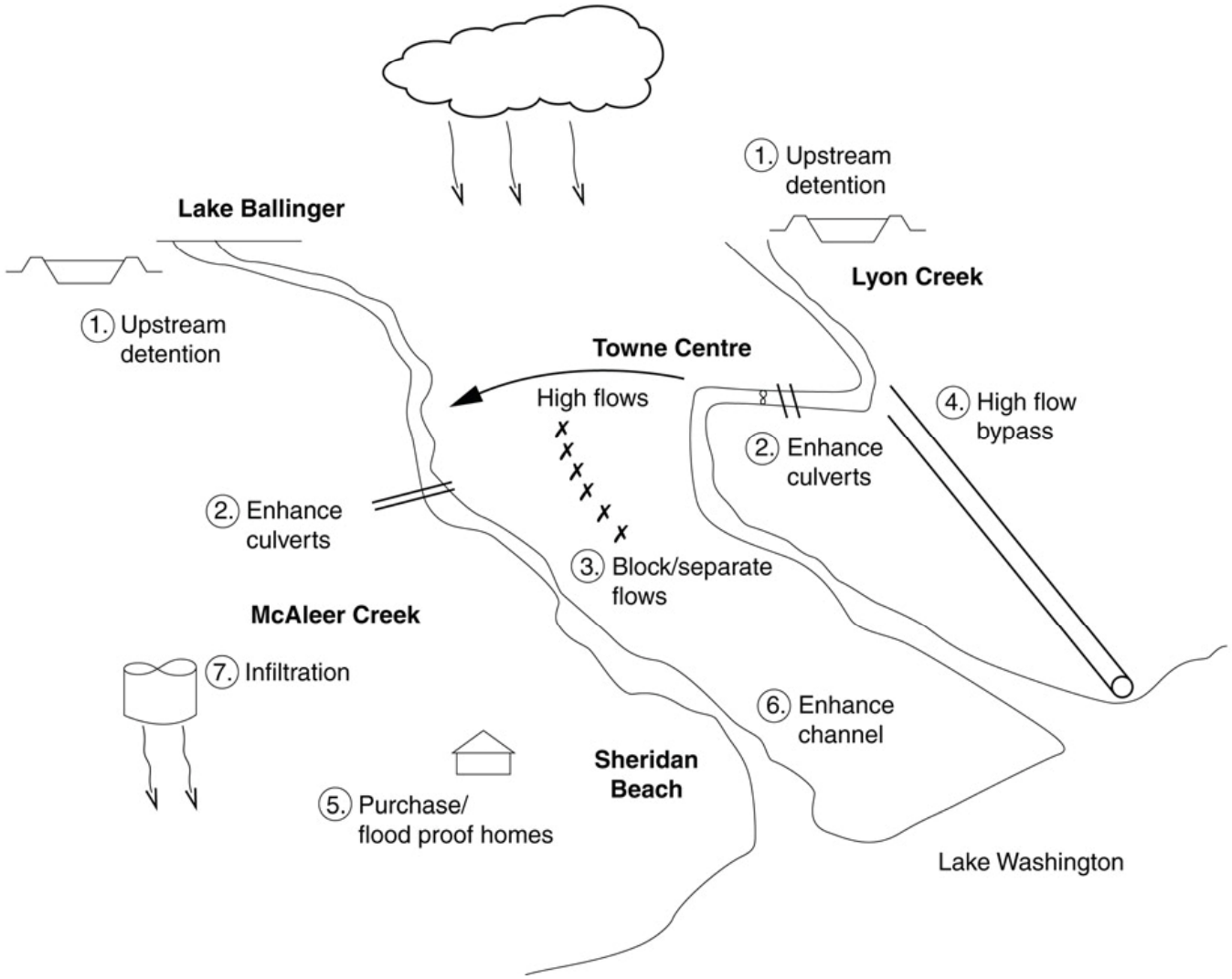
Solution Identification Process

- **Level I Analysis – possible options**
  - List, evaluate and rank possible actions
    - Capital and programmatic
    - Short Term (1-3 yrs), Medium-Term (4-6 yrs), and Long Term (>6 yrs)
    - Rated and ranked
- **Level II Analysis – ability to address the problem**
  - Analyze options: present highly ranked alternatives
- **Level III Analysis – potential alternatives**
  - Select highest alternatives

How to address Lake flooding?



How to address downstream flooding?



Pre-Engineering Analysis

Level I	Issue A: Lake Flooding	Issue B: Lake WQ/Habitat	Issue C: Downstream Flooding	Issue D: Downstream WQ/Habitat
Short-Term (1-2 years)	12*	13	12	10
Medium-Term (4-6 years)	7	8	9	7
Long-Term (>6 years)	10	4	10	4
Level I Subtotal	**29**	**25**	**31**	**21**
Highly Rated for Level II Analysis	**9**	**4**	**11**	**3**
Level III Highest Rated Alternatives	**3**	**4**	**4**	**3**

* = number of alternatives rated and ranked

Evaluation Criteria*

- **Effectiveness** (0 to 5 points)
  - Addresses project's ability to reduce flooding and/or enhance water quality/habitat around the lake and downstream.

- **Cost/Benefit Analysis** (0 to 5 points)
  - Addresses the value or benefit(s) (in flow reduction and/or water quality/habitat enhancement) received for the cost invested.

- **Ability to Implement/Construct** (0 to 5 points)
  - Includes the project's ability to be implemented including complexity of design, if it requires the acquisition of land, if permitting and regulatory concurrence will be easy or difficult, if funding is available etc.

** Highest score = 15 points*

Level II Pre-Engineering Analysis

Issue	Highly Ranked Alternatives (Rating)
A: Lake Flooding	**Short-Term** -Education: flood-proofing (8) -Flood-proofing: wet or dry flood-proofing techniques (private funding) (11) -Enhanced maintenance of stormwater facilities (11) **Medium-Term** -Construct regional detention facilities above Lake Ballinger (7) -Construct regional infiltration facilities above Lake Ballinger (7) **Long-Term** -Flood-proofing: elevate or relocate structures, flood wall, etc. (private funding) (10) -Buyout properties around Lake Ballinger that get flooded in the 100-year storm (11) -Modify weir/develop lake level management plan to operate the lake as a large detention facility (10) -Construct high-flow bypass pipeline system from Lake Ballinger to Lake Washington (7)

Level II Pre-Engineering Analysis

Issue	Highly Ranked Alternatives (Rating)
B: Lake Water Quality-Habitat	**Short-Term** - NPDES Phase II Permit Implementation (11) - Continue TMDL Lake Ballinger Monitoring (9) **Medium-Term** - Water Quality Monitoring for Lake Ballinger (10) - Water Quality/Habitat Enhancement Plan for Lake Ballinger (9) **Long-Term** - None

Level II Pre-Engineering Analysis

Issue	Highly Ranked Alternatives (Rating)
C: Downstream Flooding	**Short-Term** -Education: flood-proofing (8) -Flood-proofing: wet or dry flood-proofing techniques (private funding) (11) -Enhanced maintenance of stormwater facilities (11) -Culvert replacement (8) **Medium-Term** -Construct regional detention facilities in McAleer Creek basin below Lake Ballinger and above the downstream flooding areas in Lake Forest Park (8) -Remove Lyon Creek overflows to McAleer Creek by upgrading Lyon Creek culverts (11) -Remove Lyon Creek overflows to McAleer Creek basin by constructing high-flow bypass system to Lake Washington (11) **Long-Term** -Flood-proofing: elevate or relocate structures, flood wall, etc. (private funding) (10)

Level II Pre-Engineering Analysis

Issue	Highly Ranked Alternatives (Rating)
D: Downstream Water Quality/ Habitat	**Short-Term** - NPDES Phase II Permit Implementation (12) **Medium-Term** - Water Quality Monitoring for McAleer Creek (12) - Water Quality/Habitat Enhancement Plan for McAleer Creek (12) **Long-Term** - None

Level III - Highest Ranked Alternatives

Issue	Highest Ranked Alternatives*
A: Lake Flooding	• Flood-proof residences and structures • Purchase flood-prone residential properties • Manage Lake Ballinger levels/modify weir
C: Downstream Flooding	• Upgrade McAleer Creek culvert system • Upgrade Lyon Creek culvert system • Flood-proof residential/commercial structures • Purchase flood-prone residential properties • Construct high flow bypass system on Lyon Creek to Lk. Wash.

* These alternatives would be designed to address flows from a 100 year storm.

Level III - Highest Ranked Alternatives

Issue	Preferred Alternatives
B: Lake Water Quality/Habitat	• NPDES Phase II Permit implementation • Continue TMDL Lake Ballinger monitoring • Water Quality monitoring for Lake Ballinger • WQ/Habitat Enhancement Plan for Lake Ballinger
D: Downstream Water Quality/Habitat	• NPDES Phase II Permit implementation • Water Quality monitoring for McAleer Creek • WQ/Habitat Enhancement Plan for McAleer Creek

Next Steps

- Receive comments on alternatives

  - Public, Forum, Technical Action Team and Staff Committee

- Complete Tech Memo #2
- Confirm highest ranked alternatives
- Develop Strategic Plan

  - Present Preferred Alternatives

Questions and Comments

Lake Levels* and Their Significance

- Elevation of 1997 Flood Event……. 283.0 ft
- Elevation of 100-year event (urban)…… 282.2
- Dec. 2007 Flood Level…….. 280.6
- *Elevation of 100-year event (forested)……. 279.9*
- Elevation of 2-year event (urban)…….. 279.74
- *Elevation to protect homes…….. 279.3*
- Elevation of 2-year event (forested)…….. 278.32
- **Elevation of Lake (1982 Court Order): Upper……. 277.8**
- Elevation of Weir (summer level)…….. 277.6
- Elevation to protect yards…….. 277.4
- **Elevation of Lake (1982 Court Order): Lower…….. 276.8**
- Elevation of Weir (winter level)…….. 276.5
- Elevation of Culvert under I-5 …….. 272.8

*Datum: NGVD 29 - Court Order